

RELATIONSHIPS OF THE FALSE DATE PALM OF THE FLORIDA KEYS, WITH A SYNOPTICAL KEY TO THE FAMILIES OF AMERICAN PALMS.

By O. F. COOK.

THE GENUS PSEUDOPHOENIX AND THE FAMILY PSEUDOPHOENICACEAE.

PSEUDOPHOENIX AN ISOLATED TYPE.

Though the false date palm (*Pseudophoenix sargentii* Wendl.) was discovered over twenty years ago, little attention has been given to the problem of its relationships. The fact that the natural distribution is limited, as far as known, to two or three islands of the Florida Keys does not make it less interesting from the standpoint of classification. Isolated types often have a special bearing upon questions of phylogeny and classification. Reasons are usually found for believing that such types are the remnants of ancient groups that have elsewhere become extinct. Several genera not known from other parts of the world are represented in the unique palm flora of Florida and Cuba. That the other peculiar genera are fan palms only makes *Pseudophoenix* the more interesting because it represents an intermediate stage of development between the fan palms and some of the pinnate-leaved families.

ANALOGIES WITH FAN PALMS AND TRUE DATE PALMS.

The generic name applied by Wendl. may be taken to indicate that *Pseudophoenix* was looked upon at first as an American analogue of the true date palms of the Old World, which seem to be related, not very remotely, to *Chamaerops* and other Old World fan palms. The analogy with *Phoenix* is made somewhat closer by the form of the leaves of *Pseudophoenix*, with their rather narrow, closely folded pinnæ arranged in irregular groups and standing at different angles to the rachis. Yet the pinnæ are altogether different from those of *Phoenix*, for they are reduplicate or folded back, with the channel on the under side, as in all of the pinnate palms except *Phoenix*.

Pseudophoenix is also like *Phoenix* in sharing some of the characters of fan palms, such as the large, branching inflorescence, the stipitate flowers, and the fleshy fruits with equal development of two or

three carpels. But they are not the same resemblances that are shown in Phoenix and they afford no indication that Pseudophoenix is at all related to the true date palms. They furnish additional proof, if any were needed, of the derivation of the pinnate-leaved palms from fan-leaved ancestors, but the fact that some of the ancestral features have been retained should not cause profound differences in other respects to be overlooked.

ALLEGED RELATIONSHIPS WITH OTHER PINNATE-LEAVED PALMS.

Sargent states that the original example of the palm, on Elliotts Key, was at first mistaken for a royal palm (*Roystonea*). The resemblance lay in the smooth, columnar trunk, the irregular positions of the pinnæ, and the elongated, sheathing leaf bases, but it became apparent that these similarities were merely external, as soon as the inflorescences and fruits were examined.¹

Wendland at first suggested an affinity with *Chamaedorea* and afterward with *Gaussia*, in which Drude seems to have agreed. *Gaussia* is a Cuban genus of *Synechanthaceae*, while *Chamaedorea* belongs to a strictly continental group, chiefly Central American. In addition to the geographical proximity there is a slight resemblance between *Pseudophoenix* and the *Synechanthaceae*, both in the habit of growth and in the crowded, deeply furrowed pinnæ. Moreover, the seeds of *Pseudophoenix* are marked on the surface with a few impressed branches of the raphe, much as in *Synechanthus*. But such similarities are shared by so many other palms that they are of very little account as evidences of relationship. There is a complete contrast between the highly specialized inflorescence characters of the *Synechanthaceae* and the relatively primitive condition represented by *Pseudophoenix*.

The characters that afford the most definite suggestions regarding the affinities of *Pseudophoenix* are found in the fruits. The fruit characters indicate that *Pseudophoenix* is much more closely related to the ivory palms, or even to the coconut palms, than to *Chamaedorea* or to *Gaussia*. With only the dried fruits, as represented in herbarium specimens, it is easy to overlook some of the most suggestive features. New characters have been learned from fresh material of the ripe fruits, sent in by Mr. E. Simmonds from Miami, Florida,

¹ Sargent, C. S. *New or Little Known Plants. Pseudophoenix sargenti.* Gard. & For. 1: 352. f. 55, 56. 1888. The figures consist of a photograph of a group of the palms on "Long's Key" and drawings of the fruits and seeds. Wendland's Latin diagnosis is given. A preliminary notice of the palm, with the name "*Pseudophoenix sargentii* H. Wendland," had been published two years before, in the *Botanical Gazette* (11: 314. 1886). Sargent's most complete account of *Pseudophoenix* is in the *Silva of North America* (10: 33. pl. 506. 1896.) The localities mentioned in the *Silva* are Elliotts Key and Key Largo.

in February, 1912, to the office of Seed and Plant Introduction of the Bureau of Plant Industry, U. S. Department of Agriculture. A specimen of the inflorescence with the fresh flowers was also received in August, 1912, from Mr. Simmonds, through the courtesy of Mr. R. A. Young of the same office.

One reason why it did not seem possible to assign *Pseudophoenix* to a satisfactory place in the classification was that the flowering stage was still unknown, the floral characters having been inferred from the parts that persist on the mature fruits. The most significant fact to be learned in this way was that the flowers of *Pseudophoenix* are borne on distinct pedicels. This feature alone would make it evident that there could be no very close alliance between *Pseudophoenix* and any of the genera with which it has been associated by previous writers. From the fresh inflorescence it is still more apparent that *Pseudophoenix* is not merely similar to the fan palms in having pedicellate flowers, but in several other floral characters that entirely exclude the idea of alliance with *Gaussia* or *Chamaedorea*.

