PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for July

Cover Picture

Chamaerops humilis blasted by winter winds and salt spray on a cliff top in northeastern Majorca, Spain. See p. 151. Photo by J. Dransfield.

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Principes, 37(3), 1993, p. 123

Editorial

This third issue of 1993 contains much to entertain and inform anyone interested in palms. Those of us who live outside the tropics in climates that will support only a few, if any, palm species in our gardens occasionally dream of what it must be like to grow palms in ideal conditions—conditions of soil, climate and rainfall that allow palms to shoot away. Even our members in Florida, who have to contend with thin poor soil overlying limestone, occasional freezes, lethal-yellowing disease and hurricanes must pine for the growing conditions of a volcanic island in the Pacific. Don Hodel describes in his article the joys of gardening for palms in near perfect conditions in his mother-in-law's garden in Tahiti. His article gives graphic evidence for the rapidity of palm growth that can be achieved.

How palms are pollinated is turning out to be more complex than we first thought. Finn Borchsenius describes what happens in three species of *Aiphanes* that grow in Ecuador and includes some intriguing comments on how the flower structure relates to the activities of insects. The structural adaptations to insect pollination in orchid flowers have long been recognised; it seems now that palm flowers, though not so colorful or so well known, also display some remarkable and intricate adaptations.

The Mediterranean fan palm, the familiar *Chamaerops humilis*, is in many ways a classic member of the family. It was the flowers of *Chamaerops* that inspired Goethe, the 18th century poet and philosopher, to write about the metamorphosis of plants in 1790. Goethe's palm was still extant in 1982 (see *Principes* 26(4): 194–199, 1982). The only palm that grows naturally in the milder areas of southern mainland Europe, it is cultivated throughout the world; its shrubby habit, long petioles bearing attractive flat palmate blades with narrow segments, and its resistance to cold and drought, make it useful for landscaping in the drier subtropics. An up-to-date account of *Chamaerops* in the wild with new well documented information on germination and culture is given by M. E. Merlo, M. M. Alemán, J. Cabello and J. Peñas.

In an area almost exactly antipodean to *Chamaerops* grows another palm, equally important in horticulture—*Howea forsteriana*. Shortly before he died, IPS member Bill Gunther sent us his thoughtful account of the palms of Lord Howe Island and the problems for conservation of *Howea* and the other endemic genera. We present this, Bill's last article, with sad overtones.

Three short contributions discuss different aspects of palms. Andrew Henderson and Grandes Rioz add to our understanding of the enigmatic genus *Manicaria* which is used in unusual ways (see also *Principes* 24(3): 105–109, and 24(4): 162–169, 1980). S. Veerasamy and G. D. Arekal describe some remarkable fasciation patterns in the staminate inflorescence of *Borassus flabellifer*. Richard Vlasic's account of a visit with August Braun provides a preview of things to come in Venezuela at the 1994 Biennial (see pp. 168–171). Finally, as usual, President Jim Cain has given us an overview of chapter activities.

NATALIE W. UHL
JOHN DRANSFIELD

Principes, 37(3), 1993, pp. 124–138

The Growth of Some Palms in Tahiti

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One of the titles I contemplated for this article was "Growing Palms in Tahiti." However, if there ever was a misnomer for an article, that would probably be it, since no one really grows palms in a place blessed with a wet tropical climate such as Tahiti. In reality, palms simply grow by themselves. To state that I am responsible for the growth of these palms would simply be untrue. Although my wife, Marianne, and I did plant the palms, we did not, nor did anyone else, water, fertilize, control pests, or in any way maintain the palms after planting. Thus, the title decided upon is more appropriate and reflects our experiences with palms in Tahiti.

I met my wife in 1976 on my first trip to Tahiti at the end of a three-month expedition to islands in the South Pacific from New Caledonia to Papua New Guinea to collect living plant material for botanical gardens in Hawaii. We were married a year later in Tahiti, but returned to Hawaii to make our home. At the time of our wedding in 1977, we planted a few palms around my mother-in-law's home in Papeari, located on the southeast side of Tahiti. Among the palms we planted in 1977 was *Pelagodoxa henryana*, which we call our wedding palm since we planted it on the day we were married, July 7 (see Fig. 9).

Since 1977 we had the opportunity to return to Tahiti about every year or two and, thus, a familiar pattern was established. At each visit we would plant a few more palms around my wife's former home. By circumstance, we usually visited during the rainy season (December–April) and this proved ideal for establishing the palms, since basically no one would water them after planting. Most of the plants were obtained from the Jardin Botanique de Papeari as rather large, overgrown seedlings in 3.5 liter (ca. 1-gallon) containers. These were planted out without the use of fertilizer or soil amendments and only watered and maintained for the remaining few weeks of our visit. Then they were left on their own to live or die. Happily, most lived! Slowly over the years, the yard around my wife's former home filled up with palms, much to the increasing dismay of my skeptical, although somewhat amused, mother-in-law.

My mother-in-law, Christina, could not begin to comprehend why anyone would plant trees that for the most part didn't produce edible fruits or leaves. Although Tahitians have a great love for the ornament that plants provide, utilitarian reasons are foremost in their minds when planting a tree. Also, she thought it was most strange that I would actually plant many of the palms under existing trees and other vegetation where they would not receive the benefit of full sun. I explained to her that some palms needed shade when young but full sun when older and that they would eventually be compatible and not compete with the other plants, but she simply looked at me as if I were a crazy *popa'a* (Tahitian word for white person).

As her yard filled with palms, Christina's skepticism and bemusement turned to concern and consternation as she envisioned her home being taken over completely by these utterly worthless plants that were growing up into her prized fruit trees. On more than one occasion she called or wrote

us saying that she was considering taking out this or that palm. She really "had it in" for the few spiny palms, because she was concerned about the children getting the needles in their shoeless feet. Out of deference to her, I had planted the spiny palms on the far side of her property next to an overgrown, mosquito-infested, swampy area where only the bravest (most fool-hardy?) of palm lovers ventured. I did explain to her that my intentions were honorable, as I put the few spiny palms in an isolated, remote area of her yard. Also, I reminded her that it was she who had planted the vegetable garden beyond the spiny palms so that anyone tending the vegetables had to pass them.

Perhaps the final straw was when the *Pigafetta* started to grow with leaps and bounds and thrust its large, spiny leaves into the garden with increasing speed. She threatened to cut them down and I wrote an impassioned letter pleading with her not to do so, that given time the palm would develop a beautiful, spineless trunk that would pose no danger to anyone. Even the fierce-looking needles on the leaves were soft and relatively harmless.

I don't think it was my letters or her love for her daughter, but Christina didn't remove any of the palms, including the *Pigafetta*. I think it was the palms themselves that won her over with their beauty and ornament, not to mention that every visitor who stopped in at her house raved and ranted about how beautiful her palms were and that they wanted seeds or small plants of all of them to take to their homes and gardens! Although Christina denies this and instead says that she didn't remove any of the palms out of deference to my wife and me, I think that over the years as the palms grew and developed into their full beauty, she grudgingly at first and then willingly accepted and began to admire the palms in her yard. Would you believe that she now plants palm seeds from the trees that are fruiting so that she can give small plants to enthusiastic friends? As evidence that all things come around, it has been reported that I was observed planting fruit trees in Christina's yard—obviously a baseless rumor that I vigorously deny as quickly as I can shinny bare-legged up an *Aiphanes caryotifolia!*

Most of the palms have grown well in Tahiti. Papeari is a wet, warm area that averages about 250 centimeters (100 inches) of rain annually and temperatures that range from 22–32° C (70–90° F) year round. Also, most of my mother-in-law's yard is blessed with a rich, well drained loam. The fringes of her property have poorly drained and/or water-logged soils and most of the few palms we have planted there have struggled. The property, which is contiguous with the lagoon, has two streams, numerous springs, and large trees for shade, imparting a natural ambience in which the palms grow.

One may have the impression that it has been a veritable bed of roses for the palms and that they have led a virtually blissful existence in paradise. Nothing could be further from the truth, though, as in addition to tolerating a doubting mother-in-law for several years, they have had to withstand a host of ominous enemies including a full fledged hurricane in 1983 and several tropical storms with damaging winds; power lawnmowers; my numerous nieces and nephews on bicycles and with machetes in hand; falling coconuts and breadfruits; and perhaps the greatest scourge of all, the persistent and fearless *tupa* crabs.

*Tupa*s are land crabs that make rather extensive burrows and tunnels throughout the soil as gophers and moles do in other parts of the world. In fact, a *tupa* is the Tahitian equivalent of a gopher and can cause just as much damage in a garden as its furry counterparts. *Tupa*s love to invade the holes of freshly planted palms where the soil is still soft and not compacted, leaving fist-sized tunnels around and through the roots of the newly planted palm; occasionally they will even uproot a

plant. As natural scavengers that will consume just about anything, they pose the greatest danger to small and/or newly planted palms with leaves close to the ground. In one night they can completely defoliate a small palm, leaving nothing but a few leaf rachises and bases. I have retaliated by refilling the *tupa* holes with soil or heavy stones or erecting a wire mesh cage completely around the palm. The strategy hasn't put an end to my *tupa* troubles but it usually gives the palm a chance to grow up a bit where it is more resistant to attacks.

My numerous nieces and nephews, who number about a dozen at last count, delight in riding their bikes through the garden, occasionally flattening a small palm. They also have a penchant for walking around the garden swinging a machete about as long as they are tall. They have left their calling cards on several palm stems.

My mother-in-law has numerous coconut and breadfruit trees in her garden that also pose a danger to palms, especially the young or newly planted ones. A coconut (not to mention the leaf) or breadfruit dropping from 15 meters (50 feet) is a lethal weapon, pulverizing anything, living or not, that is unfortunate enough to get in its path. I can say this about coconuts, though, that at least the damage they inflict is relatively clean and clear-cut. Breadfruits, on the other hand, are usually ripe when they fall and add insult to injury by leaving behind a visually obnoxious, fly-infested, smelly glob of putrifying tissue completely obscuring its damage.

Since many of the palms were planted in lawn areas of my mother-in-law's yard, some have on occasion become the target of errant lawnmowers. Although occasionally they regrew, most became added mulch in the lawn. I finally wised up and made a circle of stones around small or newly planted palms to deter intrusions by lawnmowers as well as by bicycles.

In the early and mid 1980s, the *El Nino* effect of ocean currents in the Pacific pushed the tracks of hurricanes (typhoons, cyclones) and tropical storms close to Tahiti. Several brushed close by and in 1983 a hurricane with 150 kilometer-per-hour winds (90 miles per hour) struck Tahiti, causing considerable damage to property. The wind blew potted palms that my mother-in-law kept on her patio across the yard, some never to be seen again. However, the palms in the ground didn't seem to suffer greatly and actually seem to have benefitted from the wetter than normal years. That we have a preponderance of palms from the South Pacific in the garden was probably advantageous, since they are indigenous to areas frequented by hurricanes and are probably more tolerant of potentially damaging winds.

One of the most remarkable aspects of the hurricane was that it dislodged and knocked over but did not uproot a large rambutan tree under which I had planted what I thought were small, shade-loving, mottled-leaved pinangas such as *P. copelandii* and *P. maculata*. Once the tree was knocked over, the palms were exposed to nearly full sun. Much to my surprise, a few years after the hurricane these palms were medium-sized and growing quite well. The only difference seemed to be in the less graceful, more compact crown of leaves with shorter petioles; otherwise they were just as healthy and vigorous as their counterparts in full shade.

Another situation where a palm lost the protective shade provided by a tree but continued to grow well serves to demonstrate the amazing tolerance of these plants, especially when the climate is as forgiving as that in Tahiti. In 1985 we received a plant of *Johannesteijsmannia altifrons* from the Jardin Botanique and planted it under the shade of a *pacay* tree (*Inga edulis*). Two years later during the course of a telephone conversation with my mother-in-law, she told us that she had had to cut down the *pacay* tree since one of my nephews was allergic to its pollen.

I cringed when I contemplated the pitiful state of this rare and beautiful palm from the dense jungles of Malaysia now exposed to the full sun. At best, on our next visit to Tahiti I expected to find a stunted, shriveled, necrotic and/or chlorotic plant, barely clinging to life and a sorry excuse for this majestic species. Much to my surprise and delight, the plant has done exceedingly well in its new environment, has quadrupled in size, and exhibited only slight yellowing in the leaves.

Like other tropical places, Tahiti has its share of ants, mealybugs, and other insects that attack palms. In fact, many of the palms at my mother-in-law's house support tremendous and thriving populations of mealybugs and their attendant ants. However, we don't apply pesticides to the palms and, regardless, the palms and their insect pests seem to be happily coexisting. It's almost as if the palms are growing so vigorously that they stay one jump ahead of the ants and mealybugs.

Although most of the palms have grown well, a few have struggled and/or died. Most of the species that do poorly are from more temperate regions and probably cannot tolerate the constant wet heat of Tahiti. In other cases, palms planted on the margins of the property near or in the poorly drained soil or newly filled soil near the lagoon have for the most part grown poorly. These include *Corypha*, *Pritchardia*, and *Satakentia*. A few species just don't seem to grow well even though they are from similar climates and were planted in good soil. *Actinokentia divaricata*, *Chamaedorea elegans*, *C. metallica*, and *C. tepejilote* all struggled and eventually died. I suspect that nematodes attacked them since they were planted amongst anthuriums, a plant known to harbor these injurious pests.

Archontophoenix sp. from Mt. Lewis, Queensland, Australia, *Dictyosperma album*, and, to a lesser extent, *Neodypsis decaryi* suffer from potassium deficiency as they exhibit the classic yellowish translucent flecking of older leaves symptomatic of this disorder.

Since the soils in Tahiti are volcanic in origin and rainfall is heavy, several palms restricted to limestone rocks in their native habitat have not done well. The chamaedoreas mentioned before as well as *Copernicia* and *Gaussia* have all struggled and/or died. However, *Chamaedorea geonomiformis*, *C. seifrizii*, *C. sartorii* and *Schippia concolor* appear to grow well if not thrive.

Some palms, including *Burretiokentia vieillardii* and *Areca vestiaria*, just have not done well; I don't know what ails them. Other species of both genera thrive close by.

Some of my favorite palms include *Areca guppyana*, *Kentiopsis oliviformis*, *Phoenicophorium borsigianum*, *Neodypsis lastelliana*, *Reinhardtia latisecta*, *Clinostigma samoense* (see Figs. 1–8), and *Chrysalidocarpus cabadae*. Other favorites are *Licuala* aff. *ramsayi* (see Figs. 10–13), *Verschafeltia splendida* (see Figs. 13–16), *Pinanga insignis* (see Figs. 21, 22), *Veitchia winin*, *Hydriastele microspadix*, *Drymophloeus beguinnii*, *Cham-*

→

1. *Areca guppyana* (1990), a dramatic plant with stilt roots, bright red fruits, and large pinnae, is probably my favorite palm, chamaedoreas notwithstanding of course! 2. Another favorite is *Kentiopsis oliviformis*. Shown here (1990) is the smaller of our two plants with my daughter, Christina. 3. For bold, dramatic foliage, *Phoenicophorium borsigianum* is hard to beat. My wife, Marianne, stands next to our only plant of this species (1990). 4. A flaring base, conspicuous rings, and a powdery-white covering give *Neodypsis lastelliana* one of the most attractive trunks in the palm family. The leaves on this specimen reach to eight meters (25 feet) above the ground (1990).

5. Marianne stands with *Reinhardtia latisecta* (1990). 6. *Clinostigma samoense* (1985). 7. *Clinostigma samoense* (1986) with Marianne. 8. *Clinostigma samoense* (1990), flowering with more than 11 meters of trunk (35 feet), also rates as one of my favorite palms.


1


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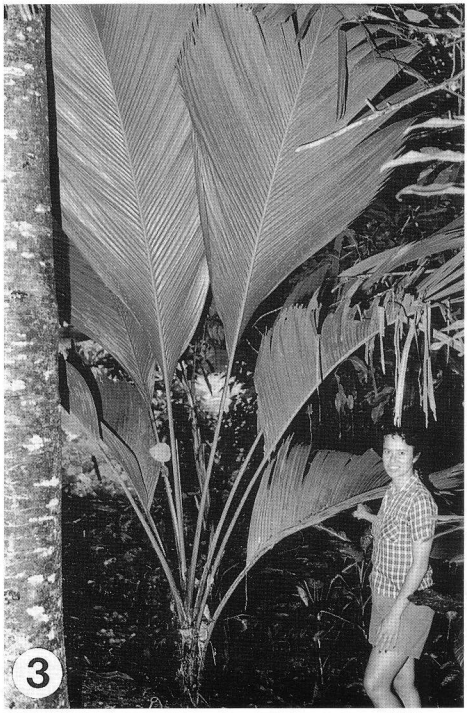
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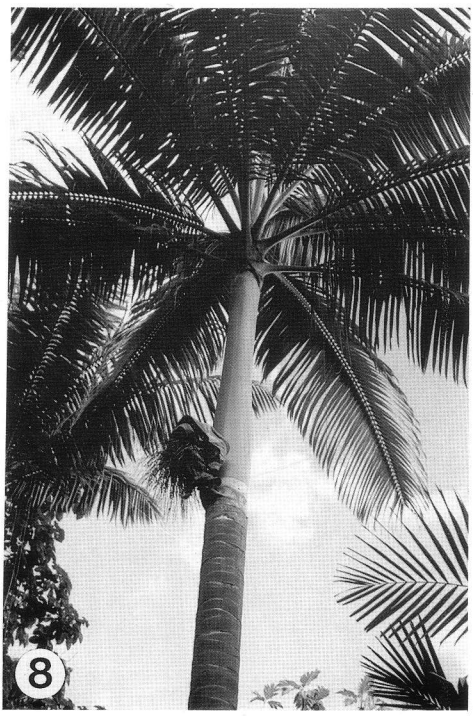
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9. Our wedding palm, the *Pelagodoxa henryana* planted in 1977, has been fruiting since 1987 with large, curious, warty fruits. 10. *Licuala* aff. *ramsayi* (1985). 11. *Licuala* aff. *ramsayi*, with Marianne (1986). 12. *Licuala* aff. *ramsayi*, again with Marianne (1990), showing large, dramatic leaves.

beronia macrocarpa, and *Brassiophoenix schumannii*. I guess I could go on and on; there's no end to them!

I have a special fondness for Pacific Island palms, since to me most are the quintessence of what a palm should be: tall, solitary, crownshafted, pinnate-leaved monarchs of the plant kingdom. Also, the South Pacific holds a special place in my heart and I have many fond memories of my travels there and of seeing most of the palms in their native habitat.

