PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for January

Cover Picture

The restored and replanted Palm House at Kew, November 1990. Photo by Sue Minter. See pp. 9–18, 26.

PRINCIPES

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Principes, 35(1), p. 3

Editorial

We begin 1991 with the second 60 page issue of *Principes*, one of the richest and most varied issues ever.

In the first article Don Hodel and J. J. Castillo Mont describe two more new Chamaedoreas from Guatemala, further preparing the way for his book. The book is complete and we find it a very impressive work. Don is now doing some rewriting and polishing. Certainly it is worth spending a little longer to be sure that such a major advance is as well done as possible.

In November 1990 the Palm House at the Royal Botanic Gardens Kew was officially reopened by HRH the Queen Mother after a major restoration underway from 1985 to 1988 and costing over L9 million. "The Greatest Glasshouse" has been deeply involved in the history and development of palms and represents as well a landmark in architecture, especially in the use of curved wrought iron beams to support large structures. Sue Minter has prepared a special srticle for *Principes* with a striking Cover Photo and many other pictures. The elegant restored building is replanted to present a rainforest environment and a marine display in central London. Kew's goals for the plantings are noteworthy. The tropical collections will provide a gene bank to be used for research, development, and possibly for reintroduction into the wild. The palm collection is outstanding, most of them grown by David Cook, a friend of many IPS members. The story of the building, its restoration, and the plants it houses are also discussed in more detail in a new and attractive book by Sue, see p. 26.

Native palms of several countries are featured in this issue. Dick Endt considers the Chilean Wine palm, *Jubaea chilensis* and the only other native palm of Chile, *Juania australis.* Palm communities of two "Terre firme" forests are discussed by Francis Kahn and Kember Mejia. These important forests cover most parts of the Amazon basin and their palms, which are largely understory species, have not been previously surveyed in this way. The large number at the Copal site is a new record, 34 genera in 0.5 ha.

Our longest paper is an annotated key to the species of *Coccothrinax*, which are handsome and frequently cultivated but have been confused taxonomically. Cliff Nauman and Roger Saunders present a masterful and much needed treatment.

The affects of tourism on the renowned Coco de Mer has been studied in some detail by Andrew Savage and Peter Ashton. The importance of protecting the wild stands of these palms needs no justification and we hope that our article will support the efforts of the Seychelles' government to do so.

In this issue we have our first photo article—19 fine pictures by Thomas Zanoni graphically illustrating the uses of *Roystonea hispaniolana* on the island of Hispaniola.

Finally Norman Bezona describes the Postbiennial tour to Malaysia and Jim Cain brings us up to date on the activities of the Chapters.

Best wishes to all for 1991.

NATALIE UHL
JOHN DRANSFIELD

Principes, 35(1), 1991, pp. 4–8

Additional New Species of Chamaedorea

DONALD R. HODEL AND JUAN JOSE CASTILLO MONT
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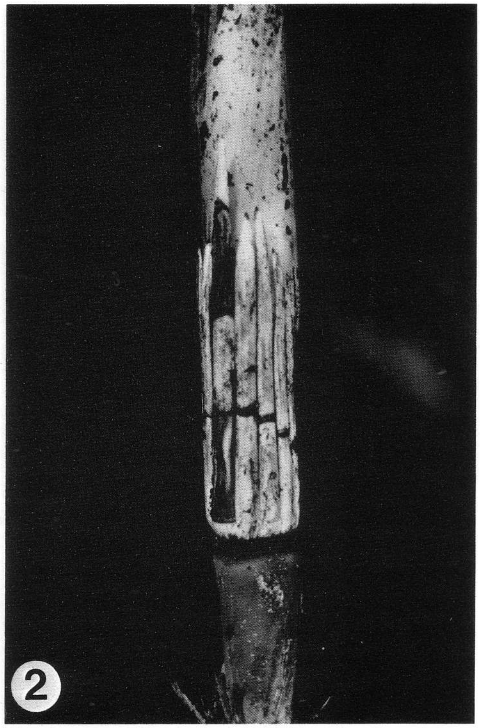
Recent work in Guatemala for a project on *Chamaedorea* that the International Palm Society will publish in 1991 has yielded two undescribed species, one from the Atlantic slope and the other from the Pacific slope. This latter species also occurs in Chiapas, Mexico.

Chamaedorea nationsiana D. R. Hodel & J. J. Castillo Mont **sp. nov.** (Figs. 1–4).

Subgeneris *Stephanostachydis* Klotzsch, floribus masculis contiguis. *C. arenbergianae* H. A. Wendl. affinis sed inflorescentiis masculis spicatis aliquot per nodum differt. Typus: Guatemala, *D. R. & J. J. Castillo Mont 1021A* (Holotypus BH; Isotypus AGUAT).

Stem solitary, erect, to 2.5 m tall, 2–3 cm diam. (Fig. 1), green, smooth, ringed, internodes to 10 cm long. Leaves 5–6, erect-spreading, pinnate; sheath to 30 cm long, obliquely open apically and there rough- and brown-margined, longitudinally striated, green with a raised yellowish central costa; petiole to 75 cm long, green and flat or slightly channeled adaxially, green laterally, rounded and pale abaxially; rachis to 1 m long or perhaps more, green and angled adaxially, rounded abaxially with a distinct yellow band extending onto the sheath; pinnae to 11 on each side of the rachis, opposite to subopposite, lanceolate, middle ones the largest, these to 53 × 9 cm, slightly sigmoid, falcately long-acuminate, 8–9 prominent primary nerves adaxially, middle one often most prominent, these pale and keeled abaxially, 1 secondary between each pair of primaries, tertiaries numerous, faint, lowest pinnae to 40 × 6 cm, apical pair to 35 × 8.5 cm, 10-nerved.

Inflorescences inter- or infrafoliar in flower, infrafoliar in fruit, spicate. Staminate inflorescences several to a node (Fig. 2), usually 8, each with a separate prophyll and peduncular bracts but borne on a common hypodium, center inflorescence developing first followed sequentially by the others on either side; peduncle ascending, to 25 cm long, 5 mm wide at the base, 2–3 mm diam. at apex; bracts 4–5, fibrous, greenish in flower, tips brown and tattered, acute-acuminate, longitudinally striate-nerved, shredding with age, prophyll to 5 cm long, 2nd bract to 9 cm long, 3rd to 15 cm long, 4th to 25 cm long, 5th to 25 cm long and greatly exceeding peduncle; rachis or flower-bearing portion to 15 cm long, pendulous, densely flowered. Pistillate inflorescences solitary at a node (Figs. 3,4), ascending in flower, nodding in fruit; peduncle to 30 cm long, 1 cm wide at base and there ± flattened, 2–5 mm diam. at the apex, greenish or pale in flower, bright orange and swollen in fruit; bracts 5, fibrous, brownish in flower becoming tattered in fruit and often fallen away, longitudinally striate-nerved, prophyll to 3 cm long and bifid, acute, 2nd bract to 6 cm long, 3rd to 10 cm long, 2nd–3rd bracts acutely bifid, 4th to 18 cm long, 5th to 23 cm long and exceeding peduncle, 4th–5th bracts acuminate and obliquely long-open; rachis or flower-bearing portion to



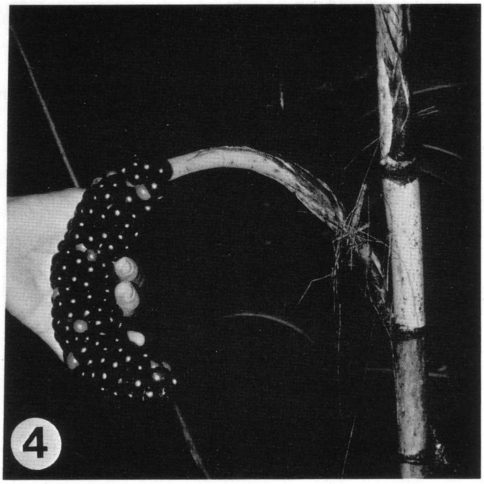
1. Mature plant of *Chamaedorea nationsiana, D. R. Hodel & J. J. Castillo Mont 869,* at type locality, Izabal, Guatemala. 2. Immature staminate inflorescences of *Chamaedorea nationsiana, D. R. Hodel & J. J. Castillo Mont 871,* showing the multiple arrangement at a node.

15 cm long in flower and ± straight, to 20 cm long in fruit and ± straight to strongly curved.

Staminate flowers densely placed in spiralling rows, contiguous in bud, ± globose but angled by mutual pressure, 2 × 1–1.5 mm; calyx well developed, prominent, membranous, cupular, 1 mm high, sepals connate, scarcely 3-lobed; corolla 1 mm high, petals valvate, triangular, 1.5 × 1.5 mm, acute and spreading apically; stamens included, 0.8 mm high, ± sessile, tightly placed around but not exceeding pistillode, anthers oblong, 0.8 mm long, bilobed; pistillode columnar, 1 mm high, flared basally and apically. Pistillate flowers in 5 dense spiral rows, contiguous in bud, ± superficial, leaving elliptic scars 2 × 0.75–1 mm, rhombic-shaped from mutual pressure in bud and 3–3.5 mm long, × 2.5–3 mm wide, 1.5–1.75 mm high at anthesis and depressed-globose; calyx well developed and prominent, ± membranous, scarcely 3-lobed, sepals connate in a thin sheathing cupule 1–1.5 mm high; petals imbricate in basal three-fourths, broadly triangular, 1.5 × 2.5 mm, inflexed and rounded apically; pistil 2 mm high, ± columnar but swollen and to 1.5 mm wide basally, 0.5 mm diam. apically, terminal cap broadly flared, styles lacking, stigma lobes recurved, bifid. Fruits black, densely packed and angled from mutual pressure, 1–1.5 cm diam.; seeds angled, brown, 6–9 mm diam.

Distribution: GUATEMALA. Izabal: wet forest on the Atlantic slope, to 900 m elevation.

Specimens examined: GUATEMALA. Izabal: Cerro San Gil, *D. R. Hodel & J.*



3,4. Infructescences of *Chamaedorea nationsiana* showing densely packed fruits.

J. Castillo Mont 869, 871, 873, 1017, 1021B (BH; AGUAT), *1021A* (Holotype BH; Isotype AGUAT).

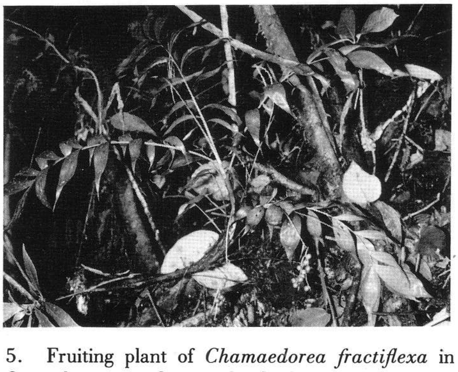
The specific epithet honors biologist and conservationist James D. Nations of Ciudad Vieja near Antigua, Guatemala, who has contributed greatly to conservation and rural development efforts in that country.

Chamaedorea nationsiana is closest to *C. arenbergiana* with which it has been confused and would key out next to this species in an earlier paper (Hodel 1990). However, the solitary, branched staminate inflorescences with up to ten pendulous rachillae of *C. arenbergiana* distinguish it from *C. nationsiana.* Fisher and Moore (1977), reporting on multiple inflorescences in palms, stated that *C. arenbergiana* had multiple staminate inflorescences. However, this is in error; Wendland's type specimen of *C. arenbergiana* at GOET and his original description clearly show this species to have solitary, branched staminate inflorescences.

Although all the known specimens of *C. nationsiana* are from one locality in Guatemala, this highly localized distribution may be more apparent than real. Nearly all collections labeled as *C. arenbergiana* from the Atlantic slope of Guatemala and adjacent Honduras are in fruit. Some of these may actually be *C. nationsiana* since the two species are difficult to distinguish when only fruiting material is at hand.

We distributed seeds of *C. nationsiana* in December, 1989 as *C. arenbergiana* under the numbers *D. R. Hodel & J. J. Castillo Mont 869* and *873.*

Chamaedorea fractiflexa D. R. Hodel & J. J. Castillo Mont **sp. nov.** (Figs. 5–7).



5. Fruiting plant of *Chamaedorea fractiflexa* in Quetzaltenango, Guatemala displaying procumbent stem.

6. Staminate plant of *Chamaedorea fractiflexa* from which we collected the type specimen, *D. R. Hodel & J. J. Castillo Mont 912A.* 7. Fruiting plant of *Chamaedorea fractiflexa, D. R. Hodel & J. J. Castillo Mont 912B* showing filiform peduncles.

Subgeneris *Chamaedoropsi* Oerst. inflorescentiis masculis solitariis, floribus masculis solitariis petalis patentibus apicaliter. *C. digitatae* Standl. & Steyerm. affinis sed floribus remotis, inflorescentiis masculis rhachidibus valde fractiflexis, peduculis femineis filiformibus pendulis, rachillis fructiferis pendulis differt. Typus: Guatemala, *D. R. Hodel & J. J. Castillo Mont 912A* (Holotypus BH; Isotypus AGUAT).

Stem solitary, procumbent (Fig. 5) to erect, to 2 m tall, 5–8 mm diam., smooth, green, ringed, internodes 3–7 cm long, often covered with persistent leaf sheaths. Leaves 3–8, spreading, pinnate; sheath to 12 cm long, tubular, tightly clasping, obliquely open apically, green, longitudinally striate-nerved; petiole to 5 cm long, flat and green adaxially, rounded and pale abaxially; rachis to 20 cm long, angled and green adaxially, rounded abaxially with a pale band extending onto sheath; pinnae 5–8 on each side of rachis, regularly placed, opposite, lanceolate to broadly lanceolate, to 13 × 3.5 cm, sigmoid, long-acuminate apically, contracted basally, a prominent midrib and 2 primary nerves on each side of this, a secondary between each pair of primaries, tertiaries numerous, faint, end pinnae sometimes broader, to 6 cm wide, 4–5-nerved.

Inflorescences interfoliar, slender, few-branched; peduncles to 30 cm long, very slender, 2 mm wide at base and ± flattened, 0.5–1.5 mm diam. at apex and there filiform, green in flower, pendulous and orange apically in fruit; bracts 5–6,

± loosely sheathing, brown in flower and fruit, acute to acuminate, papery-thin, finely longitudinally striate-nerved, prophyll 2 cm long, 2nd bract 4.5 cm long, 3rd and 4th 9 cm long, 5th 7 cm long, often a rudimentary 6th concealed by 5th. Staminate inflorescence with rachis to 3 cm long (Fig. 6), strongly flexuous, green; rachillae 5, these to 7 cm long, each attached at an "elbow" of rachis, green and slightly drooping in flower. Pistillate inflorescence with rachis to 1 cm long, green in flower, orange in fruit; rachillae 3, these to 7 cm long, green in flower, downward-pointing and orange in fruit (Fig. 7).

Staminate flowers ± densely arranged, 1–2 mm apart, oblong in bud, 2–2.5 × 1–1.5 mm; calyx cupular, to 0.75 × 1.5–2 mm, 3-lobed, lobes broadly rounded, 0.5 mm wide, sepals imbricate and/or slightly connate basally; petals valvate, lightly nerved on inside; stamens 1.5 mm long, filaments 0.5–0.75 mm long, anthers oblong, 1 mm long, bilobed; pistillode columnar, 1.5 mm high, finely longitudinally striated. Pistillate flowers 3–4 mm apart, ± globose, 1 × 1.5–1.75 mm; calyx coroniform, 0.75 × 2 mm, deeply 3-lobed, lobes acute, obscurely nerved, sepals connate basally; petals lightly imbricate basally, free apically, acute, obscurely nerved, 1.5 × 1.5–2 mm; pistil ovoid, 1.5 × 1 mm. Fruits black, globose, 8 × 7 mm.

Distribution: GUATEMALA. Quetzaltenango. MEXICO. Chiapas: Dense, wet forest on the Pacific slope, 2,000–2,900 m elevation.

Specimens Examined: GUATEMALA. Quetzaltenango: southwestern slope of Volcan Zunil, *D. R. Hodel & J. J. Castillo Mont 905, 905B, 912B, 986* (BH, AGUAT), *912A* (Holotype BH; Isotype AGUAT. MEXICO. Chiapas: Motozintla de Mendoza, *D. E. Breedlove 41648* (CAS).

The epithet is from the Latin *fractiflexus* meaning zigzag, in reference to the rachis of the staminate inflorescence. *Chamaedorea fractiflexa* is rare and known only from five collections in Guatemala and one in Mexico. It is closest to *C. digitata*, but the straight staminate rachis, thickened and ascending pistillate peduncle, more densely flowered rachillae, and ascending or spreading fruit-bearing rachillae distinguish this latter species.

Acknowledgments

We thank Richard W. Palmer, Pauleen Sullivan, Lynn Muir, Philip Keeler, Louis Hooper, and Inge Hoffman for supporting Hodel's field work in Guatemala. John Dransfield and Natalie Uhl reviewed and offered helpful suggestions on the manuscript.

LITERATURE CITED

FISHER, J. B. AND H. E. MOORE, JR. 1977. Multiple inflorescences in palms (Arecaceae): their development and significance. Bot. Jahrb. Syst. 98(4): 573–611.

HODEL, D. R. 1990. New species and notes on related taxa of Chamaedorea subgenus Stephanostachys. Principes 34(4): 160–176.

Principes, 35(1), 1991, pp. 9–18

The Palm House at Kew: A New Beginning

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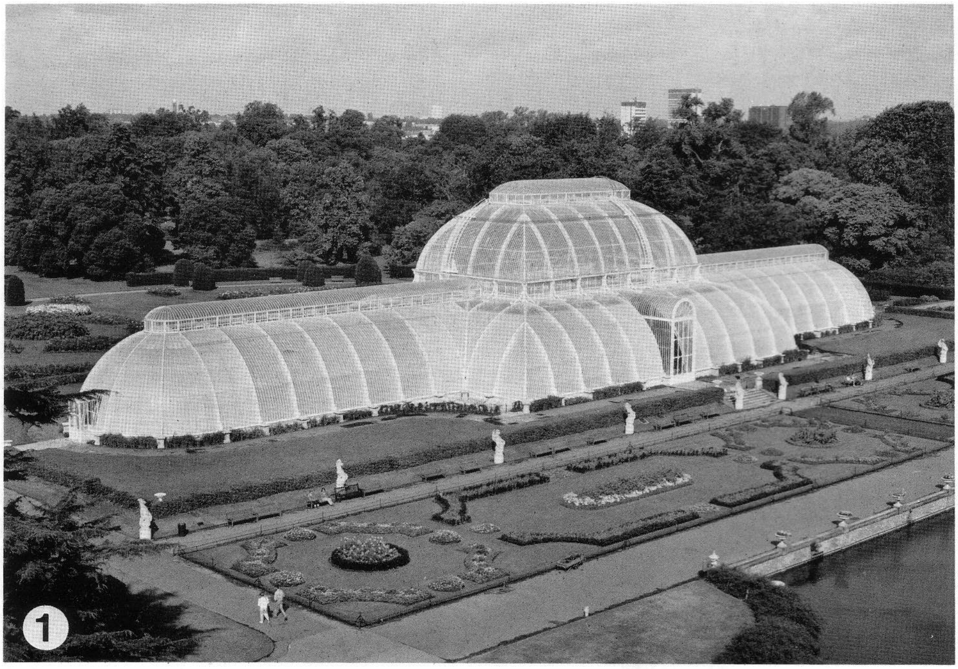
The Palm House at the Royal Botanic Gardens, Kew, probably the most famous glasshouse of palms in the world, has just undergone a restoration costing nearly £9 million. Replanting was completed last year and 167 species of palm are now displayed in a microcosm of the palm-rich (but very threatened) rainforests of the three continents.

This article will show something of the development of palm collections in Victorian England, the extraordinary building spawned at Kew by the desire to grow palms, and detail the recent restoration and replanting.

At the beginning of the nineteenth century there were significant advances in materials used in glasshouse design; paralleling this there was an increase in the complexity of plant collections with the introduction of palms. The palm collection at Kew grew greatly during its Victorian heyday. According to John Smith, the first Curator, the original collection of palms in England was that of Lord Petre at Thorndon Hall, Essex, who grew them in soil beds under a house 30 feet high in the 1730's and 1740's. Six palm species were grown at Kew in 1768, 10 by 1787 and 20 in 1813. The plants were plunged in beds of bark into which the roots grew as their tubs decayed. By 1830 the collection had grown to 40 species. In 1843 the Gardens were expanded from 20 to 65 acres under Sir William Jackson Hooker, Director, which effectively made Kew a national botanic garden as well as one enjoying many royal connections. It was thought fitting that such a garden should have a prestigious glasshouse tall enough to house tree palms, the 'principes' of the plant kingdom, the cultivation of which was limited at that date to the gentry because of the enormous cost of the glasshouses required to raise palms to maturity. There was considerable rivalry over the culture of palms, over 200 species of which were made available in England via the collection of Conrad Loddiges's Hackney Botanic Nursery in Mare Street, Hackney, East London. Kew's collection was only rivalled by that of Hermann Wendland at Herrenhausen in Germany.

Kew's Palm House was the result of a complex collaboration between the architect Decimus Burton and the Irish ironfounder, Richard Turner, between the years 1844 and 1848. Built, at Burton's insistence, next to a lake to mirror its outline (Figs. 1, 5), it came to occupy a central position at Kew with wide tree-lined avenues designed by William Andrews Nesfield radiating from it.

