Minor Products of Philippine Forests

EDITED 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

VOLUME I

Department of Agriculture and Natural Resources

Bureau of Forestry

BULLETIN No. 22

Arthur F. Fischer, Director of Forestry

MANILA
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View in dipterocarp forest, Mount Makiling; altitude, about 500 meters.

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DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
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Bulletin No. 22, Volume I

ARTHUR F. FISCHER, *Director of Forestry*

PREFACE

By minor forest products is meant all the products of the forest other than timber, the latter being regarded as the principal product. In the Philippines, as in other tropical countries, the minor forest products, while of less importance than the timber, are very varied and of great economic value. Up to the present time no attempt has been made to give a popular and general account of these products; such information as is available concerning them being for the most part in inaccessible, technical publications. In preparing a work of this kind there are always points concerning which further information would be desirable, and in the Philippines there is a great lack of data which would be necessary to make the treatment of the minor forest products reasonably thorough. It is believed, however, that the presentation of such data as we have is advisable, particularly as it can then serve as a better starting point for obtaining further information.

The preparation of the present publication on minor forest products was begun in April, 1918, and at the time that this is written the volumes dealing with plant products are in press. It is hoped that in the near future a volume dealing with animal products will be added. The rapidity with which this work has been prepared, by people whose time is largely taken up with other duties, has precluded the possibility of anything but the most casual investigation. This will account for the absence of definite data which could evidently have been obtained with but little time and effort. However, the advantages of, and necessities for preparing a publication quickly, outweighed the objections which could be raised as to the lack of data which might have been included. Without a general work as a basis on which to start, it would be very difficult to undertake a systematic collection of the knowledge concerning forest products which is possessed even by the employees of the Bureau of Forestry, and in the preparation of this bulletin no attempt has been made in that direction.

The idea of preparing a work on minor forest products is due to Mr. Arthur F. Fischer, Director of Forestry, at whose request it was undertaken. The whole enterprise has continuously had

Mr. Fischer's enthusiastic support and assistance, which has contributed greatly to such value as it may have.

These volumes on forest products have been written to meet several needs, but particularly to give an account of the products which would be accessible and useful to people without any special scientific training. Local names and descriptions have been given for all species and figures of the more important ones. The descriptions are intended merely to give an idea of the kind of plant concerned, and sufficient data to enable one to check an identification made from a local name or from a special use. The local names are very valuable aids in identifying species, but are by no means infallible guides, as there is much confusion in local names, and the same names are frequently applied to different species or groups of species even in the same locality. By the use of the local names, the descriptions, and the figures, however, it is believed that in most cases it will be possible to correctly identify the plants.

As the work of the present publication has proceeded changes have been made in the manner of presentation, and as a result there is a certain lack of uniformity. In the second volume, and to some extent in the first, we have used the following system in discussing the various species of plants: On the left of the page is given the scientific name, and on the right the local name adopted as official by the Bureau of Forestry. This is followed by a list of local names in the various dialects. The first part of the discussion takes up the general uses and importance of the products concerned. This is followed by a more technical description of the products, after which is given a description of the species, followed by a short account of its distribution and abundance.

In preparing these volumes I have been greatly indebted to a number of people, but particularly to Mr. E. D. Merrill, Botanist and Director of the Bureau of Science, who has not only consented to be joint author of the section on palms, but has been of great help throughout this work. Although he is a very busy man, I have found him at all times not only willing, but anxious to give any possible assistance. The special assistance which he has given in this work is, however, only a small portion of the indebtedness which not only I, but all people working on subjects appertaining to botany, owe to him. When he arrived in the Philippine Islands, the status of botanical classification was chaotic. Largely by his own efforts, he has straightened out the tangle, described as many new species as there were plants then known from the Archipelago, identified many more, and has

brought the knowledge of the plants in the Islands into such a shape as to make it readily accessible to workers in botany. This together with the advantages of being able to consult him in doubtful cases, may be truly said to have made possible the appearance of this or any other general work on Philippine plants. The Bureau of Forestry is pleased to take this occasion to publicly acknowledge their indebtedness to Mr. Merrill for the scientific classification of the miscellaneous, useful plants and timber trees, and for much other assistance which he has rendered to the Bureau.

The spelling of the native names throughout this work has been revised and made uniform by Mr. E. E. Schneider of the Bureau of Forestry, who is well acquainted with several Philippine languages. Mr. Schneider has also collected much information, and owing to his continued interest has been of great assistance. In preparing the sections on bamboos and mangrove swamps we have made considerable use of information gathered by Dr. F. W. Foxworthy, particularly of records of growth and planting. For all of the above assistance I desire here to express my grateful appreciation.

WILLIAM H. BROWN.

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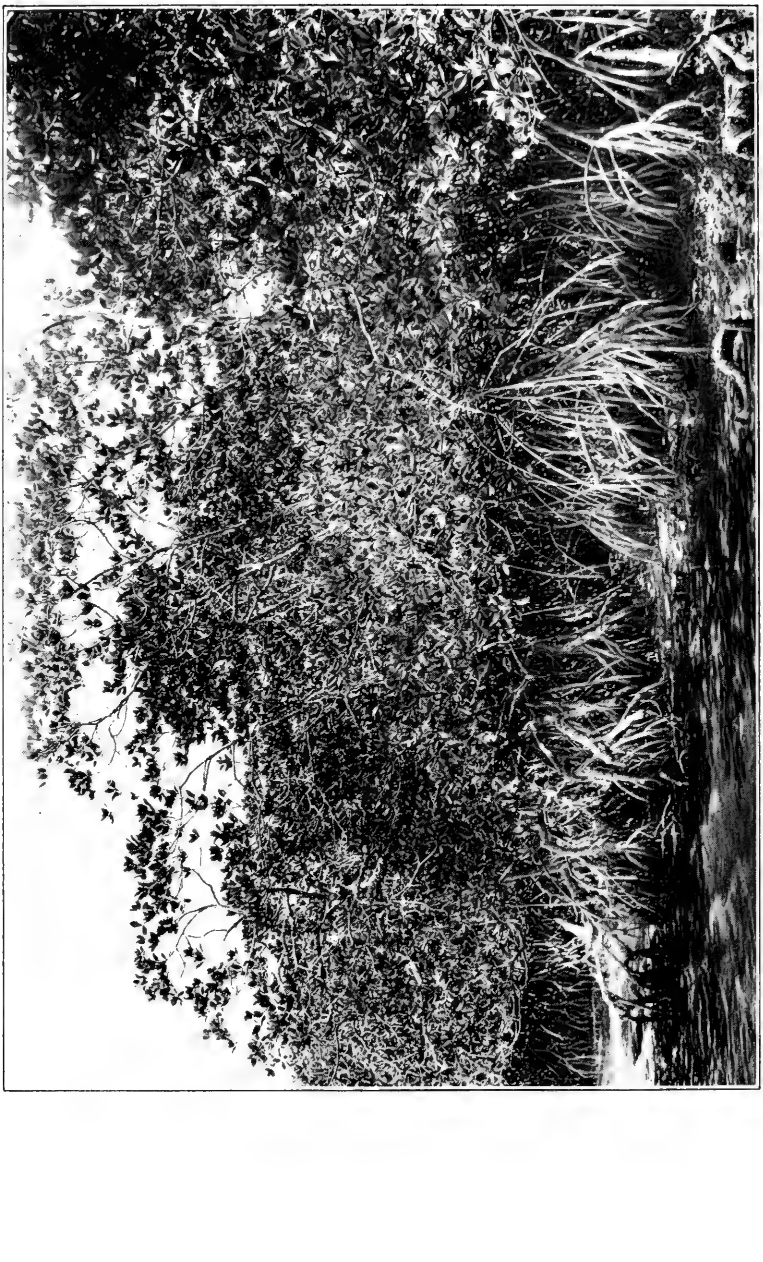

PLATE I. RHIZOPHORA CANDELARIA (BAKAUAN-LALAKI) INVADING A MUD FLAT.

PHILIPPINE MANGROVE SWAMPS

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PHILIPPINE MANGROVE SWAMPS

By William H. Brown and Arthur F. Fischer

INTRODUCTION

The mangrove swamps of the Philippine Islands apparently occupy between 400,000 and 500,000 hectares. No accurate survey of them has been made and the estimate of the area is based on reports from forest officers, Coast and Geodetic Survey maps, and forest maps. The area may exceed what is here given, but it is believed that it will not be less. The figure given includes also most of the areas of nipa swamps, as the classification has not, in most cases, been exact enough to show, in detail, how much of the swamp was in mangrove and how much in nipa.

The term mangrove swamp is applied to the type of forest occurring on tidal flats along sea coasts. They are found fringing the shores of the islands of the Philippine Archipelago and extending inland along the streams where the water is brackish (Plate II). The conditions most favorable for their development are found in quiet bays into which flow large rivers whose lower reaches have little fall.

The descending waters of the river are checked when they meet tidewater and deposit their sediment in the form of broad mud flats or deltas near the mouths of the rivers.

These flats are usually cut by a network of channels through which the advancing and receding waters of the sea move. At extreme low tide the flats are exposed and often even the larger channels are dry.

On these mud flats the trees and other plants which form the mangrove and nipa-swamp vegetation find conditions favorable to their development and, as the seeds of these species are distributed by water and can be transported for long distances without injury, the formation of flats and their seeding are practically simultaneous. The growth of all species is very rapid and the flats soon become dense forest, and remain so as long as the conditions which produced them are not disturbed (Plates III, IV). When the shore formation is favorable, new flats are formed beyond the old and the forest advances year

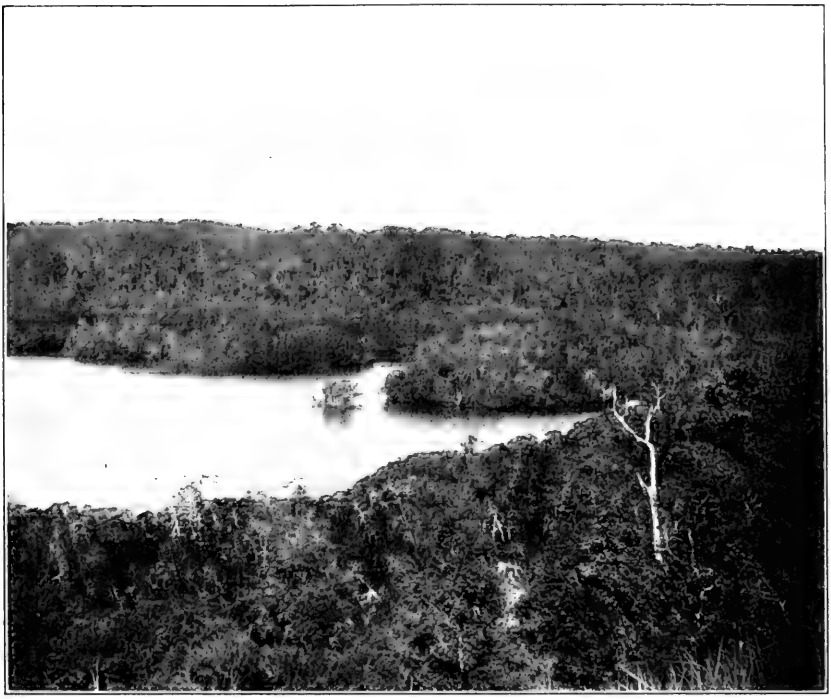

Fig. 1. Looking across a mangrove swamp at head of Tubugan Bay, Port Banga, Zamboanga.

Fig. 2. Swamps along coast, under water at high tide.

PLATE II.

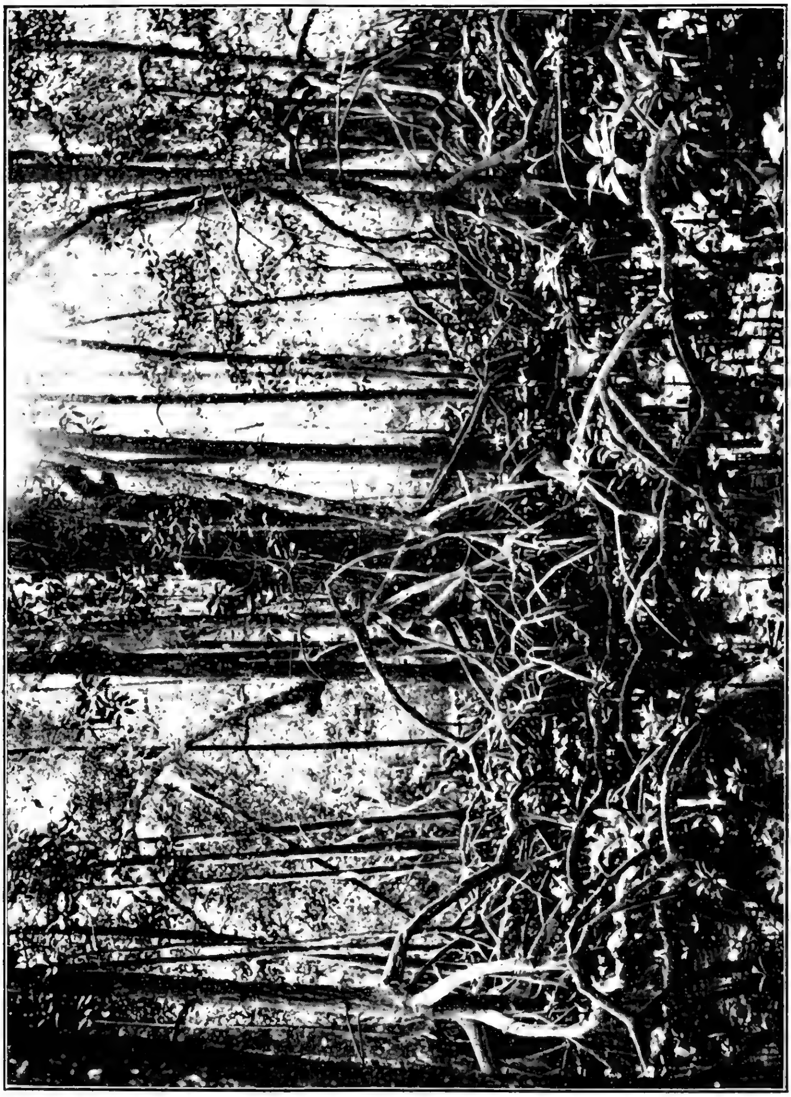

PLATE III. INTERIOR VIEW OF A MANGROVE SWAMP.

by year; its area diminishing or increasing as the lands drained or filled in by the action of the river are of greater or less extent than those newly formed. The draining and filling in of the lands on the upper limits of the swamp is very gradual, so that although the change from mangrove to dry forest is characteristic of these areas the process is extremely slow and less noticeable than the advance of the forest over newly formed flats on the sea edge of the swamp.

The mangrove forests may contain trees 1.35 meters in diameter; and when fully stocked, with mature timber, compare favorably with the commercial forests of the land. Areas with 650 cubic meters per hectare are found in the older swamps. These forests are not swamps and marshes, as we think of them in temperate regions, where trees grow in wet places that are periodically covered with standing water; but are literally forests of the sea with their roots in a stratum in which salt water is always present. For the greater part of the time the roots and even the lower part of the trunks of the trees are submerged in from 0.5 to 1 meter of salt water, while at high tide the lower limbs and foliage of the trees on the edges of the swamp are often submerged for a short time without injury (Plate II, fig. 1); conditions of life that would absolutely destroy ordinary forest trees.

Their character as forests of the sea is emphasized by the fact that when they form narrow strips, coral and sand beaches are often found back of the swamps on exposed coasts. The vegetation on these mud flats can be divided into two classes; mangrove swamps, in which large trees are present, and nipa swamps, which are characterized by a growth of the stemless palm, *Nipa fruticans*.

Mangrove-swamp forests, or "mangles," as they are called locally, are usually made up of thick stands of medium-sized and even-aged trees. Normally they are very free from undergrowth other than seedlings, and are characterized by the presence of roots showing on or above the surface of the ground (Plates I, III, IV, V, XVI, XXXVIII, and XLI). Depending upon the species in question, these may take the form of erect roots, knees, high prop roots, or mere swollen roots with side branches extending along the surface of the ground. The air roots have a spongy texture and absorb air which serves for the aëration of the root system. These peculiar roots are one of the most distinguishing characteristics of mangrove swamps. When the mud flats are not covered with water, the roots give a very peculiar appearance to the vegetation.

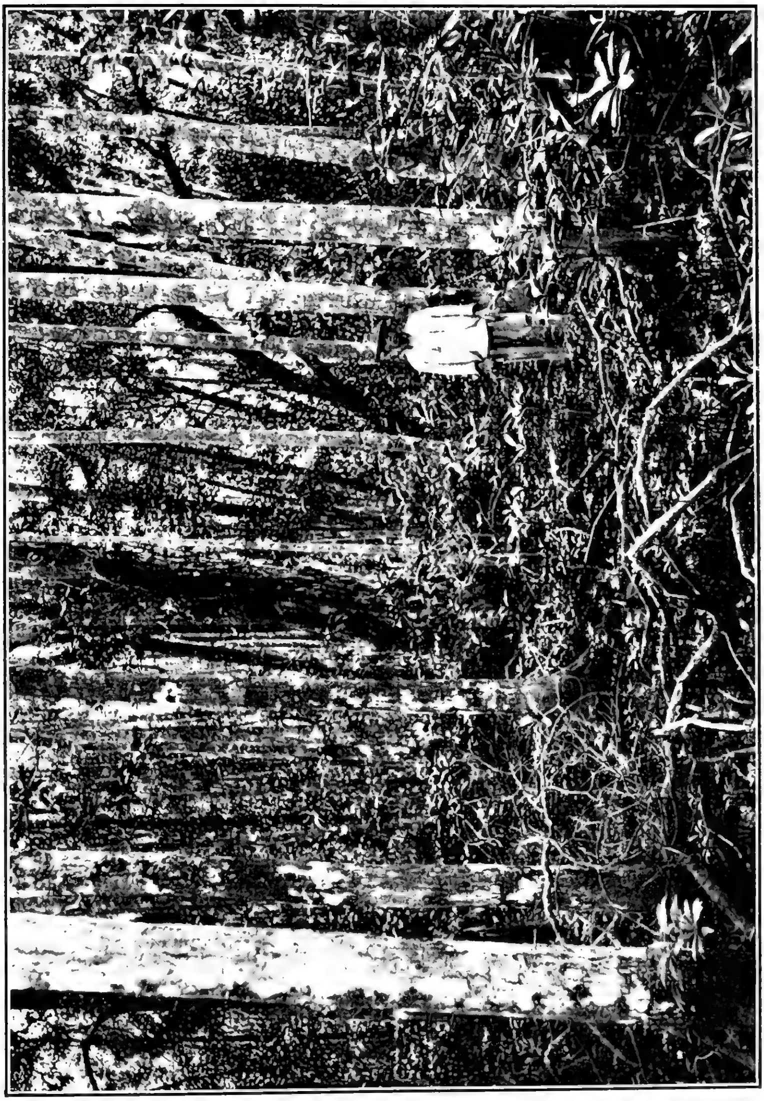

PLATE IV. INTERIOR VIEW OF A MANGROVE SWAMP.

The main tree species in a virgin swamp are few in number, and the principal ones are of the botanical family Rhizophoraceae. In this family there are found: *Rhizophora candelaria* and *R. mucronata; Ceriops tagal* and *C. roxburghiana;* and *Bruguiera conjugata, B. parviflora, B. cylindrica,* and *B. sexangula.* While these eight species are the ones most numerous in nearly all virgin swamps, scattered trees of pagatpat (*Sonneratia caseolaris*) often occur mixed with them or growing along exposed coral beaches. Api-api (*Avicennia* spp.) is sometimes found scattered in the more open places. Occasionally, this last-mentioned tree grows in pure stands along the inland edge of a mangrove swamp. Trees of the genus *Rhizophora* are frequently the first to seed upon and occupy the newly formed mud flats (Plate I). They are prop-rooted species, and normally grow on those portions of the swamp most deeply flooded by the tides. Such places are usually confined to the area along or close to water channels, although on low swamps *Rhizophora* forest extends farther inland. *Rhizophora mucronata* predominates in the fringe of trees bordering on waterways, while *Rhizophora candelaria* is by far commoner in the main forest within this outer fringe.

Trees of the genus *Bruguiera* occupy the portion of the swamp in which the ground is barely, if at all, flooded at high tide. Such places are usually toward the inland portions of the swamp and often, probably in the majority of cases, comprise a large percentage of its total area. As the ground level is raised by the natural filling in of the delta, it often happens that areas occupied by these *Bruguiera* forests become so high that they are seldom, if ever, flooded.

In open bays where the soil is mixed with considerable sand or coral limestone, there is a distinct frontal zone of *Sonneratia caseolaris* (Plate XVI), with some *Avicennia officinalis.* Wave-cut coral terraces often contain nearly pure stands of *Sonneratia caseolaris.*

Several other trees occur in these salt swamps, usually along their inner edges or in places where the stands are light. These include *Xylocarpus moluccensis, X. granatum, Lumnitzera littorea,* and *Aegiceras corniculatum. Heritiera littoralis* (dungonlate) is common on the higher ground which is still within the zone affected by salt water.

In swamp areas in which cutting has long been carried on the original and more valuable species are often largely replaced by *Avicennia* spp. (api-api). These species were considered to be of little value until the present fuel shortage.

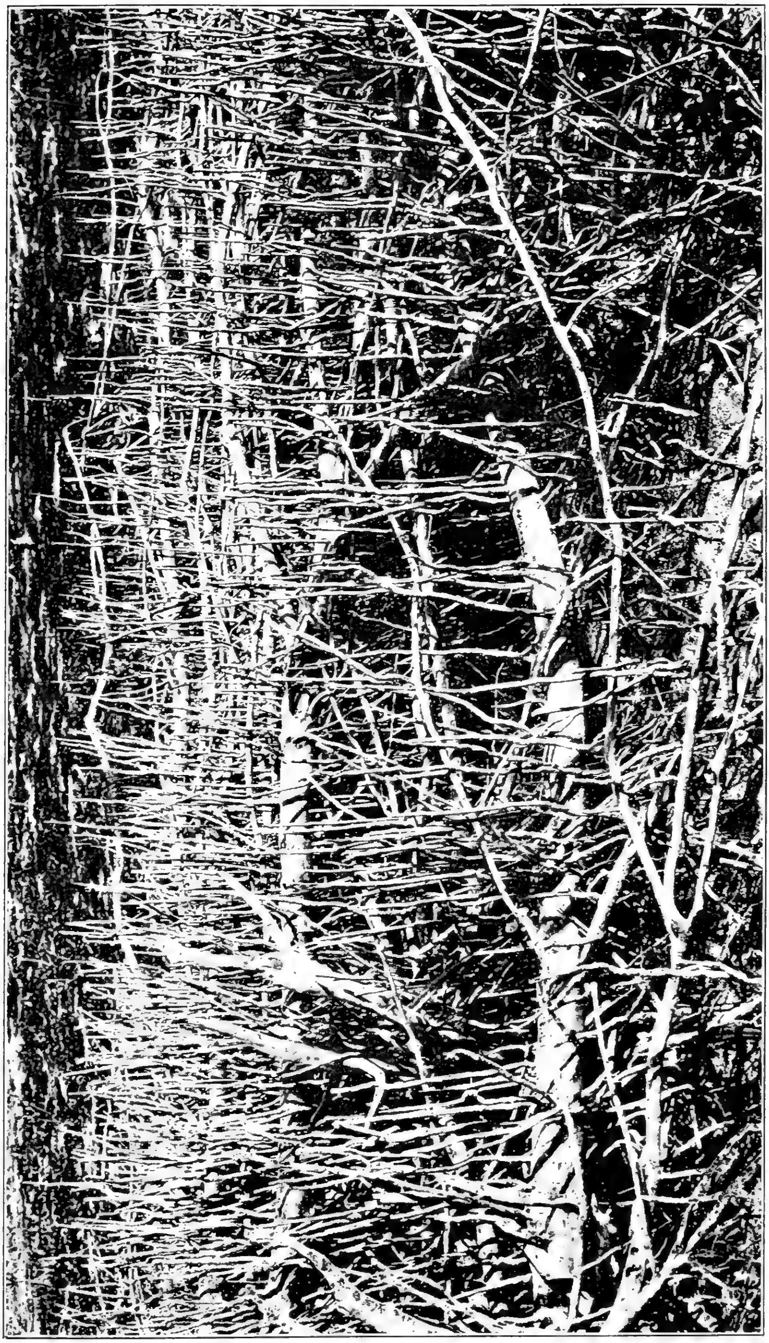

PLATE V. ROOTS OF AVICENNIA OFFICINALIS (API-API) EXPOSED BY WAVE ACTION.

Skirting the inland portions of the water channels, through which the tide ebbs and flows, is often found a strip of nipa palm (*Nipa fruticans*), usually narrow, although sometimes it occupies areas of considerable extent (Plates IX, XLV). In Pangil Bay, Mindanao, there is a single area of nipa covering 9,000 hectares. Nipa grows farther up the streams flowing through the mangrove forests than do the trees forming them, being found along streams where the effect of tide is barely noticeable. In some places the mangrove trees have been killed or cut out and nipa planted over wide areas of swamp. Such is the case north of Manila Bay, where much of the original tree growth has been entirely replaced by nipa.

Nipa has a large, branching, horizontal rhizome, or underground stem, which grows just below, or on the surface of, the soil and sends up short branches with a cluster of pinnate leaves, which rise 7 meters or more above the ground. Nipa frequently forms a dense mass of vegetation which is difficult to penetrate.

Undergrowth in a heavy virgin swamp is usually scanty, but in places where stands are light, in cut-over areas, and along the outer edges of the swamp, a fairly heavy undergrowth of vines, shrubs, ferns, and herbs is developed. Very noticeable in this are a swamp fern, *Acrostichum aureum,* and two spiny-leaved undershrubs, *Acanthus ilicifolius* and *A. ebracteatus.*

Among the commonest woody vines are *Derris trifoliata* Lour. (*D. uliginosa* Benth.), *Tristellateia australasiae* L. C. Rich., *Dalbergia candenatensis* Prain, *Caesalpinia nuga* Ait., *Caesalpinia crista* Linn., and *Finlaysonia obovata* Wall. Herbaceous vines are represented by the epiphytes *Hoya* and *Dischidia.*

Epiphytes are fairly numerous throughout the swamps. Perhaps the most conspicuous elements are the orchids, especially species of *Cymbidium* and *Dendrobium.* Epiphytic ferns are represented by *Drynaria quercifolia* J. Sm., *Polypodium sinuatum* Wall., and sometimes *Asplenium nidus* L. The most peculiar epiphytes are those containing cavities which are inhabited by ants. These are very abundant and are represented by *Myrmecodia, Hydnophytum,* and *Polypodium sinuatum* Wall. The bases of the stems of *Hydnophytum* and *Myrmecodia* are greatly enlarged and contain labyrinthine cavities in which ants are found in large numbers (Plates VI, VII). The stems of *Polypodium sinuatum* are swollen and hollow, the cavities being inhabited by ants (Plate VII). *Dischidia saccata* Warb. is

Fig. 1. Myrmecodia, a plant inhabited by ants.

Fig. 2. A section through the base of a Myrmecodia.

PLATE VI.

found in some swamps. This plant has hollow leaves in which ants are found.

Reproduction is prolific in almost all places where seed trees are found, except along the higher inland portions of the swamp.

Back of the swamps are found numerous characteristic strand plants, and representatives of nearly all such plants in the region may be found in such situations. Among the common trees and shrubs back of the swamps are *Glochidion littorale* Blume, *Hibiscus tiliaceus* Linn., *Thespesia populnea* Corr., and *Barringtonia racemosa* Roxb. The sedge *Fimbristylis ferruginea* Vahl practically always occurs in such places, while along muddy banks *Cyperus malaccensis* Lam. is very common.

The chief commercial value of mangrove-swamp trees is for the production of firewood, charcoal, tannin, and dye barks. Some of the woods are also used for ship timbers, posts, ties, telegraph poles, piling, construction, finish, and furniture.

The nipa palm is very valuable as a source of thatching and alcohol and offers considerable possibilities for the production of sugar. For a discussion of the products of mangrove trees and the nipa palm, see the sections on these various subjects.

Mangrove trees serve a useful purpose in preserving water courses through the deltas at mouths of rivers. That they may be used to advantage to retain soil in engineering projects is shown by the following quotation:*

> The latest use of the mangrove in a practical way and one of which the writer has personal knowledge is the use of these trees as ballast retainers. This has been effectively demonstrated by the Florida East Coast Railway which has used the peculiar habit of the mangrove to advantage in their great feat of engineering, viz., the Oversea extension. At certain places these keys are connected by embankments supporting the road bed or where the bed is built high over a low flat key, the mangroves have been planted to prevent the erosive action of the sea on the ballast. This has been of greatest importance to the railroad and has protected the dykes just as the mangroves naturally sown have formed and protected young islands. Still more recently the writer has been of some small service to a large asphalt company concerning their engineering projects in Venezuela in which it is proposed to plant *Rhizophora mangle* along the dykes and jetties, etc., as a ballast retainer. This, it is hoped, will prove as efficient as the plantings of the Florida East Coast Railway have been in aiding the engineer in the tropics.

Mangrove swamps occur in similar situations in the tropics

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* Bowman, H. H. M., Ecology and physiology of the red mangrove. Proceedings of the American Philosophical Society, Vol. LVI (1917) pp. 589–672.

PLATE VII.

Fig. 1. Hydnophytum, a plant inhabited by ants.

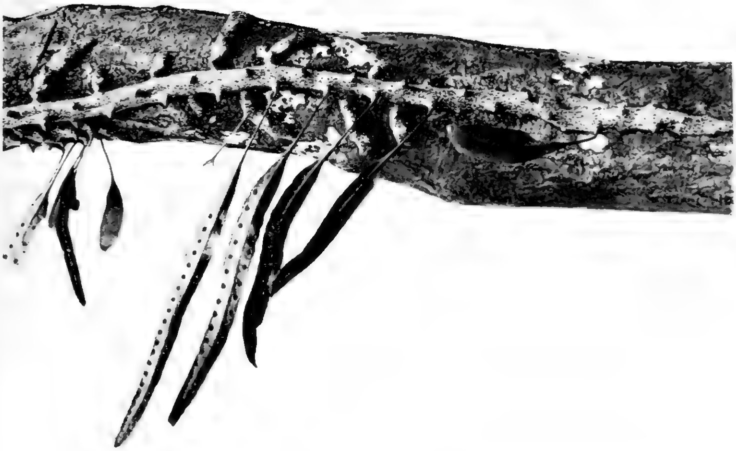

Fig. 2. Polypodium sinuatum, a plant inhabited by ants.

of both hemispheres. The Rhizophoraceae are the most prominent trees in all cases, but the species are different in America and in the Indo-Malayan regions. The composition is, however, very similar in East Africa and the Indo-Malayan regions. The tree species are few in number. In the Philippines twenty-five dicotyledonous trees have been reported from the mangrove swamps. The wide distribution of the species and the number of individuals of single species in the swamps make these forests unique among tropical forests.

LIST OF SPECIES IN PHILIPPINE MANGROVE SWAMPS WITH NATIVE AND FAMILY NAMES

Acrostichum aureum Linn. Lagólo. Polypodiaceae.
Nipa fruticans Wurmb. Nípa. Palmae.
Oncosperma filamentosa Blume. Anibong. Palmae.
Xylocarpus granatum (*obovatus*) Koen. Tabígi. Meliaceae.
Xylocarpus moluccensis (Lam.) M. Roem. Piagáu. Meliaceae.
Excoecaria agallocha Linn. Buta-butá. Euphorbiaceae.
Brownlowia lanceolata Benth. Maragómon. Tiliaceae.
Camptostemon (*Cumingia*) *philippinense* (Vidal) Becc. Gapas-gápas. Bombacaceae.
Heritiera littoralis Dryand. Dúñgon-láte. Sterculiaceae.
Sonneratia alba (*acida*) Sm. Pedada. Sonneratiaceae.
Sonneratia caseolaris (*pagatpat*) (Linn.) Engl. Pagatpát. Sonneratiaceae.
Bruguiera conjugata (*gymnorrhiza*) (Linn.) Merr. Busáin. Rhizophoraceae.
Bruguiera cylindrica (*caryophylloides*) (Linn.) Blume. Potótan-laláki. Rhizophoraceae.
Bruguiera parviflora W. & A. Lañgárai. Rhizophoraceae.
Bruguiera sexangula (*eriopetala*) (Lour.) Poir. Potótan. Rhizophoraceae.
Ceriops roxburghiana Arn. Tañgál. Rhizophoraceae.
Ceriops tagal (Perr.) C. B. Rob. Tañgál. Rhizophoraceae.
Rhizophora candelaria (*conjugata*) DC. Bakáuan-laláki. Rhizophoraceae.
Rhizophora mucronata Lam. Bakáuan-babae. Rhizophoraceae.
Lumnitzera littorea Voigt. Tabáu. Combretaceae.
Lumnitzera racemosa Willd. Kulási. Combretaceae.
Osbornia octodonta F. Muell. Tawalis. Myrtaceae.
Aegiceras corniculatum (Linn.) Blanco. Saging-ságing. Myrsinaceae.
Aegiceras floridum R. and S. Tinduktindúkan. Myrsinaceae.
Cerbera manghas (*odollam*) Linn. Baraibái. Apocynaceae.
Avicennia alba Blume. Api-ápi. Verbenaceae.
Avicennia officinalis Linn. Api-ápi. Verbenaceae.
Acanthus ebracteatus Vahl. Tigbáu. Acanthaceae.
Acanthus ilicifolius Linn. Diliuáriu. Acanthaceae.
Scyphiphora hydrophyllacea Gaertn. Nílad. Rubiaceae.
Pluchea indica Linn. Kalapíni. Compositae.

*Scientific and local names of various mangrove species.**

Scientific names.	Local names.				
	Philippine Islands.	British North Borneo.	Sarawak.	Dutch Borneo.	Malay Peninsula and Singapore.
Rhizophora spp.	Bakauan {Bakauan lalaki, Bakauan babae}	Bakau {Bankita, Taggai}	Bako	Bako	Baku.
Ceriops spp.	Tangal	Tengah	Tengah	Hulit-tengah	Tengar.
Bruguiera conjugata, *Bruguiera sexangula*	Pototan or Busain	Lenggadi or Pututan	Putut	Akat	Tumu.
Bruguiera parviflora	Langarai	B'eus	B'rus	B'eus	Lenggadai.
Avicennia spp.	Api-api	Api-api	Api-api	Api-api	Api-api.
Lumnitzera littorea	Tabau	Griting	Taruntum	Griting	Terentum.
Sonneratia caseolaris	Pagatpat	Perapat	Perapat	Perapat	Perepat.
Sonneratia alba	Pedada	Pedada	Pedada	Pedada	Pedada.
Heritiera littoralis	Dungon-late	Dungun	Dungon	Dungun	Dungun.
Xylocarpus granatum	Tabigi	Nirih			Nyireh.
Xylocarpus moluccensis	Piagao	Nirih	Niri	Niri	Nyireh batu.
Camptostemon philippinense	Gapas-gapas	Manggating			
Nipa fruticans	Nipa	Nipah	Nipah	Nipa or Hapong	Nipah.
Oncosperma filamentosum	Anibong	Nibong	Nibong	Njiboeng	Nibong.
Acanthus ilicifolius	Diliuariu			Djoeroedjoe	Jeruju.
Scyphiphora hydrophyllacea	Sagasa				Chengam.
Aegiceras corniculatum	Saging-saging			Troentoem	Kachang-kachang.
Excoecaria agallocha	Buta-buta	Buta-buta	Buta-buta	Taboeta	Buta-buta.
Acrostichum aureum	Lagolo	Piay		Pakos larat	Paku laut, Piai.

* From Foxworthy, F. W., and Matthews, D. M., Mangrove and nipah swamps of British North Borneo, Bulletin 3 (1917) Department of Forestry, British North Borneo. Revised by Dr. F. W. Foxworthy.

Key to the genera of mangrove-swamp plants.

[Based on superficial characters.]

1. Palms.
  2. Stemless, with underground rhizomes; without spines.. *Nipa,* page 26
  2. Trunks erect with numerous, long, slender spines.. *Oncosperma,* page 30
1. A large coarse fern with pinnate leaves rising in a cluster from the base .... *Acrostichum,* page 26
1. Not palms or ferns.
  2. Leaves pinnate with one to three pairs of leaflets. Large trees with round fruit 8 to 25 centimeters in diameter and containing a few, very large, angular seeds........ *Xylocarpus,* page 30
  2. Leaves not pinnate; fruits not as above.
    3. Leaves opposite.
      4. Herbs or shrubs with spiny-margined leaves.... *Acanthus,* page 76
      4. Leaves not spiny.
        5. Leaves usually pointed at the tip.
          6. Tip of leaf with prominent projection of the midrib. *Rhizophora,* page 56
          6. Tip of leaf without projection of the midrib.
            7. Petioles usually not over 2 or 3 millimeters in length. *Sonneratia,* page 38
            7. Petioles usually more than 6 millimeters in length.
              8. Lower surface of leaves green; with long, slender seedling projecting from the fruit........ *Bruguiera,* page 42
              8. Lower surface of leaves gray or white; fruit a capsule up to 2.5 centimeters in length and containing a single seed .... *Avicennia,* page 74
        5. Leaves rounded at apex and not notched; mature leaves usually more than 3 centimeters in breadth.
          6. Petioles usually more than 1.5 centimeters long; flowers about 1 centimeter in length........ *Scyphiphora,* page 78
          6. Petioles usually much less than 1.5 centimeters in length; flowers about 5 centimeters long........ *Sonneratia,* page 38
        5. Some or all of the leaves slightly or conspicuously notched at apex.
          6. Petioles very short, much less than 5 millimeters in length. *Osbornia,* page 66
          6. Petioles more than 1 centimeter in length.... *Ceriops,* page 54
    3. Leaves alternate.
      4. Small shrubs; leaves with toothed margin........ *Pluchea,* page 78
      4. Margin of leaves smooth or nearly so.
        5. Tips of leaves usually pointed, or lower surfaces of leaves with a silvery appearance.
          6. Petioles more than 2 centimeters in length; plants with abundant milky juice.
            7. Leaves more than 15 centimeters long; flowers large, white, terminal .... *Cerbera,* page 70
            7. Leaves less than 12 centimeters and usually less than 10 centimeters long; flowers very small, from branches below the leaves .... *Excoecaria,* page 34
          6. Petioles less than 2 centimeters in length; plants without milky juice.
            7. Leaves rounded at the base........ *Heritiera,* page 36
            7. Leaves pointed at the base........ *Brownlowia,* page 34

5. Apex of leaves rounded and usually notched.
   6. Petioles usually about 2 or more centimeters in length; leaves, stems, and fruits densely covered with small round scales. *Camptostemon,* page 34
   6. Petioles 1 centimeter or less in length.
      7. Fruits shaped like a banana except that the tips are sharply pointed .... *Aegiceras,* page 66
      7. Fruits not shaped like a banana........ *Lumnitzera,* page 62

Key to the genera of mangrove-swamp plants.

[Based on floral characters.]

1. Plant without flowers or seeds, reproduced by means of spores. Family 1, Polypodiaceae; *Acrostichum.*
1. Plants with flowers that produce seeds.
   2. Cotyledon one; leaves parallel-veined........ Family 2, Palmae.
      3. With erect spiny trunk........ *Oncosperma.*
      3. Without trunk and without spines........ *Nipa.*
   2. Cotyledons two; leaves netted-veined.
      3. Corolla none.
         4. Ovary inferior........ Family 10, Combretaceae; *Lumnitzera.*
         4. Ovary superior.
            5. Flowers dioecious; plants with milky juice. Family 4, Euphorbiaceae; *Excoecaria.*
            5. Flowers monoecious; plants without milky juice. Family 7, Sterculiaceae; *Heritiera.*
      3. Calyx and corolla both present; the corolla of distinct and separate petals.
         4. Ovary superior.
            5. Stamens numerous, more than twice as many as the petals.
               6. Filaments united, stamens on the outside of a column. Family 6, Bombacaceae; *Camptostemon.*
               6. Filaments free........ Family 5. Tiliaceae; *Brownlowia.*
            5. Stamens few, never more than twice as many as the petals; inside of small cup-shaped tube. Family 3, Meliaceae; *Xylocarpus.*
         4. Ovary inferior.
            5. Stamens numerous, many times as many as the petals.
               6. Flowers small; calyx lobes imbricate in bud; leaves usually with glandular dots........ Family 11, Myrtaceae; *Osbornia.*
               6. Flowers large; calyx lobes valvate in bud; leaves not glandular dotted........ Family 8, Sonneratiaceae; *Sonneratia.*
            5. Stamens usually twice as many as the petals. Family 9, *Rhizophoraceae.*
               6. Petals four........ *Rhizophora.*
               6. Petals five or six........ *Ceriops.*
               6. Petals eight to fourteen........ *Bruguiera.*
      3. Calyx and corolla both present; the petals more or less united.
         4. Ovary superior.
            5. Stamens opposite the lobes of the corolla, as many as the lobes. Family 12, Myrsinaceae; *Aegiceras.*
            5. Stamens as many as the lobes of the corolla in regular flowers and alternate with the lobes, or sometimes fewer in irregular flowers.

6. Carpels distinct, at least below, sometimes united at apex by the styles; plants with milky juice.
   Family 13, Apocynaceae; *Cerbera.*
6. Carpels entirely united; plants with watery juice.
   7. Fruits drupaceous; flowers small.
      Family 14, Verbenaceae; *Avicennia.*
   7. Fruits capsular, dehiscent; flowers large.
      Family 15, Acanthaceae; *Acanthus.*

4. Ovary inferior.
   5. Flowers not in dense heads; leaves opposite.
      Family 16, Rubiaceae; *Scyphiphora.*
   5. Flowers in dense heads; leaves alternate.
      Family 17, Compositae; *Pluchea.*

DESCRIPTION OF SPECIES

Family 1, POLYPODIACEAE

Genus ACROSTICHUM

ACROSTICHUM AUREUM Linn. (Plate VIII). LAGÓLO.

Local names: *Piai* (Agusan); *pakupakúan* (Manila); *lapole* (Tayabas).

Acrostichum aureum occurs in great abundance on open mud flats in the swamp and along tidal streams. The leaves are pinnate, leathery, and from 50 to 200 centimeters in length. The leaflets are from 20 to 50 centimeters long and from 4 to 6 centimeters wide. *Acrostichum aureum* is distributed in the tropics of both hemispheres.

Family 2, PALMAE

Key to the genera.

Stemless, with underground rhizomes; without spines.......... *Nipa.*
Trunks erect with numerous, long, slender spines.......... *Oncosperma.*

Genus NIPA

NIPA FRUTICANS Wurmb. (Plates IX, X). NÍPA.

Local names: *Sasá, lása, páuid* (Tagalog); *sága* (Sambali); *táta, anípa* (Cagayan); *nípa* (Bikol).

This palm is at once distinguished from all others in the Philippines by its habit and habitat. It occurs along tidal streams throughout the Philippines and, from an economic standpoint, is one of the most important palms in the Archipelago. It 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. Nipa frequently forms a dense mass of vegetation which is very difficult to penetrate. The

PLATE VIII. ACROSTICHUM AUREUM (LAGOLO).

PLATE IX. NIPA FRUTICANS (NIPA) WITH FLOWERS AND FRUIT.

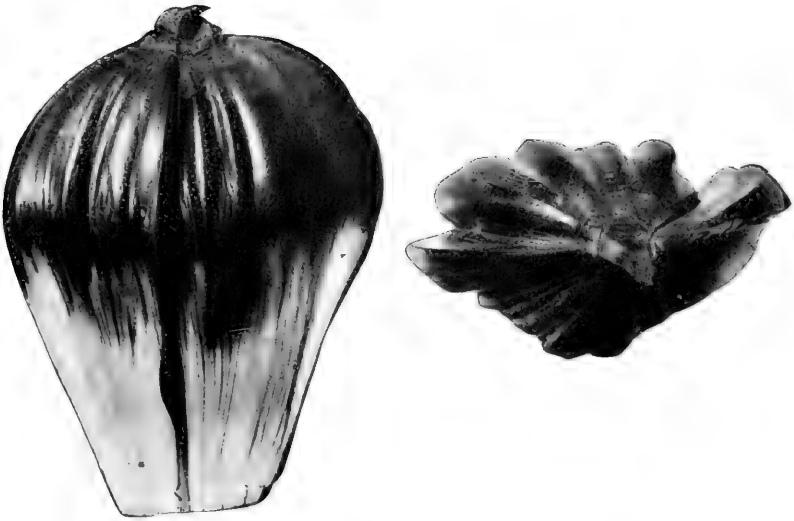

Fig. 1. Fruit of nipa.

Fig. 2. Section of fruit of nipa.

PLATE X.

fruits are flat and about 12 centimeters long by 10 centimeters broad. The inflorescence is very characteristic, notably the 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 Bulacan and Pampanga Provinces, flowers during the months of February and March. It takes about four months for the fruit to ripen.

The methods of cultivation of nipa and its economic value as a source of thatching material, alcohol, and sugar are discussed in the section on Palms.

Genus ONCOSPERMA

ONCOSPERMA FILAMENTOSUM Blume. ANÍBONG.

Local name: *Aníbong* (Tagalog and Bisaya).

Anibong can be at once recognized by the numerous, long, slender, horizontally spreading, stiff, sharp spines borne on the trunk throughout its length.

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.

Family 3, MELIACEAE

Genus XYLOCARPUS

Key to the species.

Bark light colored, smooth; fruit 17 to 25 centimeters in diameter. *Xylocarpus granatum.*

Bark dark brown, very rough; fruit about the size of a small orange. *Xylocarpus moluccensis.*

XYLOCARPUS GRANATUM Koen. (Plate XI). TABÍGI.

Local names: *Tabígi* (Lanao, Cebu, Tayabas, Guimaras Island, Zamboanga, Negros, Dinagat Island, Camarines, Masbate, Agusan, Sorsogon, Leyte, Marinduque, Panay, Basilan, Palawan, Samar, Cotabato, Culion); *pulit* (Basilan Island); *kulimbáning* (Culion Island); *tambo-tambó* (Zamboanga); *lubanáyong* (Cagayan); *nígi* (Mindoro, Camarines, Palawan, Zambales, Tayabas); *piagáu* (Masbate, Zamboanga).

Fig. 1. Xylocarpus granatum (TABIGI) with immature fruit.

Fig. 2. A germinating seed of Xylocarpus granatum (TABIGI).

PLATE XI.

This is a medium-sized to large tree, reaching a diameter of 100 centimeters, with thin, smooth, and light-colored bark. The bark contains a large amount of tannin. The inner bark is dark red and furnishes a dark-red dye. The trunk is usually crooked and very often rotten. The roots frequently extend for a considerable distance through the mud. They are crooked, and the projecting parts are very narrow on top.

The wood is moderately hard and moderately heavy. The sapwood is small in amount, whitish; the heartwood red. The grain is straight or slightly crossed; the texture fine and glossy. The wood seasons very well, shrinking little and checking or warping hardly at all; works easily. It is rarely, if ever, attacked by beetles. It is used for poles; ties; posts; beams, joists, rafters; doors; flooring; all interior finish; high-grade furniture and cabinetwork; among the best and most beautiful cabinet woods in the Islands.

The leaves are alternate and compound with one to three pairs of leaflets. The flowering branches are usually from 3.5 to 7 centimeters in length. The flowers are about 6 millimeters long. The stalks are from 7 to 13 millimeters in length. The calyx has four rounded lobes. The four petals are much longer than the calyx, rounded, the edges overlapping. The fruit is from 17 to 25 centimeters in diameter and round, with a thick, corky, leathery covering, which usually splits into four pieces as the fruit dries. The fruit contains a number of corky, more or less pyramidal seeds, which float, with the small end up, until after germination.

XYLOCARPUS MOLUCCENSIS (Lam.) M. Roem. (Plate XII). PIAGÁU.

Local names: *Piagáu* (Mindoro, Zamboanga, Negros, Cotabato, Palawan, Guimaras Island); *lagut-út* (Guimaras Island); *tabígi* or *tibígi* (Mindoro and Cotabato); *puyugáu* (Ticao Island); *sangkúyong* (Moro and Jolo); *piadak* (Palawan).

This species differs from the last in being straighter and taller; with dark, flaky bark; smaller fruits, about the size of an orange; and erect air roots. The wood is generally a little harder and darker in color than that of *Xylocarpus granatum*. The heartwood at the base of the trunk is often rotten. This tree reaches a diameter of 65 centimeters. The wood has the same uses as that of *Xylocarpus granatum*.

The leaves are compound, with two or three pairs of leaflets. The flowering branches are slender and from 7 to 25 centimeters in length. The flowers are similar to those of *Xylocarpus granatum*, but have rather broader petals and a shorter style. The fruit is rounded and about the size of a small orange.

PLATE XII. XYLOCARPUS MOLUCCENSIS (PIAGAU).

Family 4, EUPHORBIACEAE

Genus EXCOECARIA

EXCOECARIA AGALLOCHA Linn. (Plate XIII). BUTA-BUTÁ.

Local names: *Bat'áno* (Pangasinan and Cagayan); *butá* (Basilan, Bataan, Mindoro, and Palawan); *buta-butá* (Bataan and Palawan); *lipáta* (Palawan, Agusan, and Camarines); *lipátang-búhai* (Palawan); *alipáta* (Negros); *kulási* (Tayabas and Lanao).

Excoecaria agallocha is a small tree, usually not more than 8 meters in height, growing on firm mud or sand at the edge of the swamp or on relatively firm spots in swamps. The bark is light gray and broadly checked with darker streaks. It contains copious milky sap which is very poisonous, being said even to cause blindness when it touches the eyes.

The leaves are alternate, shiny, pointed at the tip and somewhat rounded at the base, and about 6 to 12 centimeters long. The flowers are very small and are densely crowded on slender flowering branches. The male flowers are found on spikes which grow singly in the axils of the leaves and are from 5 to 10 centimeters long. The female flowers occur on branches which are 2 to 3 centimeters long. There are three sepals, no petals, and three stamens. The fruits are composed of three sections, are somewhat rounded, smooth, and about 5 millimeters in diameter. The wood is pale brownish white, soft, and probably not used for any purpose but fuel.

Family 5, TILIACEAE

Genus BROWNLOWIA

BROWNLOWIA LANCEOLATA Benth. MARAGÓMON.

Local name: *Maragómon* (Bisaya).

This species is a shrub or a small tree. The leaves are pointed at both ends; 9 to 15 centimeters long, 3 to 4.5 centimeters wide; the upper surface when mature is smooth and shiny, the lower covered by a dense layer of minute, whitish-yellow scales. The inflorescences have few flowers. The flowers are about 6 millimeters long; the stalks about the same length. The calyx is 5 millimeters long, bell-shaped, and divided into three to five lobes. There are five petals, which are longer than the calyx.

Family 6, BOMBACACEAE

Genus CAMPTOSTEMON

CAMPTOSTEMON PHILIPPINENSE (Vidal) Becc. (Plate XIII). GAPAS-GÁPAS.

Local names: *Bungálon* (Tayabas); *gapas-gápas* (Negros, Capiz, Zamboanga); *dandúlit* (Zamboanga); *balúno* (Zamboanga); *libáto-putí', nígi-putí'* (Tayabas).

Fig. 1. Excoecaria agallocha (BUTA-BUTA) with fruits.

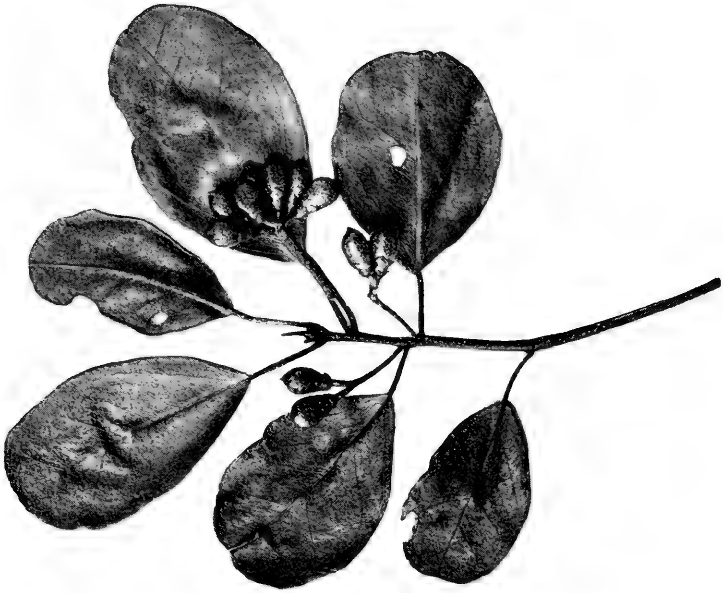

Fig. 2. Camptostemon philippinense (GAPAS-GAPAS) with fruits.

PLATE XIII.

A small tree, 6 to 10 meters high, the vegetative parts, buds, and fruits covered with numerous small round scales. Leaves alternate, rather thick, crowded at the ends of the branches, margin smooth, apex rounded, base narrowed, 5 to 10 centimeters long, 3 to 6 centimeters wide, petioles 2 to 5 centimeters long. Flowers small, crowded at the tips of short axillary stalks. nearly white, and with five petals. The anthers are few in number and crowded at the apex of a short tube. The fruit is a small, pear-shaped capsule, about 1.5 centimeters long, and contains a few small seeds densely covered with a cottonlike substance.

The wood is moderately hard; of smooth, fine texture; pure creamy-white, but bluing easily in seasoning. It is a pretty wood, but little known and rarely cut except with mixed firewood.

Family 7, STERCULIACEAE

Genus **HERITIERA**

HERITIERA LITTORALIS Dryand. (Plate XIV). DÚÑGON-LÁTE.

Local names: *Dúñgon-láte* and *dúñgon* (Tayabas, Baler, Negros, Butuan, Camarines, Masbate, Lanao, Palawan, Zamboanga, Mindoro, Bataan, Cotabato, Zambales, Manila, Misamis, Leyte, Basilan, Surigao, Palaui Island, Sorsogon, Ticao, Guimaras, Agusan); *paunápin* (Cagayan); *magáyao* (Cagayan); *palugápig, paliñgápoi, paronápin, paronápoi* (Cagayan, Pangasinan, Zambales); *baut* (Moro); *malarúñgon* (Tayabas); *paloñgápui* (Iloko); *duñgon-lalao* (Tayabas); *bárit* (Zamboanga); *dumón* (Cagayan); *bayág-kabáyo* (Manila).

This is a tree which grows on the inner part of the swamp and sometimes on dry land just back of the swamp. The bark is light colored and coarsely furrowed. There is a thin outer layer which peels off readily and leaves a dark-brown color. Most of the trees are small and useless, though occasionally large-sized trees are found. It may reach a diameter of about 90 centimeters and have a clear length of 13 meters.

The wood is very hard, heavy, very tough and flexible, but not resilient. The sapwood is up to 6 or 8 centimeters in thickness; in mature trees sharply marked off from heartwood. The heartwood is reddish brown to dark chocolate, often containing masses of stony deposits in old knots and heart cracks. The grain is crossed and sometimes curly; texture fine, dense, smooth, but not glossy. Logs and large timbers are liable to split deeply in seasoning; boards less liable to split, but must be piled carefully and heavily loaded to prevent warping. It is very difficult to work, both on account of its hardness and toughness, and because it dulls tools badly, even when no stony deposits are met. The heartwood is rarely attacked even by termites and only eaten slowly by teredos. The sapwood is rapidly

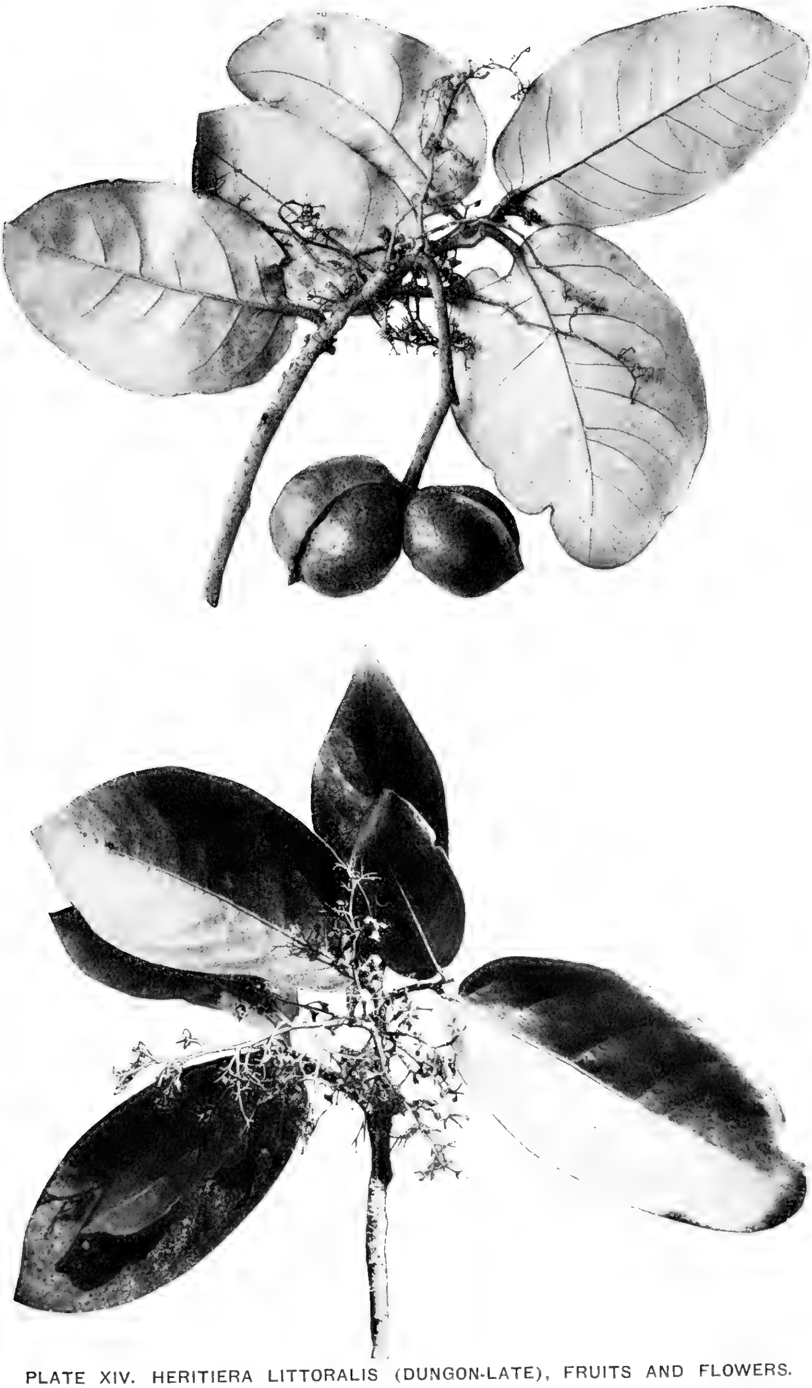

PLATE XIV. HERITIERA LITTORALIS (DUNGON-LATE), FRUITS AND FLOWERS.

attacked by both insects and fungi. The wood is used for piling; posts; foundation sills; ties, paving blocks, bridges, wharfs, and ship buildings; beams, joists, rafters; hubs, spokes, felloes, and axles; capstan bars and other levers; ax, pick, and other tool handles; mallets and other wooden tools; recommended for steamed bent work where great strength and durability are required.

The leaves are 10 to 20 centimeters long, alternate, simple, dark shiny green on the upper surface and silvery below. The flowering branches are borne in the axils of the leaves and are hairy and from 7 to 15 centimeters long with numerous flowers. The flowers are 5 millimeters long, unisexual, yellowish green, and beli-shaped. The flower has no petals. The calyx is usually 5-toothed. The anthers are borne in a ring. The fruit is hard, woody, smooth, shiny, 4 to 8 centimeters long, and boat-shaped.

Family 8, SONNERATIACEAE

Genus SONNERATIA

There are two species of *Sonneratia* in the Philippine mangrove swamps, *Sonneratia alba* and *Sonneratia caseolaris*. These two species can be readily distinguished by the shapes of the leaves. The leaves of *Sonneratia alba* are narrow and pointed at the apex, while those of *Sonneratia caseolaris* are about as broad as long and rounded at the apex.

Key to the species.

Leaves pointed at apex.. *Sonneratia alba.*
Leaves rounded at apex.. *Sonneratia caseolaris.*

SONNERATIA ALBA Sm. (Plate XV). PEDADA.

Local names: *Payar* (Pangasinan); *palapát, palata, pagatpát,* and *hikau-hikáuan* (Bataan); *pagatpát* (Manila, Bataan); *lukabbán, ilukabbán* (Cagayan).

This species is a small tree occurring along the upper stretches of tidal streams. The fruit is slightly acid and is used as an article of food and also for making vinegar. This tree rarely reaches a height of more than 9 meters. One individual with a diameter of 80 centimeters has been reported. The air roots and leaves are distinctly smaller than those of *Sonneratia caseolaris*. The air roots are sometimes used for the manufacture of wooden soles of shoes. The bark contains a moderate proportion of tannin, but is not often used as other species richer in tannin are more readily available.

The wood is whitish and moderately hard. It rarely, if ever, forms heartwood and is cut only with mixed inferior firewoods.

The smallest branches are jointed and four-angled. The leaves

PLATE XV. SONNERATIA ALBA (PEDADA), FRUIT AND FLOWER.

are thick and leathery, narrow, and taper to a broad, short petiole. They are from 4 to 10 centimeters long and from 2 to 4 centimeters wide. The flowers occur singly; the calyx is green, 2.5 to 3 centimeters long, and divided into six to eight angular lobes which are longer than the calyx tube. The petals are six in number, narrow, pink or white, and about as long as the calyx segments. The stamens are very numerous and the style long. The fruit is hard, 3 to 4 centimeters in diameter, rounded but depressed at the apex; the base is surrounded by the calyx tube, the lobes of which still persist when the fruit is mature. The fruit contains many seeds.

SONNERATIA CASEOLARIS (Linn.) Engl. (Plates XVI, XVII). PAGATPÁT.

Local names: *Pagatpát* (Cebu, Camarines, Tayabas, Cagayan, Samar, Agusan, Basilan, Zambales, Cotabato, Palawan, Mindoro, Zamboanga, Panay, Guimaras Island, Negros, Leyte, Bataan, Lanao); *bunáyon* (Dinagat Island); *patpát* (Butuan); *lukabbán, ilukabbán, lukabbaán* (Cagayan); *pirara* and *palalan* (Cotabato); *buñgálon* (Masbate).

This is a tree of the outer part of the swamp, and often occurs even on exposed reefs. The trunk is swollen at the base, at least when young. The air roots are usually from a few centimeters to 60 centimeters in length. In some places along river banks, where the tree is growing in soft mud, they are much longer, and have been known to reach a length of more than 2 meters. The bark is very dark gray. *Sonneratia caseolaris* may reach a diameter of 175 centimeters and a clear length of 26 meters.

