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ESQUINAS EXPERIMENT STATION
CIA. BANANERA de COSTA RICA
GOLFITO DIVISION

Palmar
Aug. 14, 1952

Dr. H. E. Moore
Bailey Hortorium
Ithaca, New York

Dear Emery:

Glad to hear that you are back in Ithaca, and that your trip has been so successful. In my original manuscript on the Roystoneas I predicted that they would eventually be found throughout most of the Orinoco drainage, and in coastal swamps as far north as Veracrus in Mexico, but decided it sounded brash & deleted it in galley proof. As you know, I am a lumper by inclination, and everything I see in the field tends to bear this out. My personal reaction to the Roystoneas is that there are probably at most two "good" species, with innumerable geographic races & forms. A very high percentage of the specimens in cultivation answer to no known descriptions, and are probably hybrids. I have collected more material since writing you in Honduras, in the Amapa valley, and in Eastern Nicaragua, in the coastal swamps near the mouth of the Rio Grande de Matagalpa. Each colony seems to be a little self contained, uniform unit, varying slightly from the others. The more collections are made, the more these minor groups seem to approach each other. It would be very interesting in a place like Soledad to carefully measure, describe & photograph local wild trees and grow seedlings from each & see if they match the parents. I would like very much to see your specimens, but don't honestly know how much I could do with them. My small excursions into palms are mostly a hobby, just as my orchid ventures are, and I am tremendously hampered by not having adequate literature. Just now too I'm up to my eyes trying to finish up our local timber utilization manual before being transfered bag & baggage to Research headquarters in Honduras more or less a year hence. Louis Williams intended to send you a specimen of Roystonea Dunlapiana when I last saw him in March of this year. Did you ever get it?

When in Honduras I made a rather half hearted effort to investigate the fruits of Orbignya cohune & found on cutting open some hundred or more that most are single-seeded, but that occasional large fruits may have two or even three seeds. They are exploited on a small scale in the country for oil, and people who cracked the nuts for this purpose told me that this was also their experience.

So far as I know Guilielma utilis & Gastpaes are one & the same thing. I have seen thousands of 'em from the Amazon to eastern Nicaragua, and about all you can say is that from Panama northward the fruits are much more variable in size, though many, particularly in Costa Rica exactly match the large-fruited trees so common on the Amazon & Vaupes. I have never seen any growing wild, and doubt if anyone else has. The robust habit & radiating fibers from the foramina rather suggest Astrocaryum, and I have sometimes wondered if Guilielma might not have some Astrocaryum "blood". Edgar Anderson thinks that many of our cultigens are of hybrid origin, and I should think it might be at least possible in the case of Guilielma. For the present I should however think that it might much better be treated as a section of Bactris sens. lat. since the similarities are much greater than the differences. The fairly recent trend in palms, if followed to its logical conclusion would end in a vast assemblage of monotypic genera, which God forbid! I feel that the taxonomic structure should be made to reflect relationships insofar as possible, rather than to deliberately obscure them.

PAUL

You may find these of some help. I have a key to all the genera but it does not satisfy me and needs much revision.

Hal

1952

KEY TO TRIBES OF PALMAE AFTER HUTCHINSON

1. Perianth 6-merous that of the pistillate flower at length enlarging and embracing the fruit.

2. Leaves palmately nerved or divided.

3. Leaf-segments induplicate (V in cross-section); fruit not covered with imbricate scales.

4. Hermaphrodite or polygamodiecious palms. . . . . Coryphoe

4. Dioecious palms (Old World only). . . . . .Borrassoe

3. Leaf-segments reduplicate (∧ in cross-section) fruit covered with imbricate scales. (New World).. . . . . .Lepidocaryoe

2. Leaves pinnately nerved or divided.

5. Leaf-segments induplicate (Old World). . . . . .Phoenicoe

5. Leaf-segments reduplicate.

6. Pericarp of the fruit composed of the imbricate reflexed scales. (Old World except Raphia). . . . . .Calamoe

6. Pericarp of the fruit not composed of scales.

7. Endocarp of the fruit without pores. . . . . Arecoe

7. Endocarp of the fruit with 3 pores. . . . . .Cocoinoe

1. Perianth-segments rudimentary in both sexes; fruits crowded into a head. . . . . .Phytelephantinoe

GENERA OF NEW WORLD PALMS.

Outline key to Lepidocaryinoae

1. Spadices small and slender; rhachillae short and compressed, the staminate flowers distichous or unilateral in arrangement; slender palms with unarmed arundinaceous stems. . . . . 3. Lepidocaryum

1. Spadices large and thick; rhachillae ament-like and rounded, the staminate flowers densely spiral or distichous.

2. Large palms with thick unarmed stems; staminate flowers in thick aments, the pistillate scarce on non-amentlike branches. 2. Mauritia

2. Medium palms often with spiny bases and roots; flowers of both sexes in aments. . . . . .1. Mauritiella

Calameae - One genus, Raphia

Outline key to American Coryphem. See also Beccari, Webbia 2:

1. Perianth segments distinct, in two cycles; ovary mostly trilocular.

2. Outer spathes 2, cochleariform and persistent or deciduous but not tubular and sheathing the spadix branches; spadix congested. ("Cryosophileae") endosperm homogeneous.