The most significant feature of the Palm House at Kew is that it is built of iron. It represents a milestone in the history of engineering during the Victorian "age of iron" and in the application of the material to glazed structures for the growing of plants. The novelty of the Palm House, however, is not only that it is iron but also that it is curved. Sir Gordon Mackenzie had suggested in 1815 that "the form of glass roofs, best calculated for the admission of the sun's rays is a hemispherical figure" which "has already given rise to



1. The curved shape of the Palm House is fronted by a parterre and a sizeable lake. 2. The dismantled Palm House being surveyed for re-erection in February 1987. The use of wrought iron for the supporting ribs allowed for the planting space to be unobstructed by columns.

many beautiful curvilinear structures." Loudon, who wrote prolifically on gardening matters, gave a great impetus to the practical development of this theory by inventing the rolled wrought iron glazing bar which could be curved into the curvilinear shape. He was not, however, a businessman and relinquished his patent rights to the firm of W & D Bailey who became responsible for many very attractive structures.

The shape of the Palm House is heir to the theories of Mackenzie and the glazing bar of Loudon as patented by the firm of Bailey. However, it was the skill of the Irish ironfounder, Richard Turner, who first applied wrought iron to the creation of such a large glasshouse for palms at Kew. His essential contribution was to substitute wrought iron "deck beam" used in shipbuilding for Burton's proposal of much heavier cast-iron main arches. This was a "first" in the history of building design, though Turner later claimed he lost £7,000 on the contract through its use. He used its greater tensile strength when curved to span great widths of unsupported space to the benefit of the broad crowns of the palms. So it is not inappropriate that, ever since, the house has been compared to the upturned hull of a graceful liner. Unlike the glasshouse at Chatsworth, the Palm House was constructed entirely of metal and used curved glass rather than the "ridge and furrow" design invented by Paxton and, at the Curator's suggestion, it was tinted green. The importance of the building today is that there are no other large, curved iron glasshouses left in the UK; it is a masterpiece in iron and glass.

Despite the architectural and engineering inventiveness, iron glasshouses were not popular with horticulturists who feared glass breakage through the expansion of the metal, not to mention the threat of lightning strikes. The Curator freely expressed his dislike of iron structures and his skepticism at being required to grow plants in the Palm House "for in looking up nothing but iron was to be seen in every direction in the form of massive iron rafters, girders, galleries, pillars and staircase, and the hot iron floor on which we stood and the smooth stone shelves and paths round the house had the appearance of some dock-yard smithy or iron railway station than a hothouse to grow tropical plants in, but there it was, and I was to make the best of it, and to be responsible for the good cultivation of the plants which were commenced to be put in."

Smith moved the largest plants into the center transept in September 1848 with the help of two engineers with tackle from the Deptford dockyard: "The first being the large palms *Sabal umbraculifera* (= *S. mauritiiformis*) from the old palmhouse. . . . One plant weighed 17 tons, the other not quite so much. They were then conveyed on rollers to the Palmhouse, a distance of nearly ½ a mile, and drawn up the steps of the east center door by a windlass. Their leaves occupied the whole width of the doorway." At first he was short of plants because the glasshouses from which the plants were drawn constituted only a quarter of the floor area of the new house and not enough palm species had then been introduced to fill it. The wings of the Palm House were initially left empty.

Not everything went well for the new house. The subterranean boilers flooded and it was some years before the problem was solved. The staff found great difficulty with the cast-iron floor gratings which had been laid in order to improve the circulation of heat. It did have the horticultural advantage of circulating heat around the plant roots but it committed the staff to growing everything in pots and tubs. Most of the more tender tropical economic plants which Kew was keen to show needed hotbed cultivation and for the taller palms to reach the full height of the building some planting beds were needed. By the winter of 1859–60 Dr Hooker had arranged for large beds to go into the center of the Palm House, so beginning a tradition of bed culture which has continued in later restorations. By 1882 Kew held 420 species of palm in the Palm House and in the nurseries.

Originally designed to last 100 years, the house was in a sorry state of corrosion by the 1950's. It was closed to the public in the autumn of 1952 after the engineer's report of August 1951 recommended that the condition of the structure was such that "a scheme be prepared in the near future for a complete replacement for the house." Designs were indeed mooted. One idea was to replace the house using the arches which had lined the Mall in central London for Queen Elizabeth's Coronation. Another bizarre proposal was to build a new structure over the top of the existing house. Given the post-war desire for things to reflect a new, modern, era, it is surprising that the house was not lost altogether, but was saved for us to enjoy.

The actual restoration work carried out was very comprehensive although the house was never emptied and the restoration was essentially achieved around the plants. The cost of the project was just under £100,000, excluding the cost of scaffolding, and the budget was exceeded by 25%. It was due to these efforts in the 1950's that the house did survive when so many of the other great glasshouses were destroyed and that we now have a Palm House to inherit.

However, despite the work in the 1950's, corrosion to the iron continued. The first signs that all was not well occurred at the beginning of the 1980's when several pieces of gutter fell through the glass to the floor.

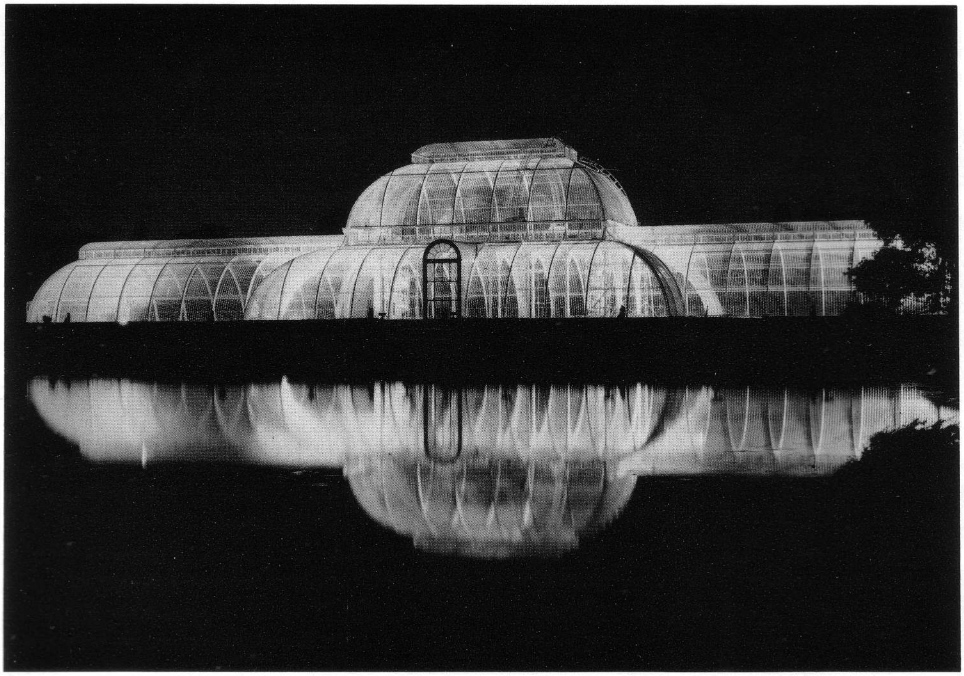
The body then responsible for maintenance of the buildings at Kew, the Property Services Agency (PSA), asked Posford, Pavry & Partners (later called Posford Duvivier) to survey the structure and heating services and report on their condition. They found that the main arch ribs were in a reasonable state, apart from certain areas where strengthening would be required and apart from a general loss of thickness throughout. But when a window was blown out by wind in the clerestory the engineers were also alarmed to find that the pilaster virtually disintegrated. It was therefore obvious that the windows were supporting the roof, not the pilasters. Apart from the clerestories, the wrought iron glazing bars were the major cause of concern. Virtually every bar was badly corroded at the ends and had suffered corrosion along the length.

Since the Palm House is a Grade 1 listed building any restoration or repair work had to be governed by the requirements of the Department of Ancient Monuments and Historic Buildings (now English Heritage). These included keeping as much as possible of the original fabric and not prejudicing any of the structural engineering principles of the building. However, the Palm House is not a building in the traditional sense of the word, it is rather an engineering structure. With a "normal" building the various philosophies of restoration or repair are well known and documented. They involve, to a greater or lesser extent, piecemeal replacement or repair of masonry, plaster or timber. There have been few restorations of engineering structures of the size and complexity of the Palm House. The house had to be dismantled completely (Fig. 2), both to allow all of the structural elements to be examined and all junctions to be protected against rust and to enable re-erection to common lines. The building contains some 7,500 castings of which about one third are structural, the remainder being purely decorative. From the survey results the amount of replacement required was assessed. For the structural elements this varied from 20% for the dado gutters above the stone wall to complete replacement of the clerestory components. A drawing was prepared for each of the structural components to such detail that it could be worked to by a foundry. The glazing bars, however, were more of a problem as wrought iron is no

3. The altered floor layout in the restored house allowed for many more deep planting beds and for seating areas. Original elements, such as the floor grilles and the redundant bench legs, were reused in the new design. 4. The replanting commenced in April 1989 and combined large specimens such as *Orbignya phalerata* (left) with young plants such as *Verschaffeltia splendida* (right).

longer made or rolled in sufficient quantity and it was decided to replace them completely in extruded stainless steel, a controversial decision which some purists felt made the house a "replica" rather than a "restored" building. The house was glazed in toughened glass to improve the safety of the public and to reduce maintenance costs.

The internal plan was changed considerably with planting beds installed in the wings as well as in the center transept. It was decided that the cast-iron gratings on which the palms and cycads used to stand should be re-used in the new walkways, to allow the heat to pass upwards from the heating void below and to re-use an important element of the original floor construction. Other materials for the new, wider paths and the bed edgings were chosen to reflect the original materials, York stone for the horizontal finishes, path edgings and pavings, and Portland stone (to match the original dado) for the vertical elements, bed edgings and walls. Benches were installed for visitors and at the end of each wing a 'conversation area' was built, recreating the perimeter benches of the old house with displays of potted palms on floor gratings. The redundant cast-iron bench legs



5. The Palm House floodlit on the completion of the £9 million restoration in November 1988.

from the rest of the house were incorporated into the design of the perimeter beds (Fig. 3). The house was provided with a humidification system for the first time and the entire boiler and ventilation systems were renewed. Beneath the center transept a new Marine Display was built for the growth and exhibition of seaweeds, an innovative venture for Kew, but not obtrusive in any way to the palm culture above.

To prepare for this restoration the Palm House had to be totally emptied of plants in 1984 for the first time in its history. This involved much propagation, thinning, dispersal of duplicates and containerization of specimens planted in beds. It ended with the felling of all palms over 8 meters tall including a large *Phoenix sylvestris*, a *Caryota urens* in full fruit and a *Polyandrococus pectinata* just renamed with a long-forgotten name. Specimens from all of these felled palms were collected for the herbarium. The Tropical Development Research Institute took the opportunity to analyse the sago content of the felled trunks of the *Caryota* species. But the visual impact was dramatic. Within a few days the famous silhouette of palms through the central dome had gone. One of the staff went home in tears.

While the conserved plant material was kept in a Temporary Palm House specially constructed for the purpose, the restoration of the Palm House by contractors Balfour Beatty commenced in the autumn of 1985 and was completed in November 1988 when the building was beautifully floodlit for a completion ceremony (Fig. 5).

Meanwhile the planning of the replanting went ahead in the knowledge that there was a totally clear canvas for design. The proposal was to plant the house as one integrated habitat, palm-rich tropical rainforest (therefore excluding many xerophytic cycads) and to show the tropics of the three continents of the world in the

6. A young plant of *Johannesteijsmannia altifrons*, not often seen outside South-east Asia, has been planted in the north wing.

three sections of the house. The center transept was to house the richest and most diverse American flora, including the enormous wealth of Amazonia; the south wing would house the African flora and the north wing the floras of Asia, Australasia and the Pacific. In order to accommodate to maturity some of the larger palms, our palm taxonomist, Dr Dransfield, suggested using the two large beds in the center transept which were directly under the dome for the tallest tree palms of the tropics worldwide (Fig. 4). This underlined, and commemorated, the original reason for the building of the Palm House to such a height and was the only deviation from the phytogeographic plan. It is from these that we hope to recreate in years to come the superb silhouette of palm crowns which were cut down prior to the 1980's restoration.

The planning was assisted by the use of a computer stocklisting system code-named "Palm" and by perspective drawings of key vistas in the house taken from 35 mm slides. Particular architectural specimens were marked as focal points destined to catch the eye at the end of each walkway in the house, an element of formality which I thought appropriate for a Victorian house. Throughout the planting the specimens were distributed to give a balance of existing size for immediate effect, as well as with regard to their potential size. Wherever possible, preference was given to material of natural source origin, which is more scientifically valuable in any plant collection that forms a gene bank of living material for research. Particular thought was given to the placement of the young, natural source palms in our nursery, many of which would reach plantable size in 1989 and would make the Palm House collection the finest in Europe (Fig. 6). To assist in the growth of some of the young palms

7. Horticultural diploma students mechanize the re-soiling of the new plantings. 8. The planting was shaded for the first two summers by thermal screening tensioned inside the curvature of the building.

from Madagascar and in particular of the double coconut from the Seychelles, an area of electric soil-warming blanket was installed in the south wing's center bed.

The distribution of economic plants was carefully planned and fast-growing plants were plotted with their eventual spread so that several of each species could be planted and then reduced as the area allotted to them became filled. The aim was to build up the multi-layered nature of a tropical rainforest, with canopy palms and trees, climbers and then shorter understory plants and palmlets.

The planting was completed between April and August 1989 using a spanning gantry to lift the large, containerized plants, many of which weighed 1 to 2 tons, up and over the bed edges and across and down into the beds. The compost was added around the rootballs of the plants after removal of their containers, many of which had to be cut off using an electric grinder. The resoiling was mechanized as far as possible using pallet bins which could be partially tipped, and then manhandled, into the beds using a small, hand-operated fork-lift truck (Fig. 7). Cabling was used to guy the root systems of several palms underground to assist their stability, and internal thermal screen shading was provided to aid establishment (Fig. 8).

Kew's overall aim in the Palm House is to demonstrate the diversity within palms as a whole and to maintain a stock of endangered species grown from wild collected seed from those areas most threatened by loss of habitat due to population pressure, shifting cultivation, and logging. So conservation is a principal theme. The Palm House demonstrates the richness of rainforest and its palms, and the geographical arrangement emphasizes several features of palm distribution including the diversity of forest floor palms and rattans in South-east Asia (north wing) and the plenitude of rare and endemic palms of Madagascar and the Mascarenes (south wing) including *Marojejya* and *Voanioala.*

So far everything is growing well and the Palm House received an official opening by HRH the Queen Mother on 6 November 1990.

"The Greatest Glasshouse, The Rainforests Recreated" by Sue Minter was published by HMSO on 11th September 1990 at £25. See p. 26.

Checklist of Palms Displayed

Acoelorrhaphe wrightii
Actinorhytis calapparia
Aiphanes acanthophylla
A. caryotifolia
A. eggersii
Allagoptera arenaria
Areca catechu
A. triandra
Arenga engleri
A. hookeriana
A. microcarpa
A. porphyrocarpa
Astrocaryum mexicanum
A. sp.
A. standleyanum
Bactris gasipaes
B. guineensis
B. major
Borassodendron borneense
Brassiophoenix schumannii
Calamus caesius
C. caryotoides
C. longipinna
Carpentaria acuminata
Caryota mitis
C. rumphiana var. *albertii*
Ceratolobus pseudoconcolor
Chamaedorea alternans
C. cataractarum
C. concolor
C. elatior
C. ernesti-augusti
C. erumpens
C. aff. sp. *erumpens*
C. falcifera
C. fragrans
C. glaucifolia
C. klotzschiana
C. metallica
C. microspadix
C. oblongata
C. pochutlensis
C. pumila
C. radicalis
C. stolonifera
C. sp.
C. tepejilote
Chambeyronia macrocarpa
Coccothrinax alta
C. argentea
C. dussiana
C. fragrans
C. martii
Cocos nucifera
C. nucifera var. *javanica*
Copernicia hospita
C. sp.
Corypha umbraculifera
Cryosophila nana
Cyrtostachys renda
Deckenia nobilis
Dictyosperma album var. *album*
D. album var. *aureum*
Drymophloeus oninensis
Dypsis hildebrandtii
D. humbertii var. *angustifolia*
D. mocquerysiana
D. pinnatifrons
Elaeis guineensis
E. oleifera
Eremospatha macrocarpa
Euterpe edulis
E. globosa
Gaussia attenuata
G. maya
G. princeps
Gulubia costata
Hydriastele microspadix
Hyophorbe lagenicaulis
H. sp.
H. verschaffeltii
Iguanura wallichiana
Johannesteijsmannia altifrons
Laccospadix australasica
Latania loddigesii
L. verschaffeltii
Licuala grandis
L. paludosa
L. rumphii
L. spinosa
Livistona chinensis
L. rotundifolia
Lodoicea maldivica
Marojejya insignis
Metroxylon sp.
Nenga sp.
N. gajah

N. pumila var. *pachystachya*
Neodypsis sp.
N. baronii?
N. decaryi
N. sp. aff. *lastelliana*
Neoveitchia storckii
Nephrosperma vanhoutteanum
Oraniopsis appendiculata
Orbignya phalerata
Pelagodoxa henryana
Phloga nodifera
Phoenicophorium borsigianum
Phoenix dactylifera
P. loureirii
Phytelephas seemannii
Pinanga coronata
P. densiflora
P. disticha
Plectocomia elongata var. *philippinensis*
Polyandrococos pectinata
Prestoea montana
Pritchardia arecina
P. hillebrandtii
P. kaalae var. *minima*
P. lanaiensis
P. pacifica
P. remota
Ptychosperma sp.
P. elegans
P. lineare
P. macarthurii
P. salomonense
P. sanderianum
P. waiteianum
Raphia farinifera
Ravenea moorei
Reinhardtia gracilis
Raphis excelsa cv. *Chiyodazuru*
R. excelsa cv. *Daruma*
R. excelsa cv. *Koban*
R. excelsa cv. *Kodaruma*
R. excelsa cv. *Kan-Non-Chiku*
R. excelsa cv. *Tenzan*
Roscheria melanochaetes
Roystonea oleracea
Sabal bermudana
S. minor
Salacca glabrescens
S. ramosiana
S. zalacca var. *amboinensis*
Scheelea butyracea
Schippia concolor
Sclerosperma mannii
Syagrus amara
S. flexuosa
S. romanzoffiana
S. romanzoffiana var. *australe*
S. schizophylla
Synechanthus warsewiczianus
Thrinax sp.
T. floridana
T. microcarpa
Trachycarpus fortunei forma *wagnerianus*
Veitchia macdanielsii
V. winin
Verschaffeltia splendida
Voanioala gerardii
Wallichia densiflora
Wodyetia bifurcata

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The Native Palms of Chile: A Rare Opportunity to Visit the Private Hacienda, Las Palmas Cocalan

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Jubaea chilensis

The Chilean wine palm, *Jubaea chilensis,* is the only native palm growing on the continental mainland of Chile. This palm has been well described in the past; hence I will limit my observations to my experiences during a visit to the Hacienda Las Palmas Cocalan.

The Chilean wine palm is no longer common in Chile. This magnificent palm has been "harvested" for the collection of "miel de palma," a maple-syrup-like product extracted from the felled trunks of these palms, a once-only operation, effectively eliminating the trees. This practice has been carried out for several hundred years. The result is that few palms are to be seen around the countryside. Today there are only two major reserves where these palms can still be seen in great numbers: one, the National Park La Campana at Ocoa, the other at Cocalan. The former park is now under total protection, including the scrub undergrowth. The felling of palms was still carried out as recently as 1982 in this park. At Cocalan the palms are preserved, not in a reserve, but in a commercial orchard for the production of coquito nuts which find a ready market in Chile.

The Hacienda Las Palmas Cocalan is not far from a small town called Las Cabras south of Santiago near the coast. This 4,500 ha holding is part of a further 1,500 ha of subtropical orchard reputed to be the largest privately-owned orchard in Chile. I was quite privileged to be able to visit the palm estate as normally the place is not open to the public.

The visual impact of the Cocalan palms is quite different from those growing at Ocoa, the difference being that these palms are "farmed" commercially with no thought of preservation of associated scrub vegetation as was typical at Ocoa. The dense forest of palms is growing on open grasslands grazed by stock. Nevertheless, the palms looked very impressive with the many huge columnar trunks often blackened by fire. The place looked more like an oasis than a commercial farm.

The entire area is managed for the production of the nuts, a remarkable operation. The commercial growing area consists of 5,400 mature palms with several thousand more growing on the steep hillsides surrounding the Cocalan valley. Records are taken of all the producing palms in the valley; those on the hillsides are harvested but are not managed by irrigation nor are harvests recorded. Each palm is coded on the trunk so that the productivity of nut production can be monitored; some palms produce better than others and some even are sterile. If the palm tree does not carry seed for ten consecutive years, the palm is cut down in order to extract the palm honey, the only instance where palms are cut down for this purpose.