The wood is moderately hard and moderately heavy to heavy. The sapwood is 3 to 8 centimeters thick, light grayish brown; the heartwood light brown to dark chocolate. When wet or under varnish, the heartwood of old mature trees looks almost black. The grain is straight or very slightly crossed; the texture fine, very homogeneous, smooth, but not glossy; it has a distinct salty taste and a fishy or swampy odor, especially when fresh. Boards season fairly well, but logs and heavy planks are liable to check internally. It is easy to work. It lasts well in the ground and even the sapwood is rarely attacked by insects; the heartwood is said to resist teredos very well. It is used for piles; posts, poles; ties; paving blocks; ship, bridge, and wharf building; general strong construction; doors; siding, sheathing, ceiling, flooring, and all kinds of interior finish; ship planking and decking; furniture and cabinetwork; and musical instruments. The wood contains a small amount of salt, making the use of copper nails and screws necessary. The air roots are used as floats for fish nets and, being corky in texture, are

Fig. 1. Sonneratia caseolaris (PAGATPAT) on an open coast.

Fig. 2. Air roots of Sonneratia caseolaris (PAGATPAT).

PLATE XVI.

employed in the manufacture of inner soles for shoes and can be used as a substitute for cork or pith.

The small branches are more rounded than in *Sonneratia alba.* The leaves are thick and leathery, rounded at the apex, 6 to 10 centimeters long, and nearly as wide as long. Two or three flower buds are usually found together. The calyx is green, leathery, 3 to 4 centimeters long, and divided into six to nine narrow segments, which are equal in length to the calyx tube or longer. The petals are white, narrow, and fall off very early; they are nearly as long as the calyx segments. Sometimes there are no petals. The stamens are very numerous and the style long. The fruit is hard, rounded, depressed at the apex, 3 to 4 centimeters in diameter, and surrounded nearly to the middle by the calyx tube, the lobes of which are still present when the fruit is mature. The fruit contains many seeds.

Family 9, RHIZOPHORACEAE

The family Rhizophoraceae is the most important one in the mangrove swamps and contains by far the largest number of species. The members of this family in the swamps are distinguished at once from all other species by the fact that the seed germinates and produces an elongated seedling before the fruit drops from the tree. This character is shown clearly in the illustrations of the members of this family. The conspicuous part of the seedling that projects from the fruit is the radicle or young root, which is very much longer than the plumule or young shoot. The family Rhizophoraceae is represented in the swamps by three genera; *Rhizophora, Bruguiera,* and *Ceriops.*

Trees of the genus *Rhizophora* are easily distinguished from all other trees in the swamps by the very numerous prop roots which grow out from the trunk and branches. These are shown very clearly on Plate I. The genera *Bruguiera* and *Ceriops* can be separated by the shapes of the leaves, which in *Bruguiera* are pointed at the apex and in *Ceriops* are rounded and notched at the apex.

Key to the genera.

1. Leaves pointed at apex.
   2. Tip of leaves with prominent projection of midrib................ *Rhizophora.*
   2. Tip of leaves without projection of midrib................................ *Bruguiera.*
1. Leaves rounded and notched at apex.. *Ceriops.*

Genus BRUGUIERA

The genus *Bruguiera* is represented in the Philippines by four species: *Bruguiera conjugata* (busáin), *B. cylindrica* (potótan-laláki), *B. sexangula* (potótan), and *B. parviflora* (lan-

PLATE XVII. SONNERATIA CASEOLARIS (PAGATPAT), FLOWER AND FRUITS.

gárai). The wood is hard and heavy to very heavy; the sapwood 2 to 4 centimeters thick, sometimes merging gradually into the darker heartwood, but often almost indistinguishable from it; the heartwood is pale dull red or reddish brown, sometimes with very irregular, narrow but ill-defined, dark streaks. The grain is straight and the texture fine. Beautiful conspicuous silver grain occurs on radial sections. Logs check badly in seasoning, but sawn lumber seasons without much checking and warping if properly stacked under a roof. The wood is hard to saw, but otherwise easy to work. It is said to last well in wet situations, is rarely attacked by insects, and is said to resist teredos for as much as seven or eight years. It has much the same uses as that of the genus *Rhizophora.*

The leaves of *Bruguiera* are usually leathery in texture, oblong, and entire. The flowers are rather large and are found in the axils of the leaves. The calyx is split into eight to fourteen lobes. The petals are oblong, and equal in number to the calyx-lobes, two-lobed or notched at the apex, embracing the stamens by pairs. There are sixteen to twenty-eight stamens. The ovary is two- to four-celled. The fruit is included in or joined to the calyx tube, is one-celled, one-seeded. The seed germinates on the tree.

The different species of *Bruguiera* are readily distinguished either in flower or fruit except in the case of *Bruguiera conjugata* and *Bruguiera sexangula,* which have forms intermediate in character between typical specimens of the two species. The flowers of *Bruguiera conjugata* and *Bruguiera sexangula* are large, 2.5 to 5 centimeters long; while those of *Bruguiera parviflora* and *Bruguiera cylindrica* are small and about a centimeter in length. The flowers of *Bruguiera conjugata* are typically red with the calyx divided into twelve to fifteen lobes; while the flowers of *Bruguiera sexangula* are usually yellow with the calyx divided into ten lobes. As the calyx-lobes of *Bruguiera* are persistent, the fruits of these two species can be readily distinguished from those of the other two species of the genus by the long calyx-lobes, while the two species themselves can be separated according to the number of the lobes of the calyx. *Bruguiera cylindrica* and *Bruguiera parviflora* can easily be distinguished by the fact that the inflorescences of *Bruguiera cylindrica* bear two or three flowers, while those of *Bruguiera parviflora* have two to five flowers. The petals of *Bruguiera parviflora* are yellow with a brown border at the tip and those of *Bruguiera cylindrica* white. The fruits of these two species are readily distinguished by the fact that in *Bruguiera cylin-*

PLATE XVIII. BRUGUIERA CONJUGATA (BUSAIN) WITH FLOWERS.

drica the calyx-lobes are bent away from the tip of the fruit, while those of *Brugiera parviflora* are erect.

Key to the species.

1. Flowers yellow or red, 2.5 to 5 centimeters long; seedlings more than 6 millimeters in diameter; inflorescences with one flower each.
   2. Flowers usually red.. *Bruguiera conjugata.*
   2. Flowers usually yellow.. *Bruguiera sexangula.*
1. Flowers greenish yellow, about 1 centimeter in length; seedlings less than 6 millimeters in diameter. Inflorescences with two to five flowers.
   2. Sepals bent back from the apex of the fruit........ *Bruguiera cylindrica.*
   2. Sepals erect on fruit, less than one-fourth the length of the ovary. *Bruguiera parviflora.*

BRUGUIERA CONJUGATA (Linn.) Merr. and **B. SEXANGULA** (Lour.) Poir.

These species are very similar, the chief difference between the two being in the color of the flowers, red in the first case and yellow in the second. These are the largest trees among the true mangroves. Full-grown individauls are from 40 to 65 centimeters in diameter and from 18 to 23 meters in height. The trees have an erect habit and thick-ridged, very dark, almost black bark, which contains many large, brown, corky pustules. The inner bark is of much the same character and appearance as that of bakáuan and contains about the same or a slightly larger amount of tannin.

The wood is very much the same in structure and appearance as that of bakáuan, except that it is lighter red. At a short distance from the base of the trees and extending out to a distance often as great as 5 or 6 meters are many air roots or knees, which are formed by roots bending upward and may extend 45 centimeters into the air. The seedlings are stouter and blunter than in the other trees of the family. They germinate and grow to a length of 15 to 25 centimeters before dropping from the tree.

BRUGUIERA CONJUGATA (Linn.) Merr. (Plate XVIII). BUSÁIN.

Local names: *Potótan* (Mindoro, Bataan, Tayabas, Negros, Leyte, Zamboanga, Basilan, and Cagayan); *busai-ing* (Tayabas); *bakáu* (Tinago Island and Zambales); *bakáuan* (Mindoro); *busi-ing* (Mindoro); *bakáu* (Negros); *busáin* or similar forms (Mindoro and Tayabas).

The leaves of *Bruguiera conjugata* are elliptic or elliptic-oblong, pointed at the tip, the base wedge-shaped. When dry the upper surface is shiny, the lower surface dull. The flowers occur singly in the axils of the leaves and are 3 to 4 centimeters in length and when fully opened slightly over 3 centimeters in breadth. The calyx is bell-shaped, leathery in texture and

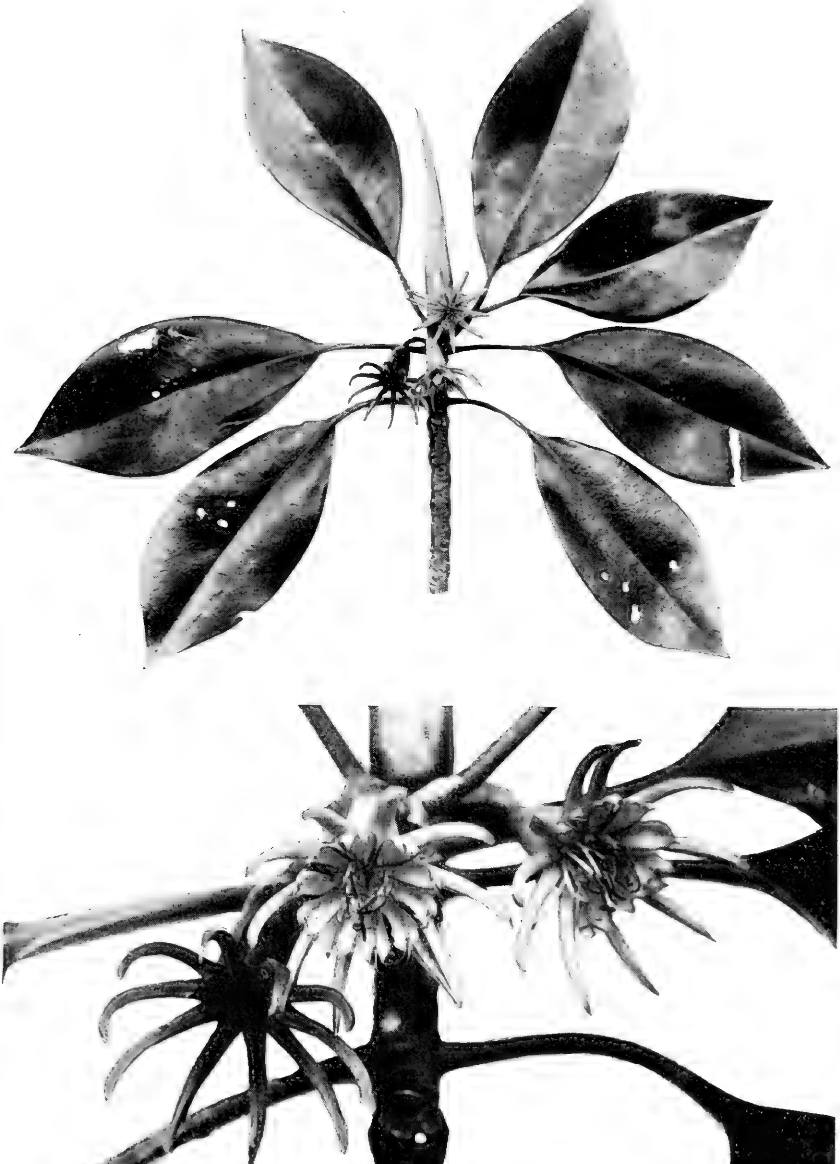

PLATE XIX. BRUGUIERA SEXANGULA (POTOTAN) WITH FLOWERS.

cut for half its length into narrow pointed teeth, usually twelve to fifteen in number. The petals are slightly shorter than the calyx-lobes and equal to them in number, two-lobed at the apex and with two to four bristles at the point of each lobe, hairy at the base, otherwise smooth or nearly so. Opposite each petal are two stamens, which are shorter than the petals. Each alternate filament is short. The fruit is small; it is found in the bottom of the calyx tube and contains a single seed which germinates in situ, forming a cylindrical root 30 to 60 centimeters in length. *Bruguiera gymnorrhiza* Lam. is a synonym of *B. conjugata* (Linn.) Merr.

BRUGUIERA SEXANGULA (Lour.) Poir. (Plates XIX, XX). POTÓTAN.

Local names: *Potótan* or *putútan* (Tayabas, Zamboanga, Mindoro, Masbate, Misamis, Cotabato, and Palawan); *tagása* (Bataan); *busáin, busáing,* etc. (Mindoro, Tayabas, Lanao, and Zamboanga); *sagása* (Cagayan); *álai* (Palawan); *lagásak* (Palaui); *bakáuan* (Manila); *sagásak* (Palaui Island); *langári* (Basilan); *potótan-babáe* (Palauan and Bataan); *bakáuan-laláki* (Bataan); *kalabayúan* (Bataan); *balinsaráyan* (Tayabas).

The leaves of *Bruguiera sexangula* are pointed at the tip, and wedge-shaped at the base; the upper surface is shining, the nerves faint; the lower surface is reddish-brown when dry, the veins are very faint or obsolete, but the midrib is prominent. The flowers are yellow, sometimes tinged with orange, and occur singly in the axils of the leaves. They are usually 3 to 4 centimeters in length and when fully opened about 2.5 centimeters in breadth. The calyx is similar to that of *Bruguiera conjugata,* but the lobes are usually only ten in number. The petals are about half the length of the calyx-lobes and deeply divided into two parts, with a stout bristle in the angle between the two narrow lobes, and sometimes with two bristles at the end of each lobe. The edges are densely clothed with stout white hairs. The fruit is similar to that of *Bruguiera conjugata,* except that the germinating root is shorter.

Bruguiera eriopetala W. & A. is a synonym of *Bruguiera sexangula* (Lour.) Poir.

BRUGUIERA CYLINDRICA (Linn.) Blume (Plates XXI, XXII). POTÓTAN-LALÁKI.

Local names: *Bakáuan* (Mindoro); *biús* (Cotabato); *busáin* (Mindoro); *hiñgáli* (Negros); *lañgárai* (Cotabato); *magtoñgóg* (Masbate); *potótan* and *potótan-laláki* (Tayabas and Mindoro); *tañgál-babáe* (Mindoro); *kalapínai* (Union); *buis* (Moro); *tañgálan* (Mindoro); *biuis* (Pangasinan); *magtañgúd* (Masbate); *biuas* (Bataan).

Bruguiera cylindrica has flowers intermediate in size between those of *Bruguiera conjugata* and *Bruguiera parviflora.* The tree is usually of low growth, otherwise it is much like *Bruguiera*

PLATE XX. BRUGUIERA SEXANGULA (POTOTAN) WITH IMMATURE FRUIT.

PLATE XXI. BRUGUIERA CYLINDRICA (POTOTAN-LALAKI), FRUITS AND FLOWERS.

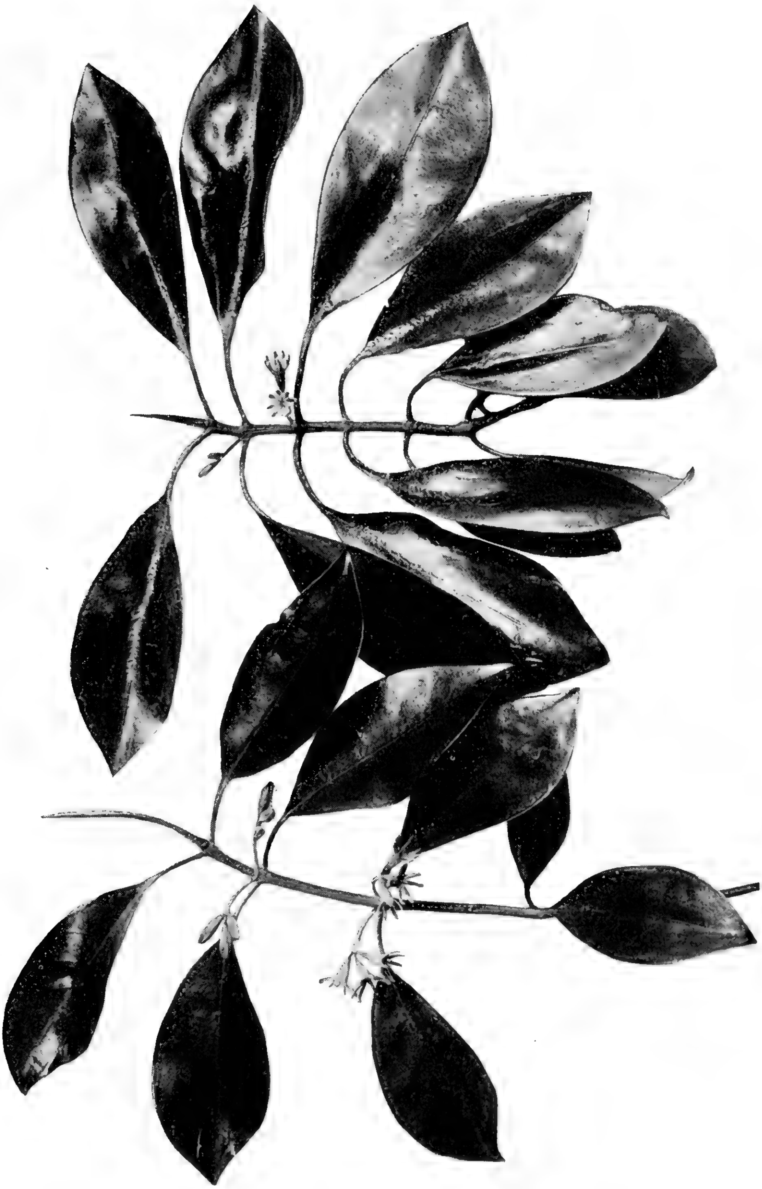

PLATE XXII. BRUGUIERA CYLINDRICA (POTOTAN-LALAKI) WITH FLOWERS.

parviflora. This species occurs in the Philippines in an exceedingly small amount. Swamps are frequently found which do not contain it, and it is usually of small size.

Bruguiera cylindrica has rather thin leaves. They are soft, 7 to 12 centimeters in length, shiny, and narrowed at both ends. The flowering stalks are found in the axils of the leaves; they are usually shorter than the petioles and bear two to three flowers. The flowers are greenish, about 1 centimeter long and slightly over a centimeter broad. The calyx is green and divided into seven or eight narrow fleshy lobes. The petals are white, equal in number with, but shorter than, the calyx-lobes. The apex of each petal is divided into two lobes; the margins have scanty white hairs outside; the apices are rounded and each is crowned with from three to five brown bristles, while one bristle is found in the angle between the two lobes. The stamens are sixteen in number and unequal in length. The germinating root is cylindrical and reaches a length of 15 to 20 centimeters before the seed falls from the tree. *Bruguiera caryophylloides* Blume is a synonym of *Bruguiera cylindrica* (Linn.) Blume.

BRUGUIERA PARVIFLORA W. & A. (Plates XXIII, XXIV). LAÑGÁRAI.

Local names: *Potótan* (Tayabas, Cagayan, Zamboanga); *hañgálai* or *hañgárai* (Mindoro, Masbate, Leyte, Iloilo, Negros); *hiñgálai* (Polillo); *lañgárai* or *lañgári'* (Zamboanga, Tayabas, Masbate, Negros, and Zambales); *bakáuan-laláki* (Batangas); *bubutígan, biósan* (Samar).

Bruguiera parviflora is a tall, slender tree which is often found in solid stands in the interior of the swamp. Trees 15 to 30 centimeters in diameter and 12 to 18 meters in height are full grown, but trees up to 55 centimeters in diameter are found. The bark is gray, hard, and thick, and has broad, smooth ridges. The air roots are similar to those of *Bruguiera conjugata* and *B. sexangula,* but usually smaller; the wood, except for being lighter in color, is also much like that of these two species.

The seedling is of the same color as the leaves, slender and nearly cylindrical. The roots of the seedling grow to about 10 or 12 centimeters in length before the seed drops from the tree.

The leaves of *Bruguiera parviflora* are yellowish green, 6 to 10 centimeters in length, and rather narrow, particularly at the base. The upper surface is shiny, the lower dull. The flowering shoots are in the axils of the leaves and bear two to five yellowish-green flowers. The whole flowering shoot, including the flowers, is considerably longer than the petioles of the leaves. The flowers are about a centimeter in length and about 6 millimeters in breadth. The calyx tube is cylindrical and ends in eight pointed lobes about one-fourth the length of the calyx tube.

PLATE XXIII. BRUGUIERA PARVIFLORA (LANGARAI) WITH FLOWERS.

The petals are the same in number as the calyx-lobes but shorter. They are yellow with a dark brown border at the tip. They are two-lobed and each bears three or four hairs, while a single hair is found between two lobes; otherwise the petals are smooth. The stamens are sixteen in number and of unequal size; two are embraced by each petal.

Genus CERIOPS

The two species of *Ceriops, C. tagal* and *C. roxburghiana,* are known as tañgal. They are separated only by very minute floral characters. Tañgál is a small tree with rather smooth, light gray or brown bark, which is perforated in many places by dark-colored lenticels. Below the outer corky layer, there is more or less orange color. The bark contains a high percentage of tannin. The trunk flares at the base. A short distance from the trunk some of the roots bend upward to form small knees.

The sapwood is small in amount and scarcely distinct from the heartwood. The heartwood is very hard and heavy, orange red, changing on exposure to reddish brown. It gives an iridescent orange-red color to water. The grain is straight and the texture fine and dense, taking a smooth, almost polished surface under sharp tools. It does not check badly, but is somewhat liable to warp in seasoning and is not difficult to work except for its hardness. The wood is used for much the same purposes as that of *Rhizophora.*

The leaves are leathery in texture, opposite, and wider toward the apex than near the base. They are notched at the apex. The flowers are small and light greenish yellow. The calyx has five or six lobes. The petals, five or six in number, are inserted at the base of a ten- to twelve-lobed fleshy disk. There are ten to twelve stamens, whose stalks are inserted between the lobes of the disk. The style is short and the stigma simple. The seedlings are angled in cross section and may reach a length of about 35 centimeters before falling from the tree.

Tañgál is found near the mouths of tidal streams. Full-grown trees are from 15 to 40 centimeters in diameter and from 8 to 11 meters in height.

Key to the species.

Flowers few on an inflorescence, each with a short stalk; apex of petals with three to four club-shaped appendages .... *Ceriops tagal.*
Flowers few on an inflorescence, without individual stalks; apex of petals lacerate, that is with a torn appearance .... *Ceriops roxburghiana.*

CERIOPS TAGAL (Perr.) C. B. Rob. TAÑGÁL.

Local names: *Tañgál* (Tagalog, Bisaya, Zambales, and Zamboanga); *tuñgód* (Bisaya in Negros); *tañghál* (Mindoro); *magtoñgód* (Mindoro);

PLATE XXIV. FRUIT OF BRUGUIERA PARVIFLORA (LANGARAI).

tañgál-lalaki (Mindoro); *tuñgúd* (Jolo); *toñgóg* (Masbate); *tagása* (Bataan); *pakat* (Palawan); *tonggui* (Culion); *tuñgóg* (Visayan); *róñgon* (Zambales); *rúñgon* (Pangasinan).

The leaves of *Ceriops tagal* are from 5.5 to 7 centimeters in length and from 2 to 4.5 centimeters in breadth; the petioles, from 2 to 3 centimeters in length. The flowers are about 6 millimeters long and are borne on short stalks. The calyx-lobes are oblong and somewhat blunt. The petals are oblong; the apex flat or notched and with three or more club-shaped appendages. Stamens ten, nearly as long as the petals.

Ceriops candolleana H. & A. is a synonym of *Ceriops tagal* (Perr.) C. B. Rob.

CERIOPS ROXBURGHIANA Arn. (Plates XXV, XXVI). TAÑGÁL.

Local names: *Matañgál* (Bataan); *tañgál* (Tayabas and Camarines); *tuñgung* (Surigao); *bakáuan* (Bataan and Mindoro); *bulubadiáng* (Panay); *tuñgúg* (Negros).

Ceriops roxburghiana has leaves up to 11 centimeters in length and 6 in breadth, petioles 1.5 to 3 centimeters in length. The flowers are about 5 millimeters long and about 5 millimeters broad and do not have individual stalks. The five or six calyx-lobes are short and somewhat pointed. The petals are oblong, white when young, turning to brown; the apex notched or slightly flattened and with a torn appearance.

Genus RHIZOPHORA

Bakáuan is the name given to the species of *Rhizophora*. These make up a very large part of the swamp and are often the most conspicuous constituent of it.

These trees are distinguished from all others by their much-branched prop roots, which hold the trees up out of the water. This is perhaps the reason why the wood of these trees is usually sounder than that of others from the swamp. Besides the roots which come out from the base of the trunk, there are often large numbers of roots developed from the lower branches. The bark is very dark, almost black, coarsely ridged, and about 2 centimeters thick. It contains a high percentage of tannin.

The sapwood is yellow or whitish; the heartwood dark orange to reddish brown. The transition from sapwood to heartwood may be either gradual or abrupt. The wood is hard and heavy. The sapwood is 3 to 5 centimeters thick, and in old trees very sharply distinguished from the dark heartwood. The grain is straight and the texture fine and dense. It has a conspicuous

PLATE XXV. CERIOPS ROXBURGHIANA (TANGAL) WITH FLOWERS.

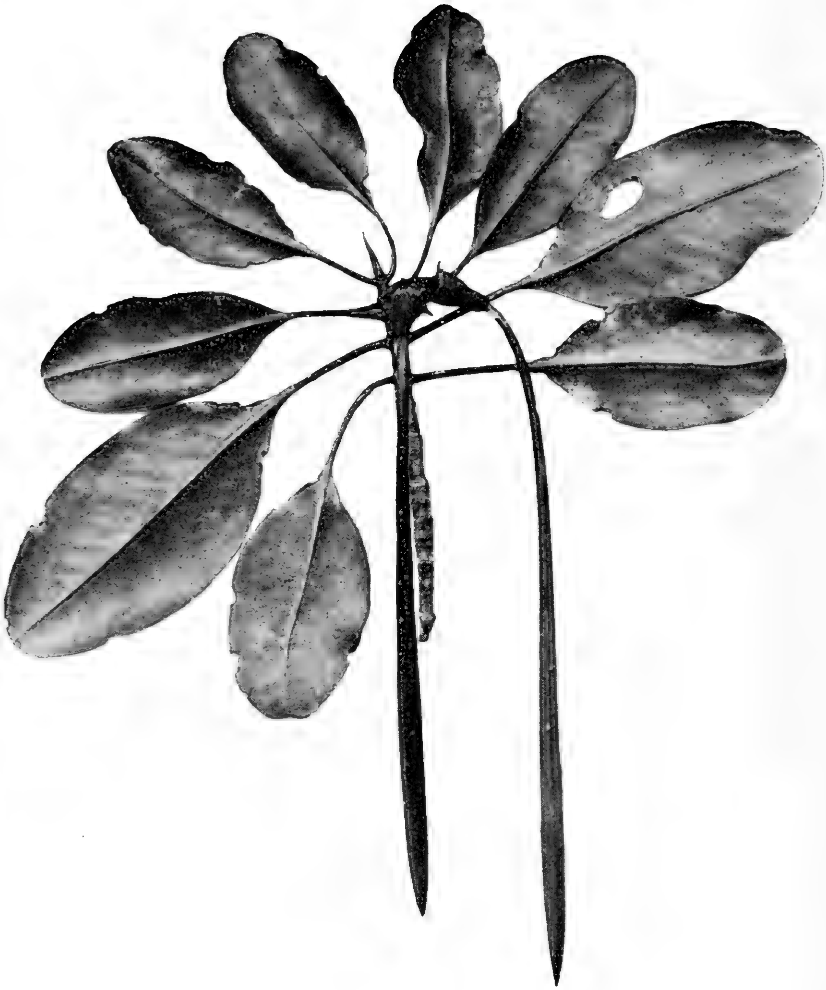

PLATE XXVI. CERIOPS ROXBURHIANA (TANGAL) WITH FRUITS.

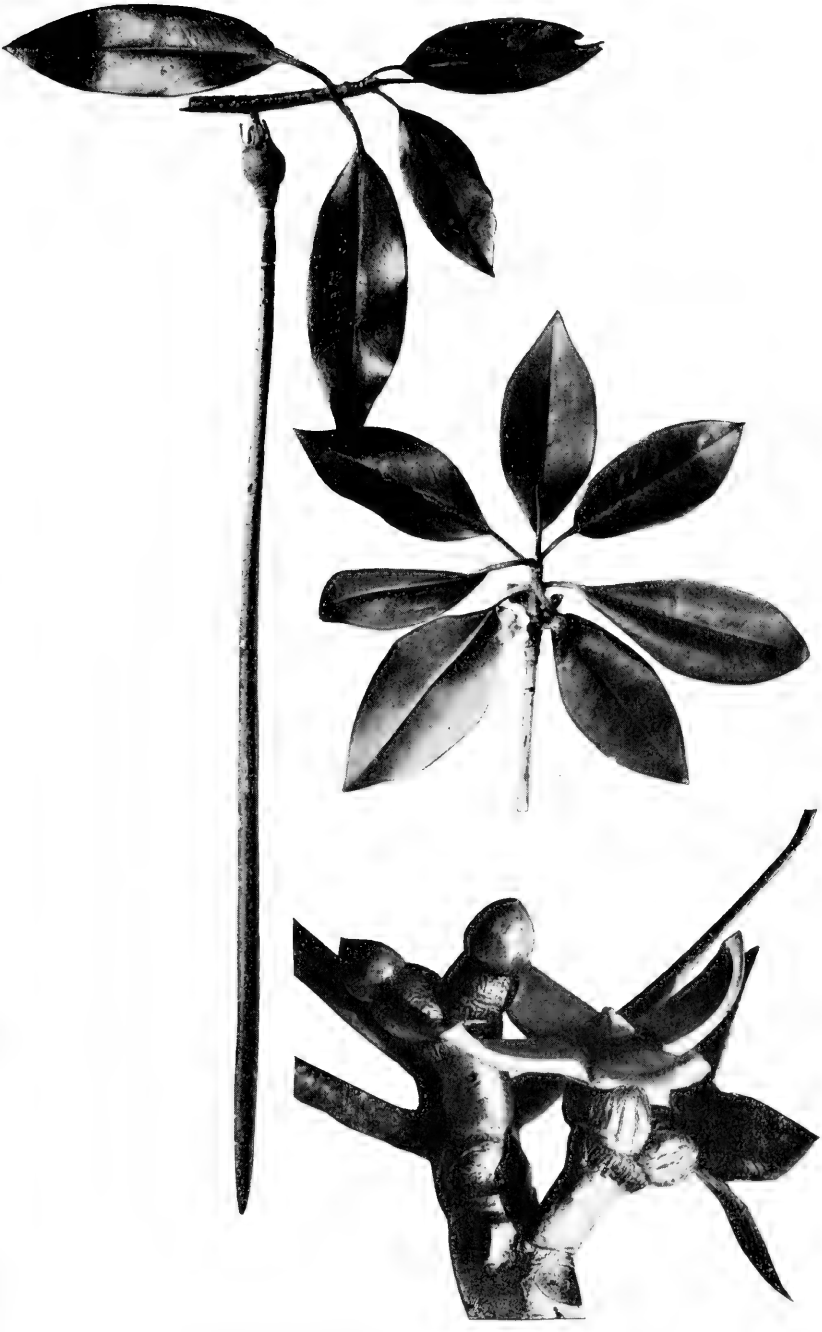

PLATE XXVII. RHIZOPHORA CANDELARIA (BAKAUAN-LALAKI), FRUIT AND OLD FLOWERS FROM WHICH PETALS HAVE FALLEN.

silver grain. Logs and large timbers are liable to check badly; but if the wood is properly sawn and carefully stacked, it seasons with little warping and splitting. It is hard to saw, but not otherwise difficult to work. It lasts well in wet situations and is rarely attacked by insects.

The wood is used for salt-water and foundation piling, mine timbers, house posts, furniture, and cabinet-work; if properly sawn and carefully seasoned, it would make an excellent flooring. On account of its shape, great strength, and durability when submerged in fresh water, it is specially recommended for submerged foundation piles.

The pear-shaped fruit is brown, with a granular or roughened surface. The seedling is long, spindle-shaped, and green. It grows downward and out of the fruit before the latter falls from the tree. The surface of the seedling is very smooth, except for occasional dark-brown lenticels which project from the surface. The seedling grows to a length of 75 to 100 centimeters before dropping into the mud, where it promptly takes root. The maximum diameter attained by bakáuan is about 60 centimeters; exceptional trees sometimes have a clear length of 25 meters. The average dimensions are, however, much smaller than the figures just given. Where there is an abundance of light, the bole is usually crooked, low branched, and practically worthless except for firewood. In the interior of the forest bakáuan is fairly straight, round boled, and has a moderately spreading crown.

The calyx is four-lobed. The petals are four in number, and slightly shorter than the calyx-lobes.

The two species of *Rhizophora* are easily distinguished, either in flower or fruit. The inflorescence stalks of *Rhizophora candelaria* are very short, being shorter than the petioles, occur below the leaves, and each bears two flowers. The inflorescence stalks of *Rhizophora mucronata* are among the leaves, as long as the petioles, and each bears from three to seven flowers. The fruits of the two species are easily separated by the length of the stalks. All of these characters are shown plainly in the illustrations of the species.

Key to the species.

Flowers below the leaves; inflorescences with two flowers; stalks of inflorescences shorter than the petioles .... *Rhizophora candelaria.*

Flowers among the leaves; inflorescences with three to seven flowers; stalk of inflorescences as long as the petioles .... *Rhizophora mucronata.*

PLATE XXVIII. RHIZOPHORA MUCRONATA (BAKAUAN-BABAE), INFLORESCENCES AND FLOWER.

RHIZOPHORA CANDELARIA DC. (Plates I, XXVII). BAKÁUAN-LALÁKI.

Local names: *Bakáuan* (Tagalog); *bakáu* (Visayan); *bakáuan-babáe* (Tagalog and Bisaya, Zamboanga); *uakátan* (Mindoro); *bakáuan-laláki* (Mindanao); *bakad* (Zambales); *bakháu* (Samar, Capiz); *bakáu-laláki* (Pampanga); *bangkáu* (Davao).

The leaves of *Rhizophora candelaria* are 10 to 16 centimeters in length, leathery in texture, green and shiny, and oblong-elliptic in shape. The apex is pointed or ends in a thornlike prolongation of the midrib. The stalks of inflorescences are found in the axils of fallen leaves and are shorter than the petioles of the leaves. Two flowers are borne on each inflorescence stalk. The flowers are pale greenish yellow.

This species is usually known by the erroneous name *Rhizophora conjugata.*

RHIZOPHORA MUCRONATA Lam. (Plates XXVIII, XXIX). BAKÁUAN-BABÁE.

Local names: *Bakáuan* (Tagalog); *bakháu* (Surigao); *bakáu* (Negros); *bakáuan-laláki* (Zambales); *bakáuang-laláki* (Zamboanga); *bangkáu* (Tagalog in Tayabas).

The leaves of *Rhizophora mucronata* are leathery in texture, oblong-elliptic, shiny, and up to 16 centimeters in length. The apex of the leaf terminates in a slender, thornlike prolongation of the midrib. The inflorescence stalks are among the leaves. They are from 2.5 to 4 centimeters in length, about as long as the petioles of the leaves, forked at the apex, and bear from three to seven flowers. The flowers are white to cream color.

Family 10, COMBRETACEAE

Genus LUMNITZERA

Key to the species.

Flowers scarlet .... *Lumnitzera littorea.*
Flowers white .... *Lumnitzera racemosa.*

LUMNITZERA LITTOREA Voigt. (Plate XXX). TABÁU.

Local names: *Batíng* or *baktíng* (Tawi-tawi, Jolo); *dalúru-babáe* (Tayabas); *sagása'* (Dinagat Island); *maóro* (Surigao); *kolasíman* (Culion Island); *libáto* (Tayabas, Polillo, Palawan); *panting-pantíng* (Basilan); *kalapíni'* (Zambales); *kulási* (Mindoro); *bulokbúlok* (Negros Occidental); *agnáia* (Zambales); *karifurúg* (Cagayan); *aniláí* (Mindoro); *papásil* (Tayabas); *magalolo* (Polillo); *santíng* (Moro and Tawi-tawi); *tabáu* (Capiz, Negros, Zamboanga, Sorsogon, Masbate); *dulokdúlok* (Masbate); *sala'sá* (Occidental Negros).

This species is a tall tree found along rivers in the swamps,

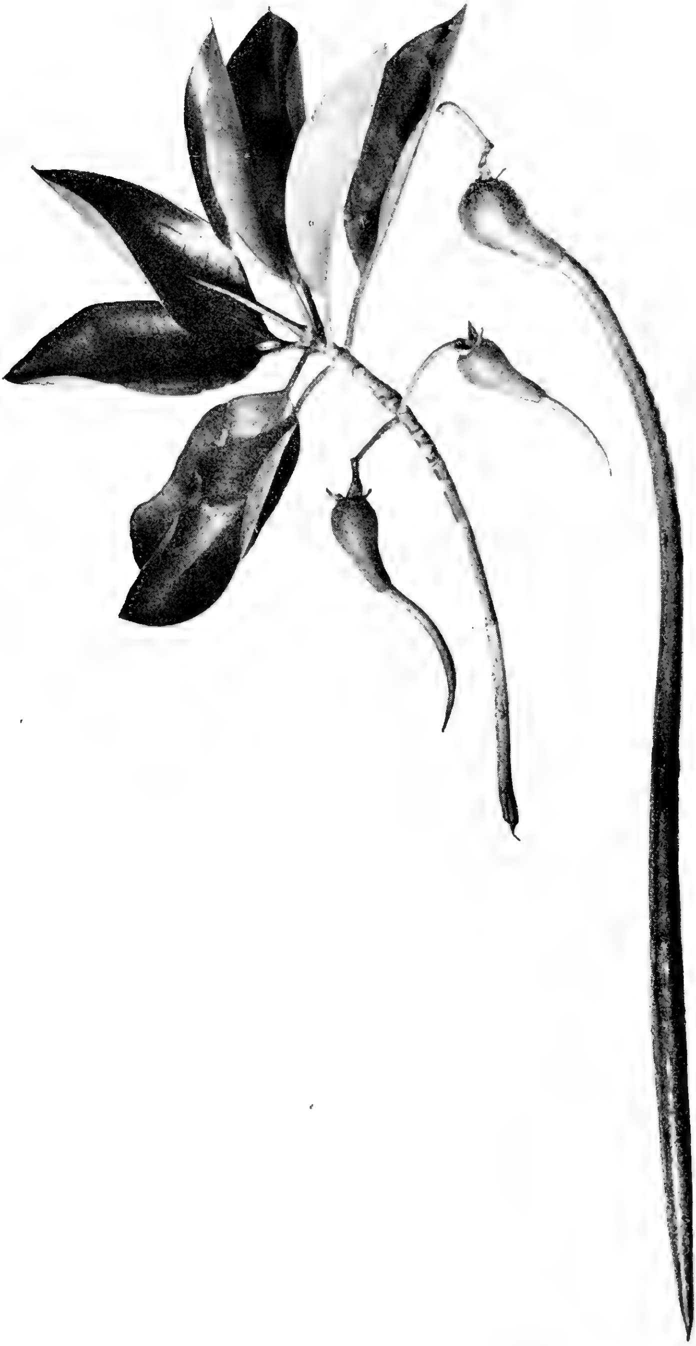

PLATE XXIX. RHIZOPHORA MUCRONATA (BAKAUAN-BABAE) WITH FRUIT.

and a smaller tree or shrub where conditions for growth are less favorable. It reaches a diameter of 50 centimeters and a height of 18 meters. The bark is gray when the tree is young and often nearly black when mature, coarsely furrowed, rather thick and corky. The air roots are few in number and similar to those of *Bruguiera conjugata, B. sexangula,* and *B. cylindrica.*

The wood has a distinct roselike odor when fresh. The sapwood and heartwood are not very different in color; the wood is pale brown, straight grained, dense and smooth, with a fine texture, and takes a silky finish under a sharp plane. It seasons well and is easy to work. It is used for piles, poles, house posts, ties, paving blocks, bridges, and wharves, general strong construction, ship planking and decks, handles, and cabinet-work.

The leaves are 5 to 8 centimeters long, alternate, very thick and fleshy, rounded at the apex and notched, and clustered toward the ends of the twigs. The petioles are very short. The flowers are bright scarlet and about 8 millimeters in length. They are borne in considerable numbers at the ends of branches. The calyx tubes terminate in five lobes. The petals are scarlet, five in number, and about 7 millimeters long. There are five to ten, but usually seven stamens, which are the same color and twice as long as the petals. The fruit is woody, elongated, about 2 centimeters long and 7 millimeters wide, narrowed at each end, crowned by a persistent calyx rim, and contains a single seed.

LUMNITZERA RACEMOSA Willd. KULÁSI'.

Local names: *Tabáu* (Iloilo, Tayabas); *sulási'* (Rizal, Manila); *kulási'* (Bataan).

This species differs from the last in being of much smaller size and in having white flowers. This tree grows in mud in the swamp or in sand at the edge of the swamp. The wood is like that of *Lumnitzera littorea.*

The leaves are fleshy, green, shiny, 2.5 to 7 centimeters in length, the apex rounded and notched, the base pointed, the petioles very short. The flowering shoots are borne in the axils of leaves and are from 2 to 6 centimeters long. The calyx is green, 5 to 6 millimeters long, with five short lobes. The petals are white, about 4 millimeters long, and five in number. The stamens are white, about as long as the petals, and five to ten in number. The fruit is woody, green, oblong, about 1.5 centimeters long, narrowed at both ends, crowned by the persistent calyx rim, and contains a single seed.

PLATE XXX. LUMNITZERA LITTOREA (TABAU), FRUITS AND FLOWERS.

Family 11, MYRTACEAE

Genus OSBORNIA

OSBORNIA OCTODONTA F. Muell. (Plate XXXI). TAWALIS.

Local names: *Tuawis* (Palawan); *tiwayos* (Masbate); *gunhun* (Basilan); *maligáng* (Polillo Island); *tawalis* (Tayabas, Camarines); *sagasá'* (Iloilo); *tabáu* (Negros); *duluk-dúluk* and *sagasá'* (Negros); *monotbonót* (Leyte); *kulási'* (Zamboanga).

Osbornia octodonta is a small tree with a very crooked trunk. The bark is reddish brown and very shaggy, and is sometimes used in the caulking of boats. The wood is light grayish brown, fine grained, and exceedingly durable.

All parts of the plant are smooth except the flowers, which are hairy. The leaves are opposite, rounded at the tip, pointed at the base, about 4 centimeters long, and 1 to 2 centimeters wide. The flowers are white, less than a centimeter in length, without stalks, and are borne either singly or in groups of a few flowers either in the axils of the leaves or at the ends of branches. Petals are lacking. The calyx is bell-shaped and terminates in eight lobes. The fruit is included within the calyx tube and contains one or two seeds.

Family 12, MYRSINACEAE

Genus AEGICERAS

Key to the species.

Leaves up to 4.5 centimeters wide; flowers in rounded clusters, all of the flower stalks joined at about the same point........ *Aegiceras corniculatum.*
Leaves 3 centimeters wide or less; flowers in compound inflorescences. *Aegiceras floridum.*

AEGICERAS CORNICULATUM (Linn.) Blanco. (Plates XXXII-XXXIV). SAGING-SÁGING.

Local names: *Timbambákis, pilápil, pagatpát, pipisík* (Bataan); *saging-ságing* (Capiz, Negros, Lanao, Surigao, Mindoro); *kindug-kindúg, sulásig, tinduk-tindúkan* (Tayabas); *dumanai* (Cagayan); *tindok-tindók* (Leyte, Tayabas); *tindók* (Mindoro); *tunduk-tundúkan* (Polillo Island); *batag-batág* (Zambales); *bulali* (Negros); *tayokón* (Surigao).

Aegiceras corniculatum is a small tree or shrub which is found along streams in the inner part of the swamp and, occasionally, on more or less sandy spots in the outer part of the swamp. The bark is dark brown. The tree rarely exceeds 8 meters in height and is usually much smaller.

The leaves are alternate, leathery, smooth, rounded and notched at the apex, somewhat pointed at the base, usually from 4 to 10 centimeters in length, and 2.5 to 6 centimeters wide; the

PLATE XXXI. OSBORNIA OCTODONTA (TAWALIS) WITH FRUITS.

PLATE XXXII. AEGICERAS CORNICULATUM (SAGING-SAGING) WITH FLOWERS.

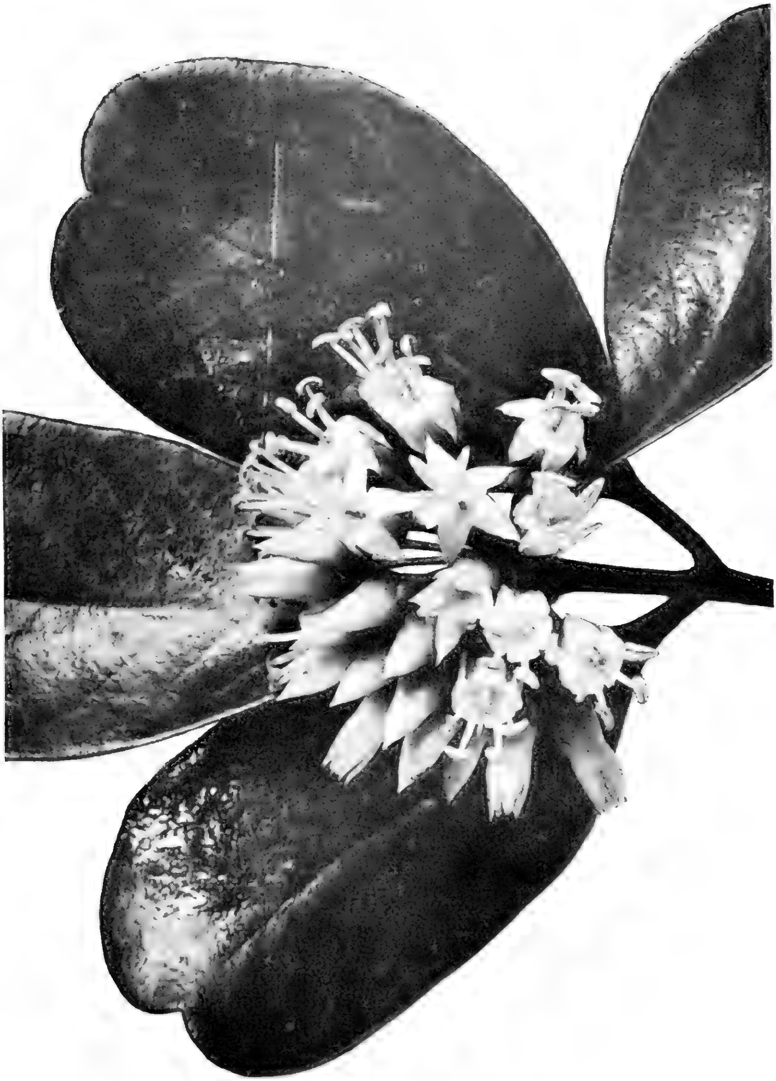

PLATE XXXIII. FLOWERS OF AEGICERAS CORNICULATUM (SAGING-SAGING).

midrib is slender; the petioles are usually about a centimeter or less in length. The flowers are fragrant and borne in rounded clusters, the bases of the stalks all rising from nearly the same point. The flower stalks are slender and 1 to 2 centimeters in length. The calyx has 5 lobes, which are leathery, twisted to the left and overlapping to the right, and about 6 millimeters long. The corolla is white and has a short tube about 6 millimeters long with five pointed lobes, which overlap to the right in the bud and are about as long as the tube. There are five stamens, which are inserted on the corolla tube and are longer than the corolla lobes. The fruit is shaped like a miniature banana except that it usually ends in a sharp point. It is up to 7 centimeters in length and contains a single, elongated seed which fills the cavity of the fruit.

AEGICERAS FLORIDUM R. and S. (Plate XXXV). TINDUKTINDÚKAN.

This species is much less abundant than *Aegiceras corniculatum* and differs from it in having smaller leaves, which are 3 centimeters or less in width, and in having branched inflorescence stalks.

Family 13, APOCYNACEAE

Genus **CERBERA**

CERBERA MANGHAS Linn. (Plate XXXVI). BARAIBÁI.

Local names: *Buto-butó* (Surigao, Dinagat Island); *bayag-usá, pandakáki* (Camarines); *baraibái* (Baler); *buta-butá* (Bataan); *bat'áno* (Camiguin Island); *kúbi* (Zambales); *ditá* (Moro); *lipáta* (Palawan); *panabulón* (Negros); *duñgás* (Cotabato).

Cerbera manghas is usually a shrub, although it may sometimes grow into a small tree. It occurs in situations similar to *Excoecaria agallocha. Cerbera manghas* has milky sap like that of *Excoecaria.*

The leaves are shiny, narrowed at both ends, and about 20 centimeters long. The flowers are white, fragrant, about 5 centimeters in diameter, and occur on terminal branches. The calyx tube is short and ends in five lobes, which are spreading, pale green, pointed, and about 2 centimeters long. The corolla tube is slender, greenish white, large above, and about 4 centimeters long. The upper part of the corolla is spreading, about 5 centimeters in diameter, white with a purple center, and divided into five lobes. The fruit is smooth, green, rounded, and about 6 centimeters long.

Cerbera odollam Gaertn. is a synonym of *Cerbera manghas* Linn.

PLATE XXXIV. AEGICERAS CORNICULATUM (SAGING-SAGING) WITH FRUITS.

PLATE XXXV. AEGICERAS FLORIDUM (TINDUKTINDUKAN) WITH IMMATURE FRUITS.

PLATE XXXVI. CERBERA MANGHAS (BARAIBAI), FLOWERS AND FRUIT.

Family 14, VERBENACEAE

Genus AVICENNIA

Trees of *Avicennia* are distinguished from all others in the swamps by the lower surface of the leaves being light gray or white. This character is most nearly approched in *Heritiera,* the lower surfaces of the leaves of which have a silvery appearance.

Key to the species.

Tips of leaves usually somewhat rounded.................... *Avicennia officinalis.*
Tips of leaves pointed.. *Avicennia alba.*

AVICENNIA OFFICINALIS Linn. (Plates XXXVII, XXXVIII). API-ÁPI.

Local names: *Miápi* (Samar, Leyte, Masbate); *api-ápi* (Capiz, Bataan, Davao, Zamboanga, Cotabato, Palawan, Mindoro); *kalapíni mañgit-ít* (Zambales); *buñgálon* (Marinduque, Tayabas, Pangasinan, Zambales, Mindoro, Capiz, Iloilo, Camarines, and Negros); *kulási* (Cotabato); *kalapíni'* (Pangasinan, Bataan, and Zambales); *pipisíg* or *pipisík* (Tayabas, Camarines, Mindoro); *piápi* (Iloilo, Capiz, Agusan, Tayabas); *liñgóg* (Cagayan); *piksík* (Mindoro).

This species is a tree of the outer part of the swamp. The bark is usually light gray or brown and rather smooth but finely checked by small cracks. The air roots are numerous, small, 8 to 20 centimeters high, and conical. This species is of little value. In swamps where cutting has been excessive, and more valuable species removed, the latter are often largely replaced by *Avicennia officinalis.*

The wood is hard, heavy, brittle, but difficult to split, having an exceedingly crossed spiral grain. The sapwood is 4 to 6 centimeters thick, whitish, turning in drying to gray or light brown, in large trees sharply marked off from heartwood. The heartwood is purplish gray. The grain is very conspicuous from alternate bands of hard and soft tissue, very strongly crossed, often irregularly wavy. The texture of the hard tissue is extremely fine and dense; of the soft tissue, somewhat coarser. The wood seasons well, but the sapwood is liable to stain badly if not seasoned quickly. It is not difficult to work. The durability is said to be poor, but the wood is rarely attacked by beetles. It is used locally for rice mortars; is a favorite in some regions for smoking fish; a wood that for its peculiar color and attractive grain should find a good place in small cabinetwork; recommended for trial in creosoted paving blocks.

The leaves are leathery, opposite, dark green above, very pale and hairy beneath, usually somewhat rounded at the apex, narrow at the base, 5 to 10 centimeters long and 2.5 to 5 centimeters broad; midrib stout and very prominent. The flowers

PLATE XXXVII. AVICENNIA OFFICINALIS (API-API), FLOWERS AND IMMATURE FRUIT.

are small, without individual stalks, and are in small heads on stiff angular flowering stalks, which occur either two together in the axils of the upper leaves or several at the end of a branch. There are three to seven flowers in each head. The corolla is orange-yellow. The corolla tube is very short, cylindrical, and has four lobes. The lobes are 5 millimeters in length, hairy without, and nearly smooth within. The calyx has five lobes, which are 2 to 8 millimeters long, hairy on the margins; the lower part of the back hairy, the rest smooth. There are four stamens, which are inserted on the throat of the corolla and extend beyond the corolla. The fruit is a capsule, 2.5 to 4 centimeters long, and contains a single seed which completely fills the capsule.

AVICENNIA ALBA Blume. API-ÁPI.

Local names: *Kachúchis* (Surigao); *piápi* (Misamis); *pundúng* (Cotabato).

This species is apparently less abundant than *Avicennia officinalis* and differs from it largely in inconspicuous floral characters. The wood appears to be identical with that of *Avicennia officinalis.*

The leaves are leathery, pointed at the apex, narrowed at the base, either smooth on both surfaces or with whitish hairs beneath, especially when young; 5 to 7 centimeters long, 2.5 to 5 centimeters broad. The midrib is prominent. The flowers, without individual stalks, grow either in small heads or in spikes. The calyx has segments, which are thick, 2.5 millimeters long, fringed with hair, and slightly hairy at the back near the base. The corolla tube is very short and sometimes almost lacking. It has four smooth pointed lobes, 2.5 millimeters long. There are four stamens inserted on the corolla throat. These do not reach to the end of the corolla. The fruit is a capsule 1 to 2 centimeters in length and contains one seed which completely fills the lower part of the capsule.

Family 15, ACANTHACEAE

Genus ACANTHUS

Key to the species.

Flowers blue; corolla about 4 centimeters long................. *Acanthus ilicifolius.*
Flowers white; corolla about 2 centimeters long.......... *Acanthus ebracteatus.*

ACANTHUS ILICIFOLIUS Linn. (Plate XXXIX). DILIUÁRIU.

Local names: *Lagoilói* (Agusan); *gregorio* (Bisaya); *dagudri, galura, tindoi, tinlui* (Tagalog); *daluári* (Bataan); *santing-santing* (Moro); *duluáriu* (Mindoro); *diliuariu* (Manila).

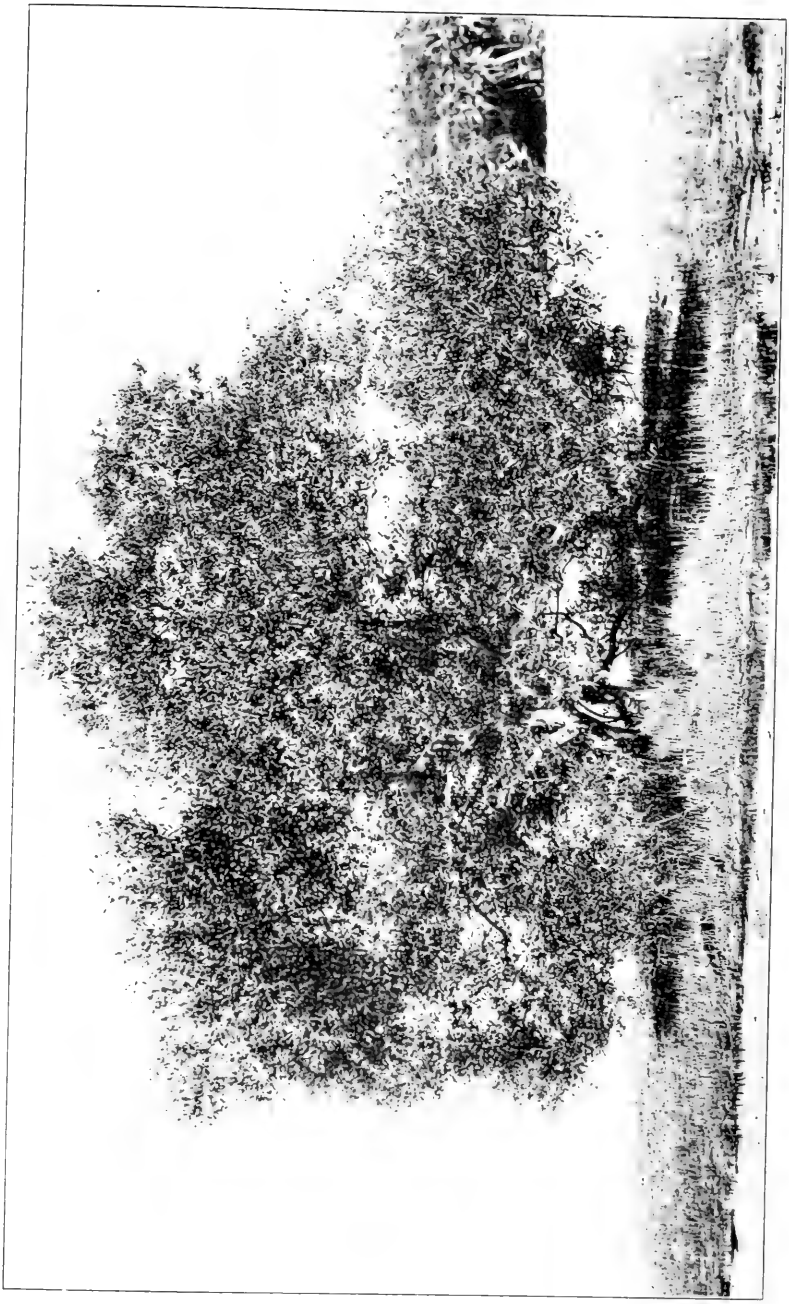

PLATE XXXVIII. AVICENNIA OFFICINALIS (API-API) WITH AIR ROOTS.

Acanthus ilicifolius is a shrub 0.5 to 1.5 meters high. It has prop roots. The leaves are opposite and up to 18 centimeters in length and 8 in breadth. They have very short petioles. The flowers are about 4 centimeters long, borne on spikes, and are surrounded by two bracts and a bracteole. The calyx is divided near the base into four parts, two of which are much longer than the other two. The fruit is a capsule from 2 to 2.5 centimeters long.

ACANTHUS EBRACTEATUS Vahl. TIGBÁU.

This species is also known by the same names as *Acanthus ilicifolius.* The flowers of *Acanthus ebracteatus* are surrounded by two bracts but no bracteole. The corolla is white and about 2 centimeters long. The calyx is shorter than in *Acanthus ilicifolius.* Otherwise the species is similar to *Acanthus ilicifolius.*

Family 16, RUBIACEAE

Genus SCYPHIPHORA

SCYPHIPHORA HYDROPHYLLACEA Gaertn. (Plate XL). NÍLAD.

Local names: *Arinaya* (Ilocos Norte); *landíng* (Culion, Tayabas); *tugisak* (Cotabato); *balasiái* (Zambales); *kulási'* (Tayabas); *hanbulali, tabáu* (Negros); *sagasá* (Zamboanga); *nílad* or *nílar* (Tagalog).

Scyphiphora hydrophyllacea is a small tree growing along streams in the swamps. It has dark-colored bark. All parts of the plant except the inside of the corolla tube are without hairs.

The leaf blades are smooth, leathery, rounded at the apex, and pointed at the base, 4 to 10 centimeters long, and 2 to 5 centimeters wide. The petioles are usually 1 to 2 centimeters long. The flowers are small, white, often tinged with red, and borne in compact groups. The calyx is about 4 millimeters long. The calyx tube ends in four or five small teeth. The corolla tube is cylindrical, about as long as the calyx with four or five lobes which are about half as long as the tube. The fruit is somewhat cylindrical, with eight to ten grooves, and usually a little less than a centimeter in length.

Family 17, COMPOSITAE

Genus PLUCHEA

PLUCHEA INDICA Linn. KALAPÍNI'.

Local names: *Banig-baníg* (Moro); *kalapíni'* (Manila); *manzanilla* (Batangas); *lagúndi'-láte* (Zambales).

Pluchea indica is a small shrub 1 to 4 meters in height. The leaves are 1 to 7 centimeters long and widest toward the tip, which is slightly pointed; the base narrows to a point; the margin

PLATE XXXIX. ACANTHUS ILICIFOLIUS (DILIUARIU), FLOWERS AND FRUITS.

is toothed. The flowers are light blue and are in dense heads arranged in compact inflorescences at the ends of branches. The fruit is minute and crowned with white hairlike projections.

STANDS IN MANGROVE SWAMPS

The present condition of the mangrove swamps in the Philippines is very variable. In places close to centers of population, as in the immediate vicinity of Manila, Iloilo, and Cebu, the swamps have been so closely cut over as to make them almost valueless. In many other places the most valuable trees have been largely removed, in other areas the swamps yield a large quantity of good material, and still others are practically untouched. The largest remaining virgin swamps in the Islands are probably in Palawan and Mindanao, although in both of these islands a considerable amount of cutting and bark collecting has been carried on.

A careful study of the swamps near Port Banga, Mindanao, has been made by Dr. H. N. Whitford and Forester W. I. Hutchinson. The following extracts from their report describes this forest:

> The mangle forests of the Port Banga tract cover an area of 2,463 hectares (6,086 acres). The largest continuous body of swamp, varying in width from 0.5 to 2 kilometers (0.31 to 1.42 miles), extends from the head of Balon Bay northward to the Baluan River. Scattered areas, some of considerable extent, also occur near the Tungauan River, and in Ticbucay Bay and Port Banga.
>
> Light cuttings have been made in these swamps for many years, and since 1902 certain situations have been heavily culled for posts and poles. Tanbark has also been extensively exploited, many areas being practically stripped of Tangal, the species from which the bark is obtained.
>
> The mangle forest is made up of a dense stand of small and medium-sized trees, many of which are raised on stilt roots from 1 to 3 meters (3 to 10 feet) above the ground. The characteristic species of the stand are Pagatpat, Bakauan, and Pototan. In certain localities Piagau and Langarai form pure stands, to the practical exclusion of all other trees. Tangal and several minor species occur scattered throughout all the swamps.
>
> The soil is soft, black mud of unknown depth. Underbrush and litter are entirely absent. The only method of travel through many of the swamps is by climbing along on the stilt roots of the trees.
>
> In the area surveyed, Pagatpat and Bakauan formed over 90 per cent of the stand. The average diameter of all trees over 40 cm. (16 inches) is 47 cm. (18 inches). The largest tree is Pagatpat, which reaches a maximum diameter of 80 centimeters (31 inches) or more, with a maximum clear length of 17.50 meters (57 feet). The clear length of Bakauan almost equals Pagatpat, and that of Pototan exceeds it, but the greater percentage of these species falls below 40 centimeters (16 inches) in diameter.

PLATE XL. SCYPHIPHORA HYDROPHYLLACEA (NILAD), FRUITS AND FLOWERS.

Where the stand is dense, the trees are tall, straight, and clean-boled. In open situations, they are low-branched and crooked. Bakauan is the only important swamp tree with stilt roots.

TABLE I.—*Stand table for 1 hectare of mangrove swamp forest near Port Banga, Mindanao. Average of 6.25 hectares.*

[Data from H. N. Whitford and W. I. Hutchinson.]

AVERAGE NUMBER OF TREES 30 CENTIMETERS AND OVER IN DIAMETER.

