



PRINCIPES

Journal of The Palm Society

July, 1960
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THE PALM SOCIETY

A non-profit corporation primarily engaged in the study of the palm family in all its aspects throughout the world. The Society relies on voluntary contribution for support, and membership is open to all persons interested in the family. Requests for information about membership or for general information about the Society should be addressed to the Executive Secretary.

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PRINCIPES

JOURNAL OF THE PALM SOCIETY

An illustrated quarterly devoted to information about palms published in January, April, July, and October, and sent free to members of The Palm Society

EDITOR: Harold E. Moore, Jr.

EDITORIAL BOARD:

Paul H. Allen, David Barry, Jr., Duncan Clement, Walter H. Hodge, Eugene D. Kitzke, Harold F. Loomis, Nixon Smiley, Dent Smith.

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The other regular features have been omitted from this issue because of the excess over the standard number of pages. The editor, Dr. Moore (now in Peru where he is engaged in field work), has standardized on 36 pages. This issue contains 48, or 12 in excess of the normal number.

Cover Picture

Leaves of *Sabal bermudana* have characteristic yellow spots here seen as lighter tissue where the petiole unites with the blade venation. Photograph by W. H. Hodge. See also page 90 for article and other photographs.

Mailed at Miami, Florida, 1 July 1960.

REPORT OF THE PRESIDENT

GIVEN AT THE BIENNIAL MEETING OF
THE PALM SOCIETY AT THE
FAIRCHILD TROPICAL GARDEN
ON APRIL 23, 1960

After an interval of two years we are gathered for another biennial meeting of The Palm Society as guests of the Fairchild Tropical Garden. To this Garden and its Director, Mr. Nixon Smiley, I should like to extend thanks on behalf of our membership. Thanks are also due to all those local Society members who have worked so hard to produce an enjoyable and profitable meeting.

In reviewing briefly Palm Society activities of the past biennium, one can come up with both heartening and disheartening notes. It is pleasant to see a steady increase in members from approximately 350 two years ago to 519 today. This is still a long way from the goal of 1000 members we some day should have in order to help put our financial house in order. Nevertheless, we continue to operate in the black though on an all too narrow margin. As our Treasurer's report will show, our bank balance continues to be just enough to cover current expenses, represented principally by the publication of *PRINCIPES*.

As you are well aware, *PRINCIPES* has been issued regularly during the past two years as a quarterly under the able editorship of Dr. Harold E. Moore, Jr. This our Society's journal and backbone has been a chief means of keeping members advised of activities and, more important, of information on the palms. I think we will all agree that it is serving its purpose in contributing useful information to the world's fund of knowledge about the great family of the

palms. That this is so is pretty well reflected in the fact that *PRINCIPES* now finds its way not only into the homes of our members but also into the libraries of a number of important botanical and horticultural establishments throughout the world. Since Dr. Moore is currently on a palm collecting trip to Peru, he cannot report personally on this journal. I know he has been concerned about the lack of articles submitted on the culture of palms. May I pass on the request to all that articles or short notes of horticultural aspects of these plants are most welcome and it is hoped that members will make special efforts to contribute regularly useful information of this nature to the editor.

The Society's other major publication project during the past reporting period has been the preparation of a Palm Handbook. As you perhaps have already read in the April *PRINCIPES* this Handbook is scheduled for publication as a special issue of the American Horticultural Society's "American Horticultural Magazine" later this year (under date of January, 1961). The year's delay in its appearance (this was scheduled for January, 1960) was occasioned, as you know, by the lamented death last July of our Vice President, Dr. Bruce Ledin. Dr. Ledin was at the time faithfully serving the Society as editor of this Handbook and one of his last acts was to deliver to me in late June of 1959 the preliminary manuscript of the Palm Handbook. The complete manuscript copy is now in the hands of the editors of the American Horticultural Magazine. One of my chief editorial jobs for the remainder of this year will be in helping see this joint Palm Society-American Horticultural Society-Fairchild Tropical Garden contribution

to press. I might add that our members will be able to purchase the Handbook directly from the American Horticultural Society, but if they are already members of that organization they will, of course, receive the issue as a part of their regular subscription to the American Horticultural Magazine.

In concluding this final report, I should like to thank each and all of you officers, directors and members for your full support during the past three years. It is my hope that you will continue such very much needed support in behalf of the new group of officers who will be carrying on during the coming biennium.

W. H. HODGE

REPORT OF THE EXECUTIVE SECRETARY

APRIL, 1958 — APRIL, 1960

Your Society has continued its rapid advance during the past two years under the dedicated guidance of its officers and directors. Inquiries concerning it have been arriving unsolicited from many parts of the world, demonstrating the fact that it is becoming steadily better known and appreciated.

MEMBERSHIP: The Society now has 513 contributing members, living in 34 countries and their possessions. Besides these, there are a few members who are not able to contribute money, due to currency restrictions, but who contribute information, seeds, photographs, etc. In the United States, the greatest number of members is found in Florida: 253. California comes next, with 111, and Texas third, with 28. Nineteen

other states and five U. S. possessions have a total of sixty-one.

ACTIVITIES: The Society's principal activity is the publication of *PRINCIPES*. It has been published regularly every quarter since its inception, and has achieved recognition among institutions of science and learning the world over. At present, 59 academies of natural science, schools and universities, botanical gardens, government bureaus, natural history museums, research organizations, public libraries and federations of garden clubs are subscribing to *PRINCIPES* for their libraries. No individuals are eligible to subscribe without being members; only organizations which are not allowed to take out memberships in societies may do so. We owe a large debt of gratitude to the editor, Dr. H. E. Moore, Jr., who devotes much of his spare time, without compensation, to the work of editing *PRINCIPES*, as well as to the contributors, who receive no pay for their articles.

SEED BANK: After a lapse of several months, during which Mr. De Leon was overwhelmed with work and could not devote the necessary time to collecting, cleaning and shipping seeds, the seed bank has been re-activated under a slightly different system. All members should have received an explanatory letter and a new list of available seed species. If you did not receive them, please write to me and they will be sent. Many expressions of appreciation for Mr. De Leon's volunteer work have been received, and members have been prompt to reimburse the seed bank for postage and packing costs.

MEETINGS: Wherever the number of members has been sufficiently large,

meetings and field trips have been held at irregular intervals. You have read reports of these meetings and trips in "News of the Society," in *PRINCIPES*.

EXHIBITS: Palm Society members have worked mightily to set up palm exhibits at flower shows in several areas. At the flower show in Fillmore, California, in May, 1959, Mr. and Mrs. Winston Haase presented fronds, photographs and lists of palms suitable for the locality. In January, 1960, Mr. Dwight A. Smith and Mr. Wesley P. Wilson set up a display of palms at the Upper Keys Garden Club flower show,

in Tavernier, Florida. In 1959 and 1960 the Miami group was responsible for two very lovely palm gardens at the Metropolitan Flower Show. All of these exhibits were very well received by the public and attracted attention to the palms and to our Society. We are very grateful to all those who labored to produce these fine shows.

May I extend my warmest thanks to the officers of the Society and to all those members who have been so generous with help and advice during the past biennium.

LUCITA H. WAIT

REPORT OF THE TREASURER

FOR THE YEAR ENDED APRIL 17, 1960

In the statement of Receipts and Disbursements shown below, no account has been taken of the sums advanced by members, totaling \$429, in payment of reservations for the bus trip, box lunches and buffet dinner planned for the Biennial Meeting of April 23-24, 1960. These funds, plus a further amount paid in cash at the time of the meeting, were applied to the purpose intended and did not constitute real income to the Society.

The item "Other receipts" is largely made up of sums received for subscriptions to *PRINCIPES* by libraries and institutions, and sums from sales of reprints from *PRINCIPES* and back numbers of it.

The item "Miscellaneous," under Disbursements, is principally made up of mimeographing expense and of petty cash accounts.

Balance April 16, 1959		\$1,117.87	
Receipts:			
Contributions	\$3,805.19		
Other receipts	921.34	4,726.53	\$5,844.40
Disbursements:			
Printing	2,873.22		
Postage	130.00		
Secretary's salary	1,335.37		
Social security	208.06		
Miscellaneous	428.76		4,975.41
		Balance	\$ 868.99

The excess shown above of Receipts over Disbursements, or the Balance of

\$868.99, would seem to indicate that the Society is operating with a margin of safety. Because of accruals, however, this appearance is more than a little deceptive. Estimated expenses for the following month of May are \$740, of which \$571 represents the publication cost of April PRINCIPES. Thus, if the Society were to receive little or no income within the five weeks following the end of its fiscal year, the bank balance would shrink to scarcely more than \$100, which would be not only unsatisfactory but would threaten solvency. Offsetting this threat to some extent is the fact that a few contributions from members are constantly being received, for as yet such income has not been concentrated within one fixed payment-period.

Because this Society belongs to its members, it is imperative to lay the plain facts before them, and not to overlook that, financially, the Society has been treading on very thin ice at the end of each quarter. To date we have always managed to squeeze by, but prudence suggests that remedies should be planned against recurring tight squeezes. The Society should have at all times a cash surplus of at least \$1,000, for otherwise its financial status will again become critical every three months when a substantial bill for printing its quarterly journal must be paid.

I should like to recommend that all possible sources of additional income be investigated. Certain foundations and industries might be willing to aid the very important work carried on by this Society, now everywhere acknowledged and accredited. I would also recommend the fixing of a definite due date for all contributions. No doubt the Finance Committee would welcome any further suggestions for betterment.

JOHN E. TURNER

REPORT OF THE BIENNIAL MEETING

APRIL 23-24, 1960

A fine group of members, their wives, husbands and friends gathered at Fairchild Tropical Garden, Miami, Fla., on the afternoon of April 23rd, 1960. After registering and receiving their name badges which had been beautifully lettered by Walter J. Murray, they were made welcome by the hospitality committee, Mr. and Mrs. A. C. Hartson and Mrs. Richard Hoeller. There was time, before the meeting began, for them to look at a fine display of some less well-known palms, lent by Bob Wilson, Nat De Leon, T. R. Baumgartner, Alix and others, and arranged by John Turner. A number of palm photographs also were on view.

At three o'clock the business meeting was called to order by the President.

Nixon Smiley, Director of Fairchild Tropical Garden, welcomed the Society, and spoke briefly about the palm collection at the Garden. He said that about thirty new species of palm seeds are received and planted each year. Not all that germinate survive our climate, but others do; these are finally planted out on the grounds, and surplus plants are distributed to members of the Garden. There are many bearing palms at the Garden, now that it is more than twenty years old. Mr. Gerard Pitt, a volunteer worker, collects the seeds, does the tedious work of cleaning off the pulp, and prepares them for shipment to many parts of the world. A good many of the seeds sent to members of the Society through the Seed Bank come from this source.

The officers presented their reports, which are printed in full in this issue of PRINCIPES.

The nominating committee was asked to present its slate of officers for the coming biennium: President, Eugene D. Kitzke, Racine, Wis.; Vice President, David Barry, Jr., Los Angeles, Calif.; Secretary, Lucita H. Wait, Miami, Fla.; Treasurer, Walter J. Murray, Miami, Fla. There being no nominations from the floor, the slate was unanimously elected. The incumbent directors were re-elected, with the addition of Mrs. David Fairchild and Eugene D. Kitzke.

Dr. Hodge read greetings from Harold E. Moore, Jr., editor of *PRINCIPES*, who was out of the country and unable to attend. He then told about the new plans to publish the Handbook of Palms in January, 1961, and showed the audience a copy of J. C. McCurrach's book, "Palms of the World," just off the presses of Harper & Brothers. A review of this book will be found in this issue of *PRINCIPES*.

After a short intermission, Eugene D. Kitzke, newly elected president of the Society, gave an illustrated talk on *Copernicia cerifera*, the carnaúba wax palm, showing the trees growing wild and also in plantations in northeastern Brasil, methods of obtaining the wax, and hybridization with a view to increasing the yield of wax. He also showed slides of some other species and hybrids of *Copernicia*, principally in Cuba, which is rich in this genus.

Due to showers, it was impossible for us to have our picnic at the Jennings estate as planned, so volunteers were called upon to help set up tables and chairs in the auditorium, which they did cheerfully and efficiently, and we had our buffet supper right there.

After the room was set back to rights we settled down to hear Leonard J. Brass, botanist of the Archbold New Guinea Expeditions, speak briefly about his trips to New Guinea and show slides

of that spectacular island. We also looked at some slides of the palm garden at the Miami flower show and of the tallest washingtonias at the Los Angeles State and County Arboretum, Arcadia, Calif. In contrast to the tallest palms, Robert G. Wilson showed us a mature living chamaedorea less than twenty-four inches high.

The main event of the evening was an account of some of the highlights of Dr. Hodge's recent trips to Australia, Indonesia and Ceylon. We had the pleasure of seeing great fields of Australian wildflowers, spectacular views and unusual tropical plants, as well as some magnificent palms.

* * *

On Sunday we had bad luck again. It rained, and our two bus-loads of palm tourists were forced to spend most of the day inside the buses, instead of walking through the promised palm collections. The first place visited was the Frank R. May home, where the cordial reception and gorgeous palms helped to offset the rain dripping down our necks. A refreshing glass of punch helped, too.