The natural stands of palms are scattered over a wide area, some parts being devoid of palms. In order to increase the

1. Dense forest of *Jubaea chilensis.* Note absence of undergrowth and trunks blackened by fire. The area is grassed for the grazing of stock.

production of palm nuts, a further 15,000 palm seedlings have been planted out in the field. This, in itself, is quite a feat as each palm seedling is irrigated with its own open water channel constructed to each seedling. To protect the young palms from the grazing stock, a metal cagelike protection is placed around each palm. When seedlings are planted out, a few fresh seeds are also placed in the planting hole as the seedling may fail to grow. A large nursery is set up near the farm buildings in the shade of some huge palm trees. The seed is collected fresh to ensure rapid germination.

The management of this farm has far-sighted expectations. The palms planted now will not bear nuts for another 50 years. There are not many commercial enterprises which can afford such a practice. The total production of palm seeds is 98,000 kg, of which 6,500 kg were exported to Spain (June 1988). The harvesting takes place between April and June. The seeds were mechanically dehusked and dried before being bagged and sold.

There are other uses of the Chilean wine palm. The leaves are used for thatching on buildings. The leaf rachises are also used in construction and fencing. One observation worth mentioning is that nearly all mature palms are of similar size, suggesting that nearly all of them are of similar age. The only younger palms were planted there about 50 years ago, now starting to bear. It remains to be seen whether the small palms planted recently will survive the interference of grazing animals, not so much by browsing, but rather by soil compaction around the roots.

There is one special palm at Cocalan. It carries the name "La Capitana"; it is the tallest palm on the estate reaching a height of 28 meters. Is this the tallest *Jubaea chilensis* in the world?

Juania australis

The only other native palm of Chile is the "chonta" palm, *Juania australis*. This palm is endemic to the Juan Fernandez Islands, situated some 600 km off the west coast of Chile at about the same latitude as Santiago. This palm has become rare on the Juan Fernandez Islands, those surviving having little chance of regeneration as rats and goats clean up the seeds and young plants. Efforts are being made to raise seedlings on a nursery on the islands with limited success.

Attempts have been made to establish the "chonta" on mainland Chile. The climate on the mainland does not suit the "chonta"; the low rainfall and dry conditions are in contrast to the equitable moist climate of the Juan Fernandez Islands. I have been told that a number of "chonta" palms are growing on the mainland but only two of them have reached maturity—actually only one produces fruit, as the other palm is a male tree, fortunately growing nearby. As it was impossible for me to visit Mas a Tierra (Juan Fernandez Islands), I had to be content with a visit to Reñaca, not far from Viña del Mar along the coast.

Here in a private botanic garden about 25 acres in size owned by a wealthy Chilean businessman grow these two magnificent *Juania australis* palms; they are estimated to be about 100 years of age. Besides palms there was a wealth of other native trees and ornamental plants such as camellias, azaleas, rhododendrons and conifers. When I first spotted the "chontas," I tended to mistake them for *Ceroxylon* palms; many of the latter genus I had come across in Ecuador only days previously. The two mature palms are growing close together. The slender trunks, 15 cm in diameter, are prominently ringed, shiny light green in color. The palms are about ten meters tall. The crown is of medium density and without a distinct crownshaft. The leaves are relatively short and arching, the leaflets being stiffly arranged, in a V on the rachis. The palms are beautifully symmetrical in shape and appeared to be in good health. The female had a large cluster of ripe seed-round red drupes about 1.25 cm in diameter. The fruits contain a rather spongy flesh, rather sweetish to the taste, with a hard brown seed in the middle.

Seedlings were growing around the base of the palm. The few seeds I collected germinated readily two months later in New Zealand. A few meters away from these palms was a younger *Juania* palm about eight years old. It seemed to be growing well. There is also a nursery where a number of *Juania* seedlings are growing. According to the owner, these are the largest collection of *Juania* seedlings outside its native habitat, perhaps even in the world. These seedlings did not look so well—many had yellow tips on the leaves, possibly because of some nutrient deficiency.

The climate of Reñaca is much less harsh than in other parts of Chile. The moderating influence of the coast provides a microclimate which suits the "chonta" palm. It is hoped more "chontas" can be grown in order to multiply the species for its survival, something difficult to achieve on the Juan Fernandez Islands.

Note: I have imported seed of *Juania australis* two years in succession. In 1987 none of the seed germinated; in 1988 nearly all seed germinated. On examination, it appeared as if the seed kernels had not developed in the first lot, while in the 1988 importation the kernels were large and obviously sound as they nearly all germinated. Perhaps pollination was more successful.

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The Palm Communities of Two "Terra Firme" Forests in Peruvian Amazonia

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ABSTRACT

Two palm surveys carried out in "terra firme" forests of the lower Ucayali River valley in Peruvian Amazonia report very high diversities with, respectively, 29 species in 16 genera on 0.71 ha and 34 species in 21 genera on 0.5 ha. In both cases, most species are small, understory palms, and more than 99% of the community is under 10 m in height. Several genera and species inventoried, which are not frequent in Peruvian Amazonia at low elevations and rather common on the Andean piedmont and on mountains slopes, point out the influence of the subandean palm flora on the western lowlands of the Amazon basin.

"Terra firme" forests, which cover the major part of the Amazon basin, are considered a species rich ecosystem (Black et al. 1950, Boom 1986, Gentry 1982, Gentry and Dodson 1987, Pires et al. 1953, Prance et al. 1976). Previous reports from French Guiana (Granville 1978, Sist 1985) and from Brazil (Kahn 1986, Kahn and Castro 1985) presented data on species richness and density of palms in eastern and central Amazonia, pointing out particularly the high diversity of the palm community in a "terra firme" forest of the central basin; but there were no quantitative data from western Amazonia. Trying to fill the gap, we present here two palm surveys carried out in "terra firme" forests in Peruvian Amazonia, including data on species richness, density, life forms and vertical distribution of the palm community.

Study Areas

Both forests are located in the lower Ucayali River valley, near Jenaro Herrera (4°55′S; 73°40′W). The first site, called "Ferrocaño," is about 6 km north of the field station of the Research Institute for Peruvian Amazonia (IIAP); the second, called "Copal," is at km 15 on the only road. Both sites belong to the same geographic unit at an elevation of about 160 m above sea level.

Climate is humid tropical, with an average annual rainfall of 2.9 m and average annual temperature of 26° C.

Soils of both sites correspond to acrisol in the FAO-UNESCO (1971) classification system. They are yellow and clayey in their upper part; brownish to dark brown at greater depth; the upper 4 meters are never waterlogged; the drainage is vertical. At the Copal site, the soil differs slightly, having a silty layer in the upper horizon at the lowest part of the slope, and a sandy clay texture, at some places on the plateau at the margin of the area surveyed, corresponding to a transition zone into an area of gleyic podzol which extends about 50 m beyond.

Methods

Palm surveys. All palms were counted on contiguous 0.01-ha plots. For multistemmed species, all axes were counted. Total areas of 0.71 ha and 0.5 ha were surveyed respectively at the Ferrocaño and Copal sites. Density of each species is given according to height classes (under 1 m, 1 to 10 m, above 10 m), and lumped on the whole area at each site.

Palm collection and identification. All species were collected. Some of them could not be identified due to the lack of comparative material in the herbaria (AMAZ, BH, K, NY, USM). J. Dransfield contributed to the identification of many palms. Several names of *Bactris* are provisional; this genus badly needs a new taxonomic treatment. Voucher numbers and herbaria where plants are deposited are given in the following list: *Aiphanes ulei* Burret (*Kahn & Mejia* 1916, K); *Astrocaryum chambira* Burret (*K & M* 1768, USM); *A. macrocalyx* Burret (*K & M* 1782, USM); *Bactris acanthocarpoides* Barbosa Rodrigues (*K & M* 1760, K); *B. acanthospatha* Trail ex Drude (*K & M* 1737, K); *B. bifida* Martius (*K & M* 1789, K); *B. humilis* (Wallace) Trail (*K & M* 1758, K); *B.* cf. *hylophila* Spruce (*K & M* 1798, K); *B. mitis* Martius (*K & M* 1763, K); *B. piranga* Trail (*K & M* 1761, K); *B. simplicifrons* Martius (*K & M* 1781, USM); *B. sphaerocarpa* Trail (*K & M* 1813, K); *B.* sp. aff. *B. mitis* Martius (*K & M* 1799, K); *B.* sp. 1 (*K & M* 1835, K); *B.* sp. 2 (*K & M* 1749, K); *B.* sp. 3. (*K & M* 1905, USM); *B.* sp. 4 (*K & M* 1904, K); *Chamaedorea integrifolia* (Trail) Dammer (*K & M* 1790, K); *Chelyocarpus repens* Kahn et Mejia (*K & M* 1974, NY); *Desmoncus* cf. *leptospadix* Martius (*K & M* 1921, K); *Euterpe precatoria* Martius (*K & M* 1778, USM); *Geonoma acaulis* Martius (*K & M* 2001, USM); *G. camana* Trail (*K & M* 1765, K); *G. leptospadix* Trail (*K & M* 1709, K); *G. oligoclona* Trail (*K & M* 1910, K); *G. piscicauda* Dammer (*K & M* 1810, K); *G. poeppigiana* Martius (*K & M* 2020, BH); *G. pycnostachys* Martius (*K & M* 1698, K); *G. spixiana* Martius (*K & M* 1808, K); *G.* cf. *tamandua* Trail (*K & M* 1888, BH); *Hyospathe elegans* Martius (*K & M* 1917, K); *H.* cf. *weberbaueri* Dammer ex Burret (*K & M* 1815, K); *Iriartea deltoidea* Ruiz et Pavon (*K & M* 1766, USM); *Iriartella stenocarpa* Burret (*K & M* 1718, NY); *Jessenia bataua* (Martius) Burret (*K & M* 1792, USM); *Lepidocaryum tessmannii* Burret (*K & M* 1999, NY); *Maximiliana maripa* (Corrêa de Serra) Drude (*Mejia* 780, USM); *Oenocarpus balickii* Kahn (*K & M* 1723, NY); *O. mapora* Karsten (*K & M* 1727, NY); *Orbignya polysticha* Burret (*K & M* 1724, NY); *Phytelephas macrocarpa* Ruiz et Pavon (*K & M* 1726, AAU); *Pholidostachys synanthera* (Martius) H. E. Moore (*K & M* 1890, BH); *Scheelea bassleriana* Burret (*K & M* 1794, USM); *Socratea exorrhiza* (Martius) Wendland (*K & M* 1702, NY); *S. salazarii* H. E. Moore (*K & M* 2013, BH); *Wettinia augusta* Poeppig et Endlicher (*K & M* 1767, USM).

Results

At the Ferrocaño site, 29 species in 16 genera were encountered on 0.71 ha (Table 1). The genus *Bactris* is the most diversified, with 10 species. Palm diversity varies from 7 to 14 species and 5 to 10 genera per 0.01-ha plot. Palm density is very high (986 palms per 0.1 ha). While species richness and density are both remarkably high, the palm community is largely dominated by two small, multi-stemmed, understory species, *Lepidocaryum tessmannii* and *Bactris sphaerocarpa*, which represent, respectively, 54.3% and 17.7% of the community.

At the Copal site, 34 species in 21 genera were encountered on 0.5 ha surveyed (Table 2). *Geonoma* with 8 species is the most diverse genus. Palm diversity varies from 6 to 18 species and 5 to 13 genera per 0.01-ha plot. Of the 50 plots surveyed, 27 present 12 or more species, and 31 have 9 or more genera. Palm density is slightly lower than in the former site (768 palms per 0.1 ha). *Lepidocaryum tessmannii* represents only 7.4% of the community. *Astrocaryum macrocalyx* and *Phytelephas macrocarpa* were only found on the lowest part of the slope where the soil differs in having a silty layer in the upper horizon; both species are frequent on alluvial soils. The four adults of *Jes-*

Table 1. Palm species richness and density at Ferrocaño site on 0.71 ha. S, single-stemmed; M, multi-stemmed; Acs, acaulescent with small leaves; Acl, acaulescent with large leaves; L, lianescent; P, procumbent; LU, lower understory (adult height less than 6 m); UU, upper understory (adult height 6–10 m); AR, arborescent (adult height above 10 m); N, total number of palms.

Palm Species	Height Classes			N	Life Form
	<1 m	1–10 m	>10 m		
Astrocaryum chambira	0	1	0	1	S.AR
Bactris acanthocarpoides	2	2	0	4	M.LU
Bactris humilis	0	1	0	1	M.LU
Bactris cf. *hylophila*	3	11	0	14	M.LU
Bactris mitis	2	10	0	12	M.LU
Bactris piranga	0	1	0	1	M.LU
Bactris simplicifrons	1	2	0	3	M.LU
Bactris sphaerocarpa	339	898	0	1,237	M.LU
Bactris sp. aff. *B. mitis*	2	3	0	5	M.LU
Bactris sp. 1	9	14	0	23	M.LU
Bactris sp. 2	12	101	0	113	M.LU
Chelyocarpus repens	18	188	0	206	S.P.LU
Desmoncus cf. *leptospadix*	1	1	0	2	M.L.UU
Euterpe precatoria	28	8	0	36	S.AR
Geonoma acaulis	17	53	0	70	Acs.LU
Geonoma leptospadix	15	22	0	37	M.LU
Geonoma piscicauda	76	102	0	178	M.LU
Geonoma poeppigiana	22	80	0	102	S.LU
Geonoma spixiana	57	191	0	248	M.LU
Hyospathe cf. *weberbaueri*	5	15	0	20	M.LU
Iriartella stenocarpa	120	67	0	187	M.LU
Jessenia bataua	151	195	0	346	S.AR
Lepidocaryum tessmannii	455	3,346	0	3,801	M.LU
Maximiliana maripa	0	1	0	1	S.AR
Oenocarpus balickii	6	3	4	13	S.AR
Orbignya polysticha	8	182	0	190	Acl.LU
Pholidostachys synanthera	27	117	0	144	S.LU
Socratea exorrhiza	2	0	1	3	S.AR
Wettinia augusta	1	5	0	6	M.UU
	1,379	5,620	5	7,004	

senia bataua were located at the limit with a gleyic podzol, on which this species forms a dense population beyond the area surveyed.

At both sites, most of the species are small, understory palms (23/29 at Ferrocaño; 27/34 at Copal), and most of the palm community is distributed under 10 m in height (99.9% at Ferrocaño; 99.3% at Copal). The density of large palms (above 10 m in height) is higher at Copal, 25 on 0.5 ha, than at Ferrocaño, which had five individuals on 0.71 ha. The percentage of palms under 1 m in height is low at Ferrocaño (19.7%) and high at Copal (62.4%). In the first site, the low value, due to the low density of most species, is accentuated by the high density reached by *Lepidocaryum tessmannii* and *Bactris sphaerocarpa* between 1 and 10 m. In the second site, the high value is due to the high density of seedlings of two arborescent species, *Iriartea deltoidea* and *Jessenia bataua*, and of juveniles of three small, understory species, *Hyospathe elegans*, *Chamaedorea integrifolia*, and *Geonoma piscicauda*, which are particularly abundant in the clearings.

Table 2. Palm species richness and density at Copal site on 0.5 ha. (Legend: see Table 1).

Palm Species	Height Classes <1 m	1–10 m	>10 m	N	Life Form
Aiphanes ulei	2	5	0	7	Acs.LU
Astrocaryum chambira	14	21	2	37	S.AR
Astrocaryum macrocalyx	31	66	0	97	S.UU
Bactris acanthospatha	3	10	0	13	M.LU
Bactris bifida	7	13	0	20	M.LU
Bactris piranga	2	2	0	4	M.LU
Bactris sp. 3	8	17	0	25	M.LU
Bactris sp. 4	1	7	0	8	M.LU
Chamaedorea integrifolia	105	103	0	208	S.LU
Chelyocarpus repens	7	14	0	21	S.P.LU
Desmoncus cf. *leptospadix*	4	24	0	28	M.L.UU
Euterpe precatoria	70	21	0	91	S.AR
Geonoma acaulis	46	53	0	99	Acs.LU
Geonoma camana	21	22	0	43	S.LU
Geonoma oligoclona	33	9	0	42	M.LU
Geonoma piscicauda	94	65	0	159	M.LU
Geonoma poeppigiana	32	42	0	74	S.LU
Geonoma pycnostachys	30	47	0	77	M.LU
Geonoma spixiana	32	52	0	84	M.LU
Geonoma cf. *tamandua*	4	9	0	13	Acs.LU
Hyospathe elegans	415	221	0	636	M.LU
Iriartea deltoidea	919	9	19	947	S.AR
Iriartella stenocarpa	28	17	0	45	M.LU
Jessenia bataua	260	161	4	425	S.AR
Lepidocaryum tessmannii	43	240	0	283	M.LU
Maximiliana maripa	34	27	0	61	S.AR
Oenocarpus mapora	0	5	0	5	M.UU
Orbignya polysticha	0	1	0	1	Acl.LU
Pholidostachys synanthera	31	51	0	82	S.LU
Phytelephas macrocarpa	0	18	0	18	M.LU
Scheelea bassleriana	18	13	0	31	S.AR
Socratea exorrhiza	14	8	0	22	S.AR
Socratea salazarii	81	36	0	117	S.UU
Wettinia augusta	7	8	0	15	M.UU
	2,396	1,417	25	3,838	

Discussion

Both palm communities are characterized by a very high diversity. Data from the Ferrocaño site were previously compared with those from central and eastern Amazonian forests (Kahn et al. 1988): 29 species in 16 genera on 0.71 ha in the lower Ucayali River valley; 26 species in 9 genera on 0.72 ha in the lower Rio Negro valley, near Manaus; and 12 species in 8 genera on 3.84 ha in the lower Tocantins valley, eastern Amazonia. The inventory at Copal site brings a new record: 34 species in 21 genera on 0.5 ha—with up to 18 species on 0.01 ha, i.e., more species than on 3.84 ha surveyed in the lower Tocantins River valley. Three genera found in the area surveyed at the Copal site, *Aiphanes*, *Chamaedorea*, and *Iriartea*, are not frequent at low elevations (less than 200 m above sea level) in Peruvian Amazonia, while they are rather common in the forests of the Andean piedmont and on mountain slopes. A fourth genus, *Dictyocaryum* (M & K 2010, USM), not inventoried in the plots, occurs in the same forest near the area surveyed. This genus was previously known only from higher elevations (1,800–2,200 m) in Peru (Gentry 1986). The occurrence of these four genera, as well as that of certain species (*Socratea salazarii* and *Wettinia augusta*) which are frequent on the Andean piedmont, points out the influence of the subandean palm flora on the western lowlands of the Amazon basin. As a result, palm diversity is high in the Peruvian Amazonia.

Acknowledgment

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LITERATURE CITED

BLACK, G. A., TH. DOBZHANSKY, AND C. PAVAN. 1950. Some attempts to estimate species diversity and population density of trees in Amazonian forests. Bot. Gaz. 111: 413–425.

BOOM, B. M. 1986. A forest inventory in Amazonian Bolivia. Biotropica 18: 287–294.

FAO-UNESCO. 1971. Soil map of the world. Vol. IV, South America. UNESCO, Paris.

GENTRY, A. H. 1982. Patterns of neotropical plant species diversity. Evol. Biol. 15: 1–84.

———. 1986. Notes on Peruvian palms. Ann. Missouri Bot. Gard. 73: 158–165.

———. AND C. H. DODSON. 1987. Contribution of nontrees to species richness of tropical rain forest. Biotropica 19: 149–156.

GRANVILLE, J. J. DE. 1978. Recherche sur la flore et la végétation guyanaises. Thèse Doctorat d'Etat, Univ. Montpellier. 272 p.

KAHN, F. 1986. Les palmiers des forêts tropicales humides du bas Tocantins (Amazonie brésilienne). Rev. Ecol. (Terre et Vie) 41: 3–13.

——— AND A. DE CASTRO. 1985. The palm community in a forest of central Amazonia, Brazil. Biotropica 17: 210–216.

———, K. MEJIA, AND A. DE CASTRO. 1988. Species richness and density of palms in terra firme forests of Amazonia. Biotropica 20: 266–269.

PIRES, J. M., TH. DOBZHANSKY, AND G. A. BLACK. 1953. An estimate of the number of species of trees in an Amazonian forest community. Bot. Gaz. 114: 467–477.

PRANCE, G. T., W. A. RODRIGUEZ, AND M. F. DA SILVA. 1976. Inventario florestal de um hectare de mata de terra firme, km 30 da estrada Manaus-Itacoatiara. Acta Amazonica 6(1): 9–35.

SIST, P. 1985. Régénération et dynamique des populations de quelques espèces de palmiers en forêt guyanaise. DEA Univ. Paris VI. 60 p.

Principes, 35(1), 1991, p. 26

PALM LITERATURE

MINTER, SUE, with contributions from CHRIS JONES, PETER MORRIS, and PETER RIDDINGTON. 1990. The Greatest Glasshouse: the Rainforests Recreated. London: HMSO. L25.00.

This attractive book is divided into two parts. The first part "Greenery among the iron: the Palm House and its collections" has ten chapters. The first three discuss the origin of the Palm House, the development of plant collections in Victorian times, and the changing methods used by the staff in caring for the important collections of plants. The remaining seven chapters present the structure of the rainforest and explain how the Palm House exhibits it. Detailed discussions of the rainforest plants grown are presented in chapters on palms, cycads and pandans, tropical climbers, fruits, flowers, and plants of the forest floor. The section on palms is 23 pages long, beautifully illustrated in color and black and white, and is a well done and very complete overview of the family. The treatments of the other plant groups are equally good.

