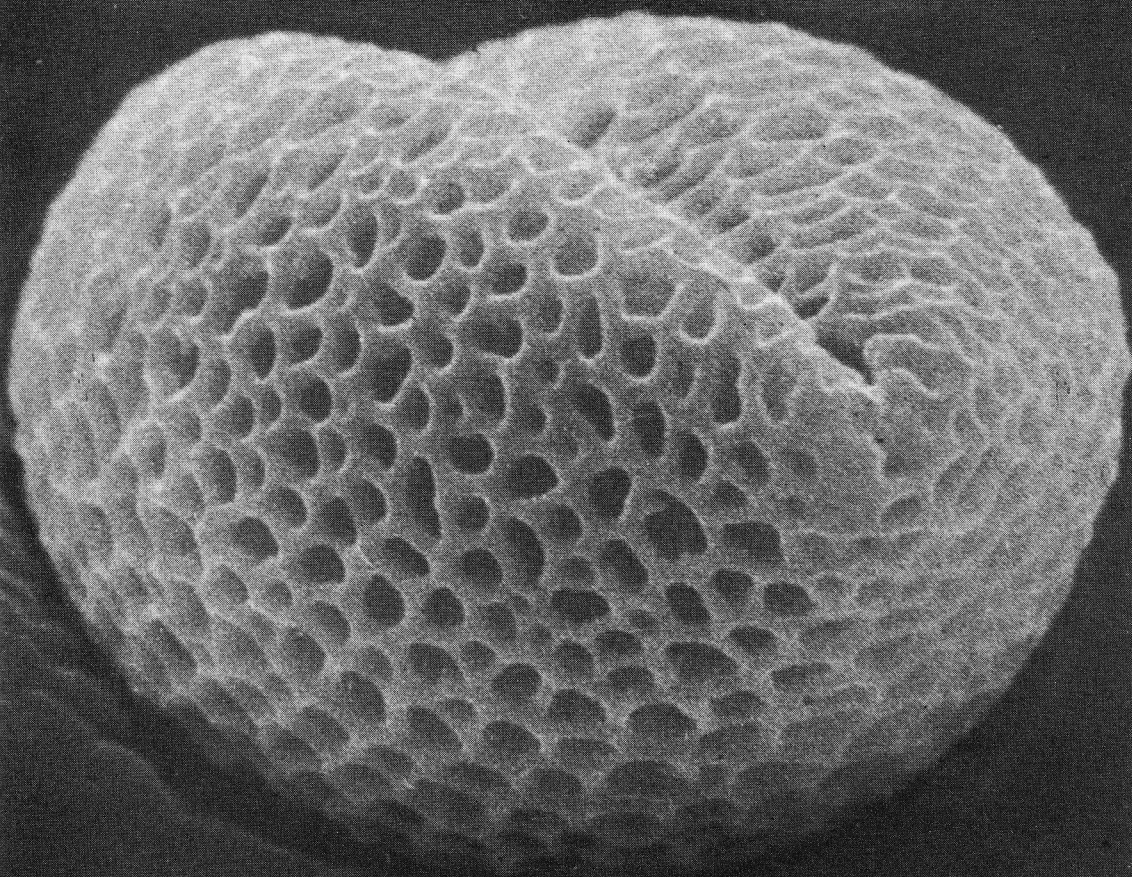




PRINCIPES

Journal of The Palm Society

April, 1970
Vol. 14, No. 2

THE PALM SOCIETY

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JOURNAL OF THE PALM SOCIETY

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Manuscript for PRINCIPES, including legends for figures and photographs, must be typed double-spaced on one side of 8½ × 11 bond paper and addressed to the Editor or the Assistant Editor for receipt not later than 45 days before date of publication. Authors of one page or more of print will receive six copies of the issue in which their article appears. Additional copies or reprints can be furnished only at cost and by advance arrangement.

Contents for April

Notes on the Reproductive Biology of <i>Asterogyne Martiana</i> (Palmae). II. Pollination by Syrphid Flies Rudolph Schmid	39
Palm Forests of the Bolivian High Andes M. Cárdenas	50
Fine Structure of Pollen Surface in Palms M. V. Parthasarathy	55
Regular Features	
Palm Briefs	62
News of the Society	72

Cover Picture

Scanning electron micrograph of a pollen grain of *Chamaedorea oblongata*, × 7200. See also pages 55-62.

PRINCIPES

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 \$6.00 per year to libraries and institutions. Membership dues of \$10.00 per year include a subscription to the Journal. Single copies are \$1.50 each. The business office is located at 7229 S.W. 54th Avenue, Miami, Florida 33143. Changes of address, undeliverable copies, orders for subscriptions, and membership dues are to be sent to the business office.

Application to mail at second class postage rates is pending at Miami, Florida 33143 and at Lawrence, Kansas 66044.

Mailed at Lawrence, Kansas
May 18, 1970

Notes on the Reproductive Biology of *Asterogyne Martiana* (Palmae).

II. Pollination by Syrphid Flies

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In 1870 Federico Delpino published part of his classic work on reproductive biology and indicated that "many palms" (p. 202) exemplify the motionless or "immobile" type of flower of anemophilous (wind-pollinated) angiosperms. Since then, a number of writers (e.g., Baker and Hurd, 1968; Drude, 1889; Eames, 1961; Good, 1956; Lepesme, 1947; Rendle, 1930; and staff and students in the Organization for Tropical Studies' Advanced Botany Course "Reproductive Biology" held in Central America in Summer, 1968) have assumed that palms are anemophilous, though exhibiting some entomophily (insect-pollination). Good (1956, p. 366), in fact, even considered the palms "in some ways [to be] functionally the counterparts of the Catkin-bearers in the Dicotyledons".

These conclusions have been re-enforced by the many features of the anemophilous syndrome that palms as a group show, namely: a certain gregariousness of individuals; production of many flowers; absence of showy parts and bright colors; a frequent lack of floral fragrance and/or nectar; a rather small perianth; prominent exposure of anthers and of the long, recurved stigmas; production of large amounts of often smooth, powdery pollen; and production of few ovules per flower (Faegri and van der Pijl, 1966; Menon and Pandalai, 1958).

The presence of entomophily in palms has been underrated, in part because many workers have concentrated on the predominantly anemophilous cultigens. Actually, the Palmae are both anemophilous and entomophilous, a fact adequately documented by Knuth (1904) and recognized by many other authors (e.g., Corner, 1966; Coulter and Chamberlain, 1903, and other works by Coulter; Kraus, 1896; Kugler, 1955; Strasburger *et al.*, 1898, and other editions; Wettstein, 1935, and other editions; Willis, 1966, and other editions). Coulter and Chamberlain (1903) and Eames (1961) considered palm pollination in transition from entomophily to anemophily.

Beetles (Coleoptera), flies (Diptera), moths (Lepidoptera), bees (Hymenoptera), and other insects visit palm flowers for pollen, nectar, floral tissue, and/or other objectives. Numerous insects are commonly observed on palm inflorescences (Knuth, 1904; Lepesme, 1947; Seemann, 1856; Wettstein, 1935; and in Costa Rica, stingless bees visiting *Elaeis guineensis*, personal observations, and *Scheelea rostrata*, G. Stiles, personal communication), particularly on the male flowers. Birds (Eames, 1961; Knuth, 1904, 1905; Porsch, 1926, 1930), bats (Corner, 1966; Porsch, 1935), and even snails (Knuth, 1904, pp. 60, 75) also visit palm flowers. Only detailed observations, however, will reveal whether

such visitations are indiscriminate, exploitative, or indeed effective for pollination. For example, it is doubtful if bats or snails effect pollination of palms (see Faegri and van der Pijl, 1966; van der Pijl, 1956).

Actually, very little is known about the pollination of wild palms. The information available is scanty, not only for the dwarf palms, but also for the large palms, the great size of which renders investigation difficult, even with the aid of binoculars. From the literature, but mainly from personal observations, Knuth (1904, 1905, 1909) compiled pollination data for 72 palm species distributed among 40 genera. The observations that Knuth (1904, pp. 55–82, 1905) made on 55 palm species (in 34 genera) at the Buitenzorg (now Bogor) Botanical Garden in Java (now Indonesia) from November 16, 1898, to March 20, 1899, are the most extensive to date, but in most cases these are merely lists of insect visitors to the palms. Knuth (1904, pp. 60–61) considered 21 palm species (in 17 genera) as entomophilous, although he had observed insects on most of the 55 palms he had studied. Knuth regarded most of the anemophilous palms as at least partly entomophilous.

OBSERVATIONS AND DISCUSSION

Although *Asterogyne Martiana* possesses some of the anemophilous features listed above, the following characteristics militate against an anemophilous nature for this palm: (1) occurrence in dense wet forest undergrowth, a habitat where several factors, including the extreme stillness of air, are unfavorable for anemophily (see Whitehead, 1969); (2) production of showy, white inflorescences, which are prominently silhouetted against the dark forest, particularly around sunrise; (3) production of fragrant flowers with copious amounts of

Little work on pollination of palms seems to have been done since Knuth's 1904 compilation, which, incidentally, is often overlooked by later writers (e.g., Corner, 1966; Lepesme, 1947; Menon and Pandalai, 1958). Almost all the subsequent work has been on such economically important cultigens as *Cocos nucifera*, *Elaeis guineensis*, and *Phoenix dactylifera*. Even here, however, controversy persists about the entomophilous and/or anemophilous nature of coconut (see Menon and Pandalai, 1958, pp. 67–68), the pollination biology of which is among the most intensively investigated of all palms.

Intrigued by the dearth of pollination data on palms, especially on wild palms, I spent five days in Summer, 1968, investigating the pollination biology of *Asterogyne Martiana*, a dwarf palm in the Geonomeae, at two sites in Costa Rica: near Rincón de Osa, Puntarenas Province, and at La Selva, near Puerto Viejo, Heredia Province. Methodology, exact locational information, and details of floral structure and phenological events are given in Schmid (1970). Unfortunately, lack of time prevented the accumulation of detailed behavioral information for most of the insect visitors.

nectar (Schmid, 1970); (4) production of stickily pollen that is shed in small clumps (Schmid, 1970); (5) no evidence of pollen on three vasoline-coated microscope slides that were suspended for five hours next to inflorescences bearing male flowers; and (6) visitation of both male and female flowers by numerous insects (Table 1, Fig. 1–7, and below), at least one group of which can be demonstrated to be the pollinating agent.