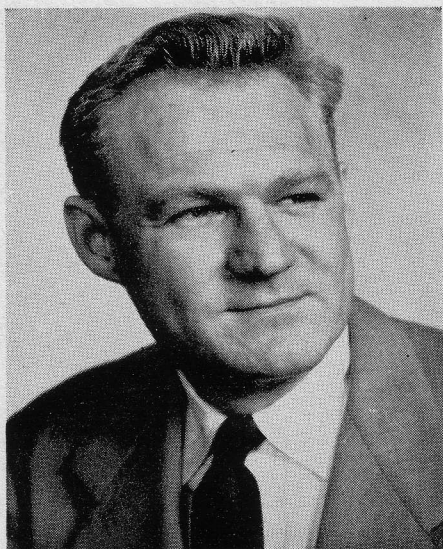
Box lunches were served on the loggia at Fairchild Garden, then we entered the buses again and wandered slowly through the Jennings estate and the U. S. Plant Introduction Station, peering out windows at what could be seen from the roads. It was most disappointing, especially to those who had planned the excursion, but the good sportsmanship of that exceptionally fine group of people, and their cheerfulness through it all, warmed the hearts of their hosts. After all, getting to know each other and sharing our palm enthusiasms was the best part of the whole affair.

LUCITA HARDIE WAIT,
Executive Secretary

THE NEW OFFICERS

E. D. KITZKE *President*

Mr. Kitzke was graduated from Marquette University with a B. S. and M. S. in Botany. Major emphasis in the fields of genetics and mycology. Additional graduate work at the University of Wisconsin in ecology.



His present post at S. C. Johnson & Son, Inc. is in the Basic Research Department as head of the Biology Section. He has devoted the past ten years to field investigations in Brazil, Cuba, Paraguay, Trinidad, Florida, and, very likely in the future, anywhere that copernicias or other waxy plants abound.

The Johnson Company maintains two experimental plantations of 400 and 100 acres respectively in Northeast Brazil where plantation methods of growing *Copernicia cerifera* Mart., the carnauba wax palm, are studied in conjunction

with a long range breeding program. The development of an improved waxy palm by selection from the wild type and by interspecific hybridization is a major project of the Basic Research Department.

Due to the diverse research interests occurring within S. C. Johnson & Son, Inc. the Biology Section also does work, under Mr. Kitzke's direction, in the fields of Microbiology, Entomology, Agronomy and Plant Physiology.

DAVID BARRY, JR. *Vice President*

Mr. Barry was born in Houston, Texas in 1897, living in Los Angeles



since 1902. After graduation from Stanford University in 1920 he worked as a real estate developer until 1953 when he became relatively inactive in this field.

Mr. Barry's interest in palms began in 1930. His love of the tropics was so strong that, when he could not visit them, he introduced palms from the tropics as a substitute. In the days before the overseas airplane he used tins as shipping containers for palm seeds, enclosed with moisture-retaining packing. For many years he operated an "International Palm Seed Exchange Service," with his tins going back and forth from botanical gardens and collectors. When on a trip around the world in 1957 he saw mature palms from his seed in such places as Panama and Durban.

About fifteen years ago Mr. Barry's plant hobby was commercialized as California Jungle Gardens, a nursery specializing in the introduction of plants new to California. In spite of a keen interest in bromeliads, cycads, and a variety of tropical plants, his work with palms has been uninterrupted.

Mr. Barry is president of The Bromeliad Society, and vice-president of American Plant Life Society.

WALTER J. MURRAY

Treasurer

Mr. Murray was born in Phoenixville,

Pennsylvania, and educated at Baltimore Polytechnic Institute and Johns Hopkins University. He is a registered



professional engineer, and bridge engineer for Maurice Connell and Associates, consulting engineers. He is married to the former Evelyn Alexander of Waynesboro, Pennsylvania. They have lived in Miami, Florida, since 1951. His hobbies are gardening, photography and travel.

Perpetuating Palms in Hawaii

At the largest grove of coconut palms in the State of Hawaii, they're perpetuating the custom started long ago by Kamehameha, Hawaii's first King.

When an old palm tree nears the end of its life span—75 to 100 years—a young palm is planted alongside, by a Hawaiian dignitary.

The ceremony is held at dusk. A torchlight procession leads to the grove, songs are sung and prayers are offered. A drum beats slowly in the background.

A native boy scrambles halfway up the trunk of the dying tree and when the last spadeful of earth is tamped around the roots of the baby palm, he gently drops an orchid lei down upon the fronds of the young tree.

Thus is baptized the new generation to replace the old.

Reprinted with permission from "Travelin' Light" by Morton Cathro in the Oakland Tribune [California], March 13, 1960.

Diseases Of The Coconut Palm*

M. K. CORBETT

*Plant Pathology Department, University of Florida cooperating with
the State Plant Board of Florida, Gainesville, Florida*

VII. — MINOR DISEASES

This seventh and last article on the diseases of the coconut palm will include those which at present are not considered to be of major importance. They include: wilt (root) disease, root diseases, bitten leaf, St. Mary disease, leaf spots, smut disease, *Exosporium* leaf spot, sooty mold, coconut thread blight, yellowing, drought wilt, pencil point, stem bleeding, and the phenomenon of lightning strike. Any of these diseases, upon further research, may be shown to be of major importance. The main reason why they are now classified as minor diseases is that so little is known about their cause and effect that it is impossible to determine their importance. It was thought desirable to include them in this series so that the reader may have a complete story and a fuller appreciation of the diseases of the coconut palm. Unfortunately, it has not been possible to secure illustrations of the various diseases; and most of the information contained in this article was obtained from the available literature.

The Wilt (Root) Disease of Coconut Palms in Travancore-Cochin

This disease is considered to cause serious damage to the coconut planta-

tions in Travancore-Cochin, India (11, 14). It has been estimated that nearly one fourth of the total area under coconuts in the state of Travancore-Cochin is affected by this disease (14).

The diagnostic symptom of the disease is a flaccidity and ribbing of the leaflets on the outer whorl of leaves, which exhibits wilting, drooping, and an abnormal curvature or bending of the rachis. The vigor of the affected palm is greatly reduced and in advanced stages of the disease the production of fruit is greatly affected, even to the extent of being completely inhibited. In addition to these symptoms, the palms may exhibit yellowing of the fronds and a premature dropping of the fruit (13). Some affected trees may exhibit necrosis of the young leaves (14), which become greyish-black (necrotic) from the tip downward and have a tendency to curl. The necrotic symptoms when observed are associated invariably with the wilt disease (13). Three to fifteen years may elapse from the first manifestation of symptoms until the palm becomes barren. Root decay appears to be closely associated with the disease. As the disease progresses, the number of decayed roots increases and the production of new ones is inhibited (14).

Nagaraj and Menon (13) obtained seven isolates of three species of fungi, *Rhizoctonia solani* Kuehn, *R. bataticola* (Taub.) Butl., and *Botryodiplodia theo-*

*For previous articles in this series, see PRINCIPES 3:5-12; 49-52; 83-86; 117-120. 4:6-9; 40-44.

Florida Agricultural Experiment Station Journal Series, No. 850.

bromae Pat., from coconut roots or soil. They attempted inoculation of coconut root tips in artificial media and found that only *Rhizoctonia solani* could parasitize the root tip, thus causing cessation of growth and brown rot of the internal tissues. They could not find any definite correlation between the amount of root decay and the external symptoms of wilt. Some of the plants they designated as healthy controls had decay of the horizontal roots for a depth of three feet. These trees apparently were maintaining what appeared to be a normal healthy condition on their vertical roots alone. Since some palms in the early stages of wilt had no root decay, the authors suggested the name "wilt" as an appropriate term for the disease. They suggested that root decay in the case of the wilt disease is probably of secondary importance (13).

In view of the infectious nature of the disease, lack of visible pathogen (13), failure to detect any nutritional deficiency (19), and similarity to lethal yellowing (unknown disease) in Jamaica (15) and the yellow mottle decline (*cadang-cadang*) disease in the Philippines (8, 17), Nagaraj and Menon suggest that a virus may be the cause of the wilt disease of coconut palms in Travancore-Cochin (14).

These same authors working under field conditions have reported successful transmission of the virus by either mechanical inoculation using Carborundum, or by the banana lace-wing bug (*Stephanitis typicus*) and subsequent symptom manifestation within eight to twelve months from the date of inoculation (14). Other attempted methods of transmission were unsuccessful, including the sap-transfusion method of Nagaraj et al. (12). This disease, in all

probability, should be classed under the group considered in this series as major diseases of coconut palms.

Root Diseases

Besides the root (wilt) disease there are other reports of root decay causing or associated with diseases of the coconut palm. Butler in 1906 (6) recorded *Ganoderma lucidum* (Leysser) Karsten as causing a root disease of coconut palms in India. Since then it has been reported from several countries (4). The symptoms of the diseases are varied, but usually are noted as a withering and dropping of the older fronds. The young fronds may remain green for some time, but the new fronds are successively smaller and yellowish. Flowering dwindles and the palm soon becomes barren. The disease may take three or more years to kill the palm (4).

The fungus *G. lucidum* occurs on many hosts throughout the temperate and tropical regions. The fruiting body of the fungus is described as follows by Britton-Jones, 1940: "The fruit body is bracket-shaped and is stalked. Its size varies from less than one to more than twenty inches in diameter. The thickness of the fruit body likewise varies up to five inches. The stalk measures upwards to four inches in length by about half an inch in thickness; it is cylindric in shape, erect, and brown to black in color. The upper surface of the bracket is shiny, light to dark brown or almost black, and concentrically furrowed. The shiny surface of the cap and stalk is most characteristic and suggests Japanese lacquer. The margin is generally white and so is the whole of the under surface. Examined closely with the naked eye or lens, numerous minute holes or pits will be seen all over the under surface. It is in these tiny pores

that the fungus produces its spores, which when released are disseminated by the wind" (4).

Besides the root diseases caused by the fungus *Ganoderma*, species of the fungus *Fomes* have been implicated by several investigators as causing diseases of the coconut palm (4).

Control of root diseases may be obtained by the removal and destruction of the diseased palm as soon as it becomes evident that it is infected with either *Ganoderma* or *Fomes*. To prevent spread, it is recommended by Briton-Jones (4) that a trench two feet deep be dug around the infected tree and left open for at least a year. The advisability of such a trench in Florida, especially in urban areas, would be doubtful. It is the opinion of Briton-Jones (4) and Dwyer (7) that root rotting diseases are not likely to be serious where vigor and health of the palms are maintained.

Bitten Leaf

The term "bitten leaf" is used when the young leaves of a palm are deformed upon emergence from the heart. The new leaves often assume various shapes, depending upon the extent of damage to the young pinnae and rachis. These deformities have been attributed to infection by several different organisms (2, 10).

Briton-Jones (4) considers bitten leaf to be a stage of recovery resulting from infection by the fungus *Phytophthora palmivora*, with the severity of the disease depending upon the extent of damage to the heart or bud tissues. Ashby (2) describes two types of bitten leaf diseases in Jamaica: the "hard type" which he associates with a species of yeast; and the "pineapple leaf bitten disease" which he attributes to infection by

the fungus *Thielaviopsis (Ceratostomella) paradoxa* (De Seyn.) Hoehn. Martyn (10) reports reproducing the symptoms of bitten leaf disease by mechanical injury to the heart tissues. He has also isolated *T. paradoxa* from lesions on bitten leaves, but he considers the fungus to be purely a secondary organism. Martyn agrees with Briton-Jones on his interpretation of bitten leaf disease, but considers that the disease may be aggravated by the feeding of beetles or other insects.

Since the symptoms may actually be the result of some predispositional factor such as mechanical injury or insect feeding and/or infection by *Phytophthora palmivora*, it is often difficult to determine the factor or factors responsible for the bitten leaf condition.

St. Mary Disease

The disease owes its name to St. Mary Parish in Jamaica where it has attracted considerable attention at various times. The disease is not necessarily confined to that area but has occurred elsewhere under the names of "leaf disease," "wet weather disease," or "leaf stalk rot." According to Martyn (10), the most conspicuous form of the disease consists of a withering of the leaves. Sometimes only the tip of the frond is affected, which dries out and breaks over. In some cases the entire leaflets turn greyish-brown, but the frond does not collapse. Palms that are constantly subjected to the disease frequently shed their fruit. Sometimes the pinnae in the middle of a frond will wither and drop off, leaving a portion of the midrib bare. Martyn has isolated several species of fungi from brown spots on the leaves, but has never been able to reproduce the disease with them. He suggests that, during stages of vigorous growth, the midrib is very susceptible

to fungus infection or insect feeding, which may cause an injury of considerable extent. It is assumed that the breakdown of the tissue in the petiole could also be attributed to lack of proper nutrients during this period of rapid growth (10).

Ashby (3) isolated the fungus *Phytophthora parasitica* Dastur from palms exhibiting dark brown sunken lesions on the leaf stalks or midribs. The rot often extends through the midrib causing the frond to break at this point. He could not control the disease with Bordeaux mixture or paste, but did achieve fair control by firing or burning. Briton-Jones (4) suggests that probably the firing treatment would cause as much damage as the disease.

The St. Mary disease is not fatal and outbreaks resulting from wet weather right themselves as the weather changes. Martyn suggests that, when the disease is chronic, if cultural practices do not lessen the effects considerably, then it is inadvisable to cultivate coconuts (10).

Leaf Spots

A number of fungi have been associated with leaf spots of coconut palms. Briton-Jones (4) reports that the fungi isolated are only weak parasites at most and are actually not the cause of any specific disease. Briton-Jones (4) and Martyn (10) associate the occurrence of these fungi with some physiological predispositional factors, insect damage, or any condition that weakens the palm to such an extent that these weak or facultative parasites may become established. The fungi *Pestalotia* (*Pestalotzia*) *palmarum* Cke. and species of *Diplodia* have been isolated from spots on coconut palm leaves (4, 10). Ashby (1) has recorded these two fungi and also

species of *Sphaerella*, *Cytospora*, and *Phyllosticta* in association with various leaf spots on unthrifty trees.

