Philippine Palms and Palm Products

By William H. Brown, Ph. D.
Chief, Division of Investigation, Bureau of Forestry; Professor of Botany, University of the Philippines; and Plant Physiologist, Bureau of Science
and
Elmer D. Merrill, M. S.
Botanist and Director, Bureau of Science

Department of Agriculture and Natural Resources
Bureau of Forestry

Bulletin No. 18

Arthur F. Fischer, Director of Forestry

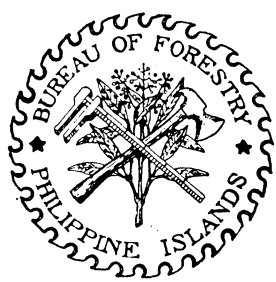
MANILA
BUREAU OF PRINTING
1919

166908

PLATE I. COCONUT TREES ON THE BEACH, CAMIGUIN ISLAND.

Philippine Palms and Palm Products

By William H. Brown, Ph. D.
Chief, Division of Investigation, Bureau of Forestry; Professor of Botany, University of the Philippines; and Plant Physiologist, Bureau of Science
and
Elmer D. Merrill, M. S.
Botanist and Director, Bureau of Science



Department of Agriculture and Natural Resources
Bureau of Forestry

Bulletin No. 18

Arthur F. Fischer, Director of Forestry

MANILA
BUREAU OF PRINTING
1919

166908

CONTENTS

ILLUSTRATIONS

PREFACE

The present Bulletin attempts to give a more or less popular account of Philippine palms and their products. Available publications on Philippine palms are, for the most part, either of a highly technical and systematic nature, or else are scientific papers dealing with the technical side of certain industrial phases of the subject. Extensive accounts of the alcohol and sugar possibilities of the more prominent species have been given by Gibbs (The alcohol industry of the Philippine Islands, parts I, II, and III. Philippine Journal of Science, Vol. 6, 1911, and Vol. 7, 1912); while hats made from palm fibers have been discussed at length by Miller and Robinson (Miller: Philippine Hats. Bureau of Education Bulletin No. 35, 1910. Robinson: Philippine Hats. Philippine Journal of Science, Vol. 6, 1911). Arnold (Rattan supply of the Philippines, Special Agents Series, No. 95, Bureau of Foreign and Domestic Commerce, Washington) has written a long discussion of the rattan supply. These sources have been drawn on extensively in the preparation of the present paper. The systematic consideration of Philippine palms has been much simplified by the appearance of a recent paper by Beccari (Philippine Palms. Philippine Journal of Science, Vol. 14, 1919). The keys to, or rather the conspecti of, the species of the various genera are taken from that paper.

WILLIAM H. BROWN.
ELMER D. MERRILL.

PHILIPPINE PALMS

By WILLIAM H. BROWN and ELMER D. MERRILL

INTRODUCTION

The palm family is well represented in the Philippines, and from an economic standpoint is a very important group of plants. They furnish alcohol, starch, sugar, oils, fibers, building materials, edible fruits and buds, numerous substances used in industrial work, and other minor products.

The species of palms known to be native to the Philippines number 123. Besides these there are five widely cultivated species, some of which may be native. More than 100 of the native species have not been reported from other countries.

The one large genus is *Calamus,* the climbing or rattan palms. Most of the other genera are represented by few species and in several cases by a single one. Some of the most important economic palms, such as the coconut palm, are not natives of the Philippines, but were introduced in prehistoric times. The native species are mostly sylvan. Palms grow from sea level to altitudes of at least 2,200 meters.

There are very few species of palms in the settled areas, but they are frequently conspicuous either on account of their abundance (coconut palm) or their great size (buri palm). One of the very few strictly gregarious species is the nipa palm. This occurs over considerable areas of salt-water swamps, to the almost entire exclusion of all other vegetation. In a few places the buri palm (*Corypha*) is dominant and gregarious, while *Livistona cochinchinensis* (tarau) is gregarious and occurs in immense numbers in the Cagayan valley. The coconut palm is artificially gregarious on account of its cultivation over vast areas. In ordinary forests, the palms, with the exception of the climbing species *Calamus* and *Daemonorops,* are not usually numerous, most erect palms being of local occurrence. The climbing palms (rattans) are usually very numerous and conspicuous in most forests, except where they have been extensively cut for commercial purposes. In fact, the most conspicuous plants in the ground-covering of virgin forests at low altitudes often are immature specimens of rattans.

Key to the genera of Philippine palms.

1. Leaves simple, fan-like.
   2. Leaves divided almost to base into 14 to 20 segments; stems tufted, small. 13. *Licuala.*
   2. Leaves not deeply divided; trunk stout, never tufted.
      3. Trunk smooth, with annular scars; inflorescences axillary, pendulous. 14. *Livistona.*
      3. Trunk without annular scars, often 60 centimeters or more in diameter; flowering-shoot terminating the trunk, the plant flowering once and then dying. 8. *Corypha.*
1. Leaves bipinnate, leaflets cuneate at the base, rhomboid, oblique, the tips resembling the fins or tails of fish. 6. *Caryota.*
1. Leaves pinnate.
   2. Climbing spiny palms; leaf-sheaths and mid-ribs armed; fruit covered with scales, usually shiny.
      3. Leaflets rhomboid or wedge-shaped, whitish beneath; leaf-sheaths usually inflated and occupied by ant nests. 12. *Korthalsia.*
      3. Leaflets elongated, never rhomboid.
         4. Branches of the inflorescences covered with very large, broad, overlapping bracts concealing the flowers; the plant flowers once and then dies. 22. *Plectocomia.*
         4. Branches of the inflorescences only slightly expanded, bracts not concealing the flowers; the plant flowers many times.
            5. Spikelets in the axils of tubular or funnel-shaped spathels; flagellae from end of midrib or from the leaf-sheaths. 5. *Calamus.*
            5. Spikelets in the axils of large boat-shaped or open deciduous spathels; flagellae always from end of the midrib. 9. *Daemonorops.*
   2. Not climbing.
      3. Tufted, spiny palms.
         4. Growing in fresh-water swamps, the inflorescences terminating the tall, mature trunks; the sago palm. 15. *Metroxylon.*
         4. Growing on dry ground; stem short or none; inflorescence from base. Rare, known only from Lanao. 24. *Zalacca.*
      3. Stems creeping in the mud of salt-water swamps; trunks none; inflorescences on short, erect stalks from the rhizomes, the infructescence a large globose head; the nipa palm. 16. *Nipa.*
      3. Erect, simple palms, the stems never tufted (except some species of *Arenga*), the inflorescences always lateral, never terminal.
         4. Inflorescences from the trunk at the base of the leaf-sheaths.
            5. Trunks covered with long, slender spines. 17. *Oncosperma.*
            5. Spineless palms.
               6. Trunks large, swollen in the middle; the royal palm, cultivated only. 19. *Oreodoxa.*
               6. Trunks small or of medium size.
                  7. Female flowers few, at the base of the branches of the inflorescences, much larger than the much more numerous male ones. 3. *Areca.*
                  7. Flowers of both sexes alike in shape and size, or flowers perfect.
                     8. Flowers in groups of threes on the spike-like branches of the compound inflorescence. 2. *Adonidia.*

8. Flowers in two or three rows on the primary branches of the once-branched inflorescence; sylvan species. 21. *Pinanga.*
8. Flowers spirally arranged on the branches; fruits large. 1. *Actinorhytis.*

4. Inflorescences axillary.
5. Leaf-sheaths with coarse, black fibers, the leaflets usually lobed and usually auricled at the base, whitish beneath. 4. *Arenga.*
5. Not as above.
6. Petioles spiny.
7. Fruits in dense head; the oil palm, cultivated only. 10. *Elaeis.*
7. Inflorescences lax. 20. *Phoenix.*
6. Petioles unarmed.
7. Fruits large, 15 to 30 centimeters in diameter; the coconut palm, cultivated. 7. *Cocos.*
7. Fruits smaller, never exceeding 10 centimeters in diameter.
8. Fruits 5 to 8 centimeters in diameter. 18. *Orania.*
8. Fruits less than 1 centimeter in diameter.
9. Fruits globose. 11. *Heterospathe.*
9. Fruits more or less ovoid. 23. *Ptychoraphis.*

LIST OF SPECIES

All of the palms known to be natives of, or naturalized in, the Philippine Islands are given in the following list.

Actinorhytis calapparia Wendl. et Drude.
Adonidia merrillii Becc.
Areca caliso Becc.
Areca camarinensis Becc.
Areca catechu L. Betel palm.
Areca catechu var. *batanensis* Becc.
Areca catechu var. *longicarpa* Becc.
Areca catechu var. *silvatica* Becc.
Areca costulata Becc.
Areca hutchinsoniana Becc.
Areca ipot Becc.
Areca ipot var. *polillensis* Becc.
Areca macrocarpa Becc.
Areca parens Becc.
Areca vidaliana Becc.
Areca whitfordii Becc.
Areca whitfordii var. *luzonensis* Becc.
Arenga ambong Becc.
Arenga pinnata (Wurmb) Merr. Kaong or sugar palm.
Arenga tremula (*mindorensis*) (Blanco) Becc.
Calamus arugda Becc.
Calamus bicolor Becc.
Calamus blancoi Kunth.
Calamus cumingianus Becc.
Calamus diepenhorstii var. *exulans* Becc.
Calamus dimorphacanthus Becc.
Calamus dimorphacanthus var. *montalbanicus* Becc.
Calamus dimorphacanthus var. *zambalensis* Becc.
Calamus discolor Mart.
Calamus discolor var. *negrosensis* Becc.
Calamus elmerianus Becc.
Calamus filispadix Becc.
Calamus foxworthyi Becc.
Calamus grandifolius Becc.
Calamus halconensis Becc.
Calamus jenningsianus Becc.
Calamus manillensis H. Wendl.
Calamus maximus (*merrillii*) Blanco (forma typica).
Calamus maxima var. *merrittianus* Becc.
Calamus maxima var. *nanga* Becc.
Calamus megaphyllus Becc.
Calamus melanorhynchus Becc.
Calamus meyerianus Schauer.
Calamus microcarpus Becc.

Calamus microcarpus var. *diminutus* Becc.
Calamus microsphaerion Becc.
Calamus microsphaerion var. *spinosior* Becc.
Calamus mindorensis Becc.
Calamus mitis Becc.
Calamus moseleyanus Becc.
Calamus multinervis Becc.
Calamus ornatus Blume var. *philippinensis* Becc.
Calamus ramulosus Becc.
Calamus reyesianus Becc.
Calamus samian Becc.
Calamus simphysipus Mart.
Calamus siphonospathus Mart.
Calamus siphonospathus var. *batanensis* Becc.
Calamus siphonospathus var. *oligolepis, major* Becc.
Calamus siphonospathus var. *oligolepis, minor* Becc.
Calamus siphonospathus var. *polylepis* Becc.
Calamus siphonospathus var. *sublaevis* Becc.
Calamus spinifolius Becc.
Calamus trispermus Becc.
Calamus usitatus (*mollis*) Blanco.
Calamus usitatus var. *major* Becc.
Calamus usitatus var. *palawanicus* Becc.
Calamus vidalianus Becc.
Calamus vinosus Becc.
Calamus viridissimus Becc.
Caryota cumingii Lodd.
Caryota majestica Linden.
Caryota merrillii Becc.
Caryota mitis Lour.
Caryota rumphiana var. *oxyodonta* Becc.
Caryota rumphiana var. *philippinensis* Becc.
Cocos nucifera L. Coconut palm.
Corypha elata Roxb. Buri.
Daemonorops affinis Becc.
Daemonorops clemensianus Becc.
Daemonorops curranii Becc.
Daemonorops gracilis Becc.
Daemonorops loherianus Becc.
Daemonorops margaritae var. *palawanicus* Becc.
Daemonorops mollis (*gaudichaudii*) (Blanco) Merr.
Daemonorops ochrolepis Becc.
Daemonorops oligolepis Becc.
Daemonorops pannosus Becc.
Daemonorops pedicellaris Becc.
Daemonorops urdanetanus Becc.
Daemonorops virescens Becc.
Heterospathe elata Scheff.
Heterospathe negrosensis Becc.
Heterospathe philippinensis Becc.
Heterospathe sibuyanensis Becc.
Korthalsia laciniosa Mart.
Korthalsia merrillii Becc.
Korthalsia scaphigeroides Becc.
Korthalsia squarrosa Becc.
Licuala spinosa Wurmb.
Livistona cochinchinensis Mart.
Livistona merrillii Becc.
Livistona robinsoniana Becc.
Livistona rotundifolia Mart. Anahau.
Livistona rotundifolia var. *luzonensis* Becc.
Livistona rotundifolia var. *microcarpa* Becc.
Livistona rotundifolia var. *mindorensis* Becc.
Metroxylon sagu Rottb. Sago.
Nipa fruticans Wurmb. Nipa.
Oncosperma filamentosum Blume.
Oncosperma gracilipes Becc.
Oncosperma horrida Scheff.
Oncosperma platyphylla Becc.
Orania decipiens Becc.
Orania decipiens var. *mindanaoensis* Becc.
Orania decipiens var. *montana* Becc.
Orania paraguaensis Becc.
Orania philippinensis Scheff.
Orania philippinensis var. *sibuyanensis* Becc.
Orania rubiginosa Becc.
Phoenix hanceana var. *philippinensis* Becc.
Pinanga barnesii Becc.
Pinanga basilanensis Becc.
Pinanga batanensis Becc.
Pinanga copelandii Becc.
Pinanga curranii Becc.
Pinanga elmerii Becc.
Pinanga geonomaeformis Becc.

DESCRIPTIONS OF SPECIES

Genus **ACTINORHYTIS** Wendland et Drude

ACTINORHYTIS CALAPPARIA Wendl. et Dr. TANGALO.

Local name: *Tangalo* (Bagobo).

This is a handsome, tall, slender, pinnate-leafed palm, widely distributed in the Malay archipelago. Reported from Davao district, Mindanao, where it was probably introduced.

Genus **ADONIDIA** Beccari

ADONIDIA MERRILLII Becc. (Plate II, III). BÚNGA DE CHINA.

Local names: *Búñga de China, búñga de Joló* (Span.-Fil.); *oring-oring* (Tagbanua).

This species is the only representative of the genus and is known only from the Philippines. In Manila it is extensively cultivated for ornamental purposes. The species was originally described from material taken from cultivated specimens in Manila, its origin being unknown. Since then its original home has been located, as it occurs in abundance on limestone formations in Palawan and the Calamianes Islands (Coron). In habit this palm resembles the betel palm, but it is not so tall, and its leaves are much more strongly arched. It reaches a height of 8 meters and a diameter of 10 to 15 centimeters. The leaves are about 2 meters long with 40 to 50 pairs of leaflets. Its inflorescence, too, is quite different from that of the betel palm. The bright-crimson fruits, contrasting with the whitish fruit-stalks and sheaths, are very ornamental. The fruits are said sometimes to be used as a substitute for the betel nut, in preparing buyo (fruit of *Areca catechu,* leaves of *Piper betle,* and lime) for chewing. The name "Bunga de Jolo," which is very seldom used, may indicate the true origin of the

trees that now occur in Manila, as the palm may grow on the island of Jolo (Sulu), and does occur in the part of Palawan inhabited by the Sulu Moros.

Genus **ARECA** Linnaeus

This genus of pinnate-leaved palms is represented by the widely cultivated *Areca catechu* L. and nine endemic species. The endemic species are of little economic value, but *Areca catechu* is extensively cultivated throughout the Archipelago.

Conspectus of the Philippine species.

a^1. Floriferous branches bearing only one or very few female flowers, sessile on their basal thickened part, and the geminate male flowers in distichous alternate indentures in their upper slender part.

b^1. Spadices spreadingly twice or thrice branched; palms with tall slender stems and relatively large fruits. (§ *Euareca.*)

c^1. Male flowers narrowly lanceolate (unknown in *A. Whitfordii*); rudimentary ovary conspicuous, trifid, as long as, or longer than, the stamens; anthers acute or acuminate. Female flowers with broadly imbricate sepals about as broad and long as the petals. Fruit with the pericarp finally entirely disintegrating into very fine and soft fibers.

d^1. Fruit having the mesocarp considerably thicker at both ends than at the sides, and the seed inserted considerably above the base.

e^1. Seed having the vascular bundles of the integument arching on the sides, and strongly anastomosing immediately from its base, even on the raphal side.....1. *A. Catechu.*

f^1. Fruit orange-red; globose-ovoid or ovoid-ellipsoid, not more than one-third or one-fourth longer than broad (4 to 5 cm long, 3 to 4 cm broad). Seed subglobose with a more or less flattish base.....*A. Catechu* (forma *communis.*)

f^2. Fruit ovoid-ellipsoid, rather ventricose, smaller than usual (4 cm long and 3 cm or a little less broad); seed globose-depressed or broader than high, the base flat.
A. Catechu var. *silvatica.*

f^3. Stems thicker and shorter than in forma *communis;* spadix denser and with shorter floriferous branches.
A. Catechu var. *batanensis.*

f^4. Fruit narrowly ellipsoid; twice, and even more, as long as broad (5.5 to 7 cm long, 2.5 cm broad). Seed ovoid-conical with a blunt apex and flat base, slightly longer than broad.
A. Catechu var. *longicarpa.*

e^2. Seed having the vascular bundles of the integument arising straight, almost erect, from the raphal side and slightly branching. Fruit elongate-ellipsoid, twice as long as broad (7 cm long, 3.2 to 3.5 cm broad). Seed ovoid-conical with a blunt apex.....2. *A. macrocarpa.*

d^2. Fruit ellipsoid-fusiform, twice and more as long as broad, having the mesocarp not much thicker at the ends than at the sides. Seed placed nearly in the middle of the pericarp and equally narrowing to both ends.

PLATE II. ADONIDIA MERRILLII (BUNGA DE CHINA).

PLATE III. FRUIT OF ADONIDIA MERRILLII (BUNGA DE CHINA).

e^1. Fruit 4 to 4.5 cm long, 1 to 2 cm broad.....3. *A. Whitfordii.*

e^2. Fruit larger, 5.5 cm long, 2 cm broad.

A. Whitfordii var. *luzonensis.*

c^2. Male flowers relatively large, ovoid-subtrigonous or trapezoidal; rudimentary ovary small, slender, entire, subulate, shorter than the stamens; anthers very obtuse. Sepals of the female flower considerably smaller than the petals. Fruit large, ovoid, about 6 cm long, 3.5 cm broad, the pericarp fibrous in its outer half, woody in the inner half. Seed broadly ovoid, its vascular bundles very numerous, parallel and almost undivided, ascending from the raphal side.....4. *A. parens.*

b^2. Spadices simply branched. Female flowers clustered around the main axis, solitary, sessile or nearly so, at the base of the branchlets; the latter slender and bearing alternately distichous male flowers. (§ *Balanocarpus.*) (Of *A. camarinensis* the detached fruits only are known, and it is doubtfully placed here.)

c^1. A palm with the habit of *Areca Catechu* but smaller (stem about 4 m high, 7 to 12 cm in diameter); fruiting spadix dense, cylindraceous-oblong, about 14 cm long, 6 to 7 cm thick. Fruit ovoid, very similar to that of *A. Catechu,* 5 cm long, 3 cm broad. Seed globose with rounded (not flat) base and with the vascular bundles of the integument very close together, much anastomosing and forming very narrow loopholes all around the seed.

5. *A. Ipot.*

d^1. A smaller plant, the stem 5 cm in diameter, the spadix smaller, with fewer female flowers, and forming a shorter mass.

A. Ipot var. *polillensis.*

c^2. Fruit ovoid, 4 to 5 cm long, 3 cm broad. Seed conical-ovoid; the vascular bundles of the integument forming a uniform network all around the seed with lozenge-shaped loopholes. Otherwise the fruit is similar to that of *A. Catechu*.....6. *A. camarinensis.*

a^2. Floriferous branches bearing several female flowers on their basal parts, gradually narrowing above and bearing male flowers only in pairs on alternating notches. Low palms with relatively small or medium-sized fruits. (§ *Arecella.*)

b^1. Spadix simply branched, with thickish floriferous branches appressed to the main axis, and bearing in their basal part numerous, approximate, alternate, female flowers. Male flowers hexandrous, the calyx with three small, distinct sepals; anthers acute. Fruiting perianth cupular, truncate, the petals exactly equaling the sepals. Fruit ellipsoid, 3 to 3.5 cm long, 20 to 22 mm thick, the pericarp entirely dissolving into very fine, soft fibers.....7. *A. Caliso.*

b^2. Spadix twice loosely branched; floriferous branches slender, bearing in their basal part three or four alternate, rather distant, female flowers, and in the upper and slenderer part alternate male flowers. Calyx of the male flowers subpedicelliform, shortly 3-dentate with a solid base; anthers bifid at the apex. Fruit small, pluricostulate, ellipsoid, the pericarp formed by only two layers of rigid complanate fibers..... 8. *A. costulata.*

a^3. Spadix diffusely, two or three times branched, the floriferous branches bearing one or more female flowers in their lower part, and above male flowers in pairs in unilateral notches. Low slender palms having very small male flowers, with the calyx completely divided into three sepals. Fruit small. (§ *Arecopsis.*)

b^1. Male flowers 2.5 to 3 mm long; stamens 6; rudimentary ovary as long as the stamens, divided into three points. Female flowers ovate, obtuse, 8 mm long, 4.5 to 5 mm broad. Fruit small, oblong-ellipsoid or subfusiform, 17 to 19 mm long and broad; pericarp rather thin, the mesocarp formed by only two layers of slender, but rigid, flattened, parallel fibers.....9. *A. Vidaliana.*

b^2. Male flowers smaller than in *A. Vidaliana* (2 mm or a little longer); stamens 6; rudimentary ovary as long as the stamens, trifid. Female flowers ovoid, conical, narrowing to an acute point, larger than in *A. Vidaliana*, 13 to 14 mm long, 7 mm broad at the base. Fruit also larger, ellipsoid-elongate or subfusiform, about 3 cm long, 9 mm broad.....10. *A. Hutchinsoniana.*

ARECA CATECHU L. (Plates IV, V). BÚNGA or BETEL PALM.

Local names: *Bóa* (Iloko); *búñga* (Tagalog, Bisaya, Bikol); *búa* (Cagayan); *dápiau* (Bataan); *lúgos* (Zamboanga); *lúyos* (Pampanga); *pasá* (Basilan); *takobtób* (Bikol).

This tall and slender tree is one of the characteristic palms found in and about towns throughout the settled areas of the Philippines. *Areca catechu* reaches a height of 10 meters and a diameter of 10 to 15 centimeters. It has dark-green, pinnate leaves about 3 meters long. The reddish-yellow fruits are found on the stem below the leaves. It is frequently spontaneous and occurs in second-growth forests, but is rarely found distant from cultivation. In the Philippines it has been reported from the virgin forest in only a single locality in Palawan, and there where an old trail crossed a small stream.

Beccari * says that *Areca catechu,* variety *silvatica,* may possibly represent the original plant from which the commonly cultivated palm has been derived. According to Beccari there are in the Philippines various forms of *Areca* so closely related to *Areca catechu* as to afford good reason to believe that in these Islands *Areca catechu* finally assumed the specific character which it now exhibits. In no other part of southern and eastern Asia or Malaysia is there any species of *Areca* which in any way approaches *Areca catechu.*

In the Philippines, as in all the Indo-Malayan and Polynesian region, the fruits of this palm are extensively utilized for chewing with lime and the leaves of the betel pepper (*Piper betle* Linn.), locally known as íkmo. The mixture is known in different parts of the Philippines as búyo, mamán, or mamón. The areca fruit is cut into rather thin slices, sprinkled with lime, and the slices wrapped in fresh íkmo leaves. Tobacco is sometimes added to the mixture. The chewing of búyo, which is exceedingly prevalent in the Philippines, colors the expectorated

* Beccari, O., Palms of the Philippine Islands. Philippine Journal of Science, Volume 14 (1919), pages 295–362.

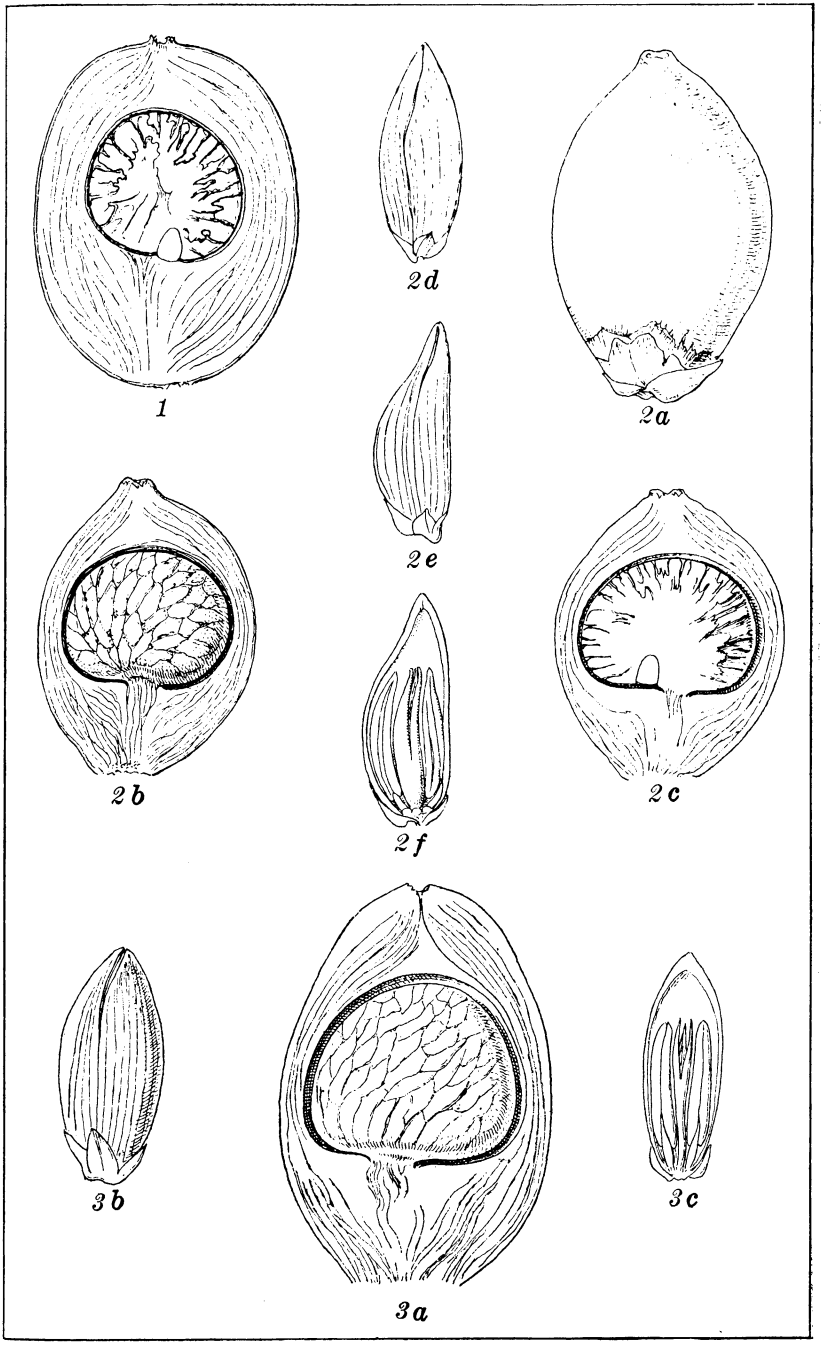


Fig. 1. Areca catechu (semisilvatica). 2. A. Catechu var. silvatica. 3. A. Catechu (communis).

