PRINCIPES

Journal of The Palm Society

October, 1978
Vol. 22, No. 4

PRINCIPES

JOURNAL OF THE PALM SOCIETY

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Contents for October

Cover Picture

Pseudophoenix sargentii subspecies *saonae* at the Fairchild Tropical Garden. Photo by M. V. Parthasarathy.

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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.

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

Mailed at Lawrence, Kansas
November 2, 1978

Principes, 22(4), 1978, pp. 119–126

Tuberous Seedlings of Borassus flabellifer

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In South India, the state of Tamil Nadu abounds in the palmyra palm (*Borassus flabellifer* L.). Annually a female tree produces 200–300 fruits (drupes) and thrice the number of seeds, since each one bears three pyrenes. The fruits of this palm are of no commercial value except for the edible pulpy endosperm of the tender stage. In older fruits the endosperm becomes horny and dry, due to extensive accumulation of hemicellulose. The pyrenes, each containing a seed, are germinated for the tuberous seedlings, which abound in starch content and form a seasonal delicacy for the villagers, especially the poorer sections of the population. The present account deals with the botanical and unexplored commercial aspects of the seedling.

The fruiting season: The mature fruits are usually harvested from July to September. It is a common practice for the villagers to roast the ripe fruit over open fire and the steaming hot, odoriferous flesh of the yellowish, fibrous mesocarp is eaten as a delicacy. The pyrenes are either discarded or collected and germinated for the tuberous seedlings.

Commercial germination: Large numbers of the drupes are germinated in specially elevated mounds of garden soil, which are usually prepared by dumping excavated earth to a height of 1–1.5 m (Fig. 1). The pyrenes are buried at the top of the mound and covered with humus and dead leaves. Frequent watering is necessary to keep the dump sufficiently moist. The seeds germinate in a period of 45 to 60 days. The embryonal axis that grows out of the pyrene penetrates downwards into the loose soil of the mound and strikes roots. The cotyledonary sheath (the apocole) is responsible for carrying the embryonal axis deep into the soil. The tuberous first juvenile (bladeless) leaf, which accumulates the food materials derived and translocated from the endosperm, forms the tuberous part of the seedling. The food reserves are in the form of starch grains accumulated in large parenchyma cells.

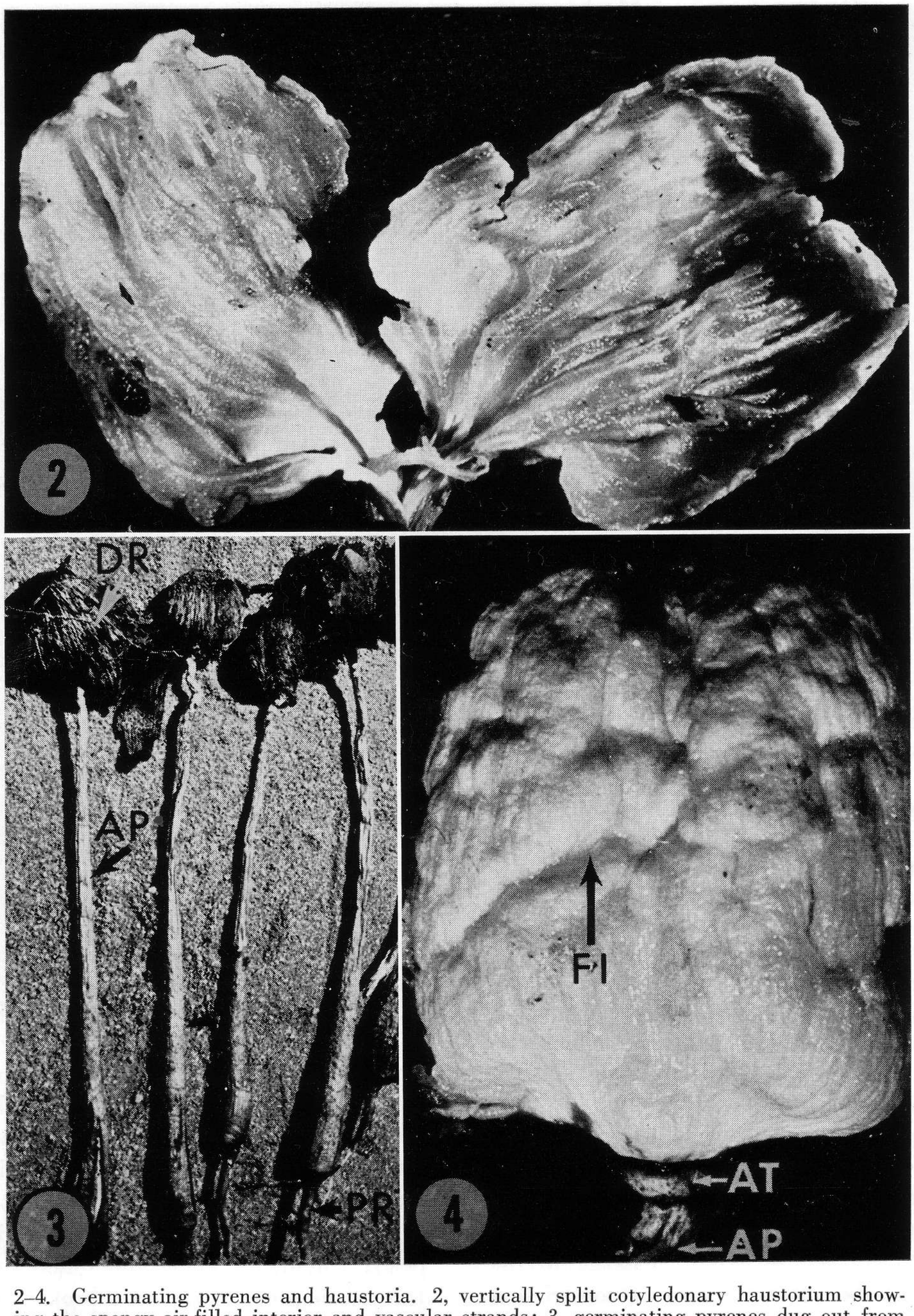
The endosperm: The endosperm of the tender fruit has a jellylike consistency and is delicious to eat. However, it becomes hard and ivorylike (Fig. 5) on maturation due to the excessive thickening of the cell walls (Figs. 12, 13). Most of the thickened wall was found to be composed of hemicellulosic material, by employing the differential extraction and PAS reaction method for cell wall carbohydrates (Jensen, 1962). The deposition of hemicellulose in the endosperm of other palm species, e.g., *Phoenix dactylifera* L. (Netolitzky, 1935) is also known. The cell contents are depleted and the endosperm tissue is devoid of viable nucleus and cytoplasm at maturity (Fig. 12). The endosperm tissue occupies the periphery of the seed leaving a narrow cavity in the center (Fig. 5). The enlarging cotyledonary haustorium converts the hard endosperm into a pulpy mass (Fig. 7).

1. View of 90-day-old heaped up soil mound for raising seedlings. Weed growth and humus help retain moisture.

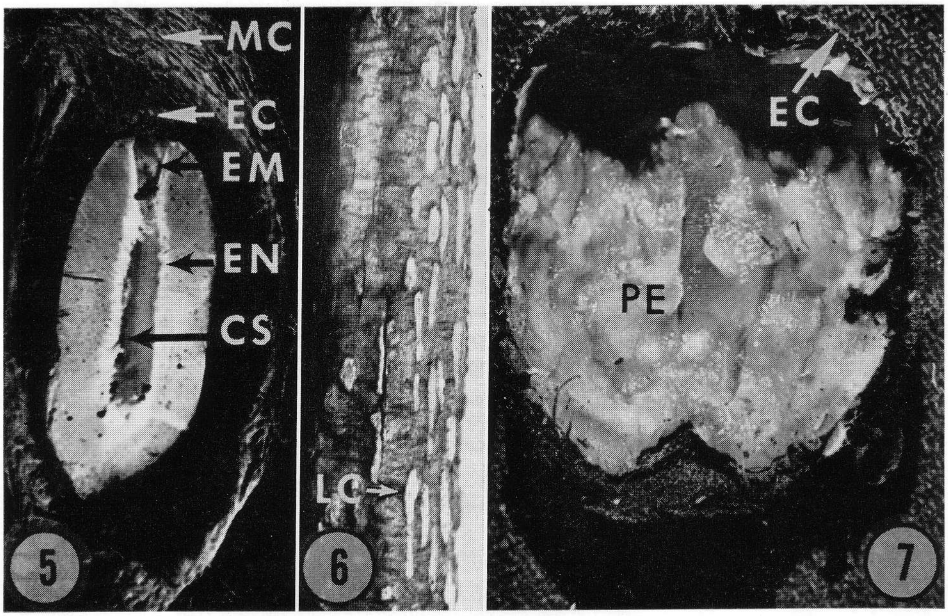
The embryo: The embryo of the mature seed is embedded in the endosperm at the micropylar end. At the time the fruits are shed, the embryo is only a small conical mass of cells (Fig. 5). Internally, it shows a much higher degree of differentiation than would be assumed by the look of it. The cotyledonary portion (Fig. 9) acts as a sucker or haustorium and is the first organ to develop. The moisture reaching the embryo activates the growth of the cotyledon, which begins to enlarge and digest the endosperm. The onset of enlargement in the haustorium is followed by growth in the lower part of the cotyledonary primordium (apocole) as a result of which the embryonal axis pushes out of the pyrene. Further growth results in the axis assuming a knoblike appearance. At this stage it is connected with the haustorium by an isthmuslike region.

The structure of the cotyledon: In the germinating seed the expanding cotyledonary haustorium is thrown into folds on the surface, while its interior becomes spongy and fibrous due to numerous air cavities that develop schizogenously (Figs. 2, 4). The outer surface is marked by ramifying fissures simulating those on the mammalian brain. The creamy-white color of the sucker completes its similarity to the brain. Histologically, the epidermis of the cotyledonary haustorium is differentiated into a secretory layer (Fig. 15) rich in protein as determined by the Mercury-Bromophenol Blue test (Pearse, 1960). This layer is responsible for the secretion of enzymes that break down the hemicelluloses. Internally, a ring of vascular bundles located in the subsurface region (Fig. 15) translocates the absorbed material down the cotyledonary sheath.