3. Spathes 2, deciduous; flowers cruciform in 2 cycles of 2 (rarely 5-6); leaves bifid-flabellate.

4. Fruit tesselate. . . . . .Chelyocarpus
Tessmanniodoxa

4. Fruit smooth. . . . . .(Tessmanniophoenix)

3. Spathes persistent, cochleariform, generally tomentose or floccose; flowers in cycles of 3.

5. Flowers and fruit distinctly pedicellate; fruit large, 1.3-1.8 cm. long by 1.5-2.2 cm. wide; ovary unilocular (fide Burret). . . . . Schippia

5. Flowers and fruit sessile.

6. Flowers hermaphrodite; style elongate; fruit glabrous.

7. Stems unarmed. . . . . .Trithrinax

7. Stems armed. . . . . .Cryosophila

6. Flowers polygamo-dioecious; stigmas sessile; fruit hirsute. . . . . Rhapidophyllum

2. Spathes tubular and sheathing the usually long internodes of the spadix.

8. Style or stigma basal in fruit: seed dorso-ventrally compressed and excavate. . . . . .Sabal

8. Style or stigma apical or subapical in fruit; seeds mostly globose or laterally compressed.

9. Endosperm ruminate, abortive carpels apical in fruit. . Copernicia

9. Endosperm homogeneous; abortive carpels basal in fruit.

10. Seeds not excavate.

11. Trunk ventricose (the sepals are at best intermediate here, the lower much resembling those of the preceding heading but the petals are described as valvate by Bentham & Hooker - in any event the ventricose trunk is a useful distinction).. . . . . .Colpothrinax

11. Trunk not ventricose: sepals.

12. Seeds elongate, pointed at both ends, the raphe extending the length of the seed, fls. solitary, or paired, Sabal-like in aspect but petals broader and reflexed. . Serenoa

12. Seeds rounded, the raphe not extending past the middle. (grape-like)

13. Petals shortly connate at the base, ovate-lanceolate and spreading or reflexed; style shorter than the filaments (Caribbean): sepals connate basally with long, imbricate lobes. . . . . .Paurotis

13. Petals connate in a distinct tube below, linear-lanceolate above, strongly reflexed; style as long as or longer than the filaments (Calif.): sepals connate in a tube about equalling lobes. . . . . .Washingtonia

10. Seeds excavate.

14. Flowers solitary, sessile or semi-imbedded in the often tomentose rhachillae; fruit small, beaked subapically. . . . Brahea

14. Flowers glomerulate, not imbedded in the tomentum of the rhachillae, borne on small protuberances, fruit large, rounded without an apical point. . . . . Erythea

1. Ovary unilocular; perianth-segments united in a 6-dentate cup or obsolete.

15. Seed not sulcate nor bilobed but sometimes excavate; albumen plane; stamens 6.

16. Anthers on subulate filaments, introrsely dehiscent. . . . .Thrinax

16. Anthers sessile or nearly so, extrorsely dehiscent. . . Hemithrinax

15. Seed sulcate or bilobed; albumen plane or sometimes somewhat ruminate (?) stamens 6-12 or more.

17. Stamens 6; fruit verrucose; style persistent on apex. . . . . Haitiella

17. Stamens 8-13; sheaths sometimes armed, fruit smooth; style deciduous.

18. Seed bilobed; sheaths armed with stout spines; fruit large, fleshy and white. . . . . Zombia

18. Seed deeply sulcate with more than two primary divisions sheaths armed or unarmed; fruit small, the exocarp becoming thin, dry and black. . . . . Coccothrinax

Key to Subtribes of Arecoe in New World

1. Fls. and fruit pedicellate. . . . . Pseudophoenicoe

1. Fls. and fruit sessile or at most on a slight elevated area, sometimes sunken in the rachillae.

2. Inflorescence infrafoliar.

3. Spathes 3-5; pinnae truncate or oblique and erose (Opiandra in Chamedoreae). . . . . Iriarteae

3. Spathes 2; pinnae acute. . . . . Euterpeae

2. Inflorescence interfoliar.

4. Spathes 3-5.

5. Stamens 9-15 (??Juania). . . . . Ceroxyleae

5. Stamens 3-6. . . . . Chamedoreae

4. Spathes 2.

6. Flowers not immersed in the rhachillae; perianth not glumaceous; pistillate petals appearing valvate. . . . . Malortieae

6. Flowers immersed in the rhachillae; perianth glumaceous pistillate petals strongly imbricate. (Welfia infrafoliar). . . . . Geonomeae

Possible alternate division

1. Flowers and fruit pedicellate. . . . . Pseudophoenicoe

1. Fls. and fruit sessile or at most on a slight elevated area, sometimes sunken in the rachillae.

2. Spathes 3-5.

3. Pinnae truncate or oblique, erose-dentate; crown-shaft developed (?). . . . . Iriarteae

3. Pinnae acute or the leaves entire.

4. Stamens 9-15 (Juania??). . . . . Ceroxyleae

4. Stamens 6 (cf. also Juania).

5. Monoecious palms, fls. in acervuli. . . . . Synechantheae

5. Dioecious palms; fls. not in acervuli. . . . . Chamedoreae

2. Spathes 2.

6. Pinnae praemorse: pistillate petals nearly valvate. . . . . .Malortieae

6. Pinnae acute; pistillate petals strongly imbricate.

7. Crownshaft developed (?): stigmatic scar lateral or basal. . Euterpeae

7. Crownshaft not developed: stigmatic scar often apical.

8. Fls. scarcely sunken in rachillae. . . . . .Neoniocholsonia

8. Fls. deeply sunken in rachilla. . . . . Geonomeae

Malortieae

A single genus, Reinhardtia (see my notes).

Ceroxyleae

1. Stigma basal in fruit; stamens 9-15. . . . . .Ceroxylon

1. Stigma subterminal in frjit; stamens 6 (?) (this seems an anomalous placement.). . . . . .Juania

Pseudophoeniceae

One genus, Pseudophoenix, that requires further study for proper placing. Perhaps somewhat intermediate between Arecoae and Cocoineae as suggested by Cook.

Iriarteae

1. Flowers of both sexes in the same spadix; ovary entire with apical or excentric stigmas, rarely the fls. in separate spadices but the stamens then 6, the ovary glabrous (Dahlgrenia).

2. Stamens 9-12-15 or more.

3. Residual stigmas apical or subterminal in mature fruit; pinnae borne in several planes; tall palms with the trunk sometimes swollen toward the middle and with spathes curved in horn-like fashion.

