PRINCIPES

Journal of The Palm Society

April, 1967
Vol. 11, No. 2

THE PALM SOCIETY

A non-profit corporation primarily engaged in the study of the palm family in all its aspects throughout the world. Membership is open to all persons interested in the family. Dues are $10.00 per annum payable in May. Requests for information about membership or for general information about the Society should be addressed to the Secretary.

PRINCIPES

JOURNAL OF THE PALM SOCIETY

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

Manuscript for PRINCIPES, including legends for figures and photographs, must be typed double-spaced on one side of 8½ x 11 bond paper and addressed to the Editor at Bailey Hortorium, Mann Library, Cornell University, Ithaca, New York, 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

Cover Picture

The American oil palm, *Elaeis oleifera* (*Corozo oleifera*) at Lancetilla Experiment Station, Lancetilla, Tela, Honduras. See Principes 9: 75-84. 1965. Photo by W. H. Hodge.

Mailed at Miami, Florida
July 21, 1967

NEWS OF THE SOCIETY

The big event of the past few months must surely have been the appearance of NEWSLETTER, the very professional informal publication being published by Palm Society members in California, and intended primarily for members in the western states. Volume 1, no. 1 appeared in January, and was an immediate success. This is not intended to be scientific (although the editors will exercise care in identifications and in spelling of botanical names). Its aim is to exchange horticultural information, tell about members' gardens and/or experiences in growing palms, and other matters of general interest to western palm growers. The editors hope to pay costs through advertisements; these, so far, have not been numerous, however they are so attractive they become part of the absorbing reading matter.

Planned as a four-page leaflet, the second number (March, 1967) came from the press with six pages, and the type size had to be reduced in order to accommodate all the material. Contributions came in from as far away as South Africa. The way things are going, the editor, Jim Specht, and the publisher, Ken Foster, are going to have to increase their staffs and work out some way for members in other parts of the country and world to receive copies.

* * *

Announcement was made in the first number of NEWSLETTER that plans were being made to reproduce out-of-print fascicles of *Gentes Herbarum*, the scholarly publication of the L. H. Bailey Hortorium, Cornell University, Ithaca, N. Y. A number of the fascicles dealing with palms have long been out of print, and are eagerly sought by palm enthusiasts. By reproducing these fascicles at absolute minimum cost, and with no salaries or compensation of any kind, it may be possible to offer the 1,128 pages, including many illustrations, for the absurdly low price of $35.00 per set. At least 100 subscribers must be had before a beginning can be made. At the latest report only 18 subscriptions had been received. If this monumental job is to be done many more of you must send in your orders.

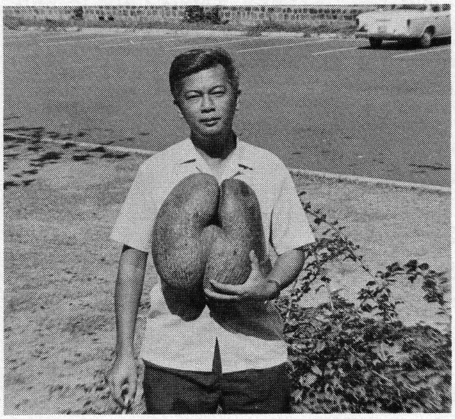
If you are interested in securing a set of the *Gentes Herbarum* palm fascicles, send in your reservation to: Western Chapter of the Palm Society, 4398 Aragon Way, San Diego, Calif. 92115, U. S. A. It is not necessary to send payment at this time.

* * *

Dr. H. E. Moore, Jr., Cornell University, and Dr. M. V. Parthasarathy, Research Associate at the L. H. Bailey Hortorium and the Fairchild Tropical Garden, returned from a fruitful trip to Central and South America late in March. The chief purpose of the expedition was to go to the places in which certain palms had been collected for the first time (perhaps many years ago) to collect new and more complete material to be studied and compared with the original collections for the purpose of more exact identification and for anatomical and cytological work.

Besides the quantity of study material collected, they returned with seeds of several new and exciting palms, which were turned over to the Seed Bank for disposal. Since most of these palms live in a very hot and humid climate, it became a matter of great responsibility to place these seeds where they would have the greatest chance of survival. They were finally placed in locations which seemed to offer the most probability of success.

Since in the northern hemisphere this is not the normal ripening season for seeds of many palm species, the activity of the Seed Bank has been reduced somewhat. We have, however, received seeds from several members, and these have been passed along to those who had asked for them. Names of donors will appear in October *Principes*.



Mr. Snidvongs holds seed of a double coconut.

The Society's membership in Thailand has increased recently—in fact, the members there are planning to form their own chapter.

One of the newer members is Mr. Ura Snidvongs. He joined the Society while spending some weeks in Honolulu, but has since returned to his home in Bangkok. Having received some valuable information from him, I wrote asking him to tell me something about himself. He replied with a very amusing account of some experiences he had while in Hawaii. I enjoyed his story so much that I asked permission to share his letter with the other members of the Society. He kindly agreed, and I feel sure that all of you will be as pleased with his delightful sense of humor and charming use of the English language as I was.

"Dear Madam:

"Really I am an engineering officer working at the Royal Thai Navy dockyard. I studied in England during 1951-55 and visited Paris in 1960. I start my hobby of palm collecting 2-3 years ago, by recommendation of Mr. Somphongs [a Society member—Ed.].

"During April and May this year I was lucky enough to have some training at Pearl Harbor shipyard. During my free time in Honolulu I visited Foster Garden every holiday and many places which have palms trees, collecting some seed of course. On Sunday I got up very early in the morning and went to Hawaii University which many palm trees grow in college ground; I collected some seeds. This was the only way I could get seed because nobody interested in palm seed, no place to buy.

"Finally every American officer at the BOQ suspected me because of my behavior. Every evening too I went in town walk to the Iolani palace just waited for some Attalea cohune seeds to drop to the ground. I walked many miles every evening, knowing nearly every palm tree in town. It looked like the 007 affair; finally some detectives were after me, I knew that because nobody outside the Palmlover world will know how we are craving for 'seeds'. Nobody will believe that an officer will collect seeds like mad. He should do it as a disguise for other purpose, maybe for area studying or OOsevening. Finally I collected about 2000 seeds (freely) and always safe (protected by some detective); now about 30 percent of the seeds germinated already.

"The detective gave up, finding no reason of my night walks, the day I left Honolulu I wrote a letter to the chief police thanking him of the security service he gave me all the time. My story is not a fiction. I still remember my past time in

Hawaii, it is really an island of paradise, anything grow beautifully there."

In another letter he says: "What is the medium you usually use to germinate palm seeds? I use the charcoal from rice husk (after they used rice husk as boiler fuel in the rice mill), it is a black and coarse grain, free from fungus and it is easy to transplant the seedling because the medium will not pack tightly after 2 or 3 months.

"Could you ask some member in Indonesia to contact with me, I want some *Pigafetta elata* seeds which is not in the Society list."

The rice charcoal adds one more to the varied list of germinating media used by Society members.

LUCITA H. WAIT

Collecting Palms in Brazil

S. F. GLASSMAN
University of Illinois at Chicago Circle

During the summer of 1965 I visited Brazil for the purpose of collecting and studying palms in the genus *Syagrus* and its allies which include *Arecastrum, Arikuryroba, Barbosa* and others.* The *Syagrus* alliance with some 40 or more species, is almost exclusively South American in distribution, only *Rhyticocos amara* being found in the West Indies. This group is a difficult one to study because many type specimens consist of incomplete material or are nonexistent; many of the descriptions are inadequate for determination; and a number of the species are known only from one or two specimens

I arrived in Rio de Janeiro in the latter part of June, and subsequently visited Dr. Klare Markley who had been with the late Gregorio Bondar on his last collecting trip. Dr. Bondar had spent many years studying palms in Bahia and Espirito Santo. Dr. Markley politely declined the offer of collecting palms with me because he was busy completing a manuscript on vegetable oils. Before leaving Rio, I spent a few days at the Jardim Botanico studying herbarium specimens and observing various living palms. Fortunately, Dr. L. H. Bailey and Dr. B. E. Dahlgren had made excellent collections of *Syagrus* in the Jardim back in the 1920's so it wasn't necessary to spend time preparing herbarium specimens here.

My next stop was the Instituto de Botanica de São Paulo which is part of the Ministerio de Agricultura in the state of São Paulo. I made arrangements with the director, Dr. Alcides Teixeira, to ship the specimens I collected back to the United States. Because of mailing restrictions, it is difficult for a foreigner to ship anything out of Brazil. The following day the director introduced me to Mr. José Correa Gomes, curator of the phanerogamic herbarium. After discussing collecting plans with Mr. Gomes, to my great delight he agreed to accompany me on the entire trip. Up to that time my plans were rather nebulous. Originally, I intended to fly to all of the major cities in the states of São Paulo, Minas Gerais, Espirito Santo and Bahia, rent a car and hire a driver or guide, and then drive to the designated collecting localities. New cars are very expensive in Brazil (even by U. S. standards) so there is an abundance of older, dilapidated models on the streets. When Mr. Gomes decided to join me my car problems were

*This study is supported by a National Science Foundation grant No. GB3737.

1. *Syagrus flexuosa* (?) between Araraquara and Baurú, S. Paulo, with J. C. Gomes.

solved because the Instituto de Botanica made a new Jeep available to us. It also solved the problem of a driver and guide who could speak Portuguese. Although Mr. Gomes spoke very little English and I spoke a fractured Portuguese, we were able to communicate with each other in Spanish. I agreed to absorb the automobile expenses and to leave a duplicate set of plants at the Instituto. In general, the cost of gasoline and maintenance of a car is slightly more expensive in Brazil than in the United States.

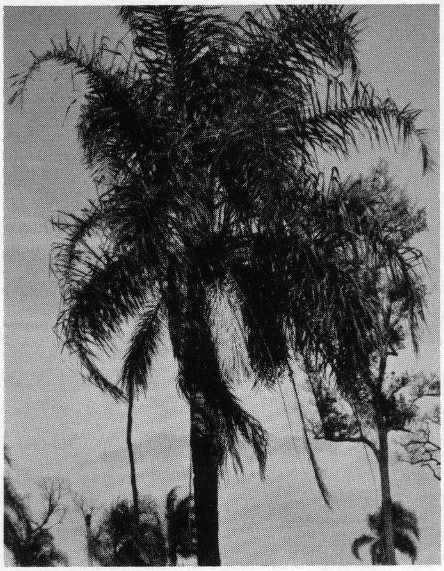
At the beginning of July we left by Jeep for a five day trip in the state of São Paulo. Travelling in a northwesterly direction, our first important stop was at Fazenda dos Caeures, about 7 miles east of the town of Rio Claro. The owner of this cattle ranch was Mr. Jorge Ferguson, formerly of Texas, who spoke Portuguese with a southern accent. Of interest were scattered trees of *Arecastrum Romanzoffianum* and *Syagrus macrocarpa* (?) from which we collected specimens.

After obtaining specimens from the first tree we changed our collecting techniques radically. At first we used a ladder to reach the crown of the tree and proceeded to saw off various leaves and inflorescences. During the process of removing these parts, I was attacked by an assortment of large biting ants, bees and wasps, and other pests. In

2. Part of a stand of *Arecastrum* and *Syagrus* with Jeep, Fazenda Pedro Felipe, 12 miles E. of Marilia, S. Paulo.

order to avoid direct contact with insects (and to avoid climbing the trees) the most satisfactory way to collect palm specimens is to cut down the whole tree by use of an axe or saw. It was usually necessary to obtain permission from the owner if the trees were on private land. After the tree fell we would wait for about five minutes at a safe distance to allow most of the creatures to fly or crawl away.

