PRINCIPES

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Contents for January

Cover Picture

A double-trunked *Roystonea dunlapiana* cultivated in the central plaza of Cosamaloapan, Edo. Veracruz, Mexico. See pp. 44–45.

PRINCIPES

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The Spotlight Interview: Myron Kimnach

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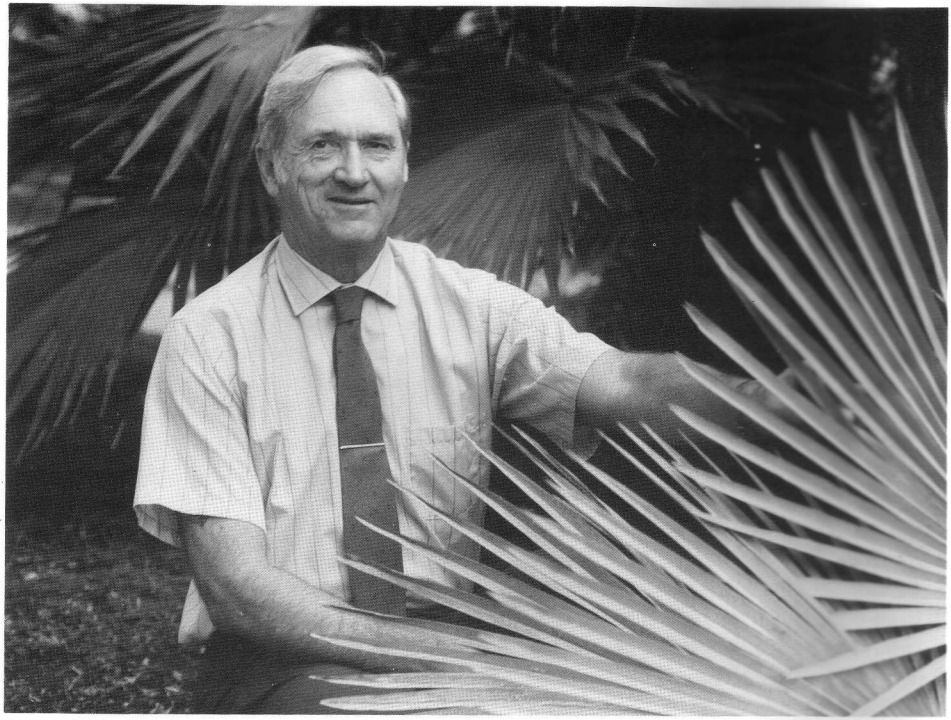
Can you imagine devoting nearly forty years of your life to plants? Not many of us can, but that is precisely what Myron Kimnach has done. A man with a broad botanical background, Myron is now in charge of the renowned Huntington Botanical Gardens in San Marino, California. In addition to having served as President of the International Palm Society, he remains a member of the Society's advisory board, and also functions as chief consultant for Lotusland, the enchanting estate in Montecito. Last but not least, Myron is nearing completion of a comprehensive handbook on subtropical palms, which will surely become a standard reference work. What follows is a conversation with a personable and extremely interesting man.

You are writing a book dealing with palms. What is the story behind it?

When I got the job here at the Huntington, I was put in charge of the gardens. This really broadened my interest in plants, including the palms. I had been here a couple of years when Hertrich's book *Palms and Cycads* sold out of all existing copies. We thought about doing a new printing of it and I was assigned to go through it and see what corrections were needed. There were so many that I got the okay to do an entirely new palm book, but the problem has been that while my intentions are good, I have been kept very busy. I still have not finished the book, and it is now twenty-two years later! It is four-fifths done, however. Hertrich's book has been very useful, but simply has become very limited for today's usage, and the nomenclature is totally out of date. So it is easier, theoretically at least, to write a new book. I plan to devote a lot of time to it over the next two years. The book will deal exclusively with palms, principally subtropical ones. It will be a large book, with keys and descriptors, cultivation techniques, and a lot of species detail. I will treat about 250 species, and plan to include observations from my trips, and the results of research done here as well. I want to focus on the palms which should be tried in this area. Many have not been tested, and in most cases, the problem is source of seed. I hope more of the palms described in my book will be introduced in the future.

You have weathered many exotic expeditions to many areas of the world.

I've gone on seventeen Huntington trips to Mexico alone. On these trips, we collect all kinds of plants, anything that is ornamental, also seeds for our seed list and herbarium specimens. On a couple of these trips we concentrated on palms. Fred Boutin, a former botanist here, was particularly interested in *Brahea*. So we collected in Sonora, Chihuahua, and Sinaloa. We brought a lot of braheas back: *Brahea pimo*, from Michoacan, and *B. aculeata*, *B. decumbens*, and *B. bella*. We also found *Brahea nitida* in Sonora. Fred acquired geological maps of Mexico showing where all the limestone was concentrated, since braheas usually grow on



1. Myron Kimnach among the palms at Huntington Botanical Gardens.

limestone. We would then focus on those areas. Braheas usually grow on high peaks, and, as there are no roads, we did some rather strenuous climbing to get to them. Around Monterrey (Mexico), *Brahea berlandierii* grows, almost inaccessible on top of the peaks, and viable seed is difficult to obtain so it's a very rare palm in California. The most exciting *Brahea* to me, is *B. decumbens*, a little dwarf which rarely gets more than two feet high.

So you attempt to bring back new palms for California?

We are doing that all the time. I recently came back from South Africa where I spent a month in the west part. I was in Bolivia a year ago, in the high, cold country. We saw *Parajubaea torralii*, which should be introduced here. At the time, there was no seed available. From Venezuela, I brought in seed of a *Ceroxylon*. We have a bit of trouble growing *Ceroxylon* in our nursery. To carry them through, from seed to a stage where they can be planted out, is difficult. And then, they often dislike our summer heat. It's a challenge to say the least.

What is your position here at the Huntington?

My title is Curator of the Botanical Gardens. I have the same job that William Hertrich had. When I first got here, I was also the superintendent of all buildings and I had the guards, the maintenance people, and the general security to oversee. Those jobs got so big that they finally split mine. Now I am just in charge of the gardens, which of course is better. I have about 65 people on my staff.

I became Curator when I got here in

1962. Prior to that, I spent eleven years at the University of California at Berkeley, where I was assistant manager of their botanical gardens. At the time, they had very little in the way of palms. Now, my job is basically that of an administrator. I do the hiring, organize committee meetings, put budgets together, sign bills. Administrative work takes up most of the day, but I usually find time to walk through the gardens, examining things and checking on conditions. I live in a house on the grounds. It is the same house where William Hertrich lived. He started the palm collections here, and many of the older plantings are a result of his efforts. He was quite a remarkable fellow.

You are also associated with Lotusland. What do you do in that context?

I am the consultant to the Lotusland board of directors. Mme. Ganna Walska wrote me several times for assistance when she resided there. She was extremely devoted to her plants, and it was her wish and intention that her estate be maintained for the public. What I am doing is writing a master plan for Lotusland. We will be opening for regular public tours, and I am planning tours, education, research, and relandscaping. Lotusland will be run as an institution; though up until now, of course, it has remained a private residence.

Will you please comment on the theory of cyclical frosts?

In 1913, 1937, and 1948, we had around 18 degrees here. It did a lot of damage, and killed many palms. Such cold cannot be predicted. Of course, we do not stop because of it. We keep on planting things out. We experiment. We test. In fact, I was just down at the Jungle Garden, and some of the palms we planted six months ago were already dead from cold. But we must keep on trying. We just run with the odds that each year may bring with it a very cold winter. Most of the really tender palms we sell at our plant sales. We do not keep them because we feel they simply will not survive our winter outside. Frost or no frost, many palms cannot take prolonged cold.

Is the annual plant sale a large source of revenue?

It is geared more towards helping plant growers and collectors. We make a bit of money, but not very much from the standpoint of a fund-raising project. We also have an endowment campaign to raise funds for the main buildings and the parking lots. We have raised eight million dollars over the last five years, and just a bit of it has come from the plant sales. We luckily get a lot from grants, and things of that nature. But the plant sales are important. Our volunteers work really hard. We also pay for expeditions out of the sale revenues. And we purchase all of the plants and seeds for the entire grounds out of the plant sale revenues. We are not funded by the state or the city. This is a private institution. We live, basically, on our endowment, which was left by Mr. Huntington, plus any donations we may receive. From the plant sale monies, every year or two we give money to people who go out and collect seeds in, for example, Fiji, the Philippines, and New Caledonia. We get seeds, germinate them, and try a few outdoors. Then we turn the others over to the plant sales, which helps to get the materials out to the general public.

There has been a lot written about preparing planting holes. What is done at the Huntington?

We try to amend, as well as pre-fertilize, the palm planting sites wherever possible. The palm garden was one of the first areas to be developed at the Huntington. The soil in that area, at least the top three feet of it, was excavated for the basement of the art gallery, which was the Hunting-

ton home, around 1910. It is a rocky subsoil. We often use a fire nozzle and inject fertilizer into this subsoil, and we also mulch the beds. One of the problems with the palm garden is that it can't expand. It is hemmed in on all sides by other gardens. So, the only thing we can do is to replace palms we already have. We own far too many *Chamaerops*, for example. We have sold off a number of them in order to make room for new palm introductions. But we must maintain a landscaped design, with large expanses of lawn.

Do you start your palms in greenhouses, or do you plant them out immediately?

We start the palms in our greenhouses, but we do not continue to grow them in that environment. Basically, we do not obtain palms unless we think they will grow successfully outdoors. We have no intention of creating a huge tropical greenhouse. We would never be able to budget that sort of thing. For example, the new public desert greenhouse, which is 35 by 100 feet, cost us $50,000 just to erect! With palms, an ordinary house would not suffice because of the height factor. It would be very nice to have a tropical house, but we simply do not have the budget for it.

Does the Huntington maintain a research library?

We have a library of about nine thousand volumes dealing with horticulture and botany, mainly subtropical plant materials. We try to stick with plants which may one day be grown here. We also have an herbarium of dried plant materials. You really need it to back up your research. And as far as research and data goes, every once in a while, somebody asks for a list of our palms. Well, we never used to maintain a list. We used a file card system, with one card for every species and hybrid in the gardens. We recently passed our 55,000th acquisition. They may not all be alive, but we keep all the data on cards. Origins, location, causes of decline, and the like. Now, however, we are inputting the information into our computer, and with it we can get printouts of particular plants and plant groups. If we want a printout of the palms, we can have it easily. Our palm collection is growing steadily. I'm guessing, but we must have nearly 160 species representing about 45 genera outside. And we have more in the greenhouses.

Do you feel that palms, as horticultural subjects, are becoming more popular?

Popularity tends to be tied in to a degree with what landscapers are providing, and what people read about in the garden sections of their newspapers. Popularity also depends on what appeals to the individual. Palms are such distinctive plants that they turn off a certain segment of the population. Many people feel that palms are stiff, which is partly a psychological reaction. I feel that palms will always be somewhat limited since they lack the element of mass acceptance. Plants which feature bold, colorful flowers, for instance, will be more popular than mass plantings of greenery. A lot more can be done with palms though. Landscape designers have tended to avoid palms because a lot of the designers were trained many years ago, by people who came from the east coast or the midwestern states. The young designers have proven, to a large extent, to be more open-minded and receptive. So, the more we plant palms, the more acceptable they will become. But if we plant things which are too tender and they are wiped out by a freeze, the entire process will be set back. People will then say "We should not even be bothering with these things (palms); let's stick with our old standards." And, of course, everyone knows that there are too many *Washingtonia* around Los Angeles, and not nearly enough other palms. But *Washingtonia* are fast growers, and rel-

atively inexpensive, and therefore overused. It's a self-perpetuating problem.

The Huntington produces palm hybrids?

We have a man on the staff, Bud Hallberg, who is in charge of our palms. He has created several hybrids here, particularly with *Phoenix*. Very few of these have gotten large enough to really tell what they will look like in maturity. There is one, *Phoenix rupicola* crossed with *P. roebelenii*, which is very nice. It can be made over and over. And *Brahea brandegeei* with *B. edulis* now occurs here naturally. Over the years this hybrid has set seed, and now we have the second generation of it. It is a very attractive, and relatively fast-growing palm. I feel that a lot can be done with hybridization. It would be valuable if some of our palm growers would do a bit of specialist work, such as hybridizing *Chamaedorea*, and working out techniques of propagation and tissue culture. Ongoing projects keep your enthusiasm up. Of course, it's a lot of fun to simply collect palms. But the special projects are nice to hear about. I would advise people to try some of those if possible.

What is your perspective on The Palm Society, as a former President?

It was interesting and I enjoyed it very much. I was in favor of changing the name to The International Palm Society because too many people felt it was strictly an American society, which of course is not the case. Strength is in numbers. As a worldwide society, it becomes a much more effective organization. Regarding *Principes*, we often hear that it is considered too technical. The general public thinks it is too technical, and the scientists feel it is too popular. It's really difficult to please everybody. I think the journal strikes a very good balance. With the local newsletters supplementing *Principes*, there is a good overall perspective and survey of both technical pieces and items of popular interest for homeowners and growers. By the way, I think the Seed Bank is one of the best features of The Palm Society. It's a unique service, getting seeds from around the world, right to your mailbox. It certainly helps to keep people busy and interested. Germinating the seed, watching the plants grow, and trying them outside is very beneficial. A steady source of seed is helpful in many ways.

Growth of The Palm Society has been slow but steady.

For several reasons growth for The Palm Society is hard to project. Membership growth seems to go in cycles, and inflation has a lot to do with it. People hate to spend money on what they consider to be non-essentials during inflationary surges. This not only applies to palms, but is also true of book-selling, art, and the theater. Subscriptions can drop way down at times. And the use of palms also depends on which plants are popular at a given time and not so much on availability. Interest is rising again in tropical plantings, but there comes a point where people feel overextended and start cutting back, and then the trend goes off in some other direction.

How are the Huntington's palm plantings watered?

With pop-ups and sprinklers, all automated with clock timers. We get the watering done during the night, so that our visitors do not get wet. Occasionally we have a gardener use a hose, since there are the inevitable dry spots. No sprinkler system is 100 percent efficient. We used to have a fogger system in the Jungle Garden and that failed because our water is so alkaline. Within a month, all the leaves on the palms were white from the salts. Overhead watering is okay, but not misting. There is too much evaporation, and there are too many salts in the water.

Are you responsible for the Pritchardia *plantings in the Jungle Garden?*

We got in ten species from several sources. *Pritchardia beccariana,* we knew was hardy, and had been previously tested. We then tried a number of others, just out of one-gallon containers, and they burned a little during the first few winters. All of them have done very well outside, so we have a lot of hope for them. They all live under trees, however. I don't think they would do as well out in the open.

How did you become involved with palms?

In 1946, after World War II, I started a collection of succulents on my windowsill in Palo Alto (California). I built up a large frame collection. I outgrew that and went to work at the greenhouses at Berkeley (University of California) in 1951. Then I got interested in the classification of cacti. I really did not become involved with the palms until I got to the Huntington in 1962. It must have been 1963 or '64 when I joined The Palm Society. I do not own any palms except a *Brahea nitida* on the front porch, which is technically mine. Everything else has been done for research purposes and for the Huntington.

Do you have any personal palm favorites?

I like chamaedoreas. They are graceful and have greater horticultural utilization than many palms. They make very nice house or office plants, if they are provided with enough light. I like braheas because I have been involved with them. *Brahea nitida,* for example, does very well in the ground. It needs light, but does not like to be damp. But braheas, of course, are slow-growing. That's one of the reasons they have never been big in nurseries. I love the tropical palms, but in this area of California I have to draw the line and choose plants that will really make it. I love to go to Fairchild and roam around. I'm just like a boy in a candy store.

Advice for homeowners with palm plans?