Insects visit *Asterogyne Martiana* for several purposes: a source of food

TABLE 1. *Insects visiting Asterogyne Martiana near Rincón de Osa (July 21, 1968) and at La Selva (August 3-6, 1968), Costa Rica. Determinations (sources given in brackets) were based on specimens, Kodachrome transparencies, and field identifications. Some groups are undoubtedly inadequately sampled; most probably occur at both sites. KEY: F = field identification(s); K = Kodachrome(s); O = insect(s) observed at Osa; S = observed at La Selva. Collection numbers in brackets.*

COLEOPTERA

Cantharidae

- Chauliognathus pallidus* Waterhouse [det. P. Vaurie—#9: S]
 other [det. H. Dietrich—K: S]

Chrysomelidae

Alticinae

- Centralaphthona robusta* Jacoby [det. J. A. Wilcox—#42-47, K: O]
 other (3 + species) [D. F. Veirs—F: S]

Galerucinae

- Monolepta* sp. near *Luperodes humeralis* Jacoby [det. J. A. Wilcox—#40-41, K: O]

- other [D. F. Veirs, R. Schmid—F: S]

Cucujidae [det. I. J. Cantrall—#39: O]

Curculionidae

- ?*Baridinae* [det. P. Vaurie—K: S]

Erirhininae

- Celetes* sp. or *Phytotribus* sp. [det. P. Vaurie—#10-13, plus ca 75 unnumbered specimens: S; #48-50: O] [also K: S, O]
 other [det. I. J. Cantrall—K: S] [det. R. Schmid—F: S]

Ptiliidae [det. D. F. Veirs—F: S]

Staphylinidae

- Aleocharinae* [det. P. Vaurie—#8, 22: S]
Staphylininae [det. P. Vaurie—#23: S]
 other [det. G. C. Eickwort—K: O]

DIPTERA

Ceratopogonidae

- Atrichopogon* spp. [det. W. W. Wirth—#31-32: S]
 other [det. L. L. Pechuman—K: S] [det. D. F. Veirs—F: S]

Drosophilidae

- Drosophila* sp. [det. W. W. Wirth—#57-58: O] [det. D. F. Veirs—F: S]
 [R. Schmid—F: S; K: O]

Empididae

- Rhamphomyia* sp. [det. L. V. Knutson—#60: O]

Sphaeroceridae

- Leptocera* (*Pterogramma*) sp. nov. [det. G. Steyskal—#54-56, 59, 61-62, plus ca. 50 unnumbered specimens: O]
 ?other [D. F. Veirs—F: S]
-

TABLE 1. Continued

DIPTERA

Syrphidae [*all* det. F. C. Thompson]

Baccha sp. [#37: O]

Ornidia obesa (Fabr.) [#38: O]

Copestylum (= Volucella) tympanitis (Fabr.) [#1, 18: S]

Copestylum (= Volucella) sp. nov. 1 [#2, 3, 19, 28, 33, K: S]

Copestylum (= Volucella) sp. nov. 2 [#6, 7, 21, 26, 30, 34, K: S; #36: O]

Copestylum (= Volucella) sp. nov. 3 [#4: S]

Copestylum (= Volucella) sp. nov. 4 [#5, 27, 29: S]

Copestylum (= Volucella) sp. nov. 5 (tricincta Bigot group) [#20: S]

Tipulidae [det. R. Schmid, D. F. Veirs—F: S]

HYMENOPTERA

Apidae: Meliponini

Melipona fasciata fasciata Latreille [det. G. C. Eickwort—#52: O]

Trigona (Partamona) ?cupira Smith [det. G. C. Eickwort—#24, 35: S]

Trigona (Partamona) ?testacea (Klug) subspecies [det. G. C. Eickwort—#14: S]

Trigona (Trigona) amalthea silvestriana Vachal [det. G. C. Eickwort—#15: S]

Trigona (Trigona) fulviventris Guérin [det. G. C. Eickwort—#51: O]

Trigona sp. [det. G. C. Eickwort—K: S] [det. R. Schmid, D. F. Veirs—F: S, O]

Formicidae

Crematogaster sp. (orthocrema species group) [det. W. L. Brown, Jr.—#53: O]

Paraponera sp. [det. D. F. Veirs—K, F: S]

Pheidole sp. [det. W. L. Brown, Jr.—K: S]

other [det. R. Schmid—F: S]

Halictidae [det. G. C. Eickwort]

Augochlorini

Neocorynura sp. [#25: S]

Halictini

Habralictus sp. [#16: S]

parasitic Hymenoptera [D. F. Veirs—F: S]

LEPIDOPTERA

?Diptidae [det. J. G. Franclemont—#17, K: S]

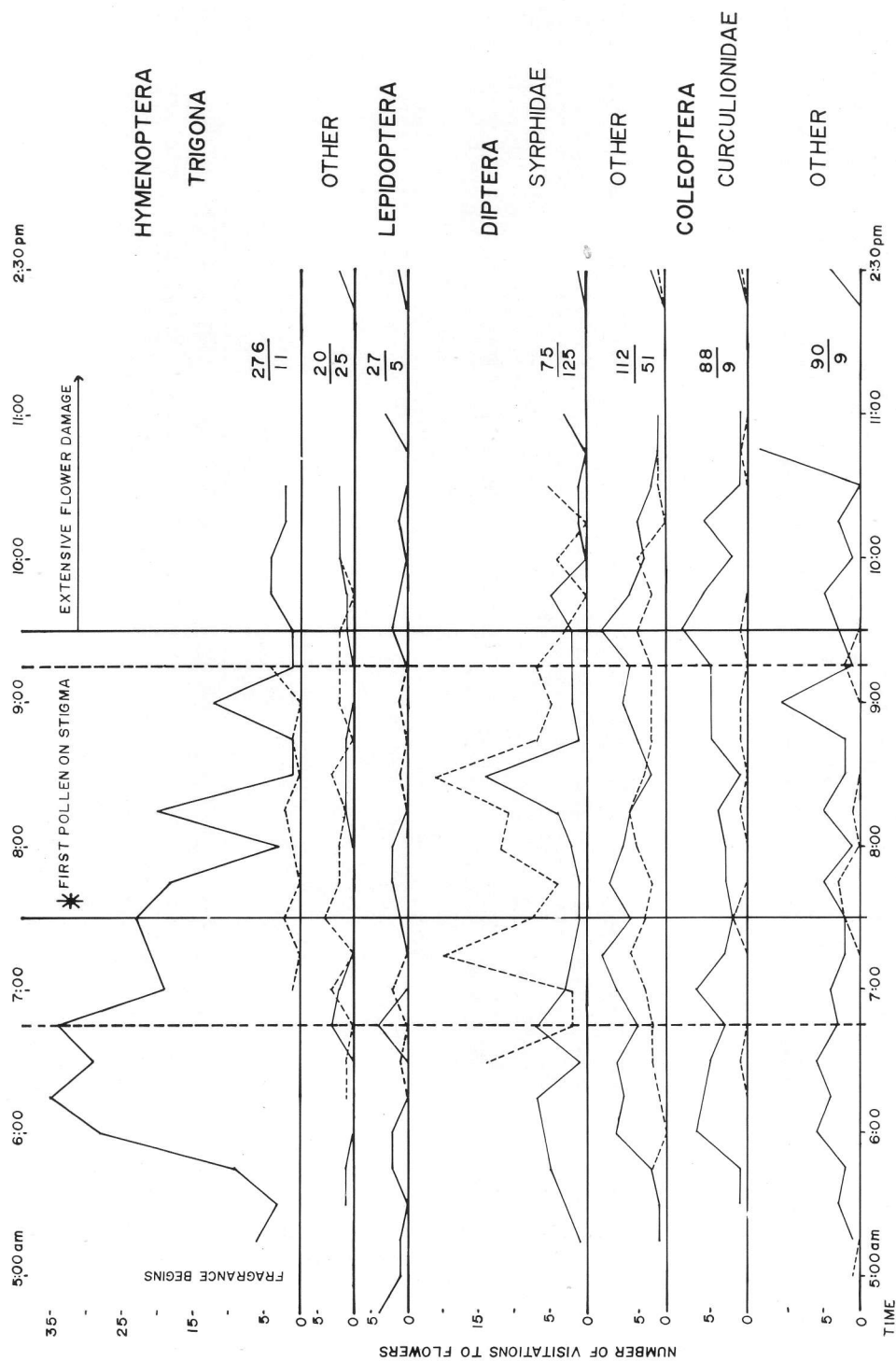
Pyralidae

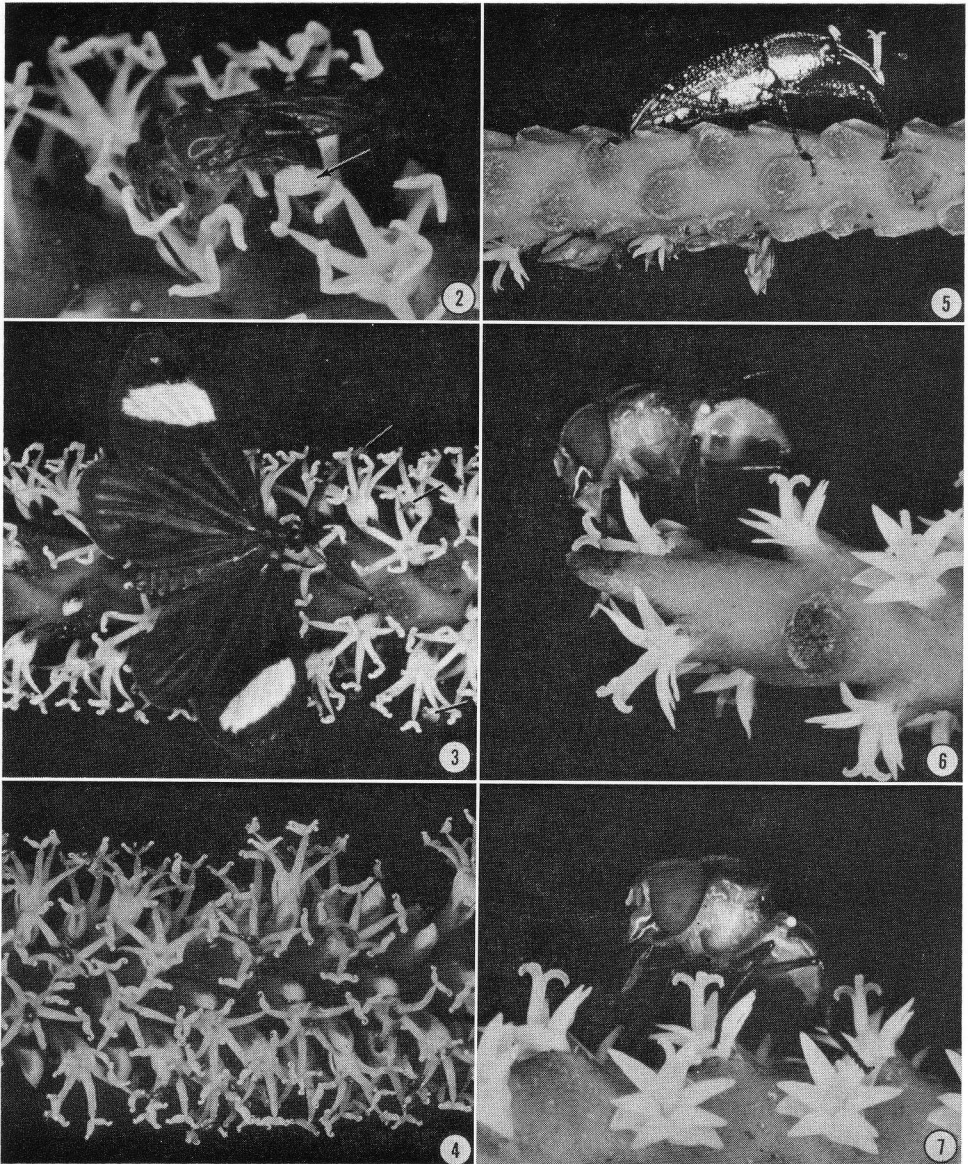
Desmia sp. [det. J. G. Franclemont—K: S]

other Heterocera [det. R. Schmid—F: S]

→

1. Visitation by main insect groups (see Table 1) to flowers of *Asterogyne Martiana*, and some phenological events (see Schmid, 1970) of the palm flowers, based on observations near Rincón de Osa (July 21, 1968) and at La Selva (August 3-6, 1968), Costa Rica. Data for insects represent the number of *individuals* detected on flowers, except for "Diptera—Other" and "Coleoptera—Curculionidae", for which data represent the number of occurrences of *groups* of insects detected on flowers. KEY: Fractions represent total recorded occurrences of insects (individuals or groups) on flowers: numerator = male flowers; denominator = female flowers. Insect visitation to flowers: solid lines = male flowers; dashed lines = female flowers. Limits of detectable nectar production: solid vertical lines = male flowers; dashed vertical lines = female flowers.