Later that afternoon we drove by a savanna (*cerrado*) northwest of Itirapina where we collected *Attalea humilis* (?) and an undescribed species of *Syagrus*. Both palms were trunkless. The following day we photographed isolated specimens of *Acrocomia* and *Arecastrum* on a coffee plantation between São Carlos and Araraquara. Both trees were in fruit. Coming back to the southwest, between Araraquara and Baurú, we noticed scattered specimens of *Syagrus flexuosa* (?) growing in a savanna. These trees had slender trunks about 5-10 ft. tall. That night we stayed

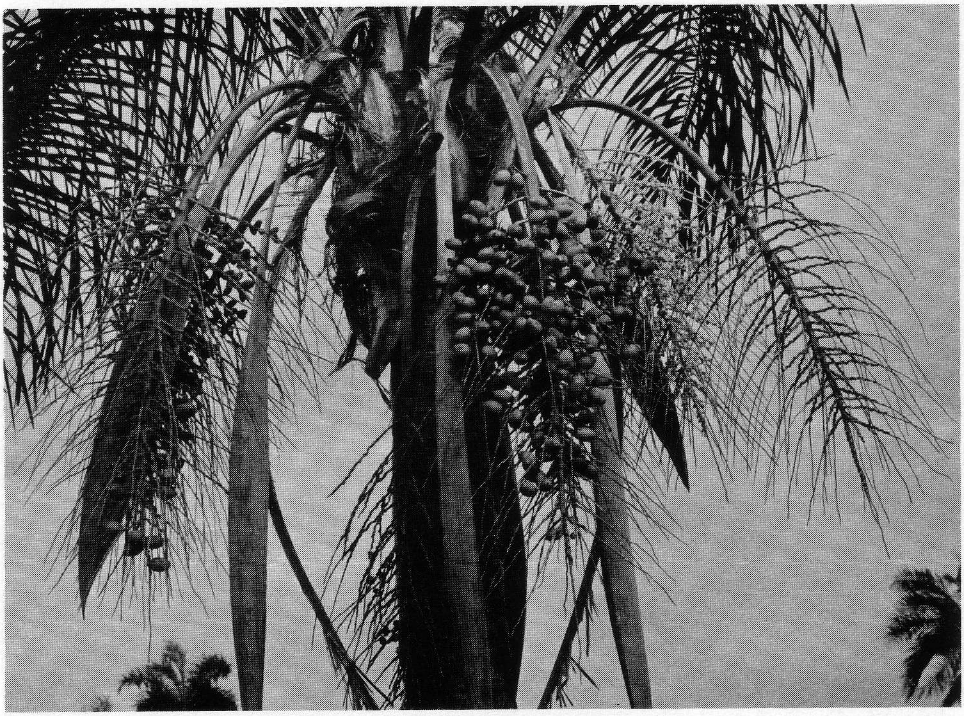


3. *Arecastrum Romanzoffianum*, closeup of crown, Fazenda Pedro Felipe.

4. J. C. Gomes holding inflorescence and infructescence (leaves on ground) of *Syagrus* growing in same stand with *Arecastrum*, Fazenda Pedro Felipe.

in a beautiful modern hotel in São Carlos for only $3.00 including meals.

During the next two days we probably saw more palms in the *Syagrus* alliance than at any time on our entire trip. The first formation encountered was about 10 miles east of Marilia on a *fazenda* (ranch) with cattle, coffee and other crops. This forest of about 200 palms, apparently exposed to periodic burning, was dominated by *Arecastrum* and *Syagrus oleracea* (?). Travelling north of Marilia, near Pompeia, we saw an extensive palm forest of an estimated 3,000 trees. There appeared to be at least three different species represented: a medium-to-tall, thick-trunked palm (*Arecastrum*), a very tall (about 120 ft.) thin-trunked plant (*Syagrus* sp.), and a much shorter, thick-trunked tree (*S. oleracea*?). Formations of the above three species were observed along the same road in the following localities: about 200 trees on both sides of the road near Iacri, 5 miles N. of Tupã; many scattered groups of 25-50 trees along the road to Pararapua; and two separate formations of 200-300 palms each, 8 miles N. of Tupã. About 12 miles N. of Tupã, on the Fazenda Vanuir, we noticed a forest of about 1,000 trees, many with charred trunks. There were no very tall, skinny trees here, but a medium-sized *Arecastrum*, a me-



5. Closeup of apparent hybrid between *Arecastrum* and *Syagrus oleracea* (?), Fazenda Vanuir, 12 miles N. of Tupã, S. Paulo.

dium-sized *Syagrus,* and a short *Syagrus* about 10 feet tall. Preliminary observations indicated that one of the species of *Syagrus* was a hybrid. By this time our Jeep was so full of palms that we had to return to São Paulo to finish pressing them.

We spent the next two or three days at the Instituto de Botanica at São Paulo sorting out and cutting up the specimens for drying. Most of the specimens are cut up into pieces the size of a herbarium sheet (11½ × 16″) or smaller so that they will fit into the compartments of a standard herbarium case when dried. Less bulky specimens can be folded back once or twice and dried in that manner. Each piece is tagged and numbered, and loose flowers and fruits are placed in paper bags or packets.

The herbarium at São Paulo has excellent facilities for handling large collections such as we had. For instance, there is a ceramic-tiled table on one side of the room that is about 50 feet long. At one point, a visiting botany class of some students taught by Dr. F. Hoehne walked into the herbarium when our specimens were spread out from one end of the table to the other. They seemed to be impressed by the magnitude of the collection. At least, I hoped they would appreciate the amount of hard labor involved.

On July 8, we set out on the major part of the trip. Plans were to visit type localities and collect abundant material of poorly known or imperfectly described species in Minas Gerais, Espirito Santo and Bahia. As was the case in São Paulo, our luck in finding specimens both in flower and fruit was phenomenal. It was the flowering sea-

6. Trunkless species of *Syagrus* originally collected by Dr. Archer, 9 miles N. of Lavras, Minas Gerais.

son for most of the species of *Syagrus*, but in many instances there were also fruits in various stages of development.

On the road from São Paulo to Bragança (near the Minas Gerais border) and between Bragança and Lavras, occasional groups of *Arecastrum* were seen. Our objective in going to Lavras was to find a trunkless species of *Syagrus* collected by Dr. Andrew Archer in 1936. After considerable searching and inquiry we finally found a stand of about 100 plants (in both flower and fruit) growing in a more or less undisturbed grassland (*campo natural*). We were also told that there were other similar stands in the immediate region. São João del Rei was next on our list, but we were discouraged by the extremely poor roads. The highway to Belo Horizonte (about 108 miles N. E.), however, is mostly four lanes and well paved. There didn't seem to be any palms of significance along this road until we approached a distance between 15-30 miles S. of the city where *Acrocomia* trees were found in dense stands.

Belo Horizonte is a modern city of nearly one million people and is the site of the University of Minas Gerais where we prepared our plant specimens. Before we left on this trip we were warned about the dangers of Chagas disease which was especially common in Minas Gerais. The disease is caused by a trypanosome and carried by a true bug (called "*barbeiro*" by the natives) which inhabits grassland and savanna areas. This bug is also particularly prevalent in old *pensões* (boarding houses) where they literally crawl out of the woodwork at night and transmit the disease by sucking the vic-

7. Stand of *Acrocomia* trees in pasture between Lagoa Santa and Serra Cipó, Minas Gerais.

tim's blood. As if that were not enough, we also learned that schistosomiasis had been recently introduced into Brazil from the Middle East and that all fresh-water ponds were a potential source of the disease. The worm larva (*cercarium*) can enter any part of the body through the bare skin when immersed in water.

On July 10, we set out for Serra Cipó, the type locality of *Syagrus pleioclada*, one of the trunkless palms. On the northern outskirts of Belo Horizonte and all along the road to Serra Cipó (a distance of about 60 miles) one or two species of *Acrocomia* seemed to be the only palms of significance; they occurred in dense stands or were scattered. At the foot of Serra Cipó, *Allagoptera*, a trunkless palm, was fairly common in the Savannas. *Syagrus pleioclada* was not to be seen until we approached the rocky outcrops of this mountain (up to 1300 m. elevation) where it was rather scarce. Another trunkless species of *Syagrus* was also found here; it was very common and had excellent flowers and fruits. I found out later that it was an undescribed species.

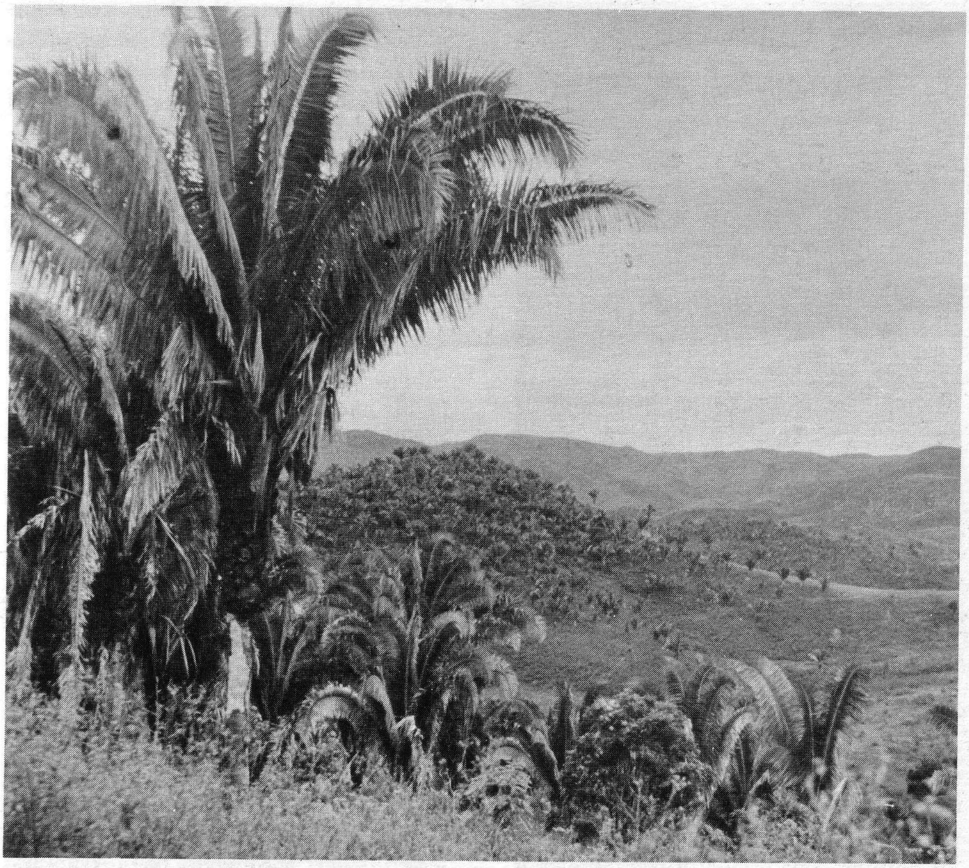
We became so engrossed with collecting and admiring the scenery that we failed to notice the gas supply was getting low. The only gas pump in the area just happened to be out of gas so we decided to drive on to the nearest town, Morro do Pilar, which was only a "short" distance away. We drove until we ran out of gas on a lonely mounttain road, in the dark and in the midst of a driving rainstorm. After waiting for about an hour, a truck came along and transported us to the town to get some gas. We returned to the Jeep with the gas and then went back to Morro do Pilar. The one "hotel" in town appeared to be a classical hiding place for the *barbeiros* which carry Chagas disease: the rooms had wooden walls and

8. J. C. Gomes holding leaf and spathes of undescribed species of *Syagrus* (trunkless) in rocky outcrops of Serra Cipó, Minas Gerais.

ceilings which were falling apart. That night we slept in our clothes and the following morning we headed back to Serra Cipó with nary a bug bite. Apparently, the cool evenings during the winter season kept the bugs inactive.

