PRINCIPES

Journal of The Palm Society

October, 1975
Vol. 19, No. 4

PRINCIPES

JOURNAL OF THE PALM SOCIETY

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Contents for October

Oil-Producing Palms of the World—a Review
W. H. Hodge 119

Palmologue
Dent Smith 137

South Carolina Palms
Alan H. Shoemaker 147

Regular Features

Palm Briefs 149
Footnotes on Palms 153
Letters 153
News of the Society 154
Index 156

Cover Picture

Cocos nucifera on Guam. Photo by W. H. Hodge. See page 119.

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JOURNAL OF THE PALM SOCIETY

An illustrated quarterly devoted to information about palms and published in January, April, July and October by The Palm Society, Inc.

Subscription price is $7.00 per year to libraries and institutions. Membership dues of $12.50 per year include a subscription to the Journal. Single copies are $1.50 each. The business office is located at **1320 S. Venetian Way, Miami, Florida 33139.** Changes of address, undeliverable copies, orders for subscriptions, and membership dues are to be sent to the business office.

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Second class postage paid at Miami, Florida and at additional mailing offices.

Mailed at Lawrence, Kansas
November 17, 1975

Oil-Producing Palms of the World – a Review

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Oil palms, as the name implies, are sources of vegetable oils. The latter, by definition, are oils of plant origin and they are of major economic importance to man. Vegetable oils are mainly of two sorts, those that are volatile—the aromatic essentials oils (familiar examples are the numerous oils used in perfumery)—and the various kinds of non-volatile or fixed oils. The latter are composed of glycerin combined with a fatty acid and are commonly termed fatty oils because of their close chemical relationship with animal fats. Fatty oils are found in oil-yielding palms, which are one of the major sources of the world's vegetable fats.

Unlike essential oils, which are believed to be mainly by-products of plant metabolism, fatty oils occur in all protoplasm where they serve as important sources of the high energy required for metabolic processes. A fatty oil is considered a true oil if liquid, but if it solidifies at ordinary temperatures, as in palm oils, it is termed a fat. Fatty oils in plants occur in greatest quantity in tissues of fruits or in seeds where they serve as food reserves. These oils may sometimes be useful as attractants to animals which effect seed dispersal, but more fundamentally they provide the energy required for germination and early growth of the seedling until it becomes self-sustaining with its own roots, stems, and leaves. In palms, the fatty oil is located chiefly in the endosperm of the seed. The amount of seed oil or so-called kernel oil depends on the quantity of endosperm; bigger palm seeds usually have larger oil reserves. The coconut, a fruit with one of the largest seeds known, has an abundance of fatty endosperm (i.e., coconut meat) which, when dried, is the important copra of commerce. The seed is surrounded by a thick endocarp and a fibrous fruit coat (pericarp or "husk") which are devoid of oil tissue but are highly useful in the dispersal of the maritime species by flotation in seawater. Many other palms depend upon animals for seed dispersal and each of their fruits contains not only an oil-rich seed but a colorful outer layer full of oily pulp (mesocarp) which attracts animals as food. Such palm fruits, exemplified by that of the African oil palm (*Elaeis guineensis*), may yield two distinct types of oil—mesocarp ("pericarp") oil plus seed or kernel oil. In world commerce, the term palm oil refers to mesocarp oil, while oil from the endosperm is traded as palm kernel oil. Coconut oil, actually a palm kernel oil, is often considered separately from other palm kernel oils.

Both types of palm oil are increasingly important as major sources of vegetable oils used as foods and in industrial products. A major reason for this is demonstrated in Table 1 which shows average factory yields of oil from some of the principal sources of commercial vege-

*Based on a presentation in the Symposium entitled "The Natural History and Utilization of Palms" at the annual meeting of the Society for Economic Botany, Ithaca, N. Y., June 14, 1973. Photos by the author except where otherwise indicated.

Table 1. Average factory yields from important oilseeds.

Species	Kilograms of oil/ hectare
Elaeis guineensis (mesocarp & kernel oil)	2790
Cocos nucifera	818
Sesamum indicum	420
Brassica spp.	392
Helianthus annuus	308
Arachis hypogaea	230
Linum usitatissimum	193
Glycine max	190

table oils. The oil palms are the highest yielders, far outstripping the soybean, which nonetheless is the chief source of the world's tonnage of vegetable oil (see Table 3). High quality or refined palm oil (i.e., mesocarp oil, primarily from *Elaeis*) has major uses in margarines and cooking fats and in the manufacture of such food products as bakery goods and ice creams; it is also essential in the manufacture of soaps, detergents and shampoos. Because of its slow oxidation rate, palm oil is also used by industry as a flux in plating tin and in the cold rolling of sheet steel. Palm oil contains valued fatty acids and yields stearic acid of high quality through hydrogenation. It contains a large amount of carotene, a precursor of vitamin A, and is also a source of proteins and antibiotics obtained through selective fermentation. Palm kernel oil (the oil derived from seeds of several genera discussed below) also has a number of uses in edible and inedible products which include cooking oils, margarines, shortenings for the bakery industry, ice cream, cosmetics, shampoos, soap, additives for lubricating oils, detergent foam boosters, biodegradable detergents, and the like.

Although the fruits and/or seeds of many palms may be oleaginous, the species yielding quantities of oil sufficient to be attractive in commerce are relatively few, about ten of the estimated 2780 kinds of palms presently known in the world. Thus about one of every 278 species of palms can be regarded as a commercial oil-yielding palm. The more important of these oil-yielding species were recognized as useful by man centuries ago when he first utilized them for domestic purposes, either for food or for edible or otherwise useful oil. Primitive man did a remarkably good job on a trial-and-error basis in selecting the useful plants from the nonuseful. He had a long time span in which to work, but his early needs did not always match those of modern man and his sophisticated industries. Thus it may be that genera and species of palms exist today which have fruits with oleaginous properties not recognized as potentially useful. Apparently no systematic survey has been made to evaluate the oil content of the fruits of all palms likely to be useful.

The presently recognized oil-yielding palms, representing eight genera, pertain to but two of the fifteen major groups of the Palmae, namely the arecoid and cocosoid groups. However only two genera, *Jessenia* and *Oenocarpus*, are arecoid taxa; the larger number of oil palms are cocosoid species belonging to the genera *Acrocomia*, *Astrocaryum*, *Cocos*, *Elaeis*, *Orbignya*, and *Syagrus*. Of interest also is the fact that of these eight genera only one, *Cocos*, is of Old World origin (probably Melanesia); *Elaeis* straddles the hemispheres with one species in tropical Africa and another in northeastern continental tropical America; all remaining genera are neotropical, the majority of species being South American.

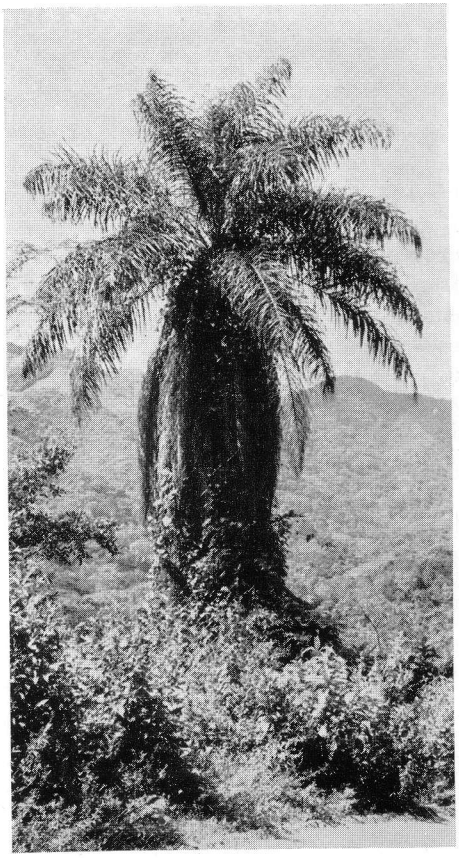
The use of certain palms for oil by man appears to predate written history,

at least in the case of the coconut palm, long considered not only the world's most important palm but one of the most useful of all trees as well. The endosperm of the coconut doubtless appealed originally to prehistoric primitive tropical man as a source of nutritious food, but the edible meat must soon have been found to yield a useful oil as well. Certainly the coconut had been widely disseminated as a cultigen and its oil was in universal domestic use throughout the coconut-growing areas of the Old World by the time of the pioneer voyages of Europeans. On the other hand, the use of the fruit of the African oil palm, the only other important source of palm oil in the Old World, appears to be of much more recent origin. Fruits of wild trees have long been collected for domestic use within its natural range in Africa, but *Elaeis guineensis* appears not to have been widely planted until very recent times, though apparently carried easterly across the African continent to Madagascar from its center of dispersal in tropical West Africa. Only within the past century has it been extensively cultivated, as *Cocos* has been for centuries.

The greatest variety if not the most important of the oil-yielding palms are natives of the New World from Mexico to Argentina, but with the greatest concentration in Brazil. Amerindians of the lowland neotropics apparently have utilized the oils derived from several different palms for a long time. Just how long is impossible to say, as written records for the pre-Columbian period are lacking and oil palms did not exist in the temperate highlands occupied by more highly developed cultures where archeological records have principally been available. However, there was no species of oil palm in the New World comparable to the coconut palm in the tropical Old World where, in its areas of distribution, it served as a primary source of food and edible oil.

Most of our early knowledge of oil-yielding palms in tropical America and their uses by aboriginals come from the accounts of various European naturalists travelling in South America, especially Amazonia, during the past century. Amerindian utilization of the oils obtained from palms, as recorded by these travellers, includes use as food and drink, cooking oils, illuminants, medicine, and as oil bases for the widely used insect-repellent and/or decorative body paints derived from the seeds of *Bixa* and the fruits of *Genipa*.

In a letter to Sir William Hooker from San Carlos del Río Negro, Venezuela [near the junction of the headwaters of the Orinoco and the Río Negro, a major tributary of the Amazon], the botanist Richard Spruce (6) wrote [March 19, 1854] "nearly all the palm fruits yield oil in greater or less quantity. . . . By allowing the liquid ["by triturating the fruit . . . in water"] to stand a short time . . . the oil rises to the top, and an idea is obtained of the quantity yielded by any particular palm fruit." Spruce noted that the greatest quantity of oil ("in appearance exactly like the oil of *E. guineensis*") is produced by what he erroneously called *Elaeis melanococca* [now known as *E. oleifera*], then adds, "but I have never heard of its being collected and put to any use [although] abundant all about the mouths of the Río Negro and Madeira . . . ." Certainly this is a strange commentary considering that its sister species, the African *E. guineensis*, is today one of the world's two most important oil palms. Spruce goes on to report that oil "of finer quality . . . colourless and sweet-tasted, . . . excellent for lamps [and] . . . cookery . . . [and] equal to olive oil or butter" is obtained from species of *Oenocarpus* ("*Oe. Ba-*



1. *Acrocomia mexicana* in the state of Oaxaca, Mexico. Photo by H. E. Moore, Jr.

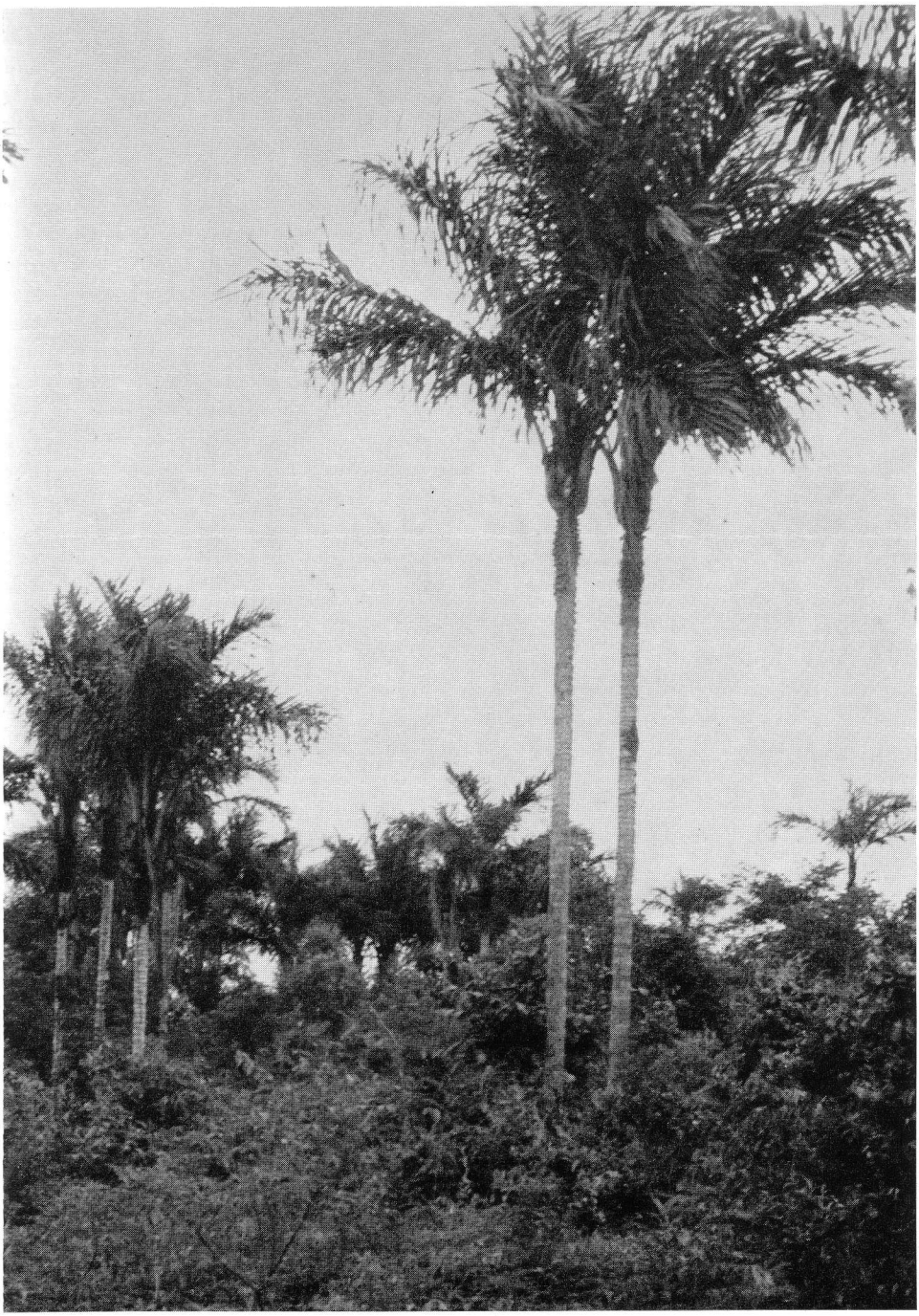
caba, pataua, distichia, etc.".* The recognition of the excellence of *Oenocarpus* oil was even shown by "the shopkeepers of Pará [who] buy Pataua oil of the Indians, and mix it in equal proportions with olive oil, retailing the whole as 'olive oil', from which indeed even the best judges can scarcely distinguish it."