The damage caused by *Diplodia* has been termed "die-back" and the disease associated with *Pestalotia palmarum* has been termed "leaf blight," according to Briton-Jones (4) and Martyn (10). *P. palmarum* occurs only in spots on leaves that have taken on a premature yellowing due to other causes. The individual leaflets exhibit yellowish-brown or grey spots (10). Sometimes the tips or margins of the leaves are dead and it is possible to isolate both *P. palmarum* and *Diplodia* species from these areas (4). If the condition that weakens the palm develops quickly, only *Diplodia* species may be isolated; but if it develops gradually, then *P. palmarum* may be isolated. Briton-Jones reports cases in Trinidad where leaves have wilted and fallen from the tree so quickly that *Diplodia* has not started to grow on them. *Diplodia* species are often isolated from the older senescent fronds on the healthiest and heaviest bearing palms.

Briton-Jones (4) and Martyn (10) consider that these fungi, from a practical point of view, cause no damage, so no direct action need be taken against them. If coconut palms are maintained in a healthy condition, then these fungi will only perform their natural functions—the decay of already weakened tissues.

Smut Disease

This is an unimportant disease caused by the fungus *Graphiola cocotis* (*G. cocoina* Pat.). The main symptom of the disease is small raised black pustules surrounded by a pale yellow ring on the upper surface of the coconut leaf (4). According to Briton-Jones, the disease has been reported by Simmonds from Fiji.

Exosporium Leaf Spot

The disease caused by the fungus *Exosporium durum* Sacc. was reported by Reinking (18) from the Philippines as being responsible for scattered or densely crowded wartlike fructifications on the leaves of coconut palms. It is not common and is reported to cause little damage.

Sooty Mold

Sooty mold is characterized by a black, sooty appearance on the coconut leaves produced by the fungus *Capnodium footii* Berk. & Desm., which grows on the honeydew of coccids. Reinking (18) reports its occurrence in the Philippines but does not consider it serious.

Coconut Thread Blight

Coconut thread blight was first described by Bryce (5) in 1924 from New Guinea and was attributed to the fungus *Corticium penicillatum* Petch. It has been redescribed by Dwyer (7) from New Guinea. One case of a similar thread blight disease caused by an unidentified fungus was reported from Trinidad (4).

The mycelium of the fungus grows along the under surface of the midrib (rachis) in the form of thread-like strands. The fungus remains superficial but may kill large areas of the leaflets (4). The older or bottom fronds are attacked and sometimes as much as one third of the crown may be involved. Bryce recommended cutting and burning infected fronds, with a supplemental spray application of Bordeaux mixture. Briton-Jones (4) does not believe that such treatments would control thread blight because of the impossibility of removing all the diseased tissue and the difficulty of spraying the under surface of coconut fronds. Since the disease occurs mostly under conditions of high

humidity and moisture, Briton-Jones suggests the possibility of planting palms further apart to reduce the moisture-retaining capacity of the foliage. He also mentions the financial aspect of such an operation and suggests that it may be better to have a diseased crop under low cost production than a healthy crop under high costs.

Yellowing

Martyn (10) describes two types of yellowing: a) yellowing due to lack of drainage and b) nutritional yellowing. Yellowing of coconut leaves may be due either to a loss or disorganization of the chlorophyll or chloroplasts, or to a partial failure of the green color in the chlorophyllous tissues. Palms on poorly drained soils may yellow to the extent that the central column is affected. The degree of yellowing caused by poor drainage may fluctuate with changes in the water level and is seldom fatal, as palms have grown for years under waterlogged conditions.

Coconut palms exhibiting yellowing due to lack of proper nutrition vary with soil types. They may show a true chlorosis due to the lack of iron caused by an excess of lime in the soil, or they may exhibit a pale yellow during the dry season. A third type of yellowing distinguished by Martyn (10) occurs in palms on good soil in areas of ample rainfall. This is the type of yellowing which occurs in palms affected with the unknown disease or bronze leaf wilt disease. The yellowing in this case is quite intense and usually the whole crown is affected.

Nagaraj and Menon (13) report two types of yellowing in coconut palms in Travancore-Cochin. In one case the yellowing of the outer leaves is associated with shedding of the fruit. They de-

scribe the symptoms of the disease as a yellowing of the tips of the outer whorl of leaves and a premature shedding of young fruit. The inflorescences become discolored and the palms do not necessarily exhibit symptoms of wilt. They have noticed that healthy bearing palms have developed such symptoms and that the disease appears to be infectious. From this brief description the disease sounds very similar to the lethal yellowing (unknown disease) or the bronze leaf wilt disease, but they do not consider the condition serious (13).

The second type of yellowing Nagaraj and Menon class as a general chlorosis that persists throughout the year. They report that palms that have exhibited this general chlorosis over a period of years produce very few nuts.

Drought Wilt

Dwyer (7) used the term "drought wilt" for the condition of wilting in coconut palms due to lack of water. The condition may result in the death of the palm, depending upon the length of time it is without water. Martyn (10) reported similar cases of wilt in Jamaica due to the lack of water. Palms grown on sandy soil without water may start to wither and die. Yellowing of the fronds does not necessarily accompany the condition, and a general shedding of the nuts does not occur. The lower fronds dry up and collapse but the heart leaves remain green for a period of months. Palms in the advanced stages of wilt do not exhibit decay of the heart or bud tissues. Mature nuts from affected trees appear to be dried up and the endosperm is abnormal in color (10). The young inflorescences dry up and are often discolored.

A similar wilt condition has been described from Ceylon (16) and Trinidad

(10). Affected palms may recover with application of water.

Pencil Point

Briton-Jones (4) describes the disease under the term "tapering stem wilt." Martyn (10) considers the term "wilt" misleading and prefers "pencil point." The disease has been known for some time in the Caribbean islands, and similar symptoms have been reported associated with different diseases throughout the world. Several species of fungi have been isolated from trees exhibiting tapering stem, but Briton-Jones does not consider them to be responsible for the condition.

The main symptom of the disease is, as the name implies, a tapering of the stem below the crown. The trunk may dwindle down until it is only a few inches in diameter. The fronds are reduced both in number and size until the crown fails to produce new leaves and death of the palm results. Although palms in the advanced stages of tapering will not respond to nutritional treatments, they will not necessarily die for a period of years (10).

No organism has been found that will produce the disease, and the physiological or environmental factors that cause it are not always clear (4, 10). The exact explanation of why some palms exhibit symptoms of pencil point and others in the same vicinity remain healthy is not understood (10). The symptoms appear frequently with senility of coconut palms. Drought, nutritional imbalance, starvation caused by the loss of soil due to erosion, and poor drainage have been suggested as some of the conditions that will cause pencil point or tapering stem wilt disease (4, 10). Nagaraj and Menon (13) have reported the disease to occur in Travan-

core-Cochin, India. They have never noticed any cases of a vigorous, healthy young palm developing symptoms of tapering stem.

In the cases where the tapering stem symptom occurs with other diseases such as yellow mottle decline (*cadang-cadang*) the condition could possibly result from starvation or nutritional imbalance brought about as a secondary effect of the disease upon the vascular system of the palm.

Stem Bleeding

The stem bleeding disease is usually the result of a previous injury to the trunk of the palm (4, 10). The fungus *Thielaviopsis (Ceratostomella) paradoxa* obtains entry through the wound and causes an internal rot of the stem tissue (14). The presence of the disease is indicated by a reddish-brown liquid that oozes out through cracks in the stem, then may trickle down the stem for a distance of a few feet, and dry up and turn black (4). The internal tissues of the trunk below the original point of entry may be rotted or yellow in color. Infection may occur anywhere in the trunk where there is an injury. Young palms may be killed by the disease since the entire trunk is of soft tissue and very susceptible to the decaying and rotting action of the fungus (4).

Most of the wounds are caused by carelessness of workers, especially with machetes, in coconut plantations. If care is practiced not to wound the trunk of the coconut palm, then the disease will be of little importance. If the disease occurs, then the diseased portion should be excised and the exposed area treated with a fungicide or wood preservative (10).

Lightning Strike

Lightning strike is not a contagious disease but does take its annual toll of coconut palms. The phenomenon is not too serious in the Caribbean area, but is of considerable importance in Malaya where electrical storms are frequent and violent (9). Palms that are struck exhibit symptoms of a collapse of the crown, splitting of the stem, and exudations from the stem (4, 9). The stem is very soon attacked by boring insects and saprophytic fungi (9). The extent of the damage and severity of the symptoms depend upon the strength of the electrical charge. Britton - Jones (4) draws attention to the fact that the weeds at the base of the palm and some of the adjoining palm fronds may be scorched by lightning, thus making diagnosis comparatively easy.

Palms killed by lightning should be removed and others planted in their places (9).

Acknowledgments

Grateful acknowledgments are made to the State Plant Board of Florida for making this study possible. The author is sincerely grateful for the assistance received in the islands of Key West, Cuba, Jamaica, Haiti, Trinidad, and St. Lucia during the period of his visit to each island.

Literature Cited

1. Ashby, S. F. 1915. Notes on Diseases of Cultivated Crops Observed in 1913-1914. *Bulletin of the Department of Agriculture, Jamaica*, ser. 2, 2 (8) : 299-311.
2. Ashby, S. F. 1917. Leaf Bitten Diseases of Coconuts. *Journal of the*

- Jamaica Agricultural Society*, 21: 269.
3. Ashby, S. F. 1921. Notes on Two Diseases of the Coconut Palm in Jamaica Caused by Fungi of the Genus *Phytophthora*. *West Indian Bulletin*, 18: 61-70.
 4. Britton-Jones, H. R. 1940. *The Diseases of the Coconut Palm*. pp. 1-176. Bailliére, Tindall and Cox, London.
 5. Bryce, G. 1924. Coconut Thread Blight (*Corticium penicillatum* Petch). *Territory of New Guinea, Department of Agriculture Leaflet* 5: 1-2.
 6. Butler, E. J. 1908. Report on Coconut Palm Disease in Travancore. *Agricultural Research Institute, Pusa, Bulletin* 9: 1-23.
 7. Dwyer, R. E. P. 1937. The Diseases of Coconuts (*Cocos nucifera*) in New Guinea. *New Guinea Agricultural Gazette* 3(1): 28-93.
 8. Kent, G. C. 1953. Cadang-Cadang of Coconut. *Philippine Agriculturist* 37: 228-240.
 9. Martyn, E. B. 1945. Coconut Diseases in Jamaica (I). "Bronze Leaf Wilt" and Other Diseases Affecting the Bud of Coconuts. *Tropical Agriculture* 22: 51-59.
 10. Martyn, E. B. 1945. Coconut Diseases in Jamaica (II). Diseases Affecting the Leaves, Crown and Stem of Coconuts. *Tropical Agriculture* 22: 69-76.
 11. Martyn, E. B. 1955. Diseases of Coconuts. *Tropical Agriculture* 32: 162-169.
 12. Nagaraj, A. N., Davis, T. A., and K. P. V. Menon. 1954. Sap Transfusion, a New Devise for Virus Transmission Trials in Palms. *Indian Coconut Journal* 7: 91-98.
 13. Nagaraj, A. N. and K. P. V. Menon. 1955. Observations on Root Decay in Coconuts, its Cause and its Relation to the Foliar Symptoms of Disease in the Disease Belt of Travancore-Cochin. *Indian Coconut Journal* 8: 97-105.
 14. Nagaraj, A. N. and K. P. V. Menon. 1956. Note on the Etiology of the Wilt (Root) Disease of Coconut Palms in Travancore-Cochin. *Indian Coconut Journal* 9: 161-165.
 15. Nutman, F. J. and F. M. Roberts. 1955. Lethal Yellowing: The "Unknown Disease" of Coconut Palms in Jamaica. *Empire Journal of Experimental Agriculture* 23: 257-267.
 16. Park, W. 1932. The effects of Drought on Coconuts at Puttalam. *Tropical Agriculturist* 78: 11.
 17. Price, W. C. 1958. Report to the Government of the Philippines on the Yellow Mottle Decline (Cadang-Cadang) of Coconut. *F. A. O. Report No. 850*. pp. 1-57.
 18. Reinking, O. 1919. Philippine Plant Diseases. *Phytopathology* 9: 114-140.
 19. Sankarasubramony, H., Pandalai, K. M., and K. P. V. Menon. 1952. On the Nutritive Contents of the Leaf Tissues of the Coconut Palm in Health and in Disease. *Indian Coconut Journal* 6: 7-18.

Bermuda's Palmetto

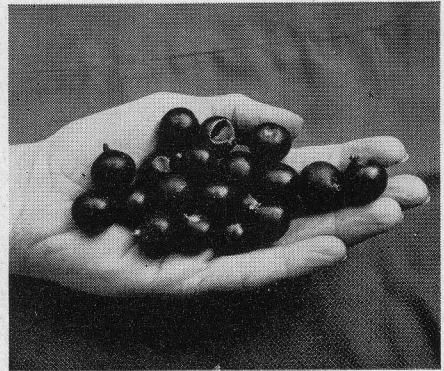
W. H. HODGE

Visitors to Bermuda, especially those also familiar with our South, may spot in the island's lovely gardens or along her charming roadsides a tree that may pass as the common cabbage palmetto (*Sabal Palmetto*) of the Carolinas, Georgia or Florida. Though resembling the continental species, the Bermuda palmetto (*Sabal bermudana*) is endemic—not known anywhere else except on this tiny oceanic isle.

It may come as a surprise to some that an island as small and as isolated as Bermuda can boast of a native palm of its own. For many years this fact was not so recognized and the species was believed to be just a form of *Sabal Palmetto*. Being a palmetto it is related and, in the distant past, under circumstances probably never to be known, palmetto seed must have been carried to Bermuda somehow from either the American continent or the West Indian islands to the south. Centuries of isolation on Bermuda have resulted in the evolution of a race of palmettos now sufficiently distinct to warrant a specific name of its own.