The structure of the cotyledonary sheath: The cotyledon can be divided into the haustorium (embedded in the endosperm), the petiole, and the sheath (Fig. 9). The petiole and the sheath in *Borassus* elongate geotropically. Such



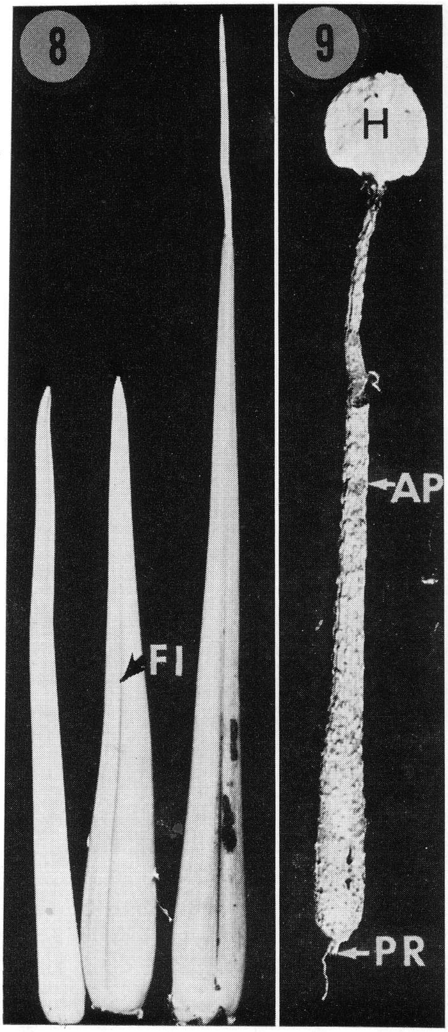
2–4. Germinating pyrenes and haustoria. 2, vertically split cotyledonary haustorium showing the spongy air-filled interior and vascular strands; 3, germinating pyrenes dug out from the mass germination mound; 4, a close view of the fully grown cotyledonary haustorium showing the surface foldings that digest the endosperm. Details: AP, apocole; AT, annular thickenings; DR, pyrene; FI, fissure; PR, primary root.



5–7. Cotyledonary sheath and sections of pyrenes. 5, vertical section of a pyrene showing the endosperm, embryo, and the fibrous layers; 6, lenticel-like openings in the cotyledonary sheath taken from specimens shown in Fig. 3; 7, vertical section of a pyrene showing the endosperm reduced to a pulp by the haustorium of the cotyledon. Details: CS, central cavity; EC, endocarp; EN, endosperm; EM, embryo; LC, lenticel-like opening; MC, mesocarp; PE, pulpy endosperm.

an elongating organ of palm seedlings has been termed apocole by Cook (1939). The apocole in *Borassus* buries the embryonal axis deep (50 cm) below the surface (Fig. 3).

The sheath primordium of the cotyledon, which measures 1 mm in the embryo, exhibits extensive growth and elongation during germination. It forms a bridge between the haustorial organ embedded in the endosperm and the embryonic axis (Figs. 3, 9). Initially the emergence of the axis from the shell through the narrow opening is facilitated by the growth of the apocole. At late stages the narrow passage in the hard shell causes a sort of constriction in the apocole and an annular swelling. Beyond this region the sheath enlarges into a stalklike structure measuring 5 mm across. Along with the process of elongation, the diameter of the tuberous seedling leaf keeps on increasing, especially near the axis (Fig. 8) where it begins to accumulate a large amount of starch grains (Figs. 10, 11). As soon as the elongation of the apocole ceases the tuberous structure attains a thickness of about 2.5 cm (Fig. 3). The apocole itself forms a leathery and protective covering around the tuberous seedling leaf (Fig. 9). At maturity the inner epidermis of the apocole becomes a thin, white, and papery covering while the outer tissue becomes brownish. Numerous lenticel-like structures disposed lengthwise along the outer surface of the seedling impart a broken appearance (Fig. 6). These lenticel-like structures are really fissures in the epidermis through which the underlying parenchyma cells are exposed and pro-



8–9. Seedling and seedling leaves. 8, starch-bearing first tuberous seedling leaves separated from the enclosing cotyledonary sheaths; 9, seedling with haustorium removed from shell. Details: AP, apocole; FI, fissure; H, haustorium; PR, primary root.

ject out. The epidermis becomes ruptured during the course of development and 4–5 layers of corky cells develop in the subdermal zone, imparting a brownish appearance. The interior of the sheath is filled with parenchyma cells loosely packed with large air spaces. A ring of large vascular bundles develops in the peripheral zone of the sheath. These vascular bundles extend into the haustorium and supply the fissures and folds. As mentioned earlier, the inner epidermis of the cotyledonary sheath surrounding the tuberous juvenile leaf remains intact and becomes a white, papery, protective structure. It is composed of compact polygonal cells, many of which accumulate brown contents consisting of tanniniferous compounds (Fig. 14). After the death of the sucker, the sheath usually rots and is lost. Further growth of the seedling leaves is supported by the food materials stored in the tuberous juvenile leaf.

The tuberous first (juvenile) leaf: The activity of the shoot apical meristem results in the initiation of the first bladeless juvenile leaf. Unlike some other palms (e.g., the coconut) the first bladeless juvenile leaf becomes tuberous in *Borassus.* The growth of the tuberous structure is mainly concentrated on the abaxial half which becomes about 50 cell layers thick and its overall shape is an attenuated cone (Fig. 8). This structure is tightly enclosed by the inner epidermis of the cotyledonary sheath. The tuberous part exhibits a smooth shiny outer surface, a well developed epidermis, vascular bundles, and innumerable parenchyma cells, which store a large amount of starch grains (Fig. 11). The maximum girth of the tuberous parts is about 2.5 cm. From base to tip it measures about 15 cm. An elongated groove on the juvenile leaf indicates its adaxial side (Fig. 8).

The morphology of the fleshy tuberous region appears not to have been correctly understood. Tomlinson (1960, p. 57) writes, "In *Borassus* and *Hyphaene*, for example, the fleshy cotyledon may be up to two feet long and it is often eaten as a succulent vegetable by the natives of India and parts of

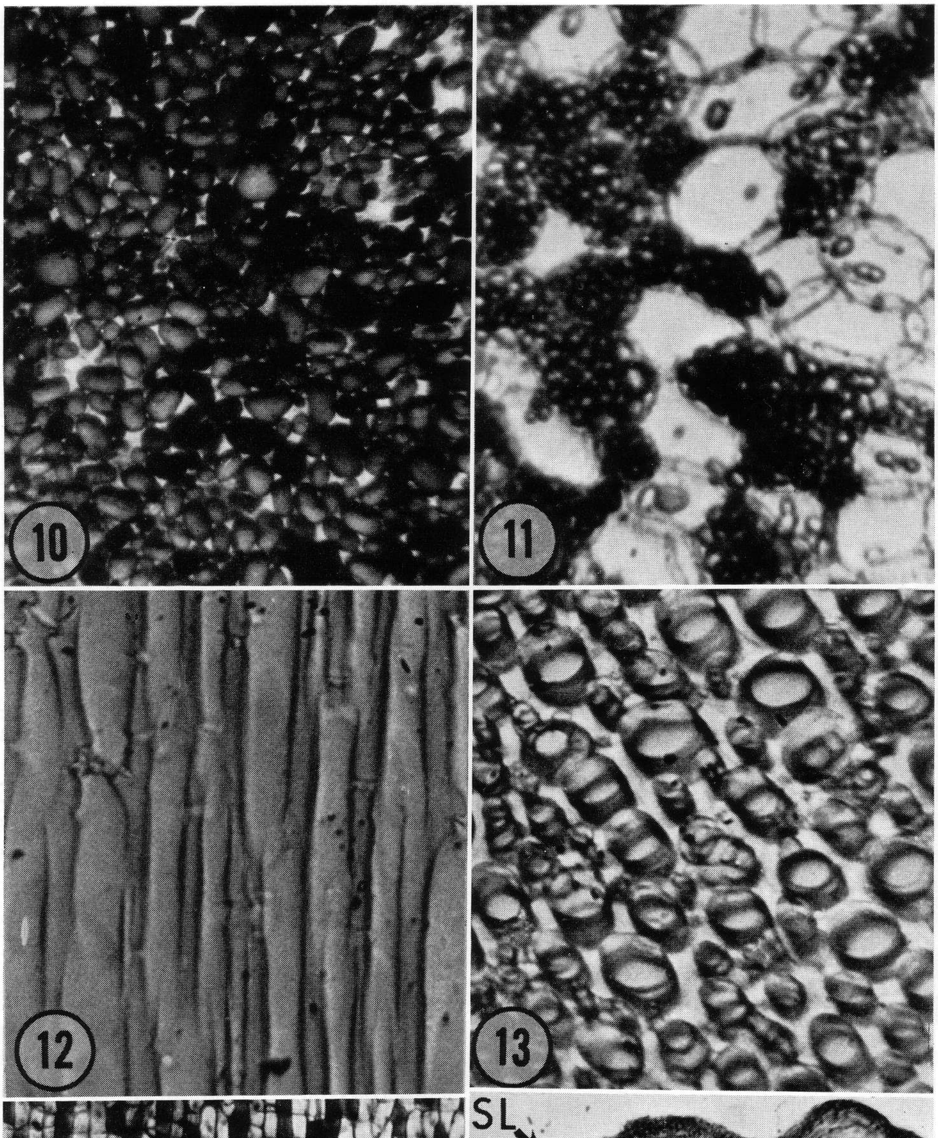

10
11
12
13
14
15
SL
VB
SP

Table 1. Products and yield from fruit and seedlings of Borassus flabellifer

Product	Yield/pyrene (g)	Yield/fruit (g)	Yield/tree (kg)	Yield/acre (kg)
Starch	30	90	18–27	18,000–27,000
Fresh endosperm (Mature)	80	240	48–72	48,000–72,000
The hard shell* (Endocarp)	32	96	20–30	20,000–30,000
Mesocarp fiber** (From fruit)	6	18	4–6	4,000–6,000

* A good fuel.
** A good filling material and insulator.

Africa." However, it is the first bladeless juvenile leaf that becomes tuberous and not the cotyledon or apocole.

The starch content: The starch in the tuberous part of the seedling was isolated (Fig. 10) after cutting it into smaller bits, grinding with alcohol, and evaporation. In sections of fresh material, each parenchyma cell was found to contain about 15–20 grains (Fig. 11). The quantity of starch in the tuberous structure was remarkably high. One gram of the fresh material yielded 500 mg of starch. The average fresh weight of a tuberous juvenile leaf is about 60 g, from which about 30 g of starch could be derived. On this basis, a fruit containing three pyrenes would yield ultimately 90 g of starch, and the quantity that can be obtained from the seeds of a tree bearing 200–300 fruits on an average would be 18–27 kg. Considering that an acre of land can support not less than a thousand trees, the yield per acre would be very high (i.e., 18,000 to 27,000 kg.). In other words palm seedling starch is a potential supplement to rice. In fact, palmyras could be grown without much input on dry sandy soil where rice cultivation is out of question.

The total output of tuberous seedlings annually raised in the state would be a very considerable quantity. On an average about 5,000 to 8,000 kg of seedlings are being produced annually in a village. The normal custom is to cook these by boiling and the cooked tuberous parts are eaten with salt and spices. At present, starch is not extracted from the tuberous seedlings on a commercial scale. However, the potential in the southern districts of the state of Tamil Nadu is very high. The seedling starch could also be used in the fermentation industry as well as in sizing fabrics in the textile industry.