On the return trip we drove through Serra do Palacio. The vegetation here was much more lush, undoubtedly due to the higher annual rainfall. The most conspicuous element of the vegetation was *Attalea compta* (?), a palm about 30-40 feet tall with long upright leaves. Over a distance of about 18 miles several thousand trees of this species were seen, then they began to disappear as we approached the drier Serra Cipó mountain range. Before returning to Belo Horizonte, we decided to stop off at Lagoa Santa to confirm a collection of *Syagrus graminifolia.* We circled the lake a few times but could not find this plant anywhere. Instead, we found a stand of *S. campestris* (?) growing in a savanna adjacent to the *Quartel Aeronautico* (Air Force Barracks). We counted about 48 trees with a trunk 1-2 m. tall, but the flowering period was over so only old inflorescences, fruits and leaves were collected.

We spent the next day pressing our plants at the University of Minas Gerais.



9. An extensive stand of *Attalea compta* (?), Serra do Palacio, Minas Gerais.

The Biology Department and herbarium is located in the new Faculdade de Filosofia building. The following day we drove to Ouro Preto, about 60 miles southeast of Belo Horizonte, to check on some records. Between the two cities the terrain is mountainous and the vegetation consists mainly of savanna, grassland and pasture. In places the vegetation has the aspect of Serra Cipó, but the only palms seen were scattered trees of *Acrocomia*, a tall *Syagrus* and *Arecastrum*. Ouro Preto ("black gold") is being preserved as a national shrine. The historical buildings, dating from colonial times, are now being restored. "Black gold" refers to iron ore which is mined throughout the area.

Our next big trip in Minas Gerais was to Diamantina, a delightful little town about 150 miles north of Belo Horizonte. The road to Sete Lagoas, with its vegetation mainly crop land and pasture, had many *Acrocomias* along the way, but only scattered specimens of a tall and a medium-sized species of *Syagrus*. For the next 30 miles or so only occasional clusters of *Acrocomia* and scattered *Syagrus* trees could be seen. In the vicinity of Paraopeba we found the same trunkless species of *Syagrus* as in Lavras. On the west side of the road, in a partly grazed grassland, only seven specimens were seen; but there were about 50 specimens with a much healthier appearance growing in

10. Trunkless species of *Attalea*, J. C. Gomes holding fruits, junction of highway leading to Brasilia and Curvelo, Minas Gerais.

a savanna on the other side of the road. This species was also found here and there (in groups of 25-50 specimens) in other pasture areas along the road. At the junction of the highways leading to Brasilia and Curvelo we saw about 30 plants of a trunkless species of *Attalea* with leaves 10 feet tall. About 12 miles farther up the road to Curvelo we approached some swampy land with 20 or more tall *Mauritia* trees growing there. This is part of the "Resfriado" association which can be identified by certain characteristic species including *Mauritia*. Not too far from here a small stand of *Acrocomia* and several *Syagrus oleracea* (?) were seen. On the Fazenda da Prata and other places along the road to Curvelo for the next 12 miles or so, the *Syagrus* of Lavras was frequent. An interesting observation was that some of the older specimens had trunks up to two feet high. Near Curvelo we noticed several specimens of the trunkless *Attalea* again in a pasture. The road from Curvelo to Diamantina (about 89 miles) was mostly unpaved, but it was fairly straight and not too hilly. The only place of any significance between the two towns is Gouvea, about two-thirds of the distance. There was a gas station, but unsatisfactory sleeping accommodations. From about 9 miles south of Diamantina to the outskirts of the city interrupted stands of *Allagoptera* and the *Syagrus* from Lavras (some with short trunks) were seen in pastures. On the rocky hills in the distance, *Syagrus glaucescens*, with a trunk 5-15 feet high, was common. Diamantina is the type locality of this species.

The beautiful town of Diamantina (about 15,000 population) is nestled in the mountains adjacent to Serra de Biribiry, about 1200 m. elevation. The streets are very narrow and cobblestoned, and the restaurants serve some of the best *churrasco* (charcoal broiled beefsteak) in Brazil. It has some fairly decent hotels, one of which is very modern and inexpensive. The name of the town is derived from diamonds and other precious gems which have been or still are being mined throughout the area. On the northern outskirts of town, several small stands of *Allagoptera* were seen in over-grazed savannas. In the foothills of Serra de Biribiry we collected some specimens of a trunkless *Syagrus* growing in a rocky savanna. It appeared to be *S. pleioclada*, previously found in Serra Cipó. Perhaps the most common palm throughout this mountain range, and in Serra do Gombo as well, is *Syagrus glaucescens*. Several hundred trees were seen growing only in rocky outcrops. We collected this plant in all stages of development, and no other palms were seen until we reached a distance of 14 miles northwest of Diamantina. In a secondary growth forest (*mata*) in the foothills of Serra do Gombo, we noticed a few trees of *Syagrus comosa* (in flower and fruit), about 40 feet tall. Other palms in the area were a trunkless *Attalea* and *Syagrus flexuosa* (?). With the exception of *Syagrus glaucescens*, the aspect of the vegetation around Diamantina appeared to be similar to that of Serra Cipó.

We returned to Belo Horizonte on July 17 to prepare our specimens and ship the dried ones back to São Paulo. At this point we had completed about one-half of our proposed itinerary. Careful plans had to be made for the trip to Vitoria, Espirito Santo. Although the distance between the two cities is only about 240 miles, there is no direct route. If I had known how bad the roads really were, I would have decided to fly to Vitoria instead. Most of the maps showed roads under various stages of construction so that travelling in that direction was more or less guesswork.

Being brave and adventurous souls we started out on a trip that soon proved to be disastrous. On July 20 we left for Vitoria by way of Ouro Preto. About 39 miles east of Belo Horizonte we noticed four very tall, narrow trunked *Syagrus* trees. Between Ouro Preto and Mariana, several *Arecastrum* trees were seen along the road. Between Mariana and Ponte Nova (distance of some 33 miles) occasional trees in genera *Acrocomia, Arecastrum, Attalea* and *Euterpe* were seen. Because of a detour we had to proceed back in a northerly direction to Nova Era on a bumpy, unpaved road for about 48 miles. *Arecastrum* was frequent, *Euterpe* was occasional and a few tall *Syagrus* trees were seen. That night we slept in Fabriciano in a brand new hotel which was very inexpensive, some 30 miles to the northwest of Nova Era. Several stands of *Acrocomia* were seen along the way. Because of numerous detours we had been travelling in a zigzag fashion and surely had gone at least 120 miles out of the way. The worst stretch of road that we encountered was between Fabriciano and Manhuaçu, a distance of only about 60 miles on the map, but it took

11. J. C. Gomes holding inflorescence and infructescence of *Syagrus comosa* collected in secondary growth forest, Serra do Gombo, Minas Gerais.

us about 10 hours to get there. I dubbed this the "Oregon Trail" because it reminded me of some of the cattle trails that are shown in cowboy movies. Even though I was badly shaken up from this nightmare, I managed to record some of the palms seen on the way; stands of a trunkless *Attalea,* a medium-sized *Attalea* and stands of *Euterpe* were common on the hillsides and in some of the valleys; and scattered *Arecastrum* trees were seen here and there. That evening we decided to drive on to Iuna, Espirito Santo, which is roughly one-third of the distance to Vitoria. Incidentally, some of the highest mountains in Brazil are found in this particular region. We slept in Iuna and the following morning we started out for Vitoria. It was a clear, beautiful day with the temperature in the 70's; and although the road was hilly and somewhat winding, it was dry and passable. Our spirits were high because we knew that in four or five hours we would reach our destination. We never made it because at one point we ap-

12. J. C. Gomes holding leaves of same *Syagrus comosa.*

proached a steep, sharp curve in the road and before we knew it the car went sailing over a 50-foot cliff. As the Jeep tumbled down the hillside, I was thrown out the side door before it finally struck a rock and came to a stop. Gomes got the full impact of the crash. He struck his head on the windshield and was killed instantly. It was tragic that the trip should end this way because we had been over roads far more dangerous for driving and still managed to survive. I was much more fortunate, escaping with an assortment of nasty cuts and bruises. After four days in a hospital at Iuna, I negotiated a ride to Vitoria where I made plane connections to Rio and then to the United States.

It is with deep sadness that I conclude this article. Mr. Gomes was a fine gentleman and field companion. His death puts an extremely high price on collecting palms.

A Potting Mixture for Palms

Russell C. Mott

Experimentalist, Department of Floriculture and Ornamental Horticulture, Cornell University, Ithaca, N. Y.

Research carried on at Cornell University in the Department of Floriculture and Ornamental Horiculture and Department of Vegetable Crops by James W. Boodley and Raymond Sheldrake, Jr. has been concerned with artificial soil mixtures for commercial plant growing. A modification of the so-called Peat-Lite mixes has been developed for general potting of aroids, begonias, ferns, gesneriads, and many other species of plants now growing in the tropical greenhouses at Cornell, as well as palms which are grown in clay pots and redwood tubs and are maintained under glass throughout the year at a night temperature of 65° F. The results of using this mixture for palms have been very encouraging and are thought worth reporting in Principes. This information is not based on data derived directly from experiments with palms but rather from observation and experience.

The components of the potting mixture were selected because they are readily available, are uniform in composition, and because they have certain physical and chemical characteristics that are important to the growth of plants. German or Canadian sphagnum peat moss is preferred to the domestic peat mosses which frequently contain large quantities of nutrients or other material in unknown amounts and are usually too decomposed to provide the necessary structural and water-drainage properties. No substitution of different types of nutrients or other materials should be made.

Vermiculite is a micaceous material that has been heated to 1400° F. and the horticultural rather than the insulation grade of Vermiculite No. 2 should be used. It has a relatively high cation exchange which means it can hold nutrients in reserve and release them. The nutrients and water are held within the plate-like structure of the particles. Vermiculite also has good buffering characteristics that resist rapid change in pH. The material contains a certain amount of potassium and magnesium that is available for the growth of plants as well as a small amount of calcium.

Perlite is a form of volcanic rock that has been expanded by heating to 1800° F. It is sterile, has a pH of 7.0-7.5 and weighs six to nine pounds per cubic foot. This material contains no mineral nutrients and, unlike vermiculite, has neither cation exchange capacity nor buffering capacity. It does not decay or deteriorate but does hold water on its irregular surface areas.

The modified Peat-Lite Mix used as a medium for culture of palms contains the following:

Shredded German or Canadian Sphagnum peat moss (½ inch mesh screen)	4 bu.
Vermiculite No. 2	2 bu.
Perlite	2 bu.
12-12-12 Fertilizer	1 lb.
20 per cent superphosphate (powdered)	¾ lb.
Dolomitic limestone	2 lb.
Iron sulphate	¼ lb.
Fritted Trace Elements*	5.6 gm.

*Fritted Trace Elements contain the following: Manganese — 7.5 per cent as Mn; Iron — 18 per cent as Fe; Copper — 3 per cent as Cu; Zinc — 7 per cent as Zn; Boron — 3 per cent as B; Molybdenum — 0.2 per cent as Mo.

