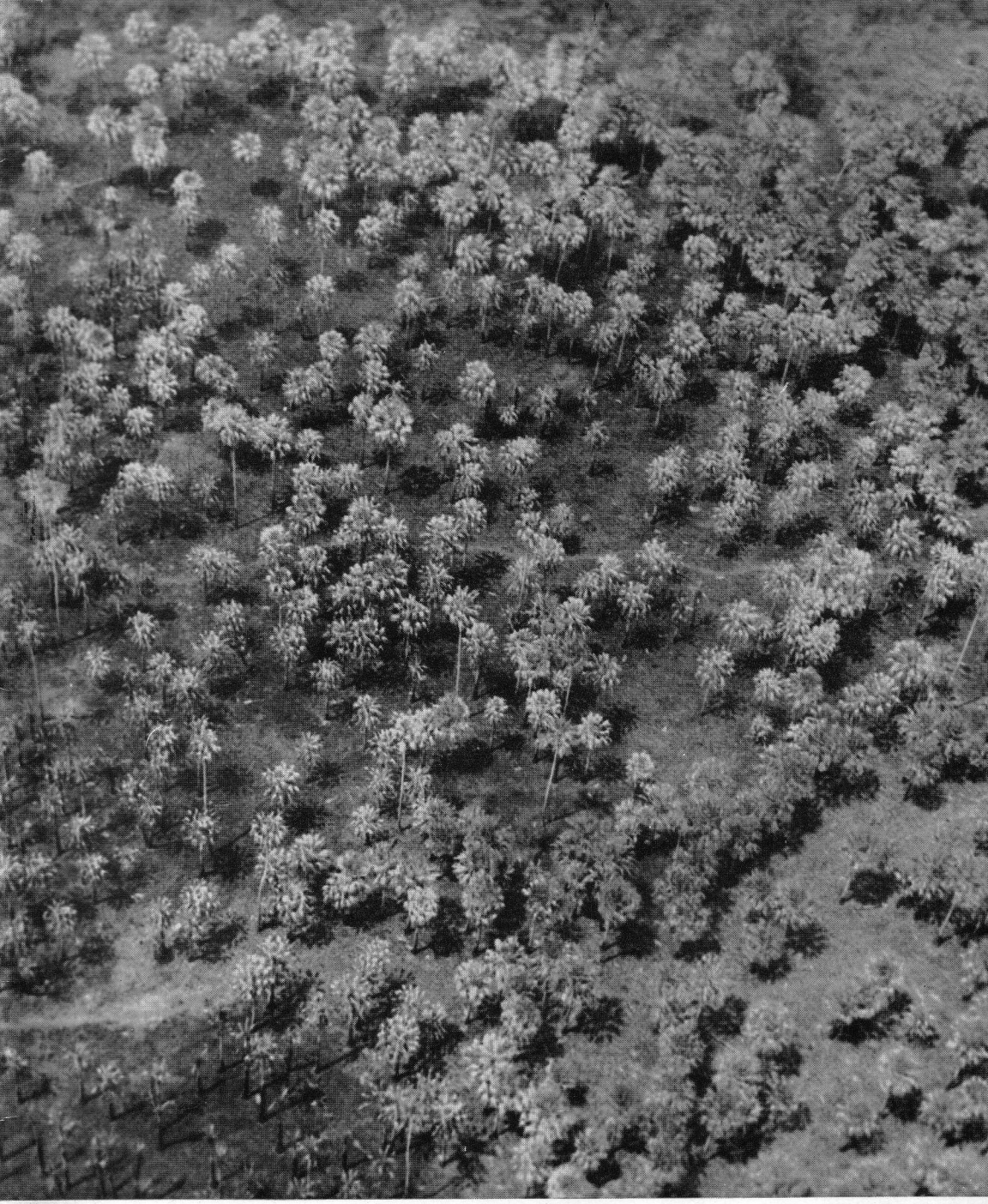

PRINCIPES

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Contents for January

Cover Picture

Aerial view of a natural stand of *Copernicia alba* in the upper Chaco, Paraguay. Photo courtesy of S. C. Johnson & Son, Inc.

PRINCIPES

JOURNAL OF THE PALM SOCIETY

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Commercial Palm Products Other Than Oils

EUGENE D. KITZKE AND DENNIS JOHNSON*
Biology Research Center, S. C. Johnson & Son, Inc., Racine, Wisconsin, and Earth Resources Programs, Rockwell International, Downey, California

Standard works on plant science and economic botany mention about 30 different palms as being useful to man. Not all of them, however, can be classified as being commercial, despite the fact that some are of limited local importance. For the purposes of this paper, commercial palm products are generally defined as those which are sold in domestic or international markets, and for which some production or trade statistics are collected. Excluded from consideration are palms as sources of edible and nonedible oils; however, palms which serve as sources of other commercial products as well as oils will be discussed for their nonoil products. The coconut is the best example of such a palm.

Researching commercial palm products must deal with two major problems. First, there are a number of palm products which appear to be commercial in nature but for which very little information is available outside the area or country of production. Tagua or vegetable ivory, for example, was reportedly a commercial palm product in Ecuador in the 1940s. No recent information on this product, however, is available either in Ecuadorian statistical reports or U. S. import data. If production still exists, it is probably unreported or combined with other forest products when reported. Substitution of plastics for vegetable ivory may, in fact, have removed it from the list of commercial products.

A second problem is that palm products identified only by a common designation may be derived from more than one palm type. Moreover, there are no requirements that even the main source of such products be identified. Hearts of palm, for example, are obtained from a number of different palms, but production statistics are combined under the general common name.

The purpose of this paper is to examine the commercial palm products other than oils, by focusing on the geography of the palms, how they are exploited or cultivated, the utility of the products, and the quantity of current production and, if applicable, foreign trade. Prices and monetary values of the products will be avoided to limit the amount of statistical data.

The commercial palm products included in this paper can be divided into four groups: waxes, fiber, food, and miscellaneous, each of the palm products being discussed under the appropriate heading. The order in which the products are discussed is arbitrary and in no way represents their relative commercial importance.

Waxes

Waxes of commerce are derived from a wide variety of sources including plant, animal, petroleum, and synthetic. Here

* Presented as part of a 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. Figures 1–10 courtesy of S. C. Johnson and Son, Inc.

1. Carnauba wax palms, *Copernicia prunifera*, that have never been harvested. Raposa Plantation, northeastern Brazil.

we are concerned only with plant waxes, specifically the waxy palms.

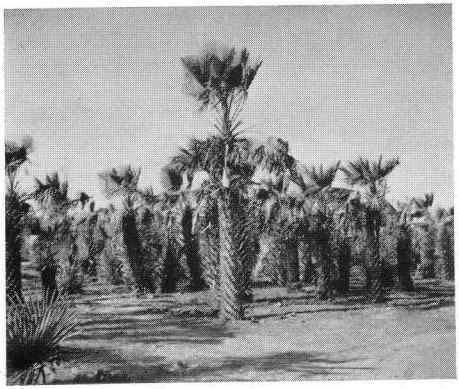
Waxes are widely distributed in nature in many plants and there is good evidence that most palms have wax present in the leaf. Because of the rare quality of a caducous character associated with the naturally occurring wax in a few species of the genus *Copernicia*, a commercial harvest of this valuable raw material has been possible.

The caducous or self free-flaking character is most striking in the carnauba palm (*Copernicia prunifera*) that yields the carnauba wax of commerce (Figs. 1–6). A simple procedure of excising the mature leaves, removing the spiny petiole and sun-drying the palmately compound blade has supported a large cottage industry in Northeast Brazil.

Early in the drying process the blades and pinnae fold and close, essentially returning to a state similar to the unopened leaf in the terminal bud. There is some indication that this phenomenon may be due to collapse of the bulliform cells which occur strategically along the leaf blade divisions. It is a remarkably fortuitous property since the caducous or free-flaking wax would otherwise be lost. This dry, tightly folded leaf blade in essence becomes a package which pro-