Well, if you plant them in your yard, leave lots of space. People tend to plant things too closely, and later, the palms are in each other's way. Palms need space and light. Use long-range planning. Even here, in our efforts to plant as many kinds as possible, we have, in some places, become a bit overcrowded. It is a very human thing to want to plant a huge variety. But use care. Don't overplant, and try to be patient. In time you will certainly be rewarded.

How are palm seeds germinated at the Huntington?

We have experimented a lot with seed filing. *Brahea* seed, in particular, tends to be very hard, and slow to germinate in quantity. We often notch the seed just enough to thin the outer coat. We find that this encourages rapid germination. We use bottom heating cables. A lot of bottom heat, quite a bit of moisture, and very good air circulation are our basics. Of course, many palm seeds just do not remain viable for very long. And a lot of the seed we receive, especially from other botanical gardens, is not too good. We are on about two hundred seed lists. Many of the people at other institutions believe that palm seed will "keep" for several years, if stored in a jar. Because the botanists deal with enormous numbers of plants, they too often assume that, like many other types of seed, palm seed will last in storage. Some palm seeds do last for a few years, but others do not.

The Huntington is located in a subtropical area, yet many palms are thriving here.

We have been successful in some areas, and we have failed in others. Take, for

instance, our ceroxylons. All of them have done very well here, in spite of negative factors. But, the palms from New Caledonia that we have tried outdoors have failed miserably. We have great difficulty with the New Caledonian material: there is some deficiency in our soil, perhaps lack of nickel. The plants turn yellow and die. In other areas of California they seem to do quite well. And then, things from the Philippines and Fiji did well enough in the nursery here, but had trouble once planted out. You have to keep trying though. Mardy Darian is very adventurous with trying out new material, and this is important. We are trying all the caryotas we can get, and so far none of them have died. They have been very successful, in fact, and now we have self-sown seed of *Caryota urens* coming up around the older trees. We have a *Roystonea* which is about twenty feet tall. It was planted in the warmest spot we could find and is growing well. But, don't forget, we have been lucky in recent years, and have not had to deal with extreme cold. Another interesting palm is our *Hyphaene* specimen, which has not grown noticeably above ground in over seven years. It has developed absolutely huge roots though, and so I think it may spend most of its early years building up the root system. It is in a dry area, but is basically a tropical palm and seems to be just fine. A lot of work is being done with livistonas in Australia, and we are getting in a lot of those, which, a few years ago, were scarce. Our *Serenoa repens* are fine specimens, hardy, low-growing, and very attractive. I'm not sure why more people are not growing *Serenoa* here in California; it's really a gem. We did not have any *Jubaeopsis caffra* plants for the longest time. Then we received two plants from an institution in South Africa. They very kindly air-mailed the two palms, one gallon size, to us here. And the plants are doing beautifully; no problems at all. Incidentally, the largest *Jubaeopsis caffra* in California is in Beverly Hills. It is twice the size of this room; a beautiful palm. People are trying to cross it with *Cocos nucifera*, the coconut palm. We will see what happens as a result of those experiments.

You are obviously optimistic about new palms for the subtropical areas.

There are many exciting palms to be brought in. We have a small plant here of *Trithrinax biflabellata* from northern Argentina. It is a nice, multi-trunked palm, which should be brought into the country in large numbers. *Juania* also offers promise, but not necessarily for us here. It prefers a damper climate, and we are thirty miles from the ocean on the edge of the desert. You know, it is hard to draw the line between what is subtropical and what is not. There are often no clear distinctions. San Diego, for example, has a very fortunate climate, whereas other areas of California differ. Again, it reverts back to the popularity of palms as a whole. The landscapers, the nurseries, and the street people, all want to do the job as easily as possible, and make as much money as possible. That is understandable, but it certainly does not help to increase palm variety. People want fast results, and many palms do not grow rapidly.

Final comments for our readers?

I do not want to leave my book unfinished; it is now about two years from completion. I plan to create a happy medium between solid technical material and popular growing styles. My aim is a useful, readable book containing a good many pictures. Palms are the essence of tropical landscaping. They are great plants. Keep your interest up by sprouting seeds of unfamiliar palms. Conduct experiments and write them up. Keep trying new palms.

Partial listing of Kimnach's subtropical palm handbook:

History, Introduction, Protective Methods, Hardiness, Culture, Hybridizing, Seeds, Division, Soils, Fertilizing, Water, Transplanting, Exposure, Insects, Diseases, Pruning, Public Collections, Glossary, Alphabetical Treatment of Genera and Species, Bibliography, Index, Classifications.

BOOKSTORE

A MANUAL OF THE RATTANS OF THE MALAY PENINSULA (J. Dransfield 1979, 270 pp.)	$25.00
COCONUT PALM FROND WEAVING (Wm. H. Goodloe 1972, 132 pp.)	3.95
COCONUT RESEARCH INSTITUTE, MANADO (P. A. Davis, H. Sudasrip, and S. M. Darwis, 1985, 165 pp., 79 pp. color)	35.00
CULTIVATED PALMS OF VENEZUELA (A. Braun 1970, 94 pp. and 95 photographs.)	6.00
EXOTICA (4) (A. Graf, pictorial encyclopedia, 2 vols., including 250 plant families, 16,600 illust., 405 in color, 2590 pp.)	187.00
FLORA OF PANAMA (Palms) (R. E. Woodson, Jr., R. W. Schery 1943, 122 pp.)	17.00
FLORA OF PERU (Palms) (J. F. MacBride 1960, 97 pp.)	8.00
FLORIDA PALMS, Handbook of (B. McGeachy 1955, 62 pp.)	1.95
HARVEST OF THE PALM (J. J. Fox 1977, 244 pp.)	22.50
INDEX TO PRINCIPES (Vols. 1–20, 1956–1976, H. E. Moore, Jr., 68 pp.)	3.00
MAJOR TRENDS OF EVOLUTION IN PALMS (H. E. Moore, Jr., N. W. Uhl 1982, 69 pp.)	6.00
OIL PALMS AND OTHER OILSEEDS OF THE AMAZON (C. Pesce, 1941, translated and edited by D. Johnson, 1985, 199 pp.)	24.95
PALMAS PARA INTERIORES, PARAQUES Y AVENIDAS (in Spanish, A. Braun 1983, 83 pp., 39 pp. color)	8.95
PALMAS TROPICALES: CULTIVADAS EN VENEZUELA (in Spanish, J. Hoyas F. and A. Braun, 1984, all in color, 134 pp.)	50.00
PALEM INDONESIA (in Indonesian) (Sastraprdja, Mogea, Sangat, Afriastini, 1978. 52 illustrations, 120 pp.)	5.50
PALMS (A. Blombery & T. Rodd 1982, 192 pp., 212 colored photographs)	25.00
PALMS IN AUSTRALIA (David Jones 1984, 278 pp., over 200 color photographs)	25.00
PALMS FOR THE HOME AND GARDEN (L. Stewart 1981, 72 pp., some color)	10.95
PALMS OF SOUTH FLORIDA (G. B. Stevenson 1974, 251 pp.)	7.95
PALMS OF THE WORLD (J. C. McCurrach 1960, 290 pp.)	19.00
PALM SAGO (K. Ruddle, D. Johnson, P. K. Townsend, J. D. Rees 1978, 190 pp.)	10.00
SECRET OF THE ORIENT DWARF RHAPIS EXCELSA (L. McKamey 1983, 51 pp.)	3.95
SUPPLEMENT TO PALMS OF THE WORLD (A. C. Langlois 1976, 252 pp.)	25.00
THE GENUS PTYCHOSPERMA LABILL. (F. B. Essig 1978, 61 pp.)	6.50
THE INDIGENOUS PALMS OF NEW CALEDONIA (H. E. Moore, Jr., N. W. Uhl 1984, 88 pp.)	12.00
THE INDIGENOUS PALMS OF SURINAME (J. G. W. Boer 1965, Part of Flora, 172 pp.)	42.00
THE MINIATURE PALMS OF JAPAN (U. Okita, J. L. Hollenberg 1981, 135 pp.)	19.95
TROPICA (A. Graf, 7000 color photos, 1138 pp.)	125.00

PALM PAPERS (Postage Included)

FURTHER INFORMATION ON HARDY PALMS (J. Popenoe 1973, 4 pp.)	1.25
RARE PALMS IN ARGENTINA (reprint from *Principes*, E. J. Pingitore 1982, 9 pp., 5 beautiful drawings)	2.75
PALMS—ANCESTRY AND RELATIONS (B. Ciesla 1979, a chart)	6.00
PALMS FOR TEXAS LANDSCAPES (R. Dewers & T. Keeter 1972, 3 pp.)	1.25
THE HARDIEST PALMS (J. Popenoe 1973, 4 pp.)	1.25

The palm books listed above may be ordered at the prices indicated plus $1.50 extra per book to cover packaging and postage. (California residents please add 6% sales tax.) Foreign checks must be in US dollars and payable on a USA bank. In some countries it is possible to send International Money Orders through the Post Office. Please include your International Palm Society membership number. Send check payable to The International Palm Society to Pauline Sullivan, 3616 Mound Avenue, Ventura, CA 93003, U.S.A. ALL SALES FINAL.

Principes, 31(1), 1987, p. 11

PALM PORTRAIT

Prestoea Palmito

Although the usual source of palm hearts, or palmito, is from species of *Euterpe*, in Ecuador a *Prestoea* is commonly used. The palm, *Prestoea trichoclada*,* is a very common species on the western Andean slopes between 1,000 and 2,000 m. It has two characteristics that make it an ideal palmito palm. Its clustered habit means that even when one or several stems are cut for palmito, new suckers will grow up to replace them. Also this *Prestoea* has a very long and prominent green crownshaft, like *Euterpe*, which means a large heart. Surprisingly palmitos are little used by local country people, and they are not sold in local markets. Rather the canning factory in Quito hires people on a contract basis to cut the palms and collect the hearts. A skilled man can collect up to 50 hearts a day, and can be paid up to 30 sucres (20¢) per heart. The hearts are canned in a factory in Quito, and the palmitos sold both inside and outside the country.

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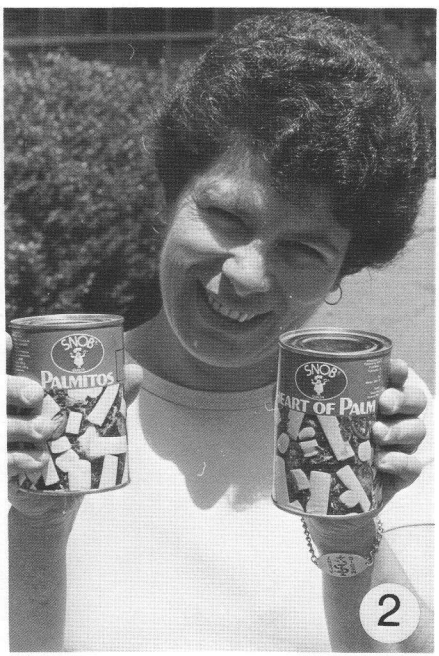
ANDREW HENDERSON
New York Botanical Garden

* *Prestoea trichoclada* (Burret) Balslev & Henderson, comb. nov. *Euterpe trichoclada* Burret, Notizbl. 13: 343. 1936.



1. A stand of *Prestoea trichoclada* near Mindo on the western Andean slopes in Ecuador. 2. Canned palmitos.

Principes, 31(1), 1987, pp. 12–13

Three Palm Species at Cataviña

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The ranges of three palm species overlap in the northern third of Baja California. The desert fan palm, *W. filifera*, occurs from southern Nevada (Frazier 1977) to the vicinity of Bahia de los Angeles in Baja California Norte (Wiggins 1980). The Mexican fan palm, *W. robusta*, is endemic to Baja California and has a range that is poorly known within the central and northern portion of the peninsula. The blue fan palm, *Brahea armata*, is also a Baja endemic with a range that extends to within 26 km of the U.S. border and then south to the vicinity of San Ignacio (Wiggins 1980).

To my knowledge, there is just one site where all three palm species occur together and that is in Arroyo Cataviña, Baja California Norte (Lat. 29°48′15″N, Long. 114°46′08″W). In its upper or easternmost reaches the canyon is shallow and supports numerous palms as a result of a year-round surface stream and presumed greater flow underground. The surface flow is barely sufficient to meander across Mexico Highway 1 where the roadway bisects the washbed in two places. In between these two points and along the highway lies the tiny village of Cataviña which takes its water from the stream. All three species

1. Southwesterly view of Arroyo Cataviña from Mexico Highway 1. The two palms on the left are *Brahea armata*. Tall palms in the center and extreme right are *Washingtonia robusta*. Two palms just right of center with skirts are *W. filifera*.

of palm can be easily seen from the highway.

Although trips into Baja California had taken me past the site on several occasions, on February 21 and 22, 1985, I was able to examine the oasis more carefully. There are at least 32 mature individuals of *W. robusta*, 23 *W. filifera*, and 15 *B. armata* within 2 km of the village. As Figure 1 shows, it is possible to photograph all three species in a single frame. Most of the palms seem to be in good health with full crowns and numerous spent inflorescences from the most recent reproductive season. One *B. armata* appeared to have exit holes of the giant palm boring beetle, *Dinapate wrightii*. This would be the first record of a palm of this species harboring the beetle.

The vegetation on the rocky hills surrounding Cataviña is typical of the Vizcaino Desert. Cardon cacti (*Pachycereus pringlei*), boojum trees (*Idria columnaris*), and elephant trees (*Pachycormus discolor*) abound and along with the palms make for a botanical display unrivaled in the North American Desert.

Acknowledgments

This report was made possible through a grant from the Richard King Mellon Foundation of Pittsburgh, Pennsylvania.

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From the Editors

To The Chapters of IPS

Please have a member or an officer—as you decide—prepare a summary for *Principes* of your main events on an annual basis or more often. We can no longer abstract the many, often long newsletters we receive. The summary may be short or long and its format of your choosing. See p. 48 for the activities of The New South Wales Chapter as written by Ken Veness.

A Garden Editor for Principes

We are happy to announce that **Lynn McKamey** of **Rhapis Gardens** has agreed to be *Principes*' first Garden Editor. Lynn will undoubtedly be talking with you about those much desired articles on palm culture and the many other facets of gardening with palms.

Principes, 31(1), 1987, pp. 14–19

Notes on the Biology, Ecology, and Use of a Small Amazonian Palm: Lepidocaryum tessmannii

FRANCIS KAHN AND KEMBER MEJIA

Convention ORSTOM/IIAP, Apartado Postal 185 Iquitos, Peru and IIAP/CI-Jenaro Herrera, Apartado Postal 784 Iquitos, Peru

Lepidocaryum tessmannii Burret is a small palm which is abundant in the understory of some tropical rain forests in the Peruvian Amazonia (Fig. 1). This species is locally known as "irapay." It is a clustering palm with slender stems, not more than 3–4 cm in diameter and 6 m in height. The leaves are palmate, like those of its giant relative, *Mauritia flexuosa* L.f., but they have only 4 segments inserted at the end of a 1.2 m long petiole. Each axis bears 4 to 7 contemporaneous leaves. All the species of the genus are dioecious. The "irapay" is distributed throughout Peruvian Amazonia; eastwards, it does not reach central Amazonia.

This small palm is remarkable for its highly unusual growth pattern with vegetative propagation, its density in the understory of the forests surveyed, its topographic distribution which is affected by soil drainage, and its use for thatching house roofs.

Our observations were made in forests near the village of Jenaro Herrera on the Ucayali River (4°55′18″ Lat S; 73°40′36″ Long W), about 200 km southwest of Iquitos. The height above sea level is 125 m. The climate belongs to the tropical humid type with about 2.9 m annual rainfall and an average temperature of 26° C.