The relative importance of seedling starch: The Khadi and village Industries Board (Tamil Nadu State) has

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10–15. Tissues of seed and seedling. 10, microscopic view of starch grains isolated from the tuberous, bladeless, first seedling leaf; 11, sectional view of a part of a tuberous tissue showing dense distribution of starch grains; 12, vertical section of a portion of a mature endosperm tissue showing highly thickened cell walls laden with hemicellulose; 13, transverse section of the mature endosperm tissue showing thickened cell walls; 14, microscopic view of the inner papery epidermis of the cotyledonary sheath. The cells with dark contents of tanniniferous compounds appear to act as chemical protectives; 15, sectional view of the peripheral zone of the cotyledon showing the secretory outer layer and the inner loosely packed parenchymatous cells. Note the vascular bundles adjoining the surface. Details: SP, spongy parenchyma; SY, secretory layer; VB, vascular bundle.

set up small scale industries for the production of refined and crude palm sugar, fiber brush, and various other handicraft products based on *Borassus*. However, the potentiality of the tuberous seedlings as a source of starch has not been exploited. The results of the present study indicate the tremendous possibilities of utilizing the starch of the tuberous seedlings on a commercial scale (Table 1). This would also avoid the wastage of useful energy content of the fruits and the seeds. The present practice of utilizing the tender endosperm as the basic material for the production of jam appears to be less economical considering the total energy in the mature endosperm. Thus, it is suggested that the commercial production of seedlings for starch should be taken up immediately in order to tap the vast resources of the palmyra plantations to a greater extent.

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Notice

The Third Meeting of the International Council on Lethal Yellowing was held at the Jupiter Hilton Hotel, Palm Beach County, Florida on October 30 to November 3, 1977. The Proceedings of this meeting, with abstracts of papers presented, has been published as Publication FL-78-2, Agricultural Research Center, Institute of Food and Agricultural Sciences, University of Florida, Fort Lauderdale, Florida, 1978. Copies of the Proceedings were sent to all participants and are available to others who may have specific interest and ask to receive a copy from the Agricultural Research Center, 3205 S.W. 70th Avenue, Fort Lauderdale, Florida 33314.

The meetings were conducted in an introductory session and six particular sessions dealing with basic biology of yellows diseases (I), disease diagnosis (II), mycoplasma isolation and culture (III), vectors (IV), disease control (V), and emerging problems in palm culture (VI). Reports of earlier meetings have appeared in *Principes* 17: 151–159, 1973 and 20: 57–69, 1976.

Palm Research

Dr. Dennis Johnson of the University of Houston has suggested that an annual listing of palm research in progress be published in Principes. Persons conducting research on palms are invited to submit appropriate information to one of the editors for publication in January 1979.

Errata

Volume 15, page 105, column 2, line 5; for **S. texana** read *S. texana.*
Volume 20, page 103, line 22: for **drymophloeiodes** read **drymophloeoides**.
Volume 21, page 169, column 2, line 5: for currently read current.
Volume 22, page 23, column 1, line 15: for *precatoria* read *oleracea.*
Volume 22, page 33, column 2, line 24: for *tumuca* read *tucuma.*

Principes, 22(4), 1978, pp. 127–135

A Census of Palms Cultivated in the Indian Botanic Garden, Howrah

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Indian Botanic Garden, Botanical Survey of India, Howrah-711103, India

The Indian Botanic Garden, Howrah, is situated near sea level (4.5 m alt.) in West Bengal. It comprises an area of 109.29 hectares, the approximate annual rainfall is 1536 mm, and temperatures range from 21° to 31° C. A population of more than 12,000 plants is spread over the landscape. Among others, palms play a dominant part in enhancing the beauty and scientific aspects of the garden.

The main object of bringing out this list of palms cultivated in the Indian Botanic Garden is to give an idea of the palm wealth after nearly two centuries of the garden's existence. References to the palm collection of the garden appear in the works of Griffith (1844–45), Gage (1912), Blatter (1926), Benthal (1946), Sen and Naskar (1965), and Basu (1969). Blatter includes, among others, the history of the introduction of *Lodoicea maldivica*, the giant coco-de-mer palm, into the garden.

Many species recorded earlier have died, many were replaced, and at the same time many have been introduced and established in the garden. With this continuous process, many species are not found in the localities mentioned for them earlier, and in many cases their previous names are no longer in use. An up-to-date census providing recent botanical names and synonyms, country of origin, location in the garden, and habit, was therefore felt necessary. *Nypa fruticans*, mentioned in earlier records, is no longer found in the garden but grows luxuriantly at the Governor's residence garden in Calcutta, only a few miles from the garden on the other side of the Hooghly River.

The accompanying map of the Indian Botanic Garden (Fig. 1) shows 25 working divisions corresponding to the numbers mentioned with each species as a guide to its location. The abbreviations used herein are as follows: C, clustering; DN, division; F, flowering and fruiting; LPH, Large Palm House; N, Nursery No. 1; NF, not yet flowering; OH, Orchid House; P, pinnate-leaved; PA, palmate-leaved; PT, potted plant; RB, river bank; S, single-stemmed; SPH, Small Palm House. In a few instances—*Daemonorops jenkinsiana, Desmoncus horridus, Rhopalostylis sapida, Salacca edulis*—plants are flowering but have not fruited. Nomenclature largely follows Moore (1963).

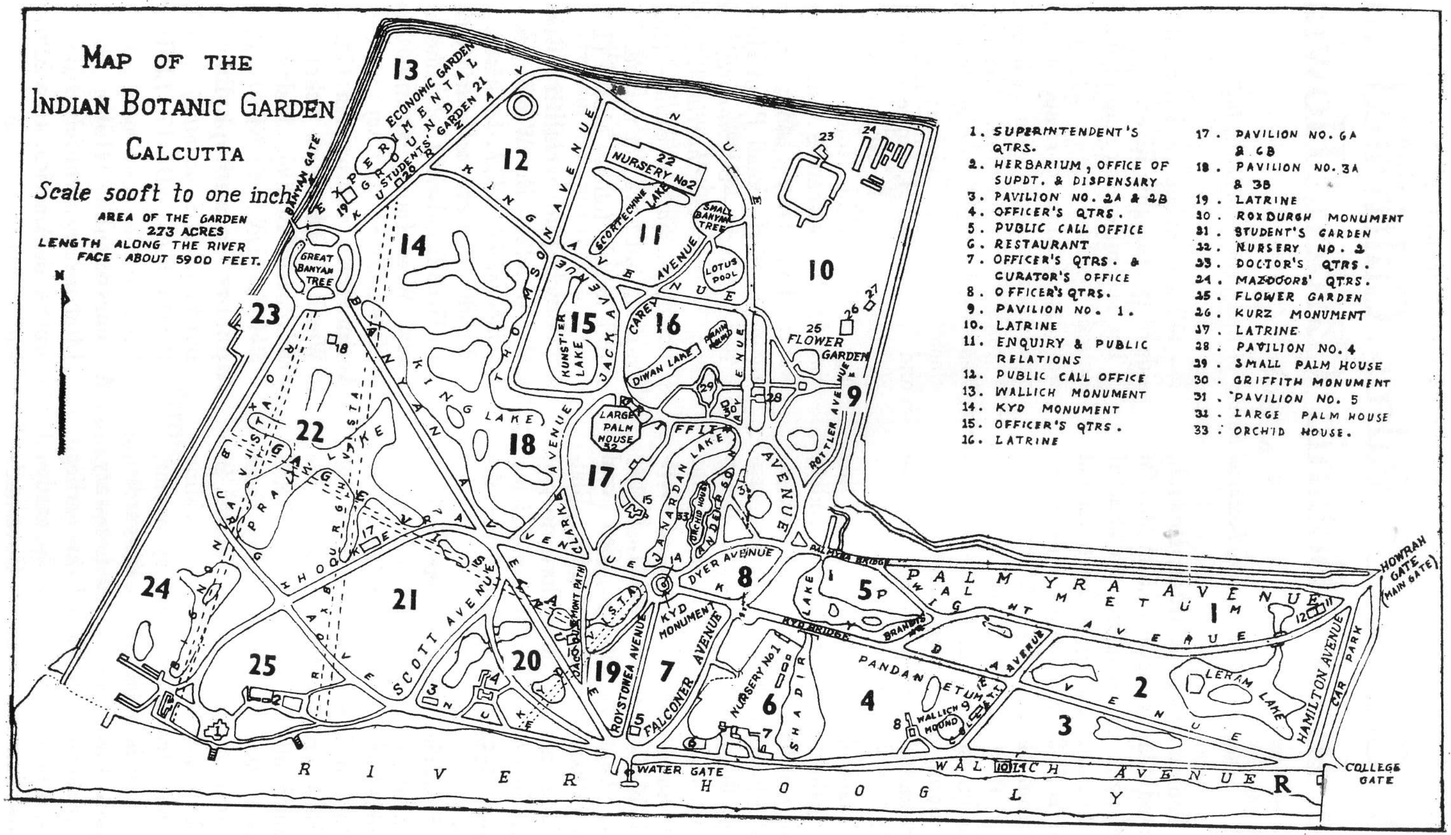
Acoelorrhaphe wrightii (Griseb. & H. Wendl.) H. Wendl. ex Becc. [*Copernicia wrightii* Griseb. & H. Wendl., *Paurotis wrightii* (Griseb. & H. Wendl.) Britt.]. Southern Florida, West Indies, Central America. (DN-4, 5; F; C; PA.)

Actinorhytis calapparia (Blume) H. Wendl. & Drude ex Scheff. [*Areca calapparia* Blume]. Malaya to New Guinea. (DN-5, 6; NF; S; P.)

Aiphanes acanthophylla (Mart.) Burret [*Bactris acanthophylla* Mart.]. Puerto Rico. (DN-17, LPH; F; S; P.)

A. caryotifolia (HBK) H. Wendl. [*Martinezia caryotifolia* HBK]. Northern South America. (DN-5, 6; F; S; P.)

Archontophoenix alexandrae (F.



1. A map of the Indian Botanic Garden, Howrah, with divisions numbered.

Muell.) H. Wendl. & Drude [*Ptychosperma alexandrae* F. Muell.]. Eastern Australia. (DN-5, 17, N; NF; S; P.)

A. cunninghamiana (H. Wendl.) H. Wendl. & Drude [*Ptychosperma cunninghamianum* H. Wendl., *Seaforthia elegans* Hook. not R. Br.]. Eastern Australia. (DN-8, N; S; P.)

Areca catechu L. Tropical Asia. (DN-1, 4–7, 17, 22, 24, 25; F; S; P.)

A. macrocalyx Zipp. ex Blume. New Guinea. (DN-6, N; NF; PT.)

A. triandra Roxb. India, Malaya. (DN-2, 4, 5–7, 9, 17, LPH; F; C; P.)

Arenga engleri Becc. [*Didymosperma engleri* (Becc.) Warb.]. Formosa, Ryukyu Islands. (DN-6, 22, LPH; F; C; P.)