2-7. Insect visitors to male (Fig. 2-4) and female (Fig. 5-7) flowers of *Asterogyne Martiana*. Fig. 2, *Trigona* sp. (Apidae) probing for nectar; note corbicular pollen load (arrow); 6:24 A.M., $\times 4.7$. Fig. 3, moth (?Diopside) obtaining nectar, and small Diptera (Ceratopogonidae) perched on anthers (arrows); 7:42 A.M., $\times 2.0$. Fig. 4, weevils (Curculionidae: Erihinae: *Celetes* sp. or *Phytotribus* sp.), especially at tips of staminal tubes and on anthers; eating, ovipositing, or copulating; 7:57 A.M., $\times 1.9$. Fig. 5, weevil (?Baridinae); 2:30 P.M., $\times 2.0$. Fig. 6, *Copestylum* sp. 2 (Syrphidae) probing for nectar; 7:32 A.M., $\times 4.0$. Fig. 7, *Copestylum* sp. 2 with ventrum of thorax positioned over stigmata; 7:31 A.M., $\times 4.1$.

(nectar, pollen, and floral tissue), a site for mating, and a site for oviposition and breeding. Table 1 lists the insects that were observed visiting flowers of the palm. Figure 1 summarizes the frequency of visitation of the main insect groups to both male and female flowers.

HYMENOPTERA: APIDAE—Several species of stingless bees (*Trigona* spp., Table 1) were common on male flowers throughout the morning, but especially early in the day when the supply of pollen was greatest (Fig. 1). At La Selva the orange species of stingless bee (including *T. ?testacea*) were much more numerous and more active than the black species (including *T. amalthea silvestriana* and *T. ?cupira*). In five mornings of observations only eleven *Trigona* were detected on female flowers of the palm (Fig. 1).

The stingless bees visited the male flowers to gather pollen soon after the flowers opened (and as early as 5:20 A.M.). While crawling over the male flowers, the worker bees picked up abundant pollen and brushed it back to the corbiculae on their hind legs, where the pollen collected as balls a millimeter or more in diameter (Fig. 2, arrow). Fragments of the anthers of the palm sometimes also accumulated on the corbiculae. By 9:30 A.M. pollen remaining on the anthers occurred mainly at the extremities of the pollen sacs; pollen removal by the bees was more difficult, and their activity and numbers on the palm were greatly reduced (Fig. 1). The bees were also observed taking nectar from the flowers (Fig. 2).

At Osa a species of *Melipona* (Table 1), active only on male flowers, collected pollen, which was transferred to its corbiculae. Pollen collecting was accompanied by a buzzing sound audible at a distance of twelve feet. This bee was not observed at La Selva.

Microscopic examination of the corbicular pollen loads of the *Melipona* species from Osa and of three specimens of *Trigona* (#14, 24, 35, Table 1) from La Selva revealed only pollen of *Asterogyne Martiana*. In addition, all specimens of Apidae (Table 1) bore only *Asterogyne* pollen on other parts of their bodies.

OTHER HYMENOPTERA—Other Hymenoptera (Table 1), notably ants (Formicidae), visited the palm in very limited numbers (Fig. 1), chiefly to obtain nectar. The Halictidae and Formicidae (Table 1) bore very sparse amounts of pollen.

LEPIDOPTERA—Throughout the morning small numbers (Fig. 1) of several species of moths (Table 1) sporadically visited the palm flowers, particularly the male flowers. The moths systematically worked over the inflorescences for nectar, generally probing each flower only once (Fig. 3). Although the abdomens of the moths repeatedly contacted the anthers or stigmas of the flowers, the one diptid moth examined bore no pollen. The diptids visited both male and female flowers.

COLEOPTERA: CURCULIONIDAE—Small weevils of the subfamily Eirrhiniinae (Table 1; Fig. 4; also Fig. 5–6 in Schmid, 1970) were extremely abundant on the inflorescences, especially on male flowers (Fig. 1). Many members of the Eirrhiniinae breed in palms; for example, larvae of *Celetes* and *Phytotribus* develop in the interior of the spathes of palms whereas the adults feed on pollen and the epidermal tissue of reproductive structures of newly opened spathes (Lepesme, 1947). On *Asterogyne* these weevils were typically oriented at the tips of the staminal or staminodial tubes (Fig. 4). Less frequently the weevils were perched on the anthers (Fig. 4); they were rarely seen on stigmas. The

weevils sought nectar and chewed floral tissue, including pollen. Copulating weevils (Fig. 4) were common on flowers and inflorescence axes. Oviposition was also prevalent and was usually into the staminal (or staminodial) tubes. The weevils generally seemed restricted to one plant, quickly returning to an inflorescence if it was disturbed by vigorous shaking. Many weevils were examined microscopically; several bore a few pollen grains, which belonged exclusively to *Asterogyne Martiana*.

Small numbers of medium- and large-size weevils (including the Baridinae) also visited the palm (Fig. 5).

OTHER COLEOPTERA—An assortment of other beetles in at least five families (Table 1), but most notably the Chrysomelidae, was found on the palm flowers. Species diversity and number of beetles on the palm increased toward the end of the morning (Fig. 1). The beetles used the palm as a mating site (particularly the Chrysomelidae) and as a food source, chewing floral tissue, including pollen, and possibly also obtaining nectar. The beetles usually gnawed on the fleshy parts of the palm flowers (see Schmid, 1970). These Coleoptera, including the weevils discussed above, seemed responsible for most of the damage to the palm flowers, which by 9:30 A.M. was usually quite extensive. All insect specimens bore very little pollen.

DIPTERA: EXCEPT SYRPHIDAE—

Small flies (Table 1), chiefly Ceratopogonidae (Fig. 3, arrows) and Sphaeroceridae, were present in large numbers on both male and female flowers of the palm (Fig. 1). These flies usually sat on or moved about the anthers (Fig. 3) and stigmas, which generally served as landing platforms, although the stamens and perianth parts were also used for this purpose. Several flies were often active on one anther.

Drosophilidae were abundant on the female flowers (including the stigmas) but rarely visited the male flowers. Empididae and nectar-sucking Tipulidae (crane flies) were very infrequent visitors to the palm.

Many of these Diptera (Table 1) tended to be restricted to one plant for long periods of time. Nectar (and possibly pollen) seemed the main attractant. Only a few of the approximately 60 dipteran specimens (Table 1, DIPTERA, except Syrphidae) examined bore pollen, and then only one to several grains of *Asterogyne Martiana*.

For a variety of reasons none of the insect groups discussed so far can be considered effective pollinators of *Asterogyne Martiana* (see Table 1, Fig. 1):

(1) inability to carry much pollen: Hymenoptera—except Apoidea; Lepidoptera; all Coleoptera; Diptera—except Syrphidae.

(2) small numbers on both male and female flowers: Hymenoptera—except Apidae; Lepidoptera; Diptera—Empididae, Tipulidae.

(3) infrequent occurrence on male flowers: Diptera—Drosophilidae.

(4) infrequent occurrence on female flowers: Hymenoptera—Apidae; Lepidoptera; all Coleoptera.

(5) failure to contact stigmas of female flowers: Coleoptera—especially Curculionidae.

(6) sedentary nature of the insects (coupled with the tendency of palms bearing male or female flowers to be separated by some distance): Hymenoptera—Formicidae; Coleoptera—Curculionidae; Diptera—except Syrphidae.

DIPTERA: SYRPHIDAE—None of the above characteristics apply to the Syrphidae. There is strong evidence that syrphid or hover flies are the effective pollinators of *Asterogyne Martiana*.

The Syrphidae, which are specially

adapted to live on floral nourishment, visit the flowers of many plants (see systematic lists in Knuth, 1905, pp. 383–390, and 1909, pp. 567–579) to obtain pollen (see Baker and Hurd, 1968; Faegri and van der Pijl, 1966; Knuth, 1906, especially pp. 174–177; Kugler, 1955; Percival, 1965) and nectar. In Europe the Syrphidae contribute more to the pollination biology of flowers than all the other Diptera combined (Knuth, 1906). At Java Knuth (1904) observed syrphids on flowers of the palms *Phoenix "hybrida"* and *Latania Loddigesii*.

At least eight species of both male and female Syrphidae (Table 1) visited flowers of *Asterogyne* throughout the morning (Fig. 1), as many as thirteen syrphids active on an inflorescence at one time. The flies were initially much more abundant on the male flowers but became numerous on the female flowers when the latter began producing nectar around 7:00 A.M. (Fig. 1). Significantly, this activity correlates with the first record of pollen on stigmas at 7:36 A.M.

The syrphids systematically foraged both male and female flowers for nectar (Fig. 6). The flies also visited male flowers to eat pollen as a protein source or perhaps to squeeze the pollen to extract juices. Abundant pollen was evident not only on the heads and mouth parts of many of the syrphids collected, but also within the labellae, the lobes of

tissue at the tip of the proboscis. Although syrphids foraged male flowers for nectar very early in the morning, it is questionable whether they obtained any liquid since I could detect no nectar in male flowers before 7:30 A.M. (Schmid, 1970).

The syrphids probed for nectar at the bases of the ovaries (pistillodes or pistils) of both male and female flowers (Fig. 6), typically probing one to three times per flower. Flies usually obtained both nectar and pollen from the same flower. In foraging, the flies dragged their ventral surfaces, especially their abdomens, over the anthers or the stigmas (Fig. 7). Thus pollen could be readily picked up from the anthers or deposited onto the papillate stigmatic surfaces (Fig. 7).

The syrphids carried abundant pollen, all of which seemed to belong to *Asterogyne Martiana*. For example, four flies (specimens #27–30) collected from female flowers between 8:45 and 8:50 A.M. bore an estimated total of 600 pollen grains, about 75 to 300 grains apiece. Pollen, frequently adhering in clumps, accumulated on or especially between hairs on all parts of the body, but particularly on the legs and on the posterior ventral surface of the abdomen. At least 100 pollen grains alone were restricted to the ventral abdominal region of one specimen (#38).

CONCLUSIONS

My studies on *Asterogyne Martiana* strongly suggest entomophily, specifically myophily (fly-pollination), for this plant. Anemophily can be definitely excluded. The evidence presented for the Syrphidae, in conjunction with the extensive evidence disqualifying the other insect groups as pollinating agents (see p. 46), necessitates the conclusion that the Syrphidae are the effective pollinators

of *Asterogyne Martiana* in the areas studied.

From the moment the conspicuous white inflorescences are silhouetted against the dark forest by the dawn light, *Asterogyne* is very attractive to a wide array of insects. Apoidea, particularly stingless bees, forage on the male flowers for nectar and pollen, but rarely visit the female flowers. Other Hymenoptera

are very infrequent visitors to the palm. Lepidoptera, notable in their paucity, shift from inflorescence to inflorescence, draining the flowers of their nectar. Numerous Coleoptera gorge themselves on nectar or on floral tissue, mutilating the flowers in the process. Visiting first the male flowers for pollen and/or nectar and then, later in the morning, the female flowers for nectar, syrphid flies are responsible for almost all the pollen transfer. Large numbers of other Diptera visit both male and female flowers (including anthers and stigmas), but their significance as pollinators remains largely unknown. Their contribution is probably small, however, as these Diptera tended to be restricted to one plant for long periods of time and carried little pollen.