FRUIT CHARACTERS.

In external appearance the fresh fruits of *Pseudophoenix* may be described as smooth, shining berries, orange red in color and very variable in form, depending on the number of seeds developed. Many of the fruits have only one or two seeds, but so large a proportion are three-seeded that this must be considered as the normal condition. The size and shape of the fruits, and the characters of the attached floral organs are shown at natural size in plates 74 and 75. The general structure of the fruit is much like that of some of the cocoid palms, such as *Bactris*, *Attalea*, and *Acrocomia*. A smooth, thin epidermis incloses a thick, fleshy, oil-bearing pulp with an embedded fibrous network, surrounding a firm endocarp. Though the endocarp is quite thin, it is very hard and bony and has a distinctly columnar structure as in *Manicaria* and *Phytelephas*. And as in the latter genera, the endocarps of the three pistils remain distinct instead of being united as in the *Cocaceae*.

Thus in the fruits of *Pseudophoenix* the exocarp characters of some of the *Cocaceae* may be said to be combined with the endocarp characters of the *Manicariaceae* and *Phytelephantaceae*. The method of germination is also closely similar to that of the ivory palms. Instead of being related to the *Synechanthaceae* or the *Chamaedoreaceae*, *Pseudophoenix* finds a closer alliance with the coconut palms and other families recently recognized as members of a cocoid series.¹

¹ Cook, O. F. Relationships of the Ivory Palms. Contr. U. S. Nat. Herb. 13: 133-142. 1910.

In affording such a combination of the characters of the *Cocaceae* with those of *Manicariaceae* and *Phytelephantaceae*, *Pseudophoenix* adds to the evidences of relationship drawn from the characters of the other families. On account of their peculiar flowers and fruits the ivory palms of South America had not been considered genuine palms, but had been placed in other orders, usually in association with *Nipa*, an altogether different Old World type. The recognition of the *Phytelephantaceae* as true palms and their association with the *Cocaceae* appear the more completely justified, now that we have *Pseudophoenix* as well as *Manicaria* to illustrate intermediate conditions of development of the characters of the fruits. Indeed, *Pseudophoenix* is much more directly intermediate than *Manicaria* in the particular characters in which the coconut palms and the ivory palms appear most widely divergent. The exocarp of *Manicaria* is much like that of *Phytelephas* and quite unlike that of any of the *Cocaceae*, while *Pseudophoenix* appears closer to the *Cocaceae* in the exocarp and closer to the ivory palms in the endocarp.

PSEUDOPHOENIX THE TYPE OF A NEW FAMILY.

Though the characters of the fruits and the germinating seedlings afford consistent and substantial evidences of the affinity of *Pseudophoenix* with the ivory and coconut palms, it does not appear that any very close alliance can be established. *Pseudophoenix* would certainly appear as a very anomalous genus if placed in the *Cocaceae*, *Manicariaceae*, or *Phytelephantaceae*. The only reasonable course seems to be to assign it to an independent position in the classification as representing a new and distinct family, *Pseudophoenicaceae*. The salient characters are indicated in the following description:

Family PSEUDOPHOENICACEAE.

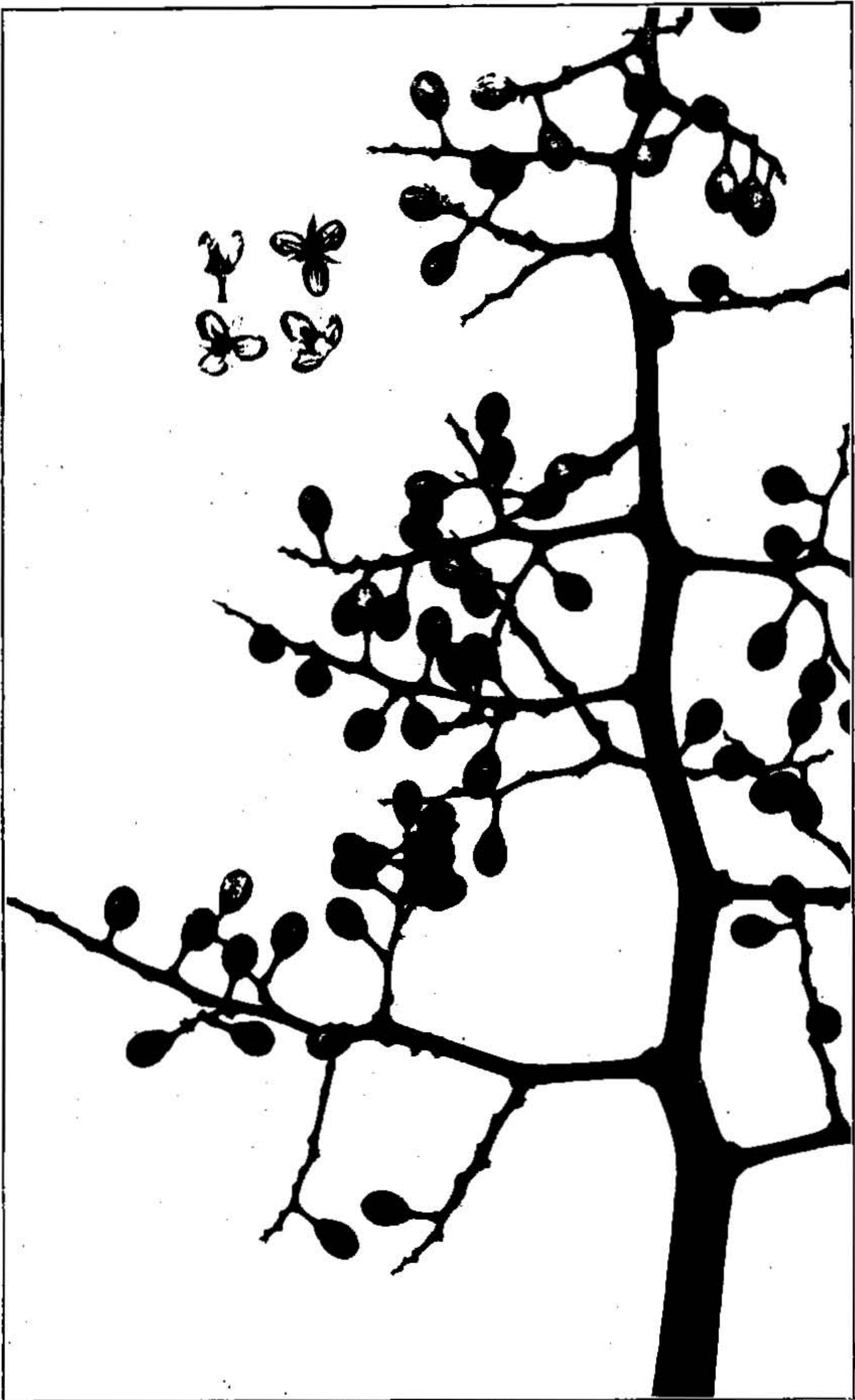
Inflorescence exerted on a long-jointed, naked peduncle, dividing into numerous compound, naked branches, the spathes confined to basal joints. (PL. 75, c.) Flowers andromonœcious, male and bisexual in the same inflorescence, widely scattered on the ultimate branchlets, each flower supported on a slender pedicel articulated to the branch by an expanded hollow base. (PL. 75, a, b.)