A. obtusifolia Mart. Malaya, Java. (DN-8; F; C; P.)

A. pinnata (Wurmb) Merrill [*A. saccharifera* Labill.]. Malaya to Philippine Islands. (DN-1, 2–4, 6–8, 10, 13, 17, LPH, SPH, N, RB; F; S; P.)

A. undulatifolia Becc. Borneo, Celebes. (DN-17; F; S; P.)

A. wightii Griff. India. (DN-1, 8; F; C; P.)

Bactris gasipaes HBK [*Guilielma gasipaes* (HBK) L. H. Bailey]. Central America to Peru. (DN-6, N; NF; S; P.)

B. major Jacq. Central America to northern South America. (DN-1, 2, 3, 5, 6, 9, 17, 22; F; C; P.)

Bentinckia nicobarica (Kurz) Becc. [*Orania nicobarica* Kurz]. Nicobar Islands. (DN-5, 17; F; S; P.)

Borassus flabellifer L. India, Malaya. (DN-1, 2, 3, 7–13, 22, 24; F; S; PA.)

Calamus arborescens Griff. Burma. (DN-4, 5, 20; F; C; P.)

C. ciliaris Blume. Malaya. (DN-6, PT; NF; C; P.)

C. erectus Roxb. [*C. erectus* var. *schizospathus* (Griff.) Becc., *C. schizospathus* Griff.]. India. (DN-1; C; P; NF.)

C. guruba Buch.-Ham. ex Mart. Malaya. (DN-1, 2; F; C; P.)

C. leptospadix Griff. India, Burma. (DN-1, 2; F; C; P.)

C. longisetus Griff. India, Malaya. (DN-5; F; C; P.)

C. rotang L. [*C. roxburghii* Griff.]. Sri Lanka. (DN-6; F; C; P.)

C. viminalis Willd. Malaya. (DN-1, 2; NF; C; P.)

Calyptrocalyx spicatus (Lam.) Blume [*Areca spicata* Lam.]. Amboina. (LPH; F; S; P.)

Caryota mitis Lour. [*C. furfuracea* Blume ex Mart., *C. griffithii* Becc., *C. sobolifera* Wallich ex Mart.]. India to Java. (DN-1, 2, 3, 5, 6, 9, 11–13, 15, 17, 18, 22, 23; F; C; P.)

C. rumphiana Mart. Australia, New Guinea, Solomon Islands. (DN-1, 17; F; S; P.)

C. urens L. India. (DN-1, 2–5, 9–12, 22, 24, 25; F; S; P.)

Chamaedorea elegans Mart. [*Collinia elegans* (Mart.) Liebm. ex Oerst.]. Mexico, Guatemala. (N; NF; S; P.)

Chrysalidocarpus lutescens H. Wendl. [*Areca madagascariensis* Mart.]. Madagascar. (DN-1, 2, 5–8, LPH, SPH; F; C; P.)

C. madagascariensis Becc. [*Areca madagascariensis* Hort. not Mart., *Dypsis madagascariensis* Hort.]. Madagascar. (DN-5, 6, 8, 12, 25; F; C; P.)

C. madagascariensis var. **lucubensis** (Becc.) Jumelle. Madagascar. (DN-17; F; S; P.)

Coccothrinax argentata (Jacq.) L. H. Bailey. Florida, Bahama Islands. (DN-5; F; S; PA.)

C. crinita Becc. Cuba. (DN-23, PT; S; PA. NF.)

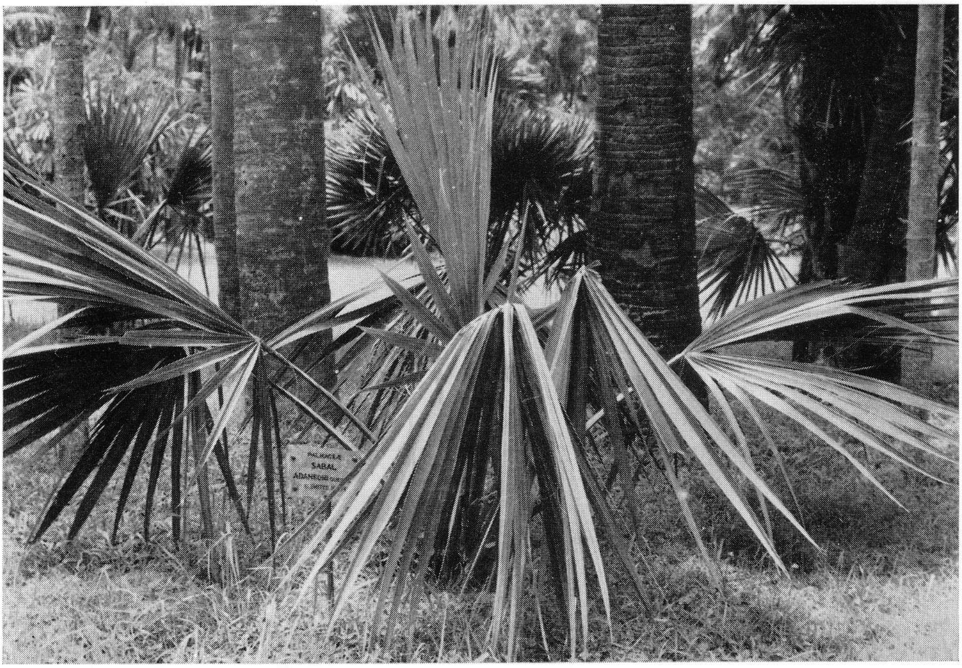
C. dussiana L. H. Bailey [*Coccothrinax barbadensis* Becc., *Thrinax barbadensis* Lodd. ex Mart.?]. Guadeloupe. (DN-6, N, PT; NF; PA.)

2. *Caryota rumphiana* with two stems.

C. inaguensis Read. Bahama Islands. (DN-6, N, PT; NF; PA.)

Cocos nucifera L. Pantropic. (DN-12, 5, 25; F; S; P.)

Corypha elata Roxb. [*C. gebanga* (Blume) Blume, *Taliera gebanga* Blume]. India and Burma. (DN-9, 12, 18, 24, RB; F; S; PA.)



3. *Sabal minor.*

C. taliera Roxb. India. (DN-6; F; S; PA.)

C. umbraculifera L. Sri Lanka. (DN-6; F; S; PA.)

Daemonorops didymophylla Becc. India and Burma. (DN-2; NF; C; P.)

D. jenkinsiana (Griff.) Mart. [*Calamus jenkinsianus* Griff.]. Burma, India, Malaya. (DN-8; C; P.)

Desmoncus horridus Splitg. ex Mart. Surinam. (DN-5; C; P.)

Dictyosperma album (Bory) H. Wendl. & Drude ex Scheff. Mascarene Islands. (DN-2, 5, 8; F; S; P.)

Elaeis guineensis Jacq. [*E. melanococca* Gaertn.]. Tropical Africa. (DN-2, 5–9, 11, 22, LPH; F; S; P.)

Heterospathe elata Scheff. Amboina. (DN-1, 2, 5, 7, 22; F; S; P.)

Howea belmoreana (C. Moore & F. Muell.) Becc. [*Kentia belmoreana* C. Moore & F. Muell.]. Lord Howe Island. (DN-6, N; NF; S; P.)

Hyophorbe lagenicaulis (L. H. Bailey) H. E. Moore [*Mascarena lagenicaulis* L. H. Bailey]. Mascarene Islands. (DN-6, N; NF; S; P.)

H. verschaffeltii H. Wendl. Mascarene Islands. (DN-6, SPH, N, PT; S; P.)

Hyphaene bussei Dammer ex Busse. Kenya. (DN-5; F; S; PA.)

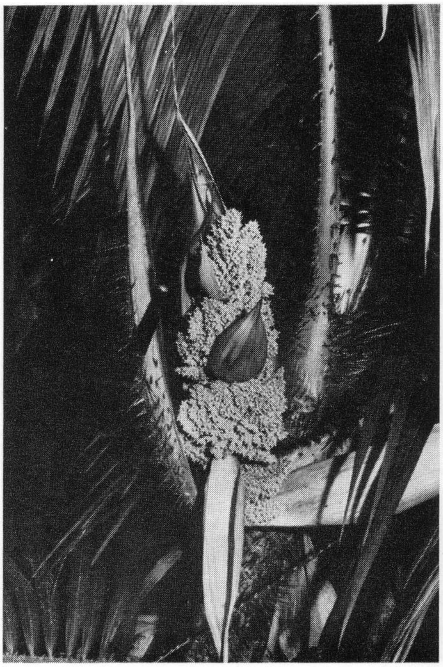
H. natalensis Kuntze. East Africa. (DN-5; F; C; PA.)

H. indica Becc. India. (DN-5; F; S; PA.)

H. schatan Bojer ex Dammer. Madagascar. (DN-5; F; C; PA.)

H. thebaica (L.) Mart. North Africa. (DN-5; F; S; PA.)

Latania loddigesii Mart. [*L. glaucophylla* Hort.]. Mascarene Islands. (DN-5; F; S; PA.)



4. A staminate plant of *Daemonorops jenkinsiana* in flower.

L. lontaroides (Gaertn.) H. E. Moore [*Cleophora lontaroides* Gaertn., *L. commersonii* J. F. Gmel., *L. rubra* Jacq.]. Mascarene Islands. (DN-8; F; S; PA; staminate.)

Licuala grandis H. Wendl. New Hebrides. (DN-6, 17, LPH; F; S; PA.)

L. peltata Roxb. ex Buch.-Ham. India. (DN-5, LPH; F; S; PA.)

L. spinosa Thunb. [*L. horrida* Blume]. Southeast Asia. (DN-1, 2, 4–9, 14, 15, 17, 18, 22; F; C. PA.)

Livistona australis (R. Br.) Mart. [*Corypha australis* R. Br.]. Australia. (DN-1, 2, 5; F; S; PA.)

L. chinensis (Jacq.) R. Br. ex Mart. [*Latania chinensis* Jacq., *Livistona oliviformis* (Hassk.) Mart.]. China. (DN-1, 2, 4–7, 9–11, 15, 17, 22; F; S. PA.)

L. decipiens Becc. Australia. (DN-5; F; S; PA.)

L. humilis R. Br. Australia. (LPH; NF; S; PA.)

L. jenkinsiana Griff. India. (DN-5; F; S; PA.)

L. rotundifolia (Lam.) Mart. [*Corypha rotundifolia* Lam.]. East Indies. (DN-1, 2, 5, 7, 8, 11, 15–17; F; S; PA.)

L. saribus (Lour.) Merrill ex A. Cheval. [*Corypha saribus* Lour., *Livistona cochinchinensis* (Blume) Mart.]. East Indies, Southeast Asia. (DN-16, 18; F; S; PA.)

Lodoicea maldivica (J. F. Gmel.) Pers. [*Cocos maldivica* J. F. Gmel., *Borassus sonneratii* Giseke, *L. sechellarum* Labill., *L. callipyge* Comm. ex St.-Hil.]. Seychelles. (LPH; NF; PA.)