On the basis of such anemophilous characters as the exerted stamens, the long, recurved papillate stigmas, and the absence of nectaries, Wessels Boer (1968, p. 36) thought the small flowers of the geonomoid palms to be unattractive to insects and, hence, wind-pollinated. Spruce (1869, p. 96), however, more accurately suggested that *Geonoma* is pollinated by insects. Ule (1900, p. 130) observed various flies (unidentified) sucking secretions of both male and female flowers of a *Geonoma* in Brazil. *Asterogyne Martiana* is clearly insect-pollinated. In view of the rather similar, specialized floral structures of the other geonomoid palms, and their occurrence in dense, wet, generally tropical and montane rain forests (Wessels Boer, 1968), insect-pollination seems the prevailing situation in the tribe.

The frequently expressed notion that palms are predominately or exclusively wind-pollinated is also suspect. Palms cannot *a priori* be considered anemophilous. Rather the family exhibits a number of features of both the entomophilous and anemophilous syndromes. De-

tailed observations, for the most part lacking to date, are required for each taxon.

ACKNOWLEDGEMENTS—I am greatly indebted to Dr. H. E. Moore, Jr., to Dr. G. C. Eickwort, and to my wife Marvin J. for critically reading the manuscript, and to the persons listed in Table 1 for determinations of insects.

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ADDENDUM: Like so many other authors apparently unaware of Knuth's work [see R. Schmid and M. J. Schmid, 1970. Knuth's often overlooked "Handbuch der Blütenbiologie, III. Band." *Ecology* 51(2): (In press.)], T. S. Mahabálé [1965. Evolutionary trends in the Palmae with special reference to fossil palms. *The Palaeobotanist* 14(1-3): 214-222.] in his recent review erroneously assumes that the palms are mainly anemophilous; L. Emberger [1960. *Traité de Botanique. Systématique. T. II. Les Végétaux Vasculaires. Fasc. II.* Paris: Masson et Cie Éditeurs.] also perpetuates the myth.

Palm Forests of the Bolivian High Andes

PROFESSOR M. CÁRDENAS, F.M.L.S.

Cochabamba, Bolivia

The first reference to the big palms of Chuquisaca in Bolivia seems to have been that of a Carmelitan friar, Antonio Vazquez de Espinosa, who travelled for about 12 years through America from Mexico to Chile before 1622. In his manuscript, "Compendio y Descripción de las Indias Occidentales," kept at the Vatican Library, he says that a mile beyond the city of La Plata or Chuquisaca there begin to appear the big native trees which continue far away in the direction of the warm lands and mountain ravines to form there dry forests. Among these trees he mentions *soto*, *tarco*, *nogal*, *aliso*, *algarrobo*, *palma*, *ceiba*, *villca*, *uruche*, *mara*, *sutapo*, *aya-yanta*, and *trusumo*.

The Indians used the nuts of these palms probably long before the Conquest. The name they give them today in Quechua is *janchi coco*. The word *janchi* is certainly Quechua and means "oil harsh bagasse" and *coco* is rather a universal word for palm nut. Thus *janchi coco* means chewing nuts to suck the sweet oil and spit out the remaining material. People here in the home of *janchi coco* do not realize where it comes from. The Indians living near the *palmares* or palm forests are the only known traders of the nuts which they bring to the cities of Sucre and Cochabamba and sell for a dollar a pound.

Alcide d'Orbigny from the Natural History Museum at Paris, a well known explorer of South America, was the first scientist to see one of these palms when he visited Chuquisaca in 1832. He discovered this new palm cultivated in a garden on the outskirts of Chuquisaca

(Sucre), made the necessary drawings, and took field notes from which Martius described the new species as *Diplothemium Torallyi* in *Palmetum Orbignianum* published at Paris between 1842 and 1847. Later on, Barbosa Rodrigues from Brazil created the new genus *Polyandrococos* in which he included the Chuquisaca palms. The well known palm specialist, Hermann Wendland, transferred the Chuquisaca species again in 1878, this time to the genus *Jubaea* of Humboldt, Bonpland and Kunth. Finally, Max Burret diagnosed another new genus of palms called *Parajubaea* and included in it two species of South America that grow at high altitudes, *Parajubaea cocoides* from Ecuador and and *P. Torallyi* from Bolivia.

The first reference I had about this palm of Chuquisaca was a photograph taken by the agronomist Otto Braun 25 years ago at Soroma, Province of Tomina, Department of Chuquisaca. I was not interested in these palms at all until 1959 when I received a request from the Fairchild Tropical Garden to send seeds of all the palm species of Bolivia. Then I asked Ing. Luis Mendoza, a former student under my direction at the School of Agronomy, University of San Simon, Cochabamba, who was at that time Director of the Agricultural Extension Service at Chuquisaca, to send seeds of the Soroma palms. Some 200 seeds averaging 3 cm. (1 $\frac{3}{16}$ in.) long were received in two bags labelled "Palmar Grande" and "Palmar Chico." About 50 seeds from both were sent to the Fairchild Tropical Garden. Some complete seeds were also planted in pots. After one or



1. The Pasopaya palms, *Parajubaea Toralloyi*, in their native habitat. From color transparency by M. Cárdenas.

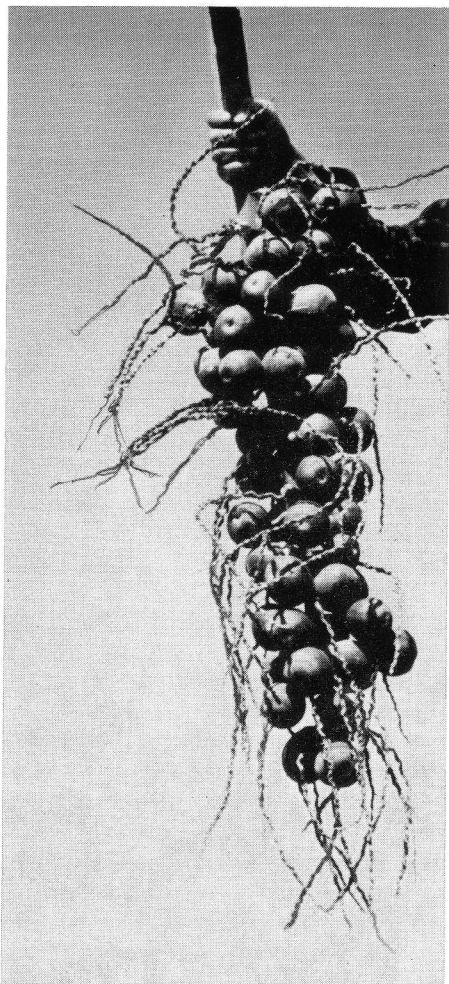


2. Inflorescences of *Parajubaea Torallyi* among the leaves. From color transparency by M. Cárdenas.

two years, there was a vigorous little plant which now, after nine years, is already 2 m. (about 6 ft.) tall. Three years ago, we began to organize a City Botanical Garden in Cochabamba at an altitude of 2,576 m. (about 8,456 ft.). On this occasion, while planting some native trees to make up the future main avenues of the garden, we remembered the Chuquisaca palms for our central avenue. On the other hand, we knew various specimens of this palm growing here at the Monastery of Santa Teresa, at Sucre in the Central Park and the Jesuits College of Sagrado Corazon. The latter plant

was known as *palmera de Pasopaya*. The garden where d'Orbigny discovered *Diplothemium Torallyi* was located at Garcilaso, 1.5 km. (0.9 mi.) east of the Central Park. It is reported that the garden still exists and the d'Orbigny palm also. I do not believe that the existing specimen is the same seen by d'Orbigny in 1832. The fruits of these palms germinate when fallen so one sees under a big palm many small plants of various sizes.

At the beginning of May, 1969, I decided to go to the *palmares* to collect seeds and herbarium specimens with the



3. An inflorescence of *Parajubaea Torallyi* with fruits. From color transparency by M. Cárdenas.

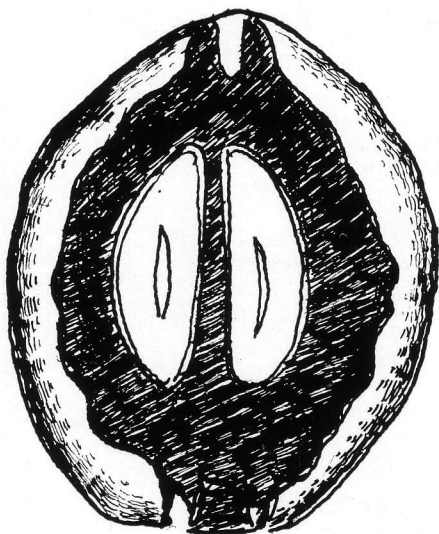


4. Kawana, the Indian from "Palmares" close to a nine-year-old *Parajubaea Torallyi* in a garden at Cochabamba.

assistance of my former student, Ing. E. Meneses. I went to Sucre by plane and continued the next day by jeep to Presto about 250 km. (156 mi.) from Sucre. From Presto, there was only a very rough stony road of about 40 km. (25 mi.) to Pasopaya. From Pasopaya, the first *palmares* appear at about 15 km. (10 mi.) in the ravines of sandstone mountains. Pasopaya was an important hacienda before the "Agrarian Reform."

Its last owner was Mr. Humberto Malpartida, now living at Sucre, who gave us interesting references about the trade of *janchi coco*. Actually Pasopaya is inhabited by the Indians as it is the *palmar*. The population there, with a rural school, is only some 200 people.

The palms occur in dense groups in the somewhat fertile and humid ravines from 2,400 to 2,700 m. altitude (7,872 to 8,856 ft.). They are very handsome with cylindric trunks of an average height of 14 m. (46 ft.) and a diameter of about 0.50 m. (1 ft. 8 in.). The pinnate leaves attain a length of 4.5 to 5 m. (13 to 16 ft. 5 in.). The whole inflorescence measures 1 m. long (3 ft. 3 in.) with 40 to 60 flowering branches. Most of the flowers are staminate but ordinarily each inflorescence branch bears



5. Tangential section of a fruit of *Parajubaea Torallyi*, natural size, showing two of the three crests of the irregularly roughened endocarp at the top and two seeds. The pores are at the base of the endocarp. Drawing by M. Cárdenas.

two fertile fruits at its base. A whole inflorescence shows over 100 fruits which are slightly ovoid, averaging 5 cm. (2 in.) long. The epicarp is green-grayish and smooth. The mesocarp is rather hard and fibrous but sweet because of a yellow pulp which is eaten. The endocarp is very hard, irregularly pitted, dark brown to blackish, with one to three seeds about 1.5 cm. ($1\frac{1}{32}$ in.) long and three germinating pores below. The freshly collected fruits bear persistent perianth parts. The fruit examined by d'Orbigny in 1832 and appearing as an illustration of *Diplothemium Torallyi* is

spotted. This does not occur on the hundreds of fruits we have seen. Thus we think that the plant discovered by this French explorer at Garciloso had some kind of virus or fungus disease.

The plants growing as cultivated specimens in the monasteries and central parks today must have been planted about a century ago but we can't say whether they came from Soroma or Pasopaya regions. The palm existing in Cochabamba at the Monastery of Santa Teresa might be of Soroma origin because the size of its fruits is rather small compared with those of Pasopaya.