Calyx represented by a narrow, saucer-like rim of a thickened receptacle, the sepals indicated by slightly prominent, broadly rounded angles alternating with the petals.

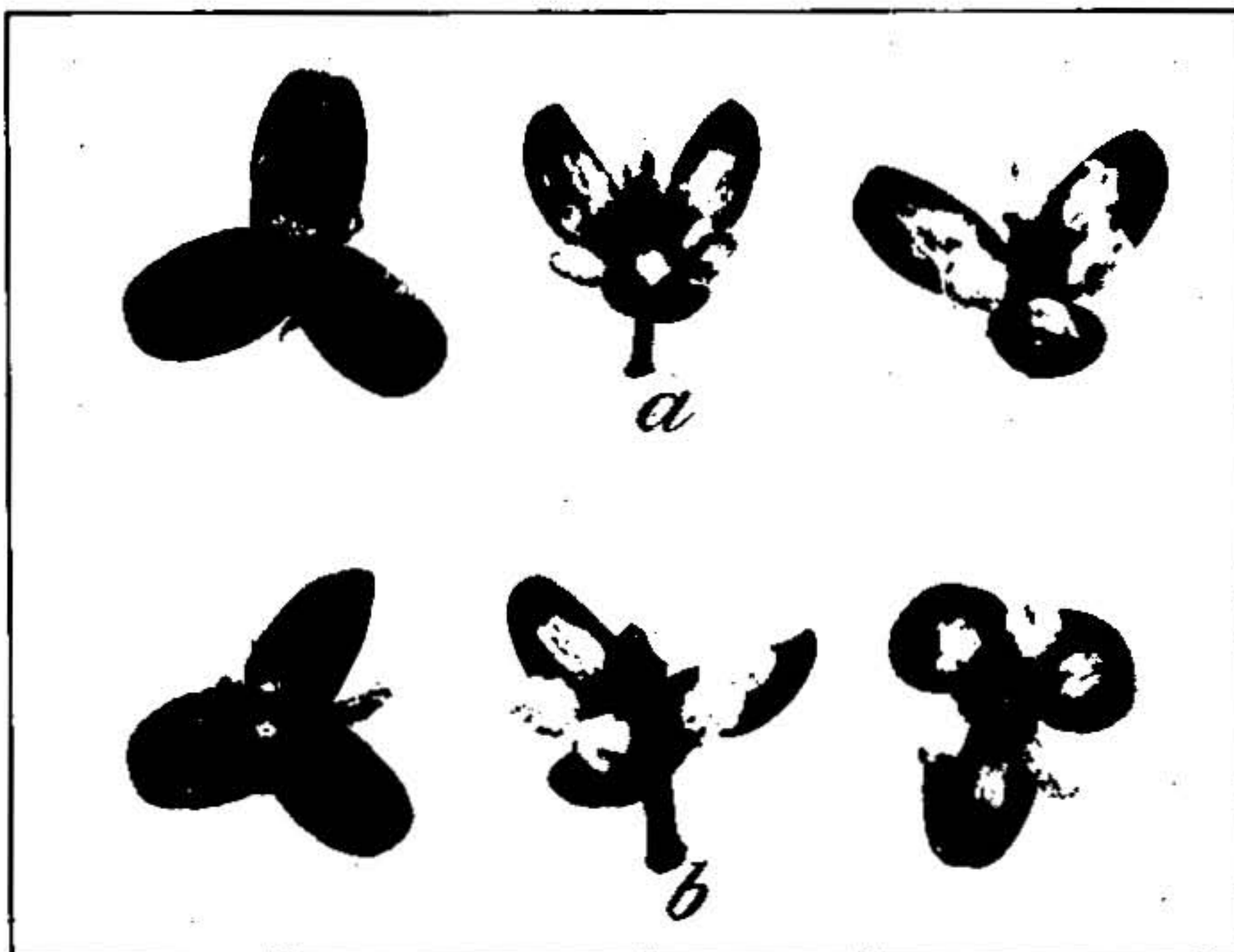
Corolla of three large, thick, valvate, persistent petals, firmly fleshy in texture and with distinct longitudinal veins. Stomata present on both surfaces. Tissues supplied with chlorophyll and with numerous bundles of raphides.