Normanbya normanbyi (W. Hill) L. H. Bailey [*Cocos normanbyi* W. Hill, *Normanbya muelleri* Becc.]. Australia. (DN-6, 25, N, PT; NF; S; P.)

Orbignya cohune (Mart.) Dahlgr. ex Standl. [*Attalea cohune* Mart.]. Belize to Honduras. (DN-1, 6, 8, 17, LPH; F; S; P.)

Phoenicophorium borsigianum (C. Koch) Stuntz [*Astrocaryum borsigianum* C. Koch, *Stevensonia borsigiana* (C. Koch) L. H. Bailey]. Seychelles. (N, PT; NF; S; P.)

Phoenix acaulis Buch.-Ham. ex Roxb. India and Burma. (DN-5; F; P; C.)

P. loureirii Kunth [*P. hanceana* Naud., *P. humilis* var. *hanceana* (Naud.) Becc., *P. ousleyana* Griff.]. India to Hong Kong. (DN-1, 15, 22; F; S; P.)

P. paludosa Roxb. India. (DN-2, 4; F; C; P.)

P. reclinata Jacq. Tropical Africa. (DN-4, 9; F; C; P.)

P. roebelenii O'Brien. Laos. (DN-5, staminate; NF; S; P.)

P. rupicola T. Anderson. India. (DN-1, 2, 5–8, 11, 17, 18, 20; F; S; P.)

P. sylvestris (L.) Roxb. [*Elate syl-*

5. A clump of *Arenga wightii*

vestris L.]. India. (DN-1, 2–4, 7, 9–12, 17, 18, 20, 23–25; F; S; P.)

P. zeylanica Trimen. Sri Lanka. (DN-5; F; S; P.)

Plectocomia assamica Griff. Assam. (DN-4, LPH; NF; C; P.)

Pritchardia pacifica Seem. & H. Wendl. Fiji Islands. (DN-5, N, LPH, SPH; NF; PA.)

Ptychosperma elegans (R. Br.) Blume. Australia. (DN-1, 2–5, 9–14, 17, 18, 20, 21, 25; F; S; P.)

P. macarthurii (H. Wendl.) Nichols. [*Actinophloeus macarthurii* (H. Wendl.) Becc., *Kentia macarthurii* H. Wendl.]. Australia, New Guinea. (DN-1, 2–5, 9–15, 17, 18, 20, 21, 25; F; C; P.)

Rhapis excelsa (Thunb.) Henry ex Rehd. [*Chamaerops excelsa* Thunb., *R. flabelliformis* L'Hèr. ex Ait.]. China? (DN-2, 5, 7, 9, 17, 20, 23, 25; NF; C; PA.)

R. humilis Blume. China? (DN-9, 17; NF; C; PA.)

Rhopaloblaste augusta (Kurz) H. E. Moore [*Areca augusta* Kurz, *Ptychoraphis augusta* (Kurz) Becc.]. Nicobar Islands. (DN-5, 12, LPH; F; S; P.)

R. singaporensis (Becc.) Hook. f. [*Ptychosperma singaporense* Becc., *Ptychoraphis singaporensis* (Becc.) Becc.] Malaya. (DN-5, LPH; F; C; P.)

Rhopalostylis sapida H. Wendl. & Drude [*Areca sapida* Soland. ex Hook. f.]. New Zealand. (SPH; S; P.)

Roystonea borinquena O. F. Cook. Puerto Rico. (DN-5, N; NF; S; P.)

R. oleracea (Jacq.) O. F. Cook [*Areca oleracea* Jacq., *Oreodoxa oleracea* (Jacq.) Mart.]. West Indies. (DN-4, 5, SPH; F; S; P.)

R. regia (HBK) O. F. Cook [*Oreodoxa regia* HBK]. Cuba. (DN-1, 5, 11, 13, 15–17, 19; F; S; P.)

Sabal domingensis Becc. [*S. um-*

6. Emergence of the terminal inflorescence in *Arenga undulatifolia.*

braculifera Hort. not Mart.]. Dominican Republic. (DN-5; F; S; PA.)

S. mauritiiformis (Karst.) Griseb. & H. Wendl. [*S. glaucescens* Lodd. ex H. E. Moore, *S. nematoclada* Burret]. Belize to northern South America. (DN-4, 5; F; S; PA.)

S. mexicana Mart. [*S. guatemalensis* Becc., *S. texana* (O. F. Cook) Becc.]. Texas to Guatemala. (DN-4, 5, 6; F; S; PA.)

S. minor (Jacq.) Pers. [*S. adansonii* Guersent]. Southeastern United States. (DN-4, 5, 6; F; S; PA.)

S. palmetto (Walt.) Lodd. ex Schult. & Schult. f. [*S. viatoris* L. H. Bailey.] Southeastern United States. (DN-5; F; S; PA.)

Salacca edulis Reinw. [*Calamus zalacca* Gaertn., *S. blumeana* Mart.]. Java. (DN-1, 8; F; C; P.)

Scheelea insignis (Mart.) Karst. [*Maximiliana insignis* Mart.]. Northern South America. (DN-20; F; S; P.)

Serenoa repens (Bartr.) Small [*Corypha repens* Bartr.]. Southeastern United States. (N, PT; NF; PA.)

Syagrus romanzoffiana (Cham.) Glassman [*Cocos romanzoffiana* Cham., *Arecastrum romanzoffianum* (Cham.) Becc.]. Brazil. (DN-4, 5, N, LPH; F; S; P.)

S. schizophylla (Mart.) Glassman [*Cocos schizophylla* Mart., *Arikuryroba schizophylla* (Mart.) L. H. Bailey]. Brazil. (DN-4, 5, LPH; F; S; P.)

Thrinax parviflora Swartz. Jamaica. (DN-2, 4–6, 17, 22; F; S; P.)

Trachycarpus fortunei (Hook.) H. Wendl. [*Chamaerops fortunei* Hook., *T. excelsa* Hort.]. China. (DN-6, PT; NF; S; PA.)

T. martianus (Wallich) H. Wendl. [*Chamaerops martiana* Wallich]. India. (N, PT; S; PA.)

Veitchia merrillii (Becc.) H. E. Moore [*Normanbya merrillii* Becc., *Adonidia merrillii* (Becc.) Becc.]. Philippine Islands. (N; NF; S; P.)

Wallichia densiflora (Mart.) Mart. [*Harina densiflora* Mart., *Wallichia oblongifolia* Griff.]. India. (DN-5; F; S; P.)

Washingtonia filifera (L. Linden) H. Wendl. [*Pritchardia filifera* L. Linden]. Southwestern United States, northern Baja California, Mexico. (DN-6; NF; S; PA.)

W. robusta H. Wendl. Baja California, Mexico. (DN-4; NF; S; PA.)

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PALM LITERATURE

Familton, A. K., A. J. McQuire, J. A. Kininmonth, and A. M. L. Bowles (eds.). 1977. Coconut stem utilisation seminar: held at Nuku'alofa, Kingdom of Tonga, 25–29 October 1976 under the New Zealand aid programme for the South Pacific region. Ministry of Foreign Affairs, Wellington, New Zealand. 521 pp.

About 400,000 people (about 10%) of the population of the scattered South Pacific nations are more or less completely dependent on the coconut for their livelihood. The economy of these islands is often linked closely to this palm—Copra provides from up to 80% of export income in Tonga and Tuvalu, to as little as 10% in Fiji. In the nearby Philippines 25% of all export earnings comes from coconuts, an obvious major industry to a nation of 44 million people. Thirteen million people are said to be directly involved in the coconut industry.

And yet, only a small proportion of the total biomass produced by a coconut palm enters into commerce—its fruit, via copra, supplies edible oil, and to some extent the husk and endocarp may be used. At the end of the productive life of a coconut the trunk remains, normally to be left to rot (where, unfortunately, it may serve as a breeding ground for rhinoceros beetle).

The question was asked recently—"What is the potential value of the stem of overmature, i.e., unproductive coconut palms?" This is an appropriate question to ask in the South Pacific where natural resources are limited and where it is estimated that out of almost half a million hectares of coconuts, nearly one-third may be considered overmature and require a vigorous replacement program.

(*Continued on page 148*)

Principes, 22(4), 1978, pp. 136–141

Aerial Roots in Raphia

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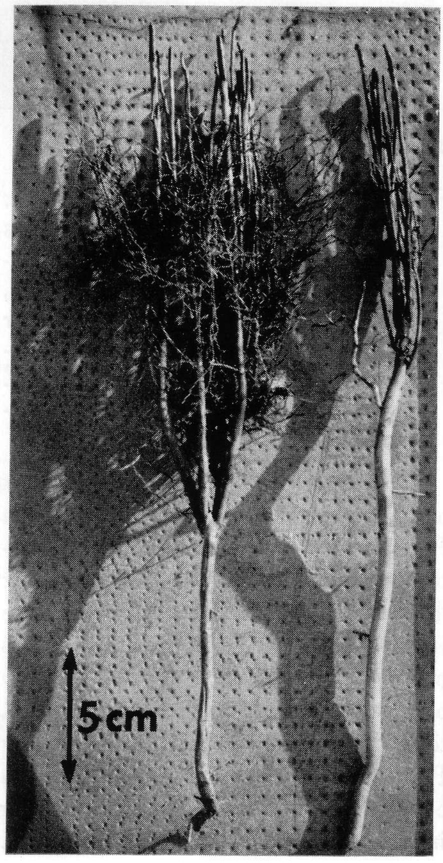
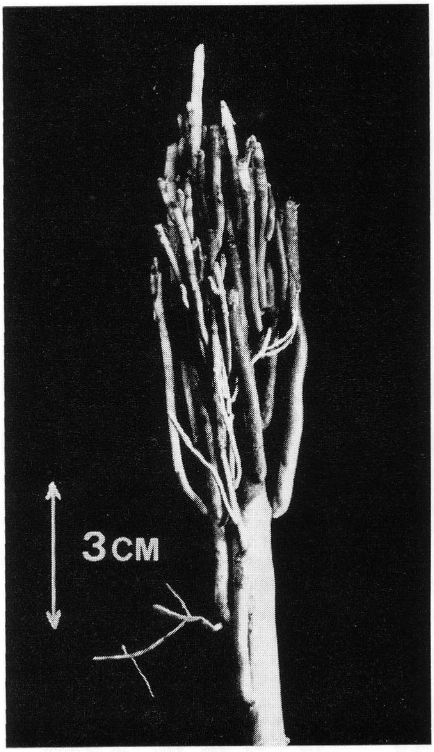
Among plants that produce aerial negatively geotropic roots, the best known are the mangrove genera, especially *Avicennia* and *Sonneratia.* Aerial roots of this kind occur in palms, especially *Raphia,* an essentially African genus (but with one species in South America) noted for the length of its leaves and inflorescences. These skirting roots were noted by Jumelle and Perrier de la Bathie (1913) in *Raphia farinifera* (*R. ruffia*) in Madagascar and by Chevalier (1932) in most of the West African species. Authors who studied the anatomy of aerial roots in several palms (Jost, 1887; Gage, 1901; Gatin, 1907) noted on the surface of these organs plates of mealy tissue, called pneumathodes by Jost, which played a respiratory role in the manner of lenticels. Here the usual external protective

1. *Raphia vinifera* in South Cameroon, to a height of 15 m.