Diameter at breast height or above buttresses.	Bakauan.	Pagatpat.	Tangal.	Pototan.	Total.	Other species.	Grand total.
cm.							
30	72.96	8.00	6.08	0.80	87.84	1.12	88.96
40	22.24	10.88	2.24	0.48	35.84	0.64	36.48
50	3.04	7.84	0.32	0.16	11.36	0.32	11.68
60	0.32	5.44	0.32	0.32	6.40		6.40
70		2.56			2.56		2.56
80		2.08			2.08		2.08
90		0.48			0.48		0.48
100		0.32			0.32		0.32
Total	98.56	37.60	8.96	1.76	146.88	2.08	148.96
Per cent	66.17	25.24	6.01	1.18	98.60	1.40	100.00

AVERAGE NUMBER OF TREES 40 CENTIMETERS AND OVER IN DIAMETER.

Per hectare	25.60	29.60	2.88	0.96	59.04	0.96	60
Per cent	42.67	49.32	4.80	1.60	98.40	1.60	100

AVERAGE AND MAXIMUM DIAMETER OF COMMERCIAL TREES.

Species.	Average diameter breast high or above buttresses.		Maximum diameter breast high or above buttresses.	Number of trees measured.
	Trees 30 centimeters and over.	Trees 40 centimeters and over.		
	cm.	*cm.*	*cm.*	
Bakauan	32.97	41.44	60	616
Pagatpat	48.26	53.19	100	235
Pototan	40.00	48.33	60	11
Tangal	34.28	43.33	60	56
Average	38.88	46.57		

Table I shows the number of trees over 30 centimeters in diameter according to species and diameter classes of 10 centimeters. In Table II are shown the number of poles 6 to 15 centimeters and 16 to 25 centimeters in diameter. These figures were obtained in a virgin stand.

TABLE II.—*Stand of poles on one hectare in mangrove swamp forest, Port Banga area, Mindanao. Average of 6.25 hectares.*

[Data from H. N. Whitford and W. I. Hutchinson.]

Pole class.	Average number of poles per hectare.								
	Baka-uan.	Tangal.	Pagat-pat.	Po-totan.	Total.	Miscel-laneous species.	Grand total.	Per cent.	Aver-age stand per acre.
Small, 6 to 15 cm. diameter	57.75	7.52	5.44	0.64	71.35	1.92	73.27	43.5	29.65
Large, 16 to 25 cm. diameter	74.88	11.04	7.04	1.12	94.08	1.12	95.20	56.5	38.53
Total	132.63	18.56	12.48	1.76	165.43	3.04	168.47	100.0	68.18
Per cent	78.73	11.02	7.41	1.04	98.20	1.80	100.00		

Dr. F. W. Foxworthy has found stands of from 300 to 650 cubic meters per hectare in large swamps in Mindanao.

Tables III to V, taken from a report by Ranger Vicente Castillo on a virgin mangrove swamp on Basiad Bay in Tayabas Province, give a good idea of the original composition of a mangrove swamp. In these tables cords are calculated by allowing 30 per cent for air space in stacking. One cord is the equivalent of 3.62 cubic meters.

An examination of these tables shows that the stand of timber in a virgin forest is comparatively heavy.

TABLE III.—*Stand of firewood 10 centimeters and over in diameter on 2.3 hectares. Survey applicable to 440 hectares between Mapinghil and Poctol Point, Capalonga, Luzon.*

[Data from report by Ranger Vicente Castillo.]

Species.	Trees.	Volume.		Species by number of trees.	Species by volume.
		cu. m.	*Cords.*	*Per cent.*	*Per cent.*
Busain	816	146.22	58.49	45.0	55.6
Langarai	620	73.33	29.33	34.2	27.9
Bakauan	257	36.66	14.66	14.2	13.9
Tabigi	74	3.90	1.56	4.0	1.5
Tangal	46	2.21	0.88	2.5	0.8
Pagatpat	2	0.55	0.22	0.1	0.2
Total	1,815	262.87	105.14		
Stand per hectare	789	114.29	45.71		

TABLE III.—*Stand of firewood 10 centimeters and over, etc.*—Continued.

NUMBER OF TREES AND VOLUME BY DIAMETER CLASSES.

Species.	Diameter class in centimeters. 10.		15.		20.		25.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*		*cu. m.*
Busain	100	3.55	124	10.11	267	42.84	237	58.00
Langarai	273	17.17	236	30.76	86	18.15	25	7.25
Bakauan	60	1.58	49	3.54	71	10.04	67	15.40
Tabigi	49	1.61	19	1.45	6	0.84		
Tangal	29	0.78	13	0.91	4	0.52		
Pagatpat							2	0.55
Total	511	24.69	441	46.77	434	72.39	331	81.20

Species.	Diameter class in centimeters. 30.		35.		40.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*
Busain	72	24.17	14	6.55	2	1.00
Langarai						
Bakauan	8	5.04	2	1.06		
Tabigi						
Tangal						
Pagatpat						
Total	80	29.21	16	7.61	2	1.00

In Table III busain (*Bruguiera conjugata*) is represented by more individuals and about twice the volume of any other species, and contains more than half the total volume. Langarai (*Bruguiera parviflora*) is the next most numerous species and after busain is represented by a larger volume than any other species. These two species of *Bruguiera* compose 83.5 per cent of the total volume of the stand. Bakauan (*Rhizophora* spp.) contains 13.9 per cent of the total stand. The other species are present in small quantities. The greatest volume is found within the 20- and 25-centimeter diameter classes, these classes composing 58 per cent of the total volume.

PLATE XLI.

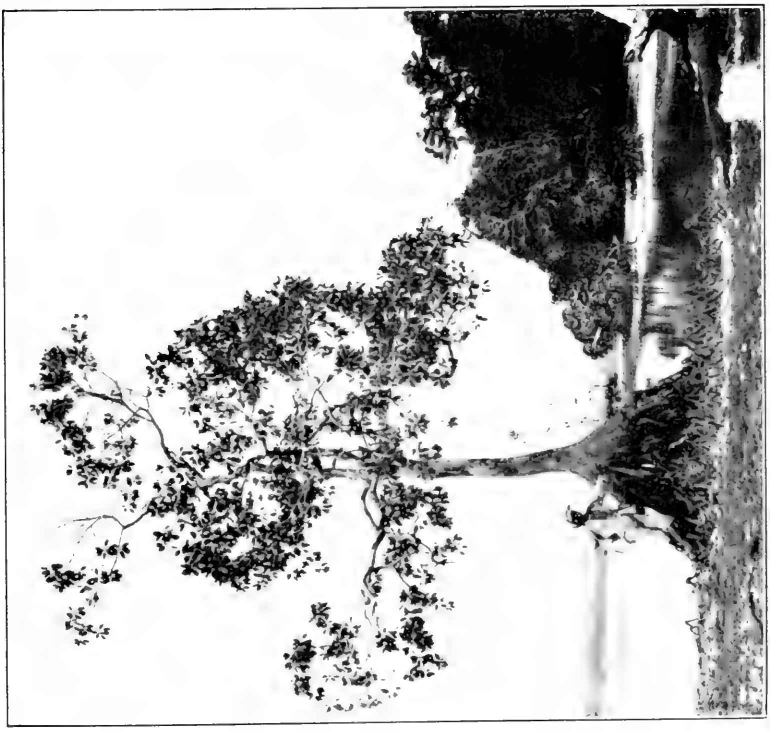

Fig. 1. Pototan tree on the seacoast at low tide.

Fig. 2. Pototan; lower trunk and roots.

TABLE IV.—*Stand of firewood 10 centimeters and over in diameter on 3.8 hectares, between Mapinghil Point and Basiad River, Capalonga, Luzon. Survey applicable to 890 hectares.*

[Data from report by Ranger Vicente Castillo.]

Species.	Trees.	Volume.		Species by number of trees.	Species by volume.
		cu. m.	*Cords.*	*Per cent.*	*Per cent.*
Tangal	990	61.19	24.48	41.37	33.06
Bakauan	572	50.99	20.40	23.90	27.55
Busain	358	36.08	14.43	14.96	19.49
Langarai	456	33.46	13.38	19.06	18.08
Pagatpat	6	2.28	0.91	0.25	1.23
Tabigi	11	1.08	0.43	0.46	0.58
Total	2,393	185.08	74.03		
Stand per hectare	629	48.71	19.48		

NUMBER OF TREES AND VOLUME BY DIAMETER CLASSES IN CENTIMETERS.

Species.	Diameter class in centimeters.							
	10.		15.		20.		25.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*		*cu. m.*
Tangal	549	19.28	369	32.05	72	9.86		
Bakauan	211	6.49	212	15.19	81	11.46	60	15.10
Busain	92	2.85	121	9.08	109	15.88	26	5.40
Langarai	243	10.80	183	17.45	30	5.21		
Pagatpat					2	.35		
Tabigi	3	0.24	5	0.31	1	0.13	2	0.40
Total	1,098	39.66	890	74.08	295	42.89	88	20.90

Species.	Diameter class in centimeters.					
	30.		35.		40.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*
Tangal						
Bakauan	4	1.19	4	1.56		
Busain	10	2.87				
Langarai						
Pagatpat	2	0.70	1	0.48	1	0.75
Tabigi						
Total	16	4.76	5	2.04	1	0.75

In Table IV tañgal (*Ceriops roxburghiana*) is the most numerous species and is represented by the largest volume. Bakauan (*Rhizophora* spp.) ranks next to tañgal, while busain (*Bruguiera conjugata*) and langarai (*Bruguiera parviflora*) are third and fourth, respectively. The other two species present occur in small quantities. In this table the largest percentage of volume is the 15-centimeter diameter class. In both Tables III and IV the number of individuals is greatest in the smallest diameter class and decreases in the larger classes.

TABLE V.—*Stand of firewood 10 centimeters and over in diameter on 3 hectares, between Basiad and Angas Rivers, Calauag, Luzon. Survey applicable to 720 hectares.*

[Data from report by Ranger Vicente Castillo.]

Species.	Trees.	Volume.		Species by number of trees.	Species by volume.
		cu. m.	*Cords.*	*Per cent.*	*Per cent.*
Bakauan	940	259.00	103.60	39.46	54.23
Langarai	1,002	150.52	60.21	42.07	31.51
Busain	246	32.63	13.05	10.33	6.83
Pagatpat	105	30.29	12.12	4.41	6.34
Tangal	82	4.49	1.79	3.44	0.94
Tabigi	7	0.70	0.28	0.29	0.15
Total	2,382	477.63	191.05	100.00	100.00
Stand per hectare	794	159.21	63.68		

NUMBER OF TREES AND VOLUME BY DIAMETER CLASSES IN CENTIMETERS.

Species.	Diameter class in centimeters.							
	10.		15.		20.		25.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*		*cu. m.*
Bakauan	121	4.90	176	19.93	206	47.69	209	72.73
Langarai	485	30.64	281	42.53	172	46.18	59	27.91
Busain	104	5.48	74	6.97	32	5.96	23	6.81
Pagatpat	1	0.06	13	1.50	26	6.17	52	10.14
Tangal	54	1.79	26	2.10			2	0.60
Tabigi	3	0.09			4	0.61		
Total	768	42.96	570	73.03	440	106.61	345	118.19

TABLE V.—*Stand of firewood 10 centimeters and over, etc.*—Continued.

Species.	Diameter class in centimeters.					
	30.		35.		40.	
	Trees.	Volume.	Trees.	Volume.	Trees.	Volume.
		cu. m.		*cu. m.*		*cu. m.*
Bakauan	146	47.06	53	38.59	29	28.10
Langarai	5	3.26				
Busain	5	2.28	2	1.35	6	3.78
Pagatpat	4	2.77	1	0.96	8	8.69
Tangal						
Tabigi						
Total	160	55.37	56	40.90	43	40.57

In Table V, bakauan (*Rhizophora* spp.) is represented by the largest volume, but *Bruguiera parviflora,* by the greatest number of individuals. Langarai (*Bruguiera parviflora*) ranks next to bakauan (*Rhizophora* spp.) in volume, these two trees composing 86 per cent of the total volume. In this table the greatest percentage of volume is contained in the 20- and 25-centimeter diameter classes.

Forester Rafael Medina has made a valuation survey of 3 hectares between Catubig and Laoang in the mangrove swamps of Samar, to show how much merchantable saw timber over 40 centimeters in diameter can be taken from the mangrove swamps in that region. The results are given in Table VI. There was

TABLE VI.—*Stand of timber 40 centimeters and over in diameter on 3 hectares between Catubig and Laoang, Samar.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.		Average volume per tree.	
					cu. m.	*bd. ft.*	*cu. m.*	*bd. ft.*
Api-api	49.04	741	741	1	31.28	7,820.0	0.042	10.5
Bakauan	23.69	358	358	1	17.19	4,297.5	0.048	12.0
Busain	16.61	251	251	1	9.33	2,332.5	0.037	9.3
Tabigi	8.67	131	131	1	8.20	2,050.0	0.063	15.6
Tangal	1.99	30	30	1	1.10	275.0	0.037	9.2
Total	100	1,511	1,511		67.10	16,775.0	[a]0.045	[a]11.3
Per hectare		504	504		22.37	5,592.0		

[a] Average.

Fig. 1. Mangrove swamp. Stumps of Ceriops in foreground. Trees of Rhizophora and Bruguiera.

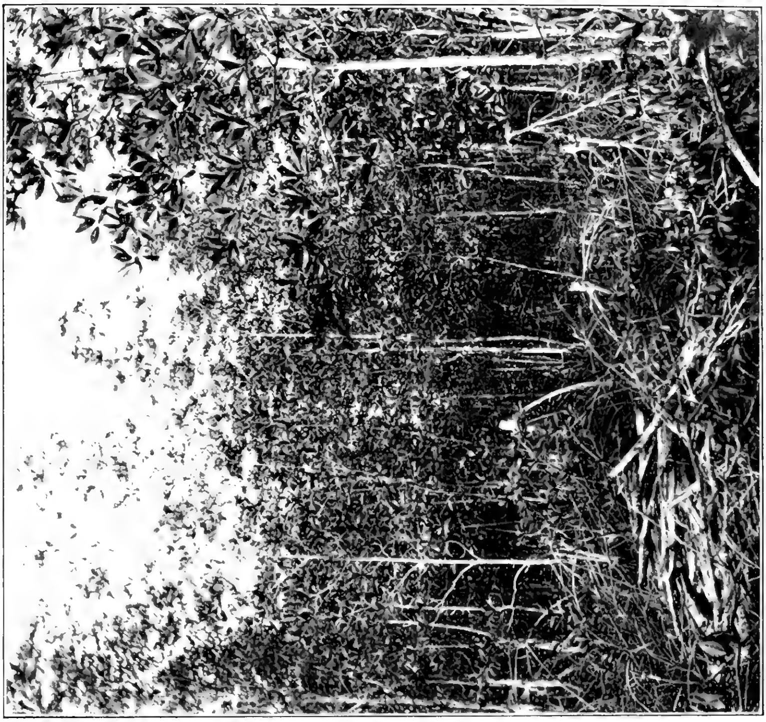

Fig. 2. Mangrove swamp. Bakauan rajas in foreground.

PLATE XLII.

an average volume of 22.37 cubic meters in trees more than 40 centimeters in diameter. No trees produce on the average more than one log 5 meters in length. The most numerous tree was api-api (*Avicennia*), and the next was bakauan (*Rhizophora* spp.). The third most numerous species was busain (*Bruguiera sexangula*). The wood of api-api (*Avicennia*) is of comparatively little value, but is extensively used as firewood. That of the other species is very valuable.

Forester Medina has also made valuation surveys of other stands in Samar. The results are given in Tables VII to XI. In all of these tables, bakauan (*Rhizophora* spp.) is the most numerous tree. The second most numerous is api-api (*Avicennia*). This species, however, is very much less numerous than bakauan (*Rhizophora* spp.) and is represented by a much smaller volume. In Table VIII, langarai (*Bruguiera parviflora*) ranks next to bakauan (*Rhizophora* spp.) and api-api (*Avicennia*) third. The average volume per hectare in the different areas varies from 13.77 to 120.87 cubic meters. These tables represent swamps which have been used to some extent for the collection of firewood.

TABLE VII.—*Stand of firewood 5 centimeters and over in diameter, between Pinamacdan River and Matnog Creek, Samar. Valuation survey taken on 6.35 hectares. Applicable to 2,710 hectares.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.	
					cu. m.	*Cords.*
Bakauan	70.02	1,009	3,088	3.1	68.63	27.45
Api-api	13.88	200	449	2.2	9.78	3.91
Pagatpat	9.58	138	249	1.8	3.64	1.45
Pototan	2.08	30	94	3.1	1.84	0.74
Langarai	2.29	33	125	3.8	1.60	0.64
Tabigi	1.66	24	59	2.5	1.50	0.60
Tabau	0.21	3	13	4.3	0.22	0.09
Tangal	0.28	4	7	1.8	0.20	0.08
Total	100.00	1,441	4,084		87.41	34.96
Stand per hectare		227	643		13.77	5.50

TABLE VII.—*Stand of firewood 5 centimeters and over, etc.*—Continued.

NUMBER OF LOGS BY DIAMETER CLASSES.

Species.	Diameter class in centimeters.		
	5-10.	10-20.	20-30.
Bakauan	1,152	1,611	325
Api-api	199	188	62
Pagatpat	146	103	
Pototan	48	43	3
Langarai	95	27	3
Tabigi	14	38	7
Tabau	8	5	
Tangal		7	
Total	1,662	2,022	400

TABLE VIII.—*Stand of firewood 5 centimeters and over in diameter, between Motiong Creek and Pinamacdan River, Samar. Valuation survey taken on 9.05 hectares. Applicable to 3,110 hectares.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.	
					cu. m.	*Cords.*
Bakauan	50.93	3,988	11,879	3.0	597.31	238.92
Langarai	27.19	2,129	7,086	3.3	350.29	140.12
Api-api	10.38	813	2,066	2.5	64.97	25.99
Pagatpat	4.23	331	926	2.8	45.72	18.29
Tabigi	6.47	507	992	1.9	27.90	11.16
Dungon-late	0.49	39	105	2.7	6.15	2.46
Pototan	0.22	17	38	2.2	1.35	0.54
Tabau	0.09	7	16	2.3	0.22	0.09
Total	100.00	7,831	23,108		1,093.91	437.57
Stand per hectare		865	2,553		120.87	48.35

NUMBER OF LOGS BY DIAMETER CLASSES.

Species.	Diameter class in centimeters.			
	10-20.	20-30.	30-40.	40-50.
Bakauan	3,817	3,155	2,347	2,560
Langarai	2,347	1,800	1,357	1,582
Api-api	1,080	545	303	138
Pagatpat	236	258	116	316
Tabigi	491	332	147	22
Dungon-late	34	19	27	25
Pototan	6	5	10	17
Tabau	12	4		
Total	8,023	6,118	4,307	4,660

TABLE IX.—*Stand of firewood 5 centimeters and over in diameter, between Dapdap River and Motiong Creek, Samar. Valuation survey taken on 14 hectares. Applicable to 1,080 hectares.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.	
					cu. m.	*Cords.*
Bakauan	56.84	4,099	9,259	2.3	472.59	189.04
Api-api	25.02	1,804	4,250	2.4	144.34	57.74
Pagatpat	6.74	486	1,052	2.2	53.23	21.29
Langarai	3.49	252	808	3.2	39.74	15.90
Dungon-late	3.01	217	547	2.5	29.83	11.93
Pototan	2.09	151	346	2.3	20.30	8.12
Tabigi	2.32	167	323	1.9	18.94	7.58
Tangal	0.49	35	49	1.4	2.15	0.86
Total	100.00	7,211	16,634		781.12	312.46
Stand per hectare		515	1,188		55.79	22.32

NUMBER OF LOGS BY DIAMETER CLASSES.

Species.	Diameter class in centimeters.			
	10-20.	20-30.	30-40.	40-50.
Bakauan	2,721	1,858	1,893	2,787
Api-api	2,388	936	465	461
Pagatpat	393	191	241	227
Langarai	298	227	165	118
Dungon-late	169	148	91	139
Pototan	95	72	85	94
Tabigi	121	51	61	90
Tangal	28	7	5	9
Total	6,213	3,490	3,006	3,925

TABLE X.—*Stand of firewood 5 centimeters and over in diameter, between Carayman or Bongon River and Dapdap River, Samar. Valuation survey taken on 11.5 hectares. Applicable to 4,360 hectares.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.	
					cu. m.	*Cords.*
Bakauan	63.09	2,748	6,202	2.2	335.47	134.19
Api-api	15.15	660	1,334	2.0	74.35	29.74
Langarai	8.10	353	1,070	3.0	67.77	27.11
Tabigi	5.26	229	505	2.2	60.14	24.06
Dungon-late	3.67	160	364	2.3	26.49	10.60
Pagatpat	3.67	160	401	2.5	26.41	10.56
Pototan	1.06	46	147	3.2	11.82	4.73
Total	100.00	4,356	10,023		602.45	240.99
Standard per hectare		379	872		52.38	20.96

NUMBER OF LOGS BY DIAMETER CLASSES.

Species.	Diameter class in centimeters.							
	10-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	80-90.
Bakauan	2,058	1,445	1,155	1,544				
Api-api	401	315	260	358				
Langarai	136	365	296	273				
Tabigi	57	135	129	135	9	7	7	26
Dungon-late	75	70	70	149				
Pagatpat	89	89	91	132				
Pototan	14	18	60	55				
Total	2,830	2,437	2,061	2,646	9	7	7	26

TABLE XI.—*Stand of firewood 5 centimeters and over in diameter, between Barrio Peña and Carayman or Bongon River, Samar. Valuation survey taken on 1 hectare. Applicable to 300 hectares.*

[Data from report by Forester Rafael Medina.]

Species.	Per cent of each species by number of trees.	Trees.	Logs.	Average number of logs per tree.	Volume.	
					cu. m.	*Cords.*
Bakauan	55.77	266	619	2.3	33.83	13.53
Api-api	24.74	118	195	1.6	11.96	4.78
Pagatpat	9.22	44	129	2.9	6.76	2.70
Tabigi	8.38	40	88	2.2	6.31	2.52
Dungon-late	1.89	9	18	2.0	1.32	0.53
Total	100.00	477	1,049	----------	60.18	24.06

NUMBER OF LOGS BY DIAMETER CLASSES.

Species.	Diameter class in centimeters.			
	10–20.	20–30.	30–40.	40–50.
Bakauan	198	150	96	175
Api-api	53	60	26	56
Pagatpat	39	43	15	32
Tabigi	15	15	27	31
Dungon-late	4	2	6	6
Total	309	270	170	300

CULTIVATION OF RHIZOPHORA (BAKAUAN)

Cultivated swamps are found in the whole region around the upper part of Manila Bay, from Malabon on the east to Balanga on the west side; here, the virgin mangle has long since disappeared. The extent of the area covered by this cultivation has not been determined; but, in places, it extends 20 or more kilometers inland from the bay. Extensive reports on the cultivation of bakauan (*Rhizophora* spp.) in the above region have been made by Dr. F. W. Foxworthy and Ranger De Mesa. The following information is taken from their reports:

Nipa and bakauan are planted extensively in solid stands, but there is little planting of other swamp species.

Hundreds, and may be thousands, of hectares are planted to bakauan, which is grown for firewood, and sold principally in the Manila market, this wood being preferred to almost all others for fuel. The Manila supply is inadequate, as is indicated by the remarkably complete utilization of the swamps in the vicinity, and by the use of other and inferior species.

No records seem to exist as to how, when, and where bakauan was first cultivated, but it is safe to say that the present planting methods have been in use for at least three generations. An evident reason for the cultivation is the large agricultural population on the level lands of Pampanga Province and the accessibility of the Manila market.

In the municipalities of Macabebe, Guagua, Lubao, Sexmoan, and Orani there are a number of barrios along the rivers which have a population that divides its labor among the fishing, bakauan, and nipa industries.

PLANTING AND CULTIVATION

The land chosen for planting bakauan is brackish or salt swamp, at or near the edge of a river in places which are affected by the tide. Nipa and bakauan are often planted in the same kind of mud. Very soft muddy soil is said to be the best for bakauan; and on such soil it makes its most rapid growth. On comparatively firm mud, it grows far more slowly, sometimes requiring much more than twice as long to produce a crop as when grown on the very soft mud. Freshly deposited soft mud at the edge of a stream, even though the strip may be no more than 2 meters in width, is eagerly appropriated for new planting.

The unit of area used in the mangrove cultivation is the "luang," which is 279.56 square meters. There are thus 35.77 luangs in 1 hectare.

If the ground which is to be planted has not been in cultivation for some time, it is covered with a dense tangle of low shrubs and vines. These are, for the most part, the low shrubby diliuariu (*Acanthus ilicifolius* L.); the spiny, woody vine known as sapinit [*Caesalpinia nuga* (L.) Ait.]; and several small, low-growing vines.

The land must be thoroughly cleared before planting. This is a difficult task and usually costs 2 pesos per luang, sometimes 2.50 pesos per luang. This would mean the work of two men for about two days. The clearing consists in cutting off the brush, pulling up or digging up the roots, if this is possible, and filling and leveling crab holes.

Clearing is reduced to a minimum by promptly replanting cut-over areas. After bakauan has been harvested, the ground may be left idle for from four months to a year, or until the bark on the roots is evidently rotten. The area can then be replanted without any new clearing being necessary.

The seedlings are frequently gathered from special seed trees which are left for this purpose. Often low-growing or dwarf trees near the edge of the stream are selected for the production of seed, as it is easier to collect seed from small than from large trees. This results in the use of rather small seedlings.

These are gathered at a cost of from 2 to 3 pesos per thousand. The higher price is given for prompt delivery and when cash payment is made. The smaller sum is paid when the money is given as an advance, several months before the performance of the work. The advance-payment method seems to be the one in commoner use. In some places, bakauan-lalaki seedlings are paid for at the rate of 2 or 3 pesos per thousand and bakauan-babae at 3 or 4 pesos per thousand. The bakauan-lalaki seedlings are smaller and more numerous and are, therefore, easier to collect than those of bakauan-babae. If the seedlings were placed 100 centimeters apart, 10,000 would be required to plant a hectare. If they were only 20 centimeters apart, 250,000 would be required.

After gathering, the seedlings are placed in a shady place and allowed to wilt for about two weeks. This is said to render them resistant to the attacks of crabs and other marine animals, which would eat them if they were planted perfectly fresh.

The principal planting season appears to be from May to August. May seems to be considered a less desirable month for planting than are the others, as the seedlings are said to be rather small during that month.

In planting, the seedlings are simply shoved a short distance into the mud, so that they will stand erect. They are spaced 40 to 100 centimeters apart. In some of the places visited, the seedlings were as close together as 20 centimeters. The most usual spacing seemed to be from 40 to 60 centimeters.

The planting may be done very rapidly, as a man can go almost at a run and plant two luangs or more per day. From 50 centavos to 1.20 pesos are paid for the planting of 10,000 plants.

The young plants are killed, if they are submerged for as long as three days; or if there is a flood while the plants are young, the excess of fresh water will kill many.

Young plantations at the edge of the river are protected from damage from floating objects by a fence of branches stuck in the mud or by a planted hedge of pagatpat (*Sonneratia* spp.). Sometimes a line of older bakauan trees is left to protect a new plantation. Bakauan-babae is usually planted along the edge next the stream, while bakauan-lalaki makes up most of the stand back of the bakauan-babae.

After the first year, it is customary to replant any blank spaces left by the death or destruction of any of the stand.

Cultivation consists principally in keeping the plantation clear of vines. It is said that it is sometimes necessary to cut out the vines each year. Usually there is very little of this to do; and, in many cases, there is no occasion to do it at all. The cost of this weeding is hard to estimate, because the man who does the work usually devotes only a part of his time to it. A man is able to do all the weeding for a large plantation, guard the plantation from thieves, and still have a considerable part of his time to spend in fishing. It seems that the cost of weeding is never a large item.

In some cases, where it is considered that the plants are too far apart, the terminal bud is split during the second year. This is said to cause the plants to form two or more trunks, thus filling up the space more completely.

During the first year, a plant produces from two to four pairs of leaves and does not grow much more than half a meter in height. At this time rather fleshy underground roots are formed and the whole plant is more herbaceous than woody in texture. In the second year the plant begins to branch at the top and to send out prop roots, while the stem become partly woody. During the third year the plant becomes stout and woody, while in succeeding years it makes height growth and thickens more symmetrically.

With the very close planting which is the rule, the plants grow very slender and straight. The dense shade produced, in time, causes self-pruning. Self-pruning is regarded as indicating that the bakauan is ready for cutting. Self-pruning takes place seven to twelve or more years after planting, according to the character of the soil.

Only small firewood sizes are grown. Material large enough for rajas [1] is very rarely seen.

Hacenderos all agree that the individual tree will grow more rapidly and will reach a larger size, if it is given more room. They feel confident, however, that they would lose money if they planted at a greater interval; as they would have fewer trees. However, planting at an interval at least twice as wide as is commonly used would probably be a profitable experiment.

Bakauan-babae is said to grow more rapidly than does baka-

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[1] Rajas are sticks of firewoods split from sections of trunks 8 to 15 centimeters in diameter and 80 to 100 centimeters in length. Trunks 10 centimeters in diameter are split into four pieces; those 20 centimeters in diameter into six or eight pieces. Rajitas are smaller and are split from sections of trunks, branches, and roots ranging from 1 to 3 centimeters in diameter and from 60 to 70 centimeters in length. Three centimeter sticks are split into two or four pieces.

uan-lalaki; but it is much more inclined to be crooked, and its wood is not so good.

Bakauan-babae begins to flower in its third year, but is said not to bear fertile fruit till the fourth or fifth year.

In going hurriedly through the swamp in a boat, one gets the impression that more bakauan-babae is planted than bakauan-lalaki. This is because the bakauan-babae is planted at the edge of the stream.

CUTTING

Different practices in cutting are followed in different localities. In the Sexmoan and Guagua neighborhoods, the cutting is often done by contract. The owner gives the contractor one-half of the cut and furnishes the bancas for transportation. In such cases, the woody prop roots do not enter into the contract and are the property of the cutter, if he chooses to take them. It is said, however, that the owner can make a larger profit by employing his own men to do the cutting.

The firewood is regularly of three grades. The first grade is about 60 centimeters in length and 2 or 3 centimeters in thickness. It is split from the pieces of larger diameter and, locally, has a value of 2 pesos per thousand. The second grade is of the same length as the first, but is split from pieces of smaller diameter. It sells locally for 1 peso per thousand. The third grade is made of pieces which are shorter and of still smaller diameter. This grade sells locally for 2 pesos per 10,000 pieces.

Woodcutters, who cut the trees in the swamp, transport the poles to the wood yard, and split them there, are paid 0.625 peso per 1,000 pieces of the first grade, 0.625 peso per 2,000 of the second grade, and 0.625 peso per 10,000 pieces of the third grade. Consequently the cutter does not know just how much he will receive until the pieces have been split. The cutter takes the poles from the swamp in a banca and delivers them at his own or some other wood yard, where they are cut into firewood size. This splitting into firewood is often done by women and children. Only the straight pieces are cut up for firewood. The splitting is either done with a special, heavy-bladed, long-handled bolo, which is used with a chopping movement like an ax; or with a special, short-bladed, narrow ax.

The small air-roots of the bakauan are sometimes sold after being split once. They then bring about 50 centavos per thousand. They are not regularly classified, and often are not cut but are left to decay in the swamp.

The straight and slender tops of the bakauan, which are about 4 meters long, a centimeter in diameter at the top, and

2 or 3 centimeters in diameter at the base, are often sold to planters of ikmo (betel pepper) at 12 pesos per 100.

The very rough pieces, particularly those that occur where the prop roots are joined to the trunk, are used in making charcoal. The bark is also occasionally used for cooking, especially in the roasting of corn. This use does not seem to be general enough to have fixed a market price.

Ranger De Mesa has made a careful count of the number of the trees on several plots in bakauan plantations. The results are given in Tables XII to XIV. These tables show the number of trees of different lengths and diameters and the volume according to the length and diameter of the trees, also, the total number of trees and the total volume, and the percentage of trees and volume in the different length classes. In the lower portion of the table are shown the number, grades, and volume of the rajitas obtained by cutting and splitting the trees.

TABLE XII.—*Measurements of planted bakauan-lalaki near Orani, Bataan, at age of 7 years on 0.1 hectare (50 by 20 meters).*

[Data from report by Ranger De Mesa.]

Diameter class in cm.		Length class in meters.				Total.
		2.	3.	4.	5.	
2	Trees	454	300	189	104	1,047
	Volume in cu. m.	0.285	0.283	0.238	0.163	0.969
3	Trees		120	187	309	616
	Volume in cu. m.		0.254	0.529	1.092	1.875
4	Trees		50	165	376	591
	Volume in cu. m.		0.188	0.829	2.362	3.379
5	Trees			7	301	308
	Volume in cu. m.			0.055	2.955	3.010
Total	Trees	454	470	548	1,090	2,562
	Volume in cu. m.	0.285	0.725	1.651	6.572	9.233
Percentage of stand by	Trees	17.72	18.35	21.39	42.54	100.00
	Volume in cu. m.	3.09	7.85	17.88	71.18	100.00

STACKED RAJITAS.

Grade of rajitas.	Pieces.	Volume.
		cu. m.
First	12,650	7.80
Second	22,195	6.40
Third	500	0.22
Stumps		1.50
Total	35,345	15.92

TABLE XIII.—*Measurements of planted bakauans, near Orani, Bataan, at age of 8 years on 0.1 hectare (50 by 20 meters).*

[Data from report by Ranger De Mesa.]

Species.	Diameter class in cm.		Length class in meters. 3.5	4	5	6	Total.
Bakauan-lalaki	2	Trees	331	278	177		786
		Volume in cu. m.	0.364	0.349	0.278		0.991
Do	3	Trees		104	234	60	398
		Volume in cu. m.		0.294	0.837	0.254	1.385
Do	4	Trees			161	426	587
		Volume in cu. m.			1.012	3.212	4.224
Do	5	Trees			19	292	311
		Volume in cu. m.			1.865	3.440	5.305
Do	6	Trees			72	16	88
		Volume in cu. m.			1.018	0.271	1.289
Bakauan-babae	8	Trees		4		16	20
		Volume in cu. m.		0.064		0.387	0.451
Do	12	Trees				16	16
		Volume in cu. m.				1.086	1.086
Total		Trees	331	386	663	826	2,206
		Volume in cu. m.	0.364	0.707	5.01	8.65	14.731
Percentage of stand by		Trees	15.01	17.50	30.05	57.44	100.00
		Volume in cu. m.	2.48	4.79	34.01	58.72	100.00

STACKED RAJITAS.

Grade of rajitas.	Pieces.	Volume.
		cu. m.
First	13,400	8.011
Second	23,400	6.425
Third	1,800	0.504
Stumps		3.42
Total	38,600	18.36

TABLE XIV.—*Measurements of planted bakauan-lalaki, near Sexmoan, Pampanga, at age of 7 years on 0.1 hectare (50 by 20 meters).*

[Data from report by Ranger De Mesa.]

Diameter class in cm.		Length class in meters.			Total.
		3.	4.	5.	
2	Trees	214	280	72	566
	Volume in cu. m.	0.201	0.352	0.113	0.666
3	Trees	200	246	262	708
	Volume in cu. m.	0.424	0.696	0.926	2.046
4	Trees		240	560	800
	Volume in cu. m.		1.206	3.519	4.725
5	Trees		30	160	190
	Volume in cu. m.		0.236	1.571	1.807
Total	Trees	414	976	1,054	2,264
	Volume in cu. m.	0.625	2.49	6.129	9.244
Percentage of stand by	Trees	18.29	35.16	46.55	100.00
	Volume in cu. m.	6.76	26.94	66.30	100.00

STACKED RAJITAS.

Grade of rajitas.	Pieces.	Volume.
		cu. m.
First	5,560	4.774
Second	17,600	7.825
Stumps		5.367
Total	23,160	17.966

The trees measured in Table XII were cut by six laborers, each working three hours a day for four days; those in Table XIII by four laborers working two to three hours a day for four days; and those in Table XIV by four laborers working half a day for three days.

The results in Tables XII and XIV were obtained from plantations 7 years old. The total volume in each on 0.1 hectare was 9.2 cubic meters. The trees recorded in Table XIII were 8 years old and showed a volume of 14.7 cubic meters on 0.1 hectare. The volume of stacked rajitas was in every case much greater than the volume obtained by measuring the trees. This difference was caused by the space occupied by air spaces.

MARKETING OF BAKAUAN

Manila is the market place for most of the bakauan grown around Manila Bay, and transportation is naturally by water. The firewood is loaded into cascoes which are towed to Manila by launches. The charcoal is loaded on the regular steamer and pays a freight charge of 5 centavos per sack.

The first-grade rajitas sell in Manila and Malabon at from 3 to 4 pesos per 1,000 pieces; the second grade, from 3 to 4 pesos per 2,000 pieces; the third grade, from 3 to 4 pesos per 10,000 pieces; and the fourth grade, from 3 to 3.50 pesos per 4 cubic meters.

In Table XV are given the figures on cost of transporation from Bataan to Manila.

TABLE XV.—*Cost of transportation of firewood from Bataan to Manila.*

[Data from report by Ranger De Mesa.]

	Pesos.
Second-class casco with a load of 70,000 first-grade rajitas (7 to 14 days' trip)	[a] 1.50
Crew of 5 men at 3 pesos each and 1 pilot at 6 pesos (1 trip)	21.00
Subsistence of crew while on trip	8.00
First-class casco with a load of 100,000 first-grade rajitas (7 to 14 days' trip)	[a] 2.00
Crew of 6 men at 4 pesos each and 1 pilot at 8 pesos (1 trip)	32.00
Subsistence of crew while on trip	10.00

From the figures given in Tables XII and XIII, we have made rough estimates of the total cost, selling price, and profits derived from 1 hectare of a bakauan plantation. These figures are given in Tables XVI and XVII.

TABLE XVI.—*Cost and sale value in Manila of the crop of bakauan on 1 hectare, based on figures in Table XII for crop 7 years old.*

PLANTING COST.

	Pesos.	
Clearing at 2 pesos per luang	72.00	
Seedlings, 25,620 at 2 pesos per 1,000	51.00	
Planting at 0.75 peso per 1,000	19.00	
Compound interest on planting cost for seven years at 5 per cent	58.00	
Total planting cost		200.00

HARVESTING AND SELLING COST.

Cutting and splitting 126,500 first-grade rajitas at 0.625 peso per 1,000	79.00	
Cutting and splitting 221,900 second-grade rajitas at 0.625 peso per 2,000	69.00	
Transportation 126,500 first-grade rajitas at 62 pesos per 100,000	78.00	
Transportation 221,900 second-grade rajitas at 40 pesos per 100,000	89.00	
Total harvesting and selling cost		315.00
Total cost		515.00

[a] Daily.

SELLING PRICE.

126,500 first-grade rajitas at 3.50 pesos per 1,000	443.00
221,900 second-grade rajitas at 3.50 pesos per 2,000	388.00
Total selling price	831.00
Total cost	515.00
Total profit	316.00
Profit for one year	45.00
Profit per year based on cost of original planting (per cent)	32

TABLE XVII.—*Cost and sale value in Manila of the crop of bakauan on 1 hectare, based on figures in Table XIII for crop 8 years old.*

PLANTING COST.

	Pesos.	
Clearing at 2 pesos per luang	72.00	
Seedlings, 22,060 at 2 pesos per 1,000	44.00	
Planting at 0.75 peso per 1,000	17.00	
Compound interest on planting cost for 8 years at 5 per cent	64.00	
Total planting cost		197.00

HARVESTING AND SELLING COST.

Cutting and splitting 134,000 first-grade rajitas at 0.625 peso per 1,000	84.00	
Cutting and splitting 234,000 second-grade rajitas at 0.625 peso per 2,000	73.00	
Cutting and splitting 18,000 third-grade rajitas at 0.625 peso per 10,000	1.00	
Transportation of 134,000 first-grade rajitas at 62 pesos per 100,000	83.00	
Transportation of 252,000 second- and third-grade rajitas at 40 pesos per 100,000	101.00	
Total harvesting and selling cost		342.00
Total cost		539.00

SELLING PRICE.

134,000 first-grade rajitas at 3.50 pesos per 1,000	469.00
234,000 second-grade rajitas at 3.50 pesos per 2,000	409.00
18,000 third-grade rajitas at 3.50 pesos per 10,000	6.00
Total selling price	884.00
Total cost	539.00
Total profit	345.00
Profit per year	43.00
Profit per year based on original planting cost (per cent)	32

The value of the land is not taken into consideration, because the area in cultivation is really a part of the shore line, or perhaps of the sea, and properly belongs to the Government. No account is taken of the cost of supervision, as it is very difficult to arrive at an estimate of this. However, a bakauan plantation requires but little supervision and so this item is probably very small. From the figures given in Tables XVI and XVII, it would appear that raising bakauan should be profitable. It would appear further that it is much more profitable to market the crop in Manila than where it is grown. This is brought out in Table XVIII, in which the cost and selling price in Bataan are shown.

TABLE XVIII.—*Cost and selling prices in Bataan of the crop of bakauan on 1 hectare, based on figures in Table XIII for crop 8 years old.*

SELLING PRICE.

	Pesos.
134,000 first-grade rajitas at 2 pesos per 1,000	268.00
234,000 second-grade rajitas at 1 peso per 1,000	234.00
18,000 third-grade rajitas at 2 pesos per 10,000	4.00
Stumps, 34.2 cubic meters at 2 pesos per cubic meter	17.00
Total selling price	523.00
Cost of clearing, seedlings, planting, and harvesting, with interest on planting	355.00
Total profit	168.00
Profit per year	21.00
Profit per year based on original planting cost (per cent)	16

If sold in Manila, it will be seen that the profit per year, based on the planting cost, is 32 per cent plus 5 per cent compound interest, which is calculated in the tables as a part of the cost. When the wood is sold where grown, the calculated profit per year is 16 per cent plus the interest on the planting cost. About half of the original planting cost as calculated is due to clearing, which is frequently not necessary, perhaps never so for the second crop, if the planting is done at the right time. Where clearing is unnecessary, the percentage of profit would be much greater than that calculated.

When bakauan is planted on bare ground in shallow water, the roots by holding sand or mud on the area have a tendency to raise the level of the ground. When the land has been raised to about the level of high tide, the bakauan is frequently cut for firewood and the area made into fish ponds by the construction of dikes. The water in these ponds is usually brackish. In the Philippines, there is a considerable industry in the raising of the fish *Chanos chanos* Forskål, locally known as bañgós, in such ponds. As the raising of fish is a very profitable business, old bakauan plantations are frequently converted into fish ponds. In many places the growing of a crop of bakauan and the subsequent use of the land for fish ponds should be an exceptionally profitable investment. There are large areas in Manila Bay where this could be undertaken.

MANGROVE-SWAMP FIREWOOD

The demand for fuel in the Philippines, excepting in the case of transportation companies and manufacturing plants, is met almost entirely by the use of firewood, as up to the present time comparatively little coal has been mined in the Archipelago and most of the supply comes from Japan. The coal industry in the Philippines is being developed, and 3,200 tons were mined in 1917.† The demand for fuel in a tropical country, such as the Philippines, is not nearly so great as in a temperate region; nevertheless, there is a large demand for domestic purposes, such as cooking, washing, etc., and for the smaller industries.

The most highly prized firewood is furnished by various species of mangrove-swamp trees. However, the available, accessible supply of these is not great enough to satisfy the demand and dry-land species have to be substituted. The amount of firewood of both classes on which taxes were paid in the Archipelago from 1914 to 1918, inclusive, is given in Table XIX.

TABLE XIX.—*Amount of firewood on which taxes were paid in the Philippine Islands from 1914 to 1918.*

Year.	Mangrove species.	Dry-land species.
	cu. m.	*cu m.*
1914	28,120	133,274
1915	70,427	142,814
1916	97,856	194,480
1917	130,472	277,224
1918	134,431	588,109

From this table, it will be seen that during each successive year the amount of mangrove-swamp wood used has been greatly increased and that there has been a corresponding increase in the dry-land species; and further, that in every case the amount of the dry-land species was each year more than twice as great as that of mangrove species. The figures in Table XIX show that the firewood business in the Philippine Islands is one of considerable proportions.

An extensive study of mangrove-swamp woods has been made by Cox.* In Table XX are given the results of analyses and

† Cox, Alvin J., Annual Report of the Director, Bureau of Science, for 1918.

* Cox, Alvin J., Philippine firewood, Philippine Journal of Science, Sec. A, Vol. 6 (1911), page 1.

* Cox, Alvin J., Philippine fuels, Bureau of Science Press Bulletin No. 86.

calorific determinations made by him on air-dried wood without bark. In this table the dried wood is taken as the basis on which to compute the percentages of moisture and ash. From the table

TABLE XX.—*Analyses and calorific determinations of air-dried wood without bark.*

[The numbers and common names are those given by Cox in the original table. The scientific names have been inserted by Mr. E. E. Schneider, wood expert of the Bureau of Forestry, after a recent examination of specimens of the wood used by Cox.]

No.	Common and scientific names.	Moisture.	Ash.	Main calories.[a]	Available heating value.	Heating value of combustible matter, wood — (water + ash) in main calories.[a]	Available heating value of combustible matter, wood — (water + ash).
		Per cent.	*Per cent.*		*Calories.*		*Calories.*
3	Pototan (*Bruguiera conjugata*)	13.01	1.46	4,180	3,833	4,798	4,480
		13.26	1.44	4,191	3,829	4,793	4,475
4	Bacauan (*Rhizophora mucronata*).	11.22	2.23	4,118	3,772	4,689	4,365
		11.37	2.29	4,107	3,746	4,682	4,358
5	Bacao (*Bruguiera* sp.)	11.03	1.81	4,159	3,781	4,699	4,340
		10.94	1.74				
6	Bacauan-tubig (*Bruguiera* sp.)	13.21	5.75	3,753	3,366	(b)	(b)
		--------	5.57				
7	Catutan (*Bruguiera* sp.)	13.79	1.28	4,142	3,705	4,787	4,368
		13.77	1.29				
8	Tabigue (*Xylocarpus moluccensis*).	13.93	2.80	4,005	3,634	4,694	4,345
9	Bacauan (*Bruguiera* sp.)	13.77	2.05	4,066	3,764	4,723	4,456
		13.39	2.12				
10	Tambu-tambu (*Xylocarpus moluccensis*).	12.99	2.72	4,162	3,873	4,833	4,578
		12.99	2.71				
11	Pagatpat (*Sonneratia caseolaris*).	14.27	2.62	4,116	3,841	4,831	4,596
		14.27	2.65				
14	Bacauan (*Rhizophora candelaria*).	10.71	2.41	4,136	3,721	4,689	4,284
		--------	2.26	4,154	3,760	4,720	4,328
15	Tangal (*Ceriops tagal*)	11.41	1.60	4,292	3,924	4,747	4,399
		--------	--------	4,293	3,906	4,747	4,378
16	Pototan (*Bruguiera conjugata*)	12.26	1.55	4,286	3,895	4,840	4,466
		--------	--------	4,227	3,855	4,773	4,421
17	Lenggadi (*Bruguiera parviflora*).	11.97	1.65	4,072	3,716	4,629	4,296

[a] In the usual determination of the calorific value of a fuel in a calorimeter the products are cooled to the ordinary temperature and the result is therefore higher than can ever be realized in ideal practice, where the resulting gases always leave the flues at a temperature above 100°. Since the object of the determination of the calorific value of a fuel is to show its technical worth, I always have calculated the results on Philippine fuels on the assumption that the moisture present and the water formed during the combustion remain as steam at 100°, i. e., I have made a water correction by subtracting 6 calories for each per cent of water. Some mechanical engineers do not make this correction, and therefore obtain a result from 3 to 10 per cent too high, and in order that my results may be comparable in all cases I have decided to give also the uncorrected result under the caption "Main calories."

[b] On account of the very high ash content and the possibility of error in its determination (cf. p. 10), this sample has little comparative value and I have therefore not included the heating value of the combustible matter in the average. The calculated results for the combustible matter wood — (water + ash), in main calories and available calories are 4,482 and 4,123, respectively.

Fig. 1. Piled firewood cut mainly from tañgal and bakauan.

Fig. 2. Lorcha load of rajitas.

PLATE XLIII.

it would appear that the moisture content is fairly constant for the different species. Cox found that in the Philipines, where the humidity is high and fairly constant, the variations in the moisture content are much less than where the climate is hot or cold, moist or dry, according to the season. He concluded that the moisture content of wood seldom falls below 12.5 or 13 per cent of the dry weight, and that these figures may be taken as good averages for thoroughly seasoned firewoods. The ash content varies considerably in different species. Cox says of the ash content that this is of comparatively little importance from the standpoint of firewood because the amount of ash is usually small. The calorific value based on the dry weight of the various species is fairly constant, as might be expected from the fact that the part of the wood left after deducting the water and ash would be almost the same in all cases.

TABLE XXI.—*Specific gravities of Philippine firewoods.*

[The numbers and common names are those given by Cox in the original table. The scientific names have been inserted by Mr. E. E. Schneider, wood expert of the Bureau of Forestry, after a recent examination of specimens of the wood used by Cox.]

No.	Common name.	Scientific name.	Moisture.	Ash.	Specific gravity.
			Per cent.	*Per cent.*	
3	Pototan	*Bruguiera conjugata*	13.58	1.46	0.7671
			13.51	1.44	0.7441
4	Bacauan	*Rhizophora mucronata*	[b]12.10	2.29	[c]0.9861
			[d]11.46	2.23	[c]0.9801
5	Bacao	*Bruguiera* sp		1.81	
				1.74	
6	Bacauan-tubig	*Bruguiera* sp	12.26	5.75	0.8799
			11.88	5.57	0.8732
7	Catutan	*Bruguiera* sp	13.24	1.29	0.9136
			13.03	1.28	0.8868
8	Tabigue	*Xylocarpus moluccensis*	13.71	2.80	0.7412
			12.73		0.7333
9	Bacauan	*Bruguiera* sp	13.07	2.12	0.996
			12.77	2.05	0.991
10	Tambu-tambu	*Xylocarpus moluccensis*	[b]13.00	2.72	0.5954
			[d]12.50	2.71	0.5668
11	Pagatpat	*Sonneratia caseolaris*	12.94	2.65	0.6688
			12.83	2.62	0.5867
14	Bacauan	*Rhizophora candelaria*	12.78	2.41	[e]1.071
			12.45	2.26	[e]1.002
15	Tangal	*Ceriops tagal*	13.25	1.60	0.890
			13.09		0.880
16	Pototan	*Bruguiera conjugata*	13.24	1.55	0.9426
			12.63		0.9336
17	Lenggadi	*Bruguiera parviflora*	13.37	1.65	0.8936
			13.32		0.8881
18	Pagatpat	*Sonneratia caseolaris*	(a)		0.8186
19	Pagatpat	*Sonneratia caseolaris*	(f)		0.8447

[a] Air-dry.
[b] Heartwood beginning to form.
[c] The heartwood sinks.
[d] Sapwood.
[e] Heavier than water.
[f] Unseasoned.

Fig. 1. Marketing firewood in Manila.

Fig. 2. Firewood piled for sale in the Manila market.

PLATE XLIV.

In Table XXI are given the specific gravities of various mangrove-swamp woods as determined by Cox. From this table it will be seen that the woods of the Rhizophoraceae have a high specific gravity, averaging about 0.9. Usually the mature heartwood of all Rhizophoraceae sinks in water. As all well-seasoned woods have very nearly the same calorific value per unit of weight, the specific gravity is highly important in determining the relative fuel value of different woods. The specific gravity also indicates certain other factors. In general it may said of woods otherwise equal, that those with low specific gravities kindle easily and flash quickly, the fire spreading rapidly; while those of high specific gravity behave in the opposite way.

From the determinations of specific gravity, Cox has made comparisons of the fuel value of certain North American woods and of the mangrove-swamp species of the Philippines. Good woods include those having specific gravities between 0.60 and 0.75. Among the North American species classed as good are hard pines, maple, ash, beech, birch, elm, black walnut, and a number of different oaks. The only mangrove-swamp wood placed by Cox in this class is tinductinducan (*Aegiceras corniculatum*). Very good woods are those with specific gravities between 0.75 and 0.90. North American woods included in this class are some of the oaks and various species of hickory. In this class Cox includes tabigue (*Xylocarpus moluccensis*), pagatpat (*Sonneratia caseolaris*), and langarai (*Bruguiera parviflora*). Cox does not mention any of the North American species as having excellent woods, that is with a specific gravity greater than 0.9. In this class are included pototan (*Bruguiera conjugata*), bacauan (*Rhizophora mucronata*), catutan (*Bruguiera* sp.), tangal (*Ceriops* spp.). This comparison emphasizes the very high value of the mangrove-swamp species for firewood.

In Table XXII are given the analyses and calorific determinations made by Cox on air-dried bark.

TABLE XXII.—*Analyses and calorific determinations of air-dried bark.*

[The numbers and common names are those given by Cox in the original table. The scientific names have been inserted by Mr. E. E. Schneider, wood expert of the Bureau of Forestry, after a recent examination of specimens of the wood used by Cox.]

No.	Common and scientific names.	Moisture.	Ash.	Main calories.[b]	Available heating value.	Heating value of combustible matter, wood—(water +ash) in main calories.	Available heating value of combustible matter, wood—(water +ash).
		Per cent.	*Per cent.*		*Calories.*		*Calories.*
3	Pototan (*Bruguiera conjugata*)	13.90	6.72	3,983	3,668	4,863	4,568
4	Bacauan tubig (*Rhizophora mucronata*)	10.23	10.37	3,971	3,664	4,884	4,575
6	Bacauan (*Bruguiera* sp.)	15.67	8.19	4,054 4,034	3,708 3,692	5,124 5,099	4.791 4,771
7	Catutan (*Bruguiera* sp.)	16.27	4.60	4,037	3,710	4,920	4,624
8	Tabigue (*Xylocarpus moluccensis*)	16.21	7.93	3,848	3.488	4,857	4,510
9	Bacauan (*Bruguiera* sp.)	15.70	8.17	3,891	3,565	4,903	4,594
10	Tambu-tambu (*Xylocarpus moluccensis*)	15.74	8.39	3,841	3,536	4,853	4,571

[b] See footnote "a" of Table XXI.

Concerning the relative value of mangrove-swamp woods and imported coal we may quote the following from Cox:

The available heating value of any well-seasoned wood is about 3,680 calories, and the specific gravity of well-seasoned mangrove wood (Rhizophoraceae) is about 0.9. From the latter value the weight of a solid cubic meter of meter lengths is about 900 kilograms and of a solid cord (8 by 4 by 4 English feet) is about 3,260 kilograms. In some parts of the Philippine Archipelago 2 cubic meters (2 by 1 by 1 meters) are called a talacsan. Since there are generally 35 per cent of voids, or interstices, in wood of a meter or more in length, one actually obtains about 585 kilograms and 2,120 kilograms of this wood in a cubic meter and in a cord, respectively. The available calorific (fuel or heating) value of green wood is less than that of dry wood by an amount not only proportional to the decreased wood fiber per unit weight, but also by the amount of heat necessary to evaporate and be carried away by the excess moisture, and that of green mangrove wood containing 38 per cent water is about 2,420 calories. * * * A commercial concern found that a cord of green mangrove wood contained about 18 per cent more water than well-seasoned wood weighing 2,550 kilograms, which checks with these numbers. The available heating value of an average imported coal (Tagawa) is approximately 6,500 calories. From the above numbers it may be computed that, in general, a ton of this coal is theoretically equivalent to 3 cubic meters or 0.83 cord of air-dry Philippine mangrove wood and to 3.24 cubic meters or 0.89 cord of green mangrove wood containing 38 per cent moisture. In the latter case 42 per cent extra weight will have to be handled. However, various consumers report the use in actual practice of one and one-third or more cords of wood in lieu of 1 ton of coal.

In view of the data given above it is not surprising that the mangrove-swamp species are highly prized for firewood, that the swamps near the centers of population have been largely depleted of the more valuable species, and that bakauan is raised in plantations.

TANBARKS

The mangrove barks constitute the greatest single source of tanning material in the Philippines. The species of mangrove trees which are used commercially for tanning purposes grow in the Philippines in large numbers. The export of mangrove tanbarks and of the bark extract, known as cutch, is an important industry in some tropical countries. In the Philippines this industry has never been developed, and the barks are used locally to only a limited extent; although there are extensive swamps in the Archipelago. The Philippines possess an advantage over such countries as Borneo in that owing to a large population the wood can be used as firewood; so that it would seem advisable to combine the bark collection with the cutting of firewood.

Extensive analyses of Philippine mangrove-swamp barks have been made by Bacon and Gana * and by Williams.† In Table XXIII are given the results of analyses made by Bacon and Gana of barks from Mindanao; and in Table XXIV analyses of barks from Mindoro made by the same workers. Table XXV gives the results of analyses of barks submitted by the Bureau of Forestry to the Bureau of Plant Industry at Washington. These figures are published by Williams. In Table XXVI are given the results of analyses made by Williams. Table XXVII shows the results of analyses made on barks from Sarawak, Borneo.

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* Bacon, R. B., and Gana, V. Q., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 4 (1909), pages 205 to 210.

† Williams, R. R., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 6 (1911), pages 45 to 61.

TABLE XXIII.—*Analyses of mangrove-swamp barks from Port Banga, Zamboanga.*

[Data from Bacon and Gana.]

Common name.	Scientific name.	Moisture	In parts per 100 of water-free bark.			
			Insolubility.	Total extract.	Non-tannin.	Tannin.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Busain	*Bruguiera conjugata* (Linn.) Merr.	16.1	63.0	36.96	9.8	27.2
Do	do	13.5	62.0	38.0	13.5	24.5
Lañgárai	*Bruguiera parviflora* W. and A.	13.9	84.1	15.9	7.1	8.8
Do	do	13.8	80.4	19.6	8.0	11.6
Tañgál	*Ceriops tagal* (Perr.) C. B. Robinson.	12.4	65.2	34.8	11.6	23.2
Do	do	11.9	58.6	41.4	19.1	22.3
Bakáuan-lalaki	*Rhizophora candelaria* DC.	13.4	68.7	31.3	13.3	18.0
Bakáuan-babaye	*Rhizophora mucronata* Lam	14.4	61.7	38.3	12.4	25.9
Tabigue	*Xylocarpus granatum* Koen	14.9	69.7	30.3	8.6	21.7
Do	do	14.2	67.6	32.4	7.7	24.7

TABLE XXIV.—*Analyses of mangrove-swamp barks from Mindoro.*

[Data from Bacon and Gana.]

Common name.	Scientific name.	Moisture.	In parts per 100 of water-free bark.			
			Insolubility.	Total extract.	Non-tannin.	Tannin.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Busain	*Bruguiera conjugata* (Linn.) Merr.	13.9	60.2	39.8	11.6	28.2
Do	do	13.9	63.4	36.6	12.6	24.0
Lañgárai	*Bruguiera parviflora* W. and A.	14.0	77.4	22.4	9.6	12.8
Do	do	14.8	75.5	24.5	9.6	14.9
Do	do	12.9	82.1	17.9	8.3	9.6
Tañgál	*Ceriops tagal* (Perr.) C. B. Robinson.	11.8	69.1	30.9	9.7	21.2
Do	do	12.3	72.5	27.5	10.5	17.0
Do	do	12.7	71.5	28.5	8.0	20.5
Bakáuan-lalaki	*Rhizophora candelaria* DC.	13.2	67.4	32.6	12.0	20.6
Do	do	13.5	64.8	35.2	10.8	24.4
Do	do	14.4	66.6	33.4	10.7	22.7
Do	do	14.1	67.1	32.9	10.0	22.9
Bakáuan-babaye	*Rhizophora mucronata* Lam.	13.2	64.3	35.7	14.1	21.6
Do	do	13.4	67.1	32.9	15.1	17.8

TABLE XXV.—*Analyses of Philippine mangrove-swamp barks submitted by the Bureau of Forestry to the Bureau of Plant Industry at Washington.*

[Data from Williams.]

Common name.	Scientific name.	Total solids.	Soluble solids.	"Reds."	Non-tannin.	Tannin.
Lañgárai	*Bruguiera parviflora* W. and A.	24.43	19.82	4.61	7.27	12.55
Potótan	*Bruguiera sexangula* (Lour.) Poir.	37.36	36.81	0.55	10.15	26.66
Tañgál	*Ceriops tagal* (Perr.) C. B. Rob.	58.58	49.02	9.56	13.19	35.83
Bakáuan	*Rhizophora candelaria* DC	53.91	51.03	2.88	11.64	39.39

TABLE XXVI.—*Analyses of Philippine mangrove-swamp barks.*

[Data from Williams.]

Species.	Number of determinations.	Average of determinations.
Bruguiera conjugata (Linn.) Merr. *Bruguiera sexangula* (Lour.) Poir	13	32.4
Bruguiera parviflora W. and A	14	9.1
Ceriops tagal (Perr.) C. B. Rob	5	31.3
Rhizophora candelaria DC	9	27.8
Rhizophora mucronata Lam	23	27.6
Sonneratia caseolaris Linn	4	11.8
Xylocarpus moluccensis (Lam.) M. Roem	2	23.0
Xylocarpus granatum Koen	2	23.2

TABLE XXVII.—*Analyses of mangrove-swamp barks from Sarawak, Borneo.*[a]

[Data from Bacon and Gana.]

Common name.	Scientific name.	Moisture.	Insolubility.	Total extract.	Non-tannin.	Tannin.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Busain	*Bruguiera conjugata* (Linn.) Merr.	15.5	64.3	35.7	9.0	26.7
Potótan	*Bruguiera sexangula* (Lour.) Poir.	16.1	64.0	36.0	8.0	27.2
Tañgál	*Ceriops tagal* (Perr.) C. B. Robinson.	13.8	63.8	36.2	6.9	29.3
Bakáuan-lalaki	*Rhizophora candelaria* DC	14.7	58.3	41.7	9.6	32.0
Bakáuan-babaye	*Rhizophora mucronata* Lam	14.4	70.1	29.9	9.4	20.5

[a] Analysis was made of some samples of mangrove barks brought from Sarawak, Borneo, by Dr. Foxworthy, of the botanical division of this Bureau. These barks are used by cutch factories and among the species in Borneo probably yield the highest amount of tannin.

TABLE XXVIII.—*Yield of bark from mangrove trees of different sizes.*

[Data from Foxworthy and Matthews.]

Diameter.	Species.			
	Rhizophora candelaria.	Rhizophora mucronata.	Bruguiera conjugata and Bruguiera sexangula.	Ceriops tagal and Ceriops roxburghiana.
Inches.	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*
3	4	4	3	2
4	6	6	5	3
5	12	11	7	5
6	21	19	9	9
7	30	30	16	13
8	41	41	18	21
9	56	52	24	30
10	72	66	30	40
11	90	83	39	54
12	110	98	47	----------
13	133	121	57	----------
14	157	145	66	----------
15	193	178	78	----------
16	236	223	91	----------
17	287	266	103	----------
18	----------	----------	120	----------
19	----------	----------	139	----------

In Table XXVIII is shown the yield of bark from trees of different sizes of *Rhizophora candelaria, Rhizophora mucronata, Bruguiera conjugata* and *Bruguiera sexangula,* and *Ceriops tagal* and *Ceriops roxburghiana.* The figures in this table were calculated from a table by Foxworthy and Matthews.*

Very various results have been obtained by analyzing the barks of the same species, and it has been often stated that the bark from some countries is richer in tannin than that from others. Williams † says that the percentage of tannin increases with the size of the tree. He believed, however, that this increase was due rather to the age than to the size. In drying, barks also lose a certain portion of their tannin, especially if not properly dried. Owing to these facts and to the varied results obtained by analyses it is questionable as to

* Foxworthy, F. W. and Matthews, D. M., Mangrove and nipah swamps of British North Borneo, Department of Forestry Bulletin No. 3 (1917), page 16.