Growth Dynamics

The clumps of *Lepidocaryum tessmannii* are formed from basal branching, which corresponds to the growth pattern defined as Tomlinson's model by Hallé et al. (1978): "This architecture results from the repeated development of equivalent orthotropic modules in the form of basal branches which are initially restricted to the epicotyledonary region of the seedling axis (the first module), and the basal nodes in subsequent axes." In the case of the "irapay," inflorescences are lateral.

Numerous Amazonian palms develop such a growth pattern. The unusual feature of the "irapay" is its production of creeping, stolonlike rhizomes.[1] Each axis produces several rhizomes from its base, with a diameter of 0.5 to 1 cm, running generally in the first 5 cm of the soil or sometimes on the surface, and attaining up to 2 m in length. During the horizontal expansion phase before the apex grows vertically and elaborates a new stem with a larger diameter, scale leaves are formed and roots are emitted from the lower side of the rhizome throughout its length.

Amazonian palms rarely produce such stolonlike rhizomes. Another New World case is provided by *Iriartella setigera* (Mart.) H. A. Wendl. (Kahn, 1983). Sev-

[1] We use "rhizome" in its broadest sense: "Rhizome is a useful general name, readily qualified as fleshy, stoloniferous, aerial, descending, scale bearing, leafly, etc. Semantic obstacles arise only when the term is too rigidly defined" (Bell and Tomlinson 1980).

1. High density of *Lepidocaryum tessmannii* as shown by the abundance of palmate leaves with 4 leaflets.

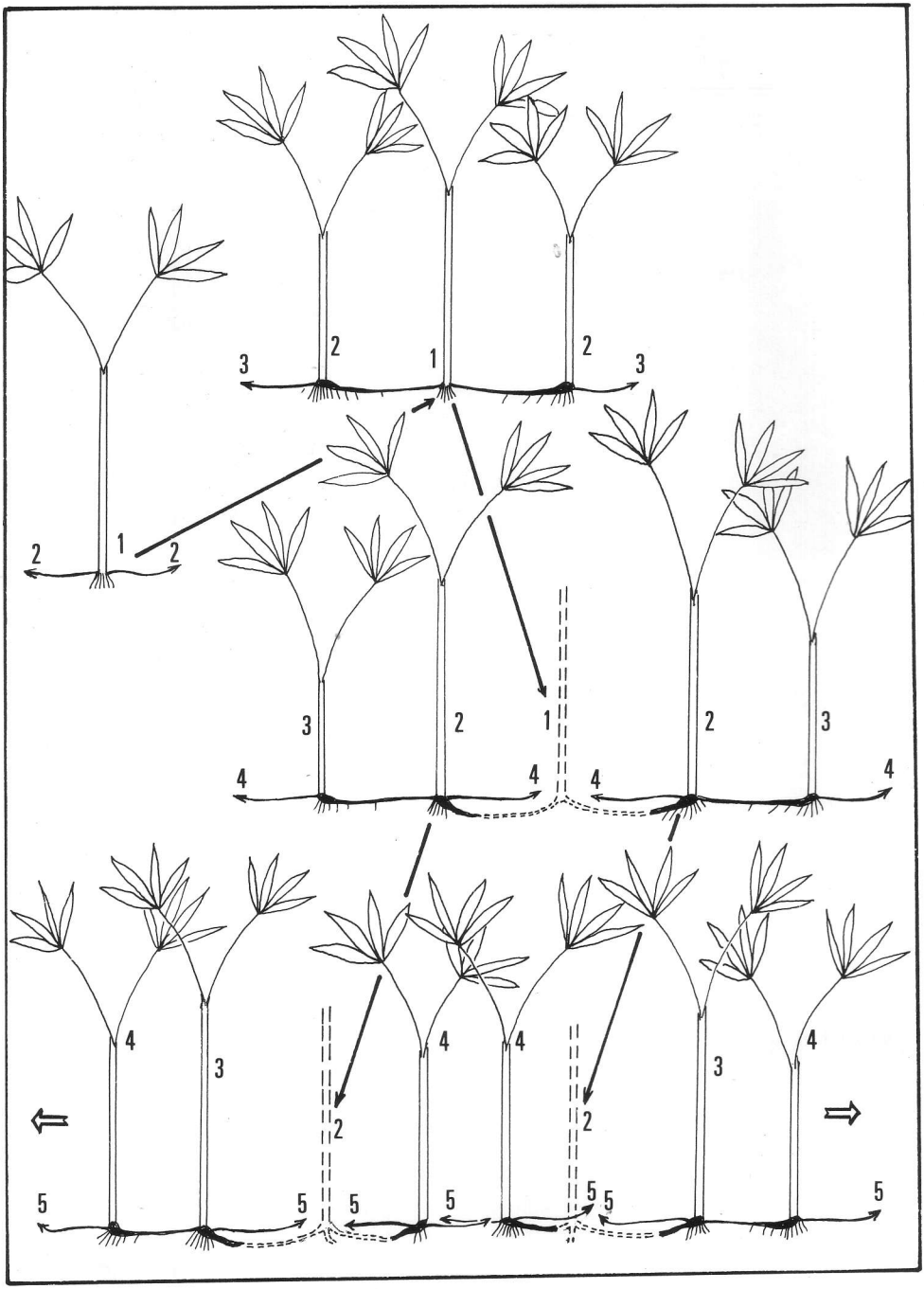
eral palms in the Old World have been described with such rhizomes: *Podococcus barteri* G. Mann. et Wendl. (Bullock 1980) in Africa, *Salacca* (Corner 1966), *Arenga*, *Calamus*, and other rattans in Asia, the rhizomes of which realize diverse forms as described by Dransfield (1978).

Density of *Lepidocaryum tessmannii*

The density of the "irapay" was estimated from two plots, each of 0.2 ha. One is located on well-drained, yellow ferralitic soil, in an upland forest described by Marmillod (1982). *Lecythidaceae*, *Sapotaceae* and *Caesalpiniaceae* are particularly abundant in the forest canopy, reaching up to 40 m in height and 1.5 m in DBH. The other is on poorly drained, gleyic soil, in a seasonal swamp forest dominated by arborescent palms (*Mauritia flexuosa*, *Jessenia bataua* (Mart.) Burret, *Euterpe precatoria* Mart.), with a lower density of dicotyledonous trees. Both forests cover vast areas in the region. All axes of *Lepidocaryum tessmannii* above 1 m in height were counted in each plot.

On well-drained soil, 508 axes (2,540/ha) were counted. This number is smaller than that found by Marmillod (1982) who calculated 3,500 axes per ha from 0.7 ha surveyed. The difference between these two studies would not surprise those who know the particular forest; the density of the palm varies considerably from place to place and is apparently related to forest dynamics.

On poorly-drained soil, the density of the palm falls to 266 axes counted (1,330/ha), demonstrating its capacity to tolerate anaerobic conditions due to waterlogging. De Granville (1978) and Sist (1985) described analogous edaphic behavior in another understory species of the forests of French Guiana, *Astrocaryum paramaca* Mart., the populations of which are smaller on poorly-drained soil. However, such edaphic behaviour is not general in Amazonian forests; a clear-cut distribution



2. Vegetative propagation of *Lepidocaryum tessmannii* Burret by the production of stolonlike rhizomes. The palm can overrun the understory of the forest and become the most abundant species. Each axis can produce numerous rhizomes during its lifetime.

3. House thatched with leaves of "irapay" (village of Jenaro Herrera). The walls are made with split stems of *Euterpe precatoria*, and the door and the floor (inside) with split stems of *Iriartea ventricosa*.

of palms in relation to soil drainage as shown by Kahn and Castro (1985) in central Amazonia, is observed more frequently.

Vegetative Propagation

All the axes of the "irapay" were dug in a 50 m^2 area on well-drained soil. Only one seedling of this species was found in the area surveyed. Most of the axes were related to other living or dead individuals. Isolated axes clearly presented the remainder of a degenerated rhizome at their base. While propagation by vegetative means is well developed, fruiting palms are observed over a long period with peaks from March to April during the rainy season and from September to October during the drier period. Production of rhizomes from axes originating from seedlings is apparently precocious, making a comparative estimate of sexual and vegetative reproduction rates very difficult.

Such intense vegetative propagation appears to be infrequent in Amazonian palm species as we can judge from our own experience in Brazil, Peru, and French Guiana (Kahn and Castro 1985, Kahn 1985, 1986). Most examples of Tomlinson's growth form constitute isolated clumps of related stems, sometimes up to 25 together, as in *Euterpe oleracea* Mart. (Cavalvante 1974). In this case basal branching contributes more to maintain population sizes, stabilizing the number of fruiting axes in the long term, than in propagating the species (Hallé et al. 1978), as is found for "irapay." *Iriartella setigera* which also produces stolonlike rhizomes, behaves differently; only 1 or 2, rarely 3 new stems are built from the 4 to 8 rhizomes born of the first axis base, generally when the first axis is dying. *Lepidocaryum tessmannii* is the most abundant species in the understory of the Peruvian forests surveyed and this is due to its vegetative propagation by stoloniferous rhizomes (Fig. 2).

4. How leaves of "irapay" are attached on an axis made from the stem of *Wettinia augusta* for composing a cover unit.

Thatching with "irapay"

The leaves of the "irapay" are used to thatch houses (Fig. 3); this use is widespread in all areas of "terra firme" forests where the palm is abundant, and described by Mejia (1983).

The roof cover unit is composed of an axis, up to 3 m in length, made from the stem of another understory palm, *Wettinia augusta* Poepp. et Endl., to which 90 to 150 leaves of "irapay" are attached by their petioles. The 4 leaflets of one leaf are interwoven with those of the two neighbors as shown in Figure 4. The roof lifetime varies from 4 to 6 years depending on the leaf density in the cover unit as well as on the space left between the cover units. The longest lifetime of a 60° dihedral roof is obtained with cover units composed of 150 leaves with a spacing of about 10 cm.

A house with an area of 35 m^2 covered by a two-planed roof needs 160 cover units, 70 for each side and 10 for each gable. With an average of 130 leaves per cover unit, some 20,800 leaves are necessary for thatching such a house. If an average of 4 leaves are collected from each "irapay" axis, then collecting must be extended to 5,200 axes, i.e. about 2 hectares of these forests, each with a density of 2,500 to 3,500 axes (1 m in height).

Collection is made by cutting the long petiole at the middle. Leaves are packed in bundles of a thousand, which is about as much as a man can carry.

Acknowledgments

This study was supported by the Conselho Nacional de Desenvolvimento Científico e Technologico (CNPq), Instituto Nacional de Pesquisas da Amazônia (INPA) and by the Projeto multilateral "Ecologia da Floresta Tropical" of the Organization of the American States. We thank J. Lopez Parodi, Director of the Research Center of Jenaro Herrera, who permitted us to carry out this study in 1983. We are indebted to A. Rylands and C. Padoch for their help on the English manuscript.

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Principes, 31(1), 1987, pp. 20–22

Observations on the Floral Biology of the Monoecious Form of Salacca zalacca

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ABSTRACT

The monoecious form of *Salacca zalacca* has both staminate and hermaphroditic flowers on the same inflorescence. Observations suggest that ants may be active in pollen transfer. Environmental constraints on fruit set are discussed.

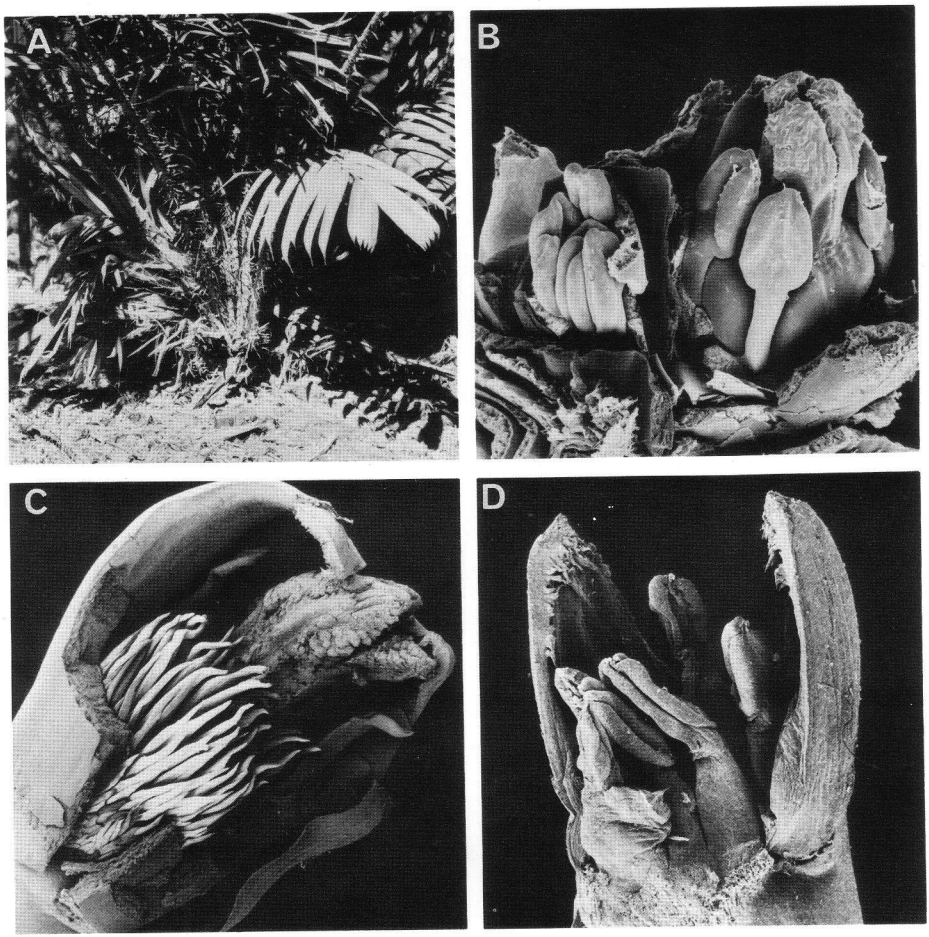
Salacca zalacca (Gaertn.) Voss, as named by Mogea (1982), is an economically important palm cultivated mainly in Malaysia and Indonesia for its edible fruit. The palm is considered to be dioecious (Ochse et al. 1961, Purseglove 1968, Mogea 1978) with a pistillate inflorescence that produces mature fruit 3–4 months after fertilization. Observations in Java suggest that curculionid insects are active in pollination (Mogea 1978). The Balinese *salak* has been reported as being monoecious (Mogea 1978) with fertile seeds, however its developmental pattern and method of pollen transfer is unknown.

Phenological Observations

Observations were made on mature palms (Fig. 1A) growing at Kamerunga Horticultural Research Station, Queensland (Lat. 16°55′S; Long. 145°47′E; Alt. 40 m). The palms were grown from seeds imported from Bali in 1977.

Although inflorescences are formed throughout the year, the main flowering period is between August and October, with fruit maturing approximately five months later, between January and March. Usually one, but occasionally two, inflorescences develop in spathes at each leaf axil. These are 7–10 cm long and consist of numerous pairs of flowers (Fig. 1B). The larger of a pair is perfect with a 3-parted stigma and 6 stamens, while the smaller is staminate with 6 stamens. The flowers may open when the inflorescence is still enclosed in the spathes or after exsertion. At anthesis the sepals open to expose the dull red petals, receptive white stigma (Fig. 1C), and anthers (Fig. 1D). A sticky nectarlike secretion was observed on the stigma and petals. The presence of nectar was determined with Tes-tape strips of Eli Lilly Comp., Indianapolis, USA, which react positively at concentrations exceeding 0.25% glucose (=14 m Mol/L). In the center, 80% of flowers open first, followed later by the basal flowers. Those at the base are often constricted especially if the inflorescence has not fully exserted from the spathe. Twenty-four hours later the flowers on the tip open. These are mainly staminate. After about two days the flowers lose color and appear to dry out and the sepals commence closure. If fertilization is unsuccessful, the inflorescence will dry out completely within 5–7 days.