2. *Raphia* cf. *monbuttorum.* Aspect of aerial roots.

* Translated from French by P. B. Tomlinson.



3. *Raphia farinifera.* Apical part of an aerial root forming a mass of secondary branches, each with a root cap.

4. *Raphia farinifera.* Detail of attachment and origin of root branches, to show their basal constriction.

tissues were absent and the underlying layers formed a loose tissue of rounded cells produced by a diffuse meristematic zone. These cells were sometimes covered with minute warty thickenings.

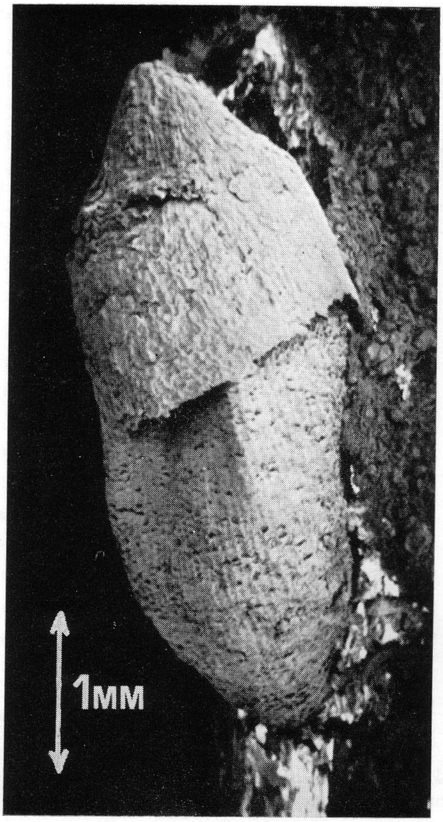
The following detailed account of the aerial roots of *Raphia* uses not only classical methods of microscopy, but the scanning electron microscope, applied to this subject for the first time.

Morphology

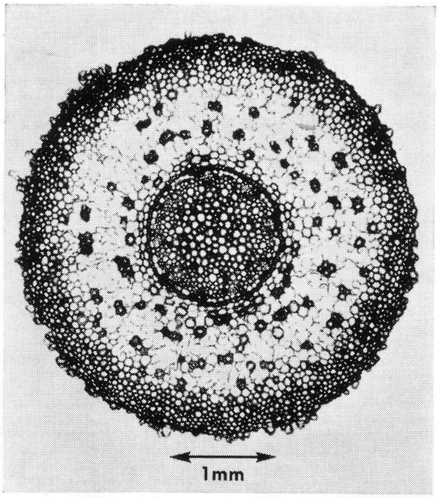
On penetrating a population of *Raphia* (Fig. 1), one discovers the surface of the swampy soil covered with a veritable carpet of aerial roots. These are produced by horizontal roots forming a subterranean network in the mud, and extend to a height of 20–30 cm above their insertion. The upper half more or less emerges above the surface of the soil or water and is branched (Fig. 2). Branches are quite numerous and form a dense mass of small secondary roots (Fig. 3). The apical root cap is clear on each of them (Figs. 4, 5).

The distribution of these secondary branches seems without order. Each new root has a pronounced negative geotropism evident from its inception. At the level of insertion of the secondary root on its parent there is a constriction where the cortex is somewhat narrower (Fig. 4).

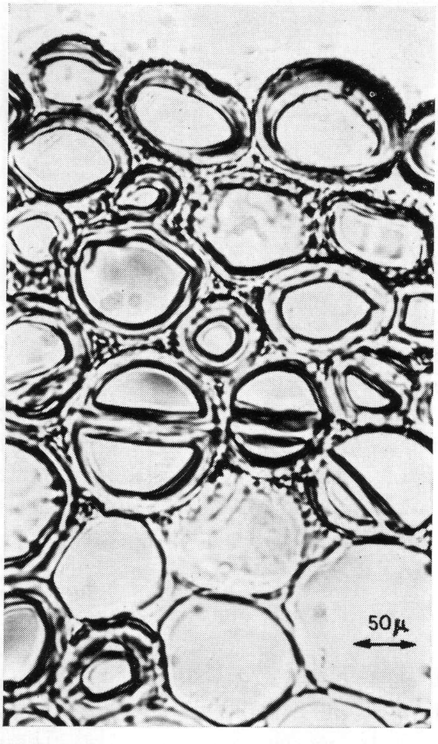
Surface observation of aerial roots



5. *Raphia farinifera.* Origin of a new lateral root (SEM photo), with prominent root cap. Exodermis still continuous.



6. *Raphia farinifera.* Transverse section of aerial root. Cortical parenchyma includes numerous fibers, mainly in groups; outer cortex without a protective layer.

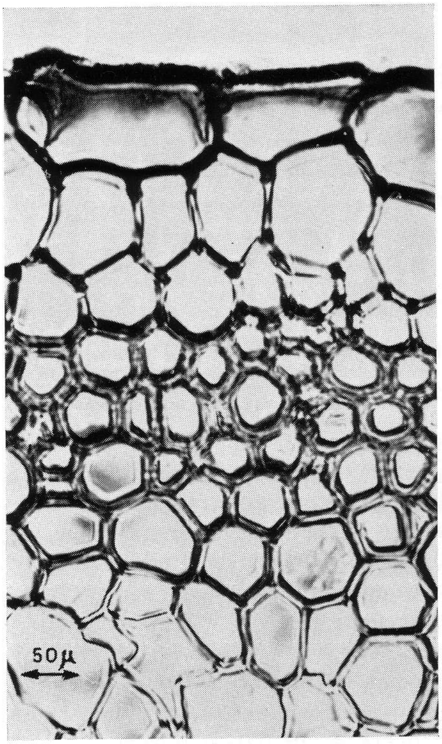


7. *Raphia farinifera.* Detail of the outer cortex of the aerial root.

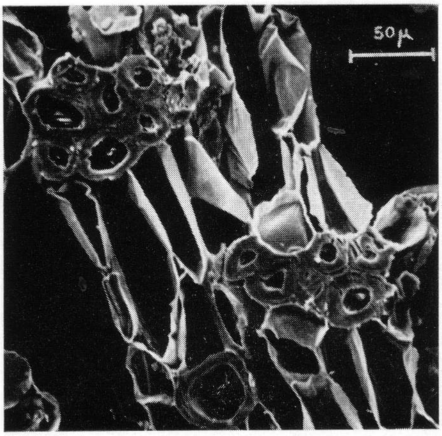
with both a binocular microscope and the scanning electron microscope demonstrates the strips of exodermis between which masses of elongated, rounded cells appear. Anatomical study provides details of internal structure.

Anatomy

A transverse section of a root stained with methyl green shows the typical monocotyledonous anatomy, the central cylinder including numerous vascular strands (Figs. 6, 9). The cortical parenchyma includes an internal region composed of two or three layers of small



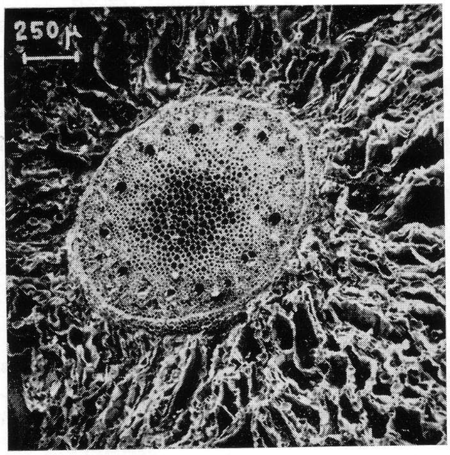
8. *Raphia farinifera.* Detail of the outer cortex of a subterranean root, for comparison with Fig. 7.



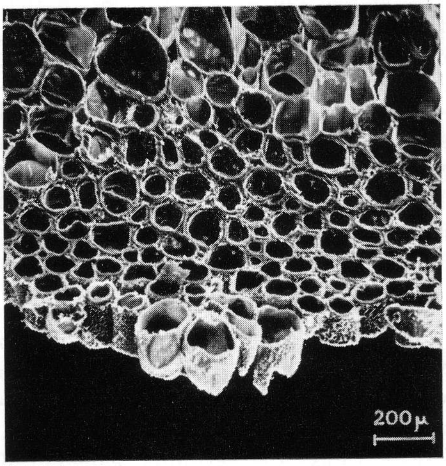
10. *Raphia farinifera.* SEM photo of cortical parenchyma to show cortical fibers which maintain some rigidity in the lacunose system.

regular cells and a middle lacunose region with radially elongated air spaces together with numerous cortical fibers, either isolated or in narrow bundles (Fig. 10).

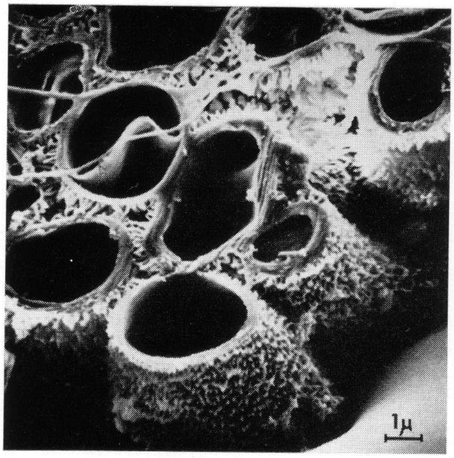
The aerial root (Fig. 7) differs from the subterranean root (Fig. 8) mainly in the outer cortex. The exodermis is developed only in the form of strips, or is completely absent. The two or three



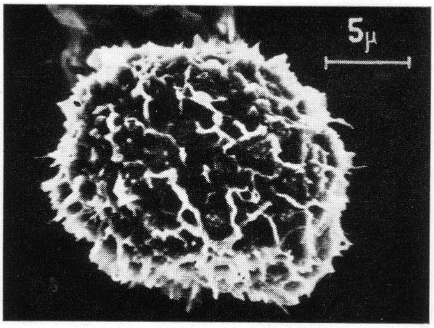
9. *Raphia farinifera.* SEM photo of central cylinder of an aerial root. Metaxylem vessels of central cylinder evident. Cortex with lacunae separated by radial files of cells.



11. *Raphia farinifera.* SEM photo of outer cortex of aerial root, the outer layers forming a loose tissue.



12. *Raphia farinifera.* SEM photo of peripheral cells showing their dissociation.