4. Stamens 20-25 or more; embryo sub-apical. . . . . Socrateae

4. Stamens 9-20; embryo dorsal or lateral. . . . . Iriarteae

3. Residual stigmas basal in fruit; pinnae borne in one plane; stamens 15; low, arundinaceous palms, the stem and petioles frequently covered with pointed hairs. . . . . Iriartella

2. Stamens 6; stigmatic residue basal.

5. Sepals separate, [dilated or gibbous at the base]; pinnae strongly laciniate in several planes; fruit with basal stigmatic residue; tall palms. . . . . Dictyocaryum

6. Fls. in same spadix: ♂ sepals dilated or gibbous at base.

6. Fls. in separate spadices: ♂ sepals not dilated. . . . .Dahlgrenia

5. Sepals united in a cup with entire orifice; pinnae entire or with one incomplete tooth and disposed in one plane; fruit with basal stigmatic residue; small shade palms with arundinaceous stems. . . . . .Cuatrecasea

1. Flowers of each sex in separate spadices but sometimes the pistillate flowers accompanied by two rudimentary staminate; staminate flowers (unknown in Catostigma, Wettiniicarpus and several species of other genera with 6, 9, 12, or 15 stamens having usually apiculate anthers; ovary nearly always 3-lobed (the basal lobes smaller and abortive) pubescent or velutinous with the style or stigma basal or on the basal lobes; medium to tall palms.

6. Fruit neither closely spaced nor angled; style shortly columnar or none; stigmas sessile.

7. Endosperm more or less ruminate. . . . . Catoblastus

7. Endosperm plane. . . . . Catostigma

6. Fruit closely spaced and appressed, prismatic or obpyramidal from mutual pressure; flowers very closely spaced on a fleshy aroid entire or little-branched spadix.

8. Style none; stigmas sessile; elongate; pinnae laciniate and radiate. . . . . Wettiniicarpus

8. Style elongate, filiform, the stigmas more or less flexuous pinnae entire or nearly so. . . . . .Wettinia

Outline key to "Euterpeae"

1. Fruit with basal stigmatic scar; stamens 6: arundinaceous palms with entire and regularly or unequally pinnate leaves: endosperm homogenous with laterally basal ovule. . . . . .Hyospathe

1. Fruit with lateral or apical (rarely basal?) stigmatic scar: medium to tall palms with regularly pinnatisect leaves having linear to ensiform pinnae.

2. Stamens 9-20: inflorescence hippuriform, interfoliar or sometimes post-foliar. Pinnae with an indument of scales. . . . . .Jessenia

2. Stamens 6-(8) inflorescence completely post-foliar.

3. Sepals of the staminate flowers valvate and small: spadix hippuriform with elongate, pendulous branches: fr. globose with basal stigmatic scar, crown-shaft not developed: embryo basal. . . . . .Oenocarpus

3. Sepals of the staminate flowers imbricate and relatively large: spadix escorbiform or paniculate.

4. ♀ petals valvate. . . . . .Roystonia

4. ♀ petals imbricate. Euterpe, Prestoea, Oreodoxa, Acrista, Catis, Rooseveltia.

Outline key to Chamaedoreae

a. Synechantheae

1. Flowers monoecious, arranged in linear acervuli of 2-10 along the rhachilla, the pistillate basal, the staminate above.

2. Slender arundinaceous or acaulescent palms with 5-10 flowers per acervulus. . . . . .Synechanthus

2. Arborescent palms with thick stems; flowers various.

3. Trunk ventricose; (not ventricose in G. attenuata) flowers 3-5 per acervulus. . . . . .Gaussia

3. Trunk not ventricose; flowers 2-3 per acervulus (infl. infrafoliar through persistence but young spathes in leaf axils), many spadices on a single trunk persisting after leaf-drop.Opsiandra

b. Chamaedoreae verae

1. Flowers dioecious or if monoecious then in separate spadices.

4. Staminate flowers in longitudinal groups of 2-3 along the rachis, crowded; staminate spadices 6 in a ring included by one leaf-sheath. . . . . .Morenia

4. Staminate flowers solitary, isolated, spirally disposed; staminate spadices solitary from the leaf-sheath.

5. Style elongate, exserted, with 3 divergent stigmas; staminate and pistillate spadices simple; leaves entire. . . . . .Dasystachys

5. Style obsolete, stigmas sessile or nearly so.

6. Corolla of staminate and pistillate flowers gamophyllous, trifid, urceolate; pistillodium 3-lobed or capped by a 5-angled crown: spadices mostly long-pedunculate, 1-2-branched, the rachillae erect, spino-tipped. . . . . .Collinia

6. Corolla of staminate flowers valvate.

7. Pistillate corolla of valvate cucullate petals. . . .Neutheropetalum

7. Pistillate corolla of imbricate non-cucullate petals. . . .Chamaedorea

Wendlandiella also belongs here.

Outline key to Geonomeae

1. Stamens numerous; flowers bracteate.

   2. Fruit smooth, oblong-ellipsoid with basal stigmatic scar; pistillate flowers with about 18 staminodes united at the base and radiate at the apex; inflorescence infrafoliar. . . . . .Welfia

   2. Fruit covered with angled pyramidal corky protuberances, globose 2-3-lobed; pistillate flowers with about 12 short slender free staminodes; inflorescence interfoliar. . . . . .Manicaria

1. Stamens 6 or rarely 3; inflorescence interfoliar or rarely post-foliar.

   3. Stamens free or united only at the base; staminodes? (very small or none in Leopoldiana) 0 in (Woodsonia) Neonicholsonia.