No insects were observed on the flow-



1. A) Mature palm at Kamerunga, Queensland. B) Scanning electron micrograph of flower pair prior to anthesis. Small flower on the left is staminate. C) Perfect flower at anthesis with receptive stigma unfolding. D) Staminate flower at anthesis.

ers, however, small black ants, *Iridomyrmex glaber* (Mayr), breed in the still closed spathes and were occasionally observed on open flowers.

Discussion

Although mature fruit contained seeds, indicating successful pollen transfer, the mechanism is unclear. As the flowers often open before inflorescence exsertion from the spathes, it would appear likely that the ants, attracted to the nectar, may well be involved in pollination. Essig (1973) has described pollination through feeding and breeding of dystrophic beetles in the still closed spathes of various palm genera. The growth habit of the plant restricts wind movement and would seem to rule out anemophily.

Although an inflorescence emerges in association with every leaf, fruit set appears to be influenced by environmental conditions. Mogea (1979) reported that fruit yields were high with rainfall of 150–800 mm per month and when the increase in rainfall from one month to the next is

not more than 400 mm. The main flowering period in north Queensland coincides with rising temperatures and increasing solar radiation (Table 1) with fruit maturing during the wetter months. A similar pattern is reported from Darwin (Lat. 12°28′S; Long. 130°51′E; Alt. 35 m) (M. Lyons, pers. comm.).

Many tropical fruit trees commence flowering following significant changes in seasonal conditions. A growth check, as a result of either low temperatures or limited water supply, appears to be a necessary trigger for flowering in Cashew (*Anacardium occidentale* L.) and Mango (*Mangifera indica* L.). Why fruit-set in Salak is only successful for a short period at Kamerunga is not clear, as the palms were irrigated and it is unlikely that temperatures were limiting fertilization. However, the palms are exposed to full sunlight and relative humidity levels may well be lower than that encountered in Salak gardens in Indonesia.

Salak is highly regarded in the lowland tropics and it is hoped that research can be instigated so that the potential of the species can be further exploited.

Table 1. Long term climatic averages for Cairns, Queensland.

	Month													
	J	F	M	A	M	J	J	A	S	O	N	D	Mean	Total
Max. temperature, °C	31.9	31.4	30.3	29.2	27.0	25.9	25.3	26.4	28.1	29.2	30.8	31.9	29.2	
Min. temperature, °C	23.1	23.1	22.6	20.9	18.7	17.6	16.0	16.5	17.6	19.8	20.9	22.6	19.8	
Relative humidity, %	74	76	78	78	77	77	74	72	69	67	68	69	73	
Rainfall (mm)	422	399	460	287	112	74	41	43	43	53	99	221		2,253

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Principes, 31(1), 1987, p. 23

PALM LITERATURE

PESCE, CELESTINO. 1985. Oil Palms and Other Oilseeds of the Amazon. Translated by Dennis V. Johnson. Reference Publications, Inc., Algonac, MI. $24.95. Originally published in Portuguese as *Oleaginosas da Amazônia* by Oficinas Gráficas da Revista da Veterinaria, Belém, Brazil. 1941.

The accelerating loss of native Amazonian forest is a problem with implications for all humankind. Yet, human colonization of the vastness that is the Amazon Basin and attendant destruction of its vegetational resources are unlikely to cease. If development is to be channeled in directions that will favor the preservation of significant tracts of unspoiled vegetation and the biota it represents, then ways must be found to create and sustain viable, yet ecologically sound, economic systems throughout the region. One promising approach is to utilize native plant species as sources of basic commodities, such as oils, in a variety of integrated planting schemes. Palms, as conspicuous elements of the Amazonian flora and already storehouses for the wants of humankind, inevitably will be part of such agricultural approaches.

Plant utilization is based on an adequate knowledge of the character of this resource base. As the owner/operator of a small oil pressing factory in the Brazilian state of Pará early in this century and through subsequent travels along the Amazon River, Celestino Pesce amassed information about the region's oilseed wealth. He was a visionary who saw in Amazonian oil palms and other plants producing oilseeds opportunities for economic development using indigenous resources. His survey and eventual publication of *Oleaginosas da Amazônia* were notable achievements in their time, but ones that take on greater importance today, for the needs he sought to fill have become more compelling. Thanks to Dennis V. Johnson's enthusiasm for palms, his concern for the wise use of plant resources, and his meticulous translation, Pesce's work is now available to a wide audience.

In this translated edition the contents of the original book have been rearranged to group and give emphasis to the oilseed bearing palms, which include among others, species of the genera *Acrocomia*, *Astrocaryum*, *Elaeis*, *Euterpe*, *Mauritia*, *Oenocarpus*, and *Orbignya*. About half the pages are devoted to palms, the other half to species in other families of plants. Since the original was written from a compilation of notes, the details of generic and species treatments vary, some being extensive, others abbreviated, but overall they convey a wealth of information. The emphasis is on oil, that is, content in seeds, extraction, physical characteristics and uses, but the entries contain fascinating observations on a much wider range of uses. The nomenclature has been brought up to date, and explanatory notes have been added as needed.

In addition to the Pesce's observations the translated version offers several bonuses, including a foreword by Richard E. Schultes, an epilogue essay on the current status of Amazonian oil palms by Michael J. Balick, bibliographies to oil palms and other oilseed plants, and several excellent photographs. The publication of this volume adds to the growing list of excellent books concerned with economic botany produced by Reference Publications, Inc. It will be of special interest to those concerned with the potential of our plant resource base, especially that of palms.

DAVID M. BATES

Principes, 31(1), 1987, pp. 24–30

Studies on Seed Dormancy, Viability, and Germination in Ornamental Palms*

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ABSTRACT

Initial seed viability and presence or absence of dormancy were found to affect germinability of different species of palms newly introduced into Nigeria. Requirements differed among species and the paper discusses optimum conditions of germination for many palms of ornamental and economic importance.

Seed dormancy may be defined as the cessation of growth under environmental conditions that normally favor later growth of a species. It is often considered as an evolutionary adaptation to the environment, preventing germination that would otherwise cause death of young sprouts by unfavorable environment, and delaying further development until favorable conditions for growth prevail. However, dormancy is regarded as a nuisance in many instances in agriculture and horticulture when conditions that support growth of young seedlings could be provided artificially in nurseries.

Palms are a unique group of plants by their widespread importance in agriculture, horticulture, and floriculture. As a rule true seed dormancy (i.e. embryo dormancy) is absent among the Palmae. In many instances development of the intact embryo after fruit ripeness is continuous (Kozlowski and Gunn 1972) and vivipary is not uncommon. There should therefore be no great difficulty in germinating most palm seeds. Nevertheless, many members of the family exhibit various degrees of seed dormancy. In those palms of economic value or of other interest to growers it is desirable to devise simple techniques of ensuring satisfactory germination especially when seed is not available in large quantities. In addition, it is essential that methods of fruit processing and seed storage are appropriate in order to preserve maximum seed viability.

With the exception of a few commercial palms like the oil palm (*Elaeis guineensis*) and coconut palm (*Cocos nucifera*) most of the information on germination of palm seeds has been acquired from purely empirical trials, and reports of systematic investigations, such as in *Jubaeopsis caffra* (Robertson and Small 1977), are very few. It is now known that failure experienced by growers in seed germination is often due to initial nonviability of samples, or to use of inappropriate procedures for germination.

Dormancy is overcome and germination hastened in many plant species by scarification, exposure to light (sometimes of specific wavelength) or to ionizing radiations, cold or warm stratification, treatment with various growth substances and chemicals, or simple leaching with ordinary water. In order to devise the simplest and most appropriate procedures for large-scale production of different palms, mostly exotic to Nigeria, seeds were given different treatments to overcome their dormancy, or to hasten their germination.

* Work carried out while author was Chief Research Officer at the Nigerian Institute for Oil Palm Research.

Table 1. Optimum treatments for germinating seeds of different palms.

Species	Optimum Treatment
Aiphanes erosa	4 (100.0), 3 (97.0), 5 (96.6), 2 (93.5), 1 (93.3)
Archontophoenix alexandrae	2 (98.0), 3 (97.5), 1 (94.7)
Areca lynn	4 (100.0), 4 (100.0), 2 (90.0)
Arenga microcarpa	4 (85.7), 3 (80.0), 2 (74.3)
Butia capitata	3 + 5 (87.5)
Caryota mitis	4 (93.4), 1 (89.5)
Chrysalidocarpus lutescens	2 (100.0), 4 (100.0), 1 (86.6)
Dictyosperma aureum	1 (100.0), 4 (100.0), 2 (90.0)
Gaussia attenuata	4 (100.0), 1 (90.0), 3 (80.0)
Hyphaene schatan	3 (75.0), 4 (75.0), 5 (75.0)
Livistona rotundifolia	3 (96.3)
**Livistona* spp.	2 (100.0), 3 (100.0), 4 (100.0), 1 (90.0), 5 (90.0)
Phoenix acaulis	3 (91.5), 2 (86.3), 1 (85.3)
Phoenix dactylifera	2 (100.0), 3 (100.0), 1 (90.5)
Phoenix reclinata	3 (88.1)
Ptychandra glauca	4 (100.0), 3 (98.0), 1 (93.8)
Ptychosperma macarthuri	4 (96.0), 2 (88.0), 1 (83.2)
Ptychosperma sanderianus	3 (96.7), 2 (96.4), 1 (93.0), 4 (89.6)
Roystonea oleracea	3 (88.5), 1 (83.3)
Sabal palmetto	4 (100.0), 1 (89.5), 3 (86.9)
Syagrus romanzoffianum	4 (83.0)
Syagrus schizophylla	1 (100.0), 3 (100.0)
Thrinax parviflora	2 (85.0), 4 (83.0)
Veitchia merrillii	3 (100.0), 5 (100.0)
Verschaffeltia splendida	1 (100.0), 3 (92.0), 2 (83.3), 4 (83.3)

Numbers outside of brackets represent treatment numbers.
Figures in brackets represent mean germination percentages.
* Unidentified species.

Among the hormonal treatments only gibberellic acid gave consistent results with the exception of thiourea on *Thrinax parviflora*. In responding species gibberellic acid was not effective below 10 ppm. In *Aiphanes erosa*, and *Sabal palmetto*, gibberellic acid enhanced germination at 10 ppm and 25 ppm, but not at 50 ppm. In *Arecastrum romanzoffianum* on the other hand, the minimum effective concentration of gibberellic acid was 25 ppm.

Materials and Methods

Fruits were harvested at different stages from bearing palms. Mesocarp was removed by retting, scrubbing, and washing in tap water. In difficult cases where this process was unsatisfactory because of a fibrous, hard or relatively impermeable mesocarp (e.g. *Syagrus romanzoffianum* and *Latania* spp.), the latter was removed by scraping with a sharp knife. Indication of initial seed viability was obtained by bisecting nuts and placing (cut surface downwards) in a 0.5% solution of triphenyl tetrazolium chloride (TTC) in a dark cupboard for 24 hours. Palm nuts were given different regimes of the following treatments:

(1) Control: placement in 500 gauge translucent polyethylene bags at ambient temperature.
(2) Soaking in standing or running tap water for 1, 3, 5, 7, or 14 days.
(3) Warm stratification for 2, 4, or 6 weeks at ambient temperature (circa 27° C), 35° C, or 40° C in 500 gauge translucent polyethylene bags.
(4) Soaking overnight in different concentrations of dilute solutions of growth substances and chemicals including gibberellic acid (5, 10, 25, or 50 ppm

Table 2. Comparison of mean germination rates (m.g.r.) of some palm seeds under different treatments.*

Palm Species	Treatments and m.g.r. (in Parentheses)				L.S.D. between m.g.r.
Aiphanes erosa	10 ppm GA (16.3)	40° C for two weeks (19.4)	scarification (14.8)	Control (24.1)	3.6
Arenga microcarpa	10 ppm GA (28.4)	40° C for four weeks (31.0)	soaking in running water five days (39.3)	Control (44.7)	5.1
Hyphaene schatan	10 ppm GA (32.5)	38° C for four weeks (36.3)	scarification (18.9)	Control (50.6)	5.6
Phoenix acaulis	10 ppm GA (33.8)	40° C for two weeks (28.5)	soaking in running water five days (24.3)	Control (35.2)	4.8
Sabal palmetto	25 ppm GA (40.9)	40° C for four weeks (61.6)	scarification (36.7)	Control (60.5)	7.2
Phoenicophorium borsiqianum	10 ppm GA (25.7)	38° C for two weeks (42.8)	scarification (23.1)	Control (47.0)	3.5
Veitchia merrillii	10 ppm GA (43.4)	40° C for four weeks (29.5)	scarification (22.0)	Control (41.2)	8.6

* Mean germ rate = Mean no. of days to attain 50% of total germination.

Table 3. Comparative germination behavior of species in some palm genera.

Genus	Species	Treatment	Mean Lag†	Mean Germination %	Mean Germination Speed††	Mean Total Germination Period (Days)
Phoenix	*acaulis*	Soaking in water 5 days	16.5	85.8	24.3	81.8
	dactylifera		7.2	100.0	19.6	50.3
	reclinata		15.7	63.4	27.5	91.7
		L.S.D.	3.8	15.7	5.0	18.2
Phoenix	*acaulis*	40° C for 2 weeks	11.0	91.5	28.5	97.5
	dactylifera		8.3	100.0	20.2	52.1
	reclinata		11.0	88.1	21.0	34.0
		L.S.D.	2.2	10.7	3.1	14.5
Ptychosperma	*elegans*	Soaking in water 3 days	26.0	76.7	29.5	98.0
	macarthuri		24.7	90.4	30.0	86.7
	sanderianus		19.6	94.7	31.0	71.0
		L.S.D.	4.3	5.2	3.5	12.8
Sabal	*palmetto*	25 ppm. GA.	23.0*	92.6*	40.9**	75.1***
	texana		20.0	72.5	70.0	133.0

Key:
† Lag means time elapsed between completion of treatment and first visual observation of germination.
†† Speed represents time to attain 50% of total germination.
* Represents significant difference at the 5% level.
** Represents significant difference at the 1% level.
*** Represents significant difference at the 0.1% level.

of GA_3), ethrel (2 chloroethyl phosphonic acid at 5, 10, 25, or 50 ppm), potassium nitrate (0.5%, 1%, or 2%), thiourea (1%, 2%, 5%, or 10%), and ethylene chlorhydrin (5, 10, 25, or 50 ppm).

(5) Various degrees of scarification (removal of seed-covering structures such as endocarp) followed by surface sterilization with 0.05% $HgCl_2$/Teepol solution for 2 minutes.

(6) Exposure in 500 gauge polyethylene bags to continuous light from fluorescent tubes or to continuous darkness in a dark room.

Each treatment was replicated five times but the number of seeds per replicate depended on seed set and availability. One hundred seeds per replicate were used wherever sufficient quantities of seeds were available. In other cases fewer seeds were used, such as 50 seeds/replicate in *Dictyosperma aureum*, *Sabal palmetto*, and *S. texana*; and 20 seeds/replicate in *Butia capitata*. After appropriate treatment seeds were placed in 500 gauge translucent polyethylene bags at ambient temperature.

Records were taken of earliness to germinate, speed of germination, and total germination obtained.

Results

Highest viability was observed with TTC when fruits were harvested just ripe. This stage was observed by the coloration of the pericarp and by the falling of fruits when the healthy bearing palm was gently shaken.

There was no consistent relationship between palms and type of dormancy at the sub-familial level. However, at the generic level some palms appeared to have common dormancy or germination characteristics. Furthermore, in many species dormancy could be overcome by more than one method, but the best or simplest methods are summarized below (Table 1).