† Williams, R. R., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 6 (1911), pages 45 to 61.

whether or not bark of the same age has a different tannin content in different regions. The barks from East Africa are, however, reported to be richer in tannin than those from the Indo-Malayan region. The Philippine barks certainly appear to be as rich as those in Borneo which have been used in cutch factories. Owing to the relatively low price that the crude barks command and the expenses of shipping, it would probably be advisable to export cutch rather than the crude barks.

Cutch is not only used as a tanning material but also as a dye. A short history of the uses of cutch has been given by Foxworthy.* The name cutch was originally applied to a product of the heartwood of *Acacia catechu* Willd., which has been known from India and Burma for many years.

TABLE XXIX.—*Amount of tanbarks and dye barks on which forest charges were paid in the Philippine Islands from 1914 to 1918, inclusive.*

Year.	Tanbarks.	Dye barks.
	Kilos.	*Kilos.*
1914	2,793,295	58,714
1915	1,913,558	94,492
1916	1,543,686	93,057
1917	3,165,687	84,364
1918	1,973,786	148,764

The supply was however not entirely uniform or reliable. When the product from the mangrove trees came into the market it superseded the Indian cutch to such an extent that this term is now used mainly with reference to the mangrove extracts. With the advent of the common use of aniline dye it was found that the Bismarck browns furnished a cheaper and a more easily handled dye than cutch and, consequently, the use of the latter as a dye gradually ceased.

The bark of *Ceriops* spp. is used locally for coloring rice and tuba and for dyeing. The bark of *Xylocarpus granatum* is also used locally to a considerable extent for dyeing purposes. The dyeing property of the barks of *Ceriops tagal* and *Xylocarpus granatum* is not great, and they are of more use as mordants. They are, however, used in large quantity for dyeing fishnets, ropes, sails, and clothing used in salt water. Table XXIX shows the amount of tanbarks and dye barks upon which forest charges were paid from 1914 to 1918. The barks consisted very largely of mangrove-swamp species, the dye barks chiefly of *Ceriops* spp. and *Xylocarpus granatum.*

* Foxworthy, F. W., Cutch, Philippine Journal of Science, Sec. A, Vol. 3 (1908), page 534.

Many mangrove swamps in the Philippines have been so thoroughly depleted of the larger-sized and more valuable trees that even though they cover extensive areas they would not be capable of supporting a cutch factory. However, there are areas in Mindanao, Mindoro, and Palawan which, although they may not be as large as some in Borneo, still offer promising sites for cutch factories. In Sibuguey Bay, Mindanao, there is a well-developed swamp covering an area of 25,000 hectares. Concerning this area Williams † says:

I have found that this area will yield about 20 metric tons per hectare of fresh bark of mature trees of selected species averaging about 28 to 30 per cent of tannin on the dry weight. Only four species are included in this estimate, all others being negligible from a commercial standpoint. The natural resources are sufficient for a profitable industry, the swamps being fully as valuable, hectare for hectare, as many now being worked in the East Indies.

A survey of the data shows that only four species can be depended upon to furnish a supply of bark. They are *Rhizophora mucronata*, *R. conjugata* [*candelaria*], *Bruguiera gymnorrhiza* [*conjugata*], and *B. eriopetala* [*sexangula*], the two former commonly known as "bacauan" [bakáuan-lalaki and bakáuan-babaye respectively], the two latter as "pototan" or "pituṭan." Tañgal, which is the "teñgah" bark of Borneo upon which the manufacturers there depend to a considerable extent, is scarce on Sibuguey Bay. Both *Xylocarpus granatum* [*moluccensis*] and *X. obovatus* [*granatum*] yield too small quantities of bark per tree to be remunerative. *Bruguiera parviflora* has a very low tannin content, as has *Sonneratia pagatpat* [*caseolaris*].

However, a use may be found for the last mentioned for blending with the more valuable barks, since it produces a leather of good, brown color, very different from any tanned by barks of the Rhizophoraceae.

In calculating the yield of bark in the area examined, only bacauan and pototan tree 20 centimeters or more in diameter have been counted. For this purpose seven rectangular areas of about one-fourth hectare each were selected as representative after a fairly thorough exploration of the surrounding swamp. These areas are distributed at approximately regular intervals between the mouths of the Vitali and Buluan Rivers. The yield of bark per tree was determined by felling three representative trees each of bacauan and pototan and stripping and weighing the bark. Bacauan averaged 140 kilograms per tree, pototan 190 kilograms. On this basis the area will yield 20.6 metric tons of bacauan bark per hectare, and 5.8 tons of pototan. We may safely state the yield at 20 tons per hectare of bark . . .

In Mindoro there is a tract of 10,000 hectares and in Palawan a fairly compact area of good swamp. The swamps in the other islands of the Archipelago are so scattered as to make the success of a cutch factory doubtful.

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† Williams, R. R., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 6 (1911), page 47.

Concerning the manufacture of cutch from Philippine materials Bacon and Gana * write as follows:

There are three large cutch factories in Borneo using tan barks from the same species of mangrove as those found in the Philippines. These factories regard the process of manufacturing cutch as a trade secret, but we can not believe that these so-called trade secrets are of a very formidable nature, as we have succeeded in preparing very good grades of cutch without any complicated processes in this laboratory. Our cutch is a dry, brown solid with a brilliant, almost metallic, fracture. It is easily and completely soluble in water and the analysis shows the following constituents:

Constituent.	In parts per 100 of water-free material.	
	I.	II.
	Per cent.	*Per cent.*
Moisture	2.6	5.7
Insoluble	1.9	1.3
Soluble	98.1	98.7
Non-tannin	28.8	26.1
Tannin	69.3	72.6

The following was the method used to prepare the cutch:

The finely ground bark was leached with cold water, and this solution evaporated to dryness *in vacuo.* Hot water extracts too much of the coloring matter, and no more tannin than cold water. The evaporation, at least the latter stages, must always be made *in vacuo* to avoid burning the cutch. It is sufficiently obvious that the extraction on a large scale would be carried out in such a manner that strong solutions would be employed to leach fresh bark while weak ones would be used to extract the last percentages of the tannin from the partly exhausted bark. All the parts of the factory, except the vacuum dryers, could be built on the ground, and it is evident that the fuel for the boilers and for the dryers would cost very little, so that it would appear that if the cutch manufacture were taken up in connection with the lumbering or firewood industry that it would be exceedingly profitable.

The chief objection to the use of cutch as a tanning material seems to be that it produces a reddish-brown leather which is somewhat harsh and thick-grained, due to the high astringency of the tannin; but when mixed with other materials it gives a very satisfactory tannage.†

* Bacon, R. F. and Gana, V. Q., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 4 (1909), pages 206 and 207.

† Williams, R. R., The economic possibilities of the mangrove swamps of the Philippines, Philippine Journal of Science, Sec. A, Vol. 6 (1911), page 56.

FOREST REGULATIONS AND CHARGES

The mangrove-swamp areas are property of the Philippine Government and are not sold but developed under a license system. Usually small operators work under an ordinary yearly license for definite small areas. Exclusive licenses (or concessions, as they are popularly called) are generally in the form of a twenty-year exclusive license to cut and extract timber, firewood, dye and tanbarks and other minor forest products from a specific tract. The land is in no way affected, as merely the timber and minor forest products are included. Areas of 10 hectares are leased for factory or mill sites free of charge, as are also all rights of way for the operation of a concession. The charges are only nominal and are collectable after the products have been gathered.

A charge of 20 centavos per cubic meter is paid on wood cut for firewood; if cut for lumber, the charge is according to the group, Philippine woods being divided into four groups. *Lumnitzera* belongs to the second group, which is assessed at 1.50 pesos per cubic meter. *Sonneratia caseolaris* and *Xylocarpus moluccensis* belong to the third group, on which there is a charge of 1 peso per cubic meter. All of the other timbers from the mangrove swamps belong to the fourth group on which a charge of 50 centavos per cubic meter is paid. Tanbarks are assessed at 30 centavos per hundred kilograms, and dye barks at 50 centavos per hundred kilograms.

PHILIPPINE PALMS AND PALM PRODUCTS

By William H. Brown and Elmer D. Merrill

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

PHILIPPINE PALMS AND PALM PRODUCTS

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ACKNOWLEDGEMENTS.

Extensive accounts of the alcohol and sugar possibilities of the more prominent species of palms 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, with only slight changes in nomenclature.

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; leafsheaths and midribs armed; fruit covered with scales, usually shiny.
      3. Leaflets rhomboid or wedge-shaped, whitish beneath; leafsheaths 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 leafsheaths. 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 leafsheaths.
            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 maximus var. *merrittianus* Becc.
Calamus maximus var. *nanga* Becc.
Calamus megaphyllus Becc.
Calamus melanorhynchus Becc.
Calamus meyenianus 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 palindan (Blanco) Merr.
Orania palindan 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.

Pinanga heterophylla Becc.
Pinanga insignis Becc. (forma typica).
Pinanga insignis var. *gasterocarpa* Becc.
Pinanga insignis var. *leptocarpa* Becc.
Pinanga insignis var. *loheriana* Becc.
Pinanga isabelensis Becc.
Pinanga maculata Porte.
Pinanga modesta Becc.
Pinanga negrosensis Becc.
Pinanga philippinensis Becc.
Pinanga rigida Becc.
Pinanga samarana Becc.
Pinanga sclerophylla Becc.
Pinanga sibuyanensis Becc.
Pinanga speciosa Becc.
Pinanga urdanetana Becc.
Pinanga urosperma Becc.
Pinanga woodiana Becc.
Plectocomia elmerii Becc.
Ptychoraphis cagayanensis Becc.
Ptychoraphis elmerii Becc.
Ptychoraphis intermedia Becc.
Ptychoraphis microcarpa Becc.
Zalacca clemensiana 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).

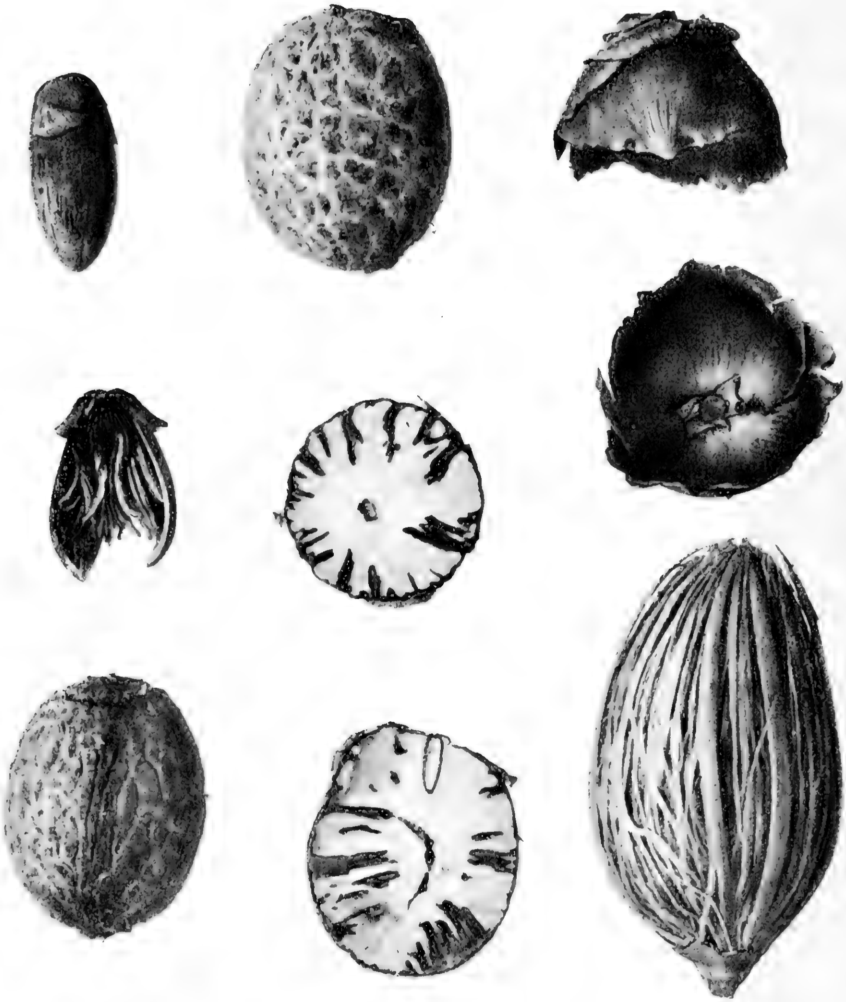

PLATE III. FRUIT OF ADONIDIA MERRILLII (BUNGA DE CHINA).

*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). BÚÑGA 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.

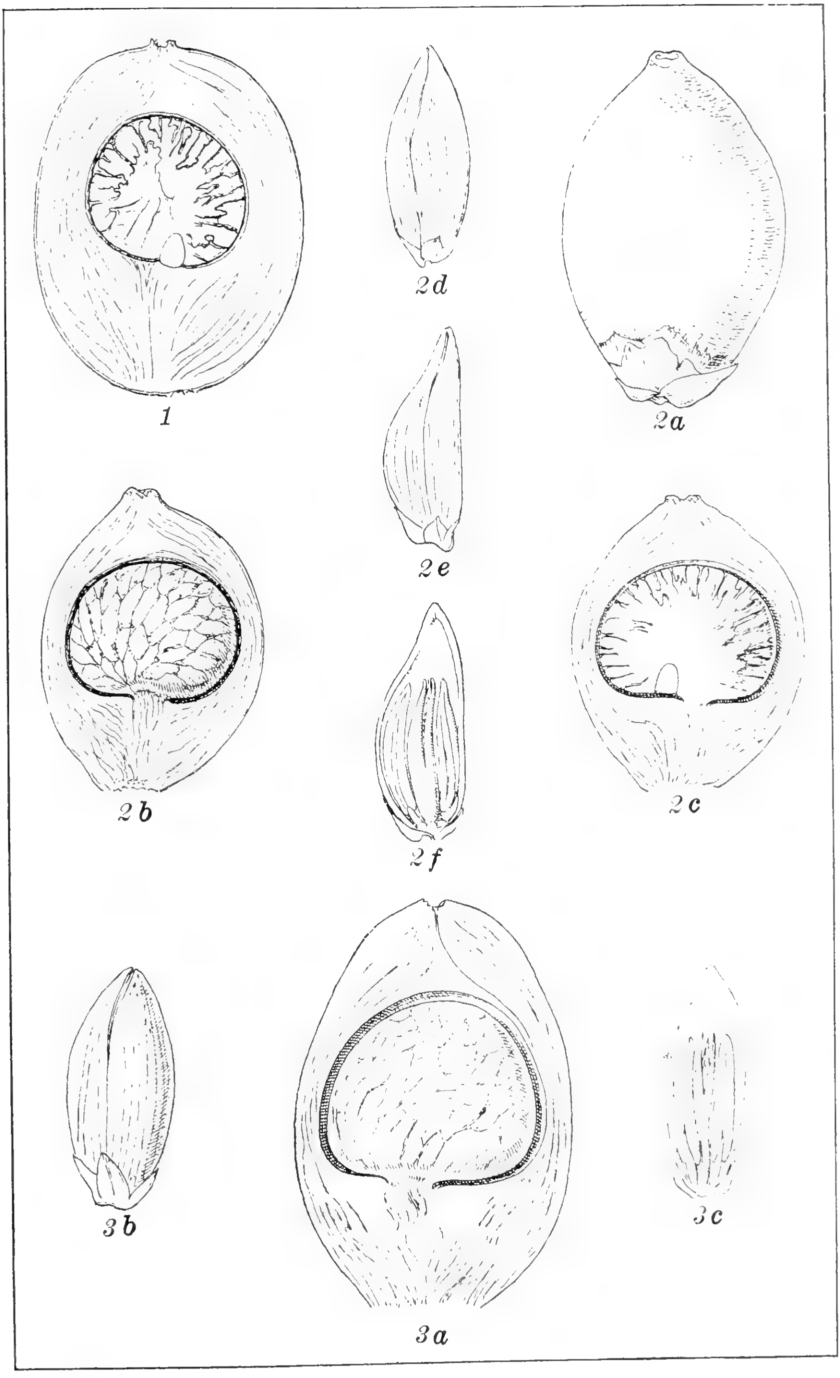

Fig. 1. Area catechu (semisilvatica). 2. A. catechu var. silvatica. 3. A. catechu (communis).

PLATE IV.

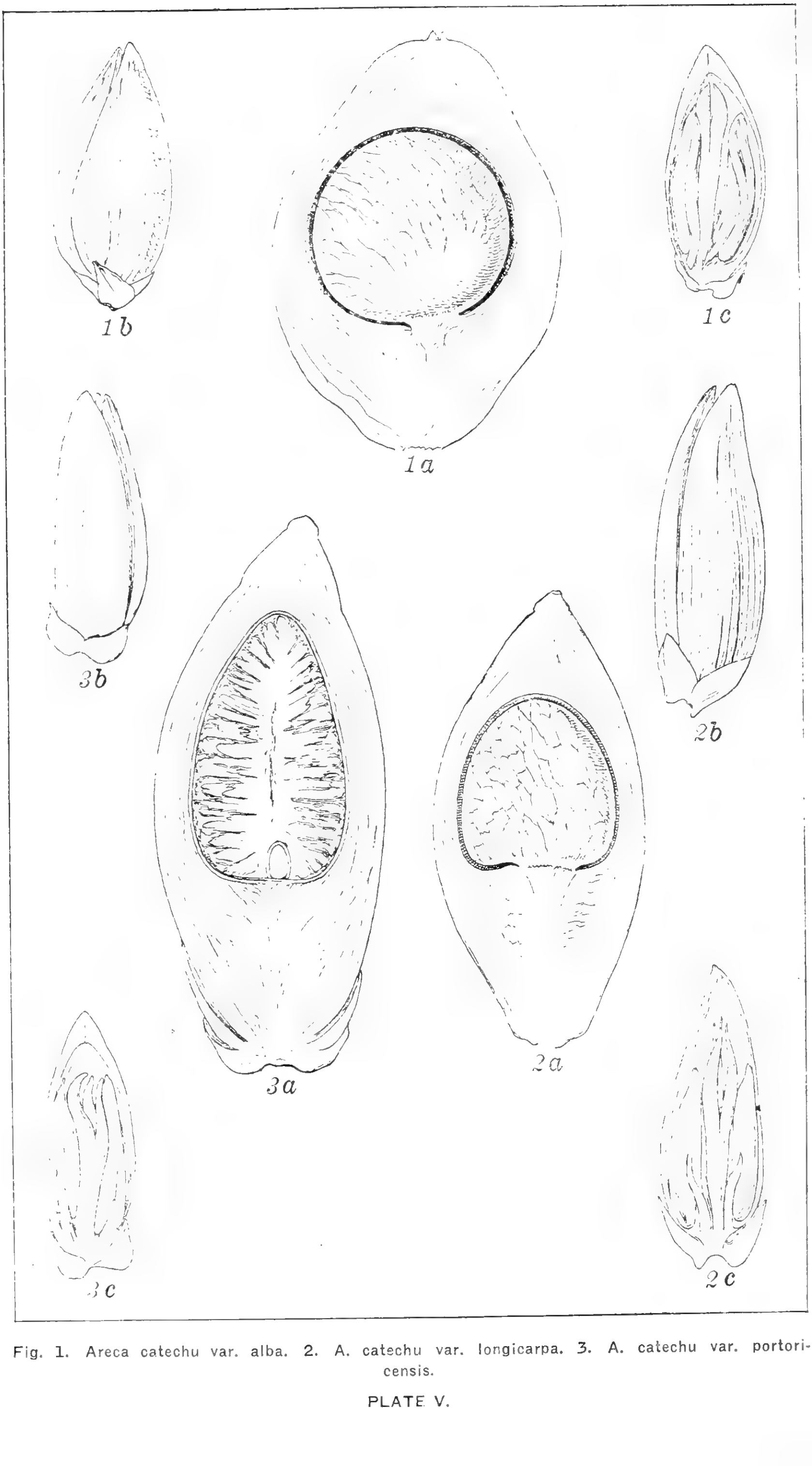

Fig. 1. Areca catechu var. alba. 2. A. catechu var. longicarpa. 3. A. catechu var. portoricensis.

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. PISÁ.

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.

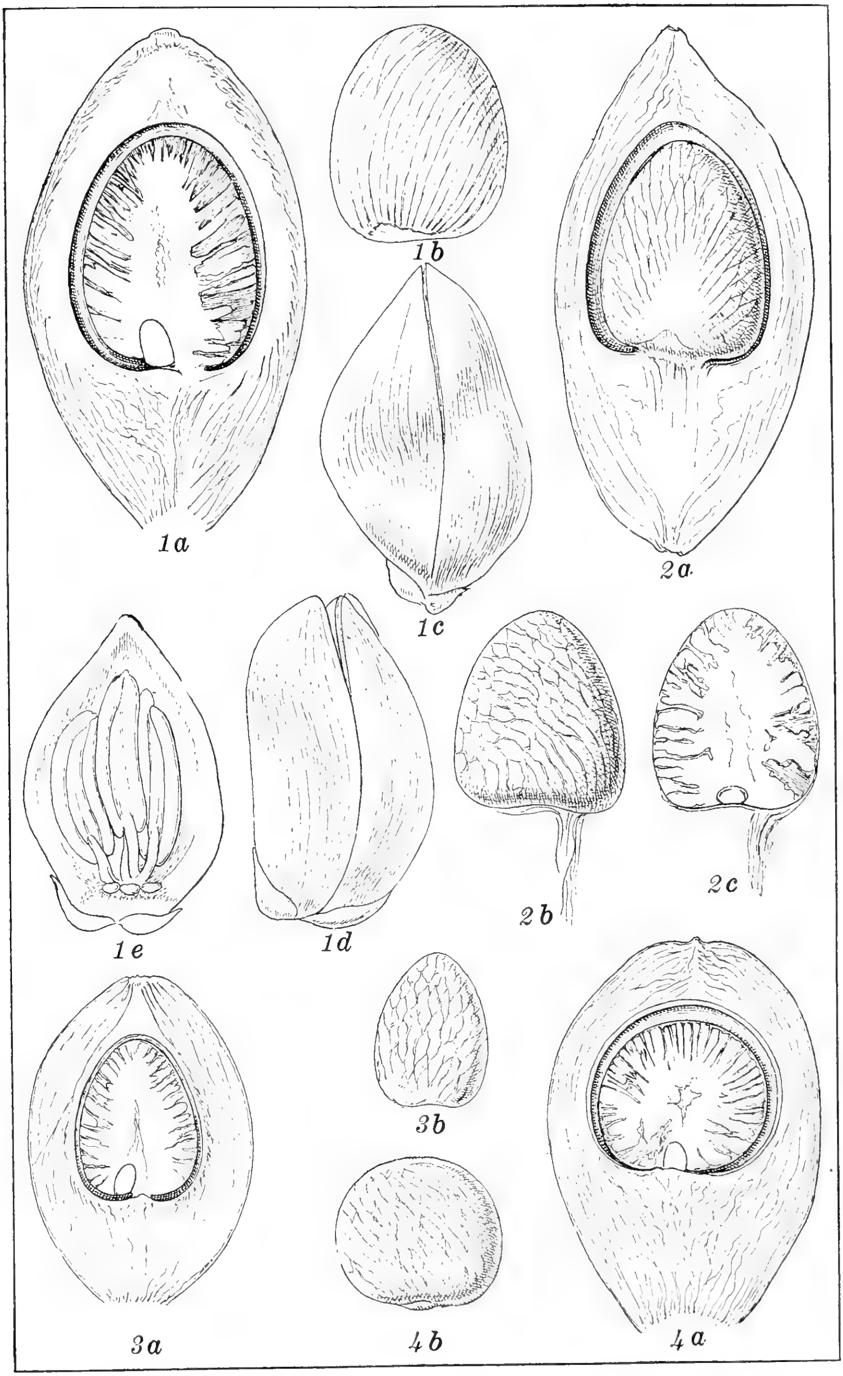

Fig. 1. Areca parens. 2. A. macrocarpa. 3. A. camarinensis. 4. A. ipot.

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. pinnata.*

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. tremula.*

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

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* 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).

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* 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

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* 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.

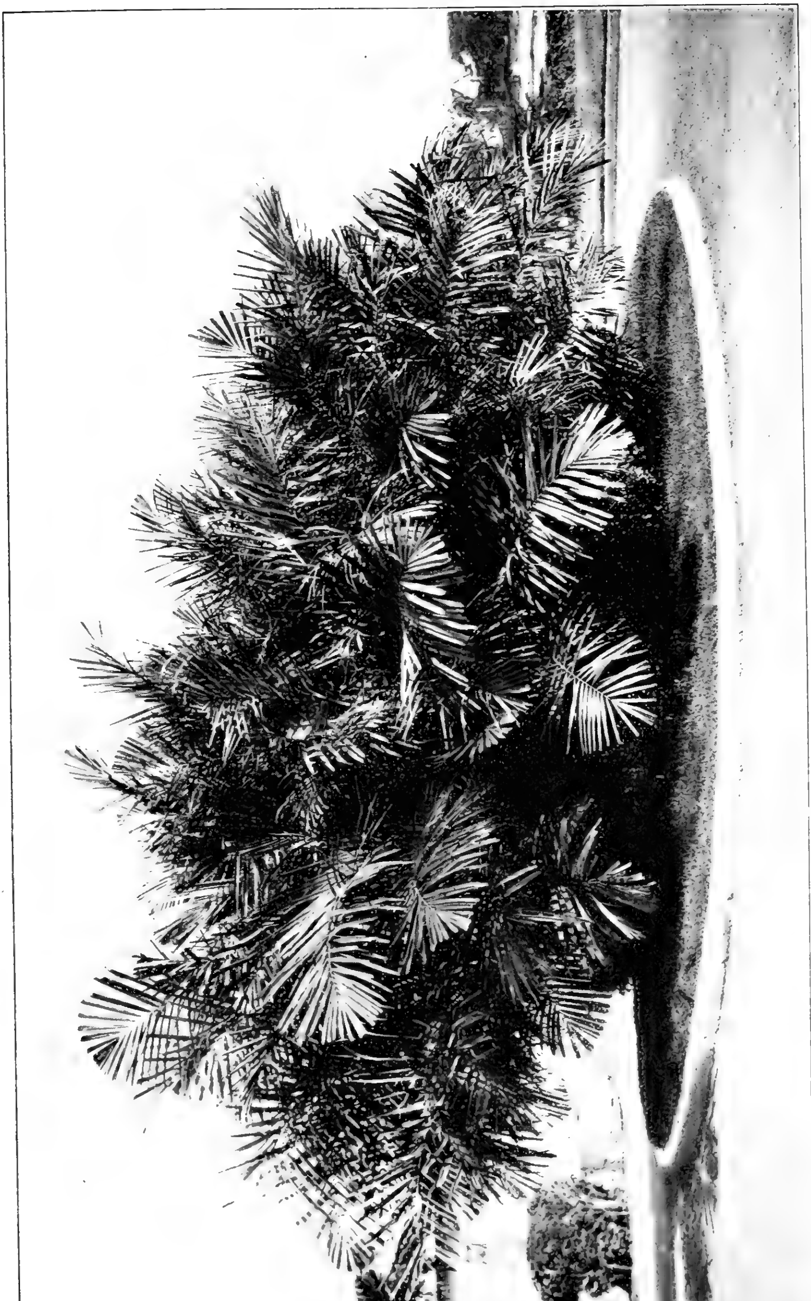

PLATE IX. ARENGA TREMULA (DUMAYAKA).

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); *banísan* (Moro); *baris* (Bagobo); *batbát* (Tagbanua); *bélis, típon-típon* (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).

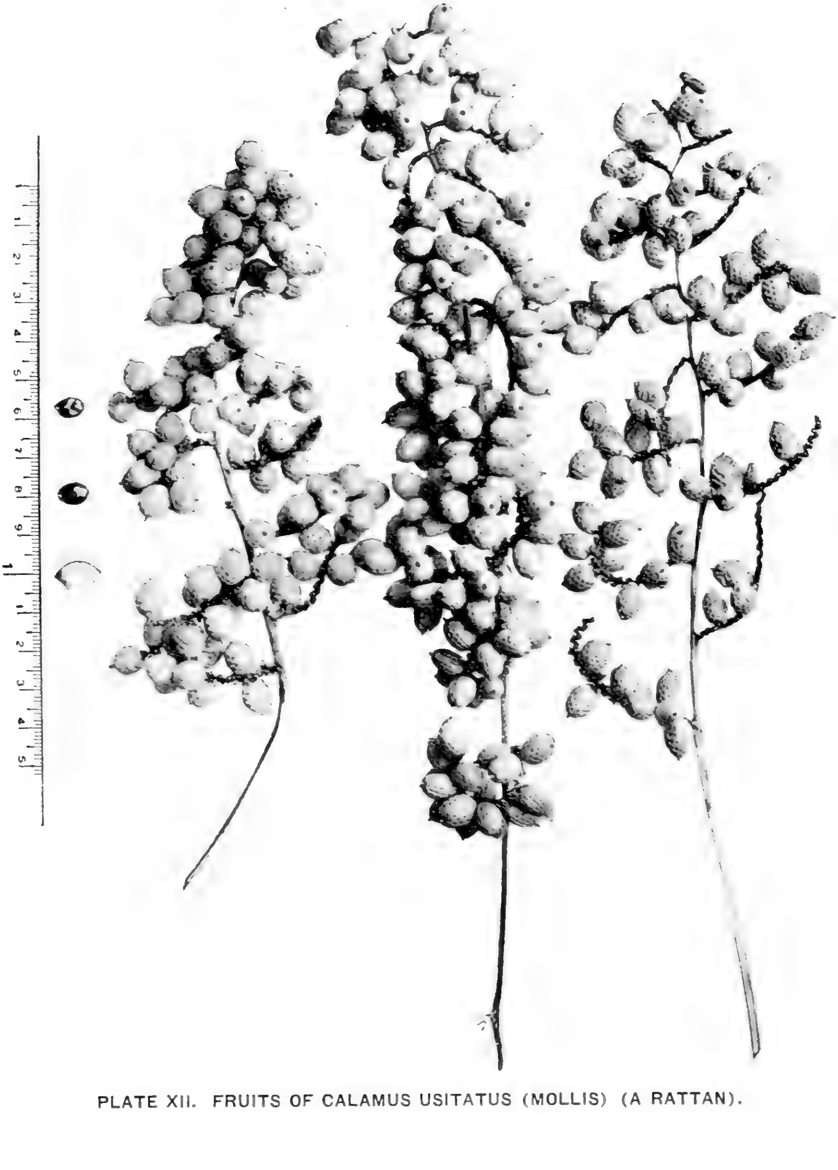

PLATE XII. FRUITS OF CALAMUS USITATUS (MOLLIS) (A RATTAN).

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. usitatus.*

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. usitatus* (forma *typica*).

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

g^3. Slender; sheathed stem 12 to 15 mm in diameter; leaf-sheaths almost spineless.... *C. usitatus* 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. maximus* (forma *typica*).

d^1. Secondary spathes prickly............ *C. maximus* 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. maximus* 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*.

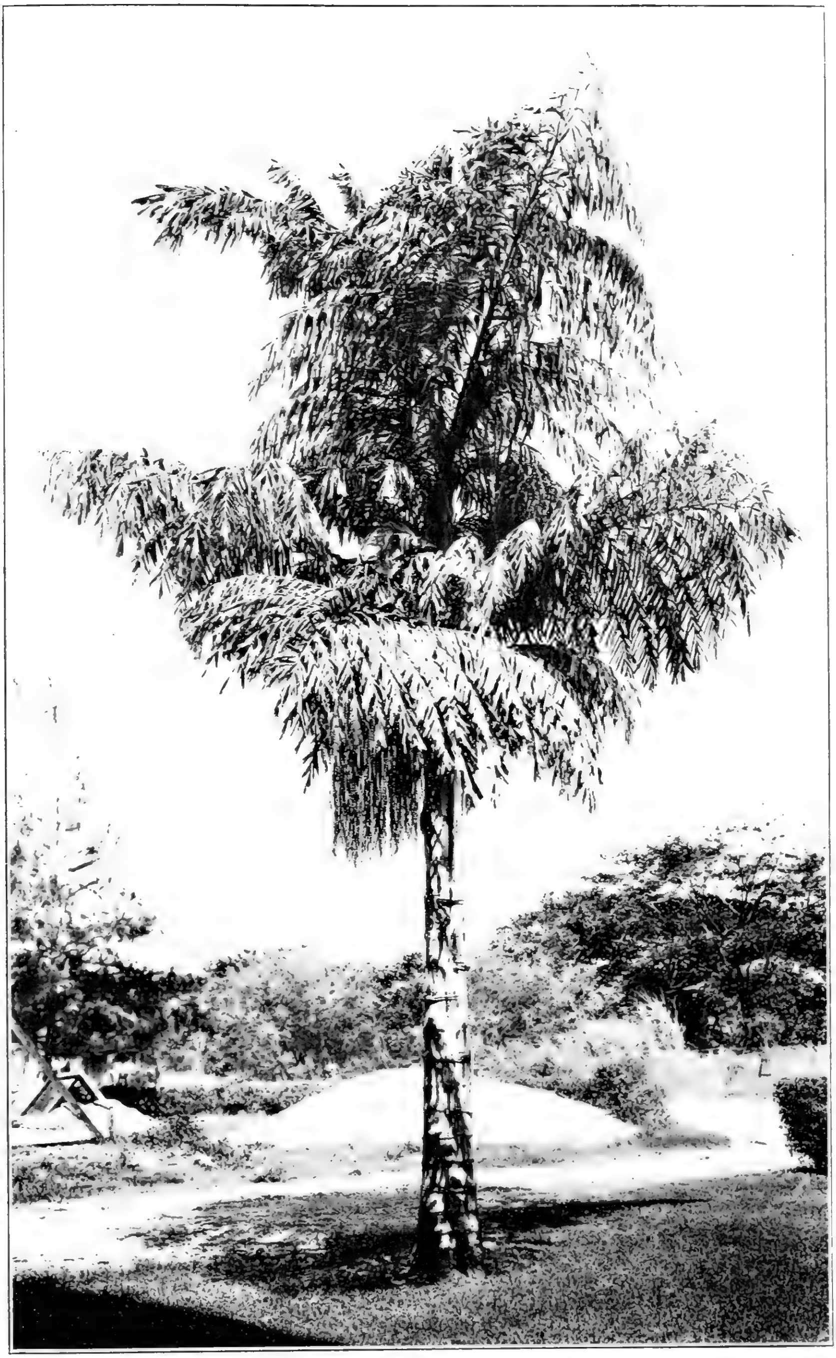

PLATE XV. CARYOTA RUMPHIANA (PUGAHAN).

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. INFLORESCENCE OF CARYOTA RUMPHIANA (PUGAHAN).

CARYOTA CUMINGII Lodd. PUGÁHAN OR FISH-TAIL PALM.

Local names: *Báhi* (Mandaya); *hágol* (Bikol); *patíkan* (Bisaya); *pugu-han* (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.

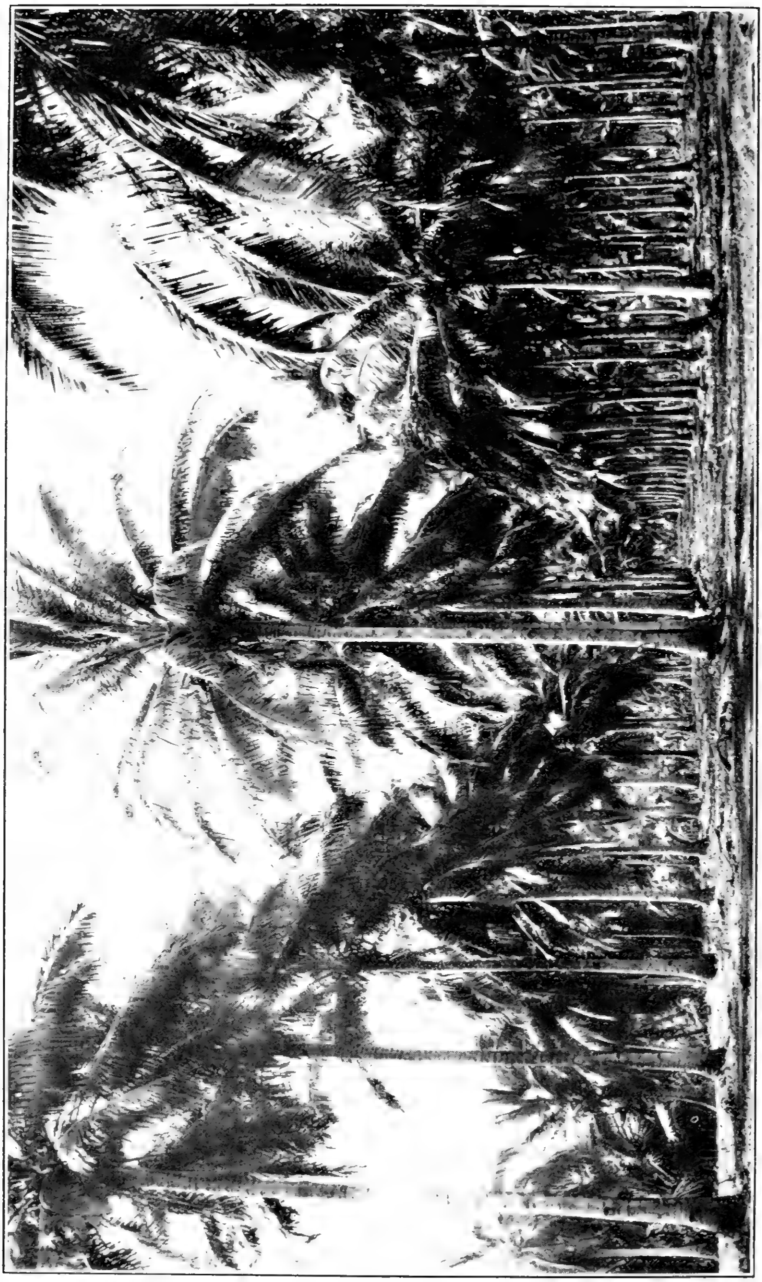

PLATE XIX. COCONUT PLANTATION IN THE PHILIPPINES.

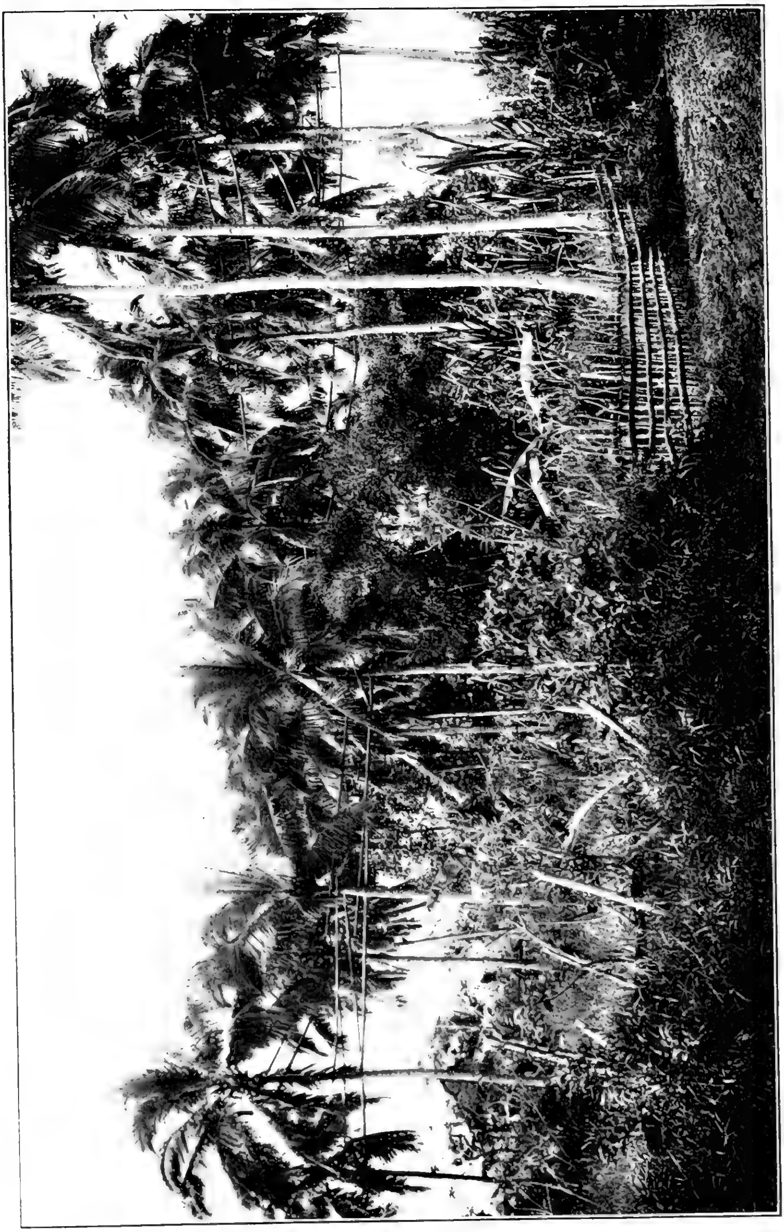

PLATE XX. COCONUT GROVE WITH BAMBOO POLES IN TREES FOR GATHERING TUBA.

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.

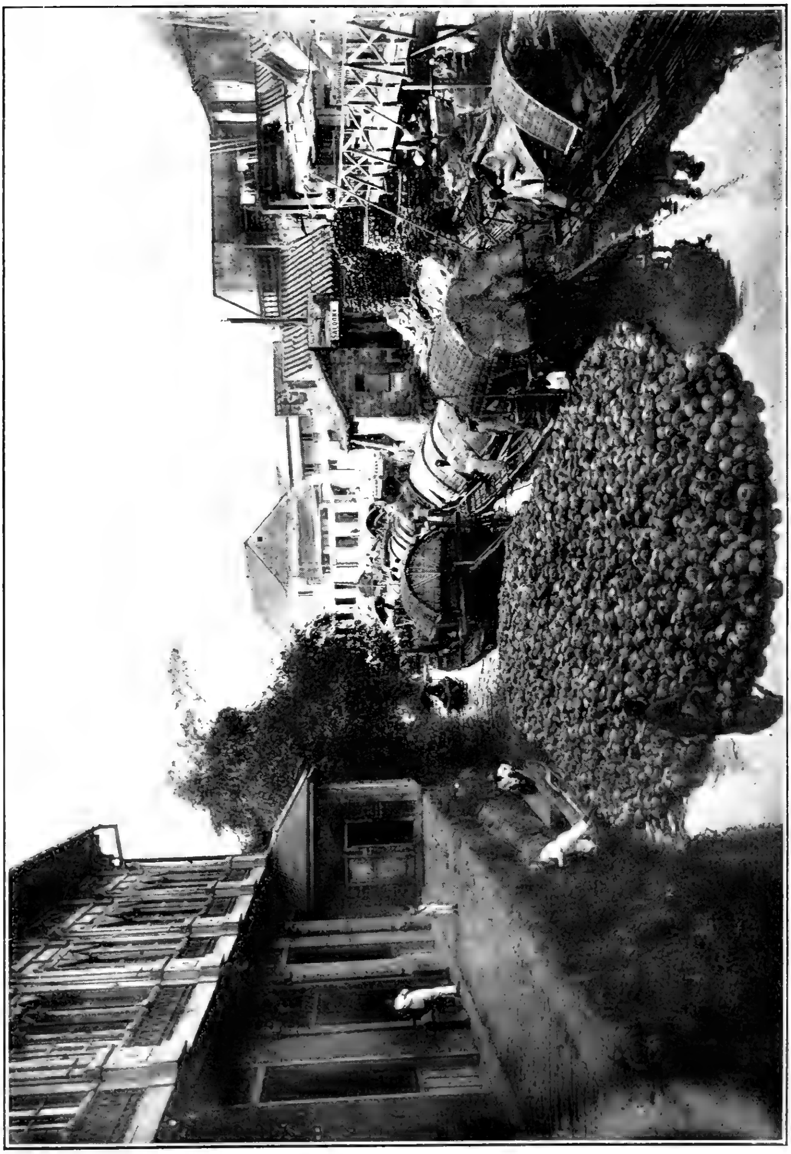

PLATE XXIII. RAFTS OF COCONUTS.

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). Without trunk. Height in meters. Less than 1.	1 to 2.	More than 2.	With trunk.	Total plants on one block.
	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

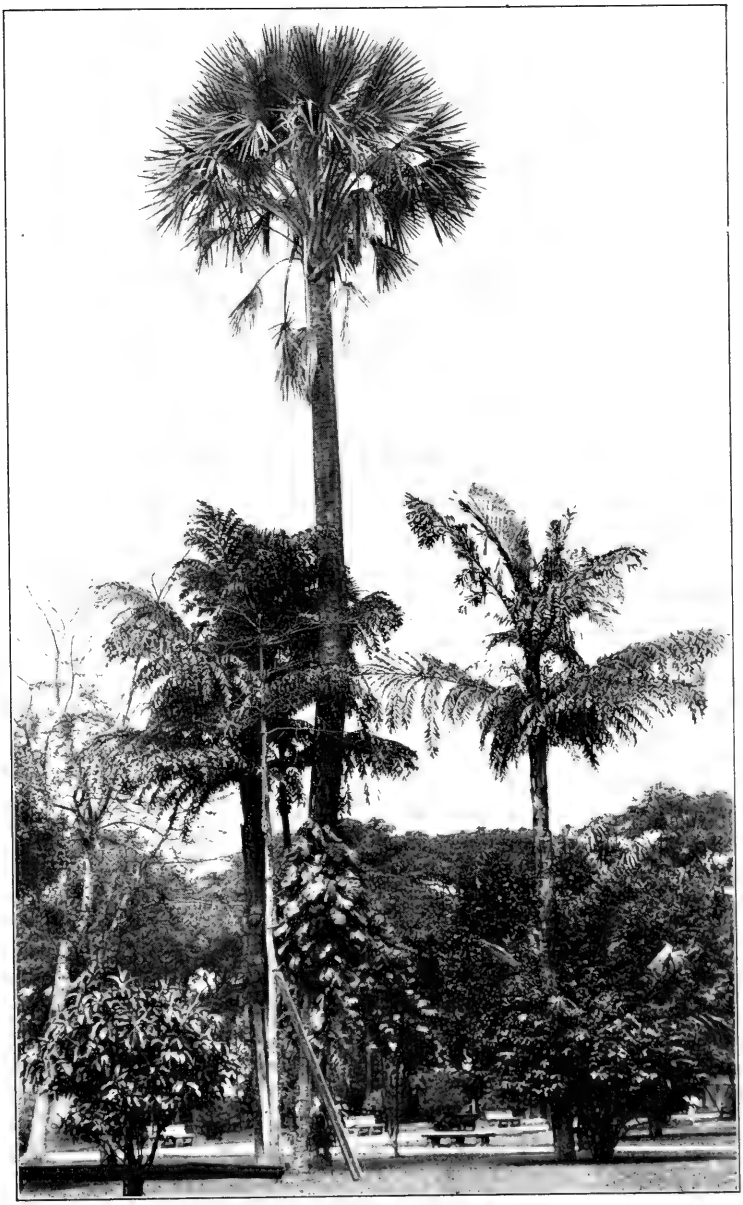

PLATE XXIV. CORYPHA ELATA (BURI) AND TWO SPECIMENS OF CARYOTA (PUGAHAN).

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). Without trunk. Height in meters. Less than 1.	1 to 2.	More than 2.	With trunk.	Total plants on one hectare.
	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-

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

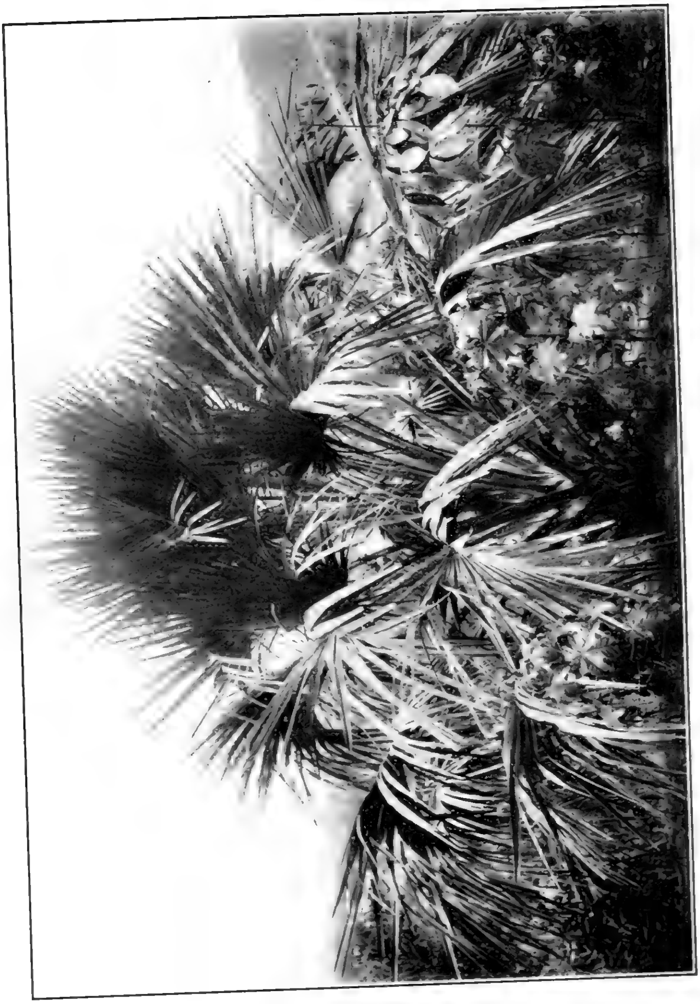

PLATE XXVI. YOUNG SPECIMEN OF CORYPHA ELATA (BURI).

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

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* 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.

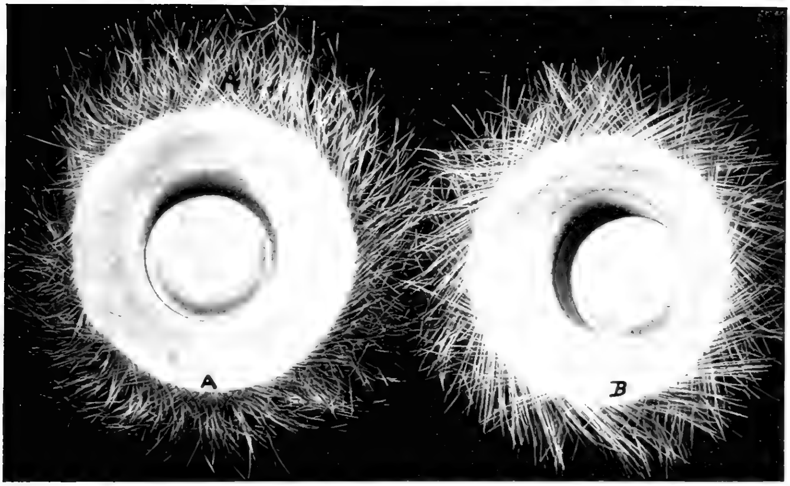

Fig. 1. Outer and inner halves of one Calasiao hat.

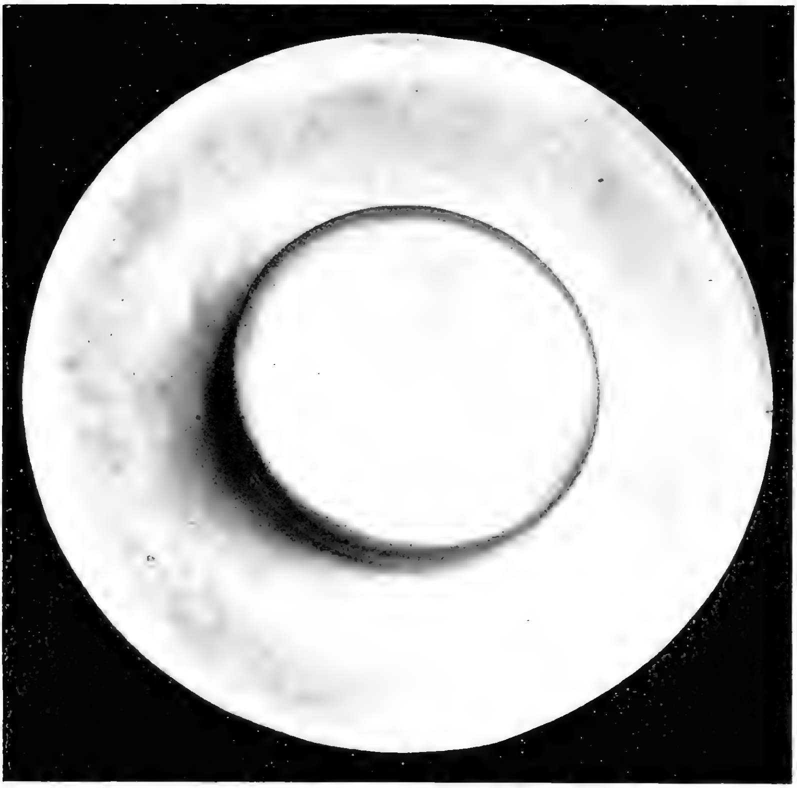

Fig. 2. Completed buri-midrib (Calasiao) hat.

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.

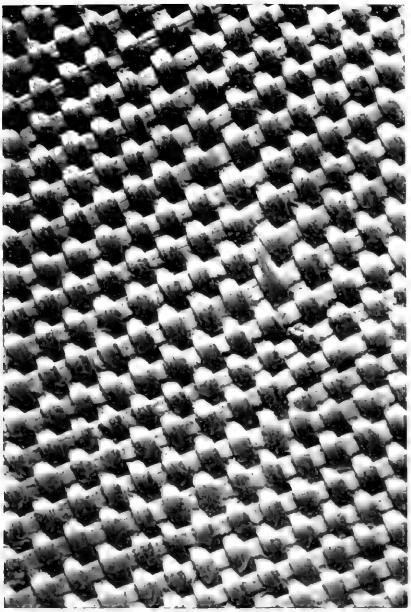

Fig. 1. Buntal (Lukban).

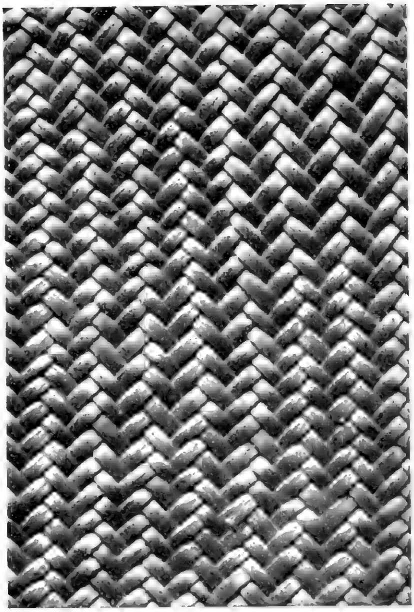

Fig. 2. Buntal (Baliuag).

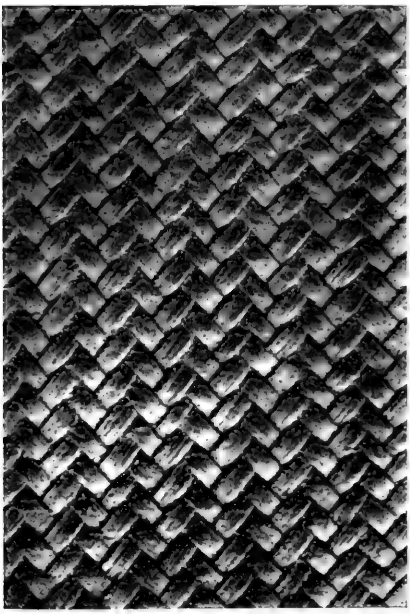

Fig. 3. Calasiao.

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 for a 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.

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* 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.

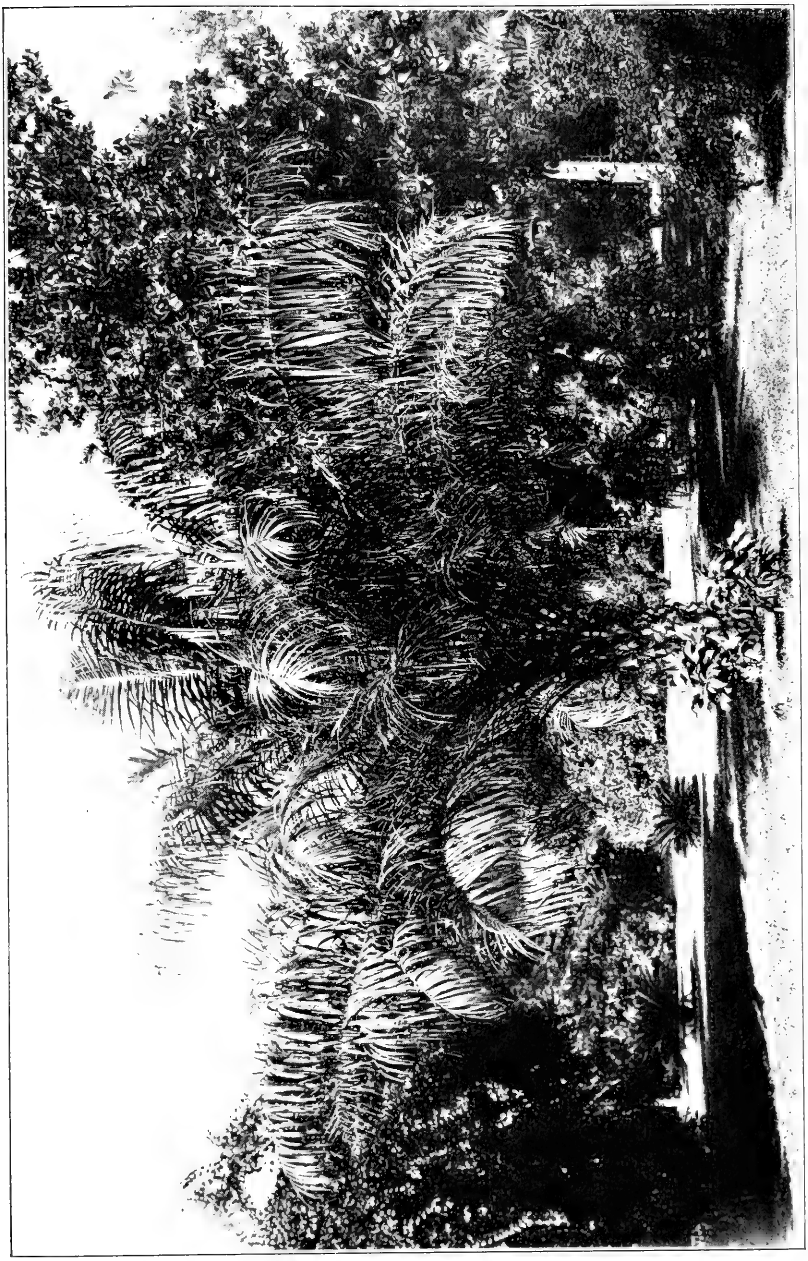

PLATE XXX. ELAEIS GUINEENSIS (OIL PALM).

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.

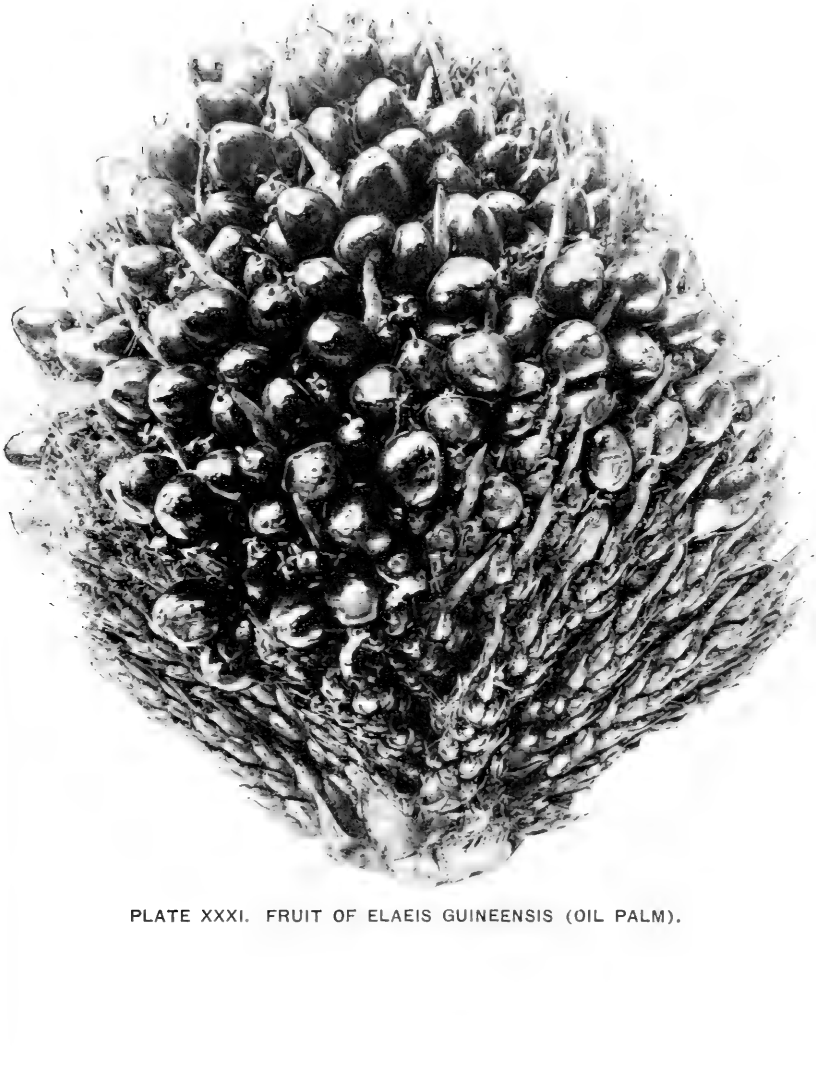

PLATE XXXI. FRUIT OF ELAEIS GUINEENSIS (OIL PALM).

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.