      4. Spadix much-branched; fruit large, laterally flattened and excentrically rounded in outline with basal stigmatic scar. . . . . Leopoldinia

      4. Spadix simple; fruit conic (where known). . . . . .Neonicholsonia

   3. Stamens united except at the apex; staminodes united in a cylindric, infundibuliform or urceolate tube.

      5. Anthers sagittate or cordate, the thecae parallel and united with the connective except at the free base.

         6. Staminodial tube 6-lobed and exserted; style none, stigmas sessile; inflorescence post-foliar, spadix short-pedunculate. . . . . .Pholidostachys

         6. Staminodial tube 6-dentate and included; style elongate; inflorescence interfoliar.

            7. Arborescent palms; spadix once or twice-branched with numerous rhachillæ. . . . . .Calyptronoma

            7. Arundinaceous palms; spadix simple or with 1-2 branches at the base. . . . . .Calyptrogyne

      5. Thecæ of the anthers separated, divergent, reflexed or pendulous.

         8. Connective somewhat uncoiled and expanded before anthesis forming at anthesis a straight continuous line with the filament; ovary with terminal style. . . . . .Taenianthera

         8. Connective very short and forming a right angle with the filament before and after anthesis.

9. Staminodial tube urceolate with 6 lanceolate radiating lobes; ovary with terminal style. . . . . Asterogyne

9. Staminodial tube cylindric and truncate, entire or more or less toothed or laciniate at the apex.

10. Stamens 3, the filaments united in a solid column ovary with elongate terminal style. . . . . Kalbreyera

10. Stamens 6, the filaments united in a hollow tube; ovary with elongate lateral or basal style. . . . . Geonoma

Outline Key to Cocoineae

1. Spiny palms (rarely unarmed in Bactris) with pores of the seed borne above the middle and not covered with a fibrous coat, or very rarely (Acanthococos) borne below the middle.

   2. Foliar rhachis normally covered with segments to the apex; arundinaceous to tall palms with erect stems.

      3. Perianth of the pistillate flowers divided nearly to the base.

         4. Staminate flowers not immersed in the rhachilla.

            5. Pinnae acute; pores of the endocarp basal; spathe broad, larger than the spadix. . . . . .Acanthococos

            5. Pinnae truncate or erose at the apex; pores of the endocarp above the middle. . . . . .Aiphanes

         4. Staminate flowers immersed in the rhachilla; spathe large and woody.. . . . . .Acrocomia

      3. Perianth of the pistillate flowers united, cupuliform, tubular or urceolate.

         6. Staminate flowers immersed in the rhachilla and densely congregated at the upper part. Pinnae acuminate or truncate.

            7. Staminodia of the pistillate flower free; pores apical on the seed. . . . . Hexopetion

            7. Staminodia of the pistillate flower united in a ring; pores below the apex of the seed. . . . . Astrocaryum

         6. Staminate flowers not immersed in the rhachilla, mostly scattered among the pistillate; pinnae usually acute or acuminate.

            8. Large palms with stout columnar stem; leaf-segments irregularly disposed along the rhachis, fruit large, fleshy, edible, pink, orange or yellow: endocarp. with fused fibers.. . . . . Guilielma

            8. Slender, medium to arundinaceous palms; leaf-segments regular or in groups in one place on the rhachis; fruit large or small mostly pointed at the apex, endocarp without fused fibers. . . . . .Bactris

Acanthococos seems to present a connecting link between the Attalineae and Bactrineae with its basal pores. However, supra median pores are present in certain of the former vs. Jubaeopsis.

2. Foliar rhachis with the terminal pinnae modified to straight or recurved hooks; stems vine-like, not self-supporting. . . . Desmoncus

1. Unarmed palms (except for the sometimes spiny petiole margin).

9. flowers deeply sunken in alveolae of the spadix; stamens 6, the filaments united below; pores nearly apical on the seed or above the middle.

10. Pistillate flowers subtended by a long stout spinelike bract; fruit without persistent perianth. Erect and caulescent. . . . . Elaeis

10. Pistillate flowers not subtended by a long bract, trunk prostrate or absent.

11. Flowers of both sexes on the same spadix, the pistillate below; spadix long-pedunculate, laxly branched. . . . . Barcella

11. Flowers in separate spadixes; spadix shortly peduncu-late and densely branched. . . . . .Corozo

9. ♀ flowers not or only slightly sunken in the spadix; stamens 6-24 or more(?) with free filaments; pores usually borne below the middle or near the base and usually covered with fibers. (Jubeopsis)

12. Fruit very large, to 25 cm. long or more; mesocarp thick and fibrous; endocarp with a single large cell filled with milky endosperm. . . . . Cocos

12. Fruit smaller, less than 15 cm. long.

13. Thecae of the anthers separate and divergent, irregularly twisted, sinuous or inrolled. . . . . Orbignya

13. Thecae of the anthers united or free only at the base below insertion of the filaments.

14. Petals of the staminate flowers rounded and fleshy, linear-subulate or narrow, elongate, spindle-shaped, straight or much-curved and hooklike; stamens always 6, endocarp 1-3-celled.

15. Petals of the staminate flowers coherent in a column up to a third their length, much curved and hook-like; anthers helicoid-twisted. . .Parascheelea

15. Petals of the staminate flowers free or slightly united only, straight and subulate; anthers straight. . . . . Scheelea

14. Petals of the staminate flowers plano-concave mostly ovate, oblong or lanceolate.

16. Stamens much exserted; corolla of the staminate flowers very small; endocarp usually 1-celled, smooth and sharp-pointed; leaf-segms. with conspicuous transverse veinlets; stamens always 6. Maximiliana