PLATE IV.

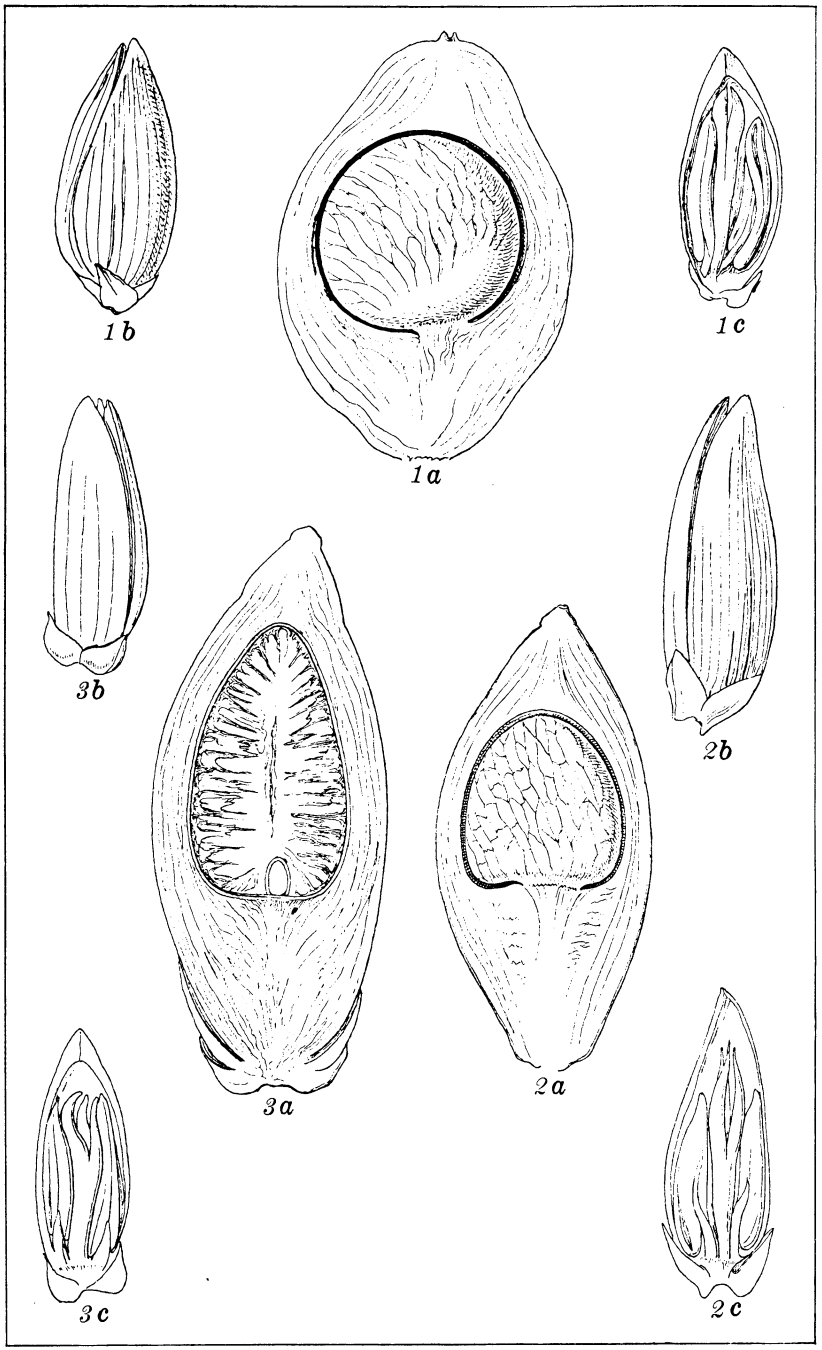


Fig. 1. Areca Catechu var. alba. 2. A. Catechu var. longicarpa. 3. A. Catechu var. portoricensis.

PLATE V.

saliva a characteristic red; and its continued use blackens the teeth and gums, eventually destroying the teeth themselves. Búyo is very generally regarded as a tonic and a general stimulant, but its excessive use is certainly harmful. Tavera cites as symptoms of excessive use of búyo: loss of appetite, salivation, and general degeneration of the organism. He notes also that beginners usually experience a disagreeable combination of symptoms, including constriction of the esophagus, a sensation of heat in the head, red and congested face, dizziness, etc. The fruits contain about 18 per cent tannin, and from 14 to 17 per cent of fatty material. They are used to some extent in the Philippines in dyeing red and black shades. In the Indo-Malayan region they are generally used as a vermifuge. The active principle, arecaine, according to Jahns, is poisonous. It affects the respiration, the heart, increases the peristalsis of the intestines, and causes tetanic convulsions. The bud or "úbud" is edible either raw as a salad or cooked, but Tavera states that disagreeable sensations, corresponding to those experienced when one first chews the nut, are caused by eating it. The large, tough, sheathing parts of the leaves are used as a substitute for cardboard or strawboard, in protecting packages; for making the odd hats worn by some of the wild people in Mindanao (Manobos, etc.); for the inner soles of slippers; by school-children for book-covers; and, were they available in sufficient abundance, would apparently make excellent paper-pulp material. The husks are used for toothbrushes. These are made by cutting off one end of a piece of the husk square across the grain and scraping away the pulp for a short distance. The stiff fibers remain like a row of short bristles.

While this palm is of considerable importance in the internal commerce of the Archipelago, the fruits appearing on sale throughout the Islands, it does not enter at all, or only to a very slight extent, into the foreign commerce of the Philippines. The fruit is exported to India in considerable quantities from Java, Sumatra, Singapore, and other parts of the Malayan region.

A number of forms, such as búñgang-matuliá, búñgang-páto, and tagabúñga, are distinguished by the Filipinos. These distinctions are based chiefly, if not entirely, on the shape of the fruit.

ARECA CALISO Becc. KALISO.

Local names: *Kaliso* (Bagobo); *sakolon* (Manobo).

This is a species growing on mountain slopes and in dense, humid woods. It is a slender palm about 7 to 15 centimeters in diameter and reaches a height of 6 meters or more. The leaves

are about 3 meters in length. The Manobos use the fruit as a substitute for the betel nut. The sap is also collected and used as a beverage of an inferior quality.

ARECA HUTCHINSONIANA Becc. PISA.

Local names: *Búñga, pisá* (Moro).

A pinnate-leafed palm with a diameter of about 15 centimeters. The immature fruit is white; the mature, yellow.

ARECA IPOT Becc. (Plate VI). BUÑGANG-ÍPOT.

Local names: *Búñgang-ípot, ípod, ípot, mañgípod, saksík, saksíg* (Tagalog).

This palm somewhat resembles a dwarfed *Areca catechu* in habit. It never exceeds 4 meters in height and is often much smaller than this. The infructescence is very different from that of the above species, the fruits being densely crowded. It is common in the towns surrounding Mount Banajao, in the Provinces of Laguna and Tayabas, Luzon, in various provinces in southern Luzon, and in Polillo. It is chiefly planted for ornamental purposes, although the fruit is sometimes used as a substitute for the true betel nut (*Areca catechu*), to which it is, however, considered much inferior.

ARECA VIDALIANA Becc.

Local names: *Boga, píta* (Palawan).

This is a very slender palm widely distributed in Palawan and occurring also in Mindoro. Its trunks do not exceed 3 or 4 centimeters in diameter and it rarely exceeds 3 meters in height. It is a sylvan species, growing at low and medium altitudes, and is decidedly ornamental, although nowhere utilized.

ARECA WHITFORDII Becc. BÚÑGANG-GÚBAT.

This species is allied to *Areca catechu*, but has thicker trunks, about 20 centimeters in diameter, and differs in numerous other ways. It grows in the semi-swampy forests in eastern Mindoro, where it is known as búñgang-gúbat, literally "wild bunga." No special economic use has been reported.

Genus **ARENGA** Labillardière

This genus is represented by four species, of which the sugar palm is by far the most common and widely distributed and the most valuable economically.

Conspectus of the species.

a^1. Leaflets elongate, narrow, having smooth or remotely and minutely toothed margins, the secondary nerves parallel, all starting from the base.

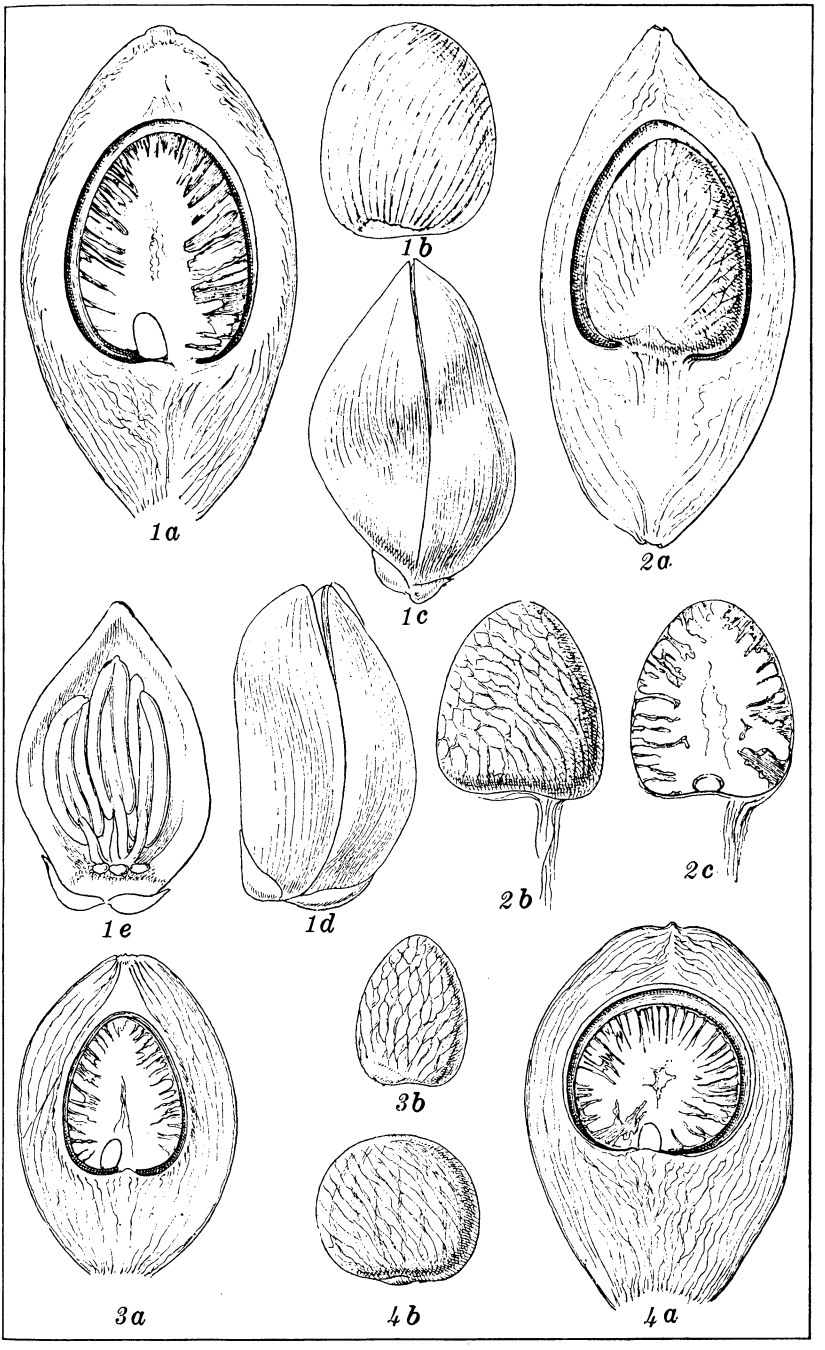


Fig. 1. Areca parens. 2. A. macrocarpa. 3. A. camarinensis. 4. A. Ipot.

PLATE VI.

b^1. Large, with solitary stems. Fruit more or less turbinate, 3 cm or more in diameter. Male flowers with very numerous stamens; anthers aristate..... 1. *A. saccharifera.*

b^2. Relatively small and caespitose. Male flowers with 20 to 30 stamens; anthers blunt or slightly apiculate. Fruit spherical, 15 to 18 mm in diameter..... 2. *A. mindorensis.*

a^2. Leaflets elongate, yet broad, margins very irregularly undulate or else very boldly toothed, or lobed; secondary nerves divergent from the rachis at different levels.

b^1. Caespitose; stem attaining 2 to 3 m in height and 15 cm in diameter. Male flowers with a rounded top. Stamens about 150. Fruit longer than broad, rounded at both ends..... 3. *A. tremula.*

b^2. Stem short and thick, about 30 cm in diameter. Male flowers apiculate. Stamens about 100. Fruit spherical..... 4. *A. Ambong.*

ARENGA AMBONG Becc. AMBÚNG.

Local name: *Ambúng* (Moro).

This palm, like *Arenga tremula,* has a very short stem and grows in large tufts or clumps. It is much larger than the above species and is characterized by its very much broader leaflets which are prominently lobed, about 70 centimeters long and from 6 to 10 centimeters wide. It occurs in Palawan, Balabac, Mindanao, Cebu, southern Luzon, and probably in some other islands. *Arenga ambong* is a very beautiful species, but is never cultivated in the Philippines for ornamental purposes, although well worthy of being so used. The buds (úbud) are edible. In Palawan, the aborigines, Tagbanuas, use blowguns and small poisoned darts made of bamboo. Small obconic plugs secured from the pith of this palm are put on the upper ends of the darts for the purpose of making them fit closely the bore of the blowgun. This species probably has other economic uses, but no definite ones have been as yet recorded.

ARENGA PINNATA (Wurmb) Merr. (Plates VII, VIII). KÁONG or SUGAR PALM.

Local names: *Bagatbát* (Oriental Negros); *batbát* (Bohol); *cabo negro* (Spanish-Filipino, "black rope"); *ebiók, ibiók* (Bohol); *habiók* (Capiz); *hibiók* (Capiz, Occidental Negros); *hidiók* (Camarines, Albay, Antique, Capiz); *igók* (Antique); *irók* (Zambales, Cavite, Tayabas, Mindoro); *káong* (Manila, Rizal, Cavite, Laguna); *kauing* (Bataan); *onáu, unáu* (Misamis, Surigao); *rapitan* (Ilocos provinces).

This rather large palm (commonly known as *Arenga saccharifera* Labill.) is characterized among the Philippine species by its very long, ascending, pinnate leaves, which are up to 8.5 meters in length with 100 or more pairs of linear leaflets which are whitish beneath, 1 to 1.5 meters long, lobed at the apex and auricled at the base. The large axillary, pendulous inflorescence is also characteristic. *Arenga pinnata* reaches a

PLATE VII. ARENGA PINNATA (SUGAR PALM).

height of from 12 to 15 meters and a diameter of 40 centimeters. When the tree has attained mature size, a flowering shoot is usually sent out from the axil of the upper leaf. This is followed by others which are produced successively lower down, until the tree is finally exhausted and dies. *Arenga pinnata* has very numerous, crowded, green nuts, which turn yellow when mature. This palm is widely distributed at low and medium altitudes throughout the settled areas of the Philippines, in ravines along streams, and in semi-cultivation. It may not however be native to the Philippines, but a species purposely introduced by the Malays in their early invasions. Its occasional occurrence in virgin forest may be due to the fact that it is naturally a sylvan species, and that its ripe fruits have been distributed by wild hogs and fruit bats, both of which eat the mature fruit.

The sugar palm is one of considerable utility in the Philippines, although no product of it enters into foreign commerce. It yields sugar, starch, fermented drink, alcohol, thatching material, various fibers that are utilized in industrial work, and other minor products.

The fruits are about 5 centimeters in diameter and contain two or three seeds. Immature seeds are sometimes eaten by the Filipinos, being usually boiled with sugar to form a kind of sweetmeat. The buds make an excellent salad.

The outer part of the fruit contains very numerous, microscopic, needle-like, stinging crystals or rhaphides; and this part of the fruit is exceedingly irritating. Blanco relates how, in former times, the fruits were thrown into the water and allowed to decay, and the resulting fluid, which causes intense itching and burning sensations wherever it comes in contact with the skin, used sometimes to repel the attacks of Mohammedan pirates. Another interesting use of this "Hell water", as described by Rumphius, * was to pour the liquid into streams, thus rendering fish more or less helpless, so that they might be seized with the hands. At the present time the crushed fruits are sometimes strewn along the paths on the banks and dikes of fish ponds to protect them against nocturnal robbers, as the stinging needles in the pericarp irritate the bare feet.

The leaves are sometimes used for thatching roofs, and are said to be very durable. For this purpose the leaflets are removed and prepared in a manner similar to that of preparing the nipa palm. The midribs of the leaflets are frequently used

* Herbarium Amboinense. Volume I (1741), page 57.

PLATE VIII. FRUITS OF ARENGA PINNATA (SUGAR PALM).

for rough brooms, and are sometimes woven into coarse baskets. Splints prepared from the petioles vary in color from greenish-white through various shades of brown to nearly black, depending on the age of the leaf. They are used in making baskets and for a sort of marquetry work on tables, stands, screens, boxes and other light pieces of furniture. The bud (úbud), either raw or cooked, makes a fine salad.

The most important industrial yield of this palm is, however, the black tough fiber locally known as yunot or cabo negro (eju or gomuto fiber). This stiff, black, tough, horsehair-like fiber is produced at the base of the petioles in considerable quantities, and is employed in the Philippines chiefly for manufacturing rope for use in salt water, and for thatching houses.

For the latter purpose, it is prized not only for its remarkable durability against exposure to either fresh or salt water, but also because it does not readily burn. Well-informed Filipinos claim that as thatch it will last for 100 years; Blanco states that when so used it will last 30 years or more. Its cost is comparatively high. This fiber is in demand in Europe for certain industrial purposes, but there is no record that it ranks among the exports of the Philippines. Heyne * quotes its price at from 12 to 35 pounds per ton, according to grade, length of fiber, etc., and gives the Javan export for the year 1912 as 31 tons.

In the Philippines, the stiffer fibers are used for making brushes of various types, such as floor and hair brushes, brushes for cleaning horses, etc. A minor local use is for the purpose of tying epiphytic orchids to pieces of wood in establishing these plants under cultivation. Thatch-like raincoats are sometimes made of it.

Associated with the black, stiff fibers of the basal parts of the petiole is an entirely different substance, soft, light, dry, punky, varying in color from nearly white to rather dark shades. This material, called barok, is used in caulking boats; formerly, and perhaps still to a very limited extent, as tinder. For the latter purpose it is first soaked in the juice of the banana plant or of talbák (*Kolowratia elegans* Presl), or in lye made from the ashes of the lagúndi (*Vitex negundo* L.), and then dried.† According to Heyne, from 60 to 75 tons of this material are exported from Cheribon, Java, to Singapore each year under the name of zwam (Dutch=sponge or tinder).

* Heyne, De Nuttige Planten van Nederlandsch-Indië. Volume I (1913), page 114.

† Blanco, M., Flora de Filipinas. Edición II (1845), página 512.

Starch in the form of a kind of sago is secured from this palm by a general process of extracting quite similar to that used with *Metroxylon, Corypha,* and other palms. The tree is felled and the interior fibrous part of the trunk cut into chips or small pieces, which are eventually thoroughly crushed or pulverized. The crushed material is then washed in a trough, and the water, with the starch in suspension, drawn off into a settling-tank. In practice the starch is usually washed with several changes of water, but is eventually dried in the sun. If well prepared, it is rather white and comparatively pure. As in the case of the true sago (*Metroxylon*) and the buri (*Corypha*), a kind of tapioca is sometimes prepared from this starch, by dropping wet pellets of it on hot plates. The estimated yield per tree is from 50 to 75 kilos of starch. The débris, after most of the starch is washed out, is sometimes boiled and used to feed hogs. It is claimed by Barrett * and Hines † that in Cavite Province, Luzon, starch is secured only from the male or sterile trees, and that before the tree is felled for starch the inflorescences are removed as they appear, for a period of about one year. Hines states also that the trees are tested as to the amount of starch present by cutting notches in the lower part of the trunk and examining the pithy part. Starch production from this palm is apparently only a local industry, and the product is perhaps used only when there is a scarcity of other food. Blanco ‡ speaks of it as miserable food, and wonders that the natives were content with it, adding that the civilized ones scarcely used it at all.

The tree is apparently much more commonly tapped for its sweet sap than utilized as a source of starch. This sap is used for the production of sugar, a fermented drink called túba, vinegar, and sometimes distilled alcohol. The method of tapping is as follows:—An inflorescence stalk is selected and beaten with a stick or wooden mallet for a short period each day. This beating sometimes extends over a period of two or three weeks, the object being to produce wound tissue and stimulate the flow of sap to the injured part. The stalk is then cut off at the base of the inflorescence, and the exuding sap caught in a hollow joint of bamboo. A thin slice is removed from the wounded end of the stalk once or twice each day during the period of

* Barrett, O. W., The sugar palm. Philippine Agricultural Review, Volume 7 (1914), pages 216 to 221.

† Hines, C. W., Sugar-palm sap. Philippine Agricultural Review, Volume 7 (1914), pages 222 to 228.

‡ Blanco, M., Flora de Filipinas (1837), page 741.

sap flow. The yield varies greatly, depending on climatic conditions, the age of the tree, and the length of time the sap has been running. According to Hines, the flow gradually diminishes from 10 or 12 to 2 liters per day after two and one-half months. Gibbs,* however, reports a maximum of over 2 liters per day on two trees tapped under his directions.

Ordinarily the sap is allowed to ferment, the product being known as túba. This palm wine is a very popular drink in the Philippines and corresponds to the túba of the coconut, buri, and nipa palms. Túba is popularly supposed to have curative properties, especially for persons suffering from tuberculosis. Fermentation commences in the bamboo tubes in which the sap is collected, and is usually well advanced when the product is gathered.

In some regions much of the túba gathered from the sugar palm is converted into vinegar of a good quality. Alcohol is distilled from the fermented túba only to a very limited extent.

Sugar is made in some parts of the Philippines by boiling the sweet, unfermented sap of this palm. The general practice is to use a new receiver (bamboo joint) for the sap each day, because old receivers would at once start fermentation. To prevent rapid fermentation a little crushed ginger or crushed chile-pepper fruit is sometimes added to the receiver.† In Java, for the same purpose, the bamboo joints are smoked before being used for collecting the sap. The general method of manufacturing sugar is to thicken the juice by boiling in an open kettle until the liquid is of such consistency that a drop of it will solidify when it falls on a cold surface. Sugar manufacture on a commercial scale has apparently never been attempted, and various authors who have investigated the sugar possibilities of this palm, have considered its commercial cultivation impracticable. Both Barrett † and Hines ‡ give optimistic reports regarding the possible commercial utilization of this palm as a source of sugar; the former reporting an estimated annual yield of 20 tons of sugar per hectare, with from 150 to 200 trees, the latter that 20 tons of sugar per hectare would be the minimum yield with an average of 160 trees. It seems probable that these estimates were based on insufficient data, especially

* Gibbs, H. D., The alcohol industry of the Philippine Islands, Philippine Journal of Science, Volume 6 (1911), Section A, pages 147 to 206.

† Barrett, O. W., The sugar palm. Philippine Agricultural Review, Volume 7 (1914), pages 216 to 221.

‡ Hines, C. W., Sugar-palm sap, Philippine Agricultural Review, Volume 7 (1914), pages 222 to 228.

PLATE IX. ARENGA TREMULA (DUMAYAKA).

as Gibbs reports a very much smaller sap flow from Philippine palms than do Barrett and Hines, while De Vry * and Tachirch,† give the estimated sugar yield at a much lower figure than do these writers. The small amount of sugar produced in the Philippines is brown in color, resembles that secured from the buri palm (*Corypha*), and enters the local commerce of the Philippines to a very limited degree.

ARENGA TREMULA (Blanco) Becc. (*A. mindorensis* Becc.). (Plate IX). DUMAYÁKA.

Local names: *Abigi, abíki, gumaká rumaká* (Bikol); *abikí* (Tagalog); *banisan* (Moro); *baris* (Bagobo); *batbát* (Tagbanua); *bélis, tipon-tipon* (Bisaya); *dumayáka, dayumáka, gumayáka* (Tagalog).

This small-sized, endemic palm, often growing in large clumps or tufts, is very distinctly ornamental, and on this account well worthy of extended cultivation. There are now some beautiful specimens in cultivation in Manila. It is usually only 3 to 4 meters in height, the trunk usually being very short or almost wanting. The petioles are rather long, while the leaflets are narrow, linear, 20 to 35 centimeters long and from 13 to 18 millimeters wide, toothed and sometimes slightly lobed at the apex. It is widely distributed in the central Philippines, but is of very local occurrence, although abundant in some localities. The peduncles of the inflorescences are said to be sometimes tapped for the juice or tuba; but as the palm is decidedly small, the tuba yield must be slight, so that it is certainly very little utilized for this purpose. The chief use of the palm is found in the industrial materials it yields, these being especially good for the manufacture of certain types of baskets. Splints are prepared from the petioles and vary in color from light to dark brown when the epidermis is removed. Parts showing the epidermis are grayish green.

The bud, if eaten in considerable quantity, is said to cause a sort of intoxication followed by long and profound sleep.

Genus **CALAMUS** Linnaeus

The RATTANS (Plates X-XIV).

This genus is represented in the Philippines by many species, while individuals are exceedingly abundant in the forested areas of the Archipelago. The rattan palms are strictly sylvan, and individuals are most abundant at low and medium altitudes in the virgin forest. They are occasionally found in thickets or in the second-growth forests, but never in the open country.

* Watt, A dictionary of the economic products of India.
† Indische Heil-und Nutzflanzen.

PLATE X. RATTANS (CALAMUS) IN FOREST.