A comparison of Tables 1, 2, and 3 with results obtained by earlier investigators (Table 4) shows improved results for many species such as *Aiphanes erosa*, *Arikuryroba schizophylla*, *Livistona rotundifolia*, *Phoenix reclinata*, *P. acaulis*, *Ptychosperma macarthuri* etc. The methods outlined in Table 1 have been successfully applied to large-scale germination of the different palms at the Nigerian Institute for Oil Palm Research.

Discussion

Braun (1968) remarked that no plant family showed so many germination peculiarities as the palms. From these studies no single treatment was found that was equally satisfactory for all the different species of palms. On the contrary a wide variety of germination triggers is required to obtain satisfactory performance among the Palmae.

Seed dormancy and germination requirements have been considered as evolutionary adaptations to environment (Thompson 1972, Nikolaeva 1969). Exhibition of these characters underscores the success of the palms in different environments. This success has been well stressed by Corner (1966). Within the family there are species in which germination is accomplished by a wide variety of treatments, such as *Aiphanes erosa* in which excellent or satisfactory germination is provided by soaking in water, heat treatment, hormonal application, scarification, or simple placement in a polyethylene bag. On the other hand there were palms in which only one, or at most two different treatments resulted in removing dormancy or hastening germination. An example of these is *Butia capitata* in which the best result was obtained by a combination of heat treatment and scarification. Another interesting observation was that in some cases seed dormancy and the germination requirement appeared to be a generic property, whereas in others

Table 4. Comparison of germination data on palms by different investigators.

Palm Species	Germ %	Lag (Days)	Speed (Days)	Reference
Areca catechu	—	79	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Areca sp.	29	22	—	Rees, A. R., 1963 *Principes* 7: 27–30
Arenga pinnata	4	27	—	Rees, A. R., 1963 *Principes* 7: 27–30
Arenga wightii	8	3	—	Rees, A. R., 1963 *Principes* 7: 27–30
Aiphanes erosa	—	115	—	Carroll, 1969 *Principes* 13: 109
Aiphanes erosa	67	4	—	Rees, A. R., 1963 *Principes* 7: 27–30
Bentinckia nicobarica	—	75	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Butia capitata	—	142	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Borassus flabillifer	65	—	35	Rees, A. R., 1963 *Principes* 7: 27–30
Chrysalidocarpus lutescens	—	31	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Chrysalidocarpus lutescens	86	150	—	School, G. B., 1962 *Principes* 6: 118
Chrysalidocarpus lutescens	9	—	—	Rees, A. R., 1963 *Principes* 7: 27–30
Cocos nucifera	—	119	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Caryota mitis	46	—	28	Rees, A. R., 1963 *Principes* 7: 27–30
Caryota mitis	—	135	—	Murrow, R. B., 1973 *Principes* 17: 64–66
Coccothrinax argentea	—	120	—	Murrow, R. B., 1973 *Principes* 17: 64–66
Dictyosperma aureum	—	75	—	Loomis, H. R., 1958 *Principes* 2: 98–102
Dictyosperma aureum	—	102	—	Kobernick, J., 1966 *Principes* 10: 4
Gaussia attenuata	—	43	—	Loomis, H. R., 1958 *Principes* 2: 98–102
Gaussia attenuata	—	25	—	Kobernick, J., 1966 *Principes* 10: 4
Livistona rotundifolia	—	67	—	Kobernick, J., 1966 *Principes* 10: 4
Phoenix reclinata	—	42	—	Loomis, H. F., 1958 *Principes* 2: 98–102
Phoenix reclinata	—	12	—	Kobernick J., 1966 *Principes* 10: 4
Phoenix acaulis	37	—	59	Rees, A. R., 1963 *Principes* 7: 27–30
Pinanga sp.	—	49	—	Carroll, 1969 *Principes* 13: 109
Pinanga sp.	—	140	—	Murrow, R. B., 1973 *Principes* 17: 16–64
Pinanga kullii	81	—	13	Rees, A. R., 1963 *Principes* 7: 27–30
Pritchardia sp.	—	46	—	Kobernick, J., 1966

Table 4. Continued.

Palm Species	Germ %	Lag (Days)	Speed (Days)	Reference
				Principes 10: 4
Ptychosperma macarthuri	57.1	90	—	School, G. B., 1962 *Principes 6: 118*
Sabal mauritiaeformis	—	55	—	*Braun, A., 1968* *Principes* 12: 5
Syagrus schizophylla	—	51	—	Kobernick, J., 1966 *Principes* 10: 4
Verschaffeltia splendida	—	38	—	Kobernick, J., 1966 *Principes* 10: 4
Veitchia merrillii	—	38	—	Kobernick, J., 1966 *Principes* 10: 4
Veitchia spp.	—	49	—	Carroll, 1969 *Principes* 15: 136
Thrinax argentea	63	—	30	Rees, A. R., 1963 *Principes* 7: 27–30

"Lag" represents period of time between treatment and first observation of germination.
"Speed" represents days to 50% of final germination.

only certain species of a genus had dormant seeds. There are also some genera such as *Ptychosperma* in which a single treatment accomplished germination of many species. In this genus soaking in water was satisfactory for *P. macarthuri* and *P. sanderianus* and to a lesser extent, *P. elegans*. Still, there are cases in which germination of seeds of different species of the same genus is promoted by different treatments. Kitzke (1958) gave the example of *Copernicia* in which prolonged soaking in water yielded excellent germination in fifteen species. However, in *C. alba*, soaking was ineffective, but germination was enhanced by scarification or use of sulphuric acid.

Many palm species have nondormant seeds and germinate readily without special requirements. When propagators find such seeds difficult, the problem is due to other factors. As De Leon (1958) pointed out many failures of germination attributed to poor practices were really due to low initial viability. This could be a consequence of harvesting unripe seeds, faulty storage or of collecting aged, desiccated, or unhealthy, immature, fallen fruits from palm bases. Little is known of precise storage requirements of many palm seeds, but the present studies confirmed that palm seeds are best harvested at the "just ripe" stage of the fruit. Indication of ripeness may be obtained by closely watching for changes in pericarp color or by the fall of fruits when palm is gently shaken. Test of initial seed viability of a sample with triphenyl tetrazoliun chloride solution may be helpful.

A comparison of results of the present work with those of earlier investigators (Table 4) shows tremendous improvement over earlier work. In some cases such as *Ptychosperma*, the more important improvement was in the shortening of the lag and total germination period. In others, total germination has been greatly increased through improved treatments. This is exemplified by results presented for *Areca*, *Chrysalidocarpus lutescens*, *Arenga*, etc. It should be noted however, that not all satisfactory treatments may be useful under all circumstances. For instance, scarification gives excellent results in *Aiphanes erosa*, *Hyphaene schatan*, *Livistona*, *Stevensonia grandifolia*, and *Veitchia merrillii*. However in large-scale or commercial production of

these species, the less tedious but slower methods of heat or hormone treatment may be preferable for economic reasons. The reasons for varied success of different germination treatments in different palm species were not investigated. Nevertheless, it seems likely that species which germinate well after prolonged soaking in water may have seed-covering structures that have low permeability to water. Those seeds that responded to prolonged soaking in running water (such as *Thrinax parviflora*) may contain water-soluble inhibitors. Species whose seeds germinate after scarification may have seed coats that act as mechanical barriers to embryo elongation, as the situation in the oil palm, *Elaeis guineensis* (Odetola and Kozlowski 1979). Further research is required, therefore, to elucidate the physiological basis for the responses of different palms to different germination treatments.

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Principes, 31(1), 1987, pp. 31–40

Shedding of Vines by the Palms Welfia georgii and Iriartea gigantea

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Vines are abundant in tropical forests (Richards 1952) and can often be found growing on arborescent palms. Do vines have detrimental effects on the palms on which they grow? Do palms have characteristics that protect them from vines? Herein, we survey the occurrence of vines in natural populations of the arborescent palms *Welfia georgii* H. A. Wendl. ex Burret and *Iriartea gigantea* H. A. Wendl. ex Burret in Costa Rica and we discuss characteristics of palms that allow palms to avoid and shed vines.

Vines are climbing plants that require other plants for mechanical support. Vines include both woody forms, or lianas, and non-woody forms. In some cases, vines growing up tree trunks may become detached from the ground, as is common among aroids; and some may start growth on the trunk and secondarily become rooted in the ground, as in the case of some cyclanths. By using other plants for mechanical support, vines do not need to produce as much of their own support tissue, and thereby have increased resources available for extension growth, leaf production, and reproduction (Darwin 1867, Putz 1983, 1984). Vines can have various adverse effects on their tree hosts, including interference with light interception, interference with proper development of leaves, and increased mechanical load on the host's supporting stem. For instance, in palms, twining vines that reach the spear leaf can prevent proper leaf expansion (Fig. 1). Putz (1984) reviewed observed detrimental effects of lianas on their hosts, which included inhibition of growth (Featherly 1941, Trimble and Tryon 1974, Putz 1978), mechanical abrasion and passive strangulation (Lutz 1943), increased host susceptibility to ice and wind damage (Siccama et al. 1976), increased probability of host tree falling (Webb 1958, Putz 1984), and increased access to tree crowns by folivores and harmful arboreal animals (Montgomery and Sunquist 1978, Charles-Dominique et al. 1981).

Trees have evolved various means to avoid and shed vines. Symbiotic *Azteca* ants keep *Cecropia* free of vines (Janzen 1973). Black and Harper (1979) hypothesized that tree buttresses and smooth bark may deter lianas from climbing trees; however field observations by Boom and Mori (1982) found no inhibition of liana growth in trees with buttresses or smooth bark. Putz (1980) suggested that rapid stem thickening may enable trees to avoid lianas. Putz (1980) observed that most lianas on Barro Colorado Island, Panama, climb with twining stems, tendrils, or modified branches, which therefore constrains lianas to climb on other lianas and on small diameter trees and branches. Maier (1982) suggested that spines and thorns may protect palms from vines, and observed that vines were less abundant on *Bactris* and *Cryosophila* than on non-spiny palms in

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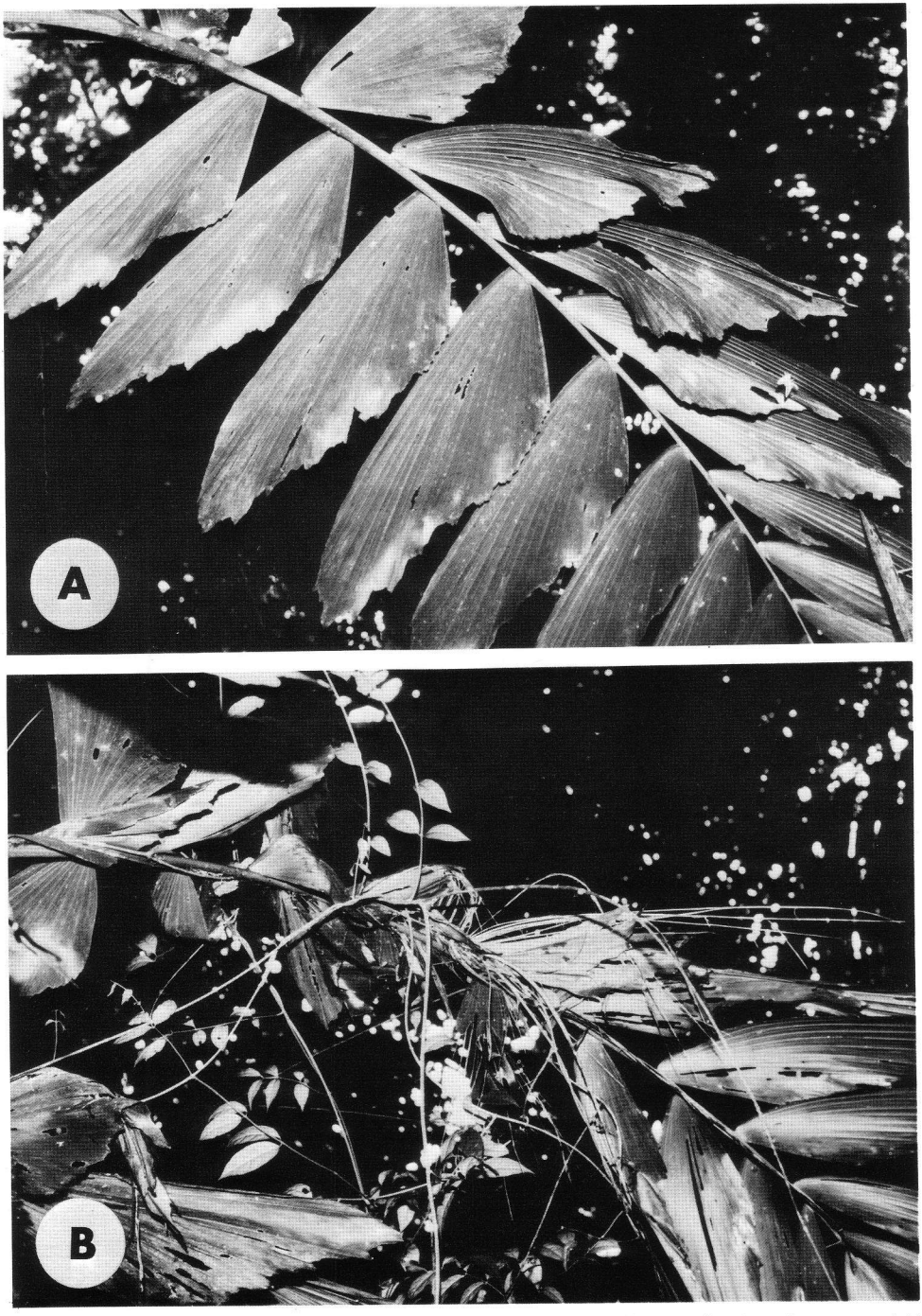


1. Vines can interfere directly with proper leaf expansion in palms, as is shown in this pictoral sequence of A) a healthy leaf from a 6 m tall *Iriartea gigantea*; and B) a leaf from the same individual that did not expand properly because a twining vine constricted the leaf during the spear stage.

Panama. Putz (1984) suggested that trees with flexible stems and long leaves are able to avoid and shed lianas. Putz observed that the arborescent palms *Astrocaryum standleyanum* and *Scheelea zonensis* were free of lianas on Barro Colorado Island, Panama, and suggested that this was due to shedding of lianas when the long leaves abscissed. We examined the distribution of vines on palms in a Costa Rican tropical wet forest and tested the hypothesis that the shedding of palm leaves dislodges adherent vines.