To prepare, first mix the peat moss, Vermiculite and Perlite thoroughly. Then weigh the quantities of fertilizer elements. The small quantity of trace elements, when weighed, may be mixed with the superphosphate. Finally, all ingredients are very thoroughly mixed and moistened with tap water. Enough water should be added to provide potting moisture consistency.

Since the components are considered sterile, it is expedient to store the mix in polyethelene bags or a closed container for future use. To further safeguard a clean mix, it is advisable to mix on a clean surface, preferably sterilized with a disinfectant such as LF-10 or chlorox solution.

Applications of fertilizer should commence about a month after repotting. Weekly applications of 20-20-20 fertilizer and potassium nitrate alternately are made throughout the year at one-half the normal dosage or four ounces in 25 gallons of water.

The following palms are growing in the modified mixture at the present time: *Areca* sp.; *Brahea* sp.; *Carpentaria acuminata; Caryota urens; Chamaedorea alternans, C. cataractarum, C. elegans, C. Ernesti-Augusti, C. erumpens, C. geonomaeformis, C. metallica, C. microspadix, C. oblongata, C. Seifrizii; Geonoma* sp; *Livistona chinensis, L. Mariae; Phoenix canariensis, P. pusilla; Phytelephas macrocarpa; Rhapidophyllum hystrix; Ravenea Hildebrandtii.*

And though . . . a Contemplative Person . . . had onely the Palm or the Cocco, which furnishes a great part of the World with all that even a Voluptuous Man can need, or almost desire, it were sufficient to employ his Meditations and his Hands, as long as he had to live, though his years were as many as the most aged oak. John Evelyn's *Sylva.* 1664.

Fossil Palms

JOSEPH A. TUTA, M. D.

Living palms are familiar plants to all who grow them and are a characteristic feature of many parts of the tropics. That palms have a long history in time is not always recognized. It is the object of this article to illustrate some of the fossil palms found in the United States, correlating structure of stems, roots, and leaves with those seen in living palms, the anatomy of which has been reviewed and evaluated by Tomlinson in his volume on Palmae in Anatomy of the Monocotyledons (1).

Palms first definitely appeared in the Upper Cretaceous rocks, some 63-90 million years ago by the geologic time scale of Kulp (2). A fossil which has been called *Palmoxylon cliffwoodensis* dating from that period has been found in the Magothy formation of New Jersey where today no palm lives (3). Delevoryas (4, p. 173) mentions that palm-like leaf impressions from France (the *Propalmophyllum* of Lignier) were reported in 1907 as dating from the Jurassic period (135-181 million years ago). If truly a palm, this stands as evidence for the presence of flowering plants at that early date. However, going back still further, the discovery of a palm-like leaf imprint in sandstone was reported and illustrated in color by Ladd and Brown (5) and by Brown (6) from the Triassic period (181-230 million years ago). This ancient fossil leaf was found by Dr. G. Edward Lewis near Placerville, Colorado, in the vicinity of the San Miguel River. Several months later, Dr. Brown and Dr. Lewis explored the area where the first imprint had been found. Six more imprints were uncovered and taken back to the Smithsonian Institution. Delevoryas (4, p. 172) mentions that the discovery was "one of the most significant finds in recent times" although with incomplete evidence it should be classified only as palm-like. Ladd and Brown also illustrated in color the cross-section of a fossil palm trunk of a later era found on Antigua in the West Indies. It has a light yellow-brown color similar to much of the fossil palm wood found in Southern California.

Arnold (7, p. 341) places most of the fossil palms in North America along with rocks of the Eocene epoch (36-58 million years ago). There was a shifting or migration of palms southward due to climatic changes at the end of the Eocene which continued into the Pliocene (1-13 million years ago). Thus the occurrence of palms in the fossil record has served more or less as an indicator of the prevailing climate of the past. Noé (8), La Motte (9) and Mahabalé (10) give many references on fossil palms.

There are several important areas from which material of fossil palms has been obtained. One of the most famous is the extensive region along the coastal plain of the United States bordering the Gulf of Mexico, where rocks containing what is known as the Wilcox flora were laid down in lower Eocene times. These beds contained many fossils including *Chamaedorea*-like species. At about the same time, the Raton flora existed in northern New Mexico and southern Colorado. Knowlton (11, p. 180) includes a photograph of a leaf impression of a *Sabal*-like palm from this flora. From a succeeding middle Eocene flora, the Claiborne which extended from Alabama to Texas, Berry (12, p. 51) described several palms based on leaf structure—one suggestive of *Thrinax,* and two feather-leaved species called *Bactrites* and *Geonomites* from their resemblance to modern *Bactris* and *Geonoma.* Still later in time, from the upper Eocene Jackson flora of Texas, fossil fruits of a date-like palm were found. Chaney (13, p. 11) published a photograph of a large bed composed of layers of fossil palm leaves from the Clarno shale of Oregon, also of Eocene age. Most of

GEOLOGIC TIME SCALE

after Kulp (2) and others

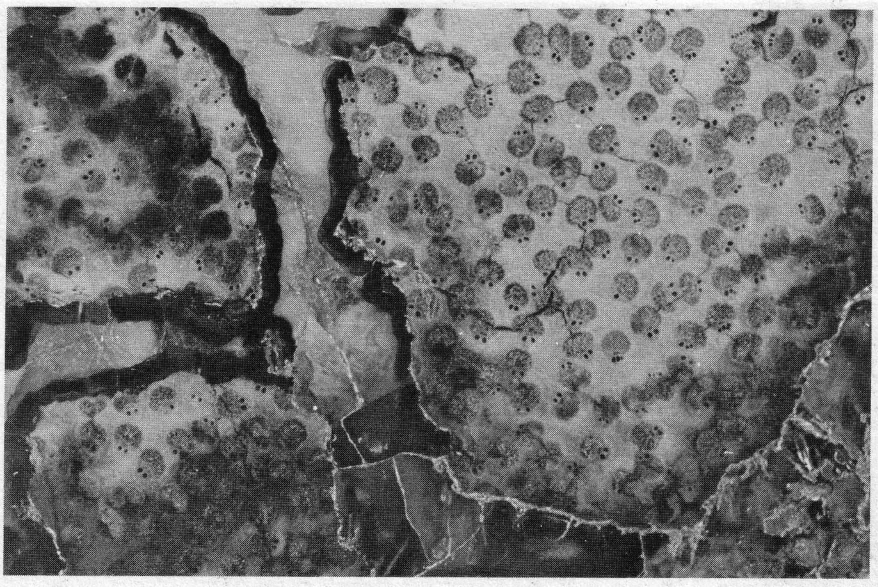
ERA		PERIOD	MILLIONS OF YEARS: BEGINNING & END OF PERIOD	MILLIONS OF YEARS: DURATION	POSITION OF FOSSIL PALMS IN GEOLOGIC TIME SCALE *PALMS IN AUTHOR'S COLLECTION
CENOZOIC	QUATERNARY	RECENT	0 - 0.01 (10,000 yrs)	0.01	
		PLEISTOCENE	0.01 - 1.0±	1	VERO, FLORIDA
	TERTIARY	PLIOCENE upper lower	1 - 13	12	*RICARDO BEDS (LAST CHANCE CANYON) CALIFORNIA COPIAH COUNTY, MISSISSIPPI *ROSAMOND, CALIF. (NEAR MOHAVE)
		MIOCENE upper middle lower	13 - 25	12	JAPAN (TERTIARY) EPOCH NOT KNOWN *BARSTOW BEDS (MULE CANYON) CALIF. *TEHACHAPI, CALIF. (HORSE CANYON) *LAGRANGE, FAYETTE COUNTY, TEXAS
		OLIGOCENE	25 - 36	11	ANTIGUA, WEST INDIES ? OLIGOCENE SUB-DIVISION NOT KNOWN
		EOCENE	36 - 58	22	*FARSON, WYOMING (EDEN-VALLEY) *NEPHI, UTAH *SIERRA COUNTY, NEW MEXICO
		upper	36 - 45	9	CLARNO, OREGON, FOSSIL LEAVES JACKSON-FLORA - GULF COAST REGION BRAZOS CO. TEXAS. NIPA-LIKE FRUITS
		middle	45 - 52	7	CLAIBORNE-FLORA - GULF COAST REGION
		lower	52 - 58	6	RATON-FLORA NORTHERN NEW MEXICO WILCOX FLORA GULF COAST REGION NIPA-LIKE FRUITS GRANADA CO. MISS.
		PALEOCENE	57 - 63	5	*NORTH CAROLINA BRAZIL. NIPA-LIKE FOSSIL FRUITS
MESOZOIC		CRETACEOUS upper lower	63 - 90 90 - 135	27 45	FOSSIL PALMS FIRST APPEAR IN UPPER CRET. PERIOD (MAGOTHY FORMATION) N.J. TURONIAN OF FRANCE
		JURASSIC	135 - 181	46	PALM-LIKE LEAF IMPRINTS PROPALMOPHYLLUM OF LIGNIER (FRANCE)
		TRIASSIC	181 - 230	49	PALM-LIKE LEAF IMPRINTS (COLORADO)
PALEOZOIC		PERMIAN	230 - 280	50	NO EVIDENCE OF PALMS OR PALM-LIKE STRUCTURES BELOW THE TRIASSIC PERIOD
		PENNSYLVANIAN	280 - 320	40	
		MISSISSIPPIAN	320 - 345	25	
		DEVONIAN	345 - 405	60	
		SILURIAN	405 - 425	20	
		ORDOVICIAN	425 - 500	75	
		CAMBRIAN	500 - 600	100	
PRECAMBRIAN		INCLUDES THE OLDEST BASEMENT ROCKS FROM THE TIME OF ORIGIN OF THE EARTH UP TO THE LOWER CAMBRIAN PERIOD	600 - 3600+	3000+	

the fossil palms of Wyoming occur in rocks of the same age.