I would be remiss if I did not include *Pelagodoxa henryana* as one of my favorites. When its leaves are not tattered and split by the wind it is a striking plant, and its large, warty fruits are certainly a curiosity. We have planted 18 around my mother-in-law's place, since we were concerned that the number of mature, fruiting trees in Tahiti (only about 15 at its peak in the late 1970s) had been reduced to about ten by 1990. Also, since the species just was not being propagated to any great extent, it was possible that it would vanish from Tahiti, surviving only as a few specimens in its native habitat in the Marquesas Islands to the northeast.

Table 1 is a list of palms at my mother-in-law's home in Papeari, Tahiti as of August, 1990. The palms are presented alphabetically by genus and species. Following the species name is the number of plants in parentheses. Additional data

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13. *Verschaffeltia splendida* (1985). 14. *Verschaffeltia splendida* with Marianne and my son, Robert (left background, 1986). 15. *Verschaffeltia splendida* (1988) with conspicuous stilt roots at base. 16. *Verschaffeltia splendida* with Marianne (1990). What growth!


13


14


15


16

17. Trio of *Pigafetta filaris*, just four years in the ground (1985). Note Marianne at the base of the tree on the right. Palm on the far right is *Cocos nucifera*. 18. Trio of *Pigafetta* with Marianne again at the base of the tree on the right (1986). Note the tremendous growth of *Pigafetta* trunk in a year's time. Also, note growth of *Cocos nucifera*.

→

19. Trio of *Pigafetta* (1990) just before cutting down the center, staminate tree. Note fruiting tree on the left and my children, Robert and Christina, at the base of the left and center trees. 20. Intriguing patterns of spines on leaf bases and petioles of *Pigafetta* (1985). 21. Marianne stands with *Pinanga insignis* (1986), a rather robust species. Trunk in the left center background is *Clinostigma samoense*. 22. Inflorescences and infructescences of *Pinanga insignis* (1990).


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21


22

(taken as of 1990) follow the species and are arranged in columns as numbered.

There are different ways to measure and assess the growth of palms, and palms can be ranked by their rate of growth, but the results can vary depending on the method used to measure growth. Number of leaves produced, height of stem, ratio of number of leaves to stem, and simple biomass (weight) are all methods of evaluating and comparing palm growth. The first three methods are easier and more practical than measuring biomass, and columns eight, nine, and ten of Table 1 list these data where recorded for each species.

The clear champions in terms of trunk growth were *Syagrus sancona* and *Pigafetta filaris* with 267 cm (8.8 feet) and 217 cm (7.1 feet) respectively of trunk produced annually. They were far ahead of the runners up. In fact, the *Syagrus* more than doubled the rate of the next closest competitors, *Veitchia winin*, *V. montgomeryana*, and *Caryota rumphiana*, the last three with 133, 121, and 120 centimeters respectively of trunk produced annually. I was not surprised at the growth rate of the *Pigafetta*, since it is well known as an extremely rapid grower. However, the growth of the *Syagrus* was amazing, since my experience with other species of the genus had not led me to believe it would develop a trunk at the same rate as *Pigafetta*, let alone surpass it!

Other relatively fast producers of trunk—i.e., 100 or more centimeters (3.3 feet) annually—included *Clinostigma samoense* (108 cm), *Heterospathe elata* (100 cm), and *Veitchia macdanielsii* (100 cm). All these fast growers are large, solitary, sun-loving palms which inhabit open forest or become emergents above the canopy. However, some small, shade-loving, clustering palms were also fast producers of trunk. *Hydriastele microspadix* and *Ptychosperma microcarpum* with 110 and 100 centimeters respectively of trunk produced annually can compete with most of the tall, solitary palms, and *Areca triandra*, at 90 centimeters per year, was not far behind.

The slowest producers of trunk on an annual basis included *Calyptrocalyx stenoschista* (10 cm), *Pritchardia lanigera* (10 cm), *Licuala lauterbachii* (14 cm), *L. spinosa* (15 cm), *Hyophorbe lagenicaulis* (15 cm), and *Rhapis subtilis* (15 cm).

Another way to measure growth is by the number of leaves produced per year. In this category, the unabashed champion was the diminutive *Phoenix roebelinii*, that has produced 40 leaves per year since a trunk formed. In second place was the giant *Pigafetta filaris* with 33 leaves produced per year, followed closely by *Livistona* aff. *benthamii* with nearly the same number. *Livistona rotundifolia* and *Licuala spinosa* were in fourth and fifth with 26.7 and 20.0 leaves respectively.

There was tough competition among nine species for the title of the lowest leaf producer. The winner by less than a frond was *Gronophyllum pinangoides* with five leaves produced annually. Close runners up and their annual leaf production were *Verschaffeltia spendida* (5.2), *Areca triandra* (5.4), *Alloschmidia glabrata* (5.5), *Areca multifida* (5.5), *Brassiophoenix schumannii* (5.5), *Pinanga philippinensis* (5.5), *Caryota rumphiana* (5.6), and *Pinanga kuhlii* (5.7).

The final way I measured growth was by the amount of trunk produced per leaf (internode). Internodes can vary and seem somewhat dependent on the vigor of the plant. Healthy, normal-growing plants tend to have longer internodes than stressed, weak-growing plants of the same species. The clear champion in this category was *Caryota rumphiana* with internodes that averaged 37.5 cm, nearly twice as long as the runners up. In a dead heat for second were *Syagrus sancona* and *Wallichia disticha* with internodes of 20 cm and in third

and fourth place were *Caryota mitis* and *Areca triandra* with internodes of 21.7 cm and 22.5 cm respectively.

The species with the shortest internodes were *Licuala lauterbachii* and *Calyptrocalyx stenoschista* with 1.4 cm and 2.7 cm respectively. Others with short internodes (and their size) included *Socratea exorrhiza* (2.9 cm), *Hyophorbe lagenicaulis* (3.0 cm), *Licuala grandis* (3.3 cm), *Nephrosperma vanhoutteanum* (3.7 cm), *Veitchia merrillii* (3.9 cm), and *Alloschmidia glabrata* (4.0 cm). Several other species, including *Licuala* aff. *ramsayi*, *L. spinosa*, *Livistona benthamii*, *Phoenix roebelenii*, and *Rhapis subtilis*, certainly are among those having short internodes, if not the shortest. However, although these species had developed trunks, it was difficult to measure them accurately since their trunks were covered with leaves all the way to the ground.

I can only guess at biomass production but the clear leaders would probably be the tall, fast-growing, solitary species such as *Pigafetta*, *Syagrus*, *Veitchia*, *Clinostigma*, and *Caryota rumphiana*.

There were no species that were leaders in all three categories of trunk produced, leaves produced, and trunk produced per leaf. Species that produced few leaves per year were not necessarily slow growers. *Caryota rumphiana* was the leader for trunk produced per leaf and among the leaders for trunk produced per year, but was among the lowest in leaves produced per year. So one can say that it gets the most out of each leaf that it produces. Likewise, *Areca triandra* gets a lot out of each leaf it does produce. Species that had short internodes could be among leaders in trunk produced if leaf production was high, as *Pigafetta filaris* demonstrated. *Syagrus sancona* was the leader in trunk production because of a combination of long internodes and moderately high leaf production.

Conversely, species which produce a high number of leaves per year are not necessarily among leaders in trunk produced. *Phoenix roebelenii*, *Licuala* aff. *ramsayi*, *L. spinosa*, *Livistona* aff. *benthamii*, and *L. rotundifolia* all were leaders in leaves produced. However, all with the exception of the last one were not anywhere near the leaders in trunk produced, since they get so little out of each leaf that they do produce.

One of the few pleasures that I have derived from not living in Tahiti is that I appreciate to a greater extent the growth of palms there. Their growth, already generally much faster than that of palms in cooler subtropical areas, seems even that much more spectacular and dramatic when observed only on an annual or biennial basis. Their growth seems astonishing; the plants nearly seem to be leaping out of the ground. I have to pinch myself and ask, "Is this the same plant that was in this spot just two years ago?"

I have been fortunate to document pictorially the growth of several palms from year to year. Figures 6 (March, 1985), 7 (March, 1986), and 8 (August, 1990) show rather graphically the growth of *Clinostigma samoense*. Similarly, Figures 10 (March, 1985), 11 (March, 1986), and 12 (August, 1990) show *Licuala* aff. *ramsayi*. Figures 13–16 are of *Verschaffeltia splendida* in 1985, 1986, 1988, and 1990 respectively.

Figures 17 (1985), 18 (1986), and 19 (1990) document the tremendous, nearly frightening, growth of *Pigafetta filaris*. We planted three *Pigafetta* in 1981, and by 1988 the two pistillate ones had flowered and were dropping abortive, nonfertile fruits. By 1990, the third specimen had flowered and it was staminate, resulting in the ground beneath the trees being carpeted by seedlings of *Pigafetta*. In fact, they were coming up like hair on a dog's back and I was mowing them down as if they were grass. Alarmed by its propensity for reproduction and John Dransfield's

Table 1. Palms in Papeari, August, 1990. 1 = years in ground, 2 = years in ground to flowering, 3 = overall height (meters), 4 = height of trunk (meters), 5 = leaves in crown, 6 = leaf scars on trunk, 7 = years since trunk formed, 8 = trunk produced (centimeters) per year since trunk first formed (#4 ÷ #7), 9 = number of leaves per year since trunk first formed [(#5 + #6) ÷ #7], 10 = trunk produced (centimeters) per leaf since trunk first formed (#4 ÷ #6).

	1	2	3	4	5	6	7	8	9	10
Aiphanes caryotifolia (1)	8	7	5.0	2.3	20	40	5	46	12.0	5.8
Alloschmidia glabrata (1)	7	—	3.0	1.0	8	25	6	17	5.5	4.0
Archontophoenix sp. (Mt. Lewis) (2)	8	—	5.8	1.8	9	29	6	30	6.3	6.2
Areca catechu (3)	13	8	11.5	9.0	10	66	10	90	7.6	13.6
Areca guppyana (2)	5	4	4.0	1.3	7	15	4	33	5.5	8.7
Areca multifida (1)	5	3	2.7	1.3	9	14	3	43	7.7	9.3
Areca ipot (1)	9	4	5.0	2.3	8	35	7	33	6.1	6.6
Areca triandra (2)	7	4	8.0	4.5	7	20	5	90	5.4	22.5
Areca vestiaria (1)	5	—	1.3	—	6	—	—	—	—	—
Arenga porphyrocarpa (1)	5	—	2.0	—	9	—	—	—	—	—
*Bismarckia nobilis** (5)	4	—	1.0	—	22	—	—	—	—	—
Brassiophoenix schumannii (1)	5	—	3.3	1.3	8	14	4	33	5.5	9.3
Burretiokentia hapala (3)	7	6	6.0	2.0	12	26	4	50	9.5	7.7
Burretiokentia vieillardii (1)	5	—	0.7	—	6	—	—	—	—	—
Calyptrocalyx spicatus (1)	5	—	5.0	2.0	9	15	3	67	8.0	13.3
Calyptrocalyx stenoschista (1)	5	—	1.3	0.3	10	11	3	10	7.0	2.7
Caryota mitis (2)	5	4	8.0	1.3	15	6	3	43	7.0	21.7
Caryota rumphiana (3)	8	7	10.0	6.0	12	16	5	120	5.6	37.5
Chamaedorea geonomiformis (6)	2	1	0.7	—	13	—	—	—	—	—
Chamaedorea hooperiana (5)	2	—	1.3	—	5	—	—	—	—	—
Chamaedorea sartorii (5)	5	3	3.0	1.3	13	23	4	33	12.0	5.7
Chamaedorea seifrizii (12)	5	2	3.3	2.7	6	25	4	68	7.8	10.8
Chambeyronia macrocarpa (7)	8	—	8.0	3.3	10	19	4	83	7.3	17.4
Chrysalidocarpus cabadae (4)	9	7	8.0	4.0	12	26	5	80	7.6	15.4
Chrysalidocarpus madagascariensis (1)	13	9	11.0	6.5	21	86	7	93	15.3	7.6
Clinostigma samoense (1)	9	7	11.5	6.5	20	78	6	108	16.3	8.3
Corypha elata (1)	4	—	1.0	—	8	—	—	—	—	—
Cyrtostachys renda (1)	2	—	0.7	—	5	—	—	—	—	—
Dictyosperma album (1)	5	—	0.7	—	—	—	—	—	—	—
Drymophloeus beguinii (2)	5	—	4.0	2.0	9	20	4	50	7.3	10.0
Drymophloeus sp. (Papua New Guinea) (2)	5	4	6.0	3.0	12	37	5	60	9.8	8.1
Gronophyllum pinangoides (1)	5	4	2.5	2.0	5	20	5	40	5.0	10.0
Gulubia costa (3)	5	—	3.0	—	6	—	—	—	—	—
Gulubia macrospadix (1)	5	—	3.0	—	7	—	—	—	—	—
Heterospathe elata (1)	12	9	12.0	9.0	25	120	9	100	16.1	7.5
Hydriastele microspadix (1)	5	4	6.0	3.3	7	21	3	110	9.3	15.7
Hyophorbe lagenicaulis (1)	5	—	2.5	0.3	6	10	2	15	8.0	3.0
*Hyphaene coriacea** (1)	4	—	0.3	—	3	—	—	—	—	—
Johannesteijsmannia altifrons (1)	5	—	1.0	—	6	—	—	—	—	—
Kentiopsis oliviformis (2)	8	—	6.0	1.7	11	14	4	43	6.3	12.1
Latania lontaroides (3)	4	—	3.0	—	10	—	—	—	—	—
Licuala grandis (2)	12	7	4.0	2.0	25	60	6	33	14.2	3.3
Licuala lauterbachii (2)	8	7	2.3	0.7	26	50	5	14	15.2	1.4
Licuala aff. *ramsayi* (3)	5	—	3.0	—	9	—	—	—	—	—
Licuala spinosa† (3)	8	7	3.7	0.3	40	—	2	15	20.0	—
Livistona aff. *benthamii*† (3)	7	—	5.0	1.0	130	—	4	25	32.5	—

Table 1. Continued.

	1	2	3	4	5	6	7	8	9	10
Livistona rotundifolia (12)	12	—	11.0	5.0	70	90	6	83	26.7	5.6
Mackeea magnifica (2)	5	—	1.5	—	5	—	—	—	—	—
Metroxylon warburgii (1)	13	—	10.0	2.0	35	21	4	50	14.0	9.5
Neodypsis decaryi (3)	5	—	4.0	1.0	14	6	2	50	10.0	16.7
Neodypsis lastelliana (1)	8	—	8.0	0.7	17	5	2	35	11.0	14.0
Neodypsis sp. ("Darian") (1)	8	7	8.0	4.0	18	33	5	80	10.2	12.1
Neoveitchia storckii (1)	8	—	8.7	3.7	17	32	4	93	12.3	11.6
Nephrosperma vanhoutteanum (1)	8	—	4.0	0.7	8	19	4	18	6.8	3.7
Normanbya normanbyi (3)	8	7	8.0	4.0	11	43	6	67	9.0	9.3
Nypa fruticans (2)	13	—	2.0	—	6	—	—	—	—	—
Pelagodoxa henryana (18)	13	10	7.0	3.0	25	50	5	60	15.0	6.0
Phoenicophorium borsigianum (1)	5	—	4.0	—	8	—	—	—	—	—
Phoenix roebelenii† (1)	5	—	2.5	0.7	120	—	3	23	40.0	—
Pigafetta filaris (2)	9	6	16.0	13.0	28	167	6	217	33.0	7.8
Pinanga copelandii (4)	9	3	6.0	5.0	8	69	8	63	9.6	7.2
Pinanga insignis (1)	8	5	9.0	4.0	10	27	5	80	7.4	14.8
Pinanga kuhlii (2)	11	3	7.0	4.0	6	45	9	44	5.7	8.9
Pinanga maculata (3)	9	3	7.7	5.0	10	68	8	63	9.8	7.4
Pinanga philippinensis (2)	9	—	5.0	2.0	11	22	6	33	5.5	9.1
Pritchardia lanigera (2)	5	—	3.0	0.3	12	10	3	10	7.3	3.0
Pritchardia vuylstekeana (3)	4	—	0.7	—	7	—	—	—	—	—
Ptychococcus elatus (1)	7	—	8.5	5.0	15	30	6	83	7.5	16.7
Ptychosperma elegans (1)	13	6	8.0	5.3	12	70	10	53	8.2	7.6
Ptychosperma macarthurii (2)	5	4	4.0	2.3	9	20	3	77	9.7	11.5
Ptychosperma microcarpum (1)	7	6	5.5	3.0	9	18	3	100	9.0	16.7
Ptychosperma sp. (Papua New Guinea) (1)	5	—	4.0	1.3	9	15	4	33	6.0	8.7
Reinhardtia latisecta (1)	5	—	2.3	—	7	—	—	—	—	—
Rhapis subtilis‡ (1)	5	3	2.0	0.3	25	—	2	15	12.5	—
Rhopaloblaste augusta (2)	9	8	9.0	4.5	18	51	5	90	13.8	8.8
Satakentia liukiuensis (1)	2	—	0.3	—	5	—	—	—	—	—
Schippia concolor (1)	5	—	1.7	—	18	—	—	—	—	—
Siphokentia beguinii (1)	5	4	5.0	2.3	12	27	4	58	9.8	8.5
Socratea exorrhiza (1)	4	—	2.7	0.7	4	24	4	18	7.0	2.9
Syagrus sancona (4)	7	—	11.0	8.0	18	40	3	270	19.3	20.0
Thrinax radiata§ (1)	13	8	8.0	—	—	—	—	—	—	—
Veitchia macdanielsii (1)	8	7	9.0	6.0	11	58	6	100	11.5	10.3
Veitchia merrillii (1)	13	6	7.0	4.0	16	103	10	40	11.9	3.9
Veitchia montgomeryana (1)	9	8	12.0	8.5	12	96	7	121	15.4	8.9
Veitchia winin (5)	8	5	11.0	8.0	12	76	6	133	14.7	10.5
Verschaffeltia splendida (1)	7	—	5.0	1.7	6	20	5	34	5.2	8.5
Wallichia disticha (1)	5	—	9.0	1.0	16	5	3	33	7.0	20.0
Wendlandiella polyclada (1)	2	—	0.7	—	8	—	—	—	—	—
Wodyetia bifurcata (1)	5	—	8.0	2.1	12	21	4	53	8.3	10.0

* Grown from seeds planted *in situ*; † leaves occur to ground, no bare trunk; trunk height estimated; ‡ not possible to count leaf scars on stem; § missing data.

observation that *Pigafetta* was a colonizer of disturbed areas, we cut down the staminate tree in 1990 to eliminate any possibilities of it escaping from cultivation and becoming naturalized in Tahiti.

As much as I admire *Pigafetta*, it would truly be a disaster if large groves of it one day covered Tahiti's beautiful hillsides. The only other specimen of *Pigafetta* in Tahiti is at the Jardin Botanique about two kilometers distant, and it too is a pistillate plant.