16. Stamens included; corolla longer than the anthers.

17. Spadix simple.

18. Endosperm plane; stamen 6-20. . . . . Diplothemium

18. Endosperm ruminate; stamens 90-120. . . . . Polyandrococos

17. Spadix branched.

19. Inner spathe more or less profoundly plicate-sulcate.

20. Albumen ruminate.

21. Petioles spiny-margined. (Brazil). . . . . Arikuryroba

21. Petioles unarmed.

22. Endosperm oily, broadly hollowed in center; endocarp thinly woody. (Brazil?). . . . . Barbosa

22. Endosperm dry, narrowly hollowed in center endocarp very thick and bony (W. Indies). . Rhyticocos

20. Albumen plane.

23. Endocarp 2- or more-celled; stamens 6-24; fruit large, 5 cm. long or more (?). . . . . Attalea

23. Endocarp 1-celled; fruit mostly less than 5 cm. long. (check?)

24. Cavity of endocarp irregular; seed irregular, gibbose-uncinate. . . . . .Arecastrum

24. Cavity of endocarp regular with 3 smooth bands; seed regular. . . . . Syagrus

19. Inner spathe not plicate-sulcate, smooth.

25. Staminate flowers with 6 stamens; petioles conspicuously spiny on the margin; endocarp 13-celled. . . . . .Butia

25. Staminate flowers with 9 or more stamens; petioles unarmed, endocarp 1-celled.

25. Stamens numerous; sepals of the staminate flowers united and attenuate to a pedicel. . . . . .Jubaea

26. Stamens 9-16; sepals of the calyx free or very shortly united at the base.

27. Pores of the endocarp borne above the middle. (Africa). . . .Jubaeopsis

27. Pores of the endocarp borne at the base. . . . . Parajubaea

According to Beccari, Webbia 4: 190-202 (1913), the genus Hugeissona of the Malay Peninsula may belong here - separates on squamose fruit.

Phytelephantes

1. Palms with slender trunks and few leaves; fruits with a fleshy rind and a soft edible pulp. . . . . .1. Yarina

1. Palms with stout trunks or rootstocks and numerous large leaves 6-8 meters long; fruits with a hard shell armed with large woody spines and lined with stiff fibers.

   2. Staminate flowers represented by large capitate-angular receptacles rather sparingly beset with minute stamens, the anthers and filaments both very short; leaves with long slender sheaths and petioles. . . . . .2. Ammandra

   2. Staminate flowers with flat patelliform receptacles closely crowded with the filaments of the large stamens, the anthers and filaments both very long; leaves with short sheaths; petioles very short or wanting.

      3. Staminate flowers sessile or on very short pedicels, forming a continuous covering of the spadix; stamens 36 to about 200 in a close tuft or tassel; leaves with pinnae regularly spaced along the rhachis. . . . . 3. Phytelephas

      3. Staminate flowers on slender tapering pedicels 4-6 cm. long; stamens more than 1000 forming large spherical heads 2-3 cm. in diameter; leaves with pinnae aggregated in groups. . . . . .4. Palandra

1. Yarina: Cook:
   Y. microcarpa (R & P) Cook (Phytelephas microcarpa R & P.)
   Eastern Andes of Peru between the Ucayali & Huallaga rivers.

3. Phytelephas R. & P.:

P. macrocarpa R. & P.	Eastern Peru, rio Huallaga
P. tumacana Cook	Colombia
P. Seemanni Cook	Panama
P. Karsteni Cook	Magdalena River., Colombia
P. longiflora Cook	Caracas, Venezuela

2. Ammandra Cook:
   A. decasperma Cook Buenaventura, Colombia (coastal)

4. Palandra Cook:
   P. aequatorialis (Spruce) Cook (Phytelephas aequatorialis Spruce) Ecuador Guayaquil.

September 1952

CORYPHEAE

[31-32 genera, ca 330 spp.]

Genera insertae Chuniophoenix (Hainan, Indo China (2)) Symphogyne (Malaya 2), Wissmannia (Arabia 1)

1. Perianth-segments distinct, in two cycles; gynoecium of one or generally three carpels.
   2. Inflorescence suprafoliar, paniculate; monocarpic and single-stemmed or caespitose palms; ovary deeply or superficially 3-lobed; fruit with basal stigmatic scar (Old World) [the Corypha Group or Coryphinae]
      3. Gigantic monocarpic single-stemmed palms; petioles spiny, the leaf-blade with a distinct hastula; ovary superficially 3-lobed (India and Malaya to Australia). 24. Corypha (5-6)§
      3. Dwarf caespitose palms with monocarpic stems; petioles smooth, the leaf-blade without a hastula; ovary deeply 3-lobed (India, Iran, S. Arabia). 25. Mannorhops (4)
   2. Inflorescence interfoliar; polycarpic palms.
      4. Plants hermaphrodite, andro-monoecious, polygamo-dioecious or dioecious; carpels 1-3, free or only slightly united at the base, the styles always free and erect, divergent or sessile: spadix relatively short and congested, 1-2-branched; spathes 1-5 or sometimes more, often tomentose, bifacial or cochleariform, tubular at the base, open above, the lower branches of the spadix sometimes subtended by persistent or deciduous open bracts, the upper generally naked, never tubular-sheathed; flowers glomerate or solitary with generally 3-lobed calyx and free, imbricate or rarely united (Rhapis) petals; fruit globose to oblong with terminal stigmatic scar; seed with plane or more rarely slightly ruminate endosperm, often with intruded integu-

§ Approximate number of species indicated in parenthesis.

ment or umbilicate below the raphe, embryo lateral, antirapheal [Cryosophilinae]

5. Styles elongate, erect; spathes 2-several, cochleariform where known, the spadix branches often subtended by deciduous spathe-like bracts; flowers solitary; endosperm plane or marginally ruminate; hermaphrodite or andromonoecious (Schippia) plants with solitary or rarely (Trithrinax) caespitose stems [the Cryosophila Group]

6. Flowers without a pedicelliform base, perfect; carpels (2)-3-(4).

7. Fruit smooth; spathes mostly more than 2 and persistent.

8. Stamen-filaments free; stems lacking root-spines.

9. Leaf-sheath fibrous, unarmed; leaves bifid-flabellate (Bolivia, Peru) Colombia, Brazil) 1. Tessmanniodoxa (2)

9. Leaf-sheath coarsely and stiffly spinose at apex; leaves not bifid-flabellate (Brazil to Argentina) 2. Trithrinax (4-5)

8. Stamen-filaments united halfway or more; stems armed with root-spines (N. Colombia to Mex.) 3. Cryosophila (4-7)

7. Fruit tesselate; endosperm more or less marginally ruminate; spathes 2, deciduous; stems unarmed (Peru) 4. Chelyocarpus (2)

6. Flowers with a pedicelliform base, perfect or staminate by abortion in the same spadix; carpel 1; stem unarmed (British Honduras) 5. Schippia (1)

5. Styles short, erect or more usually recurved; spathes 1-5, the outer tubular below, bifacial and more or less keeled on the margins above, the apex acute, open; flowers often glomerate; endosperm generally with intruded integument below the raphe, sometimes marginally ruminate as well; polygamo-dioecious or dioecious, often caespitose plants. [the Rhapis Group]

10. Flowers nearly the same in both sexes or the ♂ differing only in having less well-developed or rudimentary carpels; corolla of free, imbricate, usually acute petals; styles short, divergent; stem stout or stoutish

11. Flowers 2–4 on a slightly or conspicuously elevated pulvinus; stamens or staminodes with slender filaments; seeds reniform or oblong, more or less grooved or thickened on the rapheal side; endosperm plane; petiole minutely toothed or tuberculate; spathes generally several.