The average person would probably have to see *Sabal bermudana* and *Sabal Palmetto* growing together in a garden to be able to spot differences between them. One distinctive feature is fruit size. Our cabbage palmetto produces spherical fruits measuring $\frac{1}{4}$ to $\frac{1}{2}$ an inch (7-12 mm.) in diameter, whereas the Bermuda palmetto has much larger fruits, normally twice this diameter (15-20 mm.), and these are not strictly

spherical but slightly pyriform or pear-shaped. Another characteristic that is



39. "There is a Palmetoe-tree which hath a very sweete berrie"—the black cherry-sized fruits of *Sabal bermudana*.

readily seen and has been pointed out by others is a noticeable yellow spot surrounding the upper end of the leaf stalk (petiole). Whether this vegetative characteristic is unique among palmettos is unknown to me.

Bermuda's palmetto has justly been called the most interesting of the island's native plants. It has also been termed the most conspicuous tree after the endemic cedar (*Juniperus bermudana*). Unfortunately the last decade has seen the inadvertent introduction of scale insects whose depredations have all but destroyed the cedars with the result that *Sabal bermudana* will soon in fact be Bermuda's most conspicuous native living tree. One might add "for a time," for the palmetto is threatened by man himself.



40. Paget Marsh, Bermuda—home of the finest stand of Bermuda palmettos seen in the foreground.

The earliest Bermuda chroniclers indicated an abundance of palmettos which in those days were to be found everywhere throughout the islands on windswept as well as sheltered sites. This is a far cry from the status today of these palms which are gradually but surely disappearing as a result of the expanding population of the island. They may occasionally be seen along the roadsides or preserved in private gardens. The finest groves of these palmettos are making their last stand in the isolation of certain of the inland marshes. But even here their days are probably numbered, for unless such areas are acquired by the local government and set aside in perpetuity as natural preserves they will in time be

drained, filled and sold for building sites. The one consolation is that on an island famous for its gardens there ought to be ample space to conserve this interesting palm species at least as a garden subject. It remains only for all Bermudians who are garden-conscious to encourage the preservation of these trees especially when they are to be found growing within their properties. Such a program might also be a fitting civic objective for the island's outstanding Garden Club.

Probably the finest palmetto stand extant in Bermuda today is the one in Paget Marsh near Hamilton. This stand has been known for some years to visiting botanists. In 1932 Liberty Hyde

Bailey described this as "a noted stand." I had the pleasure of being introduced to the palmettos of Paget Marsh in February of 1959 by a long-time friend, now resident in Bermuda. Surrounded by home-studded hills, this marsh is a 25 to 30 acre refuge of wild, untrammelled Bermuda vegetation. Once within its confines, the visitor feels quite remote from the familiar tourist world of Bermuda and once again in touch with the primitive Bermuda of several centuries ago. Even from the roads which ring this natural enclave one can see the abundance of the now dominant palmettos which, at the time of my visit, were overtopped only by diseased or dying junipers. The marsh area was probably once occupied by a sizeable body of water. Over the centuries this has been gradually filling in, in classic fashion, by action of aggressive marginal vegetation, until now the sole remnant is a tiny mangrove-ringed pond hidden to all but airborne eyes.

Paget Marsh hardly reminds one of more common Bermuda habitats where the underlying limestone produces soils which are usually shallow and typically alkaline. Though surrounded by typical low limestone hills, the marsh is an oasis of deep, organic material having that decidedly un-Bermudian soil characteristic of acidity with a range in pH of 4.5 to 5. Palmettos which thrive here share the marsh with a strange mixture of temperate and tropical species. In lower areas one finds bayberry (*Myrica cerifera*) and dogbush (*Baccharis glomeruliflora*), along with the common red mangrove (*Rhizophora mangle*) and white stopper (*Eugenia axillaris*). *Ardisia humilis*, *Pittosporum undulatum* and Carolina laurel cherry (*Laurocerasus carolinianum*) — all woody species, are apparently natural-

ized. Wet open sites are colonized by the giant marsh fern (*Acrostichum excelsum*) while the prickly sedge (*Mariscus jamaicense*) forms large swales in some areas. In the thickets poison ivy (*Rhus radicans*) and woodbine (*Parthenocissus*) are occasional climbers with cinnamon³ and royal ferns (*Osmunda*) common on the shaded marsh floor. Besides the native Bermuda palmetto and cedar, Paget Marsh is also the home of at least two other much rarer local endemic plants, the Bermuda maidenhair fern (*Adiantum bellum*) and Bermuda sedge (*Carex bermudiana*).

Under the generous conditions of soil, moisture and the important protection from wind that exist in Paget Marsh, the Bermuda palmetto grows as well as its cabbage palmetto confrere in a southern Florida "hammock," forming rather sizeable colonies and attaining a girth, height and luxuriousness of foliage probably not met with elsewhere at present under drier Bermuda conditions. The tallest palm observed in Paget Marsh was about 35 feet tall, considerably less than a specimen of 53 feet reported in nearby Pembroke Marsh. Most trees in Paget Marsh run 15 to 25 feet tall with an average diameter of 10 inches. The stout trunks with their rings of old leaf scars are seldom perfectly erect but rather grow at various odd angles and are reminiscent in this habit of the more familiar coconut palm. Occasional trunks show the peculiar constriction of the stem characteristic of this species. This was described some 50 years ago by Harshberger (1) and related by him to alternating periods of good and poor growth.

Paget Marsh palmettos are somewhat protected from the full force of the strong gales which constantly sweep



41. Seedling palmettos in Paget Marsh.

Bermuda, especially during mid-winter. Due to this wind protection the old drier leaves of the marsh trees hang from their crowns for a considerable period before falling to form a tawny mat of old leaves on the marsh floor. Elsewhere

on the island, where growing sites are without protection, the older leaves fail to linger.

Fruiting is apparently heavy in this species, the black, cherry-sized berries ripening towards the end of the year.

Quantities of fruit are still maturing as late as mid-February. The pulp surrounding the brown discoid seed is ample and it is easy to understand why the early colonists appreciated this as an emergency food, for it has a pleasant, almost date-like flavor. Under favorable conditions seed germination is abundant and in Paget Marsh, at least, seedling palmettos are common under shelter of the groves. Like most palmettos the Bermuda species is very slow growing though more rapid during the first decades than in subsequent years. After the first half century, growth tends to be very slow and certain mature specimens in well-known gardens are said to have added no appreciable height during the past fifty years.

Although the Bermuda palmetto has been associated with man ever since he first set eyes upon the island in the early 16th century, its exact identity and relationships with other palmettos were not appreciated until 1934 when Bailey (2) published the name, *Sabal bermudana*. Prior to this the palm had been passing under the binomial, *Sabal Blackburniana* Glazebrook, a name based upon a palm of apparent unknown nativity cultivated in England in the early 1800's. This plant was described in 1829 (in the *London Gardener's Magazine*) but interpreted by Hemsley (in 1885) as being of Bermuda origin. Bailey demonstrated that the native palmetto of Bermuda differs in several important characteristics from the plant originally described in Britain, thus suggesting that *Sabal Blackburniana* was probably not of Bermudian ancestry. Nor does it appear that *Sabal bermudana* has been grown widely in living palm collections elsewhere. A quantity of fresh seed collected by me

in Paget Marsh in 1959 and subsequently sent to the Fairchild Tropical Garden at Miami evoked the following comment. "Oddly enough we do not have it [*Sabal bermudana*] represented here in the Garden unless it is represented among the many *Sabal* species transplanted here from the Montgomery Palmetum years ago."

Bermuda's palmetto has probably had a longer historical association with Europeans than any other North American palm. It would seem that all of the early visitors mention this palm. Excerpts from some of these early accounts are to be found in a delightful book by Louisa Hutchings Smith (3). First to land on the island was a Spanish Captain, Diego Ramirez, who wrote, "All the islands . . . are covered with cedar forests, crested palms. . . ." Henry May, first English visitor, was wrecked and marooned for five months on the island in 1593. He found the native palmettos to be one of the most useful native plants and wrote "the tops of the Palmeta berries was our bread, and the iuce (juice) we got out of the trees we cut down, our drink, and of the leaves . . . we covered our cabins, and made our beds." Three prime uses of the palmettos—for food, drink, and shelter—were thus discovered at a very early date.

In succeeding years settlers rediscovered these same utilitarian uses and added several others. Though the fruits first served chiefly as mast for island hogs, settlers later found them an acceptable human food. Jourdan, another chronicler, records "There is a tree called a Palmitoe-tree which hath a very sweete berrie, upon which the hogs doe most feede; but our men finding the sweetnesse of them did willingly share with the hogs for them, they being very



42. Fruit clusters of *Sabal bermudana* as they appear in February.

pleasant and wholesome. . . ." Jourdan also is the first to mention use of the tender terminal bud as cabbage. "The head of the Palmitoe-tree is very good meate either raw or sodden. It yieldeth a head which weigheth about 20 pounds,

and is farre better meate than any cabbage." Palmettos even served early Bermuda Izaak Waltons. At least, records have it that one Andrew Hilliard "Upon a Fridaye morneinge in March 1615 . . . with six able and strong-bodied men, in



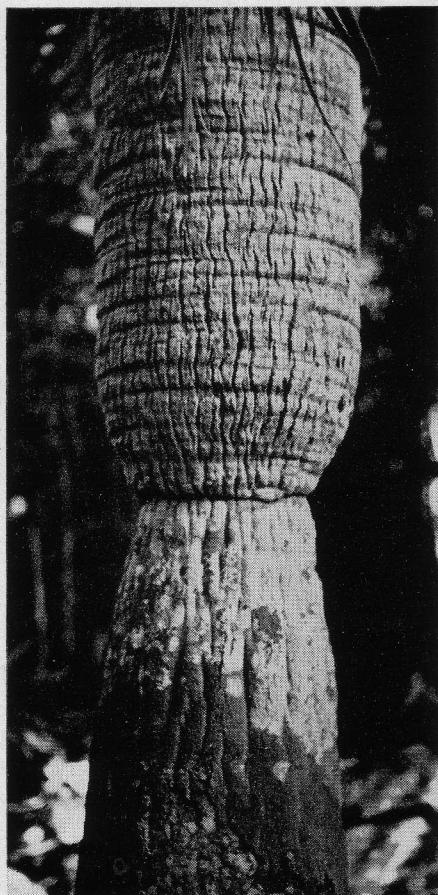
43. In the shelter of the marsh old leaves hang for some time before dropping.



44. Old native palmettos are featured in the garden at Elm Lodge, the home of Mr. and Mrs. Pierre Pattisson, Warwick West, Bermuda.

a bote of 2 or 3 tunnes, went out to sea to fish; and so eager they wer on the voiage, that neither a break-fast is made before they went, nor any other victualls carried along with them, save only a fewe palmitoe berries."

Richard More, first Bermuda governor (1612-1615), mentioned another use in a letter to London in 1612:—"I must needs mention the Palme tree once



45. Constricted bole of *Sabal bermudana*, Paget Marsh, Bermuda.

again, I have found it so good: take a hatchet and cut him, or an augur and bore him, and it yields a very pleasant

liquor much like unto your sweet wine." It was inevitable that in the absence of the vine the early Bermudians should have learned how to distill palmetto liquor, or "bibby" as they called it, into an intoxicating drink. In July, 1618, a married couple "were presented to the grand jury for suffering bibby to be too inordinately drunk in their house on the Sabbath day, as well as on all the other days of the week, so that there is swearing and such like disturbances." This was undoubtedly one reason for a Governor's order in 1627 that "No Palmetto tree should be cut for the procuring of bibby by any person whatsoever, except by special permission, because the inhabitants are deprived of the leaves for thatching their houses."

Actually one of the commonest early uses of palmetto was as a thatch and in this the fan-shaped leaves of *Sabal bermudana* proved as useful as have the leaves of other palmetto species in the New World. British Admiral Sir George Somers, survivor of the famed wreck of the "Sea Venture" on the coral reefs off Bermuda in 1609, after passing through that famous storm which an even more celebrated bard called "The Tempest," wrote: — "Palmetto cabins were easily built." William Strachey, one of his companions among the same shipwrecked Virginia colonists, admired the palmetto leaves . . . "so broad . . . a man may well defend his whole body under one of them from the greatest storme rain that falls." Governor More early made "small cabbins of palmitoe leaves for himselfe, his wife, and some few others" at St. Georges. When a church constructed of cedar blew down in a storm, another was built of palmetto leaves which "appears to have answered better."

In the century that followed, the



46. Occasional trunks show peculiar stem constrictions caused by alternating periods of good and poor growing conditions.

bleached leaves found other utilitarian uses as a plaiting material for hats, baskets, fans and similar objects. In 1725 it was reported that Bermuda palmetto hats were "the only commodity . . . exported from Bermuda to Great Britain" while a century later (1857) . . . "every mail was carrying home as presents, some portions of this fabric (palm plaiting)" to such a degree that "the supply of palmetto plants is becoming quite unequal to the demand" and "English

ladies are gradually extinguishing this tree in Bermuda."

Descendants of those same ladies may now have the chance to reverse the trend and save for posterity the last remnants of the once-abundant palmetto woodlands, if for no other purpose than to be able to see a 100 per cent Bermudian tree still live on. For certainly, with the gradual elimination of natural plant habitats by Bermuda's population ex-

plosion, *Sabal bermudana* is the only native species that has a chance to really survive in Bermuda's gardens, now that the cedar seems to be doomed.