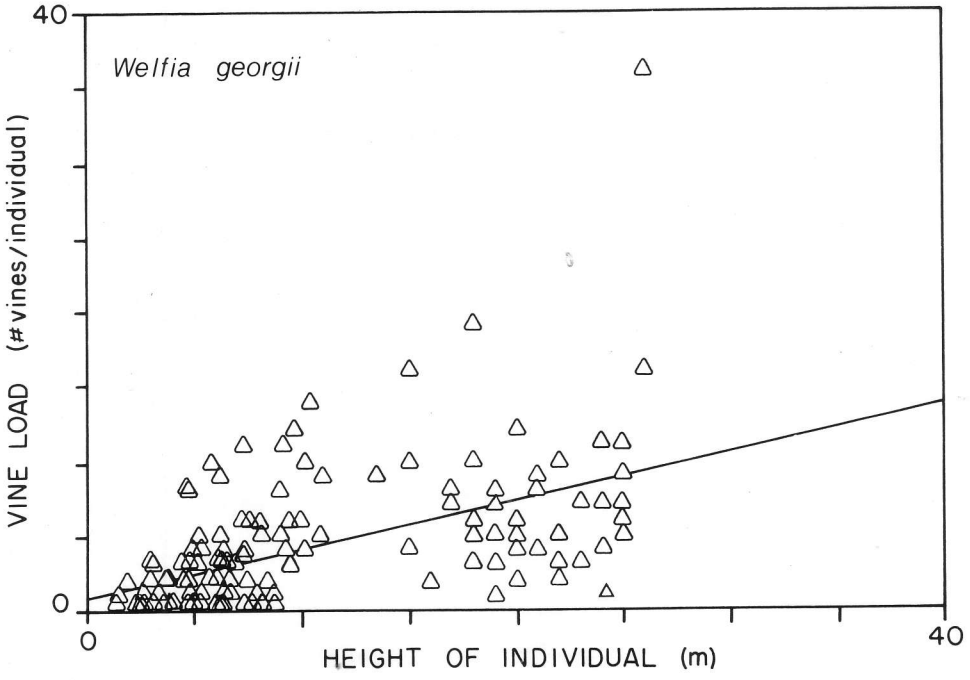
Methods

The occurrence of vines was surveyed for the arborescent palms *Welfia georgii* and *Iriartea gigantea* in tropical wet forest at La Selva Biological Station, Costa Rica. The study site is described in detail elsewhere (Hartshorn 1983, Chazdon 1985). In conjunction with studies of leaf production and height extension in arborescent palms (Rich 1985, 1986), we recorded the family identity of vines and the height to which individual vines grew on marked populations of 100 *Welfia* and 100 *Iriartea* with overall heights shorter than 13 m. We also surveyed family identity of vines growing on 50 individuals each for *Welfia* and *Iriartea* taller than 13 m, bringing the total sample size to 150 for each palm species. We recorded the height of each palm as measured to the top of the highest expanded leaf. Height was measured directly for shorter individuals and estimated for taller individuals. We noted the frequency with which vines grew into the crown and whether the vines grew into the lower crown, which we defined as the lowermost three leaves, or into the upper crown. For individuals less than 13 m tall, we recorded the occurrence of vines that were being carried to the ground by falling leaves. For tabulation of results, the samples of *Iriartea* and *Welfia* were divided into two groups, short palms (with individual heights less than 13 m) and tall palms (with individual heights greater than 13 m). For short *Welfia*, we recognized two subgroups, short individuals with no above-ground stem (generally individuals with heights less than 7 m tall) and short individuals with an above-ground stem (generally individuals with heights greater than 7 m tall). Vines were tabulated for seven taxonomic categories: Araceae, Cyclanthaceae, Melastomataceae, Piperaceae, Leguminosae, ferns, and a miscellaneous category.

Results

For both species, total vine load increased with palm height, though with a broad variance. For *Welfia georgii*, the linear regression of vine load as a function of height ($Y = 0.319X + 0.860$) had a low coefficient of determination ($r^2 = 0.26$), but a significant increase in vine load with height ($P < .01$) (Fig. 2A). For *Iriartea gigantea*, the linear regression of vine load as a function of height ($Y = 0.437X + 0.614$) also had a low coefficient of determination ($r^2 = 0.56$), but a significant increase in vine load with height ($P < .01$) (Fig. 2B).

Table 1 summarizes the mean vine loads and taxonomic distribution of vines encountered on palms. Short *Welfia* had a mean of 3.17 vines per individual, with a broad variance (sd = 2.97), whereas tall *Welfia* had a mean of 7.08 vines per individual (sd = 5.69). Among short *Welfia*, individuals with an above-ground stem had higher vine loads than did tall individuals and individuals without an above-ground stem. Tall *Iriartea* had a mean of 10.34 vines per individual (sd = 6.47), whereas short *Iriartea* had a mean of 2.31 vines per individual (sd = 2.56). For all palm groups, vines of the family Araceae comprised approximately 80% of the total vine load, with other less abundant vines including representatives in each of the other families. Vines of the family Cyclanthaceae comprised approximately 10% of the vine load. Vines in the Leguminosae


40
Welfia georgii
VINE LOAD (# vines / individual)
0
0
40
HEIGHT OF INDIVIDUAL (m)

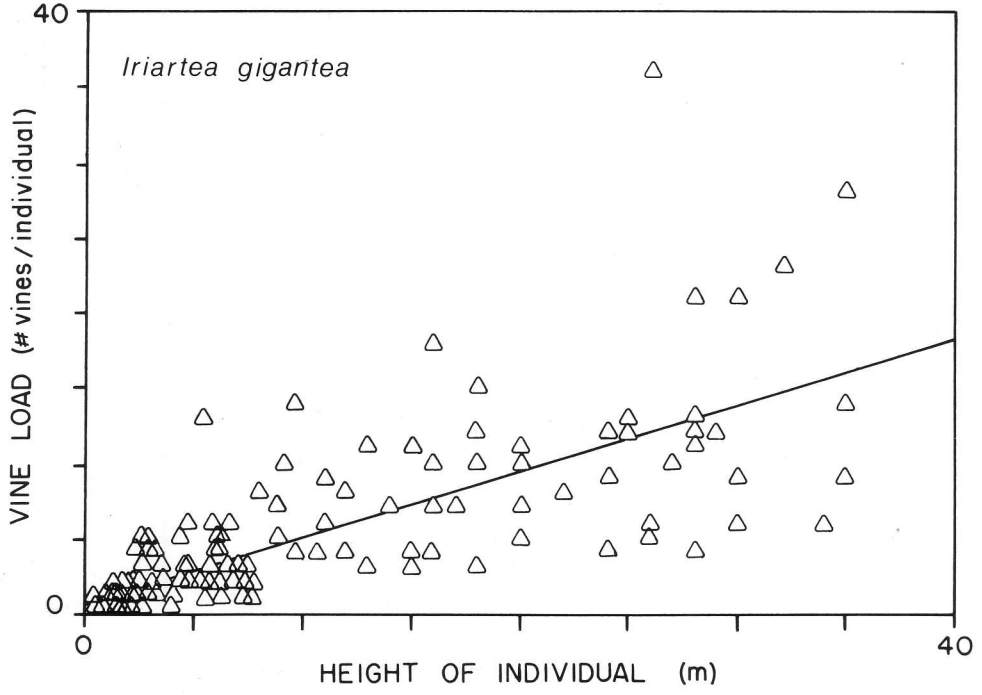

40
Iriartea gigantea
VINE LOAD (# vines / individual)
0
0
40
HEIGHT OF INDIVIDUAL (m)

Table 1. Taxa of vines on palms.[a]

Palm Group	n	Mean Vine Load	sd Vine Load	Proportion of Vine Load						
				Aro	Cycl	Mel	Pip	Fern	Leg	Other
Wg <13 m height	100	3.17	2.97	0.77	0.12	0.01	0.00	0.05	0.01	0.05
Without stem	66	1.94	1.99	0.85	0.01	0.00	0.00	0.08	0.02	0.05
With stem	34	4.97	4.00	0.70	0.20	0.02	0.00	0.03	0.00	0.05
Wg >13 m height	50	7.08	5.69	0.80	0.12	0.02	0.01	0.03	0.00	0.03
Ig <13 m height	100	2.31	2.56	0.82	0.10	0.01	0.03	0.02	0.00	0.02
Ig >13 m height	50	10.34	6.47	0.80	0.13	0.02	0.03	0.01	0.02	0.01

[a] Key to symbols: n = sample size; sd = standard deviation; Aro = Araceae; Cycl = Cyclanthaceae; Mel = Melastomataceae; Pip = Piperaceae; Fern = Polypodiaceae; Leg = Leguminosae; Wg = *Welfia georgii*; Ig = *Iriartea gigantea*.

(of which all were species of *Bauhinia*) and the miscellaneous category were small lianas (<0.5 cm stem diameter) and comprised only 2–7% of the vine load. In no case were larger lianas observed among the vine load. Most vines were root climbers, with the exception of some ferns, all Leguminosae, and all vines in the miscellaneous category, most of which were twiners.

Table 2 summarizes the proportion of individual palms with vines growing into the crown, the proportion of total vine load in the crown, and among the vines that grew into the crown, the proportion that was restricted to the lower crown. Although tall individuals had greater vine loads than short individuals, tall individuals had fewer vines growing into the crown. Among vines that grew into the crown, most were restricted only to the lower crown. In none of the 300 cases did we observe substantial blockage of light by leaves of vines. We did observe several cases where vines interfered with leaf expansion, all of which involved vines that grew into the upper crown (Fig. 1). We have observed some palms, not included in this study, that had crowns that were inundated by vines and had definite light blockage and interference with leaf development.

Table 2 also summarizes the proportion of individuals that were shedding leaves with vines attached. Among short individuals, 3–15% were shedding leaves with vines attached. Typically, the lowermost leaf was brown and beginning to fall, carrying any attached vines with it (Fig. 2). Short *Welfia* with an above-ground stem had a lower proportion of individuals with vines growing into the crown than either short *Welfia* without an above-ground stem or tall *Welfia*; and this same group had the highest proportion of individuals (15%) that were shedding leaves with vines attached. On numerous occasions we encountered recently fallen leaves on the forest floor that had vines attached to them (Fig. 3), however these cases were not systematically recorded. Entire vines were not necessarily torn from the trunk of a palm when a leaf fell, but rather were partially dislodged or broken. This disruption of the leading end of vines was especially prevalent among vines in the Araceae, and many aroids showed branching from secondarily released lateral buds.

←

2. Vine load, expressed as the total number of vines per individual palm, increases significantly with height ($P < .01$) within the arborescent palms A) *Welfia georgii* ($n = 150$; $r^2 = 0.26$; $Y = 0.319X + 0.860$) and B) *Iriartea gigantea* ($n = 150$; $r^2 = 0.56$; $Y = 0.437X + 0.614$). In both cases there is broad variance in the vine load for a particular height individual, especially among taller individuals.

Table 2. Palms that had vines growing into the crown and palms with vines falling with leaves. (Palm groups are as in Table 1.)

Palm Group	n	Proportion of Palms with Vines in Crown	Proportion of Vines in Crown	Proportion of Crown Vines in Lower Crown[a]	Proportion of Palms with Vines Falling with Leaves
Wg <13 m height	100	0.60	0.57	0.92	0.07
Without stem	66	0.70	1.00	0.93	0.03
With stem	34	0.47	0.24	0.90	0.15
Wg >13 m height	50	0.08	0.01	0.75	—
Ig <13 m height	100	0.37	0.29	0.87	0.03
Ig >13 m height	50	0.06	0.02	0.55	—

[a] The lower crown is here defined as the lowermost three leaves.

Table 3 summarizes findings concerning the taxa of vines that grew into palm crowns. Aroids comprised the majority of the vine load in palm crowns (75–97%), except in the case of tall *Iriartea* (22%). Only the aroid and miscellaneous categories were encountered in the crowns of tall *Welfia* and in the crowns of both short and tall *Iriartea*. Cyclanths, ferns, and legumes were encountered at low frequency in the crowns of short *Welfia*. Melastomes and pipers were not encountered in palm crowns.

Discussion

The greater vine loads on taller palms resulted from an accumulation of vines over time. The wide variance in vine loads among palms probably resulted because of differences in the microsites provided by the trunk, the rate of colonization by new vines, and the rate of death and detachment of vines. Tall palms had fewer vines growing into their crowns than short palms because the crowns grew above suitable microsites for some vines and because vines were shed with the leaves.

The prevalence of root climbers and absence of large lianas supports the hypothesis of Putz (1984) that the thick trunk of many palms deters attachment of lianas with twining stems and tendrils. *Welfia* shows little increase in stem diameter during height growth, and has a stem diameter at breast height of 15–25 cm even in short individuals, whereas stem diameter in *Iriartea* rapidly increases from 4 cm in short individuals to more than 20 cm in tall individuals (Rich 1985, 1986, Rich et al. 1985). In addition, the lack of branches in palms prevents colonization by lianas growing on surrounding trees. Palm stems are stiff near the base and flexible toward the crown (Rich 1985, 1986, in press), a characteristic that may also contribute to the exclusion of lianas (Putz 1984).

Aroids are the most abundant vines growing on palms in the forest at La Selva. Various characteristics favor aroids on the palm stems, including their ability to form root attachments to the broad, smooth surface of the palm trunks; their flexible, non-woody stems that allow bending with the palm stem; their ability to form leaves of different size and shape suitable for the different microhabitats at different heights (Givnish and Vermeij 1976); and their ability to continue growth after mechanical damage. Aroids that are broken or partially detached by falling palm leaves are often able to continue growth because axillary buds are released and efficient vascular connections are formed at these branching regions (French and Tomlinson 1984). The year-round rainfall and high humidity at La Selva provide an environ-

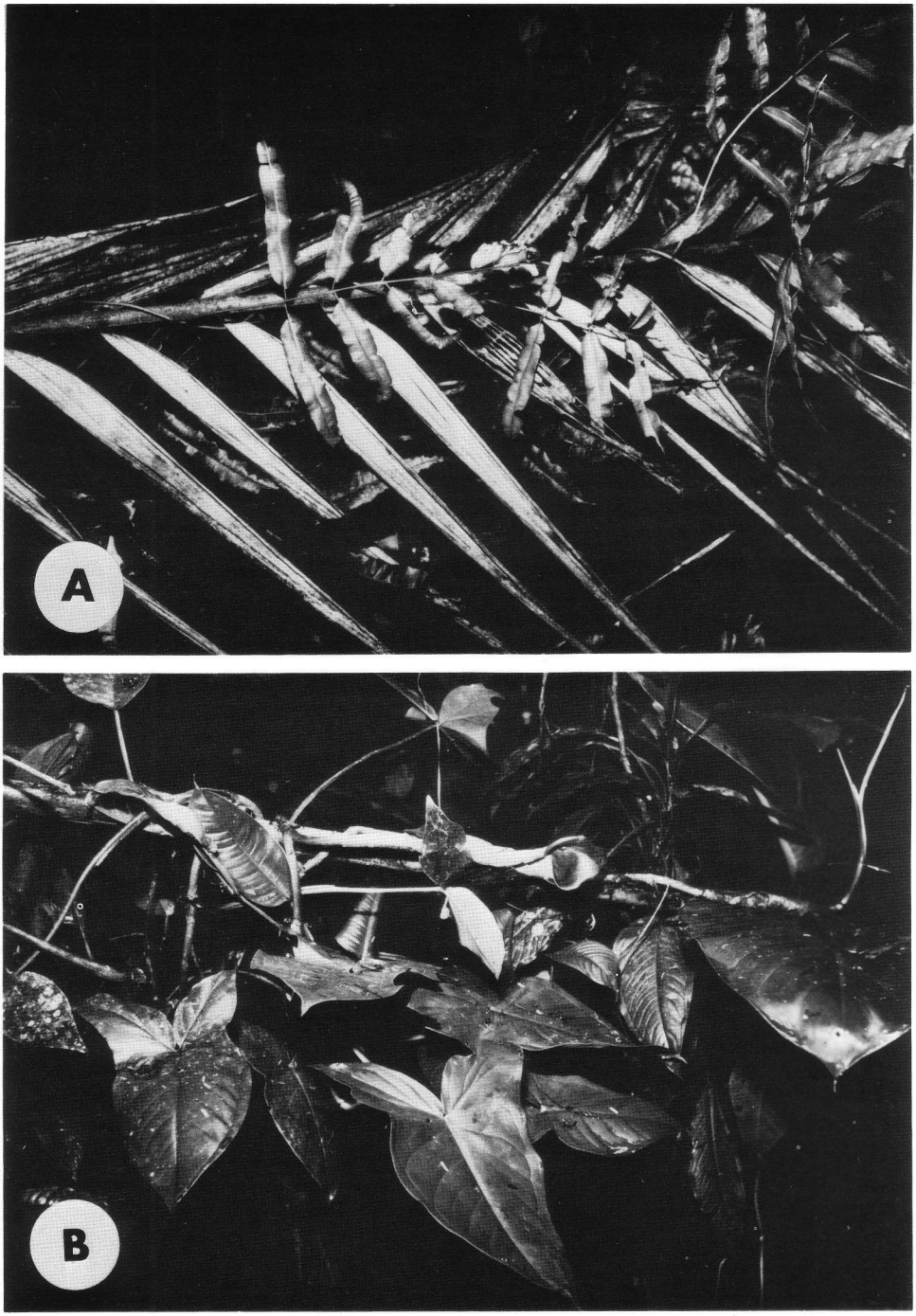
3. A) Palms can accumulate large vine loads at La Selva Biological Station, Costa Rica, as can be seen on the trunk of the palm *Welfia georgii*. Vines of the family Araceae comprising more than 80% of the vine load. B) When leaves are shed, they often carry adherent vines with them.

ment that is favorable for aroids and other non-woody evergreen vines. Most of the vines that were common on palm trunks, including aroids and cyclanths, are able to reproduce and complete their life cycle without growing into the crown.