12. Seed reniform and umbilicate or oblong and grooved on the rapheal side with deeply intruded integument; flowers sessile or on a conspicuous pulvinus; leaf-sheaths unarmed; stems solitary or more rarely caespitose (Asia).

6. Trachycarpus (2–6)

12. Seed oblong, the integument thickened below the raphe but not conspicuously intruded; flowers sessile or on an inconspicuous pulvinus; leaf-sheaths armed with long, stout, needle-like fibers; plants soboliferous (S.E.U.S.)

7. Rhapidophyllum (1)

11. Flowers solitary; stamens or staminodes with short fleshy filaments united basally in a ring; seed globose or ellipsoid, not grooved or thickened along the rapheal side; endosperm ruminate marginally with deeply infolded integument below the raphe; petiole strongly antrorse-spinose; spathes 1–2; plants generally caespitose (Mediterranean).

8. Chamaerops (1)

10. Flowers differing in the two sexes, solitary; calyx cupular and 3-lobed, corolla of ♂ flowers tubular and 3-lobed, ♀ corolla stipitate and tubular; styles very short, the stigmas essentially sessile; spathes 2–3; petiole unarmed; plants soboliferous with arundinaceous stems. (S. E. China, Indo-China)

9. Rhapis (6±)

4. Plants hermaphrodite; carpels 3, free or united but the styles always erect and connate; spadix elongate with few to many "partial inflorescences", the spathes generally tubular and closely sheathing rhachis, branches and branch-

lets, more rarely cochleariform or sword-like and flaring above; flowers glomerate or solitary with free or united sepals and free, valvate petals; fruit various with terminal or basal stigmatic scar; seed with plane, intruded or ruminate endosperm. [Sabalinae]

13. Carpels free or connate styles, generally only one developing, the stigmatic remains apical in fruit; fruit and seeds globose or laterally compressed; abortive carpels apical or basal.

14. Spathes cochleariform or sword-like, tubular below, expanded above, not closely sheathing, generally subtending each primary branch of the spadix and sometimes equalling or exceeding it, the internodes bare; flowers solitary with tubular and more or less stipitate-based calyx, the fruit pseudostipitate with adherent cupule and bearing abortive carpels at the apiculate apex; petals flat or cucullate, ± asymmetric, strongly veined without anther foveolae; seed globose with plane endosperm and subbasal to basal antiraphal embryo; medium to large or very large solitary palms. [The Pritchardia Group]

15. Flowers sessile with dry or fleshy, usually coriaceous but not glumaceous, perianth forming a short, truncate cupule in fruit; styles shorter than the stamens; fruit with fibrous mesocarp; petiole unarmed.

16. Spathes cochleariform, acute or acuminate; petals fleshy, not caducous, discolored in drying, the filament-tube not forming a collar; seed with more or less thickened and intruded integument, the embryo lateral; trunk ventricose in some part; leaves with deciduous brown lacerate-fimbriate scales below becoming punctate by persistent bases below. (Cuba) 10. Colpothrinax (1)

16. Spathes sword-like or cochleariform; petals dry, caducous, not discolored in drying; stamen-filaments forming a collar; seed without thickened or intruded integument, the embryo basal; trunk uniform; leaves with persistent whitish or yellowish scales below (Hawaiian Is., Dangerous Is., Fiji Is.) 17. Pritchardia (304)

15. Flowers pedicellate with dry, more or less glumaceous perianth, the corolla falling entire, the calyx forming a flaring persistent appressed cupule in fruit; styles as long as or longer than the stamens; spathes sword-shaped; fruit with fibrous mesocarp; trunk thickened basally; petiole armed. (S.E.U.S., N.W.Mex.) 12. Washingtonia (2)

14. Spathes tubular, closely sheathing the basal portion of primary branches and internodes of the spadix, never equalling the branches; flowers glomerate to solitary with calyx of free or more rarely united sepals but not stipitate-based, the petals symmetric with prominent anther foveolae; fruit generally lacking adherent cupule, the abortive carpels basal or more rarely apical; seed globose to oblong with lateral antirapheal embryo; small to medium or rarely large palms with solitary or caespitose stems. [the Copernicia Group]

17. Endosperm plane but frequently with intruded integument below the raphe; abortive carpels generally basal in fruit.

18. Integument not intruded into endosperm below raphe; ovary glabrous.

19. Flowers ternately glomerate at base or rachillae, sometimes paired or even solitary at tip, 2.5 mm. long or less, the petals more or less deltoid, about twice as long as the sepals; sepals free or very shortly connate at the base; stamen-filaments united in a basal ring, the free portions short, rather abruptly narrowed from a triangular base; mature fruit globose or depressed globose with a short raphe scarcely more than half as long as the seed; petioles armed with stout widely spaced

spines 2 mm. long or more, hastula present only on ventral surface; caulescent palms with slender stems to 10 m. high. S. Fla., W.I., Mex. to Cent. Amer. 15 Pauratis

19. Flowers paired or more often solitary, 4 mm. long or more, the petals linear-lanceolate, about 3 times as long as the sepals; sepals united in a distinct tube; stamen-filaments shortly united at base, the free portions elongate and gradually narrowed: mature fruit ellipsoid, 15 mm. long or more; seed ellipsoid with a prominent raphe extending its length; petiole closely denticulate or serrate with spines less than 1 mm. long, hastula present on dorsal and ventral surfaces; acaulescent or short-caulescent (rarely to 8-9 m. high) palms. N. Car. to Fla. & La. 14. Serenoa (1)