(*Continued on p. 52*)

Principes, 35(1), 1991, pp. 27–46

An Annotated Key to the Cultivated Species of Coccothrinax

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Though slow growing, species of *Coccothrinax* are attractive landscape palms and are especially well suited to drought-prone areas with calcareous soils. Because of these attributes, *Coccothrinax* has been a focus of horticultural interest for many years in south Florida among palm enthusiasts and staff members of Fairchild Tropical Garden (FTG). As a result, FTG displays about 120 accessions of *Coccothrinax*, which makes it one of the largest generic collections there.

Until recently, however, these living specimens remained unidentified as a consequence of confusion in the taxonomic literature, which is fragmented and hinders easy genus-wide comparisons for routine identification. For example, we point out the following five situations: 1) Bailey (1939*b*, 1949) provided keys only to the species of the southern Greater Antilles and the Lesser Antilles. Moreover, Read (1979) has shown that the species Bailey accepted are oversplit, which makes them difficult to identify. 2) León (1939, 1946) and Muñiz and Borhidi (1982*b*) provided keys only for Cuban taxa. 3) The original descriptions often lack comparative discussion of characters. 4) The total number of species that Moore (1973) cited is 20, whereas Glassman (1972) listed 37. 5) Since 1966, numerous name changes have been proposed, and 14 new taxa have been described (Borhidi and Muñiz 1971, 1972, 1985; Muñiz and Borhidi 1982*a*, *b*; Quero 1980; Read 1966*a*, *b*, 1980).

Fortunately, many of the species are endemic, each to a particular region, and are often each the sole representative of the genus there. Consequently, wild collections from those areas can aid one greatly in evaluating the original descriptions and other taxonomic literature. To identify the plants in *Coccothrinax* at FTG, we incorporated a study of wild collections in the following ways: 1) By computer assisted morphometric techniques, four populations of *C. argentata* in Florida were analyzed for morphological variation (unpubl. data, but see Sanders 1986). 2) Herbarium specimens and seeds of *Coccothrinax* species were collected in Hispaniola, Trinidad, and the Yucatan peninsula (Appendix I). 3) Specimens were made from accessions grown from seeds of known provenance (Appendix I). 4) We studied specimens of garden accessions given to FTG as authentic material by H. León, R. Read and the National Botanical Garden of Cuba (HAJB) (Appendix II). 5) Specimens and photographs of specimens cited in the original descriptions were examined (Appendix III).

Together, these specimens were compared with the available keys (cited above) and with descriptions and illustrations of all the known species of *Coccothrinax* (Bailey 1939*a*, *b*, 1947*a*, *b*, 1949; Beccari 1907, 1913; Borhidi and Muñiz 1971, 1972, 1985; Borhidi et al. 1978; Britton and Wilson 1923; Burret 1929; Chapman 1883; Duss 1897; Grisebach 1864; Hodge 1942, 1954; Kunth 1822, 1841; León

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1939, 1946; Little et al. 1974; Martius 1837–53; Maycock 1830; Mueller 1858; Muñiz and Borhidi 1982*a*, *b*; Quero 1980; Read 1966*a*, *b*, 1972, 1975, 1979, 1980; Sargent 1899, 1902; Sauvalle 1871, 1873; Schultes and Schultes 1830; Sprengel 1825; Urban 1903, 1920; Victorin and León 1942, 1944, 1956). The wild and authentic collections were matched with species names. This clarified the use of terms in the various descriptions and allowed us to establish our concepts of the species. To identify the unidentified accessions, we then attempted to match them with the named collections. If unsuccessful, we matched the specimen with a description or also an illustration. With respect to "lumping," "splitting," and synonymy, we followed the judgement of recent authors with extensive field experience, such as Read, Muñiz, and Borhidi.

To facilitate matching unidentified plants with our concepts of the cultivated species, we composed the key below. Because FTG has all the species that, to our knowledge, are in cultivation in south Florida and perhaps elsewhere outside of Cuba, we believe that the key should be available to the public, especially for the benefit of palm enthusiasts. The key is preceded by brief cautionary notes and definitions of characters. The key is organized to present the species in three easily recognizable, coherent species-groups—the Argentea Group, the Argentata Group, and the Miraguama Group—that are based on unpublished morphometric analyses that were presented at the Palm Symposium held at Cornell University in 1987. After the key, each species is listed with its author and place of publication, common names, synonyms, native habitats (as a guide for culture needs), and notes for distinguishing closely related or confusing species. The species are alphabetical within species groups, which also are described. The common names in italics are those proposed here as unique English names to be used in American horticulture.

Guide to the Use of the Key

The key is intended to be used with adult plants; i.e., plants that have produced at least one inflorescence. Many of the characteristics are size-related and, therefore, are of little use with juvenile plants.

Plants grown from seeds obtained from a garden under conditions of open pollination are likely to be hybrids. If so, they will not key out well because the key characters may be intermediate or recombined. We encountered several such putatively hybrid accessions in FTG. In particular, our plants of *C. miraguama* from garden sources exhibit much wider variation within the subspecies than what is described in the literature. We attribute this variation to the ease of hybridization among these genetically close taxa.

The name *Coccothrinax martii* (Griseb. & H. A. Wendl.) Becc. has been used in horticulture (Moore 1963). Beccari (1907) published the combination after he saw specimens preserved at Stockholm that were collected by Charles Wright. Although these were given the same distribution number as the type specimens of *Thrinax martii* studied elsewhere by Grisebach and Wendland (Grisebach 1866), they are not part of the type collection. Because *T. martii* is a synonym of *T. radiata* J. A. & J. H. Schult. (Read 1975), *C. martii* is also a synonym of *T. radiata* and is not to be considered further in *Coccothrinax*, even though the material seen by Beccari (but not the type) belongs to *Coccothrinax* rather than *Thrinax*.

Several terms and structures used repeatedly in the keys require explanation (Figs. 1–10).

Lamina (Leaf-Blade) Orbicularity. This character refers to the outline of the leaf blade in mature leaves. Fully (4/4) orbicular refers to a circular outline; less than fully (e.g., 1/3, 1/2, or 3/4) orbicular refers to a condition in which the outer segments form an angle giving the leaf a cuneate, semi-circular, or crescent shape; and more than fully (e.g., $\frac{5}{4}$) orbicular refers to a condition in which the outer segments overlap in a spiral-like manner.

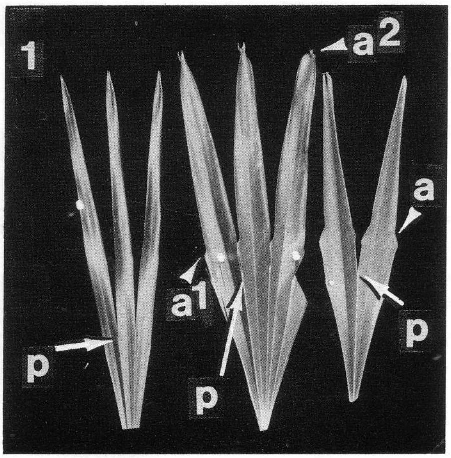
Lamina Coloration. The adaxial (upper) and abaxial (lower) leaf surfaces are both green in color. In most species, the presence, persistence, and color of an indument of finely dissected scale-like hairs will variously modify the overall color of the abaxial surface. The abaxial surface may range from green (with almost no indument and the lamina therefore concolorous) to whitish, gray, or silver (with a very dense indument), and in some taxa, it may have ferrugineous, yellowish, golden, or bronze hues. The feature is sometimes variable within a species, especially when the indument is caducous to deciduous.

Segments. This term refers to the leaf segments in the central region of the blade (Fig. 1). Length is measured from the hastula to the apex; width, at the widest point along the segment.

Hastula. Although frequently used by previous authors to distinguish many taxa, the hastula is often too variable to be used taxonomically. *Coccothrinax readii* exhibits a unique hastula, which is two-toothed at maturity. The split results from a normal developmental process and should not be confused with physical tearing or splitting seen in other species.

Palman. The palman is that portion of the leaf which is not split and excludes the free segment apices (Fig. 1). Because the length of the unsplit area decreases from the central segments to the outer or basal segments, the palman measurements in the key are taken from the hastula to the sinus along the line between the two central segments. Occasionally, these segments are unsplit for an abnormally much longer distance than are the remaining segments. In this case, a reasonable estimate of the palman can be obtained from the degree of splitting in the next adjacent pairs of segments.

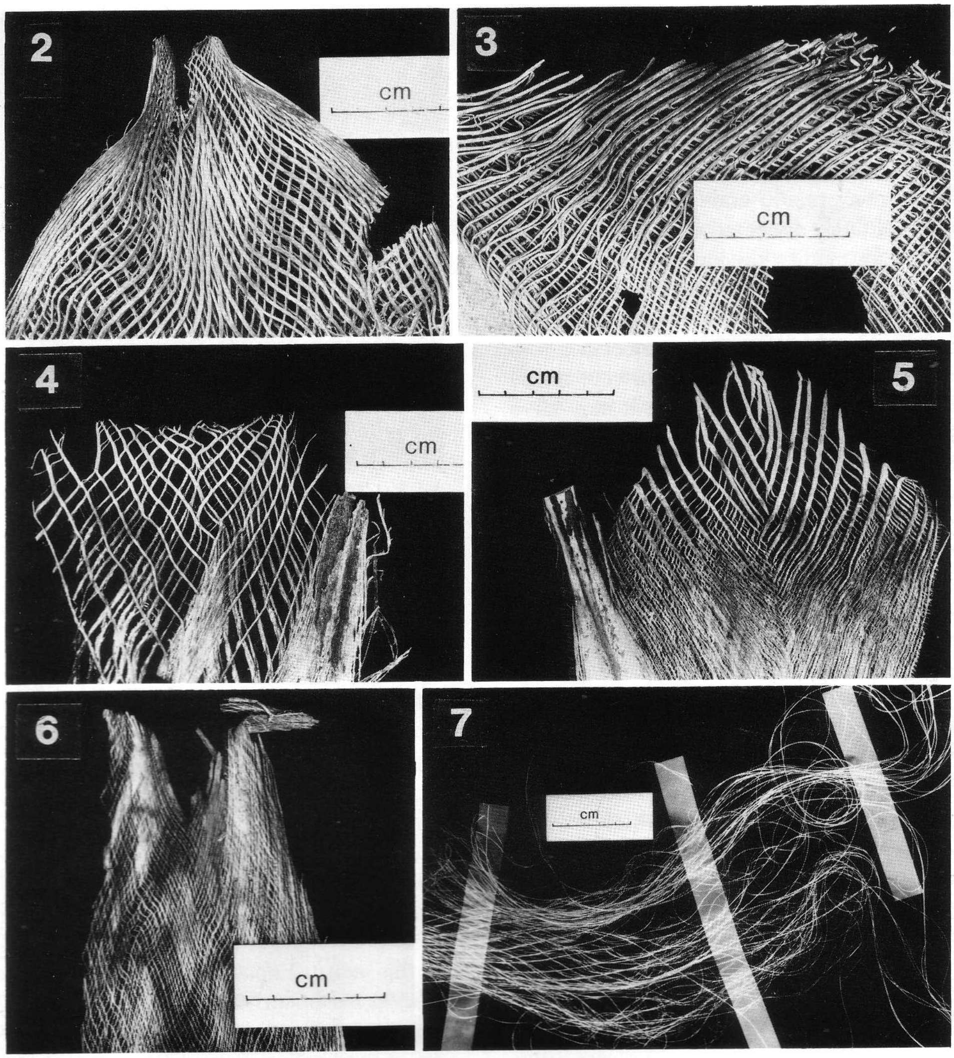
Distal Taper of Segments (Fig. 1). In general, the leaf segments gradually taper



1. Central portions of laminas × $\frac{1}{10}$. Left, *C. readii*, note lax, ± gradually tapering segments and pleating only in palman (p = outer limit of palman). Center and right, *C. miraguama*, note shoulder-shaped acuminations (a) and ± strong longitudinal pleating for entire length of segments. In center, note less pronounced proximal acuminations (a^1) and extreme apical ones (a^2). Apical point is portion of each segment from *a* (or a^2) to tip.

distally from their widest point to the very tip. In many plants, the segment is slightly constricted with opposite, shallowly concave indentions at a point about half way from the palman to the tip. The original width of the segment and original tapering lines of the margin are resumed just distal to this constriction. However, in certain species, particularly the Miraguama Group, this constriction is accentuated as a shoulder-shaped acumination. The margins follow convex-concave courses, such that the segment is abruptly narrowed at that point from where it begins its final distal taper to the apex. In extreme cases the acumination is further accentuated by a noticeable dilation just proximal to the constriction. In *C. miraguama*, a few plants, which we suspect have a hybrid ancestry, have only the shallow, concave constriction near the palman and small "shoulders" within about one cm of the segment apex.

Leaf-Sheath Structure (Figs. 2–7). The



2–7. Leaf sheaths. 2–3. *C. miraguama* subsp. *roseocarpa*, note strands in three layers, tightly woven. 2. Ligule of newly matured sheath, note entire margins of fused finer strands. 3. Persistent sheath from trunk below crown of leaves, note that deterioration of margin has left a few strands falsely "free" and that stretching on trunk has warped many strands. 4. *C. scoparia*, strands in two layers, loosely woven, a few strands falsely "free" by aging. 5. *C. ekmanii*, strands in two layers, tightly woven, with free tips (due to fusion of strands). 6. *C. argentata*, strands in two layers, tightly and loosely woven bands alternating, ligule constituting approximately upper half of this flap of sheath. 7. *C. crinita*, central portion of ligule, strands in two layers, loosely woven, with free tips (due to elongation of strands).

leaf sheath contains a network of greatly enlarged fibrovascular bundles. These are the "sheath fibers" of other students of *Coccothrinax*. However, because of confusion with anatomical fibers, we follow Tomlinson (1964) in calling them strands. In *Coccothrinax*, the strands occur in two or three distinct layers; those within a layer run parallel to one another and more or less perpendicular to those of an adjacent layer. The strands within a layer are held together by a reticulum of distinctly smaller cross-strands that branch at right angles from the strands and anastomose with adjacent strands.

Number of Leaf-Sheath Layers. The number of layers is best determined from mature leaf sheaths. If the strand layers on the inside (adaxial surface) and outside (abaxial surface) run in perpendicular directions, then there are only two layers (Figs. 4–7). If the inside and outside layers run the same direction, there is a third layer sandwiched between them, running in the perpendicular direction (Figs. 2,3). Notably, the distinction between two and three leaf-sheath layers breaks down in *C. miraguama,* in which the leaf sheaths can have three layers toward their bases and two layers toward their apices.

Thickness of Leaf-Sheath Strands. This character is measured as the average width of the thicker strands in the body of the leaf sheath (unless otherwise specified).

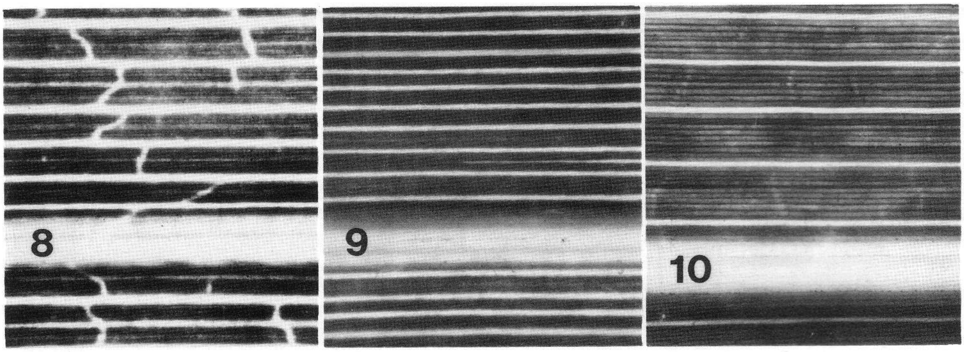
Tightly vs. Loosely Woven Leaf Sheaths. Strands are separated by a distance 1–2 times the strand thickness in tightly woven leaf sheaths (Figs. 2,3,5), and by 3–5 times or more their thickness in loosely woven leaf sheaths (Figs. 4,7). This character is evaluated in the central portion of the leaf sheath. Extreme expressions of this character are useful for distinguishing some taxa or groups but are more variable in other taxa (Fig. 6).

Free Strand Tips. The apical margin of the leaf sheath can bear free strand tips, of which there are two distinct types that differ in development. The first is the result of extensive elongation of the distal portions of the leaf sheath and is characterized by long, flexuous, thin, very loosely interconnected strands (Fig. 7). The overlapping sheaths resemble a mat of hair densely covering and concealing the stem and petiole bases. This type is found exclusively in the Crinita Complex of the Argentata Group. Studies of juveniles indicate this type is derived from leaf sheaths characteristic of the Argentata Complex. The second type of free strand tips is not a result of elongation but of a persistence of stout "vertical" strands and a developmental deterioration and loss of interconnecting cross strands at the leaf sheath apex. These strand tips are often thick and spinelike and usually consist of fused bundles of smaller individual strands (Fig. 5). In species considered here as *not* having free leaf-sheath strand tips, the leaf sheath may fragment with age or abrasion, and some strands are left falsely "free" along the margin (Figs. 3,4).

Ligule. Above its tubular portion, the leaf sheath usually bears an apical, nontubular projection, the ligule, opposite the stem from the petiole (Uhl and Dransfield 1987). The length of the ligule is sometimes difficult to measure because, as the leaf matures, the strands that attach the sheath to the petiole are stretched and broken. The resulting free flap of sheath, thus, includes ligule plus the detached tubular portion. In measuring the ligule, disregard any basal portion of the unattached flap that has its lateral margins bounded by broken strands (Figs. 4,5,6).

Transverse Veinlets (Figs. 8–10). These are veins running perpendicular to the long axis of the segment. Transverse veinlets are considered "present" only if a well developed reticulum is exhibited, that is one that can easily be seen with the unaided eye or a hand lens (Fig. 8 vs. 9). These are sometimes obscure in dry material; and, regardless of whether observed in dry or fresh leaves, the veinlets are most clearly visible when viewed with transmitted light. Some species, notably *C. crinita,* will sometimes exhibit poorly developed, minute, or indistinct transverse veinlets at maturity (Fig. 10).

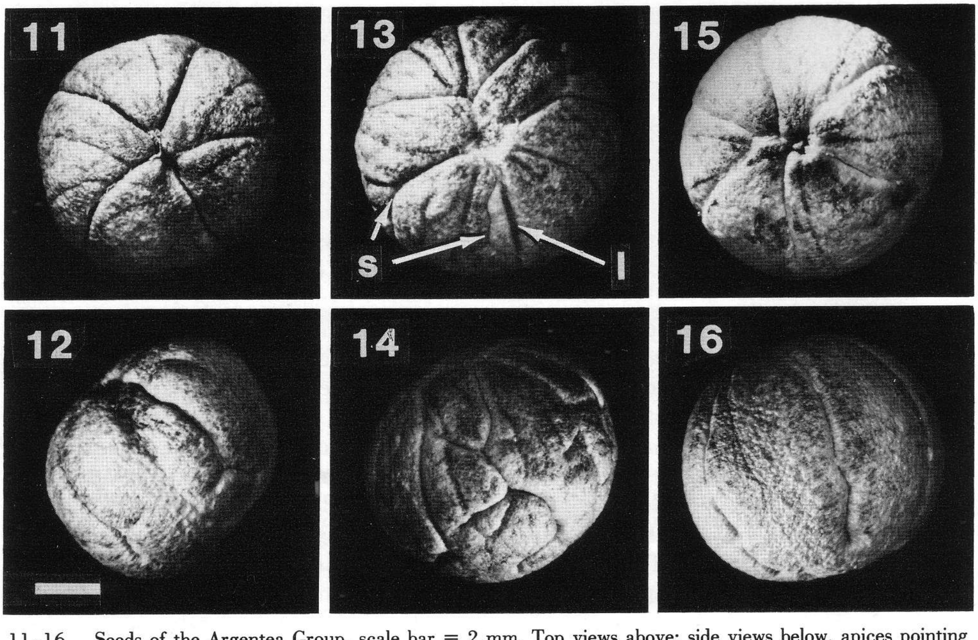
Pedicel Length. Pedicels often elongate during fruit set so that the flowers and fruits may have considerably different pedicel lengths on a given plant. Since anthesis is short-lived (1 to 2 days), pedicel lengths are given for fruits. Also, pedicel length is



8–10. Fresh leaf segments, viewed with transmitted light ×10. Largest vein in each is segment midrib. 8. *C. barbadensis*, with well developed transverse veinlets. 9. *C. argentata*, lacking veinlets. 10. *C. crinita*, adult leaf; note very weakly translucent transverse lines, interpreted here as not representing well developed veinlets.

often variable even along a single rachilla and flowers or fruits may range from distinctly pedicellate to subsessile along the rachis. Therefore, pedicel length refers to the longer pedicels on a given inflorescence, generally those on the lowermost rachillae of the lower primary branches of the inflorescence.

Stamen Number. Stamen number is variable, even within an inflorescence, but a reasonably narrow range generally can be determined for a given plant. Therefore,



11–16. Seeds of the Argentea Group, scale bar = 2 mm. Top views above; side views below, apices pointing toward upper left. Note differences between grooves (i.e., sulci, s) and the shallowly impressed segmented lines (l) which sometimes converge with the grooves. 11–12. *C. argentea.* 13–14. *C. barbadensis.* 15–16. *C. spissa.*

several flowers should be counted to determine the most frequent number. The filaments (and perianth) often persist and can be examined on fruiting specimens.