Locally, the rattan palms are of very great importance, yet the exports of the prepared cane are negligible at the present time. The stems vary considerably in size, depending on the species, the Philippine forms ranging from less than one-half centimeter to as much as 5 centimeters in diameter. All of our species are climbing, some of them reaching such lengths as 100 to 200 meters. In a few species, the slightly swollen basal part, just above the surface of the ground, contains a considerable amount of starch and is sometimes roasted and eaten by woodsmen who run out of food. The bud of some species is likewise edible, but in most species is too bitter. The species commonly eaten have a mild bitter flavor, very like that of dandelion salad. A few species have an edible, gelatinous pulp, either sweet or sour, surrounding the seed. The stems of certain forms produce good drinking water, a feature of considerable importance to the woodsman when drinking water is not otherwise available.

The real value of the rattan palms, however, is found in the very long stems, which are of uniform diameter throughout, except for the very base and apex.

The outer portion of these stems, or so-called canes, has great tensile strength, while the outer surface is very hard.

The rattan-gatherer enters the forest, selects the cane he desires, cuts it off just above the surface of the ground, and pulls down the entire plant, whose tip is in the tops of the tallest trees. The palm is then stripped of leaves and the cane cut into convenient lengths, ranging from 3 to 6 meters, which are bent sharply at the middle and tied into bundles for convenient transportation. The external part may be stripped from the cane right in the forest, or the entire canes may be transported, depending on how the product is to be utilized. The entire stems of species that are of a proper size are used for making "bent-wood" chair frames, as cables for ferry boats, for hauling logs, standing-rigging on small sailing-vessels, and sometimes to support short suspension bridges. The split canes are used for making mats, hats, baskets, chairs, various types of fish traps, and the bottoms and backs of the so-called "cane-bottomed" chairs, these latter being the most familiar products made from the rattan palm. The interior part of the stem is softer than the outer part; but split into strips, or in the form of round rods left after peeling off the cortex, it is much utilized in making so-called "reed" furniture. Among the Mohammedan inhabitants of the Philippines, the entire canes are used for making a peculiar kind of mat or screen. The canes are

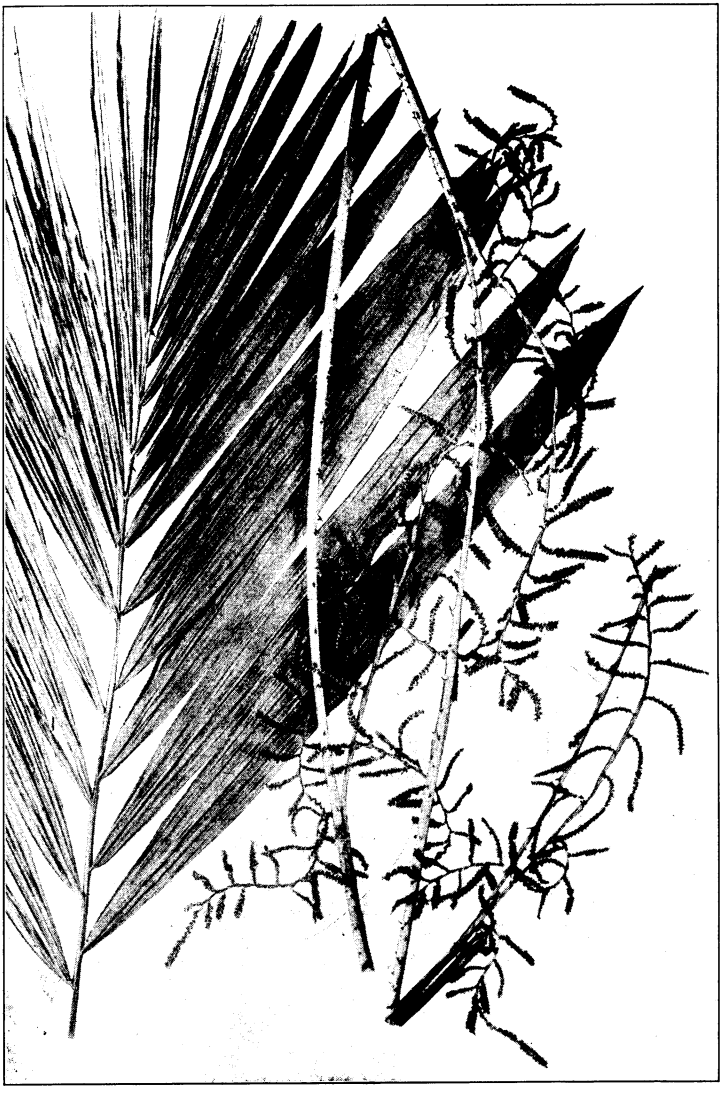


PLATE XI. MALE INFLORESCENCE OF CALAMUS USITATUS (MOLLIS) (A RATTAN).

cut into proper lengths and then attached by their sides to form an oblong mat or screen that can readily be rolled up. Buffers of rattan are made in Cavite in enormous numbers by the United States Navy.

The rattan strips, so familiar as the "cane" in certain types of chairs, are the most important product of this genus in the Philippines. They are locally utilized for all purposes for which rope or cord may be used. Most of the houses in the Archipelago are of light construction, framed wholly or in part with bamboo and thatched with palm leaves or grass. The frames of these houses are usually tied together with strips of rattan. Commercially, large quantities of it are used in baling tobacco, abaká (Manila hemp), etc., and for tying the mat bags in which practically all the sugar of the Philippines is packed for export.

A species found in Palawan and Surigao furnishes material for very fine walking-sticks, known in commerce as Malacca canes.

GENERAL SUPPLY OF RATTAN

The virgin forests of the Philippines, according to Whitford,* cover 104,000 square kilometers (40,000 square miles), and in nearly all of the virgin forests, except those near the tops of high mountains, rattans are abundant; in fact, the young rattans are often the most prominent element in the ground-covering of these virgin forests, while older specimens are very conspicuous and lend character to the appearance of the forest. In some localities large quantities of rattan have been taken from the forests, but except in the immediate neighborhood of places having a considerable population, the amount has not been appreciably reduced. It is practically impossible to make any estimate of the total amount available. Some attempt has been made to determine the actual average yield for a given area. Two plots in the forest of the eastern portion of Mindoro, each 25 meters square, were cut over and the yield of rattan of commercial grade estimated to be at the rate of 5,000 lineal meters per hectare, or about, 6,700 feet per acre. This yield is believed to be rather above the average for the forests of Mindoro, but there are large areas which should be fully as productive.

A compilation of the quantities of rattan on which forest charges are paid is made each year by the Bureau of Internal Revenue. These figures, however, may not represent more than half the actual output, as they do not include the portion cut

* Whitford, H. N., The forests of the Philippines. Bureau of Forestry Bulletin No. 10 (1911).

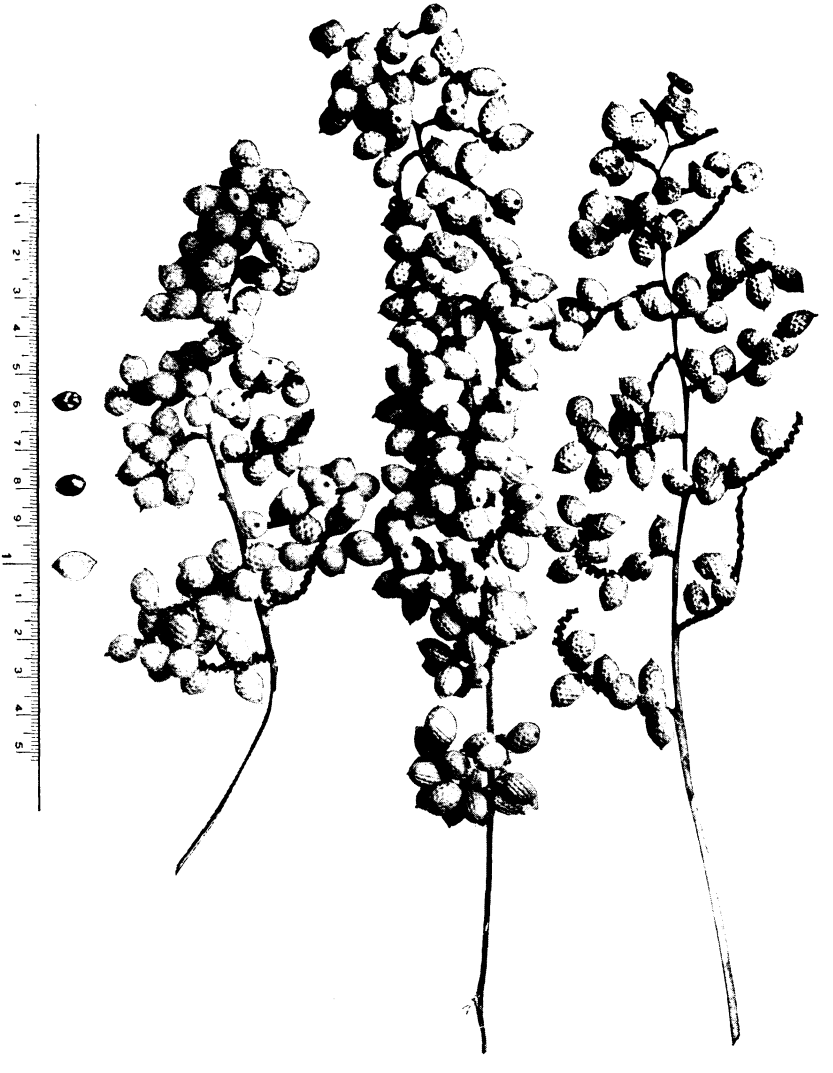


PLATE XII. FRUITS OF CALAMUS USITATUS (MOLLIS) (A RATTAN).

by the inhabitants of rattan-producing localities for domestic purposes (this being by law free from forest charges), while a considerable proportion of that cut for commercial purposes escapes the payment of taxes. The annual amount on which forest charges were paid for a series of years is given in Table I. Arnold * has written a lengthy discussion of the supply of rattans, from which much of the following data is taken.

TABLE I.—*Amount of rattan on which forest charges were paid from 1914 to 1918.*

Year.	Split rattan.	Unsplit rattan.	
		Over 2 cm. in diameter.	2 cm. or less in diameter.
	Kilograms.	*Linear meters.*	*Linear meters.*
1914	3,316,925	1,360,664	9,054,343
1915	3,733,918	1,041,238	19,008,440
1916	3,112,126	1,884,679	20,930,522
1917	4,606,310	2,824,473	13,468,264
1918	7,920,066	3,631,849	10,066,058

The returns for each year are given by provinces, and these figures make it possible to get some idea of the localities from which the larger amounts of rattan are obtained. Table II, taken from Arnold, gives the average production for the five fiscal years 1909 to 1913, inclusive. While the amount of rattan given is much too small, the figures for the more thickly settled provinces give some idea of the relative amounts available. This does not apply to Palawan, the Moro Province, Nueva Vizcaya, or Mindoro, since these provinces are sparsely inhabited and the cutting is done by uncivilized and partly unsettled tribes; nor does it apply exactly to other provinces, as questions of labor organization and transportation have to be taken into consideration, and especially as the best commercial rattan is in the virgin forest which may not be easily accessible from the towns. The heaviest production is shown by the provinces of Ambos Camarines, Sorsogon, Tayabas, Occidental and Oriental Negros, Cagayan, Samar, Mindoro, Albay, Zambales, Leyte, and La Union.

* Arnold, J. R., Rattan supply of the Philippines. Bureau of Foreign and Domestic Commerce, Department of Commerce. Special Agents Series No. 95 (1915), pages 3 to 23.

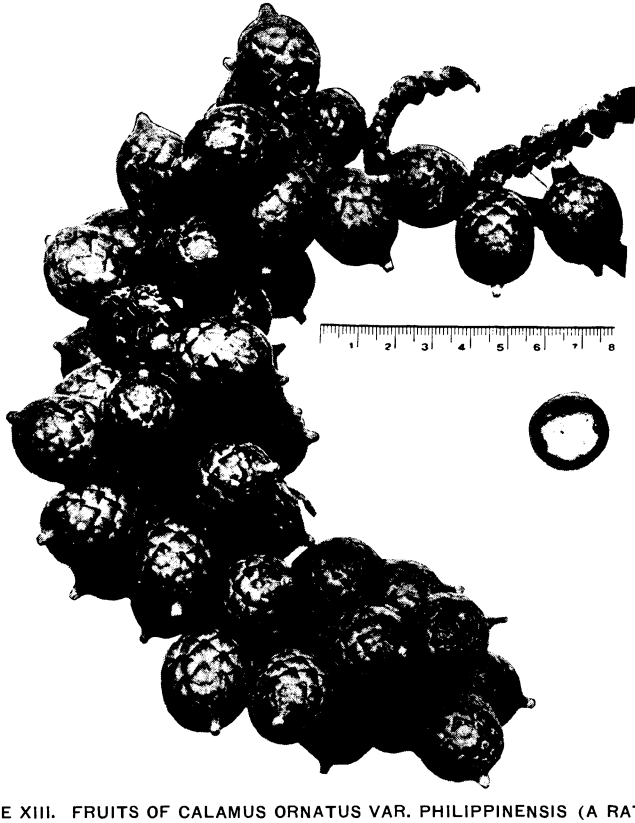


PLATE XIII. FRUITS OF CALAMUS ORNATUS VAR. PHILIPPINENSIS (A RATTAN).

TABLE II.—*Average annual production of rattan for the five years 1909–1913 for each of the various provinces of the Philippines.*

Provinces.	Average recorded annual output of rattan, 1909-1913.	Percentage of total average annual output.	Areas of provinces.	Ratio of average annual output to area.	Estimated average population, 1909-1913.	Ratio of average annual population.	Percentage of municipalities in which rattan is not found.	Percentage of municipalities in which rattan is found but not shipped out.	Percentage of municipalities from which rattan is shipped out.
	Kilos.		*Square miles.*	*Kilos.*		*Kilos.*			
Agusan	26,155	0.7	8,020	3.26	76,812	0.34	(a)	(a)	(a)
Albay	114,321	3.2	1,708	64.12	263,397	.43	10	33	57
Ambos Camarines	955,730	26.5	3,279	291.47	262,387	3.64	13	15	72
Antique	7,970	.2	1,134	7.03	146,035	.05	36	18	46
Bataan	57,560	1.6	537	107.19	51,278	1.12	----------	45	55
Batangas	571	----------	1,201	.47	282,455	----------	50	11	39
Bohol	4,182	.1	1,511	2.77	295,068	.01	52	39	9
Bulacan	67,069	1.9	1,173	57.18	245,221	.27	67	----------	33
Cagayan	191,438	5.3	----------	----------	156,536	1.22	5	45	50
Capiz	8,532	.2	1,749	4.88	310,791	.03	28	28	44
Cavite	1,235	----------	619	2.07	145,717	.01	62	8	30
Cebu	6,910	.2	1,939	3.56	716,484	.01	55	17	28
Ilocos Norte	89	----------	1,330	.07	196,178	----------	54	8	38
Ilocos Sur	8,810	.3	1,642	5.37	262,241	.03	70	6	24
Iloilo	6,000	.2	2,027	2.96	449,705	.01	74	5	21
Isabela	1,791	----------	----------	----------	75,397	.02	25	----------	75
Laguna	9,916	.3	629	15.76	162,872	.06	37	11	52
La Union	80,724	2.2	634	127.32	140,056	.57	86	7	7
Leyte	91,843	2.6	3,008	30.53	426,258	.21	10	38	52
Mindoro	116,723	3.2	4,024	29.00	43,381	2.69	----------	18	82
Misamis	20,220	.6	1,380	14.61	142,736	.14	29	50	21
Moro Province	48,136	1.3	27,260	1.77	507,583	.09	11	67	22
Mountain Province	342	----------	----------	----------	299,796	----------	81	7	12

Nueva Ecija	52,751	1.5	2,169	24.32	143,002	.37	29	14	57
Nueva Vizcaya	20				33,564		17	66	17
Occidental Negros	229,973	6.4	3,130	73.47	337,866	.68	14	14	72
Oriental Negros	146,541	4.1	1,864	78.61	220,837	.66	22	22	56
Palawan	40,040	1.1	5,238	7.64	51,622	.78	45		55
Pampanga	241		868	.28	245,232		75	10	15
Pangasinan	7,449	.2	1,193	6.30	436,100	.02	51	11	38
Rizal	48,185	1.3	733	65.74	165,411	.29	73	4	23
Samar	149,042	4.2	5,276	28.25	291,795	.51	9	50	41
Sorsogon	598,058	16.3	2,325	257.23	312,860	1.91	10	21	69
Surigao	38,519	1.1	2,620	14.70	88,018	.48	54	15	31
Tarlac	27,266	.8	1,205	22.63	148,077	.18	12	38	50
Tayabas	337,452	9.4	6,354	53.11	224,353	1.50	10	35	55
Zambales	107,266	3.0	2,125	50.48	114,585	.94	7	14	79
Total	3,609,120	100.00			8,473,708				

[a] Included in Surigao.

The next to the last column in the table shows what provinces have an unutilized supply; although, of course, the fact that rattan is found but not exported in a large proportion of the municipalities, does not necessarily mean that it is there to be had in great quantities. Such, however, may be assumed to be the case with regard to the Moro Province and Nueva Vizcaya and, to a less extent, with Mindoro, Palawan, Samar, Misamis, Bataan, Cagayan, Tayabas, and Leyte. In general, it is probable that these latter provinces offer the best fields for commercial exploitation.

As rattan is primarily a plant of virgin forests, the destruction of the forests practically means the end of the supply. Moreover, heavy cutting of the rattan will at least temporarily exhaust the supply in a locality, as has happened in the immediate neighborhood of most of the larger towns. It has not yet been determined whether it is possible to collect rattan in the forest on a commercial scale and within reasonable cost, without cutting it faster than it reproduces itself. Unfortunately there is very little information concerning the rates of growth of rattans under forest conditions. The supply has been reduced in many countries where it naturally occurs, to such an extent as to raise prices considerably. As yet the effects of indiscriminate cutting in the Philippines have been no worse than to increase the cost and difficulty of putting rattan on the market in the more thickly populated areas. It has not yet become necessary, as in the Malay Peninsula, to consider the question of cultivation on a large scale. The satisfactory situation in the Philippines may, however, be due to the fact that hitherto there has been almost no exploitation for foreign markets.

UTILIZATION AND EXPORT

Only a very small portion of the comparatively large total production, indicated by the statements and figures in the foregoing paragraphs, is at present exported. The total shipment of crude rattan from the Islands for the year ending June 30, 1914, was valued at 8,480 pesos and the manufactured rattan products, chiefly baskets, at about 1,600 pesos. More than half of the former amount was collected on the island of Palawan, shipped to British North Borneo, there mixed with the local product, and then sent to Singapore and Hongkong ready for shipment to Europe. A certain portion of the supply which goes to Hongkong, after being prepared or cleaned, is re-imported into the Philippines for use in furniture manufacture.

PLATE XIV. RATTANS (CALAMUS) FORMING BULK OF UNDERGROWTH IN FOREST.

The original exports are made at prices ranging from 4 centavos to 20 centavos per kilo; while the partially manufactured products are repurchased at from 1 peso to 1.30 pesos per kilo. The total value of all imports during the year ending June 30, 1914, was 30,730 pesos, or nearly four times the value of the exports. During the fiscal year 1913 more than one million dollars worth of rattan was imported into the United States, while only four hundred dollars worth came directly from the Philippines. The export business in Palawan is partly conducted by the Palawan Exchange, a government institution for providing the uncivilized tribes in that island with the means of disposing of their products on fair terms; and partly by a few merchants of Puerto Princesa, the capital of the province. The exports from the other parts of the Islands are insignificant.

Much of the remaining production in the Philippines is used in or near the localities where it is collected for the many domestic and industrial purposes it serves, and especially in place of twine or wire for baling hemp, copra, and tobacco. Nearly all of the comparatively small portion of the total supply which reaches Manila and the other large centers is brought together in small quantities by Chinese shopkeepers.

QUALITY AND GRADE

It is widely stated that there are to be had in the Philippines large quantities of rattan equal in quality to that produced elsewhere. The authorities of the Industrial Division of Bilibid Prison say that the best native product is equal to the best to be had from Hongkong, and merchants state that American firms have repeatedly approved samples. Nothing is known to contradict these statements, except the assertion of the handlers in Singapore that the very finest of all rattans are not to be had outside of two districts in Dutch Borneo.

Great difficulty is encountered in any attempt to classify the various grades or to determine the relative plentifulness in the different localities in which they are found. This is probably due to a considerable extent to the fact that the various grades have not been connected with authentically named botanical specimens. This is not an easy task, as flowering specimens are rare and commercial canes are, of course, gathered without flowers, while botanical specimens are usually collected without canes. An exact classification of the canes seems, therefore, to be out of the question until an extensive study of them has been made.

The adoption of a native system of nomenclature or grading

is impractical. Native collectors and dealers recognize certain grades of rattan in any given locality and are familiar with something of their abundance, size, and tensile strength. For different operations of tying and fastening, different sizes are obviously needed. Some kinds become brittle when dried and are therefore useless for tying purposes in constructing houses and for baling hemp, but may serve perfectly well for binding fish traps and rafts. On the basis of such points of difference the people of any given locality distinguish a number of different varieties, usually half a dozen to a dozen, to which they give distinct names. Just how far these distinctions coincide with botanical ones is uncertain, but these names vary too greatly in different localities for them to serve a useful purpose except very locally.

The situation above described raises the question as to what practical method of classification recourse may be had. Broadly speaking, it cannot be said that there is any which could be put into immediate operation in a way that would be of special assistance either to an exporter or a purchaser. Until a classification based on a thorough investigation has been devised, the only safe plan is to purchase by samples from each important region.

Apparently the only variety of Philippine rattan distinguished with any degree of definiteness is that which forms the bulk of the exports from Palawan and which goes under the name of sika or sicca. It is perhaps the same or nearly the same as the high-grade Borneo rattan exported as segah and with which the Philippine product is probably mixed. Sika is generally agreed to be the best of the Philippine rattans. It is smooth and very tough, with a fairly light-yellow color, has small nodes, and a very uniform diameter averaging about a centimeter. The authorities of Bilibid Prison have stated that if a steady supply of this rattan could be secured at reasonable prices they would use it regularly as fully equal to the cane imported from Hongkong. Very little is known of the available supply or the extent of territory from which sika can be secured. Palawan is one of the most sparsely inhabited and least systematically exploited islands in the Archipelago. The present supply of sika is collected almost entirely by the unsupervised labor of the Tagbanuas and other pagan tribes. It is generally believed among those who handle the product in Manila that rattan of approximately this quality, whether under the same or other names, is only to be had from Palawan. There is, however, no

positive evidence of this, although it is known that the flora of Palawan is more closely related to that of Borneo than is that of the more northern islands of the Archipelago. The fact that at present no rattan of equal grade comes in commercial quantities to the Manila market from other parts of the islands, and that most of that sold in Manila is large and inferior, can scarcely, in view of our present ignorance of the subject and the unorganized nature of the trade, be regarded as proving much of anything.

While sika is the only single variety of Philippine rattan that has been definitely distinguished for commercial purposes, there is another kind, or rather group or class—for it probably includes a number of species—which to all appearances meets the essential specifications for export rattans. This is what might be called the high-grade mountain rattan and is found on the spurs and lower ridges of the forested highland portion of nearly all sections of the Philippines. It probably includes most of the smaller and less coarse varieties distinguished by special names in the localities where they are found. Much of it is cut for ordinary local uses, although in the more thickly inhabited parts of the Islands the best quality has to be sought in the less accessible regions. It forms the bulk of the material used in industrial schools and small factories in Bulacan Province for making rattan furniture. It is relatively plentiful and considerably cheaper than sika. It is generally said to be much inferior in quality to sika, but the existing data on this subject are by no means complete, and there is reason to believe that the better grades are almost, if not quite, as good for ordinary manufacturing purposes.

The large amount of rattan available in the Philippines does not imply that a large quantity of high-grade Philippine rattan can at once be obtained, as no organized industry of any great extent exists. Most of the rattan cut is sold and used locally. The lack of a system of classification and of an extensively organized industry naturally results in great uncertainty as to prices. The collection of rattan is usually carried on entirely as a side line during the dry season, either when other local employment is lacking and a little ready money wanted, or when crops fail and a living must be had by other means. Under such conditions few men work steadily in gathering rattan and the supply is necessarily precarious. The holders of rattan licenses issued by the Bureau of Forestry are mainly the middlemen, a great majority of whom are Chinese shopkeepers. With them, rattan,

even when it is not a means of barter, is one of many articles of trade and they have neither the desire, knowledge, nor facilities for handling it on a large scale.