18. Integument intruded into endosperm below the raphe; ovary glabrous or pubescent.

20. Fruit smooth.

21. Petiole unarmed; spathes more or less cochleariform; flowers glomerate; fruit large, 3.5 cm. diam. (New Caledonia)

15. Pritchardiopsis (1)

21. Petiole generally armed with stout spines; spathes mostly tubular.

22. Calyx deeply lobed or of 3 separate sepals; arborescent or rarely acaulescent (Brahea) palms.

23. Sepals free; leaves with scattered or no cross-veinlets; seed adherent to endocarp at maturity (?); fruit yellow, brown or black; leaves weakly costapalmate.

24. Flowers ternately glomerate at base of rachillae, sometimes paired or even solitary at tip; mature fruit ellipsoid to subglobose, 20 mm. long or more, with blunt subapical stigmatic scar. Baja Calif., Mex. to Honduras. 16. Erythea(8)

24. Flowers all solitary; mature fruit ellipsoid, 18 mm. long or less with apiculate stigmatic scar. N.L., Mex. to Guate. 19. Brahea (7)

23. Sepals united in a low ring at base; leaves generally with continuous cross-veinlets; seed free from endocarp at maturity (?): leaves strongly costapalmate, the segments often with pendulous apices: fruit blue, blue-green to black. Australia to S. China. 20. Livistona (23+)

22. Calyx subcampanulate or tubular, corolla urceolate or tubular below: small frutescent or acaulescent palms; leaves scarcely costapalmate with stiff segments often united in groups and appearing biserrate at apex. Australia to India and S. China. 17. Licuala (75+)

20. Fruit tesselate with corky ridges and tubercles; flowers glomerate.

25. Corolla with shortly connate petals; stamen-filaments forming a short 6-lobed cup; leaves costapalmate; small swamp palm of Sumatra, Malaya and Borneo. 22. Teysmannia (1)

25. Corolla tubular to the middle; stamen-filaments in a long tube; leaves not costapalmate; stout, single-stemmed palms of Malaya and Malay Archipelago. 21. Pholidocarpus (5-6)

17. Endosperm ruminate; abortive carpels apical in fruit; petioles often leaves strongly spinose. W.I. & S. Amer. 22. Copernicia (30)

13. Carpels more or less united forming a depressed-globose fruit with stigmatic remains basal; seed dorsally compressed with excavate endosperm; flowers solitary; petiole smooth. Bermuda to N. Colombia. 23. Sabal (ca. 30)

1. Perianth-segments united in a 6-dentate cup or obsolete; carpel 1, ovary unilocular [Thrinacinae]

26. Seed not sulcate nor bilobed but umbilicate-excavate below the raphe with plane endosperm; stamens 6.

27. Anthers on subulate filaments, introrsely dehiscent. S. Fla., Bahamas to Lesser Antilles, Yucatan. 26. Thrinax (10)

27. Anthers sessile or nearly so, extrorsely dehiscent. (Cuba) 27. Hemithrinax (4)

26. Seed sulcate or bilobed; endosperm plane or somewhat ruminate (?); stamens 6-12 or more. Caribbean. (incl. Zombia, Haitiella) 28. Coccothrinax (30+)

Zombia may yet prove a good genus

PHOENICEAE

[1 genus, ca. 12 spp.]

One genus - Phoenix. 29. Phoenix (ca. 12)

Chamaephoenix is said by Hutchinson (Monocots) to be an additional genus of this tribe but I do not find it in Index Kewensis.

This tribe might be better considered on a par with subtribes of Corypheae differing in pinnate leaves and dioecious condition with marked floral dimorphism.

BORASSEAE

1. Branches of ♂ and ♀ spadices similar, ament-like; ♂ flowers in 3's; ♀ flowers small, globose, pedicellate; fruit globose with basal stigmatic scar [Hyphaeneae]

2. Seed esulcate; petiole ligulate.

3. Endosperm homogeneous; petiole spiny. 30. Hyphaene (Afr., Madagascar)

3. Endosperm ruminate; petiole smooth. 31. Medemia (Afr.)

2. Seed deeply multisulcate, spuriously ruminate; petiole eligulate.

32. Bismarckia (Madagascar)

1. Branches of the ♀ spadix unlike the ♂, large and thick; spathels coriaceous, concave-navicular or shortly infundibuliform; flowers large, globose, sessile; fruit symmetric, 1-3-seeded with apical stigmatic scar [Euborasseae]

4. Staminate flowers numerous in each alveole.

5. Stamens 6; ♂ spadix of numerous aments; spathels with connate margins; fruit large with fibrous mesocarp, mostly 3-seeded, the seeds lightly bisulcate, emarginate at apex; leaf with short rachis; petiole armed. 33. Borassus (India, Malaya, Afr., Madagascar, N.Guin.

5. Stamens numerous; ♂ spadix with few large aments; fruit 1-seeded, very large with fleshy mesocarp, the seed deeply bilobed; leaf with elongate rachis, petiole unarmed. 34. Lodoicea (Seychelles Is.)

4. Staminate flowers solitary in each alveole.

6. Bracts of ♂ spadix free; stamens 6; mesocarp fibrous; seed deeply multisulcate. 35. Borassodendron (Malaya)

6. Bracts of ♂ spadix connate; stamens numerous; mesocarp succulent, not fibrous; seed not sulcate. 36. Latania (Mascarene Is.)

CARYOTEAE§

1. Leaves simply pinnate or pinnatisect; spadices branched, the divisions again 1-branched, ~~and~~ greatly congested and basipetal in development within the principal spathes; endosperm plane.