A number of palm genera are known to be sources of palm oil, either derived from the mesocarp and/or the endosperm. The records of some like *Rhyticocos* (2) and *Brahea* describe only minor local usually aboriginal use. Those genera that have been exploited commercially, either in the past or at present, are discussed briefly below in alphabetical order. It should be emphasized that these genera, despite their importance as economic plants, are poorly known biologically and, except for *Cocos* and *Elaeis*, also are in need of taxonomic study.

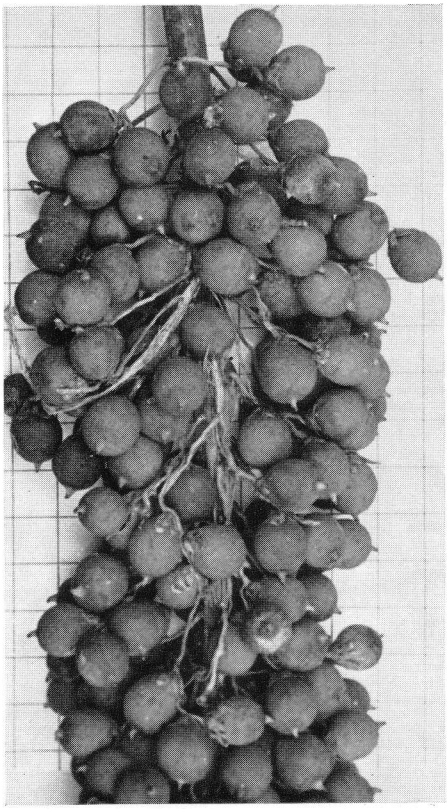
* Certain of these palms are now considered species of *Jessenia*.

Acrocomia

Acrocomia, a genus of about 26 species of prickly cocosoid palms (Fig. 1) of the New World, occurs naturally in sites that are seasonally dry from Mexico and the West Indies to Paraguay and northern Argentina. The somewhat spherical druplike fruits (to 2 inches in diameter in some species) yield a kernel oil which at present is commercially valuable only from *A. totai*, a native of savannas in northeastern Argentina and Paraguay where it is locally abundant and of increasing importance in the export trade. Annual exports of this oil from Paraguay in 1971 were 7,400 metric tons, representing a gradual annual increase from the 2,300 metric tons recorded in 1964 (1). During the past decade this appears to be the only palm kernel oil exported from South America, and in 1971 it represented about three percent of the overall world export total of that commodity, the balance of which represents *Elaeis* oil (1). However, Brazil doubtless produces substantial palm kernel oil all of which is used domestically. In Paraguay, the kernel oil is obtained from the seed of wild trees. *Acrocomia totai* is of special interest in being a subtropical rather than a strictly tropical species. As such it may have potential as a cultivated species in similar latitudes where *Cocos* and *Elaeis* cannot be grown productively. Unlike the latter genera, which produce fruit continuously throughout the year but only under hot, wet, tropical conditions,



2. *Astrocaryum tucuma* near Manaus, Brazil. Photo by H. E. Moore, Jr.



3. Fruits of *Astrocaryum standleyanum* in Panamá. Photo by Paul H. Allen.

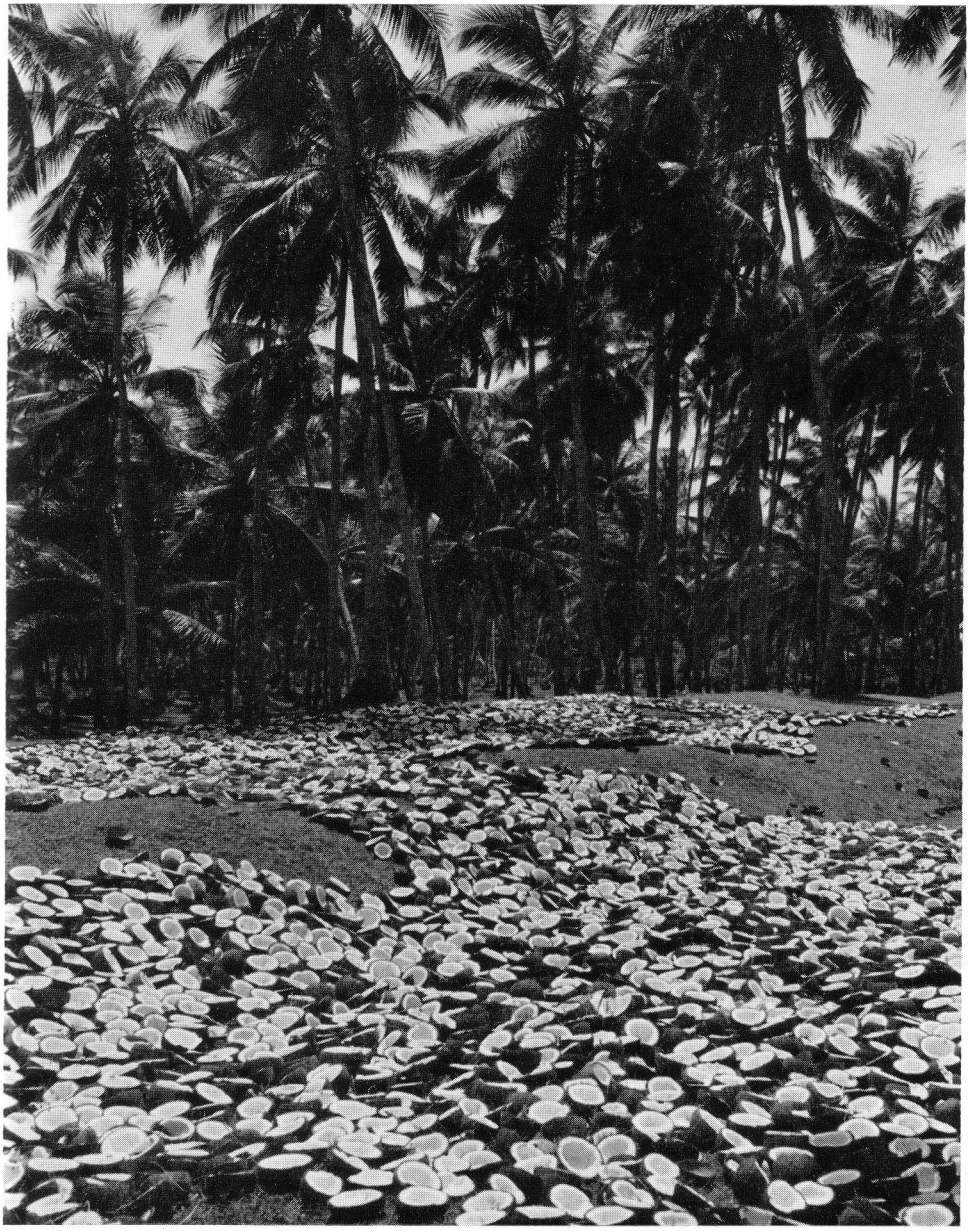
A. totai at its latitude produces seasonally and consequently is presumed to be less productive.

Astrocaryum

Astrocaryum includes nearly 50 species of neotropical cocosoid palms (Figs. 2, 3) mostly native to hot areas of heavy rainfall in lowland South America. Several taxa are recognized sources of commercial palm oils but in all cases fruits are obtained from wild trees. Most important have been *A. murumuru* and *A. tucuma* of the lower Amazon basin, especially that part located within the Brazilian state of Pará. During World War II, and for a short period thereafter, substantial quantities of tucum palm kernels were exported (about 14,000 metric tons in 1949) but the total palm kernel oil production for domestic use in Brazil for these two species has seldom exceeded 1,000 metric tons (3). It should be noted that these palms occupy an area in Amazonia which is essentially the climatic analogue of the native range of *Elaeis guineensis*. Any consideration of the possible culture of *Astrocaryum* should therefore be made on the basis of its pros and cons vis-à-vis the African oil palm, a far more productive species.

Cocos

Cocos is the genus of the familiar monotypic cocosoid palm *C. nucifera* (cover), a cultigen widely planted along many humid tropical shores and adjacent lowland areas but probably of Melanesian origin. The coconut has been for many years the world's most important single source of a vegetable oil derived from a palm, the kernel oil (coconut oil) derived from copra (Fig. 4). Copra, containing about 65% oil, is the dried meat or endosperm of the familiar coconut seed. Unlike *Elaeis*, which produces both a mesocarp and seed oil, *Cocos* has a fibrous husk devoid of any oil (Fig. 5) and the collection of coconuts and preparation of copra which require much hand labor is not amenable to mechanization. The yield of coconut oil runs between 800–1,200 pounds per acre which is about one fourth the oil production of the African oil palm, a major reason why plantings of the latter palm are increasing dramatically at the present time. According to Purseglove (5), there are five million bearing palms on ten million acres planted to coconuts. This acreage is scattered throughout the lowland tropics but the Philippine Islands, Oceania, Indonesia, Malaysia, and Sri Lanka together produce over 90%

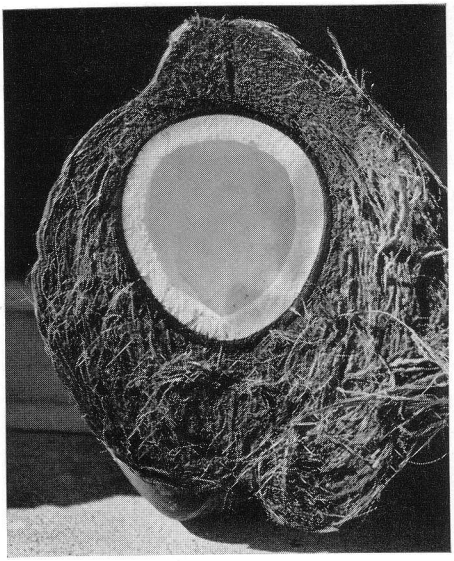


4. Copra drying at the edge of a coconut plantation in Sri Lanka.

of the copra and coconut oil entering world trade. India, Burma, and Thailand also have large plantings but utilize most of their production domestically.

Elaeis

Elaeis (including *Corozo*) is a small genus of two species of cocosoid palms. One, *E. guineensis* (Fig. 6), including



5. A coconut split lengthwise to show husk and seed.

E. madagascariensis, is native to wet paleotropical Africa; the other, *E. oleifera* (Figs. 7, 8), occurs in the humid lowland neotropics of the lower Amazon, northern South America, and Central America. This is an unusual distribution among palm genera and one shared only with the genus *Raphia* (4). *Elaeis oleifera* has oleaginous characteristics similar to those of *E. guineensis* (see Spruce's comments above), but it is not cultivated, although it may be utilized locally for domestic purposes within its natural range. *Elaeis guineensis*, cultivated in extensive plantations mainly in the Old World, is the important commercial species and may soon displace *Cocos* as the most important source of palm oils (inclusive of both palm oil and palm kernel oil). In the decade 1962–1972 world exports of coconut oil increased 16% compared with a 75% increase in exports of *Elaeis* oils. The reason for this increase is obvious. The African oil palm fruit contains 45–48% of palm oil (mesocarp oil) in its fleshy coat (vs. none in the fibrous coconut husk) and another 56% of palm kernel oil in the endosperm of the seed (Fig. 9). And although the fruit clusters require hand harvesting, all subsequent operations including oil extraction (at the plantation) can be completely mechanized. Since *Elaeis guineensis* is a tree crop which fruits continuously in large, dense, many-fruited clusters (Fig. 10), it is not only the most efficient oil palm but apparently the most efficient of all oil-yielding plants as well. Certainly the majority of man's important oil plants (soybean, sunflower, peanut, cotton, and rapeseed) are herbaceous species of seasonal culture and hence do not produce crops the year around.