From what has been said in preceding pages, it will be seen that the Philippines offer a promising field for the export of rattan, but that before success is attained in this direction the whole industry must be much more highly organized than it is at the present time. Considerable discussion of the difficulties and their possible remedies is given by Arnold.*

Conspectus of the species.

a^1. Leaves noncirriferous (the rachis not prolonged into a filiform, clawed or aculeate appendix).

b^1. Female flowers and fruits sessile or nearly so; that is, not furnished with a distinct pedicel derived from the lengthened involucrophore.

c^1. Leaflets almost equally green on both surfaces.

d^1. Leaflets narrow, linear or linear-lanceolate, 1- to 3-costulate.

e^1. Spadices shortly flagelliferous, about as long as the leaves; fruits small, ovoid; seeds with equable albumen.

f^1. Leaf-sheaths armed with slender straight spines; primary spathes also spinulous; leaflets very numerous; spathels of the female spikelets very short, bracteiform. A very variable plant, of which it is difficult to establish well-defined varieties, as one merges into the other by intermediate forms..... 1. *C. mollis.*

g^1. Sheathed stem usually 15 to 20 mm in diameter; leaf-sheaths more or less densely spinous; leaves 50 to 80 cm long ..... *C. mollis* (forma *typica*).

g^2. Robust; sheathed stem 2.5 to 3 cm in diameter; leaves up to 1.2 m long..... *C. mollis* var. *major.*

g^3. Slender; sheathed stem 12 to 15 mm in diameter; leaf-sheaths almost spineless..... *C. mollis* var. *palawanensis.*

f^2. Leaf-sheaths and spathes unarmed; leaflets numerous; spathels of the female spikelets very short, bracteiform. 2. *C. meyenianus.*

f^3. Very slender; leaflets very few and very inequidistant; spathels of the female spikelets shortly infundibuliform. 3. *C. Blancoi.*

e^2. Spadices (male and female) extremely long, and flagelliform, considerably longer than the leaves.

f^1. Leaflets sparingly spinulous on three nerves above, the midrib alone minutely hairy-spinulous underneath; female spadix with thickish spikelets drawn together around the main axis; fruit nearly spherical (13 to 14 by 10 mm), with a broad, blunt, black beak; seed pitted-ruminate. 4. *C. melanorhynchus.*

* Arnold, J. R., Rattan supply of the Philippines. Bureau of Foreign and Domestic Commerce, Department of Commerce. Special Agents Series No. 95 (1915), pages 3 to 23.

f^2. Leaflets having three slightly bristly nerves on the upper surface and covered throughout on the lower surface with numerous fulvous bristles; female spadix with slender, very spreading spikelets; fruit small, globose-ovoid (11 to 12.5 by 7 mm), with a narrow beak; seed pitted-ruminate. 5. *C. filispadix.*

f^3. Leaflets with two bristly lateral nerves and the midrib smooth on the upper surface, the midrib bristly and the lateral nerves smooth underneath; spadices very loosely branched; male spikelets short, comblike; fruit spherical, 15 to 16 mm in diameter; seed very deeply ruminate throughout ..... 6. *C. Diepenhorstii* var. *exulans.*

d^2. Leaflets lanceolate, 5-costulate; very robust; leaflets large, equidistant; fruit large, ellipsoid, 3.5 cm long, 2.3 mm thick; seed quadrangular ..... 7. *C. ornatus* var. *philippinensis.*

c^2. Leaflets conspicuously discolorous, green above, white underneath; leaf-sheaths flagelliferous; spadix flagelliferous at its apex; primary spathes much lacerated in their upper part.

d^1. Leaflets bristly on three nerves above and on the midrib alone beneath ..... 8. *C. discolor.*

d^2. Leaflets without bristles or nearly so on the upper surface, densely sprinkled with numerous subspiny bristles beneath. *C. discolor* var. *negrosensis.*

b^2. Female flowers supported by a distinct pedicel derived from the elongation of the involucrophore; leaves of the upper part of the plant having the apices with gradually diminishing, pluricostulate leaflets, and the rachis clawed and subcirriferous.

c^1. Leaflets distinctly grouped, broadly oblanceolate and suddenly apiculate, slightly paler below than above; spikelets branched; fruit pisiform ..... 9. *C. Cumingianus.*

c^2. Leaflets not grouped, lanceolate, gradually acuminate, more or less covered underneath with a very thin, adherent, ochraceous coating; spikelets simple, elongate; fruit pisiform..... 10. *C. simphysipus.*

a^2. Leaves having the rachis prolonged into a clawed cirrus.

b^1. Male and female spadices having the spikelets provided with a very distinct pedicellar part which is inserted at the bottom of the spathes.

c^1. Very robust; leaf-sheaths covered with slender spiculae, the latter individually distinct or more or less confluent by their broadened bases; leaflets more or less furnished with long bristles, especially on the midrib underneath; secondary spathes coriaceous, entire; fruit spherical, 10 to 12 mm in diameter; secondary spathes smooth..... 11. *C. Merrillii* (forma *typica*).

d^1. Secondary spathes prickly..... *C. Merrillii* var. *Merrittianus.*

d^2. Secondary spathes smooth or nearly so; a smaller plant and with slenderer spikelets than in the species, the fruit also smaller (9 mm in diameter)..... *C. Merrillii* var. *Nanga.*

c^2. Moderately large; leaf-sheaths very densely covered with blackish uniform bristles; leaflets with long bristles on three costae on both surfaces; fruit spherical, 10 to 12 mm in diameter. 12. *C. Foxworthyi.*

b^2. Male and female spadices having sessile spikelets inserted at or near the mouths of their respective spathes.
c^1. Primary spathes elongate and closely sheathing.
d^1. Fruit containing three seeds.
e^1. Robust; leaflets large, subequidistant, lanceolate, long-acuminate, plicate-pluricostulate; spikelets thickish, as much as 15 to 16 cm long; fruit spherical, 14 to 17 mm in diameter. 13. *C. manillensis.*
e^2. A smaller plant; leaflets broadly lanceolate, shortly acuminate, subequidistant in the full-grown plant, in pairs on each side of the rachis in young plants; fruit obovoid, conspicuously beaked ..... 14. *C. trispermus.*
d^2. Fruit 1-seeded.
e^1. Leaflets equidistant or nearly so.
f^1. Leaflets broadly lanceolate, pluricostulate.
g^1. Two female flowers at every spathel with a neuter one interposed between the two.
h^1. Female spadix very dense and with short branches; spikelets short and with few flowers; female flowers relatively large, 6 mm long; immature fruits fusiform; fruiting perianth campanulate ..... 15. *C. Arugda.*
h^2. Female spadix very diffusely branched; spikelets elongate and with numerous flowers; fruit globose-ovoid; fruiting perianth shortly pedicelliform..... 16. *C. vinosus.*
g^2. One female flower only at each spathel, with a neuter flower at its side.
h^1. Fruit small, pisiform; seed pitted, the albumen equable or nearly so.
i^1. Leaflets narrowly elliptic-lanceolate, equally narrowed at both ends, more or less spinulose on some nerves above, smooth underneath; fruit 8 to 9 mm in diameter, having squarrose scales in twelve longitudinal series ..... 17. *C. Moseleyanus.*
i^2. Leaflets lanceolate, acuminate, more or less spinulous on some nerves above, smooth underneath; fruit 6.5 mm in diameter, having appressed scales in 18 to 20 longitudinal series ..... 18. *C. mindorensis.*
i^3. Leaflets lanceolate, very long-acuminate without bristles or spines on either surface; fruit globose-ovoid, 6 mm in diameter, shortly conical-ovoid, and having squarrose scales; leaf-sheaths quite unarmed. 19. *C. multinervis.*
h^2. Fruit rather large; seed with a deeply ruminated albumen.
i^1. Leaflets large, broadly lanceolate, 40 to 42 cm long, 4 to 4.5 cm wide, pluricostulate and with the nerves smooth on both surfaces; fruit spherical, 2 cm in diameter ..... 20. *C. grandifolius.*
i^2. Leaflets 5-costulate, elliptic-lanceolate, 22 to 25 cm long, 30 to 32 mm wide, with the nerves smooth on both surfaces; fruit ovoid-ellipsoid, conspicuously beaked, 25 mm long, 18 mm thick. 21. *C. Jenningsianus.*

f^2. Leaflets very narrowly lanceolate, 3-costulate; leaflets more or less bristly-spinulous on three nerves above and smooth underneath; fructiferous spikelets curved-scorpioid; fruit spherical, shortly and obtusely beaked, 12 to 13 mm in diameter; albumen deeply ruminated; leaf-sheaths armed with scattered spines ..... 22. *C. Samian.*

e^2. Leaflets conspicuously inequidistant.

f^1. Leaflets more or less distinctly geminate on each side of the rachis, 5-pluricostulate, oblong or lanceolate, the leaflets of each pair parallel, that is, not approximate by their bases and not divaricating; fruiting perianth pedicelliform, the fruit itself furnished with a short, pedicelliform or necklike involucrophore.

g^1. Robust; leaflets very large, pluricostulate oblong-spathulate with smooth nerves on both surfaces; 35 to 45 cm long, 6 to 10 cm wide; fruit spherical, 13 mm in diameter; leaf-sheaths unarmed ..... 23. *C. megaphyllus.*

g^2. Rather slender; leaf-sheaths armed with slender spines; leaflets elliptic-lanceolate or oblanceolate, 15 to 25 cm long, 3 to 6.5 cm wide, with five slender costae almost smooth on both surfaces..... 24. *C. Elmerianus.*

g^3. Slender; leaf-sheaths unarmed; leaflets oblanceolate-elliptic or oblong-spathulate, 20 to 24 cm long, 5 to 6.5 cm wide, smooth on both surfaces; fruit globose, 9 to 10 mm in diameter..... 25. *C. mitis.*

f^2. Leaflets 5-costulate, those of each pair very approximate by their bases and divaricate; female spikelets having the involucrophorum (where known) not the least pedicelliform or necklike, but immersed within its spathel.

g^1. Of medium size; leaf-sheaths strongly spinous; leaflets elliptic-lanceolate, 22 to 25 cm long, 6 to 6.5 cm wide, very frequently furnished with one or two rigid spines on the midrib above near the base, otherwise smooth on both surfaces; fruiting perianth obconical, almost spreading ..... 26. *C. Reyesianus.*

g^2. Slender; leaf-sheaths smooth or very sparingly spinulous; leaflets elliptic-lanceolate, 10 to 16 cm long, 2 to 3.5 cm wide, usually furnished with a few erect needlelike spines on some of the five costae on the upper surface and on the margins or else entirely smooth; fruiting perianth almost explanate; fruit spherical, 10 to 11 mm in diameter..... 27. *C. spinifolius.*

g^3. Leaf-sheaths 2.5 cm in diameter, armed with short spines; leaflets deep green and smooth when dry, almost equally shiny on both surfaces, lanceolate-elliptic, quite devoid of hairs or spinules even at the apex and on the margins, occasionally furnished above with a robust spinule on the midrib near the base; male spikelets flattened-pectinate, with contiguous flowers and very approximate bracteiform spathels..... 28. *C. viridissimus.*

f^3. Leaflets in distant groups; the latter composed of more than two leaflets on each side of the rachis; leaf-rachis smooth.

g^1. Slender; leaf-rachis smooth above; leaflets in groups of 2 to 4 on each side of the rachis, lanceolate, very long-acuminate to a filiform tip, 3- sub 5-costulate, 20 to 30 cm long, 15 to 20 cm wide; female spadix very diffusely paniculate; spikelets filiform; fruit very small, spherical, 5 mm in diameter..... 29. *C. microsphaerion.*

h^1. Leaf-sheaths unarmed; leaflets glabrous on both surfaces. *C. microsphaerion* (forma *typica*).

h^2. Leaf-sheaths strongly armed with short spines; leaflets slightly bristly-spinulous on one to three nerves on the upper surface..... *C. microsphaerion* var. *spinosior.*

g^2. Rather slender; leaflets in distant groups of 3 to 9 on each side of the rachis, linear, 1-, sub 3-costulate, smooth on both surfaces, 20 to 25 cm long, 1 cm wide; female spadix very diffuse and much branched; spikelets filiform; fruiting perianth shortly pedicelliform; fruit very small, globose..... 30. *C. ramulosus.*

f^4. Leaflets very inequidistant, yet not distinctly grouped on each side of the rachis, the latter strongly prickly above, at least in its lower portion; leaflets elongate, linear-lanceolate, rigid, 3-costulate, more or less spinuliferous on the upper surface, smooth underneath, 30 to 32 cm long, 20 to 25 mm wide; leaf-sheaths about 2 cm in diameter, armed with scattered, pale, acicular spines; male and female spadices shorter than the leaves, simply and spreadingly branched..... 31. *C. Vidalianus.*

c^2. Primary spathes very loosely sheathing, usually short, and more or less inflated in their upper part. The species of this group are difficult to discriminate if the specimens are not with mature fruits; the male spadices alone do not offer appreciable characters for specific distinction.

d^1. Fruit very small, having convex scales, the latter only slightly or not at all grooved along the center and with the points not appressed or subsquarrose.

e^1. Leaf-sheaths armed with scattered slender spines or almost smooth; fruiting perianth pedicelliform, terete.

f^1. Leaf-sheaths armed with scattered slender spines; primary spathes aculeolate; fruit ovoid or subobovoid, 6 mm long, 3.5 to 4 mm thick, the scales arranged in fifteen longitudinal series..... 32. *C. siphonospathus* (forma *typica*).

f^2. Leaf-sheaths almost spineless; primary spathes smooth; fruit with scales arranged in fifteen longitudinal series. *C. siphonospathus* var. *sublaevis.*

f^3. Fruit with scales in twelve longitudinal series; leaflets with five bristly nerves on the upper surface. *C. siphonospathus* var. *oligolepis major.*

f^4. Smaller; fruit with scales in twelve longitudinal series; leaflets with three bristly nerves on the upper surface. *C. siphonospathus* var. *oligolepis minor.*

f^5. Primary spathes aculeolate; fruit with scales in eighteen longitudinal series..... *C. siphonospathus* var. *polylepis.*

f^6. Primary spathes very slightly inflated; fruit elongate-ellipsoid, 10 to 11 mm long (including the perianth), 5 mm thick; scales in fourteen or fifteen longitudinal series. *C. siphonospathus* var. *batanensis.*

e^2. Leaf-sheaths very densely armed, at least in their upper part, with ascending unequal spines.

f^1. Leaf-sheaths armed with elongate, ascending, very narrowly laminar spines; the elongate ligula densely armed with similar spines; petiole and rachis armed irregularly with unequal spines; leaflets with rigid bristles on the midrib alone above, smooth underneath; margins conspicuously spinulous-ciliate; fruit small, ovoid-ellipsoid, 8 to 9 mm long, 5 mm thick; fruiting perianth campanulate, subpedicelliform..... 33. *C. dimorphacanthus* (forma *typica*).

g^1. Leaf-sheaths armed with unequal long spines, some of which are very slender and criniform, others laminar; the very elongate ocrea is also armed with similar spines; leaflets with rigid bristles on three nerves above and smooth underneath; margins closely and finely ciliate-spinulous. *C. dimorphacanthus* var. *montalbanicus.*

g^2. Leaf-sheaths very densely armed, in their upper part mostly, with very rigid subcriniform spines; leaflets very rigid, furnished on the upper surface with distant coarse bristles on the midrib alone, the lower surface smooth, margins coarsely spinulous; fruit larger than in the species, globose, 13 mm long, 10 mm thick; supported by the short terete pedicelliform perianth. *C. dimorphacanthus* var. *zambalensis.*

d^2. Fruit covered by strongly gibbous scales, very deeply grooved along the center, and with very appressed points.

e^1. Fruit ovoid or subglobose-ovoid, 8 to 12 mm long, including the short, terete, supporting perianth, and 5 to 8 mm thick, obtusely beaked.

f^1. Leaflets numerous, elongate, 10 to 15 mm wide; leaves with subequidistant leaflets, at least in their lower part, and more or less grooved above. 34. *C. microcarpus* (forma *typica*).

f^2. Very slender; leaflets very narrow, not numerous, and very inequidistant; spadix small..*C. microcarpus* var. *diminutus.*

e^2. Fruit ovoid or subovoid, minutely beaked, 17 mm long, including the short, terete, pedicelliform perianth, and 12 mm through ..... 35. *C. halconensis.*

c^3. The primary spathes at first enveloping the partial inflorescences, then splitting longitudinally and opening flat, becoming laminar and finally falling in decay; leaflets conspicuously discolorous, green above and with a chalky coating underneath; fruit small, ovoid or globose-ovoid, 8 to 9 mm long, including the short, terete, pedicelliform perianth, and 5 mm thick ..... 36. *C. bicolor.*

PLATE XV. CARYOTA RUMPHIANA (PUGAHAN).

Genus **CARYOTA** Linnaeus

(Plates XV-XVII)

Species of the genus *Caryota*, the so-called fish-tail palms, are decidedly ornamental, and are well characterized by their bipinnate leaves, their peculiar, inequilateral leaflets, which are toothed on the upper margins, and by their axillary, pendulous inflorescences. Some species of *Caryota* send up shoots from the base of the trunk, but in the Philippines only a single species has this characteristic. When the palm reaches full size, it sends out a flowering shoot from the axil of the uppermost leaf and then produces successive shoots in the lower axils until the tree is exhausted and dies. There are five species known from the Philippines.

Conspectus of the species.

a^1. Large trees. Stem tall, solitary. Fruit 1- or 2-seeded. Fruiting perianth 10 to 11 mm in diameter. Male flowers large, 15 to 17 mm long, with numerous stamens.

b^1. Leaflets of the full-grown plant long and narrow, having the upper margin at times very obsoletely, yet at times rather sharply, and very unequally toothed, and the lower margin much produced into a taillike point. Male flowers with 40 to 60 stamens. Stem up to 30 to 40 cm in diameter..... 1. *C. Rumphiana* var. *philippinensis.*

b^2. Leaflets having the upper margin deeply and acutely toothed, the teeth long, narrow, acuminate, and very close together. Male flowers with 27 to 30 stamens. A smaller plant than var. *philippinensis.* *C. Rumphiana* var. *oxyodonta.*

a^2. Of medium size. Fruit always 1-seeded. Male flowers (where known) small and with few stamens.

b^1. Stem solitary. Male flowers with 6 to 9 stamens only.

c^1. Trunk 5 to 8 m high, 10 to 20 cm in diameter. Leaflets erect-spreading, dimidiate-rhomboidal. Male flowers 6 to 7 mm long, with 9 stamens. Fruiting perianth 6 to 7 mm in diameter. Fruit 12 to 17 mm in diameter, spherical. Seed with a chestnut-brown polished surface. Branches of the spadix strongly hairy-scurfy ..... 2. *C. Cumingii.*

c^2. Leaflets very spreading or horizontal, frequently opposite, very sharply toothed. Male flowers * * *. Fruit spherical, 12 mm in diameter. Seed nearly spherical, 8 to 9 mm in diameter, with a black, even, and polished surface..... 3. *C. Merrillii.*

c^3. Leaflets ascending, very narrow and very deeply and sharply toothed. Male flowers having 6 stamens only. Fruit 11 to 12 mm in diameter. Seed slightly broader than high, 9 mm broad, of a shiny chestnut-brown color, the surface slightly grooved. 4. *C. majestica.*

b^2. Soboliferous or with stems in clusters, about 4 m high and 10 cm in diameter. Male flowers 8 to 12 mm long, with 12 to 16 stamens. Fruit 15 to 16 mm in diameter, frequently broader than high. Fruiting perianth 8.5 to 9 mm in diameter..... 5. *C. mitis.*

PLATE XVI. INFLORESENCE OF CARYOTA RUMPHIANA (PUGAHAN).

CARYOTA CUMINGII Lodd. PUGÁHAN OR FISH-TAIL PALM.

Local names: *Báhi* (Mandaya); *hágol* (Bikol); *patíkan* (Bisaya); *pugúhan* (Manobo); *pola* (Bagobo); *pugáhan, tagípan* (Tagalog).

This palm is widely distributed in the Philippines. It is usually about 6 meters in height and 20 centimeters in diameter, with spreading alternate leaves scattered along a considerable portion of the upper part of the rather slender trunk. A kind of sago is sometimes secured from this palm by the method used in obtaining sago from the buri, sugar palm, and the true sago palm. *Caryota* is, however, apparently less utilized for its starch than are the other palms just mentioned. This and other species of the genus are occasionally used as a source of túba or palm wine. It is claimed that this tuba has a rather unpleasant odor and flavor, for which reason it is gathered only when the more desirable palms are not available. The fruits are globose, small in size, and with a single seed. The pulpy outer covering contains very numerous, stinging, needle-like crystals or rhaphides. Blanco states that the mature seeds are sometimes used by the Filipinos as a substitute for the *Areca* fruit for chewing. The lower parts of the petiole furnish a soft, rather flossy fiber similar to that obtained from the sugar palm (*Arenga pinnata*). The two fibers are called by the same name, barok, and are used for the same purposes, that is, as tinder, for caulking boats, and formerly, according to Delgado, for stuffing pillows. Splints cut from the petioles are used in making baskets. This palm, like all other representatives of the genus, is very attractive and is quite commonly cultivated for ornamental purposes. It is possible that some of our species might be relatively as valuable as the toddy palm of India (*Caryota urens* Linn.) which is extensively used as a source of starch, tuba, alcohol, and sugar, although none of the Philippine species are thus utilized to any great extent.

Among the other species of the genus reported from the Philippines is *Caryota mitis* Lour., which has recently been found in Palawan and which is now occasionally cultivated in Manila for ornamental purposes. This is a slender palm, and the only representative of the genus in the Philippines which sends up shoots from the base of the trunk. *Caryota rumphiana* Mart. is a magnificent species much larger in every way than *Caryota cumingii,* and is planted in Manila for ornamental purposes. *Caryota merrillii* Becc. is apparently closely allied to *Caryota cumingii,* and *Caryota majestica* Lodd. to *Caryota rumphiana.* The various species do not appear to have specific local names, but are all designated by names quoted under *Caryota cumingii.*

PLATE XVII. LEAF OF CARYOTA RUMPHIANA (PUGAHAN).

The buds (úbud) of all the species are edible. The outer part of the trunk of most of them is split and made into very durable slat flooring.

Genus **COCOS** Linnaeus

With the exception of the recently introduced *Cocos plumosa* Hook. that is now cultivated to some extent for ornamental purposes in Manila, this genus is represented in the Philippines by a single species, the common coconut palm.

COCOS NUCIFERA L. (Plates I, XVIII–XXIII). COCONUT PALM.

Local names: *Coco* or *cocotero* (Spanish); *giragara* (Zamboanga); *lóbi* or *lúbi* (Pampanga, Bisaya); *niog* or *niug* (Ibanak, Iloko, Pampanga, Tagalog, Bikol, Bisaya); *ñgotñgót* (Zambales); *oñgót* (Cagayan); *punlaing* (Basilan).

This palm is the most abundant, most universally distributed. and from an economic standpoint by far the most valuable in the Philippines, and for that matter the most important of the commercial palms of the entire world. It is cultivated in most parts of the Philippines; and, where favorable conditions are found, thrives equally well on the seashore and inland up to altitudes of about 700 meters, and in some regions up to 1,500 meters. The palm can not successfully withstand a long dry season, such as is found in the region about Manila Bay, Luzon, but thrives best in those regions where the rainfall is more or less distributed throughout the entire year, especially on slopes where moving ground water is constantly available. In the Archipelago larger areas are devoted to its cultivation than in any other similar part of the world.

Cocos Nucifera is not a native of the Archipelago, but was apparently introduced during the prehistoric period. It is never found wild in the Philippines.

The coconut palm has a multitude of uses, in number and importance probably not exceeded by any other palm. It yields timber; food; fermented and unfermented drinks; alcohol; vinegar; thatching material; splints; strips and fiber for making baskets, mats, rope, hats, brushes, brooms, etc.; fuel; caulking material; utensils for household use, such as cups, bowls, spoons, etc.; oil for food, cooking, illumination, for making soap, substitutes for butter and lard, ointments; and oil cake for feeding domestic animals and for fertilizer. The bud makes an excellent salad. The palm is very ornamental and is frequently planted for decorative effect. The fresh leaves are extensively used for temporary decorations, and large numbers

PLATE XVIII. COCONUT PALM IN FRUIT, MINDANAO.

PLATE XIX. COCONUT PLANTATION IN THE PHILIPPINES.

PLATE XX. COCONUT GROVE WITH BAMBOO POLES IN TREES FOR GATHERING TUBA.

of prepared young leaves are used for religious purposes on Palm Sunday. The leaflets are used for wrapping a rice confection known as suman, as described under *Corypha elata*. While the most valuable crop in the Philippines is rice, the coconut and abaká (Manila hemp) compete for second place.

The most important product of the coconut palm is coconut oil, which is obtained by pressing the kernels. Formerly the dried kernels, known as copra, were exported from the Philippines, but recently a number of factories have been established, and it seems that in the future the oil rather than the copra will be exported. The pressed cake is valuable as a food for stock or as a fertilizer. With the present high price of fuel in the Philippines it has been used to a considerable extent as fuel. The oil is used extensively for the manufacture of food products and soap.

The shells of the coconut make a very high grade of charcoal widely used for gas-masks. In 1918 the United States military authorities had an extensive organization for securing large quantities of this charcoal in the Philippines. Locally these shells have been much used as fuel for drying copra.

In the internal commerce of the Philippines the most important product of the coconut palm, after the fruit and the derived products, food, copra, and oil, is the fermented sap or túba and the alcohol distilled from it. A large number of palms are devoted entirely to the tuba industry. The general method of tapping the coconut palm in the Philippines for the production of tuba is as follows: The unopened inflorescences are selected and are bent downward slowly and gradually, this operation being repeated several times a day for one or two weeks. The tip of the inflorescence, including the tip of the spathe and the branches of the inflorescence, is then cut off with a sharp knife. In general practice the spathe is not removed, and the whole inflorescence may or may not be bound with string; the wounded end of the inflorescence may or may not be bruised to stimulate the flow of sap, but usually the cutting alone is relied upon to produce the flow. When the flow of sap commences, a bamboo receiver (bamboo joint) is placed in position to catch and retain the sap, as with the nipa, buri, and sugar palms. A thin slice is removed from the wounded end of the inflorescence twice each day to ensure a continued flow.

The average daily yield of sap from properly managed trees was found by Gibbs * to be about 1.4 liters, and it is estimated

* Philippine Journal of Science, Section A, Vol. 6 (1911), page 157.

PLATE XXI. COCONUT TREE TAPPED FOR SAP.

that the general annual average per tree under good conditions is about 400 liters. Gibbs says that fresh sap probably contains about 16.5 per cent sucrose. As with other palm saps, fermentation commences almost as soon as the sap drips from the wounded inflorescence. The partly fermented sap, or tuba as it is locally known, is extensively utilized by the Filipinos as a beverage. In many parts of the Philippines, an extensive industry has grown up in the fermentation of tuba and the distillation of its alcohol content, this product being known in the Philippines as *álak, árak,* or *bino* (the last a corruption of Spanish *"vino"*). Some idea of the extent of the industry may be gained from the fact that in the year 1910 a total of nearly 700,000 pesos in internal revenue was collected on alcohol from this source, and the production of coconut-tuba alcohol presents a steady annual increase.

If acidic fermentation be allowed to follow alcoholic fermentation in coconut tuba, the result will be vinegar, which is said to be of good quality. Care must be taken, however, to prevent putrefaction of the sap, to guard against which some bark rich in tannin is usually added to tuba destined for the manufacture of vinegar. Coconut-tuba vinegar is manufactured in the Philippines only to a limited extent for local use.

As with the sweet, unfermented saps of the buri, nipa, and sugar palms, fresh coconut-palm sap can be evaporated to a syrup or sugar. Sugar, however, is but rarely, if at all, manufactured in the Philippines from the coconut-palm sap. In gathering the sap for this purpose, fermentation must be prevented or inhibited, as in other palm saps.

Locally, large quantities of the nuts are utilized for food and for extracting oil for domestic purposes. The unripe as well as the mature fruits are utilized in various ways for food.

Some trees produce abnormal fruits, known as makapunó (from Tagalog *punó* = full). In these the whole interior of the nut is occupied by a soft, rather firm tissue quite different in texture from the hard flesh of normal nuts. These abnormal fruits are produced on the same tree with normal ones, and will not germinate. Only a small percentage of coconut trees in a given area will produce the makapunó nuts, which are valued as a delicacy and which command a much higher price than the normal fruits, often selling at a price ten times as great as the latter.

A commercial product of the coconut that is but slightly utilized in the Philippines is the fiber prepared from the husk

Fig. 1. Coconut palm with inflorescences cut and bound to be inserted in bamboo joint for collecting tuba.

Fig. 2. Coconut palm with bamboo tube for collecting tuba attached to inflorescence stalk.
PLATE XXII.

or pericarp. This is commercially known as coir. It is variously employed for making bags, mattings, door mats, and for stuffing cushions, especially carriage cushions. In many parts of the Indo-Malayan region and Polynesia, coir is an important source of cordage for local use. One of its chief local uses is for caulking boats. Coir is also locally used for making a thatch-like raincoat much used by both Filipino and Chinese teamsters. There is no record that it enters into the external commerce of the Archipelago.