Ovary and Fruit Surface. Muricate ovaries (roughened by papillae) are typical of *C. ekmanii.* They usually develop into fruits that are dry, tan or pale brown, and papillate to warted. Most other species possess a smooth ovary and a fruit that is fleshy, and purple to blackish purple.

Key to the Cultivated Species of Coccothrinax

1. Transverse veinlets present (sometimes obscured in *C. guantanamensis*; i.e., intermediate between Figs. 8 and 10) [ARGENTEA GROUP]. 2
1. Transverse veinlets absent (or sometimes poorly developed in *C. crinita* and *C. inaguensis* of the Argentata Group). 6
2. Palman less than 20 cm long (sometimes central 2 to 3 segments unsplit for as much as 25 cm); grooves on seed 3 to 6, ± straight, with endosperm lobes not closely compressed but separated by thin to rather wide spaces (at least in upper ⅔) [Figs. 11,12]. 3
2. Palman usually 20 cm or more long (i.e., all segments of central portion unsplit for more than 20 cm); seed grooves 6 or more, straight to flexuous, very narrow, with endosperm lobes closely compressed or overlapping and not separated by any spaces [Figs. 13–16]. 4
3. Leaf segments mostly 30–50 cm long; inflorescence 30–50 cm or less long with 2 to 4 (5) primary branches; stamens 6 to 8 (9), ca. 1 mm long. .... **2. C. argentea**
3. Leaf segments mostly 50–80 cm long; inflorescence (50) 60–100 cm long with (4) 5 to 8 primary branches; stamen 9 to 15, ca. 2 mm long. .... **4. C. guantanamensis**
4. Seed grooves much branched, flexuous or contorted giving the seed a brainlike appearance (cerebriform) [Figs. 13,14]; inflorescence with (4) 5 to 10 primary branches; fruiting pedicels usually more than 3 mm long. .... **3. C. barbadensis**
4. Seed grooves little branched, ± straight, not giving the seed a brainlike appearance [Figs. 15,16]; inflorescence with 3 to 4 (rarely to 6) primary branches; fruiting pedicels usually 0.5–3 mm long. 5
5. Stem 5–15 cm thick, columnar; primary inflorescence branches less than 25 cm long. .... **1. C. alta**
5. Stem 20–30 cm or more thick, often ventricose; primary inflorescence branches 25–45 cm long. .... **5. C. spissa**
6. Leaf-sheath layers always 2 with strands fine, the larger ones usually less than 0.5 mm, (occasionally up to 1 mm thick near base of sheath in *C. proctorii* and *C. litoralis*); leaf segments [Fig. 1] usually lax or drooping, becoming flattened beyond the palman, usually lacking shoulder-shaped acuminations [ARGENTATA GROUP]. 7
6. Leaf-sheath layers 2 or 3 with strands rather stout, the larger ones mostly 1–2 mm or more thick (if only 0.5–1 mm thick, then the sheath layers 3); leaf segments [Fig. 1] usually rigidly folded lengthwise from hastula to near tips, usually with prominent shoulder-shaped acuminations [MIRAGUAMA GROUP]. 16
7. Leaf sheath with free strand tips (due to strand elongation) present, the ligule a swatch of hair more than 10 cm long [Crinita Complex]. 8
7. Leaf sheath lacking free strand tips, the ligule an entire or tardily fragmenting flap of woven strands 0–30 cm long [Argentata Complex]. 10
8. Seeds less than 12 mm diam.; leaf segments 40–70 cm long; petioles 10–15 cm long; inflorescence less than 70 cm long; stamens 7 to 9. .... **7. C. borhidiana**
8. Seeds 12 mm or more in diam.; leaf segments 70 cm or more long; petioles more than 20 cm long; inflorescence 70 cm or more long; stamens 10 or more. 9
9. Ligule equal to or longer than the tubular portion of the sheath; abaxial lamina surface shiny with conspicuous ferrugineous glands. .... **8a. C. crinita** subsp. **crinita**
9. Ligule shorter than the tubular portion of the sheath; abaxial lamina surface dull ferrugineous-tomentose becoming glabrescent and exposing inconspicuous whitish glands. .... **8b. C. crinita** subsp. **brevicrinis**
10. Lamina abaxially dull, green or grey-green, indument lacking or, if present, partly deciduous and sparse to patchy on mature leaves (sometimes so in depauperate members of *C. argentata*, see discussion of *C. fragrans*). 11
10. Lamina abaxially lustrous, silvery, metallic light green, golden or bronze, the indument persistent and dense on mature leaves. 12

11. Lamina shallowly saddle-shaped, abaxially with scattered pale mounded dots that are conspicuous under a 10× lens and give the veins a noduled appearance; leaf segments shallowly bifid 1–3 (5) cm at apex; ligule 0–3 cm long, usually subtruncate. .... **9. C. fragrans**
11. Lamina usually shallowly conic (like an inverted umbrella), abaxially without minute pale mounded dots, such that veins do not appear noduled; leaf segments usually deeply bifid (3.5) 5–11 cm at apex; ligule often attenuate or narrowly triangular, (3) 10–30 cm long. .... **10. C. inaguensis**
12. Primary inflorescence branches 2 to 6 (rarely more); the longer fruiting pedicels mostly 1–3 mm (occasionally to almost 5 mm in southern Bahamian *C. argentata*). 13
12. Primary inflorescence branches 6 to 9 (mostly 7, but rarely as few as 4); the longer fruiting pedicels (3) 4–7 mm long. 14
13. Leaf segments mostly 30–50 cm long (sometimes up to 70 cm); palman 4–15 (20) cm long; ligule triangular, lobed, or nearly truncate; stem 3–15 cm diam.; inflorescence axes dark yellow in fruit. .... **6. C. argentata**
13. Leaf segments mostly 70–100 cm long; palman 20–40 cm long; ligule usually irregularly truncate; stem (12) 15–20 cm diam.; inflorescence axes greenish in fruit. .... **12. C. litoralis**
14. Leaf segments 60–100 cm long; sheath strands wiry, often 0.5–1 mm thick; style plus stigma longer than ovary (before late anthesis). .... **13. C. proctorii**
14. Leaf segments mostly 40–70 cm long; sheath strands threadlike, usually 0.5 mm or less thick; style plus stigma shorter to almost equalling ovary. 15
15. Adaxial hastula two-toothed at the apex; stem 3–6 (9) cm diam.; number of leaf segments usually fewer than 40. .... **14. C. readii**
15. Adaxial hastula not two-toothed at the apex; stem 6–20 cm diam.; number of leaf segments usually 40 or more. .... **11. C. jamaicensis**
16. Leaf sheath with free strand tips lacking or only up to about 1 cm long; sheath-strand layers 2 or 3. 17
16. Leaf sheath with free strand tips well developed, more than 2 cm long, sheath-strand layers only 2. 24
17. Number of leaf segments mostly 40 to 55; longer fruiting pedicels mostly 3–6 mm long (occasionally as little as 2 mm long in *C. miraguama* subsp. *arenicola*) [*C. miraguama*, couplet 18 leads to subspecies]. 18
17. Number of leaf segments 20 to 38; longer fruiting pedicels mostly 0–2 mm long (occasionally up to 4 mm long in *C. cupularis*). 21
18. Strands of the leaf sheath wiry, the larger ones 0.5–1 mm thick, in 3 layers; adaxial hastula ovate-triangular, about 1.5–2.5 cm long. .... **20b. C. miraguama** subsp. **arenicola**
18. Strands of the leaf sheath woody, the larger ones (1) 1.5–2.5 mm thick, in 2 or 3 layers; adaxial hastula low, rounded or with a central rounded triangular part, usually 1.5 cm or less long. 19
19. Leaf segments mostly 40–50 cm long, with the apical point (distal to shoulder-shaped acumination, Fig. 1) mostly 4–14 cm long; sheath-strand layers 3; fruits maturing rose-purple. .... **20d. C. miraguama** subsp. **roseocarpa**
19. Leaf segments mostly 60–70 cm long, with the apical points mostly (15) 20–30 cm long; sheath-strand layers 2 or 3; fruits sometimes passing through a rose purple phase but quickly maturing purple-black. 20
20. Leaf-sheath layers 2 (occasionally with a few strands in 3 layers near the base); stamens 8 to 10, with filaments fused together only at very base; fruit usually 7–9 mm diam. .... **20a. C. miraguama** subsp. **miraguama**
20. Leaf-sheath layers 3; stamens usually 12, with filaments often fused together in lower ⅓ forming a shallow cup; fruit usually 8–12 mm diam. .... **20c. C. miraguama** subsp. **havanensis**
21. Lamina ½–¾ orbicular; filaments fused together for about ½ their length, forming a cupule around the ovary. .... **16. C. cupularis**
21. Lamina ¾–⅘ orbicular; filaments fused together only at very base, not forming a cupule around the ovary. 22
22. Number of leaf segments about 32 to 38; leaf-sheath strands in 2 layers; perianth lobes ovate or rounded, each with 3 or more irregular apical teeth. .... **22. C. scoparia**
22. Number of leaf segments about 20 to 30; leaf-sheath strands in 3 layers; perianth lobes triangular, attenuate, or cuspidate, ± apically entire. 23
23. Leaf-sheath strands about 1–2 mm thick, woody; leaf segments 1–1.8 cm wide; stamens ± 6. .... **19. C. gracilis**
23. Leaf-sheath strands about 0.5–1 mm thick, wiry; leaf segments 2–4 cm wide; stamens ± 9. .... **23. C. yuraguana**
24. Number of leaf segments 35 to 50; leaf sheath with the free strand tips 4–9 mm wide. .... **21. C. salvatoris**
24. Number of leaf segments 20 to 32; leaf sheath with the free strand tips 1–3 mm wide. 25

25. Ovary muricate, fruit dry and corky; lamina about ½ orbicular. **17. C. ekmanii**
25. Ovary smooth, fruit fleshy; lamina ± orbicular. 26
26. Leaf sheath with free strand tips 2–3 cm long; leaf segments 30–60 cm long; primary inflorescence branches 4 to 7. **15. C. clarensis**
26. Leaf sheath with free strand tips 4–7 cm long; leaf segments 20–25 cm long; primary inflorescence branches 2 to 4. **18. C. garciana**

Species Notes

Argentea Group

This group contains a single complex of closely related species, distributed from Cuba to Trinidad. The group is characterized by robust, often tall (to 15 m or more) plants, by tightly woven leaf sheaths of relatively fine strands without free strand tips at the margin, by gradually tapering leaf segments (except in some plants, especially those of *C. argentea,* which have shoulder-shaped acuminations), by transverse veinlets, and by somewhat tubular inflorescence bracts. This suite of characters appears to be rather primitive, having changed little from the condition in the related genus, *Thrinax*. Together, the Argentea and Argentata Groups correspond roughly to *Coccothrinax* section *Coccothrinax* of Muñiz and Borhidi (1982*b*).

1. Coccothrinax alta (*O. F. Cook*) *Becc.*, Webbia 2: 331. 1907.
SYNONYMS: *Coccothrinax laxa* (O. F. Cook) Becc., Webbia 2: 333. 1907. *Coccothrinax latifrons* (O. F. Cook) Becc., Webbia 2: 326. 1907. *Coccothrinax eggersiana* Becc., Webbia 2: 321. 1907. *Coccothrinax sanctithomae* Becc., Webbia 2: 303. 1907. *Coccothrinax discreta* L. H. Bailey, Gentes Herb. 8: 104, f. 11c, 15–17. 1949.
PALMA DE ABANICO, TYRE PALM OR TEYER TREE, YARAY, *PUERTO RICAN SILVER THATCH.*

Puerto Rico and the Virgin Islands, frequent in low hills and slopes of calcareous areas.

Coccothrinax alta appears to be closely related to *C. barbadensis,* differing from the latter primarily in smaller inflorescences, shorter pedicels, and non-cerebriform seeds.

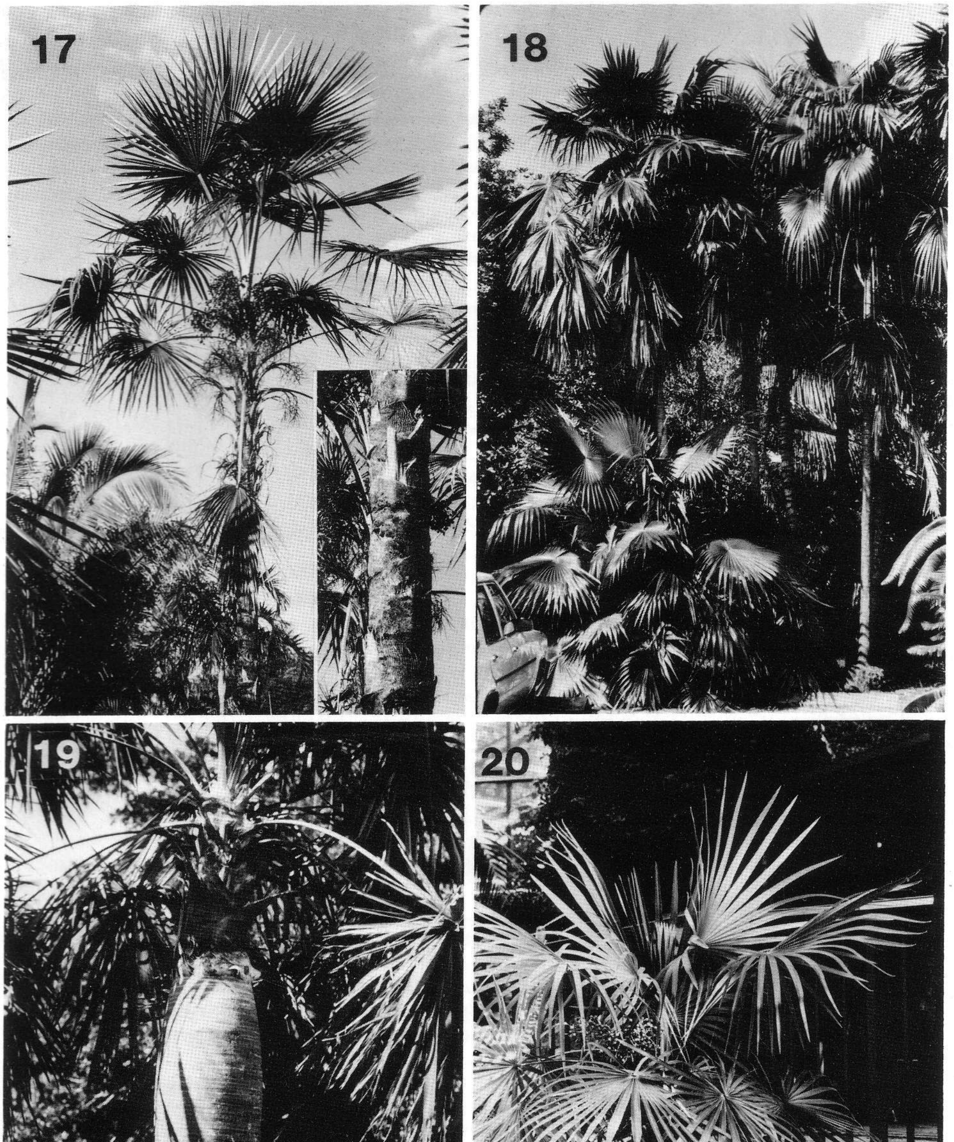
2. Coccothrinax argentea (*Lodd. ex J. A. & J. H. Schultes*) *Sarg. ex Becc.*, Webbia 2: 317. 1907. (Figs. 11,12,17). GUANO, PALME COYAU, *HISPANIOLAN SILVER THATCH.*

Hispaniola, common in dry rocky areas.

Bailey (1949) distinguished the species by seed grooves that are nearly straight from the apex to the base without anastomosing or curving connections, usually 5 or 6, wide and extending directly into the endosperm. Apparently this also characterizes the closely related Cuban species, *C. guantanamensis*.

Specimens with palmans ca. 20 cm may be hard to separate from *C. alta* but may be distinguished from the latter by ca. 30–50 cm long, 1–3.5 cm wide, rigid segments vs. 40–80 cm long, mostly 2.5–5 cm wide, lax segments; 6 to 8 (9) vs. 9 to 12 stamens; and short (less than 1 mm long), ovate-oblong, ± straight anthers vs. longer (1.3–2 mm long), linear-oblong, twisted or contorted anthers.

3. Coccothrinax barbadensis (*Lodd. ex Mart.*) *Becc.*, Webbia 2: 328. 1907. (Figs. 8,13,14,18).
SYNONYMS: *Coccothrinax martinicensis* Becc., Webbia 2: 324. 1907. *Coccothrinax australis* L. H. Bailey, Gentes Herb. 7: 365, f. 149–152. 1947. *Coccothrinax dussiana* L. H. Bailey, Gentes Herb. 8: 109, f. 11b, 20–21. 1949. *Coccothrinax sabana* L. H. Bailey, Gentes Herb. 8: 110, f. 4, 22–23. 1949. *Coccothrinax boxii* L. H. Bailey, Gentes Herb. 8: 113, f. 24–25. 1949.



17–20. Argentea and Argentata Groups. 17. *C. argentea*; inset, closeup of stem and persistent leaf sheaths. 18. *C. barbadensis*, several adults and juveniles. 19. *C. spissa*. 20. *C. argentata*, note saddle-shaped leaves.

LATANIER, LATANIER A'BALAI, THATCH PALM, *LESSER ANTILLES SILVER THATCH.*

Lesser Antilles to southern Trinidad, on dry calcareous hills, littoral woodland and scrub woodland near coast from sea level to 200 m (Read 1979).

It is easily recognized by its transverse veinlets and cerebriform seeds.

4. Coccothrinax guantanamensis (*León*) *Muñiz & Borhidi*, Acta Bot. Acad. Sci. Hung. 27: 449. (1981). 1982.

SYNONYM: *Coccothrinax argentea* var. *guantanamensis* León, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 134. 1939.

GUANTANAMO SILVER THATCH.

Cuba: Guantánamo.

The species is related to *C. argentea*, but is more robust with a larger palman, broader and laxer segments, and larger inflorescences.

5. Coccothrinax spissa *L. H. Bailey*, Gentes Herb. 4: 253, f. 160. 1939. (Figs. 15,16,19).

GUANO, *SWOLLEN SILVER THATCH.*

Dominican Republic: Peravia and Santiago, in open dry areas or edges of deciduous broadleaf forests.

Together with *C. alta* and *C. barbadensis*, it forms a closely knit group. Like *C. alta*, it has more compact, fewer-branched inflorescences than *C. barbadensis*. In addition to the key characters, it differs from *C. alta* in having generally larger fruits (9–12 mm vs. 7–10 mm), larger seeds (7–8 mm vs. mostly 5–6 mm), stouter rachillae (ca. 2 mm at midlength vs. ca. 1 mm), and leaf sheaths with densely woven or solid margins and a loosely woven center vs. tightly woven, uniform, and burlaplike. However, some collections from northern Dominican Republic have characters in the range of *C. alta*.

Bailey (1939) reported 6 stamens for the species, but our material, including that from the type locality, has mostly 8 to 12 stamens.

Argentata Group

The Argentata Complex, occurring in the northwestern Caribbean, appears to be a natural assemblage. It is characterized by a mixture of primitive and advanced traits: thin-stranded, two-layered sheaths; blades with usually silvery abaxial indument, lacking transverse veinlets but with additional longitudinal veins, and with various curvatures (e.g., inverted conic, saddle-shaped, etc.) characteristic for different species; usually gradually tapered segments (except some leaves of some plants may have shoulder-shaped acuminations); and ± tubular inflorescence bracts.

The Argentata Group contains two recognizable species complexes, the Argentata Complex and the Crinita Complex. The groundplan of the Crinita Complex is simply modified from that of the Argentata Complex in having extended sheath strands in the adult plants (Figs. 7,21) and in having much elongated inflorescences. However, the homology of the sheaths is clear because very young juveniles from the two complexes are nearly indistinguishable. Additionally, the presence of weak transverse veinlets in juveniles (poorly developed to absent in adults; Fig. 10) of the Crinita Complex suggests a possible transitional relationship to the Argentea Group.

6. Coccothrinax argentata (*Jacq.*) *L. H. Bailey*, Gentes Herb. 4: 223, f. 140–143. 1939. (Figs. 6,9,20).

SYNONYMS: *Coccothrinax garberi* (Chapm.) Sarg., Bot. Gaz. (Crawfordsville) 27: 90. 1899. *Coccothrinax jucunda* Sarg., Bot. Gaz. (Crawfordsville) 27: 89. 1899.

SILVER PALM, SILVER THATCH PALM, SILVERTOP, *FLORIDA SILVER PALM.*

U.S.A.: Florida, along the southeastern coast and Keys; Bahamas. The species

21–24. Argentata Group. 21. *C. crinita* subsp. *crinita*. 22. *C. inaguensis*, note shallowly conical leaves. 23–24. *C. proctorii*. 23. Habit; note sadddle-shaped leaves. 24. Fruiting inflorescence and stem with leaf sheaths of young mature plant. Note wiry sheath strands and long pedicels.

generally occurs on limestone thinly covered with sandy soil, in relatively open to partially closed habitats of tropical hammock, coppice, or pinelands. It also occurs on dunes and forest ecotones and is relatively tolerant of salt spray.

Where this species and *C. inaguensis* grow together (e.g., San Salvador Island) intermediates often occur.