Most of the world's supply of palm oil and palm kernel oil has until recently originated in the native range of *Elaeis guineensis* in West African countries where the major source has been mostly wild or semiwild trees. However, commercial plantations, utilizing selected superior seedstock and with modern integrated extractive mills on the premises, have been developing rapidly elsewhere in the tropics both in the Old World and the New World wherever the necessary conditions of heat, humidity and high rainfall suitable for the best yields prevail. The high rate in development of new plantations of the African oil palm is illustrated dynamically in Malaysia where the species was first introduced in 1875. It remained unrecognized as an oil source but was grown as an ornamental for nearly 50 years. Its potential was finally recognized and in 1917 it began to be developed as a crop species. 12,548 acres had been planted by 1926, 186,680 acres in 1964, 660,000 acres in 1967, and over a million acres in 1973. This explosive recent growth of oil palm plantings is related directly to the world population explosion and

6. *Elaeis guineensis* in plantation culture, Honduras.

the greatly increased need for vegetable oils. The rationale for such success with this species is more than evident, for the productivity of this plantation palm, which begins to bear when plants are three years old, is two tons of vegetable oil per acre for mature trees (eight years old or more).

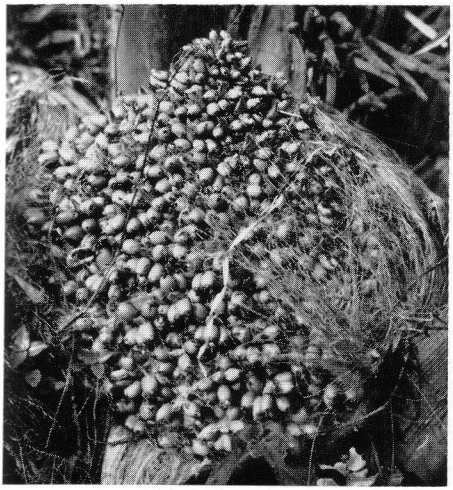
7. *Elaeis oleifera* in the former experiment station at Lancetilla, Honduras.

Jessenia

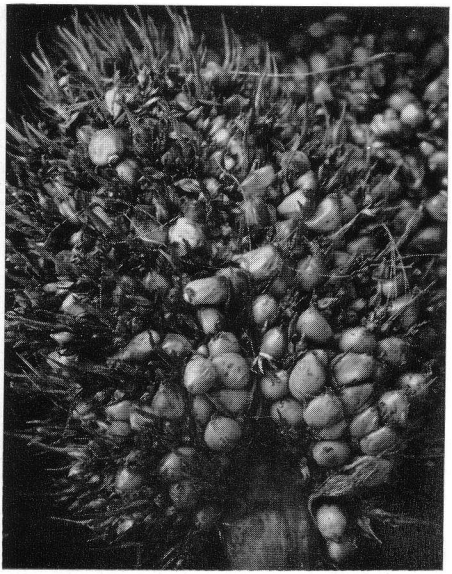
Jessenia is believed to include about five species of arecoid palms (Fig. 11) native to high rainfall areas of lowland tropical South America, including the river systems of the Amazon and Orinoco, and of the Atrato and San Juan in the Colombian Chocó. The drupaceous fruits produced abundantly by several Amazonian species, especially *J. bataua* (called *patauá* or *batauá* in Brazil and *seje* in Colombia and Venezuela), have long been utilized by Amerindians who relish the light greenish-yellow, edible, mesocarp oil. The edible oil of the *J. bataua* fruit is of high quality and practically identical in chemistry and utility with olive oil, a fact commented upon by Richard Spruce (see above, as *Oenocarpus pataua*). The *Jessenia* drupe is apparently unique among oleaginous palms in that there is scarcely any oil in the kernel (less than 1%) while the pericarp yields 18–24% oil (3). The very small commercial production of *pataua* oil, all obtained from wild trees, has been limited to Brazil where exports peaked in 1944 (215 metric tons) during the World War II scarcity of vegetable oil. Markley points out that the patauá palm occupies a natural range that would be ideally suited to plantation culture of *Elaeis guineensis*, a far more efficient palm oil producer.

Oenocarpus

Oenocarpus is an arecoid genus including about 16 species (Fig. 12) occu-



8. *Elaeis oleifera* in fruit at Lancetilla.



9. A fruit cluster of *Elaeis guineensis* in Honduras.

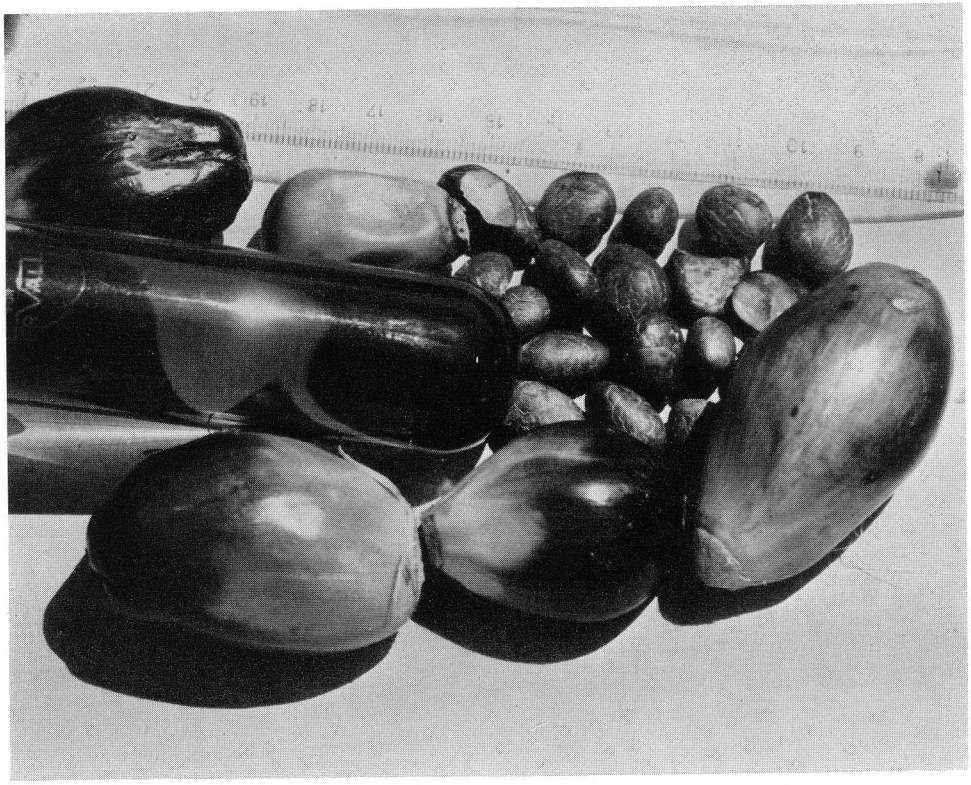
pying essentially the same geographical range in lowland tropical South America as the closely related *Jessenia*. Both genera are poorly known taxonomically and a comparative study of the two would seem desirable. The fruits of the two genera appear to be similar in general morphology and aboriginal use.

Orbignya

Orbignya includes about 24 species of often massive cocosoid palms native to the continental neotropics, mostly in South America. As is so frequently the case with large tropical plants, basic information on their biology and taxonomy is woefully inadequate. The genus includes what have been up to now the most important native oil-yielding palms of the New World. These are the Brazilian *curuá* (*O. sabulosa*) and *babassú* palms (*O. martiana* and *O. oleifera*) and the cohune palm (*O. cohune*, see Fig. 13) of lowland Central America. The potential of other species of *Orbignya* as oil producers is unknown as is the potential of species of the closely related genera *Attalea*, *Maximiliana*, and *Scheelea*.

Babassú and *cohune* palm fruits are produced abundantly in enormous pendant clusters (Fig. 14) with several hundred (each 3–5 inches long) in each giant infrutescence. The oil is derived from the kernels, for the pericarp in *Orbignya* is fibrous, not oleaginous. Each *babassú* fruit may have up to eight seeds, the endosperm containing about 65% oil. However the kernel oil represents, on an average, only about six percent of the total weight of the fruit. This fact, together with the physical difficulty of extracting the kernels (mostly a hand operation), have made *Orbignya* oil production relatively uneconomic when it is in normal competition in the world market with other seed oils, whether from palms or other plants, and primarily because of this the oil is no longer exported from Brazil.

Up to the end of World War II, most Brazilian *babassú* kernels were exported for oil extraction abroad, about 44,000 metric tons having been produced in 1945. Brazil's rapidly increasing pop-



10. Fruits, seeds, and mesocarp oil (in test tube) of *Elaeis guineensis*.

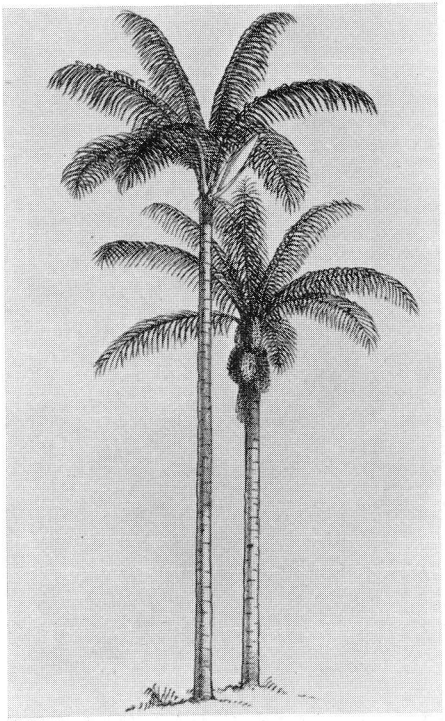
ulation and concomitant increases in domestic requirements for vegetable oil after the war have meant that *babassú*-derived oil has been used entirely in Brazil where the oil's large lauric acid content has made it of value primarily in the domestic soap industry (3). During a recent five-year period (1968–1972), production of *babassú* kernels increased from 177,000 to 190,000 metric tons, representing an increase in oil production from 65,000 to 107,000 metric tons (1).

Babassú fruits have always been obtained from wild trees, of which the largest stands are found in the Brazilian "campos" in the states of Maranhão, Piauí and northern Goiás. Although the wild stands of *Orbignya* apparently continue to be productive domestic sources of palm kernel oil, eventually they will be unable to hold their own economically with more efficient plantings of *Elaeis* which most certainly will be developed in favorable sites in Amazonia.

Syagrus

Syagrus includes 34 species of cocosoid palms of tropical South America. Only one species, *S. coronata*, the *licuri* or *ouricury* palm (Fig. 15), has been utilized as the source of palm kernel oil, used domestically in Brazil's soap industry. Formerly, during World War II, *licuri* kernels were exported, peak production reaching about 15,000 metric tons, but utilization of this species has

11. *Jessenia bataua* near Pucallpa, Peru. Photo by H. E. Moore, Jr.



12. *Oenocarpus bacaba* as illustrated in Wallace, Palm Trees of the Amazon and Their Uses, plate IX.

apparently decreased greatly in recent years (3). Unlike other oleaginous palms, the majority of which require rainy lowland tropical conditions, *Syargus coronata* occurs in areas of low rainfall and inhabits poor, arid soils throughout its natural range in Brazil from Pernambuco to Minas Gerais.

Discussion

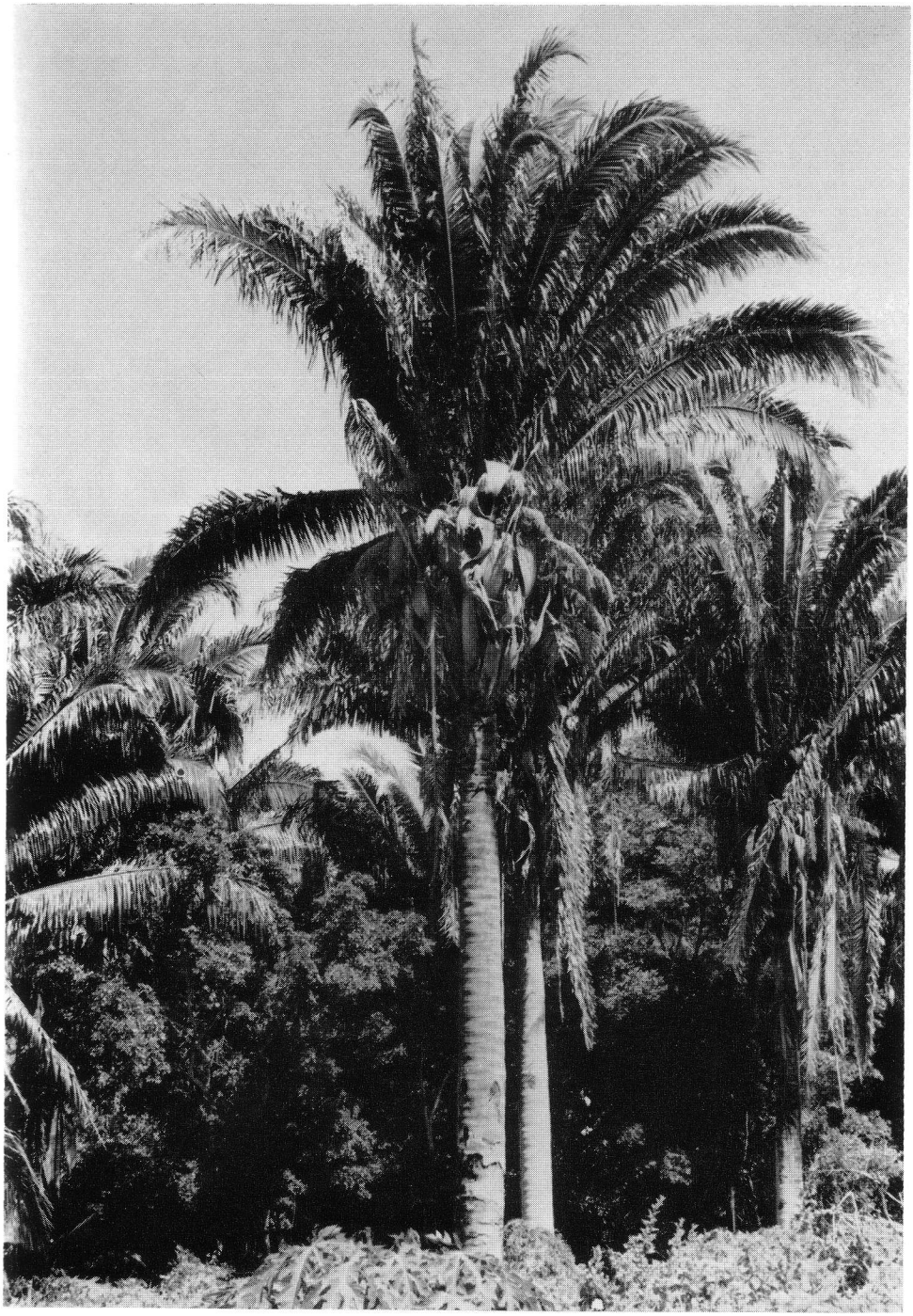
In this brief review of the world's oil-producing palms, it is clear why *Cocos nucifera* and *Elaeis guineensis* are the only two species of prime economic importance. Table 2, which compares the oil content of all the useful palm species, demonstrates that the African oil palm stands far above all the others in the total oil content of its fruit. Furthermore it can outproduce the coconut in oil production four to one on an acreage basis. It has lagged behind the coconut up to now simply because the development of *Elaeis* as a plantation crop is comparatively very recent. The combination in *Elaeis* of highest oil content and highest yield per acre—plus the fact that modern plantation culture of this species can involve automatic oil extraction plants as an integrated part of a year-round production-extraction plantation operation—promises that *Elaeis guineensis* will soon outstrip *Cocos* (which does not lend itself so easily to such integrated production) as the most important of oil-yielding palms.