13. *Raphia farinifera.* SEM photo of peripheral cells with irregular warted sculpturing.

adjacent layers develop as a zone of rounded cells that form a loose exfoliating tissue (Fig. 11). Microscopy shows that these cells are covered with numerous minute spines (Figs. 12, 13). Towards the center of the root there is a more or less lignified zone and an adjoining zone of parenchyma 2–3 cells wide with the walls of recent divisions, forming a diffuse meristematic zone. Scanning electron microscopy shows that the peripheral cells (10 μ long, 5 μ wide) are covered by a banded network of irregular protuberances (Fig. 13). The functional interpretation of this structure is difficult, but it seems certain that the loose tissue formed by these cells facilitates gaseous exchange with the atmosphere.

Conclusions

The presence of aerial roots is tied up with the ecology of *Raphia.* Populations of *Raphia* are localized in swampy depressions and backwaters of rivers. These roots are certainly capable of aerating subterranean roots, which are found in an anaerobic substrate. This interpretation is supported by three facts. First, at all levels there is an increase in the surface for gas exchange; the surface of the mud is entirely covered by roots; each root is much branched; there is a surface proliferation of cells provided with warty bands. Second, all species of *Raphia* that occur in the Cameroons (*R. farinifera, R. hookeri, R.* cf. *monbuttorum, R. vinifera*) show the same root development. The only exception is *R. regalis,* which does not grow in swamps but on slopes and summits of hills in Nigeria and Gabon. Third, other plants that grow in mud develop aerial roots, such as *Avicennia, Sonneratia,* and other mangroves adapted to anaerobic soils.

One can conclude that the aerial roots of *Raphia* function as aerating organs or *pneumatophores.* This term is used to describe roots with *pneumathodes,* which refers to the lenticel-like structures that occur on different organs.

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Principes, 22(4), 1978, p. 141

NOTES ON CULTURE

Proper Watering the Key to Keeping Palm Green*

In recent months, I have counted seven dead palms along my block in New York. It's not that we've taken to planting palms as street trees, of course, but a lot of people seem to have trouble keeping them alive indoors—especially the areca.

The irony in this is that while the areca (uh-REEK-uh) is the cheapest and most widely distributed palm, it is also one of the most difficult to grow as a house plant.

The chief killer of the areca is lack of water. As nearly as I can tell, this stems not so much from neglect, but from widely published and spoken advice to let it dry out between waterings.

I learned about the areca's need for soil that is always evenly moist when a super gardener friend from Florida visited me a few years ago. We had hardly exchanged proper greetings when he walked over to my sickly areca and said, "Why don't you ever give it a decent drink of water?"

It was then that I discovered what an amazing difference proper watering can make in the life of a plant. My areca is about five feet tall and grows in a 14-inch standard clay pot. I had been giving it about one quart of water a week, which meant that the soil sometimes became quite dry between waterings. In order to keep the soil always evenly moist, I have found it necessary to apply from four to six quarts of water every week.

Within six months after I switched to watering more, the new growth was shooting up vigorously—without so much as a single dead leaf tip.

In a nutshell, here is the care I recommend for areca palms: Light, some direct sun, especially in the winter, or bright light all day. Temperature, an average house during the winter heating season; avoid drafts of hot or cold air. Humidity, medium (30 per cent or more). Mist the fronds frequently with water to help keep them rain-fresh. Water generously, often enough to keep the soil moist at all times, but do not leave the pot standing in a saucer of water for more than an hour or two. Feed with a foliage plant fertilizer in the spring and summer; fish emulsion in particular is excellent for palms.

My areca has been growing in the same pot for five years without a change of soil.

ELVIN MCDONALD

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* Reprinted with permission from the Miami News, February 15, 1977, copyright King Features Syndicate Inc. 1977. The technical name for the palm in question is *Chrysalidocarpus lutescens*.

NEWS OF THE SOCIETY

A Question from One of Our Members

One of our new members in Australia, Paul C. Savage, asks if anyone can give him information on the fruiting habits of licualas. He writes: "There are large forests of *Licuala muelleri* [= *L. ramsayi*] in the Cardwell shire but in the three years we have lived here they have not thrown any seed after flowering. One of the members might be able to enlighten me on the *Licuala* seeding habits." Do write to the Editor if you have any knowledge on this matter.

Notice

The newly revised Bylaws of the society should be ready to be mailed when this issue appears. Any member interested in a copy of both Charter and Bylaws may write to the business office for them.

Minutes of the Biennial Meeting

The twelfth Biennial Meeting of The Palm Society was held at Cafe del Rey Morro, in Balboa Park, San Diego, California, at 1:00 p.m. on July 9, 1978. One hundred and five members and guests were present.

The meeting was called to order by President Myron Kimnach, who welcomed members and guests to California.

The minutes were read and approved.

Mr. Paul Drummond, Treasurer, read the financial report. Mrs. Teddie Buhler, Executive Secretary, read the report of the Executive Secretary.

The President then called upon the Ballot Counting Committee Chairman, Mr. Ralph Velez to report the results of the election:

OFFICERS

President:
Donn Carlsmith .... Hawaii
Vice President:
Paul Drummond .... So. Florida
Secretary:
Pauleen Sullivan .... So. Calif.
Treasurer:
Ruth Shatz .... So. Florida

DIRECTORS: 1978–1982

Dr. Byron Besse .... Central Florida
Ernie Chew .... So. Calif.
Dr. Ian Daly .... Australia
DeArmand Hull .... So. Florida
Warren Dolby .... So. Calif.
Dial Dunkin .... Texas
Dr. H. E. Moore, Jr. .... New York
Dr. Merrill Wilcox .... No. Florida

Mrs. Lucita Wait, Chairman of the Society's Seed Bank gave a report on the Seed Bank, telling of the astonishing success it has had in finding reliable collectors abroad, who, financed by the Seed Bank, have been able to collect very rare and even unidentified palm seeds.

President Myron Kimnach announced that after 7 years of Madam Ganna Walska's "Lotusland" being closed to botanical groups, that members of The Palm Society would be able to tour "Lotusland" in Montecito, Calif. on Friday, July 14, 1978.

It was announced that Chapter Chairmen would get together during the biennial to discuss problems of their chapters. Dick Douglas of The Northern California Chapter was appointed chairman.

Mrs. Teddie Buhler read a letter from Hal Moore, Editor of Principes, saying he would be unable to attend the biennial as he was recovering from an operation.

Mrs. Teddie Buhler suggested we send

a wire to Dent Smith, founder of the society, who was in the hospital, wishing him a speedy recovery. Seconded and carried.

Paul Drummond, Treasurer, said the society gave Hal Moore $100.00 for his own use, when he was sick last December.

Mr. Tom Pavluvcik, of St. Petersburg, Fla. suggested that biographies should be written of deceased people who had great knowledge of palms, and that they be published in *Principes*.

There being no further business, the meeting was turned over to the program committee.

Respectfully submitted,
PAULEEN SULLIVAN,
Secretary

Report of Executive Secretary at Biennial Meeting, July 9, 1978

As your Executive Secretary I have responsibility for the day-to-day running of the society. When questions come up that I feel involve major policy I refer them to the President. But, with such a far-flung membership and Board, it is not easy to make changes or initiate them, so we do that at the Biennial Meetings. It makes for slow going. Please write me if you have suggestions to offer; we suffer most from a lack of communication, it seems to me. That is why it is good when members can meet from time to time locally. However, many of our members are not near others and so do not have a chance to form a chapter or to visit one.

It is gratifying to see the constant, steady growth of our society. Our total membership is not large and impressive, yet it reflects the number of people whose interest in palms is serious enough to have made them make an effort to join. We now have some 1150 members in good standing and add between two and five a week to that number. However, unfortunately, we also lose many when dues time comes around—this year it was some 275. If any of you have suggestions or ideas of how to keep the interest of some of these dropouts, please tell either a Board member or me.

We presently have members in 51 countries other than the United States accounting for about one-fifth of our total membership. By far the largest contingent is from Australia where 78 have joined to date. They are becoming more palm conscious there, and also, I gather, an article appeared in some publication that attracted the attention of palm lovers. If any of you travel "down under," or in fact elsewhere in the world, be sure to take along your membership roster—you'll meet friends all over.

One of the rather petty, unnecessary problems that arises in the office is the matter of address changes. When someone moves without notifying us the post office charges 16¢ to return that copy of PRINCIPES (unless it has more than the minimum of 36 pages when it costs 22¢), plus 25¢ for the new address that is usually affixed to the envelope. Then there is the additional 16¢, or 22¢, to remail that issue. It does not represent a large amount of money—not more than $25 a year, but it is the fact that it is unnecessary that makes it so annoying. We now ask anyone who has not notified us of a change of address to pay that postage.

Perhaps some of you do not realize that not only do we have members who receive all the benefits of the society—roster, Seed Bank, voting, etc.—but we also have about 140 who subscribe only, to PRINCIPES. These are botanical gardens and institutions as well as college and university libraries. We can all be proud of the fact that these scientific institutions consider PRINCIPES worthy of their consideration. It is for them that the more serious, technical articles appear, so do not overly complain about them. However, we also need your help, every one of you, to send us the kind of articles, long or short, that offer information of interest to the amateur. Most of us are amateurs but most of us wait for the other fellow to write something that adds to our knowledge instead of sharing ours. So, feel that this request is going to each of you, individually, to please write something and submit it to the office or to Dr. Moore. If you feel your way of expressing yourself needs polishing, we can arrange for that to be done. Just please send an article of some kind about your plants, your experiences or your questions. It is fun to see your name in print and might inspire others to try their hand at it too.

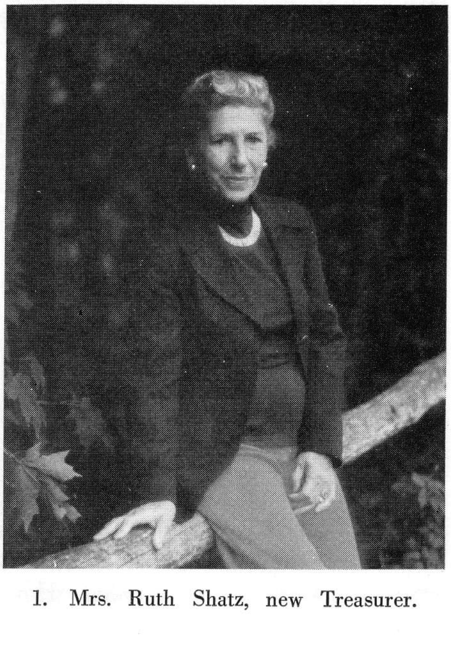
This year we have been working on bringing our old Bylaws up to date. It has not been an easy task since the Committee—Dr. John Popenoe, Miami, FL, Dr. H. E. Moore, Jr., Ithaca, NY, Dr. Jerome Keuper, Melbourne, FL, and I were unable to meet in person to discuss additions or revisions. So, some or all the Board members in Miami were asked for help, then the possibilities were sent to the other Committee members to consider. We have finally produced a set of Bylaws that we hope will be of help to the society for the next years. In the past we have always had our elections at the Biennial Meetings, but that seemed unfair to the many who could not attend. We have now worked out a system that we hope will be a satisfactory solution to this problem. Unfortunately, not all the details had been worked out before the various voting notices were sent, but we trust the next election will go more smoothly, having learned by doing. Towards the end of August those interested in a copy of our Charter and/or Bylaws can write to the office to ask for them.