The leaves are utilized in various ways in the Philippines. The leaflets are sometimes used to thatch houses, for making hats, coarse baskets, mats, etc., but are much less durable for these purposes than the leaflets of some other palms. The midribs of the leaflets are commonly used for making coarse brooms and certain types of baskets and trays. Splints prepared from the outer part of the leafstalk are used in making baskets.

Genus COELOCOCCUS Wendland

COELOCOCCUS AMICARUM Wendl. POLYNESIAN IVORY-NUT PALM.

The ivory-nut palm is a native of the Caroline Islands, and was introduced into Guam and the Philippines by the Spaniards. The flowering shoots grow from the axils of the leaves. The globose fruits, up to 10 centimeters in diameter, are covered with closely overlapping, hard, shiny, brownish scales. The large seeds are very hard, ivory-like in texture and appearance, and are commercially utilized for making buttons. This species apparently occurs as a widely scattered, cultivated palm in Panay and Zamboanga, in the latter province known as *timbúñgan.*

Genus CORYPHA Linnaeus

CORYPHA ELATA Roxb. (Plates XXIV–XXVIII). BURÍ.

Local names: *Bagátai, táktak* (Ibanag, Nueva Vizcaya); *bulí, burí* (Tagalog, Bisaya, Bikol); *ébus* or *íbus* (Pampanga, Tarlac); *piet* (Nueva Ecija, Pangasinan); *serar* (Bagobo); *sílad* (Bisaya); *sílag* (Iloko, Pangasinan, Tarlac).

This is the largest and most stately palm to be found in the Philippines. Its straight trunk attains a diameter of 1 meter and a height of 20 meters. The species has very large, fan-shaped leaves which are rounded in outline and up to 3 meters in length. The outer part is split into about one hundred narrow segments. The very stout petioles are from 2 to 3 meters long and their margins are armed with very hard, rather large, black teeth. The plant grows 25 to 30 or more years, during which time large quantities of starch collect in the trunk.

PLATE XXIII. RAFTS OF COCONUTS.

It then flowers once and dies, the enormous quantities of stored starch being used up during the short flowering and fruiting period. At maturity the leaves wither and there appears an enormous, pyramidal, terminal, flowering shoot, which may be 7 meters in height.

From an industrial standpoint the buri palm is one of great local importance. A fermented drink or palm wine (tuba), alcohol, vinegar, syrup, and sugar are produced from the sap. The trunk yields large quantities of food material in the form of starch. The buds (ubud) are used for salads or as a vegetable. The kernels of the young fruits are edible and are made into sweetmeats; while Blanco states that the outer covering of the mature fruit is eaten by birds and sometimes by children. The mature seeds are used for beads (rosaries) and buttons. The wood is practically valueless. The leaf is of special importance. The petiole yields the so-called buntál fiber of which the famous Lucban hats are made; or which, when crudely extracted, is sometimes twisted into rope. The mature leaf is used for covering tobacco bales, rarely as a thatch for houses, while the ribs are used for making brooms. From the unopened leaf is obtained a very fine fiber, corresponding to raffia fiber, which is utilized in making cloth, fancy articles, and as string. Fibers secured from the ribs of the unopened leaves are extensively used in the manufacture of the so-called Calasiao or Pototan hats. Strips of the unopened leaf are made into hats, mats, bags, sails, baskets, and other articles.

TABLE III.—*Stand of buri palms (Corypha elata) on five blocks, aggregating 4585 hectares in the Rio Chico region of Luzon. Data from report by Ranger Rola.*

[Plants per block.]

Number of block.	Area of block.	Area surveyed.	Size of plant. (Figures represent number of trees per block).				Total plants on one block.
			Without trunk.			With trunk.	
			Height in meters.				
			Less than 1.	1 to 2.	More than 2.		
	Hectare.	*Hectare.*					
1	1,795	0.5	538,500	721,590	3,532,560	17,950	4,810,600
2	386	1.2	32,810	38,600	203,422	386	275,218
3	1,109	0.5	166,350	609,950	1,137,834	4,436	1,918,570
4	919	0.3	218,722	183,800	904,296	----------	1,306,818
5	376	0.4	151,152	151,152	590,320	1,880	894,504
Total	4,585	2.9	1,107,534	1,705,092	6,368,432	24,652	9,205,710

PLATE XXIV. CORYPHA ELATA (BURI) AND TWO SPECIMENS OF CARYOTA (PUGAHAN).

TABLE III.—*Stand of buri palms (Corypha elata) etc.*—Continued.

[Plants per hectare.]

Number of block.	Area of block.	Area surveyed.	Size of plant. (Figures represent number of trees per hectare).				Total plants on one hectare.
			Without trunk.			With trunk.	
			Height in meters.				
			Less than 1.	1 to 2.	More than 2.		
	Hectare.	*Hectare.*					
1	1,795	0.5	300	402	1,968	10	2,680
2	386	1.2	85	100	527	1	713
3	1,109	0.5	150	550	1,026	4	1,730
4	919	0.3	238	200	984	------	1,422
5	376	0.4	402	402	1,570	5	2,379
Average	------	------	235	331	1,215	4	1,785

Among Philippine palms, the buri ranks next to the coconut and nipa palm in economic importance, yet in few parts of the Archipelago is it fully utilized. It does not supply material of any special export value except the buntál and Calasiao hats.

This palm is widely distributed in the Philippines at low and medium altitudes, extending from northern Luzon to southern Mindanao, Palawan, and the Sulu Archipelago. In some regions it appears as a widely scattered palm, and is occasionally planted. In other regions it is exceedingly abundant, gregarious, and locally the dominant species. Mr. Franks * reports approximately 2,000,000 trees on an area of 5,000 hectares in Mindoro, of which about 12 per cent were mature. The island of Burias is said to take its name from this palm. Ranger Rola has made valuation surveys in a buri forest covering approximately 5,000 hectares in the Rio Chico region, Pampanga Province, Luzon. The surveys were made on five different blocks. The results are given in Table III. These five blocks covered a total area of 4,585 hectares. They contained 9,205,710 buri palms. Most of the plants were over 2 meters in height but without clear trunks. Of such sizes, there were 6,368,432 palms on the area. Buri is especially abundant in the provinces of Pangasinan, Pampanga, Tayabas, Camarines, and Sorsogon in Luzon, and in parts of the islands of Palawan, Mindoro. Panay. Negros. Masbate. Cebu. Bohol, and Mindanao.

* Philippine Craftsman, Volume I (1912), page 194; Philippine Journal of Science, Sec. A, Volume VI (1911), page 168.

PLATE XXV. CORYPHA ELATA (BURI) IN FLOWER.

The buntal fiber, derived from the petiole, is especially valuable and is extensively used in the manufacture of fine hats both for local use and for export. The production of buntal fiber originated in the region about Sariaya, Tayabas Province, Luzon, while the hats are commonly known in the market as Lucban hats, being mostly manufactured in the neighboring town of Lucban. These are the so-called Bangkok hats of the American trade. Now, however, the production of buntal is extending to other regions, and buntal hats are being manufactured in other towns, sometimes from materials locally produced, sometimes from fiber purchased in Sariaya or neighboring towns. Technical Bulletin No. 3 of the Philippine Bureau of Education * gives minute directions for the production of the fiber, for the problem of buntal production is not only one of method of extraction, but also of proper selection of petioles. Buntal is extracted from the petioles of young or immature palms, and apparently the fiber is best obtained from those plants having considerable sap flow. Buntal fiber commands a price of about 4.00 pesos per kilo, which in a country like the Philippines indicates that the cost of extraction is great and that the yield of fiber of the proper length and quality is small.

The material prepared from the unopened leaf of the buri palm is of great local significance; buri strips, which are prepared from the young leaf, being perhaps most important. The coarser strips are used in weaving sacks, coarse mats, and sails, which are sometimes of considerable size; the finer, better prepared ones in manufacturing various grades of hats, mats, and baskets. Hundreds of thousands of sugar sacks made from buri strips and known as bayones, annually convey practically all the sugar exported from the Philippines.

In some towns the manufacture of buri-strip hats for export is an important local industry. These hats are chiefly of low grade and cheap. Buri-strip mat making is an extensive industry wherever the palm grows. The coarse mats serve for packing and baling various materials for export. The finer ones, as the finer hats, are always made from bleached strips. Frequently the strips are dyed different colors and combined to produce various geometric figures.

The unopened leaves are important for another reason. They produce the so-called buri raffia, variously known in the Phil-

* Philippine Craftsman, Volume III (1914), page 45.

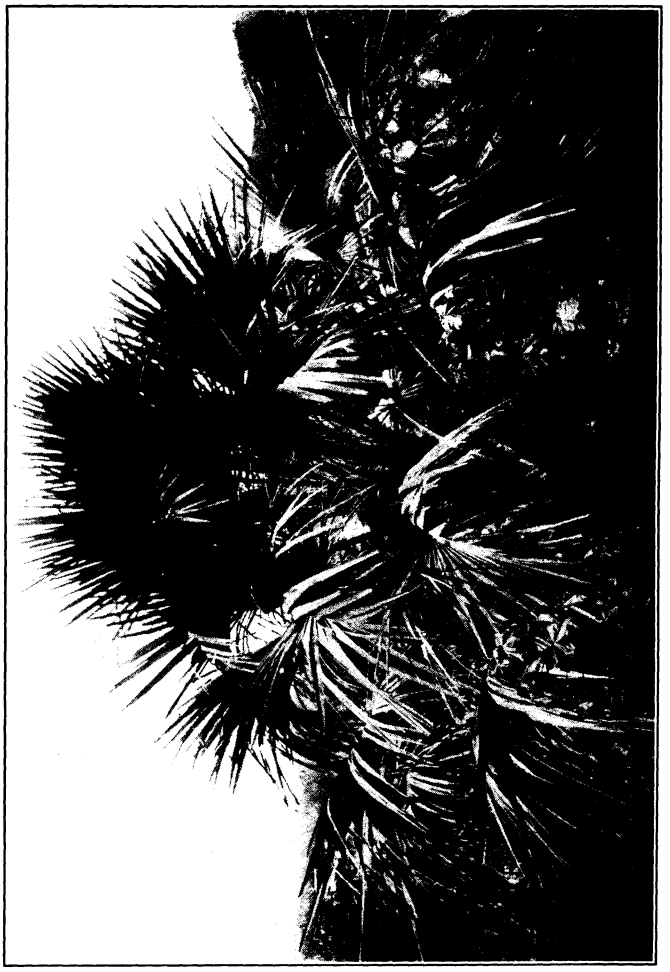


PLATE XXVI. YOUNG SPECIMEN OF CORYPHA ELATA (BURI).

ippines as *sagúran, daet, banló, bayokbók,* and *hubúk* fiber. This fiber is stripped from the outer part of the petiole. The material from the upper surface is stronger than that from the lower, but not so fine in texture. The stripping must be done not only from young, unopened leaves, but also within a short time after the leaves are removed from the palm. This fiber is the same as the *agel* fiber of the Dutch East Indies, that is quite extensively produced in southern Celebes and there commands a price of from 4 to 8 guilders per picul. It is much used there for making fine matting.* This material is now quite widely employed in the industrial work of the Philippine schools for all purposes for which true raffia fiber is used. Comparative tensile-strength tests, made by Saleeby † on raffia fiber from Madagascar and the Philippine product of *Corypha elata,* showed that the true raffia was about 30 per cent stronger than the buri product, but that the latter was superior in color, fineness and lustre. This material was formerly used in many parts of the Philippines for weaving cloth. The cloth varies greatly in fineness, is not especially durable, yet in some parts of the Islands is still used for clothing. The material readily takes colors and is excellent for making cushion covers, screens, bags, coiled baskets, etc.

From the ribs of the unopened leaves important fibers are secured that are used for the manufacture of the Calasiao or Pototan hats; so called from the two towns where this type of hat originated, Calasiao in Pangasinan Province, Luzon, and Pototan in Panay. The ribs are removed from the leaf, graded as to color, split, the softer interior removed, and the halves again split once or twice. The strands thus produced are smoothed, worked down to the required thickness, and are then ready for weaving. Hats made of this material have a well-deserved reputation for appearance and durability. Fine baskets, trays, cigarette cases, etc., are also manufactured from this material. Sometimes the entire ribs are used for making coarse brooms.

In many parts of the Philippines the leafstalks are gathered, thoroughly pounded or crushed, and the vascular strands removed for the purpose of manufacturing cordage. The fibers

* See Heyne, De Nuttige Planten van Nederlandsch-Indië, Volume I (1913), page 41.

† Philippine Agricultural Review, Volume 6 (1913), page 192; Philippine Craftsman, Volume 2 (1913), page 422.

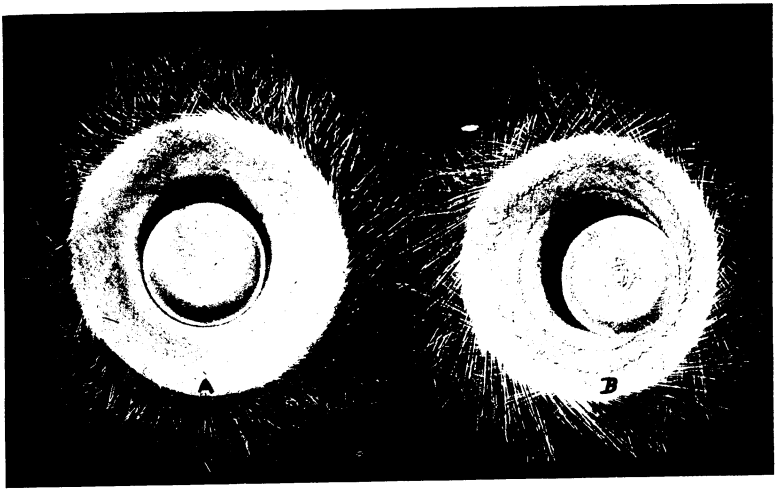


Fig. 1. Outer and inner halves of one Calasiao hat.

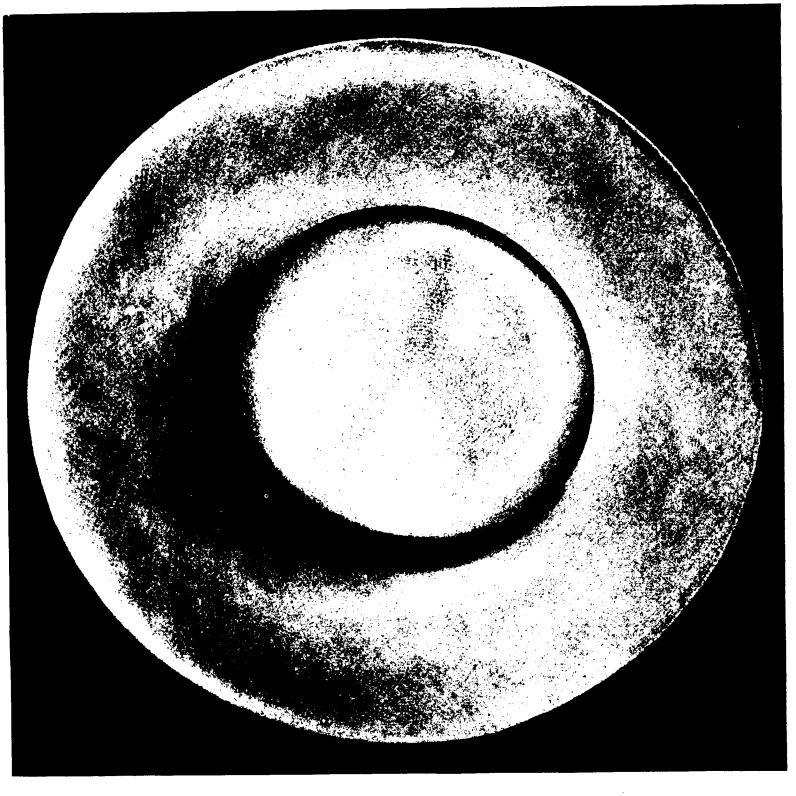


Fig. 2. Completed buri-midrib (Calasiao) hat.

PLATE XXVII.

are twisted into a rope which is extensively used in some parts of the Philippines, notably in Panay.

Strips made from the leaves are used for wrapping a confection of glutinous rice, known as suman. The strips are wrapped in a spiral form around the confection to form a sausage-shaped package. Whole leaves are regularly brought for this purpose to Manila, where suman making is an established industry. In the provinces it is merely a domestic affair.

For a discussion of the various buri fibers and their products see the following:

Miller, H. H., Philippine Hats, Philippine Bureau of Education Bulletin 33, (1910), pages 1 to 60; Robinson, C. B., Philippine Hats, Philippine Journal of Science, Section C, Volume 6 (1911), pages 93 to 131; Muller, T., Industrial Fiber Plants of the Philippines, Bureau of Education Bulletin 49, (1913), pages 73 to 85; Gibbs, H. D., The Alcohol Industry in the Philippine Islands, Part I, Philippine Journal of Science, Section A, Volume 6 (1911), pages 147 to 206; Miller, H. H. and others, Philippine Mats, Philippine Craftsman, Volume I (1912), pages 194 to 203; Parker, L., Philippine Craftsman, Volume 2 (1913), pages 376 to 395.

At present, the production of sugar, alcohol, and starch from the buri palm is only of minor local importance and gives little promise of future development into industries of great magnitude. The subject has been extensively investigated by Gibbs * with the following general results.

The sap is obtained from the buri palm in two ways. Apparently the more usual way is to cut an inflorescence near its base, protecting the cut surface from the sun and rain by a small covering of leaves, and collecting the sap which flows from the cut surface, in small earthen jars. The second method, used in Tayabas and some other provinces, but not known to a great many localities, is employed on trees which have not flowered and which may, indeed, be very far from maturity. The trees are stripped of leaves, the top bound with bamboo hoops 8 to 10 centimeters apart for a distance of about 1 meter, and then cut off so that the heart of the tree is exposed. The surface thus produced is cut and channeled, furnishing a clean tissue which is continually exposed to the air, but protected from the sun by a covering of leaf thatch. In three or four

* Gibbs, H. D., The alcohol industry of the Philippine Islands. Part I. Philippine Journal of Science, Volume 6 (1911), pages 99 to 206.

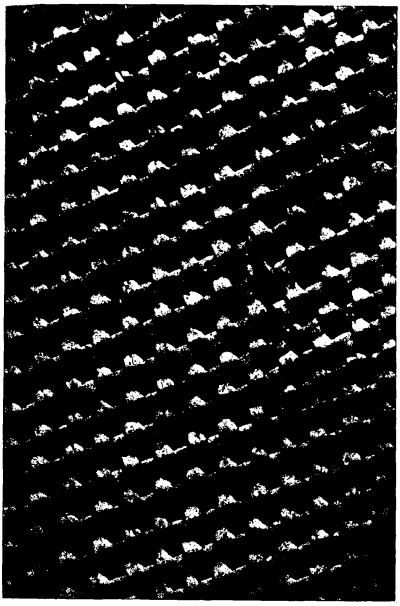


Fig. 1. Buntal (Lukban).

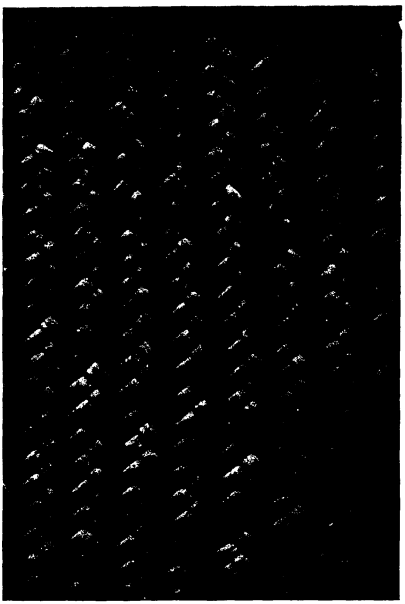


Fig. 2. Buntal (Baliuag).

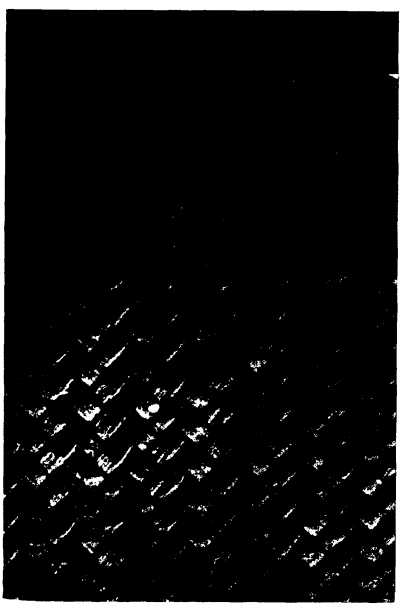


Fig. 3. Calasiao.

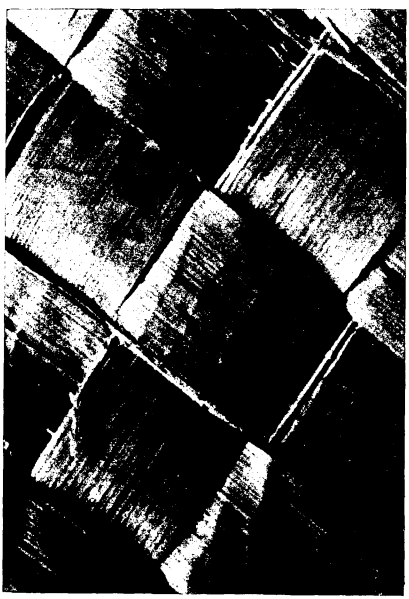


Fig. 4. Buri leaf.

PLATE XXVIII. PORTIONS OF PHILIPPINE HATS MAGNIFIED FOUR DIAMETERS.

days, sometimes one, the sap begins to flow steadily and rapidly. In either case, the tree can of course be tapped but once, and death ensues in a short time. Gibbs observed two trees tapped by the first method. In one case the flow continued for four and one-half and in the other for three and one-half months. An old tree, tapped according to the second method, gave a flow for 132 days. This tree produced a total of 2,699.65 liters of sap or an average daily flow of 20.45 liters. The maximum flow recorded from this tree per day was 45.2 liters. Another tree, about 12 years old, produced sap for 55 days. Fresh cuts should be made at frequent intervals, as the rate of flow may be thus temporarily increased as much as 50 per cent. The rate also varies according to the thickness of the slice removed; at least, if the exudation is from the top of the trunk. Gibbs found that a daily decreasing rate of flow could be changed to

TABLE IV.—*Sugar in total sap flow of the buri palm (Corypha elata).*

Tree number.	Method of tapping.	Estimated age of tree.	Estimated daily flow.	Approximate sugar content.	Daily sugar yield.	Duration of sap flow.	Total sugar yield.
		Years.	*Liters.*	*Per cent.*	*Kilos.*	*Days.*	*Kilos.*
1	Inflorescence cut	30	20	14	2.8	100	280
2	Inflorescence cut	30	30	8	2.4	135	324
3	Stem cut	12	40	9	3.6	50	180

an increasing one by augmenting the thickness of the cuttings. Table IV gives data on the sugar content and yield of sap from three palms.

The fresh sap is too sweet to be palatable as a beverage, but makes a popular cider when fermented.

As it flows from the tree and for a short time after, the sap is colorless, odorless, and neutral or slightly alkaline. After standing, a viscous, followed by a putrid, fermentation develops when no precaution is taken to prevent it. The sucrose begins to invert in a few hours and the process is complete in about thirty hours. A comparatively small yield of alcohol results from the spontaneous fermentation of the sap; a greater portion of the reducing sugars being changed by the viscous, putrid, and other fermentations than by the alcoholic.

Sugar is made from the buri sap, which is boiled in ordinary kettles and sold as a confection. The boiling requires about six hours, after which the kettle is removed from the fire and the contents stirred until the sugar granulates. It is then ladled

out and molded. This is usually done either in coconut shells or small square boxes made from buri leaves. Gibbs reports that sugar of excellent quality, polarizing at 94° to 98°, has been produced in the laboratory of the Bureau of Science by boiling the sap, preserved with lime, in open pans. Although the sap contains a high percentage of sugar and the yield per tree is considerable, Gibbs was not of the opinion that buri sap alone could be successfully employed as a commercial source of sugar. He says, however, that when a large stand of buri occurs in the proximity of a sugar mill it seems entirely feasible to use the sap in connection with sugar-cane juice.

Filipinos make starch from the trunk of the buri. The entire pithy portion of the trunk is cut into strips, dried, and then pounded to separate the starch from the fiber. The fine dust thus obtained is washed in cold water; the starch settles out in the usual way, and is dried. Bacon * obtained a yield of 6 per cent of starch, and on this basis he calculated that from an averaged-sized tree about a hundred kilos of starch could be obtained. The starch is in large grains. According to Bacon, it does not wash white, but always has a decidedly red hue. In view of this fact and of the difficulty in extracting it, he did not think that the buri palm could be utilized commercially for starch.

Genus **DAEMONOROPS** Blume (Plate XXIX).

The species of *Daemonorops,* like those of *Calamus,* are slender, climbing palms (rattans) having the same sylvan habitat, growth-form, general adaptations for climbing, and uses. As a rule, however, the rattan yielded by *Daemonorops* is decidedly inferior to that of *Calamus. Daemonorops* has by some authors been reduced to *Calamus,* and there is no single character that will always distinguish the two genera. However, they can usually be separated by the following characters: In *Daemonorops* the leaf sheaths never produce long whip-like structures; in *Calamus* they often do. In the former the ocrea is very short, in the latter often greatly developed; in the former the upper leaves are always supplied with a whip-like structure, in the latter the flagellum may or may not be present. In *Daemonorops* the spathes are never armed with claws and the panicle is short, while in *Calamus* the lower parts of the spathes are so armed and the spadices are usually greatly elongated.

* Gibbs, H. D., The alcohol industry of the Philippine Islands. Part I. Philippine Journal of Science, Section A, Volume 6 (1911), pages 99 to 206.