2. A typical crown of *Copernicia prunifera* before harvest.

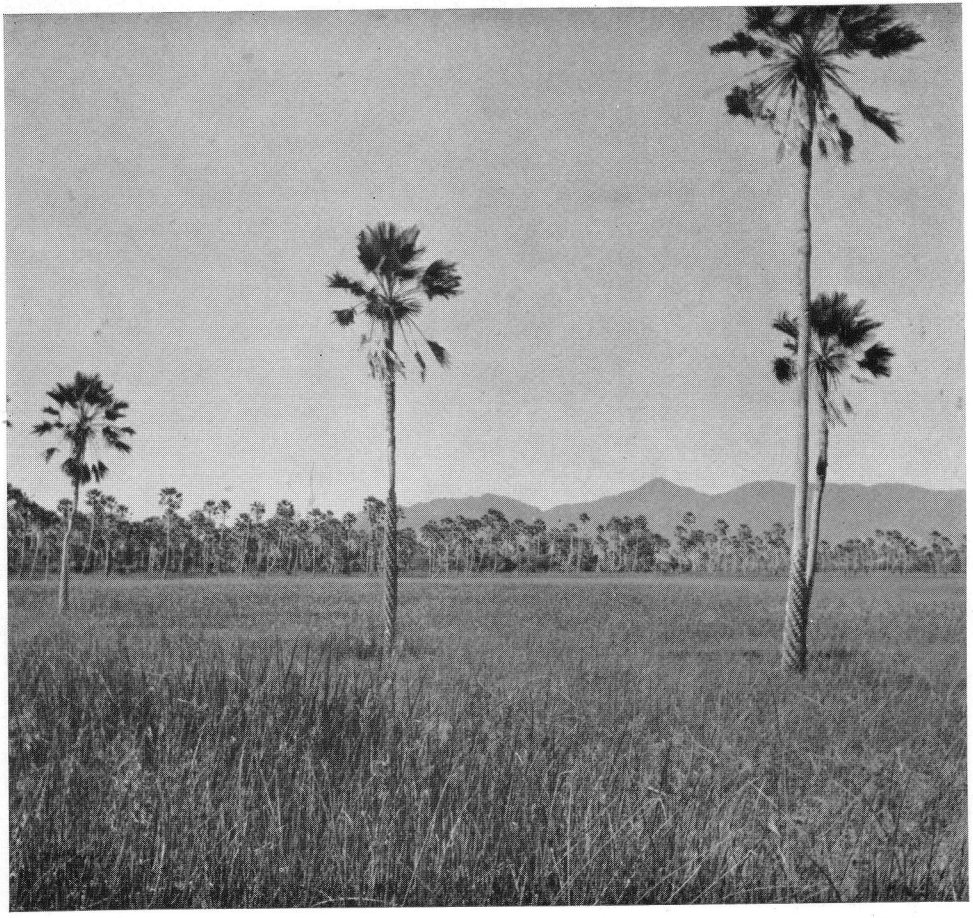
tects against loss of powdery flakes of wax. Later these "packages" of wax are gathered into centralized locations where the wax powder is harvested from the leaves by a mechanical beating process. In the more primitive operations this was done manually; however, economics and technology have led to lower cost and more efficient ways of harvesting the waxy powder.



3. *Copernicia prunifera* after harvest.

Detailed reports of the historical origins of the carnauba wax industry, the natural distribution of the wild stands of palms in Northeast Brazil, a description of the palm, the wax harvesting techniques and industrial applications are described by Taube (1954) in *Economic Botany*.

S. C. Johnson & Son, Inc. (Johnson Wax), studied various aspects of the carnauba industry including improved harvesting techniques, plantation management, and genetic selection. It is clear that wax powder processing has

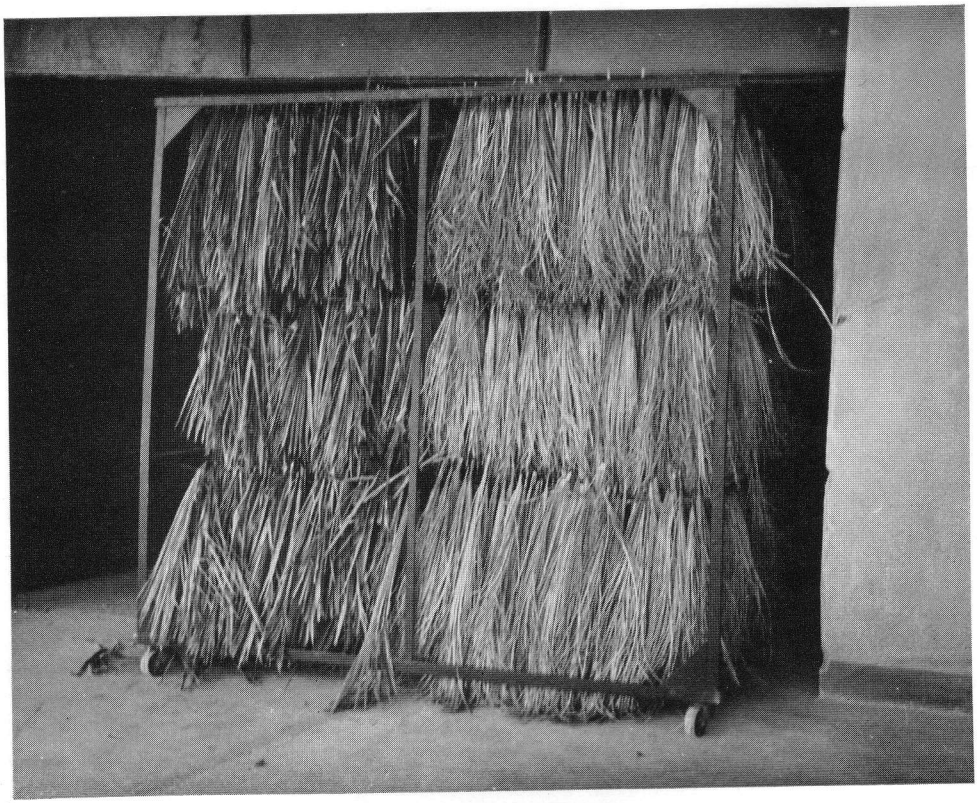


4. A natural stand of *Copernicia prunifera*.

5. Freshly cut carnauba leaves being transported to a drying area.

been and can further be benefited by improving melt temperature control, filtering, and decolorization techniques. Data have been collected that demonstrate genetic variability in the yield of wax and evidence that this character is not significantly affected by rainfall or climate factors. The carnauba palm produces a premier quality wax widely appreciated throughout the world for its unique properties of hardness, high melting point, emulsifiability, thixotropic gel properties and durability for end product uses in polishes, cosmetics, carbon paper, dental coating and other uses. Different grades of wax have been standardized in commerce under the auspice of the Brazilian government through mutual cooperative effort of the wax producers and exporters and the world-wide clientele of customers and users of wax.

There are other palms that produce considerable amounts of wax but none have achieved the commercial prominence of the carnauba. The ouricury or licuri palm (*Syagrus coronata*, Figs. 7, 8) yields a commercial wax which is used as a substitute for carnauba wax. It appears that the ouricury wax industry came into prominence during the 1950s when carnauba was in short supply. Its earliest origins are reported in the literature around 1935. According to Bondar (1942a), the state of Bahia alone has an estimated 5 billion trees. However, the noncaducous character of the wax on the finely pinnately compound leaves destined this palm to be a competitive source of commercial wax



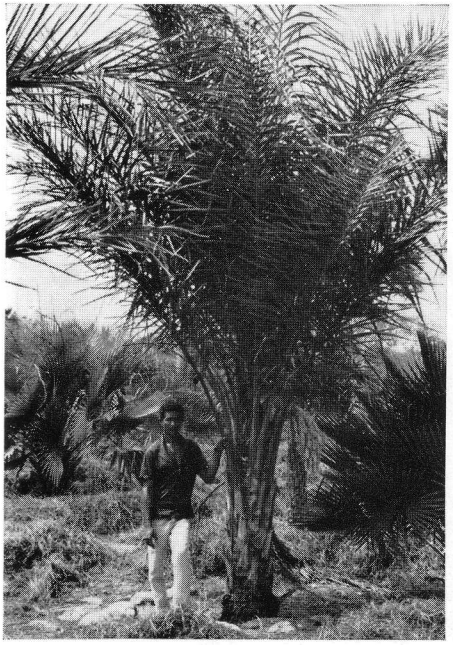
6. A rack for drying carnauba leaves.

only so long as the high world market price for carnauba combined with a low labor cost in Bahia permitted a competitive price. The laborious task of scraping wax powder from the leaf divisions was assigned to children as part of a family cottage industry operation.

The wax crop from this palm must be considered a kind of bonus cash crop since it has greater commercial value for the yield of oil from the fruits. Despite the poor market for ouricury wax the Brazilian production, all from the State of Bahia, averaged about 200 metric tons for the period 1968–1970. According to U. S. import statistics, more than one-half the Brazilian exports go to the United States.

It appears that ouricury wax brings a better price than carnauba, leading one to speculate that it is being used in some specialized application not competitive with carnauba, or that manual wax extraction yields an overall higher grade product.

Two other New World palms have commercial potential as sources of wax. The caranday palm (*Copernicia alba*, Figs. 9, 10) temporarily appeared to be destined for a competitive commercial role originating in a business attempt in Paraguay, although this species also occurs in vast natural stands in Brazil and Argentina. The saw palmetto (*Serenoa repens*), which grows in the wild from South Carolina to the Florida Keys to Mississippi, has caducous wax. It never could quite make it commercially al-



7. *Syagrus coronata*, the licuri or ouricury palm.

though one could predict a market if the price was right. The cost of harvesting the saw palmetto wax would simply exceed its value. The wax is moderately caducous, but the palm's natural distribution is in an economic sphere of influence where production cost would preclude commercial success.

It is interesting to examine the relative numbers of the three most important waxy palms. The carnauba palms are estimated to total a mere 100 million. The caranday palm is estimated at 1 billion. The ouricury is estimated at 5 billion. The magnitude of these numbers are inverse in order of commercial wax yield. The two main influences are human population density (labor supply) and degree of caducous character (free-flaking).

There are probably many other sources of palm wax that will continue to go unrecognized simply because there is no current commercial reason for anticipating their being. It is an acceptable thesis that all palms may have waxy lipids in the cuticular structure of the leaves. Few may be cuticular and caducous in character and this imperfection alone probably will result in their remaining unrecognized. However, it may happen that someday an enterprising researcher will gather a few leaves of all of the palms in the world in order to extract by solvent, to characterize the chemistry, and to announce to the world his finding of other waxes in palms.