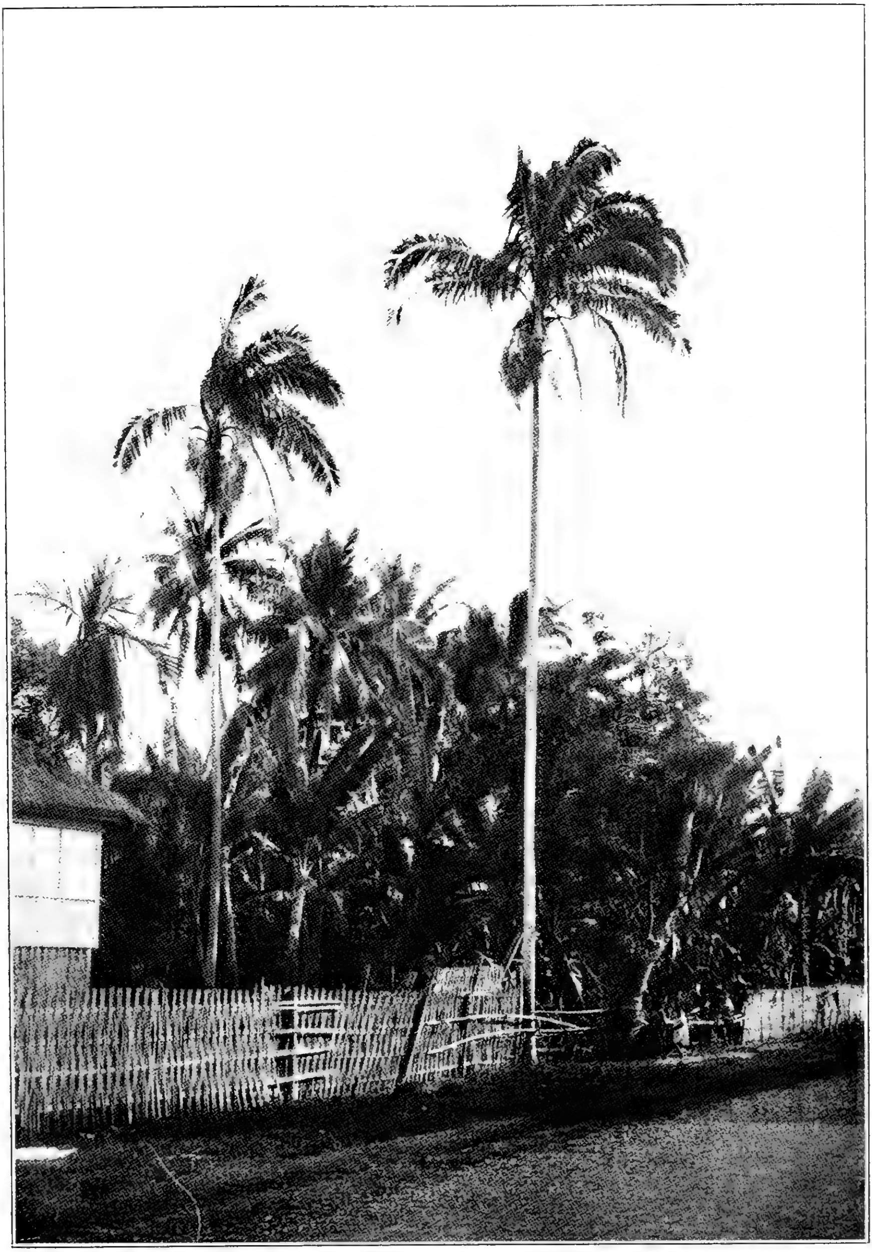

PLATE XXXII. HETEROSPATHE ELATA (SAGISI).

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 666 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 the section of this publication dealing with 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

PLATE XLI.

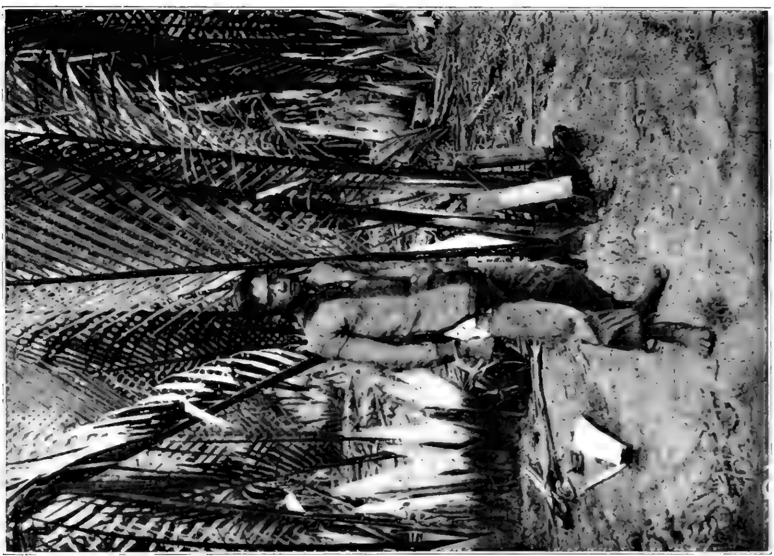

Fig. 1. Collecting the nipa sap.

Fig. 2. Nipa palms in fruit.

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 Blume ANÍBONG.

Local names: *Aníbong* (Tagalog, Bisaya); *aníbung* (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. palindan.*

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. palindan* 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, búñgamachín, 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. mauritiforme* 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* (tarau), 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, Oreodoxa regia, Pinanga* spp., *Areca ipot,* and *Arenga mindorensis.* The following 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 houseposts, 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.

PHILIPPINE BAMBOOS

By William H. Brown and Arthur F. Fischer

PLATE I. VIEW ALONG A TRAIL IN FOREST OF SCHIZOSTACHYUM LUMAMPAO.

PHILIPPINE BAMBOOS

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PHILIPPINE BAMBOOS

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INTRODUCTION

The bamboos form a section of the grass family and contain the largest known grasses, many of which are of tree size. Bamboos, according to form, can be divided into three classes: clump-forming erect species; erect ones which send up shoots singly from an underground stem; and climbing bamboos. Erect clump-forming species are characteristic of tropical countries, while those which send up shoots singly are more characteristic of subtropical or temperate regions. Bamboos are the most useful plants for domestic purposes in the Philippine Islands. Their most promising possibilities for export are as paper pulp, hats, baskets, mats, and matting.

In the Philippine Islands are found about 30 species of bamboo, 17 erect and 13 climbing, as follows:

ERECT

Arundinaria niitakayamensis Hayata.
Bambusa cornuta Munro.
Bambusa glaucescens (Willd.) Sieb.
Bambusa merrillii Gamble.
Bambusa spinosa Roxb.
Bambusa vulgaris Schrad.
Bambusa vulgaris striata Gamble.
Dendrocalamus curranii Gamble.
Dendrocalamus latiflorus Munro.
Dendrocalamus merrillianus Elm.
Gigantochloa levis (Blanco) Merr.
Guadua philippinensis Gamble.
Schizostachyum brachycladum Kurz.
Schizostachyum hirtiflorum Hack.
Schizostachyum lima (Blanco) Merr.
Schizostachyum lumampao (Blanco) Merr.
Schizostachyum textorium (Blanco) Merr.

CLIMBING

Cephalostachyum mindorense Gamble.
Dinochloa ciliata Kurz.
Dinochloa elmeri Gamble.
Dinochloa luçoniae (Munro) *Merr.*
Dinochloa pubiramea (Merr.) Gamble.
Dinochloa scandens O. Kuntze.
Schizostachyum luzonicum Gamble.
Schizostachyum curranii Gamble.
Schizostachyum dielsianum (Pilger) Merr.
Schizostachyum diffusum (Blanco) Merr.
Schizostachyum fenixii Gamble.
Schizostachyum palawanense Gamble.
Schizostachyum toppingii Gamble.

At present the climbing bamboos are of slight commercial importance, and are rather a disadvantage than an advantage, as they occupy space which might be utilized by more valuable plants. They grow at the edge of the forest or in deserted caiñgins,[1] or in the forest whenever space has been opened up

[1] A word used in the Philippines for a clearing made for temporary cultivation.

by the falling of large trees. They require considerable insolation for their best development and then grow very densely—so densely that it is very difficult to penetrate the thickets formed. In fact climbing bamboo forms the most impenetrable thickets that are to be found in our forests. They seem to be decidedly inimical to tree growth, and are hard to eradicate when once they have fully occupied an area.

The erect species may, for convenience, be divided into thick- and thin-walled bamboos. The framework of a great majority of the houses in the Philippine Islands is constructed from the thick-walled species. Unsplit culms are used for posts, beams, and rafters. The same species, when split and flattened, are used for the sides of houses; or when split in two employed like tiles for roofing. Most frequently the sides and partitions, and occasionally the floors, are formed from thin-walled species split and woven into a coarse matting (sawale).

Sawale is a promising material for the construction of light-material bungalows even in temperate countries. It is also very attractive as an interior finish in strong-material houses. Sawale is of particular advantage in the construction of large temporary buildings. In Manila there is held an annual Carnival, in which very imposing structures are constructed rapidly and cheaply with the aid of this material. When the Philippine National Guard was organized, all the barracks were constructed very quickly on account of the use of sawale. In the entire Philippine exhibits at the Panama-Pacific International Exposition at San Francisco, California, various weaves and classes of sawale were used extensively in the installation of the different booths. This proved so attractive and demonstrated so clearly its use, that people visiting the Exposition ordered material of the heavier weave for summer cottages in California. These orders, aggregating 3,000 linear yards, were for the kind of material used in the exhibits. It was only due to a lack of an organized industry and the subsequent rise in freight rates that a considerable export trade did not result from this beginning.

The domestic uses of bamboo are innumerable and include bridges, fences, rafts, fish traps, vessels for carrying and storing water, cooking, splints for baskets, hats and mats, vehicle shafts, chairs, cupboards, tables, beds, benches, flowerpots, etc. In fact, on account of the ease with which it is worked, bamboo is used for almost every purpose for which wood is employed in temperate countries. The young shoots of many species are also used for food. As an interesting use of bamboo we may mention that complete bands, in some cases having 32 or more pieces, are equipped with musical instruments constructed of bamboo. These pieces are of the same general character as brass instruments and include horns, clarinets, flageolets, saxophones, flutes, piccolos, and drums. A church in Las Piñas, a few kilometers from Manila, has a famous organ with bamboo pipes.

For construction purposes bamboo should be cut a year after it has reached mature size and after the rainy season; that is, in most parts of the Philippines, after November. If cut during the rainy season the culms are full of sap, which soon attracts small beetles in great numbers and these rapidly destroy the bamboo. In practice, newly cut bamboo is often kept in water for several weeks in order that the sap, or at least the sugar and starch contents of the sap, may be eliminated. Filipino bamboo carpenters say that when flies gather around the newly worked bamboo, it is a sign that this bamboo is not durable. The flies, of course, are attracted by the sugar in the bamboo.

Owing to the wide distribution of bamboo and the ease with which it is worked without any special implements, it offers a promising field for the development of local household industries for the manufacture of various useful and ornamental articles. If this industry were developed, no doubt considerable export trade could be secured.

Key to the genera of Philippine bamboos.

1. Climbing.
    2. Flowers in widely scattered, dense, globose heads; rare, known only from Mindoro .... *Cephalostachyum.*
    2. Flowers not in widely scattered, dense, globose heads.
        3. Spikelets very small, ovate .... *Dinochloa.*
        3. Spikelets elongated, linear or linear-lanceolate. *Schizostachyum.*
1. Erect.
    2. Two and a half meters in height or less, only on high mountains, wild .... *Arundinaria.*
    2. Clumps one to three meters in height, leaves small and whitish, cultivated only .... *Bambusa glaucescens.*
    2. More than 3 meters in height.
        3. Base of clump protected with long, interlaced, spiny branches. *Bambusa spinosa.*
        3. Base of clump not protected with long spiny branches.
            4. Culms thin walled; mostly small or medium sized bamboos.
                5. Keels of palea broadly winged; rare, known only from Mindanao .... *Guadua.*
                5. Palea not winged .... *Schizostachyum.*
            4. Culms thick walled; mostly large bamboos.
                5. Pericarp thin, adnate to the seed.
                    6. Filaments free .... *Bambusa.*
                    6. Filaments connate in a thin tube .... *Gigantochloa.*
                5. Pericarp fleshy or crustaceous, separable from the seed .... *Dendrocalamus.*

DESCRIPTION OF SPECIES

Genus ARUNDINARIA Michaux

ARUNDINARIA NIITAKAYAMENSIS Hayata. UTOD.

Among the Igorots, this bamboo is known as utod. It is the only representative of the genus found in the Philippines. This species was originally described from the mountains of Formosa, and is known only from Formosa and the mountains of Luzon. It is locally very abundant, forming dense thickets, at altitudes from 2,100 to 2,600 meters in the Mountain Province, Luzon. This bamboo reaches a height of 2.5 meters, but in unfavorable habitats is frequently only a few centimeters in height. Its maximum diameter is about 1 centimeter. Its only recorded use in the Philippines is for pipestems. A flowering specimen is shown in Plate II.

Genus BAMBUSA Schreber

1. Culms unarmed.
    2. Small shrubby species 2 to 3 meters high with glaucous leaves. *B. glaucescens.*
    2. Coarse species of tree size.
        3. Leaf-sheaths with rounded auricles .... *B. vulgaris.*
        3. Leaf-sheaths with hornlike, erect processes.
            4. Leaves large; spikelets glabrous; keels of the palea not prominently ciliate .... *B. cornuta.*
            4. Leaves small; spikelets densely hirsute; keels of the palea prominently ciliate .... *B. merrillii.*
1. Culms spiny .... *B. spinosa.*

The genus *Bambusa* is represented by five species, of which at least three appear to have been purposely introduced. It includes the most valuable single species of the entire group in the Philippines. With one exception, all of the species have large, tall culms.

BAMBUSA CORNUTA Munro. LOPA.

Local name: *Lopa* (Isinai).

Rare in the forests of Nueva Vizcaya and Benguet, known also from Java. An erect bamboo reaching a height of 7 to 8 meters, and a culm diameter of 3 to 3.5 centimeters, with internodes 40 to 45 centimeters long. It is characterized by prominent horns at the tip of the leaf sheath. A flowering specimen is shown in Plate III.

BAMBUSA GLAUCESCENS Sieb. KAWÁYAN-CHINA.

Local names: *Kawáyan-china*, *kawáyan-sina* (Tagalog).

Kawayan-china is a native of China or Japan and occurs in the Philippines only as an introduced and cultivated plant.

The clumps are usually from 1 to 3 meters in height, the culms up to 2 centimeters in diameter. The culms may be 5 meters in length but when long are usually much bent. The leaves are from 3 to 10 centimeters long and whitish in appearance. This species is planted for ornamental purposes and in some parts of Manila is used as a hedge plant. The stems are used for fishing rods.

BAMBUSA MERRILLII Gamble.

This species is known only from collections from the Caraballo Sur mountain ranges in Nueva Vizcaya, where it grows in forests at an altitude of about 600 meters.

It is an erect straggling species about 18 meters in height. See Plate IV.

BAMBUSA SPINOSA Roxb. (*B. blumeana* Schultes f.). SPINY BAMBOO.

Local names: *Dugían, kabugáwan, marurúgi, rugían* (Bikol); *kawáyan, kawáyan totóo* (*i. e. true bamboo*), *kawáyan tiník* (Tagalog); *aon-o, batákan, paua, kawáyan-gid* (Bisaya); *kawáyan si-ítan* (Iloko); *bayóg* (Zambales); *lam-nuan* (Isinai); *baugin* (Pampanga); *pasingan* (Cagayan); *caña espina* (Spanish).

This bamboo is the one to which the name kawayan is most frequently applied. It is found throughout the settled areas of the Philippines at low and medium altitudes, and is apparently always planted, there being no valid reason for considering it a native of the Archipelago. This bamboo was apparently purposely introduced at an early date. Spiny bamboo, as well as the other large, probably introduced species, has been cultivated quite extensively in clearings which have since been abandoned, so that considerable areas are now covered by virtual forests of this species. Spiny bamboo offers considerable possibilities as a valuable reforestation crop.

Spiny bamboo reaches a height of about 25 meters and a culm diameter of 20 centimeters. The internodes are usually hollow, and from 40 to 60 centimeters in length. The culms have thick walls, becoming progressively thicker toward the lower part of the culm. It occasionally happens that the lower internodes are so thick walled that they become almost or quite solid. The stem contains a large amount of silica and sometimes an internode is completely filled with a hard, white, siliceous mass, which damages any instrument used in cutting it. This bamboo is rarely found in flower and the interval between flowering periods is not known. It is by far the most commonly used bamboo in the Philippines, being prized above all others by the Filipinos for building purposes on account of its great strength and durability. It is distinguished from all other species of Philippine bamboos by the fact that it grows in large clumps, the basal portions of which are surrounded to a height of from 2 to 3 meters by a densely interlaced thicket of very spiny branches, which make access to the culms exceedingly difficult. The function of these spiny branches, apparently, is to protect the delicate young shoots from herbivorous animals. This species is illustrated in Plates V to VII.

The splints from green stems of this species are used extensively in the manufacture of baskets and hats, it being the most valuable species for hat making. It also has some commercial possibilities for paper pulp. The basal portions of the culms have been used as heads for polo mallets and for shuttles on hand looms.

Distributed in southern China, Indo-China, Malay Peninsula, and Malay Archipelago.

BAMBUSA VULGARIS Schrad. KAWÁYAN-KILÍNG.

Local names: *Kawáyan-kilíng, kawáyan bayúgin, kawáyan hobéro, taiwanák, tewanák* (Tagalog); *bulínau, burírau, lúnas, sinambáng* (Bisaya); *kabolóan* (Bikol).

This is a clump-forming spineless bamboo, which reaches a height of about 17 meters or more and a diameter of about 12 centimeters. The stems are smooth, usually yellowish or yellowish-green. It is usually smaller than *Bambusa spinosa* and has thinner walls. This species is illustrated in Plates VIII to X.

Kawayan-kiling is one of the building bamboos and is generally utilized in the regions where it grows for the various purposes, such as house construction, bridges, furniture, for which the coarse erect bamboos are adapted. It is much inferior to *Bambusa spinosa.* Like the spiny bamboo, it is probably not a native of the Philippines, but was purposely introduced in prehistoric times on account of its general utility. The variety *striata* Gamble is occasionally cultivated in Manila and in other large towns for ornamental purposes; it is readily distinguished by its culms being bright yellow with a few green stripes. This form is a native of China or Japan, but is now widely distributed in cultivation.

The native country of *Bambusa vulgaris* is so far unknown; it is cultivated and half wild in Asia, Africa, and America.

Genus CEPHALOSTACHYUM Munro

CEPHALOSTACHYUM MINDORENSE Gamble. BAKTO.

This species is rare and known only from Mindoro. It is a climbing species well characterized by having its flowers in dense, globose, widely scattered heads the larger of which are about 2 centimeters in diameter. See Plate XI.

Genus **DENDROCALAMUS** Nees

Spikelets large; leaves large .... *D. latiflorus.*
Spikelets medium-sized; leaves long .... *D. curranii.*
Spikelets very small .... *D. merrillianus.*

This genus of large erect bamboos is represented by three species. It is economically unimportant and none of the species are especially abundant.

DENDROCALAMUS CURRANII Gamble.

A rare species known only from Sampaloc, Tayabas, and the Island of Polillo off the coast of Luzon, and possibly not distinct from *Gigantochloa levis.*

DENDROCALAMUS LATIFLORUS Munro. BOTÓNG.

Local names: *Botóng, bolong-sína* (Bikol, Bisaya); *butún* (Bisaya); *kabolóan, patóng* (Bicol); *kawáyan-sina* (Tagalog).

This is a tall, tufted, spineless bamboo apparently of general distribution in the central Philippines. It is frequently utilized for building purposes, but is not considered to be good material for basketry.

DENDROCALAMUS MERRILLIANUS Elm. BAYÓG.

Local names: *Bayóg* (Ilocos); *kawáyan-bayóg* (Pangasinan).

This bamboo is apparently widely distributed in the Philippines. It is a tall graceful bamboo with slender stalks forming large clumps. The culms have very thick walls and prominent nodes. They are used for vehicle shafts and for other purposes where great strength is desired. The green culms of this bamboo are split and made into ropes, used particularly for hauling logs. A flowering specimen is shown in Plate XII.

Genus **DINOCHLOA** Büse

1. Woody.
    2. Leaves broad.
        3. Lodicules absent; caryopsis globose; floral rachis glabrous. *D. scandens.*
        3. Lodicules present; caryopsis oblong; floral rachis pubescent. *D. pubiramea.*
    2. Leaves narrow; no lodicules.
        3. Culms smooth; caryopsis globose .... *D. ciliata.*
        3. Culms rough; caryopsis oblong .... *D. luçoniae.*
1. Herbaceous, or woody only at the base; lodicules present .... *D. elmeri.*

The genus *Dinochloa* is represented in the Philippines by five species. With one exception our representatives are all scandent, thick-walled, sylvan forms and are locally very abundant, forming almost impenetrable thickets under favorable conditions.

No special economic uses are indicated for any of the forms, yet like all bamboos they are more or less utilized by the Filipinos for general purposes. They should be adapted to the same special uses as the thick-walled scandent species of *Schizostachyum.* The most common species is *Dinochloa scandens,* zigzag bamboo, (Plate XVIII) which is abundant and widely distributed in the central and southern Philippines; it is characterized by its very broad leaves and is variously known as baía in Palawan, bokáue in Balabac, bukáu in Basilan, usíu, timák, and bolokáui in Mindoro. Most of these names are also used for the scandent species of *Schizostachyum. Dinochloa luçoniae* (Plate XVI) is very similar in general character to *Dinochloa scandens,* but has much narrower leaves, which is also true of *Dinochloa ciliata* (Plate XIV). *Dinochloa luçoniae* is known as baíto (Tagalog) and esu (Iloko). *D. pubiramea* (Plate XVII) is a broad-leaved species similar to *D. scandens* and distinguished chiefly by having the branches of the inflorescence pubescent. Its local names are kandi (Bis.) and bukáu (Moro). *Dinochloa elmeri* (Plate XV) is a dwarfed, half-woody form growing in the mossy forest at the summits of high mountains.

Genus GIGANTOCHLOA Kurz

GIGANTOCHLOA LEVIS (Blanco) Merr. BOLÓ.

Local names: *Kawáyan-bóo, kawayan-sina, kawáyan-putí, bohó* (Tagalog); *bokó, boló, botóng* (Bisaya).

Gigantochloa levis is a stout bamboo reaching a height of 20 meters or more and a culm diameter of 20 centimeters. Its culms are very straight and smooth, dull green, covered with siliceous pubescence, and entirely unarmed. It is found in and about towns in the settled areas of the Philippines, and also in the forests. The stems are used as pipes for temporary water supplies, as they are usually long and straight, and for building fish traps. They are, apparently, rarely employed in building operations, except for walls of houses, perhaps because they are not especially durable. A flowering specimen is shown in Plate XIX.

The Philippine specimens referred to *Gigantochloa robusta* Kurz and *Gigantochloa atter* Kurz are not considered by Mr. E. D. Merrill to be specifically distinct from *G. levis.*

Genus GUADUA Kunth

GUADUA PHILIPPINENSIS Gamble.

This is a rare species known only from a single collection from Davao. The nodes are reported to be about 75 centimeters long and 2.5 to 5 centimeters in diameter. The culms are thin walled and 4 to 6 meters in height. A cotype specimen is shown in Plate XX.

Genus SCHIZOSTACHYUM Nees

1. Climbing.
    2. Flowers in long panicles, usually from flower-bearing culms or axillary on leafy ones.
        3. Leaves usually broad, rounded at the base, mouth of leaf sheaths and ligules long-bristly-ciliate.
            4. Spikelets glabrous .... *S. diffusum.*
            4. Spikelets densely pubescent .... *S. fenixii.*
        3. Leaves usually narrow attenuate at the base, mouth of leaf sheaths and ligules not or only slightly bristly.
            4. Spikelets very sharply pointed; apicules of anthers shortly hirsute .... *S. dielsianum.*
            4. Spikelets acute only; apicules of anthers very long bristly. *S. palawanense.*
    2. Flowers in short, terminal spikes up to 10 centimeters long; leaves very narrow .... *S. textorium.*
1. Erect.
    2. Spikelets sharply pointed, not in rounded capitula. *S. longispiculatum.*
    2. Spikelets sharply pointed, usually in rounded capitula; no lodicules.
        3. Spikelets glabrous outside.
            4. Internodes about a meter or more in length or longer. *S. lima.*
            4. Internodes shorter .... *S. brachycladum.*
        3. Spikelets more or less pubescent outside; anthers obtuse.
            4. Spikelets densely white-hairy, both on the empty and on the flowering glumes; leaves 1 centimeter broad. *S. hirtiflorum.*
            4. Spikelets shortly white-hairy only on the flowering glume; leaves over 1.5 centimeters broad .... *S. lumampao.*
    2. Spikelets hardly sharp-pointed, obtuse or acute, usually in long panicles; lodicules usually present .... *S. luzonicum.*

The genus *Schizostachyum* is extensively developed in the Philippines. Among the bamboos it has by far the largest number of species, and presents several of the most common and widely distributed bamboos in the Archipelago. All of the species are indigenous, and none of them are cultivated. The genus contains both erect, thin-walled species, and scandent, thick-walled ones, several of which are used for special purposes. None of the species are of large size. Most of them are sylvan or subsylvan and usually do not occur in the open settled areas. Several of them are gregarious and in some provinces occupy rather large areas of land to the practical exclusion of other vegetation.

SCHIZOSTACHYUM BRACHYCLADUM Kurz.

Local names: *Bohó* (Isinai and Mindanao); *bagákai* (Leyte); *bagákan* (Palawan).

This is an erect bamboo about 10 meters in height and up to 5 centimeters in diameter. A gregarious species abundant in Palawan and Culion on dry open slopes. Reported from Nueva Vizcaya, Leyte, Butuan, and Palawan. A flowering specimen is shown in Plate XXI.

SCHIZOSTACHYUM DIFFUSUM (Blanco) Merr. BÍKAL.

Local names: *Bíkal* (Tagalog, Iloko, Pampanga, Pangasinan, Cagayan); *usíu* (Tagalog); *baliáro, balikáu, bongbong, lo-ob* (Bisaya); *hindi, indi, inri* (Bikol); *butor* (Isinai); *bábui* (Bikol).

Bikal is widely distributed in the forests of the Philippines and is endemic. It is characterized not only by its habit, but also by its very thick walls. Sometimes the lumen is almost entirely wanting, especially in the lower parts of the stem. The plant is well known to all Filipino woodsmen as a source of drinking water, as water of good quality can be secured from the internodes. In some parts of the Philippines this bamboo is extensively used in making baskets, while it is now beginning to attract attention for the purpose of making chairs, for which it is adapted on account of its thick stout walls. A flowering specimen is shown in Plate XXIV. The very closely allied *Schizostachyum dielsianum,* bikal-bábui, (Plate XXII) has the same names, distribution, and uses as *S. diffusum,* and is distinguished only by minor characters.

SCHIZOSTACHYUM LIMA (Blanco) Merr. ANOS.

Local name: *Anos* (Tagalog).

This endemic, erect, thin-walled bamboo is distinguished among all the Philippine forms by its long internodes, which are usually about one meter in length. It is sometimes called boló and bagákai by confusion with *Schizostachyum lumampao.* It is used by the Filipinos for making blow guns, while the cortex is hard and rough and can be used for polishing brass. It is also used for the various purposes for which all thin-walled bamboos are utilized, and after boiling, even for weaving fans, cushions, and hats; broad splints prepared from it are used in making the broad shallow baskets used for winnowing rice. Widely distributed in the Philippines. A flowering specimen is shown in Plate XXVII.

SCHIZOSTACHYUM LUMAMPAO (Blanco) Merr. BÚHO or CAÑA-BOJO.

Local names: *Caña-bojo* (Spanish-Filipino); *bólo, búho, lumampáu, bokáui, kauáyan-songsóng* (Tagalog); *bagákan, bagákai* (Bisaya); *búlu, bolo* (Bisaya, Iloko); *orás* (Bikol).

This species is endemic and widely scattered in the Philippines. It is a thin-walled, erect, gregarious bamboo usually reaching a height of about 10 meters, and often nearly exclusively occupying considerable areas. Forester Medina has surveyed two tracts of this bamboo in Bataan Province, one containing 1,200 hectares, of which 800 hectares have a dense stand; the second containing 650 hectares, of which more than 40 per cent is covered with *Schizostachyum lumampao.* There are also very extensive areas in other parts of Bataan, in Zambales, and in the Cagayan Valley. Fifteen small plots of *Schizostachyum lumampao* have been measured in Bataan Province back of the town of Limay. These plots aggregated 3.5 hectares and covered stands at widely separated intervals. The surveys showed an average of 8,983 canes per hectare. One of the surveys of one quarter of a hectare indicated a stand of 19,162 canes per hectare.

This thin-walled bamboo is the species chiefly utilized in making the building matting known as sawale. It is also used for making baskets, fences, fish corrals, fish poles, flutes, and for many other purposes.

Buho has been thoroughly investigated by Richmond as a paper-making material, and it is probably the one species of Philippine bamboo that, without extensive cultivation, promises commercial possibilities for this purpose. This point is discussed in the section on paper. Observations on its rate of growth are given later. This species is illustrated in Plate I and Plates XXVIII and XXIX.

SCHIZOSTACHYUM TEXTORIUM (Blanco) Merr. KALBÁNG.

Local name: *Kalbáng* (Tagalog).

This is an erect bamboo with small leaves, which is locally abundant in the Provinces of Batangas and Rizal, Luzon. The stems are used in the manufacture of looms, as they are very straight and smooth. A flowering specimen is shown in Plate XXXII.

Among the other Philippine representatives of the genus are *Schizostachyum palawanense* (Plate XXXI), a scandent species known from Palawan and Laguna; *S. hirtiflorum* (Plate XXVI), a widely distributed species closely allied to and with the same growth form as *S. lumampao; S. toppingii* (Plate XXXIII), erect or subscandent, reported from Laguna, Rizal, and Mindoro; *S. curranii* (Plate XXIII), scandent, a species of higher altitudes in northern Luzon; *S. luzonicum* (Plate XXX), known only from Zambales; and *S. fenixii* (Plate XXV), reported from Abra, Cagayan, Benguet, Ilocos Sur, and Panay, known as paua in Iloilo, and puser in Abra, Luzon, and there utilized in the manufacture of baskets.

PLANTING OF BAMBOO

Until very recently almost no reliable information concerning the rates of growth of planted Philippine bamboo was available. For this reason, Mr. H. M. Curran and Dr. F. W. Foxworthy in 1912 started a bamboo plantation at the Division of Investigation of the Bureau of Forestry at Los Baños, Laguna, the direction of the planting being intrusted to Rangers de Mesa and Villamil. This plantation was started on a rather dry hill on steep slopes, covered with a mixture of tall grass and small second-growth trees. The material selected for planting was from shoots 1 to 2 years old or older from poorly grown plants which were overtopped and not well supplied with light, and from upper twigs. A few butts were also used. The length of cuttings was from 60 centimeters to 2 meters. The cuttings were collected 3 to 36 hours before planting, and were laid in water at the edge of a stream whenever it was not possible to plant immediately. During the time that this work was done the weather was very rainy and so there was less than the usual amount of drying out. The planting was done between August 29 and October 10, 1912. The implements employed were mattocks and heavy pointed sticks, the mattocks being used only when rocky soil was encountered or when very large pieces were to be planted. In all there were planted 1,015 cuttings of *Bambusa spinosa,* 145 of *Bambusa vulgaris,* and 105 of *Gigantochloa levis.* The area of the plantation was 2.2 hectares. More than half of the area was covered with a dense tangle of small trees and climbing bamboo. All of the small brush and climbing bamboo was cut, but some of the larger trees were left to shade the young plants. Where the bamboo was shaded it has done better than it has in the open. This may perhaps be due to the fact that the planting was done toward the end of the rainy season so that the young shoots were exposed to drier conditions than they would have been if planted earlier.

On January 10, 1914, the living bamboos were counted; these included 349 individuals of *Bambusa spinosa* or 34 per cent of the original number planted, 46 of *B. vulgaris* or 32 per cent, and 6 of *Gigantochloa levis* or 6 per cent. This low percentage of success was probably due in part to several avoidable causes. The planting was done toward the close of the rainy season, so that young plants did not have as favorable moisture conditions as they would have had if planted earlier. Again the methods of planting, as previously described, were not favorable, while some of the young plants are known to have been destroyed by cattle; moreover, the selection of material was poor, and the site unfavorable. The best material for planting is from stumps, which, though harder to prepare, will probably be cheapest in the long run. Small twigs are much harder to handle than larger pieces. The cutting should be planted oblique to the ground. Planting material should be taken from full-sized shoots which are not fully mature. Subsequent careful planting of small numbers of these same bamboos in the early part of the rainy season gave 100 per cent success.

During the year 1914, blanks in the plantation were filled.

Bamboo cuttings, at first, send up thin whiplike shoots and it is only after a considerable period that regular culms are produced. The number and size of these culms increases yearly until mature size is reached.

In Table 1, from a report by Ranger Oro, is given a summary of the height of the culms in December, 1915; from this table, it will be seen that in three years some of the culms had reached a height of from 8 to 9 meters, but that most of them were much smaller than this.

TABLE 1.—*Heights of bamboo clumps at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, P. I., December, 1915, three years after planting.*

[The figures in the table give the number of clumps.]

Species.	Height in meters.							
	Less than 2.	2-3.	3-4.	4-5.	5-6.	6-7.	7-8.	8-9.
Bambusa spinosa	85	59	65	27	16	13	10	10
Bambusa vulgaris	11	12	12	6	3	1	1	1
Gigantochloa levis		1	1	2			1	2

In Table 2, also from a report by Ranger Oro, is given a summary of the height of the clumps and the diameter of the canes in October, 1917. It will be seen that, five years after the original planting, most of the culms were still small, but 26 clumps of *Bambusa spinosa*, one of *B. vulgaris* and one of *Gigantochloa levis* were between 13 and 15 meters in height and 7 of *Bambusa spinosa* over 15 meters in height. *Bambusa spinosa* had produced 80 culms, 7 centimeters in diameter; 71, 8 centimeters; 29, 9 centimeters; and 17, 10 centimeters in diameter; while *Gigantochloa levis* had produced 3 culms, 11 centimeters in diameter. The culms of *Bambusa vulgaris* were smaller, the largest being 8 centimeters in diameter. These figures show that in five years, the planted bamboo had produced some usable culms; and, judging from the difference in the size of the bamboo in 1915 and 1917, it may be predicted that a considerable number of usable canes would be produced in another two years.

TABLE 2.—*Heights of bamboo clumps and diameters of canes at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, P. I., October, 1917, five years after planting.*

[Figures represent number of clumps.]

Species.	Height of clumps in meters, October, 1917.								
	Less than 1.	1-3.	3-5.	5-7.	7-9.	9-11.	11-13.	13-15.	15-17.
Bambusa spinosa	2	26	24	32	53	55	44	26	7
Bambusa vulgaris	1	6	8	5	7	5	7	1	
Gigantochloa levis				1	1	1	3	1	

[Figures represent number of canes.]

Species.	Diameter of canes in centimeters, October, 1917.							
	Less than 5.	5.	6.	7.	8.	9.	10.	11.
Bambusa spinosa	994	150	97	80	71	29	17	
Bambusa vulgaris	153	11	10	5	4			
Gigantochloa levis	33	11	8	3	4	2	2	3

In Table 3 is given a summary of the number of cuttings planted in 1912 and the condition of the plantation at subsequent dates.

TABLE 3.—*Summary of bamboo cuttings planted at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, P. I., in 1912, and condition of plantation at subsequent dates.*

Summary.	Species.		
	Bambusa spinosa.	Bambusa vulgaris.	Gigantochloa levis.
Number of cuttings planted in 1912	1,015	145	105
Number of clumps alive, January 10, 1914	349	46	6
Per cent of original planting alive, January 10, 1914	34.38	31.72	5.71
Number of clumps, December, 1915	285	47	7
Total number of canes, December, 1915	628	98	30
Average height, December, 1915	3.01	2.81	5.57
Number of clumps, October, 1917	269	40	7
Total number of canes, October, 1917	1,440	183	66
Average number of canes per clump, October, 1917	5.04	4.56	9.40
Greatest diameter of canes in centimeters, October, 1917	10	8	11
Greatest height in meters, October, 1917	16.87	13.11	13.14
Average height in October, 1917	8.51	6.87	10.40

The area planted was 22,000 square meters. The time employed in selecting cuttings was 200 hours, in clearing 207 hours, and in planting 140 hours, making a total of 547 hours. Assuming labor at 10 centavos per hour, the cost of planting would be 25 pesos per hectare, planting being at intervals of 2 to 3 meters. During the first four years the plantation was cleaned twice a year, which included the cutting back of vines and felling and pruning of trees. This was done at a cost of about 10 pesos per hectare, per year, with labor at 10 centavos per hour.

A second bamboo plantation was started by Dr. F. W. Foxworthy at the Division of Investigation, Bureau of Forestry, at Los Baños, during June, 1917. This plantation covered 2 hectares and was planted with a single species, *Bambusa spinosa*. The planting was done in the months of June and July during the early part of the rainy season. The ground was covered largely with small trees and climbing bamboos, there being very little grass. The climbing bamboos were cut, but the trees left standing. The planting was done with stump and stem cuttings. The stump cuttings used had roots and were about a third of a meter in length. They were planted either in a slanting position or erect. A stem cutting consisted of a segment with a node at either end. A slit was made in the internode, and then the whole segment buried in the ground, except that the slit was left uncovered to permit water being poured into the internode. In all there were planted 225 stump cuttings and 800 stem cuttings.

All of the living shoots were counted and measured during December, 1917, and again at the end of June, 1918, when the plants were about a year old. The results of the measurements are given in Table 4. An examination of Table 4 shows that at the end of the year 59 per cent of the stump cuttings and 40 per cent of the stem cuttings were alive. A comparison of these figures with those given in Table 3 indicates a greater percentage of success in the second than in the first plantation.

TABLE 4.—*Record of plantation of Bambusa spinosa at Division of Investigation, Bureau of Forestry, Los Baños, Philippine Islands.*

	Number of cuttings planted June July, 1917.	December, 1917.			June, 1918.		
		Number living.	Height, centimeters.	Percentage living.	Number living.	Height, centimeters.	Percentage living.
Stump cuttings	225	198	150	88	133	260	59.1
Stem cuttings	800	560	150	70	320	210	40.0

There is, however, reason to believe that much better results than those recorded in Table 4 could be obtained as the dry season of 1918 was unusually severe and the plants were not irrigated. It will be noticed that there was a high percentage of mortality between December, 1917, and June, 1918. Moreover, many of the plants were probably subjected to too much shade, as they were freed from vines only once during the year and in general those plants which survived received more light than those which died.

The total cost of selecting, transporting, and planting the cuttings was 72.82 pesos per thousasd. This cost was considerably more than in the case of the 1912 plantation, which is accounted for by the greater care used in the selection of cuttings for the second than the first plantation. The superior cuttings used in 1917, however, gave much better results than the poorer ones employed in 1912.

It appears from the data derived from the planting at Los Baños that the commercial planting of bamboo on a large scale would be very profitable and that bamboo should be a valuable reforestation crop.

A number of bamboos, other than those here considered, have been propagated from hard-wood cuttings at the Division of Investigation of the Bureau of Forestry at Los Baños, and it is probable that all or most Philippine bamboos can be thus reproduced.

GROWTH OF MATURE CLUMPS

Actual measurements of growth of canes in mature clumps are available for only three species, *Bambusa spinosa*, *Bambusa vulgaris*, and *Gigantochloa levis*. A clump of *Bambusa spinosa* sends up yearly a number of shoots, the number in some cases being as large as 130. In clumps from which the mature canes are harvested, the number of new shoots may exceed the number left in the clump when the new culms are produced. A considerable proportion of the young shoots die before reaching maturity, many of them while still quite small. In Table 5 are given observations on the number of shoots produced by 8 clumps of *Bambusa spinosa*. The greatest number of canes produced by any clump recorded in Table 5 is 128; these grew from a clump having 49 mature canes. However, only 24, or 19 per cent of the 128 canes, reached maturity. The average of all the canes produced, by the 8 clumps, which reached maturity is 28.5 per cent. In all, the number of mature canes produced is 46.5 per cent of the total mature canes originally in the clumps.

TABLE 5.—*Number of shoots produced and yield of mature living canes from 8 clumps of Bambusa spinosa at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Total number of mature canes.	New shoots.			Percentage living.	Percentage yield.
	Total number of shoots.	Total number of dead.	Total number of living.		
39	78	58	20	25.5	51
24	29	24	5	17.5	21
18	20	10	10	50	55.5
21	30	22	8	26.5	38
8	12	9	3	25	37.5
13	34	25	9	26.5	69
31	35	19	16	45.5	51.5
49	128	104	24	19	49
Average				28.5	46.5

Observations were also made on 5 clumps of *Bambusa vulgaris*. The results are given in Table 6. Thirty-eight per cent of the young shoots reached maturity, which is 6 per cent of the original number in the clump. *Bambusa vulgaris* produced fewer canes than *Bambusa spinosa,* but showed the same general phenomena which have just been described for *Bambusa spinosa.*

TABLE 6.—*Number of shoots produced and yield of mature living canes from 5 clumps of Bambusa vulgaris at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Total number of mature canes.	New shoots.			Percentage living.	Percentage yield.
	Total number of shoots.	Total number of dead.	Total number of living.		
48	48	34	14	29	29
9	24	13	11	46	122
30	39	30	9	23	30
22	20	12	8	40	36
44	52	25	27	52	61
Average				38	56

Gigantochloa levis also produces a very large number of new shoots, many of which fail to mature. Records obtained from 5 clumps of *Gigantochloa levis* are given in Table 7. It will be seen from this table that 31 per cent of the new shoots reached maturity while the yield of the new culms is 54 per cent of the number originally in the clump.

TABLE 7.—*Number of shoots produced and yield of mature living canes from 5 clumps of Gigantochloa levis at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Total number of mature canes.	New shoots. Total number of shoots.	Total number of dead.	Total number of living.	Percentage living.	Percentage yield.
22	36	25	11	31	50
16	39	27	12	31	75
12	26	19	7	27	58.5
10	14	10	4	28	40
60	72	45	27	37.5	45
Average				31	54

The death of the young shoots is due to various causes; some of them are attacked by insects or rats; others are broken by the wind; while still others die without any very apparent reason, but probably because under the existing conditions more shoots are produced than can be matured by the clump. This may be due to scarcity of food, water or other causes, but concerning this point we have no information.

The culms of *Bambusa spinosa* and *Bambusa vulgaris* start to grow during the latter part of the dry season, but make very slow growth until the rainy season. *Gigantochloa levis* starts to grow about the beginning of the rainy season. The period of rapid growth is in the latter part of the rainy season. *Bambusa spinosa, Bambusa vulgaris,* and *Gigantochloa levis* reach about full height in approximately five months. This means that for this period there is an average daily growth in large culms of *Bambusa spinosa* of about 17 centimeters, in *Bambusa vulgaris* of about 13 centimeters, and in *Gigantochloa levis* of 13 centimeters.

Beginning with 1912 and extending up to the present time, measurements of the rate of growth of bamboos have been taken by the Division of Investigation of the Bureau of Forestry at Los Baños, Laguna, by means of a measured stick. The most extensive series of measurements of large culms was made by Ranger Oro in 1915. From this series we have selected for presentation in the following tables all shoots of *Bambusa spinosa* which reached a height of more than 20 meters, and of *Bambusa vulgaris* and *Gigantochloa levis* which reached a height of more than 12 meters. This selection has been made so as to represent the growth of only large commercial culms.

In Table 8 are given the measurements of the rates of growth of *Bambusa spinosa*. The first measurement was taken on June

5, 1915, while a considerable proportion of the canes were not measured until after this date. The height at the time of the first measurement is given in the first row of figures in the table. Each column shows the growth figures for a single culm during successive weeks, the first space in each column being for the week ending June 12. When measurements were not started until later than June 5, the first measurement of growth is recorded lower in the column, the number of blanks appearing before the first measurement of growth indicating the number of weeks after June 5 that the first measurement was taken. It will be seen that, as is usual in the growth of plant parts, the rate is at first slow and gradually increases until it reaches a maximum, after which it decreases as the culms assume mature size. The most rapid growth usually occurs nearer the end than the beginning of the growth period and takes place in the latter part of the rainy season. Three of the shoots showed a weekly growth in excess of 3 meters; the fastest rate was 3.17 meters, or an average of 45 centimeters a day for a week.

TABLE 8.—*Growth of culms of Bambusa spinosa, at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Height in meters at first measurement.									
.24	.16	.29	.06	.40	.14	.40	.18	.31	.27
Growth in meters during successive weeks.									
.04	.03	.09	.00			.21	.08		
.13	.09	.16	.02			.56	.12		
.13	.09	.20	.03	.21		.84	.14		
.48	.16	.74	.04	.50		1.19	.41		
.73	.11	.82	.04	.59	.00	1.21	.81	.45	.29
.95	.43	1.35	.11	1.03	.02	1.39	1.24	.71	.85
1.43	.83	1.81	.15	1.23	.10	2.48	1.22	1.11	1.13
1.57	1.10	2.32	.31	1.68	.54	2.45	1.68	1.20	1.51
1.56	1.41	2.19	.72	1.65	.89	1.88	1.12	1.72	1.67
1.34	1.29	2.97	.86	1.76	.91	1.99	2.96	2.04	2.76
1.22	1.49	1.33	1.15	1.26	1.56	2.92	2.40	1.81	2.33
1.37	1.87	.94	1.20	1.75	1.63	1.84	1.33	2.63	2.02
1.48	1.73	1.02	1.09	1.91	2.44	1.63	2.88	1.58	2.51
1.56	1.89	1.10	1.77	1.96	2.12	1.84	2.42	2.62	1.60
1.60	2.10	2.15	2.59	1.85	2.18	1.21	2.30	1.75	1.40
2.85	2.75	1.65	2.93	2.34	1.79			1.71	1.66
2.44	2.33	2.02	3.05	1.54	2.09			1.05	1.57
1.53	1.94	1.26	2.88	.75	2.84			.94	1.15
.71	1.40		1.18		1.37			.68	.58
	.80		.92		1.04				
Total height.									
23.36	24.00	24.41	21.10	22.41	21.66	24.04	21.29	22.31	23.30

TABLE 8.—*Growth of culms of Bambusa spinosa, etc.*—Continued.

Height in meters at first measurement.									
.32	.23	.44	.39	.35	.27	.24	1.6	.24	.54
Growth in meters during successive weeks.									
.12	.06				.12	.20	.08	.10	
.16	.13				.17	.22	.15	.20	
.45	.19	.16	.14	.56	.56	.70	.34	.56	.44
1.00	.70	.50	.20	.98	.94	1.04	.92	1.01	.97
1.15	.99	.85	.45	1.11	1.29	1.10	.95	1.49	1.25
1.73	1.22	1.07	.77	1.73	1.49	1.65	1.56	1.48	1.43
1.64	1.60	1.34	1.19	1.97	2.09	2.11	2.33	2.08	1.92
2.09	1.00	1.64	1.23	2.35	2.06	2.51	1.79	2.13	2.26
2.26	2.00	1.21	1.79	2.80	2.25	1.97	2.23	2.35	2.18
3.17	2.75	2.88	2.13	2.86	2.64	2.89	2.20	2.38	2.67
2.49	2.35	2.24	1.80	1.98	2.63	2.91	2.36	2.76	2.68
1.95	3.07	2.31	2.65	2.33	2.43	2.30	2.58	2.46	2.94
1.85	2.61	2.89	2.94	1.93	1.94	1.09	1.49	1.74	1.63
1.58	2.68	2.03	2.15	1.11	1.01		1.94	1.18	1.23
1.06	1.47	1.89	2.57	.78	.73		.90	.77	.91
	.96	1.43	1.72						
		.91	.75						
Total height.									
23.02	24.01	23.79	22.87	22.84	22.62	20.93	21.98	22.93	23.05

From the table it would appear that the period of most rapid growth of any individual culm depends rather on the height of the culm than on the season.

The culms for which measurements are given in Table 8 were all large or fairly large; smaller culms show slower rates of growth, but mature in about the same length of time.

In Table 9 are given measurements of the growth of culms of *Bambusa vulgaris*. This table is constructed in the same manner as the previous table for *Bambusa spinosa*. The rates of growth are slower than those for *Bambusa spinosa,* as might be expected from the fact that *Bambusa vulgaris* is a smaller bamboo. These figures show even more clearly than do those for *Bambusa spinosa* that the time of most rapid growth depends more on the stage of the development of the culm than on the season.

TABLE 9.—*Growth of culms of Bambusa vulgaris, at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Height in meters at first measurement.										
.10	.17	.20	.14	.45	.12	.18	.12	.16	.03	.05
Growth in meters during successive weeks.										
--------	--------	--------	--------	.40	.00	--------	--------	.00	.01	--------
--------	--------	--------	--------	.91	.00	--------	--------	.07	.03	--------
--------	--------	--------	--------	.92	.02	--------	--------	.00	.04	.12
--------	--------	--------	.00	1.34	.00	--------	--------	.02	.03	.01
.06	--------	--------	.00	.96	.00	.04	.04	.06	.02	.08
.08	--------	--------	.09	1.60	.08	.00	.01	.09	.05	.17
.08	.07	.10	.03	1.42	.17	.14	.06	.12	.14	.17
.15	.06	.20	.04	1.71	.35	.46	.14	.25	.28	.73
.39	.10	.51	.46	1.41	.26	.56	.24	.16	.98	.93
.83	.38	.84	.94	2.26	1.09	1.08	1.13	.82	.99	.97
1.04	.89	1.05	1.29	1.28	1.20	1.11	1.56	1.06	1.01	.72
1.11	.94	1.01	1.26	.19	1.20	1.12	1.38	1.00	1.08	.85
1 50	1.32	1.37	1.30	.17	1.14	1.12	1.19	.79	.65	1.04
1.56	.72	.82	.81	.14	1.24	.91	1.63	.94	1.26	.98
.58	1.43	1.40	1.49	.14	1.68	1.85	1.40	1.36	1.25	1.20
1.07	1.22	1.42	2.10	--------	1.43	1.53	1.80	1.35	2.02	1.21
1.55	1.75	1.78	1.60	--------	1.52	1.30	1.40	1.65	1.05	1.32
.45	1.70	1.80	.35	--------	1.15	1.25	1.00	.90	.98	.85
1.70	1.35	1.05	.23	--------	.85	1.25	1.80	.70	1.35	.65
1.36	1.00	1.04	--------	--------	.92	.91	.50	.65	--------	--------
.94	.92	1.01	--------	--------	--------	--------	.15	.20	--------	--------
.40	.62	.49	--------	--------	--------	--------	--------	--------	--------	--------
.23	.41	.29	--------	--------	--------	--------	--------	--------	--------	--------
Total heights.										
16.18	15.05	16.38	12.13	15.30	14.42	14.81	15.55	12.35	13.25	12.05

Measurements of growth of culms of *Gigantochloa levis* are given in Table 10. This species sends up its shoots in general later than do *Bambusa spinosa* and *Bambusa vulgaris.* Measurements were started on a few shoots which had commenced to develop on June 5, but only one of these shoots reached maturity and then produced only a small culm. The measurements of this individual have not been included in our table on account of the small size attained. In general the shoots did not commence to develop in 1915 until July. The date of the first measurements of culms given in Table 9 is July 3. Except for the later development of the culms, *Gigantochloa levis* shows the same general growth phenomena as *Bambusa spinosa* and *Bambusa vulgaris*, but the rates of growth, according to our tables, are intermediate.

TABLE 10.—*Growth of culms of Gigantochloa levis, at Division of Investigation, Bureau of Forestry, Los Baños, Laguna, Philippine Islands. Data from report by Ranger Oro.*

Height in meters at first measurement.								
.09	.05	.10	.09	.24	.10	.20	.15	.37
Growth in meters during successive weeks.								
	.03	.04						
	.02	.05						.14
.08	.05	.07	.08	.12	.01			.33
.07	.02	.11	.11	.16	.03	.13		.88
.20	.08	.11	.10	.32	.01	.30	.01	1.14
.16	.01	.23	.18	.88	.01	.49	.10	1.80
.58	.23	.60	.49	1.21	.01	1.14	.07	2.04
.92	.27	1.13	.92	1.58	.01	1.69	.14	1.57
.68	.64	1.16	1.05	1.19	.33	1.00	.26	1.30
1.29	1.12	1.22	.98	1.48	.22	1.19	.72	1.15
2.73	1.11	1.81	1.63	.99	.77	1.81	1.45	.75
1.88	1.01	1.55	1.90	2.28	1.30	1.85	1.55	1.41
.87	2.16	1.97	1.67	1.20	1.90	1.57	2.35	1.09
1.75	2.60	1.65	1.35	1.35	2.70	.99	2.10	.63
1.49	1.05	1.00	1.45	.92	2.00	.70	1.05	
.78	1.11	.50	.90	.57	1.47	.30	1.20	
.33	.94	.30	.50	.22	.92		.95	
	.50	.20	.16		.50			
		.16			.20			
Total heights.								
13.90	13.00	13.96	13.56	14.71	12.49	13.36	12.10	14.60

TABLE 10.—*Growth of culms of Gigantochloa levis, etc.*—Continued.

Height in meters at first measurement.								
.21	.22	.23	.72	.24	.22	.31	.11	.13
Growth in meters during successive weeks.								
-----	-----	-----	.68	-----	-----	-----	-----	-----
.09	-----	-----	1.10	-----	-----	-----	-----	-----
.13	-----	-----	1.68	.19	.33	-----	-----	-----
.20	.02	.08	1.60	.10	.74	.57	.11	.02
.31	.01	.35	2.18	.09	1.06	.99	.11	.11
.69	.02	1.16	1.61	.02	1.41	1.46	.11	.12
1.31	.13	1.20	.59	.36	1.66	1.66	.27	.21
1.76	.18	1.90	.50	1.10	1.38	2.00	.64	.51
1.55	.60	1.60	2.09	1.52	1.50	1.33	1.20	1.20
2.05	1.17	1.80	1.20	2.26	1.90	1.98	1.17	1.10
1.93	1.35	1.96	.93	1.49	1.40	2.36	1.43	2.27
2.27	2.00	.77	.12	2.03	1.15	1.34	1.66	2.03
1.15	2.00	1.75	-----	1.40	.95	.90	1.49	1.70
1.20	2.75	1.35	-----	1.30	.60	.70	1.80	1.20
.78	1.35	.83	-----	.93	.50	.30	1.35	1.20
.27	1.15	.26	-----	.64	.30	.30	.45	.78
-----	.75	-----	-----	-----	-----	-----	-----	.18
-----	.40	-----	-----	-----	-----	-----	-----	-----
Total heights.								
15.90	14.10	15.24	15.00	13.67	15.10	16.20	11.90	12.76

Osmaston[1] found that *Dendrocalamus giganteus* at Dehra Dun, India, began to develop new culms toward the middle of the rainy season and that these did not complete their growth until two months after the rains normally ceased. It would appear from this that all bamboos do not behave alike in respect to their season of growth.

[1] Osmaston, B. B., Rate of growth of bamboos, *Indian Forester*, Vol. 44 (1918), page 52.

Ranger Mabesa has made counts of the number of shoots produced in one season on two areas of *Schizostachyum lumampao*, each area consisting of 100 square meters. The two areas together contained 340 canes and produced 35 shoots, or 10 per cent of the original number. All canes were cut from two smaller-sized plots in May, 1917, and the number of new canes counted in November, 1917. These two plots originally contained 221 canes. After the clearing they sent up a large number of shoots about the size of a lead pencil and 10 usable canes, which is only 4.5 per cent of the original number. This would indicate that it requires some years for this bamboo to regain its original density when once completely cut-over.

COST OF HARVESTING AND PRICES

Data on the cost of harvesting were collected during the year 1916 on the College of Agriculture farm at Los Baños, Laguna. One man was employed for a total of 91 days, during which time 1,000 canes of *Bambusa spinosa* were harvested, an average of 11 canes per day. The cost of labor was 80 centavos per day, making the total cost of harvesting 1,000 canes 72.80 pesos or an average per cane of 7.28 centavos. In the same locality these canes sold at 4 pesos per dozen.

Bamboo sold in Manila is floated down the river from the country behind or across Manila Bay. In Manila the present prices for canes in the river are: First-class canes, 32 pesos per hundred; second-class canes, 27 pesos per hundred; and third-class canes, from 18 to 20 pesos per hundred. The cost of floating bamboo to Manila is very small, as rafts containing large numbers of canes can be operated by a very few men.

PLATE II. ARUNDINARIA NIITAKAYAMENSIS (UTOD).

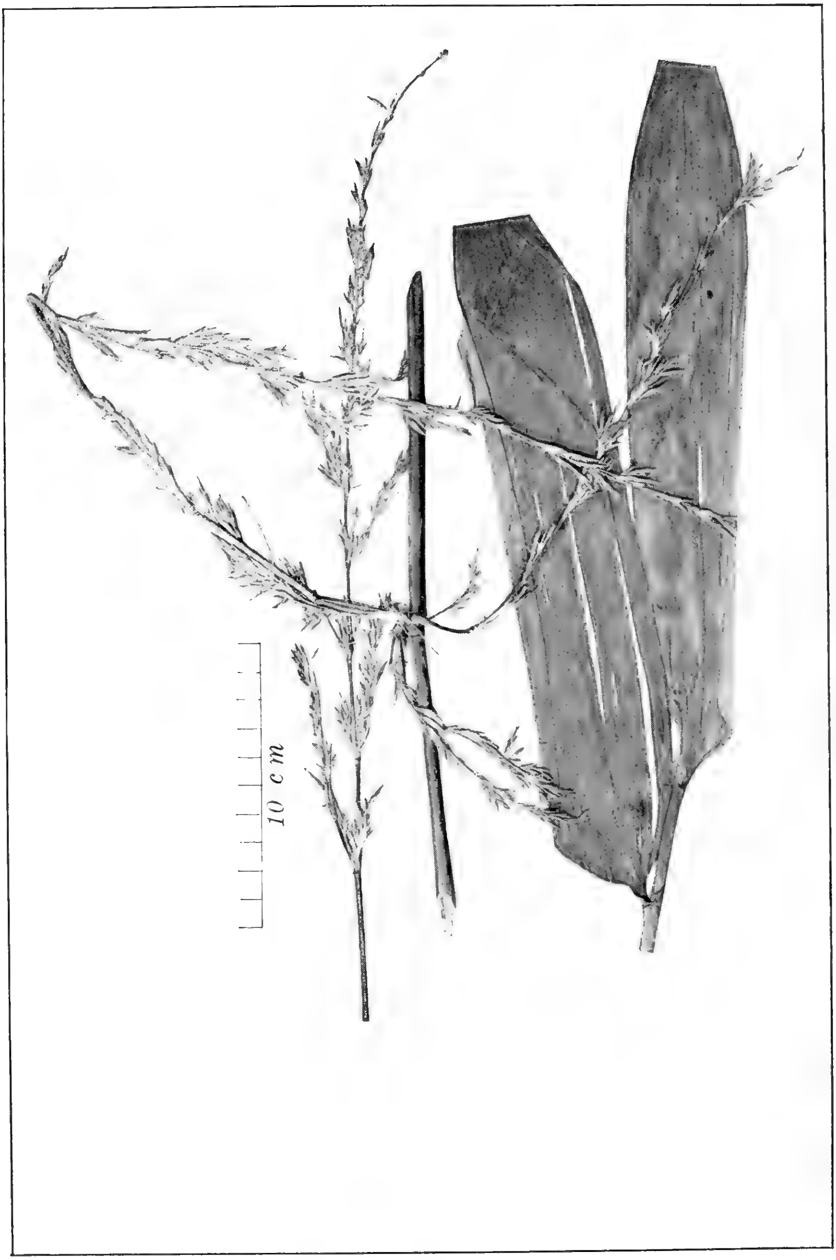


PLATE III. BAMBUSA CORNUTA (LOPA).

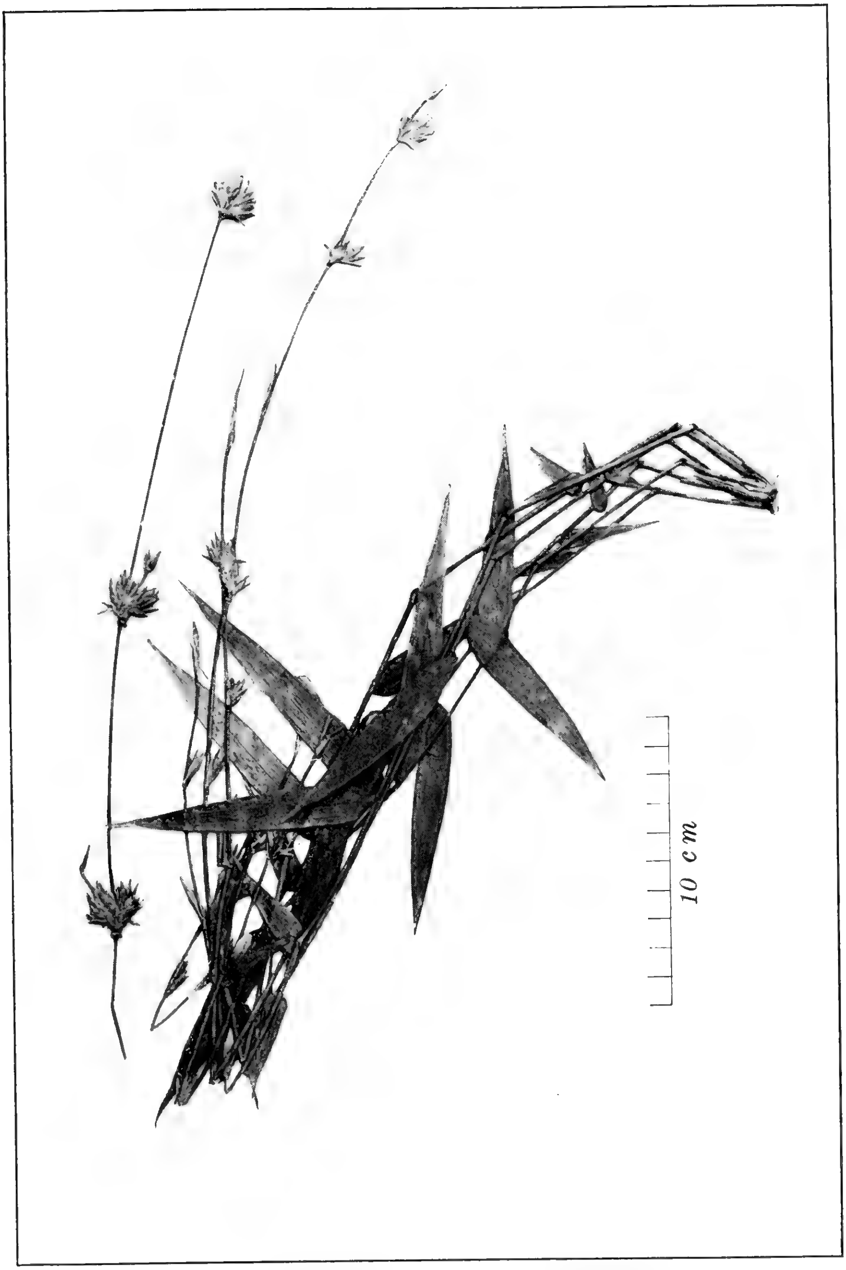


PLATE IV. BAMBUSA MERRILLII. TYPE SPECIMEN.

PLATE V. BAMBUSA SPINOSA (SPINY BAMBOO).