The crown development and architecture of palms provide a mechanism for shedding vines. The large compound leaves expand at the top of the crown. Each leaf shifts from the top to the bottom of the crown and is sequentially shed (Tomlinson 1979, Hallé et al. 1978). When the weighty leaves fall, they dislodge any adherent vines (Putz 1984). The lack of branches and continual turnover of leaves helps to prevent palms from accumulating vines in the crown. Givnish (1978) observed that compound leaves, with leaflets arranged about a rachis, serve as tem-

Table 3. Taxa of vines that grew into palm crowns. (Palm groups and symbols are as in Table 1.)

Palm Group	n	Aro	Cycl	Mel	Pip	Fern	Leg	Other
Wg <13 m height	100	0.83	0.02	0.00	0.00	0.09	0.01	0.05
Without stem	66	0.85	0.01	0.00	0.00	0.08	0.02	0.05
With stem	34	0.78	0.05	0.00	0.00	0.13	0.00	0.05
Wg >13 m height	50	0.75	0.00	0.00	0.00	0.00	0.00	0.25
lg <13 m height	100	0.97	0.00	0.00	0.00	0.00	0.00	0.03
lg >13 m height	50	0.22	0.00	0.00	0.00	0.00	0.00	0.78



4. Fallen palm leaves on the forest floor at La Selva Biological Station, Costa Rica, often have vines attached to them. A) A leaf of *Welfia georgii* carried a twining fern (*Salpichlaena volubilis*) to the ground. B) Another

porary "throw-away branches" that are favored in many circumstances over presumably more expensive branches with similar arrangements of simple leaves. In arborescent palms, the large compound leaves not only serve as "throw-away branches" that form a parasol-shaped crown and enable exploitation of light in canopy openings, but also serve to help keep palm crowns free of vines.

Conclusion and Summary

Vine loads increased with individual height in *Welfia georgii* and *Iriartea gigantea*, but the proportion of vines reaching the crown decreased with height. About 80% of vines were in the family Araceae. Other vines included representatives of the Cyclanthaceae, Melastomataceae, Piperaceae, Leguminosae, and ferns. Most vines that grew on palms were root climbers. Vines that grew into palm crowns usually only grew on the lowermost leaves. Some vines that grew into the palm crowns interfered with proper leaf expansion, especially in younger palms. As palm leaves were shed from the base of the crown, adherent vines were dislodged. The lack of branches, thick stem, flexibility of the upper stem, and continual shedding of large compound leaves of palms all appear to contribute to keeping palm crowns relatively free of vines.

Acknowledgments

We thank Francis Putz and P. B. Tomlinson for their comments and the staff of the Organization for Tropical Studies for logistical support. Research was supported by the Atkins Garden Fund of Harvard University, the Jesse Noyes Foundation through the Organization for Tropical Studies, a Fulbright Graduate Fellowship, and National Science Foundation Doctoral Dissertation Improvement Grant #BSR84-13187.

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← leaf of *Welfia georgii* carried several aroids to the ground. In this case, some of the aroids broke off, with a portion remaining attached to the palm trunk.

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CLASSIFIED

Principes, 31(1), 1987, p. 41

Worldwide Endangerment of Useful Palms

The Palmae consists of 200 genera and approximately 2,600 species. Most are native to the tropics. The Tropical American and Tropical Asian (including Australia) regions are each rich in palm species, whereas Africa is very poor. Wherever they occur, native palms represent valuable forest resources and are used by local populations for food (fruit, palm heart, oil, starch, beverage); fiber (leaf, petiole, leaf-base); building material (stem, leaf, petiole); basketry and mats (leaf); medicine, etc. Commercial exploitation of natural palm stands for certain of these products is important in regional and national economies. Accelerating tropical forest cutting for agriculture, grazing and other purposes threatens this resource as well as the survival in the wild of a yet undetermined number of palm species. A project on palm utilization and conservation in Tropical America has as its objective to identify the species of economic importance, document local utilization patterns, and assess the status of species commercially exploited for domestic and foreign markets. A similar project is planned in Tropical Asia. In both regions the long-term objective is to establish a baseline for the formulation of management systems for palm-rich tropical forest areas. Among the palms under study are the açaí (*Euterpe oleracea*) in the Lower Amazon Basin; the palmyra (*Borassus flabellifer*) in South India; and certain rattans (*Calamus* spp.) in peninsular Malaysia.

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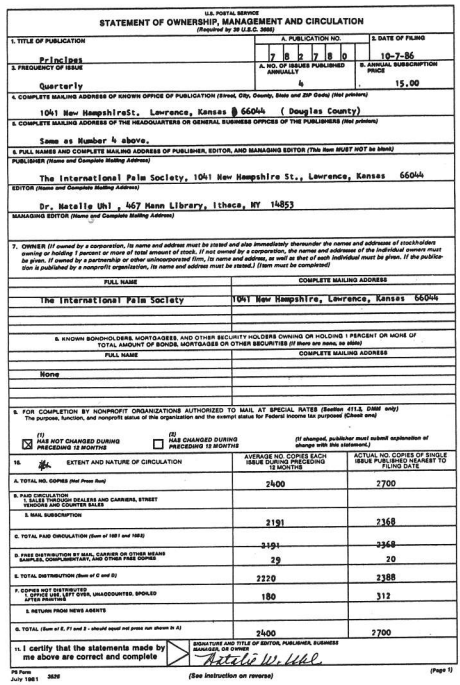

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Principes, 31(1), 1987, pp. 42–43

Sabal Palmetto Distribution Update

DR. KYLE E. BROWN
Lake City Community College, Lake City, Florida, USA

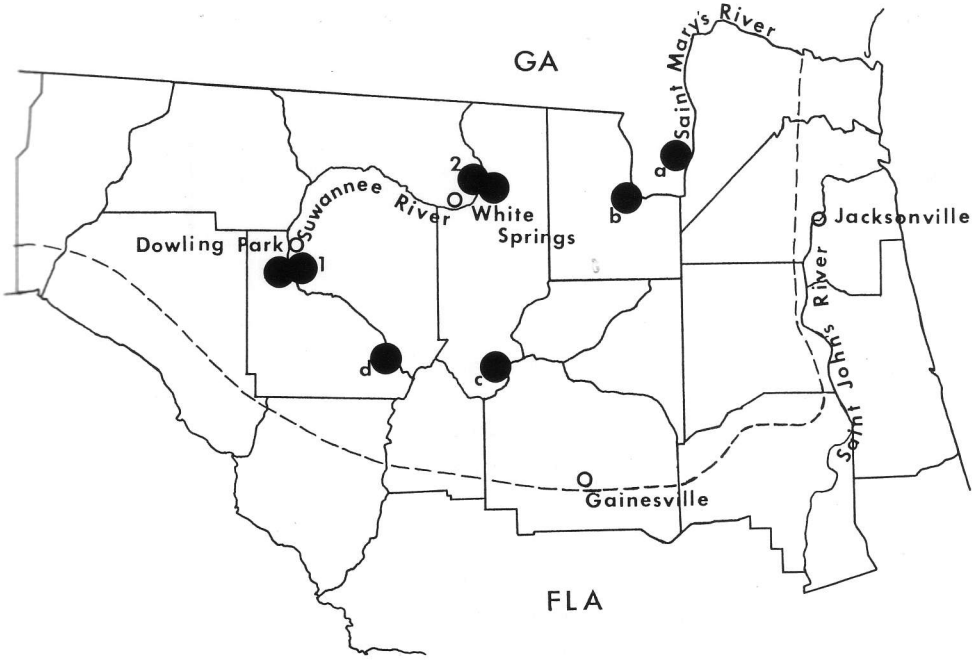
The distribution of cabbage palms (*Sabal palmetto*) in north Florida has been characterized as isolated and widely scattered along rivers and streams (Brown 1976). Two populations, hitherto unreported in the literature, have been located in remote areas along the Suwannee River north and further inland than those previously reported.

The discovery of these two sites came about quite unexpectedly. It was on two separate canoe trips on the Suwannee River, one in June 1982, the other in June 1983, that these two populations of cabbage palms were found.

The first trip was on a 40 mile stretch of the river between Dowling Park and Branford. Within a few miles of our launch point at Dowling Park, numerous cabbage palms up to 4.5 m in height were observed on both sides of the river. Scattered plants in all age classes from seedling to reproductive were seen for several miles. The river runs in a southerly direction for approximately ten miles below Dowling Park before turning to the east. No further sightings were made after the turn to the east until reaching the Branford area where the river again is on a southerly course. Unfortunately, I did not have my camera on this trip so no photographic record of these trees exists.

The second trip, approximately one year later, was considerably further upstream on the Suwannee near White Springs. Entry point for this 15 mile canoe trip was about ten miles northeast of White Springs off U.S. 441. The purpose of this trip was to experience Florida's only stretch of class three and four white water rapids, locally known as Big Shoals. About five miles downstream from the entry point cabbage palms were sighted on both sides of the river for several miles north of Big Shoals. Again individuals in all age classes were observed. The river at this point also has a southerly course. On a second trip through the same stretch of river in June 1984, I had my camera along and have thus recorded the species' presence in Figure 1. This population was completely

1. Mature specimen of *Sabal palmetto* on the banks of the Suwannee River, Hamilton County, Florida, June 1984.



2. Distribution of *Sabal palmetto* in northern Florida. The dotted line represents the approximate limit of the continuous range. Points a, b, c and d indicate locations of previously reported isolated interior populations. Points 1 and 2 indicate new population locations hitherto unreported in the literature.

unexpected and is quite exciting to me as it is the most remote interior population yet reported. It is approximately 75 miles inland from the Atlantic Ocean, 70 miles from the Gulf of Mexico, and 55 miles north of the continuous range across the peninsula near Gainesville. (Fig. 2).

These populations further support my earlier conclusions that *Sabal palmetto* is a viable, range expanding species. I am now inclined to think that isolated populations may be present in interior south Georgia and perhaps even southeastern Alabama. If such populations do not yet occur I would expect them there in the future.

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Principes, 31(1), 1987, pp. 44–45

PALM PORTRAIT

A Roystonea with a Double Trunk

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Five genera of large palms, each with a single species, are conspicuous in the vegetation of the Gulf coastal plain of the State of Veracruz, Mexico (Smith, 1958). *Scheelea liebmannii* Becc. is common in humid forests; *Sabal mexicana* Mart. often forms dense stands in savannalike or seasonally inundated forests; *Acrocomia mexicana* Mart. is mostly found in the dry, deciduous thorn-scrub; *Acoelorraphe wrightii* (Griseb. & H. A. Wendl.) Becc. is found only in the marshes of the southeast (Orozco and Lot-Helgueras, 1976); and *Roystonea dunlapiana* P. H. Allen is seen occasionally in seasonally inundated forests.

Branched stems are very unusual in palms except in *Hyphaene* (Hodge, 1965) and a few other genera. A picture of an unidentified double-headed *Roystonea* in Haiti was published in *Principes* 1: 126, 1957; another was mentioned by Smith (1958) from the nearby state of Tabasco, Mexico. In the central plaza of Cosamaloapan, Veracruz, I was very surprised to encounter the double-trunked royal palm shown in the photos (Cover and Fig. 1). The tree is about 15 m tall and is divided halfway up into two equal trunks; it appears as healthy and vigorous as the other *Roystonea* (and *Cocos nucifera*) in the plaza. It is not known what caused the tree to branch but it does not show any sign of the trauma now.

The town of Cosamaloapan is situated on the levee of the Rio Papaloapan, about 5 m above sea level and 50 km (by air) south of the river's entrance into the Gulf of Mexico at Alvarado; it was an important river port long before roads were built in the region. The surrounding area is now devoted mainly to cattle ranching, mangos, sugar cane and other crops but it was formerly covered with a seasonally inundated forest. I presume that these cultivated trees were obtained from native trees in the general region.

It was not possible to obtain very satisfactory herbarium material, only fallen leaf bases and fruits (*Nee 29252* at BH, F, NY, XAL). Collections of *Roystonea* from Veracruz are very few and this "palma real" is only tentatively assigned to *R. dunlapiana*. The trunks are sometimes split to make "boards" for house construction and the leaves are sometimes used for thatch, but it does not produce edible fruits, hence another name, "palma macho" (male palm). It seems to be becoming less common with land clearing for I have not noticed it along roads which were new when travelled by Smith in 1958.

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1. Close-up of the division of the trunk in *Roystonea dunlapiana*; see also the Cover Photo.

Principes, 31(1), 1987, pp. 46–47

LETTERS

Dear John:

While perusing the visitors' book of Instituto de Ciencias Naturales, I have found the following note, written by David Fairchild the 15th July 1941 and which I would like to share with the readers of *Principes*:

"I have come and have seen one of the most wonderful plant sights of the world—the wax palms of the Quindío. To stand among them as the clouds roll down the valley is to have the aesthetic sensation of a lifetime. I predict the time will come when thousands will fly down from the North, just to have the experience of a day among the wax palms on the Quíndio."

David Fairchild, 15 July 1941

Yours sincerely,

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Instituto de Ciencias Naturales
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Principes, 31(1), 1987, pp. 41–42

Dear Natalie,

There is a new Palmetum being built in Townsville as a Townsville City Council–Australian Bicentennial project.

The Palmetum site occupies approximately 25 hectares of undulating lowlands west of the city center and with considerable frontage along the Ross River. The area has meandering creeks, lagoons, closed-forest patches, open spaces and includes a variety of soil types.

This variety of vegetation, drainage and soil types allows us a wide range of creativity in terms of environment, for with little modification we can create rainforest, swamp forest, savannah, swamp-savannah and semi-arid areas, all according to the natural features existing there.

Progress is well under way now, we have just completed excavation works on a central lake and constructed two large rocked areas for planting. The plant collection is progressing well also, we now have 85 genera represented by over 250 species, (with an emphasis on native Australian species), followed closely by South-East Asian rainforest species.

Although our representation is broad, for example we have all subfamilies (except the Phytelephantoideae) and of them we have over 80% of the currently known tribes, we are interested to expand the collection further.