With a crowd of curious onlookers composed of my wife, children, and numerous

nephews and nieces, my brother-in-law, who is very talented with a chainsaw, made quick work of the majestic beauty. Recorded on our video camera, the 16-meter (50-foot) giant fell with a resounding crash into an abandoned taro patch, much to the delight of the numerous children. They all agreed it was much more exciting than school!

I encourage all travelers to Tahiti to stop during their around-the-island tour and visit my mother-in-law and the palms. She lives about an hour's drive from the capital Papeete in the village of Papeari and about two kilometers from the Jardin Botanique and Musee Gauguin. She is a wonderful and delightful person whom I admire very much and who would be happy to show visitors the palms. She may even put a machete and a rake in your hand and order you to start cleaning in the garden!

1994 IPS BIENNIAL MEETING SCHEDULE SET FOR CARACAS, VENEZUELA FOR JUNE 13-16, 1994

Plans have been finalized for the 1994 IPS Biennial Meeting to be held in Caracas, Venezuela during mid June of 1994. The Instituto Botanico (and Botanic Garden) Foundation in Caracas and the Asociacion Venezolana de Palmas (Venezuelan Palm Society) have graciously agreed to co-host this event in conjunction with the IPS Executive Committee. Arrangements are being finalized with the Hotel Avila, a reasonably-priced and tranquil host hotel. Arrangements for overflow are being set up with another hotel near the Avila, but without its tropical garden ambiance. Lost World Adventures has been selected to oversee several planned horticultural tours and side trips, with additional cooperation from the local Venezuelan Palm Society.

Superior International Services of Houston, Texas will serve as the travel agent who will handle flight and hotel arrangements. Local assistance in Venezuela will be provided by Lost World Adventures, through their local office there.

Quite a few local excursions are planned to palm gardens and local indigenous palm habitats. In addition, a suite of additional in-country excursions will be offered as Pre- and/or Post-Biennial trips.

All IPS members are encouraged to start making their plans to attend! Further details will be provided in subsequent issues of *Principes*. Please contact Jim Cain should you have any questions in the interim.

(For more about Caracas and the pleasures of visiting with August Braun, see the article by Richard Vlasic, p. 168.)

Principes, 37(3), 1993, pp. 139–150

Flowering Biology and Insect Visitation of Three Ecuadorean Aiphanes Species

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Aiphanes consists of 22 species of small to medium sized, monoecious and protandrous, spiny understory palms, distributed in the Antilles, Venezuela, southern Panamá and along the Andes to Bolivia, at elevations up to 3,000 m above sea level. The genus belongs to the subtribe Bactridinae of tribe Cocoeae in subfamily Arecoideae (Uhl and Dransfield 1987), a subtribe in which protogyny and beetle pollination appear to predominate (Bullock 1981, Beach 1984, Burquez et al. 1987, Listabarth 1992, Scariot et al. 1990). Borchsenius and Balslev (1989) suggested that the morphological and phenological characteristics of *Aiphanes* corresponded better to the bee- or fly pollination syndromes described as common in palms (Henderson 1986). Listabarth (1992) reported that *Aiphanes aculeata* in Amazonian Peru was pollinated by a mixture of wind, bees, beetles, and bugs.

In this paper I report some observations on the phenology and insect visitors of three Ecuadorean species: *Aiphanes erinacea* (Karsten) Wendland, a cespitose, 3–6 m tall palm, found in the understory of pre-montane and montane rain forest at 600 to 2,000 m altitude in western Colombia and Ecuador; *A. chiribogensis* Borchsenius & Balslev, a solitary, 1–4 m tall palm endemic to montane rain forest at 1,700 to 2,100 m altitude in western Ecuador; and *A. eggersii* Burret, a cespitose, 4–7 m tall palm, endemic to dry semi-deciduous forest on the coastal plain of Ecuador. All are discussed in a recent publication on taxonomy of Ecuadorean *Aiphanes* (Borchsenius and Balslev 1989).

Study Sites and Observation Periods

Aiphanes erinacea (Figs. 1–3) was studied at km 113 along the road from Quito to Puerto Quito in western Ecuador, within an 81 hectare reserve of pre-montane rain forest at 650–800 m altitude, owned by the timber company ENDESA. A general description of this forest reserve is found in Jørgensen and Ulloa (1989). The studied population consisted of ca. 25 individuals growing in a small area, about ¼ hectare, of disturbed forest in the northwestern end of the reserve. Within the population 14 individuals with a total of 17 flowering shoots were marked and observed during five visits of one to three days between 21 October and 22 November 1989. Additional observations on insect visitation and behavior were made between 1 and 3 March 1991.

Aiphanes chiribogensis was studied at its type locality in the Pichincha province, near the caserío Las Palmeras, at km 59 along the old road from Quito to Sto. Domingo de los Colorados, at 1,950–2,050 m altitude. The studied population consisted of ca. 15 individuals growing on slopes along a ca. 2 km long trail through

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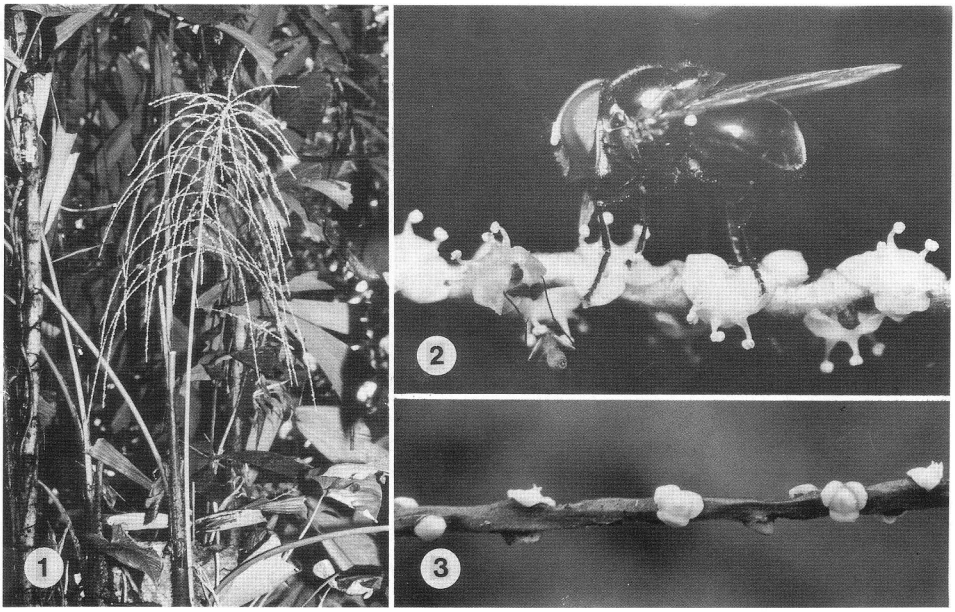


1–3. *Aiphanes erinacea*. 1. Inflorescence at staminate anthesis. 2. *Copestylum* sp. (Syrphidae) on staminate flowers. 3. Pistillate flowers.

undisturbed forest. Eight flowering individuals were marked and observed during seven visits of one to four days between 22 October and 3 December 1989.

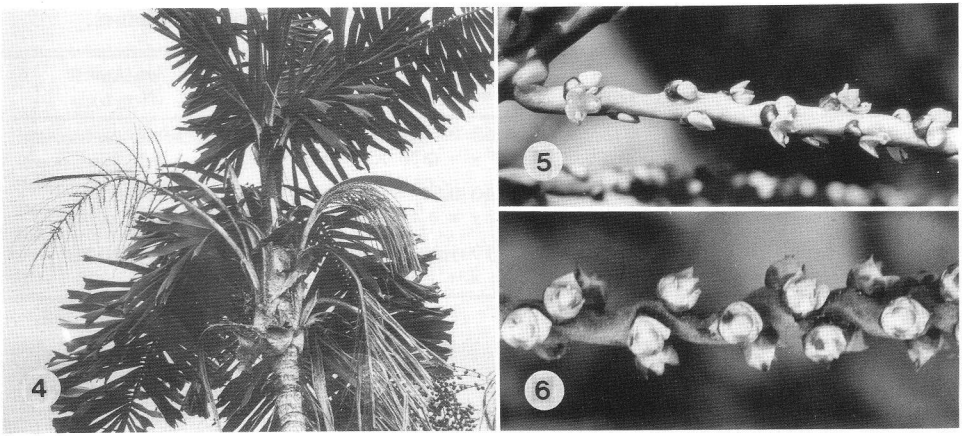
Aiphanes eggersii (Figs. 4–6) was studied in a cattle pasture on the coastal plain of Ecuador, in the Manabí province, at km 41 along the road from Jipijapa to Guayaquil; 17 individuals, with a total of 36 fertile shoots, were marked and observed on two visits with an interval of one week, 4–5 November and 11–12 November 1990.

For all three species, observations on phenology and insect visitors were made and a number of inflorescences was sampled to determine number of flowers of each sex. Insect visitors were caught and preserved in alcohol. The number of staminate and pistillate flowers per inflorescence was estimated by counting numbers on every fifth rachilla throughout the inflorescence or, in the case of *A. chiribogensis*, every rachilla. The pollen content per anther was estimated by counting the number of pollen in one theca. Flowers for anatomical study of nectaries were soaked in hydrofluoric acid (HF) for a week, embedded in paraffin, and sectioned with a sledge microtome.

Inflorescence Morphology

Inflorescences of *Aiphanes* are spicate, once or rarely twice branched, and enclosed in bud by a single, slender peduncular bract. The proximal part of the rachillae bears triads of one pistillate and two staminate flowers; distally on the rachillae the triads are substituted by dyads or, at the apex, sometimes single staminate flowers. The distal rachillae normally bear only staminate flowers. The numbers of branches, staminate, and pistillate flowers for each of the three species are given in Table 1. Floral sex ratios were highly variable both within and between the three species.

Staminate flowers of *Aiphanes* are fairly uniform, disc-shaped, with three free, imbricate sepals, three nearly free, valvate



4–6. *Aiphanes eggersii.* 4. Flowering individual. 5. Staminate flowers. 6. Pistillate flowers.

petals, six stamens, and a minute rudimentary pistillode, which contains small amounts of nectar-secreting tissues. Staminate flowers of the three species differ in color, anther size, and pollen production (Table 2). In *A. erinacea* and *A. chiribogensis*, petals become completely reflexed at anthesis; in *A. eggersii* the petals open to an angle of ca. 45°.

Pistillate flowers have three broadly ovate, imbricate sepals, three half-connate, fleshy, valvate petals, six staminodes fused in a nearly truncate cup, and a triovulate pistil with three sessile, papillose stigmas, which become reflexed at anthesis. The pistil contains septal nectaries which empty via three channels opening just below the stigmas. Pistillate flowers of *A. erinacea* are white, with greenish pistil, those of *A. chiribogensis* are reddish violet with pink pistil, and those of *A. eggersii* are yellow, with brown sepals.

Estimated values for total pollen production per flower and per inflorescence, as well as P/O (pollen/ovule) ratios for the three species, are given in Table 3.

Phenology

The basic phenological pattern was the same in all three species, though there were great differences in the speed with which the inflorescences developed. The lengths of the different phenological phases

Table 1. Inflorescence characters of three Ecuadorean Aiphanes.

		A. chiribogensis	*A. erinacea*	*A. eggersii*
No. inflorescences sampled		N = 9	N = 7	N = 5
No. rachillae	range	1–29	77–169	39–68
	mean	x = 12	x = 105	x = 55
No. male flowers	range	78–4,300	10,390–28,464	4,800–15,010
	mean	x = 1,673	x = 22,145	x = 8,658
No. female flowers	range	29–408	567–2,231	567–1,178
	mean	x = 167	x = 1,135	x = 946
Male/female ratio	range	2.6–26.5	9.7–40.0	7.8–13.3
	mean	x = 10.9	x = 20.9	x = 9.9

Table 2. Staminate flower characters of three Ecuadorean Aiphanes.

Species	Color	Anther Size (mm) (N = 14, 9, and 12, resp.)	Pollen/Anther (N = 6)
A. chiribogensis	purple	0.63–0.79 × 0.63–0.71 x = 0.70 × 0.69	1,968–2,764 x = 2,376
A. erinacea	white	0.40–0.59 × 0.47–0.67 x = 0.47 × 0.58	1,086–2,018 x = 1,342
A. eggersii	yellow	1.19–1.82 × 0.79–1.02 x = 1.49 × 0.93	6,800–20,528 x = 12,073

for the three species are given in Table 4. Inflorescences and infructescences in all stages were found within the populations, and all three species appeared to flower continuously. Individual shoots never bore more than one inflorescence at anthesis at a time, but multistemmed individuals of *A. erinacea* and particularly *A. eggersii* sometimes had two or more inflorescences in different flowering phases simultaneously.

Staminate anthesis started immediately after the inflorescence was liberated from the bract or up to two weeks later and lasted 8–50 days. The upper staminate flower of each flower group opened first, and the lower did not open until the upper had fallen from all flower groups. Otherwise no particular sequence of flower opening was observed. Flowers of *A. chiribogensis* opened at all hours, including the night. In *A. erinacea* there seemed to be a peak in the early morning, before 0900 hr. Individual flowers lived from a few hours to about one day, depending on the weather conditions, after which they fell to the ground or remained attached as a decaying mass. Opening flower buds contained a small drop of nectar, but nectar production was not evident in older flowers. No scent was detected. Staminate flowers of *A. erinacea* were only slightly damaged because of insect gnawing, whereas those of *A. chiribogensis*, on rainy days and especially nights, were heavily predated by slugs which ate the entire androecium. A high proportion of staminate flowers of *A. eggersii* contained microlepidopterous larvae, which fed on the receptacle and tissues basally in the petals.

After staminate anthesis there was a pause of several days before pistillate anthesis began. During this pause pistillate flower buds increased significantly in size and attained their final color.

Pistillate anthesis lasted from seven to more than 10 days. Flowers on the basal rachillae opened first. In *A. erinacea* all

Table 3. Pollen production and pollen/ovule ratios of three Ecuadorean Aiphanes.

		A. chiribogensis	*A. erinacea*	*A. eggersii*
Pollen/male flower ($\times 10^3$)	range	11.8–18.6	6.5–12.1	40.8–123.2
	mean	x = 14.3	x = 8.1	x = 72.4
Pollen/inflorescence ($\times 10^6$)	range	1.1–61.3	83.7–390.2	347.7–1,087.3
	mean	x = 23.9	x = 178.3	x = 627.2
Pollen/ovule ratio ($\times 10^3$)	range	12.9–125.4	26.0–107.4	188.3–321.1
	mean	x = 51.4	x = 52.7	x = 240.0

Values calculated using data from tables 1 and 2. The pollen/ovule ratio is calculated as the male/female flower ratio (table 1) multiplied with the average pollen content per flower (table 2) and divided by the number of ovules per female flower (3 for all species).

Table 4. Phenology of three Ecuadorean Aiphanes.

Phenology (in days)	*A. chiribogensis*	*A. erinacea*	*A. eggersii*
Inflorescence liberation	>5	short	short
Pre anthesis phase	7–14	<1 to 6	<1
Staminate anthesis	40–50	17–23	ca. 8–10
Pause	>15	4–8	ca. 8
Pistillate anthesis	>10	7–9	ca. 8

pistillate flowers were open after a few days; in *A. eggersii* less than half were open at a given time. In *A. chiribogensis* a large proportion of the pistillate flowers or even entire rachillae were observed to rot away without ever coming into anthesis. Individual flowers remained open and unchanged for 4 to 7 days, after which time the petals changed in color, to brownish-pink in *A. erinacea* and to dull orange in *A. chiribogensis*. Small amounts of nectar were produced, visible as tiny drops on or just below the reflexed stigmas.

Insect Visitors

Aiphanes erinacea. Hundreds of insects, predominantly flies, were present on the inflorescences during the day. Insect activity was nearly constant from early morning to late afternoon, but after dark it fell and visitors included only a few flies and some micro-moths. More than 50 different insect species belonging to five orders were caught on the flowers, including 37 species of flies belonging to 16 families and ten species of beetles belonging to four families (Table 5); 35 species were caught on both staminate and pistillate flowers, and more intensive sampling would probably have augmented this number.

Most visitors came to feed on the small amounts of nectar secreted from flowers of both sexes. Most common was a 2–3 mm long yellow species of Drosophilidae with ca. 50 individuals present simultaneously and a less than 1 mm long biting midge (Ceratopogonidae sp. 1) with up to 100 individuals present simultaneously, which was observed to land directly on the anthers. Two other Ceratopogonidae (spp. 2–3) apparently came to lick nectar as well as to oviposit. The majority of the individuals were females with swollen abdomens, either filled with eggs or just emptied, and eggs similar to those present in the abdomen of intact specimens were recovered from samples of flowers in alcohol. Three hover flies (Syrphidae spp. 1–3) and three beetles (Chrysomelidae spp. 1–2, Cantharidae sp. 1) fed on pollen. The syrphids also visited staminate flowers of a *Prestoea* species, feeding on pollen, and pistillate flowers of *A. erinacea* to lick nectar. Examination of 40 specimens of *Copestylum* sp. (Fig. 2), the largest and most common syrphid with 5–15 individuals present simultaneously, revealed only one female individual; all others were males. Gut loads of specimens caught on staminate flowers consisted of pure *A. erinacea* pollen. Gut contents of specimens caught on pistillate flowers consisted of pure loads of either *A. erinacea* or *Prestoea* pollen. Two species of chrysomelid beetles, each present in numbers of ca. 10–20 at a time, fed on floral tissues. One sepsid fly was frequent on pistillate but infrequent on staminate flowers. It was observed running back and forth on the rachillae while waving with the wings. Two rove beetles (Staphylinidae) were quite frequent on both types of flowers, moving actively around on the inflorescences where they fed on floral tissues and perhaps nectar. No pollen was found in their guts.