There is the possibility that we may institute some changes in the running of the office. These changes seem necessary to lighten my work load which has become rather heavy, more than I had bargained for when I agreed to take over from Mrs. Wait some six years ago and we had only 450 members. The work is a pleasure because my heart is in it and I hope to serve for many years to come.

Respectfully submitted,
TEDDIE BUHLER
Executive Secretary

New Officers

The new President, Vice President, as well as the continuing Secretary, were introduced to readers of PRINCIPES in volume 21. The new Treasurer, Mrs. Ruth Shatz, was born in New York City and after her marriage moved to Carmel, New York, where she and her husband raised three children and operated a model dairy, poultry, and fruit farm.



1. Mrs. Ruth Shatz, new Treasurer.

In 1956, Mr. and Mrs. Shatz moved to Coral Gables, where she has continued to live since her husband's death in 1966.

Ruth has always been an ardent gardener and was a charter member of The Palm Society. She is also a member of the Fairchild Tropical Garden and a volunteer guide at Vizcaya, James Deering's beautiful estate in Miami, Florida, which is now a Dade County Museum.

Report of the Seed Bank, 1976–1978

As the members of The Palm Society know, the Seed Bank is a service rendered by the Society to its members. The work of this branch of the Society is done by volunteers, with some paid secretarial help. The seeds distributed by the Seed Bank are never sold; the $1.00 per package charge is only to cover the expenses of distribution: bags, postage, etc.

The aims of the Seed Bank are as follows:

1) *To furnish fresh, viable palm seeds to the Society's members who request them.* Each new member receives two mimeographed lists, on which he or she may indicate the seed species desired. On receipt of the member's request list, he or she is given a code number, and the species requested are entered in a permanent file. (At present there are over 800 species on file). The requests are kept open until the seeds are available, so repeated requests are not necessary. When the seeds are received they are distributed to members on the basis of "first come, first served." As of July 1, 1978 there are 668 members' names in our request file.

2) *To search for and obtain seeds of very rare or perhaps as yet unknown or undescribed palms.* In order to find and obtain these treasures, a search must be made for knowledgeable and reliable collectors, either those who live in the far reaches of the earth or those who can travel there. Untold effort and *much* correspondence has been involved. The few remaining rare and/or undiscovered palms are found only in the most remote areas, and transportation to them is difficult and expensive. Usually jeeps, boats, helicopters, and their crews must be hired, and hardships and dangers endured. All this is very expensive, and often would be impossible if it were not for the funds the Seed Bank has made available. Mr. DeArmand Hull, Co-Chairman of the Seed Bank, has spent much of his own time and money in arranging for these expeditions. Results have been remarkable: as of today more than 150 new and/or rare species have been introduced into cultivation.

We wish to thank all the Society's members who have so generously contributed toward the expeditions. First and foremost, Madame Ganna Walska, who contributed $10,000 as a memorial to our beloved Otto Martens. Then, Commander Watana Sumawong, an ardent palm lover in Thailand, who sent $4000.00, and Mrs. O. C. Corbin, who gave us $3000.00. Other members have sent us from $5.00 to several hundred, all of which have been received with utmost gratitude and have been put to the best possible use.

The three most important expeditions funded in part by the Seed Bank are:

1) Madagascar. A Malagasi native collector, not only of palm seeds but of orchids and succulents, was engaged to explore for rare palms. Due to his efforts many seeds were obtained, including 10 species new to cultivation. Unfortunately, his whereabouts are now unknown to us.

2) Malaysia and Borneo. We have been most fortunate in having Dr. John Dransfield, of Kew Gardens in England,

who is working on the Flora of Malaysia, as a most competent and enthusiastic seed collector. Our funds were, in part, helpful in making it possible for him to go to remote areas of Sumatra, Java, and Borneo, from where he sent us some very unusual species of *Pinanga, Areca*, etc., over the past years. His latest trip to Borneo, for which we solicited, and received, your contributions, was unproductive, due to a very dry year, which severely reduced the seed crop. However, there will be other, better years. (Our explorers make personal contacts with native residents, and leave funds to expedite future collections).

3) New Guinea. About 15 new species have been received from both the highlands and lowlands of the largely unexplored island of New Guinea. Dr. Fred B. Essig, now an Assistant Professor of Botany at the University of South Florida, spent a year in New Guinea studying palms. He and one of his students (the son of long-time Palm Society members Dr. and Mrs. U. A. Young) recently spent several months there, and sent the Seed Bank enough seeds of rare palms that we could send some to every person who contributed to their explorations. They, also, left funds with trusted residents for future collecting.

How are the seeds distributed?

The highest priority is given to Botanical Gardens. These public institutions can propagate plants in quantity and eventually pass along plants and seeds to the general public. They also may have the best facilities for propagating and growing them.

Next, the members of the Seed Bank, including those who have asked to receive "Any Rare Seed," receive the precious packages. We are happy when there are enough seeds for all those who requested them, but sometimes the latecomers have to wait until the next shipment arrives. If the seeds are extremely rare and delicate, we try to place them in the environment where they are most likely to succeed.

We want especially to thank all those devoted members who take the trouble to gather, clean, and send us seeds. Our work load is so great that we cannot write and ask you for certain kinds of seeds, but we are so pleased to have them arrive "out of the blue," and there is always a waiting list for them. Some of you go to great effort for us.

We also are most gratified when you good people give us a pat on the back, as Mr. Chris Scheepers, of South Africa did recently: "Thank you for the magnificent service that you continue to provide. It really is the world's best!"

Besides all the more available species, about 150 palms new to cultivation have been distributed among our members. In the past two years, over 4000 little cloth bags have been mailed, containing more than 50,000 seeds.

Respectfully submitted
Lucita H. Wait
Chairman, the Seed Bank

Treasurer's Report

Calendar Year 1977

Income		
Membership dues	$18,417.22	
Subscriptions	3,512.36	
Seed bank sales and postage	6,623.16	
Interest income	402.89	
Miscellaneous	42.00	
	$28,997.63	
Expenses		
Printing publication and postage	$11,110.60	
Seed bank	6,239.05	
Salaries and payroll taxes	3,999.75	
Office rent, supplies, and expenses	803.48	
Printing and plate maintenance	1,357.85	
Postage	1,157.21	
Dues and subscriptions	92.50	
Insurance and accounting	130.00	
	$24,890.44	
Income, total	$28,997.63	
Expenses, total	24,890.44	
Net receipts	$ 4,107.19	
Assets		
First National Bank of South Miami		$ 4,315.92
First Federal Savings and Loan		8,363.41
First National Bank (Seed Bank)		111.94
Coral Gables Federal		301.10
		$13,092.37
Liabilities		
Payroll tax accrued	$ 35.10	
Net worth		
Fund balance 1/1/77	8,950.08	
Net receipts	4,107.19	
Total liabilities and net worth	$13,092.37	

1 January to 23 June 1978

Balance forward from 1977	$ 4,315.92	
Income	15,961.59	
Total receipts	$20,277.51	
Expenses	17,472.56	
Net receipts	$ 2,804.95	
Assets		
Cash on hand		$ 60.00
First National Bank of South Miami		2,744.95
Security Federal Savings and Loan		14,400.78
Total assets		$17,205.73

(*Continued from page 135*)

In October, 1976, under the sponsorship of the New Zealand Ministry of Foreign Affairs, a group of experts from coconut-growing countries met to assess the possibility of utilizing this resource. The proceedings have been made available, via the staff of the New Zealand Forest Service, and the wealth of detailed information it contains may be of interest to readers of PRINCIPES. Of particular value is the observation that, since all coconuts have a limited life span, the raw material represented in the trunk of a coconut palm is a continual resource, as within a plantation trees continually age and cease to be productive.

The Proceedings show that several possibilities for conversion of coconut stem are available—as a constructional material, because coconut wood is fairly homogeneous and can be sawn into planks, as pulp, fuel (charcoal), and decorative material. It is clear that a great deal of research and ingenuity has gone into attempts to make profitable use of the coconut trunk, but the problems of effective utilization seem very great.

The trunk is not homogeneous throughout its length; the "wood" is highly silicified and difficult to saw without special blades. It seems difficult to impregnate the tissue with preservatives. There are problems to be faced in harvesting and processing material in small countries with little capital.

The potential benefit of even a partial resolution are considerable—it is estimated that in the South Pacific 38.6 million cubic feet of coconut wood could be made available annually for the next 50 years, while a yearly output of almost four times this volume could be produced in the Philippines. For comparative purposes, the latter figure is a greater output than all forest pulpwood from New Zealand, where the pulp industry is a major source of export income and the industry is highly mechanized, regulated, and financed. The potential economic benefit in more complete utilization of the coconut palm certainly does not escape the organizers of this seminar and one looks forward to advancement in this field.

For further information and copies of the Proceedings, contact Mr. A. K. Familton, New Zealand Forest Service, Private Bag, Wellington, New Zealand.

P. B. TOMLINSON
Harvard Forest
Petersham, MA 01366

ESSIG, FREDERICK B. 1977. The palm flora of New Guinea: a preliminary analysis. Botany Bulletin No. 9, Office of Forests, Division of Botany, Lae, Papua New Guinea. 29 pp., 7 plates, 2 maps.

A list of species described from New Guinea is provided with maps, a key to type localities shown on the maps, a glossary of terms, and seven photographic plates.

———. 1978. A systematic histological study of palm fruits. I. The *Ptychosperma* alliance. Systematic Botany 2: 151–168, fig. 1–21.

The histology of the fruit of the eight genera of the *Ptychosperma* alliance of arecoid palms is described and the genera keyed on fruit characteristics.

FISHER, JACK B. AND JAMES H. TSAI. 1978. In vitro growth of embryos and callus of coconut palm. In Vitro 14: 307–311.

A medium for growing coconut embryos is described together with a report on the lack of success in inducing formation of callus from embryos but success from endosperm. A chromosome number of 8 was obtained for the callus.

GLASSMAN, S. F. 1977. Notes on *Syagrus microphylla* Burret. Phytologia 38: 66–68, fig. 1.

Syagrus microphylla is reported from the type locality in Brazil and a neotype is designated.

———. 1978. Preliminary taxonomic studies in the palm genus *Maximiliana* Mart. Phytologia 38: 161–172.

Maximiliana is reduced to two species, which are not easily distinguished by the overlapping key characteristics used. The name *M. martiana* Karsten (1857) is taken up as the earliest valid name although *Palma maripa* Corréa de Serra (1806) is cited in synonymy. The correct name to have been taken up for this species in Glassman's circumscription is *Maximiliana maripa* (Corréa de Serra) Drude.

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