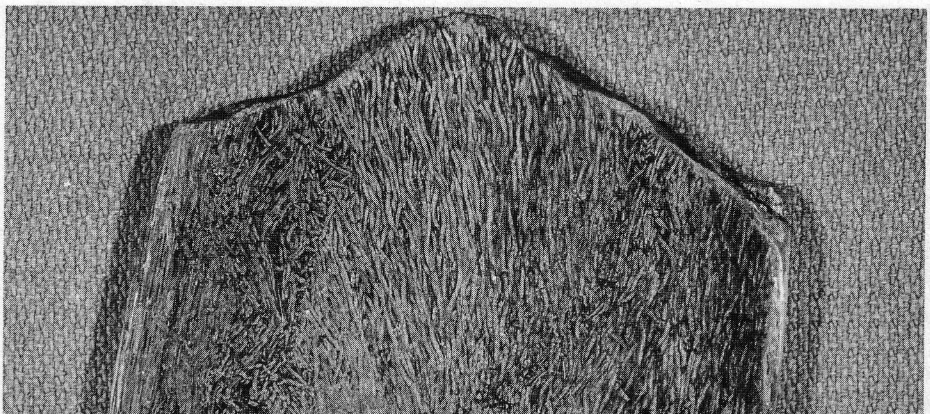
Fossil palms in Texas are found in rocks from both the Miocene and Eocene epochs, those from Fayette County being of Miocene age. In California, the Tehachapi flora of the present western Mohave Desert region was laid down in the Middle Miocene (about 18 million years ago) while the Barstow beds, which include the Mule Canyon area north of Yermo, are of upper Miocene age (15 million years ago) and the Ricardo beds of Southern California, which occur in the Last Chance Canyon area, are of lower Pliocene age. Axelrod (14) described fossil palms of Pliocene age from Palmdale, California. An imprint of a *Sabal*-like leaf with a costapalmate blade was revealed during the process of road building near Castaic in Los Angeles County and is illustrated by Hertrich (15, p. 4). From Japan on the islands of Hokkaido and Kyushu, Kryshtofovich (16) has described *Sabal*-like palm leaf impressions. In Europe, during the Eocene epoch, *Sabal*-like palms grew in England, France and southern Russia and also appear in the Pliocene rocks of the Rhone Valley. Eocene beds of England occur in two separate basins, the Hampshire and the London. Fossil fruits of the tropical palm *Nypa* (*Nipa*) have been found in the old delta mud or clay which lies below London. It is also exposed in the cliffs of eastern Kent County and the Isle of Sheppey located at the mouth of the Thames River. Reid and Chandler (17) and Chandler (18) have made extensive studies on the flora of the London clay in which fossil *Nypa* structures have been found. Geologically this important palm has existed since the Cretaceous period. At the present time *Nypa* is restricted to parts of southeast Asia and some of the South Pacific Islands. Fossil *Nypa* fruits of Eocene age have also been found in Belgium, Borneo, France, India and Russia. Some of these structures have also been found in beds of Miocene age in India. Fossil pollen grains have been reported from Borneo in beds of Cretaceous age. In the United States *Nypa*-like fossil fruits have been found (Berry 19, p. 176) in the Wilcox (Eocene) flora, Granada formation, Granada County, Mississippi. From Texas Berry (12, p. 150) reported similar fruits found in the Eocene Fayette formation near Wellborn, Brazos County. Also from the Paleocene of Brazil, fossil fruits of *Nypa* have been reported by Dolianiti (20) in 1955. These structures can drift for long distances with the ocean currents. The oceanic paths of migration are discussed by Corner (21, pp. 249-252). He also suggests the possibility that the *Nypa*-like fruits found in southern U.S.A. may be from tropical American palms other than *Nypa*.

One of the most informative descriptions of how plants became fossils is given by Arnold (7, p. 14-40). Compressions, casts and petrifications (permineralization) are the most important methods by which fossilization is effected. Of the monocotyledonous plant forms, the petrified (silicified) palms are among the best preserved. Many factors are involved in the petrification process. One important factor for setting the stage for petrification is the rapid submergence of the trunk and roots in a body of water where oxygen is absent. Another important factor is deposition in the water of finely divided sediments such as clay, mud, sand and volcanic ash.

The complex petrification process has been studied by Arnold (22), Darrah (23) and Barghoorn (24, 25). They have produced much evidence indicating that the fundamental basic process

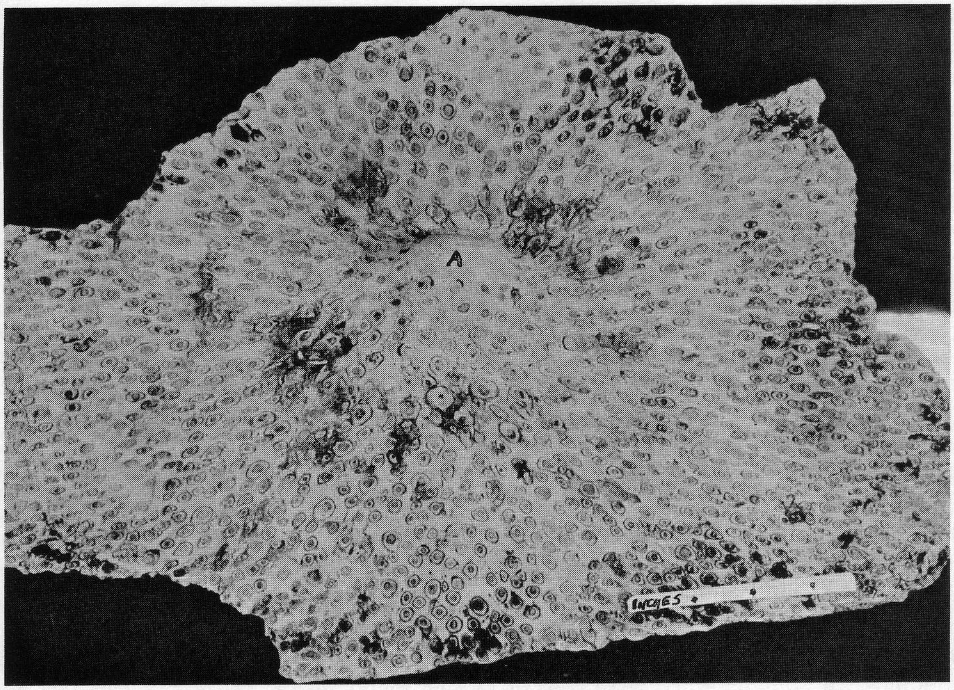


1. Fossil palm, Tehachapi, Kern Co., Calif. Photograph enlarged 3×. Two xylem vessels, occasionally three, in each vascular bundle stand out like ink dots. With the use of a 4× or 10× lens some bundles show groups of phloem structures between the xylem vessels and the large fibrous bundle sheath "cap", also agatized septa dividing the palm structure into islands.



2. Fossil palm, Horse Canyon, Kern Co. California. Longitudinal section showing the intricate interwoven appearance of the vascular bundles.

is chiefly one of infiltration, rather than the "molecule by molecule" replacement of the plant structure by mineral substances. The nature of the process can be shown in preparations using a highly carbonaceous black Wyoming



3. Fossil root mass, Mule Canyon, Yermo, California. The central area at (A) devoid of root structures, has typical vascular bundles and represents the lowermost portion of the stem. The opposite or upper side of the specimen shows stem structure with vascular bundles and a narrow rim showing roots.

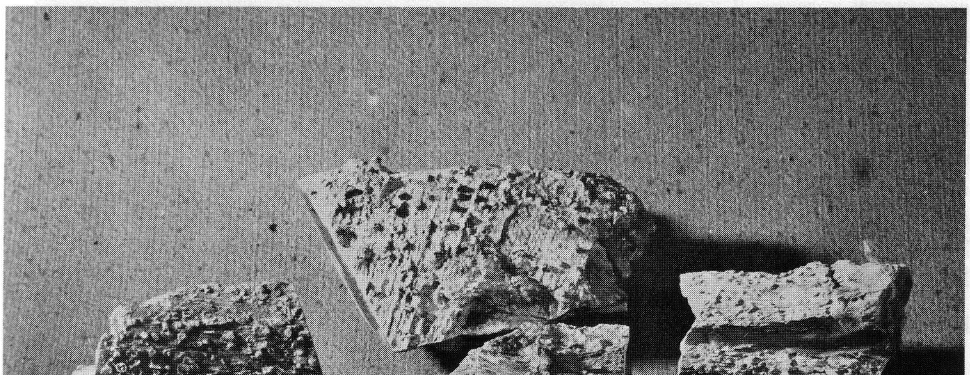
fossil palm. Microtome sections and "peel" preparations were made following the techniques described by Darrah (26), Joy, Willis and Lacey (27) and Kummel and Raup (28). The silica was removed with hydrofluoric acid, leaving a residual organic carbonaceous framework which outlines the cellular pattern of the fossil structure. This material represents the degradation products of cellulose, hemi-cellulose and lignin, of which the original woody structure of the plant cell walls is chiefly composed. The complex structure of lignin has recently been reviewed by Brown (29). Figures 15 and 16 compare the peel preparation with a standard thin section, both methods showing a similar carbonaceous framework.

Collecting Fossils

Apart from providing material for the study of detailed structure, one of the incentives for collecting petrified wood (chiefly stems and roots) is the wide variation in color and pattern in the polished sections. Most palm wood is a yellow brown, some is multicolored with red, black, green and blue, in fact every imaginable color combination. In general, however, palm woods are not as colorful as the diffusely agatized silicified *Araucarioxylon arizonicum* of the Petrified Forest National Monument of Arizona, or the Utah Cycadeoids. Certain of the fossil palms show exceptionally well preserved vascular bundle and ground tissue. Naumann (30) has described the variation in color found in palm wood from Fayette County, Texas, and especially has given a detailed account of searching for fossil palms in that region.

Only a few specimens have been il-

4. Semi-cast of black Wyoming fossil palm shows trunk rings (leaf base scars) in the surface layers of the stem, also vertical fissures in the spaces between the rings. The interior consists of sandstone and black areas containing crystallized and carbonaceous remnants of the vascular bundles and ground tissue.



5. Wyoming fossil palm with spiny stems shows numerous bases of spines which had been broken off close to the stem either before or after petrification. At (A) the stem structure had been disrupted by some severe mechanical force before petrification had taken place.

lustrated in this article to demonstrate the variety of fossils one may encounter. Choice specimens are not easy to find today since most material near the surface has already been taken by private collectors. Most of the material has been collected in Southern California, Utah and Wyoming. Other locations from which fossil palm specimens have been obtained are Arizona, Baja California (Mexico), Louisiana, Mississippi, southern Nevada, North Carolina, southwest Oklahoma and Texas. The Arizona fossil wood came from a mine 50 miles north of Wickenburg, and contained visible yellow areas of radioactive material, probably carnotite. The specimens from Searchlight, Nevada have been thought by some to be petrified Joshua Tree. Wyoming has furnished the greatest variety of fossil palm material, most of it being in rocks of Eocene age from the Eden Valley area near Farson, Wyoming. The material includes stems with bark-like outer structures showing leaf base rings and longitudinal fissures, adventitious roots, branch-like structures, cane-like stems, spiny stems, underground root masses and specimens which are suggestive of damage by insects and fungi. Some examples of these structures follow.

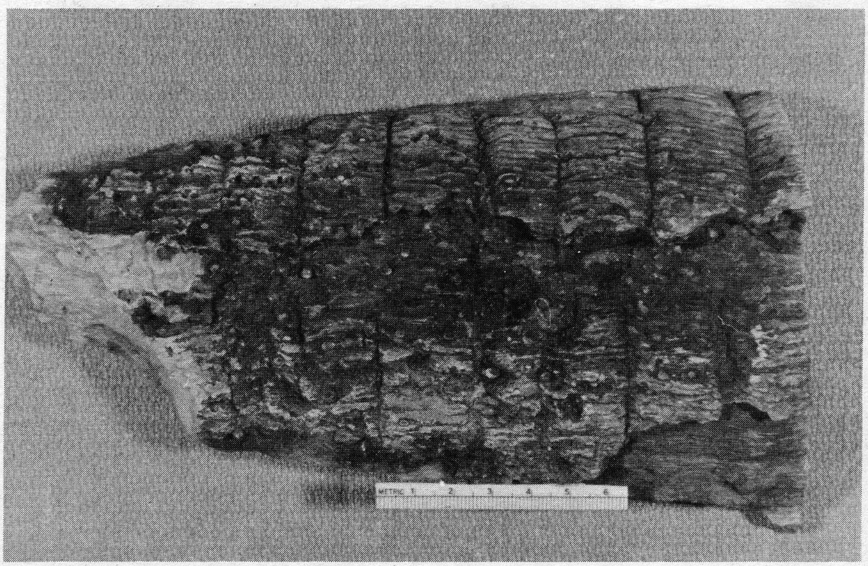
Fossil Palms with Adventitious Roots

Some of the Wyoming stems show an overlying layer of adventitious roots up to 1½ inches in thickness (Fig. 7). The outer surface of the adventitious root mass is covered with a bark-like layer up to 0.15 inches in thickness. In the outer layer, some specimens show well-defined rings of leaf scar origin. It is interesting that this outermost layer covering a thick layer of roots resembles closely the bark-like outer surface layers of many of the Wyoming specimens which do not have adventitious roots. The junction of the inner surface of the adventitious root mass and the cortex of the stem shows some of the roots lying at right angles to the cortex and entering the ground tissue for a distance of about a millimeter. In two specimens the adventitious roots were unequally distributed, some areas having a layer of matted roots up to 1 inch in thickness, whereas on adjacent areas of the same specimen, the roots do not form a thick layer but show single closely spaced short spine-like structures perpendicular to the stem. In some places, two or three of these spines are conjoined and capped by a bark-like silicified structure. The spines show a root structure and their appearance is somewhat suggestive of the root-spines seen on stems of living *Cryosophila.*