Aiphanes chiribogensis. Insect visitors were few; never were there more than 10

Table 5. Insect visitors of Aiphanes erinacea *(Palmae).*

Insect Group	Visiting		
	Male	Female	Time
Order Diptera			
Suborder Nematocera			
Cecidomyiidae spp. 1–4	○		day/night
Ceratopogonidae spp. 1–3	**X**	**X**	day
Chironomidae sp. 1	○		day
Culicidae spp. 1–3	○	○	day
Mycetophilidae spp. 1–2	×	×	day
Sciaridae sp. 1	×	×	day
Sciaridae spp. 2–3	○	○	day
Tipulidae sp. 1–2	○		day/night
Suborder Cyclorhapha			
Calliphoridae sp. 1	○	×	day
Chloropidae spp. 1–3	○	○	day
Drosophilidae sp. 1	**X**	**X**	day
Drosophilidae spp. 2–4	○	○	day
Empididae spp. 1–2	○		day
Lauxaniidae sp. 1	×	×	day
Richardiidae spp. 1–2		○	day
Sepsidae sp. 1	○	×	day
Syrphidae, *Copestylum* sp.	**X**	**X**	day
Syrphidae sp. 2	×	×	day
Syrphidae sp. 3	○		day
Tachinidae sp. 1	○	○	day
Order Coleoptera			
Cantharidae sp. 1	○		day
Chrysomelidae sp. 1–2	**X**	**X**	day
Curculionidae spp. 1–5	○		day
Staphylinidae sp. 1–2	×	×	day
Order Lepidoptera			
Indeterminate spp. 1–2 (micro-moths)	○		night
Order Hymenoptera			
Indeterminate (wasp)		○	day
Formicidae spp.	×	×	day
Order Hemiptera			
Indeterminate sp. 1	○		day

X: common; ×; frequent; ○: rare. No observations were made of insect visitors to pistillate flowers at night.

individuals observed on one inflorescence at a given time, and often none was observed, even in dry weather. A total of 22 insect species was caught on staminate flowers; only three species were caught on pistillate flowers (Table 6). Most visitors were flies, including 15 different species belonging to five families. The most common visitor on staminate flowers, a 2–3 mm long, yellow species of fruit fly (Drosophilidae), was the same as the most common visitor in *A. erinacea*. It was observed licking the center of the flowers, but was also attracted by unopened flower buds. One species of Muscidae and two Lauxaniidae were observed licking nectar from pistillate flowers, frequently contacting the stigmas, but only one of these (Lauxaniidae sp. 1) was also observed on staminate flowers. After dark, insect activity increased,

Table 6. Insect visitors of Aiphanes chiribogensis *(Palmae).*

Insect Group	Visiting		
	Male	Female	Time
Order Diptera			
Suborder Nematocera			
Cecidomyiidae spp. 1–6	○		night
Ceratopogonidae sp. 1	○		night
Mycetophilidae spp. 1–3	○		night
Sciaridae sp. 1	○		night
Suborder Cyclorapha			
Drosophilidae sp. 1	×		day
Drosophilidae sp. 2	○		day
Muscidae sp. 1		○	day
Lauxaniidae sp. 1	○		day
Lauxaniidae sp. 2	○	○	day
Order Coleoptera			
Curculionidae sp. 1	○		day
Ptilodatylidae sp. 1	○		day
Chrysomelidae, Galerucinae sp. 1	○		day
Order Lepidoptera			
Indeterminate sp. 1 (micro-moth)	○	○	night
Order Hymenoptera			
Indeterminate sp. 1	○		day
Order Hemiptera			
Indeterminate sp. 1	○		day
Order Ephemeroptera			
Indeterminate sp. 1	○		day

×: frequent; ○: rare.

and visitors caught one evening between 2000 and 2200 hr included several species of gnats and midges. One species of micromoths (Lepidoptera) visited both staminate and pistillate flowers after dark, several individuals being present simultaneously.

Aiphanes eggersii. Only two insect species were observed to visit the flowers: one bee species (Hymenoptera: Apoidae: *Apis mellifera*?), and one wasp species (Hymenoptera: indeterminate). The bees collected pollen from staminate flowers, but were also observed on pistillate flowers. The carnivorous wasps might have been attracted by the presence of small microlepidopteran larvae present in ca. ¼ of the staminate flowers collected from two different plants.

Pollination

Pollination of pistillate flowers with pollen produced on the same inflorescence is precluded in all three species, since the staminate and the pistillate phases are separated by several days. Thus, geitonogamy is impossible in *A. chiribogensis*, where plants never had more than one inflorescence at a time, and probably rare in *A. erinacea*, where multistemmed individuals only rarely had inflorescences in staminate and pistillate anthesis simultaneously. It may be more frequent in *A. eggersii*, provided that the palms are self-compatible. In the examined population in a cattle pasture, ca. 10% of the individuals bore pistillate and staminate flowers simulta-

neously, but this figure might be lower under natural conditions in the forest understory where the energy available for reproduction is likely to be lower. The P/O ratios estimated in this study (P/O = 13,000–321,000) are somewhat higher than those listed by Cruden (1977) for obligately xenogamous hermaphroditic-flowered species (P/O = 1,000–19,500), but ratios of up to 800,000 have been reported for a dioecious dicot tree, *Myristica fragrans* (Armstrong and Drummond 1986).

Wind pollination is probably insignificant in *A. erinacea* and *A. chiribogensis*, since winds of any strength are very rare in the understory where these palms grow. Short filaments of the stamens and sticky pollen further make wind pollination unlikely. Winds were frequent at the study site of *A. eggersii*, and wind pollination could occur in this species, as demonstrated in another entomophilous palm growing in exposed habitats, *Orbignya phalerata* (Anderson et al. 1988).

Among the potential insect pollinators of *Aiphanes erinacea*, Drosophilidae sp. 1 and *Copestylum* sp. (Syrphidae) warrant special attention, since these were abundant visitors on both types of flowers and had frequent contact with anthers and stigmas. Drosophilid flies are common visitors to palm inflorescences, in some cases effecting pollination (*Nypa fruticans*—Essig 1973; *Geonoma macrostachys*—Olesen and Balslev 1990). Schmid (1970) concluded that drosophilid flies were unlikely to be of importance as pollinators of *Asterogyne martiana* in Costa Rica because of their sedative behavior and lack of pollen transporting capability. The same may be true in the case of *A. erinacea*, where washings of 18 individuals of Drosophilidae sp. 1 caught on pistillate flowers did not reveal any pollen. Hover flies (Syrphidae) are known as effective pollinators of a large number of flowering plants, including palms (Schmid 1970), and the most common of these (*Copestylum* sp.) could be a major pollinator of *A. erinacea*. The finding of *Prestoea* and *Aiphanes* pollen in the gut of *Copestylum* specimens caught on pistillate flowers shows that they were moving relatively large distances between plants; the nearest flowering *Prestoea* was at least 20 m away from the *Aiphanes* where they were caught. Other potential pollinators include ceratopogonid, calliphorid, lauxaniid, mycetophilid, and sciarid flies, as well as chrysomelid and staphylinid beetles. All had frequent contact with both anthers and stigmas. Biting midges (Ceratopogonidae) have been reported to visit flowers of *Asterogyne martiana* (Schmid 1970) and *Orbignya phalerata* (Anderson et al. 1988), without having any importance in pollination. Their role in the pollination of *A. erinacea* is uncertain. Calliphorid flies are well known visitors to palm flowers (Douglas and Bimantero 1956, Essig 1973), whereas Lauxaniidae, Mycetophilidae, and Sciaridae have never been reported to visit palms. Chrysomelid beetles are well known visitors to palm flowers (Henderson 1986), and their relative abundance coupled with their pollen feeding habit suggests that they may be of some importance as pollinators. Staphylinid beetles appear to be ubiquitous visitors to palm inflorescences, but are usually not considered of importance as pollinators (Henderson 1986).

Lauxaniidae may be of some importance in *A. chiribogensis*; a species of these flies was the only visitor recorded on both staminate and pistillate flowers. Otherwise the extremely low insect activity during the day focuses on the possible role of night active insects as pollinators, particularly gnats and midges. Fungus gnats (Mycetophilidae, Sciaridae) are known to pollinate several plant species from various families with simple disc-shaped flowers (Vogel 1978). Gall midges (Cecidomyiidae) pollinate dioecious species of *Siparuna* (Monimiaceae) with population densities of only 1–2 trees per hectare (Feil 1993). Biting midges (Ceratopogonidae) and small

nocturnal Lepidoptera may also contribute to pollination. The latter are active flyers and may be able to transport pollen over larger distances.

Bees apparently were the pollinators of *A. eggersii*, at least at the study site. That bee visitation occurs also under natural circumstances is suggested by observations of the closely related *Aiphanes aculeata* near Yopal in northeastern Colombia with inflorescences and flowers very similar to those of *A. eggersii*. Both staminate and pistillate flowers were visited by bees (unidentified) which collected pollen and licked nectar. In addition, numerous small curculionid and nitidulid beetles and microlepidopteran larvae were present in staminate but not in pistillate flowers. Listabarth (1992) found that *Aiphanes aculeata* in seasonal rainforest in Amazonian Peru were visited and in part pollinated by meliponid bees, curculionid beetles, and bugs. Wind was, however, the most important pollen vector.

Discussion

Aiphanes flowers are visited and presumably pollinated by a series of different insect groups, depending on flowering intensity and floral morphology. *Aiphanes eggersii* produces far the largest amount of pollen per inflorescence and has the highest pollen/ovule ratio and the most intensive staminate flowering, lasting only little more than a week. The resulting high daily pollen output makes the flowers attractive to pollen collecting bees, which are known as effective pollinators. *Aiphanes erinacea* represents an intermediate situation; fewer inflorescences are produced, inflorescence development is slower, and pollen is shed over twice as long a period as in *A. eggersii*. Inflorescences attract numerous flies, which are less demanding and perhaps also less efficient pollinators. The complete lack of bee visitors in this species is unusual compared to other myophilous understory palms such as *Asterogyne martiana* (Schmid 1970) and *Geonoma macrostachys* (Olesen and Balslev 1990). It may be explained by the very small size of the anthers and their short filaments, making them difficult to handle. This raises the question of whether the minute anthers encountered in many species of *Aiphanes* are in fact an adaptation to avoid pollen collecting bees. *Aiphanes chiribogensis* represents a low-energy flowering system; inflorescence development is exceedingly slow, and only a few flowers open on a daily basis. The result is a sharp drop in the number of insect visitors, and a switch in the spectrum of these towards a higher proportion of minute species such as gnats and midges. The purple color and the diurnal opening of flowers may be adaptations favoring visitation by such flies. The very slow inflorescence development in *A. chiribogensis* may be comparable to the phenomenon known in other plant groups where single-flower longevity increases with altitude, e.g., Melastomataceae (Renner 1989) and Monimiaceae (Feil 1992). Lower insect visitation rates and a change in the pollinator spectrum with increasing altitude were also found by Arroyo et al. (1982, 1985) along a gradient ranging from subandean scrub at 2,200 m to subnival feldfield at 3,600 m in central Chile. Many of these differences could be explained by foraging energetics and different modes of thermoregulation in the insect groups involved. These results were, however, obtained in a very different climatic regime, temperate with pronounced winters, and at higher altitudes, so it is uncertain to which degree the conclusions reached apply also for mid-elevations in the tropics.

Other bactrid palms studied have proved to possess a highly specialized beetle pollination syndrome involving protogyny, rapid inflorescence development, the formation of a kind of pollination chamber, and precise timing of pistillate and staminate anthesis with respect to the activity pattern of the insect pollinators. Listabarth

Table 7. Pollination syndromes and altitudinal distribution of native Ecuadorean palms.

	Altitudinal Range	Number of Species in Altitudinal Interval				Reference
		Total	0–1,000 m	1,000–2,000 m	2,000–3,000 m	
Cantharophilous genera						
Socratea	0–1,400	4	3	2	0	Henderson, 1985
Jessenia	0–900	1	1	0	0	García Menez 1988
Attalea	0–600	1	1	0	0	Balslev and Henderson 1987
Elaeis	0–400	1	1	0	0	Syed 1979
Bactris	0–1,700	15	14	2	0	Essig 1971, Beach 1984
Desmoncus	0–900	5	5	0	0	Listabarth 1992
Astrocaryum	0–800	4	4	0	0	Bullock 1981, Bruquez et al. 1987
Phytelephas	0–1,500	2	2	1	0	Barfod et al. 1987
Ammandra	0–500	1	1	0	0	Barfod 1991
Aphandra	0–700	1	1	0	0	Balslev and Henderson 1988
Total		35	33	5	0	
Mellitophilous/myophilous genera						
Synechanthus	0–500	1	1	0	0	Henderson 1986
Chamaedorea	0–2,100	3	3	2	1	Henderson 1986
Dictyocaryum	1,100–1,700	1	0	1	0	Henderson 1990
Iriartea	0–1,000	1	1	0	0	Henderson 1985
Euterpe	0–1,900	5	4	3	0	Henderson 1986
Prestoea	0–2,500	6	5	5	2	Bannister 1970, Bullock 1981
Parajubaea	2,400–3,000	1	0	0	1	Moraes and Henderson 1989
Aiphanes	0–2,500	12	8	8	3	orig.
Welfia	0–500	1	1	0	0	Bullock 1981
Geonoma	0–2,900	27	20	11	6	Olesen and Balslev 1990
Total		58	43	30	13	

Data are based on ca. 1,200 collections of Ecuadorean palms deposited in AAU, and separate taxonomic treatments of several genera (see Balslev 1990).

(1992) surveyed the pollination strategies of *Aiphanes*, *Bactris*, *Desmoncus*, and *Astrocaryum* in seasonal rainforest in Amazonian Peru. He found that the pollination syndrome in *Aiphanes* was far the least specialized and most opportunistic. The results of this study support this conclusion. Further they suggest that a transition from mellitophily or mixed mellitophily/anemophily to different forms of myophily need only to involve small changes in morphology and phenology. Perhaps the flexibility and opportunistic nature of the pollination syndrome found in *Aiphanes* is part of the reason why this genus has been able to diversify in the Andean forests at higher altitudes, as the only member of the Bactridinae to do so. Indeed, it seems that beetle pollinated genera in the neotropics in general are restricted to lowland areas. In Ecuador the majority of the beetle pollinated genera occur below 1,000 m altitude (Table 7). One species of *Bactris* reaches altitudes above 1,500 m, and a species of *Catoblastus*, presumed to be beetle pollinated (Bernal, pers. comm.), occurs at up to 2,200 m. The Andean palm flora above 1,500 m is dominated by apparently mellitophilous or myophilous genera such as *Geonoma*, *Prestoea*, and *Aiphanes*. Data are, however, still uncertain and many

genera have not been studied with respect to pollination mode, including one of the most conspicuous elements of the Andean palm flora, the genus *Ceroxylon*. Further investigations will show whether the indicated pattern holds up to scrutiny.

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On the Mediterranean Fan Palm (Chamaerops humilis)

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ABSTRACT

Chamaerops humilis L., a palm commonly found on the Spanish Mediterranean coast, is currently being used in gardening in preference to other palms of alien origin. This fact, together with its potential use for regenerating Mediterranean ecosystems, accounts for our interest in its propagation. Vegetative reproduction of this plant has not been successful, and seed-sowing seems to be the most convenient method. Previous reports indicate that seeds take 2 to 3 months to germinate. However, our experience shows that this period can be considerably shortened.

RESUMEN

En los últimos tiempos *Chamaerops humilis* L., palmera abundante en el litoral mediterráneo español, se está utilizando en la jardinería, con preferencia a otras palmeras de procedencia foránea. Esta circunstancia, así como su uso potencial en la regeneración de ecosistemas mediterráneos, nos ha hecho interesarnos por su forma de propagación. La reproducción vegetativa de esta planta no da buenos resultados, sino que, la forma más conveniente para propagarlo es por semillas. De acuerdo con la bibliografía consultada, las semillas tardan de dos a tres meses en germinar, sin embargo, nuestra experiencia demuestra que este periodo puede ser mucho más corto.

The generation of plant cover with native species, though highlighted in the past by some naturalists, is still an area of major concern. The present awareness has been brought about by the understanding that the surrounding landscape provides the most suitable species for planting. The surroundings will normally contain those species capable of using the environmental resources in the most balanced way without causing negative effects. This trend is also being followed by gardeners, who are increasingly including autochthonous species in their designs.

As supporters of the above idea, we have investigated the propagation of one of the most important species in the natural conformation of the "garigues" and "macchias" of the Mediterranean coastline, that is, the Mediterranean fan palm or "palmito" (*Chamaerops humilis* L.). We focused our research on seed germination, given the relatively long periods (2–3 months) required for its completion (Blombery and Rodd 1988).

Our interest in improving the propagation technique of this palm is further enhanced by the fact that it is one of the only two native palms in Europe and the only one in the Iberian Peninsula. It is also one of the very few palms the origin of which is not in the tropics (it reaches latitudes of up to 44°N).

Chamaerops humilis is a multi-stemmed shrub with short trunks, hence its name "dwarf palm." However, in gardens it can reach heights of 4 and even 6 m. The leaves, which emerge in a terminal tuft, have long woody stalks armed with thorns and fan-shaped blades which fold along the midribs. It is dioecious and blooms in spring, from March to May. The fruit is a globular reddish-brown drupe, oblong or ovoid, measuring 1–4 cm. The mesocarp is fibrous and very rich in butyric acid. Inside the fruit there is a single seed. The seed is very hard and has a single cotyledon which feeds the embryo during the first stages of germination. The palm yields fruits during summer–autumn.

Besides its potential use in regenerating vegetation cover in arid areas and its application as an ornamental plant in warm

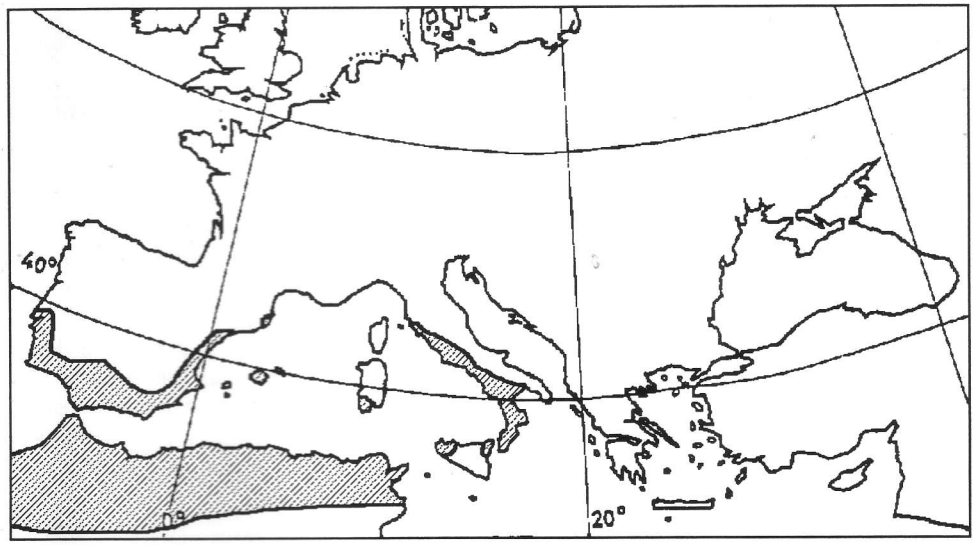
Map 1. Distribution of *Chamaerops humilis* L. in the Iberian Peninsula.

seaside regions, this palm has traditionally been used for other purposes (López 1982, Font Quer 1988, Mabberley 1990, Rivera and Obon de Castro 1991). The leaves of the adult plant have been used in basket-weaving to make mats, carrier baskets, and brooms. The young unopened leaves are treated with sulphur to make them softer and supple and are then used for finer work. The husk, known in southern Spain as "higa," is edible before its full development. The fruits have also been traditionally used in medicine as an astringent because of their bitterness and high tannin content.