Properties of waxes that have been useful to man include plasticity, hydrophobicity, lipid solvent solubility, high melting point, solvent gel formation, emulsifiability and buffability. Changing technology and economics have severely reduced the markets for these natural palm waxes. Synthetic resinous polymers have supplanted their use in floor polishes. In furniture polishes, silicone polymers have provided the competition.

Changing habits and the growing sophistication of the household user of these products have demanded performance characteristics that the synthetic chemistry technology has been able to provide. Other benefits to the user industries have been a stabilization of raw material price, uniformity of raw material, and adequate supplies to support growing market needs.

Comparative chemical constants for the two waxes of commerce are noted in Table 1. Also, the values for three noncommercial waxes are included. If one examines the various original reports, the values given vary somewhat but this would be consistent with the variations usually found in a raw material of natural origin.

Fortunately for the carnauba wax industry of Northeast Brazil, there still are

8. A fruiting specimen of *Syagrus coronata.*

substantial markets for this raw material including carbon paper, shoe polish, automobile polish, paper coatings, candy glaze, post-harvest fruit and vegetable coatings, cosmetics, dental, and institutional floor maintenance products. In 1967 the Brazilian government formed the Carnauba Wax Export Board with the specific purpose of improving marketing conditions and stabilizing prices.

9. A natural stand of caranday palms, *Copernicia alba*, in upper Chaco, Paraguay.

Table 1. Comparative chemical constants for some palm waxes.

Wax	Melting Point °C	Specific Gravity	Refractive Index Temp. °C	Iodine Value	Acid Value	Saponification Value
Carnauba	83–86	0.990–0.998	(40) 1.467–1.472	5–15	5–12	70–95
Ouricury	79–83	1.053	—	6.9–7.8	3.4–4.1	61–85
Caranday	84	0.992	—	7–10	10	65
Saw Palmetto	81	—	—	9–8	16–3	101–5
Copernicia hospita	81	0.995	—	10	14	80

10. An individual of *Copernicia alba* at the Raposa Plantation, northeastern Brazil.

There also is substantial polish use of carnauba wax in Brazil for floor-care polish products where a preferred position provides economic incentive to use a native raw material. In the three-year period, 1964–1966, an average of 1,400 metric tons was used annually in Brazil.

Total carnauba wax production in Brazil for the three-year period 1968–1970, averaged 19,000 metric tons. The

states of Rio Grande do Norte, Ceará, and Piauí in Northeast Brazil account for about 75 percent of all production. During the same three-year period, Brazil exported an average of 13,000 metric tons. The United States importation of carnauba wax for the period 1970 through 1972 averaged 4,400 metric tons per year. Germany, Britain, and France are also major importers. Statistical summaries indicate that the usage on a worldwide export basis appears to have stabilized.

There is much more to be learned about the chemistry of natural waxes, given research opportunity; however, support for some of this esoteric research has dwindled in recent years. Recently a report of previously unsuspected aromatic acids, cinnamic and para hydroxycinnamic acid, were found in carnauba wax. As a renewable resource, palm wax may prove to be of greater importance in the future, as sources of hydrocarbons become in short supply. The impact of the energy shortage on petrochemicals has made carnauba once again competitive and much sought after.

Fiber

Palms are exploited and cultivated to obtain fiber from leaves, leaf stalks, and, in the case of the coconut, from the husk. Piassava, palmyra, tucum, and coir are here discussed.

Piassava. This term designates leaf sheath or leaf stalk fiber from a number of different palms native to tropical America and Africa. In Brazil, two palms are of commercial importance: Bahia piassava (*Attalea funifera*), which occurs in great numbers in the state of Bahia; and Pará piassava (*Leopoldinia piassaba*), so-named for its predominance in that state in the Amazon region. These two fibers together are sometimes referred to as Brazilian piassava. The fibers of interest in both palms are located at the base of the pinnate leaves. The leaves of the Bahia piassava are large and erect, up to 10 m. in length; leaves of the Pará piassava are neither as long nor as erect. Fibers hang down from the leaf bases as much as 1.5 m., completely obscuring the trunk and leaf-bases and giving the tree a strange shaggy appearance.

The fibers of these two palms are stiff and bristlelike and can be removed from partially decayed leaves without any laborious procedures such as retting. No treatment of the fiber is required before it is used in making brushes for street-sweeping machines and other stiff brushes. Within Brazil, the fiber is used to make packing cord, brooms, and brushes.

In the three-year period 1968–1970, Brazil produced an annual average of nearly 22,000 metric tons of piassava fiber. Nearly all of it originated in the state of Bahia. During the same period, Brazil exported an average of 2,500 metric tons yearly, with shipments going to the U.S.A. and several European countries. The importance of the product in the Brazilian fiber industry is exemplified by the fact that only about 10 percent of the production is exported.

West African piassava is derived from the leaf bases of two native African palms, *Raphia vinifera* and *R. palmapinus*, both of which occur predominantly in swampy areas. Both species have large, erect, pinnate leaves which may reach 15 m. in length. The fiber is obtained by cutting the leaves, removing the bases and retting them in water for about two months until the fiber can be separated from the other plant tissue. The fiber is then beaten, the remaining pith and extraneous matter is removed by drawing the strips of fiber over up-

11. Coconuts on the tree at Acapulco, Guerrero, Mexico. The husk provides fiber.

right nails, and the fiber is then dried. West African piassava is used in much the same way as the Brazilian types, although it serves best for ordinary brushes and brooms. It is also used within the producing countries for making various types of rope. Sierra Leone is the chief exporter of West African piassava, with shipments of about 5,000 tons per year. Data on total production are unavailable.

None of the palms exploited for piassava fiber, either in Brazil or West Africa, is cultivated; production is derived entirely from the exploitation of natural stands. Exploitation does not, however, endanger these species.

Palmyra. Palmyra fiber or bassine is obtained from the palmyra palm (*Borassus flabellifer*), which occurs throughout much of tropical Asia. The palm favors drier climates and will not grow well in the humid tropics. Palmyra is abundant in India, especially in the states of Maharashtra (Bombay) and Tamil Nadu (Madras). The fiber is obtained from the base of the stalks of the large palmate leaves. The stalks are removed from the tree and beaten with wooden mallets to separate out the strong, wiry fiber which is up to one-half meter long. The fiber is then cleaned by combing, dried and bundled. Retting is not necessary.

Palmyra fiber somewhat resembles piassava but is not as elastic. The fiber is used in the manufacture of carpet and scrubbing brushes, commonly in combi-

nation with agave fiber. In India, and elsewhere where the fiber is utilized, it is used for making rope and twine. Statistics on the total production of palmyra fiber in India are not available, but it is known that about 4,000 tons per year are exported. The U.S.A. is a major importer.

Fiber production comes from both native stands and from informally planted trees. Formal cultivation on plantations is not practiced.

Tucum. A decidedly more minor palm fiber is obtained from two other species of native Brazilian palms—*Astrocaryum tucuma* and *A. ayri.* Although the exact distribution of these two palms is not known, they reportedly occur from Pará to Bahia. The palms are described as occurring in large groves, favoring areas of well-drained soil. The fiber is obtained from the pinnate leaves by mechanical thrashing. It is resistant to sea water and is used in Brazil for making fish nets, hammocks, and ropes. Industrialization of this product is increasing; however production levels are still very low. In the 1968–1970 period, production averaged only 150 metric tons per year. Tucum fiber is a commercial palm product only within Brazil; there are no recorded exports.

Coir. The fibrous husk of the coconut (*Cocos nucifera*) surrounding the inner kernel yields the fiber of commerce called "coir." The husk is rarely found on marketed coconuts, for it is large, bulky, and is commonly removed in or near the area where the nuts are harvested.

Coconuts are found growing naturally or under cultivation in coastal areas throughout the humid tropics (Fig. 11) and the many products derived from this familiar palm make it the most important of the world's commercial palms. Commercial coir production, however, is not always associated with coconut cultivation. To make coir fiber extraction profitable generally requires an abundant, cheap supply of labor and large stretches of shallow water for retting the husks. In many countries where coconut cultivation is important the husks are discarded or buried for fertilizer.

Coir fiber is short compared to the other hard vegetable fibers but has desirable characteristics of buoyancy and resistance to bacterial action and salt water; it is, however, less durable and less flexible than other hard fibers.

There are three main types of coir fiber. The first, yarn fiber, is obtained from the husk of unripe coconuts. In the production of this type of fiber, coir is the main economic product, for unripe nuts yield little or no copra, although the coconut milk can be utilized. Yarn coir fiber is commonly associated with subsistence agriculture where coir is a cash crop. Husks from unripe coconuts must be retted for up to nine months to loosen the fibers; these are extracted by hand by beating the husk, shaking the fibers, washing, drying, and passing them through a winnowing machine before they are finally spun into yarn. Yarn fiber is used for making various kinds of mats and matting, carpets, tufted door mats, oil filters, etc. The leading production areas of yarn coir fiber are the west coast of southern India, southern Sri Lanka, the Philippines, and Tanzania.