Stamens 6, borne on short, flattened, triangular-subulate filaments slightly united at base to form a narrow fleshy disk. Anthers triangular-cordate, about twice as long as broad, attached to the filaments at the base in a deep cavity of the outer face. Cells separated on the inner face by a distinct groove, but appearing completely coalesced on the smooth outer face, opening by lateral slits as soon as exposed. Pollen white.

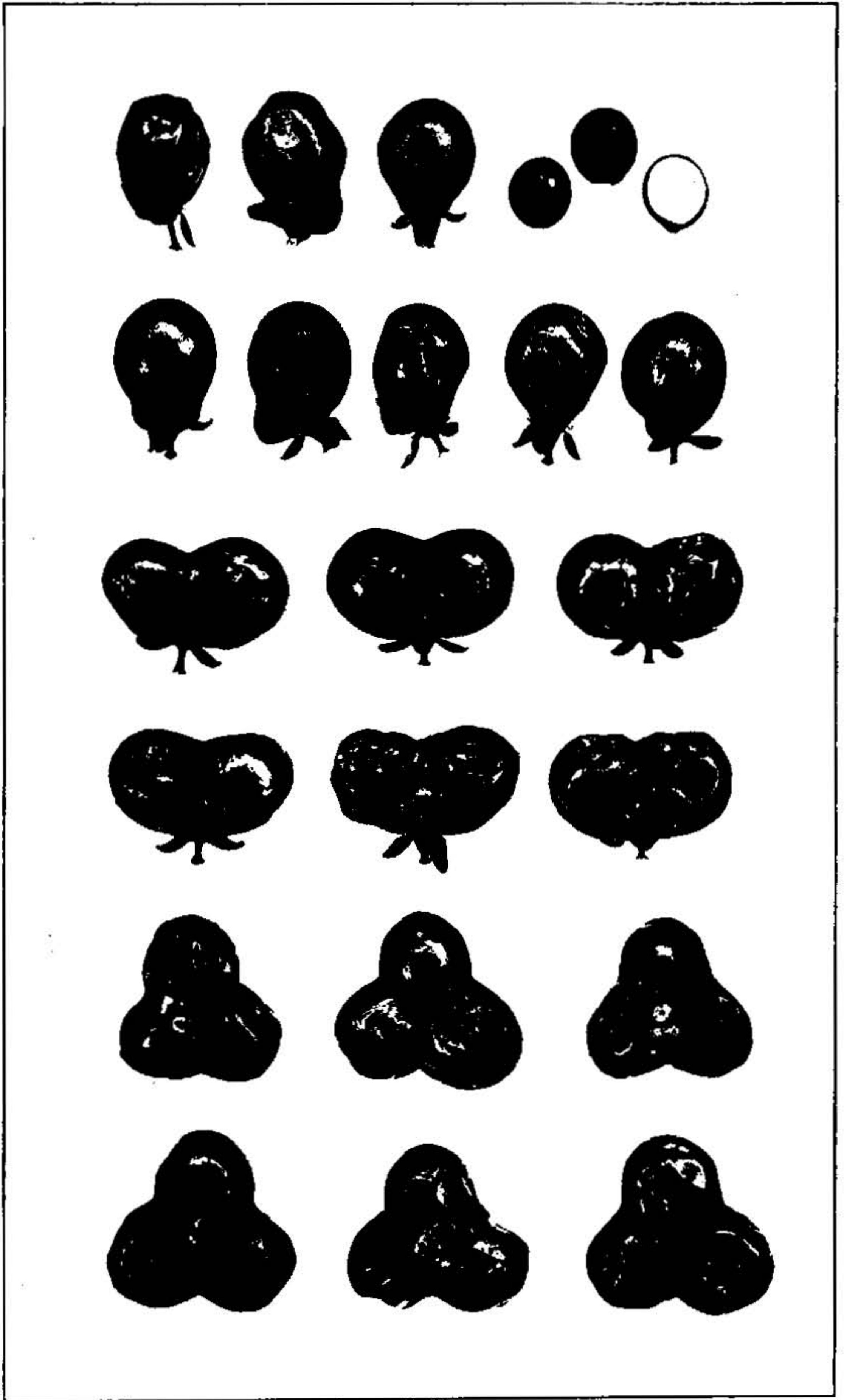
Pistils 3, united to near the apex into a rather narrow, triangular-conic pyramid shorter than the stamens. Styles not differentiated; stigmas represented by three obtuse, appressed apical lobes, separating only by narrow slits. Pistillodes of imper-