Due to the current decrease of the ecosystems where this plant is naturally found, regulations towards its preservation have been passed in some areas. For example, in Murcia (southeast Spain), one of the leading Spanish regions for nature preservation, this palm is included in the list of protected species, which means that the whole plant or any of its parts including the seeds cannot be picked or cut deliberately; neither is it permitted to market or carry out any other activity in respect to this plant which can result in its destruction or damage, except for scientific, conservation, or craft (leaf collection) purposes.

Biogeography and Ecology

Distribution. It is a western steno-Mediterranean taxon. In the Iberian Peninsula it is distributed as follows: its most northwesterly boundary is in the Arrábida Mountains, south of Lisbon, and it is not found again until further south in Cape San Vicente; from here it extends uninterrupted to Cape of Gata and then northwards up to the delta of the river Llobregat, its most northeasterly border. Incursions



Map 2. Map showing the location of the *Chamaerops humilis* L. in the Mediterranean area.

inland into more continental areas happen only in Valencia, Alicante, Murcia, and, more extensively, in the Guadalquivir valley (Western Andalucía). Such boundaries in the Iberian Peninsula (Font Quer 1954) are explained by the nature of the substrate required by the plant and its inability to stand oceanic exposure or high levels of rain (Map 1).

In the whole of the Mediterranean, this palm is found on the north coasts of Africa, from Morocco to Libya; in the Italian coastal strip from Tuscany to the south; and at its most northern limit it is found in an isolated locality on the Portofino Promontory in eastern Liguria. It is also found on the islands of Sicily, Sardinia, and other smaller islands, its easterly boundary being on the island of Malta (Map 2).

Geology and Edaphics. The Mediterranean fan palm is most commonly found on limestone soils, although it can grow on siliceous substrata, as well as on granite rock (SW of Sierra Morena). It grows on all sorts of ground, such as hills, slopes, ravines, etc., always in sunny and dry locations where the substrate is sandy, marly or even rocky, but never covering dune areas.

Climate. It is a thermophilic taxon associated with coastal and subcoastal areas. It disappears, together with other thermophilic species in the same environment, as altitude and latitude increase and also with oceanic influence. Its distribution is conditioned by sensitivity to frosts and is, therefore, heavily influenced by latitude. In its most northern locations in the Iberian Peninsula it is hardly ever found at altitudes above 300–400 m, while in the southern parts it can be found above 1,000 m in S-SE facing areas of stony ground and little soil. According to Freitag (1971), fruits have been collected in the SE of Spain in areas as high as 800 m. Authors such as Jahandiez and Maire (see Font Quer 1954) report findings of this palm on the opposite Mediterranean coast in northern Africa, at 1,400 m in the Middle Atlas, and up to 2,300 m in the Great Atlas.

With regard to water tolerance, it can survive rain levels above 700 mm (see

Freitag 1971). Under optimum environmental conditions it can possibly stand rain levels of 1,000–1,300 mm and higher, but in this case its dominance is diminished because of competition of other species with higher water requirements. As for minimum levels of rain, the most important feature of the palmito is its ability to survive severe summer droughts. However, growing conditions cease to be optimum when annual rain levels fall below 150 (125) mm.

The ability to stand strong winds is also an important feature.

Occurrence and Associated Species. The Mediterranean fan palm (*Chamaerops humilis*) is a phanerophyte typical of the thermophilic vegetation found in the western Mediterranean basin and which, together with other species such as Carob (*Ceratonia siliqua*), olive (*Olea europaea*) and kermes (*Quercus coccifera*), are the most representative species of this region. From a physiognomic point of view, it is one of the most important determinants of the natural landscape of the coastal "garigues" and "macchias."

This palm can sometimes appear as a basic component of the phytoceonoses, representing either permanent communities or replacement stages of the planosclerophyllous woods, which abound in Mediterranean regions with rain levels above 400 mm. However, it is more commonly found in the chamaephyte state as part of thickets and spiny shrublands, not just because these are drier areas, but also because of the current deterioration of the Mediterranean vegetation caused by the action of man.

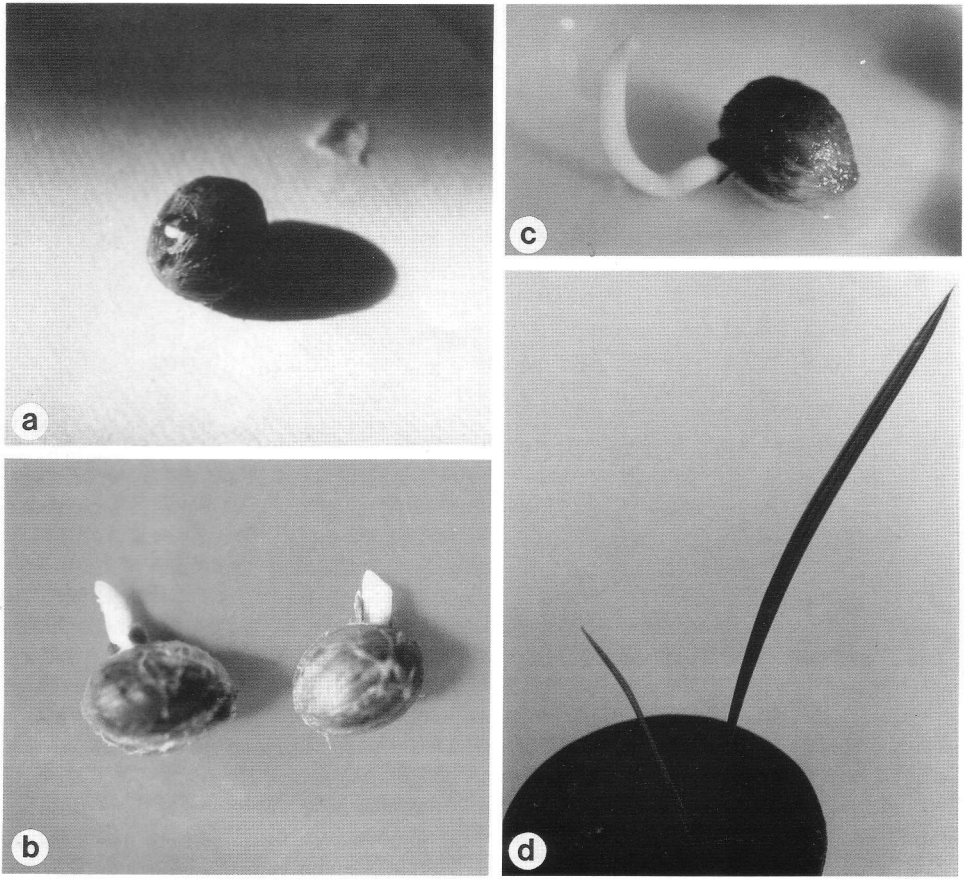
Although in the Iberian Peninsula this palm is not unequivocally associated with other species, it is, together with other taxa, a good bioindicator of the thermic peninsular strip which they cover. Among such thermophilic elements, it is worth mentioning the following shrubs and lianas: *Aristolochia baetica*, *Calicotome spinosa*, *Ceratonia siliqua* (spontaneous), *Clematis cirrhosa*, *Juniperus macrocarpa*, *J. navicularis*, *J. turbinata*, *Lycium intricatum*, *Maytenus senegalensis* ssp. *europaeus*, *Osyris quadripartita*, *Periploca laevigata* ssp. *angustifolia*, *Prasium majus*, *Rhamnus oleoides* ssp. *oleoides*, *Salix pedicellata*, *Tetraclinis articulata*, *Whitania frutescens*, *Ziziphus lotus*, *Olea europaea* var. *sylvestris*, *Myrtus communis*, *Pistacia lentiscus*, *Smilax aspera*, etc.

The palmito is to a greater or lesser extent represented in all thermophilic vegetation formations, except in those of sands. The surrounding flora varies according to the geographical region and the nature of the substrate.

Seed Propagation

Material and Methods. Flowering occurred during March–May and fruits were collected in September–October, 1990, in Cape of Gata, Almería, Spain. After collection, the fleshy fruits were selected according to size and appearance, extracted, and washed by hand in tap water. Fruit and seeds were then allowed to dry at laboratory temperature for 10–15 days, mixed thoroughly, and placed in dry container and stored at 4° C in darkness for periods of 2–4 months. For preservation purposes, fruits were kept in airtight glass jars containing silica gel in order to obtain an inert and dry environment.

Several germination trials were then carried out by subjecting the seeds to various preliminary treatments (Hartmann 1983). In all cases, fruits and seeds were first washed for a few minutes with a 1% solution of sodium hypochlorite and an excess of sterilized distilled water to prevent the risk of contamination, particularly by fungi. The washed seeds were left to germinate in Petri dishes (20 cm diameter) containing filter paper dampened with 10 ml of water or other solutions. Fruits or seeds were left to grow in germination chambers in darkness at 25° C and 70%



1. Appearance of palmito seeds (*Chamaerops humilis* L.): a) just after splitting of the protective coat; b) 8 days later; c) 12 days after germination; d) appearance of the seedlings 40 days after germination. Seeds have been planted into peat when they were 12 days old.

humidity. An average of 20 seeds was put in each dish. Tests lasted an average of 5 weeks, although in the case of some treatments, favorable results were obtained in as little as 7 days. Germination was considered to have taken place at the radicle emergence.

All glassware was sterilized prior to use in an oven at 120° C for 20 minutes.

A first or control test was carried out in which fruits did not undergo any previous treatment. This was not successful. In further tests, the outer coat of the seeds was softened (scarification) in order to enable gaseous exchange and water inbibition. Scarification can be carried out in two ways: either removing all or part of the fleshy cover (manual or mechanical scarification) and/or using chemical agents (chemical scarification).

Manual scarification is done by removing the fruit with a lancet, leaving the bare seed. Mechanical scarification is a similar process but much faster. The fruits are dipped in distilled water and shaken with an electric mixer for 2–3 minutes. After repeating this process once, the mixture is sieved and washed with excess water to

2. *Chamaerops humilis* L. in fruit.

separate the pericarp tissue from the seeds. Sterilized water was used in the final wash.

The seeds scarified by the above method were subjected to the control test (germination in sterilized water) or treatments with gibberellic acid (1,000 ppm), concentrated H_2SO_4 (96%) or 30% (w/v) NaOH rinsing after acid or caustic pre-treatments. Similar tests were carried out with non-scarified seeds. The results are shown in Table 1.

The seeds germinated by the above methods were placed in pots containing peat in nursery, and 95% continued to grow into normal seedlings.

In order to investigate the effects of temperature over the germination process, tests were carried out at 16° C, 25° C, and 30° C.

Results and Discussion

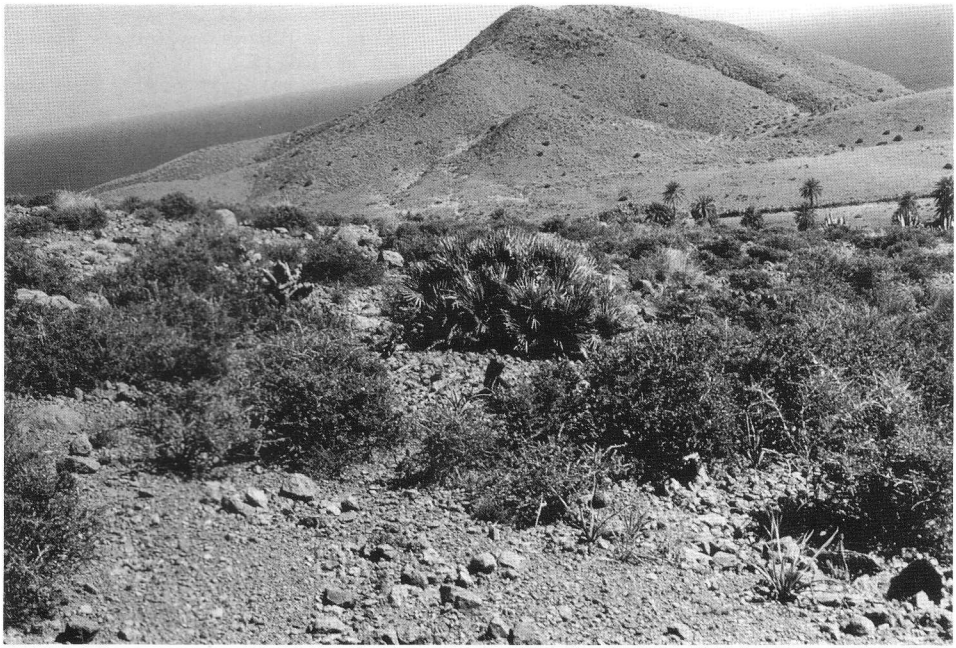
Table 1 shows a summary of the results obtained for the various treatments. Germination occurrences are expressed in percentages, and time in days.

Table 1. Germination pattern.

Treatment	25°C	
	% Germin.	Time (days)
Scarified seeds		
Manual		
Control	60	25
GA3	0	35
4.5 hours H_2SO_4 96%	90	7
3 hours NaOH 30% (w/v)	75	10
Mechanical		
Control	75	25
4.5 hours H_2SO_4 96%	67	7
3 hours NaOH 30% (w/v)	60	20
Seeds with flesh		
Control	0	35
4.5 hours H_2SO_4 (96%)	0	35
7 hours H_2SO_4 (96%)	80	35
3 hours NaOH 30% (w/v)	0	35
7 hours NaOH 30% (w/v)	15	35

The above tests allow us not only to study the germinating capacity of the seeds, but also to know the optimum laboratory conditions needed for the radicle to emerge. We can deduce in this way the environmental conditions which determine the germination process in the natural habitat during the development of the embryo. We can also establish whether dormancy occurs and to what extent (Bewley and Black 1982).

With regard to temperature, an important exogenous parameter in the germination process (Bewley and Black 1982), high percentages of germination were obtained at 25° C optimum, but considerably lower at other temperatures. Thus, 25% of the manually scarified seeds sown



3. *Chamaerops humilis* L. in its natural environment.

in sterilized water germinated at both 16° C and 30° C, while 60% germinated at 25° C. In the control test carried out with mechanically scarified seeds, germination was 35% at 16° C and 55% at 30° C, as opposed to 75% at 25° C. No germination could be induced in seeds with flesh at any of the temperatures attempted.

These results could be an indication of the way in which the germination process is affected by temperature under natural conditions. Account must be taken, however, of the fact that in nature temperatures undergo, not only seasonal, but also daily changes which have an immediate effect on many metabolic processes such as cell permeability and growth (Aldasoro et al. 1981), protein synthesis (Rodriguez et al. 1985), etc.

The best results were obtained when manually scarified seeds were treated with concentrated H_2SO_4 for 4.5 hours and then put in a germination chamber. Germination was 90% in just seven days, as opposed to 60% in 25 days for the control test in water. As can be seen in Table 1, good success rates, 75% after 10 days, are also obtained by treating the seeds with 30% NaOH for 3 hours.

In the case of mechanically scarified seeds, the control test gave good results in comparison with other tests (75% after 25 days). However, when mechanical scarification was combined with chemical scarification, in contrast to manual scarification alone, the success rate decreased (67% in 7 days after pretreating the seed with H_2SO_4 for 4.5 hours; 60% in 20 days with 30% NaOH). Germination time was also longer, which could be explained because mechanical scarification leaves the embryo exposed to damage by strong acid or alkaline agents.

In the tests carried out with whole fruits without removing the flesh, germination could only be induced by prolonged treatments with acids (after 7 hours treatment, germination was 80% in 35 days) and alka-

lis (15% in 35 days). An explanation for these results could lie in the similarities between our tests and the natural process. The fruits are eaten by animals and go through a digestive process of enzymatic attack, after which the bare seeds are released in the feces. In our treatment, the mesocarp of the fruits is degraded by acid and the seed is released. A longer exposure to acid could probably also accelerate germination.

It is not surprising that chemical scarification for a relatively short period, combined with either manual or mechanical scarification, is equivalent to chemical scarification for a considerably longer period.

We conclude, therefore, that in order to obtain seedlings in just a few days (one week), it is necessary to carry out manual scarification followed by treatment with acid for at least 4.5 hours. Mechanical scarification is also recommended, but in this case, seedlings do not appear until after 25 days. When whole fruits are used, 7 hour treatment with sulphuric acid is advisable. In all cases, a further incubation period at 25° C in darkness and 70% humidity is necessary.

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A New Record of Manicaria for Peru

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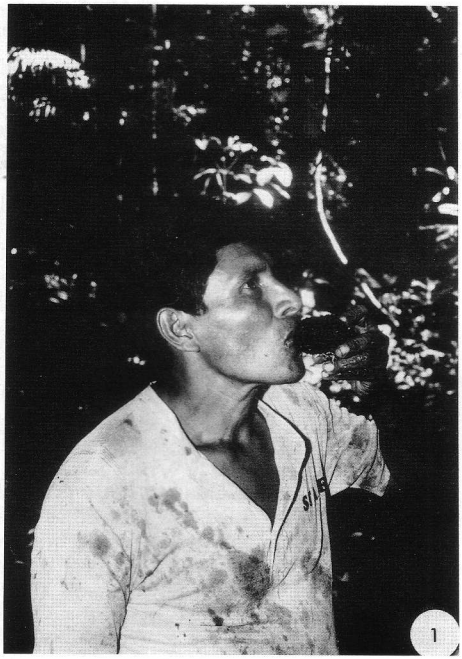
The genus *Manicaria* occurs in Central America (Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panama) and northern South America (Brazil, Venezuela, Colombia, Ecuador, the Guianas). It is found in widely scattered localities, often with great distances between them. There is just one species, *M. saccifera* Gaertn., although various botanists have described it with different names. This is a very distinctive palm, with large, usually entire leaves with serrated margins. The fruits are also very distinctive in being covered with corky protuberances. Plants usually grow at low elevations, especially near the sea. There are also many inland populations, especially along the Amazon and Orinoco rivers. There is one extraordinary occurrence on Cerro Marahuaca in Venezuela, where plants were found growing at 1,200 m elevation.

Until very recently the genus was not



1. Liquid endosperm from *Manicaria* fruits being drunk.

2. The stem of *Manicaria* in the forest near Iquitos.

known from Peru; the farthest west it had been recorded in the Amazon basin was in Colombia, on the Río Apaporis. Now it has been found in Peru (voucher specimen: *C. Grández 2233*). The locality is near the confluence of the Río Napo and Río Amazonas, not far from Iquitos. The palm grows in lowland forest, in an area with almost 3,000 mm of rainfall per year. The forest here is on non-flooded, sandy soils at 130 m above sea level. Other palms growing in association with *Manicaria* are *Astrocaryum huicungo*, *Iriartea deltoidea*, *Phytelephas macrocarpa*, *Socratea exorrhiza*, and *Scheelea* sp. Local people use the palm in various ways. The liquid endosperm from the fruits is drunk (Fig. 1). Bora Indians use the palm in a special way. "Ampiri" is a mixture of tobacco and the ash from burnt *Manicaria* stems (Fig. 2). This ash contains salt, and by mixing it with the tobacco this is rendered less toxic; it is then taken as a stimulant.