The scenery of the *palmares* in the district of Pasopaya is fantastic. On sandstone mountains where it does not rain for eight or ten months, one finds thousands of these handsome palms in the rather humid ravines. The whole landscape suggests to the exotic fancy the long past Tertiary Age.

In a backward country like Bolivia, nobody realizes the value of this natural treasure for science and the oil industry. It is a pity that so far these *palmares* have not been declared national parks. The Indians, who know nothing about culture or economic value of plants, are accustomed to burn the palm shells after they have removed the nuts on a primitive stone crusher. The Indian who was sent by us to the place to collect the fruits for sowing in our botanical garden arrived early in November and he said that a violent wind blew a fire on a whole ravine where thousands of palms were entirely burned.

Fine Structure of Pollen Surface in Palms^{*}

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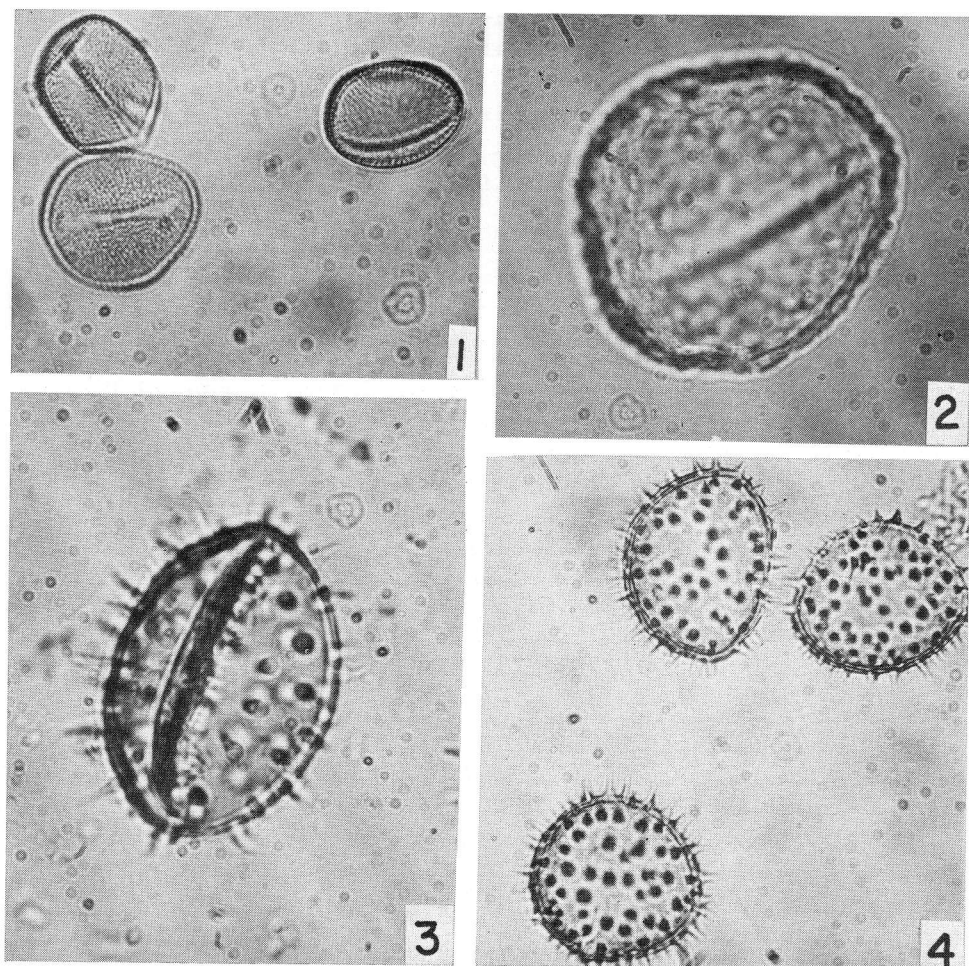
Botanists such as von Mohl (1834) and Fritzsche (1837) recognized the importance of pollen morphology in the last century, and Lindau (1894) used pollen in the classification of the Acanthaceae. It was not until a hundred years later, however, that a truly comprehensive study on pollen was started. The classical works of Wodehouse (1935) and Erdtman (1943, 1952) were the keys that opened the door to a new and exciting field in the biological sciences—palynology—the science of pollen and spores. Palynology (from the Greek verb *palynein*: to spread, to distribute) has since gained tremendous impetus and has been particularly useful to taxonomists and paleobotanists. Several botanists in the past two decades have done brief studies on the pollen morphology of different palms. However the recent contributions of Thanikaimoni (1966) and Sowunmi (1967) are perhaps the most comprehensive of them all.

The size and shape of the pollen grain, the number of furrows, the position, number and types of apertures or openings (colpi, pores) and the structure of the pollen wall are some of the main morphological characters that are used in classifying pollen grains. Detailed studies on the structure of the pollen surface were limited until recently by the resolution of the light microscope (about 1/2000 millimeter). Thus only major structural features of the surface of the

pollen wall such as its smoothness, reticulation (Fig. 1), warts (Fig. 2), spines (Fig. 3, 4) and other prominent patterns could be observed with the light microscope. The advent of the scanning electron microscope (also known as scanning reflection electron microscope) has made it possible in recent years to study fine surface structures of biological material, including pollen, in great detail (Echlin 1968). Briefly, the scanning electron microscope differs from the conventional electron microscope in its use of solid or whole specimens instead of ultrathin sections. The image formed by the scanning electron microscope has a great depth of focus, a three dimensional appearance, and a far better resolution (about 1/50,000 millimeter) than the light microscope. The present investigation, which is a preliminary study of the fine structure of the surface of the pollen wall in seven species of palms, was conducted at The Institut für Allgemeine Botanik, Eidgenössische Technische Hochschule, Zürich, and at the Research Laboratory of J. R. Geigy S. A., Basel, both in Switzerland.

Pollen material of *Chamaedorea* sp. (FG 57-755), *Hyphaene Schattan*, *Mascarena lagenicaulis*, *Phoenix* sp. (P-1596) and *Ptychosperma* sp. (FG 60-675F) were collected by Dr. P. B. Tomlinson at the Fairchild Tropical Garden, Miami, Florida, and those of *Chamaedorea brachypoda* and *C. oblongata* were collected by Dr. Harold E. Moore, Jr., at Cornell University, Ithaca, New York. The pollen was air-mailed to Zürich, Switzerland, in gelatin capsules

^{*} This investigation was carried out as part of a research program conducted as a Montgomery Fellow of the Fairchild Tropical Garden, Miami, Fla.

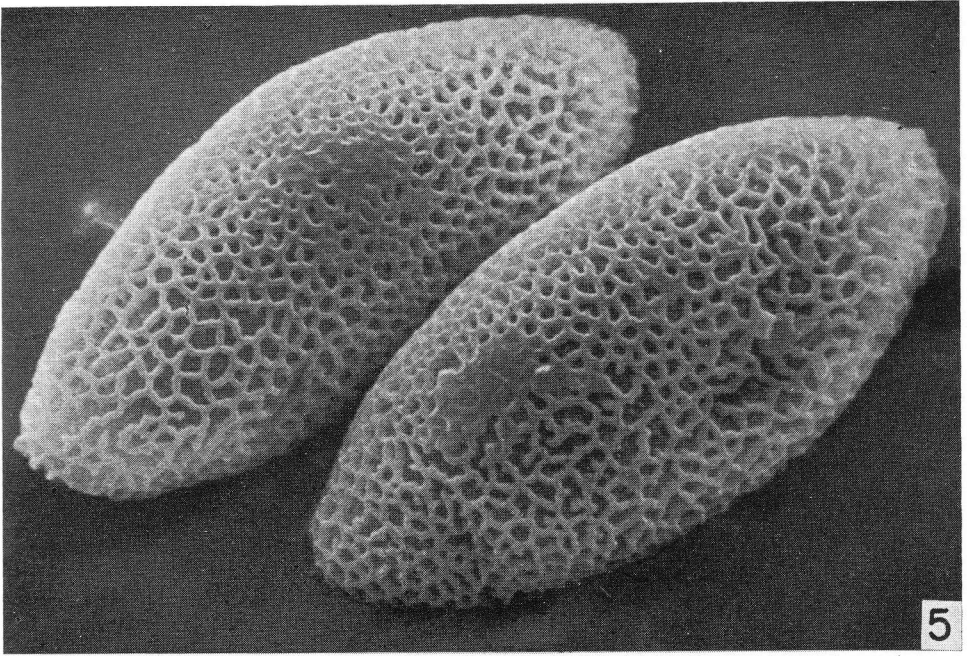
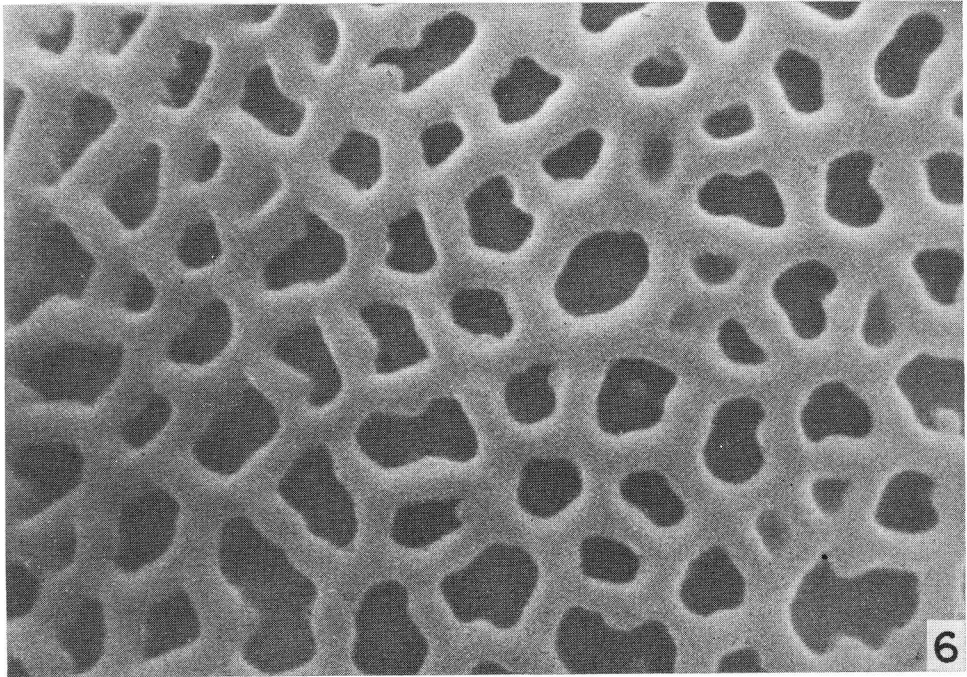


1-4. Photomicrographs of palm pollen grains. Fig. 1, *Chamaedorea oblongata*: pollen with reticulate surface; each grain with a furrow, $\times 500$. Fig. 2, *Hyphaene Schatan*: pollen grain with wartlike ornamentation, $\times 1500$. Fig. 3, *Arenga pinnata*: pollen grain with spiny wall; note the prominent furrow, $\times 1500$. Fig. 4, *Nypa fruticans*: pollen with spiny surface similar to that in *Arenga*, $\times 500$.