Most specimens at FTG have fruiting pedicels 1–2 mm long, but a few from the Bahamas have pedicels reaching 5 mm. This species is similar to *C. proctorii* in having the style plus stigma longer than the ovary.

7. Coccothrinax borhidiana *Muñiz* **in Borhidi et al.,** Acta Agron. Acad. Sci. Hung. 27: 437. 1978.

DWARF OLD MAN PALM.

Cuba: Matanzas.

This species is closely related to *C. crinita*, but it is a smaller plant in many gross morphological features.

8. Coccothrinax crinita (*Griseb. & H. A. Wendl. ex Wright in Sauvalle*) *Becc.*, Webbia 2: 334. 1907.

PALMA PETATE, OLD MAN PALM.

This is perhaps the most distinctive species in the genus. *Coccothrinax crinita* (as well as *C. borhidiana*) is characterized by elongate free strand tips of the leaf sheath.

8a. Coccothrinax crinita subsp. **crinita** (Fig. 7,10,21).

Cuba: Pinar del Río and Sancti-Spíritus, on serpentine soils in low seasonally flooded prairies.

The strand tips are often 20 to 50 cm long, flexuous, and persistent, forming a thick hairlike covering over the stem.

8b. Coccothrinax crinita subsp. **brevicrinis** *Borhidi & Muñiz in Muñiz & Borhidi*, Acta Bot. Acad. Sci. Hung. 27: 448. (1981). 1982.

SHORT-HAIRED OLD MAN PALM.

Cuba: Cienfuegos, serpentine soils, at middle altitudes in open montane areas.

9. Coccothrinax fragrans *Burret*, Kongl. Svenska. Vetenskapsakad. Handl. 6: 15. 1929.

YURAGUANO, *FRAGRANT CUBAN THATCH.*

Cuba: Santiago de Cuba.

In having longer fruiting pedicels 4–7 mm long, *C. fragrans* should not be confused with the occasional depauperate plants of *C. argentata* that have abaxially dull laminas.

10. Coccothrinax inaguensis *R. W. Read*, Principes 10: 30, f. 1–6. 1966. (Fig. 22).

BAHAMIAN THATCH.

Bahamas: Caicos, Great Inagua and San Salvador Islands, in thickets on limestone or sand dunes near the coast.

In addition to the key characters, *C. inaguensis* can be distinguished from *C. argentata* by the following: 1) dull light green vs. dark green adaxial leaf surface, 2) stem diameter of 6–8 cm vs. ca. 13 cm, 3) 39 to 47 segments vs. 15 to 44, 4) fruiting pedicels 3–6 mm vs. 1–3 mm, 5) 8 to 10 stamens vs. 11 to 12, 6) longer anthers (2.5–4 mm vs. 1.5–2 mm) with retuse instead of bifid apices, and 7) fruits 12–13 mm diam. vs. 10–12 mm (Read 1966*a*).

11. Coccothrinax jamaicensis *R. W. Read*, Principes 10: 133, f. 1–10. 1966.

SILVER THATCH, *JAMAICAN SILVER PALM.*

Jamaica, widely distributed along coastal regions from sea level to 1,500 feet on a variety of substrates. Not generally found far inland nor in areas of heavy rainfall and good soil. Generally found on steep mountain slopes and cliffs of limestone or deeply eroded "dog tooth" limestone and sand near the beach. Plants in more exposed situations show a less pronounced silveriness on the abaxial leaf surfaces, and are generally taller with thinner stems (Read 1966*b*).

12. Coccothrinax litoralis *León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 138, t. 16(2), 19(1). 1939.
YURAGUANA DE COSTA, MIRAGUANO, *CUBAN SILVER PALM.*

Cuba, along the northern coast and offshore islands, sandy littoral scrub.

This species is most closely related to *C. argentata,* from which it can be separated by its truncate, nearly absent ligule, larger more numerous (40 to 45 vs. 15 to 44) leaf segments, wider stem, more distant inflorescence branches, and an occasional yellowish, golden, or bronze leaf undersurface. *Coccothrinax litoralis* may eventually prove to be simply a robust Cuban form of *C. argentata.*

Having fruiting pedicels mostly about 2 mm long, it should not be confused with *C. jamaicensis* and *C. proctorii,* which have pedicels mostly longer than 3 mm.

13. Coccothrinax proctorii *R. W. Read,* Phytologia 46: 285. 1980. (Figs. 23,24).
THATCH PALM, *PROCTOR'S SILVER PALM.*

Cayman Islands, on limestone in fields, woodlands, thickets and dry ground.

This species is most closely related to *C. jamaicensis* and *C. readii.* It can be distinguished from them by the key characters, frequently larger blades, and lamina anatomy (Read 1980, 1988). It is intermediate between *C. jamaicensis* and *C. readii* in usually having one or more leaves per plant with two-toothed hastulas.

14. Coccothrinax readii *Quero,* Principes 24: 118, f. 1–11. 1980. (Fig. 1).
KNACÁS, *READ'S SILVER PALM.*

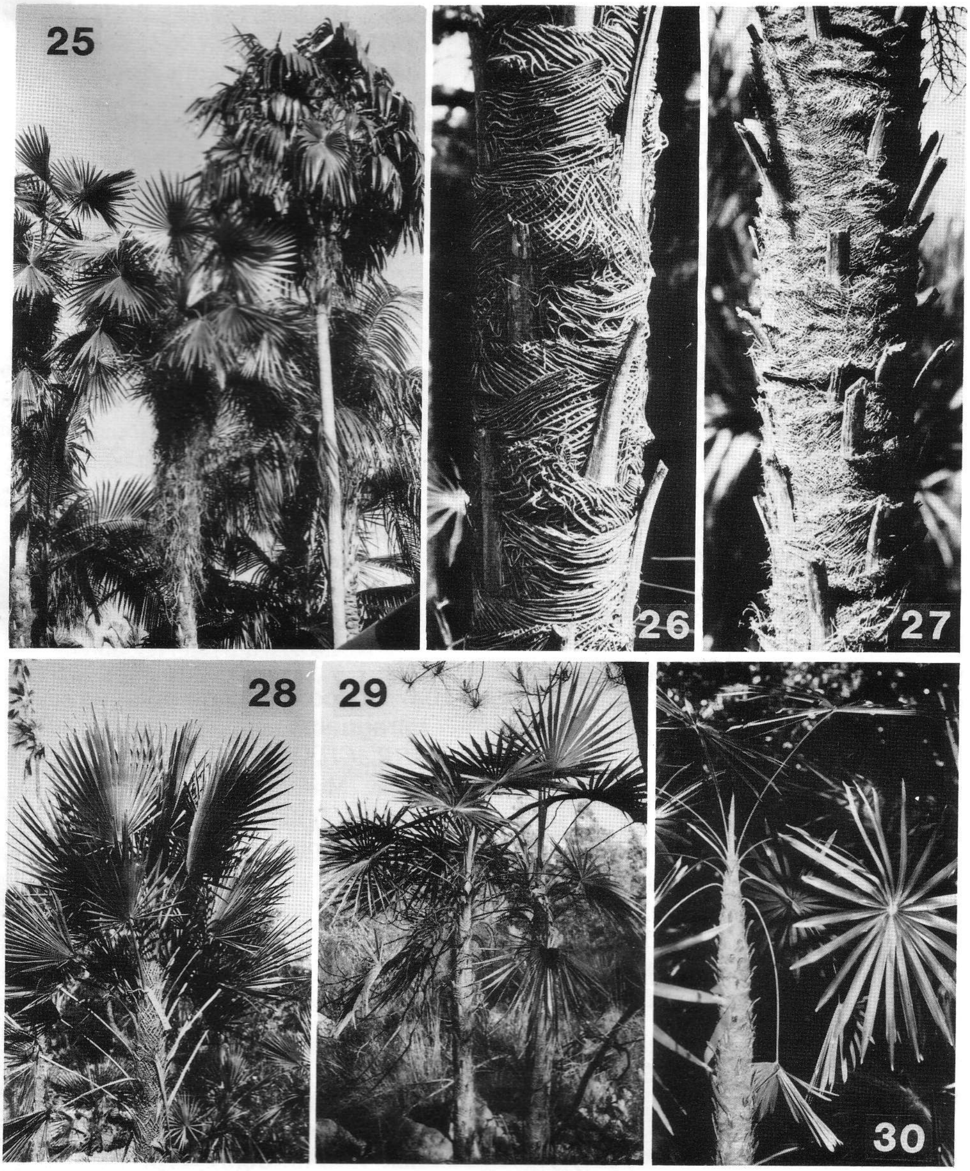
México: Quintana Roo and Yucatán, locally abundant in coastal seasonal tropical forest or sandy dunes.

Plants were described by Quero (1980) as small solitary palms, 1–4 m tall, with brownish or grayish, 3–8.5 cm wide stems. It appears to be most closely related to *C. jamaicensis* and *C. proctorii.* Read (in Quero 1980) noted that lamina anatomy is distinct.

Miraguama (or Pauciramosa) Group

The Miraguama Group is restricted to Cuba and adjacent Hispaniola, but contains a majority of the species in the genus. It is heterogeneous and may comprise two or three species complexes. However, because only a small portion of its species are widely cultivated, it is not divided further here. It is characterized by advanced characters: usually slender trunks; usually small, rigidly plicate (pleated), pinwheel-shaped leaves; segments with pronounced shoulder-shaped acuminations; absence of transverse veinlets; abaxial lamina surface with less silvery, less persistent indument; and coarse, persistent sheaths. Several additional advanced features are variously combined in different species: leaf sheaths with three strand layers (usually diagnostic for a species but variable in *C. miraguama*), strands loosely woven, strands thickened and woody, free strand tips present and stoutly spine-like, inflorescences ascending, inflorescences with dilated and flattened bracts, ovaries muricate, and fruits dry and corky. The Miraguama Group corresponds roughly to *Coccothrinax* section *Longispadiceae* of Muñiz and Borhidi (1982*b*) in which they place most species in subsection *Pauciramosae.*

The major common names for this group are the Spanish *guano, miraguano,* and *yuraguana* (or variant spellings of these) and are used interchangeably in Cuba for all stiff-leaved thatches. We propose here MIRAGUAMA and YURAGUANA as general English names within the group. These are taken directly from the Latin epithets of two well-known species, whose scientific names are based on the Spanish names. We feel that these Latin names are more familiar to American enthusiasts and English speakers than are the various local Spanish ones. Moreover, the characteristics signified by these names can be



25–30. Miraguama Group. 25–27. *C. miraguama.* 25. Two plants of subsp. *roseocarpa*, left, and one of subsp. *havanensis*, right. 26. Subsp. *roseocarpa*, stem with persistent leaf sheaths. 27. Subsp. *arenicola*, stem with persistent leaf sheaths. 28. *C. ekmanii.* 29. *C. scoparia*, in native habitat. 30. *C. yuraguana.*

associated with those two species. "Miraguama" is used here for the species with heavier leaves and generally more numerous or closely set, less deeply divided segments. "Yuraguana" is used for those with lighter, more open leaves and generally less numerous or more widely spaced, more deeply divided segments.

15. Coccothrinax clarensis *León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 147, t. 17(4), 18(3). 1939.
YURAGUANA, *SHORT-SPINED YURAGUANA.*
Cuba: Santa Clara to Camagüey, in arid serpentine soils.

16. Coccothrinax cupularis (*León*) *Muñiz & Borhidi*, Acta Bot. Acad. Sci. Hung. 27: 449. (1981) 1982.
SYNONYM: *Coccothrinax miraguama* var. *cupularis* León, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 117, f. 5. 1939.
CRESCENT-LEAVED MIRAGUAMA.
Cuba: Southeastern Mantanzas and southwestern Cienfuego, on calcareous rocks of coastal mountains. *Coccothrinax cupularis* is most closely related to *C. miraguama*. It can easily be distinguished by the fewer segments, half orbicular laminas, generally shorter fruiting pedicels, and strongly connate filaments. Also see notes under subspecies of *C. miraguama.*

17. Coccothrinax ekmanii *Burret*, Kongl. Svenska. Vetenskapsakad. Handl. 6: 11, t. 4. 1929. (Figs. 5,28).
SYNONYM: *Haitella ekmanii* (Burret) L. H. Bailey, Contr. Gray Herb. 165: 7. 1947.
GOUANE, GUANITO, *HAITIELLA PALM.*
Haiti and southwestern Dominican Republic, near sea level, on exposed dog-tooth limestone near the coast.

The muricate ovaries and fruits, as well as other features of the fruit wall prompted Bailey (1947*a*) to erect a new genus, *Haitiella*, for this species. The distinctness of the fruit wall needs detailed study, but in all other respects no additional differences could be found to justify recognition of the genus *Haitiella.*

18. Coccothrinax garciana León, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 143, t. 17(2), 20(1). 1939.
LONG-SPINED YURAGUANA.
Cuba: Holguín, in arid siliceous areas.

19. Coccothrinax gracilis *Burret*, Kongl. Svenska. Vetenskapsakad. Handl. 6: 14. 1929.
LATANIER, GUANITO, *SLENDER-LEAVED YURAGUANA.*
Haiti, in calcareous areas.

20. Coccothrinax miraguama (*Kunth*) *León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 113. 1939. (Figs. 1,2,3,25–27).
SYNONYM: *Coccothrinax acuminata* (Griseb. & H. A. Wendl. in Griseb.) Becc., Webbia 2: 313. 1907. (*non C. miraguano* Becc. = *C. yuraguana*).
MIRAGUANO, YURAGUANA, YURAGUANCILLO, GUANITO, *MIRAGUAMA.*

20a. Coccothrinax miraguama subsp. **miraguama**.
MIRAGUAMA.
Cuba: Most widely distributed of the subspecies, from Matanzas to Santiago de Cuba, in savannas and serpentine rocky hills.

This subspecies is unique within *C. miraguama* in having only two strand layers of the leaf sheath (occasionally three layered near base of sheath). It is similar to subsp. *havanensis* and subsp. *roseocarpa* in having thickened, woody sheath strands.

20b. Coccothrinax miraguama subsp. **arenicola** (*León*) *Borhidi & Muñiz*, Bot. Közlem. 58(3): 175. 1971. (Fig. 27).
SYNONYM: *Coccothrinax miraguama* var. *arenicola* León, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 115, f. 2. 1939.
WIRY MIRAGUAMA.
Cuba: Pinar del Río and Isla de Pinos, sandy savannas.

This subspecies is unique in having thin, wiry sheath strands. It is similar to subsp. *miraguama* and subsp. *havanensis* in having mostly 42 to 55 segments, the leaf segments 50–70 cm long, the palman 20–25 cm long, and purplish black fruits. It is similar to subsp. *miraguama* in having the fruit 7–9 mm diam. It is more variable than the other subspecies in the length of the fruiting pedicel (2–4 mm long) and in the length of the apical point beyond the acumination of the leaf segment (12–35 cm long). Although it overlaps with *C. cupularis* in pedicel length, it is easily distinguished by the thin, wiry sheath strands, more numerous leaf segments, orbicular laminas, and nearly free stamen filaments.

20c. Coccothrinax miraguama subsp. **havanensis** (*León*) *Borhidi & Muñiz*, Bot. Közlem. 58(3): 175. 1971. (Fig. 25).

SYNONYM: *Coccothrinax miraguama* var. *havanensis León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 116, f. 3. 1939.

HAVANAN MIRAGUAMA.

Cuba: Havana, calcareous coastal soils and serpentine rocky hills.

This is unique among the subspecies in having about 12 stamens vs. 6 to 10, in having the stamen filaments often fused about ⅓ their length into a shallow cupule, and in having larger fruits that are 8–12 mm diam. vs. 7–9 mm. It is similar to subsp. *miraguama* and subsp. *arenicola* in having about 42 to 55 leaf segments, the segments mostly 50–70 cm long with apical points 20–30 cm long, the palman 20–25 cm long, and purple-black fruits. It is similar to subsp. *roseocarpa* in having thickened, woody sheath strands in three layers. It is clearly distinguished from *C. cupularis* by the longer pedicels, more numerous segments, and orbicular laminas.

20d. Coccothrinax miraguama subsp. **roseocarpa** (*León*) *Borhidi & Muñiz*, Bot. Közlem. 58(3): 175. 1971. (Figs. 2,3,25,26).

SYNONYM: *Coccothrinax miraguama* var. *roseocarpa* León, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 117, f. 4. 1939.

ROSE-FRUITED MIRAGUAMA.

Cuba: Matanzas, siliceous hills.

This is unique among the subspecies in having fewer leaf segments (usually 40 to 42 vs. 42 to 55), shorter segments with shorter apical points, smaller palmans (10–18 cm long), and rose-purple fruits. It is similar to subsp. *miraguama* and subsp. *havanensis* in having thick, woody sheath strands and consistently longer fruiting pedicels. It is similar to subsp. *miraguama* in having 8 to 10 nearly free stamens, and to subsp. *havanensis* in having three layers of sheath strands.

21. Coccothrinax salvatoris *León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 125, t. 12(6), 15(1). 1939.

YURAGUANA, *THICK-SPINED MIRAGUAMA.*

Cuba: Western Camagüey to Oriente, mostly on calcareous soils.

22. Coccothrinax scoparia *Becc.*, Feddes Repert. Spec. Nov. Regni Veg. 6: 95. 1908. (Figs. 4,29)

LATANIER BALAI, *HISPANIOLAN YURAGUANA.*

Haiti and southwestern Dominican Republic, in dry open pine forests on limestone above 1,000 m elevation.

23. Coccothrinax yuraguana (*A. Rich.*) *León*, Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 119, t. 11(2(6–9)), 12(2). 1939. (Fig. 30).

SYNONYM: *Coccothrinax miraguano* Becc., Webbia 2: 295. 1907.

MIRAGUANO DE LOMA, YURAGUANO, GUANICHICHE, *WIRY YURAGUANA.*

Cuba: Pinar del Río and Isla de Pinos, serpentine foothills.

This species is most likely to be confused with *C. miraguama* subsp. *arenicola* because both have thin, wiry sheath strands in three layers. However, this species has distinctly fewer leaf segments, a very short palman, and fruiting pedicels only 1–2 mm long.

Acknowledgments

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LITERATURE CITED

BAILEY, L. H. 1938. *Thrinax*. Gentes Herb. 4: 129–149.

———. 1939*a*. *Coccothrinax* of Florida. Gentes Herb. 4: 220–224.

———. 1939*b*. *Coccothrinax* in the southern Greater Antilles. Gentes Herb. 4: 239–284.

———. 1947*a*. *Haitiella*, a new palm genus from Hispaniola. Contrib. Gray Herb. 165: 5–9.

———. 1947*b*. Indigeneous palms of Trinidad and Tobago. Gentes Herb. 7(5): 353–445.

———. 1949. Palms uncertain and new. Gentes Herb. 8: 91–205.

BECCARI, O. 1907. Le palme americane della tribu delle Corypheae. Webbia 2: 1–343.

———. 1913. The palms indigeneous to Cuba. III. Pomona Coll. J. Econ. Bot. 3: 391–417.

BORHIDI, A. AND O. MUÑIZ. 1971. Contributiones novae florae cubanae. I. Bot. Közlem. 58(3): 175–177.

——— AND ———. 1972 (1971). New plants in Cuba. I. Acta Bot. Acad. Sci. Hung. 17(1–2): 1–36.

——— AND ———. 1985. Adiciones al catálogo de las palmas de Cuba. Acta Bot. Hung. 31(1–4): 225–230.

———, N. IMCHANITZKAYA, AND O. MUÑIZ. 1978. Dendrological novelties in the flora of Cuba. Acta Agron. Acad. Sci. Hung. 27: 428–437.

BRITTON, N. L. AND P. WILSON. 1923. Botany of Porto Rico and the Virgin Islands. Scientific Survey of Porto Rico and the Virgin Islands. 5: 112.

BURRET, M. 1929. Palmae cubenses et domingensis a cl. E. L. Ekman 1914–1928 lectae. Kongl. Svenska. Vetenskapsakad. Handl. 6(7): 3–28.

CHAPMAN, A. W. 1883. Flora of the southern United States. 2nd ed. American Book Co., New York.

DUSS, A. 1897. Flore phanérogamie des Antilles Francais. Macon. 656 pp.

GLASSMAN, S. F. 1972. A revision of B. E. Dahlgren's index of American palms. Cramer Verlag, Lehre.

GRISEBACH, A. 1864. Flora of the British West Indian Islands. Lovell Reeve & Co., London.

———. 1866. Catalogus plantarum cubensium. Wilhelm Engelmann, Leipzig.

HODGE, W. H. 1942. A synopsis of the palms of Dominica. Caribbean Forester. 3: 103–109.

———. 1954. Flora of Dominica, B.W.I. Lloydia 17(1–3): 1–238.

KUNTH, C. S. 1822. Synopsis plantarum aequinoctialium orbis novae. (Voyage de Humboldt et Bonpland. Sixieme parte: Botanique) 1: 301–311.

———. 1841. Enumeratio plantarum 3: 108–110, 168–294. Stuttgart and Tubingen.

LEÓN, H. 1939. Contribución al estudio de las palmas de Cuba: Genero *Coccothrinax*. Mem. Soc. Cub. Hist. Nat. "Felipe Poey" 13: 107–156.

———. 1946. Flora de Cuba. Vol. I. Gymnospermas—Monocotiledones. Havana.