Table 2. Percentage of oil in the fruits of oil palms.

Species	% mesocarp oil	% kernel oil
Acrocomia totai	–	60
Astrocaryum spp.	–	?
Cocos nucifera	–	65
Elaeis guineensis	45–48	56
Jessenia bataua	18–24	1
Orbignya spp.	–	65
Syagrus coronata	–	60

The coconut has remained most important up to now because as a cultigen it has been grown for a far longer period. Moreover it can continue to be an important plantation crop in many extensive tropical low-island areas, such as in Oceania, where other industrially important crops cannot be grown and where it serves also in the domestic economy for food and other uses. Like *Elaeis*, the coconut tree produces the year around. However, far more hand labor is required in producing copra, for each fruit must be dehusked and the seed split to permit drying the kernel.

For reasons mentioned earlier, the



13. *Orbignya guacuyule* on the west coast of Mexico much resembles *O. cohune*. Photo by H. E. Moore, Jr.

14. Fruit of *Orbignya cohune* at Soledad, Cuba.

other oil-yielding palms will not prove to be serious economic competitors to *Elaeis* and *Cocos*. *Acrocomia totai* and several species of *Orbignya* are essentially equal to the coconut in the oil content of their seeds but as uncultivated palms they have other drawbacks and at best they can remain economically viable only as local domestic or special-situation sources of oil. However, the situa-

15. *Syagrus coronata*, the *licuri* or *ouricury* palm of Brazil. Photo by Eugene D. Kitzke. Reprinted from Principes 19: 9, 1975.

tion might change if serious disease problems were to develop with the primary palms—diseases to which these secondary species proved resistant.

In conclusion, it may be worthwhile to examine the relative importance of the palms versus other species that are also of major importance as sources of vegetable oils in the world export market. Table 3 lists world production of vegetable oil from the most important species for 1972. Four palms appear in the list of 13 species which, except for the palm genera *Orbignya* and *Acrocomia*, represent cultivated plants. The only other tree crop that produces oil is the olive. The soybean, *Glycine max*, dominates in oil production. It produces a general-purpose oil that, when hydrogenated, can be used in many different ways, the principal exception being that of a foaming agent in soap, where coconut oil is required. However palm

Table 3. World production of vegetable oils by plant species, 1972 (in 1,000 metric tons).

Glycine max	6,585
Cocos nucifera	4,265
Helianthus annuus	3,625
Elaeis guineensis	3,142
Arachis hypogaea	3,335
Gossypium spp.	2,580
Brassica spp.	2,575
Olea europaea	1,565
Sesamum indicum	635
Zea mays	305
Carthamnus tinctorius	300
Orbignya spp. (babassú)	107
Acrocomia totai	16

oils from both *Cocos* and *Elaeis* can be used in place of either soybean oil or the oil from other important species which are not palms. The palm-derived oils are used increasingly because they are produced the year around in an efficient manner which makes them far more competitive than oils from annual herbaceous species in yield and price. The supply of palm oil is far more dependable since it is produced under growing conditions which are essentially unvariable. Soybeans (and most other oilseeds) are highly susceptible to poor growing seasons.

Recent newspaper accounts in January, 1975 note that both palm oil (*Elaeis*) and coconut oil have been selling in the United States at as much as 13 cents per pound cheaper than soybean oil. Little wonder then that vegetable users such as the entire potato-processing industry of the Pacific Northwest have shifted during the year from use of soybean oil to palm oil. It is anticipated that increasing demand for use of palm oils will result in the continued expansion of *Elaeis guineensis* plantations. There are still substantial undeveloped

natural areas available for the culture of this tree crop in the wet lowland tropics of the world, but the same situation does not exist for the annual oil crops, or for the olive tree.

The greatest potential threat to contemporary *Elaeis* plantations is disease. This species is increasingly grown in monoculture over extensive new areas. Past experience has shown what can happen suddenly to such crop monocultures as, for example, Arabian coffee, formerly an important plantation industry in Sri Lanka but wiped out by red rust (*Hemileia*). The endemic leaf disease (*Dothidiella*) of *Hevea* in Amazonia has barred profitable monocultural plantings of the Pará rubber tree in the New World. Tree crops require more time to be replaced than do annuals, which can be quickly replaced or rotated with another crop whenever serious disease threatens. Palms are more susceptible than most trees because of their unique growth from a single terminal bud. Once that bud is killed, the tree is dead. Standard horticultural techniques such as grafting on disease-resistant stock, used to combat disease in some woody plants, cannot be used with palms. Several serious but little known diseases already attack the coconut. One of these, "lethal yellowing," attacks some other palm genera as well. Is *Elaeis* also susceptible? What are the endemic diseases and pests of this genus within its natural range in Africa and tropical America? These are questions concerning the basic biology of these palms for which answers are largely unknown but for which answers should be obtained now, not after an epidemic strikes.

Acknowledgment

I would like to extend thanks for the generous aid provided by United Brands Corporation and its subsidiary, the Tela Railroad Company in Honduras. Without this help it would have been impossible to study at first hand present-day plantings of oil palm (*Elaeis*) in Central America.

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Palmologue

This and That

DENT SMITH

Palms in Spain

Only one palm, *Chamaerops humilis*, is supposed to be native in Spain or anywhere else in Europe, but that supposition depends on the definition of native. "Only" is a word to be wary of, at least sometimes. If logic means anything, another palm, *Phoenix dactylifera*, also should be considered native in Europe, even though the range is confined to a small region in and around Elche in southeastern Spain. The coconut palm that circles the world is called "native" in hundreds of localities in the Torrid Zone, but manifestly did not originate simultaneously on opposite sides of the globe. No one disputes that the wild washingtonias of desert California are native there although they may have been introduced from Mexico by Indians in prehistoric times, or vice versa, from what is now California to what is now Mexico.

How many centuries, or millenia, must elapse before a palm is qualified to be termed "native" when it becomes established beyond its primeval and original range? The date palm *Phoenix dactylifera* has been in Spain over two thousand years, introduced by the Phoenicians. But cultivated palms, says an opponent, should not be ranked as natural occurrences. True enough, though only up to the point that they also have been established in the wild state since time out of mind; and that is precisely the case with the date palms of the Elche region in Spain. So it seems that flaws in the textbooks have to be unlearned.

The Iberian peninsula, which includes both Spain and Portugal, lies in a latitude south of the French Riviera, where numerous palm species are cultivated with success, and accordingly it might be assumed that the Spanish climate would be hospitable to still more species. Not so of all Spain, but hospitable enough in the southern parts in proximity to the Mediterranean coast. The hospitality is not being taken advantage of now. Palms there are, but of so few kinds as to be called a great paucity. Where a hundred or more species might be successfully cultivated, we were hard put to find more than eight on public view.

The "we" that popped up in the preceding paragraph has to be elucidated. We were, besides myself, two relatives from San Luis Potosí, Mexico, my brother-in-law Leonardo (not Da Vinci) and his wife María de la Luz, whom for the sake of greater politeness I should call Don Leonardo and Doña Luz. Well, we had flown over to Madrid in May of 1974, had taken all the standard tours to Avila, Segovia, Toledo and other points roundabout, and then had started out in a rental car to motor about 4,000 kilometers in southern Spain, driving on the first leg down through Don Quixote's tilting territory of La Mancha and on south to Elche, which is either the palmiest city on this planet or else a leading candidate for the honor. When we found ourselves amiddlemost all those palms, I felt a sudden urge to do a book entitled, "You Never Saw so Many Palms," with a subtitle to this effect: "Nor even imagined that so many could exist in just one place."

1. *Phoenix dactylifera* grows by the thousands along the banks of the Río Vinalopo which traverses the city of Elche.

Only a short distance from the bigger city of Alicante, Elche is not blessed with a euphonious name for such a palmy town. In Castilian ch is pronounced exactly as in the English word church, so the name of the town is pronounced El-chey, in two syllables, with the accent on the first syllable. It was once spelled Elxe. A townsman, however, is called an ilicitano, not because he is illicit, but because the adjective derives from Ilici, the ancient name of Elche. Euphonious or not, Elche is palm heaven or palm haven, as one might prefer, and for a random surmise, it may have the largest urban concentration of palms anywhere on earth.

Madrid had not prepared us with any expectation of seeing great numbers of palms, for there we had noted only a few old *Trachycarpus* palms about forty feet tall with sparse, raggedy crowns and looking quite decrepit. In Toledo, Avila, Segovia and other towns in mid-Spain we had observed no palms at all, but this may have been owing to having had our attention riveted on castles, town walls, cathedrals and other such attention-getters, which in Spain are among the most compelling. In Toledo I asked a Polish tourist if she had observed any palms, and with some vehemence she replied, "Zilch!"

But the palms at Elche? The claim is made that they number 600,000, which to me seemed grossly underestimated. They are all date palms, none other than *Phoenix dactylifera*, and they come in many shapes and sizes—short, tall, bent, straight, and some few of them freakish, with arms or "branches," like the saguaro cactus. If vast numbers of date

2. Elche. Date palms in the left foreground of a Moorish structure.

palms suggest monotony, it would be much the same kind of monotony to be found in a forest of tall redwoods. The impression made on us was one of magnificence. Certain it is that in Elche we were swamped with palms, pleasantly awash in seas of them, in the parks, in gardens large and small, in street plantings, in patios, on the river banks, among the ruins of crumbling buildings, and in cracks and crannies, pots, cans, and tubs. If an ilicitano eats a date (he does), he spits out the seed, it germinates, he pots it, he grows it without apology and loves it shamelessly, perhaps as a symbol of allegiance to his homeland.

Quite apart from the date palms, nowhere in Europe is there any concentration of other palms to vie in numbers with Elche. And apparently the date palms have been there since the Phoenicians came in the seventh or eighth century B.C. Of course they had been cultivated long before their introduction in Spain, and are believed to have existed near the Tigris and Euphrates for 4,000 years or more. If that can be interpreted to mean that they are not native in Spain, but only naturalized there, then the accepted range of numerous other palm species would have to be greatly shrunken in extent, for quite obviously, to cite just one example, the large-fruiting *Acrocomia mexicana* native on both Atlantic and Pacific coasts of Mexico could only have been distributed across high mountain ranges and intervening aridity by human agency.

After the Phoenicians, came the Romans, and Elche was a Roman colony until the Moors wrested it from them in the eighth century and held it nearly 500 years. The date palms had long

3. Elche. The date palms dominate every section, old or new.

since been naturalized there and many were cultivated for the fruit, but today the date harvest is not of so much importance as once it was. We bought from small shops several kinds of dates and found them all platable enough without inquiring into their comparative merits. My interest was focused on the palms themselves rather than on their product or on the industry.

The most remarkable date palm in Elche is a strange vegetable indeed and a cause for wonder. It has seven "brazos" or arms, which are so-called branches, each of the seven about the thickness of the normal trunk and rising almost perpendicularly from the point of attachment about three feet above the base. As may be seen from the illustration on the back cover of this issue, a steel support has been placed beneath the seven columnar arms, or branches if you will, and steel hoops have been affixed at higher points to guard against breakage—a wise precaution, for the loss of any arms would maim this vegetative wonder and destroy its symmetry.