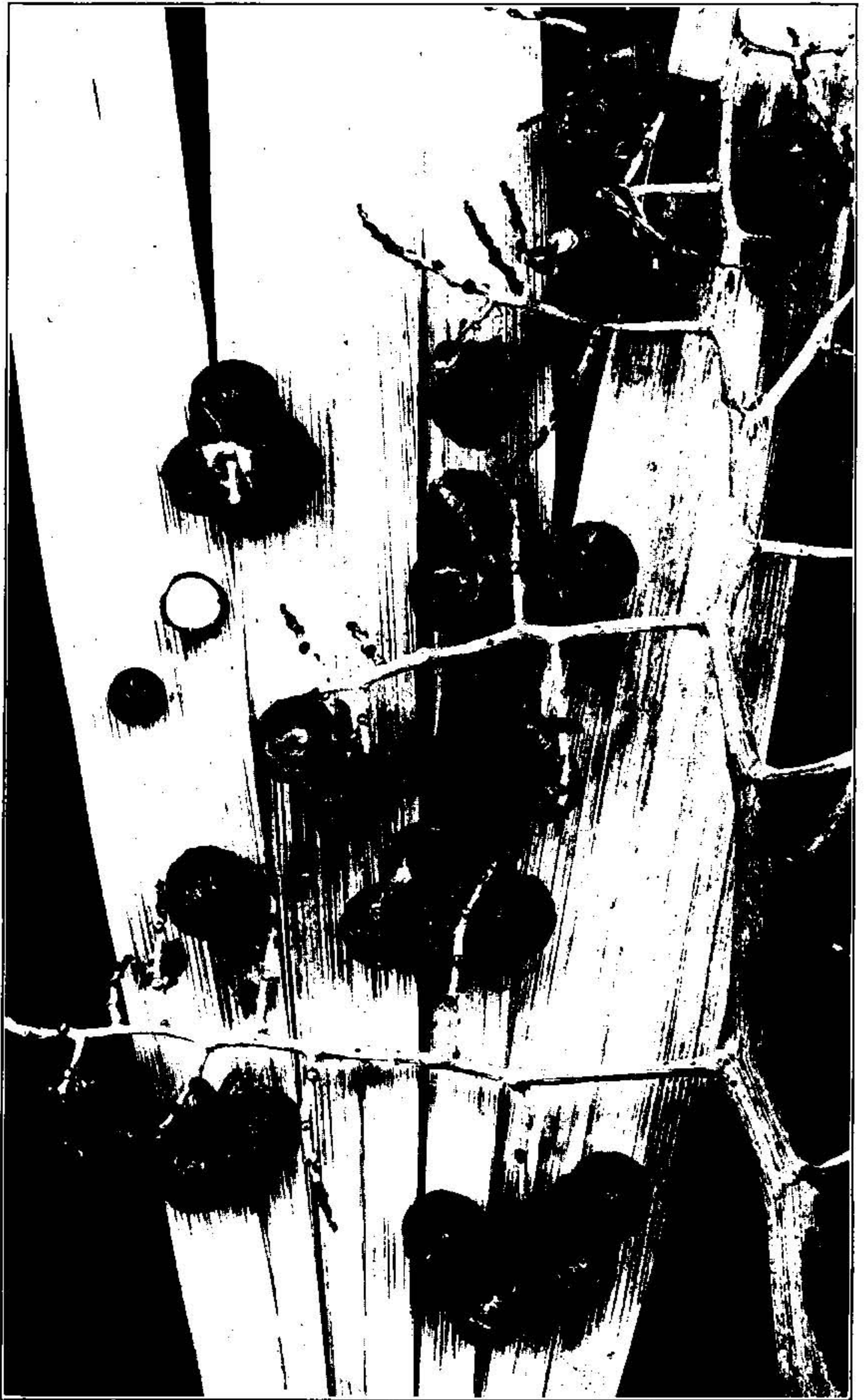
PSEUDOPHOENIX SARGENTII WENDL.



PSEUDOPHOENIX SARGENTII WENDL.



PSEUDOPHOENIX SARGENTII WENDL.



PSEUDOPHOENIX SARGENTII WENDL.

fect flowers as long as or longer than the pistils, but forming a much more slender-pointed column tapering to a narrow, three-pointed apex. (Pls. 74, 75, *a*, *b*.)

Fruits with a thin, smooth epidermis composed of a mosaic of polygonal cells very irregular in size and shape, with scattering stomata. Exocarp represented by a fleshy pulp with two distinguishable layers, the outer of rather watery consistency richly supplied with raphides, the inner firmer and more fibrous, containing oil globules and spiral vessels. Endocarp smooth, with a closely adherent outer coating of whitish material, as in *Phytelephas*, and an inner layer hard and bony, composed of columnar cells. (Pl. 76.)

Seed covered with a closely adherent, fibrillar membrane. Surface slightly impressed by the branches of the raphe, these usually six in number, three on each side, the lower pair short. Albumen uniform, bony, solid. Embryo subbasal. (Pls. 76, 77.)

Germination as in *Attalea* and *Phytelephas*, by the emergence of a burrowing cotyledon that carries the plumule down into the soil. Cotyledon emerging through an operculate aperture of the endocarp, as in *Phytelephas*. First two leaves represented by bladeless sheaths. A long, fleshy primary radicle developed directly from the cotyledon before the leaves begin to grow. (Pl. 75, *d*.)

EXPLANATION OF PLATE 74.—One of the primary branches of the inflorescence with mature flower buds and with four detached open flowers. Natural size.

EXPLANATION OF PLATE 75.—*a*, Staminate flowers; *b*, bisexual flowers; *c*, main axis of inflorescence with bases of primary branches showing smooth surfaces of axillary pulvini and subtending bracts; *d*, young seedling, showing method of germination with burrowing cotyledon and long primary radicle. *a*, *b*, Scale about 2; *c*, *d*, natural size.

EXPLANATION OF PLATE 76.—Ripe fruits with attached pedicels and floral parts, the different forms of the fruits depending on whether one, two, or three of the carpels develop; also three seeds with flesh removed, one with the endocarp, one naked, and one in vertical section. All natural size.