The discovery of *Manicaria* emphasizes how poorly collected the Amazon region is. The region near Iquitos has been relatively well-collected, and yet new records, such as *Manicaria*, are still being found within a short distance from the city.

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Lord Howe Island

BILL GUNTHER

Lord Howe Island lies 435 miles northeast of Sydney, Australia; it is part of the Territory of Australia. It is an oceanic volcanic island, about a half mile wide and 7 miles long, with mountain peaks rising to 5,000 feet. Discovered in 1788, it was not inhabited by man until 1834, and its total population now is just 300 persons.

To members of The International Palm Society, Lord Howe Island is famed for being the home of four palm species: *Howea forsteriana*, *Howea belmoreana*, *Hedyscepe canterburyana*, and *Lepidorrhachis mooreana*. All four species are endemic to Lord Howe Island, which means that in nature that small island is their one and only home. Additionally, and even more remarkably, the three palm genera on the island also are endemic there.

The inhabitants of Lord Howe Island have a unique status in that the sale of sprouted palm seedlings is their prime source of income. By far the largest part of that income derives from the species *Howea forsteriana*. But palms are their business rather than their hobby, so not one of the 300 citizens of the Island belongs either to The International Palm Society or to the Palm and Cycad Society of Australia. And that is why, even today, there still are no exotic palms on Lord Howe Island. "We have plenty of palms; why should we import more of them?"

When we asked the travel agency for round trip air tickets to Lord Howe Island, the response was, "Where on earth is that place?" After diligent effort, we located a small local Australian airline which flies 10-passenger propeller-driven planes to a more popular South Pacific island, but which en route makes a refueling stop on Lord Howe Island. The air fare from Sydney to Lord Howe Island is exorbitant even to gringos. However, we were determined to go—so we paid up. Then we telephoned the Government Office on Lord Howe Island and advised them that we were palm specialists from the U.S.A. who were visiting Lord Howe Island, specifically to view the palms, in order to write an article on those palms for *Principes*, the journal of The International Palm Society. The folks in the office had never before heard either of *Principes* or of The International Palm Society, but nonetheless they decided that if two Americans were sufficiently interested in palms to come to Lord Howe Island to view them, they should be treated as "Official Guests." As such, we were met on arrival by a young and likeable government ranger with a government jeep. He was assigned as our guide and the three of us immediately set out via the jeep for Mount Gower, the palm center of the Island.

En route, the dirt road passed first through farmlands and then through groves of *Howea forsteriana* palms; they were so old and large in comparison with those we had seen in California that we, at first, didn't even recognize them. The road also passed by the government-owned palm nursery, a vast operation which ships out by far the largest bulk of the world market's seedling Howeas. As a matter of economic policy, no seeds from Lord Howe Island have been sold for export during recent years. At the termination of the road, which is the beginning of the hiking trail, to the 5,000 foot top of Mount Gower, the jeep was simply turned off and parked, unlocked, keys left in place. No one would steal the jeep; the Island is too small to hide it.

The walking trail proceeds southward along the palm lined beach for a mile or more, then it abruptly turns 90 degrees inland, up a grade so steep that a rope had been tied palm-to-palm to provide hand-held assistance for hikers. After gaining perhaps 1,500 feet of altitude, thanks to the rope, further ascent there is blocked by a vertical cliff, and the path then again turns southward along the base of that cliff—with an almost vertical dropoff one step to the right straight down to the Pacific Ocean. This portion of the horizontal trail is so narrow that for about half its distance, a horizontal rope is attached by iron spikes into the rock cliff for hand-held security of hikers. And after one glance downward, they use it! Finally, after at least a full mile of sheer terror, the end of the cliff is reached, after which, to the hiker's great relief, the trail turns inland and upward over more friendly terrain.

In this area, the forest was a mixture of the two species of *Howea* and of other semitropical trees. Here the *Howea forsteriana* palms were decidedly smaller than at sea level, and *Howea belmoreana* gradually became more prominent. In this transition zone, the trail reaches Goat Flat, a stream which flows over the bare bedrock; this provides a very welcome rest spot and an opportunity for the sunshine to penetrate down through the otherwise solid overgrowth of trees.

At this point, our guide told us how very lucky we were—in that purely by chance we had come to visit Lord Howe Island during the best weather experienced there for many months. Ordinarily, Goat Flat and everything above is completely shrouded in low clouds and mist, and often it is windy. But when we saw the area in full sunlight, there seemed to be very definite indications of hybridization between the two species of *Howea*. Some of the palms were *Howea forsteriana*, and some were *H. belmoreana*, but some others seemed to be hybrids between the two species. When a taxonomist can visit Lord Howe Island, he or she should hike up to Goat Flat, hopefully in clear and calm weather conditions, and after study announce a decision as to whether or not natural hybridization has occurred.

Continuing above this point, the trail leaves the altitude of the Howeas and enters the area of *Hedyscepe canterburyana*. This palm, the only species in this genus, is smaller than either of the *Howea* species and it occupies a smaller portion of the Island than does its lower altitude kin. But it too is a very attractive palm, and it seems to have the potential of becoming a popular cultivated addition to the landscaping in the coastal areas of California.

Toward the top of Mount Gower there grow thousands of individuals of the palm *Lepidorrhachis mooreana*. Plate 66D of the book *Genera Palmarum* is an excellent close-up photo of this species. A number of collectors have palms labeled as this species, but many of these appear to be incorrectly labeled. Thus, we caution those who think they have *Lepidorrhachis* to withhold final judgment until identification can be verified by a taxonomist.

Yes, our trip to Lord Howe Island was a real joy. But to anyone who undertakes that trip in the usually prevailing cloudy and misty weather conditions, it might rather become just one big frustration—including inability of the plane to land because of poor visibility.

But if you decide to try it, this is to wish the best of luck to you.

In this world of ours there are several very comparable, but widely separated, volcanic oceanic islands which are of special interest to The International Palm Society because of their unique endemic palm species. These include Lord Howe Island (off the east coast of Australia), the Juan Fernandez Islands (off the west coast of Chile), and Guadalupe Island (off the west coast of Mexico).

Each of these three islands happens to be near 30 degrees from the equator, and on each of these islands live about 300

people. But different contacts which pertained during prehistoric times result now in very different endemic palm species on each. On Lord Howe Island are the four species listed in the above article. On the Juan Fernandez Islands is *Juania australis*. On Guadalupe Island is *Brahea edulis*.

As is true in the flora of all oceanic islands, many of the plants (including palms) which developed are endemic to those islands because of the water barriers which separate them from the mainland.

The big problem for the endemic island palms came after man became dominant on earth. Man, both by deliberate and by unintentional actions, upset the previous balance of things by introducing mainland animals to the Islands.

The northwestern highland of Guadalupe Island (Isla Guadalupe), Mexico (located about 250 miles southwest of San Diego, California) until about 200 years ago was covered with a large forest of the endemic palm *Brahea edulis*. Then came the clipper ships, which deliberately introduced goats to the Island (as a source of meat for future trips) and which also, unintentionally, introduced rats and mice. Ever since, the goats, the rats, and the mice have been eating the seeds of the palm ("edulis" means edible), and the feral goats, now numbering in the thousands, have been eating all the palm leaves they can reach. As a result, the palm population on the Island now is down to a few hundred very old trees, and in an estimated 20 years the last of these palms on the Island will have died of old age. This will not mean extinction of the species, because members of The International Palm Society who live in southern California are growing the species. But in our lifetime, it is very doubtful if conditions will exist for reintroduction of the palm back to Isla Guadalupe, its only native habitat. It is doubtful because to the human inhabitants of the Island, the goats, as a source of meat, are more valuable than the palms. And it is doubtful because to date no conservation organization has offered support toward killing off the goats.

Goats, rats, and mice were introduced in the same way to Lord Howe Island, but Australia vigorously counters the threat—because palms are the main livelihood of the residents of that Island. Domestic goats no longer are allowed on the Island because they might escape and go wild. And every ranger now going into the wild carries a loaded rifle, with which he shoots every feral goat sighted. As a result, now, only a very few goats remain at large; when these are shot or when they die of old age, the threat of goats to the palms on Lord Howe Island will have been eliminated. And the rats and mice, which if uncontrolled would eliminate *Lepidorrhachis mooreana* by eating all of its seeds, now are being very vigorously poisoned on that Island under coordinated Federal and State government programs. Whether poisoning alone will exterminate all of the rats and mice on the Island is doubtful, but it is very successful as a "holding" operation to preserve the palms until the time when a more effective rodent-killing method is devised.

On the Juan Fernandez Islands, off Chile, the endemic palm *Juania australis* seems not to be bothered so much by goats, rats, and mice as by domestic horses and donkeys, which are allowed to run loose to pasture over the expanse of the Island. The Chilean forestry agent on the Island agitates toward prohibition of this open grazing right, but his wishes are overcome by the contrary wishes of the other Island residents, to whom the value of their horses far exceeds the value of the native palms which are out of their sight far up on the mountains. Thus far, the will of the populace prevails, and quite likely it will prevail in the future, so long as the forestry station is able to sustain the historic size of the Island's palm population by replacing dead palms with equivalent numbers of new baby palms which are specially

grown for that purpose in the forestry service nursery.

In summary, on the islands considered, the influence of man on the endemic palms has been severe, but not devastating except on Isla Guadalupe. On Lord Howe Island and on the Juan Fernandez Islands, man seems able to overcome his past mistakes with corrective measures which serve to maintain the endemic palm populations.

Seed Bank Update

As probably most members are aware, the Seed Bank was reorganized in 1989. It had grown too unwieldy for one or two volunteers to manage and successive directors suffered from burn-out. The plan that was finally put into effect spread the work around more and also involved as seed Distribution Centers, two botanical gardens to give continuity. A special computer program was written so as to keep better track of payments, seed orders and shipments and members' accounts. Donors were again solicited for seeds and finally a new seed list put out, which provided for the pre-payment of any seeds ordered.

Over the next 3½ years (July, 1989–December, 1992) there were 419 members who ordered seed and as of December 31, 1992, 365 were still active accounts. Of 7,225 orders, 3,018 had been shipped. In dollars, that is approximately $10,000 of seed shipped with $13,000 yet to go.

Again, as under previous directors, the biggest problem was obtaining donated seed to fill orders. There was a bad freeze in Florida during the winter of 1989-90 and two seasons later South Florida was hit with a terrible hurricane.

Of the 365 active members (orders), 33% are in foreign countries. Sending seed to foreign countries can be quite tedious, time consuming and difficult to meet all government regulations. Finally the Seed Bank had to stop sending seed to South Africa entirely because the chemicals required to fumigate the seed have to be solely handled by experts and we are not allowed by our own government to purchase them or handle them. In addition, the U.S. government started to require a charge of $19 for each phytosanitary certificate prepared. This came as a real blow, as most foreign countries to which we ship seed require this certificate.

The new computer system worked quite well, although it is a bit cumbersome if members change their minds about their seed orders. But with little rare seed being donated, the two botanical gardens involved with supplying volunteers for the Distribution Centers are re-thinking their roles and some problems are arising here.

Robert Egge in Hawaii, who took over as Seed Bank Director at the invitation of then IPS President Jules Gervais, as of July, 1989, asked to be replaced as he felt his major strengths in analysis and systems and procedures had been used, the Seed Bank was again up and running and a new Director who could better cajole potential donors for seed was now needed. He was asked to stay on until December 31, 1992 when Lynn Muir, Chairman of the Seed Bank Committee, took over as acting Director until such time as a permanent Director was named. He is now actively engaged in strengthening the Seed Bank and smoothing out some of the rough edges.

R. G. EGGE
June 3, 1993

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Fasciation in the Male Rachillae of Borassus flabellifer

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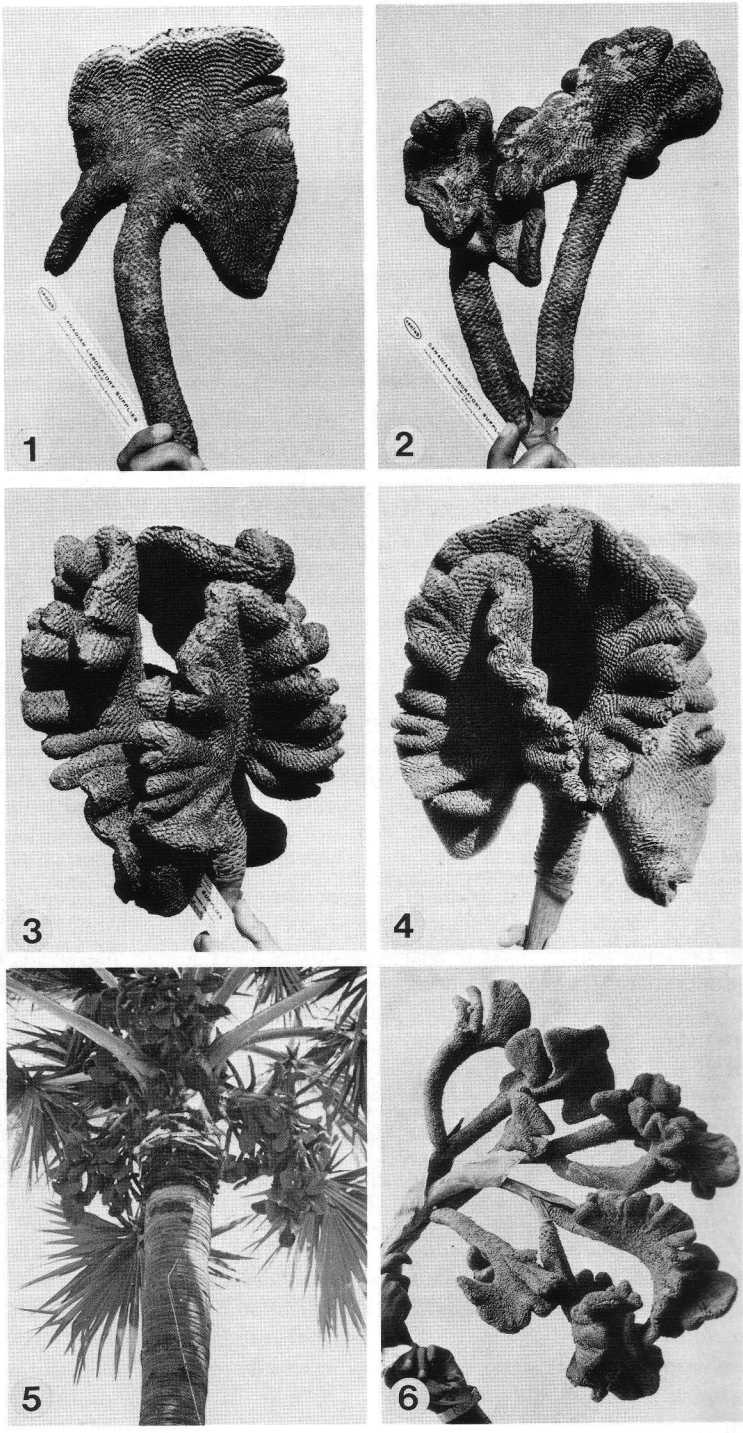
Fasciation (the flattening or banding due to fusion of organs) is relatively rare in the reproductive regions of palms. A perusal of the literature reveals that fasciation of rachillae was reported in *Areca catechu* (Costerus and Smith 1923), *Borassus flabellifer* (Andy 1869), *Cocos nucifera* (Costerus and Smith 1925, Davis 1957, Kempanna 1969) and *Latania* (Costerus and Smith 1923). In the course of ontogenetic studies on *Borassus flabellifer* Linn., interesting cases of fasciation of male rachillae were observed. Such an abnormality has not been recorded in this species except for a casual report by Andy (1869). Several plants in Kanyakumari, Tirunelvely, Ramnad and Madurai districts of Tamil Nadu, India, displayed abnormalities of the male rachillae and periodical field trips were undertaken to collect material.

In *Borassus flabellifer*, normal male rachillae are cylindrical and elongate and are covered by tubular bracts in the early stages of development. Rachillae emerge through an opening at the distal end of the bract. Cincinni of male flowers are located in pits and the subtending basally connate bracts are spirally arranged around the central axis. Flowers, located in a pit, come out one after another and liberate pollen. The green color of rachillae changes to brown after anthesis.

In the abnormal cases, the tip of the rachilla becomes fasciated and produces different shapes. In simple cases, the tip becomes a dorsiventrally compressed structure while its proximal part remains cylindrical. In some instances, the fasciated part becomes divided into two units. In pronounced fasciation, the tip becomes highly compressed and bent and looks like the hood of a cobra (Fig. 1) and in some assumes a honeycomb-like body. Sometimes, the fasciated part is variously curved (Fig. 2). In extreme cases, the tip initially fasciates into three different units; each of the units proliferates independently forming variously shaped ridges and furrows with different types of extensions, with some of the extensions, located along the margins, being fingerlike and becoming miniature rachillae. Such cylindrical miniature rachillae also bear spirally arranged bracts enclosing cincinni of flowers. The three main units remain distinct and flare apart during later stages of development. The rachilla simulates the body of a sponge and appears most bizarre (Figs. 3,4).

The number of rachillae of an inflorescence undergoing fasciation varies. Among the several rachillae, only one fasciates and is conspicuous among the normal ones. In others, rachillae of only one primary branch fasciate and the rachillae in all the rest of the primary branches remain normal. In still others, rachillae in some primary branches are normal while among the rest, fasciation occurs only in isolated rachillae. There are instances where fasciation occurs in an inflorescence while all the others are normal. In extreme cases, almost all the rachillae of all the inflorescences of the plant fasciate variously and present all possible combinations of various shapes men-



1. Fasciated rachillae appearing like the hood of a cobra. ×⅓. 2. Two fasciated rachillae variously curved. ×¼. 3 and 4. Two different views of an intensely fasciated rachilla with a bizarre appearance. ×¼. 5. A crown of the plant full of fasciated rachillae. ×1/30. 6. One inflorescence with all the rachillae fasciated. ×⅙.

tioned above (Figs. 5,6). Such inflorescences, during later stages, hang down from the crown due to the great increase in weight. As a result of crowding of such peculiar inflorescences, it is difficult for a person to get into the crown (Fig. 5). Despite the fasciation, these rachillae still bear normal flowers.

The fasciated rachillae possess some basic trends. It is the distal end of the rachilla that undergoes fasciation, while a major portion of its proximal part is unaffected. Whatever may be the size and shape of the fasciated rachillae, it is fertile and bears clusters of normal flowers with fertile pollen. The rachilla bracts are also normal. Defasciation does not occur in a rachilla after fasciation.