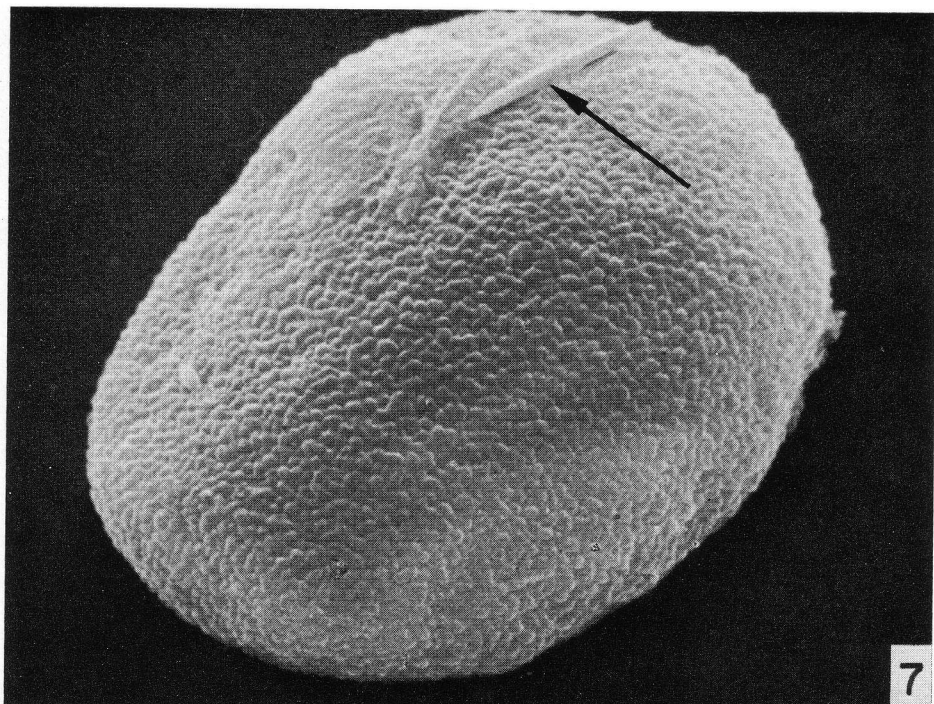
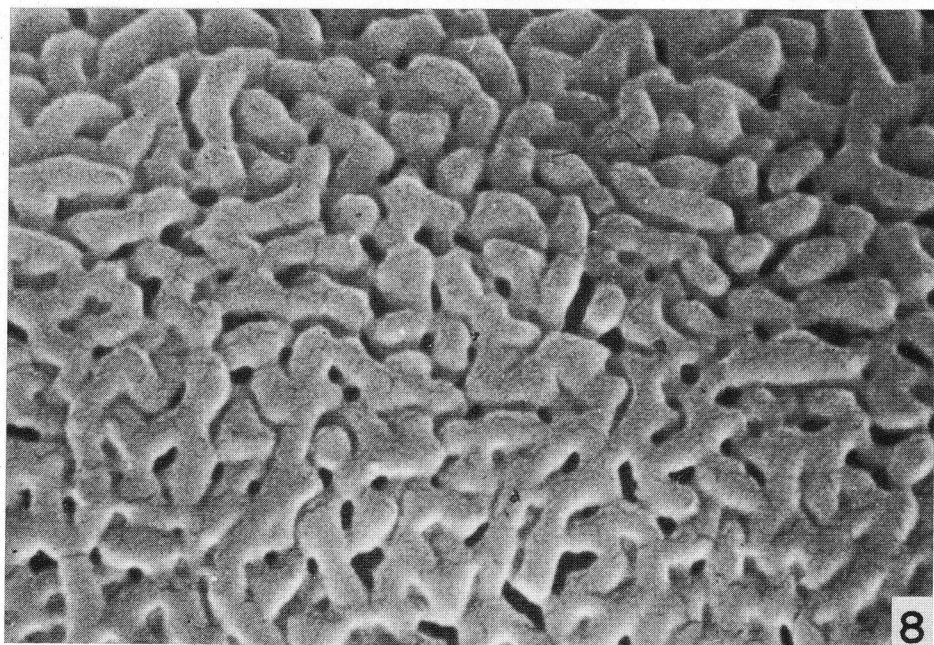
and was kept dry during shipment and subsequent cold storage by packing the capsules in silica-gel. Observations using the light microscope were also made on pollen from *Nypa fruticans*, *Chamaedorea* sp. (FG 57-755), *C. oblongata*, and *Hyphaene Schatan*.

Figures 5-17 demonstrate the tremendous detail and three-dimensional qualities of pictures taken with the scanning

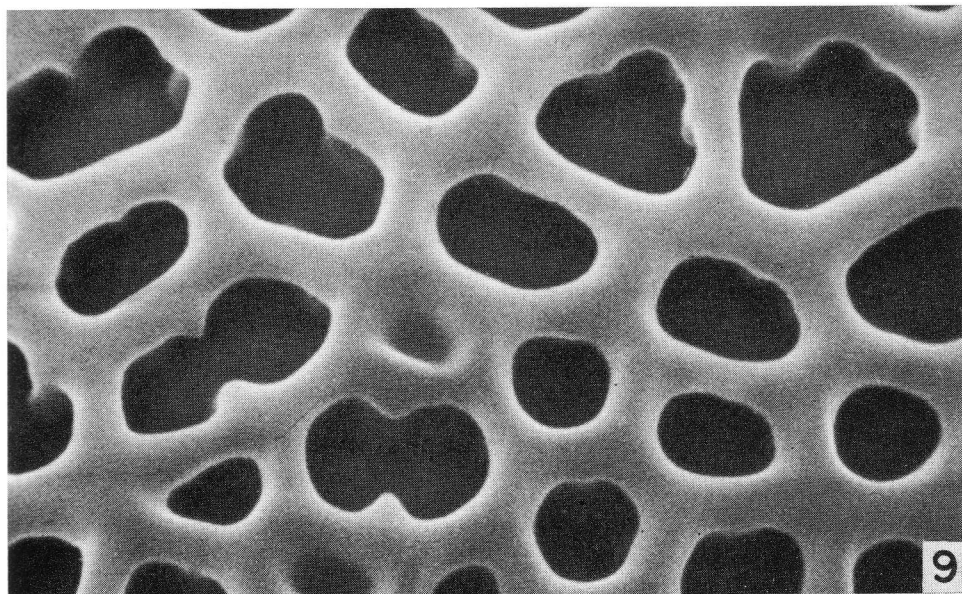
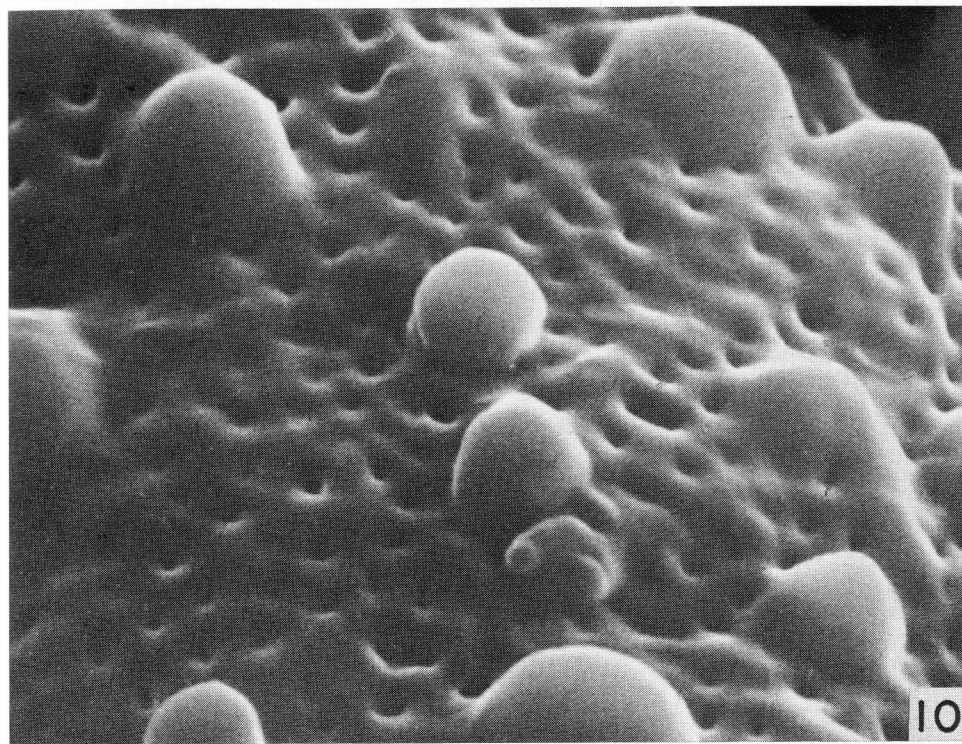
electron microscope. The usefulness of scanning electron microscopy can be demonstrated especially well in the pollen of *Mascarena* and *Ptychosperma*. The surface of pollen in these palms appears finely reticulate when examined with a light microscope (Thanikaimoni, 1966; Sowunmi, 1967). Under low magnifications with the scanning electron microscope, the pollen wall of these palms does



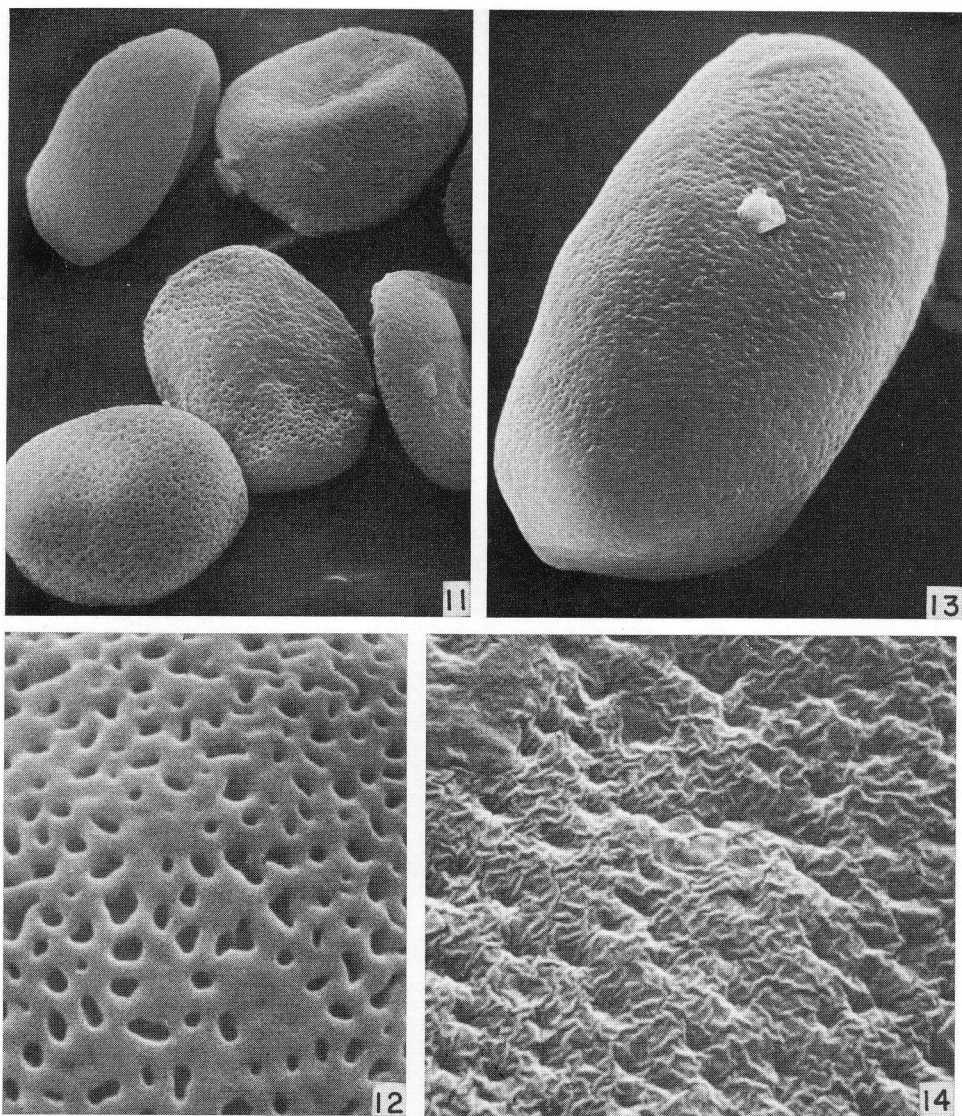
5-6. *Chamaedorea brachypoda*. Scanning electron micrographs. Fig. 5, two pollen grains showing prominent reticulate surface structure, $\times 5400$. Fig. 6, magnified view of the reticulate surface, $\times 19000$.