Our curious palm is called in a printed leaflet, "La Palmera Imperial." This Imperial Palm is to be seen in a garden called the Priest's Grove, consisting largely of date palms, and it seems that the priest, Don José M. Castano, was a de luxe palmateer, with a grand passion for the palms, for his entire life was dedicated to the care of the palm garden. The leaflet has more to say in flowery Spanish, some of which I have Englished. "The Imperial Palm was so named because of having been dedicated to the Empress Elisabeth of Austria, who visited the garden in 1894. The palm is a botanical phenomenon unique in the world, not so much for its size and its eight columns in candelabrum

4. Elche. Not restricted to parks and gardens, the streets are lined with palms.

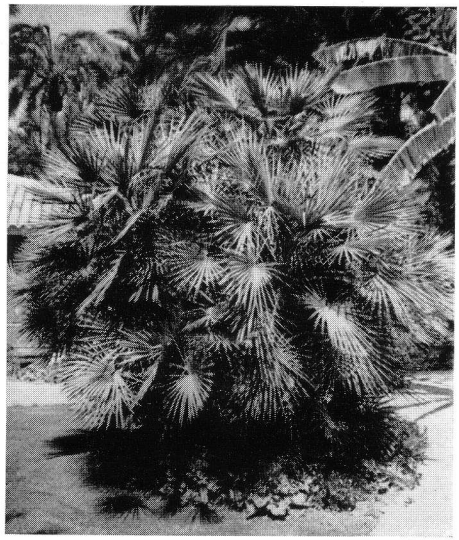
fashion as for the truly remarkable fact that, having been a male palm until 65 or 70 years of age, it put forth seven trunks [*troncos*] equally spaced, that actually grow from the parent trunk and are nourished from the common stem." But still more remarkable is it that anyone should have thought the palm had changed its sex because it put forth new growth. The writer proceeds, "This phenomenon began to be observed by Chaplain Castano about 1880, wherefore the age of the Imperial Palm may be calculated to have been some 150 years. Since the date palms may live up to 300 years, the year 1880 represents only one moment during its relative youth."

Travel folders being what they are, it seems futile to expect accuracy, but one such folder seemed much too far afield in stating that the Imperial Palm, together with the charms of all the other palms in Elche, is second only to the Alhambra in the number of tourists drawn thither. A laughable claim, for the Alhambra is constantly thronged by visitors, perhaps in the ratio of 1,000 to 1 drawn to Elche, which though a city of 75,000 inhabitants, has never even been heard of by the general run of foreign tourists and at best has precious little fame abroad. Foreigners hardly go to Spain hell-bent on seeing palms,

5. Elche. Lost among the countless date palms is an occasional example of another species, in this case *Washingtonia filifera* flanked by companions Doña Luz and Don Leonardo.

though Elche does attract a good many Spanish visitors and a modest number of other nationals.

Leaving Elche astern, we drove down to the Mediterranean coast and followed it wherever we could for about 400 kilo-



6. Elche. *Chamaerops humilis*, something of a rarity as a cultivated palm, which it is in the illustration, in its native Spain.

7. *Archontophoenix cunninghamiana*, a young palm giving scant competition to the date palms of Almería, an important Mediterranean port of Spain.

8. Almería. Two *Washingtonia filifera* on either hand of a *Trachycarpus* species.

meters, from a point just south of Alicante to Cartagena, Almería and Nerja before turning north and away from the sea for a stay in Granada. Throughout Andalusia we saw in the cities a few ornamental palms of no more than a half-dozen genera, but despite the undeniable existence of wild colonies of *Chamaerops humilis*, and despite a sharp lookout for them, I saw nary one of those palms, to say nothing of a colony. (We careful grammarians are wont to say "nary" for heavy emphasis.) In all our travel I saw a grand total of three *Chamaerops* plants, each one cultivated, in three separate localities. The other palms seen in the south, except *Phoenix dactylifera*, were all exotics: *Washingtonia filifera*, *W. robusta*, *Archontophoenix cunninghamiana*, *Trachycarpus* species, and *Phoenix canariensis*. Possibly there are a few others, but if so they seem to be kept pretty well hidden from the vulgar gaze. In any case there are pitifully few kinds in a region warm enough for oranges and lemons, or on a parallel with most of central Florida as it was only a quarter century ago. But *Chamaedorea* in Spain? Yes, I did see either one or two plants, I forget which, but not three.

Semantics would rule that *Phoenix canariensis* is not an exotic, as it was termed in the preceding paragraph, for it is a native of the Canary Islands which form two bona fide provinces of Spain. So as not to excite opposition, it may be prudent to say it is not still a third Spanish native, disqualified by its natural habitat offshore. Yet, to be perfectly inconsistent, we must be circumspect to say that some of the *Pritchardia* species endemic in Hawaii are native in the United States.

The climate in Andalusia, a large region, varies according to differences in latitude, terrain, rainfall, elevation and marine influence. Winter snowfall is not uncommon in Granada and hotel rooms are equipped with heat radiators,

9. Almería. Again the date palms, inside, outside and all round the town.

but slightly farther north in Seville the winter climate is milder if not exactly benign, and palms are much more in evidence because of that considerable difference. No matter, if you look for a *Butia* in Seville, it would probably be a great waste of time. As for less common palms, either with or without cold tolerance, perish the thought! Nevertheless it might be possible to cultivate with fair success over 100 palm species in Seville, for the mean temperature in January, the coolest month, is 52° F. and in August, the warmest month, is 85°. An occasional frost or light freeze is no great menance, for instance, to dozens of *Chamaedorea* species, and much less of one to the species of *Sabal*, which, like so many other genera, seems not to be represented in Seville or in the coastal cities to the south. Here are cited but two genera with a high degree of cold tolerance, though no doubt many others having a lesser degree would prove suitable in Seville.

At one point in the journey we turned south once again toward the Mediterranean, this time with Málaga as the objective. I told my passengers Doña Luz and Don Leonardo that we simply had to go there to eat Málaga grapes in the middle of Málaga, but my wily real motive was to find the *Chamaerops* colonies along the littoral. After reaching the city, we drove eastward on a highway paralleling the shoreline for about seven miles, and lo, nary a palm did we see! They just had to be there, but they weren't. We retraced the same route and headed north to Antequera and then west to Huelva, from whence we again approached the seacoast to see both the wild palms sure to be there and also at Palos the exact spot where Columbus embarked on his voyage of discovery. In Palos, however, no one we encountered knew anything about either Columbus or *Chamaerops*, and besides there was no sea in which to embark anyhow. We subsequently learned it had receded

several kilometers from the town, and the palms, *quien sabe*, nobody knows. We drove on north to explore Roman ruins and visit sundry cities, hamlets, monasteries and places where one just doesn't go, with a palm yield of close to zero. In spite of this, there had to be one long last drive south to Jerez, where all that sherry comes from, and then we had in mind to drive on beyond to the seacoast town of Cádiz. But it got late and we were so frazzled out from the long hours in that half-pint Renault that we never made the short ride from Jerez on down to Cádiz. And that's how I never got to see *Chamaerops* growing wild in Spain, even though I tracked them doggedly until they were right there within a stone's throw near Cádiz.

Before we had undertaken the journey to Europe, our persevering palmophile Mr. William D. Manley, who cultivates his palms in the countryside near Atlanta, had spent some time together with Mrs. Manley in Spain, mostly at Rota on the Mediterranean coast west of Jerez and north of Cádiz, and accordingly I wrote to him about the failure to see *Chamaerops*. He responded, "I can't understand why you did not see the palms in the wild. When we started south from Seville down to Rota, I began to see some around. They are not as numerous as they are south of Cádiz on the way down to the Rock of Gibraltar. I saw large clumps, possibly 50 to 75 feet in diameter, in wheat fields."

Many months later, in a letter just received from Bill the same correspondent, he still ". . . can't understand why you did not see those *Chamaerops* palms. After we had been in Rota several days, we drove on down to the Rock, and on the way where the road nears the sea, I saw such an array of oleander, olive and *Chamaerops* that I had to get Ruth to take several pictures of me in the field looking at them. It is possible that you drove on a different road, or that these palms have been plowed up and done away with, though I don't see how this would be possible. It would take a lot of plowing to get all the ones I saw."

To clarify for Bill and anyone else, if anyone else has persevered up to this point, my failure to see the wild palms, I dangle the following facts. There are two separate highways from Seville to Jerez, and we must have taken the palmless one. At Jerez we abandoned the intention to drive onto Cádiz, and we did not drive to Gibraltar. Nor did we follow the highway that hugs the coast for many miles southwest from Málaga. So here in one paragraph is a whole essay on how not to see *Chamaerops* in Spain.

But why repine? Elche alone was worth more than the price of admission, and the castles in Spain were thrown in free.

And in This Corner

The occurrence of a freakish palm is by no means confined to Elche. A short piece down the road from my home lies the town of Port Orange, which harbors a single-stem palm with adventitious branches. Just when this palm freaked out with the new growth has not been ascertained, but it was planted about eight years ago in the median strip dividing U.S. Highway 1, very likely because thought to be a novel prize.

If the palm is *Phoenix dactylifera*, which offhand appears to be a close guess, the eccentric branching is neither proof nor disproof of it. Its lack of basal offshoots is common to date palms grown commercially after removal of the suckers. One cannot always be sure of specific identity hereabouts, for either some or all of the species tend to hybridize readily wherever growing in diversity. But hybridization has nothing

10. A branching *Phoenix* in the median strip of U.S. Highway 1 at Port Orange, Florida, Dr. Walter H. Hodge standing at its base.

11. Telephoto of the upper part of the Port Orange palm to show close up its eccentric growth.

to do with the eccentricity of the Port Orange palm, for adventitious branching is not typically found in *Phoenix* and presumably not transmitted. Offshoots above ground level are not unusual on some of the date palms, but unlike adventitious branches, these offshoot forms roots.

Dr. Walter Hodge and I are apt to go calling on any noteworthy plants whenever he comes to my locality, and this last spring was one of those occasions. We paid a visit to the Port Orange palm, viewed it critically, stared it down, photographed it (Fig. 10), and left on other important business such as to see the Fairchild Oak, a gigantic live oak named in honor of David Fairchild.

Texas Palms Rescued

A recent issue of "Happy Motoring News," a leaflet published monthly by Exxon Company U.S.A., contains the following Happy Palm News.

"In southern Texas, where the Rio Grande empties into the Gulf, a few hundred invaders from Mexico live. They're pampered, guarded by uniformed patrolmen, and encouraged to 'be fruitful and multiply.' They are Mexican sabal palm trees, and they don't grow wild anywhere else in the U.S. but in this unique sanctuary.

"Destruction of stands of the sabal palm, which were never numerous north of the Rio Grande, has reduced the trees to a 34-acre plot southeast of Brownsville, Texas. Alarmed that the last environmental complex characteristic of tropical Mexico in the U.S. might be bulldozed into a cottonfield, the National Audubon Society turned to Exxon Company, U.S.A. for help. With the company's financial assistance, the Society bought the plot and another 136 surrounding acres and created the Texas Sabal Palm Sanctuary."

Hurray for the big, bad oil company! But did *Sabal mexicana* invade Texas, or did *S. texana* invade borderland Mexico? L. H. Bailey cited the type locality of *S. texana* as in Mexico near Matamoros, only a short distance south of Brownsville, Texas. It's a safe bet that the Texans will be aggrieved if *S. texana* has to lose its specific status in that of *S. mexicana*, but taxonomy has its own flag to carry. In 1957 and again in 1968 I visited the grove that is now a sanctuary, and a casual inspection revealed nothing different from a grove of *Sabal palmetto* in Florida, but specific differences in the palms do exist. Close resemblance, or rather just look-alike, is not a determining factor with taxonomists in any case, for if it were, the many species of *Sabal* would be reduced to a half-dozen or so.

South Carolina Palms

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Successful palm introduction to an area experiencing minimum Zone 8 temperatures is currently being investigated by several institutions and Palm Society members. *Sabal palmetto* is native to South Carolina and is the state tree but when sold for landscaping, specimens of this species are usually dug from wild stands as it grows too slowly for artificial propagation. *Trachycarpus* grows well throughout the state and further north, but is also exasperatingly slow. *Rhapidophyllum hystrix* and *Sabal minor* are easily able to withstand Zone 7 temperature to 0° F or below (Popenoe, 1973), but the absence of a trunk reduces their desirability as street plantings or major landscaping subjects. Cole (1973) records the survival of other *Sabal* species, *Jubaea chilensis*, and *Washingtonia filifera* in Tennessee during extremely cold winters with temperatures much lower than South Carolina experiences, but his method of protection is not practical for larger specimens and street plantings.

Many palms are described as suitable for Zone 8 but experience by the Columbia Zoological Park and Palm Society members has not borne this out. *Washingtonia robusta*, *Phoenix roebelenii*, and *Livistona chinensis*, for instance, are described by some Florida and California nurseries as viable in Zone 8 and therefore able to withstand 10–20° F. Most of these however have been found to be damaged immediately by temperatures below 20° F. Low humidity in California may increase tolerance to low temperatures but probably not much below 20° F. After two winters, one extremely mild, one average, and the other very cold and snow-filled, selected species not ordinarily utilized or sold within the state are beginning to stand out as suitable for central and coastal South Carolina, at least in protected locations.

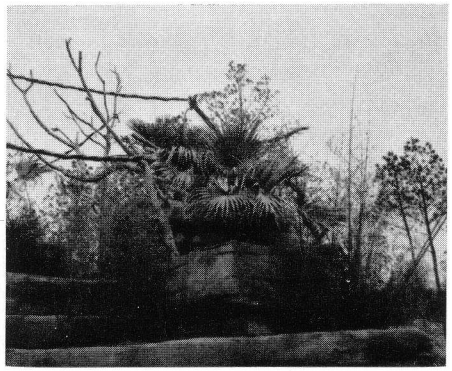
Columbia Palms

While palms are becoming more common within Columbia and central South Carolina, the variety planted has been very limited—*Sabal minor*, *Sabal palmetto*, *Trachycarpus fortunei*, and *Butia capitata*. All of these easily withstood record lows of 6° F and heavy snow in 1972, the larger individuals completely unaffected.