A casual observation might suggest that fasciation of rachillae is a result of compression within the bracts or leaf sheaths. However, an analysis reveals that compression within the limited space is not responsible because all the bracts, primary axis, and proximal part of the rachillae are normal, the rachillae are not only compressed but show peculiar shapes that cannot be the result of compression, different units of a fasciated rachillae flare apart and are separated by ample space, and sometimes, only one rachilla of an inflorescence fasciates leaving all the others unaffected.

Data collected in the field reveal that fasciation does not appear to be the result of physical damage, disease or insect attack, neither can it be due to superabundant nourishment nor other environmental factors since plants in the vicinity do not show it. It seems that the fasciation noted in *Borassus* must be due to some physiological disturbance, causing stimulation in the growing point. When the single growth center of the rachilla is converted into an extended plate, the derivatives can produce a honeycomb-like structure. If it is changed into a number of such centers, curious shapes of rachillae as seen in Figures 3 and 4 will result. It seems that fasciation is a peculiarity of certain individuals.

Discussion

Costerus and Smith (1925) gave no details about the fasciated rachilla of *Cocos nucifera*. However, their figure 17 reveals that the distal part of the spike is fasciated while its proximal end is cylindrical. This is similar to fasciation noted in *Borassus* of the present study. A similar observation was made in *Cocos nucifera* by Kempanna (1969). Branching and rebranching of a fasciated spike of *Cocos nucifera*, as observed by Davis (1957) was not noted by Costerus and Smith (1925).

The occurrence of normal male flowers with functional pollen in the fasciated spike of *Cocos nucifera* (Kempanna 1969) is also similar to *Borassus flabellifer* of the present study, and differs from the observations of Davis (1957) who recorded only sterile or underdeveloped male flowers. In contrast, flower-bearing is normal and never leads to sterility in the individuals of *Borassus* studied by us.

In *Latania*, fasciation was noted in the rachillae of only the lowest branch of the first order (Costerus and Smith 1923). In the present study, there was no such restriction. In some cases, almost all the rachillae in all the inflorescences of a plant were fasciated (Fig. 5).

In *Areca catechu* the tips of the fasciated rachillae were flowerless (Costerus and Smith 1923), but such a flowerless condition in fasciated rachillae was never met with in *Borassus* of the present study.

The factor responsible for fasciation in *Borassus flabellifer* (Andy 1869), *Areca catechu*, and *Latania* (Costerus and Smith 1923) and *Cocos nucifera* (Costerus and Smith 1925) was not identified while Davis (1957) suggested that fasciation in *Cocos nucifera* was caused by insect attack or similar injury during meristematic stage and Kempanna (1969) believed that insect or damage of the part by disease during

ontogeny or giving out some kind of stimuli for rapid growth by the plant might be responsible. In the present study fasciation seemed to be due to physiological disturbance to the growing points of the rachilla.

Acknowledgment

We are thankful to Dr. Natalie W. Uhl and Dr. K. Periasamy for going through this manuscript and offering valuable suggestions. One of us (S.V.) is grateful to the University of Mysore for the award of a fellowship during the tenure of which this work was carried out.

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Principes, 37(3), 1993, pp. 168–171

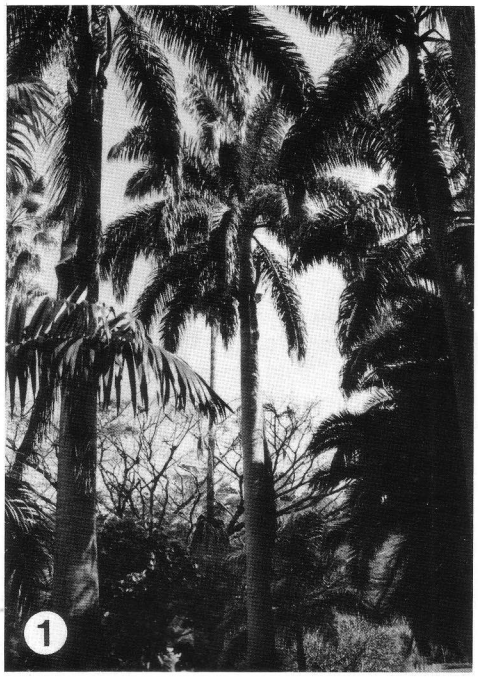
PALM BRIEF

A Visit with August Braun at Jardin Botanico, Caracas

As guests of Dr. Rodolfo Belloso, in November, 1990, Crafton Clift and I had an opportunity to visit the Jardin Botanico in Caracas before proceeding to the Rio Tuy farm where Crafton was working in research and development of tropical fruits.

Shortly upon arriving at the garden, we made ourselves known to the former director, August Braun, who is known for his articles in *Principes* and as author of a number of books on palms indigenous to and growing in Venezuela. His recent publications, especially well-written, are *Palmas Autoctonas de Venezuela y de los Paises Adyacentes* (Native Palms of Venezuela and Adjacent Countries) and *El Cultivo de las Palmas en el Tropico* (The Cultivation of Palms in the Tropics). Both of these books in Spanish are quite useful and have information on species not normally found in some of the books written in the United States or Australia. Crafton and I were each presented with autographed copies for our own libraries.

Dr. Braun is a very gracious, friendly man whose main direction in life has been and is to study and grow palms. His vast experience over many years relate to both common and rare species. Since arriving at the garden in 1951 from his native Switzerland, he has almost singlehandedly planted the wide variety of species in the garden's collection, many of which grow to absolute perfection in Caracas' climate. The long avenue of *Roystonea venezuelana* (Fig. 1)—perhaps the longest planting of these grandest of all royals in the world—were planted just before his arrival but nurtured to perfection by his loving attention. In other parts of Caracas where a lowering of the water table has resulted in many *R. venezuelana* mortalities (such as the once-great boulevard in the Country Club of Caracas, since replaced with *Washingtonia*) his royals are now almost 40–50 m high and still healthy and still growing. One wonders at the maximum height these plants can achieve. Though some question exists as to the validity of this species—some classifying it as only a variety of *B. oleracea*—there is a dis-



1. *Roystonea venezuelana* planted in 1950 in Jardin Botanico, Caracas. 2. *Neoveitchia storckii*, 15 year old plants in the Jardin Botanico, Caracas with C. Clift and August Braun.

tinctive appearance that singles out this royal. Wide short pinnae on stiffly erect petioles and in younger plants the maroon red petioles and crownshaft combine with a steadily-tapering massiveness with more prominent leaf scars to make this an outstanding palm. As an aside, I have been growing this royal in South Florida for some years. Its robustness and excellent resistance to cold spells make it perhaps more adaptable than most royals. I have observed it growing throughout Venezuela from steamy swamps to mountain sites, and it always looks good.

Impressive stands of *Washingtonia* are found in the garden, and this palm seems to grow taller and more vigorously than in California or Mexico. Dr. Braun thought his plants set out in the early fifties were probably hybrids. Even *Brahea* species do well in the garden, a situation quite different from Florida where they do not do well at all.

Probably the collection of *Licuala* species is one of the most impressive sights in the garden. While by no means a complete collection (readers might help here) the beauty of these plants in the tropical cool and misty climate of Caracas leaves nothing to be desired. Large specimens are so well-adapted that one is hard pressed to find damaged leaves even at the lowest part of the plants.

Growing equally well are *Neoveitchia storckii* (Fig. 2), *Polyandrococos caudescens*, and *Pigafetta filaris*. In some cases, unfortunately, the garden does not have enough plants to reproduce these palms. The *Pigafetta*, for example, seem to be only pistillate plants—so with a lack of pollen, the reproduction of this easy-to-grow palm becomes impossible. Since Dr.

Braun has been good at sharing seeds with palm enthusiasts and local nurserymen, providing the garden with the means of developing its palm collection will do service to the distribution of exotic palms both in Venezuela and abroad. Collectors and growers desiring to help may contact August Braun, Inparques, Jardin Botanico, Caracas, Venezuela.

Presently, August Braun is retired and living inside the garden. His loving interest in palms is not diminished, and living with them enables him to continue to carry out his life work. In a large shade house, divided by a center isle of bromeliads and ferns are long rows of magnificently grown palms—*Reinhardtia simplex*, *Chamaedorea* sp., an unnamed *Prestoea* species from the highland forests of Anzoategui state with unusually drab green-colored leaves of large size, orange-tinged trunk and petioles, and multiple trunks, and a delicate *Geonoma* species from Parque Nacional Guatopo. Above all was his pride and glory—a magnificent unnamed *Chamaedorea* with long pendulous infructescences adorned by large bright orange fruits. Unfortunately the male plant of this single-trunked species died shortly after producing its pollen. Unless found again in the high forests of Guatopo, the present seeds, hand-pollinated by Dr. Braun, may be the only survivors. These seeds were shared with us, and hopefully a reproducing colony of this beautiful *Chamaedorea* can be established in Florida. At this writing the seeds were germinating for several persons growing them. The plant was discovered by Dr. Steyermark of Missouri Botanical Garden fame and never found again. Dr. Steyermark, since deceased, worked incessantly and cooperated and travelled with Dr. Braun. His relentless search for new species in a lifetime of work in Venezuela gave him the distinction of having named more plants than any other person, perhaps even Linnaeus.

As in many gardens, the work in Caracas has been curtailed by insufficient funding and bureaucracy. Dr. Braun would be delighted to receive seeds of palms from members who would be interested in participating in his efforts to save many species from extinction. He is particularly interested in the genus *Chamaedorea* and other small-growing palms, but any palms—particularly those that can be grown well in Caracas' climate—would be gratefully received. Seeds not utilized by the garden would never be wasted, as he is very generous in helping others with an interest in palms.

The center of the garden is a hilly undeveloped rainforest region. It is perhaps the only surviving bit of natural habitat in the city of Caracas. There, over the years, Dr. Braun has planted many palms that have naturalized into the habitat, an area unlike the manicured design of the garden proper. As we walked the trails, the palms introduced everywhere overpowered the less resplendent growth, without any care or development. Lianas and vines rose and fell to add an other-worldly feel to this verdant paradise. The expressways, traffic, and urban noise of Caracas disappeared in this remnant forest attesting to the ability of plants to provide us with solace and peace even in a metropolis.

Members visiting the garden will enjoy a good collection of palms native to the American tropics as well as the exotics. They should also call on Dr. Braun who welcomes visits from Society members. He is a man with a big heart, kind personality, and a life devoted to his favorite plants—palms. He is deserving of recognition for his accomplishments, and I hope this article will help introduce him and his garden to our membership.

RICHARD A. VLASIC

See notice of 1994 BIENNIAL, p. 138.

Principes, 37(3), 1993, pp. 171–177

CHAPTER NEWS AND EVENTS

South Florida News

The South Florida Chapter met on April 16th at Fairchild Tropical Garden, to hear Lim Chong Keat speak on"Conservation of Palms in Malaysia." Lim's presentation was filled with many spectacular slides of Malaysian palms. The meeting was very well attended and the presentation outstanding.

The Chapter participated in the Fairchild Tropical Garden's Spring Sale. An advance sale open to Palm Society members was held on April 23rd, with the public sale held on Saturday, April 24th, from 9:30 a.m. to 4:30 p.m.

The Texaco "Leaves over Miami" and the American Forest Association's "Global ReLeaf" school planting programs are continuing in 1993. The first planting was at Perrine Elementary School on April 29th, with the participation of volunteers and the school children. An additional elementary school was planted on each following Friday through June 11.

Central Florida Chapter Activities

On March 13, the CFPS attempted to participate in the annual Leu Botanical Gardens plant sale but the few members attending the sale were treated to the "storm of the century." The next event planned for March 27th in conjunction with the Palm Beach Palm & Cycad Society was much more successful. With excellent weather and tour guides the nearly 50 attendees had a wonderful tour of Gemini Gardens in Manalapan. It was very exiting to return to this botanical garden just 4 months since the IPS biennial tour and see the transformation. Though far from complete, it is obvious this garden is a must visit for the future. From there, we retraced the Biennial tour path to the North Sculpture Garden for an excellent lunch sponsored by the Palm Beach Palm and Cycad Society. By mid afternoon we were trying to select the perfect palms to purchase from over 500 different species at Paul Craft's Cricket Creek Nursery.

On May 1, the CFPS participated in the annual one-day plant sale at the University of South Florida sponsored by Dr. Fred Essig. In just one day 9 growers sold 577 plants for over $6,400. This is a new CFPS record and much credit is due to Ted Langley's efforts. Ten percent of the sales were donated to USF.

On May 16, the CFPS hosted a joint meeting of the First Coast Palm Society of North Florida. The meeting started by touring Doris Smith's yard in Daytona Beach. This is a mature palm collection planted years ago by the founder of the IPS, Dent Smith. From there we headed south to Sugar Mill garden for a brief tour and discussion with demonstration by Martin Wittbold on a low-cost structure for providing cold protection to the palm collection. Arrangements were made through Martin for the CFPS to donate a palm to the garden. Then we were on to Doug and Barbara Keene's residence in Deland. Though many of the species are young, Doug has 120 varieties in the ground. After a brief palm sale of 47 plants, with a net income of $187.40 to the CFPS, we all toured the garden.

Future chapter plans include a tentative meeting in August in the Jacksonville area with the First Coast Society and a two-day meeting in the Ft. Myers/Cape Coral area the first weekend of October (the weekend prior to the IPS Board of Directors meeting in New Orleans).

ED AND NANCY HALL

West Palm Beach Palm & Cycad Society Activities

The West Palm Beach Palm and Cycad Society (WPBP&CS) IPS Chapter hosted a garden tour and joint meeting with the Central Florida Palm Society Chapter on

March 27th. See CFPS writeup for details on this meeting.

The chapter met on April 7th at the Mounts Botanical Gardens. Scott Zona gave a presentation on the genus *Roystonea*. Scott has done extensive research on this genus.

The Spring Palm Sale was held on April 17–18 at Morikami Park, Delray Beach. Numerous palms, cycads, books, fertilizer and T-shirts were available. A display area was also featured.

Broward County Palm & Cycad Society Activities

The initial meeting of 1993 on March 25th featured David McLean speaking on "*Chamaedorea* in the Landscape." In addition to serving as speaker, David McLean was also the auctioneer for the Chinese auction. His talk covered such critical issues as canopy, irrigation, maintenance and fertilization. On May 1 and 2, the Broward County Palm and Cycad Society held its first palm sale. Set up on April 30, the vendors grew from 22 to 24, but everything came together well at Flamingo Gardens. The next two days found many members working very hard, thus making the sale a very successful one.

The May 27th meeting featured DeArmand Hull, South Florida Cooperative Extension Agent and avid palm grower, speaking on "Palms of the Seychelles." The Seychelles contain some of the most sought-after palms, among them *Phoenicophorium borsigianum* and *Verschaffeltia splendida*. Both palms have entire or sparsely-divided leaves and the latter has prominent stilt roots.

News from the Southern California Chapter

The Southern California Chapter of the IPS met on May 22 at Palomar College in San Marcos in north San Diego County. This is the 20th anniversary year of the arboretum at the college. The first speaker was Wayne Armstrong, noted author and botany instructor at Palomar College. Wayne spoke on various aspects of palms, including palm ivory, Caribbean palms, and interesting facets of the coconut palm. Wayne was followed by Gret Hamann, a San Diego businessman, whose presentation featured slides from his recent expedition up the seldom traveled Rio Dulce River in eastern Guatemala and Caracol in Belize. This area is home to many rare and unusual palm species, including species of *Geonoma*, *Chamaedorea*, *Synechanthus*, *Acrocomia* and *Astrocaryum*. The meeting, with approximately 100 in attendance, ended with a fantastic palm auction and raffle.

Earlier on the day of the May meeting, a number of chapter members attended a public lecture and slide presentation by Don Hodel on the *Chamaedorea* genus at Quail Botanical Gardens, Encinitas. Don is the author of the excellent book *Chamaedorea Palms* published by the IPS and available through the IPS bookstore. The lecture had been widely publicized and was quite well attended. Copes of the new book are available for sale at the Quail Gardens giftshop.

The July 17th meeting will be hosted by the Ventura–Santa Barbara Region members and will feature a tour of Pauleen Sullivan's garden at the Tonga Apartments. Special plants there include a large *Polyandrococos caudescens*, a fruiting *Neodypsis decaryi*, a fruiting *Lytocaryum insigne*, a *Euterpe edulis*, an *Astrocaryum mexicanum* and a large *Pritchardia hillebrandii*. An educational meeting will be held at Ventura College beginning in the late morning, followed by an auction and raffle. Ventura College also will host its own palm sale that morning, with over 100 species available for sale.

News of the Pacific Northwest Chapter

The Pacific Northwest Palm and Exotic Plant Society (PNWP&EPS) held a gen-

eral meeting and plant sale on May 18th at Van Dusen Gardens. A summer BBQ is planned with date and location not available at press time. Future meetings for 1993 are scheduled for August 23rd and November 29th at Van Dusen Gardens in Vancouver. In addition, the group plans a booth at the Pacific National Exhibition in Vancouver on August 20 through September 6, 1993.

North Queensland Palm Society News (PACSOA)

The North Queensland Palm Society (NQPS) met on April 5th to hear Michael Ferrero of Cairns speak on "Palms of New Guinea." Michael recently returned from an excursion through the north coast provinces of Morobe and West and East Sepik. This wet equatorial region is an area rich in palms, and the local people use palms extensively in their day-to-day lives. Michael's talk was illustrated by excellent slides and examples of palm artifacts. At this meeting, John Dowe gave a short talk on the genera *Pinanga*, *Nenga* and *Areca* and their distinguishing characteristics. The major raffle prize was *Pinanga disticha*, donated by the Townsville City Council, Parks Services, Botanic Gardens.

Palm and Cycad Society of Mackay [Australia]

Officers of the PACSOM group have changed, with Percy Simonsen of Sarina taking the reins as President. Russ King of Eimeo will serve as Secretary and Henry Duncan of Mackay will serve as Treasurer. Margaret Brown has scampered off to England [again]. PACSOM membership has steadily grown and has stabilized around the sixty mark, with about 40% participating on a regular basis.

The Palm and Cycad Society of Mackay (PACSOM) of PACSOA met on March 21st at the home of Clive and Rosemary Rowles, in Alligator Creek, Queensland. The April 18th meeting of PACSOM was hosted by Lewis and Betty Dovey, 18 Mogford Court, Mackay.

A Garden Party and Street Fete was organized by Louis McGregor in Jansen Street, Slade Point, on May 2nd. Over 40 stalls were in operation. Apart from palms and other plants, sales items included pottery, stained glass, and glass blowing, woodwork, resort wear, herbs, and numerous other assorted services including head massage and astrology. Palmists anyone??

The palm collection at Farleigh continues to expand, with 300 species within 110 genera currently represented. The cycad collection at present comprises 19 species within 8 genera. The overhead spray system is nearly complete, due solely to the efforts of PACSOM Vice-President Keith Boyden. Palm growth has visibly accelerated since sprayer introduction. An article on the Farleigh Mill Plot was given in the Oct–Dec 1992 issue *Palms & Cycads*.