Conspectus of the species.

a^1. *Cymbospatha.* Spadix, ♂ and ♀, contracted. Primary spathes cymbiform, beaked, the outermost completely inclosing the inner ones.
1. *D. Margaritae* var. *palawanicus.*

a^2. *Piptospatha.* Spadix, ♂ and ♀, elongated. Inner primary spathes gradually longer than the outermost.

b^1. Leaflets very inequidistant, ensiform, the largest 40 to 50 cm long, 2.5 to 3 cm wide; fruit ovoid-ellipsoidal, 25 mm long, 16 to 17 mm thick, very shortly pedicellate..... 2. *D. virescens.*

b^2. Leaflets equidistant.

c^1. The mouths of the leaf-sheaths unarmed.

d^1. Leaflets lanceolate-ensiform, the largest 30 to 45 cm long, 3 to 3.5 cm wide, the midrib only sparsely bristly below, smooth above or else minutely spinulous near the apex; fruit spherical, mammillate-beaked, 18 to 20 mm in diameter..... 3. *D. ochrolepis.*

d^2. Leaflets less than 3 cm wide, bristly on three to five nerves above.

e^1. Leaflets 30 cm long, 15 to 16 mm wide (the largest), bristly on three nerves above, and on the midrib only underneath; the axis of the spadix and spikelets coated with a rusty-brown scurf; fruit carried on a pedicel 8 to 10 mm long, globose-ovoid, obtusely mammillate-beaked.
4. *D. urdanetanus.*

e^2. Leaflets very narrowly lanceolate, 20 to 23 cm long, 14 to 18 mm wide (the largest), bristly on three nerves above, and with a few long bristles on the midrib only underneath. Male flowers very long and slender (12 mm long).
5. *D. Loherianus.*

e^3. Leaflets 30 cm long, 15 to 20 mm wide (the largest), bristly on five nerves above, but only on the midrib beneath, fruit 12 to 17 mm long, 9 to 11 mm through, ovoid-ellipsoid, carried on a pedicel 4 to 6 mm long..... 6. *D. pedicellaris.*

d^3. Leaflets less than 3 cm wide, having the midrib alone spinulous, on only one or on both surfaces.

e^1. Leaflets 30 to 32 cm long, 2 to 2.5 cm wide (the largest), having the midrib alone spinulous on both surfaces; axis of the spadix and spikelets densely coated with a copious brown felt; fruit ovoid-ellipsoid, blunt-mammillate, carried on a thick, 5 to 6 mm long pedicel..... 7. *D. pannosus.*

e^2. Leaflets 30 to 40 cm long, 2 to 2.5 cm wide (the largest), smooth or nearly so on the upper surface, underneath the midrib alone remotely spinulous; axial parts of the spadix and spikelets coated with adherent rusty-brown scurf; fruit globose and obtusely mammillate, 17 to 18 mm in diameter, with a few well-conformed scales, and carried on a pedicel 10 to 12 mm long..... 8. *D. oligolepis.*

c^2. The mouths of the leaf-sheaths armed with erect spines, longer than those on the body.

d^1. Fruit large, over 2 cm in diameter; leaflets narrowly ensiform, 40 to 42 cm long, 13 to 15 mm broad (the largest), spinulous on three nerves above and bristly on the midrib alone beneath; fruit spherical, 20 to 24 mm in diameter.... 9. *D. Clemensianus.*

d^2. Fruit less than 2 cm in diameter.

PLATE XXIX. DAEMONOROPS MOLLIS (GAUDICHAUDII) (A RATTAN).

e^1. Leaflets linear-ensiform, 35 to 45 cm long, 16 to 24 mm broad (the largest), with three bristly nerves on the upper surface, underneath the midrib alone or, occasionally, also three nerves bristly; partial inflorescences and spikelets spreading; fruit globose, mammillate-beaked, often slightly depressed, 15 to 18 mm in diameter..... 10. *D. Gaudichaudii.*

e^2. Leaflets narrowly ensiform, 55 to 60 cm long, 20 to 22 mm broad (the largest), almost smooth above and with only a few short bristles on the midrib underneath; partial inflorescences and spikelets inserted at a very acute angle; fruit globose, conically beaked, 12 mm in diameter. 11. *D. affinis.*

e^3. Leaflets lanceolate-ensiform, 33 to 40 cm long, 17 to 20 mm broad, bristly on three to five nerves on the upper surface and on the midrib alone underneath; spikelets spreading; fruit globular or shortly ovoid, minutely beaked, 12 mm in diameter..... 12. *D. Curranii.*

e^4. Leaflets linear-lanceolate, 25 to 28 cm long, 12 to 14 mm broad (the largest), sparingly spinulous on three nerves above and underneath with only a few bristles on the midrib from the middle upward; fruit small, broadly ovoid-ellipsoid, 12 mm long, 9 mm thick. A slender plant, sheathed stem 12 to 15 mm in diameter..... 13. *D. gracilis.*

Genus **ELAEIS** Jacquin

ELAEIS GUINEENSIS Jacq. (Plates XXX, XXXI). OIL PALM.

The oil palm, which was introduced into the Philippines some time after the middle of the last century, is grown in Manila and in some of the other larger towns merely for ornamental purposes. It flowers and fruits abundantly in the Philippines, but no part of the palm is utilized by the Filipinos. It is of immense value in tropical West Africa, its original home, and large quantities of oil and kernels are annually sent to Europe. Hubert * states that the annual export of oil and kernels from tropical Africa exceeds in value 40,000,000 dollars. In various parts of Africa, palm wine, corresponding to our tuba from the coconut, nipa, buri, etc., is extracted, either by making incisions in the upper part of the trunks of standing trees; by making small incisions just below the insertion of the fruiting peduncle, or by felling the tree. The yield per tree by the first method varies from 50 to 200 liters; by the other it is said not to exceed 26 gallons. The buds, like those of many different kinds of palms, are edible.

Genus **HETEROSPATHE** Scheffer

This genus is represented by four species all similar in appearance and apparently for the most part closely allied. The

* Hubert, P., Le Palmier á huile, Volume 9 (1911), pages 1 to 314.

PLATE XXX. ELAEIS GUINEENSIS (OIL PALM).

Philippine species are *Heterospathe philippinensis* Becc., *H. negrosensis* Becc., *H. sibuyanensis* Becc., and the extra-Philippine *H. elata* Scheff. The genus is relatively unimportant from an economic standpoint and a consideration of the most common and widely distributed species will suffice.

Conspectus of the species.

a^1. Large trees.

b^1. A tree 8 to 10 m high. Leaflets with strong secondary nerves, the midrib without paleolae underneath. Spadix three times branched, floriferous branches slender. Fruit globular, 7 to 7.5 mm in diameter, excentrically apiculate, the surface granulose from short scattered sclerosomes. Seed spherical ..... 1. *H. elata.*

b^2. A tree as much as 9 m high, 12 cm in diameter. Leaflets having rather distinct secondary nerves, and the midrib furnished underneath with conspicuous brown paleolae. Spadix three times branched; floriferous branches thickish (2.5 mm thick). Fruit ovoid, 1 cm long, 7 mm thick, having the point conical and slightly oblique and the surface shagreened by linear sclerosomes. Seed globose-ovoid, blunt ..... 2. *H. sibuyanensis.*

a^2. Shrubs or small trees.

b^1. Stem slender, 1 to 3 m high, 2 to 3 cm in diameter. The largest leaflets 25 to 30 cm long, 10 to 15 mm broad, secondary nerves faint. Spadix twice branched in its basal part, simply branched above. Fruit ovoid, 10 to 11 mm long, 6 mm thick, very suddenly, and nearly centrally, apiculate, the surface closely shagreened by conspicuous, shortly fusiform sclerosomes. Seed globose-ovoid, blunt. 3. *H. philippinensis.*

b^2. More robust than the preceding, 3 to 5 m high. Stem 4 to 5 cm in diameter. Leaflets 35 to 40 cm long, 2 to 2.5 cm wide, the secondary nerves rather distinct. Spadix twice branched. Fruit ovoid-ellipsoid, narrowing above to a conical, nearly symmetrical point, 9 to 11 mm long, 5 mm thick. Seed ovoid, acute. 4. *H. negrosensis.*

HETEROSPATHE ELATA Scheff. (Plate XXXII). SAGÍSI.

Local names: *Dayumaka* (Cagayan); *sagísi, segísi* (Bisaya); *salanióg* (Bagobo); *tagisé* (Bikol).

This is a tall, slender palm with pinnate leaves 3.5 to 4 meters in length, and long, pendulous, branching, axillary fruit stalks with numerous, small, globose fruits. The palm is widely distributed in the Philippines from Luzon to Mindanao. In the Bisaya islands it is not uncommonly planted about houses, either for ornamental or economic purposes. The small hard seeds are said sometimes to be chewed as a substitute for the Areca seed. The buds of this, and apparently of all the species of the genus, are edible. From the petioles, splints are secured for use in making baskets. In Bohol the leaflets are extensively used in the manufacture of the sun-hats known as salokots.

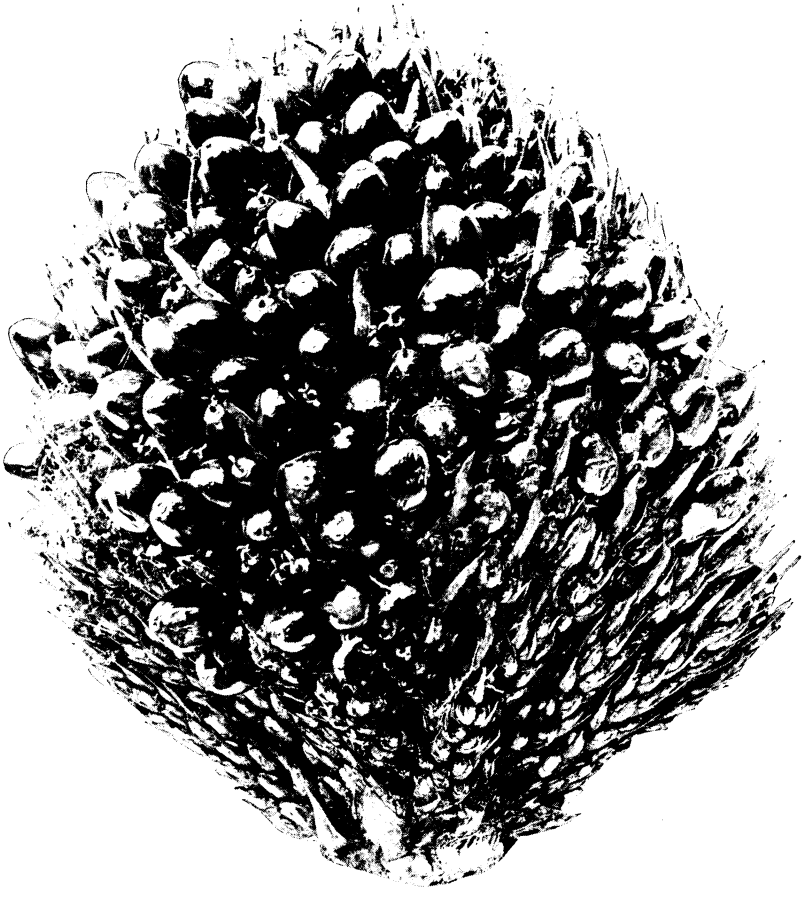


PLATE XXXI. FRUIT OF ELAEIS GUINEENSIS (OIL PALM).

The palm is decidedly ornamental and is worthy of more extended cultivation for this reason.

Heterospathe negrosensis is known in Visayan as salúai and *Heterospathe sibuyanensis* as bilis.

Genus KORTHALSIA Blume

This genus is represented in the Philippines by four known species. It is closely allied to *Calamus* and *Daemonorops,* but is readily distinguishable by its inflorescence and its broad, wedge-shaped leaflets which are usually whitish beneath. Like *Calamus* and *Daemonorops,* our species of *Korthalsia* are climbing palms. They are invariably sylvan. The stems are of indefinite length and of the same diameter throughout. These palms are of some biological interest from the fact that the more or less inflated sheaths are always inhabited by colonies of ants. In general the stems of *Korthalsia* may be used for the same purposes as those of *Daemonorops* and *Calamus,* but no special use is recorded for any of the Philippine forms.

Conspectus of the species.

a^1. Spikes amentiform with very closely crowded flowers and appressed spathels.

b^1. Leaf-sheaths produced at the base of the petioles into an inflated elongate-elliptic ocrea; leaflets more or less nearly white underneath ..... 1. *K. scaphigeroides.*

b^2. Leaf-sheaths produced at the bases of the petioles into a closely sheathing, densely spinous ocrea.

c^1. Slender; leaflets of the upper part of the fertile plant small, rhomboidal, green on both surfaces or slightly paler beneath than above..... 2. *K. Merrillii.*

c^2. Robust; leaflets large, cuneate-rhomboidal or trapezoidal, sharply double-toothed, paler beneath than above..... 3. *K. laciniosa.*

a^2. Spikes of squarrose appearance, the spathes scarious and not appressed; leaves furnished with an elongate, cornet-shaped ocrea which is truncate at the apex; leaflets cuneately rhomboidal, white underneath ..... 4. *K. squarrosa.*

Genus LICUALA Thunberg

LICUALA SPINOSA Wurmb. (Plate XXXIII). BALATBÁT.

Local names: *Balatbát* (Bisaya); *ugsáng* (Balabac, Palawan, Moro).

This is the only representative of the genus found in the Philippines and no special economic uses are recorded for it. It is found near the sea in Palawan and in the Calamianes Islands, sometimes growing immediately back of the mangrove and within the influence of salt water, sometimes on banks and in ravines near the sea. The palm is of small size, has fan-shaped leaves, and is decidedly ornamental. It is now being grown considerably in Manila for ornamental purposes.

PLATE XXXII. HETEROSPATHE ELATA (SAGISI).

Genus LIVISTONA Linnaeus

All of our palms of this genus are tall, graceful species, with fan-shaped leaves; pendulous, axillary inflorescences; rather small, globose fruits, and decidedly hard wood. Several of the species are cultivated for ornamental purposes.

Conspectus of the species.

a^1. Leaves irregularly parted into primary 2- to 6-costulate segments; secondary segments 1-costulate, very deeply parted into two very long flaccid laciniae. Petiole armed, especially in its lower portion, with very robust spines. Flowers sessile and in small groups on the branchlets. Fruit globose or very slightly reniform, bluish even when dry, 11 to 15 mm in diameter..... 1. *L. cochinchinensis.*

a^2. Leaves entire in their central part, and with the periphery more or less deeply divided into always unicostulate segments. Flowers solitary, spirally inserted around the branchlets.

b^1. Flowers relatively large, 4 to 4.5 mm long. Leaves of adult plants having unarmed or, at times, slightly spinose petioles. The dry mature fruit spherical, 22 to 23 mm in diameter, with a very dark brown polished surface. The young fruits are slightly oblong and narrow a little toward the base..... 2. *L. Merrillii.*

b^2. Flowers very small, at most 2 mm in diameter.

c^1. Petioles of the adult plant spinose in their basal part, unarmed elsewhere. Spadix composed of three main inflorescences, free from their bases and all issuing from a common flattened spathe; upper spathes very tightly sheathing throughout, truncate at the mouth, and, as are all the other parts of the spadix, reddish-brown when dry. Fruit spherical even when young, dark-violaceous when fresh, quite black when dry..... 3. *L. rotundifolia.*

Forma *typica* (not yet found growing in the Philippines) is especially characterized by the seed having the intrusion of the raphe penetrating only two-thirds of the albumen.

d^1. Fruit 2 cm in diameter. Seed traversed completely from base to apex by the intrusion of the raphe. Leaves of very young plants having the petioles armed, in their basal part, with conspicuous spines, as much as 15 to 20 mm in length, the leaves of adult plants with the central segments shortly bifid.

L. rotundifolia Mart. var. *luzonensis.*

d^2. Fruit 12 to 15 mm in diameter, the kernel alone 10 to 13 mm in diameter. Seed 8 to 10 mm in diameter, more or less traversed by the intrusion of the raphe. Central segments of the adult leaves shortly bifid at their apices.

L. rotundifolia var. *microcarpa.*

d^3. Fruit of medium size. Central segments of the adult leaves parted into two 15 to 20 cm long laciniae.

L. rotundifolia var. *mindorensis.*

c^2. Petioles of leaves in the adult plant unarmed, at least in their upper part; in young plants armed with very small spines. The mature fruit yellowish orange when fresh, yellowish brown when dry. Spathes straw-colored, slashed at the mouth.

4. *L. Robinsoniana.*

PLATE XXXIII. LICUALA SPINOSA (BALATBAT).

LIVISTONA COCHINCHINENSIS Becc. (Plate XXXV). TARÁU.

Livistona cochinchinensis is a palm reaching a height of about 20 meters and a diameter of about 20 centimeters. This species grows gregariously in large numbers in open places in the Cagayan valley. The trunks and leaves are employed for much the same purposes as are those of *Livistona rotundifolia.*

The leaves are used for making a peculiar type of broom. The young leaves, while still closed, are cut off with the whole petiole attached. The thin part of the blade is then removed, leaving the ribs attached to the petiole. Six or eight of these leaves are then tied together, making a long-fibered, very flexible broom, about 1.5 meters long.

LIVISTONA ROTUNDIFOLIA (Lam.) Mart. (Plate XXXVI). ANÁHAU.

Local names: *Abiáng* (Pampanga, Pangasinan); *anáu* (Cagayan, Isabela); *anáau* (Ilocos Norte and Sur); *anáhau* (Manila, Rizal, Laguna, Tayabas, Camarines, Albay, Sorsogon); *bagsáng* (Samar); *báhi* (Samar, Leyte, Antique, Capiz, Iloilo, Cebu, Occidental and Oriental Negros, Bohol); *balák* (Moro); *ballá* (Bagobo); *balláng* (Cagayan); *bulnó* (Bicol); *labíg* (Ilocos Norte and Sur, Pampanga); *lúyong,* (Zambales); *palma brava* (Spanish-Filipino); *pilíg* (Tagalog); *saráu, taráu* (Cagayan); *tíkal* (Tagalog); *tíkis* (Zambales).

This species is widely distributed, but grows naturally only in the forested areas, and is of somewhat local occurrence in the Archipelago. It is sometimes planted for ornamental purposes. The trunks, which are about 20 centimeters in diameter, are frequently used for pillars in houses, as they take a beautiful finish, and last well when not exposed to dampness. The outer hard part of the trunk is sometimes removed in the form of strips and used for floors of houses. These strips supply the Negritos with the wood for their bows. Anahau wood is often used also for spear shafts. The wood is hard, takes a high polish, and is considerably utilized in the Philippines for canes or walking sticks. The buds are edible and rather highly esteemed as a vegetable, but as with the other palms, the removal of the bud means the death of the plant. The leaves are frequently used for thatching houses, being laid on much like shingles and sewed in place with strips of rattan; or separated into strips and made into shingles like those of the nipa palm. According to Delgado, the entire leaves were formerly sewed together and made into sails for boats. A kind of raincoat, made of several leaves of this palm sewed together, is commonly used in many parts of the Philippines; while a very broad and shallow sun-hat, popular in many provinces, consists of a frame of bamboo or rattan covered with *Livistona* leaves. The fruits are eaten by various animals and by birds,

PLATE XXXIV. LIVISTONA SP. (ANAHAU) IN A CLEARING.

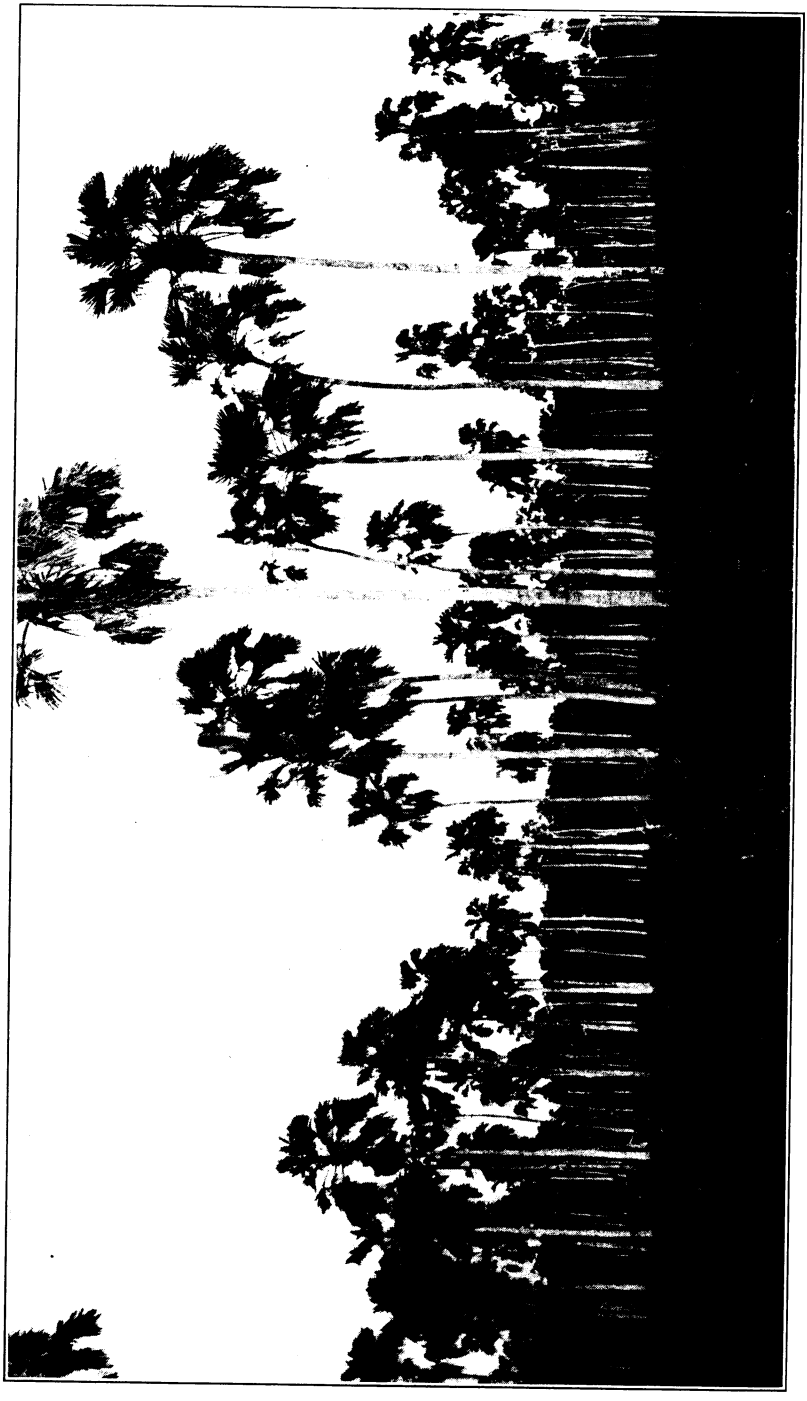


PLATE XXXV. LIVISTONA COCHINCHINENSIS (TARAU).

PLATE XXXVI. LIVISTONA ROTUNDIFOLIA (ANAHAU).

and sometimes by children. Young plants of this and allied species are very frequently cultivated in pots or tubs in Manila and other large towns for ornamental purposes. In other countries the leaves of *Livistona* are used for making fans.

The statements made above regarding *Livistona rotundifolia* will apply to most or all of our Philippine forms.

Genus METROXYLON Rottboell

Only a single species of this genus is definitely known from the Philippines, and this has been identified as *Metroxylon sagu* Rottb. (*M. rumphii* Mart.). At least two forms occur, the spiny and the spineless ones.

METROXYLON SAGU Rottb. (Plate XXXVII). LUMBIÁ or SAGO PALM.
Local names: *Ambólong, ambúlong, bagsáng, langdáng, lumbai, lumbiá, lumbiág, sagú* (Bisaya); *lumbiá* (Bagobo).

This palm has pinnate leaves 6 to 9 meters long. The stems are very thick and grow in clumps. It is widely distributed in the central and southern Philippines, but in many regions is only planted, this probably being true of all parts of the Bisaya islands, north of Mindanao. It has been reported from Cebu, Negros, Panay, Bohol, Siquijor, and from many parts of Mindanao. It grows in valleys and along streams, and is especially abundant in the extensive fresh-water swamps of the Agusan valley in Mindanao.

Most of the sago of commerce is produced from this tree. While sago is produced in the Philippines for local use, it does not enter into the external commerce of the Archipelago; in fact a considerable amount of sago is annually imported. According to data given by Heyne the annual export of sago from the Dutch East Indies is at least 15,000 tons.* Sago is one of the important exports from Sarawak.

In the Philippines, sago is extracted by the crudest methods. The tree is felled, and the crushed or macerated pith is washed in troughs; the starch, which is carried in suspension in the water, being then allowed to settle. After several washings the starch is dried and stored for use. Sometimes the pith is cut into strips and dried, the dried strips pulverized in mortars, and then washed as needed. Delgado states that occasionally the fresh pith is toasted and eaten although it is somewhat bitter. The buds are edible. Delgado † says that tuba is sometimes secured from this palm, but this practice, described by him in 1753, is apparently very rare, or perhaps obsolete.

* De Nuttige Planten van Nederlandsch Indië. Volume 1 (1913), page 61.
† Delgado, J. J., Historia General de Filipinas, pages 66 and 667.

PLATE XXXVII. METROXYLON SAGU (SAGO PALM).

Sometimes the leaves are used to thatch houses, for which purpose they are said to be very durable; while the external parts of the trunk are employed for floors and rafters. In some parts of the Malay Archipelago, the leaflets are split into strips and extensively used for making mats. Parts of the petioles, and the midribs of the leaflets, are variously utilized for weaving mats and baskets; a utilization which has not been recorded from the Philippines.

This palm is usually propagated by suckers that are produced in abundance about the base of the trunk, but it can also be readily grown from seeds.

Genus NIPA Wurmb.

This genus contains only a single species.

NIPA FRUTICANS Wurmb. (Plates XXXVIII–XLI). NÍPA.

Local names: *Anípa* (Cagayan); *lasá* (Bulacan, Bataan, Rizal, Laguna, Cavite, Tayabas); *nípa* (Camarines, Albay, Sorsogon, Antique, Spanish-Filipino); *sága* (Zambales); *sasá* (Pampanga, Bulacan, Bataan, Rizal, Manila, Laguna, Cavite, Tayabas, Mindoro); *tatá* (Cagayan).

From an economic standpoint this palm is one of the most important in the Philippines. It is at once distinguished from all others in the Islands by its habit and habitat. It occurs along tidal streams throughout the Archipelago and is of special interest from the fact that it thrives only in brackish swamps. Nipa has a stout, creeping, subterranean stem or rhizome. The leaves are pinnate, 7 meters or more in length and occur in erect clusters. It frequently forms a dense mass of vegetation through which it is very difficult to penetrate.

Nipa is usually found further up streams than the trees of the mangrove swamps and, as a rule, forms narrow strips in the inland portions of water channels through which tides ebb and flow. The areas covered by this palm are, however, frequently very extensive. There is in Pangil Bay in Mindanao a single area of nipa covering 9,000 hectares. In some places mangrove trees have been killed or cut out and nipa planted over extensive swamps. Such is the case north of Manila Bay, where much of the original tree growth has been entirely replaced by nipa. (For a further consideration of the habitat of nipa, see Bulletin No. 17, Bureau of Forestry, Manila, on Mangrove Swamps.) Nipa fruits, which are flat, about 12 centimeters long by 10 centimeters broad, are crowded in a very characteristic, large, globose, fruiting head, which is up to 30 centimeters in diameter and borne on a special, erect stalk. This plant apparently has no very definite blooming season, but as a general rule, at least in the provinces of Bulacan and

PLATE XXXVIII. NIPA FRUTICANS (NIPA) ON MUD FLAT.