In 1972, the Columbia Zoological Park, looking for species new to the area, received specimens, many 4–6 feet high, of *Phoenix reclinata*, *Livistona chinensis*, and *Washingtonia robusta*. These plants were subjected to snow, sleet, and temperatures to 6° F in the winter of 1972–73. Some of the plants had not been set out and were still in containers or ball and burlap; most plants were completely defoliated but began producing new growth by late spring. Large *Washingtonia robusta* in 30-gallon containers fared much better. Not only was the defoliation less severe but new growth was initiated much earlier and completed by midsummer. The protection afforded the roots probably had much to do with the renewed vigor and hardiness of these plants since the ball and burlaped specimens were only 10 percent recovered by late spring. The weather conditions mentioned above are, fortunately, in the extreme, never having occurred previously in the history of the area; temperatures normally do not go below 18° F.

Winter conditions in 1973–74 and

1. *Washingtonia robusta* in outside exhibit of birdhouse at Columbia Zoological Park. After one winter and exposure to wind and cold, this species fared quite well.



2. *Livistona* sp., planted in elevated windy cold exposure, was virtually undamaged after 17° F winter lows. Palm in back is *Trachycarpus fortunei*.

1974–75 were much milder (typical), with no snow and cold periods in both winters going below 18° F. In addition to the species mentioned previously (Fig. 1 and Fig. 2), other species were added to the Park's collection or that of the writer:

Washingtonia filifera, *Jubaea chilensis*, *Brahea armata*, *Brahea edulis*, *Chamaerops humilis*, *Chamaedorea microspadix*, *Trachycarpus wagnerianus* (identified by Myron Kimnach), *Livistona australis*, *Phoenix canariensis* × *Phoenix sylvestris*, *Butia capitata* × *Arecastrum romanzoffianum*, *Sabal texana*, *Sabal etonia*, *Sabal causiarum*, *Sabal domingensis*.

These species suffered little or no damage when subjected to minimum temperatures of 18° F. Unfortunately, many of these species, *Brahea* spp., *Washingtonia filifera*, and *Jubaea chilensis*, are unobtainable from Florida nurseries and must be shipped from California. *Washingtonia robusta*, the only *Washingtonia* readily available from Florida nurseries, suffered slight tipburn and together with *Livistona chinensis* would require a sheltered location or mechanical protection when grown in the Columbia area. The *Sabal* varieties mentioned above were obtained from Palm Society members or grown from Seed Bank seed and were not numerous enough for area marketing. The same is true of purposeful hybrids.

Charleston Palms

The coastal city of Charleston (Zone 9) is warmer than Columbia and in addition is favored by the Gulf Stream. The lowest recorded temperature in 25 years is 14° F and many species of palms not seen in Columbia, 100 miles away, are over 30 feet tall in Charleston. These species—*Phoenix canariensis*, *P. dactylifera*, *Livistona chinensis*, *Chamaerops humilis*, and both species of *Washingtonia*—are often very old, being present in photographs which date to 1935. In searching for new, cold-hardy species (Terrell and Del Porto, personal communication) additional exotic species to those tried in Columbia were tried through two winters. These were:

Butia eriospatha, *Trithrinax acanthocoma*, *Phoenix sylvestris*, *Acoelorrhaphe wrightii*, *Rhapis* sp., *Arengia engleri*, *Syagrus coronata*, *Arikuryroba*

schizophylla, *Arecastrum romanzoffianum*, *Phoenix sylvestris*, *Phoenix* sp., *Phoenix rupicola*, *Phoenix reclinata*.

Admittedly, many of the above additions have not been exposed to unduly severe conditions such as temperatures below 20° F. *Rhapis* sp., *Syagrus coronata*, *Phoenix sylvestris*, and others were exposed to 14° F while covered with five inches of snow and survived, quickly recovering during the spring (1973). Although many of these species would never be suitable in unprotected locations, many old homes of this city have enclosed courtyards which offer a great deal of protection from wind, snow, and severe freezes, thus protecting some of the borderline species for the palmophile. Future winter testing will undoubtedly add new insight into their suitability for different locations, and additional species soon to be available from seedlings still in greenhouses will be reported on later.

Conclusion

Cold-hardy species are being tested for South Carolina. While the potential variety is greater for Charleston (Zone 9) than Columbia (Zone 8), the use of hybrids and desert or western species, in conjunction with mechanical protection, could add new promise to the small list of palms grown within the state.

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PALM BRIEFS

Commercial Use of Chamaedorea elegans

A Florida nurseryman, Roger Nason of Delray Beach, is credited with developing the use of the palm *Chamaedorea elegans* as a house plant. The first commercial production of these plants in pots took place in 1945 when Nason obtained 25 pounds of seed from Mexico. Three years later the sale of seed to the world horticultural trade amounted to 100 pounds, and its use spread to Europe and the Far East.

The source of seed is still primarily Mexico, where last year 70,000 pounds of seed were shipped to nurserymen all over the world. There are about 2,000 seed per pound with germination approximately 60 percent. This means that last year approximately 84,000,000 palm seedlings were produced. Mexico is the only good source of seed, although small quantities are shipped from Guatemala.

The palm is known in the plant trade as "Neanthe bella," a name that has no scientific standing. It has character from the first leaf which makes it so desirable as a small house plant. The best strain of seed has a broad leaf. The seed is collected by Indians from the wild, but as of 1975 about 15 percent of the crop will be from cultivated mother plants. It takes about four years for a stock plant to produce seed.

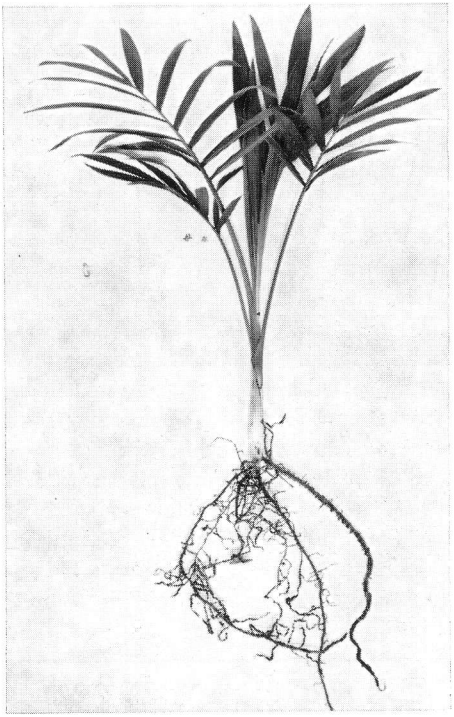
There is currently no shortage of seed, and the quantity shipped next year will undoubtedly go to 40 tons. The only limiting factors in seed production are insufficient rain to permit plants to set seed or dry winds that tend to make the mother plant drop the the seeds before maturity.

Natives of Mexico are now growing seed plants, but 90 percent of the worldwide sales are handled by L. E. Guerra of Mission, Texas. Guerra is an American citizen of Mexican origin and is considered to be the "father" of the trade in "Neanthe bella" palm.

The palm is relatively fast growing and has virtually no pests. It is used in terrariums or as a single plant or several plants in a pot. It likes low light intensity and grows best at 1000 footcandles. It can stand as little light as 50 footcandles and still survive. This makes it a very important product for interior landscaping because it has such good keeping qualities. The writer of this article is a major producer in the U. S. of this palm. Plants are grown in Miami, Florida, and seedlings are shipped all over the world. Most of the export shipments are made to England, Germany, and Holland.

Seeds are generally collected in November. They can be stored for approximately six months, but germination is higher with fresh seed sown promptly. Seeds are sown in sterile peat moss, preferably in raised benches. If at ambient Miami, Florida temperature, the seed will germinate in six to seven months. If the seed is kept at 70°F., minimum germination is within four months. Seedlings are potted or shipped to others to pot when the plant has two or more leaves. The price of the seedling varies with the age—i.e., seedlings with two leaves sell for less than plants with four to five leaves.

There was great fear that the mother plants of *Chamaedorea elegans* would become extinct in Mexico because the mature leaves are used for cut foliage in floral decorations. This product is sold in large quantities in the U. S. under the trade name "Comodor." In 1974, 370 million bunches of leaves were shipped to the U. S. alone. There are 25 individual leaves in a standard bunch. This tremendous cutting of leaves destroys the mother plants in some cases and has driven the seed sellers to cultivate mother plants for seed production only.



1. Seedling of *Chamaedorea elegans*.

"Neanthe bella" is still considered a "slow" plant by commercial growers, so the largest specimens commercially available in the U. S. are no more than four feet tall in a pot usually no larger than ten inches in diameter. A "Neanthe bella" this size would retail at about $40–$50. The big volume of sales, however, is in the 40¢ to $2.00 price range.

Chamaedorea elegans is a good staple item in the house plant field, and one which gives great customer satisfaction. It is also very good as a housewarming gift or premium-promoting item. It will remain a favorite of our plant lovers for many years to come.

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The Identity of Rhapis arundinacea

The genus *Rhapis* is native to southeastern Asia, but William Aiton described *Rhapis arundinacea* in *Hortus Kewensis* 3: 474, 1789, stating that it was a native "of Carolina" introduced to England in 1765 through the agency of Mr. John Cree. The species is listed as a synonym of *Rhapidophyllum hystrix*, the needle palm of the southeastern United States, in Dahlgren's *Index of American Palms* (1936) and in Glassman's *Revision of B. E. Dahlgren's Index of American Palms* (1972). Were this truly so, the epithet *arundinacea* would have to replace the later epithet *hystrix*, which was not published until 1814.

In 1963, I examined the type specimen of *Rhapis arundinacea* (Fig. 1) which is preserved in the British Museum (Natural History). The specimen represents an aberrant, early-flowering, juvenile plant which compares well with *Sabal minor* so far as inflorescence and flowers are concerned, but not with *Rhapidophyllum hystrix* or *Serenoa repens*, also from the southeastern United States. The name *Rhapis arundinacea*, therefore, should appear as a synonym of *Sabal minor* and the familiar name *Rhapidophyllum hystrix* remains the correct one for the needle palm.

Although Aiton did not mention the fact, the name *Rhapis arundinacea* and a more elaborate description appear in the younger Linnaeus' unpublished manuscript on palms which is now in the library of the Linnaean Society in London. A discrepancy between the habitat "Carolina" given by Aiton and that of "Florida orientali" which appears on the type specimen is perhaps explainable as an abbreviation of the information provided by Linnaeus, who wrote "Habitat in Carolina Australi America: Florida orientali."

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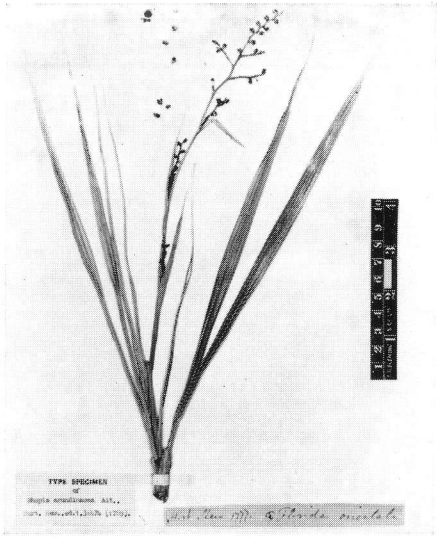


1. Photograph of type specimen of *Rhapis arundinacea*, courtesy of the British Museum (Natural History). Positions of label, script, and scale have been modified from the original.

Impact

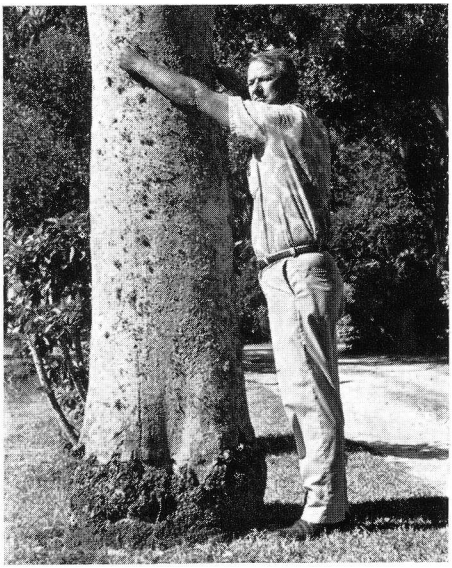
In January, 1931, a 1925 Lincoln four-door sedan ran into a young royal palm in my father's yard in Orchid, Florida. At the time, the palm had about five feet of trunk from the bottom of the leaf bases to the ground where it hit the tree.

The bumper injured the tree sufficiently that within several months two rotten holes developed side by side. The rotten material was chiseled out leaving two holes about the size of a man's two fists held together and about five inches deep. These were filled with concrete.