Bristle and mattress fiber are the other two types of coir fiber. Both are from the husks of ripe coconuts, and can be considered a by-product of copra production. Extraction of the fiber is quicker, retting requiring only one to six weeks, depending upon the method used. Machines are used to separate the fiber from the husk and to separate the bristle and mattress fibers. Bristle fiber is coarse and thick and suitable for mak-

ing brushes, brooms, rubberized upholstery pads, etc. The mattress fiber is finer but shorter. Among its many uses are as filling in innerspring mattresses, in air filters, sound-proofing panels, etc. Sri Lanka, Tanzania, and Thailand are the leading producing areas for bristle and mattress coir fiber.

FAO estimated world production in 1964–1966 at about 290,000 metric tons per year, more than 90 percent of which came from India and Sri Lanka. In the Western Hemisphere, Mexico, Brazil, Jamaica, and Trinidad produce small quantities for export.

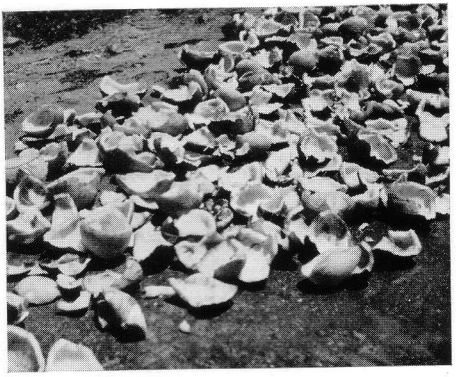
Although India is the world's foremost producer of coir, Sri Lanka is the leading exporter. In 1964–1966, about 88 percent of the coir in world trade came from that country. West Germany, Britain, and Japan are leading importers.

Food

Numerous commercial food products are derived from palms, most notably from the coconut and date palms. Of lesser importance are palm cabbage, palm sugar, and palm starch.

Coconut. This discussion of the coconut (*Cocos nucifera*) is limited to considering it as a fresh fruit; production as such is secondary in commercial importance to copra in both volume and value. Fresh coconut refers to the coconut in the shell (the husk having been removed) which is exported and utilized in the importing countries primarily in the preparation of various grades of coconut used in making baked goods and candy. Coconut meat (Fig. 12) may also be used to make coconut cream or syrup employed in a variety of dessert dishes. It can also serve as a base for a refreshing coconut drink.

Whole coconuts are also commonly sold in supermarkets in the United States; the purchaser removes and eats



12. Coconut meat (endosperm) is used fresh for food or, as here, is dried for the production of oil. Photo by H. E. Moore, Jr.

the fresh coconut as it is, or uses it in home baked goods or in special dishes. Although most imported fresh coconuts go into making shredded coconut, the impression should not be left that all shredded coconut is so derived. Shredded coconut itself is an important export from commercial coconut regions, especially Sri Lanka, the Philippines, and India.

One reason that fresh coconuts, unlike many tropical tree nuts or fruits, can easily be transported is that the hard endocarp provides excellent protection against the shell being broken, and the nut keeps very well without spoilage. Under even high tropical temperatures the nut will keep for 1–2 months; if kept under refrigeration it will remain preserved for up to 24 months.

World production of coconuts, cultivated for all products, is impressive. According to FAO estimates, annual production (1968–1970) is running at about 2.9 billion nuts per year. Estimates place the area under coconut cultivation in the world at over 4 million hectares, or about 10 million acres. The three leading producing countries are the Philippines, India, and Indonesia.

Major exporters of coconuts in the

shell, however, are not the same countries. In this case, Sri Lanka, Honduras and Malaysia are the most important. This indicates that production of fresh coconuts for export and copra production are not of equal importance in commercial coconut areas.

The United States is by far the major importer of coconuts in the shell. Imports in the period 1969–1971 averaged 14,357 metric tons per year. These imports originated almost entirely from the Caribbean and Central America. The Dominican Republic and Honduras are currently the most important United States sources.

Coconuts are also produced within the United States. Puerto Rico is the prime area, with commercial coconut growing in the coastal areas of the island. Fresh coconuts are utilized on the island in local industries producing shredded coconut and coconut cream; they are also shipped to the continental United States. Although coconut production is important in Puerto Rico, production is decreasing as agricultural lands are shifted to more profitable crops or converted to nonagricultural uses.

Coconuts are produced in Hawaii as well. Fresh coconuts are shipped from the outer islands to markets in Honolulu. These coconuts originate from casual plantings; the islands reportedly do not have commercial plantations. The coconut palm is also a familiar sight in southern Florida, although once again there are no commercial plantations.

Date. Dates represent the oldest commercial palm product. The date palm (*Phoenix dactylifera*) has been cultivated for about 5,000 years and is a truly domesticated palm, for the species is unknown as a wild plant (Fig. 13). Date palms are subtropical in origin and cultivation. They originated somewhere in the Middle East and are widely cultivated in the arid portions of both the Middle East and North Africa. It is interesting to note that the general region which today accounts for most commercial date production is the same region where the palm was domesticated. The opposite has been true of many other subtropical and tropical crops.

Commercial date production is successful only in areas having a sunny climate with high temperatures, low humidity and rainfall, and sufficient underground water or irrigation. The palm will grow in other subtropical and tropical areas, but is rendered sterile because rain prevents pollination or produces fruit of inferior quality.

World date production in 1970 amounted to 1,878,000 metric tons. The three leading countries were Egypt (355,000 metric tons), Iraq (330,000 metric tons), and Iran (310,000 metric tons). Dates are exported to nearly every country in the world. They are eaten in the natural semidry state, covered with sugar and stuffed with walnuts, glazed, or used in a variety of baked goods and candies.

The United States is not a major date importer in comparison to countries such as India and China. In 1971, the U. S. imported over 13,000 metric tons, nearly all originating from Iraq and Iran. The United States is also a producer and minor exporter of dates. Since the date palm is cultivated in the United States, some attention should be given to that activity.

Dates were first introduced into what is now the United States in the late eighteenth century by the Spanish who were establishing missions in southern California. Large-scale date cultivation, however, did not begin until about the turn of the present century. The U. S. Department of Agriculture established an experimental date cultivation station

13. Date palms (right) and young dates on a female inflorescence (left) at Indio, California. Photos by H. E. Moore, Jr.

in the Coachella Valley, California, just north of the Salton Sea, and another in the Salt River Valley near Phoenix, Arizona. Extensive research on cultivation practices and botanical varieties led to commercial plantings which began to produce significantly in about 1920. Production climbed steadily in the ensuing years and was over 20,000 metric tons in the late 1950s and early 1960s. In recent years production has ranged between 15,000 and 20,000 metric tons. In terms of the area presently under date cultivation, California has 1,460 hectares (4,050 acres) and Arizona 80 hectares (200 acres).

Date cultivation in California is expected to remain fairly stable at present levels. There are, of course, labor problems with date growing, for the trees require considerable care. All cultivated dates must, for example, be hand-pollinated. In California mechanical harvesting equipment has helped make labor problems less severe. Despite a decrease in the area under date cultivation in recent years, new plantings are still being made to replace groves removed to free land for nonagricultural use or to replace older plantings. An interesting practice in California is the occasional interplanting of citrus and date palms.

14. Brazilian tinned palm cabbage (possibly from *Euterpe edulis*), as taken from a can. Photo by W. H. Hodge. Reprinted from Principes 9: 130, 1965.

Initially the citrus trees provide protection for the young palms, and later continue to grow and produce in the shade of the mature date palms.

Indio is the chief city of the date-growing region of California. Each year it is the site of the National Date Festival; it is also the location of the U. S. Date and Citrus Station, and the Date Grower's Institute which publishes an annual report on all aspects of date cultivation, processing, and marketing. In the Indio area, a number of date growers sell their products at the roadside. In addition to dates in bulk, fancy gift boxes are sold for shipment to friends and relatives, and date milk shakes are a popular refreshment. Any palm enthusiast visiting California should certainly include Indio on his itinerary and see the only major example of commercial palm cultivation in the continental United States.

Cabbage. Palm cabbage, hearts of palm, or palmito are the common names given to the edible portion of the terminal bud of certain palm trees (Fig. 14). The bud is the growing tip of the palm. It is removed by cutting down the tree and splitting open the uppermost portion of the trunk to remove the tender cabbage.

About a dozen species of New World palms are mentioned as providing good quality palm cabbage for human food. These species range over the Latin American tropics. Species of *Euterpe* are commonly identified as the source of commercial hearts of palm. Determination of the species involved is impossible from statistics since production is reported collectively under the term "palmito." In Paraguay and Brazil, the two leading producers of commercial palmito, *Euterpe edulis* is reported to be the most desired species (Fig. 15). This palm is a tropical forest tree found on the southern coast of Brazil, Paraguay, and northern Argentina. Undetermined

15. *Euterpe edulis* ?, growing in mountain forests near Rio de Janeiro, Brazil. This slender, single-stemmed palm is probably the major source of palm cabbage widely available in the Brazilian market. Photo by W. H. Hodge. Reprinted from Principes 9: 125, 1965.

species of palm also support a palmito industry in the Orinoco Delta in Venezuela.