7-8. *Chamaedorea* sp. (FG 57-755). Scanning electron micrographs. Fig. 7, pollen grain with finely reticulate surface; a calcium oxalate crystal (arrow) can be seen on the top of the pollen grain (such crystals are commonly found in the anthers of this species), $\times 4800$. Fig. 8, magnified view of the pollen surface showing the fine structure; note the difference between this pattern and pollen surfaces of the other two species of this genus (Fig. 6, 9), $\times 19000$.



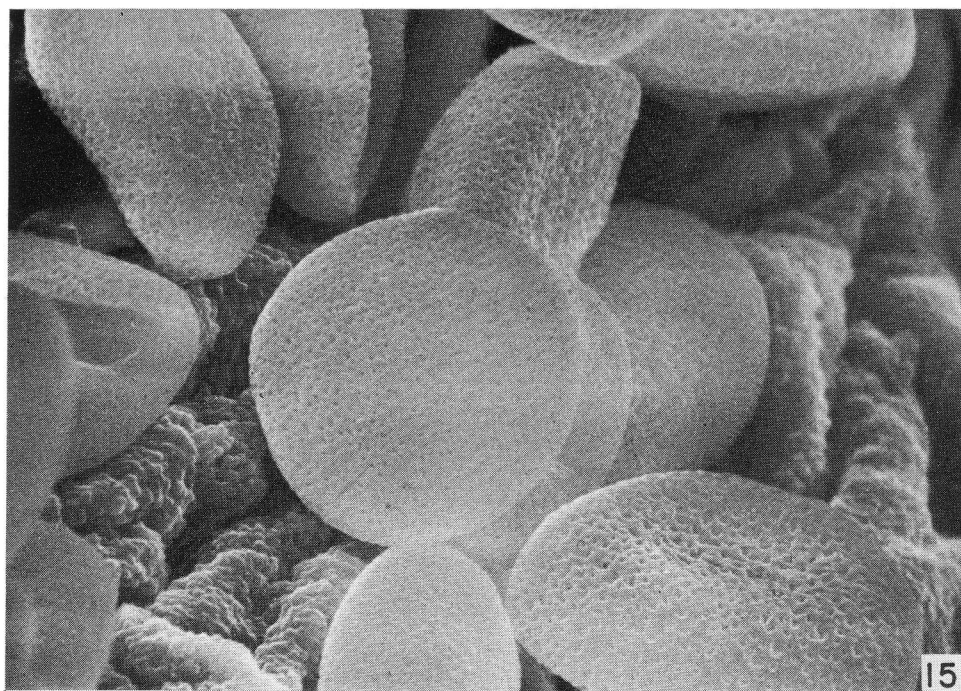
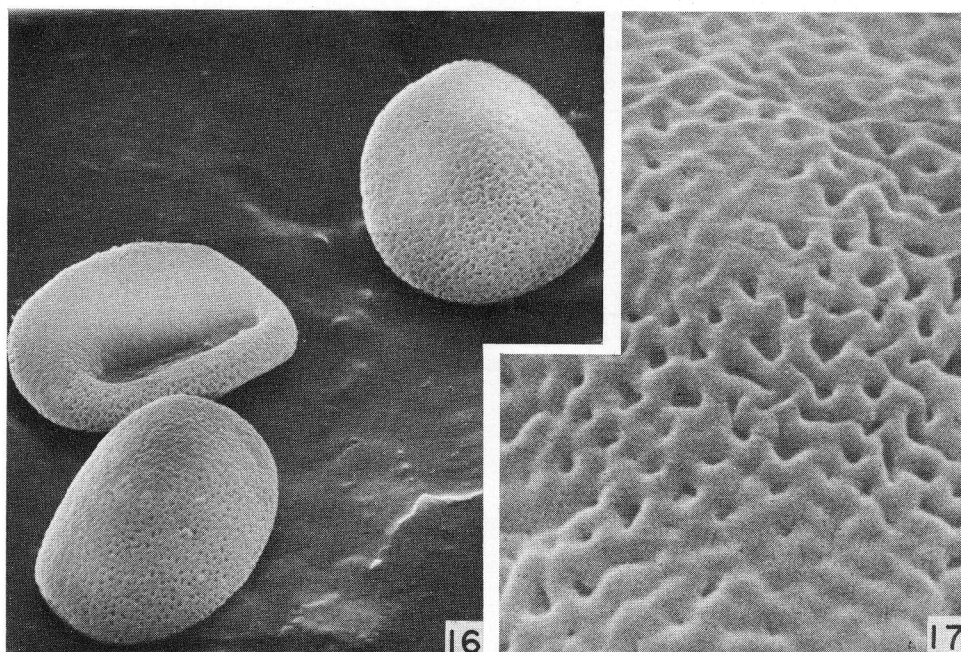
9-10. Scanning electron micrographs. Fig. 9, *Chamaedorea oblongata*: magnified view of the reticulate pollen surface (see cover picture), $\times 19000$. Fig. 10, *Hyphaene Schatan*: magnified view of the pollen surface showing bumps and "warts" in addition to the reticulate structure of the wall; compare details of this with the photomicrograph in Fig. 2, $\times 19000$.



11-14. Scanning electron micrographs. Fig. 11-12, *Ptychosperma* sp. (FG 60-675F). Fig. 11, A cluster of pollen grains, $\times 2500$. Fig. 12, magnified view of the pollen surface showing the reticulate wall; note the smooth exterior of the reticulate structure, $\times 12700$. Fig. 13, 14, *Mascarena lagenicaulis*. Fig. 13, pollen grains with a finely reticulate surface, $\times 2500$. Fig. 14, magnified view of the pollen surface; note the crinkled exterior in addition to the reticulate pattern of the pollen surface, $\times 12700$.

not show any obvious difference in surface architecture (Fig. 11, 13). However, higher magnifications with the scanning electron microscope reveal that the finely reticulate pollen surface of

Mascarena has a crinkled appearance (Fig. 14) while that of *Ptychosperma* appears smooth (Fig. 12). Among the three species of *Chamaedorea* examined, the pollen of one of the species has a



15-17. *Phoenix* sp. (P-1596). Scanning electron micrographs. Fig. 15, pollen grains within the anther, $\times 3000$. Fig. 16, three isolated pollen grains, one of them showing a deep furrow, $\times 1950$. Fig. 17, magnified view of the pollen surface showing the reticulate pattern, $\times 12700$.

different surface structure (Fig. 7, 8) from that of the other two (cover, Fig. 5, 6, 9). More samples of pollen from different groups of this horticulturally important genus need to be examined before one can determine whether there are any correlated variations in the fine structure of the pollen surface in different species.

Since the outer wall (exine) of most pollen is made up of a very tough substance called saporollenin, the pollen wall remains intact under very harsh conditions. Consequently pollen grain surfaces are probably one of the materials best suited for scanning electron microscopy where objects are subjected to high vacuum and temperature. Detailed investigations on the fine structure of pollen surface in different groups of palms could yield information that might be helpful in resolving problems in taxonomically difficult genera and species when the data are used in conjunction with other morphological characters.

The author wishes to acknowledge his indebtedness to Professor A. Frey-Wyssling, Institut für Allgemeine Botanik, Eidgenössische Technische Hochschule, Zürich, Switzerland for his advice and encouragement, and to Dr. R. Gasser, Research Department, J. R. Geigy S. A., Basel, for the use of a scanning electron microscope (Stereoscan, Cambridge In-

strument Company). The author is also very grateful to Miss Christel Brücher for her skillful technical help.

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PALM BRIEFS

Some Palms in Jamaica

These days, I spend much of my time in the splendid Caribbean island nation of Jamaica. My interest in palms, of long standing, continues, and scarcely a week passes but that I discover some fascinating cultivated or indigenous specimen which I have not previously seen.

Visitors to this island are never disappointed in its exuberant and rich flora. Though with a rather small indigenous representation of palms, there are excellent examples of mature cultivated species in several places which are indeed rewarding.

Just now (May 1969) an especially impressive talipot palm (*Corypha um-*



1. The impressive talipot palm (*Corypha umbraculifera*) in full inflorescence in Victoria Park, downtown Kingston, Jamaica. The palm is leaning, not the author, who is seen nearby. Photo courtesy The Daily Gleaner. This palm collapsed in early April, 1970.



2. A spent and collapsed talipot palm at the Bath Botanical Gardens in Jamaica. The endemic mountain royal palm (*Roystonea altissima*) is seen to the left and a coconut to the right.



3. Palms at the Royal Botanic Gardens, Hope, in the outskirts of Kingston, Jamaica. From left to right are *Phoenix canariensis*, *Pritchardia Thurstonii*, *Elaeis guineensis*, *Chrysalidocarpus madagascariensis*, and *Arecastrum Romanzoffianum*.

braculifera) is completing its flowering and fruits are forming, are shown in the accompanying photograph which was taken by one of *The Daily Gleaner* photographers (Fig. 1). The palm is situated in downtown Kingston, in Victoria Park, and stands near a companion tree which produced its prodigious inflorescence two years ago, and has since collapsed and been hauled away.

Here in Jamaica, this is most often called either century palm or talipot palm. The first epithet is given it because of the very persistent belief that this *Corypha* requires at least one hundred years to attain maturity, much like an overdone kind of *Agave*—the well-known century plants.

There are still some numbers of these coryphas extant hereabouts, though un-

fortunately—at least in the public Botanic Gardens of the island, such as Hope and Bath—no particular effort seems to have been made by the officials in charge to replant expired specimens. In my second photograph, I show one of the recently-collapsed talipots at the Botanic Gardens at Bath (our island's oldest extant gardens, dating from 1779), with the endemic mountain royal palm, *Roystonea altissima*, to the left, a coconut to the right (Fig. 2). There are still a couple of handsome immature coryphas at Bath, as well as a grand alley of them at the Royal Botanic Gardens at Hope.

The third illustration I submit here is of a group of palms at the Royal Botanic Gardens at Hope, on the outskirts of Jamaica's sprawling capital of Kingston.

These stand alongside the principal entry road into the extensive and handsome gardens, and as can be seen, are interspersed by attractive beds of showy annuals, among these being a chartreuse *Coleus* and some red amaranths.

Reading left to right in the photograph, we see *Phoenix canariensis*, *Pritchardia Thurstonii*, *Elaeis guineensis* (the African oil palm, which was long ago planted on a trial commercial purpose in various parts of the island), *Chrysalidocarpus madagascariensis*, and *Arecastrum Romanzoffianum*.