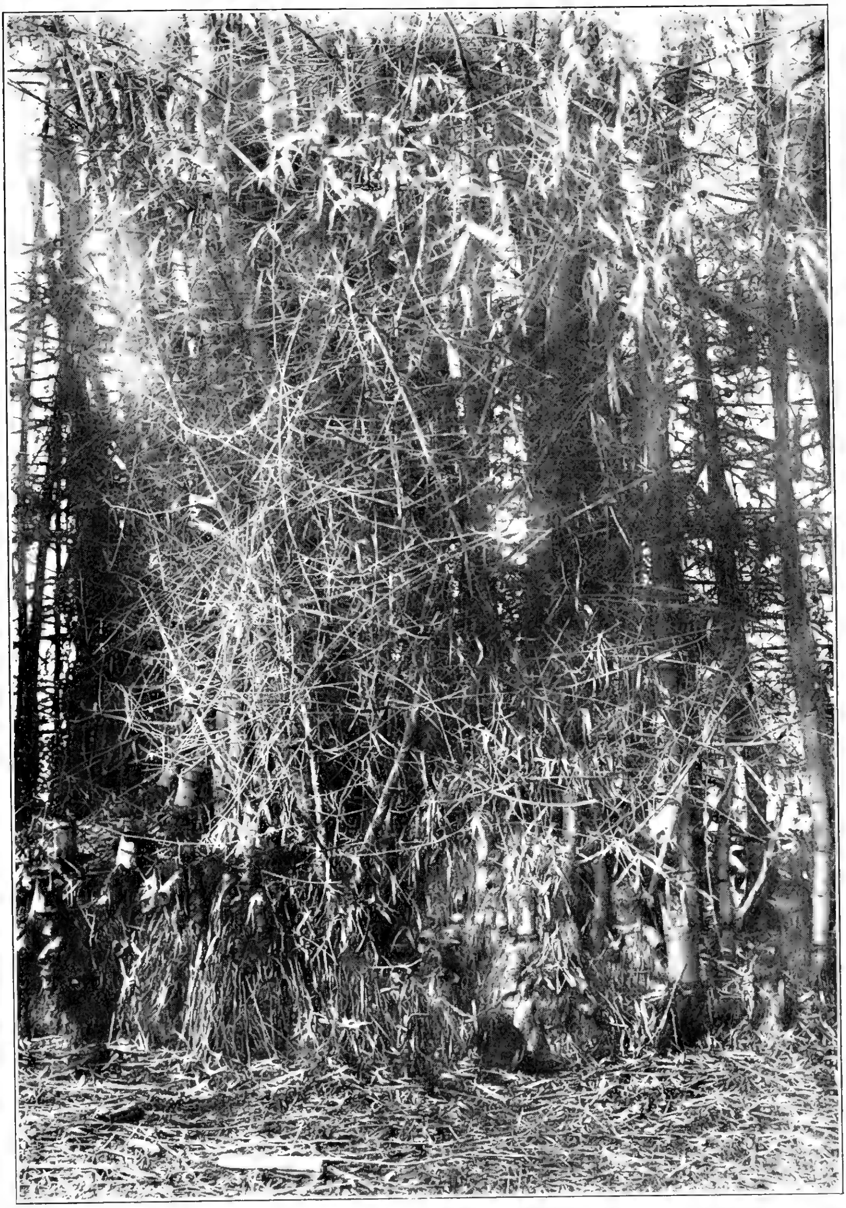


PLATE VI. BAMBUSA SPINOSA (SPINY BAMBOO).

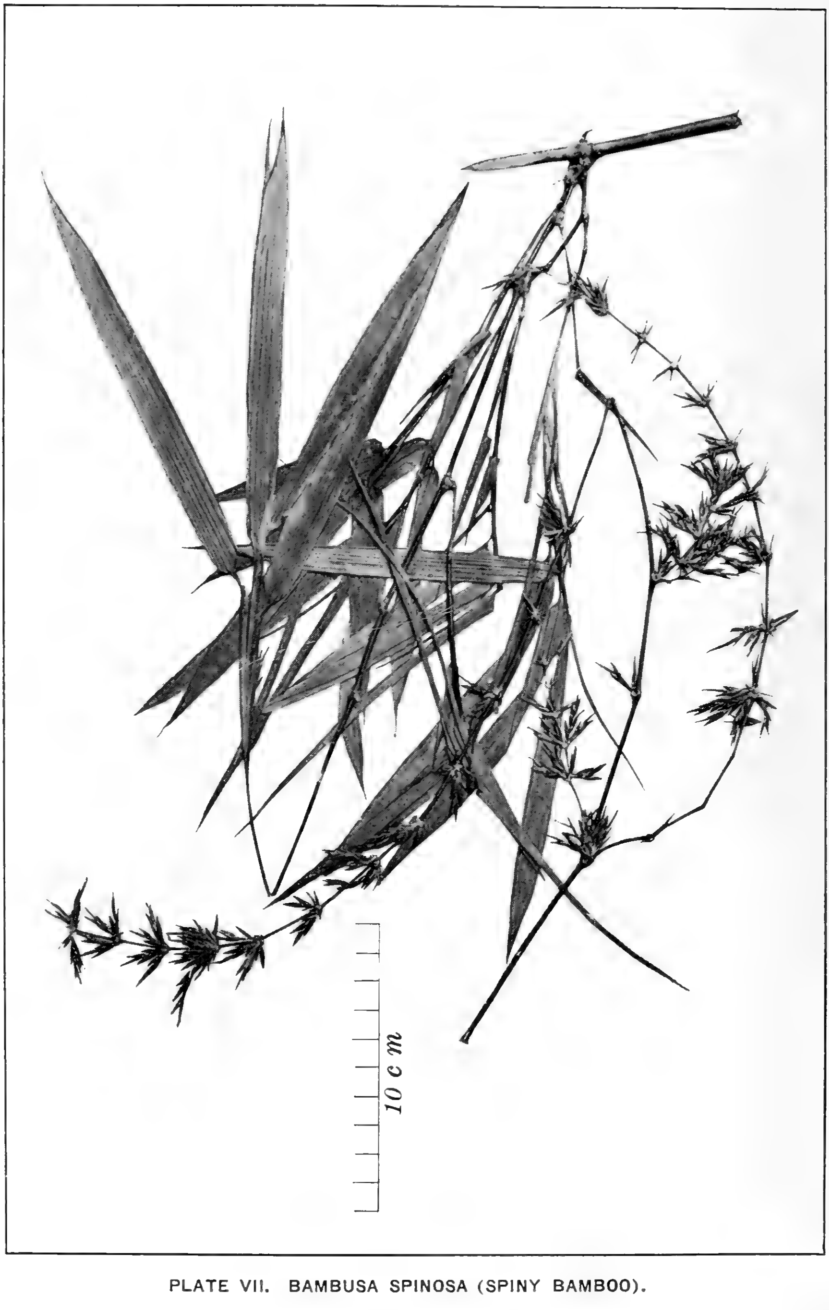


PLATE VII. BAMBUSA SPINOSA (SPINY BAMBOO).

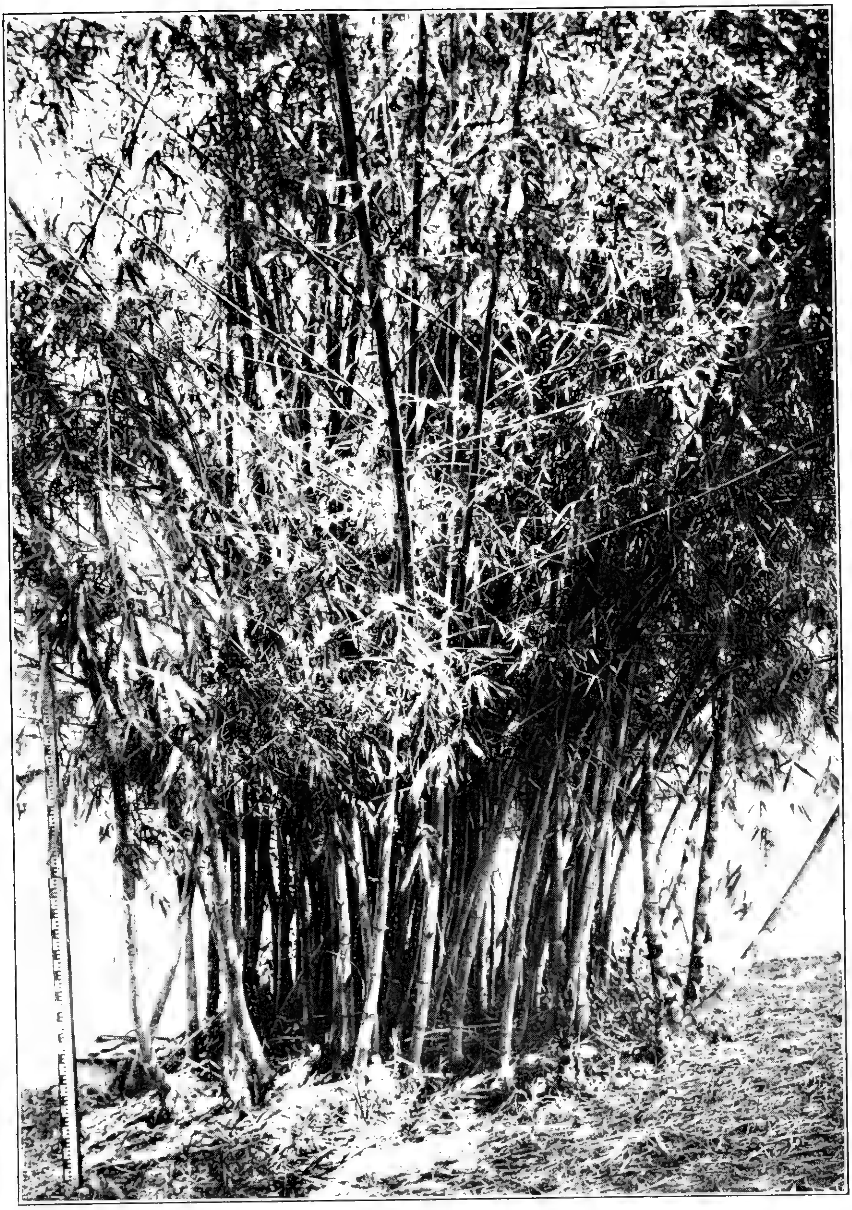


PLATE VIII. BAMBUSA VULGARIS (KAWAYAN-KILING).

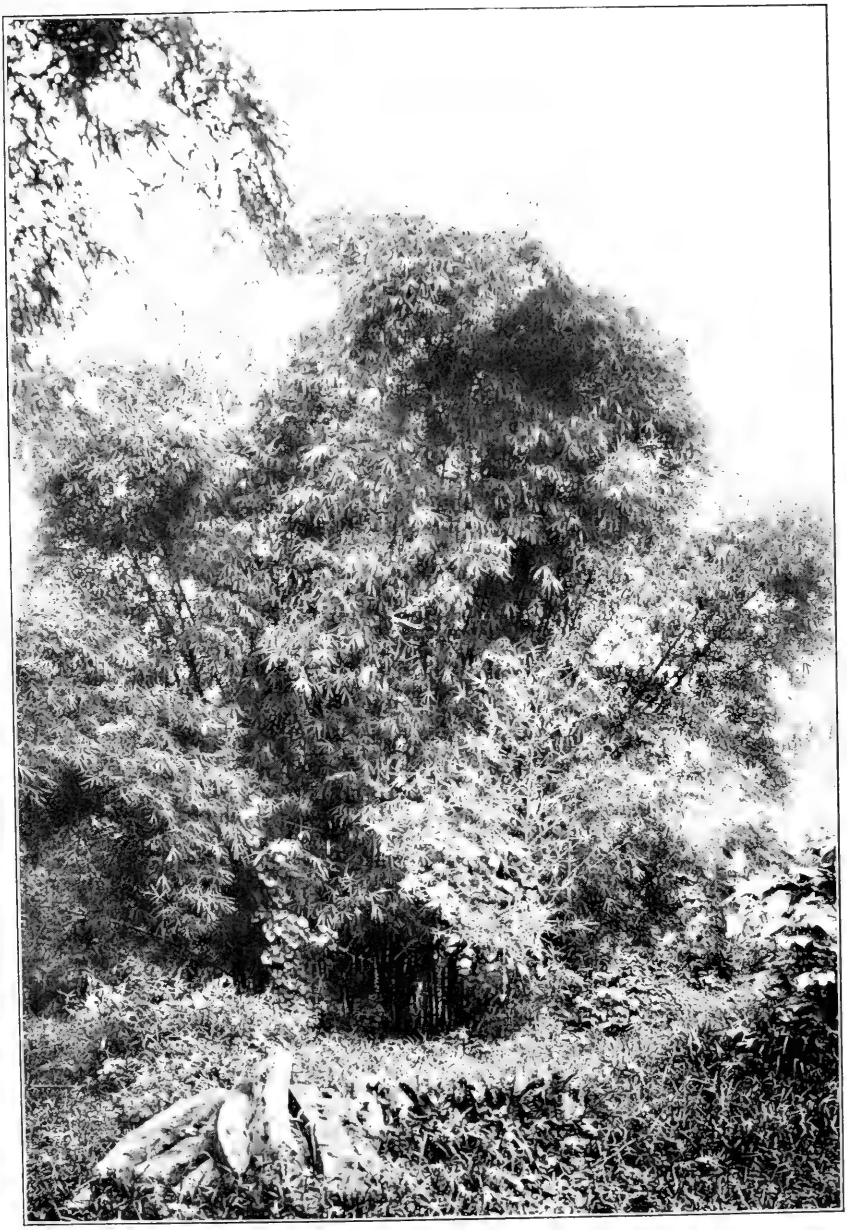


PLATE IX. BAMBUSA VULGARIS (KAWAYAN-KILING).

PLATE X. BAMBUSA VULGARIS (KAWAYAN-KILING).

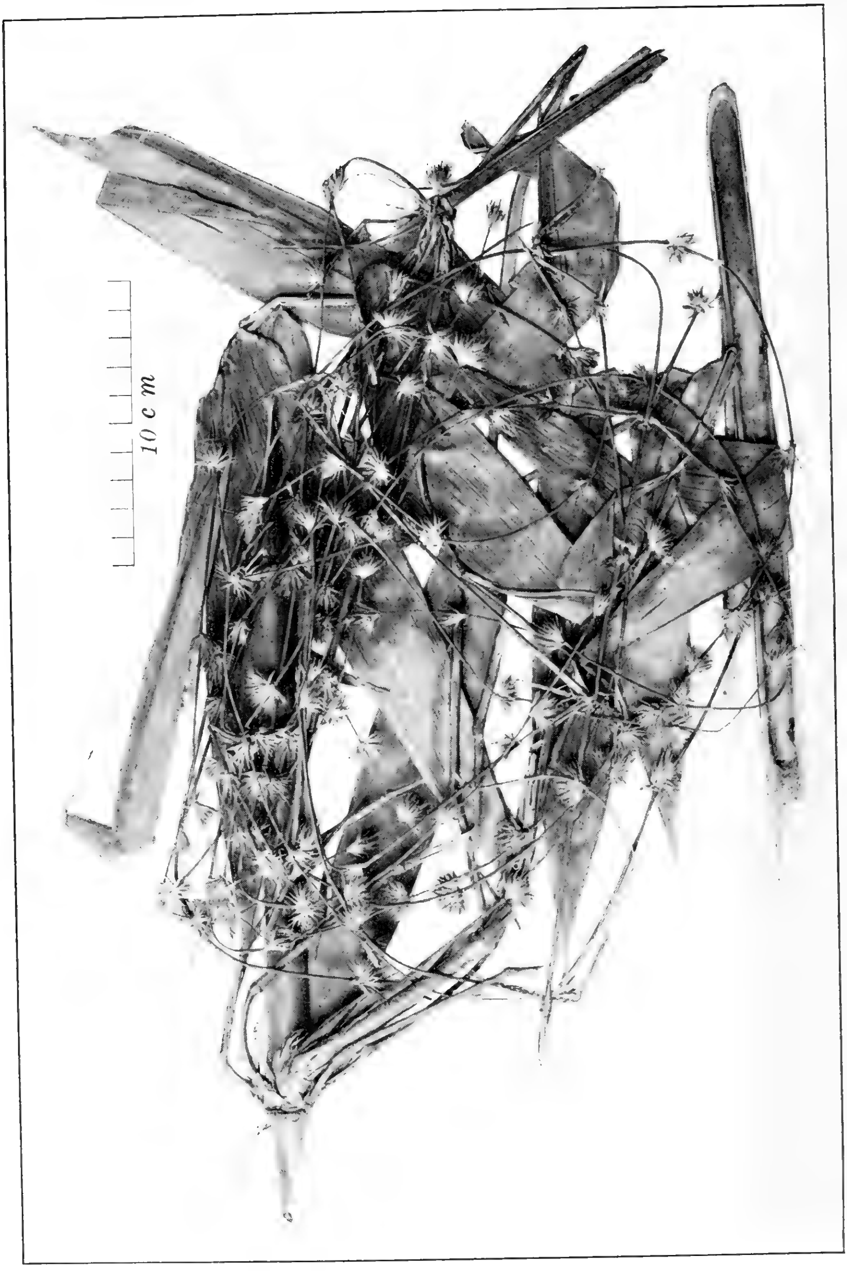


PLATE XI. CEPHALOSTACHYUM MINDORENSE (BAKTO). COTYPE SPECIMEN.

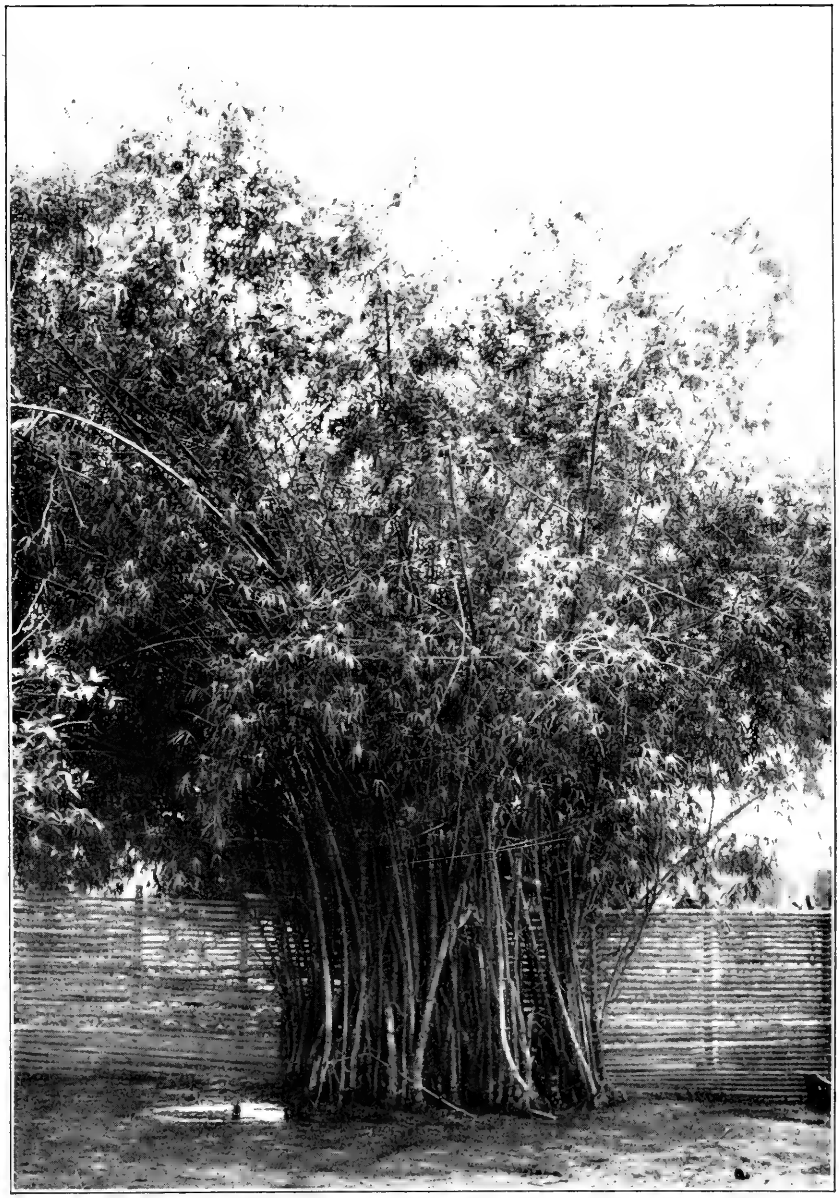


PLATE XII. DENDROCALAMUS MERRILLIANUS (BAYOG).

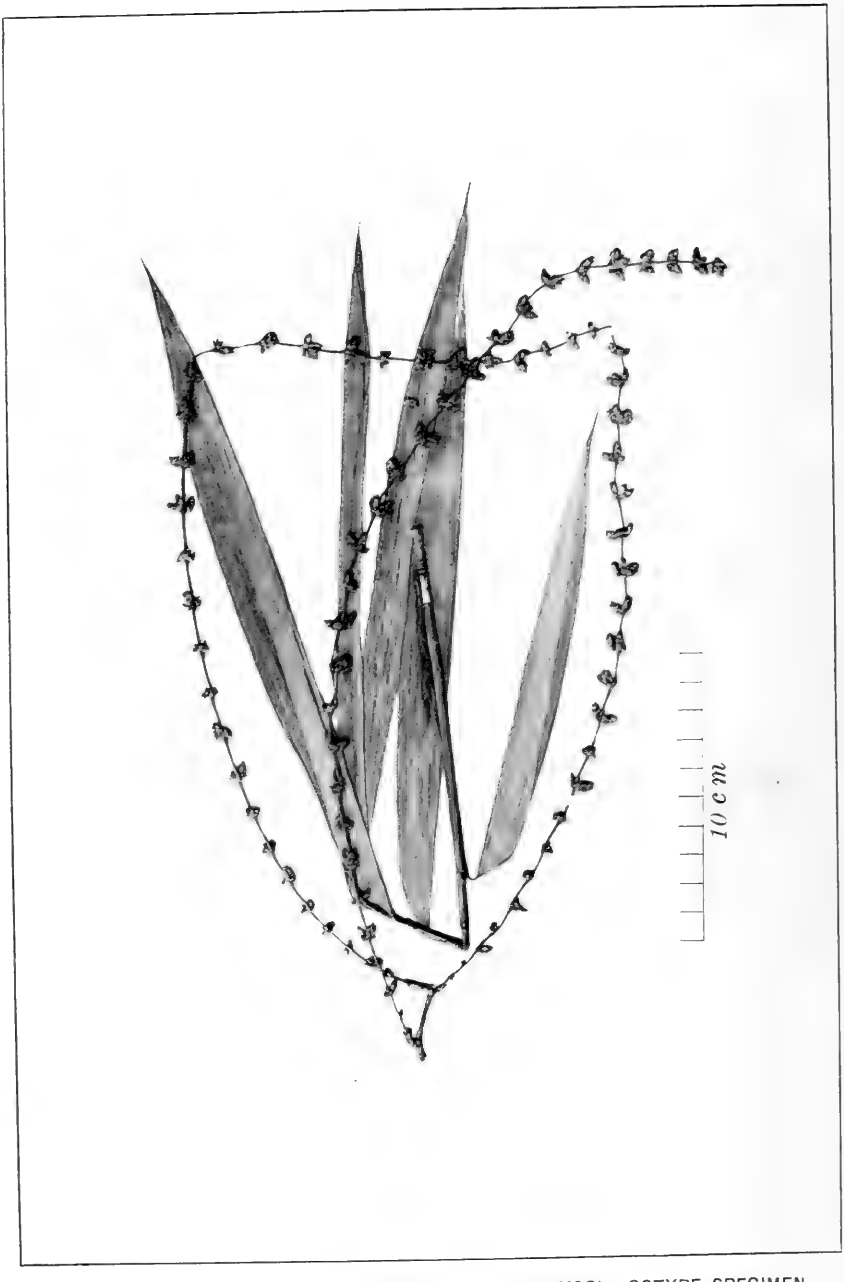


PLATE XIII. DENDROCALAMUS MERRILLIANUS (BAYOG). COTYPE SPECIMEN.

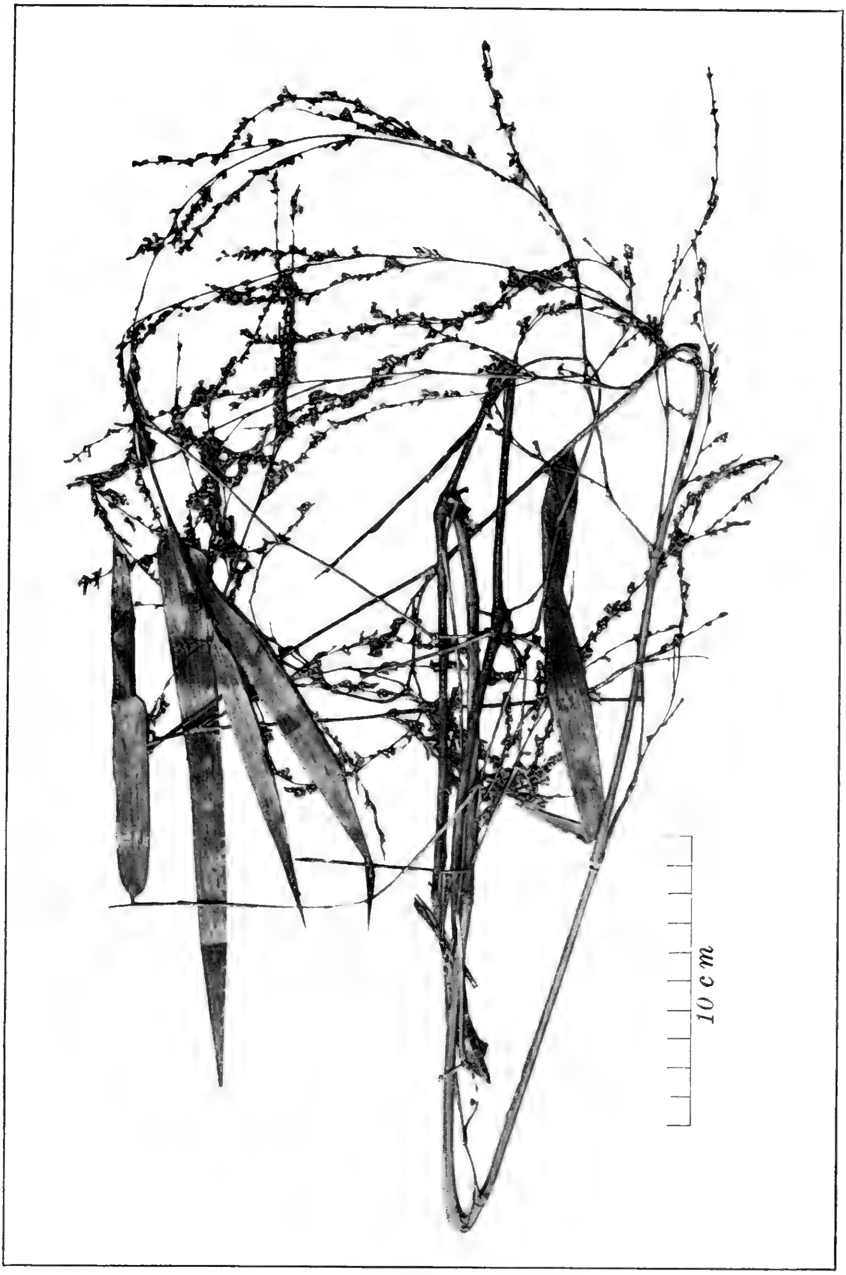


PLATE XIV. DINOCHLOA CILIATA.

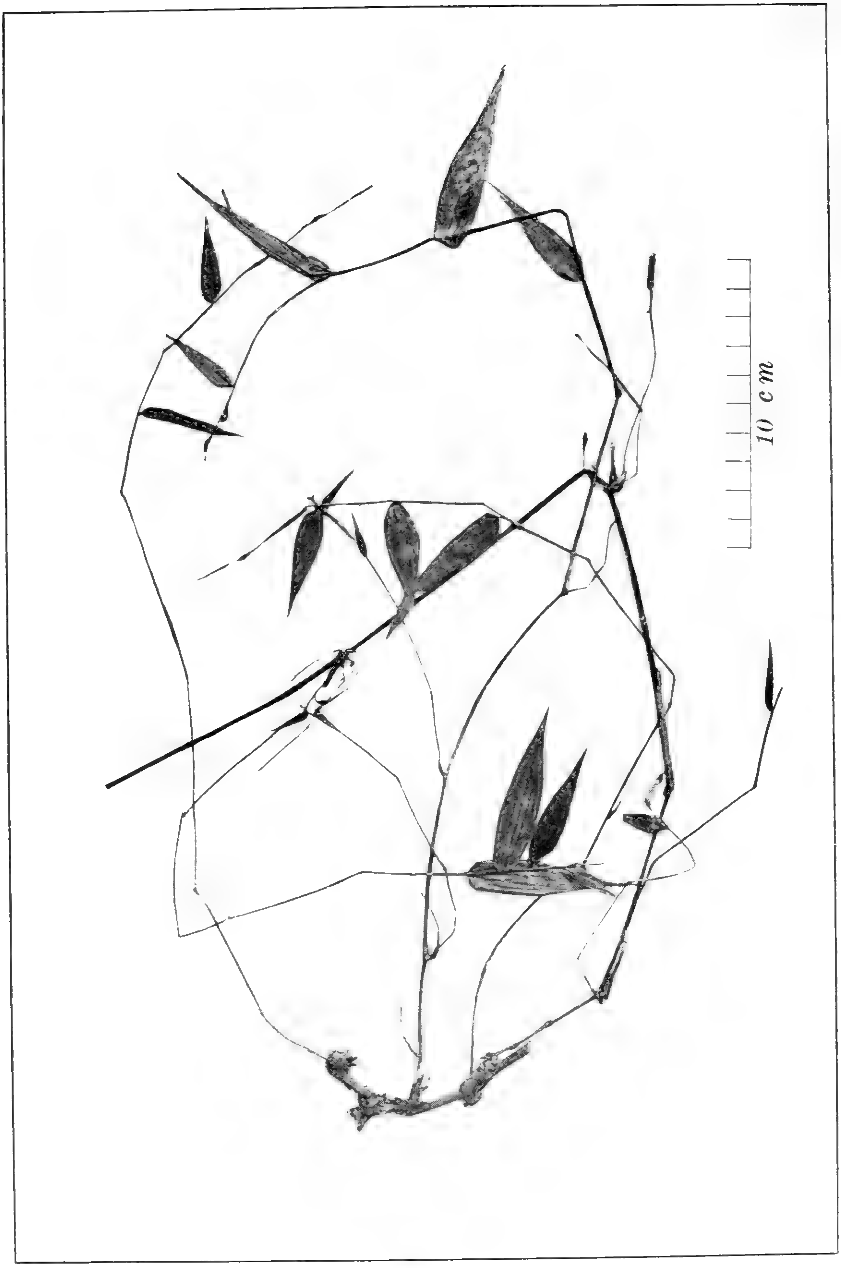


PLATE XV. DINOCHLOA ELMERI.

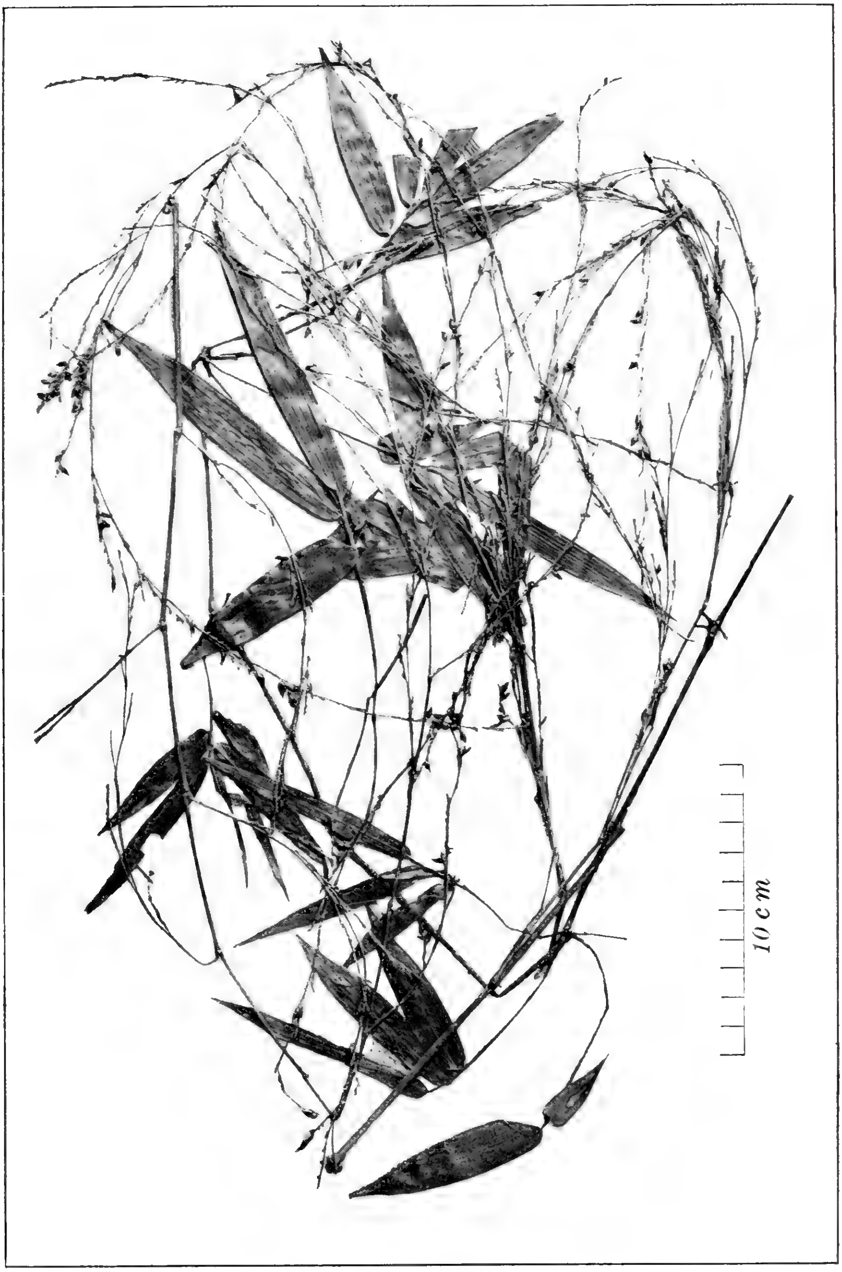


PLATE XVI. DINOCHLOA LUÇONIAE.

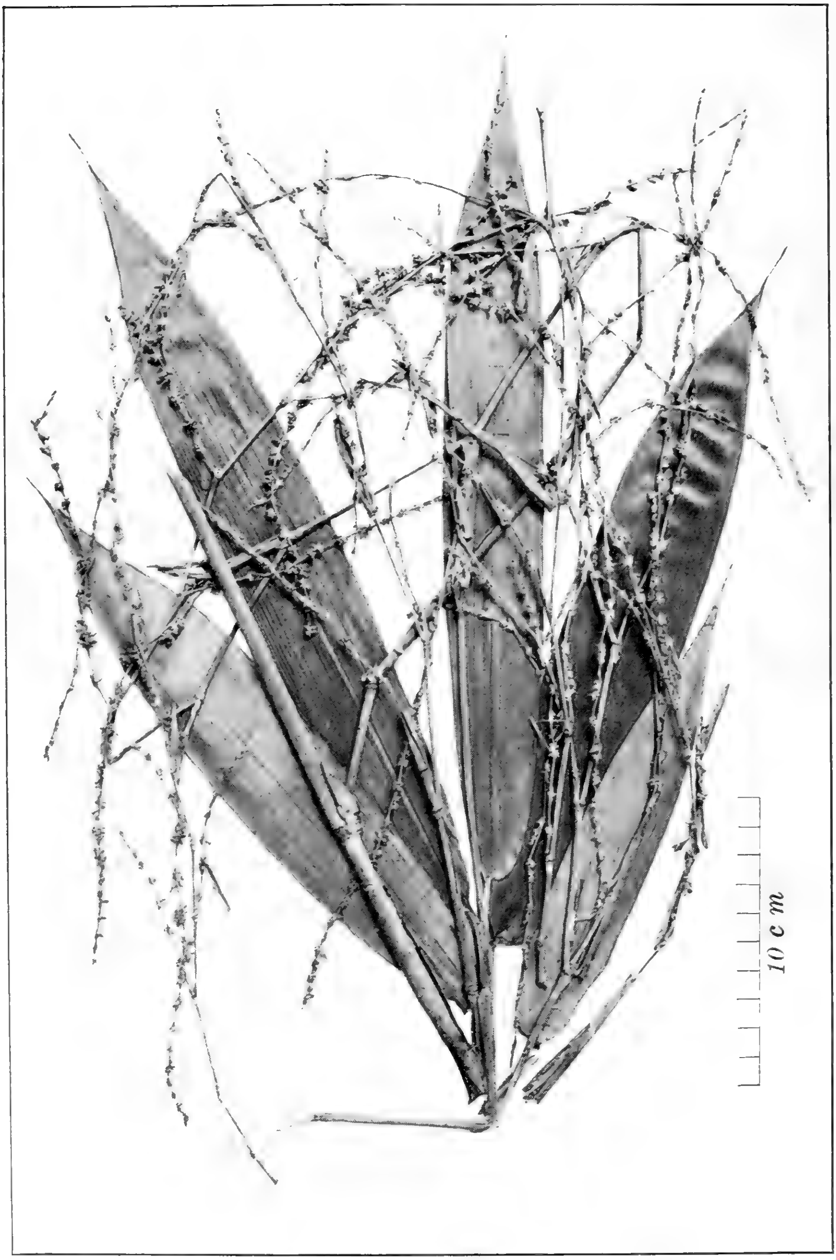


PLATE XVII. DINOCHLOA PUBIRAMEA. TYPE SPECIMEN.

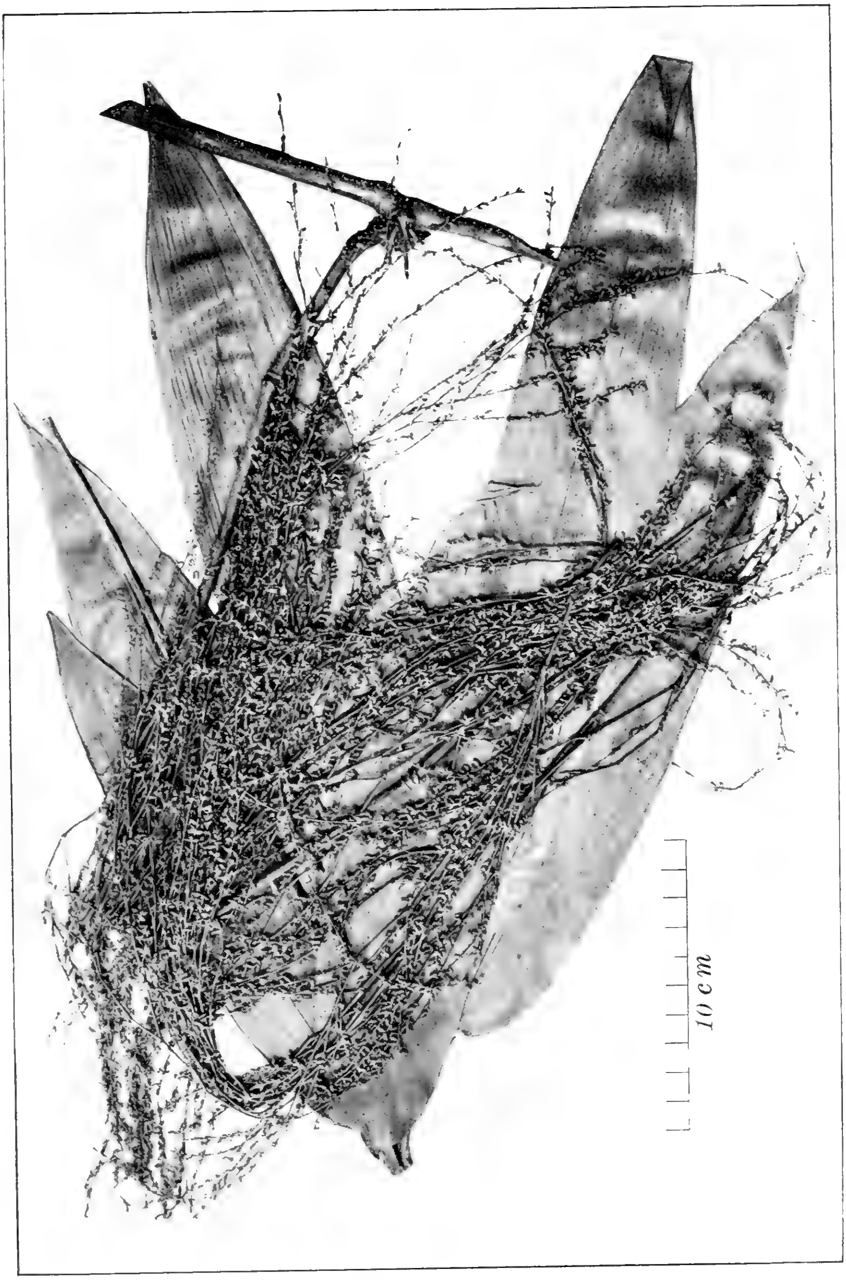


PLATE XVIII. DINOCHLOA SCANDENS (ZIGZAG BAMBOO).

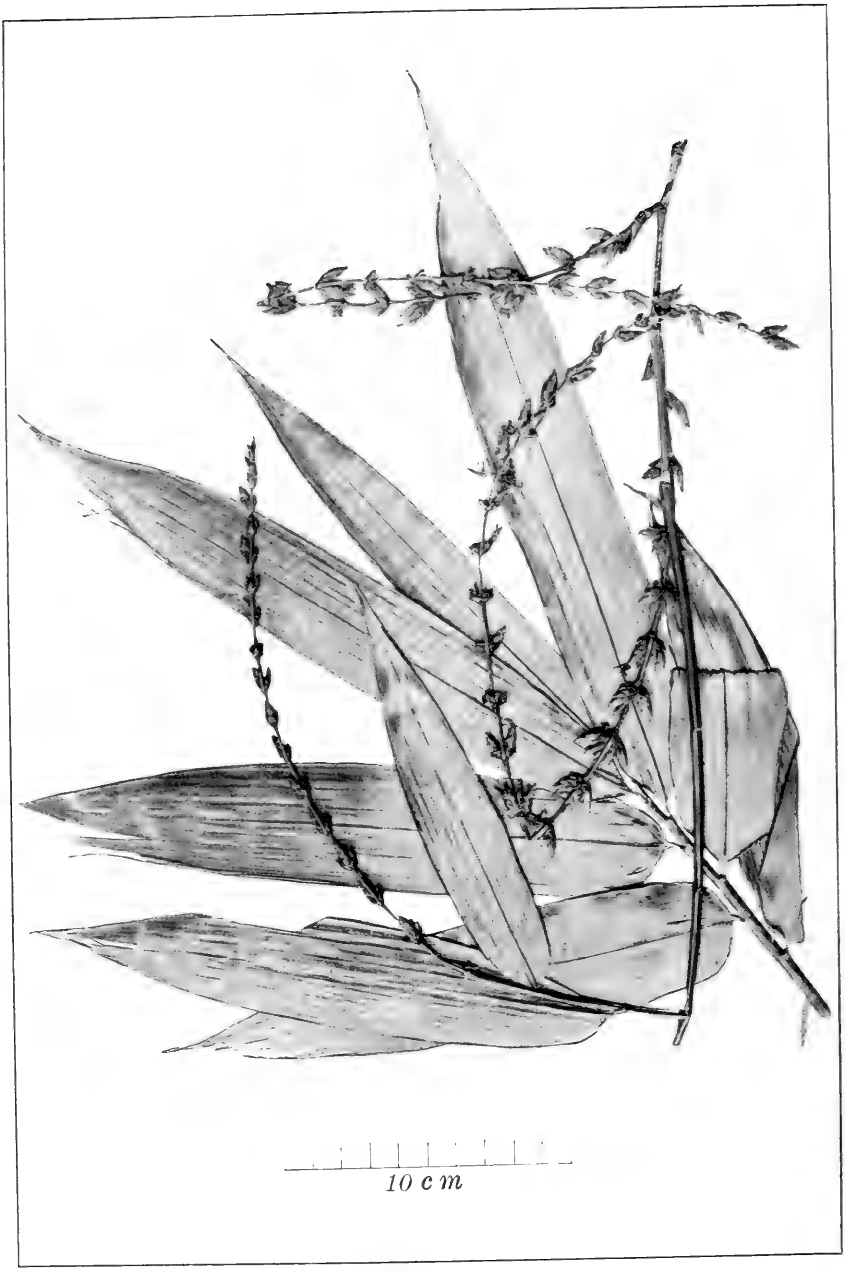
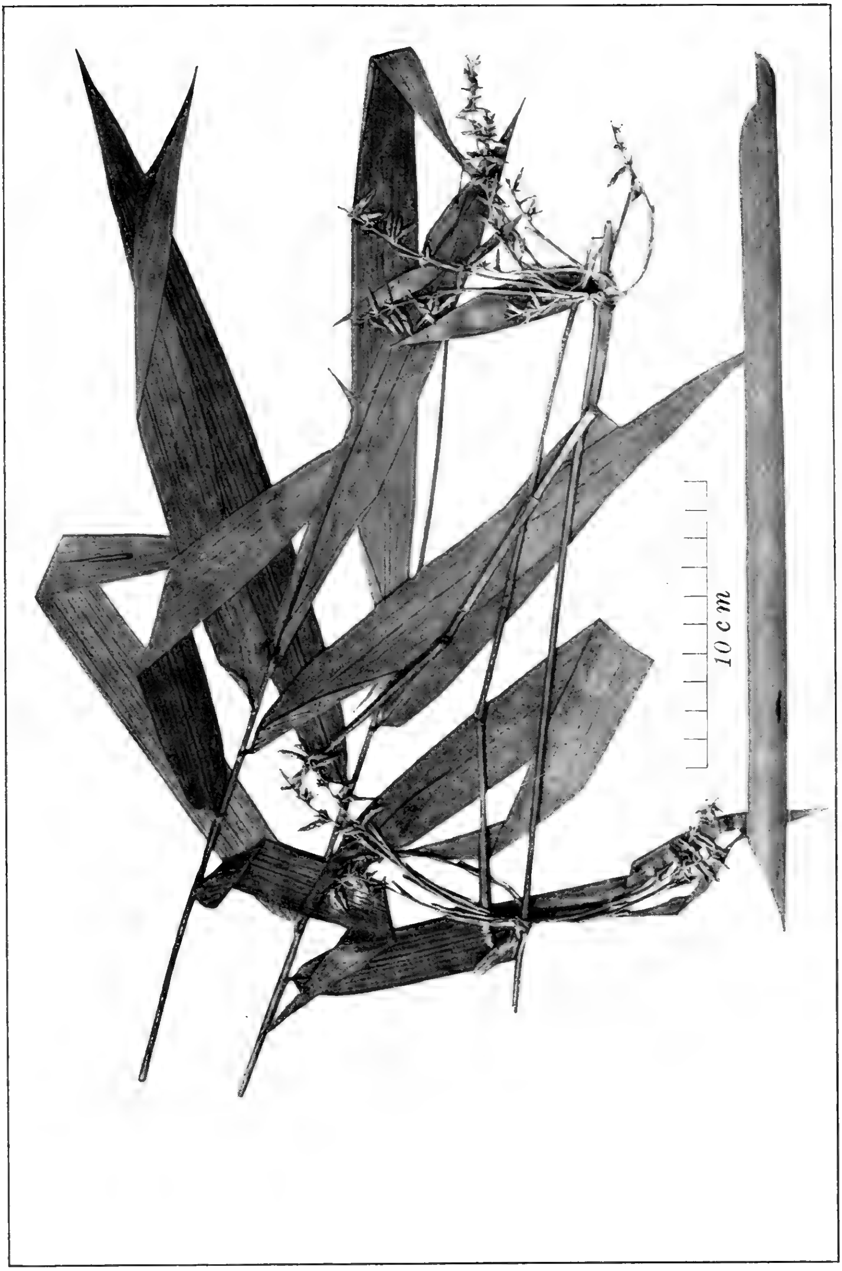


PLATE XIX. GIGANTOCHLOA LEVIS (BOLO).



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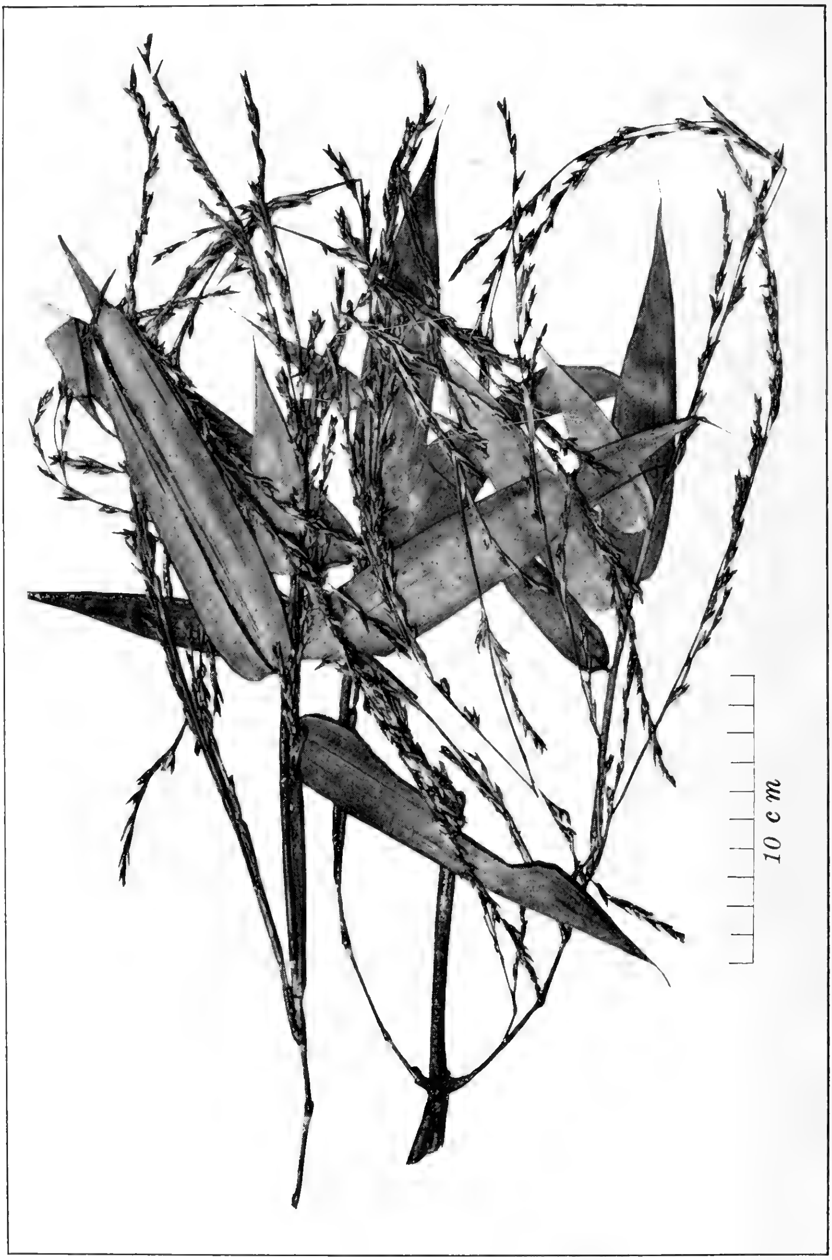
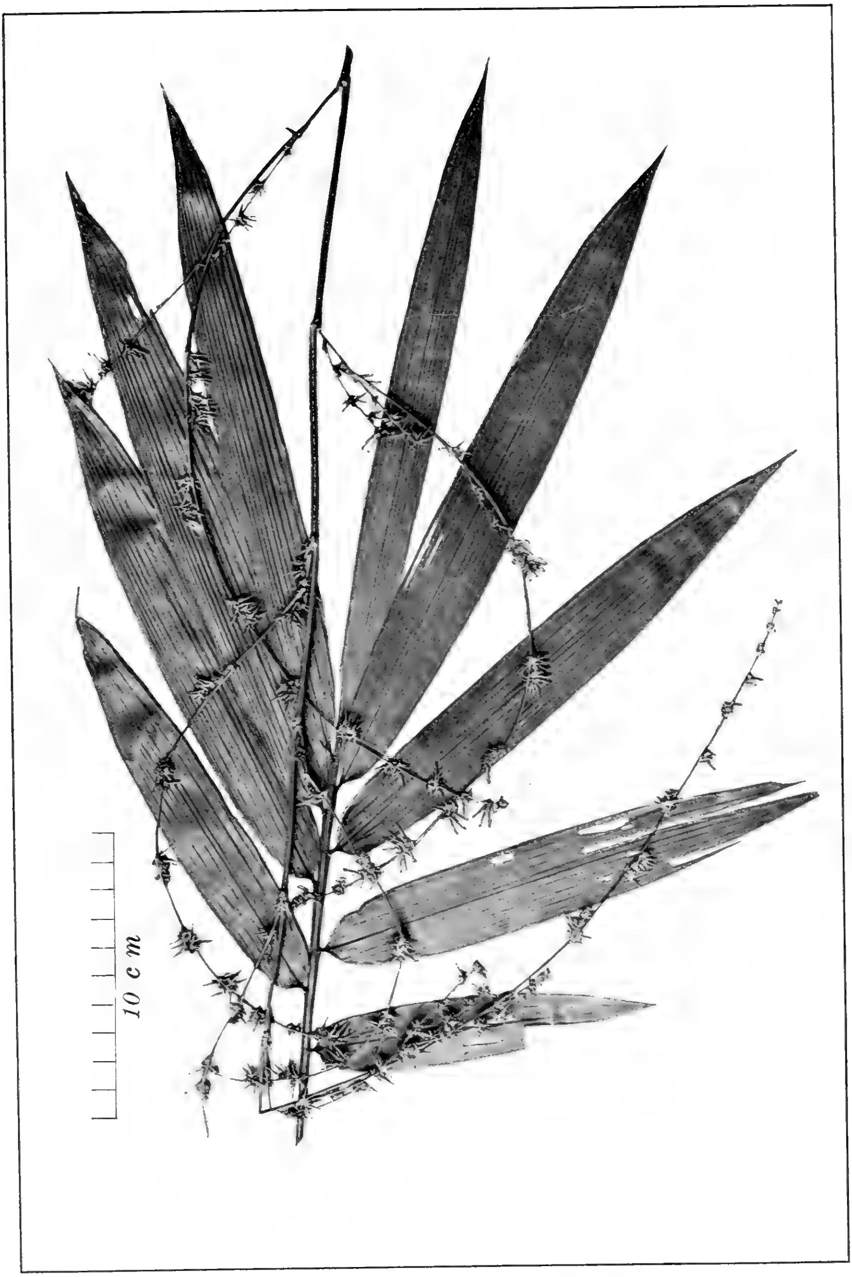


PLATE XXIII. SCHIZOSTACHYUM CURRANII.



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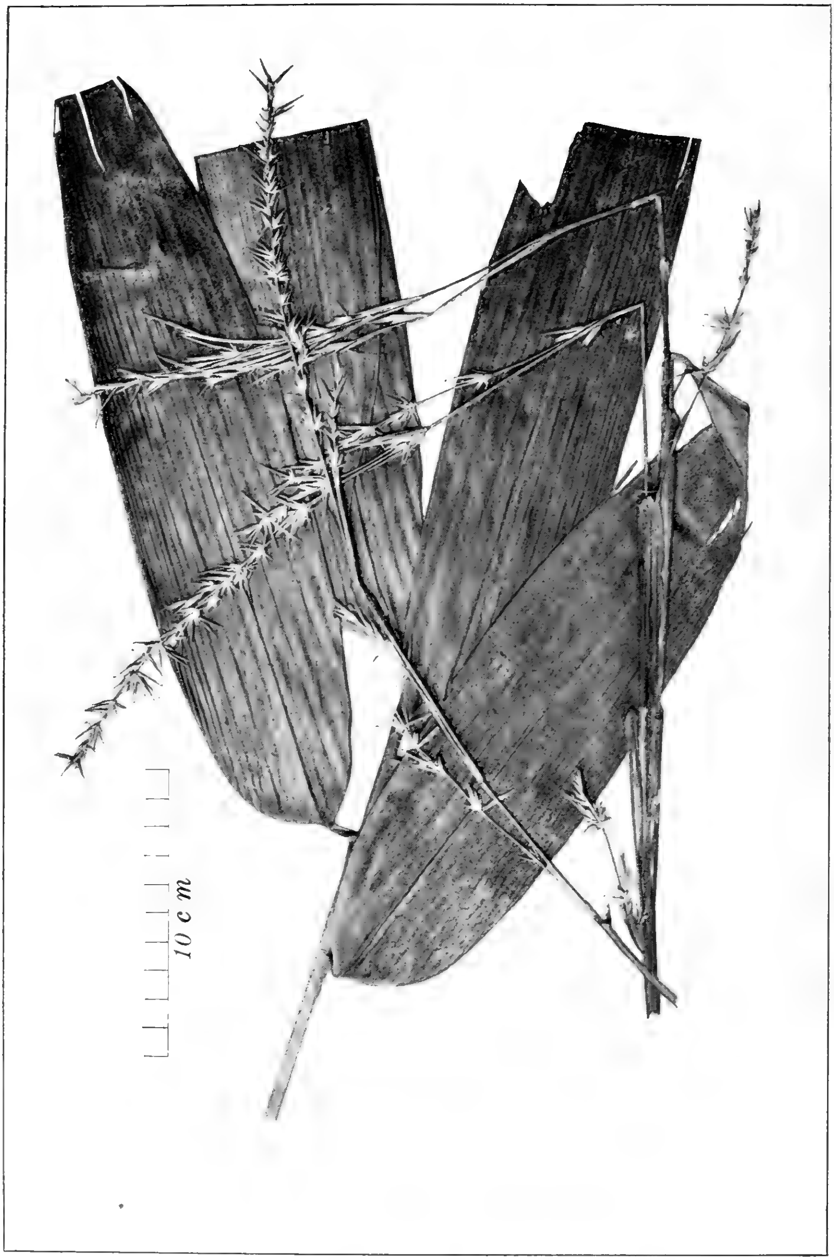

PLATE XXVII. SCHIZOSTACHYUM LIMA (ANOS).

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PHILIPPINE FIBER PLANTS

By William H. Brown

Giant pandans in Agusan, Mindanao.

PHILIPPINE FIBER PLANTS

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INTRODUCTION

With the great variety of plants occurring in the Philippines it is not surprising to find a large number which produce useful fibers. Most of the fibers derived from the wild plants are, however, of little economic value and are used very locally for making inferior grades of ropes or for other minor purposes. However, some of them, as in the case of the buri, pandan, rattans, and bamboos, are the bases of considerable industries; while abaka (Manila hemp), which produces the premier cordage of the world, is a native of the Philippines. The use of Philippine fibers in the manufacture of hats has been extensively discussed by Miller * and Robinson.† Muller ‡ has written a very good account of the various Philippine fibers used in the industrial work of the schools. A short account of some plants producing bast used in making ropes is given by Mendiola §; while King ‖ has written a very extensive and detailed discussion of the mechanical properties of a large number of bast fibers used in rope manufacture.

Some of the most useful fibers which can be considered as forest products are derived from palms and bamboos, and have been discussed in sections dealing with these plants. They are used in the manufacture of hats, baskets, mats, furniture, ropes, thatching, etc.

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* Miller, H. H., Philippine hats. Bureau of Education Bulletin Number 33 (1910).

† Robinson, C. B., Philippine hats. Philippine Journal of Science, Volume VI (1911), pages 93 to 131.

‡ Muller, T., Industrial fiber plants of the Philippines. Bureau of Education Bulletin Number 49 (1913).

§ Mendiola, N. B., A study of Philippine bast fibers. Philippine Agriculturist and Forester, Volume VI (1917), pages 6 to 39.

‖ King, A. E. W., Mechanical properties of Philippine bast fiber rope. Philippine Journal of Science, Volume XIV (1919).

Philippine bast fibers are derived from plants ranging in size from small shrubs to large trees and belonging chiefly to the families Sterculiaceae, Tiliaceae, Malvaceae, and Moraceae. As yet none of these fibers have entered into the external commerce of the Islands, but their manufacture into ropes is an important local industry. Mendiola has made a microscopic study of a number of these fibers and has given some data on the cost of production and the tensile strength of ropes made from them. The fibers studied by Mendiola were the basts of *Abroma fastuosa, Kleinhovia hospita, Melochia umbellata, Urena lobata, Hibiscus sabdariffa, Malachra capitata, Triumfetta bartramia, Grewia multiflora, Pipturus arborescens, Sesbania grandiflora, Columbia serratifolia, Malachra fasciata,* and *Wikstroemia ovata.* From the figures given by Mendiola it would appear that, with labor at 80 centavos a day, the cost of manufacture (not including the collection) of these fibers into rope would be greater than the present selling price; from which it would appear that there is little prospect of any considerable industry in the manufacture of such rope. However, as a local industry between seasons, it does afford a man an opportunity to utilize his spare time profitably. Some of these bast fibers, notably *Abroma fastuosa* and *Urena lobata*, have been considered as having great commercial possibilities. This subject has been extensively dealt with by King.

In Table I, taken from King, is shown the relative strength of various bast fibers both dry and wet, as compared with abaka and other standard fibers. Except where noted, the ropes were made by the plane-stripping process and so the strands contained considerable extraneous tissue in addition to the bast. Data from King are given in discussions of the various fibers studied by him.

Table II gives the dimensions of the various fibers studied by Mendiola.

TABLE I.—*Rope made of Philippine fibers arranged in the order of mean dry tensile strength, beginning with the strongest and ending with the weakest.*

[Data from King.]

	Species.	Mean tensile strength.			
		Dry.		Wet.	
		Per square centimeter.	Per square inch.	Per square centimeter.	Per square inch.
	ROPE MADE OF BAST FIBERS.	*Kilos.*	*Pounds.*	*Kilos.*	*Pounds.*
1	*Gnetum* sp.	773	11,100	1,000	14,500
2	*Ficus palawanensis*	752	10,700	766	10,900
3	*Abroma fastuosa* (retted)	643	9,100		
4	*Malachra fasciata*	637	9,030	543	7,700
5	*Bombycidendron vidalianum*	630	8,940	468	6,670
6	*Abroma fastuosa* (crude strips)	545	7,760	319	4,530
7	*Corchorus olitorius*	503	7,130	360	5,100
8	*Urena lobata*	482	6,850	366	5,200
9	*Ficus benjamina*	480	6,830	471	6,700
10	*Sida acuta*	475	6,740	502	7,190
11	*Ficus pachyphylla*	464	6,600	544	7,760
12	*Helicteres hirsuta*	438	6,230	396	5,620
13	*Bombax ceiba*	405	5,720	351	4,960
14	*Sterculia oblongata*	398	5,650	291	4,130
15	*Sterculia crassiramea*	398	5,660	308	4,380
16	*Grewia eriocarpa*	394	5,630	381	5,450
17	*Commersonia bartramia*	392	5,580	266	3,780
18	*Cordia cumingiana*	388	5,500	364	5,160
19	*Pterocymbium tinctorium*	381	5,420	435	6,180
20	*Grewia multiflora*	376	5,360	332	4,730
21	*Artocarpus communis* (old bast)	367	5,220		
22	*Artocarpus communis* (young bast)	356	5,070	340	4,830
23	*Goniothalamus amuyon*	345	4,940	293	4,180
24	*Cordia myxa*	324	4,610	263	3,730
25	*Grewia bilamellata*	320	4,570	180	2,570
26	*Kleinhovia hospita*	309	4,370	286	4,070
27	*Columbia blancoi*	302	4,270	306	4,340
28	*Sterculia stipularis*	268	3,800	366	5,200
29	*Thespesia lampas*	268	3,800	291	4,130
30	*Pterospermum diversifolium*	263	3,740	261	3,690
31	*Allaeanthus glaber*	231	3,290	253	3,590
32	*Sterculia foetida*	200	2,840	200	2,840
33	*Ficus forstenii*	154	2,200	222	3,160
34	*Trema orientalis*	134	1,920	262	3,720
	Average	406	5,770	375	5,338

TABLE I.—*Rope made of Philippine fibers arranged, etc.*—Continued

	Species.	Mean tensile strength.			
		Dry.		Wet.	
		Per square centimeter.	Per square inch.	Per square centimeter.	Per square inch.
	ROPE MADE OF MISCELLANEOUS FIBERS.	*Kilos.*	*Pounds.*	*Kilos.*	*Pounds.*
1	*Musa textilis* (grade "G" abaka rope 16 mm in circumference)	1,110	15,700	1,180	16,700
2	*Musa textilis* (grade "F" abaka rope 15 mm in circumference)	974	13,800	923	13,100
3	*Musa textilis* (grade "F" abaka rope 31 mm in circumference)	943	13,400	946	13,500
4	*Musa textilis* (grade "G" abaka rope 26 mm in circumference)	744	10,600	759	10,800
5	*Agave cantala* (maguey; grade, Cebu No. 2)	739	10,400	651	9,220
6	*Dendrocalamus merrillianus*	237	3,380	179	2,540
7	*Corypha elata* (leaf of palm)	232	3,300		
8	*Corypha elata* ("buntal;" vascular fibers in petioles)	222	3,150	257	3,650
9	*Cocos nucifera* (rope 50 mm in circumference)	185	2,640	136	1,940
10	*Cocos nucifera* (rope 24 mm in circumference)	176	2,490	148	2,100
11	*Cocos nucifera* (rope 44 mm in circumference)	170	2,420	146	2,070
12	*Anamirta cocculus* (rope made from entire stems)	149	2,120	110	1,570
13	*Amomum* sp.			325	4,600
	Average	490	6,950	480	6,816

TABLE II.—*Dimensions of some Philippine bast fibers.*

[Data from Mendiola.]