EXPLANATION OF PLATE 77.—Segments of leaf and branch of inflorescence with dried fruits; also a seed showing radiating branches of the raphe and a seed in vertical section showing the position of the embryo. All natural size.

Plates 74, 75, and 76 represent material from cultivated trees growing in the Plant Introduction Garden of the U. S. Department of Agriculture, at Miami, Fla.; received in February and August, 1912. Plate 77 represents a specimen collected on Long Key, Fla., by A. H. Curtiss (no. 5637), April 25, 1896; U. S. National Herbarium, no. 280541.

FLORAL PECULIARITIES OF PSEUDOPHOENIX.

The flowers of *Pseudophoenix* show several noteworthy peculiarities, although they are only slightly specialized in the direction followed by most other palms, the separation of the sexes. The sexual specialization extends only to the loss of function in the pistils of a part of the flowers, and especially in those that are borne at the ends of the branches. But the pistils of the staminate flowers are not much reduced and there are only slight differences in other respects. It was noticed by Mr. C. B. Doyle, in preparing the photographs for the plates, that the pedicels of the staminate flowers were somewhat more slender, the buds somewhat narrower, and the stamens a little larger, but all the differences are slight and might easily be overlooked. The lowest bud shown on plate 74 was probably staminate, while most of the others were bisexual. Wendland and Sargent described the flowers as monœcious, evidently on the assumption that the persistent filaments attached to the ripe fruits represented staminodes instead of functional stamens.

The floral specializations of *Pseudophoenix* are in the external organs rather than in the internal. The long pedicels jointed at the

base, the reduced limb of the calyx, and the very large, firm petals are the most peculiar features. The pedicels are as highly specialized as in any of the fan palms, or even more so. They are articulated to the branches by an expanded, circumscissile, hollow base leaving a conical persistent core. This might be mistaken for a short pedicel after the flowers have fallen. The calyx, receptacle, and pedicel are completely fused together. (PLS. 74, 75, *a*, *b*.)

The unusual development of the petals is doubtless connected with the fact that the inflorescences become exposed at an early stage of growth, whereas in most palms they are protected by spathes until just before the flowers open. The spathes of *Pseudophoenix* are so short that the flowers must become exposed while they are still very young. At the time of flowering the spathes extend only to about the middle of the longest joint of the peduncle. The spathes are narrow and compressed, with naked green surfaces and brown scaly margins, and are bilabiate at the aperture.

The equipment of the petals with stomata, chlorophyll-bearing cells, fibrovascular bundles, and raphides indicates that they are able to discharge vegetative functions. This makes it possible to understand how they are able to remain alive until the fruit ripens. The veins of the petals are usually five in number, but are often somewhat irregularly branched. The chlorophyll is more abundant along the veins. The epidermis is composed of an irregular mosaic of cells whose lateral walls are often interrupted or perforated. The bundles of raphides are irregularly scattered, but all lie in a longitudinal direction. It is not known whether stomata and raphides are to be found in the petals of other palms. The abundant development of raphides in the petals of *Pseudophoenix* may have relation to an unusual period of exposure of the flowers to the attacks of snails or insects.

The ease with which the pedicels separate from the branches, the great abundance of pollen, and the very prompt opening of the anthers indicate that the flowers are ephemeral and dependent on fertilization by the wind, though it is possible that nectar to attract insects may be secreted by the fleshy staminal disk.

Though the petals remain green, the anthers are of a bright orange color that may render the inflorescences conspicuous at flowering time. A broad, longitudinal band along the middle of the smooth outer surface of the unopened anthers is of a darker yellow than the pollen cells, which contrast in turn with the white pollen.

THE PSEUDOPHOENICACEAE AND ALLIED FAMILIES DISTINGUISHED BY FRUIT CHARACTERS.

The fact that the fruits are borne on distinct columnar pedicels at once distinguishes *Pseudophoenix* from any of the American pinnate-leaved palms. Only the wax palms (*Ceroxylon*) show structures

suggestive of pedicels, but these are only small, cushion-like prominences, whereas in *Pseudophoenix* the pedicels are an even more prominent and specialized feature than in any of the fan palms.

Apart from the pedicels, the fruit characters of *Pseudophoenix* suggest affinity with the *Cocaceae*, *Manicariaceae*, and *Phytelephantaceae*, as already stated. The external appearance, as well as the texture of the exocarp, is much the same as in *Bactris* and other related genera of cocoid palms, such as *Trichobactris*, *Curima*, and *Tilmia*. Yet there are three independent seeds, as in *Manicaria*, instead of a composite, fused endocarp as in the *Cocaceae*. The resemblance to the ivory palms is in the structure of the endocarp, in which there is almost complete agreement, in spite of the enormous differences in the size of the fruits and in the structures of the exocarp and epidermis.

The following analytical key states the most obvious external characters of the fruits, those that enable the *Pseudophoenicaceae* to be distinguished from the other related families, even without reference to the more minute details of structure or to other parts of the plant. Though these differences might not in themselves be considered of family importance, they afford simple means of recognizing the different groups.

ANALYTICAL KEY TO FAMILIES BASED ON FRUIT CHARACTERS.

- Fruits with endocarps completely coalesced to form a solid shell, usually with a single cavity containing a single embryo and endosperm..... **COCACEAE.**
- Fruits with free endocarps, usually developing two or more separate seeds.
- Fruits with a thin, smooth, membranous epidermis.... **PSEUDOPHOENICACEAE.**
- Fruits covered with a thick, rough, corky epidermis.
- Fruits with numerous (4 to 9) seeds, borne in dense heads on a simple inflorescence..... **PHYTELEPHANTACEAE.**
- Fruits with only 1 to 3 seeds, borne in loose clusters on a branched inflorescence..... **MANICARIACEAE.**

COMPARISON OF PSEUDOPHOENIX WITH THE WAX PALMS OF COLOMBIA.