Palm cabbage was a traditional food among Amerindian peoples of the American tropics; its use was adopted by Europeans and Africans alike and it remains today of some local importance. Hearts of palm can be eaten fresh, cooked into a variety of dishes, or packed in tins with salted water. Canned hearts of palm are consumed in the producing countries and exported. Consumption of the fresh product is limited to producing areas because of rapid spoilage.

Production statistics on palmito are incomplete. Paraguay, in 1965, exported 3,205 metric tons of canned palmito, with 99 percent going to neighboring Argentina. More recent data are available from Brazil, where in the period 1968–1970, annual exports averaged 2,650 metric tons. These figures represent only a part of the total annual production, for palmito is a popular item to be found in the stores and on the tables in the producing countries.

There are reports of palmito canning industries in Argentina and in Venezuela. Palmito is not a commercial item outside the New World.

The United States is a major consumer of palmito, and in the period 1969–1971, an annual average of about 600 metric tons was imported, coming from Brazil, Paraguay and Argentina. Canned hearts of palm can be purchased in gourmet food stores almost anywhere in the U.S.A. They are sold under about 50 different labels, for importers have their brand names affixed to the cans at the factory.

There is no indication that *Euterpe* or other genera which supply palm cabbage are cultivated. The entire production comes from the exploitation of wild stands. The activity, if continued, may, in fact, result in the extermination of these palm species. The numbers of trees which must annually be destroyed to furnish current production amounts is staggering. For example, if it is assumed that a single tree yields about 1 kg. of cabbage, Paraguay is destroying 3.2 million trees per year, and Brazil 2.7 million, these amounts to provide exports only. Clearly, efforts should be made to establish these palm species on plantations to assure that a continuing supply is available, and so that the palm heart production may be improved by modern plant breeding and plantation management practices.

A lesson may be learned from the experience of the Dominican Republic, a country that was formerly an exporter of palmito. Recent legislation enacted to prevent the cutting of any trees without a permit has stopped exports. Palms and other tree species were being decimated by overexploitation.

Other food products. A number of other palm products are of commercial stature as food sources. Palm sap, for example, is obtained from at least eight different palms in different parts of the world and fermented into a palm wine or toddy, or boiled down to make a dark-colored sugar. The sap is collected by tapping either the inflorescence or upper portion of the stem. Providing tapping is not excessive, the trees are not killed.

The three most important sources of palm sugar are the sugar palm (*Arenga pinnata*), which grows wild from India to the Philippines; the palmyra palm (*Borassus flabellifer*), already discussed as a fiber source in India; and the wild date palm (*Phoenix sylvestris*), which is planted in India as a sugar source.

Other palms mentioned as providing sugar or toddy are the date palm (*Phoenix dactylifera*), coconut (*Cocos nuci-*

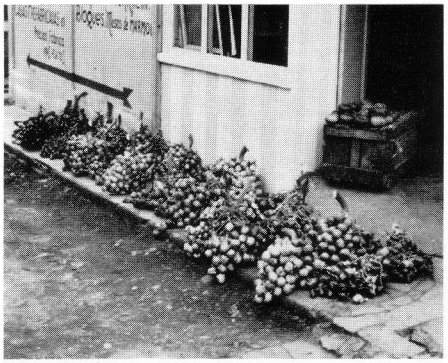
16. The sago palm, *Metroxylon sagu*, dies after fruiting, but the stems are felled for the production of sago before flowering. Photo by H. E. Moore, Jr.

17. *Pejibaye* palms (*Bactris gasipaes*) in the collection at Lancetilla, Honduras. Photo by W. H. Hodge. Reprinted from Principes 9: 83, 1965.

fera), nipa palm (*Nypa fruticans*), fishtail palm (*Caryota urens*), and the African fan palm (*Borassus aethiopum*).

Products derived from palm sap are generally of only local importance and foreign commerce appears to be almost nonexistent. Statistical data on production in the individual countries are either unreported or unavailable.

Sago or palm starch is another minor commercial product. It is obtained principally from the sago palms, two species of *Metroxylon* found in Southeast Asia and Indonesia. The sago palm has a rare flowering habit; it produces a terminal inflorescence and then dies (Fig. 16). This occurs when the tree is about fifteen years old, and is preceded by a maximum buildup of starch reserves in the trunk. Before flowering occurs the tree is cut down, the trunk split, and the pith scooped out. The starch is obtained by grating the pith and leaching out the starch which can be used as a liquid or dried into a flour. Sago is consumed locally, and exported for use in puddings and sweet dishes. Malaysia and Indonesia are the chief exporters. Small



18. Fruits of the peach palm or *pejibaye* for sale in front of a store at Turrialba, Costa Rica. From a color transparency by H. E. Moore, Jr.

quantities are imported by the United States.

Sago starch is also obtained from other palms, but from palms which do not die when they flower, though they must be cut down to extract the starch.

The *pejibaye* or peach palm (Fig. 17) is a final food item which should be discussed. This palm occurs in regions of warm temperature and heavy rainfall throughout Central America and the tropical portions of South America. The peach palm produces a fruit (Fig. 18) which is inedible when raw but after being boiled in salt water tastes something like a chestnut. This palm may well represent the only domesticated New World palm for there exist seedless varieties.

Despite its wide distribution, the peach palm is only a commercial crop in Costa Rica. In that country the palms are cultivated by small landholders and the cooked fruits sold in local markets and also packed in tins. *Pejibaye* has not yet been accepted by large landholders as a worthwhile commercial crop; nevertheless, there is general agreement that it does possess considerable potential.

In the past few years a number of papers on the peach palm have appeared, indicating a continuing interest in it as a tree crop. It appears that the *pejibaye* is not yet of sufficient value to be included in Costa Rican agricultural statistics, and there is no indication that the fruits are exported.

Miscellaneous Products

The betel or areca palm (*Areca catechu*) is not well known in either Europe or the Americas, yet it ranks as one of the world's most important cultivated palms. This is attributed to the common use of chewing gum or tobacco in Europe and the Americas rather than chewing betel which is the analagous practice in the Indo-Malaysian region.

The areca palm is widely grown from East Africa to the Pacific Islands, with the greatest concentration in the Indian subcontinent. The palm grows well in tropical coastal areas of plentiful rainfall. Origin of the areca palm is unknown and the problem virtually insoluble for there are no wild species found in any of the countries where it is cultivated. The areca palm is a cultigen, much like the date palm and the peach palm.

India is the chief betel-producing and betel-consuming country and most of this discussion is based on material about that country. Chewing betel is an ancient custom in India, dating back to the earliest historical records, and it is still today a common practice among all ages and classes of people.

The seeds of the areca palm are not chewed alone, but a quid is prepared by wrapping small pieces of the nut in the leaf of the betel pepper (*Piper betle*) and adding a dab of lime. Betel-chewing differs little from tobacco-chewing, for excess saliva is expectorated and the quid is not swallowed. Betel contains a

harmless narcotic which produces mild stimulation. Among the many benefits said to be derived from its use are that it sweetens the breath and promotes digestion.

The areca palm is a plantation crop in India, especially in the southwest coastal region. It is grown from seed in nurseries, and transplanted when about one year old. Commonly it is grown as a mixed crop with fruit trees such as mango. The areca begins to bear in seven to eight years and will continue until about 40 years old. Ripe bunches of the fruit are harvested, and the fruits husked and dried.

Over the past five years (1967–68 to 1971–72), production of betel nuts in India has been averaging 140,000 metric tons, from an area of about 160,000 hectares (395,000 acres) under cultivation. Areca nuts are an item of international trade. India, Bangladesh (formerly East Pakistan), Sri Lanka, Malaysia and Indonesia are the major producers and exporters.

Despite being a plantation crop, the betel palm has not received a great deal of research attention. This is understandable, however, because the tree does not provide food products.

Another miscellaneous palm product is saw palmetto berries. This palm (*Serenoa repens*) is a native to the United States and occurs in considerable numbers from South Carolina to southern Florida and westward to Mississippi. The berries were utilized as food by native Indians and they have reported medicinal value.

The recent surge of interest in health foods has led two companies in California to obtain the dried fruits from Florida and market them as an herb tea. Processing simply consists of slicing up the dried berries. One of the companies reported that saw palmetto berry tea is not very popular, although sales are increasing and presently amount to several hundred pounds per year.

Other commercial palm products could have been included in this paper. The rattans (*Calamus* spp.), for example, and a number of palm fruits are of commercial significance. They have not been discussed, however, because of time limitations and the general scarcity of detailed information.

Conclusion

This discussion has covered a wide range of commercial palm products. These products are derived from cultigens such as the date palm, from trees which exist as both cultivated and wild palms such as the coconut, and from exclusively wild palms exploited for palm cabbage. In some instances, palms have benefited from man's economic interest in them, in other instances the wild stands are being overexploited. In most cases commercial palms should be given more research attention to assure a continuing supply of these valuable commodities.