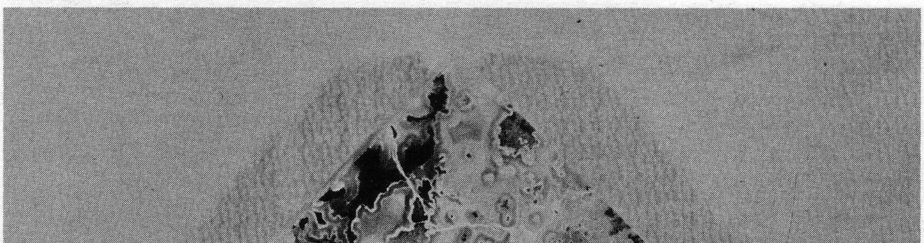
Cane-like Stems

Many fossil palm stems are thick but some are slender and cane-like, resembling those of such modern genera as *Chrysalidocarpus* or *Geonoma.* In Wyoming, cane-like fossils are found in a small valley about one mile across at its greatest width in Sublette Co., near the Big Sandy Reservoir north of the town of Farson. The floor of the valley is covered with sage brush and surrounded by rolling hills about 300 feet high. The matrix which held some of the stems appears to be composed chiefly of limestone which dissolves in hydrochloric acid leaving a small silicate residue soluble in hydrofluoric acid. Most of the cane-like specimens are found free from their matrix.

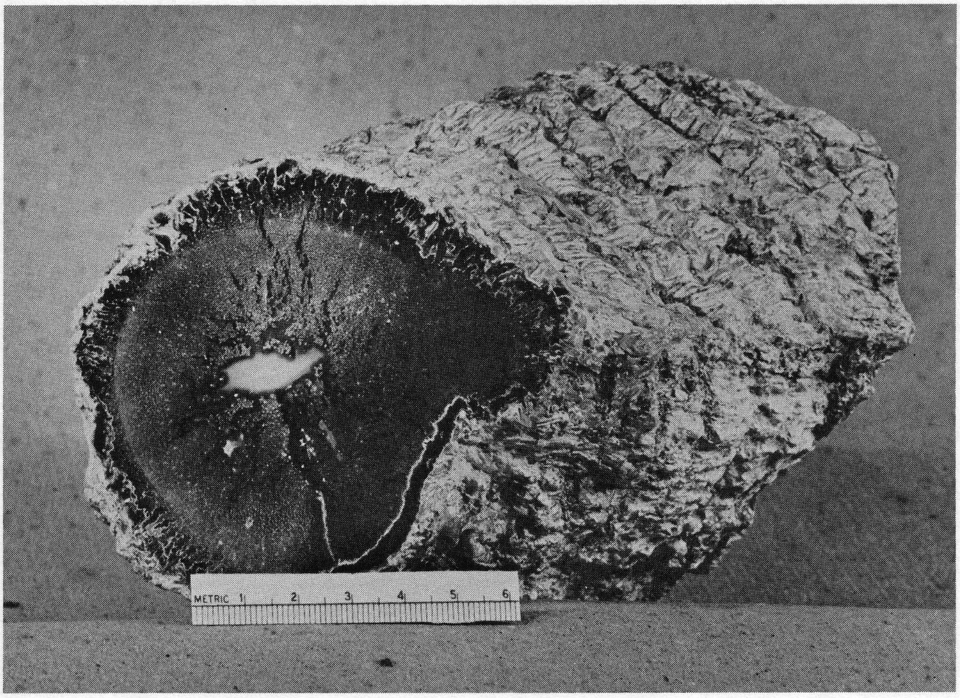
One of the external molds where the stem had fallen out of the matrix shows plainly the outlines of rings (leaf base scars) on the trunk (Fig. 10). A few specimens are black due to a high content of carbonaceous material. The stems are mostly short sections though some are up to 12 inches in length and



6. Wyoming fossil palm with spiny stems shows numerous short spines scattered throughout the spaces between the trunk rings.



7. Wyoming fossil palm with thick zone of adventitious roots. (A) cortical zone of stem. (B) central zone of stem agatized in a variegated fashion. (C) zone of adventitious roots. (D) deposits of fossil algae.



8. Wyoming black fossil palm with central area of white agate formation. The stem is covered by a thick layer of adventitious roots, also an overlying bark-like surface layer showing trunk rings. The spaces between the rings show a gray to white surface layer marked by roughly parallel vertical fissures.

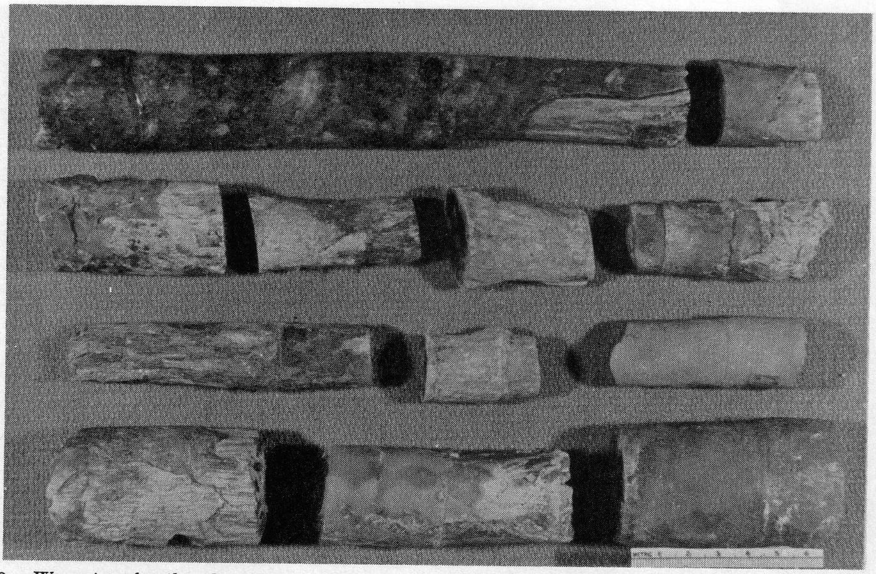
1½ inches in diameter. An occasional stem with attached roots has been found When the ends are polished some of them show glistening quartz crystals lining cavities; others have jet black areas and foci of blue agate. The broken ends are roughly perpendicular to the long axis. Why they break up or fracture in this particular manner is not easily explained. Visitors have asked this question of the park naturalists in the Petrified Forest National Monument of Arizona (31). They see the huge petrified logs with the ends looking as though they had been sawed by man, instead of having been broken by the mechanical forces of nature. One explanation given is that shock waves caused by earthquakes initiate rhythmic vibrations which caused more or less regularly spaced breaking up of the trunks.

Spiny Stems

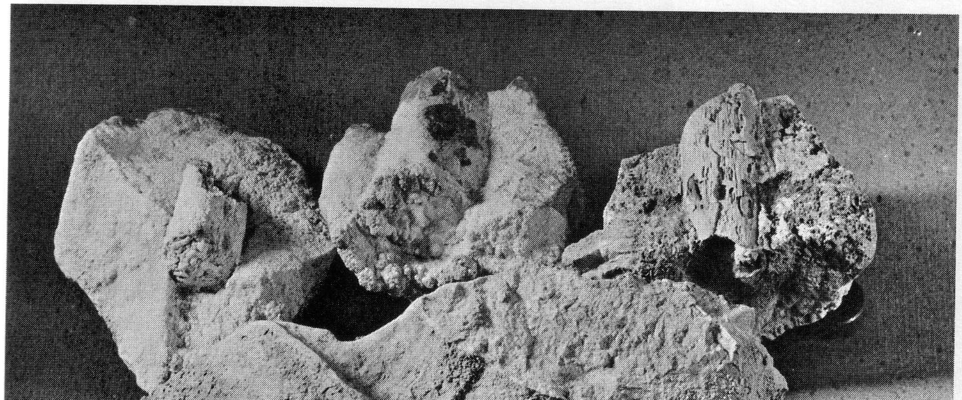
Several examples of stems with spiny structures are found among Wyoming fossil palms. The spines have been broken off close to the stem due to mechanical forces which occurred before or after the process of petrification had taken place. Only scars of the bases of the spines or short stumps remain. The spines are scattered diffusely throughout the internodes between the trunk rings (Fig. 6) without a definite distribution pattern, except in one specimen where the spines were lined up in a more or less parallel fashion. No fossil palms were found where the spines were lined up along the leaf scar rings.

Damage from Insects and Fungi

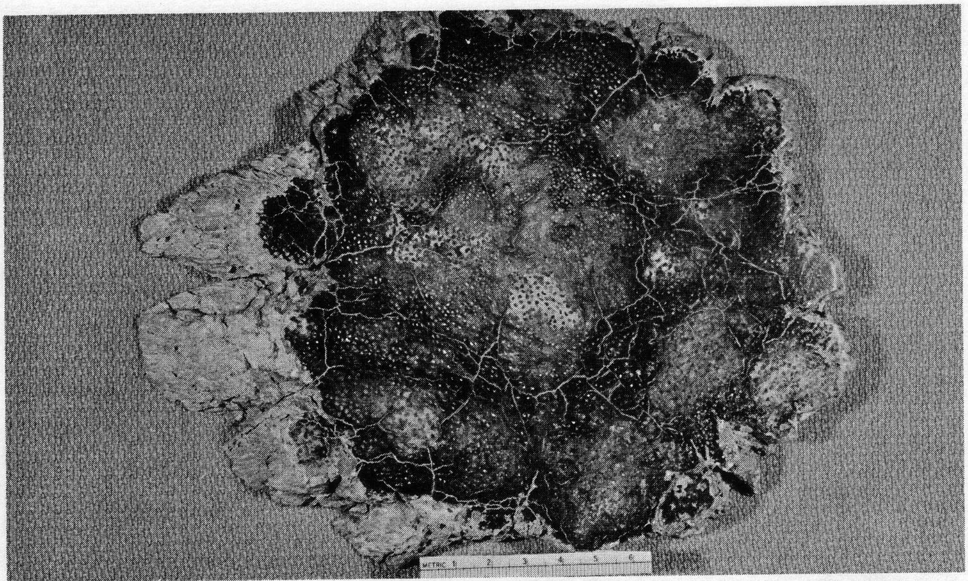
A distorted specimen of fossil palm



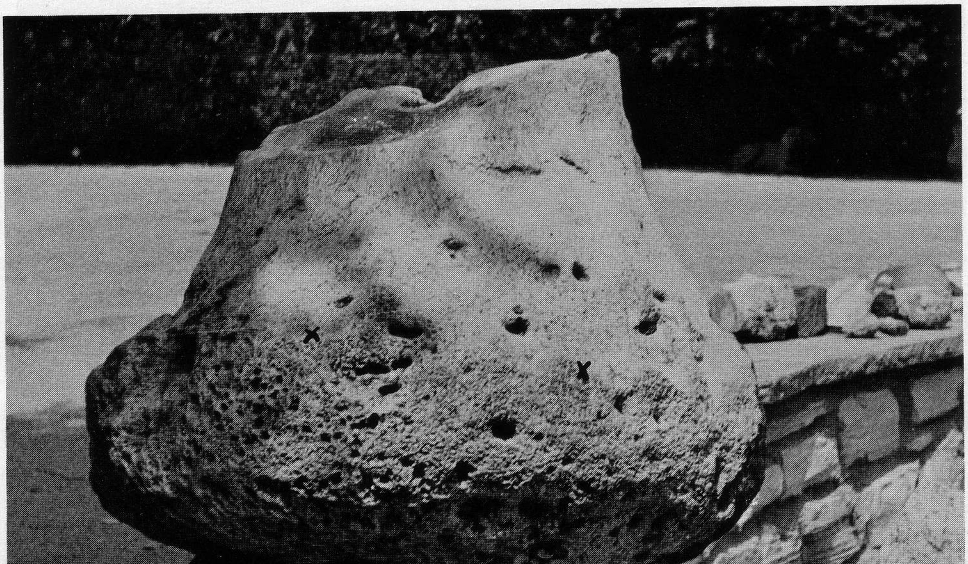
9. Wyoming fossil palms with cane-like stems. The spaces between the trunk rings vary from 2-10 cm. in length. The surface layers have partially disappeared in most of the specimens probably due to weathering.