LITTLE, E. L., JR., R. O. WOODBURY, AND F. H. WADSWORTH. 1974. Trees of Puerto Rico and the Virgin Islands (Vol. 2). U.S.D.A., Agriculture handbook 449. Washington, D.C.

MARTIUS, C. F. P. VON. 1837–1853. Historia naturalis palmarum. T. O. Weigel, Leipzig.

MAYCOCK, J. D. 1830. Flora barbadensis. James Ridgeway, London.

MOORE, H. E., JR. 1963. An annotated checklist of cultivated palms. Principes 7: 119–182.

———. 1973. The major groups of palms and their distribution. Gentes Herb. 11: 27–141.

MUELLER, C. 1858. Walpers' annales botanices systematicae. 5: 804–857.

MUÑIZ, O. AND A. BORHIDI. 1982*a* (1981). Palmas nuevos del género *Coccothrinax* Sarg. en Cuba. Acta Bot. Acad. Sci. Hung. 27(3–4): 439–454.

——— AND ———. 1982*b*. Catálogo de las palmas de Cuba. Acta Bot. Acad. Sci. Hun. 28(3–4): 309–345.

QUERO, H. J. 1980. *Coccothrinax readii*, a new species from the peninsula of Yucatan, Mexico. Principes 24(3): 118–124.

READ, R. W. 1966*a*. *Coccothrinax inaguensis*—a new species from the Bahamas. Principes 10: 29–35.

———. 1966*b*. *Coccothrinax jamaicensis*. The Jamaican silver thatch. Principes 10: 133–141.

———. 1972. Palmae. *In*: C. D. Adams (ed.). Flowering plants of Jamaica. Univ. of the West Indies. Mona, Jamaica, pp. 73–76.

———. 1975. The genus *Thrinax* (Palmae: Coryphoideae). Smith. Contrib. Bot. 19: 1–98.

———. 1979. Palmae. *In*: R. A. Howard (ed.). Flora of the Lesser Antilles. Vol. 3. Monocotyledonae. Arnold Arboretum, Harvard Univ., Jamaica Plain.

———. 1980. Notes on Palmae, I. Phytologia 46(5): 285–287.

———. 1988. Utilization of indigeneous palms of the Caribbean (in relation to their abundance). Adv. Econ. Bot. 6: 137–143.

SANDERS, R. W. 1986. Research review: identification, taxonomy and chemistry of palms. Fairchild Trop. Gard. Bull. 41(3): 18–19.

SARGENT, C. S. 1899. New or little known North American trees. Bot. Gaz. (Crawfordsville) 27: 81–94.

———. 1902. The silva of North America. Palmae. 14: 75–88, t. 734–737. N.Y.

SAUVALLE, F. A. 1871. Flora cubana. Ann. Acad. Cien. Habana 7: 560–566.

———. 1873. Flora cubana. Enumeratio nova plantarum cubensium; vel revisio catalogi Grisebachiani. Havana.

SCHULTES, J. A. AND J. H. SCHULTES. 1830. *In*: J. J. Roemer and J. A. Schultes (eds.). Systema vegetabilium, ed. 16 "15," Vol. 7(2). Stuttgart.

SPRENGEL, K. 1825. Systema vegetabilium, ed. 17 "16," Vol. 2. Gottingen.

TOMLINSON, P. B. 1964. The vascular skeleton of coconut leaf base. Phytomorphology 14: 218–230.

UHL, N. W. AND J. DRANSFIELD. 1987. Genera palmarum: a classification of palms based on the work of H. E. Moore, Jr. L. H. Bailey Hortorium and the International Palm Society, Allen Press, Lawrence, Kansas.

URBAN, I. 1903. Flora portoricensis. Symbolae antillianae. 4: 126–131. Leipzig.

———. 1920. Flora domingensis. Symbolae antillianae. 8: 73–80. Borntraeger, Leipzig.

VICTORIN, F. MARIE- AND F. LEÓN. 1942. Itineraires botaniques dans l'île de Cuba. Part 1. Contrib. Inst. Bot. Univ. Montreal No. 41: 1–496.

——— AND ———. 1944. Itineraires botaniques dans l'île de Cuba. Part 2. Contrib. Inst. Bot. Univ. Montreal. No. 50: 1–410.

——— AND ———. 1956. Itineraires botaniques dans l'île de Cuba. Part. 3. Contrib. Inst. Bot. Univ. Montreal. No. 68: 1–227.

Appendix I. Specimens collected in the wild or grown from wild-collected seeds. The FTG number is the Garden's accession number of the living plants. The collection number in italics designates the herbarium specimen housed at the FTG herbarium.

C. argentata: FTG 57-727, *Nauman 1904*; FTG 70-7, *Nauman 1909*; *Sanders 1666*; *Sanders 1826*; *Sanders 1827*; numerous other wild-collected herbarium specimens from Florida and the Bahamas. *C. argentea*: FTG 4639, *Fantz 3878*, *Kutz 16*; FTG 4646, *Hammer 31*, *Kutz 15*; FTG 4648, *Hammer 30*, *Kutz 8*; FTG 58-474, *Hubbuch s.n.*; FTG 84-255; *Mejía & Zanoni 6797*; *Sanders 1670*; *Sanders 1699*; *Sanders 1704*. *C. barbadensis*: *Sanders 1755*. *C. ekmanii*: FTG 83-202, 84-306, *Sanders 1685*. *C. gracilis*: FTG 84-396. *C. guantanamensis*: FTG 58-420, *Nauman 1903*. *C. inaguensis*: FTG 64-284, *Nauman 1750*, *1790*; FTG 64-777, *Nauman 1789*, *1907*; FTG 65-3, *Nauman 1788*; numerous wild-collected herbarium specimens from the Bahamas. *C. jamaicensis*: *Evans 173*; *Read & Proctor 1152*. *C. proctorii*: FTG 62-20, *Nauman 1794*, *1795*. *C. readii*: FTG 59-514, *Coons 1466*; FTG 59-1031, *Coons 1432*, *Nauman 1748*; FTG 84-385, *Sanders 1721*; FTG 84-386, *Sanders 1726*. *C. scoparia*: FTG 58-839, *Nauman 1913*; *Sanders 1684*. *C. spissa*: FTG 4627, *Nauman 1900*; *Mejía & Zanoni 13287*; *Sanders 1673*; *Sanders 1688*; *Sanders 1789*; *Sanders 1700*.

Appendix II. Critically determined material sent as seed to FTG by Brother León, Dr. R. W. Read, or the National Botanical Garden of Cuba (HAJB).

C. borhidiana: (HAJB) FTG 85-195, 86-370, 87-519. *C. clarensis*: (HAJB) FTG 85-196, 87-520. *C. crinita* subsp. *brevicrinis*: (HAJB) FTG 87-225. *C. cupularis*: (HAJB) FTG 85-198, 87-226. *C. fragrans*: (León) FTG RM-1291, *Houghton 1008*. *C. litoralis*: (HAJB) FTG 85-197. *C. miraguama* subsp. *havanensis*: (León coll. no. 16155) FTG 62-31, *Nauman 1902*; (León coll. no. 16869) FTG RM-1692; (Read) FTG 80-538; (HAJB) FTG 82-409, 85-299. *C. miraguama* subsp. *miraguama*: (HAJB) FTG 85-322. *C. miraguama* subsp. *roseocarpa*: (HAJB) FTG 82-408, 85-199. *C. readii*: (Read coll. no. 81-PS-3) FTG 81-103. *C. salvatoris*: (HAJB) FTG 85-200. *C. yuruguana*: (HAJB) FTG 85-201, 86-371.

Appendix III. FTG specimens or photographs of specimens cited in the original descriptions of the species or its synonyms. Specimens marked with * are photographs of specimens at US, sent as a gift by US.

C. acunana León: *León 16749**. *C. alexandri* León: *León 15822**, *16191**. *C. alta*: *Eggers 3117* (Field Mus. Neg. 21122). *C. argentata*: *Curtiss 2679**. *C. bermudezii* León: *León 16290**. *C. clarensis*: *León 16080**. *C. concolor* Burret: *Ekman 5958**. *C. crinita*: *Wright 3967**. *C. ekmanii*: *Ekman 6991**. *C. garciana*: *León 15476**. *C. guantanamensis*: *León 16100**. *C. gundlachii* León: *Roig et al. 6725**. *C. hioramii* León: *León 16099**. *C. inaguensis*: *Read 1377* (Isotype). *C. jamaicensis*: *Read*

1563 (Isotype). *C. miraguama* subsp. *havanensis*: *León 16834**. *C. miraguama* subsp. *miraguama*: *Wright 3966**. *C. miraguama* subsp. *roseocarpa*: *León 16958**. *C. muricata* León: *León 15892**, *15910**. *C. orientalis* (León) Muñiz & Borhidi: *Schafer 3217**. *C. proctorii*: cited as plant cultivated at USDA Subtropical Introduction Station, USDA PI 102600 (D. Fairchild coll. no. 3108, Allison Armour Expedition, Georgetown, Grand Cayman), at FTG from same USDA PI no., but accessioned as FTG 59-627, *Nauman 1792*. *C. pseudorigida* León: *León 15779**. *C. salvatoris*: *León 16489**. *C. saxicola* León: *León 18618**.

Notice From The Seed Bank

For the past several years, the Seed Bank has been sending out seed called *Phloga* sp. from what has been called the Robinson garden (formerly belonging to Jane Robinson, IPS member now living in California) at Aiea Point (adjacent to Hilo) on Hawaii Island.

We have been informed that this seed is from a palm properly identified as *Dypsis pinnatifrons*. This palm is very similar to *Phloga* and thrives under similar growing conditions. For a general idea of the appearance of the fronds, please see Figure 82, Page 74 of *Supplement to Palms of the World* by Arthur Langlois. (*Dypsis gracilis*).

The Seed Bank is offering this seed to you in place of *Phloga* sp., due to its availability, its similarity, and the general unavailability of *Phloga* seed from Madagascar.

Should you decide you do not want this seed, please write to me at the below address, telling me if: you want a $3.00 refund; you wish an alternate seed on the Seed List (and give me the name of the seed you want); or possibly another alternative. Do not return the seed sent with this note; it would be too old for us to send to another member due to the lag time.

Should you have good germination results, we believe this palm will give you much pleasure.

For those of you who wish to wait for *Phloga*, we cannot say how many months or years this might be. It would probably involve a seed collection expedition to Madagascar.

ROBERT EGGE
65 Halaulani Place
Hilo, HI 96720

NEWS OF THE SOCIETY

South Florida Trip to Key West

The South Florida Chapter of the IPS organized a January Field Trip to Key West on Saturday, January 19, 1991, departing fgrom Matheson Hammock at 9:00 am (sharp) with return early Sunday evening. Round trip sightseeing bus transportation to Sugarloaf Key and Key West was to include a tour of Baxter Gentry's "Punta RoqueÊa" on the Atlantic Ocean side of Sugarloaf Key with catered lunch, a tour of Peter Whelen's marvelous Key West garden, featuring *Copernicia* and *Corypha* species, dinner and program at LaConcha Holiday Inn, Key West with evening free after 9:00 pm. Group planned to overnight at LaConcha then have the morning free after American-style breakfast buffet. Lunch was to be BBQ poolside with scheduled departure for Miami around 2:00 pm, Sunday.

Principes, 35(1), 1991, pp. 47–48

Tourism Is Affecting the Stand Structure of the Coco-de-Mer

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The double coconut or coco-de-mer, *Lodoicea maldivica* (Gmelin) Pers., the justly renowned endemic palm of the islands of Praslin and Curieuse in the Seychelles, has already been the subject of a conservation study (Polunin and Proctor, Biological Conservation: vol. 5, 4 (1973) 314–316).

Praslin, alone among the islands, is inhabited by all palm genera endemic to the Seychelles. Five are conserved in the small Vallée de Mai Nature Reserve which, with its dense stand of the celebrated coco-de-mer, has become a popular calling point for tourists.

One of us (A.J.P.S.) spent the summer of 1976 on Praslin in order to record the stand structure, and estimate the longevity, of the coco-de-mer, and the other four endemic palms of the Reserve. The overall results have been published elsewhere (*Biotropica*, 15, 1 (1983) 15–25). Here we wish to draw attention to those aspects of the results which are relevant to the conservation of these species, all of which figure in the Red Data Book, and which may assist in the future management of their populations in the reserve.

Our study indicated that adults of *Nephrosperma vanhoutteanum* H. A. Wendl. ex Van Houtte Balf., and all individuals of *Verschaffeltia splendida* H. A. Wendl., are confined to a small study area even within the reserve, on moist lower slopes and streamsides respectively. *Deckenia nobilis* H. A. Wendl. ex Seem. appears to be excluded from areas of highest *Lodoicea* density. The sample sizes were too small, however, to statistically confirm departure from random distributions in either case. *Lodoicea*, and also *Phoenicophorium borsigianum* (Koch) Stuntz., are almost ubiquitous. Interestingly, the ratio of the number of juvenile and sterile plants to fertile plants increases with decreasing total stand density, implying that the species depend on certain habitat conditions for their survival, but exist in adjacent suboptimal habitats through continuing subsidy by seed dispersal. The ratio is strikingly lower in *Lodoicea* than in the other species.

The population structure of young plants, at least in those species in which numbers were sufficient for study, implies that, as in all organisms, mortality is highest among the youngest plants; however there seems to be extremely little mortality thereafter until senility sets in. This suggests, in plants as vulnerable as palms with their single terminal shoot and inability to branch, that serious pests and herbivores do not yet exist in these islands. It is particularly fortunate that none of the pests which have already affected the coconut, an important crop in the Seychelles, have so far seriously attacked the endemic palms; it will clearly be of the greatest importance to see that none are accidentally imported.

The stand structure of the double

Table 1. Stand density, and ratio of sterile to fertile individuals among five endemic palm species in sample plots in the Vallée de Mai Reserve.

	Plant Density (no./ha)	Ratio (Sterile to Fertile Individuals)
Lodoicea maldivica	329	3.2
Phoenicophorium borsigianum	764	13.8
Deckenia nobilis	414	15.4
Nephrosperma vanhoutteanum	124	32.4
Verschaffeltia splendida	26	?

coconut notably differs in two respects from those of the others. First, female trees do not attain the stature of males. Males and females, we found (Savage and Ashton 1983), grow in height at the same rate, and we therefore conclude that females die younger. This is thought to be due to the increasing proneness to decapitation of female crowns during storms, weighed down as they are with up to 500 kg of giant fruit. Earlier mortality of females results in a predominance of male reproductive individuals, which will be advantageous in maintaining fruit set if the species is wind-pollinated. As coco-de-mer is the sole palm in the canopy this emphasizes the importance of maintaining high stand densities if the number of females, and hence fruit, is not to be adversely affected.

Second, the population structure of *Lodoicea* juveniles differs dramatically from the others in the low ratio of immature (sterile) to mature (fertile) individuals (Table 1). Specifically, there are some fifteen times as many young plants with four leaves as those with one, whereas in the other species plantlets with a single leaf predominate and numbers decline steadily as the number of leaves increase. Young palms initially show a single leaf, and the numbers continually increase until the full crown is formed; thereafter the number remains rather constant. The number of leaves, therefore, gives a measure of the age of the young plant. By measuring the rate of leaf expansion it has been possible to equate leaf numbers with age. We calculate that the four-leaf stage in 1976 represented seedlings most of which germinated in 1970, the year before the International Airport was opened at Mahe. The fruit, with their suggestive shape, are a prime tourist commodity and in 1976 commanded a local price of $US 60. It is therefore hardly surprising that removal rates had by that date already far outstripped the levels beyond which the stand cannot maintain itself at present density. It is ironic that man himself should become the first predator of this vegetable dinosaur!

It is, nevertheless, understandable if the authorities have regarded a temporary shortfall in the regeneration of coco-de-mer as of little consequence, for the palm has been regarded as of immense longevity and possibly exceeding 1,000 years (see Polunin and Proctor, *ibid.*). We find, in fact, that coco-de-mer probably never exceeds 400 and rarely 300 years, so that the effects of overintensive exploitation will be felt much earlier than would have been expected. We draw attention to these facts in the hope that they may aid the Seychelles government in its quest for a system of management which will ensure the continued survival and productivity of what has become a valuable natural resource as well as a unique national legacy.

Principes, 35(1), 1991, pp. 49–54

The Royal Palm on the Island of Hispaniola

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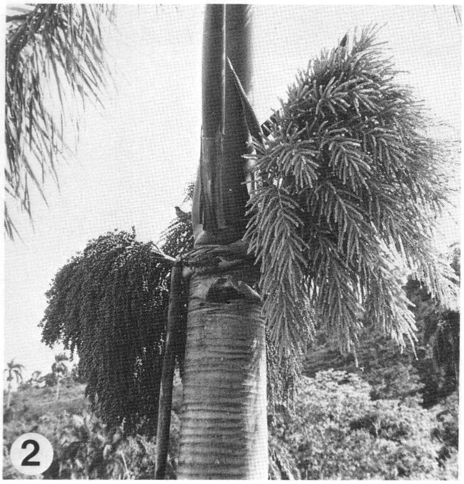
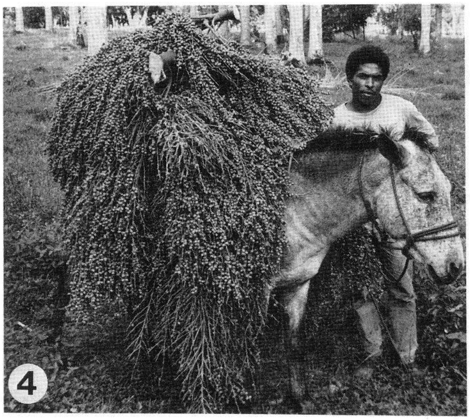
The royal palm, *Roystonea hispaniolana* L. H. Bailey, is native to the island of Hispaniola—the Dominican Republic and Haiti. Bailey (1939 and Bailey & Moore

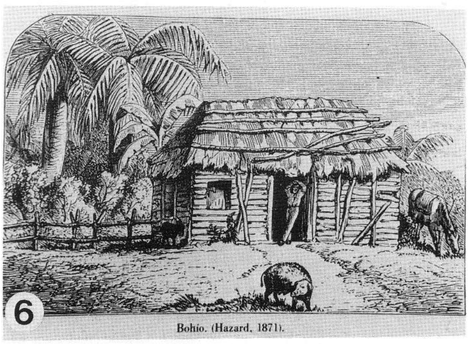


1. The Hispaniolan royal palm is usually encountered in large populations. Since the palm grows very tall (10–15 m), it can remain in cultivated fields or in pastureland for cattle or horses. 2. Flowering occurs at the base of the leaf sheaths. The bracts start out erect and appressed against the leaf sheaths. As the inflorescence matures within the bracts, the bracts then tilt at an angle from the trunk. The peduncular bract is filled with an enormous quantity of pinkish-white hairs that coat the inflorescence. As the bract opens, the inflorescence loses most of the hairs, the flowers are creamy white. As the ovaries mature, the inflorescence becomes heavier and assumes a drooping or weeping habit.

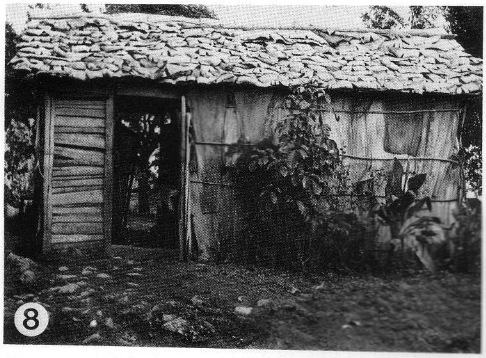
→

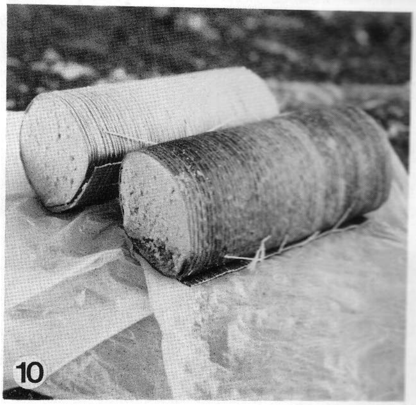
3. Infrutescences of nearly-mature (greenish) or mature (yellowish) fruits are cut from the palms, often with the use of a long pole of several pieces of bamboo (*Bambusa vulgaris*). Great force is needed to cut free the tightly attached infructescences.





4. Mules are often used to carry the cut infructescences back to the farm or road where pickup trucks may then carry them off. 5. The fruits are left to dry on the inflorescences. If they do not detach by themselves, they are knocked off by farm workers. The dried fruits are used to feed pigs. The fruits are used by landowners or are sold to other farmers who have pigs for meat production. Transport is usually local and not over long distances. The naturally high production of seeds means that reproduction of the palm can still occur even though the seeds are used as animal feed. 6. Even in pre-Columbian (prior to 1492) times the Hispaniolan royal palm played an important part in daily life. The Spanish soon learned from the Taino Indians to use the palm in construction. This "bohio" or typical house was seen by Samuel Hazard (1873) when he traveled in Haiti and the Dominican Republic in 1871. The walls are made from the trunk and the roof is "thatched" by a covering of flattened leaf sheaths. The royal palm is shown in the background. 7. The leaf sheaths that fall from the old leaves are gathered, stacked, and air-dried. Usually the men of a farm will collect their own sheaths for their own use. Sometimes where there is a great abundance of the palms, the sheaths may be sold in bundles much like those shown here (Cupey, Puerto Plata).