Another group of palms that may prove to have affinities with *Pseudophoenix* is the wax palms (*Ceroxylaceae*), which grow at high altitudes in the mountains of Colombia. Like *Pseudophoenix* the wax palms retain several obvious evidences of derivation from fan palms. In addition to large compound inflorescences, rather unspecialized flowers, and fruits borne on short pedicels, the *Ceroxylaceae* share with the palmettos the habit of producing in the juvenile stage a creeping rootstock before commencing to form an erect trunk. In this respect *Ceroxylon* shows a definite contrast with *Pseudophoenix*, in which the seed germinates by sending down a burrowing cotyledon quite as in *Phytelephas* and *Attalea*.

COMPARISON OF CHARACTERS WITH THOSE OF COCOID PALMS.

GERMINATION CHARACTERS.

Some of the cocoid palms, such as *Acrocomia*, afford a suggestion of the method of germination followed by the palmettos and wax palms by a creeping rootstock. The seedling of *Acrocomia* does not have a long burrowing cotyledon, but the first four or five joints of the stem grow downward into the ground, forming a thickened, subterranean bulb that serves apparently for the storage of the food materials that are soon removed from the seed. After this subterranean structure has been developed the stem turns abruptly upward to begin the formation of the trunk. In *Manicaria*, which grows only in very wet swamps; neither of these specializations is found. The young plant appears much like a young *Attalea*, but there is no elongated cotyledon to carry it away from the seed. The same unspecialized method of germination is found in some of the species of *Astrocaryum* that are natives of very damp forests.

The fact that *Acrocomia* and *Attalea*, both members of the family *Cocaceae*, have specialized in different ways in their methods of germination may be considered as evidence of derivation from the more simple state represented by *Manicaria* and *Astrocaryum*. The very close agreement of *Phytelephas* and *Pseudophoenix* with the more specialized *Attalea* method of germination is also suggestive of the idea that these aberrant genera may have arisen as offshoots of a primitive cocoid type.

ENDOCARP CHARACTERS.

But if such a history be projected to account for the agreement of *Pseudophoenix* with *Attalea* and *Phytelephas* in methods of germination, the divergence from the primitive cocoid stock must be supposed to have taken place before the development of the composite endocarp that now appears as the most striking characteristic of the cocoid series.

That the coalescence of the endocarps may have taken place independently in the ancestors of the different groups of *Cocaceae* is not to be considered as an impossibility in view of the several apparently independent cases of coalescence of the exocarps in other families of palms. The fact that many of the relatives of *Acrocomia* (subfamily *Bactridineae*) have the coalesced endocarps perforated by apical foramina, while other *Cocaceae* have only basal or peripheral foramina, would seem to support the idea that the coalescence of the endocarps might have occurred independently in the two groups. The coalescence of the endocarps would naturally have been preceded by a strong tendency to coalescence of the exocarps, as illustrated in *Phytelephas*, *Manicaria*, and *Pseudophoenix*.

THE FAMILIES OF AMERICAN PALMS.**CHARACTERS AND SYNOPTICAL KEY.**

The determination of the status of *Pseudophoenix* as a distinct family has made it possible to complete a review of the classification of American families of palms. This was undertaken several years ago, but the impracticability of assigning *Pseudophoenix* to any of the groups caused it to be put aside. The following synoptical key indicates the characteristic features of the different families and may serve as a provisional arrangement of the family groups. The key is arranged to permit the diagnostic characters of a family to be followed in each case by a definitely contrasted statement of the characters of the other families. As several of the families have very definite ecological and geographical limitations, the habitat and distribution are indicated in the key. When the distribution extends over more than one region the principal center is mentioned first.

Some of the groups have been recognized by previous writers though usually only as subfamilies or tribes, but in addition to the *Pseudophoenicaceae* the last six, at the end of the key, may be considered as new families.

KEY TO FAMILIES.

- Fruits covered with thin, polished, retrorse scales. Genera numerous, *Lepidocaryum*, *Raphia*, *Mauritia*, etc. In coast swamps and flood lands, Brazil to Costa Rica. **THE SCALE PALMS..... LEPIDOCARYACEAE.**
- Fruits without scales, usually naked, but sometimes with warts, spines, or hairs.
- Leaves palmate or fan-shaped, the segments radiating from a thickened ligulate base. Genera numerous, *Sabal*, *Inodes*, *Copernicia*, *Thrinax*, *Paurotis*, etc. In swamps, forests, and deserts, North and South America. **THE PALMETTO PALMS..... SABALACEAE.**
- Leaves pinnately veined or divided, the segments or pinnæ inserted on a distinct midrib or rachis, not ligulate.
- Seedlings with creeping rootstocks as in the *Sabalaceae*; adults with massive, columnar trunks, whitened by a thick coat of wax. Genus *Ceroxylon*. On mountain summits in Colombia and Ecuador. **THE WAX PALMS..... CEROXYLACEAE.**
- Seedlings of columnar types without a creeping juvenile stage; trunks naked or only slightly waxy.
- Flowers borne on slender pedicels, staminate and bisexual in the same inflorescence. Genus *Pseudophoenix*. Florida Keys. **THE FALSE DATE PALMS.. PSEUDOPHOENICACEAE.**
- Flowers sessile or depressed in pits, of separate sexes, monoecious or dioecious.