Palm and Cycad Society of Western Australia Activities

A garden tour and afternoon tea was hosted by the President, Ken Adcock, at his home in Bentley on Sunday, March 28th. Members were treated to a guided tour of Ken's well established garden, glasshouse, shade house, and fish farm. In addition, guests viewed a video on "Cycad reproduction," discussed palms and cycads, and generally had a relaxed afternoon in the great weather.

The Society met on April 19th at the Leederville Town Hall. Barry Winter gave a talk and demonstration on how to divide a *Rhapis excelsa* palm. Barry also donated two *Rhapis* palms for the meeting raffle. The raffle raised A$172 for the Society. Norm Patterson gave a brief talk on *Pritchardia*, noting that *P. affinis*, *P. hillebrandii*, *P. rockiana*, and *P. martii* were all suitable for the Perth area. The remaining species were considered to be too tropical. The May 17th meeting included the Palm and Cycad Auction night, with Russel Dyer serving as auctioneer. There was a

great selection of plants. The Annual General Meeting was scheduled for July.

The planned Karrinup Shopping Centre palm display was moved forward two weeks and ran from May 3 through May 8. Sam Fagani provided several large palms for the display, with various other members providing smaller ones.

Work continued on the Gascoyne Park Palm Garden project. Work days were held on February 20th and March 20th. Condolences to the family and friends of Tim Erceg, Chairman of the Gascoyne Park committee, who was killed in a traffic accident.

Sunshine Coast News (PACSOA)

The Annual General Meeting was held on Monday, February 1st, 1993, at 7:30 p.m. at the Nambour Band Hall on Daniel Street. Stan Walkley spoke on Cycads in the Northern Territory, in the Kimberleys and in Northwest Thailand. His presentation also covered some rare palms of Thailand. The talk was followed by a big sale of palms and cycads. Palms available were too numerous to list; cycads included *Cycas wadei*, *C. thourasii*, *C.* sp. Philippines, *C. chamberlainii* × *C. taiwaniana*, *Stangeria eriopsis*, *Zamia fischeri*, *Z. splendens*, *Z. manicata*, *Dioon mejiae*, *D. califanoi*, *Encephalartos ameulans*, *E. gratus*, *E. horridus*, *E. lehmannii*, *E. msinga*, and *E. ngoyanus*. Palm and cycad seeds were also available for sale. Leo Gamble pointed out the danger of inadvertently importing the infamous Palm Beetle (already present in Cairns) if bringing stock down from northern Queensland.

The April 5th meeting focused on "In the Red—Palms with Red Leaves." Various members brought specimens for display and sale. Included were: *Neophloga* sp. (pink crownshaft), *Gronophyllum pinangoides*, *Pinanga crassipes*, *P. coronata*, *Chambeyronia macrocarpa* and many more!

The Sunshine Coast Palm Society also held a social evening at the La Trattoria Italian Restaurant in Forest Glen on April 8th. A very delicious Italian dinner was enjoyed by all.

South Queensland Group (SQG) News (PACSOA)

The Annual Palm and Cycad Sale was held at the Mt. Coot-tha Botanical Gardens in Brisbane and was once again a great success. A large queue awaited the opening hour of 9 a.m. and probably half of the weekend sales were taken within the first few hours. By the time the sale ended on Sunday afternoon, 1,600 visitors had filed through the display and in excess of 4,000 plants were sold. Palms and cycads had separate sales areas, with the cycads arranged to areas of origin. The display has evolved with an emphasis toward increased educational value. Separate sections feature special areas of interest such as "palms and cycads of Madagascar," "the genus *Chamaedorea*," "*Rhapis excelsa*" and "cold-hardy palms and cycads." Special poster and seed displays and a bookshop were featured.

The next Annual Show and Sale will be held on March 4–6, 1994, at the same venue. This will be the tenth anniversary and will feature several special events. Make your plans to attend.

The SQG held an outing on Sunday, April 18th, to Stan Walkley's "Australian Rare Palm Supplies" nursery at Buckley Road, Burpengary. This outing also featured a palm sale/swap and a picnic lunch.

The group also met at Bread House in Brisbane on May 17th.

Sydney Branch (PACSOA) News

The Sydney Branch of PACSOA met on Tuesday, March 16th at the Maiden Theatre of the Sydney Royal Botanic Gardens. Ian Edwards and Peter Kristensen presented a slide show of their experiences on the post-Biennial IPS trip to Costa Rica.

Sunday, April 18th, featured an infor-

mal walk around the Sydney Botanic Gardens followed by a picnic lunch.

At the May 18th meeting John Dowe gave a very interesting talk and slide show about the Townsville Palmetum and various other topics.

Future meetings are scheduled for the third Tuesday of each odd month at the same location, starting at 7 p.m.

Texas Chapter News

The Texas Chapter held their Annual Spring Palm Sale at the Mercer Arboretum on April 17th, from 9:30 a.m. until 5 p.m. The event was very well attended with gross palm sales of slightly over $5,000. A very wide variety of cold-tolerant palm species were available for sale through the efforts of Grant Stephenson and Horace Hobbs. In addition to the sale, Gordon Hintz provided a public lecture on "Palms for Houston."

On May 8th, the group met for a special tour of the new Moody Garden Rainforest Pyramid by Gary Outenreath, who heads up the garden's horticultural exhibits. Following a short business meeting in the greenhouse lecture room, the group toured Moody Garden's production greenhouses and some of the outdoor plantings, then moved into the special Rainforest Pyramid. The exhibit looked surprisingly well balanced and mature for its brief existence—the Grand Opening was only held on March 27–28 of this year. In addition to palms and other tropical plants, the rainforest features various tropical "critters," including various butterflies, macaws, scarlet ibis, ducks, turtles, and various fish (including some very large specimens) in a scenic aquarium/lake. The Rainforest Pyramid, 3-D IMAX and visitors' center began construction 2 years ago and cost $30 million. In addition to the Pyramid, the complex now features an IMAX 3-D theater (one of only 3 such in the world), a convention center, a children's petting zoo, the white sand Palm Beach and lagoon, a Vietnam War Memorial and a rose garden. Future plans for the $90 million complex include a 200-room hotel, an Oriental garden designed by a London architect, a wetlands conservatory, an aquarium and a deep swimming lagoon for adults. Gary was one of the earliest members of the Texas Palm Society in the mid 1970's, during his work with the Busch Gardens' Houston Garden and Zoo, prior to its closing. Gary's interest in palms has continued and shows clearly in the Moody Garden plantings, which are very well maintained.

On June 12th, the Texas Chapter ventured south to Palacios to tour Annette and Bob Stonedale's nursery. The Stonedale Nursery is producing various *Sabal* species commercially.

Future meetings planned for 1993 will be July 24th at Alfred and Wendy Loeblick's home, August 14 at Bill Bittle's in Rockport, September 4th at Grant Stevenson's, October 2nd hosted by Horace and Cynthia Hobbs, and in November at the home of Bill and Kelley Burhans.

J. CAIN

Hawaii Island Palm Society Chapter Activities

The Hawaii Island Palm Society (HIPS) Chapter met on May 21st for a slide show on "Palms of the Amazon Basin" by former IPS President Ken Foster. The show took the viewers from the Rio de Janeiro Botanical Gardens to a tour of the Amazon, with stops along its entire length to Leticia, Colombia and Iquitos, Peru, on the eastern edge of the Andes. Along the way there were collecting stops in tiny villages and trips on barely passable roads in search of rare palms. Ken has traveled to 34 countries in search of rare and endangered palms and he now provides consulting services for palm growers, giving advice on palm nutrition and disease and on the identification and placement of palms. Ken commented that it is now necessary to travel several hundred miles from the river to find virgin forest. "Everyone knows the Amazon rainforest is disappearing," he

says, and you could see it in his slides. A specimen of the rare *Mauritiella armata*, featured in the slide show, was given as a door prize.

The Panaewa Rainforest Zoo Planting Project, begun in November 1992, continues under the coordination of David Sylvia and Jan Anderson in cooperation with Zoo Director, Lloyd Yoshina. There are genuine rainforest conditions at the zoo. The goal is to make available, in an easily accessible location, a collection of beautiful and interesting palms from around the world and especially from the Hawaiian Islands. The March 20th zoo planting saw 15 rare and unusual palm species put in the ground. Volunteers planted *Clinostigma samoense*, *Thrinax parviflora*, *Chrysalidocarpus decipiens*, *Neodypsis lastelliana*, *N. leptocheilos*, *Neoveitchia storckii*, *Pinanga copelandii*, *P. modesta*, *P. caesia*, *P. isabelensis*, *Phoenicophorium borsigianum*, *Rhopaloblaste sinaporensis*, *Actinorhytis calapparia*, *Euterpe precatoria* var. *variegata*, and *Normanbya normanbya*, all donated by David Sylvia, Jeff Marcus, and Jan Anderson. The zoo already has three large *Metroxylon amicarum*, *Dictyosperma album*, *Aiphanes aculeata*, *Pritchardia beccariana*, *P. hillebrandii*, *P. affinis*, *P. pacifica*, *Verschaffeltia splendida*, *Pinanga coronata*, *Licuala spinosa*, and a whole host of other unusual and common palms.

The HIPS participated in the Hawaii State Horticultural Show on June 17–19 at the Edith Kanakaiole Tennis Stadium. The show ran from 2 to 9 p.m. on Thursday and from 9 a.m. until 9 p.m. on Friday and Saturday. The chapter had a booth at the show, with Rozak Bizel in charge of the display setup and takedown. Mitzi Christensen organized HIPS booth staffing.

Review of *Palms and Cycads*, Journal of the Palm and Cycad Societies of Australia (PACSOA)

PALMS & CYCADS, journal of PACSOA, is published four times per year, with color covers and well illustrated articles about palms and cycads. The average length is about 30–40 pages per issue. The journal is A5-sized (similar to *Principes*, but slightly smaller). Subscription/Membership fee is A$20 (Australian residents) or A$30 (non-Australian residents) plus an initial A$5 first time "joining fee." Occasionally issues of *PALMS & CYCADS* are devoted entirely to specific topics. Send checks in Australian currency to Palm & Cycad Societies of Australia, P.O. Box 1134, Milton, QLD 4064 Australia.

The July–Sept 1992 issue included a collection of remembrances of Robert Tucker (1955–1992) as well as an article on "The Bowen [Queensland] *Corypha*" written by Robert Tucker. An article on the sterile cross between *Butia capitata* and *Syagrus romanzoffiana* can be found in the article "× *Butiagrus nabonnandii* (Proschowsky) Vorster—The Clean Cocos" and "Destruction of Cycad Seed by the Bush Rat" describes this problem.

The Oct–Dec 1992 issue contained a most interesting article on "The Phenomena of Mottled Leaves in Palms" by the late Robert Tucker. Also featured were "*Macrozamia johnsonii*" by Paul Kennedy, an article of "Freeze Damage on Cycads" by Roy Works, and "The Palmetum at Farleigh Mill" by Jeanne and John Price. The issue also featured an excellent review of Keith Boyer's new book, "Palms and Cycads Beyond the Tropics: A Guide to Growing Cold-hardy Species." This book was published by PACSOA's publication fund. PACSOA news items and the PACSOA bookstore listing made up the remainder of the two above issues.

The Jan–Feb 1993 issue featured three articles on Cycads: "*Lepidozamia peroffskayana* in New South Wales," "Notes on *Lepidozamia hopei*," and "A Summary of the Genus *Cycas* in Queensland" as well as various administrative PACSOA reports. No articles on palms were featured in this issue, but this rarely occurs.

The nest issue of *Principes* will feature a review of the various individual local

Palm Society newsletters published within Australia and available via PACSOA.

JIM CAIN

Mid-Term IPS BOARD and COMMITTEE Meetings French Quarter, New Orleans—October 1993

The Mid-Term meetings of the IPS Board of Directors will be held on Friday, October 8th and Saturday October 9th at the Royal Sonesta Hotel (lovely southern elegance) on Bourbon Street in the French Quarter. Individual Committee meetings will be held on Friday afternoon, and the full Board of Directors meeting (with reports from committee meetings) will be on Saturday. Our Louisiana and Gulf Coast chapters are planning an exciting 4–5 day schedule! If you wish to attend, it is important to arrange hotel bookings now. Basic schedule follows.

THURSDAY Oct. 7th—Afternoon private garden tour with catered meal.

FRIDAY Oct. 8th—Morning: tour of a portion of Jean Lafitte National Historic Park and Preserve to see flora and fauna of the area swamps! Transportation will be provided. Afternoon: IPS Committee meetings followed by dinner/fais-do-do dancing at Mulatte's, a popular "authentic" Cajun place.

SATURDAY Oct. 9th—Directors' meeting at the Royal Sonesta with continental breakfast and lunch for directors included. A list of suggested restaurants for dinner will be provided. Other IPS members are invited to attend the directors' meeting as observers if they so wish, but will need to arrange their own luncheon plans—an easy task in the heart of the French Quarter. Those members not wishing to attend the formal meeting are free to conduct a walking tour of New Orleans (informative suggestions to be provided at the meeting registration).

SUNDAY Oct. 10th—Select from French Quarter activities, or take an optional day-tour to Maxwell Stewart's 10-acre palm garden and estate in Mobile, Alabama, with lunch at Maxwell's in conjunction with the Gulf Coast Chapter. Mobile is about a three-hour drive from New Orleans. You may return to New Orleans that evening the group, or elect to fly home from Mobile. Route to Mobile will be along the colorful Gulf Coast highway, offering a nice introduction to this area for those not familiar. Transportation will be provided for those needing it.

MONDAY Oct. 11th—Possible morning garden tour for those who spend Sunday night in New Orleans. Many things to do in New Orleans—world class aquarium, jungle zoo, riverboat rides, antique/boutique shopping, relaxing at Cafe du Monde with beignets and cafe au lait—and every kind of night life imaginable.

While this is primarily a business meeting of the IPS Board of Directors and standing Committees, all IPS members are welcome to attend and observe. However, it is imperative that a reasonable count be obtained as soon as possible. If you wish to attend this meeting, please make your room reservations directly with the hotel (504-586-0300) as soon as possible. Also advise the IPS Secretary, LYNN MCKAMEY, P.O.B. 287, GREGORY, TX 78359 or FAX (512) 643-3111 so that conference and catering numbers can be preplanned. Be sure and include any guests you may bring in your count.

If you have any questions, please contact Lynn McKamey or Jim Cain.

Principes, 37(3), 1993, pp. 178–179

PALM LITERATURE

CHAMAEDOREA PALMS: THE SPECIES AND THEIR CULTIVATION. By Donald R. Hodel. 338 pp. Allen Press, Inc., Lawrence, Kansas.

Donald Hodel's eagerly awaited book on the Chamaedoreas has been meeting with appreciative reactions, both from botany specialists and from amateur collectors. For many years the classification of these popular palms had been a gigantic puzzle. To bring order to the confusing picture, Hodel has carried out an in-depth review of the existing *Chamaedorea* descriptions and herbarium specimens, making careful and extensive comparisons with the living plants in the field and under cultivation.

A major stumbling block to field study for botanists has always been the difficulty of arriving at the precise time that the plants are flowering and fruiting; Hodel has neatly—and ingeniously—overcome this problem by bringing back over 60 species to be grown in his research greenhouse in Los Angeles.

On the basis of floral and other characteristics, Hodel has assigned the nearly 100 species of *Chamaedorea* to eight subgenera, offering keys to the species within each subgenus. Previously existing descriptions and synonyms for each of the species are listed, the common and vernacular names, if any, are given, and then the species is described in botanical detail. Each presentation goes on with a statement of the palm's natural distribution, followed by a discussion of its characteristics, its history, and its environments in the wild and under cultivation.

Knowledge of the conditions of growth in the wild, of course, is invaluable to those of us with collections, as are the more than 550 clear, carefully selected color photographs. One can now easily determine, for example, that for optimum growth, *C. cataractarum* needs lots of percolating water if it is to avoid brown-tipping. Even more exacting requirements must be met if one is to grow many of the cloud-forest species, as Hodel points out.

As to nomenclature, many of us will now be switching our labels or making new ones, in at least one case rather like a game of musical chairs: the *Chamaedorea* we've been calling *costaricana* is most likely *pochutlensis*, while our erstwhile *woodsoniana* turns out to be *costaricana*. The true *woodsoniana* is now revealed as a large, single-trunked *Chamaedorea* which we may have been cultivating as *C. vistae*. And so it goes.

Useful tips are offered for recognizing species from their vegetative characteristics alone, e.g., *C. costaricana* and *C. quezalteca* can be identified by the prominent ligule bases at the top of the leaf sheath, clearly visible in the photos. Many of these characters are ultimately incorporated near the end of the book in a key to the commonly cultivated species, based entirely on vegetative material! In addition, there are chapters on hybrids, economic uses, and conservation—this last subject of particular importance in a world where species are daily becoming rare or extinct.

Especially appreciated among palm fanciers is the chapter on culture, including soils, nutrients, pathogens, propagation and pests. The palm grower can find here solutions to longstanding problems such as "frizzletop" (manganese is needed), as well as suggestions for such arcane procedures as marcottage. For botanists contemplating the study of these palms—as Hodel points out, much still remains to be done—the three introductory chapters, covering nomenclature, general history, distribution and ecology are an essential prerequisite.

Two sizes of type are used in this book, corresponding to Hodel's two writing styles: a smaller typeface for the scientific

descriptions, written in a formalized style with a high density of imagery, and a larger, easy-to-read type appropriate to Hodel's expository style: clear and forthright, with flashes of irony and humor.

Viewing the book as a whole, one must marvel at what an enormous and demanding feat Hodel has accomplished: he has examined and compared hundreds upon hundreds of specimens and descriptions, many of these fragmentary or seemingly in conflict with one another. Next he has worked his way through this thicket to reduce the view of each species to what was truly essential. And lastly, adding much collateral material, he has presented his work to us in the form of what is commonly called a "good read": a book to be perused and savored at our leisure.

Hodel's "Chamaedorea Palms" is without a doubt a landmark work, one which will stand the test of time; it is an indispensable acquisition for botanist, collector and palm novice alike.

BARRY OSBORNE

The Roster

If you are looking for the new *Roster*—It will be mailed with the October 1993 issue of *Principes*.

CLASSIFIED

FOR SALE: New Caledonian palm seed: *Chambeyronia macrocarpa*, $US 450 per 1000; *Kentiopsis oliviformis* $US 300 per 1000. Airmail postage extra. Write to: BRYAN J. LAUGHLAND, 20 Vic Butler Street, Mt. Roskell, Auckland, New Zealand.

Back Cover

Well grown *Chamaerops humilis* in its limestone habitat, Majorca, Spain. Photo by J. Dransfield. See p. 151.