8. In rural areas, it is still frequent for houses or outdoor kitchens to be made of parts of royal palm. This out-building has its walls and roof made of leaf sheaths (Cupey, Puerto Plata, Dominican Republic). 9. "Petaca" is an open box made from green leaf sheaths. With about four cuts of the sheath and a few folds, the box is easily formed. It is tied at the corners by using a strip of the corner. No other material is needed to make the "petaca." Photographs from the turn of the last century show row boats on Rio Ozama loaded with petacas full of charcoal. Today, one can still see these no-deposit, no-return, biodegradable boxes in use in the countryside. 10. "Dulces criollos." Homemade candy made from whole milk and sugar boiled down to a thick, almost dry paste is placed on dry or almost dry pieces of leaf sheath. It is then rolled and hand-sewn closed. The traditional candy is now sold in most food stores in waxed paper or plastic wrappers. Candy shops that feature traditional sweets will often carry "dulce de leche en yagua." The "yagua" is the name for the palm leaf sheath. 11. In Spanish colonial times, slaves were common on the island. They did most of the manual, agricultural, and mining work. Here, slaves are shown preparing harvested tobacco leaves. In the foreground, the worker strips the leaves from the stalks. Under the shade of an open sided "bohio," two men are preparing tobacco products. The man at the right is preparing an "andullo." The tobacco that was dried and cured under a shed with palm-thatched (royal palm or often of *Sabal domingensis*) roof was taken and bound to form a long spindle. The leaf sheaths of royal palm were used to cover the bundle. A rope was then wound and tightened around the wrapped tobacco. The prolonged pulling and wrapping the rope compacted the tobacco.

12. The worker manipulates the "andullo" so that the tobacco is compressed by the tension of the rope wrapped around the bundle. Sometimes the tobacco is moistened with water or rum or other alcoholic beverages to add flavor and also soften the tobacco a bit so that it compresses well. "Andullos" may be almost 2 meters long as seen here (near Sanate, Higuey, Dominican Republic, May, 1981).

(*This article continued on page 53*)

NEWS OF THE SOCIETY

Thanks to South African Chapter for Palm Enthusiast Copies

The Chapter Committee would like to especially thank Adrian van Rensen, editor of the South African Palm Society journal, *The Palm Enthusiast*, for making many copies of available back issues available for distribution to all of the IPS Chapters worldwide. Members can now review more than one issue of this excellent publication in their individual chapter libraries. For those interested in subscribing, please see information on page 6 of your current IPS roster.

IPS Directors Meet in Florida

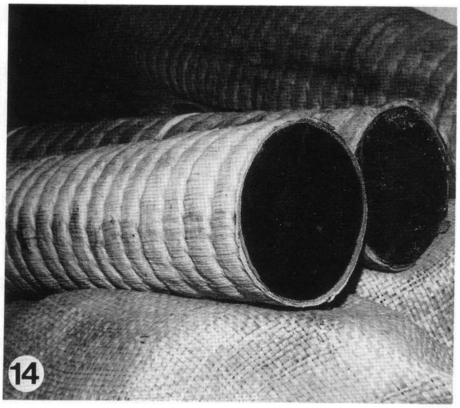
The IPS Board of Directors scheduled an interim board meeting in Miami at the home of Lester Pancoast on Friday evening, January 18. Lester and his Biennial Committee presented outline for the 1992 Biennial to be held in South Florida. The meeting was timed to coincide with the T.P.I.E. Meeting at Coconut Grove (January 17th to 19th) and the South Florida chapter Key West Field Trip, so that the maximum possible number of directors would be able to attend.

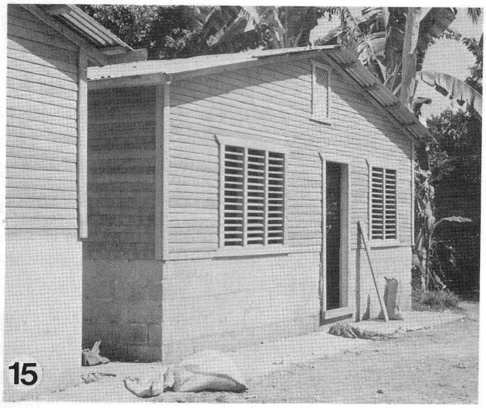
PALM LITERATURE *(Continued from page 26)*

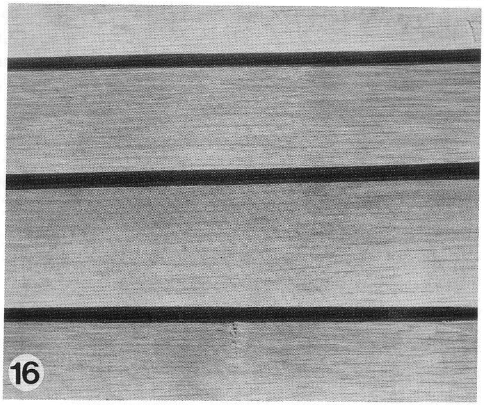
The second part of the book, entitled "Restoration and Renovation" gives an historical background for iron glasshouses and tells in fascinating detail the stories of the 1950 and the 1980 restorations of the Kew House. The planning and special construction for the marine display, a new collection at Kew, are explained in this section.

In the introduction the author states that the book came about because of her desire to point out the different ways in which the Palm House might be appreciated. These include from the disciplines of history, architecture, engineering, and horticulture. She used many sources such as old photographs, some actual memories, memoirs, and handwritten notes. The result is a book that is a valuable source in each of the areas listed above. Beautifully designed and illustrated, accurate, and clearly written, it is a pleasure to read and highly recommended.

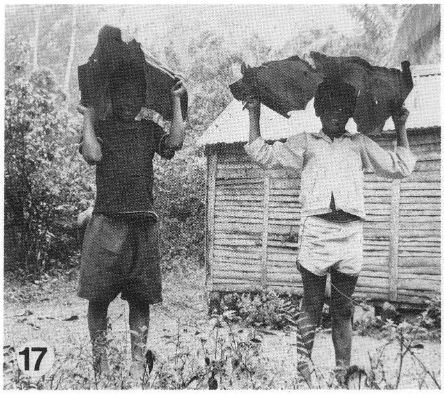
NATALIE W. UHL







13. The worker at this bench works the winch that puts tension on the rope. The rope continues (Fig. 12) to the "andullo" and wraps around the palm sheath-wrapped tobacco. The rope then continues on to a post or tree where it is tied to maintain the tension. 14. The "andullo" is removed from the rope press. The palm sheaths are left as a wrapper even when the "andullo" is ready to be sold by the piece to the purchasers. The tobacco is so well compacted that the dark-rusty brown mass has the appearance of dense wood. The "andullo" is cut into slices according to the quantity desired. A small homemade vice is used to support the "andullo" and an attached blade or knife is used to cut it. In rural areas, a man may carry an andullo and sell pieces. He often carries his cutter with him as he walks through rural towns or at the "gallerai" (cock-fight galleries). The tobacco cut from the "andullo" is used for chewing and smoking. 15. The trunk of royal palm is used to produce "clam shell" siding for houses. This rural house in Provincia Duarte (1981) has walls made up of cement blocks for about one meter above ground level. On the walls a wooden framework was mounted. Siding made from tangential slabs cut from the palm trunk were then nailed in place. Each slab overlaps the lower one, so that no gaps are left. 16. Detail of the slabs of the house shown in Fig. 15 shows that the royal palm was neatly cut and the outer surfaces planed smooth.




17. Not all houses are finished so finely. A house south of Miches, Dominican Republic shows a rustic finish with gaps in the walls. A corrugated zinc roof covers the house in this area of high rainfall (almost 2,000 mm average per year). The two boys were caught in a torrential downpour and found quick shelter under royal palm leaf sheaths. 18. A finished spool of cord. The boy (Fig. 18) said he was going to use it as kite string.

1949) was the first to recognize the species as differing from the other royal palms in the Caribbean. The Hispaniolan royal palm grows from below sea level, in the valley of lakes Enriquillo and Etang Saumatre, to about 1,000 m elevation in many of the mountain chains of the island.

The palm is used in many ways, and the accompanying photos show that the palm is a part of everyday life on the island.

LITERATURE CITED

BAILEY, L. H. 1939. The royal palm of Hispaniola. Gentes Herb. 4: 266–270.

——— AND H. E. MOORE, JR. 1949. Royal palms—new enumeration, pp. 114–134, *in* Palms uncertain and new. Gentes Herb. 8: 92–205.

HAZARD, S. 1873. Santo Domingo, past and present, with a glance at Haiti. Harper & Brothers: New York.

←

19. The "cojollo" or new palm leaf while it is still erect in the sword leaf stage, is used for several purposes. The new leaf is cut off by machete by men who climb to the top of the palm. It is then left to dry in the sun. The pliant leaflets are then twisted into a cord that is then used to weave seats of chairs or rocking chairs. Here a young boy—5 or 6 years old—is twisting the young leaflets into a cord. The un-opened leaf is held against his body as he twists. The spool of cord acts as a spindle. The process is similar to spinning wool (Anse-a-Foleur, Haiti, June 1985).

Principes, 35(1), 1991, pp. 56–57

The 1990 Post Biennial Trip to Malaysia

Thirty two rough and ready travelers left for a two week trek with leaders Jules Gervais, IPS President, and Trudy Zelco of Hawaii 2000 on June 23. The flight was a long fifteen hours via Taiwan, but Singapore is such a beautiful city-island-nation that arrival brightened everyone's spirits. It is surprising that an island half the size of Oahu can support almost four times the population and still be like a big green garden. High rises are massive but with the extensive park and street plantings, the buildings do not dominate. Rare and unusual shrubs and trees including many palms line the streets. Sealing wax palms are almost as common as *Areca* palms are in Hawaii. Several different species of *Licuala* are used in masses under large shade trees. The drive from the airport to the Marco Polo Hotel is landscaped with miles of royal palms and takes the traveler along a six kilometer stretch of public beach and coastline.

By Sunday the group was ready to explore the nearby Singapore Botanical Gardens with hundreds of native and exotic palms. Some of the group managed side trips to the Natural Forest Reserve and an outstanding bird park. Early Tuesday, it was off to Malaysia by way of the Bukit Timah expressway over the straits of Johore. Our local guide, C. Devon, gave us a running commentary on Malaysian culture and history. Also with us was David Tanswell, Australian palm expert, who knew the area we were about to explore.

David told us that Malaysia is a rapidly developing country. Forests are disappearing at an alarming rate as the country is preparing to be one of the leaders of the 21st century. He warned us that the tour would be rigorous. We would concentrate on the southern half of the peninsula, covering almost 2,500 kilometers and see at least 27 of the 30 native genera of palms. With more than 200 species already identified and more to be discovered, we would get a good feel for the rich flora of the area. Our assignment was to formally photograph and describe the palm species in specific localities. David emphasized that conservation of the forests is of main concern now. The main threats are agricultural development, clear cut forestry, and even commercial seed collection from endangered species.

Driving up the east coast of Mersing, we passed through miles of African oil palms and great forests of commercial rubber trees. These areas were rainforests just a few years ago with tigers, elephants, and other unique wildlife. It is still beautiful but after a while, it seems much like driving through miles of corn or wheat country. The occasional native forest stands were an interesting relief and we had numerous opportunities to stop and peer into the mysterious proliferation within the forests. Closer inspection of the oil palm plantations revealed trunks and "orchard" floors covered with all kinds of interesting palms, ferns, orchids and epiphytes. Many were attractive enough to grace any Hawaiian garden, so nature does seem to hang in there!

The diverse and unique lowland native forests are being cleared all over Southeast Asia, but the pressure is strong in developing nations like Malaysia to grow profitable products. Some governments are becoming aware of the value of these forests and are beginning to protect them in national parks and reserves. Along the Malaysian east coast we saw tracts of land abounding in palms with exotic names like *Licuala, Iguanura, Pinanga, Calamus, and Korthalsia.* Some suggest that the richness of Malaysian rainforests is probably due to their being relatively untouched by major climatic change for millions of years during which the forests evolved. The Malaysian forests have been relatively unaffected by ice ages and other catastrophes. It is believed that the area through which we were traveling has changed more in the last 20 years than it had in the last million.

As our group discussed these thoughts we arrived in Mersing, a small and rustic fishing village, several hundred kilometers north of Singapore. Later in the afternoon, we boarded three rickety fishing boats to go to an even more rustic hotel retreat about an hour's ride out into the South China Sea. After we took a snake out of one cabin, rubbed down with mosquito repellent, and were reminded to take our malaria tablets on schedule, we settled in to an early night. Sleep may not have come easy to all, but the night sounds of the forests and nearby sea lulled this tour member off immediately.

From Mersing north to Kuantan the meandering road travels through thickets of *Nypa* and *Metroxylon.* Palms like *Oncosperma*, *Eugeissona*, and *Pholidocarpus*, rarely seen outside their native habitats, were also common. Many species of rattan palms could be seen clambering in great forest trees. One of the very rare species of palms we spotted along the way was *Johannesteijsmannia* or "Joey" as the Australians called it. There are four species in Malaysia with giant simple leaves. Hopefully they will someday grace Hawaiian gardens. On our way to Kuantan we passed quaint villages like Endau and Rompin, and Pekan, home of the Sultan of Pahang.

Kuantan is the largest town in the area with a beautiful beach and well landscaped hotel where we spent two nights. The backdrop for the hotel was a lush forest from which we could hear sounds of birds and even monkeys. Trails that led into the forest meandered through *Arenga*, *Licuala* and rattan palms. The Australians called the rattans by the name "Wait-a-while" since when snagged by the barbed leaves, one has to wait while getting disengaged. They also call rattans "Lawyer Vines" but didn't explain why.

One side trip from Kuantan took us to Lake Chini in the interior. We reached the lake by dugouts through a river system that was reminiscent of a Tarzan movie. The lake was an extensive marsh covered with what seemed like miles of flowering lotus. The area is home to birds, monitor lizards, and other things we were happy not to see. Along the banks, we did see elephant tracks.

On leaving Kuantan, we headed west into the interior on a good but winding road up into the hill country and arrived in late afternoon at Fraser's Hill. The last few miles of road were so narrow that the bus could hardly make the corners. This part of Malaysia is much like areas around Kaloko Mauka or Volcano on the Island of Hawaii and is a cool 1,300 meters above sea level. We spent three relaxing days there, exploring for palms, tree ferns, carnivorous pitcher plants, and other unusual vegetation. The lodge where we stayed was very rustic and thanks to the efforts of our tour leaders, the food was delicious. Several species of tree fern were abundant in the area. The most spectacular was the giant blue fern with trunks to 30 feet and more. Palms included mountain species of *Pinanga*, *Nenga*, *Licuala*, *Caryota* and *Iguanura* which would be great additions to the gardens of subtropical regions like Southern California. The giant mountain fishtail palm (*Caryota maxima*) was particularly striking. Dr. Ruth Kiew of the Malaysia Nature Society was our guest lecturer and guide for the region and focused on conservation in her talks.

As we headed back down the mountains toward Singapore via Kuala Lumpur, we passed miles of agricultural development. Again mostly rubber and oil palm, but we also saw orchards of rambutan, durian, and guava. Near Kuala Lumpur we visited a major Hindu shrine, the Batu Caves with hoards of monkeys and people. Three hundred or more steep steps lead to the cave temple inside the limestone mountain. Truly it was mysterious and beautiful.

Kuala Lumpur, the nation's capital is a mixture of old and new. It appears that great efforts are being made to follow Singapore's example since many historic areas are being restored and new areas lushly landscaped. The drive from Kuala Lumpur to Singapore is a parkway with landscaping for scores of miles. Flowering trees, rare palms, and cycads are well maintained. The backdrop scenery is again oil palm and rubber forests.

The trip gave us all an opportunity to observe rare and unusual palms, landscaping using palms, and beautiful towns and country. Most memorable was meeting all of the smiling and friendly folks we found everywhere. Singapore and Malaysia are shining examples to the rest of the world of what can be done to rebuild after the destruction of war.

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***PALMS OF THE SOUTH-WEST PACIFIC** (J. L. Dowe, 1989, 198 pp., 33 pp. color) 29.95

PALMS OF SUBEQUATORIAL QUEENSLAND (Robert Tucker, 1988, 91 pp., 12 pp. color, many black and white photographs and maps) 20.00

SECRET OF THE ORIENT DWARF RHAPIS EXCELSA (L. McKamey, 1983, 51 pp.) 3.95

THE GENUS PTYCHOSPERMA LABILL. (F. B. Essig, 1978, 61 pp.) 6.50

THE INDIGENOUS PALMS OF NEW CALEDONIA (H. E. Moore, Jr., N. W. Uhl, 1984, 88 pp.) 12.00

***THE STRUCTURAL BIOLOGY OF PALMS** (P. B. Tomlinson, 1990, 477 pp.) 99.95

TROPICA (A. Graf, 7000 color photos, 1138 pp.) 125.00

***TROPICALS** (G. Courtright, 1988, 153 pp., Color Pictorial sourcebook & descriptions, 12 pp. of palms) 34.95

PALM PAPERS (Postage Included)

A NEW PRITCHARDIA FROM KAUA'I, HAWAI'I (Reprint from *Principes*, R. W. Read, 1988, 4 pp.) 2.00

FURTHER INFORMATION ON HARDY PALMS (J. Popenoe, 1973, 4 pp.) 2.00

NOTES ON PRITCHARDIA IN HAWAII (D. Hodel, 1980, 16 pp.) 2.50

RARE PALMS IN ARGENTINA (reprint from *Principes*, E. J. Pingitore, 1982, 9 pp., 5 beautiful drawings) 2.75

***PALMS FOR SOUTHERN CALIFORNIA** (Trish Reynoso, 1990, 11 pp.) 3.00

PALMS FOR TEXAS LANDSCAPES (R. Dewers & T. Keeter, 1972, 3 pp.) 1.25

PINANGA ISSUE OF PACSOA (#16, 1987, 17 pp.) 2.50

THE HARDIEST PALMS (J. Popenoe, 1973, 4 pp.) 2.00

***TROPICAL RAINFOREST** (A. Newman, 1990, 241 pp., World survey of endangered habitats, all color.) 45.00

* New arrival

The palm books listed above may be ordered at the prices indicated plus $2.00 extra per book to cover packaging and postage. (California residents please add 6.25% sales tax.) Foreign checks must be in U.S. dollars and payable on a USA bank. In some countries it is possible to send International Money Orders through the Post Office. Please include your International Palm Society membership number. Send check payable to The International Palm Society to Pauleen Sullivan, 3616 Mound Avenue, Ventura, CA 93003, U.S.A. ALL SALES FINAL.

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PS Form 3526, Dec. 1987 (See instructions on reverse)

Principes, 35(1), 1991, p. 59

CHAPTER NEWS AND EVENTS

Temperate Chapter Reorganization

The Temperate Chapter journal, *The Palm Quarterly,* will no longer be published by Tamar Myers, who has announced her "retirement" from this activity. There continues a large groundswell of interest in maintaining this mail-order Chapter complete with suitable journal covering temperate palm enthusiasts. A Temperate Chapter Committee has been formed to assist in the required reorganization. Additional interested volunteers are solicited to help with Temperate Chapter reorganization. If you are interested in serving in the leadership of this chapter or if you just wish to make sure you can sign up for the new journal, please contact either:

Richard Woo
3614 Handel Avenue
Vancouver, B.C.
Canada V5S 4G8

or

John B. Churcher
47 Grove Avenue
Portchester,
Fareham, Hants P016 9EZ
England, U.K.

Both of these gentlemen have offered, along with others, to assist in reformation of the Temperate Chapter and journal publication. Let them know your interest!

PACSOA 1991 Palm and Cycad Show

The 1991 annual Palm and Cycad Show will be held on the weekend of 9th and 10th March at the Auditorium, Mt Coot-tha Botanical Gardens, Brisbane, commencing at 9:00 am on both days, but finishing at 6:00 pm on Saturday and 5:00 pm on Sunday. The display will include hundreds of species of palm and cycads; Australia's largest such event. The amazing plant sales area will cater to collectors at reasonable prices, whilst there will be Seed sales, Book sales, light refreshments and an audio-visual showing. Setup day will be Friday, 8 March. Those interested in additional information, please contact Ted van Ginnekin on 61(07)-408-2331.

Australian Officers and Next General Meeting

PACSOA have a new Secretary as of January 1, 1991, in Mrs. Jeanne Price, who is presently Assistant Secretary, whilst Greg Cuffe was renominated as Treasurer, a position he has held for the previous two terms. John Dowe steps down from the Executive Committee but shall remain as Editor of *Palms and Cycads* and co-director of the PACSOA Publication Fund and Assistant Secretary of PACSOA. It should also be noted that PACSOA became an incorporated Company Limited by Guarantee as of January 1, 1991. The decision to incorporate was brought about by sustained and increasing interest in membership and planned continued publication and distribution of books through the Publication Fund.

The 1991 Annual General Meeting of PACSOA was held concurrently with the Annual General Meeting of the Southern Queensland Group on Monday, 21st January, 1991, at Bread House, Gregory Terrace, Brisbane, commencing at 7:30 p.m.

Eds' Note: see also pp. 46 and 52.

Back Cover

Dypsis forficifolia, an elegant clustering palm in the undergrowth of the lowland rain forest, Masoala. Madagascar. Photo by J. Dransfield.