Endocarps of each fruit fused into a single bony shell.

Genera numerous, *Cocos*, *Attalea*, *Acrocomia*, *Bactris*, etc. In undergrowth and open forests, South and North America. THE COCONUT PALMS.....

COCACEAE.

Endocarps either not fused or not forming a bony shell.

Pistils of 4 to 9 united carpels, usually maturing several large, bony seeds. Genus *Phytelephas*. In forests and coast plains, Panama to Peru. THE IVORY PALMS.....

PHYTELEPHANTACEAE.

Pistils with only 3 carpels, rarely maturing 2 or 3 small seeds, usually only 1.

Inflorescences not emerging from the persistent, bag-like, fibrous spathes. Genus *Manicaria*. In tidal swamps, Brazil to Guatemala. THE BAG PALMS....

MANICARIACEAE.

Inflorescences emerging from incomplete or deciduous spathes.

Flowers inserted in deep, closed pits. Genera numerous, *Geonoma*, *Calyptronoma*, *Welfia*, etc. In forests, South and Central America. THE FISHTAIL PALMS.....

GEONOMACEAE.

Flowers superficial or in shallow depressions.

Seeds inclosed in the three equally developed, coalesced carpels. Genera *Malortiea* and *Reinhardtia*. In forest undergrowth, Central America. THE LATTICE PALMS.....

MALORTIEACEAE.

Seeds inclosed in single carpels, the three pistils separate or attached but not coalesced.

Dioecious, flowers of different sexes on different plants. Genera numerous, *Chamaedorea*, *Morenia*, *Eleutheropetalum*, *Dasystachys*, etc. In forest undergrowth, Central and South America. THE PACAYA PALMS...

CHAMAEDORACEAE.

Monocious, the flowers of separate sexes, but both in the same inflorescence or on the same plant.

Trunk not reaching the ground, entirely supported by a cluster of long stilt-like roots. Genera numerous, *Iriartea*, *Catoblastus*, *Wettinia*, etc. In forests, South America to Nicaragua. THE STILT PALMS.....

IRIARTEACEAE.

Trunk rooted in the ground, not depending on the support of aerial roots.

Flowers arranged in longitudinal rows; spathes several. Genera *Synechanthus*, *Aeria*, and *Gaussia*. On slopes and summits, Central America to Porto Rico. THE ROW-FLOWERED PALMS.....

SYNECHANTHACEAE.

Flowers arranged in clusters of 3; spathes 2. Genera numerous, *Acrista*, *Plectris*, *Catis*, *Roystonea*, etc. In swamps and forests and on mountain summits, South and North America. THE ROYAL PALMS.....

ACRISTACEAE.

ALLIANCES WITH OLD WORLD PALMS.

Though the relationships of the Old World and New World palms are still very imperfectly understood it is evident that only a few of the families extend over both hemispheres. The geographical limitations of the families do not appear so remarkable when the ecological limitations of this group of plants are considered. The palms grow too slowly to be able to compete with other types of vegetation and the large, heavy seeds are not readily disseminated. There may have been a palm age in some former geological epoch when the palms occupied a larger proportion of the land and enjoyed better facilities of distribution, but at the present time the tendencies are in the other direction. Even inside the continental areas the different groups of palms have local or definitely limited distributions. Thus only a few of the South American and Central American types have secured footholds on the West Indian Islands.

The land connection between North and South America has resulted in only a slight interchange of palm floras. The Chamaedorea-ceae, which are so richly developed in Mexico and Central America, have penetrated only to a slight extent into Colombia and Venezuela and are practically absent from the great Brazilian region. On the other hand, the distinctively South American families have as little to show in the way of any complete occupation of the tropical regions of North America. This is true of the Iriarteaceae, Geonomaceae, Ceroxylaceae, Manicariaceae, Phytelphantaceae, and especially of the Cocaceae, the most numerous and highly developed of the American families. None of these groups has any extra-American representatives, unless the coconut palm itself and the African oil palm (*Elaeis guineensis* Jacq.) be considered as such.¹

The scale palms (Lepidocaryaceae) are the only family that can be said to have a cosmopolitan distribution. Some of the Old World fan palms, such as *Pritchardia* and *Livistona*, may belong with the American palmetto palms instead of with the Asiatic talipot palms (Coryphaceae). In geologic times the fan palms are known to have had a circumpolar distribution, which would account for their presence in both hemispheres.

The closest approach among the pinnate-leaved tropical types is between the royal palm family (Acristaceae) of the New World, and the betel palm family (Arecaceae) of the Old World. Several peculiar genera found on the Pacific Islands may connect the more divergent continental forms. Some of the American stilt palms have leaves that suggest those of the Old World sugar palms (Caryotaceae), but

¹ Cook, O. F. Origin and Distribution of the Coconut Palm. Contr. U. S. Nat. Herb. 7: 257-293. 1901. Also History of the Coconut Palm in America. Contr. U. S. Nat. Herb. 14: 271-342. 1910.

in other respects they are entirely different. The toddy palms (Borassaceae) and the true date palms (Phoenicaceae) are also specialized Old World types apparently quite remote from any of the New World families.

The Old World palm flora as a whole seems to be much inferior to that of the New World from the standpoint of specialization of family types. The American preponderance is especially striking when the pinnate-leaved groups are compared. Apart from the Phoenicaceae and Caryotaceae, which are to be considered as independent derivatives from the ancestral fan palms, the Old World has only the Arecaceae to counterbalance the numerous pinnate-leaved groups of the American tropics.