Here are some of the genera we have yet to obtain:

Chelyocarpus	Mauritia
Itaya	Mauritiella
Schippia	Lepidocaryum
Maxburretia	Juania
Guihaia	Louvelia
Pholidocarpus	Ravenea
Pritchardiopsis	Synechanthus
Colpothrinax	Wendlandiella
Nannorrhops	Iriartella
Chuniophoenix	Iriartea
Medemia	Catoblastus
Laccosperma	Wettinia
Eremospatha	Podococcus
Eugeissona	Halmoorea
Metroxylon	Manicaria
Korthalsia	Leopoldinia
Eleiodoxa	Vonitra
Calospatha	Neophloga
Pogonotium	Phloga
Ceratolobus	Dypsis
Retispatha	Prestoea
Myrialepis	Neonicholsonia
Plectocomiopsis	Oenocarpus
Plectocomia	Jessenia
Oncocalamus	Hyospathe

Kentiopsis	Burretiokentia
Mackeea	Physokentia
Actinokentia	Goniocladus
Calyptrocalyx	Tectiphiala
Drymophloeus	Roscheria
Balaka	Schlerosperma
Ptychococcus	Marojejya
Brassiophoenix	Masoala
Loxococcus	Carpoxylon
Siphokentia	Lytocaryum
Neoveitchia	Allagoptera
Iguanura	Polyandrococos
Brongniartikentia	Attalea
Sommieria	Scheelea
Clinosperma	Maximiliana
Moratia	Barcella
Clinostigma	Acrocomia
Alsmithia	Gastrococos
Satakentia	Desmoncus
Actinorhytis	Welfia
Lavoixia	Calyptronoma
Alloschmidia	Calyptrogyne
Cyphophoenix	Palandra
Campecarpus	Phytelephas
Veillonia	Ammandra

Of course there are some species and even some genera that probably will not grow here. So far, however, we have been surprised with some that were considered difficult, if not impossible to grow in Townsville, like *Rhopalostylis baueri* and *Chamaerops humilis*. Primarily we are looking for tropical palms, and in particular South and Central American species which are not readily available to us here. I would ask any readers of *Principes* who have access to species in the genera listed above for donations of seed for the Palmetum. We can arrange postage reimbursement or an exchange of Australian (tropical) species if desired. Enquiries or seed can be sent to me at the address below. Any assistance will be acknowledged and much appreciated.

J. THOMAS, Director
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Administration Building
Walker Street
Townsville, Queensville, 4810
Australia

Principes, 31(1), 1987, pp. 48–52

NEWS OF THE SOCIETY

The New South Wales Chapter, Sydney, Australia

Dec. '85. A weekend Christmas gathering of 27 members and friends enjoyed the year's last outing at Garry Daley's new property, 65 km S. of Sydney in the foothills of the Illawarra escarpment. In walks through the regenerating rainforest, logged about 50 years ago, we saw large lianas and epiphytic ferns among the remaining *Toona australis* (Australia's famous red cedar) and also massive figs (*Ficus rubiginosa* and *F. macrophylla*), *Planchonella* and *Pennantia cunninghamii*. Fossil crinoids in the creek bed were of great interest and for other reasons, the hordes of hungry leeches.

Over a thousand palms had been planted in a herculean effort by Garry and we wish him every success in this venture.

Feb. '86. Alan Collins held an extensive sale of palms from his flourishing collection, being well patronized by members new and old and from near and far.

Apr. A visit to Australia by Garrin Fullington from U.S.A. was the occasion for our next activity, which was an afternoon meeting at the home of Bob Paisley. In warm weather an interesting time was spent, viewing the large grounds where many species were planted out in two new extensions to his palm garden. Young plants of *Roystonea regia*, *Chrysalidocarpus* spp., *Acoelorraphe wrightii*, three *Arenga* spp., *Chamaerops*, *Livistona* spp., *Rhopalostylis* spp. and *Wodyetia* were all doing well.

A party of local members took Garrin to the Wilson River Primitive Reserve, 70 km inland on the mud North Coast. The area is an unlogged section of rainforest, featuring thousands of *Linospadix monostachya* reaching two meters, very lush and beautiful, with large stands of *Archontophoenix cunninghamiana* in all sizes to six meters, forming part of the understory near the river and to 100 meters each side.

May 4. In spite of damp conditions more than 20 enthusiasts including many new members gathered at Betty Hart's to enjoy her carefully landscaped grounds, the vigorous single-stemmed *Caryota* and the well-tended street garden. All were impressed by this lone worker's dedication.

June 28. After a long drive to the Central Coast, about forty members and friends enjoyed the morning tea before inspecting the large nursery and collection of palms, bromeliads, orchids and succulents at the home of Lew Forrest, a former member. After a picnic lunch at Lake Macquarie, we visited Don Morris' beautifully secluded garden at Warner's Bay. Overhead was a canopy of *Archontophoenix cunninghamiana*, other palms and native rainforest trees; while below his tall *Normanbya normanbyi* and *Caryota mitis* to six meters were particularly striking, as was a huge native cycad, *Lepidozamia peroffskyana*. On the way home some members followed the coast road where large groves of *Livistona australis* and another indigenous cycad, *Macrozamia communis*, were seen in habitat.

Aug. This month we had the pleasure of another visit from the U.S.A., that of Mark Mizraki, who had unfortunately only a limited time in Sydney.

Sept. 28. A palm mapping project was commenced in the Royal Botanic Gardens with the intention of publishing an index for general use. About 20 people attended and about one third of the palm area was covered. It proved an interesting and informative exercise.

Oct. 9–12. We mounted a display in the Gardens during the "Spring in the Gardens" festival, featuring Australian palms, about half of our 57 species being represented. The sales section included a quantity of seedlings of our two common

species, Bangalow and Cabbage Tree, with the hope of attracting future palm enthusiasts.

During the year our public relations officer, Bob Paisley, has been busy with radio interviews, inspections by local garden clubs, and in the use of his garden for television commercials.

Lectures by members at garden societies have been well received and have created interest in the use of palms, both indoor and out.

At the meetings a high degree of enthusiasm prevails. They are well attended and afford an opportunity to join palm-culture discussions, auctions and sales, as well as to view the slide shows of members' visits to remote areas. This year these have featured Africa, Borneo, Mauritius, Reunion, and a splendid detailed presentation of Australian livistonas in habitat by our botanist member, Tony Rodd.

Discount book sales to members have been introduced, likewise a welcome new format to *Principes Minor*, with a palm exchange column and a challenging palm crossword.

In all, the Society in Sydney has had a successful year by providing a venue for members to meet, acquire rare palms, and exchange knowledge and experience of the world of palms.

KEN VENESS

The Biennial 1986

At each Biennial over the years it seems to me that there has been something special by which I remember it—perhaps a person, a place or an event. And so it was again in San Diego in June of 1986. Only this time it was a combination of all three that made this Biennial so outstanding. Bill Evans, our host and owner-manager of the Bahia Resort Hotel on Mission Bay was the person, his Bahia complex was the place, and the event consisted of several parts—the beautiful location, the gardens with their many, many palms, and not least the special treatment on room rates and the donation of morning coffee and something to go with it. Thank you from all of us, Bill Evans, you're the tops! Of course, up there too were the hard-working members of the Southern California Chapter who planned and arranged so many delightful programs. All you who did not attend missed a grand occasion; we missed you.

After arriving at various times, members registered during the afternoon of the 24th. We were handed an envelope containing all kinds of information—a gardening magazine that wrote about the event, a detailed program booklet, a sheet of writing paper and envelope with the newly-adopted logo of the Society, and even a charm on a chain of the logo for the ladies.

The pleasant Coffee Shop in the hotel proved to be a favorite meeting spot, but the gardens were what took our attention, for Bill had outdone himself with planting palms in great profusion, especially a long row of *Ravenea rivularis* that will become more beautiful as they settle into their new home. There was a magnificent *Brahea armata* almost hidden in its long pendulous bloom spikes (just how did you arrange that, Bill?), but surpassing all were the two enormous *Jubaea chilensis* that took your breath away. They were well-placed in corners of a multistory building and were astonishing to behold. Moving those two huge specimens was a Herculean task, undertaken by member Ski Torzeski who is a past-master at moving large plants. An old *Phoenix reclinata* with widely extending curved trunks greatly added to the landscaped pool area. And then there was the more intimate protected garden with its charming pools and secluded corners. Altogether the Bahia was a lovely setting for a Palm Society Meeting.

Early the first evening we were treated to a two-hour tour of Mission Bay on the

stern-wheeler "Bahia Belle," courtesy of Bill Evans. The weather was perfect, the palms onshore picturesque, large old *Phoenix dactylifera* and *Washingtonia* outlined against the sky, the company convivial, and the free drinks just added to the pleasure.

After breakfast Tuesday morning the caravan of vehicles left for the world-famous San Diego Zoo, passing by several areas attractively landscaped with palms. As always, the Zoo tour is a wonderful experience though many of us hardly had time to look at the animals, we were so interested in the many palms, both old and newly-planted. A delicious box lunch eaten al fresco gave us a short respite before touring the adjacent Balboa Park in the afternoon. The plants here are fascinating too, some of them very old, especially the *Washingtonia* planted at the turn of the century in a sort of ravine. They gave wonderful shelter to shade-loving species below them. Our well informed guides were nevertheless hard put to answer some of the many questions that the members posed about palms.

After returning for dinner on our own, we convened to hear a series of talks by our own members. The first was Ski Torzeski, a San Diego artist and landscaper, who has boundless energy and overwhelmed us with the way he handles large plantings and landscaping projects. He showed us a series of pictures taken while he was installing a most realistic tumbling stream down a formerly uninteresting dry ravine at the Quail Botanical Gardens, which we later visited. It was hard to believe what one was seeing even though we had seen the before pictures and the work-in-progress. Next our distinguished Editor, Dr. John Dransfield, told us about endangered species, a sad tale indeed. Then Tamar Myers, past Editor of the *Temperate Zone Bulletin* and a newly elected Board member, gave an amusing talk on growing palms in an inhospitable climate. It was a lively, enjoyable, and informative evening that set the tone for the following days.

Wednesday was a day devoted to touring members' gardens. First was that of Bill Clarke whose garden put many of us to shame for it was absolutely immaculate and with all the palms looking very healthy and happy, especially a large *Neodypsis lastelliana*. From here we made our way to the cul-de-sac street at the end of which Ski Torzeski has his domain. He has been able to persuade most of his neighbors on the short street to plant palms in their front yards, so it is a very palmy street indeed, absolutely delightful and showing what a strong personality can achieve when he sets his mind to it. One neighbor is still resisting, but there is hope he too will capitulate. Ski has developed the idea that most people do not utilize their front yards adequately, so he tries to plant close to the street, then have a small patio-like area between the plants and the house that can be used to advantage either as a resting spot or for more delicate plants that need shade and protection. The back of his garden is really one large slat house, with many lovely tropical plants as well as palms around a pool. We ate a delicious lunch there among the greenery.

Jim Wright was our next host. His garden has been on the itinerary during several meetings over the years, and it has grown to maturity but there is always something new added. Very impressive indeed are his *Rhopalostylis sapida* and *R. baueri* which are almost overwhelming in the impression of strength they give. Jim has now erected a sort of overlook with steps taking you up over the roof of his home so that you can see his plants from a different angle. It is a delightful garden and so thickly planted you wonder that each individual plant can grow and remain so healthy. He has a magnificent *Pritchardia* in front of a *Hedescepe* also, altogether a veritable botanic garden with many orchids and other tropical plants enhancing it.

That evening we were privileged to hear Dr. Natalie Uhl, co-editor of *Principes*, give us information about the new classification in "Genera Palmarum" and the good news that she had in hand the galley proofs of the first part, just received from the printer. Then Mardy Darian showed slides and told us about some of his adventures in Madagascar, adventures not for the timorous, while he was collecting some fabulous palms there. That same evening we had the unexpected pleasure of a short talk by Dr. Anthony Davis of India. He showed how the fronds of palms grow in an upward spiral on the trunk in a spiral to the right in the northern hemisphere, while in the southern they usually spiral to the left. He noted that sometimes a plant will, as it were, grow against the grain, but such a plant is apt not to be a strong one. The right-handed spiral seems to produce the stronger plant.

Thursday, after a drive along Mission Bay on the way to Del Mar, we arrived at the garden of Bill Gunther. Bill has spent many hours hauling in rocks with which he has fashioned paths, then lined them with walls of more rocks to create pockets large and small and miniature gardens into which he puts mulch and plants his palms. In this way he can utilize the steep hillside sloping down behind his home. It is an incredible feat when one thinks of all the rocks he has handled over the years, but the effect is delightful and the plants seem very happy.

After too short a stay, which included delicious refreshments, we took off for the drive to Quail Botanic Gardens, in Encinitas. This is a new garden which is already very interesting as there are some old trees and plants on the property. We stood in amazement looking at the tumbling water and the lovely planting around the waterfall that Ski had wrought. Further down the waterway was a quiet pond with many young palms enhancing its shores. In time Ski plans further water development. Gracious hostesses were stationed at strategic spots to answer questions about the Garden which is already a lovely spot. From here those who wished were taken to the Southern California Exposition which was like a huge fair. There were interesting botanical displays which we enjoyed after lunch on our own. No talks were scheduled for the evening.

Friday early we left for a visit to the garden of Ed Moore who has been a member since the founding of the Society. This is reflected in the many mature palms that enhance his garden. Especially noteworthy is a large *Parajubea cocoides*. From here we continued on to the garden of Phil Bergman who also lives on the steep side of a canyon. He has made this area accessible by installing wooden terraces and walkways, an engineering feat. His pool is up at the house and has lovely palm plantings around it. It was here that lunch was served as we sat amongst the palms. Then on to the well-established garden of Jim Specht where old palms are a joy to behold, among them a very large *Sabal* "Riverside," a huge *Arenga pinnata* and an enormous *Caryota*. As palms mature they present quite a different picture as is well demonstrated by this garden.

As though all these gardens were not enough, we went on to the delightful garden of our immediate past President, Al Bredeson, whose wife Sylvia was kept busy furnishing cooling drinks to all and sundry. While the weather was not particularly hot, it was dry so we were all thirsty. Al and Sylvia were our official hosts at the Biennial and they could not have been more gracious, or worked harder. Al's garden contained some very interesting plants as well as many palms. Specially noted were the *Neodypsis decaryi* and the fruiting *Caryota urens*. He has a nice group of the pretty, small *Chamaedorea stolonifera*. Altogether it was a most pleasant visit.

That evening Don Hodel told us about and showed us slides of his mother-in-law's garden in Tahiti. What a lovely spot it

must be! Then De Hull spoke of the palm research at the Institute of Food and Agricultural Sciences (IFAS) of the University of Florida at Ft. Lauderdale. De is with the Agricultural Extension Service. His love is palms, however, of which he personally grows a great many. We also had a short talk by Sylvia Olvera Fonseca of Mexico City on the uses of palm leaflets, dried, to make a variety of very attractive products, handbags, folders, etc. Since she spoke in Spanish, Al Bredeson acted as translator.

Since the next day, Saturday, was the day of the Biennial Banquet and Membership Meeting, with both outgoing and incoming Board Meetings also taking place, there was originally not much planned except a trip to the nearby Antique Car Museum led by Bill Evans who is an antique car buff. Fortunately, it was possible to schedule a visit to Mardy Darian's fabulous collection of rare and exotic palms. Of course the highlights of his collection are the palms of Madagascar that Mardy has collected himself. Because of the difficulty in getting insurance to cover the use of the elevated walkways that Mardy has installed in certain areas so plants can be viewed from above, the high path was off bounds to visitors, but it was nevertheless a source of wonder to us all—though many of us would not have dared walk on it even had it been permitted. With no railing it was not for the faint-hearted.

Before the banquet there was a no-host cocktail party on the patio adjacent to the dining hall. From the patio one had a lovely view of Mission Bay. Then to the banquet with its delicious food and an after-dinner rather humorous speech of welcome and greeting by our incoming President, Ed McGehee of Fort Lauderdale, Florida. Dr. John Dransfield was the main speaker of the evening with his topic a rather thorny one—"An Affair with Spines" which acquainted us with the many forms of spines and thorns that are to be found on our favorite palms.

There had been a raffle to benefit the Revolving Book Fund, the results of which were a set of bound *Principes* to Paul Drummond and a copy of *Flora of Madagascar* to Bill Gunther.

The Biennial Meeting was a great success from every viewpoint—we were a congenial group (just short of 200 were registered, additional local members came for certain programs) we had interesting things to do and see and hear, the weather was great and our hosts were the greatest. What more could anyone want?

TEDDIE BUHLER

Editor's Note: An account of the Hawaiian trip that followed the meetings in San Diego will be forthcoming in April.