Pampanga, flowers during the months of February and March. It takes about four months for the fruit to ripen.

THATCHING

Throughout the Islands, except in regions remote from the sea, the leaves of the nipa palm are by far the most commonly used material for thatching the light-construction houses in which most Filipinos dwell. Nipa shingles are also frequently used for the walls of houses. As nipa roofs take fire readily, and as a fire in a nipa district spreads with great rapidity and can be controlled with difficulty, if at all, the use of this material for thatching has now been prohibited in large parts of the city of Manila and other large towns.

Nipa shingles are made by removing the leaflets from the petiole, and doubling back one-third of the length of the leaflet over a slender piece of bamboo, placing them so as to overlap. They are then sewed in position to form an oblong shingle usually about 70 centimeters in length. In Pampanga a woman will, at an average, prepare 400 to 500 of these shingles in a day, some making as many as 800 a day. The shingles are usually tied in bundles of ten, to facilitate handling.

OTHER USES OF LEAVES

The leaflets are also used for making raincoats and sun-hats (salakóts), coarse baskets, mats, and bags; the midribs for making coarse brooms, for tying bundles of rice, and for sewing nipa shingles. The petioles serve as fuel, while splints prepared from the cortex are sometimes used for making baskets. The leaflets are used for wrapping a rice confection known as suman, as described under *Corypha elata*.

SEEDS

The immature seeds are used for food, their taste and consistency being similar to that of the flesh of immature coconuts. They are sometimes made into a kind of sweetmeat. The mature seeds are too hard to be eaten.

ALCOHOL

Nipa is very important as a source of alcohol and vinegar, and is a promising source of sugar. This subject has been extensively investigated by Gibbs * from whose article most of the information on this subject is taken. The production of proof alcohol in the Philippines exceeds ten million liters

* Gibbs, H. D., The alcohol industry of the Philippine Islands. Part I. Philippine Journal of Science, Section A, Volume 6 (1911), pages 99 to 206.

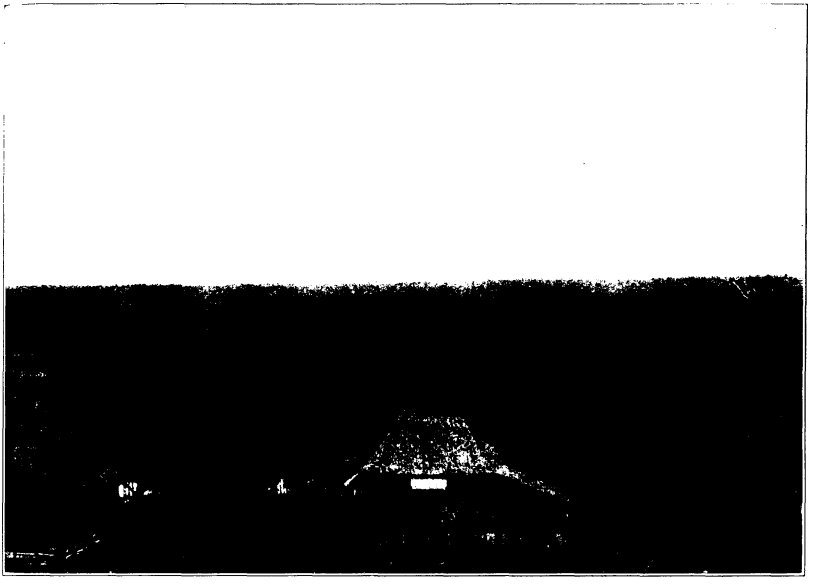


Fig. 1. Nipa swamps as far as the eye can reach.

Fig. 2. Uncultivated nipa swamp.

PLATE XXXIX.

annually, and considerably over eighty-five per cent of this probably is the product of the nipa palm. The alcohol is obtained by distilling the fermented juice which flows from a cut inflorescence stalk after the fruiting head has been removed. As the inflorescence of the nipa is near the ground, the flower stalk is conveniently situated for the gathering of the sap, called tuba. Some time after the fruit is formed, the stalk is cut across its top, usually just below the fruit, and each day a thin slice is removed to keep the wound fresh and to facilitate exudation. If the plant bears two flower stalks, the usual practice is to take sap from only one, the other being removed.

Sap is collected in bamboo joints which are hung on the stem. These containers are about 45 centimeters high and 8 centimeters in diameter, and have a capacity of about 2 liters. The stalk usually gives a flow for about three months, but it is not uncommon for it to be cut away, or at least cut so close to the ground that the daily paring is impracticable, long before the flow has ceased. In some districts the stem is cut before the fruit is formed; and under such conditions the daily yield of sap is said to be increased, but the period of flow reduced from three to one and one-half months, the total yield being practically the same in both cases. The juice-gathering season usually lasts about six months.

Gibbs * came to the conclusion that, with the present method of caring for a nipa area, an average plant would produce 43 liters of sap during the season, while a conservative estimate † places the number of palms in a cultivated swamp at between 2,000 and 2,500 per hectare, of which 750 may be depended upon to produce fruiting stalks and consequently be available for sap collection.

Gibbs gave the following composition for sap of the best quality:

Density $\frac{15^\circ}{15^\circ}$	1.0720
Total solids	18.00
Ash	0.48
Acidity	Trace.
Sucrose	17.00
Reducing sugars	Trace.

* Gibbs, H. D., The alcohol industry of the Philippine Islands. Part I. Philippine Journal of Science, Section A, Volume 6 (1911), pages 99 to 206.

† Pratt, D. S., Thurlow, L. W., Williams, R. R., and Gibbs, H. D., The nipa palm as a commercial source of sugar. Philippine Journal of Science, Section A, Volume 8 (1913), pages 377 to 398.

PLATE XL. CULTIVATED NIPA SWAMP.

He found that the inversion of the sucrose began almost immediately after the sap dripped from the stem, and concluded that it was due to the formation of an enzyme.

Tuba is carried by small boats (bancas) from the place of collection to the distilleries. According to Gibbs, the inversion is complete, the alcoholic fermentation well under way and sometimes completed before the sap arrives at the distillery. Occasionally the acetic acid fermentation has progressed to a considerable extent. The yield of alcohol obtained from the sap varied from 4.1 to 7.5 per cent, the average for 33 distilleries being 5.6 per cent. Due to faulty methods, the yield of alcohol is not what it should be. The average price paid for the sap at the distillery is, according to Gibbs, 0.006 pesos per liter. Gibbs says that the alcohol produced from the nipa sap should be about 6 per cent of the tuba, and under favorable conditions he believes above 7 per cent. With a yield of 6.5 per cent alcohol the purchase price of the raw material would be equivalent to a cost of 0.0415 pesos to 0.083 pesos per liter for 90 per cent alcohol. His estimates would indicate that nipa sap is the cheapest known source of alcohol. For manufacturing alcohol, nipa possesses several advantages over grains in that it does not need purification, pulping, etc. The storage space and fermentation vats may also be smaller, since fermentation is complete in from six to ten hours and the material ready to be distilled. Gibbs estimates that the owner of a nipa area, by selling sap, clears about 129.00 pesos per hectare per annum.

In some distilleries, especially in those near sugar-cane lands, molasses is added to the fermenting sap. The molasses, which usually contains about 60 per cent of fermentable carbohydrates, is sometimes used in amounts equal to that of the tuba. According to Gibbs the advantages are threefold; the invertase and alcoholic ferment in the tuba act with great rapidity upon the molasses, providing an easy method for the utilization of the latter; the production of alcohol is greatly increased; and when there is a shortage in the supply of sap, the uninterrupted running of the stills is assured. The use of molasses during a portion of the season enables some distilleries to operate the entire year.

TUBA

The fermented juice (tuba) of the nipa palm is used extensively by the Filipinos as a beverage.

VINEGAR

Considerable quantities of vinegar are manufactured from nipa tuba by allowing acetic fermentation to follow alcoholic

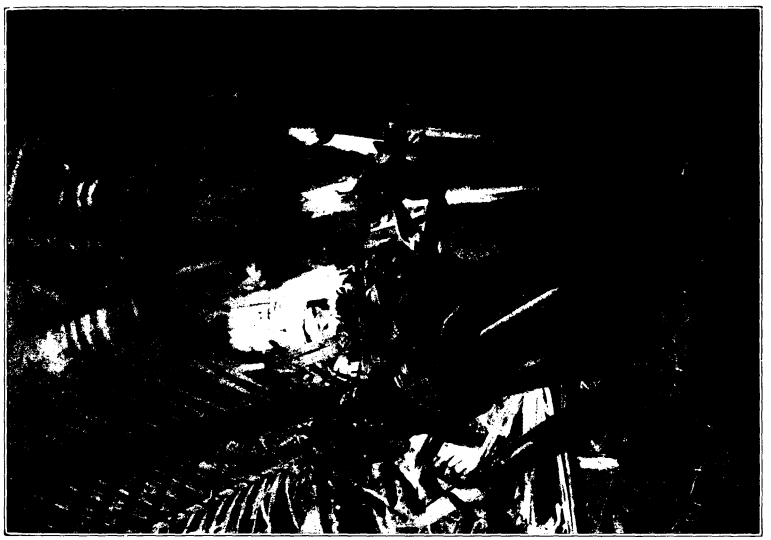


Fig. 2. Nipa palms in fruit.

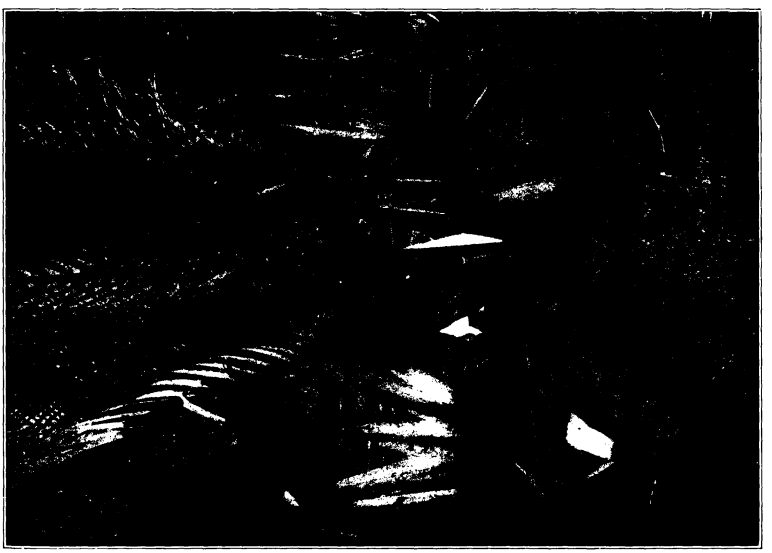


Fig. 1. Collecting the nipa sap.

PLATE XLI.

fermentation. The methods at present used are very crude and the product inferior. It contains only from 2 to 3 per cent of acetic acid.

CULTIVATION OF NIPA

A considerable amount of capital is invested in the nipa-alcohol industry. Large distilleries exist in various nipa swamps, which latter have been improved by cultivation. Artificial channels have been dredged to make the nipa areas more accessible for gathering and transporting the sap, and in some places the areas have been extended by planting. Yet at the present time only a small part of the available "nipales" is commercially utilized.

The best publication on the cultivation of nipa is a small pamphlet published in Manila in 1906 by Enrique Zobel, entitled "Estudio de la planta Nipa". The following information is taken from this publication:

Nipa is planted in the months from May to July, the seeds being placed in holes 1.7 to 2 meters apart. The period of development does not exceed four years, in which time the plant flowers, and can be utilized for the production of alcohol. During the first year the plant attains a height of from 1.5 to 2 meters. At the end of two years a nipa plant has seven or eight leaves and this number is maintained throughout its life. The seeds carried by water and deposited on land under shade seem to develop better and to produce healthier plants than those artificially planted in the open. Nipa is not only reproduced by seeds but also by the branching of the rhizome. In order to keep a nipal (nipa swamp) in good condition, the plants must be thinned until they are from 1.5 to 1.7 meters apart. In doing this it is necessary to cut up the roots of the plants removed, to prevent their regeneration. If a nipa swamp is cultivated for the sap, the fresh leaves should not be cut; while it is very advantageous to remove the drooping or drying leaves, which can be used for thatching houses, etc. When roofing material and not tuba is desired, three or four fresh leaves may be cut from each plant, but this interferes with the development of the plant and greatly decreases the flow of tuba.

If nipa is cultivated for alcohol, care should be taken not to injure the plant at the time of flowering, as an injury at this time is likely to cause the flower to die. The first thing done before gathering the sap is the cleaning of the nipal. The ground is cleared of weeds and vines and any other obstacles that interfere with the workman passing between the plants to collect tuba. At this time the mature leaves are cut off, tied into bundles, and transported to the houses where women make the nipa shingles.

SUGAR

It is possible that the nipa palm may prove to be a profitable commercial source of sugar. This subject has been quite extensively investigated by chemists of the Bureau of Science,* with the following general results: With a normal average sap flow of from 30 to 50 liters per plant per day over a period of three months, with a sap-collecting period of six months, and with an average of 750 bearing trees per hectare, it was found that one hectare would produce an average quantity of 30,000 liters of sap. The cost of collecting and delivery at a sugar mill was found to be about 3.00 pesos per 1,000 liters, and the sugar yield about 115 kilos of commercial white sugar, polarizing at 99° or above, per 1,000 liters of sap. The palm juice has the advantage over cane juice in that it is free from acids, waxes, etc., is colorless, with no debris and, when fresh, with no invert sugar. The chief difficulty in utilizing nipa as a source of sugar lies in the fact that, normally, fermentation commences with the flow of sap from the cut peduncle; that enzymes are present in the sap which will in time cause the complete inversion of the sucrose, and that it is difficult to prevent this inversion. With the use of a modified type of container for gathering the sap, freshly lined with lime cream and sulphite, fermentation and inversion can be prevented or inhibited for at least twelve hours, thus allowing sufficient time to collect and deliver the sap without undue loss of sucrose.

Genus ONCOSPERMA Blume

This genus is represented by four closely allied species, all similar in appearance. They are *Oncosperma platyphyllum* Becc. and *O. gracilipes* Becc., both endemic, and the more widely distributed Malayan species *O. horridum* Scheff. and *O. filamentosum* Blume. Among all the erect palms of the Philippines, *Oncosperma* can be at once recognized by the numerous, long, slender, horizontally spreading, stiff, sharp spines borne on the trunk throughout its length.

Conspectus of the species.

a^1. Gregarious. Floriferous branches of the spadix numerous, long, slender, and inserted at different levels on the rachis. Male flowers with 6 stamens. Fruit small, spherical, 11 to 12 mm in diameter.
1. *O. filamentosum.*

---

* Gibbs, H. D., The alcohol industry of the Philippine Islands. Part I. Philippine Journal of Science, Section A, Volume 6 (1911), pages 99 to 206.

* Pratt, D. S., Thurlow, L. W., Williams, R. R., and Gibbs, H. D., The nipa palm as a commercial source of sugar. Philippine Journal of Science, Section A, Volume 8 (1913), pages 377 to 398.

a^2. Stem very tall, solitary. Spathe very densely covered with criniform spines. Spadix with numerous, long, floriferous branches, which gradually narrow from a very thick base to a slender apex. Fruit large, spherical, 20 to 22 mm in diameter..... 2. *O. horridum.*

a^3. Rather large and growing in clumps. Spadix with rather short and thick floriferous branches; the latter clustered together and very closely scrobiculate. Fruit spherical or very slightly longer than broad, 15 to 16 mm in diameter, with the remains of the stigmas placed laterally, about halfway or a little above..... 3. *O. platyphyllum.*

a^4. Trunk slender. Spadix with relatively few, clustered, thickish, very closely scrobiculate, floriferous branches. Spathe not densely spinose. Fruit spherical, 14 to 15 mm in diameter, with nearly apical remains of the stigmas. Fruiting perianth 12 mm in diameter.. 4. *O. gracilipes.*

ONCOSPERMA FILAMENTOSUM Bl. ANÍBONG.

Local names: *Aníbong* (Tagalog, Bisaya); *anibung* (Tagbanua).

Like the other species of the genus, this is a rather tall, slender palm. It often grows subgregariously in favorable habitats, in ravines, or in lowlands back of the mangrove and often within the influence of brackish or salt water. The outer part of the trunk is very hard and durable; and split into narrow pieces is extensively used by the Filipinos, in the regions where it grows, for house floors. It is also used for spear shafts. The bud is edible, either raw or cooked; while in the Malay Archipelago, perhaps also in the Philippines, the fruits are sometimes used as a substitute for Areca fruits in preparing buyo for chewing.

Oncosperma horridum is known in Bagobo as tanaian and in Manobo as anibung.

Genus **ORANIA** Zippel

Four very closely allied species of this genus have been described from the Philippines. These are *Orania palindan* (Blanco) Merr. (*O. philippinensis* Scheff.), *O. paraguanensis* Becc., *O. rubiginosa* Becc., and *O. decipiens* Becc. The genus is of slight economic value, and a short discussion of the commonest species will suffice.

Conspectus of the species.

a^1. Floriferous branches ultimately glabrous.

b^1. Male flowers angular, lanceolate, 6 to 8 mm long, 3 to 3.5 mm broad, or about twice as long as broad, having the stamens one-third to one-half shorter than the petals; anthers linear-oblong. Female flowers broadly ovate-trigonous, the calyx cupular, very low; petals triangular, subaequilateral. Fruit spherical or very slightly narrowed at the base, usually 5.5 to 6 cm in diameter, at times somewhat less; mesocarp about 5 mm thick..... 1. *O. philippinensis.*

PLATE XLII. ORANIA PALINDAN (PALINDAN).

c^1. Fruit exactly spherical, larger than in the species (6.5 cm in diameter), yet with a thinner mesocarp (3.5 to 4 mm thick). *O. philippinensis* var. *sibuyanensis*.

b^2. Male flowers narrow, linear, 8 mm long, 2 mm broad, or about four times as long as broad, having the stamens nearly as long as the petals and the anthers very narrowly linear. Fruit spherical, smaller than in *O. philippinensis*, 4.5 to 4.7 cm in diameter, the mesocarp 3.5 to 4 mm thick..... 2. *O. paraguanensis*.

b^3. Male flowers narrowly linear. Fruit slightly narrowing to the base, or slightly pyriform, considerably smaller than in the preceding species, 4 to 4.5 cm long, 35 to 37 mm thick; kernel spherical, extended at the base into a broadly obconical blunt point; mesocarp relatively thick (3 to 4 mm) and furnished with many short and stout woody fibers. Seed about 25 mm in diameter.. 3. *O. decipiens*.

c^1. Fruit smaller than in the species (37 mm long, 31 to 32 mm thick), but always more or less narrowing to the base; mesocarp also thinner (2.5 mm thick)..... *O. decipiens* var. *mindanaoensis*.

c^2. Fruit spherical, not narrowing to the base, 42 mm in diameter; mesocarp 4 to 5 mm thick..... *O. decipiens* var. *montana*.

a^2. Floriferous branches more or less permanently rusty-tomentose. Male flowers very narrow and long, 1 cm long, 2 to 3 mm broad. Female flowers pyramidate-trigonous, acuminate, twice as long as broad, calyx campanulate. Fruit subpyriform, 40 to 45 mm long, 30 to 38 mm thick; mesocarp thin, 1.5 to 2 mm thick..... 4. *O. rubiginosa*.

ORANIA PALINDAN (Blanco) Merr. (*O. philippinensis*). (Plate XLII). PALINDÁN.

Local names: *Ambobáñga* (Cagayan); *báñga* (Bisaya); *baranggói, búñga, niógniógan, palindán* (Tagalog).

This palm, like others of the genus, is sylvan, growing in forested valleys at low and medium altitudes. In habit it somewhat resembles the coconut palm and is decidedly ornamental. It reaches a height of 6 meters and a stem diameter of 30 centimeters. Its fruits are globose, hard, and usually about 5 centimeters in diameter. No economic use has been indicated for this palm, although in some parts of the Islands it occurs in abundance. According to Delgado,* it has poisonous qualities. Many of the Philippine palms have edible buds, this portion of the palm being known as ubud in the Archipelago. One of the Filipino assistants in the Bureau of Science was made violently sick by eating the cooked ubud of this species, thus bearing out Delgado's claims regarding the evil properties of the palm.

Genus **OREODOXA** Willdenow

OREODOXA REGIA HBK. (Plate XLIII). ROYAL PALM.

This species is a native of tropical America and is extensively grown as an ornamental in the tropics of both hemispheres.

* Historia General de Filipinas (1892), page 685.

PLATE XLIII. OREODOXA REGIA (ROYAL PALM).

It is a stout, erect, stately palm reaching a height of 25 to 30 meters. The trunk is considerably swollen near the base; the leaves are crowded at the tip of the stem. This palm is apparently not naturalized in the Philippines, but is cultivated in considerable numbers.

Genus **PHOENIX** Linnaeus

PHOENIX HANCEANA Naudin. var. **PHILIPPINENSIS** Becc. VOIÁVOI.

Local name: *Voiávoi* (Batanes).

This is the only representative of the genus in the Philippines, except the introduced and cultivated *Phoenix rupicola* T. Anders, *P. canariensis* Hort., and *P. dactylifera* Linn., and occurs in the Archipelago only on the small islands north of Luzon. It grows along mountain streams. Locally its leaves are utilized in making a peculiar thatched raincoat, extensively used in the Batanes Islands. The leaflets are split into shreds and woven into an oblong mat, which is hood-like at one end. The long free ends of the shreds are arranged like thatch and very effectively shed even heavy rain.

Phoenix rupicola and *P. canariensis* are recently introduced palms now considerably cultivated in Manila for ornamental purposes; while old mature trees of the date palm, *Phoenix dactylifera,* are occasionally found. There is no record, however, that the date palm has ever produced fruit in the Archipelago.

Genus **PINANGA** Blume

(Plate XLIV)

This genus is represented by over twenty species, none of them of economic value. They are all sylvan, pinnate-leaved palms, more commonly found at medium and higher elevations than at low altitudes. So far as is known, the bud of all the species is edible, but as the palms are mostly small and slender the edible part of the bud is small. Some of the species, such as *Pinanga philippinensis* Becc., have stems that do not exceed 2 or 3 centimeters in diameter, while others, such as *Pinanga insignis* Becc., have stems up to 10 or 15 centimeters in diameter. All the Philippine species are solitary, scattered plants. None of them send up shoots from the base. Some are decidedly ornamental, but cannot be grown in most Philippine towns on account of the difference in climatic conditions between the virgin forest at medium and higher altitudes and the open, settled areas. The seeds of many, perhaps of all the species,

PLATE XLIV. PINANGA PHILIPPINENSIS.

are occasionally used as a substitute for that of the Areca palm in preparing buyo for chewing.

Conspectus of the species.

a^1. Very slender plants having simple flabellate leaves or only one or two segments on each side of the rachis.

b^1. Leaves mottled (at least those of young plants), deeply bilobed, otherwise entire..... 1. *P. maculata.*

b^2. Leaves with a terminal, deeply bilobed flabellum and 1 or 2 acinaciform segments on each side of the rachis. Spadix simple. Fruit distichous..... 2. *P. geonomaeformis.*

a^2. Leaves having few (4 to 9), very unequal, inequidistant segments on each side of the rachis. Spadix branched. Small plants with slender stems 1 to 3 cm in diameter.

b^1. Fruits biseriate.

c^1. Leaves short with very few (4 or 5), unequal, sigmoid-acinaciform, 3- to 7-costulate segments on each side of the rachis, ashy-puberulous underneath, at least in newly expanded leaves. Spadix with 3 or 4 branches only. Fruits exactly distichous, narrowly ovoid, with a conical point, 15 to 16 by 6 to 7 mm. Seed caudiculate at the base; vascular branches of the integument rather numerous, nearly simple..... 3. *P. modesta.*

c^2. Leaves having on each side of the rachis 8 or 9, narrow, 2- to 4-costulate, distant, ensiform-subfalcate, very acuminate segments, which are glabrous underneath. Spadix with 5 or 6 branches. Fruits exactly distichous, narrow, conical-subfusiform, broadest below their middle, 16 to 18 by 6 mm; seed elongate, conical in its upper part; vascular branches of the integument very few (3 or 4), almost simple..... 4. *P. isabelensis.*

b^2. Fruits 3-seriate. Leaves having on each side of the rachis 7 or 8 very inequidistant, unequal, 1- to 4-costulate, narrowly falcate-sigmoid, long-acuminate segments, which are glabrous underneath. Spadix with few (5) triquetrous branches. Fruit small, 11 to 12 by 5 to 5.5 mm, narrowly ovoid-ellipsoid, acute, equally narrowed to both ends. Seed ovoid, with a conical point; vascular branches of the integument 8 or 9, slightly anastomosing.. 5. *P. heterophylla.*

a^3. Leaves with more numerous segments.

b^1. Segments ashy-puberulous underneath; plants of moderate size.

c^1. Fruits 3-seriate. Segments relatively not very numerous, very unequal, inequidistant, 3- to 7-costulate, deeply incised into 3 to 7 bifid laciniae, the latter falcate, acuminate. Spadix with few (5 or 6) branches. Fruits relatively large, ovoid-ellipsoid, 2.5 to 3.3 cm long. Fruiting perianth low, cupular, not contracted at the mouth. Stem 3 to 5 cm in diameter.....6. *P. Barnesii.*

c^2. Fruits 2-seriate.

d^1. Segments rather numerous, very unequal, 1-pluricostulate, sigmoidal; when with more than one midcosta then deeply cleft at the apex into falcate-acuminate points. Spadix with the upper branches spirally scattered. Fruit obovoid, 18 to 20 by 13 mm. Seed spherical, with a horizontal embryo fovea. Fruiting perianth very shallowly cupular or almost explanate.