No longer a utilitarian tree that can yield mast, thatch, cabbage or plaiting stock, the Bermuda palmetto can make its last stand as an unusual native ornamental plant. Though admittedly not a graceful tree, still most would agree that it has a sturdy character of its own that fits far better into the Bermuda scene than might many a more handsome alien palm. To be sure, it is slow growing, but then, to many, this in a tree is considered a favorable characteristic. More than anything else *Sabal bermudana* is a product of Bermuda. The palm has demonstrated that it can thrive on any soil that the island can offer. And in February when gales take over, whipping everything green that grows with a dessicating incessancy and

at the same time carrying destructive salt spray across the whole island, the Bermuda palmettos, never having known anything different, merely shrug their boles, rattle their leaves, and take it in their stride as they have had to do down through the centuries. In brief, they are thoroughly acclimated.

References

1. Harshberger, John W. 1905. The Hour-Glass Stems of the Bermuda Palmetto. *Proceedings of the Academy of Natural Sciences of Philadelphia* 57: 701-704.
2. Bailey, L. H. 1934. American Palmettoes. *Gentes Herbarum* 3: 326-328.
3. Smith, Louisa Hutchings. 1950. *Bermuda's Oldest Inhabitants*. Seven-oaks, England.

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PALM LITERATURE

McCurrach, James C., *Palms of the World*, Harper & Brothers, New York, \$17.50, 1960.

Quite commonly in any specialized field of human endeavor, those whom we have come to regard as trusted authorities must of necessity become so involved in detailed investigations of materials in their particular sphere of activity that they have little time or energy left to undertake a broad compilation of a great body of data familiar to them, but possibly not so well known to the layman and amateur. This lapse in the realm of palm literature has prompted Mr. McCurrach, an enthusiastic collector and student, to write just such a broad compilation on the *Palmaceae*.

The author has taken an up-to-date alphabetical list of the world's valid palm genera as prepared by the eminent German specialists Max Burret and Eva Potzta and used this as a framework for the reading matter in the body of his text. He has garnered a vast and impressive collection of illustrations, submitted not only by private collectors but also by some of the major botanical gardens throughout the globe.

The roster of those individuals who have contributed to Mr. McCurrach's work reads like a "Who's Who among Palmateers." In addition to illustrations, they have supplied listings of palms to be found on the grounds of a number of tropical gardens, and considerable useful data on seed germination and palm cultivation in general. Some authorities have ventured opinions or interpretations not in every case endorsed by their colleagues. The author faithfully records these matters, but very wisely prefers to let time and

further investigations render the definitive judgment.

"Palms of the World," an artistic triumph of photographic reproduction and the printer's art, is not intended to be read from cover to cover in the manner of a work of fiction, but rather to be used as a basic reference source as the need or interest occasions. Perhaps one of the most unique features of the volume is an illustrated glossary, designed to acquaint the reader quite painlessly with a host of terms and concepts used in the description of palms.

Mr. McCurrach's extensive and painstaking work will hardly fail to prove of keen interest to members of The Palm Society, and may well reach out to captivate a whole new corps of tropic and sub-tropic gardeners who have come to suspect there might be something else on the scene worthy of note besides the *Orchidaceae*.

BRUCE H. BEELER

Hertrich, William, *Palms and Cycads*, Their Culture in Southern California as Observed Chiefly in the Huntington Botanical Gardens, Huntington Library Publications, San Marino, California, \$5.00, second printing 1960.

A special announcement was made in April of this new edition of *Palms and Cycads*, a work first published nine years ago. The author William Hertrich, now Curator Emeritus of the Huntington Gardens, was responsible for all the original and subsequent palm plantings in the Gardens, and has had more than half a normal lifetime of experience with the culture and observation of the palms. Anyone engaged in palm gardening, especially if some of the hardier palms are garden subjects, would find this work immensely informative and rewarding in all respects.

A New Subfamily of Palms-The Caryotoideae

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The fishtail palms (species of *Caryota*), the sugar palms (*Arenga pinnata* and some other species) and one or two species of *Wallichia* are cultivated in the tropics of both hemispheres. Sometimes they also appear as foliage plants in greenhouses or buildings. Two other palms of this alliance are occasionally grown as species of *Didymosperma*.

These palms are distinctive, not only in their ornamental or economic nature, but in several attributes of unusual botanical interest which have led botanists to associate them together in a tribe, the *Caryoteae*, within the confines of the subfamily *Arecoideae* or arecoid palms. One of the most striking differences between the caryotoid palms and all others is the manner in which individual stems (or the whole plant in single-trunked species such as *Caryota urens* and *Arenga pinnata*) commence to flower at the top and then at successive nodes down the stem. Inflorescences sometimes appear even from nodes below the soil. When flowering has ceased, the stem or plant dies. A few other palms, notably the talipot palm (*Corypha umbraculifera*) and its related species, die after flowering, but they differ in having only a terminal inflorescence with flowering progressing upward as in other palms which bear inflorescences among or below the leaves. Other differences in flowers, fruit, structure of the leaves and anatomy of caryotoid palms are less obvious but no less important.

These differences combined are such that the genera do not fit within the circumscription accorded the arecoid palms, heterogeneous as the latter are. For several years, therefore, they have been separated in the writer's manuscript keys and treatments of palms. Further detailed study is necessary before they are completely understood but the unusual characteristics they share warrant their separation from the *Arecoideae*. Separation is further demanded by their acceptance as a subfamily in a chapter on the classification of palms for a forthcoming palm handbook and an encyclopedia. It would have been preferable to wait for a considered and detailed analysis of the classification of palms as a whole. Circumstances, however, require immediate action. The taxon including the caryotoid palms is therefore accorded the rank of subfamily coordinate with that accorded other major groups of palms.

Earlier Dispositions of the Caryotoideae

Part of an unpublished manuscript on arecan palms of the Old World by Odoardo Beccari was edited and supplemented by R. E. G. Pichi-Sermolli in *Webbia* 11: 1-87, 1955, under the title "Subfamiliae Arecoidearum Palmae Gerontogae Tribuum et Generum Conspectus." Pages 10-12 of the article present a conspectus of eight subfamilies of palms accepted by Beccari, whose scheme differs from that of Sir Joseph Hooker in Bentham and Hooker's *Genera Plantarum* (1883) and from that of Otto



47. *Caryota mitis* at Fairchild Tropical Garden, illustrated here to show typical *Caryota* foliage. Photograph by Kent Gatteri.

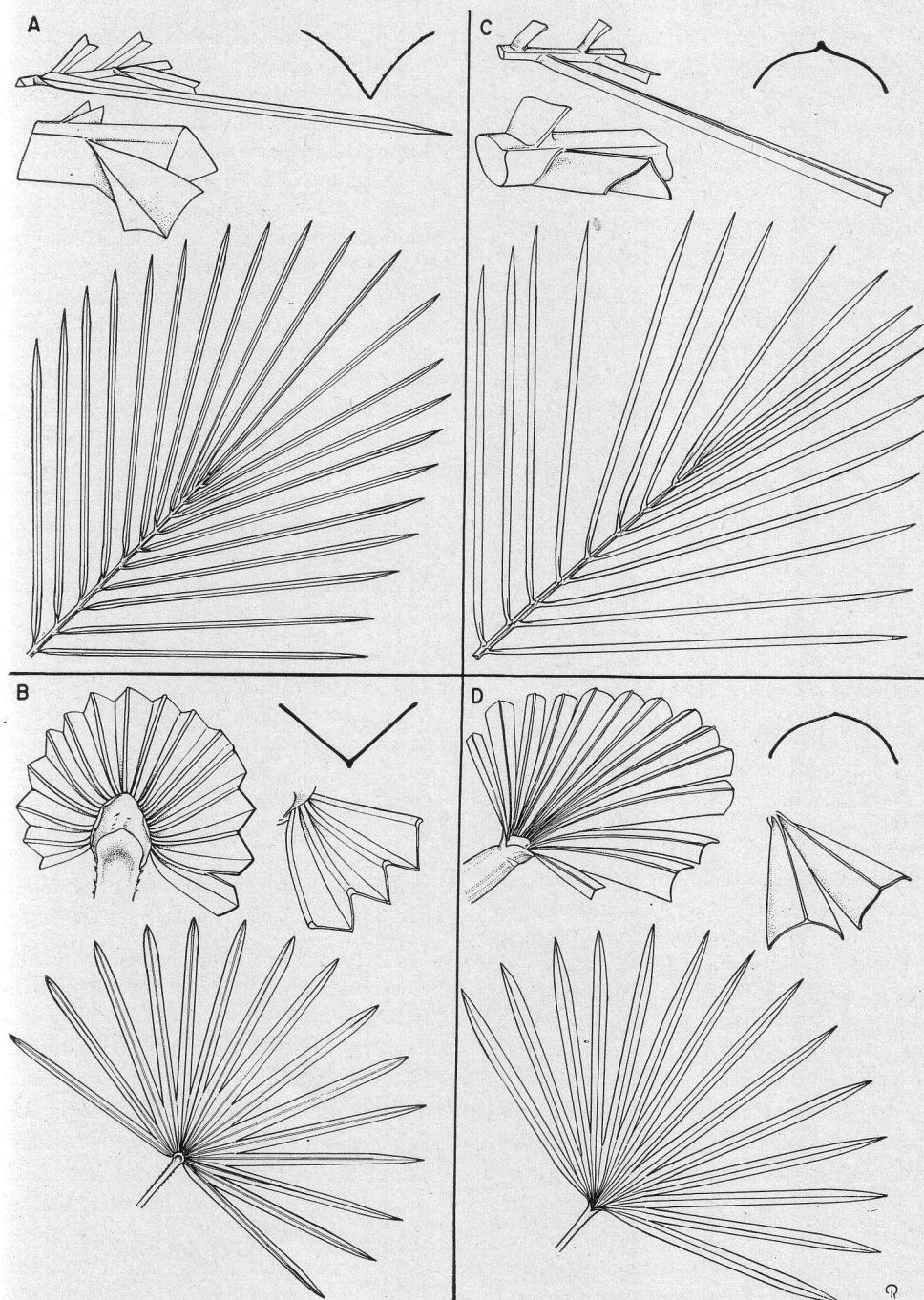
Drude in Engler and Prantl's *Die natürlichen Pflanzenfamilien* (1887) chiefly in emphasizing the important differences separating the major groups of palms and in considering *Nypa* in a subfamily of its own.

Beccari, however, included *Arenga*, *Caryota*, *Didymosperma*, and *Wallichia* in the subfamily Arecoideae where they composed the tribe Caryoteae. This taxon had been recognized earlier by Von Martius who appears to have first treated it formally as a natural group of genera. In *Historia Naturalis Palmarum* 3: 315, 1850, Martius included *Wallichia*, *Arenga* and *Caryota* in a separate unit of Arecinae which he called Arecinae Caryotinae characterized by "*Florum foem. corolla valvata, spadicum anthesis centrifuga . . .*" This subtribe was based on William Griffith's unnamed Section I of Arecinae in *Calcutta Journal of Natural History* 5: 447, 1845, and later in *Palms of British East India* 6, 8, 1850. Subsequent students of palms have continued to recognize these genera as forming a tribe or subtribe.

Reasons for removing the tribe Caryoteae from Beccari's subfamily Arecoideae and setting it on an equivalent plane are several. Chief among them is the fact, seldom observed, that the pinnae are induplicate in bud and thus fundamentally different from all other Arecoideae. The induplicate character of pinnae was used by Beccari as the primary basis for distinguishing the Coryphoideae, Phoenicoideae, and Borassoideae from the remaining subfamilies with reduplicate pinnae. Despite Drude's clear statement of the induplicate condition of caryotoid palms, Beccari apparently failed to note that his Caryoteae were similar in this respect to the above three subfamilies.

This basic difference in leaf structure is readily observed in either pinnate or palmate leaves, especially at the point where the pinnae or segments are attached to the principal axis. Segments or pinnae of induplicate palms are V-shaped at the point of attachment and in cross section, with the principal nerve below, the margins above as demonstrated by *Phoenix* (figure 48A) and *Serenoa* (figure 48B). The leaf in seedling and mature stages terminates in a single pinna or segment (except in *Caryota*) through which the principal axis terminates as the primary nerve of the segment or pinna (figure 48A). Segments or pinnae of reduplicate palms show the reverse. They are A-shaped at the point of attachment and in cross section, with the principal nerve above the margins as in *Butia* (figure 48C) and *Mauritia* (figure 48D). The mature blade, at least in the majority of reduplicate palms, terminates in a pair of opposite pinnae or segments (these rarely almost entirely united as in *Reinhardtia Koschnyana*, *Drymophloeus Beguinii*) and the axis terminates at the pinnae or continues in a slender threadlike filament between them (figure 48C). There are apparent exceptions to the general condition of the left tip outlined above. In some of the fan palms, in such cocoid genera as *Arecastrum* and often in *Butia* itself, in *Pseudophoenix* and perhaps a few others, the terminal pinnae are not obviously single in induplicate nor paired in reduplicate palms due to displacement or to unilateral union of axis and pinnae. Thus the gross appearance of the apex as an index to the nature of the leaf is usually useful but not as completely reliable as the attachment and cross section of the pinnae.

In the Caryotoideae, the pinnae are not as obviously V-shaped as in *Phoenix*



48. Leaves of palms showing tips of pinnate leaves, blades of palmate leaves, attachment and diagrammatic cross sections of pinnae. Induplicate: A, *Phoenix Roebelenii*; B, *Serenoa repens*. Reduplicate: C, *Butia capitata*; D, *Mauritia flexuosa* (young leaf).

owing to the narrowed base which is reduced essentially to a thickened nerve. Examination of seedling and expanding mature leaves, however, shows their induplicate nature as does the tip of the leaf (except in *Caryota*). The tip, however, may be irregular through union of lateral and terminal pinnae on one or both sides. It should be noted here that although morphologically induplicate, the leaves of these palms are anatomically more like those of reduplicate palms as noted by Dr. Tomlinson in an accompanying article.

The following attributes are also unusual among the arecoid palms or are unique in the whole order.