Fibers.	Length.			Diameter.					
				Total.			Lumen.		
	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Abroma fastuosa	4.240	2.213	1.360	0.039	0.017	0.006	0.001	0.005	0.002
Kleinhovia hospita	2.400	1.518	.933	.031	.015	.008	.007	.005	.001
Melochia umbellata	3.067	2.045	1.107	.027	.016	.011	.012	.007	.003
Urena lobata	2.547	1.442	.973	.027	.013	.009	.005	.003	.002
Malachra capitata	4.493	2.758	1.560	.029	.015	.007	.011	.007	.002
Triumfetta bartramia	2.827	2.027	1.133	.027	.016	.009	.006	.004	.001
Grewia multiflora	2.707	1.843	1.067	.024	.015	.006	.005	.003	.001
Pipturus arborescens	6.000	5.054	3.773	.100	.069	.042	.078	.044	.017
Sesbania grandiflora	3.760	2.737	1.800	.037	.022	.008	.023	.010	.001
Columbia serratifolia	2.533	1.593	.960	.027	.014	.005	.001	.004	.008
Malachra fasciata	5.067	2.014	1.200	.042	.016	.006	.015	.007	.003
Wikstroemia ovata	4.240	2.972	1.653	.021	.012	.003	.004	.002	.001

DESCRIPTIONS OF SPECIES

Family POLYPODIACEAE

Genus DRYOPTERIS

DRYOPTERIS PTEROIDES O. Kuntze. LOKDÓ.

Local name: *Lokdó* (Samar).

In some parts of the Philippines the stems of this fern are crushed and the cord-like vascular bundles extracted for use as decorative weaves in baskets. The fibers, however, are of inferior quality.

This species is common and widely distributed, usually growing in thickets on hillsides and in valleys at low and medium altitudes. The fronds are tufted, pinnate, and usually about 1 meter in height.

Genus NEPHROLEPIS

NEPHROLEPIS HIRSUTULA Presl. ALOLOKDÓ.

Local names: *Alolokdó, lokdó, pakó-pakó* (Bisaya); *bayangbáng* (Batanes Islands); *hagnáya* (Tayabas); *korokalaság* (Bikol); *lagunton* (Abra); *pakó* (Polillo).

The fibro-vascular bundles of the stems of this plant are sometimes extracted and used to a very limited extent in the manufacture of hats, mats, and baskets.

Nephrolepis hirsutula is a coarse fern with creeping rootstocks. The narrow pinnate fronds are from 0.3 to 1.2 meters in length and 8 to 15 centimeters wide. The plant grows both in the ground and as an epiphyte, and is commonly cultivated for ornamental purposes. It is widely distributed at low and medium altitudes in the Philippines.

Genus STENOCHLAENA

STENOCHLAENA PALUSTRIS (Burm.) Bedd. (Plate I). DILIMÁN.

Local names: *Agnáya, hagnáya* (Laguna, Tayabas, Marinduque, Leyte, Camarines, Capiz, Iloilo, Palawan, Agusan); *dilimán* (Pangasinan, Pampanga, Bataan, Bulacan, Laguna, Iloilo, Occidental Negros); *gilimán* (Pampanga); *lanas* (Apayao).

The stems of this fern are noted for their durability when submerged in salt water, and for this reason are in great demand for tying together the bamboo frames of which fish traps are made. The stems are usually from 2 to 4 meters

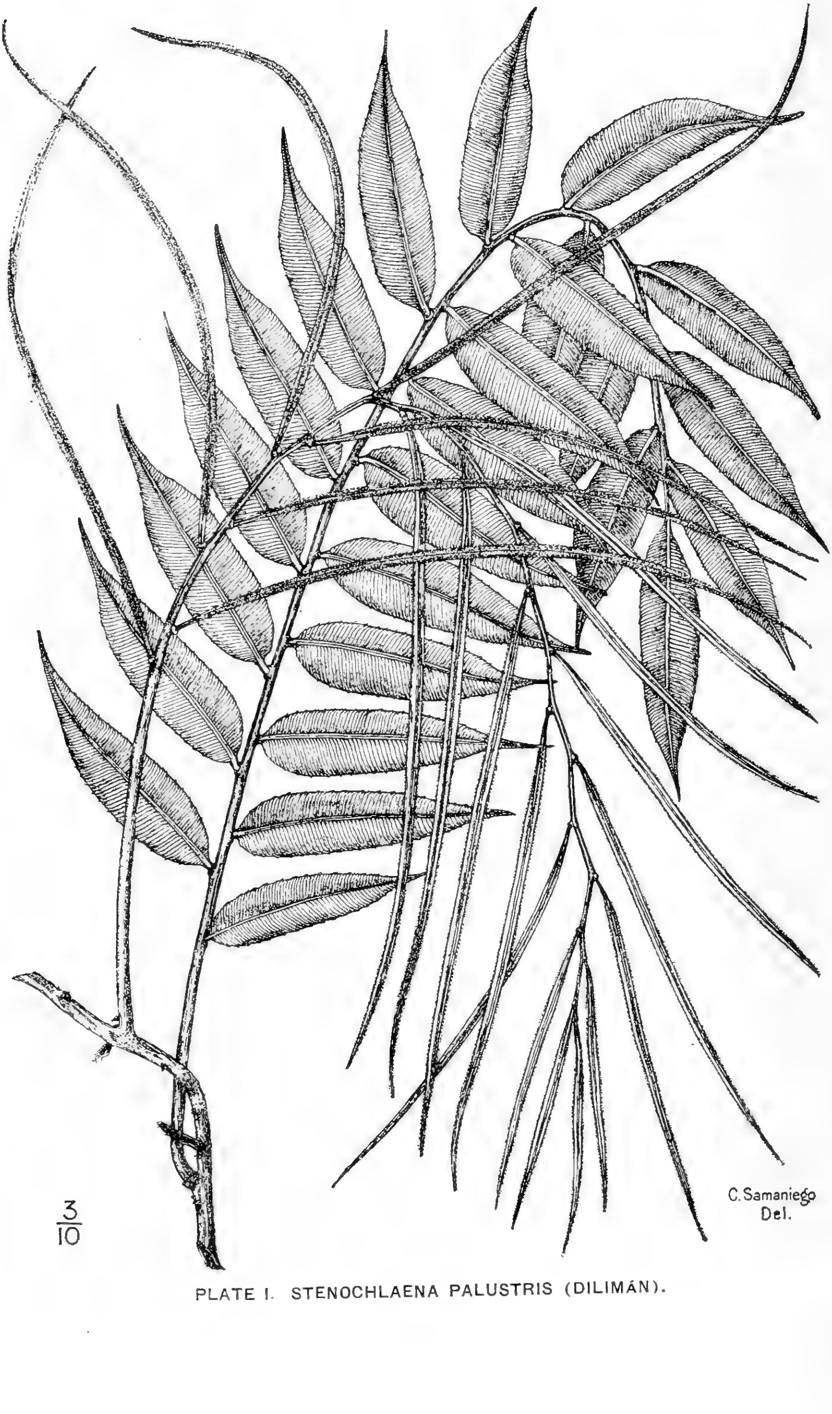

PLATE I. STENOCHLAENA PALUSTRIS (DILIMÁN).

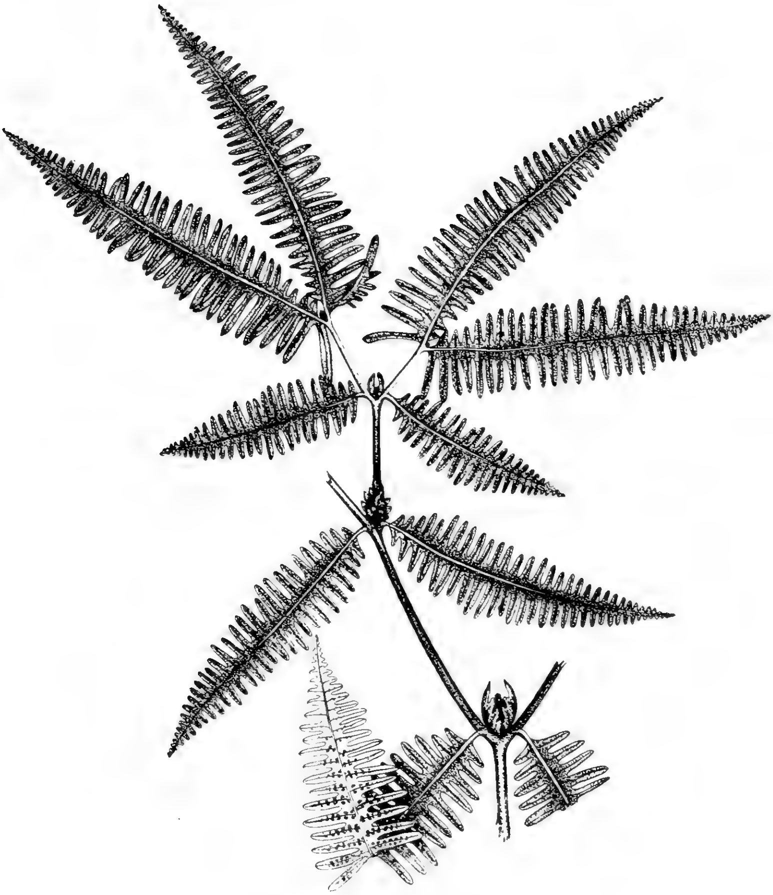

PLATE II. GLEICHENIA LINEARIS (KILóB).

in length. They are gathered, dried, tied into bundles, and in this form are brought to Manila in considerable quantities. From a commercial standpoint *Stenochlaena palustris* is undoubtedly the most important of the ferns in the Philippines, as the stems supply by far the best local material for the special purpose mentioned above. As fishing with traps is a very important local industry, *Stenochlaena* enters into the economic life of the Filipinos to a considerable extent. During the year 1918, forest charges were paid on 156,456 kilos of diliman. This fern is also used for making ropes and occasionally baskets, but it is inferior for the latter purpose.

The young shoots are eaten either raw as a salad or cooked.

Stenochlaena palustris is a coarse, climbing fern of indefinite length. The stems are brown, smooth, somewhat less than 1 centimeter in diameter and sparingly branched. The sterile fronds are up to 80 centimeters in length and pinnate, with pinnae 10 to 12 centimeters long and about 8.5 centimeters wide. The fertile fronds are somewhat shorter than the sterile ones and about 3 millimeters wide. This fern is widely distributed in thickets, usually in swampy places near the sea.

Family GLEICHENIACEAE

Genus GLEICHENIA

GLEICHENIA LINEARIS (Burm.) Clarke. (Plates II, III). KILÓB.

Local names: *Gapingoi* (Benguet); *kilóg, kilób* and *tilúb* (Tagalog).

Splints are prepared by cracking the outer covering of the very long leafstalks and pulling out the ribbon-like vascular bundles. The splints are excellent weavers for coiled baskets and are also used in making belts.

Gleichenia linearis is characterized by very large leaves which fork repeatedly and have a bud-like structure in the forks. This fern is common and widely distributed in the Philippines and frequently forms dense tangles in open places on mountains.

Family SCHIZAEACEAE

Genus LYGODIUM

LYGODIUM spp. (Plate IV). NÍTO.

Local names: The name *níto,* for the different species of *Lygodium,* is reported from the following provinces:—Ilocos Norte and Sur, Cagayan, Isabela, Union, Zambales, Pangasinan, Cavite, Rizal, Laguna, Tayabas, Camarines, Sorsogon, Samar, Occidental and Oriental Negros, Cebu, Capiz, Antique, Iloilo,

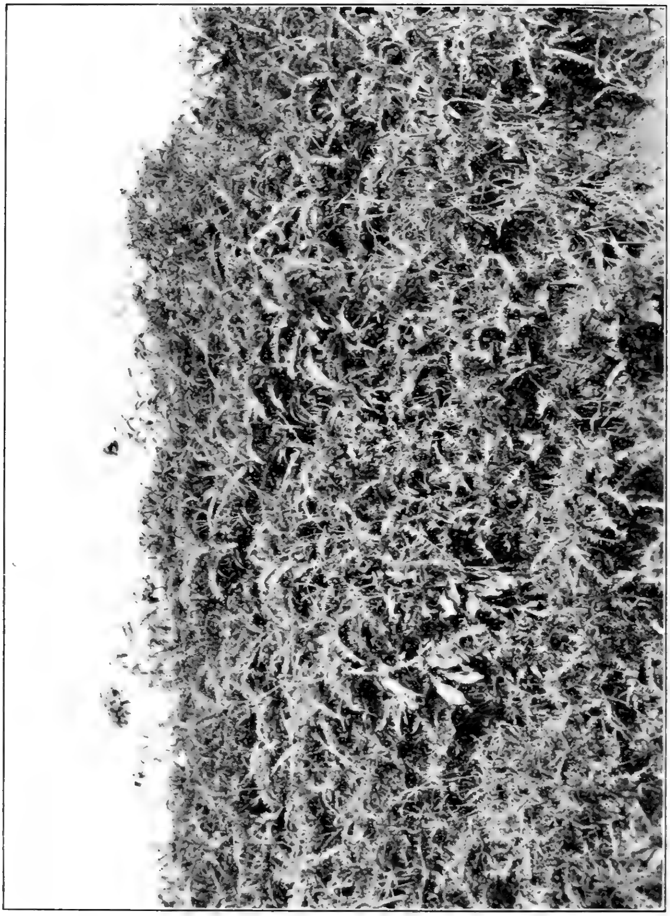

PLATE III. GLEICHENIA LINEARIS (KILóB).

Bohol, Surigao, and Misamis. *Lygodium circinnatum* is also known as *agsám* in Albay, *nítong-putí* in Tayabas and Camarines, and *náui* in parts of Mindanao; *Lygodium flexuosum* as *katák* in Cagayan, *nítong-putí* in Rizal, *níto a dadakkél* (Iloko) in Benguet, *nítu* and *kalulúng* (Ibanak) and *sasítang* (Iloko) in Isabela; *Lygodium japonicum* as *agsám* in Camarines and *karekai* (Ibanak) in Isabela, *kulót* in Cavite, and *nítong-puti* in Rizal, Cavite, and Batangas; *Lygodium scandens* as *agsám* in Camarines, *níto-nitóan* in Laguna and *nítong-párang* in Rizal; and *Lygodium semihastatum* as *antón* in Albay. The commonest and most widely known and used species is *Lygodium circinnatum.*

Splints prepared from *Lygodium* are used in the manufacture of baskets, hats, and fancy boxes. In several provinces, nito splints are combined with buri or some other fiber to make various fancy articles such as cigarette cases or pocketbooks. The effect is very pleasing, particularly when the nito is black.

The species of *Lygodium* are slender, climbing ferns. The climbing portion is the leaf, which is of indefinite growth and length. The genus *Lygodium* is distinguished from all other Philippine ferns by these characteristics of the leaves.

Family GNETACEAE

Genus GNETUM

GNETUM GNEMON L. BÁGO.

Local names: *Bágo, magatungál* (Lanao, Cotabato); *kugitas* (Butuan); *bágo* or *bágu* (Bataan, Tayabas, Camarines); *banágo* (Bisaya); *kuman* (Davao).

The bark of this tree is made into rope. The fruits are edible when cooked, while the young leaves are cooked and eaten as a vegetable.

Gnetum gnemon is a tree reaching a height of about 10 meters. The leaves are opposite, oval, 10 to 20 centimeters in length, and usually pointed at both ends. The fruits are red, ovoid or ellipsoid, and about 2 centimeters long.

GNETUM INDICUM (Lour.) Merr. (*G. latifolium* Bl.).

Local names: *Báging* (Butuan); *biás* (Rizal); *kaliát* (Benguet); *kuliád* (Cagayan); *kuliát* (Pampanga, Bataan, Rizal, Lanao).

The bark is used for tying purposes and for making rope. The vine is also utilized as a source of drinking water in the forest. The fruits are edible when cooked.

Gnetum indicum is a coarse vine. The leaves are large, pointed at the apex, usually rounded at the base, and from 10

PLATE IV. LYGODIUM CIRCINNATUM (NÍTO).

to 22 centimeters in length. The fruits are red, oval in shape, and about 3 centimeters in length. This species is common and widely distributed in the Philippines.

GNETUM sp. KALIÁT.

Local names: *Kadiat* (Itneg); *kaliát* (Iloko).

This species is a small tree with thin, glossy, elongated, pointed leaves. Rope made from the bark had the greatest tensile strength of all the bast ropes tested by King. It was, moreover, exceptionally pliable. In both the dry and wet conditions this bast stood first as regards both tensile strength and breaking length. The bast strips have a rich, brown color, are free from irregularities, and have a rather waxy appearance.

Rope made from *Gnetum* is held in high esteem on account of its great strength, pliability, and lightness, and is considered by the Igorots and Ilocanos to be superior to that made of any other local fiber. King found the rope to have a tensile strength of 773 kilos per square centimeter. Concerning its strength King says:

> *Gnetum* sp. rope is stronger than machine-laid maguey rope made of government grade Cebu No. 2 fiber and in tenacity approaches closely cordage made of the most superior grade of abacá fiber. When wetted for twenty-four hours this bast rope increases 31 per cent in strength and is actually stronger than machine-laid abacá rope made of "F" grade fiber.

Several other species of *Gnetum* are used in making ropes.

Family TYPHACEAE

Genus TYPHA

TYPHA ANGUSTIFOLIA L. (Plate V). CAT-TAIL.

Local names: *Aníbong* (Bontok); *balanggót* (Tagalog); *buhai-búhai* (Negros Occidental); *lampakanai* (Bisaya); *tubol-tuból* (Bikol, Bisaya).

The stems and leaves of the cat-tail are used for tying purposes, while the entire or split culms are utilized for making coarse bags and baskets. The straw is well adapted for making slippers. The stems and leaves are occasionally twisted into coarse ropes which, however, have little tensile strength. The floss from the protruding heads is sometimes used for stuffing pillows.

This species reaches a height of 2 meters. The leaves are long and from 10 to 12 millimeters wide. The spikes are cylindrical; the female ones when mature are brown, 12 to 20 centimeters long, and up to 2 centimeters in diameter. This plant is locally very abundant in low, wet places and shallow, stagnant, fresh water. It is widely distributed in the Philippines.

PLATE V. TYPHA ANGUSTIFOLIA (CAT-TAIL).

Family PANDANACEAE

Genus PANDANUS

PANDANUS spp. THE PANDANS.

The pandans, or screw-pines, are characteristically tropical trees or shrubs, although they may be found in subtropical countries. In the Philippines there are over forty known species. A few are generally distributed in the various islands and are likewise widely distributed in the Indo-Malayan region. Most of the species are, however, of decidedly local occurrence. The Philippine species vary in size from small shrubs less than a meter high to trees 15 or more meters in height, and are always erect and never climbing. They are characterized by a peculiar spiral arrangement of the elongated, spiny leaves. The common English name, screw-pine, refers to the spiral arrangement of the leaves and the pineapple-like fruits of the more common and widely distributed species. The leaves can be readily distinguished from those of the pineapple or maguey by the presence of a middle row of spines in the pandan leaves. The leaves are never thick like those of maguey. Most of the Philippine species have prominent prop roots, and the trunks almost invariably bear small, short, and scattered spines. Pandans occur in such widely separated habitats as along sandy beaches and in virgin forests.

The fresh wood of the pandan is hard; that of some species is durable. The larger stems are used as temporary posts. Pandans are moreover frequently cultivated for ornamental purposes. Their chief value, however, lies in the leaves, which are used for making coarse and fine baskets, bags, coarse and fine hats, mats, etc.

All of the species having long leaves are potential sources of strips that may be used in weaving baskets, mats, and other articles; but there is a great deal of difference in the texture of prepared strips, due to the difference in the thickness and other characteristics of the leaves. Some forms have been found by the Filipinos to be superior for special purposes and thus only a few of the numerous Philippine species are at present utilized.

PANDANUS COPELANDII Merr. BARÍU.

Local names: *Alasás* (Tayabas); *baleau* (Occidental Negros); *baleó, balewe, balíu* (Capiz, Romblon, Bohol, Surigao); *baliku* (Surigao); *baloi, baroi* (Agusan, Surigao); *bareu* (Samar); *baríu, baréu, buruíu* (Albay, Sorsogon); *lagutlút* (Laguna); *pandán* (Cagayan, Zambales, Nueva Ecija); *pangdán* (Benguet, Pangasinan); *pataga* (Ibanag, Apayao subprovince); *sere* (Cagayan).

This species is widely distributed at low and medium altitudes from northern Luzon to southern Mindanao. It reaches a height

PLATE VI. PANDANUS SABOTAN (SABUTÁN).

of from 3 to 9 meters. The leaves are about 2 or 3 meters long and about 5 to 8 centimeters wide. It is claimed that the fibers from this species are tougher than those from *Pandanus radicans*. The leaves are used for making coarse mats and baskets.

PANDANUS DUBIUS Spreng. TABOÁN.

Local names: *Bákong* (Bohol); *taboán* (Surigao).

This is a large pandan found in the southern Philippines. It is used locally for making coarse mats.

PANDANUS LUZONENSIS Merr. ALASÁS.

Local names: *Alasás* (Zambales, Rizal); *dasa* (Rizal); *pandan de China* (Bulacan).

This species is widely distributed in central Luzon. It reaches a height of about 7 meters. It is economically of little value, but the leaves are used for weaving baskets and mats.

PANDANUS RADICANS Blanco. OYAÑGÓ.

Local names: *Olañgó* (Leyte); *owañgó* (Surigao); *oyañgó* (Albay); *uyañgó* (Sorsogon); *wañgó* (Bohol).

This species is apparently widely distributed in the Philippines. It reaches a height of 8 meters, and has long, wide leaves and dark, brick-red fruits. It is used for making coarse mats, bags, and sometimes hats. According to Delgado, in the year 1750, fibers were extracted from the long prop roots and used for weaving a fine cloth; but Blanco, writing in 1837, states that these fibers were no longer utilized. In Mindanao the wood has been found to be excellent for the manufacture of splints used in making baskets; in fact, they are reported to be superior to rattans for this purpose.

PANDANUS SABOTAN Blanco. (Plate VI). SABUTÁN.

Local name: *Sabután* (Laguna, Rizal, Tayabas).

According to Mr. E. D. Merrill, the botanical status of this species is doubtful. It seems probable that it is a cultivated form or variety of the common and widely distributed *Pandanus tectorius*. This plant, from which the sabutan fiber is obtained, is well known and has been cultivated in Laguna province for at least two centuries. It greatly resembles the common *Pandanus tectorius* in appearance, but the fruits have never been collected. The plant is from 2 to 4 meters in height. The leaves resemble those of *Pandanus tectorius,* but are of finer texture. Sabutan is cultivated in and about towns along the eastern and northern shores of Laguna de Bay, in parts of Tayabas province, and on the island of Polillo; but has never been found wild, although it not infrequently occurs where cultivation has been abandoned. It is easily propagated by axillary suckers which grow from the lower parts of the stems.

Fig. 1. Pandanus simplex. (Karagómoi).

Fig. 2. Pandanus tectorius. (Pandan).

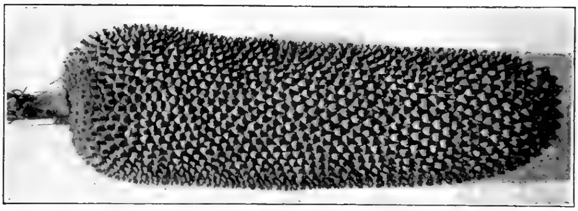

Fig. 3. Pandanus simplex. (Karagómoi).

PLATE VII.

The chief use of this plant is in the production of the fiber used in manufacturing sabutan hats. Hats made of sabutan are strong and durable, and in texture more nearly resemble the Panama hat than any other kind manufactured in the Philippines. The unbleached hats are a light green color, and the chief objection to them is that they do not bleach readily. Good sabutan hats, however, command high prices in the Philippines.

Sleeping mats of excellent quality are made from sabutan fibers either in natural or dyed shades.

PANDANUS SIMPLEX Merr. (Plate VII). KARAGÓMOI.

Local names: *Kalagímai* (Tayabas); *karagómoi* (Tayabas, Camarines, Albay, Catanduanes, Sorsogon, Leyte, Cebu); *pandán* or *pandán-totóo* (Laguna); Luisiana pandan, Cavinti pandan, Majayjay pandan (from towns in Laguna where it is much used); *bangkoáng* (Laguna, Tayabas, hat trade in Manila, mat trade in Camarines and Albay).

This species is found in the provinces of Nueva Vizcaya, Rizal, Laguna, Tayabas, Camarines, Albay, Sorsogon, Leyte, Cebu, and on the islands of Polillo and Catanduanes. It is usually planted in the Banahao region, where it is of great economic importance, and is frequently cultivated in Camarines. The karagomoi variety, of the Bikol provinces, has leaves 6 to 10 centimeters wide and up to 3.5 meters long; the variety cultivated in the Banahao region, the "Majayjay pandan," has leaves up to 20 centimeters wide and 5 meters long.*

The prepared strips of the leaves are very extensively used for making coarse and fine mats, hats, bags, and telescope baskets. They are also used extensively for making fancy articles such as picture frames, wall pockets, hand bags, and fancy slippers.

In preparing the fiber, the spiny margins and the midribs of the leaves are removed and the leaves cut into strips of desired width. The strips are then dried in the sun and allowed to wilt. To make them pliable they are rolled under one end of a heavy log. They are further dried in the sun and are then ready for use.

PANDANUS TECTORIUS Soland. (Plates VII, VIII). COMMON OR BEACH PANDAN.

Local names: *Baroi* (Sorsogon); *pandán* (Pampanga, Tarlac, Rizal, Batangas, Tayabas, Camarines, Albay, Mindoro, Iloilo, Antique, Oriental Negros, Leyte, Cebu, Surigao, Davao, Zamboanga); *pangdán* (Abra, Pangasinan, Camiguin Island); *panglán* (Iloko and Sambali in Zambales); *sabután* (Rizal); *uhañgo* (Batanes Islands).

This species is the commonest and most widely distributed pandan in the Islands. It is abundant along the seashore and

* The "pandan of Majayjay" is described by Muller and Robinson as *Pandanus utilissimus* Elmer: this is a synonym of *P. simplex*.

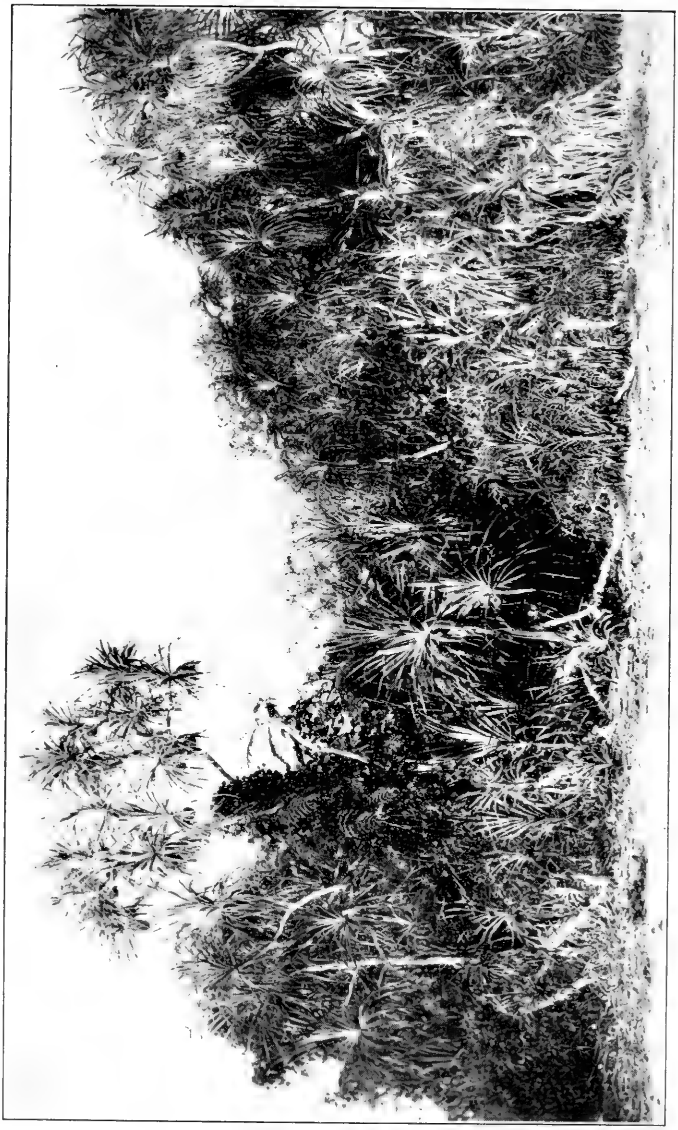

PLATE VIII. PANDANUS TECTORIUS (COMMON PANDAN).

usually forms a stand immediately back of the beach. It is never found very far inland. Under favorable conditions it reaches a height of 5 to 6 meters. The size and length of the leaves vary greatly.

This pandan is of comparatively little economic value. The leaves are split into strips and this material is used, to a limited extent, for making mats or, when bleached, for weaving hats. The longer leaves are sometimes utilized for weaving coarse, temporary baskets. Material from a form of this species is extensively used in Formosa and Liukiu for making imitation Panama hats.

The lower part of the mature fruit is covered by a yellowish-red pulp. This is rarely eaten, although its flavor is excellent.

Family GRAMINEAE

Genus ANDROPOGON

ANDROPOGON HALEPENSIS var. **PROPINQUUS** (Kunth) Merr. BATAD-BATÁRAN.

Local names: *Aróro* (Camarines); *batád* (Bukidnon); *batád-batáran* (Tagalog); *uginai* (Bukidnon).

The stalks of this grass are split into strips and occasionally utilized in making hats.

Andropogon halepensis is a coarse, perennial grass reaching a height of 3 meters. It has stout, cylindrical, solid stems, broad leaves, and open panicles.

This species is found in thickets and open, damp places, and is common and widely distributed in the Philippines.

ANDROPOGON ZIZANIOIDES (L.) Urb. MORAS or VETIVER.

Local names: *Amóra* (Cebu); *amóras* (Ilocos Norte); *anias* or *anias de móras* (Pampanga); *anis de móro* (Ilocos Sur, Abra, Pangasinan); *geron, giron* (Iloilo); *ilíb* (Pampanga); *móra* or *móras* (Pampanga, Tarlac, Rizal, Manila, Laguna, Camarines, Albay, Sorsogon, Antique, Cebu, Occidental Negros); *rimódas* (Capiz); *rimóra* (Zambales); *rimóras* (Camarines); *tres móras* (Capiz).

The roots are used for weaving fans which are prized on account of their agreeable odor. For this purpose the roots are prepared by dipping them in water for about 20 minutes and then pounding them with a light, wooden club to remove the outer portion. They are then pressed and woven into fans. These are sometimes sold in oriental curio shops in America as "sandal-root" fans.

The stalks are used in making hats. For this purpose flower stalks of suitable size are selected, and the inflorescence and outer covering removed. They are then put in boiling water for about twenty minutes, after which they are dried in the sun for two or three days. The stalks are then scraped with a sharp knife until smooth and clean. Brooms are also occasionally made from the stalks. The leaves are sometimes used for thatching.

Vetiver oil is obtained from this grass.

Andropogon zizanioides is a coarse, tufted grass 1 to 2 meters in height. It is commonly planted on the dikes of rice fields and is frequently abundant in uncultivated rice lands, especially in low, damp soil. It is sometimes planted on river banks to prevent erosion.

This species is widely distributed in the settled areas of the Archipelago.

Genus APLUDA

APLUDA MUTICA L. — KURUKAUÁYAN.

Local names: *Kauakauáyan* (Rizal); *kolokauáyan* (Laguna); *kurukauáyan* (Camarines); *magkauáyan* (Bohol); *maykauáyan* (Samar).

The stalks of this grass are occasionally utilized for making hats, but such hats never or seldom enter even the local trade.

Apluda mutica is a tall, erect or half climbing, somewhat slender grass 1 to 2 meters in height. The stems are smooth, branched, and solid. The leaves are 10 to 30 centimeters long, 5 to 10 centimeters wide, pointed at the apex and with a narrow base. The spikes are about 8 millimeters long and green or purplish.

This grass is widely distributed in the Philippines in thickets.

Genus COIX

COIX LACHRYMA-JOBI L. — TIGBÍ OR JOB'S TEARS.

Local names: *Abúkai* (Palaui Island); *adlái* (Bicol); *agagai* (Batanes Islands); *aglái* (Misamis); *apagi* (Lepanto); *attakai* (Bontoc); *balantakan* (Pampanga); *bintikái, burubayokó* (Bikol); *dumau* (Cebu); *kalabugau* (Bukidnon); *kambót* (Abra); *katigbí* (Bohol); *koldásan* (Bikol); *kudlásan* (Polillo, Balabac Island); *paliás* (Mindoro); *puyás, lamudiás* or *alimudiás* (Negros Occidental); *pintaká* (Bikol, Bisaya); *tigbí* (Samar, Bukidnon, Camarines, Laguna, Manila, Rizal, Batangas, Bontoc); *tigbikai* (Bikol).

The chief value of this coarse grass is in the hard fruits. These are gathered and strung as beads, sometimes used as rosaries, sometimes in making bead curtains, or on various kinds of ornamental baskets, trays, etc.

This species is widely distributed in the settled areas of the Philippines. It is probably not a native of the Archipelago, but of prehistoric introduction.

Genus ELEUSINE

ELEUSINE INDICA Gaertn. PALAGTIKI OF YARD GRASS.

Local names: *Balili* (Bontoc); *baráñgan* (Camarines); *bilabila* (Laguna); *damo* (Cagayan); *gagabútan* (Tagalog); *kabit-kabit* (Bataan); *palagtiki* (Bisaya); *parañgis-sabúñgan* (Pampanga); *sabung-sabúñgan* (Pampanga).

This grass is apparently introduced in the Philippines, but is widely distributed, and especially abundant in and about towns and along roads and trails throughout the settled areas. The culms are sometimes used in making hats, but this industry is very local and irregular.

Eleusine indica is a rather stout, tufted, erect, smooth, annual grass 10 centimeters to 1 meter in height. The leaves are 10 to 30 centimeters long and 3 to 7 millimeters wide. The flowering stalk has three to six spikes, 2.5 to 10 centimeters long, 3 to 5 millimeters thick, and all occurring in a terminal whorl, or one or two somewhat lower down on the stem.

This species is distributed throughout the Philippines and is very common in waste places, along roads, etc.

Genus IMPERATA

IMPERATA EXALTATA Brongn. KÓGON.

A description of this species is given in the section on paper pulp.

The leaves of this grass are extensively used for thatching in all of the interior parts of the Archipelago, where it is difficult to transport nipa shingles.

The tender shoots of kogon are used for grazing, and kogon areas are frequently burned over so that the young shoots may be utilized for this purpose.

Kogon stems are used locally to a limited extent in the manufacture of hats, while some of the industrial schools have utilized the plant for making round, braided mats suitable for bathroom use.

Genus ISCHAEMUM

ISCHAEMUM ANGUSTIFOLIUM Hack. (Plate IX). KOBBÓOT.

Local names: *Danu, pueng, puenig* (Bontoc); *kobbóot* (Iloko).

In the parts of Luzon where this grass grows it is utilized for making rope, on account of its tensile strength. Owing to its durable qualities it is also used for making both the soles and uppers of grass slippers. The straw is prepared by simply drying it in the sun.

This grass varies in height from 0.6 to 1 meter. It is tufted and the swollen bases of the stems are densely woolly. *Ischae-*

PLATE IX. ISCHAEMUM ANGUSTIFOLIUM (KOBB6OT).

mum angustifolium is widely distributed in northern Luzon, growing on open slopes, but it is not known from other parts of the Philippines.

Genus MISCANTHUS

MISCANTHUS SINENSIS Anders. BIGÁO.

Local names: *Biau* (Batanes Islands); *bigáo, bigáho, gáho, gísa* (Bikol); *bi-idu* (Benguet); *rúno* (Igorot); *taláhib* (Zambales).

This coarse grass is used for thatching houses. The stems are used like wattles for making side walls of houses and sometimes even for covering the floors. In Sorsogon, splints made from the stems are used in making screens and window shades. The stems are sometimes employed for making shafts of arrows.

Miscanthus sinensis is a coarse, erect, gregarious grass 1 to 3 meters in height. It occurs in abundance at medium and high altitudes, especially in the Mountain Province of Luzon. When repeated fires have occurred this grass frequently occupies an area to the almost entire exclusion of other vegetation, just as *Imperata exalta* (kogon) and *Saccharum spontaneum* (talahib) do at lower elevations.

Genus ORYZA

ORYZA SATIVA L. RICE.

Rice straw is used in Ilocano districts for making hats for home use, and in schools in Ilocos Norte for the upper soles of slippers. Sometimes rice straws are tied into bundles and are used as brooms for rough housework.

Genus PHRAGMITES

PHRAGMITES KARKA (Retz) Trin. LUPÍ.

Local names: *Lupí* (Camarines); *sabunóg* (Negros Occidental); *tanúbong* (Bontoc Subprovince).

This species is larger and rarer than *Phragmites vulgaris* and apparently is used for the same purposes.

PHRAGMITES VULGARIS Trin. (Plates X, XI). TAMBÓ.

Local names: *Bagang, tabúnak, tangbó* (Bisaya); *lupí* (Bikol); *tambó* (Tagalog, Bisaya, Bikol); *tagísi* (Ibanag); *tambú* (Bulacan, Rizal, Manila vicinity, Batangas); *tanóbong* (Pangasinan).

The chief use of this grass appears to be in the manufacture of a peculiar type of dust broom used for sweeping highly polished floors. The panicles arranged in a fan-like manner form the broom, while the culms tightly bound to a central strengthening piece of bamboo form the handle. These brooms are of great utility and are extensively used in the Philippines. The best grade of *Phragmites* broom is manufactured from the

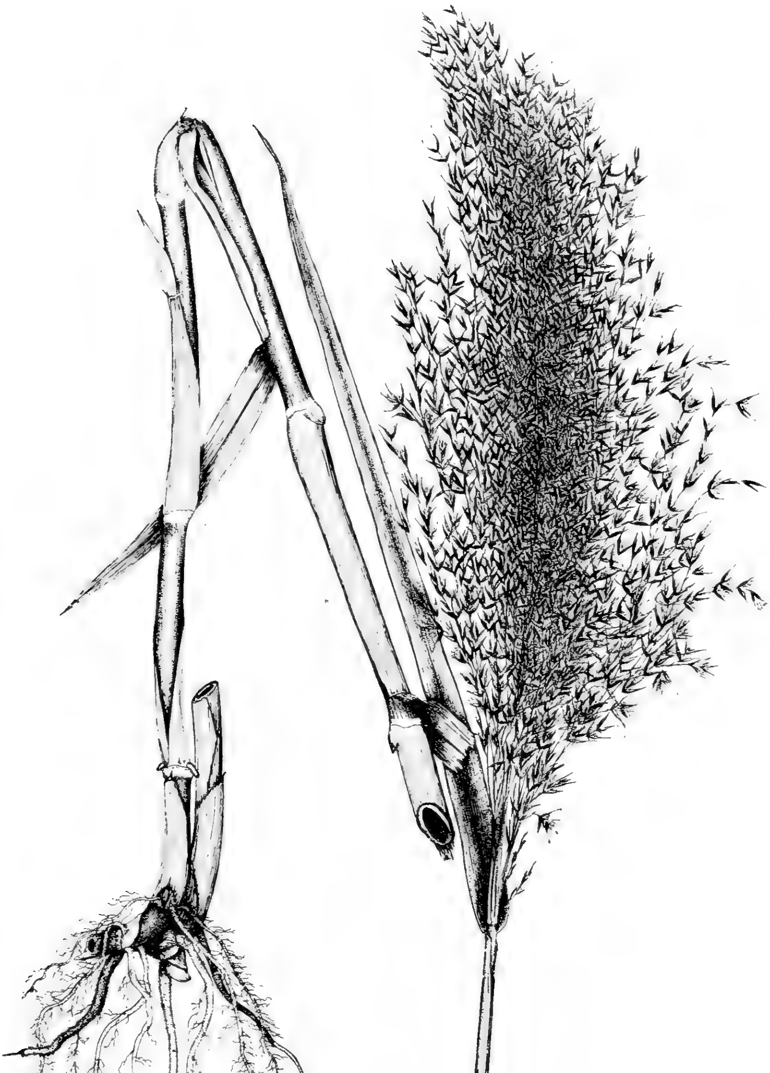

PLATE X. PHRAGMITES VULGARIS (TAMBÓ).

very young panicles, gathered before the flowering glumes have developed. Better grades are made from *Thysanolaena* panicles.

In some of the islands the stems are used in manufacturing coarse hats.

Phragmites vulgaris is a coarse, erect grass attaining a height of at least 3 meters. The stems are cylindrical and hollow. It is locally very abundant in shallow swamps and along muddy streams; and is often gregarious, occupying considerable areas to the exclusion of other vegetation. It is widely distributed in the Philippines at low and medium altitudes.

Genus SACCHARUM

SACCHARUM OFFICINARUM L. SUGAR CANE.

The flowering stalks of the sugar cane are sometimes used for making picture frames.

SACCHARUM SPONTANEUM L. TALÁHIB.

Local names: *Bugáng, tigbáo* (Bisaya); *sikál* (Isabela); *sidda* (Iloko); *taláhib* (Tagalog, Bikol).

From an economic standpoint this plant ranks very low. The very young shoots are grazed by domestic animals, but the mature plant is too hard and harsh for forage. In some regions the culms are used for shafts of arrows, while they are very frequently utilized for making temporary fences, and for wings or runs to fish weirs. In some provinces they are used as wattles for making house walls. The stalks, entire or split, have been utilized by some schools in industrial work for making brooms, hats, screens, picture frames, and wall pockets. The panicles are occasionally utilized for stuffing pillows. As superior material for all the above purposes is usually to be had in the Philippines, most of the uses for this coarse grass here indicated are apparently very limited and very local.

A description of this plant is given in the section on paper pulp.

Genus SPOROBOLUS

SPOROBOLUS ELONGATUS R. Br. BAKUÍT.

Local names: *Bakuít, bangkuít* (Iloilo); *sangsan͠gítan* (Bontoc).

A fairly fine straw of medium length is obtained from the flower stalks and utilized at times in Iloilo as a hat material.

Sporobolus elongatus is a grass with slender stems, numerous, rather long and narrow leaves, and long narrow panicles. It reaches a height of 1 meter, but is usually shorter. This species is distributed from northern Luzon to southern Mindanao, but is most abundant in the Mountain Province.

PLATE XI. PHRAGMITES VULGARIS (TAMBÓ).

SPOROBOLUS INDICUS R. Br.

The tough culms of this grass are used in Panay for the manufacture of hats.

Sporobolus indicus is usually a rather densely tufted, perennial, slender, wiry grass with erect, branched stems, 1 meter or less in height. The leaves are 10 to 20 centimeters long, and flat; when dry, rolled up lengthwise. The panicles are slender, erect or somewhat nodding, and 10 to 35 centimeters in length.

This species is widely distributed in the Philippines in waste places, along roadsides, etc.

Genus THYSANOLAENA

THYSANOLAENA MAXIMA Kuntze. (Plate XII). LÁSA or TIGER GRASS.

Local names: *Bugúbi, bugúbui* (Pampanga); *buibúi* (Iloko, Bontoc); *gatbó* (Camarines); *lása* (Tagalog); *tagádeu* (Bontoc); *tagisa* (Misamis); *tambú* (Bulacan, Rizal, Mindoro).

In the Philippines a very characteristic, light dust broom is made of the panicles of several of the coarser grasses, notably *Thysanolaena* and *Phragmites*. These brooms are extensively used for sweeping the highly polished hardwood floors so characteristic of the better houses in the Philippines. *Thysanolaena* panicles make the best grade of these brooms, and for this purpose they are gathered extensively in some parts of the Islands. The handles of the brooms are made of the flowering stems variously interwoven or bound together, the panicles being arranged in a fan-like fashion to form the broom itself. The brooms are decidedly pretty and very effective for their special purpose. *Thysanolaena* brooms are more durable than those made from *Phragmites* and command a higher price.

Thysanolaena maxima is widely distributed in Luzon, but is of local occurrence, especially at low and medium altitudes. At higher altitudes it is much more abundant, and in the pine region of the Mountain Province it is one of the characteristic, coarse grasses of ravines. It is distinguished by its ample, open panicle and its very numerous, minute spikelets.

Family CYPERACEAE

Genus CYPERUS

CYPERUS MALACCENSIS Lam. (Plates XIII, XIV). BALANGGÓT.

Local names: *Bagá-as* (Bisaya); *balanggót* (Tagalog, Bisaya); *balonggát* (Pampanga); *baranggót* (Camarines); *tíkog* (Agusan).

The stems of this sedge are used for tying purposes, for making coarse hats, slippers, mats, and perhaps for baskets. For coarse work the entire stem is employed, but for the finer

PLATE XII. THYSANOLAENA MAXIMA (LÁSA OR TIGER GRASS).

grades the stems are split. The splitting is done when the stems are fresh or, at least, before they become dry. Mats made from balanggót are very attractive. The manufacture of slippers of this material is carried on to a considerable extent in some towns of Bulacan Province, Luzon.

Cyperus malaccensis is a rather coarse, usually gregarious, perennial sedge reaching a height of from 0.5 to 1.5 meters. The stems are leafless and sharply three-angled, almost three-winged near the top. This sedge occurs in brackish swamps, along tidal streams, bordering nipa areas, and is often abundant back of the mangrove swamps when this area is not wooded. In some regions it is very plentiful.

CYPERUS RADIATUS Vahl. ALÍNANG.

Local names: *Alínang* (Bikol, Bisaya); *balabalanggútan* (Tagalog); *bal-laayang* (Union); *dagkó, óbod-óbod* (Bisaya); *upópi* (Cagayan).

In some parts of the Philippines the outer portions of the stems are stripped, dried in the shade, and used for weaving mats, mattings, and screens. This utilization is apparently local.

Cyperus radiatus is a coarse sedge 0.2 to 1 meter in height. The leaves are one-half to two-thirds as long as the stems and 7 millimeters or less in width. The inflorescence is subtended by long, leaf-like bracts. It is widely distributed in the settled areas of the Philippines at low altitudes, and occurs in shallow swamps and open wet places.

Genus FIMBRISTYLIS

FIMBRISTYLIS DIPHYLLA Vahl. TABTÁBIN.

Local names: *Muthá* (Manila); *pauai* (Benguet); *tabtábin* (Zambales); *tayok-tayók* (Zambales, Panay, Occidental Negros).

The stems of this species are used for much the same purposes as those of *Fimbristylis globulosa,* but are inferior to them. The material is prepared by drying in the sun.

Fimbristylis diphylla is a small, slender sedge growing in wet situations. The leaves are slender and grow in considerable numbers from the base of the stem.

This species is found throughout the settled areas of the Philippines and is the commonest representative of the genus.

FIMBRISTYLIS GLOBULOSA Kunth (Plate XV). TÍKUG.

Local names: *Anahíuan, táyok-táyok, tíkog, tíkug, pilokong* (Bisaya); *badang-badáng* (Ilocos Norte); *mutá* (Pampanga); *pakupakúan* (Bulacan); *sud-súd* (Moro).

This is apparently the most important matting sedge in the Philippines. It is extensively utilized in the Bisaya Islands

PLATE XIII. CYPERUS MALACCENSIS (BALANGGöT).

PLATE XIV. CYPERUS MALACCENSIS (BALANGGÓT).

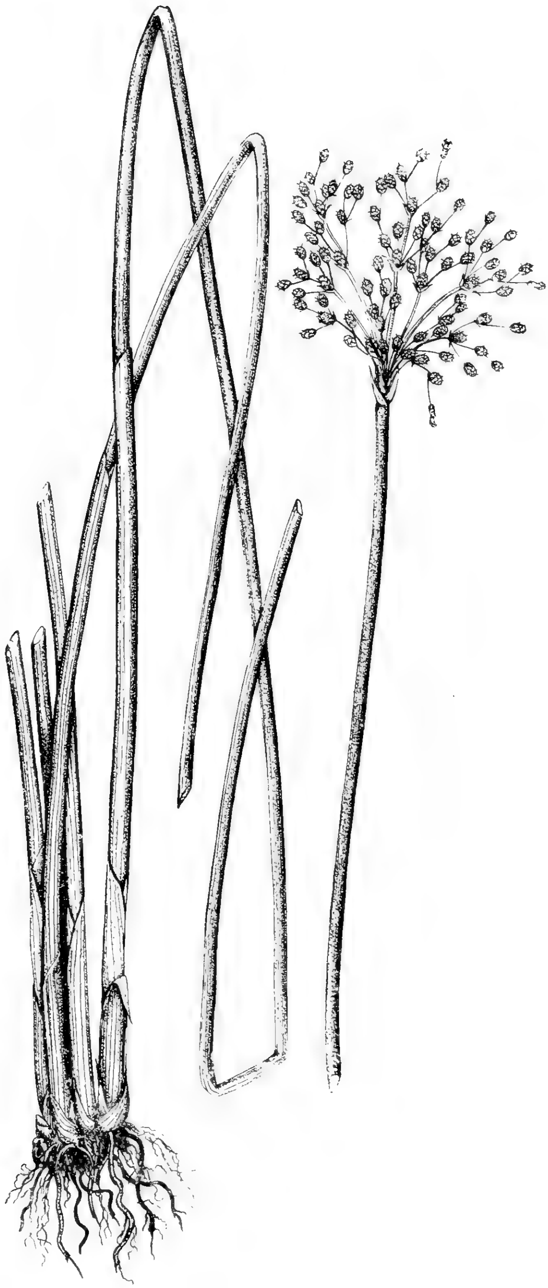

PLATE XV. FIMBRISTYLIS GLOBULOSA (TÍKUG).

for the manufacture of sleeping mats, floor mats, and to a less extent for hats, slippers, tobacco cases, cushions, etc. The stems are used either whole or split. After being gathered they are bleached for several days by spreading in the sun. They cannot be woven when too dry as they are then brittle.

Fimbristylis globulosa is widely distributed in the Philippines and although of somewhat local occurrence, is frequently found in great abundance. It occurs at low altitudes in the settled areas, and grows in low, wet, swampy places and in rice lands. In favorable habitats it is said to attain sometimes a height of 3 meters, but is usually less than half this height. This species is much more common in the central and southern Philippines than in Luzon. It is claimed that when once established in rice lands, it is difficult to eradicate; but in spite of this it would seem that, in some places, its cultivation would be justified as a source of material for mats.

Genus RHYNCHOSPORA

RHYNCHOSPORA CORYMBOSA (L.) Britt. RAGÍU.

Local names: *Agás* (Bisaya, Bikol); *báriu-báriu, ragiu-díu, ragíu, rakído, píso-píso* (Bikol).

In the provinces of southern Luzon this sedge is utilized to some extent in the manufacture of mats, sandals, baskets, and screens. The stems are used either whole or split. From an economic standpoint this plant is probably of little value.

Rhynchospora corymbosa is a coarse sedge, about 1 meter in height. The stems are distinctly triangular and the leaves broad and long. This species is widely distributed in open, wet places at low and medium altitudes.

Genus SCIRPIODENDRON

SCIRPIODENDRON GHAERI (Gaertn.) Merr. GÁAS.

Local name: *Gáas* (Bisaya).

In Leyte the leaves of this sedge are used to some extent in making hats, but the material is apparently of inferior quality.

Scirpiodendron ghaeri is the largest and coarsest sedge in the Philippines, greatly resembling a narrow-leaved pandan in appearance. The leaves are from 1 to 4 meters in length and very numerous. The edges are armed with numerous short spines. The fruits are distinctly ridged, over a centimeter in length, and borne in compact clusters subtended by large leaf-like bracts. The plant is gregarious and often found in large quantities in open ravines, along small streams, in swamps at low altitudes, and sometimes around the borders of lakes.

Genus SCIRPUS

SCIRPUS GROSSUS L. f. TÍKIU.

Local names: *Agás, bangkuáng* (Bikol); *baga-ás, báki-báki* (Bisaya); *ragiudíu* (Camarines); *tíkug* (Agusan); *tíkiu, títiu* (Tagalog).

The whole stems of this sedge are used to a slight extent in making thick sleeping mats, and the split stems for making fine mats. The stems are also used for making special types of bags or baskets.

Scirpus grossus is one of the coarsest sedges found in the Philippines. It has triangular stems up to 2 meters in height. The large inflorescences are subtended by broad leaflike bracts up to 60 centimeters in length. This species is abundant in open swamps at low altitudes, and is widely distributed in the Philippines.

SCIRPUS LACUSTRIS Linn. TÍKER.

Local name: *Tíker* (Iloko).

This species occurs in northern Luzon, where it is utilized for weaving mats. In Formosa it is said to be cultivated for this purpose.

Scirpus lacustris grows in swamps, and in the shallow ponds of the Ilocos provinces and Cagayan. The rounded stems are a meter or more in height.

This species has been reported only from northern Luzon.

Family ARACEAE

In the Philippines, as in other tropical countries, there are many monocotyledonous vines which climb up in the trees and send down aërial roots, which may stretch from the tops of tall trees to the ground. These air roots are frequently very stout and in their natural state are used for tying purposes, or are variously prepared and used industrially. In the Philippines, the air roots used are chiefly those of aroids. Woodsmen have undoubtedly used air roots for tying purposes for ages, but it has remained for the public schools to show that they are useful for industrial purposes. They are employed chiefly in the manufacture of baskets. They were first tried for baskets in the schools of the Bikol peninsula, and the Bikol name "amlong" has come into general school use.

The only part of the roots used in making baskets is the inner part or central cylinder. This cylinder should be removed from the surrounding tissue immediately after collection, as it is then easier to pull out. This, moreover, obviates the necessity of carrying superfluous tissue. The central cylinder furnishes a strong, round, pliable material with a uniform diameter. It is used either entire or split. Amlong is white, brown, or black, depending on the species from which it is obtained. Brown and black amlong can be bleached by treating with a solution of sodium peroxide.

Genus EPIPREMNUM

EPIPREMNUM spp.

This genus is very similar to *Raphidophora* in appearance and in the situations in which it grows. Material secured from the air roots is used for weaving baskets. It is apparently mostly white.

Epipremnum is distributed from Luzon to Mindanao.

Genus POTHOIDIUM

POTHOIDIUM LOBBIANUM Schott. BALONGKAHÍNAI.

Local names: *Ariman* (Cagayan); *balongkahínai* (Negros Occidental); *baralta* (Cavite, Rizal, Batangas); *magutapílak* (Butuan); *malagayáman* (Zambales).

This species is used as tying material for fish corrals. It is collected in considerable quantities in Negros and some of it reaches the Iloilo market.

Pothoidium lobbianum is very similar in appearance to *Pothos*, and grows in similar situations. It can be distinguished from *Pothos* by the fact that the inflorescences are compound, while those of *Pothos* are simple.

This species is apparently common and widely distributed in the Philippines.

Genus POTHOS

POTHOS spp. (Plate XVI).

Local names: *Bagi*; *malagayáman* (Tayabas); *bagu-balának* (Samar); *mala-ang lako lakop* (Samar); *palipe* (Camarines); *tibátib* (Bulacan); *uarat-uarat* (Camarines).

The different species of *Pothos* are vines which climb up the trunks of trees and produce numerous, long, tough, aërial roots which are uniform in diameter and frequently straight. The central cylinders of these aërial roots are extensively used in the Philippines in making coiled baskets. The color varies from white to brown or even black, depending on the species.

This genus is characterized by its peculiar leaves; the petioles being, for the most part, leaflike. In some species they are broader and longer than the blades and in others smaller than the blades. The joint between the blade and petiole is, however, always very evident.

Pothos is distributed in forests throughout the Philippines.

PLATE XVI. POTHOS RUMPHII.

Genus RAPHIDOPHORA

RAPHIDOPHORA spp. (Plates XVII, XVIII).

The central cylinders of the long aërial roots of *Raphidophora* are used in making coiled baskets. They are also utilized in some places for making hammocks and cradles, and for tying purposes.

The species of the genus *Raphidophora* are stout, fleshy vines, which climb by means of numerous aërial roots. The leaves of old plants are very large and pinnately lobed. The inflorescence is a stout, club-shaped structure.

Genus SCINDAPSUS

SCINDAPSUS spp.

Local names: *Loomoi* (Tayabas); *maragayáman* (Pangasinan); *puto-putóhan* (Laguna).

These plants produce air roots like those of *Raphidophora* and *Pothos.* They are used in making baskets.

Family FLAGELLARIACEAE

Genus FLAGELLARIA

FLAGELLARIA INDICA Linn. (Plate XIX). BALING-UÁI.

Local names: *Annuad* (Union); *auai* (Batanes Islands); *auái si gayáng* (Isinai in Nueva Vizcaya); *baling̃uái* (Laguna, Pampanga, Bataan, Nueva Ecija, Rizal, Tayabas, Polillo, Batangas, Mindoro, Basilan); *boboáya* (Agusan); *bulakáui* (Mindoro, Cebu); *hoág* (Camarines, Albay, Sorsogon, Iloilo, Capiz, Antique, Cebu, Agusan); *hoag-uái* (Sorsogon); *inuád, inuál* (Pangasinan); *kaliuáuai, tewung* (Ibanag in Isabela); *kaluuáiuai* (Cagayan); *uái ti uák* (Iloko in Isabela); *paua, tauá* (Negros Occidental); *sagakap* (Capiz); *ué na gayáng, anuad* (Iloko in Nueva Vizcaya); *uág* (Camarines, Butuan, Zamboanga); *uóg* (Culion).

The split stems of this vine are used for tying purposes, as in sewing nipa shingles and tying them in place, or for tying fences. They are also used for baskets where better material is not available.

Flagellaria indica is a slender vine with alternate leaves, the bases of which surround the stem. The leaves are slender and terminate in a curled tendril. The flowers are borne in rather large clusters at the ends of branches. The fruits are rounded, white, and about 5 millimeters in diameter.

This species is very common and widely distributed in the Philippines.

Family BROMELIACEAE

Genus ANANAS

ANANAS COMOSUS (Linn.) Merr. PINEAPPLE.

The pineapple was introduced into the Philippines by the Spaniards at an early date, and is now widely cultivated

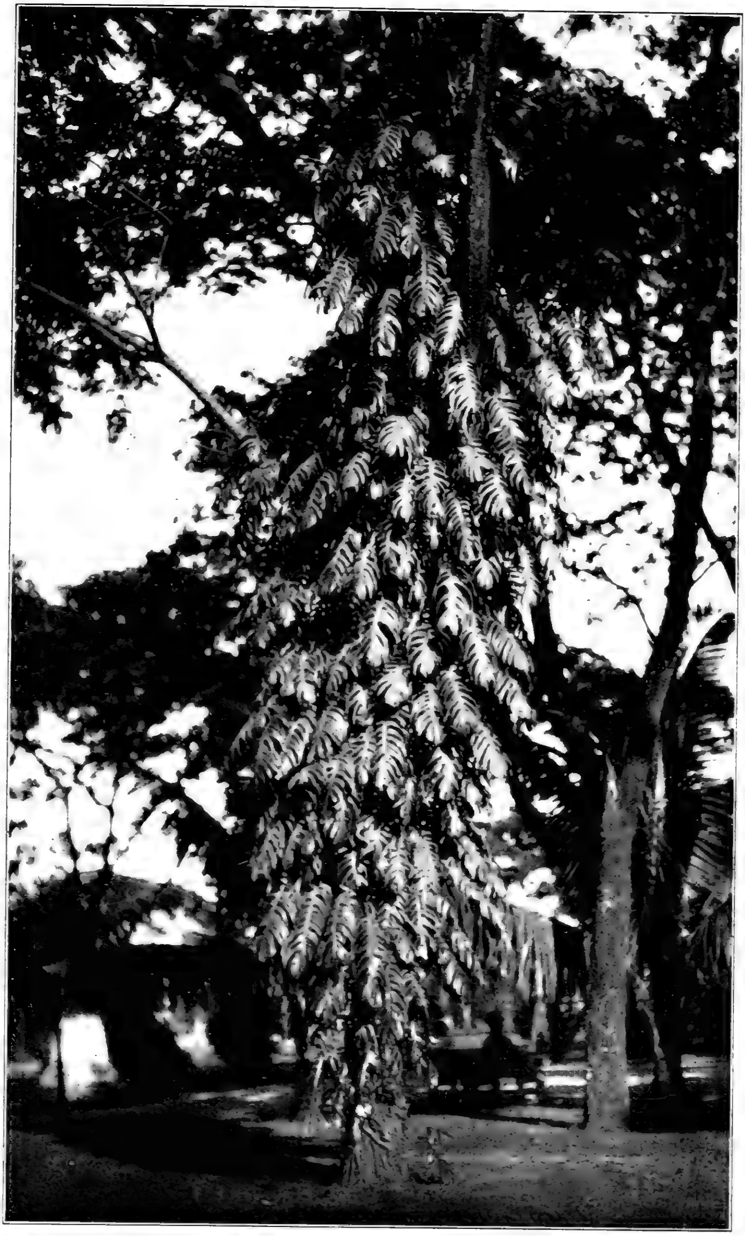

PLATE XVII. RAPHIDOPHORA MERRILLII.

PLATE XVIII. RAPHIDOPHORA MERRILLII.