7. *P. Copelandii.*

d^2. Segments numerous, 2- or 3-costulate, almost straight, not deeply incised at the apex, the divisions 2-toothed, the teeth acute. Fruit ovoid-ellipsoid, obtuse, small, 15 by 9 mm. Seed with a very oblique embryo fovea. Fruiting perianth shallowly cupular, with nearly vertical walls, not contracted at the mouth. 8. *P. Curranii.*

b^2. Segments glabrous underneath.

c^1. Spadix with rather few branches.

d^1. Fruits distichous. Small or medium-sized plants.

e^1. Stem 2 to 5 cm in diameter. Leaf-sheaths densely covered with a grayish tomentum. Segments rather numerous, slightly sigmoid, acuminate, usually 3-costulate and relatively broad, or else narrow and 1-costulate. Spadix with few, scattered or subdistichous branches. Fruit narrowly ovoid-ellipsoid, acuminate, 11 to 14 by 5 to 8 mm. Fruiting perianth cupular, contracted at the mouth.....9. *P. philippinensis.*

e^2. Very similar to the preceding. Stem 2 to 4 m high, 2 to 5 cm in diameter. Leaf-sheaths covered with appressed rusty scales (not tomentose). Segments rather numerous and subequidistant; usually 1-costulate, slightly falcate acuminate or nearly straight. Spadix with a few scattered spreading branches. Fruit ovoid-ellipsoid, 12 to 14 by 7 to 8 mm. Fruiting perianth cupular, contracted at the mouth. 10. *P. Elmerii.*

e^3. Stem 2 to 3 cm in diameter. Leaf-sheaths sprinkled with dark-purple scales. Segments rather numerous, equidistant, 8 to 9 cm apart on each side of the rachis, 3-costulate, ensiform, about 60 cm long, 4 to 4.5 cm wide, paler or subglaucous, and not sprinkled with microlepidia underneath, the apices acuminate-caudate and very slightly falcate. Spadix with 14 or 15 spirally alternate branches. Immature fruits fusiform, 14 to 15 mm long (ovate-ellipsoid at complete maturity?). Fruiting perianth contracted at the mouth..11. *P. urdanetana.*

e^4. Of medium size (?). Segments lanceolate-ensiform, acuminate, unequal, straight, 60 cm long, 3.5 cm wide, their lower surface in the dry specimens reddish-brown and densely sprinkled with extremely minute, light-colored dots (microlepidia). Spadix with strongly flattened branches. Fruit thickly fusiform, equally narrowing to both ends, 15 to 18 mm long, and about 1 cm thick. Fruiting perianth very low, contracted at the mouth.....12. *P. samarana.*

e^5. Of medium size. Segments very numerous, equidistant, approximate, long, narrow, slightly falcate, very acuminate, all unicostulate. Spadix with 5 or 6 much flattened branches. Fruit relatively large, ovoid-ellipsoid, conical-mammillate at the apex, the base narrow and subpedicelliform when dry, 23 to 32 mm long, 13 to 14 mm thick. Seed ovoid, suddenly prolonged at the base into a slender caudiculum; embryo fovea broad and slightly oblique; vascular branches of the integument simple on the raphal or dorsal side and anastomosing anticously. Fruiting perianth truncate, not contracted at the mouth.....13. *P. urosperma.*

d^2. Fruits 3-seriate, at least in the lower part of the branches.

e^1. Segments straight, not falcate at their apices. Plants of medium size. Fruits small.

f^1. Segments numerous, very approximate, inserted at a very acute angle, unicostulate, lanceolate-ensiform, quite straight, concolorous, the apex bifid, its divisions acuminate. Spadix with several spirally inserted branches. Fruits 3-seriate from the base to the end of the branches, ovoid-ellipsoid, the apices mammillate, 13 to 15 by 6 to 7 mm. Seed globular-ovoid, rounded above, not caudiculate at the base; embryo fovea oblique; vascular branches of the integument few (5 or 6), not or only very slightly divided. Fruiting perianth very low, 1.5 mm high, 4 mm broad, contracted at the mouth.....14. *P. rigida.*

f^2. Segments numerous, equidistant, 6 to 7 cm apart on each side of the rachis, ensiform, 1- or 2-costulate, straight, rigid, concolorous, very acuminate, bifid at the apex. Spadix with several, triquetrous, spirally inserted branches. Fruits 3-seriate in the lower part of the branches, bifarious near the end, small, 12 to 15 by 7 to 8 mm, ovoid-ellipsoid; seed ovoid, not caudiculate at the base; embryo fovea very oblique; vascular branches of the integument 5, all slightly anastomosing. Fruiting perianth low, 2 mm high, 4 mm broad, slightly contracted at the mouth.
15. *P. Woodiana.*

f^3. Segments numerous, equidistant, thickish and rigid, 1-costulate, concolorous, narrow, very long-acuminate. Spadix with several, 3-gonous, spirally inserted branches. Fruit broadly ovoid, 13 by 8 to 9 mm. Seed broadly ovoid; embryo fovea almost horizontal; vascular branches of the integument 8 or 9, of which two are undivided and pass over the apex, and 2 or 3 on each side are arched and slightly anastomosing. Fruiting perianth 2 mm high, 4 mm broad, contracted at the mouth.....16. *P. sclerophylla.*

e^2. Segments falcate at their apices, numerous, equidistant, rigid, concolorous, narrow, very long-acuminate, 1- or 2-costulate. Spadix with several spirally inserted branches, trigonous in their lower part and flattened above. Fruit 3-seriate in the lower part of the branches, and bifarious above, rather narrowly ovoid-ellipsoid, narrowing a good deal to both ends, 12 to 13 by 6 mm. Seed caudiculate at the base; embryo fovea slightly oblique. Fruiting perianth contracted at the mouth.
17. *P. negrosensis.*

c^2. Spadix large with numerous branches inserted spirally at different levels. Large arboreous plants.

d^1. Fruits biseriate.

e^1. Segments very numerous, uniform, equidistant, ensiform, quite straight, rigid, very acuminate, very strongly 2-costulate, more or less deeply bifid at their apices, subconcolorous, very finely granulate-scabrid on the secondary and tertiary nerves on the lower surface. Fruits rather large, ovoid-ellipsoid, narrowing to both ends, 24 to 25 by 13 to 14 mm; pericarp

containing several layers of capillary fibers. Seed obsoletely caudiculate at the base, the embryo fovea very broad, oblique. Fruiting perianth 3.5 mm high, 8 mm broad, not or only very slightly contracted at the mouth.....18. *P. insignis.*

f^1. Fruit shorter than in the species and more ventricose, 20 to 22 by 13 to 14 mm.....*P. insignis* var. *gasterocarpa.*

f^2. Fruit narrower than in the species or thickly fusiform, 20 to 22 by 8 to 9 mm.....*P. insignis* var. *leptocarpa.*

f^3. Fruit very broadly ovoid, 20 to 22 by 13 to 15 mm. Pericarp with rigid fibers, rendering the surface of the fruit striate. Leaflets dusty-subglaucous underneath.

P. insignis subsp. *Loheriana.*

e^2. Segments very numerous, unicostulate, very approximate by twos on each side of the rachis, ensiform, quite straight, very acuminate. Fruits ovoid, broad at the base and suddenly apiculate-mammillate, 20 by 12 mm. Seed ovoid, blunt; vascular branches of the integument simple on the raphal side, elsewhere rather closely anastomosing. Fruiting perianth broadening at the mouth.....19. *P. batanensis.*

e^3. Segments elongate-lanceolate, 3-costulate, 1 meter long or more, spadix with slender, strongly flattened, pendulous branches. Fruit of medium size, 20 by 12 mm, slightly obovoid or ovoid-olivaeform; pericarp somewhat fleshy, traversed by a few slender fibers. Seed relatively small, 13 by 8 to 9 mm. Fruiting perianth deeply cupular or subcampanulate, not contracted at the mouth, 4 mm high, 6 mm broad.

20. *P. basilanensis.*

e^4. Segments equidistant, large, straight, 2- to 3-costulate, of a rather herbaceous texture, the basilar and the intermediate segments acuminate, the upper with as many not very deep incisions as there are costae, and with the resulting divisions shortly 2-toothed. Fruits small, 15 by 9 mm, obovoid, rounded above. Seed oblong, the embryo fovea very slightly oblique; vascular branches of the integument almost simple.

21. *P. speciosa.*

d^2. Fruit 3-seriate. Segments ensiform, strongly bicostulate, the apex divided into two straight points. Fruits rather large, ovoid-ellipsoid, with a conical apex, 25 to 28 by 15 to 17 mm. Seed broadly ovoid, rounded above, the embryo fovea somewhat oblique; vascular branches of the integument much branched and forming a network all around the seed. Fruiting perianth somewhat contracted at the mouth.

22. *P. sibuyanensis.*

Various local names for *Pinanga* spp. are: *abikí, búñga-machín, búñga na tukáyong, habika, lubiá, saramáu, tibanglán* (Tagalog); *bagtóan, sakolon, salangisag, saráuag* (Manobo); *karliléi, kastílde, katiddéi* (Igorot); *dapíau* (Bataan); *dasígan, máma* (Iloko); *habíki, saráuag, tapíra, tibañgán* (Bisaya); *hambúding* (Yakan, Moro); *irár, sadáuag, timbañgálan, sadúag* (Bagobo); *tigáhui* (Bukidnon).

Genus **PLECTOCOMIA** Martius and Blume

PLECTOCOMIA ELMERI Becc.

Local name: *Ungang* (Bagobo).

This species is a large, climbing palm with stems 5 to 7.5 centimeters in diameter. The young stems are green, the old ones, yellowish green. It is reported from the district of Davao, where it was found in dense woods on the southeastern part of Mount Apo at an elevation of about 1,000 meters.

Genus **PTYCHORAPHIS** Beccari

This is a genus of pinnate-leaved palms closely related to *Hydrospathe*. The Philippine species are sylvan, apparently rare, and of little economic importance.

Conspectus of the species.

a^1. Fruit longer than broad.

b^1. Of medium size. Leaflets furnished underneath with a few paleolae on the midrib only. Spadix twice branched. Fruit narrowly ovoid, tapering above to a slightly oblique, conical point, 10 to 12 mm long, 5 mm thick. Seed ovoid-ellipsoid, subacute, 7 mm long, 4 mm thick; vascular branches of the integument loosely anastomosing. 1. *Pt. microcarpa.*

b^2. Of medium size. Leaflets furnished underneath with paleolae, often on three nerves. Spadix twice branched. Fruit ovoid-ellipsoid, not or very slightly and asymmetrically obtuse-acuminate, 12 mm long, 7 mm thick. Seed ovoid, rounded at both ends; vascular branches of the integument very closely anastomosing. 2. *Pt. intermedia.*

b^3. Robust, stem about 15 m high. Spadix thrice branched. Leaflets rigid, without paleolae on the lower surface; secondary nerves well marked; margins somewhat thickened. Fruit narrowly ovoid, tapering above to a conical, slightly oblique point, 12 to 13 mm long, 5 mm broad. Seed ovoid-ellipsoid, acute, 9 mm long, 4.5 mm thick; vascular branches of the integument loosely anastomosing. 3. *Pt. Elmerii.*

a^2. Fruit spherical. Stem about 6 m high. Leaflets long-acuminate, the point slightly falcate. Spadix thrice branched, floriferous branches 12 to 15 cm long, 2.5 to 3 mm thick. The bracteoles of the female flower form a regular cupular caliculum. Fruiting perianth shallowly cupular. Fruit spherical, 7 mm in diameter, with the remains of the stigmas nearly central and apical, the surface not granulose. Seed spherical, 5.5 mm in diameter..... 4. *Pt. cagayanensis.*

Ptychoraphis elmeri is known in Bisaya as belísan, and *Ptychoraphis intermedia* in Manobo as marighói. The buds of *Ptychoraphis elmeri* are said to be edible.

Genus **ZALACCA** Reinwardt

This genus is represented by a single species, *Zalacca clemensiana* Becc. of central Mindanao.

ZALACCA CLEMENSIANA Becc.

Local name: *Lakaubi* (Bagobo).

This palm does not have a trunk, but forms large, dense clumps with about 7 to 13 shoots in a cluster. The species is apparently ornamental, but no economic uses are recorded for it.

RECENTLY INTRODUCED PALMS

A number of exotic palms have been introduced into the Philippines since the year 1905, but have not become sufficiently established to warrant their inclusion in a work of this kind or in any general work on the Philippine flora, as few of them have matured as yet; and it is impossible to determine at the present time those that may persist and those that may die out. Among these recent introductions are the following: *Acoelorrhaphe wightii* Wendl., *Archontophoenix alexandreae* H. Wendl. & Drude, *Attalea cohune* Mart., *Caryota urens* L., *Chrysalidocarpus lutescens* Wendl., *Coccothrinax garberi* Sarg., *Cyrtostachys lakka* Becc., *Dictyosperma alba* Wendl. & Drude, *Dypsis madagascariensis* Nichols, *Howea belmoreana* Becc., *Hyophorbe amaricaulis* Mart., *H. verschaffeltii* Wendl., *Latania commersonii* Gmel., *L. loddigesii* Mart., *Livistona australis* Mart., *L. chinensis* R. Br., *Martinezia caryotaefolia* HBK., *Oncosperma tigillaria* Ridl., *Oreodoxa ochracea* HBK., *Phoenix canariensis* Gaertn., *P. pusilla* Gaertn., *P. roebelenii* O'Brien, *P. rupicola* T. Anders., *Pinanga kuhlii* Bl., *Pritchardia gaudichaudii* Wendl., *P. pacifica* Seem. & H. Wendl., *Ptychosperma macarthurii* H. Wendl., *Raphia ruffia* Mart., *Sabal adansonii* Guerns., *S. blackburneanum* Glazebrook, *S. mauritiformе* Griseb. & Wendl., *S. palmetto* Lodd., *Thrinax argentea* Lodd., *T. parviflora* Sev., *T. robusta* H. Wendl., and *Neowashingtonia filifera* (Wendl.) Sudw.

USES OF PALM PRODUCTS

The products of the Philippine palms and their uses have been discussed under the headings of the various species. For convenience in reference, the different products are summarized in the following section. Numerous minor, local uses are not included.

Alcohol. A number of Philippine palms are tapped for their sweet sap from which alcohol and alcoholic drinks are manufactured. The most important of these are *Nipa,* which furnishes more than 85 per cent of the alcohol manufactured in the Philippines, and the coconut. Alcohol is also obtained from *Arenga pinnata* (sugar palm) and *Corypha elata* (buri). Fermented sap (tuba) is a very popular drink obtained from *Nipa*

fruticans (nipa), *Cocos nucifera* (coconut), *Corypha elata* (buri), *Arenga tremula* (dumayaka), *Metroxylon sagu* (sago palm), while an inferior product is produced from *Areca caliso* and species of *Caryota*.

Bags. Stout bags are made in enormous quantities from the leaves of *Corypha elata* (buri) and *Nipa*.

Baskets. Splints for baskets are prepared from the petioles of *Arenga pinnata* (sugar palm), *Arenga tremula* (dumayaka), *Cocos nucifera* (coconut), *Corypha elata* (buri), *Heterospathe elata*, and species of *Caryota*. Fibers from the husks of coconuts, split leaves of *Corypha*, and split stems of the rattan palms are also used in the manufacture of baskets. In many parts of the Malay Archipelago baskets are made from *Metroxylon sagu* (sago palm), but this use is not recorded from the Philippines.

Beads. The mature seeds of *Corypha elata* (buri) are used in the manufacture of beads for rosaries.

Blowguns. The hard outer wood of *Livistona* spp. (and perhaps others) is used to make blowguns. Two half cylinders are grooved, the grooves polished (or sometimes a fine metal tube inserted in the bore) and the two halves firmly lashed together.

Bows. The outer wood of *Livistona* spp. is the favorite one for bows among practically all the hillfolk of the islands.

Brooms. Coarse brooms are made from the leaves of *Arenga pinnata* (sugar palm), *Corypha elata* (buri), *Cocos nucifera* (coconut), *Livistona cochinchinensis* (taráu), and *Nipa*.

Brushes. The fibers of coconut husks and the bases of the leaves of *Arenga pinnata* (sugar palm) are used for making brushes.

Buttons. The mature seeds of *Corypha elata* (buri) and *Coelococcus amicarum* (Polynesian ivory-nut palm) are used in the manufacture of buttons.

Buyo. The nut of *Areca catechu* sprinkled with lime and wrapped with the leaf of *Piper betle* (ikmo) is called buyo and is used for chewing. Various other palm nuts are sometimes substituted for those of *Areca catechu*. The substitutes include *Adonidia merrillii, Areca caliso, Areca ipot, Heterospathe elata, Oncosperma*, and *Pinanga*.

Canes. See Rattans and Walking sticks.

Cardboard (substitute for). The sheathing part of the leaves and also the spathe enveloping the flower stalk of *Areca catechu* are used as substitutes for cardboard.

Carriers' poles. On account of its great strength and springiness, the hard outer wood of *Livistona* spp. is a great favorite

for the "pingga", or shoulder-pole, of the Chinese and Filipino pack carriers.

Caulking. Soft fibers obtained from *Arenga pinnata* (sugar palm), *Caryota* spp., and the coconut are used for caulking boats.

Chairs. The whole stems of the rattan palms are used in making frames of chairs and the split stems for the bottoms and backs of the so-called cane-seat chairs. See Rattans.

Charcoal. The shells of the coconut furnish a high grade of charcoal extensively used in the past European war for gas-masks.

Cordage. See Fibers.

Dye. The fruits of *Areca catechu* (betel palm) are sometimes used for dyeing black and red shades.

Fertilizer. The kernels of the coconut after having the oil extracted are used as fertilizer.

Fibers. Fibers from the coconut husks are used for mats. Nipa fibers are employed in tying bundles of rice and sewing shingles. *Caryota* spp. and *Arenga pinnata* (sugar palm) produce a fiber used in caulking boats and as tinder. Fibers from the leaves, from the cortex of the petioles and from the interior of the petioles of *Corypha elata* (buri) are used for weaving fine hats. A very fine kind of thatching is made from the fibers at the base of the leaves of *Arenga pinnata*. The fibro-vascular bundles of buri petioles are frequently used in making rope, as are also the *Arenga pinnata* fibers (cabo negro). Rattans are used, twisted two or three together, for logging and towing cables and for tying logs into rafts.

Fish Traps. Rattan palms are extensively used in making fish traps. See Rattans.

Fishing rods. The hard outer wood of Livistona spp. is extremely resilient and therefore makes an excellent material for fishing rods.

Floors. The hard outer wood of *Livistona* spp. (anahau), *Oncosperma* spp. (anibong), the coconut palm, and perhaps some other genera, is split into strips from 5 to 10 cm. wide and used for flooring.

Food. The coconut is the most valuable palm from the standpoint of food. Both the mature and immature fruits are variously thus employed. The oil pressed from the mature fruits is used as food, for cooking, and as a substitute for butter and lard. The kernels from which the oil has been pressed are used as food for stock. The young seeds of *Nipa, Corypha elata* (buri), and *Arenga pinnata* (sugar palm) are employed as food, chiefly in some form of sweetmeat. The seeds of some species

of *Calamus* are covered with an edible pulp. The young stems of some species are cooked and eaten as a salad. Some have a swollen basal portion which contains starch and which is eaten by woodsmen. The bud, locally called ubud, of most palms is edible. In the Philippines the buds of the following palms are known to be used for food: *Areca catechu* (betel nut), *Arenga ambong, Arenga pinnata* (sugar palm), some species of *Calamus, Cocos nucifera* (coconut palm), *Corypha elata* (buri), *Heterospathe elata* (sagisi), and probably all other species of *Heterospathe, Metroxylon sagu* (sago palm), the different species of *Livistona* (anahau), and *Oncosperma* (anibong). The buds of many other palms are certainly edible.

Furniture. Many articles of furniture are manufactured from the stems of the rattan palms. See Rattans.

Fuel. The kernels of the coconut after having the oil pressed from them are sometimes used as fuel, while the shells are frequently used for this purpose in the artificial drying of copra, and locally as a substitute for coal in various manufacturing establishments. The petioles of nipa, coconut and other palms are also used as domestic fuel.

Hats. *Corypha elata* (buri) is the source of material from which a number of valuable types of hats are manufactured. Excellent hats are also made from rattans. Other palms employed for use in making hats are *Areca catechu* (betel palm), *Cocos nucifera* (coconut), *Heterospathe elata* (sagisi), *Livistona* spp. (anahau), and *Nipa.*

Household Utensils. The shells of the coconut are employed for various household utensils, as cups, bowls, spoons, etc., and as molds for cane and buri sugar put up in lenticular cakes for the retail trade.

Mats. *Corypha elata* (buri), *Nipa,* and the rattans are used in the Philippines for making mats. Mats are also made in other places from *Metroxylon sagu* (sago palm), but this is not recorded from the Philippines.

Oil. The coconut furnishes large quantities of oil for export. Locally it is used for food, cooking, and illumination. *Elaeis guineensis* is an important source of oil in other countries, but in the Philippines is grown only as an ornamental.

Ornament. Most palms are ornamental, although not always used for this purpose. Among those extensively planted in the Philippines for ornamental purposes are *Adonidia merrillii, Arenga tremula, Caryota* spp., *Cocos nucifera, Heterospathe elata, Licuala spinosa, Livistona* spp., *Orania, Oredoxa regia, Pinanga* spp., *Areca ipot,* and *Arenga mindorensis.* The fol-

lowing are very ornamental, but are not as yet cultivated: *Areca vidaliana, Arenga ambong,* and *Zalacca clemensiana.* The leaves of the coconut are used extensively in temporary decorations and large numbers of them are employed on Palm Sunday.

Raincoats. The leaves of *Livistona* spp., *Nipa fruticans,* and *Phoenix hanceana* are used for raincoats.

Rattans. Rattan is supplied by the climbing palms *Calamus, Daemonorops,* and *Korthalsia;* the best commercial rattan being furnished by the genus *Calamus.* The entire cane of the rattan is used in the manufacture of chairs and other furniture and for walking sticks. The split canes are used for bale-ties, baskets, hats, fish traps, mats, chairs, bottoms and backs of so-called cane-seat chairs, parts of beds, tables, etc., and in great quantities for tying together posts, beams, rafters, flooring and roofing in the majority of light wooden and bamboo houses. The central portion of the canes is split and used for wicker (so-called "reed") furniture.

Rope. See Fibers.

Slippers. The lower sheath-like parts of the leaf stalks of *Areca catechu* (betel palm) are used for inner soles; and the outer part of the petioles of *Corypha elata* (buri) for soles of sandals.

Spear shafts. The hard outer wood of *Livistona* spp. and *Oncosperma* spp. is a favorite material for this purpose. The entire stems of some of the small erect palms (perhaps *Pinanga* spp.) and occasionally some of the hardest and stiffest rattans are also used.

Starch. This product is obtained from the stems of *Corypha elata* (buri), *Arenga pinnata* (sugar palm), and *Metroxylon sagu* (sago palm) and sometimes from species of *Caryota.*

Stinging Crystals. The fruits of *Arenga pinnata* (sugar palm) contain stinging crystals which are sometimes used for the protection of fish ponds against nocturnal robbers.

Sugar. This product is obtained from *Arenga pinnata* (sugar palm) and *Corypha elata* (buri). The *Nipa* palm is a very promising commercial source of sugar, while the juice of *Corypha* used in connection with the juice of sugar cane might also be a commercial source. Sugar could be manufactured from the sap of the coconut palm.

Syrup. This product is manufactured from the sap of *Corypha elata* (buri).

Tannin. The fruits of *Areca catechu* (betel palm) contain a considerable quantity of tannin.

Thatching Material. The leaves of Nipa are the most widely used

thatching material in the Islands. A very durable thatching is made from the fibers at the base of the leaves of *Arenga pinnata* (sugar palm). The leaves of the following palms are also used for thatching: *Cocos nucifera* (coconut), *Corypha elata* (buri), *Livistona* spp. (anahau), and *Metroxylon sagu* (sago palm).

Timber. The stems of old coconut palms are used for house-posts, wharves and bridges; the split, outer portion of the stems of *Caryota* spp., *Livistona* spp. (anahau), *Metroxylon sagu* (sago palm), and *Oncosperma* (anibong) for floors; and the stems of *Metroxylon sagu* (sago palm) for rafters. The stems of *Livistona* spp. (palma brava) take a high polish and, if protected from the rain, last well. They are used extensively as pillars. Spear shafts are made from the outer shell of the stems of *Livistona* and *Oncosperma* and bows from *Livistona.*

Tinder. A fine fiber obtained from *Arenga pinnata* (sugar palm) and *Caryota* spp. makes an excellent tinder.

Vermifuge. The fruits of *Areca catechu* (betel palm) are used extensively as a vermifuge.

Vinegar. This product is obtained from the sap of *Nipa, Arenga pinnata* (sugar palm), *Cocos nucifera* (coconut), and *Corypha elata* (buri).

Walking sticks. Species of *Calamus* (rattan) found in Palawan furnish beautiful canes known in commerce as Malacca canes. The outer parts of the stems of *Livistona* (palma brava) are also used extensively as walking sticks, as are occasionally the whole stems of some of the small species of *Pinanga.*

Water. Stems of some species of *Calamus* (rattan) contain water which is used for drinking purposes.

Water pipes and troughs. Whole or split trunks of *Livistona* spp., and probably of other large palms, are used as water conduits in irrigation, as eave troughs, etc.

INDEX

166908—9

BUREAU OF FORESTRY

MANILA, PHILIPPINE ISLANDS

Bulletin No. 1 (1903).—Report on investigations made in Java in the year 1902. By Elmer D. Merrill. *Out of print.*

ulletin No. 2 (1906).—The charcoal industry of the Philippine Islands. By Wm. M. Maule. *Out of print.*

'etin No. 3 (1906).—A compilation of notes on india rubber and gutta-'cha. *Out of print.*

in No. 4 (1906).—I. Mechanical tests, properties, and uses of thirty ppine woods. II. Philippine sawmills, lumber market, and prices. lland Gardner. *Out of print.*

'o. 5 (1906).—A preliminary working plan for the public forest the Insular Lumber Company, Negros Occidental, P. I. By H. t and H. N. Whitford. *Out of print.*

B **6 (1906).**—A preliminary working plan for the public forest Mindoro Lumber and Logging Company, Bongabon, Mindoro I L. Merritt and H. N. Whitford. *Out of print.*

Bul '907).—A preliminary check list of the principal commercial t. Philippine Islands. By H. N. Whitford. *Out of print.*

Bulle 908).—The forests of Mindoro. By Melvin L. Merritt. *Ou.*

Bulletin).—A Philippine substitute for lignum-vitae. By W. I. Hutch entavos.*

Bulletin).—The forests of the Philippines. I. Forest types and produ principal forest trees. By H. N. Whitford. 2.50 pesos.

Bulletin 12).—The uses of Philippine woods. *Out of print.*

Bulletin 1912).—Volume tables for round timber. Compiled by Wil.. ne. *Out of print.*

Bulletin (1915).—Ipil-ipil. A firewood and reforestation crop. By D. iews. 50 centavos.

Bull .4 (1916).—Commercial woods of the Philippines; their prep- a .d uses. By E. E. Schneider. 2 pesos.

Bull . 15 (1918).—Philippine bamboos. By William H. Brown and A F. Fischer. 1.50 pesos.

Bull No. 16 (1918).—Philippine forest products as sources of paper By William H. Brown and Arthur F. Fischer. 50 centavos.

B No. 17 (1918).—Philippine mangrove swamps. By William H. wn and Arthur F. Fischer. 2 pesos.

B tin No. 18 (1919).—Philippine palms and palm products. By William . Brown and Elmer D. Merrill. 1.50 pesos.

lletin No. 19 (1919).—Philippine fiber plants. By William H. Brown. 1.50 pesos.

* Fifty cents U. S. currency equal 1 peso or 100 centavos.