(1) monocarpic habit with development of inflorescences basipetal from a terminal inflorescence toward the base and even at nodes below ground.

(2) pistillate flowers with petals united to or below the middle, valvate above, similar in this respect only to *Roystonea* among the arecoid palms.

(3) pinnae with veins not parallel but divergent, terminating at intervals in teeth along the margin. Pinnules of *Caryota* have the veins terminating in teeth at the tip but the simply pinnate juvenile foliage is quite characteristic for divergent veins.

(4) inflorescences often several at a node and then flowering centrifugally, the inner ones developing first.

(5) anatomical differences detailed on page 118.

A summary of palm cytology has been published recently by A. K. Sharma and S. K. Sarkar (*Genetica* 28: 361-488.

1956). On pages 436-441 of this article, the authors deal with two species each of *Arenga* (*A. pinnata*, *A. obtusifolia*) and *Caryota* (*C. mitis*, *C. urens*). Somatic chromosome complements of $2n=32$ were found for both genera, the chromosomes of *Arenga* being on an average medium to short in size compared with those of other palms as opposed to *Caryota* with chromosomes long to medium. A table of chromosome numbers, including results of other workers (pp. 459-461), lists somatic numbers of $2n=26$ and $2n=32$, meiotic numbers of $n=13$, $n=16$. It is of interest that numbers of 13 and 26 are recorded only in the report of Janaki Ammal for *Arenga pinnata* (which inexplicably is considered distinct from and derived from *A. saccharifera* by Sharma and Sarkar, pp. 460, 462).

The authors suggest (pp. 471, 486) that the Caryotoeae should be separated from the arecoid palms and that they are ancestral to the latter. With the former conclusion I concur, but it does not seem probable that the Caryotoideae are ancestral to the Arecoideae. Rather, it seems probable that they represent a highly specialized unit that diverged early from a "pro-arecoid" stock.

The Caryotoideae are still insufficiently known, but some general conclusions may be drawn from existing evidence. The subfamily occupies an isolated position and its origin is a matter of conjecture. Its chief and superficial resemblance to the Coryphoideae, Borassoideae, and Phoenicoideae lies in the induplicate veneration of the pinnae. Otherwise it shows strong ties to some groups still maintained, perhaps for lack of understanding, in the Arecoideae, though the monocarpic habit and basipetal development of in-

florescences distinguish it from that subfamily. The several bracts of the inflorescence, the aggregation of inflorescences at each node in some species of *Arenga*, the basically trilocular ovary, the urent mesocarp of the fruit are each reminiscent of New World *Chamaedorea* and its allies. On the other hand, the monocarpic habit and the structure of both staminate and pistillate flowers are quite unlike those of *Chamaedorea*. The basic arrangement of flowers in triads is similar to that of advanced members of the Arecoideae such as the tribe Ptychospermeae. Staminate flowers in particular are very similar to those of *Ptychosperma* itself, being distinguished chiefly by the absence of a pistillode, and, in *Arenga*, by the often apiculate to aristate connective.

Hooker included *Orania* and *Sclerosperma* in the *Caryota* alliance: Drude included only *Orania*, placing *Sclerosperma* with the Geonomeae. The proper disposition of these two genera is still open to question but they must be removed from the Caryotoideae on morphological and anatomical grounds. Both have reduplicate pinnae, only two bracts on the inflorescence, polycarpic habit and other distinguishing characters. With their omission the Caryotoideae becomes a homogeneous taxon characterized as follows:

PALMAE subfamily CARYOTOIDEAE (Martius) H. E. Moore *stat. nov.*

Arecinae subtribe *Caryotinae* Martius,
Historia Naturalis Palmarum 3:
315. 1850.

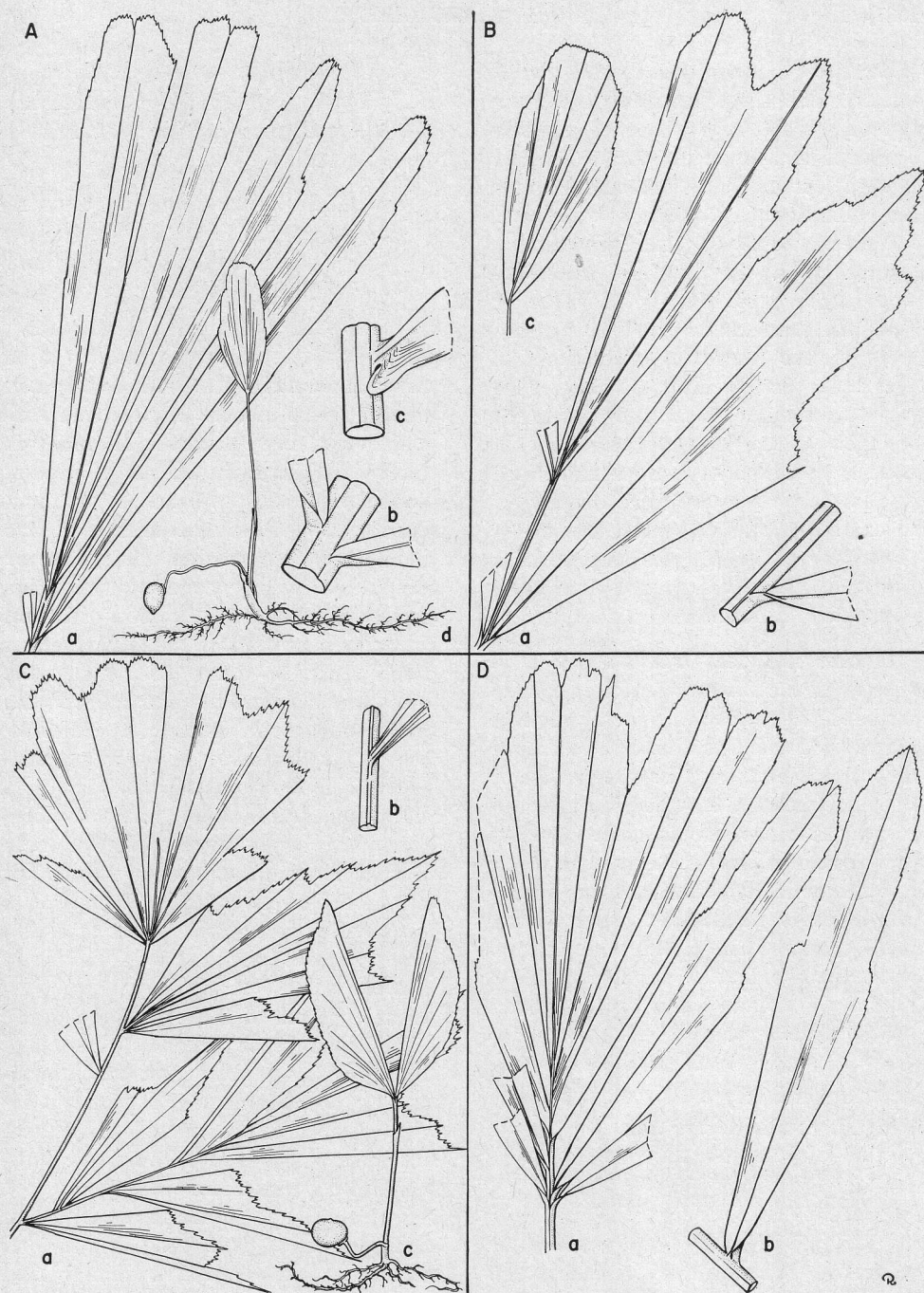
Areceae subtribe *Caryotoideae* J. D.
Hooker in Bentham & Hooker,
Genera Plantarum 3: 872, 878.
1883 (excluding *Orania*, *Sclerosperma*).

Arecinae subtribe *Caryoteae* Drude in
Engler & Prantl, *Die natürlichen
Pflanzenfamilien* 2(3): 27, 53. 1887
(excluding *Orania*.).

Arecoideae tribe *Caryoteae* Beccari,
Webbia 11: 15. 1955.

Type genus: *Caryota* L.

Three genera of small to large solitary or caespitose unarmed monoecious monocarpic palms flowering basipetally. Leaves imparipinnate, the rachis terminating in a single pinna, or bipinnate or rarely undivided, the sheaths fibrous at least marginally and more or less tubular at first, petioles short to long, pinnae induplicate in veneration, the pinnae or pinnules linear to cuneate, with veins mostly narrowly to widely divergent from the base or from the midnerve and terminating in short teeth along the often undulate or irregular margin, the base cuneate or auriculate. Inflorescences interfoliar, developing basipetally, solitary or several and then flowering centrifugally at each node, subtended by several coarse strongly fibrous acute bracts, simply branched or more rarely spicate, the flowers usually in protandrous triads of a central pistillate and 2 lateral staminate flowers at least on lower portion of rachillae, paired or solitary staminate by abortion above, or more rarely flowers of only one sex appearing on an inflorescence, the staminate and pistillate inflorescences then more or less different in aspect (*Wallichia*). Staminate flowers lacking bracteoles, with 3 rounded imbricate sepals or the sepals united in a 3-lobed tube, petals 2-3 times as long as the sepals, distinct, navicular, and valvate, or united in a deeply 3-lobed tube; stamens 6-many, inserted on the corolla tube or usually with filaments united basally in a solid stipe and adnate



49. Foliage of caryotoid palms. A, *Arenga*: a, tip of leaf $\times 1/3$; b,c, attachment of pinnae $\times 1/3$; d, seedling $\times 1/6$ (a,b, *A. Engleri*; c, *A. Ambong*; d, *A. pinnata*). B, *Arenga porphyrocarpa*: a, tip of leaf $\times 1/3$; b, attachment of pinna $\times 2/3$; c, seedling leaf $\times 1/3$. C, *Caryota mitis*: a, tip of leaf and lateral pinna with pinnules $\times 1/3$; b, attachment of pinnule $\times 2/3$; c, seedling $\times 1/3$. D, *Wallichia disticha*: a, tip of leaf $\times 1/6$; b, pinna $\times 1/9$.

to the petals, distinct and short above, not inflexed at the apex in bud, anthers linear, sagittate basally and apically acute, bifid, apiculate or aristate, introrsely dehiscent by longitudinal slits, the pollen, 1-sulcate, pilate to spinulose; pistillode not developed. Pistillate flowers smaller than the staminate, subtended by 2 prominent bracteoles; sepals 3, rounded, imbricate; petals 3, longer than the sepals, connate basally or to above the middle, valvate and acute above; staminodes 0.3 between the corolla-lobes (rarely more in *Arenga*?); pistil with prominent trilocular ovary or the ovary functionally 1-2-locular by reduction with 3-1 erect compressed ovules borne basally on the axis or inner surface of the locule, style lacking, stigmas 3-1, sessile. Fruit globose, ellipsoid or trigonous, small to moderate, with smooth exocarp, fleshy urant mesocarp and cartilaginous or papery endocarp sometimes with imbedded fibers surrounding and often strongly adherent to each seed; stigmatic remains apical or subapical; seeds 1-3, with homogeneous or ruminate endosperm and lateral embryo, the hilum basal, the raphe branched and impressed.

The Genera of Caryotoideae

In addition to *Caryota* and *Wallichia*, each of which is distinct and readily defined, *Arenga* and *Didymosperma* have been maintained separately since the latter genus was formally described by Sir Joseph Hooker in 1883, some five years after the name first appeared in the "Index Général" of Kerchov's *Les Palmiers*. Hooker distinguished the genera as follows:

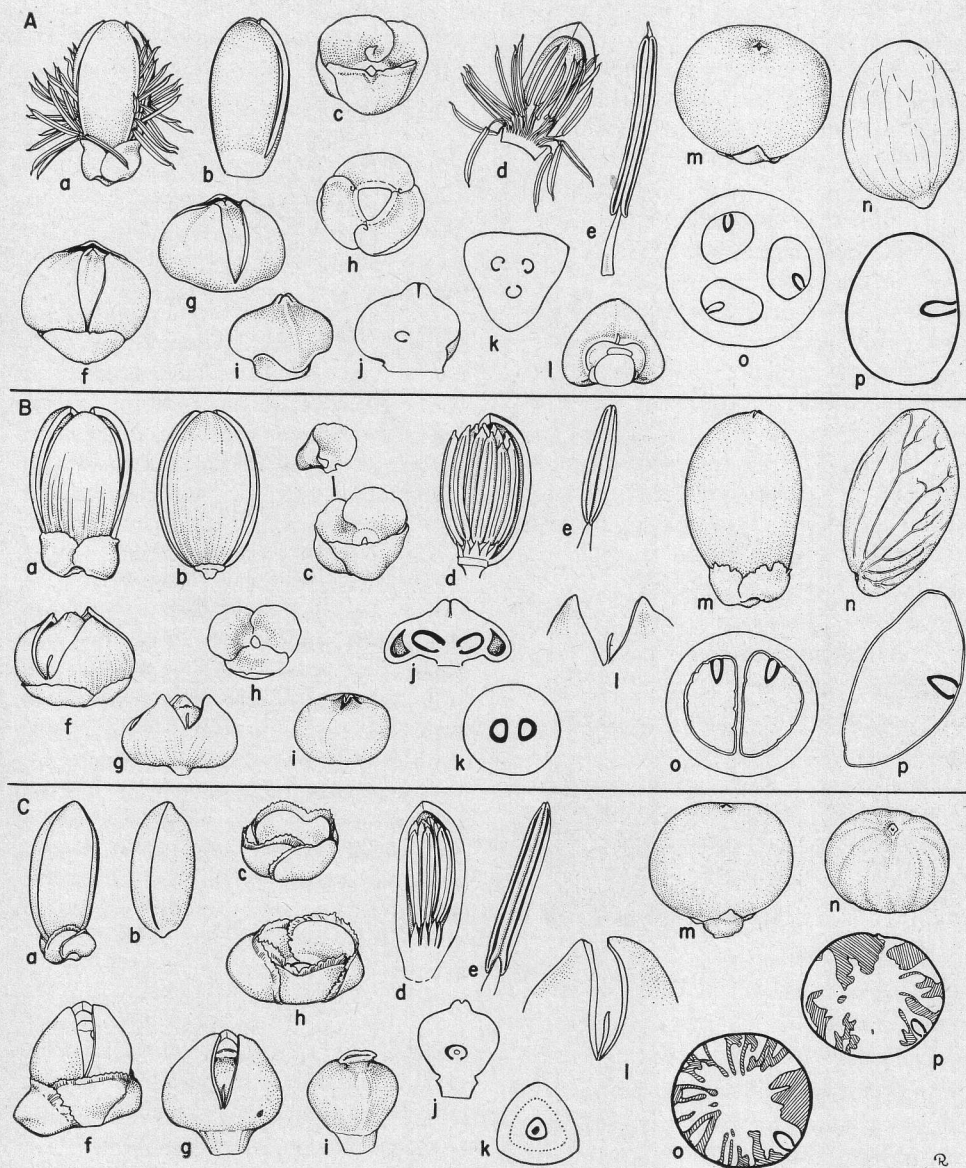
71. DIDYMOSPERMA. *Fl. masc.*:
Calyx cupularis, 3-lobus;

stamina ∞ . *Albumen aequabile. Palmae humiles, foliis simpliciter pinnatisectis.*—Asia trop.