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A Remarkable New Nenga From Sumatra

JOHN DRANSFIELD
Herbarium Bogoriense, Bogor, Indonesia

Specimens in the Herbarium Bogoriense collected by H. A. B. Bünnemeijer on Gunung Talakmau in West Sumatra in 1917 had been assigned by Furtado on his visit to the Herbarium in 1936 to the genus *Nenga*. On a preliminary examination of the palms in the herbarium in 1970, I could not agree with Furtado's identification, but even so could not assign the specimens to any genus. Then, in February 1971, I visited Kepahiang in the hills of the Bukit Barisan range of Sumatra near Bengkulu, an area extremely rich in beautiful and interesting palms. It was with great excitement that I discovered a squat palm of rather massive proportions growing in great abundance at an altitude of 800 m. in steep river valleys and on slopes; the inflorescences of the palm proved to be identical to those of the Bünnemeijer collections, and on examination of the living plants and fresh and spirit-preserved material of flowers and fruits, I now agree with Furtado's original generic identification. The most striking feature of the whole palm is the infructescence, which is borne interfoliarly, and resembles in its nodding, club-shaped form, a fruiting head of *Nypa fruticans* Wurmb.

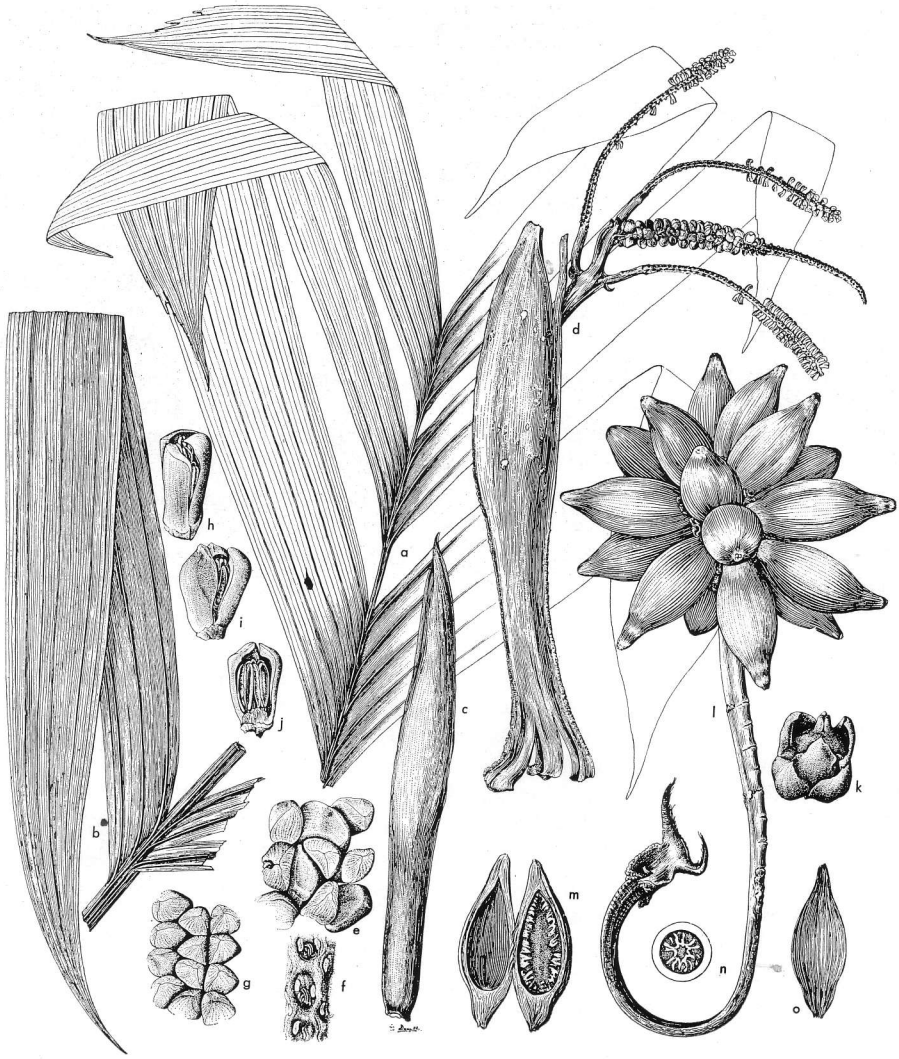
I propose to call this spectacular palm *Nenga gajah* after its local Indonesian name "pinang gajah" ("pinang" = *Areca*, *Pinanga*, *Nenga* and other arecoid palms, "gajah" = elephant).

Nenga gajah Dransfield, *sp. nov.*

Diagnosis. Differt a ceteris speciebus *Nengarum* inflorescentia interfoliacea spatham coriaceam persistentem ferente, paribus florum masculorum in 5–7 seriebus verticalibus, et capitulo fructuum.

Descriptio. Palma solitaria humilis, inermis, monoecia. Caulis crassus, ad 2 m. altus, 15 cm. diametro infra folia, radicibus gralliformibus praeditus, horizontaliter arcte ciccatricosus. Cicatrices foliorum delapsorum ad 1 cm. distantes, fibris vaginarum foliorum tectae. Internodia verticaliter rugosa, cortice aliquantum suberoso. Radices gralliformes ad 1.5 cm. diametro, atrobrunneae, radicibus conicis lateralibus spongiosis, pallidis pneumaticis, ad 1 mm. longis, serialibus. Folia 8–9 in corona, patentia, (cum vagina) ad 3 m. longa, vagina ad 50 cm. longa, pallide luteo-viridi, a caule non munde dehiscente, marcescente et vestigium fibrosum formante, indumento atrobrunneo juventute sparsim tecta. Petiolus ad 75 cm. longus, 2.5 cm. diametro, in sectione circularis, indumento atrobrunneo sparsim tectus. Rhachis triquetra, ad 8 mm. diametro in medio longitudinis, ad 3 mm. diametro prope apicem, squamis brunneis sparsim tecta. Foliola leviter sigmoidea, regularia, utrinque 8–10, paribus 1–2 inferioribus unicostatis, superioribus 3–5-costatis subopposita, horizontalia, 3–6 cm. distantia, in medio folii ad 60 cm. longa, ad 8 cm. lata, apice acuminata, infra leviter pallidiora et squamis indumentoque pallide brunneis secus costas tecta, supra glabra. Foliola terminalia sub angulo 70° inter se divergentia, acuminata aut bifida aut leviter dentata.

Inflorescentia interfoliacea erecta, 30–



1. *Nenga gajah.* a, leaf apex × ¼; b, mid-portion of leaf × ¼; c, inflorescence enclosed within the almost woody spathe × ¼; d, inflorescence at anthesis of male flowers: note female flowers still in bud, and the acropetal sequence of opening and falling of the male flowers × ¼; e, closeup of flower triads × 2½; f, scars left on rachilla by flower triads × 2½; g, grouping of male flowers on distal portions of the rachillae × 2½; h, i, male flowers × 2½; j, dissected male flower × 2½; k, female flower at anthesis × 1¼; l, whole infructescence of mature fruit × ¼; m, vertical section of fruit × ¼; n, transverse section of fruit × ¼; o, fruit with mesocarp removed × ¼.

40 cm. longa. Spatha solitaria, atrobrunnea vel violacea, dura, coriacea aut paene lignosa, ad 25 cm. longa, ad 4 cm. lata parte latissima, 2.5 cm. lata parte angustissima 10 cm. super basim, indumento furfuraceo brunneo praecipue marginibus tecta. Spatha pro parte quarta vel tertia longitudinis uno margine laterali dissiliens et inflorescentia per fissuram lateraliter emergens, spatha per anthesin

2. Palm-rich Hill Dipterocarp Forest near Kepahiang; in the centre, flowering *Areca latiloba* Ridley with *Nenga gajah* on each side; also in the photograph are *Daemonorops hystrix* Blume, *Daemonorops* sp. nov., and *Pinanga densiflora* Beccari.

longe persistens, dein in vestigiis fibrosis marcescens. Rami inflorescentiae 3–5, omnes ordinis primi. Pedunculus ad 25 cm. longus, in sectione ovalis, 20 × 8 mm., atroviolaceo-brunneus, pilis ramosis sparsim tectus. Rachillae quaeque bracta rigida triangulari crassa 5 mm. longa, basi 5 mm. lata subtentae.

Rachillae 2–4 inferiores masculae ad 10–12 cm. longae, 5 mm. latae sine floribus; rachilla terminalis ad 10 cm. longa et basi 8 mm. diametro, mascula femineaque aut raro tantum mascula; rachillae 1–3 inferiores ca. 1–3 cm. distantes, eis terminalibus et penultimis approximatis. Rachillae masculae 1–2 cm. super basim sine floribus, rachilla terminalis floribus masculis femineisque pro 3–4 cm. infimis et floribus tantum masculis prope apicem praedita. Dimensiones inflorescentiae maturitate crescentes. Flores masculi ante flores femineos aperientes, binati, quoque pare bracta minuta in rachilla subtento, quoque flore bracteola minuta subtento. Paria florum masculorum in 5–7 seriebus verticalibus aut arcte spiraliter disposita, si spiraliter tum flores contiguissimi; numerus serierum superne decrescens. Ubi rachillae in spatha contiguissimae sunt, flores masculi singuli abortantes, aspectu vestigiorum otrorum remanentes.