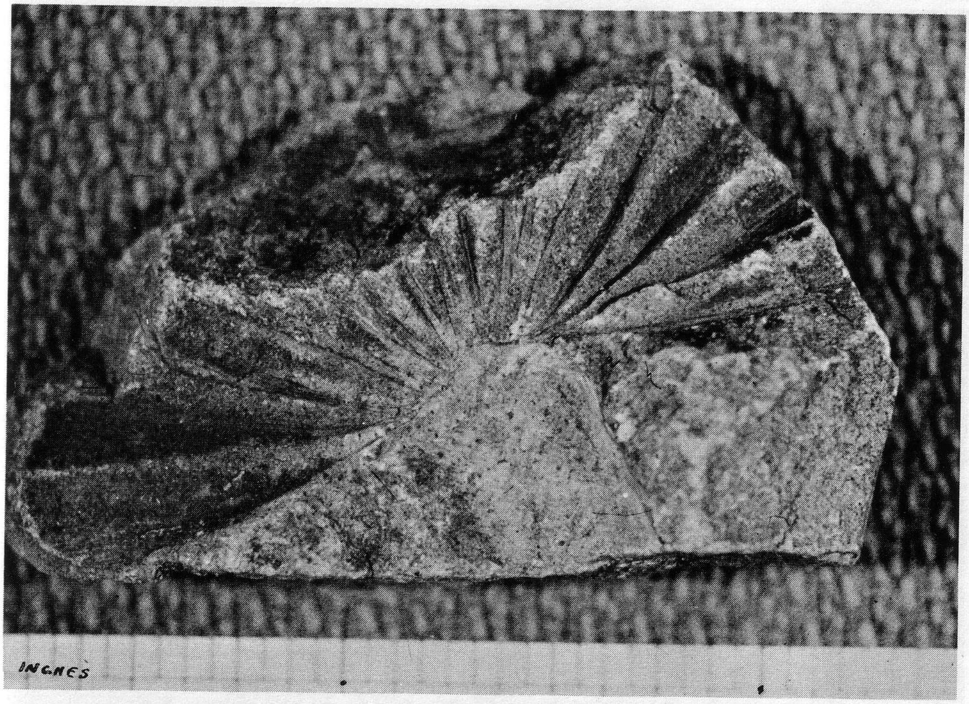
10. Segments of cane-like Wyoming palms. Photograph reduced 60%. The upper specimens represent cane-like stems embedded in a lime-stone matrix. The lower specimen without the stem shows an external mold with trunk ring markings.



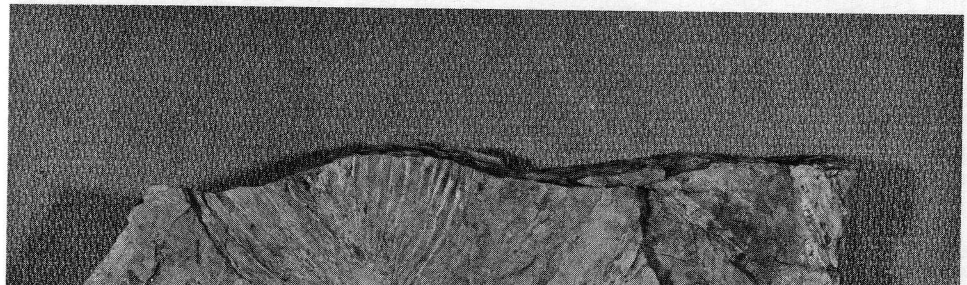
11. Distorted fossil palm (diameter of stem 18 cm.), Mule Canyon, Yermo, Calif. Polished cross-section showing a diffusely mottled gray surface with a few areas having recognizable vascular bundles. In the area to the left are several tiny holes suggestive of beetle borings before petrification. Peel preparations and thin sections show evidence of fungus involvement.



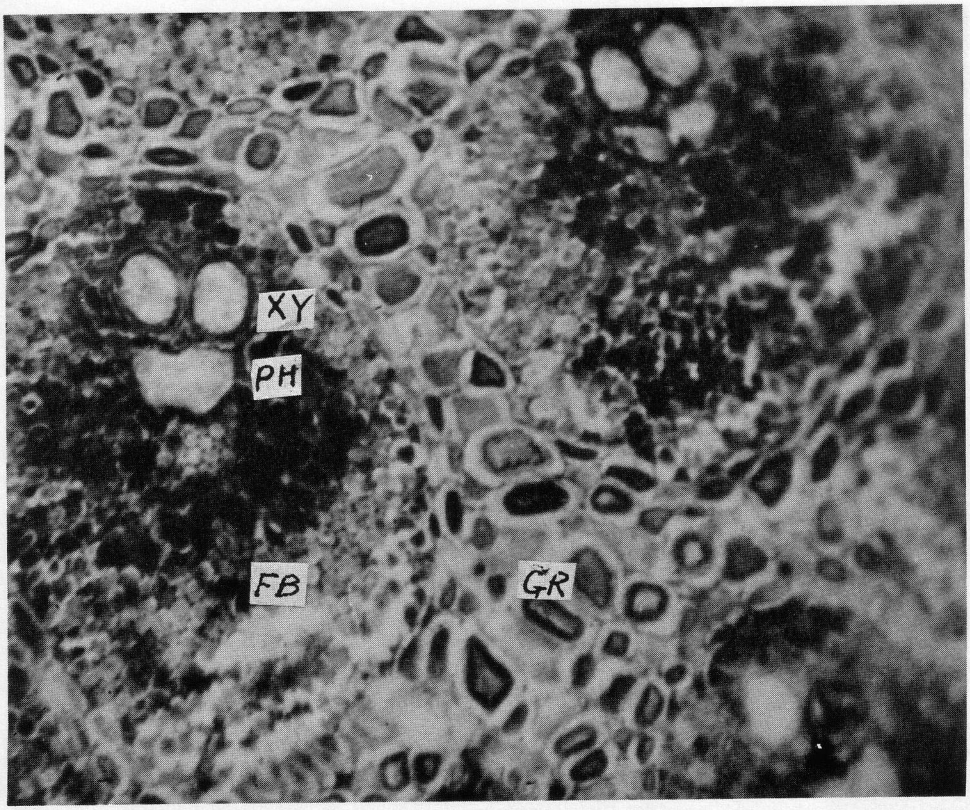
12. Fossil palm stump from LaGrange, Texas. Junction of lower end of trunk (X) and root mass, measuring 22 × 18 × 17 inches and weighing 230 lbs.



13. Fossil palm leaf imprint. Horse Canyon, Kern Co., Calif. Enlarged 2×.



14. Fossil palm leaf imprint, Horse Canyon, Kern Co., Calif. There is a continuation of the petiole as a rib extending into the blade (costapalmate). In the petiole with its rib extension, there is an area which is unfortunately missing.



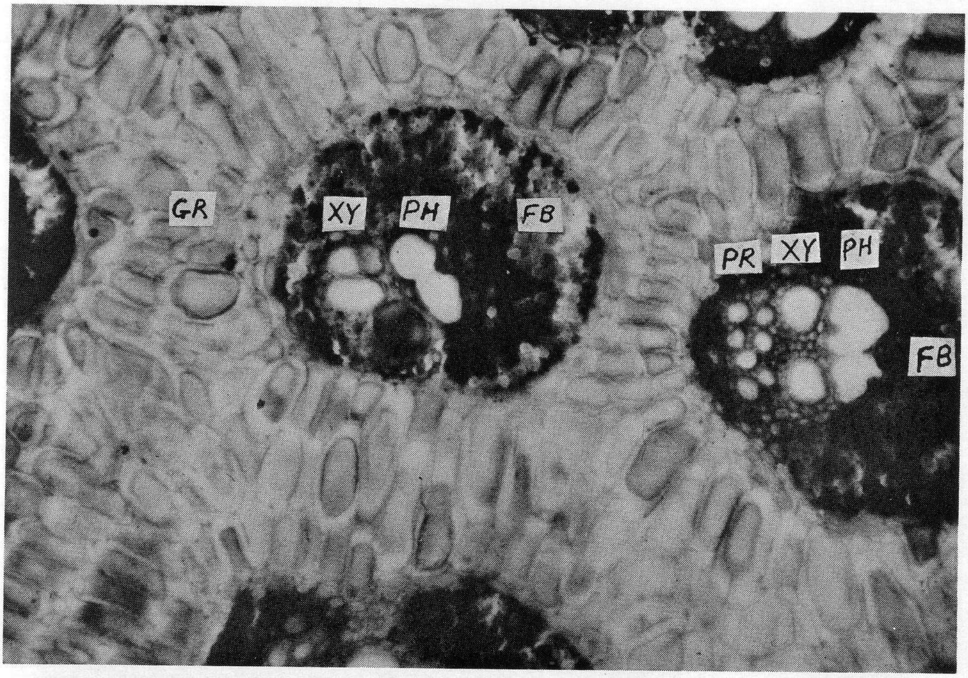
15. Black Wyoming fossil palm (diameter of stem 2.5 cm.). Photomicrograph of peel preparation, magnification 30×, enlarged 2.5×.

(Fig. 11) from Mule Canyon north of Yermo, California is of interest in that cellulose-acetate peel preparations showed filament-like structures suggestive of fungal involvement. Also on the surface of one end of the same specimen are several small superficial borings possibly due to insect damage. These might conceivably have served as the point of entry for fungi, but there is no way to prove such a relationship.

Several thin sections (30 microns thick) were made from the mottled gray areas of the specimen shown in Fig. 11. Most of these thin sections show filament-like structures. Areas are also seen containing several concentric lamellar bodies which with ordinary light show filament-like structures occupying segments of the circumference of some of the lamellae. They are not visible with polarized light. Also scattered throughout some of the micro-crystalline material are single or clumped filament-like structures. Fine fracture lines are observed in the micro-crystalline material. A thin section from this specimen was sent to Dr. E. S. Barghoorn of Harvard University who agreed that the filamentous structures were of fungal origin. Stevens (31) has reported finding fungal hyphae in the central cylinder and roots of a fossil palm coming from the upper Cretaceous, Monmouth formation, Sea Bright, New Jersey.