72. ARENGA. *Fl. masc.*: *Sepala 3; stamina* ∞ ; *albumen aequabile. Palmae monocarpicae, foliis simpliciter pinnatisectis, segmentis linearibus basi auriculatis.*—Asia et Austral. trop.

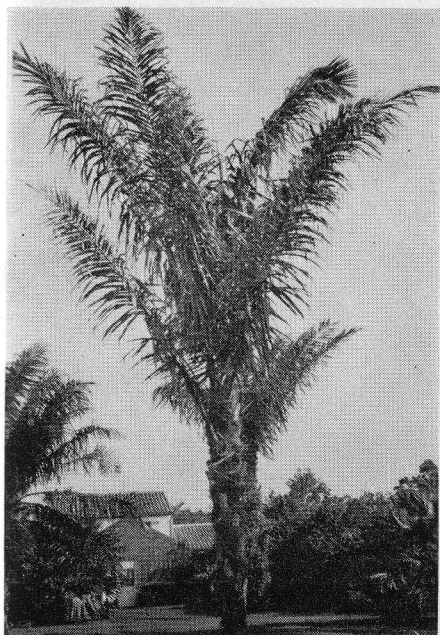
When material or descriptions of all the species presently included in these two genera are examined, it becomes evident that differences are more apparent than real and the genera are united here. There is diversity in the number of stamens (even within a single species) and in the development of an apiculate or aristate connective in *Arenga*. The pinnae of the majority of species are not auriculate and stems, though generally robust, are often low. More uniformity is found in *Didymosperma* which has canelike stems, undivided or variously and usually deeply lobed pinnae which are cuneate at the base, and small, little-branched or usually spicate inflorescences. Staminate flowers have generally fewer stamens, these never aristate.

In *Arenga pinnata* and species associated with it, the ovary is apparently always trilocular, triovulate and the fruit usually 3-seeded. *Didymosperma porphyrocarpum* also has a trilocular ovary but only two cells bear ovules; the third remains conspicuous though smaller and sterile. Were two fertile locules constant for species associated vegetatively with *D. porphyrocarpum*, two genera might be retained. *Didymosperma Hookerianum* and *D. caudatum* however, have three fertile locules in the ovary with fruit 1-3-seeded. Thus they connect the two extremes.



50. Details of caryotoid flowers. A, *Arenga* sp.: a,b,d $\times 2/3$; c,f,l,n,p $\times 1$; e $\times 1\frac{1}{2}$; m,o $\times \frac{1}{2}$. B, *Arenga porphyrocarpa*: a-k,o $\times 3$; l $\times 5$; m $\times 1\frac{1}{2}$; n,p $\times 2$. C, *Caryota* sp.: a,b,o,p $\times 1\frac{1}{2}$; c,d $\times 2$; e,l $\times 4$; f-k $\times 3$; m,n $\times 1$. a-e staminate flower: a, flower; b, corolla; c, calyx; d, flower in vertical section; e, stamen: f-l pistillate flower: f, flower; g, corolla; h, calyx; i, pistil; j, pistil in vertical section; k, ovary in cross section; l, detail of staminode; m, fruit; n, seed; o, seed in cross section; p, seed in vertical section.

The only differences between *Arenga* and *Didymosperma*, therefore, are vegetative—in the slender habit and usually rather distinctive pinnae of *Didymosperma*. These differences seem scarcely of generic order when the diversity of habit and foliage in such genera as *Bactris*, *Chamaedorea*, *Ptychosperma*, *Reinhardtia*—to note only four—is considered. Beccari had apparently come



51. *Arenga pinnata* on the estate of Mrs. A. R. Jennings, Coconut Grove, Florida. Photograph by G. H. M. Lawrence.

to a similar conclusion although he maintained *Didymosperma* in his manuscript on arecoid palms. In *Webbia* 3: 207, 1910, after describing *Didymosperma caudatum* var. *stenophyllum* ('*stenophylla*') he wrote [freely translated]:

"Differs from the typical form only by the very narrow linear segments which, in miniature, have exactly the

form of those of *Arenga saccharifera* . . . The one character that might serve to distinguish *Didymosperma* from *Arenga*, that of the form of the segments, is lacking in this variety, which seems to form a passage between the two genera. The trilocular rather than bilocular ovary seems to have little importance in this group of palms. The curiosity of this palm is, then, that the typical form should be a *Didymosperma* and the variety an *Arenga*."

Thus no character or combination of characters serves to separate *Arenga* and *Didymosperma*. They are, therefore, united under *Arenga*, the older name.

Although three adequately distinct genera may now be recognized with facility, the species of these genera are very poorly understood. Botanical specimens are often scanty—the two or probably three species of *Arenga* from New Guinea, for example, were so incompletely characterized that more ample recent collections cannot be referred with certainty to any one species nor to the possibly identical *Saguerus australasicus* from Australia. Nor can some cultivated material be readily identified with any known species. This is particularly true in *Caryota*, to a lesser extent in *Arenga*. Casual observation in gardens suggests that hybridity plays a role here. Variation in the number of stamens even on a single plant (Hance found 110-154 in flowers of *Caryota ochlandra*), variation in the size of fruit according to the number of seeds produced, and variation in the pinnae or pinnules all combine to make any attempt to identify much material completely frustrating. These genera must be studied long and carefully in their native habitats throughout their range

and characterized fully before plants and specimens can be identified with confidence.

Within the Caryotoideae, *Arenga* appears to be the most primitive genus in its simply imparipinnate or undivided leaves, often aggregate inflorescences, distinct sepals and petals in staminate flowers, numerous stamens, trilocular ovary with 2-3 fertile locules, and homogeneous endosperm.

Caryota shows advance in further cutting of the adult foliage (juvenile foliage is imparipinnate), in solitary inflorescences, in reduction of fertile locules to 1-2, and in the development of ruminant endosperm. Pistillate flowers, however, have petals less united than those of *Arenga*.

Wallichia is advanced in usually having separate staminate and pistillate inflorescences, the latter usually terminal on the plant and stiffer than the lateral staminate inflorescences, in the union of perianth parts of the staminate flower, in the reduction of stamens to 6 in most species.

It is difficult to place the Caryotoideae in any direct line of relationship within the Palmae. The subfamily as a whole is markedly advanced over any putative common stock of the palms. The significance of induplicate veneration, monocarpic habit and basipetal production of inflorescences has yet to be understood. In comparison with advanced arecoid tribes, the Caryotoideae are relatively primitive in the number of bracts on the inflorescences, in the basically trilocular, triovulate ovary and 3-seeded fruit. Yet the subfamily shows specialization in the arrangement of flowers on the inflorescence, in union of

petals in pistillate flowers, in monocarpic habit, in basipetal development of inflorescences, in bipinnate leaves. It is apparent that, if derived from a basic arecoid stock, evolution has long proceeded independently.

Key to Genera

1. Staminate flowers with distinct imbricate sepals and valvate petals; stamens sometimes only 6-9 but generally 15 or more.
2. Leaves imparipinnate or rarely undivided; inflorescences solitary or several at each node; pistillate petals connate to about the middle; fruit 1-3-seeded, the seeds with homogeneous endosperm ----- *Arenga*
2. Leaves bipinnate at maturity; inflorescences always solitary at each node; pistillate petals connate to about one-third their length; fruit 1-2-seeded, the seeds with ruminant endosperm. ----- *Caryota*
1. Staminate flowers with sepals united in a low cylindric 3-lobed or undulate calyx, the petals united in a short to long, more or less solid, cylindric base with valvate lobes; stamens generally 6, rarely 9-12-15; fruit 1-3-seeded, the seeds with homogeneous endosperm. ----- *Wallichia*

ARENCA Labillardiere in A. P. DeCandolle, *Bulletin des Sciences, par la Société Philomathique, Paris* 2(45): 162. 1800 [conserved name].

Dwarf to large solitary or caespitose monoecious palms with imparipinnate or rarely undivided leaves, the pinnae cuneate to auriculate at the base, nearly

linear to irregularly undulate-elliptic or panduriformly lobed with margins and apices variously toothed and nerves divergent from the base and often from



52. *Arenga pinnata* with a flowering inflorescence below and spent inflorescences above at Coconut Grove, Florida. Photograph by G. H. M. Lawrence.

the midnerve. Inflorescences several and flowering centrifugally or more rarely solitary at each node, simply branched or more rarely spicate, the flowers arranged in protandrous triads of two lateral staminate and a central pistillate at least basally, more rarely inflorescences unisexual through abortion of flowers of one sex. Staminate flowers with 3 imbricate sepals exceeded by 3 distinct valvate navicular petals, stamens numerous with filaments basally connate and adnate to the petals, short and distinct above, the anthers basally sagittate, apically acute to bifid or sometimes with an apiculate or aristate connective; pistillate flowers with 3

imbricate sepals, 3 valvate petals connate to about the middle; staminodes 3-0 (or sometimes many *fide* Hooker) or rarely the staminodes in some flowers partially fertile*; pistil with trilocular ovary containing 2-3 fertile locules and 2-3 sessile stigmas. Fruit orange-yellow to red or rarely white, small to moderate, globose, trigonous or ellipsoid, 1-3-seeded, the seeds with homogeneous endosperm.

Distribution: perhaps 20 species from New Guinea to the Himalaya region of India and the Philippine Islands.

Vegetative differences suggest the division of *Arenga* into two sections characterized as follows:

Stems low to moderate, always more or less robust; pinnae linear, elongate-cuneate or elongate-elliptic and sinuately or undulately margined, acute to auriculate at the base; inflorescences with numerous simple rachillae; ovary trilocular with 3 fertile locules; fruit generally 3-seeded.

Section *Arenga*

Stems low, arundinaceous; pinnae cuneate at the base, more or less rhombic in outline, sometimes panduriformly lobed above the middle, or rarely the leaves undivided; inflorescences spicate or with few simple short rachillae; ovary trilocular with 2-3 fertile locules; fruit 1-3-seeded.

Section *Didymosperma*

ARENGA section ARENKA

Arenga Labillardiere in A. P. DeCandolle, *Bulletin des Sciences, par la Société Philomathique, Paris* 2(45): 162. 1800.

**Didymosperma borneense*. The flowers then apparently pseudohermaphrodite, larger than the pistillate, smaller than the staminate, with 2 filaments antheriferous, 3 partially or completely sterile.

Saguerus Steck, *De Sagu* 15. 1757.

Gomutus Correa, *Annales du Museum d'Histoire Naturelle, Paris* 9: 288. 1807.

Blancoa Blume, *Rumphia* 2: 128. 1843.

Type: *Arenga pinnata* (Wurmb) Merrill (*A. saccharifera* Labillardiere). Additional species: *A. Ambong* Beccari, *A. brevipes* Beccari, *A. Engleri* Beccari, *A. gracilicaulis* F. M. Bailey, *A. Listeri* Beccari, *A. microcarpa* Beccari, *A. obtusifolia* Martius, *A. tremula* (Blanco) Beccari (*A. mindorensis* Beccari), *A. undulatifolia* Beccari, *A. Westerhoutii* Griffith, *A. Wightii* Griffith, ?*Didymosperma humile* Lauterbach & K. Schumann, *Saguerus australasicus* H. Wendland & Drude.

ARENCA section DIDYMOSPERMA (H. Wendland & Drude ex J. D. Hooker) H. E. Moore *stat. nov.*

Didymosperma H. Wendland & Drude ex J. D. Hooker in Bentham & Hooker, *Genera Plantarum* 3: 917. 1883.

Lectotype: *Arenga porphyrocarpa* (Blume) H. E. Moore. Additional species transferred with confidence follow. Others have been described in *Didymosperma* but are not transferred here because some or all may be no more than forms of the three species listed below. Those not transferred are *Didymosperma borneense* Beccari, *D. hastatum* Beccari, *D. Hookerianum* Beccari and *D. tonkinense* (Beccari) Beccari ex Gagnepain, all perhaps no more than forms of *Arenga caudata*, *D. Horsfieldii* (Blume) H. Wendland ex Salomon, a dubious species, and *D. humile* Lauterbach & K. Schumann. The last appears to be a species of section *Arenga* related to or identical with *A. microcarpa* or *A. gracilicaulis*. *Didymosperma gracile* J. D. Hooker appears distinct on the basis of the description but no material has been studied.