Flores masculi cremei, angulosi, oblongi, alabastris ad 5 mm. longis, 3 mm. latis. Sepala 3, ut videtur libera, disjuncta, minuta, triangularia, ad 0.5 mm. alta. Petala 3, libera, tenuiter coriacea, oblonga, plana aut cucullata, si cucullata tum leviter acuta, forma variantes, impressione staminum intra notata. Stamina 6; filamenta ad 1 mm. longa; antherae medifixae, ad 2.5 mm. longae, 0.5 mm. latae, dehiscentia latrorsa; vestigium ovarii non videtur. Grana pollinis lutea, sphaerica, uniporata. Sub anthesin

3. *Nenga gajah* by a small stream at 850 m. altitude.

4. *Nenga gajah*. Inflorescence with female flowers at anthesis; note the bare axes which once bore the protandrous male flowers.

flores masculi inter alabastros propinquos exserti dein cito caduci, rachillis nudis relictis; evolutio florum masculorum acropeta.

Flores feminei violacei, singuli cum 2 floribus masculis lateralibus aggregati, greges florum in 5–8 seriebus verticalibus dispositi, aut series verticales propter distortionem non prominentes. Quisque grex florum bracta membranosa minuta subtentus; flos unusquisque bracteolo subtentus. Flores feminei rotundati ca. 7 mm. longi sub anthesin. Sepala 3 libera, valvata, leviter cucullata, ad 7 mm. longa, basi 6 mm. lata, coriacea, persistentia, amplitudine post anthesin crescentia. Petala 3, libera, valvata, coriacea, longe persistentia, ad 6 mm. longa, post anthesin ad 1 cm. crescentia. Staminodia 6, triangularia, minuta, ad 0.5 mm. alta. Ovarium rotundatum, ad 4 mm. diametro, stigmate rostrato, conico, apice obscure trilobato. Loculo 1, ovulo 1, laterifixo, micropyle ad receptaculum spectante.

Infructescentia capitulum pendulum claviforme fructum fusiformium. Fructus ad 8 cm. longus, 2.5 cm. latus, fusiformis vestigio stigmatis terminatus; epicarpium laeve, glabrum, atroviolaceo-brunneum; mesocarpium ad 4 mm. latum, fibris verticalibus perductum; endocarpium laeve, intra nitidum. Semen fusiforme, 4.5 cm. longum, 1.8 cm. latum, secus longitudinem ad endocarpium raphe basi 4 mm., apice 1 mm. lata affixum. Testa ca. 0.2 mm. crassa. Endospermium valde ruminatum, ruminationibus ad ca. 5 mm. penetrantibus,

5. *Nenga gajah.* Pendulous infructescence with almost ripe fruit. The stocky stem with a few stilt roots and the untidy crown can also be seen.

6. *Nenga gajah* Kepahiang, August, 1973.

parte centrali endospermii non ruminata. Embryo conicus, basalis, 4 mm. longus, 3 mm. latus. Folium plantulae binatum.

Habitat in clivis et secus fluvios, 800 m., Hill Dipterocarp Forest, Kepahiang, Bengkulu, Sumatra.

Holotypus: *Dransfield 1234*, 12.2.71. BO (Isotypi BH, K, L).

Diagnosis. Differing from all other species of *Nenga* in the interfoliar inflorescence bearing one persistent coriaceous spathe, pairs of male flowers in 5–7 rows, and in the head of fruit.

Description. Solitary, squat, unarmed, monoecious, undergrowth, forest palm. Stem stout, stilt-rooted, to 2 m. high and 15 cm. in diameter below the leaves, grey-brown and marked with close horizontal leaf scars. Leaf scars more or less 1 cm. distant, to 4 mm. broad, with persistent leaf sheath fibres. Internodes with vertical wrinkles, bark somewhat corky. Stilt roots to 1.5 cm. in diameter, dark brown with rows of paler, conical, spongy, short, lateral, pneumatophore roots to 1 mm. long. Leaves 8–10 in crown, spreading, to 3 m. long including sheath; leaf sheath to 50 cm., long pale yellowish-green, not cleanly dehiscing from the stem, but rotting to form a fibrous vestige of the leaf sheath base; sheaths covered in sparse dark brown indumentum when young. Petiole to 75 cm. long by 2.5 cm. in diameter, circular in cross-section, with sparse dark brown indumentum. Rhachis about halfway along

7. *Nenga gajah* Kepahiang, August, 1973. Note stilt roots.

lamina about 8 mm. in diameter, triangular in cross-section, dwindling to 3 mm. near apex, with sparse brown scales. Leaflets regular, 8–10 pairs, the lower 1 or 2 pairs unicostate, the upper 3–5-costate, subopposite, held horizontally, separated by 3–6 cm.; leaflets slightly sigmoid, to 60 cm. long, to 8 cm. broad in the middle part of the leaf, long-acuminate, slightly paler beneath than above, with scattered pale brown hairs and scales along the main ribs beneath, glabrous above; terminal leaflets diverging from each other at an angle of 70°, acuminate, or bifid, or slightly dentate.

Inflorescence interfoliar, erect, 30–40 cm. long. Spathe single, dark brown or purplish, hard, coriaceous or almost woody, to 25 cm. long by 4 cm. wide at the widest point, 2.5 cm. wide at the narrowest point, 10 cm. from the base, covered in scurfy brown indumentum, especially at the margins. Spathe splitting down one lateral edge for ¾–⅓ of its length, and the inflorescence emerging laterally through the split, spathe long-persisting through anthesis and then rotting to leave fibrous vestiges at fruiting. Inflorescence with 3–5 branches all of the first order. Peduncle to 25 cm., elliptic in cross-section, 20 × 8 mm. when fresh, dark purplish-brown, covered in sporadic, brown, branched hairs. Rachillae each subtended by a short, thick, stiff, triangular bract to 5 mm. long and 5 mm. broad at the base.

The lower 2–4 rachillae male, 10–12 cm. long by 5 mm. in diameter without the flowers, the terminal rachilla to 10 cm. long by 8 mm. in diameter at the base, male and female, or rarely male only, and then the entire inflorescence male; lower 1–3 rachillae ca. 1–3 cm. distant, the penultimate and terminal rachillae close; male rachillae bare of flowers in the lowermost 1–2 cm., the apical rachilla with male and female in the lower 3–4 cm., and above this with male flowers only. Inflorescence dimensions increasing markedly with age. Male flowers reaching anthesis before the females, grouped in pairs, each pair being subtended by a minute bract on the rachilla, and each flower with a minute subtending bracteole; male flower groups in 5–7 vertical rows, or tight spirals, if the latter, close-packing so tight as to give the impression of vertical rows; number of vertical rows decreasing above; where close-packing with neighbouring rachillae tight, single male flowers from pairs aborting and remaining as blackened vestiges.

Male flowers cream, angular, oblong, to 5 mm. long by 3 mm. wide in bud. Sepals 3, apparently free, separated, minute, triangular, to 0.5 mm. high. Petals

3, free, thinly coriaceous, oblong, plane or cucullate, if cucullate, then slightly acute, petals variable in shape, marked with impression of the stamens within. Stamens 6, filaments to 1 mm. long, anthers medifixed, to 2.5 mm. long by 0.5 mm. wide, dehiscence latrorse, ovary vestige absent. Pollen grains yellow, sphaerical, uniporate. At anthesis, male flowers opening, pushing out between neighbouring buds, and then quickly falling, leaving the bare rachillae, male flower development being apparently acropetal.

Female flowers purplish, in triads, two lateral male flowers accompanying a central female, triads in 5–8 vertical rows or vertical rows not prominent owing to distortion. Flower groups subtended by minute membranous bracts, each flower subtended by a bracteole. Female flowers rounded, ca. 7 mm. long at anthesis. Sepals 3, free, valvate, somewhat cucullate, to 7 mm. long by 6 mm. wide at the base, coriaceous, persistent, increasing in size after anthesis. Petals 3, free, valvate, coriaceous, long-persisting, to 6 mm. long, increasing to 1 cm. long after anthesis. Staminodes 6, minute, triangular, to 0.5 mm. high. Ovary sphaerical, to 4 mm. in diameter, with a beaklike, conical stigma, obscurely 3-lobed at the apex; locule 1, ovule laterally fixed, micropyle facing the receptacle.

Infructescence a clublike, pendulous head of fruit. Fruit to 8 cm. long by 2.5 cm. wide, fusiform, tipped with remains of the stigmas; epicarp smooth, glabrous, dark purplish-brown; mesocarp to 4 mm. thick, traversed by longitudinal fibres; endocarp smooth, shiny within. Seed fusiform 4.5 cm. long by 1.8 cm. wide, attached along its length to the endocarp by a raphe 4 mm. wide at the base and 1 mm. wide at the apex; testa ca. 0.2 mm. thick; endosperm strongly ruminate, ruminations penetrating ca. 5 mm. inwards leaving a central column of more or less nonruminate endosperm; embryo conical, basal, to 4 mm. long by 3 mm. wide. Seedling leaf bifid.

Habitat: hillslopes and streamsides in Hill Dipterocarp Forest at 800 m. altitude, Kepahiang, Bengkulu, Sumatra.

Holotype: *Dransfield 1234*, 12.2.71. BO. (Isotypes in BH, K, L).

Other specimens examined: *Bünnemeijer 295*, *296*, *417*, *1013*[a], April–June 1971, N.E. slopes of G. Talakmau, Bukittinggi, West Sumatra (BO). *Dransfield 3625*, 27.8.73., from the type locality (BH, BO, K, L, SING).