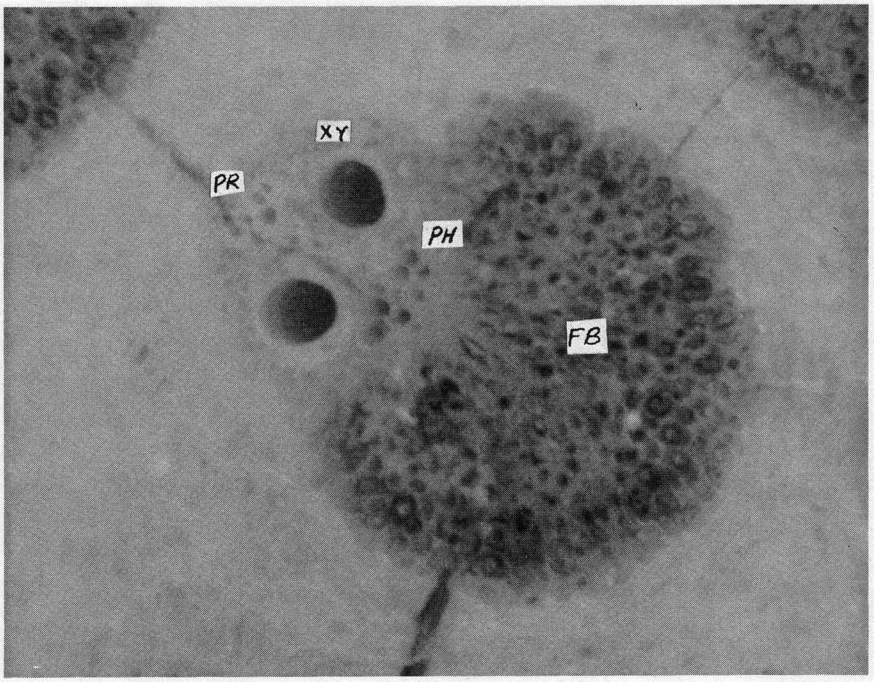
Acknowledgements

This project could not have been



16. Photomicrograph of thin section from same palm as 15, magnification 30×, enlarged 2.5×. PH-phloem. XY-xylem vessels. FB-fibrous bundle sheath or "cap". PR-protoxylem. GR-lacunae in ground tissue.

carried out without the help of interested friends who gave of their time and experience and valuable specimen material. I am indebted to Dr. Chester A. Arnold, Professor of Paleobotany at the University of Michigan for his generous help in identifying many fossil plants from the western states. Dr. E. S. Barghoorn kindly examined one of the fossil palm specimens for fungal involvement. Mr. and Mrs. Samuel E. Kirkby of Riverside, California have been generous in making their private collection of plant fossils available for study, and also for giving expert advice on fossil material. Dr. H. H. Dibbern, Dr. M. Itano and Dr. J. W. Reynolds, associates in the Dept. and Pathology, Memorial Hospital of Long Beach, Calif. and Dr. Ruth Russell of the Long Beach State College have helped with much of the photographic work. Miss Francis Ishii and Mrs. Jackie Young, hospital librarians, obtained references through the inter-library loan arrangement. Mr. and Mrs. Leo D. Berner of Glendora, Calif. and Mr. and Mrs. J. D. Rittenhouse of Azusa, Calif. have beautiful and valuable collections of petrified material which I have had the opportunity to study. Mr. and Mrs. Harry F. Ohlsen of Wilmington, Calif. have furnished several of the Wyoming specimens, which they collected over a period of 25 years. Their exceptional interest in unusual petrified material has been particularly helpful. Mr. James Frank Britsch of Long Beach, Calif. A. Greene, Mr. Archie Greene and Mr. have been of great assistance in cutting and polishing many of the specimens. Mr. and Mrs. Lowell Gordon, Long Beach Gem and Mineral Dealers, have furnished me with several Mule Canyon, Yermo, Calif. specimens. Dr. Grant Beckstrand of Palos Verdes Estates,



17 & 18. Wyoming black fossil palm, diameter of stem 5 cm. Microphotographs using polaroid film, Leitz-Wetzlar metallograph using polarized light.

17. Magnification ×100 taken from peripheral portion of central cylinder showing a single vascular bundle. FB-fibrous bundle "cap". PH-phloem structures. XY-two xylem vessels. PR-protoxylem.

Calif., palm enthusiast, gave much encouragement and valuable suggestions. Members of the Palm Society of Southern California who have been most helpful and generous with time in giving information on living palms are Mr. Horace Anderson of Leucadia, Calif., Mr. David Barry, Jr., of Brentwood, Calif., Mr. Otto Martens of the Diegaard Nurseries in Monrovia, Calif., Mr. F. A. Tetley II and Mr. F. A. Tetley III of Corona, Calif. and Mr. L. M. Whitelock of Eagle Rock, Calif.

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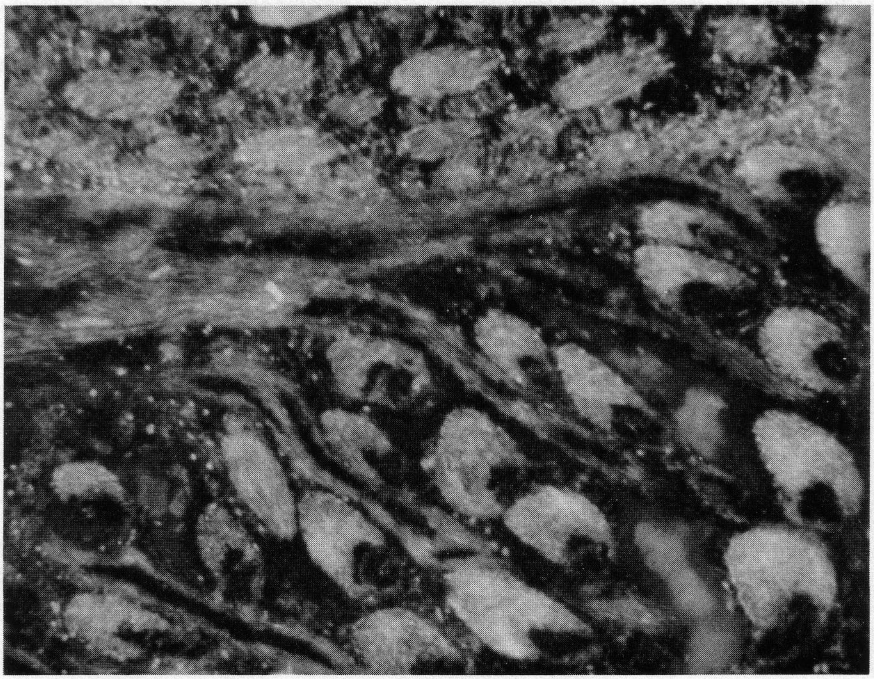

18. Magnification ×50. Upper zone: cortex. Lower: peripheral zone of central cylinder with intricate ramifications of leaf base complexes.

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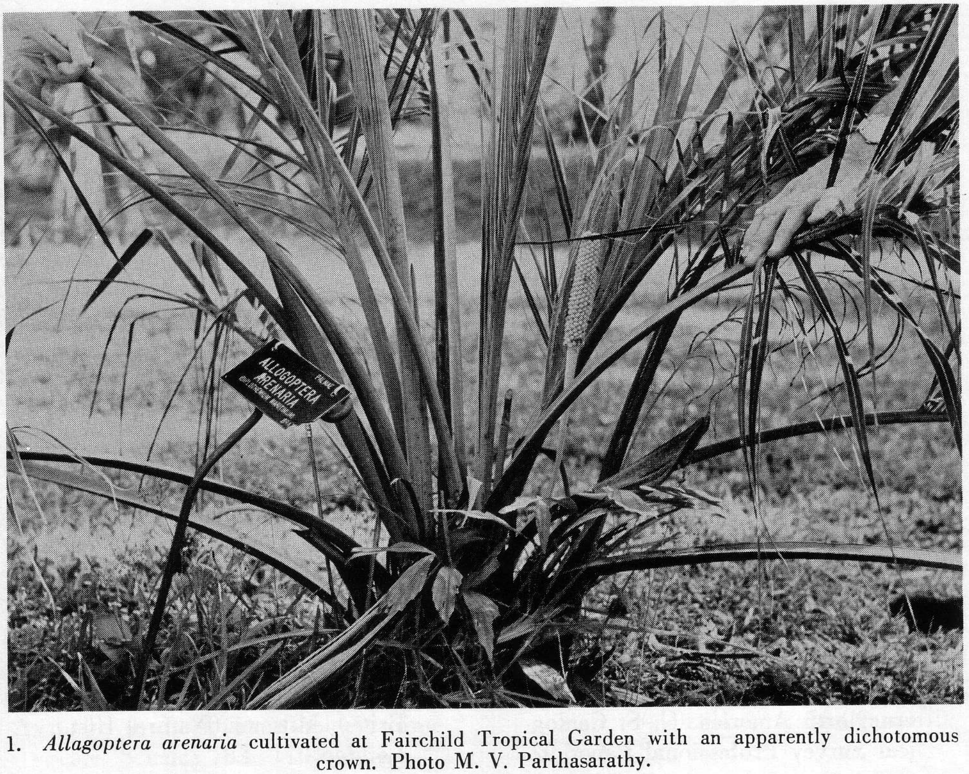

1. *Allagoptera arenaria* cultivated at Fairchild Tropical Garden with an apparently dichotomous crown. Photo M. V. Parthasarathy.

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2. Close-up of plant shown in Fig. 1. Developing leaf primordia belonging to two buds are indicated by arrows. The leaf immediately below the crown is held by the hand. Photo M. V. Parthasarathy.

Dichotomous Branching in Allagoptera?

P. B. Tomlinson

In the article on dichotomous branching in palms (*Principes* 10:21-29, 1966) by Tomlinson and Moore it was suggested that the phenomenon remains to be discovered in other palms. We are indebted to Mr. W. L. Bidlingmayer of Vero Beach, Florida for a prompt response to this suggestion. He draws my attention to *Allagoptera arenaria* (Gomes) O. Kuntze (*Diplothemium maritimum* Martius) in which he has observed division of the crown in a specimen in his own collection. I continue with Mr. Bidlingmayer's own words.

"The plant is mature, about 7 years old and has produced seed for the past 2 years. This summer I discovered a mature leaf with the rachis divided equally for about a quarter the distance from the apex. Both midribs have leaflets. When the plant was about two-thirds grown the bud divided equally as seen in *Hyphaene*. It now has two equal but closely appressed buds."

A plant cultivated at Fairchild Tropical Garden shows exactly the features described by Mr. Bidlingmayer and seems to have dichotomized in the same way. It is illustrated in the accompanying figures (Fig. 1-3). The leaf with the forked midrib (Fig. 3) appears to be the last leaf below the fork. Its petiole is grooved on two sides, suggesting pressure exerted during its early development by the two new buds. The arrangement of leaves in the two new buds suggests that they have mirror-image symmetry with respect to each other, an apparent essential feature of this type of branching.

Allagoptera arenaria grows in some abundance in its native habitat and is quite accessible (for an account see W. H. Hodge. "A strand palm of south-eastern Brazil." *Principes* 8 : 55 - 57, 1964). It should be possible to discover if this dichotomy is characteristic of the palm and look for early stages by dissecting out developing parts.

Mr. Bidlingmayer is to be congratulated on his discovery, particularly as it means that this dichotomous-like branching is now known for another of the major subfamilies of palms, the Cocoideae. I am also indebted to Mr. Bidlingmayer for allowing this note to be published.

3. *Allagoptera arenaria*, the forked midrib (arrows) of the leaf immediately below the dichotomy. Photo M. V. Parthasarathy.