There are some other very interesting palms at Hope, including a mature flowering male specimen of the unique double coconut, *Lodoicea maldivica*, and some rather neglected small examples of

the thief palm, *Phoenicophorium Borsigianum*.

In a future article, I wish to take up the still splendid palm collection at Castleton Botanic Garden, and to show several of our interesting endemics. There are many persons resident here who have more than a casual knowledge of palms, both native and introduced, and I suspect that certain of them would indeed be happy to show Palm Society visitors around, naturally if they were afforded sufficient advance notice. Interested persons can write to me c/o The Daily Gleaner, North Street, Kingston, Jamaica, West Indies, and I will forward their letters.

ALEX D. HAWKES

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Observation of Frost Damage at a Palm Nursery

The winter of 1968-69 brought California some of the coldest weather that had been experienced in over thirty years. Shortly before Christmas, after a long period of exceedingly warm fall weather, we experienced one night of killing frost in our nurseries at Monrovia in southern California. Without warning, a bitter cold north wind started to blow during the day. Temperatures dropped the first night to 24° F. and stayed there for seven or eight hours. During the following day the thermometer rose to 38° F., and during the night it sank to freezing again but not to below 30°. After those low temperatures our normal non-freezing winter weather again prevailed. Damage to subtropical ornamental plants was extensive. All plants were tender, full of sap and in growing condition because of the preceding long period of warm weather.

With the exception of *Archontophoenix*, *Arecastrum*, *Livistona*, and *Wash-*

ingtonia, all palms were in a lathhouse of 40-50% shade on the uphill side of the nursery. Temperature here was colder than at the lower open area. This frost hit in foothills which are usually frost-free. The belt extends from 500 to 1200 feet above sea level. No damage was encountered at all at the 1050-foot level where my home is located. Lower down, from there into the 500 foot area, frost burn showed up in fast succession. Avocado orchards were ruined at 600 feet. Strangely, below 500 feet damage gradually became less. A few feet could make a great difference. The twenty acres of nursery grounds are situated on a slanting level around 500 feet elevation. Plants of the same kind, size and age would be burnt at the highest point while no damage occurred at the lowest.

I was away from Monrovia during this freeze, spending the holidays in Virginia. On my return I tried the Dent Smith method on frozen palms—cutting the tops back to sound tissue. I got no results at all on *Chamaedorea*, but we saved some *Rhopalostylis*, *Archontophoe-*

Palm Species	Damage		Recovered	Killed	Remarks
	Light	Severe			
<i>Archontophoenix</i>					
<i>Alexandrae</i>		×	×	some	
<i>A. Cunninghamiana</i>		×	50%	50%	
<i>Arecastrum</i>					
<i>Romanzoffianum</i>					
young plants		×	95%		
older plants	×		×		
<i>Caryota mitis</i>		×	50%	50%	
<i>C. ochlandra</i>		×	×		
<i>C. urens</i>				×	
<i>Chamaedorea costaricana</i>		×	×		sprout from ground
<i>C. elatior</i>		×	small plants		large plants all died
<i>C. elegans</i>	×		×		
<i>C. Ernesti-Augusti</i>	×	×	×	some	
<i>C. erumpens</i>		×	×		bottom shoots
<i>C. glaucifolia</i>				×	
<i>C. metallica</i>	×	×	×		
<i>C. oblongata</i>	×	×	×	some	
<i>C. Seifrizii</i>	×		×		
<i>C. Tepejilote</i>		×	very few	×	
<i>Copernicia glabrescens</i>				×	
<i>Hedyscepe Canterburyana</i>		×	50%	50%	
<i>Howeia Forsteriana</i>		×	50%	50%	
<i>Livistona chinensis</i>	×		×		
<i>Mascarena lagenicaulis</i>				×	
<i>Microcoelum Weddellianum</i>	×		×	2%	
<i>Phoenix Loureirii</i>	×		×		turned a light yellow
<i>P. reclinata</i>		×	×		horizontal leaves burned
<i>Pritchardia</i> sp.				×	
<i>Ptychosperma elegans</i>		×		×	well-protected survived
<i>Rhopalostylis Baueri</i>	×	×	×	20%	
<i>R. sapida</i>	×		×		
<i>Roystonea</i> sp.				×	
<i>Washingtonia robusta</i>	×		×		horizontal leaves burned

nix, and *Hedyscepe*. The nursery indeed looked like a scarred battlefield.

The following palms were damaged as indicated. (Tab.). Quantities subjected to the freeze ranged from twenty or thirty of each species to several hundred plants.

Palms not touched by the frost are listed here: *Acoelorrhaphe Wrightii*, *Arenga Engleri*, *Brahea dulcis*, *Butia capitata* and other species of *Butia*, *Chamaedorea radicalis*, *C. microspadix* (improved), *C. cataractarum*, *C. atrovirens* (somewhat sheltered), *Chamaerops humilis*, *Erythea aculeata*, *E. armata*, *E.*

edulis, *E. Brandegeei*, *Jubaea chilensis*, *Linospadix monostachya*, *Livistona australis*, *L. decipiens*, *Nannorrhops Ritchiana*, *Phoenix canariensis*, *P. Roebelenii*, *P. "pumila,"* *P. robusta*, *P. rupicola*, *Rhapis excelsa*, *R. humilis*, *Sabal* (several species), *Trachycarpus Fortunei*, *T. Takil*, *Trithrinax acanthocoma*, *Washingtonia filifera*.

Some palms of small lining-out size and additional tender varieties were in the greenhouse and protected from the freeze.

OTTO MARTENS

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Research Plantation Gift

The S. C. Johnson & Son, Inc. has recently donated a 400-acre research plantation in northeast Brazil to the

Escola de Agronomia of the University of Ceará.

This property has been under research study since 1937 with major projects in-



1. An aerial view of a typical wild stand of carnauba (*Copernicia prunifera*) and the Jaguaribe Valley of northeast Brazil.



2. Access road at the entrance of the Raposa Plantation.

volving *Copernicia prunifera*, the carnauba wax palm, and the entire genus *Copernicia* as represented by the species from Venezuela, Paraguay, and Cuba. The research objective has been to develop an improved waxy palm by cultivation, selection from the wild type, and by hybridization. Sixteen species are represented in the collection of imported *Copernicia* for a total of about 3,500 specimens. The oldest of these is 20 years of age.

In addition, there are approximately 100,000 *Copernicia prunifera* that were planted from seed in field plots according to the principles of plantation management. These seeds were gathered from the high-wax-yielding regions of northeast Brazil. The oldest specimens in this collection are over 30 years of age.

This collection of *Copernicia* specimens represents a remarkable opportunity for anyone interested in specific differences. It should be recognized that these plants were collected from diverse habitats, particularly in Cuba, and have been cultivated in a singularly uniform fashion.

The agreement made with the University of Ceará included the following points:

1. The primary objective is to preserve the scientific value of the *Copernicia* collection and to keep it available to the world community of scientists.
2. A complete set of files and data on the S. C. Johnson Raposa project will be held by the University of Ceará Library for access by re-



3. The most valuable introduced waxy palm is *Copernicia hospita*. This species is faster-growing than carnauba, has larger leaves, and greater wax yield.

searchers who may wish to study these palms.

A series of short reports is being planned by S. C. Johnson & Son, Inc. for early publication; and a terminal report, which is a much larger undertaking, will be completed as soon as possible.

Anyone interested in gaining access to the Raposa Plantation to do research with these specimens should contact Dr. Vicente Lopes Gondim, Coordenador, Universidade Federal do Ceará, Programa de Educação Agrícola, Rua Carlos Vasconcelos, 1060, Fortaleza, Ceará, Brasil.

E. D. KITZKE

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4-7. *Copernicia* at the Raposa Plantation. 4, *Copernicia hospita* in another view; note the very large crown and numerous leaves. 5, A specimen typical of the "Cromo" hybrid grown from seed obtained from a natural hybrid between *Copernicia hospita* and *C. Cowellii* in Camaguey, Cuba. Although this specimen is typical of the "Cromo" hybrid, the hundreds of seedlings grown from the same source show distinct evidence of segregation typical of an F_2 generation. Some of the specimens are distinctly *hospita*-like, some *Cowellii*-like, and some typical of the intermediate "Cromo." This collection presents a remarkable opportunity for studying the evolution of the natural hybrid. 6, The two large specimens of carnauba (*C. prunifera*) attained this size after 14 years. The leaves were never harvested as part of an experiment to determine differences in growth rate. The profile of the smaller palms in the background represents the stunting effect that the annual harvesting practice caused on these relatively young palms. The harvesting began



about the seventh year after planting. 7, This stand of caranday palms (*Copernicia alba*) was grown from seed imported from Paraguay. It is the fastest growing *Copernicia* and has high wax yield, although the individual leaves are only one-third the size of carnauba. The trees are about five years old.

NEWS OF THE SOCIETY

Dale V. Bremerman

Mr. Dale V. Bremerman, 49, a building contractor of Naples, Florida, died on March 7th, 1970. An intensely active and energetic person, he was an ardent collector of plants, especially palms. On the morning of March 7th he was one of the first in line at the entrance to Fairchild Tropical Garden, ready to dash in and acquire some new treasures at the annual plant distribution. His sister had come from Naples with him, as Mrs. Bremerman was recuperating from an

operation. On the way home that afternoon he felt unwell, so his sister offered to drive. As they sped homeward, Dale suffered a massive heart attack and died within seconds.

Dale and his wife, June, were in the Palm Society group that made the trip around the world in 1968. He was known to many of the Society's members, both in person and through correspondence. Our deepest sympathy to June and their four children.

Dr. Lawrence M. Simonson

Dr. Lawrence M. Simonson, 93, of 6636 High Ridge Road, Lantana, Florida, engineer, physician and a collector and expert on rare plants, died on January 14th, 1970.

He was born on July 28, 1876, at Clifton, Staten Island, New York, where his ancestors had lived for more than 300 years. He was graduated from Columbia University School of Engineering in 1899 and the Flower Hospital, College of Medicine, New York City, in 1915. In World War I he achieved the rank of lieutenant-colonel in the U. S. Army Medical Corps.

He practiced medicine at Winter Haven, Florida, from 1919 until his move in 1944 to Lantana because of the milder climate for his plant collection. There,

on a high sandy ridge he developed an assemblage of rare plants which became a mecca for college students, botanists and others who visited his garden periodically to study his collections of palms, trees, shrubs, vines, orchids and bromeliads.

Dr. Simonson was a familiar figure at Fairchild Tropical Garden where he came to acquire more rarities at Distribution and on Members' Days. On his last visit he proudly announced that he had reached the age of 92, and was still collecting plants. He was also a member of The Palm Society, and a number of other horticultural and historical associations.

He left no survivors.

LUCITA H. WAIT

CLASSIFIED SECTION

Members who are interested in commercial quantities of *Butia Yatay* (formerly known as *Cocos Yatay*), may write to Mr. Zenkichi Ishiwatari, Manager, Kikko-En Nursery, 11-44, 1-Chome, Wada, Suginami-Ku, Tokyo, Japan.

The Palm Society is interested in obtaining the names of reputable dealers in palm seeds in commercial quantities. Will anyone knowing of such dealers kindly write to The Palm Society, 7229 S. W. 54th Ave., Miami, Fla. 33143 U.S.A. sending names, addresses and, if possible, catalogs?