ARENCA PORPHYROCARPA (Blume) H. E. Moore *tr. nov.*

Orania regalis Blume, *Rumphia* 2: pl. 95. 1837. not *O. regalis* Zippelius (1829).

Orania porphyrocarpa Blume in Martius, *Historia Naturalis Palmarum* 3: 187. 1838-39 [ed. 1] and 190. 1849 [ed. 2].

Wallichia orania Blume, *Rumphia* 2: 113. 1843.

Didymosperma porphyrocarpum (Blume) H. Wendland & Drude ex J. D. Hooker, *Report on the Progress and Condition of the Royal Gardens at Kew* 1882: 61. 1884.

Blancoa porphyrocarpa (Blume) O. Kuntze, *Revisio Generum Plantarum* 2: 727. 1891.

Wallichia Reinwardtiana Miquel, *Plantae Junghuhnianae* 1: 157. 1852.

Blancoa Reinwardtiana (Miquel) O. Kuntze, *Revisio Generum Plantarum* 2: 727. 1891.

Didymosperma Reinwardtianum (Miquel) H. Wendland & Drude ex Jackson, *Index Kewensis* 1: 756. 1895.

ARENCA CAUDATA (Loureiro) H. E. Moore *tr. nov.*

Borassus caudata Loureiro, *Flora Cochinchinensis* 2: 619. 1790.

Wallichia caudata (Loureiro) Martius, *Historia Naturalis Palmarum* 3: 315. 1850.

Didymosperma caudatum (Loureiro) H. Wendland ex Salomon, *Die Palmen* 130. 1887.

Blancoa caudata (Loureiro) O. Kuntze, *Revisio Generum Plantarum* 2: 727. 1891.

ARENCA NANA (Griffith) H. E. Moore *tr. nov.*

Harina nana Griffith, *Palms of British East India* 176, 1850.



53. *Wallichia densiflora* reproduced from Curtis's Botanical Magazine 77: pl. 4584, 1851. Flowering plant much reduced; 1, staminate inflorescence before expansion; 2, staminate flower and bud enlarged; 3, rachilla of pistillate inflorescence with young fruit about 3/4 natural size; 4, immature fruit enlarged; 5, cross section of immature fruit.

Wallichia nana Griffith in Martius, *Historia Naturalis Palmarum* 3: 315. 1850.

Didymosperma nanum (Griffith) H. Wendland & Drude ex J. D. Hooker, *Report on the Progress and Condition of the Royal Garden at Kew* 1882: 61. 1884.

Blancoa nana (Griffith) O. Kuntze, *Revisio Generum Plantarum* 2: 727. 1891.

CARYOTA Linnaeus, *Species Plantarum* 2: 1189. 1753.

Dwarf to large solitary or caespitose monoecious palms with bipinnate or rarely tripinnate leaves (pinnate in the juvenile state), the pinnules obliquely cuneate with veins divergent from the base and the truncate oblique apex toothed. Inflorescences solitary at each node, the flowers in protandrous triads of two staminate and a central pistillate at least basally on the rachillae. Staminate flowers with 3 imbricate sepals exceeded by 3 distinct valvate navicular petals, stamens 6 to usually 9-100 or more with filaments basally connate and adnate to the petals, short and distinct above, the anthers basally sagittate, apically bifid or acute, the connective sometimes apiculate; pistillate flowers with 3 imbricate sepals, 3 petals united to about 1/3 their length or less and valvate above; staminodes 6-0; ovary trilobular with generally 1-2-locules fertile, stigma conical, 3-lobed. Fruit red to blackish, small, 1-2-seeded, the seeds with ruminate endosperm.

Type: *C. urens* Linnaeus

Distribution: about 13 species of Australasia including *C. aequatorialis* Ridley, *C. bacsonensis* Magalon, *C. Cumingii* Loddiges ex Martius, *C. macrantha* Burret, *C. majestica* Linden, *C. Merrillii* Beccari, *C. mitis* Loureiro, *C. monostachya* Beccari, *C. obtusa* Griffith,

C. ochlandra Hance, *C. Rumphiana* Martius, *C. sympetala* Gagnepain and *C. urens* Linnaeus.

WALLICHIA Roxburgh, *Plants of the Coast of Coromandel* 3: 91. 1820. ('1819'). Harina F. Hamilton, *Memoirs of the Wernerian Natural History Society* 5(2): 317. 1826.

Small to moderate solitary or caespitose monoecious palms with imparipinnate leaves, the pinnae exauriculate at the base, nearly linear to cuneate or deltoid with margins and apex variously sinuately to panduriformly lobed and toothed, the nerves divergent from the base and from the midnerve. Inflorescences solitary, often dimorphic: the staminate usually lateral with numerous bracts, these nearly or quite hiding the peduncle and bases of the few to numerous slender often pendulous rachillae, flowers paired with sometimes intermediate rudimentary pistillate flowers or solitary; the pistillate usually terminal with prominent peduncle and fewer stouter generally stiffish and spreading branches, these often becoming more or less pendulous in fruit, the flowers solitary and spirally disposed. Staminate flowers with cylindric truncate 3-lobed or -toothed calyx much exceeded by the corolla, the petals united basally in a short or long, often solid cylindric tube, the lobes valvate; stamens 6 or more rarely 9-15 (*W. chinensis* 6-9, *W. siamensis* 12-15), with filaments united basally in a short to long column adnate in part or in entirety to the corolla tube, distinct and sometimes (when 6) partly adnate to corolla lobes above, the linear anthers basally sagittate, apically acute or obtuse; pistillode lacking; pistillate flowers with 3 thick imbricated sepals or the sepals united in a 3-lobed ring (?), petals 3, united basally to about the middle, valvate



54. *Wallichia disticha* in the botanical garden at Rio de Janeiro, Brazil, 1924, showing terminal inflorescence. Photograph by L. H. Bailey.

above; staminodes 3-0; pistil 2-3-locular, 2-3-ovulate with conical stigma. Fruit red or purple, small, 1-2-rarely 3-seeded, the seeds with homogeneous endosperm.

Type: *Wallichia caryotoides* Roxburgh.

Distribution: Six species of tropical Himalaya in India and Upper Burma, southern China (Kwangsi), Indochina: *W. caryotoides* Roxburgh, *W. chinensis* Burret, *W. densiflora* (Martius) Martius, *W. disticha* T. Anderson, *W. gracilis* Beccari, *W. siamensis* Beccari.

Anatomy of the Caryotoideae

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The major groups of palms, besides being distinguished from each other by morphological features also possess combinations of microscopic anatomical characters by which they can be recognized. The following notes are a summary of the main anatomical features to be found in the caryotoid palms. The combination of these features is different from that in any other group of palms, further supporting the isolation of the Caryotoideae as a distinctive taxon. Features in which this group differ from all other palms are as follows: hairs of the leaflets each with a persistent sclerotic base surrounding 1-3 central thin-walled cells, producing an ephemeral expanse of superficial filamentous cells; guard cells of the stomata each with 2 cutinized ledges bearing numerous short transverse cuticular ribs which are very conspicuous in surface view. Features characteristic of the caryotoid palms but not of the group within which they have usually been included (*Arecoideae*) are the midrib or main ribs of the leaflets usually most prominent on the abaxial surface; central vascular bundles of the leaf axis not arranged in conspicuous arcs; cortex of the root including numerous scattered fibrous strands; silica cells adjacent to vascular bundles including silica bodies described as "hat-shaped."

General Anatomy of the Caryotoideae

Leaflets. Dorsiventral. Hairs each with a persistent sclerotic base surrounding 1-3 central thin-walled cells, producing an ephemeral expanse of superficial

filamentous cells. Epidermis composed of files of rhombohedral, obliquely extended, even spindle-shaped cells; anticlinal walls never markedly sinuous. Guard cells of the stomata each with 2 cutinized ledges bearing numerous short transverse cuticular ribs, ribs very conspicuous in surface view. Hypodermis mostly 1-layered beneath each surface, adaxial cells hexagonal and transversely extended. Isolated fibres sometimes absent, otherwise present and with wide septate lumina, either solitary and scattered in the mesophyll or in small strands. Strands sometimes large and pectinating with the veins. Longitudinal veins usually in the abaxial mesophyll, independent of surface layers except for a few large veins buttressed to each hypodermis, mostly by colourless cells. Inner sclerotic sheath often fibrous and most well-developed above and below veins. Phloem sometimes sclerotic, rarely subdivided into separate strands by longitudinal fibrous partitions. Transverse veins situated at the same level as the small longitudinal veins, narrow, sheathed by parenchyma. Midrib or main ribs usually most prominent on abaxial surface, each including a sclerotic cylinder surrounding central ground parenchyma and including separate vascular bundles.

Leaf axis. Peripheral vascular bundles congested, with well-developed fibrous bundle sheaths, forming a rigid peripheral mechanical zone. Central vascular bundles more diffuse, not arranged in conspicuous arcs.

Root. Cortex including numerous scattered fibrous strands.

Silica bodies. Silica cells adjacent to vascular bundles including silica bodies described as "hat-shaped."

The Anatomical Relation Between the Caryotoid Palms and the Palms as a Whole.

Palms can be classified, according to the way in which the leaf segments are folded, into two major groups. The induplicate palms have leaf segments which are V-shaped in section and include *Phoenix* together with most of the fan palms. The reduplicate palms have leaf segments which are A-shaped in section and include all the remaining feather palms together with the fan-leaved genera *Mauritia*, *Mauritiella* and *Lepidocaryum*. Correlated with these morphological features are certain anatomical arrangements conspicuous in the ribs of the segments and in the leaf axis. One could refer to these anatomical types as "induplicate" and "reduplicate." The caryotoid palms, however, are distinctive

because although they have induplicate morphology, their anatomy is undoubtedly of the reduplicate type.

The general anatomical conclusion about the caryotoid palms is that they can be recognized instantly from the type of hair base and guard cell they possess and apart from this that they form rather an isolated group within the palms as a whole.

Attention has been drawn to the shape of the silica bodies in caryotoid palms, this being hat-shaped and not spherical as in the arecoid palms within which the caryotoid palms have usually been included. It should be noted that several other groups of palms possess silica bodies of the same shape as those in the caryotoid palms, i.e. the bactroid, chamaedoreoid, iriarteoid and nypoid palms. However, these groups are apparently not closely related and this common feature has probably evolved independently within each group and may not be an indication of close phylogenetic affinity.

Harley Harris Bartlett
1886 - 1960

The Society has lost one of its very distinguished members by the recent death of Harley Harris Bartlett, retired Professor of Botany at the University of Michigan.

Professor Bartlett had been a diligent student of the palms and had accomplished important work with them, frequently publishing on them over a period of years.

He was born March 9, 1886, at Anaconda, Montana. In 1904 he matriculated at Harvard University. He re-

ceived the A. B. degree *cum laude* in Chemistry in 1908. He took only one or two formal courses in Botany.

Professor Bartlett had extraordinary linguistic accomplishments, his attainments including fluency in Malayan and a knowledge of the finer points of the language of the Batak people in Sumatra. How many Latin descriptions of new species of plants were to come from his pen to bolster the taxonomic contributions of fellow botanists, less skilled in the classical languages!

He joined the staff of the Department of Botany of the University of Michigan

in 1915 as an Assistant Professor, and rose to a professorship within six years. He presided over the Department as an intellectual leader and powerful though benevolent administrator for 25 years. He developed the Botanical Gardens as its Director from 1915-1955.

In 1918 he made his first of many trips to foreign lands, on this initial one as a botanist with the U. S. Rubber Company in Sumatra. He conducted botanical and agricultural field work and research in Sumatra, the Philippines, Formosa, Mexico, Guatemala, British Honduras, Panama, Haiti, Argentina, Uruguay and Chile under the auspices of the University of Michigan, the United States Rubber Company, the Smithsonian Institution, the Carnegie

Institution of Washington, the University of the Philippines, and the U. S. Department of Agriculture.

Professor Bartlett's known list of publications numbers over 150 titles. They reflect a major interest at first in taxonomy, then in turn plant chemistry, genetics, and anthropology. Original observations are recorded also in paleobotany, plant anatomy and morphology, plant geography, radiation, ethnology, history, linguistics, education and philately.

He was unmarried.

Chiefly extracted from an account signed by K. L. Jones, Rogers McVaugh and Wm. Randolph Taylor.

How Many Kinds of Palms Are There?

The question is often asked "How many kinds of palms are there?" In order to answer this question with some accuracy, I counted genera and species in 1954 using my own provisional keys to genera and attempting through the use of monographs, floras, and personal knowledge to eliminate synonymous names from consideration in the number of species. The figures are not exact but seem a reasonable estimate. A reduction in the number of genera may be expected when relationships among the arecoid palms are better understood and it is certain that the number of species will change as new ones are discovered and described and as many old species become better known. Figures for 1960 are essentially those of 1954.

A total of about 230 genera and 2640 species in round numbers is distributed as follows. The "induplicate" palms include about 44 genera and 422 species: Borassoideae 7 genera and 42 species; Caryotoideae 3 genera and 38 species; Coryphoideae 33 genera and 330 species; Phoenicoideae 1 genus and 12 species. The "reduplicate" palms number about 186 genera and 2220 species: Arecoideae about 130 genera and 1100 species; Cocoideae 27 genera and 610 species; Lepidocaryoideae 24 genera and 500 species; Nypoideae 1 genus and 1 species; Phytelephantoideae 4 genera and 8 species.

It is of interest to note that the arecoid palms account for more than half the genera and somewhat less than half the species, a situation not likely to be radically changed even if further small subfamilies are segregated from them. The cocoid palms follow in number of species though not of genera. The smallest subfamily consists solely of *Nypa fruticans*.

H. E. MOORE, JR.