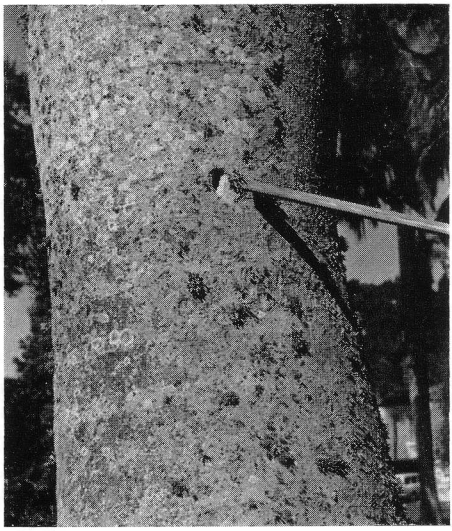
Enclosed are four photographs of this tree as it now appears 44 years later. The first photo is a picture of the tree

1. Tree with author and scale.

with a two-inch pole 14 feet 11 inches long held by me and with my right hand pointing to the scars where the holes filled with concrete used to be. The concrete has disappeared and the holes



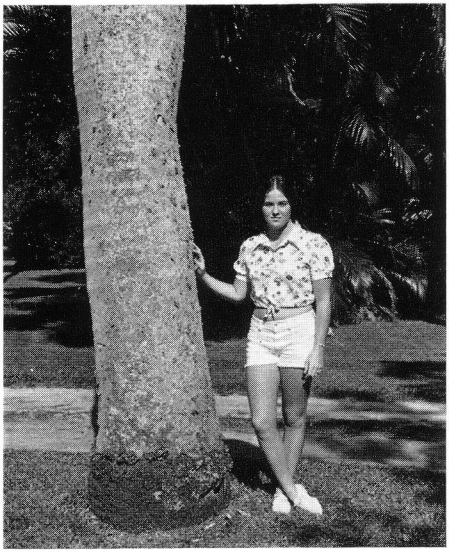
2. Two main scars.



3. Close-up of scar.

have healed very well with only small indentations remaining. The distance from the pole to the scar on the tree near my head is eight inches.

The second photo is a picture of myself pointing to the two main scars—the one on the right is now six feet two inches above the ground, the other



4. Photographer and subject.

slightly higher. The bottom part of the palm has a slight "V" from the impact. The original rotten spots were only two to three inches apart directly above the "V". The morning sun does not strike the east side of the tree to give good light for a photograph from that side.

The third photo is a close-up of the scar, originally filled with cement and pointed out by my left hand in Fig. 2. The scar is two inches high and 1 inch wide. The last picture is Cathy Welch of Vero Beach, the photographer, beside the tree. It is evident that the palm has grown from both the top and the bottom.

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FOOTNOTES ON PALMS

In Micronesia, which consists of 2,141 islands dispersed over 3,000,000 square miles in the Pacific Ocean, and is administered by the United States, the coconut palm is indispensable to the economy; one-third of the productive land is devoted to its culture. Copra, the dried meat of the coconut, is used for making margarine, cooking oil, soap, cosmetics and a protein-rich animal food; do not overlook the charcoal made from the husk that is widely used in cigarette filters. This copra is the main cash crop in Micronesia.

A legend exists in the Marshall Islands as to the origin of the coconut palm: it seems that on the island of Likileo, on Ailinglapa Atoll, lived a woman named Limokare who had two children, the second of which was a coconut, whom she named Debolar. She was amazed at Debolar's appearance, but Debolar (who could talk from birth) told her not to worry, she should bury him alive and he carefully explained to her the many uses to which she should put his parts when he materialized again as a tree. The coconut has more than redeemed that pledge of utility. From its nuts come meat, milk, jam, butter, lard, vinegar; from its husks come rope and charcoal; from its leaves, thatch, and its trunk an all purpose lumber.

We may smile at this legend but the coconut's life cycle resembles that of the human race. It begins to bear at the age of 12 or 13 (about the time of human puberty) and eventually dies at the age of 80 or 90.

Herman Melville, in his delightful book "Typee" tells in great detail how the coconut and bread-fruit were used together to produce a delicious food in the Marquesas Islands.

CLAIRE C. COONS

LETTERS

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25th Sept. 1975

As members of The Palm Society, we would like to draw attention to a largely erroneous letter that appeared in *Principes* 19(3): 115.

Overseas members reading these notes could be drawn to the area in an unsuccessful attempt to locate the species mentioned, two of which are not known from the locality according to recent botanical reports in scientific journals and our own field experience. These species are *Livistona australis*, found in New South Wales from the northern borders to south of Sydney, and *L. humilis*, a small, delicate species known from areas of northern Australia, particularly in the vicinity of Darwin.

Neither of these palms is in any way rare in its natural habitat—in fact, both can be seen in quite large stands.

It would appear from his notes that the author is devoted to the often misconstrued concept of many amateurs that any difference in size, colour, or shape immediately denotes specific or hybridized status. *Livistona* palms do not usually have complementary distribution and can rarely be found intermingling in natural stands. In an area such as the Cape York Peninsula, where there occurs such a diversity of soil types, rainfall extremes, and, in the drier parts, annual destruction by bushfires, it is to be expected that species do not retain a constant appearance.

The two *Livistona* species recorded from Cape York Peninsula are *Livistona muelleri* and *L. benthamii.*

Yours faithfully,
ALLAN P. WALFORD-HUGGINS

NEWS OF THE SOCIETY

The regular meeting of the Southern California Chapter was held Saturday, May 10th, 1975 at Santa Barbara, California. The group met at the Courthouse and after viewing the palms on the beautifully planted grounds went on to "Villa El Fureidis," the estate of Mr. Dan Hughey. After a picnic lunch, Barry Osborne took us on a tour of the grounds and then Mr. Hughey showed us through his home. This estate was formerly the "Gillespie Estate" and has some very old palm plantings. The meeting ended with a palm auction which netted about $225.00. There were about 60 members and guests present, as reported by Lois Rossten.

A small group of members attended a meeting on April 27, 1975 at the garden of Miss Eva Kobryn in Miami. Eva had acquired a much-neglected property that had to be cleared before she could set out some of her many palms. It was interesting to see how well they were doing under the big old native pines and to contrast them with the palms of neighboring member Mrs. Bryce Ryan whose mature plants in her heavily landscaped area were a delight to see. Members brought their own picnic supper and enjoyed a social hour afterwards during which time Paul Drummond mentioned the possibility of the South Florida members growing *Carpentaria, Satakentia, Heterospathe* and perhaps *Rhyticocos* to see how well they would withstand lethal yellowing so there would be additional palms to replace the *Veitchia Merrillii* that are dying by the thousands. We hope every member will be willing to grow some of these to give to neighbors and friends as soon as we can get adequate seeds.

TEDDIE BUHLER

Report of the Seed Bank 1974–1975

The past two years have been difficult ones for the Seed Bank, due to the lethal yellowing disease which has played havoc not only with the coconuts of southern Florida but with about a dozen other genera and species. A strict quarantine against shipping *any palm parts* out of the infected areas means that the richest source of seeds has been cut off, i.e. the many fruiting palms of southern Florida. We are determined that The Palm Society shall never be accused of spreading the disease, so we have been extremely careful not to send out seeds from here to as yet unaffected areas.

Our Seed Bank would have been almost out of business if it had not been for our very loyal members and friends, who have been shipping seeds to us from uninfected places in the United States and from many foreign countries. Thus we have remained quite busy passing

these seeds along to those who have requested them. At the time of writing, we have received requests from 424 members. Besides the palms on our regular list, 700 other species have been requested, and I am happy to report that many rare and even unnamed palms have been distributed. We are extremely grateful to all the friends who have helped us.

The Expeditions

My very able and enthusiastic associate, Mr. De Armand Hull, has been corresponding with dozens of people in the parts of the world where the rare and hard-to-find palms still exist. As he says, if there are 3000 kinds of palms in the world and so far we have collected and introduced less than 1000, we need to find and introduce many, many more, especially those resistant to lethal yellowing. He has made contact with a number of knowledgeable and reliable persons in those remote and difficult places. Collecting in such locations is very difficult, entailing long, rough going through swamps and jungles, up steep mountains and on remote or nonexistent trails. Transportation and supplies must be found, collecting equipment bought or rented, and days or weeks away from civilization endured. Most of these persons are unable to finance such trips. So, if we are to get these much desired seeds and/or plants we must furnish the wherewithal.

The Seed Bank has appealed to our members for funds to help these collectors. We first asked for funds for New Guinea, which is an area of many beautiful palms as yet not in cultivation. The response from our members was most generous and encouraging, so next we set our sights on some very rare and hard-to-get African palms. Two shipments of these have been received and distributed, unfortunately not enough for all who asked for them, but our contacts there have promised more when another crop is ready.

The response to our appeal for Madagascar was very generous, also. At the moment conditions there are very bad, but we are still able to obtain some seeds.

Our beloved Otto Martens, enthusiastic member of the society since its inception, former president, and member of the board until his death, was very much involved in searching for new forms of cold-hardy palms. In order to carry on this much-needed work and to perpetrate his memory, we instituted the Otto Martens Memorial Fund. Donations to this fund will be used to finance collectors in areas where the cold-hardy palms are found, such as the Andes, Himalayas and the cooler parts of the southern hemisphere. Otto's many friends and admirers, as well as many others, have responded most generously to our project. The largest contributions received so far are those of Madame Ganna Walska, California, Mrs. O. C. Corbin, Florida, Cmdr. Watana Sumawong, Thailand. To these, and to all who have contributed, our most sincere thanks.

Seed Contribution

The list of persons who have contributed seeds to the Seed Bank is a long one. Due to the quarantine we have not been able to use the sources which we have for years gratefully availed ourselves of (except for supplying persons living in the already infected parts of southern Florida). These sources are: The Fairchild Tropical Garden, The United States Department of Agriculture Introduction Station (Miami), the estate of Mr. and Mrs. A. R. Jennings, all in Florida. Botanical gardens and other institutions outside the lethal yellowing zones have come to the rescue, such as the Huntington Botanical

Gardens, California, the H. L. Lyon Arboretum, the Pacific Tropical Botanical Garden and the Waimea Arboretum, Hawaii, the Cairns Botanic Garden, Australia, the Instituto Agronomico, Brasil and the Forestry Department, Thailand. The Seed Bank has also sent seeds to them.

Among individuals donating seeds in 1974–75 are: Mr. A. Anderson, Mr. James Benzie, Mr. W. L. Bidlingmayer, Mr. Paul Berli, Mr. B. J. Boddington, Mr. August Braun, Mrs. T. C. Buhler, Mr. Donn Carlsmith, Mr. Paul Chai, Dr. H. E. Crawford, Mr. John Criswick, Cruzan Gardens, Dr. M. E. Darian, Mr. Nat De Leon, Mr. G. F. C. Dennis, Mr. Richard Douglas, Dr. John Dransfield, Mr. Paul Drummond, Dr. Fred Essig, Mr. R. H. Fackelman, Mr. Kenneth Foster, Mr. Randolph Fuller, Mr. J. A. Goodloe, Mr. Gordon Hintz, Mr. Fengchi Ho, Mr. De Armand Hull, Mr. Jack Ingwersen, Mr. Dennis Johnson, Mr. Myron Kimnach, Mrs. W. J. Krome, Mr. Richard Lacey, Mr. and Mrs. Arthur Langlois, Mr. H. F. Loomis, Mr. Billings McArthur, Mr. H. S. Manning, Mrs. Else Margraff, Mr. Otto Martens, Dr. Ben Martin, Dr. H. E. Moore, Jr., Mr. Robert Norris, Mr. R. W. Palmer, Mr. Eugenio Pingitore, Dr. R. W. Read, Mr. J. C. Scheepers, Mr. Dent Smith, Mr. M. W. Sneed, Capt. Ura Snidvongs, Dr. Paul Soderholm, Dr. Daniel Stalker, Mr. and Mrs. Joseph Sullivan, Cmdr. Watana Sumawong, Mr. Donald Thomas, Mr. R. M. Tucker, Mr. John Turner, Mr. Ralph Velez, Mrs. L. H. Wait, Mrs. A. P. Walford-Huggins, Dr. Merrill Wilcox, Mr. Ray Wilson, Mr. R. G. Wilson, Mr. John Womersley, Mr. Keith Woolliams, Mrs. Clyde Wooten, Mr. M. Yamakawa, Dr. U. A. Young and Mr. James Zarucchi. If I have inadvertently left anyone out, my sincere apologies. The Seed Bank thanks you one and all.

In the past two years the Seed Bank has introduced more than 70 species of rare palms, some of which are undetermined and may be new and still unnamed, and some of which have never as yet been in cultivation. We hope that with your support we may continue to carry on this important work.