   2. Sepals free, imbricate in staminate flowers, stamens numerous; fruit generally 3-seeded. Indo-Malaya to Formosa, Christmas Island, New Guinea and Australia. 36. Arenga (ca. 12)

   2. Sepals united in staminate flowers.

      3. ♂ calyx tubular, truncate; stamens 6-(12-15?); fruit often 1-seeded. Indo-Malaya 37. Wallichia (6)

      3. ♂ calyx cupular, 3-lobed; stamens 10-30; fruit generally 2-seeded. Indo-Malaya. 38. Didymosperma (7-8)

1. Leaves bipinnate; spadices solitary; ♂ calyx of free imbricate sepals; stamens 6-numerous; fruit mostly 1-seeded, seed rounded with ruminate endosperm. Indo-Malaya. 39. Caryota (ca. 12)

§ This tribe must yet described as such has generally been placed as a subtribe of the Areceae including in addition to the above Crania, Manicaria and Sclerosperma. The induplicate vernation of the leaves, monocarpic habit and other characters are quite at variance with the Areceae and the additional genera mentioned. It is best placed as a separate tribe with other induplicatae. The spathes and spadices as well as tricarpellary ovary are strongly reminiscent of the Borasseae but it in no wise bears the same relation to that tribe as does Phoenix to the Corypheae.

PROVISIONAL KEY TO TRIBES OF PALMAE

Leaves induplicate in vernation with the rachis or costa extending through a terminal segment or pinna, the pinnae or segments V-shaped at insertion

[Palmae Induplicatae]

2. Gynoecium of one unilocular carpel (Schippia, Thrinax, Coccothrinax, Hemithrinax) or of 3 distinct carpels or the carpels 3 and connate by the styles, rarely more or less united but the ovary then distinctly 3-lobed and the fruit with basal stigmatic scar: polycarpic palms with interfoliar spadices from the leaf-axils.

3. Leaves palmate with acute or mostly bifid segments; hermaphrodite, andromonoecious, polygamo-dioecious or dioecious palms with more or less congested spadices subtended by 2-5 more or less cochleariform or ancipitous spathes and the branches sometimes with deciduous spathe-like bracts or the spadices elongate with few to many rather widely separated branched divisions ("partial inflorescences") subtended by tubular or sheathing spathes, the ♂ and ♀ flowers essentially alike (somewhat differentiated in Khapis). Old and New Worlds.

Corypheae

3. Leaves pinnate, the lower pinnae spiniform, the remainder acute; monoecious (?) or generally dioecious palms with more or less congested, sometimes umbelliform strongly flattened spadices subtended by a single ancipitous spathe; ♂ and ♀ flowers dissimilar; fruit with terminal stigmatic scar; seed with integument intruded below the raphe. Old World Phoeniceae

2. Gynoecium globose, trilocular with 1-3 ovules maturing, the stigmatic scar apical or more rarely basal in fruit; polycarpic or monocarpic palms.

4. Leaves palmate with acute or bifid segments: dioecious, polycarpic palms with acropetal flowering, the spadix interfoliar from the leaf-axils elongate with widely separated simple or branched ament-like primary divisions subtended by sheathing spathes; ♂ and ♀ flowers more or less sunken in the rachis and/or subtended by enlarged overlapping bracts; sepals and petals imbricate; fruit with fibrous, non-irritant mesocarp. Old World Borasseae

4. Leaves pinnate or bipinnate with praemorse and often cuneate pinnae or pinnules: monocarpic, monoecious, often caespitose palms with basipetal flowering; spadix penetrating the sheath at the node and consisting of a single large simply-branched division or of several once-branched divisions densely congested at the base and subtended by several sheathing spathes, the central division maturing first, the branches or rachillae never ament-like; ♂ and ♀ flowers ~~sessile~~ generally sessile in strongly protandrous triads ♂♂♀, the sepals united or imbricate, the petals valvate: fruit with fleshy mesocarp containing irritant crystals. Old World "Caryoteae"

[this assemblage of four genera has generally been included with the Arecoae but in its several peculiarities seems best maintained as a discrete unit related in some aspects to the arecan palms but also having some similarity to the borassoid palms.]

1. Leaves reduplicate in vernation with the rachis or costa continued as a filament or lacking beyond the base of terminal paired pinnae or segments, the pinnae or segments A-shaped at insertion.

5. Perianth present, hexamerous: fruit not syncarpous (superficially so in some Iriartinae)

6. Fruit covered with imbricate scales: hermaphrodite, polygamo-dioecious or dioecious palms of various habit, sometimes fiercely spiny and climbing: spadix and its primary or all divisions generally subtended by sheathing spathes.

7. Leaves, pinnate, rarely digitate or simple and penninerved. Old World except Raphia in Africa and A merica Calameae

7. Leaves palmate. New World. Mauritieae

6. Fruit not covered with imbricate scales, smooth or more rarely spiny or tuberculate or corky-ridged; spathes 1-2 or more, rarely several and sheathing the peduncle but never the branches.

8. Hermaphrodite or andro-monoecious palms with interfoliar inflorescences: flowers pseudopedicellate with an elongate stipitate base; carpels united, 1-3 maturing; fruit with bony endocarp. Fla., Bahamas, Cuba, Hispaniola.

"Pseudophoeniceae"

[consists of the genus Pseudophoenix with five species more or less.]

8. Monoecious or dioecious palms.

9. Endocarp without pores, the abortive carpels not fused with the fertile;

Areceae

9. Endocarp with 3 pores, the abortive carpels (when present) fused with the fertile; spathes (1)-2. New World except Elaeis and Parajubaea.

Cocoineae

5. Perianth rudimentary or absent in both sexes: fruits crowded in a syncarp.

10. ♂ and ♀ flowers in separate spadices, the ♂ with free stamens, the ♀ with rudimentary perianth: spathes 2: pollen smooth: New World.

Phytelephanteae

10. ♂ and ♀ flowers in the same spadix, the ♀ with 3 united stamens and crowded on amentum-like branches below the terminal pistillate head, the ♀ flowers without a perianth: spathes numerous: pollen hispidulous: Old World

Nypeae