Seedlings from *Dransfield 1234*, and *Dransfield 3267* cultivated in Hortus Botanicus Bogoriensis.

The two most aberrant features of this palm are the interfoliar inflorescence and the structure of the male flowers. Interfoliar inflorescences are unknown elsewhere in the small genus *Nenga*. In previous accounts of genera of the Arecoideae (cf. Scheffer (1873), Wendland and Drude (1875), Beccari and Pichi-Sermolli (1955) inter alliis), this character has been given considerable prominence in the separation of genera; for example, *Gigliolia* is separated from *Areca* by a few characters, one of which is the position of the inflorescence. However, interfoliar and infrafoliar inflorescences are sometimes found within the same genus, as in *Pinanga* (most species with infrafoliar inflorescences, a few acaulescent species such as *P. latisecta* Blume with interfoliar inflorescences) and interfoliar inflorescences are usually associated with tardily dehiscent or nondehiscent leaf sheaths (and hence with no well-defined crownshaft) and/or the acaulescent habit. Furthermore, a *Gigliolia* species from Bako National Park, Sarawak, reported by Moore (1965), has infrafoliar inflorescences, otherwise being very similar to *G. insignis* with the

interfoliar inflorescences more usual in the genus, and an as yet undescribed *Areca* from Sumatra shows tendencies to the interfoliar state. In this last species, collected by me in North Sumatra in 1973 and by W. Meijer (*Meijer 6888*) in West Sumatra, the leaves are tardily dehiscent and tend to mummify on the plant before dropping off, and the inflorescences burst through the rotting leaf sheaths at anthesis. As yet, material of this species is incomplete so cannot be described.

In *Nenga gajah* leaf sheaths do not dehisce but rot on the stem, and therefore, by necessity, the inflorescences are interfoliar and erect at anthesis. Associated with the interfoliar state is the anomalous, almost woody spathe which apparently serves as a longer-lasting protection to the inflorescence than do the thin spathes of other *Nenga* species; in such species, up till leaf abscission, the inflorescence is protected by the leaf sheath, which, when it falls, releases the inflorescence, the latter normally quickly entering the state of anthesis.

In the male flowers of *Nenga gajah*, the calyx is much shorter than the corolla. In *N. pumila* and its allies (*N. intermedia*, *N. schefferana*) the calyx lobes are long-acuminate and longer than the corolla lobes. In *N. macrocarpa* the sepals are slightly shorter than or equal to the petals and are obtuse and rounded. This series may only represent a grade in calyx lengths despite the apparent anomaly of *N. gajah*.

Why then should the Sumatran palm be included in the genus *Nenga*? The inflorescence with probably spirally arranged flower groups, the proximal portions bearing triads, and the distal portions being entirely male agrees well with *Nenga*; similarly the parietal placentation of the ovule would rule out *Areca* and strongly suggests its being *Nenga*. In the ripe fruit of *Nenga pumila* and its allies, the fibres of the endocarp are free at both ends when the mesocarp has eroded away; it is not known whether the fruit of *N. macrocarpa* behaves similarly, but certainly *N. gajah* is dissimilar in this respect. If interfoliar and infrafoliar inflorescences can be found in one closely related genus (*Pinanga*) then it should not theoretically be unacceptable for the same state to occur in *Nenga*.

The aberrant nature of *Nenga gajah* does draw attention to unresolved intergeneric taxonomic problems in the *Areca* alliance of the Arecoideae (Moore 1973). It requires much more research to clarify such problems; I consider it worthwhile to draw attention to these fascinating problems by publishing the description of this species.

Little is known of the natural history of this palm. In the Bengkulu area it is locally abundant above 800 m. altitude on hillslopes and in valley bottoms—I know nothing of the upper altitudinal limit of the palm as the hills near Kepahiang where it grows do not exceed 950 m. It is apparently absent from large areas of the Bukit Barisan where I have hunted palms. The collections from near Bukittinggi suggest it has a very disjunct distribution. Inflorescences at male and female anthesis smell similarly—a penetrating, musty, sickly-sweet smell reminiscent of the smell of the flowers of *Pinanga kuhlii*—and are visited by small nitidulid beetles and trigonid bees. Immature fruit were often found chewed, and fruits in which the mesocarp had been entirely removed, were found scattered on the forest floor at some distance from the mature plants. What animal is responsible for such dispersal is not known, but it is suspected that squirrels or other rodents may be the vectors.

In August, 1973, I had the opportunity to return to the Bengkulu area and was

able to recollect "pinang gajah" and to distribute a limited number of ripe seeds to the Seed Bank of The Palm Society under the collector's number *Dransfield 3627*. It is hoped that this weird, aberrant, but hardly beautiful *Nenga* can be introduced into palm collections.

Acknowledgments

I should like to thank Pak Matsa'a of the Department of Nature Conservation, Kepahiang, Bengkulu for assistance in the field. Sdr. Damhuri, artist of the Herbarium Bogoriense, prepared the analytical drawings.

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NEWS OF THE SOCIETY

Back Issues of Principes

The Board of Directors voted at the Biennial Meeting to charge $1.50 per issue for back numbers of Principes still in stock (Vol. 3, No. 3 onward).

The 11 issues of Vol. 1, No. 1 through Vol. 3, No. 2 (Vol. 1 has five issues) are to be reprinted if enough orders are received. Each issue will cost $2.50 or a total of $27.50 for all 11 issues, including postage and handling.

Orders for these early issues must be accompanied by full payment. If all 11 issues are ordered by March 31, 1975, a prepublication discount of 10% may be deducted from the order. The discount does not apply on less than the 11 issues, or if the reprints are ordered after the above date.

Chapter Notes

A Special Meeting of the Western Chapter of the Palm Society was held September 21, 1974 at 10:30 a.m. to 3:30 p.m. at the Huntington Botanical Gardens in San Marino, California. It turned out to be a beautiful day and approximately 90 members attended the meeting. Before partaking of a catered lunch, three tours of the palm gardens were conducted by Myron Kimnach, newly elected Vice-President of the society, Fred Boutin and Bud Hallberg. They showed the many old specimen palms along with some of the new ones planted within the last few years.

After lunch in one of the meeting rooms, Fred Boutin and Myron Kimnach took turns telling about and showing slides of a recent trip they had taken to Mexico to hunt the native braheas and collect seeds. Following this was a plant auction to which the Huntington Garden and some of the members had donated plants. The interest of the members is evinced by the fact that a 2-in. pot of *Wallichia disticha* with two tiny leaves went for $25 and a purple crown-shafted *Pinanga* in a 3-in. pot sold for $10. Everyone evidently came with money and was ready to bid, so it turned out to be a very successful money-raising event.

During the business meeting chairman Lee Phelps resigned and Ralph Velez, a schoolteacher from Westminster, was elected new Chairman. He is a long-time member and in his small yard has one of the best collections of palms in California for so small an area. The group is

planning to have bi-monthly meetings. Enthusiasm is high among both the old-time and the new members.

* * *

A sale of over 2500 palms was held by the West Palm Beach Chapter on October 5, 1974 at 10 a.m. at the Mounts Agricultural Building. Most of the plants were rare to exceedingly rare, the greater number were small but some sizeable specimens lined both sides of the building. In addition a truck load of dwarf Malay coconut plants was available and hopefully will help fill the void caused by the rapid spread of the lethal yellowing disease among the palms of the area. The sale was so well attended that it was difficult to get around and sometimes two people reached for the same plant at the same time. Plants went out by the dozens. In all the sale grossed some $3,500. It took many hours of work by dedicated members to mark the price and identification, then set up the tables with the plants, and it all had to be done after 5 p.m. the evening before. Seeds too, were available and close to $100 was realized from that sale table alone. A great number of the plants had been grown by De Hull, the enthusiastic young member who is helping Mrs. Wait with the Seed Bank. There will be an interesting variety of palms in future years resulting from this sale alone. Many of the customers were not Palm Society members, which shows that palms are being appreciated by many segments of the community. Proceeds of the sale will be used to help finance further expeditions for collection of new and rare palms.

* * *

Just before press time word was received of the death, on November 15, 1974, of Otto Martens, former President of the society and one of its staunchest supporters. A more detailed obituary will appear in a forthcoming issue.

TEDDIE BUHLER

STATEMENT OF OWNERSHIP MANAGEMENT, AND CIRCULATION OF PRINCIPES, JOURNAL OF THE PALM SOCIETY, REQUIRED BY ACT OF 23 OCTOBER 1962: SECTION 4369, TITLE 39, UNITED STATES CODE, FILED 11 SEPTEMBER 1967.

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A. Total no. of copies printed	1325	1400
B. Paid circulation		
1. Sales through dealers & carriers, Street vendors, etc.	None	None
2. Mail subscriptions	922	969
C. Total paid circulation	922	969
D. Free distribution by mail carrier or by other means		
1. Samples, complimentary, and other free copies	4	4
2. Copies distributed to news agents but not sold	None	None
E. Total distribution (Sum of C & D)	926	973
F. Office use, left-over, unaccounted, spoiled after printing	399	427
G. Total (Sum of E & F should equal net press run shown in A)	1325	1400

I certify that the above statements made by me are correct and complete. Signed, Mrs. Theodore C. Buhler, Executive Secretary.