LUCITA H. WAIT

INDEX

Figures in *Italic* indicate pages with photographs or other illustrations

Acoelorrhaphe 50, 54
  wrightii 48, 62, 149
Acrocomia *53*, 122
  mexicana *122*, 139
  totai 48, 62, 122
Actinokentia 79
Aiphanes 50
  acanthophylla *54*, 62
  caryotifolia 62
Archontophoenix alexandrae 62
  cunninghamiana 62, *142*
Areca 34, 50
  alicae 62
  catechu 23, 62
  latiloba *29*
  triandra 62
Arecastrum 50
  romanzoffianum *56*, 62, 149
Arecastrum × Butia 62, 148
Arenga 50
  caudata 64
  engleri 54, 62, 149
  microcarpa 62
  obtusifolia 62
  pinnata 21, 62
  tremula 62
Arikuryroba schizophylla 62, 149
Astrocaryum 124
  ayri 15
  murumuru 124
  tucuma 15, *123*, 124
Attalea 62
  funifera 13
Avery, George N. 104
Bactris 62
  gasipaes *22*, *23*, 51, 64, 78
Beccariophoenix 112

Bismarckia 110
nobilis 52, 64
Borassodendron 110
Borassus 110
aethiopum 22
flabellifer 14, 21, 51, 62, *106*, *107*, *108*
Brahea armata 148
edulis 148
Brassiophoenix 50, 113
drymophloeoides 100, 102, 103
schumannii 100, *101*, 102
Brongniartikentia 80
Brudy, John
Notes on culture 114
Buhler, Teddie
News of the society 35, 64, 116, 154
Burretiokentia 80
Butia 50
capitata 62, 147
eriospatha 149
Calamus 24
Caryota *37*, 50
aequatorialis 62
mitis 62
ochlandra 62
rumphiana 115
urens 22, 62, 73
Ceroxylon 73
Chamaedorea 50, 53, 62, 142
costaricana × schippii 64
elatior 50, 62
elegans 62, 149, *150*
microspadix 62, 148
Chamaephoenix 113
Chamaerops humilis 62, 137, *141*, 142, 143, 144, 148
Chambeyronia macrocarpa 64
Chelyocarpus 114
chuco 51
Chrysalidocarpus 50
cabadae 62
lutescens *42*, 54, 62
madagascariensis 62
var. lucubensis 62
Chuniophoenix 113
Chusan palms, at Glasnevin 76
Coccothrinax 50, 69
argentata 62, 70
argentea 62, 71
crinita 62
dussiana 62
eggersiana 62, 71
floridana 71
martii 71
miraguama 51, 62, 71
var. novo-geronensis 71
Cocos nucifera *14*, 15, *16*, 17, 21, 62, *116*, *117*, 124, *125*, *126*
Commercial use of Chamaedorea elegans 149
Coons, Claire C.
Footnotes on palms 153
Corypha elata *81*, 82–99, 115
umbraculifera 63
Cryosophila nana 63
warscewiczii 51, 63
Cyphokentia 80
Cyphophoenix 112
Daemonorops 60
hystrix *29*
longispatha 63
Delfeld, Mrs. Phil 80
Dictyosperma album 63
Dolichokentia 80
Dransfield, John 27
A remarkable new Nenga from Sumatra 27
Notes on the palm flora of central Sumatra (notice) 111
Elaeis 50, 125
guineensis 57, 63, 125–*130*
var. idolatrica *59*
oleifera 126, *129*
Englerophoenix 113
Erythea armata 51, 63
brandegeei 63
edulis 63
Essig, Frederick B.
A new species of Ptychosperma 75
Brassiophoenix schumannii 100
Euterpe edulis 19, *20*
precatoria 78
Florida Institute of Technology,
palms cultivated at 62–64
Footnotes on palms 153
Gaussia 50
attenuata 63
Geonoma 50, 63
Gigliolia insignis 33
Gillis, William T., George R. Proctor, & George N. Avery
Indigenous royal palms in the Bahamas 104
Graf, A. B., letter from 115
Haitiella ekmanii 71
Heterospathe elata 63
Hodge, W. H.
Oil-producing palms of the world—a review 119
Howea 50
belmoreana 63
fosterana 63
Hull, De Armand
Questions and answers 73
Hydriastele 50, 63
Hyophorbe verschaffeltii 63
Hyphaene 110
thebaica 63
Jessenia 128
bataua 128, *131*
Johnson, Dennis 3,
Some palm products of the Peruvian Amazon 78
Journal of Plantation Crops (notice) 112
Joyner, Jim *52*
Jubaea chilensis 147, 148
Kentia 79
Kentiopsis 80
Keuper, Jerome P. 39, 40, *43*
Kitzke, Eugene D. & Dennis Johnson
Commercial palm products other than oils 3

Latania 110
loddigesii 63
lontaroides 63
Leopoldinia piassaba 13
Letters 72, 115, 153
Licuala 50, 54
grandis 60, 63
paludosa *49*, 63
peltata 63
pumila 63
Livistona 50, *148*
australis 115, 148, 154
benthamii 154
chinensis *55*, 63, 147, 148
decipiens 63
humilis 115, 154
mariae 63
muelleri 154
rotundifolia 63
Lodoicea 110
Louis, I. Henry & V. Eugene Mary
Hermaphroditism in Borassus flabellifer from South India 106
Major Florida palm collection 39
Martens, Otto, death of 36
letter from 72
memoir on 65
notes on culture 115
Mary, V. Eugene 106
Mauritia vinifera 78
Maxburretia 80
Metroxylon sagu *22*
Michael, Joe W.
Impact 151
Microcoelum weddellianum 63
Microkentia 80
Moore, Harold E., Jr.
What's in a name? 79, 112
Palm literature 111
The identity of Rhapis arundinacea 151
Morley, Brian
The age of the chusan palms at Glasnevin in Ireland 76
Nannorrhops 73
Neanthe bella 149, 150
Nenga 27
gajah 27–*32*
intermedia 34
macrocarpa 34
pumila 34
schefferana 34
Neodypsis decaryi 63
News of the society 35, 64, 116, 154
Notes on culture 114
Nypa fruticans 22
Oenocarpus 128
bacaba *132*
Oil-producing palms of the world 119
Opsiandra 50
maya 63
Orbignya 129
cohune 63, *134*
guacuyule *133*
martiana 129
oleifera 129
sabulosa 129
Paden, H. A.
Washingtonia robusta in north Texas 77
Palm briefs 75, 149
Palm products of Peruvian Amazon 78
Palms, germination of 110, 114
in Spain 137
of central Sumatra 111
of Santa Catarina 112
on stamps 80
of Texas 146
propagation of 115
Palm Society, biennial meetings 67
Palmyra 13
Parajubaea cocoides 51, 63, 73, 110
Pejibaye 22
Phoenicophorium 113
Phoenix 50, 112
canariensis 49, 63, 142, 148
dactylifera 17, *18*, 21, 63, 137–*146*, 148, *160*
pusilla 63
reclinata *37*, 53, 63, 147, 149
roebelenii *55*, 63, 147
rupicola 63, 149
sylvestris 21, 63, 149
Physokentia 80
Phytelephas macrocarpa *79*
Pinanga 50
densiflora *29*
kuhlii 34, 51, 63
latisecta 33
Prestoea montana 64
Principes, back issues of 35
Pritchardia 50
hillebrandii 63
pacifica 60, 63
remota 63
thurstonii 63
Proceedings of the first national symposium on plantation crops 112
Proctor, George R. 104
Pseudophoenix 113
sargentii 63
Ptychosperma 50
elegans 54, 63
macarthurii 63
mooreanum 75
praemorsum 63
propinquum 63
salomonense 64
Questions and answers 73
Raphia 50
farinifera 63, 114
palma-pinus 13
vinifera 13, 63
Ravenea 50
hildebrandtii *48*, 51, 63
Read, Robert W.
The genus Thrinax (Palmae: Coryphoideae) (notice) 111
Rehderophoenix 113
Reitz, Raulino
Flora Illustrada Catarinense, Parte I. Palmeiras (notice) 112

Remarkable new Nenga from Sumatra, 27
Rhapidophyllum 50
hystrix *46*, 47, 63, 147
Rhapis 50, 149
arundinacea 151
excelsa 63
humilis 63
Rhopalostylis baueri 51, 63
Rhyticocos amara 51, 63
Roystonea 50, 151–*153*
elata *54*, 63
hispaniolana 63
in the Bahamas 104, *105*
oleracea 63
regia 63
Sabal 50, 54, *60*, 63
causiarum 63, 148
domingensis 63, 148
etonia 63, 148
mexicana 63, 146
minor 63, 147
palmetto 39, *41*, *45*, *53*, *58*, 63, 147
texana 63, 146, 148
Satakentia 80
liukiuensis 51
Scheelea 50
leandroana 63
liebmannii 63
martiana 63
urbaniana 63
Schippia concolor 63
Seed bank, report of 155
Serenoa repens 8, 11, 24, 39, *45*, *47*, 63
Shoemaker, Alan H.
South Carolina palms 147
Siphokentia 80
Smiley, Nixon
A major Florida palm collection 39
Smith, Dent 40, 41, *43*
Palmologue 65, 137
Soderholm, Paul K. 83
Strongylocaryum 64
Sumatra, palm flora of central 111
Syagrus 50, 130
coronata 7, *9*, *10*, 63, 130, *135*, 149
inajai 64
quinquefaria 64
weddelliana 64
Tessmanniodoxa 114
Tessmanniophoenix 114
Thrinax 50
excelsa 111
floridana 111
keyensis 111
martii 111
microcarpa 111
morrisii 64, 111
multiflora 111
parviflora 111
ponceana 111
pumilio 111
radiata 64, 111
wendlendiana 111
Tomlinson, P. B. & Paul K. Soderholm
The flowering and fruiting of Corypha elata in south Florida 83
Toxophoenix 114
Trachycarpus 138, *142*, 147
fortunei 64, 76, 147, *148*
martianus 64, 76
takil 64
wagnerianus 148
Trithrinax acanthocoma 64, 149
Tucker, Robert
Letter from 115
Turner, T. S.
Notes on culture 114
Veitchia 50
arecina 64
joannis 64
merrillii 64
montgomeryana 64
winin 64
Vitiphoenix 114
Vosters, Jim
Commercial use of Chamaedorea elegans 149
Wait, Lucita H.
Report of the seed bank 155
Walford-Huggins, Allan P.
Letter from 153
Washingtonia 50, *60*, 137
filifera 64, *141*, *142*, 147, 148
robusta *37*, 53, 64, *77*, 142, 147, *148*
What's in a name? 79, 112
Zombia antillarum 50, 64

Erratum

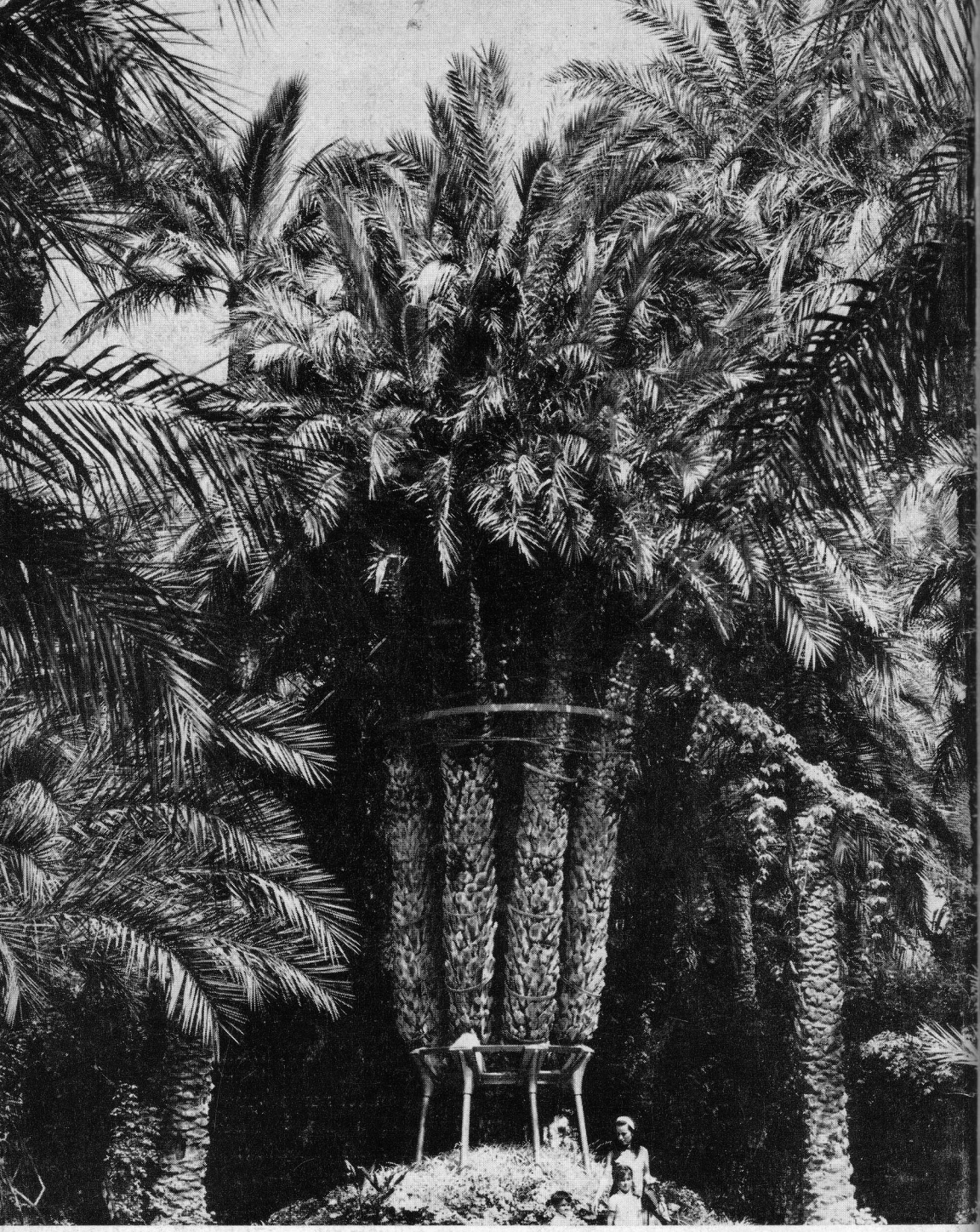
Page 103, line 22: *for* drymophloeiodes *read* drymophloeoides.

CLASSIFIED

Please contact new member Jim Menge, 2750 Dawn Road, Jacksonville, FL 32207 for the following:

1. *Erythea edulis*—5 gal @ $12.00–$15.00
2. *Erythea armata*—7 gal @ $23.00
3. *Rhapidophyllum hystrix*—3 gal @ $13.00
4. *Phoenix rupicola*—5 gal @ $15.00

and a few others.



At Elche, Spain, the "Imperial Palm" is a wayward *Phoenix* with eight columns consisting of a trunk and seven branches called "brazos" or arms.