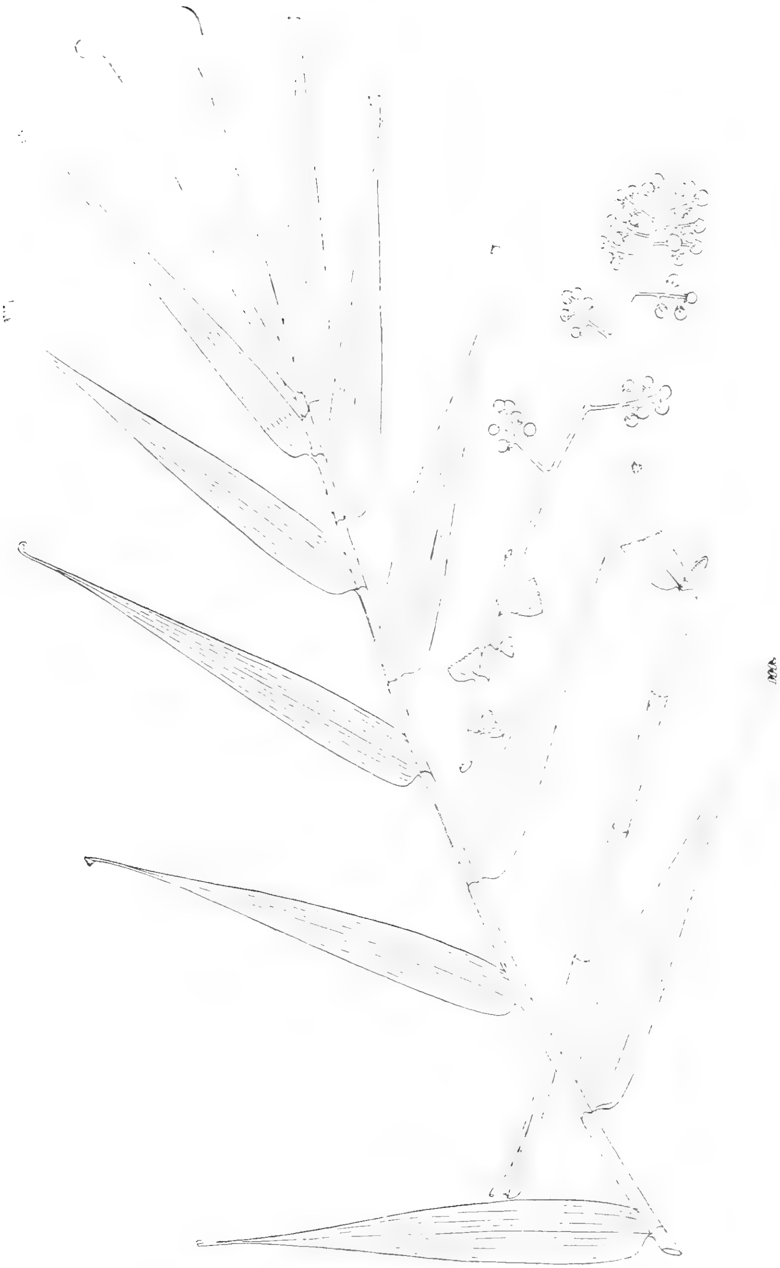

PLATE XIX. FLAGELLARIA INDICA (BALIÑG-UÁI).

throughout the Archipelago. In some islands, particularly in parts of Palawan, it has become thoroughly naturalized. In the Philippines a very fine and highly prized cloth, known as piña, is made from the fibers of the pineapple leaves. The production of the fiber and the manufacture of the cloth is chiefly confined to the island of Panay, the center of the industry being the towns in the vicinity of Iloilo. When grown for fibers, pineapples are closely crowded in planting, the object being the production of long leaves. Piña cloth, either plain or embroidered, is exported in considerable quantities.

Family JUNCACEAE

Genus JUNCUS

JUNCUS EFFUSUS L. (Plate XX). PINGGÓT or MATTING RUSH.

Local name: *Pinggót* (Bontoc).

According to Muller *, experiments conducted at Baguio showed that a fine straw could be prepared from the coarse stalks. This is done by splitting them, removing the pulp, and drying the straws quickly in the sun so as to make them curl up. Flat straws can be prepared by removing the pulp, flattening the stalks, and drawing them between the thumb and a piece of wood.

Juncus effusus has round stalks a meter or more in length. The base of the stalk is surrounded by short sheathing leaves. The seeds are small and yellow and occur in brownish capsules, which ultimately divide into three parts.

This species is found growing in marshes on the mountains from Luzon to Mindanao.

Family LILIACEAE

Genus SANSEVIERIA

SANSEVIERIA ZEYLANICA (L.) Willd. SINAWÁ.

Local names: *Aspe-áspe* (Pampanga); *banyát, kaliót, sígre* (Nueva Vizcaya); *buntút-palos* (Tayabas); *kakarohai, pakarohai, tigi* (Isabela); *lengua de león* (Sorsogon); *rabo de león* (Ilocos Norte, Union); *rabo de tigre* (Antique); *sabilá* (Iloilo); *sinawá* (Nueva Ecija); *tigre* (Laguna, Bohol).

The fiber of this plant is used only occasionally in the Philippines. It is sometimes mixed with piña in weaving fabrics. The fiber is very strong and, according to Dodge †, is used by

* Muller, T., Industrial fiber plants of the Philippines. Bureau of Education Bulletin Number 49 (1913), page 60.

† Dodge, C. R., A descriptive catalogue of useful fiber plants of the world. U. S. Department of Agriculture. Fiber investigations. Report No. 9 (1897), page 290.

PLATE XX. JUNCUS EFFUSUS (PINGGóT).

the Singhalese for making string, rope, mats, and a coarse kind of cloth. It is generally prepared by retting, or by simply beating and washing.

Sansevieria zeylanica is an herb with erect, fleshy, flat, pointed leaves which are mottled with gray, and are .4 to 1.5 meters in height. The flowering shoot is up to 80 centimeters in height. It bears numerous, pale, straw-colored flowers which are usually tinged with green, and are from 2.5 to 3 centimeters in length.

This species is widely distributed in the Philippines. It is frequently cultivated for ornamental purposes, and is occasionally half wild.

Family AMARYLLIDACEAE

Genus AGAVE

AGAVE CANTALA Roxb. MAGUEY.

This species was introduced into the Philippines by the Spaniards at an early date. In the Philippines, maguey is most extensively grown in the Ilocano provinces, Luzon, and the island of Cebu. Most of the plantations are on a small scale, and modern methods of cultivation are scarcely used. The fiber is, for the most part, extracted by retting the leaves, usually in salt water, which unfortunately detracts from its value. A considerable amount is, however, exported. The chief use of the fiber is in the manufacture of binder twine, rope, etc. In the Philippines it is used locally for textiles, cordage, for making fish nets, hammocks, slippers, and some types of baskets.

AGAVE SISALANA Perrine. SISAL.

This species is very similar to the maguey plant and in the Philippines is usually confused with it. It was not introduced into the Philippines until about 1905, but is now widely distributed. Its culture, treatment, and fiber are generally similar to that of *Agave cantala*. The fiber is, however, much more valuable than that of *Agave cantala*.

Genus CURCULIGO

CURCULIGO RECURVATA Dryand. ABANG-ÁBANG.

The hill people of Camarines use the fiber of this species for making false hair. According to Heyne * several species of this genus are reported to give a tough fiber which is used by Dyaks for cordage, and in Borneo for sacking and clothing.

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* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 1, page 187.

PLATE XXI. MUSA TEXTILIS (MANILA HEMP OR ABAKÁ).

Curculigo recurvata is an herb with a few, rather narrow, long, longitudinally folded, boat-shaped leaves growing from the base of the plant. The flowers are yellow and in dense heads.

This species is distributed from the Batanes Islands to Mindanao. It is common in the Mountain Province of Luzon.

Family MUSACEAE

Genus MUSA

MUSA PARADISIACA L. BANANA.

Fibers from the sheathing leafstalks of the banana are employed in the manufacture of a light, transparent cloth known locally as sinamay. In a few regions, this is the principal material from which are made the waists of the native dress of the Filipino women. It is also used extensively in making shirts for men. But wherever abaka is abundant it takes the place of banana fiber for the above purposes, the finer and coarser fibers being sorted by hand into as many as five grades for different textiles.

MUSA TEXTILIS Née. (Plate XXI). MANILA HEMP OR ABAKÁ.

Musa textilis is probably the most important cultivated plant endemic in the Philippines. It produces the premier cordage fiber of the world. In appearance it is almost identical with the banana, to which it is closely related. The fiber was known to the Filipinos long before the Spanish occupation. When Magellan arrived at Cebu the weaving of the fiber was widespread in the Islands, and the plant is reported to have been wild in much the same places as those in which it is now cultivated. At the present time, cultivation is carried on to such an extent that it is questionable as to whether there are any wild plants. Miller * has given a concise history of the abaká industry.

The commercial fibers are the fibro-vascular strands of the sheathing leafstalks that make up the so-called trunk of the abaká plant. In stripping the fiber the trunk is cut down, the leaves removed, and the fiber-producing portion slit into strips. These are pulled under a knife applied to a piece of smooth hard wood. The extracted fibers are then hung up and dried. The chief uses of abaká are for the manufacture of ropes, binder twines, the so-called tagal braids, and textiles. Locally abaká is used for manufacturing textiles, baskets, hats, trays, bags, laces, lamp shades, belts, matting, and furniture. The

* Miller, H. H., Abaca. Philippine Craftsman, Volume 1 (1912), pages 120 to 140.

waste left after the fiber is stripped is a promising source of paper pulp.

Abaká has been introduced into other tropical countries, but up to the present time practically the entire supply of the fiber has come from the Philippine Islands. In 1918 the exports amounted to 169,260,377 kilos, valued at 116,383,100 pesos.

Family ZINGIBERACEAE

Genus AMOMUM

AMOMUM sp.

The leaf stalks of this plant are split and made into a light rope. King found this rope, when wet, to have a tensile strength of 325 kilos per square centimeter.

Family MARANTACEAE

Genus DONAX

DONAX CANNAEFORMIS (Forst.) K. Sch. (Plate XXII). BAMBÁN.

Local names: *Aratan* (Gaddanes in Nueva Vizcaya); *bambán* or *banbán* (Cagayan, Pampanga, Bataan, Tarlac, Cavite, Laguna, Tayabas, Mindoro, Camarines, Sorsogon, Albay, Iloilo, Capiz, Antique, Cebu, Occidental Negros, Oriental Negros, Bohol, Palawan); *barasbarásan* (Iloko in Tarlac); *bonbón,* (Cavite, Mindoro); *darumaka* (Union, Iloko in Nueva Vizcaya, Zambales, Tarlac, Camiguin Island); *garomaka* (Union, Pangasinan); *langkuás* (Iloko); *manban* (Tayabas, Leyte); *matalbák* (Bataan, Bulacan); *mattapal* (Isinai in Nueva Vizcaya); *mini* (Benguet).

The split stems of this herb are used to weave baskets, usually in combination with other materials. The stems are occasionally used to make fish traps and hats, and for sewing nipa shingles.

Donax cannaeformis is a half-woody herb reaching a height of 1 to 3 meters. The bases of the branches are somewhat swollen. The leaves are usually rounded at the base and pointed at the tip. The leaf bases are very long and sheathe the stem. The flowers are white. The fruits are rounded and about a centimeter in diameter. This plant is common and widely distributed in the Philippines and also occurs in Java, Celebes, and New Guinea.

Family ORCHIDACEAE

Genus DENDROBIUM

DENDROBIUM CRUMENATUM Sw. (Plate XXII). IRÁU.

Local names: *Dápo* (Tayabas); *iráu* (Camarines, Albay, Sorsogon); *karamosi* (Ilocos Norte); *karausi* (Cagayan); *karulai* (Isabela); *magimpál, magimapau* (Bohol); *manau* (Leyte); *sanggúmai* (Laguna).

Fibers from the stems of this orchid are used as decorative material on baskets and other articles. This use is very ancient; Fray Marcos de Lisboa, author of "Vocabulario de la Lengua Bicol" written about 1590–1620, says: "YRAO. A plant that grows on trees and sends out a sort of cord, which is yellow and is used for tying and for making straw hats." The stalks are cut when they are very old and partially yellow.

The stalk of *Dendrobium crumenatum* is 60 centimeters or more in length and, for a distance of about 20 centimeters from the base, is bulbous and fluted. The flowers are white with yellow markings and are very fragrant.

This orchid is common and widely distributed in the Philippines, and is frequently cultivated for ornamental purposes.

Genus VANILLA

VANILLA OVALIS Blanco.

Vanilla ovalis is a vine reaching a great height, and is locally abundant in some parts of central Luzon. The stems give some promise of yielding fibrous products of value in making baskets and similar articles.

Family ULMACEAE

Genus TREMA

TREMA ORIENTALIS Blume. ANABIÓNG.

Local names: *Agandúng* (Cagayan); *alindagón* (Moro); *anabióng* (Tagalog and Bisaya); *anagdúng, hanagdúng, tatagtág* (Guimaras Island); *anagúm* (Bikol); *anarióng* (Batanes Islands); *anaróng* (Zambales); *arandón, lamai* (Abra); *balibágo, lagod, dalúnot, hanadióng* (Tagalog); *dalúnit, malasikongdóron, hinlaláong* (Pampanga); *hagod* (Laguna, Tayabas); *hanadgóng* (Samar, Camarines); *hanagdóng* (Tayabas); *hinagdúng* (Bisaya); *hubulos* (Bontoc); *inangdón* (Mindoro); *indai luging* (Lanao); *malarúrung* (Igorot and Tagalog); *nagdón* (Occidental Negros); *malarúrang* (Bataan); *pañgarandóñgen* (Benguet, Pangasinan).

The dry rope made from the bast of *Trema orientalis* was the weakest of all the ropes tested by King. However, when wet its resistance was nearly doubled. The tensile strength of dry rope was only 134 kilos per square centimeter. Owing to its poor qualities it is seldom used. This species furnishes a soft, light-colored wood, in great demand for the manufacture of wooden shoes (zuecos).

Trema orientalis is a small tree, 5 to 8 meters in height, with a very open crown. The leaves are 5 to 8 centimeters long, alternate, hairy, the base heart-shaped, the apex rounded, the margins toothed. The flowers are numerous in the axils of the leaves, white, and about 3 millimeters long. The fruits are ovoid drupes about 3.5 millimeters long.

This tree is a very frequent invader of open ground and in some places, where the virgin forest has been removed, forms

PLATE XXII.

Fig. 1. Dendrobium crumenatum (iráu).

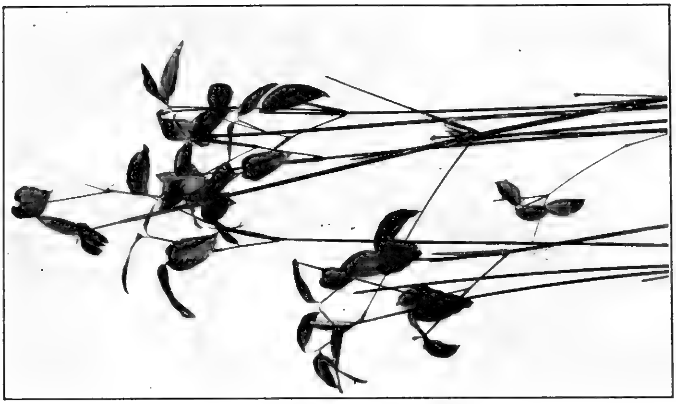

Fig. 2. Donax cannaeformis (bambán).

almost pure stands over large areas. It is a common second-growth tree at low altitudes throughout the Philippines.

Family MORACEAE

Genus ALLAEANTHUS

ALLAEANTHUS GLABER Warb. MALAMBIÑGAN.

Local names: *Alokón, buñgon* (Benguet, Ilocos Norte, Ilocos Sur, Abra); *alibabág* (Cagayan, Itneg); *alibabái* (Cagayan); *alitagtág, balitagtág* (Camarines); *alokón, baeg, boñgon* (Pangasinan); *babayan, imkabaó* (Nueva Ecija); *kabág* (Mindoro, Misamis); *karúd* (Misamis); *liba* (Davao); *malakadiós* (Masbate); *malambiñgan* (Basilan).

The crude bast of this tree shows great variations in color and size. Rope made from it is very weak. King found it to have a tensile strength of 231 kilos per square centimeter. Wetting increased the strength 10 per cent. This rope is said to be more durable than the average during the wet season.

Young leaves and flowers of this species are cooked for food.

Allaeanthus glaber is a medium-sized tree reaching a height of 30 meters and a diameter of 60 centimeters. The leaves are alternate, 5 to 15 centimeters long, the apex pointed, the base somewhat rounded.

This species is distributed from northern Luzon to Basilan.

Genus ANTIARIS

ANTIARIS TOXICARIA Lesch. LATÁ or UPAS-TREE.

Local names: *Dalít* (Tagalog in Mindoro); *ditá* (Cagayan, Apayao); *latá* (Cagayan); *salogon* (Bisaya in Mindoro).

Concerning the fiber Watt * says:

> The natives strip the bark of this tree into large pieces, soak them in water, and beat them well, when a good white fibre is obtained—a natural cloth worn by the natives. It is in Western India well known as the *sacking tree,* on acount of the tough, inner, fibrous, felted bark, being removed entire, thus forming natural sacks. Small branches are made into legs of trousers and arms of coats, the larger ones forming the bodies of the garments. In this way felt costumes are made which require no more sewing than is necessary to connect the parts together. If passed through rollers, and at the same time dyed and tanned, these natural cloths or felts are very interesting. The samples exhibited at the late Calcutta International Exhibition (contributed by the Bombay Committee) were very much admired, and proved very attractive. In making sacks sometimes a disk of the wood is left attached to the fibre so as to form the bottom of the sack. At other times a vertical incision is made on the tree and a transverse cut around the stem at the top and bottom of this vertical one. The bark is then peeled off, and after being beaten in water and dried, the top and bottom are sewed up (forming the sides of the sack). These sacks are extensively used for storing rice.

* Watt, Dictionary of the economic products of India, Volume I, page 268.

In Ceylon ropes are made of the bark. "The bark yields strong fibre suited for cordage, matting, and sacking. In making sacks a branch or trunk is cut to the required length, soaked in water, and beaten till the fibre separates from the wood. It is then turned inside out and the wood sawn off, except a small piece at the bottom." (*Bombay Gazetteer, XV, Part I., 62, Konkan District.*) There seems every likelihood that the bark of this tree may come into use as a paper fibre.

The sap of this tree is used as an arrow poison.

Antiaris toxicaria is a tree reaching a height of about 15 meters and a diameter of 30 centimeters or more. The leaves are opposite, pointed at the tip, rounded or heart-shaped at the base, and from 8 to 15 centimeters in length.

This species is apparently widely distributed in the Philippines, but is not common.

Genus ARTOCARPUS

ARTOCARPUS COMMUNIS Forst. (Plate XXIII). ANTIPÓLO.

Local names: *Antipólo* (Bataan, Manila, Rizal, Laguna, Mindoro, Basilan, Palawan); *antipólong laláki* (Rizal); *chipúhu* (Batanes); *pakák* (Cagayan, Ilocos Sur, Abra, Union, Zambales); *kamansí* (Leyte); *tipólo* (Camarines, Negros).

A rather weak rope is made from the bast of this tree. Rope made from the bast of old trees is stiff; from the bast of young trees much more pliable. King found rope made of the bast of old trees to have a tensile strength of 367 kilos per square centimeter; and rope made from young trees, 356 kilos per square centimeter. Wetting decreased the strength only 2 per cent. Rope made of the bast of old trees is said to be very durable. It stands long wetting or alternate wetting and drying. It is used in the form of traces, to yoke carabaos for field work. The Ilokos of Sappar, according to King, believe it to be more durable than rawhide.

Artocarpus communis is a tree reaching a diameter of 90 centimeters. It has an abundant milky juice. The leaves are very large and pinnately lobed. The fruits are rounded and very rough. The wood is soft to moderately hard.

This species is common and widely distributed both cultivated and wild in the Philippines.

ARTOCARPUS ELASTICA Reinw. GUMÍHAN.

Local names: *Antipólo* (Tayabas, Samar); *gumíhan* (Camarines, Albay, Sorsogon); *tugúp* (Surigao, Davao).

Heyne * gives quite a discussion of the bast of this species, which has been exported from Java to Europe. In 1902 it was

* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 48.

worth 60 to 70 cents per kilo in Holland; in 1904 a lot of a thousand kilos was sold in Rotterdam. Heyne says that old bast is much harder than young bast.

Artocarpus elastica is a stately tree with a trunk 60 to 90 centimeters in diameter. The leaves are alternate, crowded, obtuse at both ends, occasionally lobed towards the apex, the larger ones 20 to 30 centimeters wide, and 60 to 90 centimeters long. The male spikes are cylindrical, oblong, soft or spongy, and yellowish. The female heads are somewhat rounded or elliptical. The fruit is heavy, at least 10 centimeters long, and covered with brownish, hairy appendages. The seeds are embedded in a whitish, more or less gummy pulp of a delicious, tart flavor. They are about the size of peanuts, are eaten roasted, and in flavor also resemble peanuts.

ARTOCARPUS INTEGRA (Thunb.) Merr. NANGKÁ.

Local names: *Langká* (Bontoc, Bataan, Mindoro, Iloilo, Leyte); *nangká* (Cagayan, Bontoc, Laguna, Pampanga, Tayabas, Mindoro, Surigao).

Heyne † reports that the bast of this species is used for the same purposes as that of other species of *Artocarpus;* that is, for rope, bark clothing, etc.

Artocarpus integra is a tree reaching a height of from 8 to 15 meters. The leaves are alternate, leathery, broadest near the tip, with a pointed base, entire or sometimes three-lobed, shiny, and 7 to 15 centimeters long. The fruits are green, fleshy, edible, 25 to 60 centimeters long, covered with pyramidal projections, and grow on the trunk or large branches.

This species is distributed throughout the Philippines both cultivated and wild.

ARTOCARPUS RUBROVENIA Warb. KALULÓT.

Local names: *Anabling* (Camarines); *anubing* (Laguna, Bataan, Tayabas); *anubling* (Rizal); *bayukó* (Negros); *bun̄gá* (Cagayan); *hamugí, kalulót* (Mindoro); *kili-kili* (Samar); *kúbi* (Tayabas, Mindoro, Sorsogon, Samar); *tagap* (Baler); *tumolúbo* (Isabela); *ubién* (Benguet, Pangasinan).

The bark of this tree was formerly used in making cloth.

Artocarpus rubrovenia is a tree reaching a height of about 30 meters and a diameter of about 40 centimeters. The leaves are alternate, smooth, oval, pointed at the apex, and rounded or pointed at the base.

This species is distributed from the northern to the southern limits of the Archipelago.

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† Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 53.

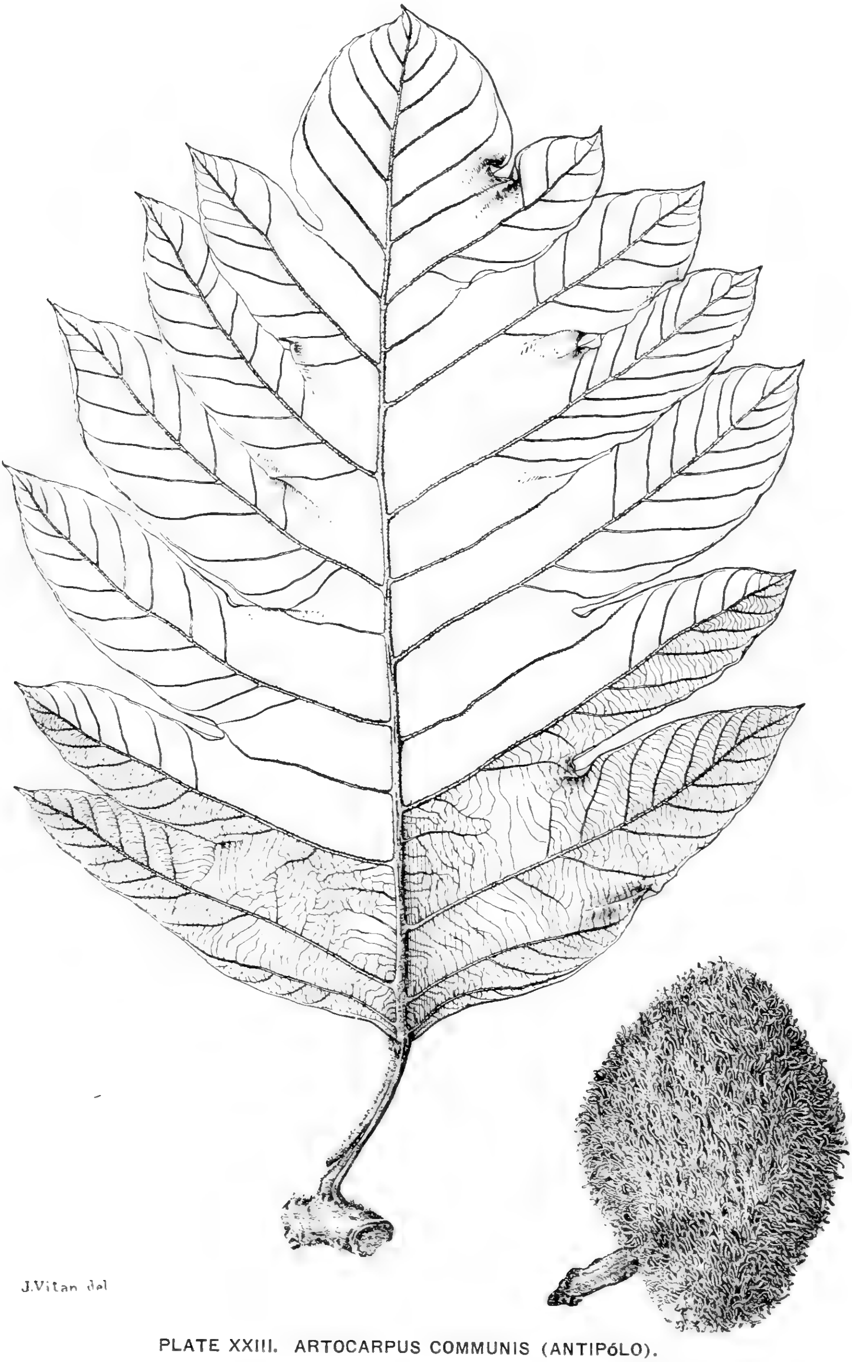

PLATE XXIII. ARTOCARPUS COMMUNIS (ANTIPÓLO).

Genus FICUS

FICUS BENJAMINA Linn. BALÉTE.*

Local names: *Anuñga* (Isabela); *baléte* (Ilocos Norte, Abra, Pangasinan, Nueva Ecija, Pampanga, Bataan, Manila, Cavite, Laguna, Camarines); *baletéon* (Nueva Vizcaya); *baléte-pulá* (Tagalog); *balíting-íbon* (Batangas); *gisi* (Ibanag and Subprovince of Apayao); *kolis* (Bataan); *kuliamot* (Negrito, Bataan); *salísi* (Nueva Vizcaya); *tibi* (Camarines); *sirisíu* (Cagayan).

The strips of bast of this species are salmon-buff; some are soft and pliable, others hard and stiff. Rope made from the bast possesses a fair degree of tenacity. King found it to have a tensile strength of 480 kilos per square centimeter. Wetting reduced the strength only 2 per cent.

Ficus benjamina is a strangling fig with smooth, leathery leaves. The leaves are alternate, somewhat oval, 8 to 15 centimeters long, pointed at the tip, and rounded at the base. The figs occur singly in the axils of the leaves, are dark purple, and about 1 to 2 centimeters in diameter.

This species is common and widely distibuted at low altitudes, from northern Luzon to southern Mindanao.

FICUS FORSTENII Miq. BALÉTE.

Local names: *Baléte* (Zambales, Bataan, Rizal, Mindoro, Moro); *basaklá* (Iloko, Abra); *dalákit* (Negros); *lañgaban* (Moro, Cotabato); *puos* (Itneg) *puspús* (Iloko, Abra).

The bast is ochraceous salmon. A very weak rope is made from it. King found the rope to have a tensile strength of only 154 kilos per square centimeter. Immersion in water for twenty-four hours increased the strength 44 per cent.

Ficus forstenii is a strangling fig with leathery leaves. It reaches a height of about 30 meters. The leaves are alternate, smooth, pointed at the apex, rounded at the base, wider near the apex than near the base, and from 7 to 17 centimeters in length. The figs are yellow and about 2 centimeters in diameter.

This species is distributed from northern Luzon to southern Mindanao.

FICUS PACHYPHYLLA Merr. BALÉTE.

Local names: *Balíte* (Laguna); *lunúg* (Occidental Negros); *pasaklá* (Abra, Itneg).

Strips of bast of this fig are colored a uniform pecan brown. Rope made from it is said to be very durable and is fairly strong.

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* Balete or baliti is a broadly generic term used in a number of the Philippine languages for all the "strangling figs" of the genus *Ficus* and is very rarely, if ever, used for any other epiphytic or climbing plants.

King found it to have a tensile strength of 464 kilos per square centimeter. Immersion in water for twenty-four hours increased the strength 17 per cent.

Ficus pachyphylla is a strangling fig with alternate, very leathery, smooth, somewhat elliptical leaves, which are 9 to 15 centimeters in length. The figs are red with yellow scales at the base, and are about 1.5 centimeters in diameter.

This species is widely distributed at low altitudes from northern Luzon to southern Mindanao.

FICUS PALAWANENSIS Merr. BALÉTE.

Local names: *Agamid* (Itneg); *agamit* (Abra); *baléte* (Cavite, Laguna, Tayabas, Lanao).

The bast from this species is stronger than that of any of the other species of *Ficus* tested by King. The rope made from it is very strong. On account of its great strength, toughness, and durability the fiber is used for making wild-hog traps. King found the rope to have a tensile strength of 752 kilos per square centimeter. Wetting increased the strength.

Ficus palawanensis is a large, strangling fig with alternate, smooth, leathery, elliptical leaves, pointed at the apex, usually rounded at the base, and 15 to 22 centimeters in length. The fig is red, oval, and about 1.5 centimeters in diameter.

This species is found throughout the Philippines at low altitudes.

Genus MALAISIA

MALAISIA SCANDENS (Lour.) Planch. MALAISÍS.

Local names: *Hinggíu* (Mindoro); *sádak* (Abra); *sigíd* (Negros); *malaisís* (Tagalog).

This vine is used for tying purposes, as in the construction of fish corrals.

The leaves of *Malaisia scandens* are alternate, smooth, somewhat oval, pointed at the tip, and from 5 to 12 centimeters in length. The flowers are small and greenish white. The fruits are oval, red, and about 7 millimeters long.

This species is common and widely distributed in the Philippine forests.

Family URTICACEAE

Genus BOEHMERIA

BOEHMERIA NIVEA Gaudich. RAMIE OR CHINA GRASS.

Local name: *Lípang-áso* (Manila).

Ramie is a well-known fiber. It is extensively cultivated in China, and has also been grown in other countries. The fiber is white, lustrous, and very strong and durable. It is woven into very fine and beautiful fabrics. The fiber lacks the elasticity of wool and silk and the flexibility of cotton. Cloth made from it is therefore rather harsh. The chief objections to a more extensive use of ramie are that it is very difficult to separate the fiber from the tissue in which it is embedded, and that the process requires considerable manual labor. In the Philippines the fiber is used in making strings, blankets, and cloth.

Watt * gives an extensive account of ramie. He says that *Boehmeria* demands the best soil, and that the fields have to be manured and carefully tended.

Ramie has been the subject of very extensive investigations, and the literature concerning it is voluminous. The yield of fiber is apparently very much greater in temperate and subtropical countries than in tropical ones. Owing to this fact and to the greater cost of labor in the Philippines than in China, it would appear that the growing of ramie on a commercial scale in the Philippines is impracticable.

Boehmeria nivea is a hairy shrub reaching a height of about 2 meters. The leaves are alternate, pointed at the tip, abruptly pointed at the base, have toothed margins, and are from 7 to 16 centimeters in length. The flowers are small.

This species is quite extensively cultivated in the mountain region of northern Luzon, particularly by the non-christian tribes. In Ifugao and neighboring subprovinces nearly every family cultivates a small amount. It is occasionally cultivated in central Luzon, where its value as a fiber plant is not appreciated, and it also occurs in the Batanes Islands.

Genus LEUCOSYKE

LEUCOSYKE CAPITELLATA (Poir.) Wedd. ALAGÁSI.

Local names: *Alagási, hanlagási, hilagási* (Mindoro); *alañgási, isísmáya* (Rizal); *anagási, hinagási, layásin, li-á-sin* (Tayabas); *anugau* (Sorsogon); *aragási, tinagási* (Camarines); *isís-ñgípin* (Laguna); *karikasin* (Nueva Ecija); *lagási* (Laguna, Mindoro).

This species produces strong bast fibers.

Leucosyke capitellata is a tree reaching a height of 8 to 10 meters. The leaves are alternate, pointed at the apex, abruptly pointed at the base, hairy, the lower surface whitish, the margins toothed. The flowers are small and whitish, and borne in compact heads.

This species is distributed from Luzon to Palawan.

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* Watt, Commercial products of India.

Family MENISPERMACEAE

Genus ANAMIRTA

ANAMIRTA COCCULUS W. & A. LIGTÁNG.

Local names: *Bay-yatíng* (Abra); *labtáng* (Abra, Ilocos Sur); *lagtáng* (Masbate); *ligtáng* (Tagalog).

The bark of this vine is made into rope used for tying animals and for hauling. It is used particularly during the rainy season. The entire stems are also twisted into rope. The fruit is used as a fish poison and is also poisonous to other animals.

Anamirta cocculus is a vine with smooth, alternate, heart-shaped leaves which are from 12 to 24 centimeters in length. The flowers are small, yellowish white, very fragrant, and borne on compound inflorescences. The fruits are round, and about 1 centimeter in diameter.

This species is common and widely distributed in the Philippines.

Genus PERICAMPYLUS

PERICAMPYLUS GLAUCUS Merr. (Plate XXIV). PAMÁGO.

Local names: *Hahun* (Basilan); *pamágo* (Camarines, Albay, Sorsogon); *silong-púgo* (Batangas); *tugi-tugían* (Mindoro).

The central cylinders of the stems of this vine are used for weavers of baskets. According to Heyne † this species is used for rope in Java.

Pericampylus glaucus is a vine occurring in thickets, waste places, or along the banks of streams throughout the Philippines. The leaves and young stems are very hairy. The leaves are heart-shaped and 5 to 10 centimeters in length. The flowers are small, greenish, and occur in small, compound, axillary inflorescences. The fruits are flattened and about 5 millimeters in diameter.

Family ANNONACEAE

Genus GONIOTHALAMUS

GONIOTHALAMUS AMUYON (Blco.) Merr. AMÚYONG.

Local names: *Amúyong* (Batangas); *lanútan* (Negros); *sagiát* (Iloko, Union).

The bast of this tree has an attractive apricot-buff color. Rope made from it is weak. King found the rope to have a tensile strength of 345 kilos per square centimeter. Wetting reduced the tensile strength 15 per cent.

Goniothalamus amuyon is a tree reaching a height of 15 meters

† Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 2, page 1.

and a diameter of 20 centimeters. The leaves are alternate, smooth, rather narrow, pointed at both ends, and from 18 to 25 centimeters in length. The flowers are greenish yellow, about 5 centimeters long, and have long narrow petals. The fruits are cylindrical, aromatic, and about 3 centimeters in length. They contain 1 to 3 seeds.

This species is of local occurrence and widely distributed at low altitudes in the Philippines.

Genus PHAEANTHUS

PHAEANTHUS EBRACTEOLATUS (Presl) Merr. KALIMATÁS.

Local names: *Amúyong* (Polillo Island); *dalinas* (Bataan); *kalimatás* (Laguna, Bataan); *langlangás* (Ilocos Norte); *lanútan* (Bataan, Mindoro, Cotabato); *manggasinóro* (Tayabas); *puropagai* (Nueva Ecija); *takúlau* (Ilocos Norte); *yambán* (Zambales).

The bark of this vine is used for tying purposes and also medicinally.

The leaves of *Phaeanthus ebracteolatus* are alternate, oval, pointed at both ends, and 10 to 15 centimeters in length. The flowers are yellow and about 2 centimeters long. The fruits are oval, red, and are borne in rounded clusters.

This species is common and widely distributed in the Philippines.

Genus POLYALTHIA

POLYALTHIA FLAVA Merr. YELLOW LANUTAN.

Local name: *Lanutan* (Tayabas, Bataan).

The bast fiber of this tree is used for making rope.

Polyalthia flava is a tree which reaches a height of about 20 meters and a diameter of about 40 centimeters. The leaves are alternate, smooth, pointed at both ends, and from 6 to 16 centimeters long. The flowers are yellowish green with petals about 2.5 centimeters long. The fruits are oval and occur in rounded clusters.

This species is distributed from Luzon to Mindanao.

Family CONNARACEAE

Genus AGELAEA

AGELAEA EVERETTII Merr. OÑGÁLI.

Local names: *Oñgáli* (Negros); *kamagsá* (Polillo); *kamaksá* (Laguna).

This vine is used for tying purposes.

Agelaea everettii is a woody vine. The leaves are alternate, pinnate, and have three leaflets, which are 2.5 to 15 centimeters long. The flowers are white and fragrant, the petals about 5 millimeters long. The flowers occur in short racemes. The

PLATE XXIV. PERICAMPYLUS GLAUCUS (PAMÁGO).

fruits are very rough and 1.5 to 2 centimeters long; the seeds about 1 centimeter long.

This species is fairly common in the forests, and is distributed from northern Luzon to Basilan.

Genus ROUREA

ROUREA VOLUBILIS (Blanco) Merr. KAMAKSÁ.

Local names: *Baralang* (Cagayan); *bitog* (Benguet); *kamaksá* (Rizal, Laguna); *pálosánto* (Pangasinan).

This vine is used for tying fish corrals. The fruits are also used for poisoning dogs.

Rourea volubilis is a vine common and widely distributed in the Philippine forests. The leaves are alternate, smooth, somewhat oval in shape, rounded at the base, and have prominent projections at the tips. The flowers are small, white, fragrant, and occur in large numbers on compound inflorescences.

Family LEGUMINOSAE

Genus ABRUS

ABRUS PRECATORIUS L. KANSASÁGA or PRAYER-BEAN.

Local names: *Aguñañáng, agunyanyáng* (Zamboanga); *báhai* (Ticao); *bugayóng* or *bugayúng* (Camiguin Is., Cagayan, Ilocos Sur, Abra, Tarlac, Pangasinan, Zambales); *bugbugayóng* (Union); *kansasága* (Pampanga, Tarlac, Camarines); *kasasága* (Pampanga, Bataan); *lago* (Culion Is.); *lása* (Batanes Islands); *matang-uláng* (Pampanga); *sága* (Laguna, Batangas, Tayabas); *sagambáging* (Polillo Is.); *sagasága* (Bulacan, Bataan, Rizal, Manila, Batangas, Tayabas); *ulañ̃giá* (Cuyo Islands).

According to Watt,* this plant yields beautiful bast fibers. These fibers are said to be suitable for cordage.

Abrus precatorius is a slender, branched, annual vine which reaches a length of 9 meters or less. The leaves are alternate, 5 to 10 centimeters in length, and compound with twenty to forty leaflets, which are 1 to 3 centimeters long. The flowers are borne in axillary racemes which are usually shorter than the leaves. The flowers are numerous, often crowded, pink to pale purple or salmon, and about 1 centimeter long. The pod is oblong, 2.5 to 5 centimeters long, about 1.5 centimeters broad, and contains three to five seeds which are shiny, 6 millimeters long, and partly black and partly scarlet.

This species is common and widely distributed in Philippine thickets.

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* Watt, Commercial products of India.

Genus BAUHINIA

BAUHINIA CUMINGIANA (Benth) F. Vill. AGPÓI.

Local names: *Agkúi* (Pampanga); *agpói* (Bataan, Camarines); *agpór, ugpói* (Bataan); *banot* or *banut* (Rizal, Laguna, Tayabas); *impíd, impíg* (Camarines); *libang-báng* (Masbate); *lupíg* (Nueva Ecija); *niogniógan* (Cotabato); *oplíg* (Abra); *salibangbáng* (Negros, Leyte); *umpíg, umpík* (Cagayan); *uplíng* (Union).

This vine is used for tying purposes, especially for hanging tobacco sticks and hauling logs. It is very durable. The bast is very strong and is used by the Negritos of Bataan Province for making bowstrings. It is also used for making rope.

Bauhinia cumingiana is a huge, woody vine growing in virgin forests. The leaves are alternate, smooth, heart-shaped, divided at the apex, and 8 to 12 centimeters in length. It has brownish-yellow flowers in large clusters and large, flat seed pods.

This species is widely distributed from northern Luzon to southern Mindanao.

Genus PONGAMIA

PONGAMIA PINNATA (L.) Merr. BÁNI.

Local names: *Balikbalík* (Tagalog); *balobaló* (Zamboanga, Basilan); *balukbalúk, balutbalút, magít* (Cotabato); *baobao* (Agusan); *báni* (Pangasinan, Zambales, Pampanga, Bataan, Cotabato); *kadél* (Tayabas); *marokbarók* (Camarines); *salingkúgi* (Zamboanga).

The bark of this tree is used for making strings and ropes.

Pongamia pinnata is a tree reaching a height of 15 meters and a diameter of about 45 centimeters. The leaves are alternate and compound with three to seven leaflets, which are smooth, pointed at the apex, usually rounded at the base, and 7 to 10 centimeters in length. The flowers are purplish, about 1.5 centimeters in length, and borne in racemes. The pods are somewhat flattened, somewhat oval in outline, and with a single seed.

This species is distributed from northern Luzon to southern Mindanao.

Family SAPINDACEAE

Genus SAPINDUS

SAPINDUS SAPONARIA L. TIKASTÍKAS.

Local names: *Amugáuen* (Union); *kasibai, kasiboen* (Ilocos Norte); *katikis* (Bataan); *teka-téka* (Pangasinan, Laguna, Batangas, Tayabas); *tekistékis* (Rizal); *tikas-tíkas* (Laguna); *kusibéng* (Cagayan, Ilocos Sur, Abra, Union); *mamalis* (Pampanga); *malahito* (Nueva Ecija); *palikpík-híto* (Nueva Ecija, Pampanga).

According to Dodge:* "The bast of this species yields a coarse fiber, suitable for native cordage."

The bark is used for washing the hair. Tobacco workers in Abra use the crushed leaves for removing the stain of tobacco leaves from their hands.

Sapindus saponaria is a tree reaching a height of about 20 meters and a diameter of about 60 centimeters. The leaves are alternate, smooth, and compound; the main stalk is expanded and leaflike. The flowers are small, white, and are borne in considerable numbers on compound inflorescences. The fruits are rounded and about 1.5 centimeters in length.

This species is distributed from northern Luzon to Mindanao.

Family RHAMNACEAE

Genus ALPHITONIA

ALPHITONIA EXCELSA Reiss.

Local names: *Aniláu* (Guimaras Island); *dunglú* (Mindoro); *tanggulái* (Mindoro); *tulo* (Samar); *uakátan* (Surigao).

The bark of this tree is used for making rope.

Alphitonia excelsa is a tree which reaches a height of 20 meters. It has alternate, hairy, narrow leaves which are pointed at the apex, rounded at the base, about 9 centimeters long, and 5 centimeters broad. The flowers are small and borne on compound, axillary or terminal inflorescences. The fruits are somewhat rounded, black, and over a centimeter in diameter.

This species is distributed in forests from northern Luzon to Mindanao.

Family VITACEAE

Genus CISSUS

CISSUS REPENS Lam. KALITKALÍT.

Local names: *Ayo* (Batangas); *kalitkalít* (Rizal, Balabac Island); *rigini* (Ticao Island).

This species is used for tying carabaos.

Cissus repens is a smooth vine reaching a length of 10 meters or less. The leaves are 7 to 12 centimeters long, the apex pointed, the base frequently heart-shaped. The flowers are small and greenish, and borne on inflorescences which are opposite the leaves or terminate the branches. The fruit is fleshy, purple, about 6 millimeters long, and with a single seed.

This species is distributed from the Mountain Province of Luzon to southern Mindanao.

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* Dodge, C. R., A descriptive catalogue of useful fiber plants of the world. U. S. Department of Agriculture. Fiber investigations. Report No. 9, page 290.

Family ELAEOCARPACEAE

Genus ELAEOCARPUS

ELAEOCARPUS CALOMALA (Blanco) Merr. KALOMÁLA.

Local names: *Bunsílak, maglumbói* (Mindoro); *hungó, ungó* (Tayabas, Mindoro); *kunákun* (Surigao); *malanopit* (Rizal); *kalomála* (Batangas, *fide* Blanco).

The inner bark is used for making rope. The fruit is edible.

Elaeocarpus calomala is a tree reaching a height of about 25 meters and a diameter of about 60 centimeters. The leaves are alternate, smooth, oval, pointed at both ends, 6 to 15 centimeters in length, and with toothed margins. The flowers are white, fragrant, about a centimeter in diameter, and borne in axillary racemes. The fruit is red, oval, and contains a single, rough, hard stone.

This species is distributed from the Mountain Province, Luzon, to southern Mindanao.

Family TILIACEAE

Genus COLUMBIA

COLUMBIA BLANCOI Rolfe. MAMAUÉD.

Local names: *Aniláu, mamadlíng, mamauéd, mamued* (Rizal); *keddéng* (Iloko, Benguet).

A weak rope is made from the bast of this tree. It is a good rope during the rainy season on account of its durability when wet. King found it to have a tensile strength of 302 kilos per square centimeter. Wetting increased the strength about 1 per cent.

Columbia blancoi is a small tree attaining a height of about 10 meters. The leaves are hairy, pointed at the apex, rounded or heart-shaped at the base, from 12 to 30 centimeters long, and with toothed margins. The flowers are pink or yellow and are in large terminal panicles. The fruits are ovoid capsules about 1 centimeter long and with two to four wings.

This species has been reported only from Luzon.

COLUMBIA LANCEOLATA Warb. KADIÍN.

Local names: *Aniláu* (Zambales); *baliuán* (Pangasinan); *kadiín, lapnít* (Pangasinan).

The bark of this tree is used for making rope.

Columbia lanceolata is a tree reaching a height of 25 meters and a diameter of 40 centimeters. The leaves have toothed margins, a conspicuous pointed tip, and an oblique base. They are hairy, and from 8 to 15 centimeters in length. The fruits have five wings.

This species is found in second-growth forests in Luzon.

COLUMBIA MOLLIS Warb. KEDDÉNG.

Local name: *Keddéng* (Ilocos Sur, Abra, Nueva Vizcaya).

The bark of this tree is used for making rope.

Columbia mollis is a tree reaching a height of about 18 meters and a diameter of about 40 centimeters. The leaves are alternate, hairy, rounded and somewhat oblique at the base, prominently pointed at the tip, from 8 to 20 centimeters in length, and with toothed margins. The fruits have two or three wings.

This species occurs in Luzon.

COLUMBIA SERRATIFOLIA (Cav.) Pers. ANILÁU.

Local names: *Alináu* (Camarines); *aniláu* (Bataan, Laguna, Tayabas, Camarines, Sorsogon, Mindoro, Masbate, Iloilo, Leyte, Surigao, Butuan, Cotabato, Zamboanga); *bagariláu* (Bataan); *banílad* (Laguna); *banlót* (Iloilo); *bainúd* (Mindoro); *hanagdóng* (Palawan); *láho* (Cagayan); *laiásin* (Marinduque); *mamauéd* (Rizal).

Judging from Mendiola's figures, the bast is very weak. A red dye is obtained from the bark.

Columbia serratifolia is a small tree, 3 to 10 meters high. The branches and leaves are hairy. The leaves are 10 to 20 centimeters in length, pointed, with a very oblique base, and toothed margins. The flowers are 6 to 7 millimeters long, with pink and yellowish or reddish petals, and borne in panicles. The fruits are about 1 centimeter long and with three or four wings.

This species is common in second-growth forests throughout the Philippines.

Genus CORCHORUS

CORCHORUS CAPSULARIS L. PÁSAU NA BÍLOG.

Local names: *Panigbin, sumpa* (Samar); *pásau na bílog* (Tag.).

For a discussion of the fiber of this plant see *Corchorus olitorius.*

Corchorus capsularis is an erect, branched, annual herb 1 to 2 meters in height. The stems are usually purplish. The leaves are alternate, the apex pointed, the base rounded with a tail-like projection on each side of the midrib, the margins toothed. The flowers occur in small groups in the axils of the leaves and are about 4 millimeters long. The petals are yellow and the sepals often purplish. The fruit is a somewhat rounded capsule, about a centimeter in diameter and with longitudinal ridges.

This species is widely distributed in the Philippines in open, low grasslands and waste places.

CORCHORUS OLITORIUS L. PÁSAU or JUTE.

Local names: *Pásau* (Zambales, Tagalog); *salúyot, salúyut* or *salóyot* (Ilocos Sur, Union, Pangasinan); *tagabang* (Manila, Bisaya); *taka magindánau, yaka* (Cotabato).

Corchorus olitorius and *Corchorus capsularis* are grown in India on a large scale to furnish most of the jute of commerce. *Corchorus olitorius* is found in all tropical countries, but it is only in India that the fibers are extracted in commercial quantities. King tested rope made from the crude bast of wild Philippine plants and found it to have a tensile strength of 503 kilos per square centimeter. Wetting decreased the strength 28 per cent.

In the Philippines the plant is better known as a vegetable, the leaves being edible, than on account of its fibers.

Corchorus olitorius is a smooth, erect, half-woody shrub, 1 to 1.5 meters in height. The leaves are pointed at the tip and have tail-like projections at the base. The flowers are small and yellow. The fruit is a rather slender pod about 3 to 3.5 centimeters long.

Corchorus olitorius is a weed found in wet places in the settled areas of the Philippines.

Genus DIPLODISCUS

DIPLODISCUS PANICULATUS Turcz. BALOBÓ.

Local names: *Balobó* (Rizal, Laguna, Batangas, Tayabas, Camarines, Agusan, Cotabato, Basilan, Zamboanga); *barobó* (Camarines); *barubó, kidéng* (Cagayan); *bulugai* (Cotabato); *buru, bukad* (Lanao); *maobó* (Cebu); *maramaní, manaring* (Isabela); *marubó* (Samar, Leyte, Albay, Ticao Island, Masbate, Iling Island); *mayubó* (Antique); *muling-mulíng* (Tayabas); *puyús* (Laguna); *talu-talu, mangalri, tagpán, dupdupan* (Zamboanga).

The bast of this species is sometimes used for making rope. The bast is, however, small in amount and difficult to extract, and so is seldom employed.

Diplodiscus paniculatus is a tree reaching a height of about 20 meters and a diameter of about 80 centimeters. The leaves are alternate, smooth, pointed at both ends, and from about 12 to 25 centimeters in length. The flowers are rather small, whitish or yellowish, and borne on large compound inflorescences. The fruit is edible.

This species is very common and widely distributed in the forests from northern Luzon to southern Mindanao. In some places it is the most numerous under-story tree in the forest. It is not cultivated except at the Lamao Experiment Station.

Genus GREWIA

GREWIA ACUMINATA Juss. AMBOI-UÁN.

Local names: *Allágat, alínau* (Union); *alagosí* (Negros); *bagun, balagan* (Palawan); *baloñgo dílang-áhas* (Zamboanga); *amboi-uán* (Union).

Bast fibers are extracted from the bark of this tree and made into ropes and strings.

Grewia acuminata is a tree reaching a height of about 10 meters and a diameter of about 15 centimeters. The leaves are alternate, somewhat hairy, pointed at the apex, rounded at the base, with toothed margins, and 8 to 15 centimeters long. The flowers have whitish petals and prominent yellow stamens, and are borne on compound inflorescences. The fruit is green, about 2 centimeters in diameter, frequently somewhat four-lobed, four-seeded, and very hairy.

This species is distributed from La Union Province in Luzon to southern Mindanao.

GREWIA BILAMELLATA Gagnep. BENGLARÉNG.

Local names: *Benglaréng* (Iloko, Itneg); *dongraréng* (Iloko); *duraréng* (Abra).

The bark is used for making a rope of slight strength. King found the tensile strength to be 320 kilos per square centimeter; wetting decreasing it 44 per cent. The rope is said to be durable during the dry season, but to deteriorate rapidly during wet weather.

GREWIA ERIOCARPA Juss. (*G. negrosensis*). BARIU-ÁN.

Local names: *Aniláu* (Cebu); *balibágo, kanas-kanás* (Batangas); *balilíuan* (Zambales); *balitnóng* (Ilocos Norte, Capiz); *baria-an* (Union); *bariu-án* (Iloko, Itneg, Abra, Union, Pangasinan, Nueva Ecija); *baruan* (Lepanto); *danlí* (Tayabas); *dirán* (Union); *durán* (Pangasinan); *keddéng* (Ilocos Sur, Abra, Union); *lapí, lapní, lapnít* (Cagayan); *masaplák* (Pampanga).

A rope of average strength is made from the bark of this tree. The fiber is extracted from the bark as soon as it is removed from the tree. The rope is used for hauling, tying cattle, and binding rice bundles. In Abra the fiber is used to some extent in making hat braids. King found rope made from the bast to have a tensile strength of 394 kilos per square centimeter. Wetting weakened it about 3 per cent.

Grewia eriocarpa is a shrub or small tree. The leaves are alternate, densely hairy, pointed at the tip, oblique at the base, from 5 to 15 centimeters in length, and with the lower surface white or nearly so. The flowers are small and yellow. The fruit is small, round, bluish, and edible.

GREWIA MULTIFLORA Juss. DANGLÍN.

Local names: *Al-alínau* (Union); *alínau* (Amburayan, Ilocos Sur, Pangasinan, Union, Zambales, Laguna, Sorsogon); *aniláu* (Benguet, Ilocos Norte, Ilocos Sur, Union, Abra, Pangasinan); *aplít* (Pampanga); *bagohon* (Mindoro, Guimaras Island); *benglalíng* (Abra); *bulubukhón* (Guimaras Island); *dalldg* (Gaddan in Nueva Vizcaya); *danglí*, *kalit-kalít* (Laguna, Tayabas); *danglín* (Pangasinan, Tagalog, Guimaras, Nueva Ecija, Bataan, Rizal, Pampanga); *danglóg* (Cagayan); *duraróng* (Ilocos Sur); *imbubuiúkan* (Palawan); *kanaroset* (Palawan); *lañgósig* (Bohol); *lánut* (Negrito in Pampanga); *lapnís* (Batangas, Cavite); *ligaá* (Mindoro); *siapó* (Mindoro); *taróì* (Camarines, Albay).

The bast is pale yellow-orange and is a non-staining fiber. Rope made from it is rather weak, but is said to be very durable for dry-weather use. It is a very commonly used rope. King found it to have a tensile strength of 376 kilos per square centimeter. Immersion in water for twenty-four hours caused a decrease in strength of 12 per cent.

Grewia multiflora is a shrub or small tree. The leaves and branches are nearly smooth. The leaves are alternate, 4 to 14 centimeters in length, pointed at the tip, rounded or pointed at the base, and with toothed margins. The flowers are yellowish green and about a centimeter in diameter. The fruits are ovoid and about 6 millimeters long.

This species is common and widely distributed throughout the Philippines.

Genus MUNTINGIA

MUNTINGIA CALABURA L. DÁTILES.

Local names: *Ceréza* (Spanish, "cherry," in Tarlac, Nueva Ecija, Pampanga, Pangasinan, Bulacan, Zambales, Cuyo Islands); *dátiles* (Spanish, "dates," in Tarlac, Pangasinan, Camarines, Albay, Capiz); *látris* (Laguna); *manzanítas* (dim. of Spanish manzana, "apple," in Ilocos Norte and Sur, Abra, Cagayan, Union); *rátiles* (Bataan, Manila, Rizal, Batangas, Tayabas, Camarines, Albay, Marinduque, Zamboanga, Cuyo Islands).

The bark of this tree is used for making rope.

Concerning the fiber Dodge * says:

> Its bast is very soft and pliable, twists easily, and if used in this manner, without attempting to separate or clean the fibers, is possessed of ordinary strength. The fibrils are exceedingly fine and silky, so much so that the bast, when broken, exhibits at the point of rupture the flossy appearance always seen at the raw ends of skein or embroidery silk. Separating the fiber would undoubtedly diminish its strength. It is employed slightly in Santo Domingo for cordage.

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* Dodge, C. R., A descriptive catalogue of useful fiber plants of the world. U. S. Department of Agriculture. Fiber investigations. Report No. 9, page 244.

Muntingia calabura is a tree from 5 to 10 meters in height. The leaves are 8 to 13 centimeters long, hairy, sticky, the base oblique, the apex pointed, and the margins toothed. The flowers are white and about 2 centimeters in diameter. The fruit is a rounded, red, smooth, fleshy, sweet, edible berry about 1.5 centimeters in diameter and contains numerous small seeds.

This species is a native of tropical America, but is naturalized in the Philippines.

Genus TRIUMFETTA

TRIUMFETTA BARTRAMIA L. KULOT-KULÓTAN.

Local names: *Balanggót* (Camarines); *bulagun* (Basilan); *kolo-kolót* (Ilocos Norte, Bataan); *kulot-kulótan* (Bataan, Palawan); *moropoto* (Leyte); *pallopallót* (Itneg, Iloko); *sauag-caballo* (Mindoro).

The bast of this species is fairly strong.

Triumfetta bartramia is an erect, more or less hairy annual, which reaches a height of from 0.5 to 1.5 meters. The leaves are alternate, hairy, entire or three-lobed, and with toothed margins. The flowers are yellow and about 6 millimeters long. The fruits are small, rounded, and covered with smooth, hooked spines.

This species is not a native of the Philippines, but it is thoroughly naturalized and is widely distributed in the Archipelago. It is found in tropical Asia, Africa, and Malaya.

Family MALVACEAE

Genus ABELMOSCHUS

ABELMOSCHUS MULTILOBATUS Merr.

Local name: *Annabó á dadakkél* (Union).

White fibers used for making rope are extracted from the bark of this plant.

Abelmoschus multilobatus is a shrub reaching a height of 2 to 3 meters. It is usually covered with long, stiff, irritating hairs. The leaves are alternate, about 8 to 12 centimeters long, and divided into five or seven lobes which are in turn divided into a number of lobes. The flowers are very large and yellow.

This species has been reported from Ilocos Norte, La Union, and Bataan.

Genus BOMBYCIDENDRON

BOMBYCIDENDRON VIDALIANUM Merr. and Rolfe. LANÚTAN.

Local names: *Lanútan* (northern Luzon to Bulacan and Bataan); *losúban* (Iloko, Itneg, Abra); *pañgardísen* (Cagayan, Ilocos Sur); *tákúlau blanco* (Ilocos Norte).

Rope made from the bast possesses considerable strength and is considered as pliable, durable, and fitted for service throughout the year. King found it to possess a tensile strength of 630 kilos per square centimeter. Immersion in water reduced the strength by about 26 per cent.

The bark is also woven into hats.

Bombycidendron vidalianum is a medium-sized tree reaching a diameter of 50 centimeters or more. The leaves are alternate, somewhat oval, pointed at the tip and rounded at the base, and 8 to 15 centimeters long. The flowers are white and about 8 centimeters in length. The fruits are oval, pointed, red, and about 4 centimeters long. The trunk is short and often crooked. The wood is rarely sawn. Its chief uses are for vehicle shafts and musical instruments.

This species has been reported from Luzon, Mindoro, and Palawan, and is common and widely distributed in Luzon.

Genus HIBISCUS

HIBISCUS TILIACEUS Linn. (Plate XXV). MALUBÁGO.

Local names: *Álum* (Zambales); *bágo* (Ilocos Norte, Abra); *balibágo* (Bontoc, Zambales, Tarlac, Bulacan, Manila, Tayabas, Polillo, Tarlac, Leyte); *balobágo* (Leyte); *danglíw* (Bulacan); *danglóg* (Balabac Island); *hánot* (Batanes Islands); *malabágo* (Pangasinan, Sorsogon, Masbate, Camarines, Albay, Iloilo, Capiz, Mindoro, Lanao); *malibágo* (Marinduque, Bataan, Tayabas, Davao); *malubágo* (Camarines, Albay, Sorsogon); *mapolá* (Batangas); *mayambágo* (Camarines, Surigao); *mulabágo* (Cotabato).

The bast fibers make a fairly strong rope. The fiber is used for string, for tying cattle, and for making hog traps.

Hibiscus tiliaceus is a much-branched tree 4 to 12 meters in height. The leaves are 10 to 15 centimeters long, alternate, hairy, somewhat rounded, the apex pointed, the base heart-shaped. The flowers are yellow with a purple center. The petals are about 5 centimeters long and wide.

This species is common throughout the Philippines. It is very easily propagated by means of cuttings.

Genus MALACHRA

MALACHRA CAPITATA Jacq. BAKEMBÁKES.

Local names: *Annabo* (Union); *bakembákes* (Abra, Ilocos Sur, Union); *bulbúlin* (Pampanga); *bulúhan, bulubulúhan* (Cavite); *labug-labug* (Iloilo, Occidental Negros); *sípit-uláng* (Bulacan); *páang-balíwis* (Manila, Rizal).

The bast is strong and is used in the manufacture of rope.

Watt * says that the fiber is excellent, 8 to 9 feet long, and that experts have declared it little, if at all, inferior to jute.

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* Watt, G., Commercial products of India.

Malachra capitata is a coarse, erect annual 0.5 to 2 meters in height and is covered with very coarse hair. The leaves are alternate, from 5 to 15 centimeters in diameter, somewhat rounded, and slightly lobed. The base is heart-shaped. The petals are yellow and about 1 centimeter long.

This species is common in waste places throughout the Philippines. It is a native of tropical America.

MALACHRA FASCIATA Turcz. PAANG-BALÍWIS.

Local names: *Annábo* (Union); *bakembákes* (Itneg, Ilocano); *malabitís-pápa* (Bataan); *páang-balíwis* (Tagalog).

The bast of this species is colored olive buff. A strong rope used for clotheslines and general purposes is made from it. The bast is prepared by retting. The entire plant is cut and kept in fresh water for about ten days, after which the bast is easily stripped and the fiber largely freed from extraneous matter by washing. King found the rope to have a tensile strength of 637 kilos per square centimeter, which wetting decreased 15 per cent.

Malachra fasciata is a coarse, half-woody herb reaching a height of 0.5 to 1 meter. The leaves are 10 to 15 centimeters long, very hairy, have a rounded base, and are cut nearly to the base into five narrow lobes which have toothed margins. The corolla is pink and about 1 centimeter long.

The species is a native of tropical America, but is now thoroughly naturalized and widely distributed in the Philippines at low altitudes, and is locally very abundant in wet places.

Genus MALVASTRUM

MALVASTRUM COROMANDELINUM Garke. SALSALÚYUT.

Local names: *Babara* (Pangasinan); *gagabúten* (Union); *sal-salúyut* (Union); *tachin-kabayo* (Batanes Islands); *tákim-báka* (Ilocos Norte).

The stems of this plant are used in making brooms.

Malvastrum coromandelinum is an erect, somewhat hairy, branched, half-woody perennial, 1 meter or less in height. The leaves are 2 to 5 centimeters long, the apex pointed, the base usually rounded, the margins irregularly toothed. The flowers are yellow with petals about 8 millimeters long. The fruit consists of eight to twelve kidney-shaped divisions, 2 to 3 millimeters long, and has three short, straight projections.

This species is a native of tropical America, but is now widely distributed in the tropics of both hemispheres. It is common in waste places throughout the Philippines.

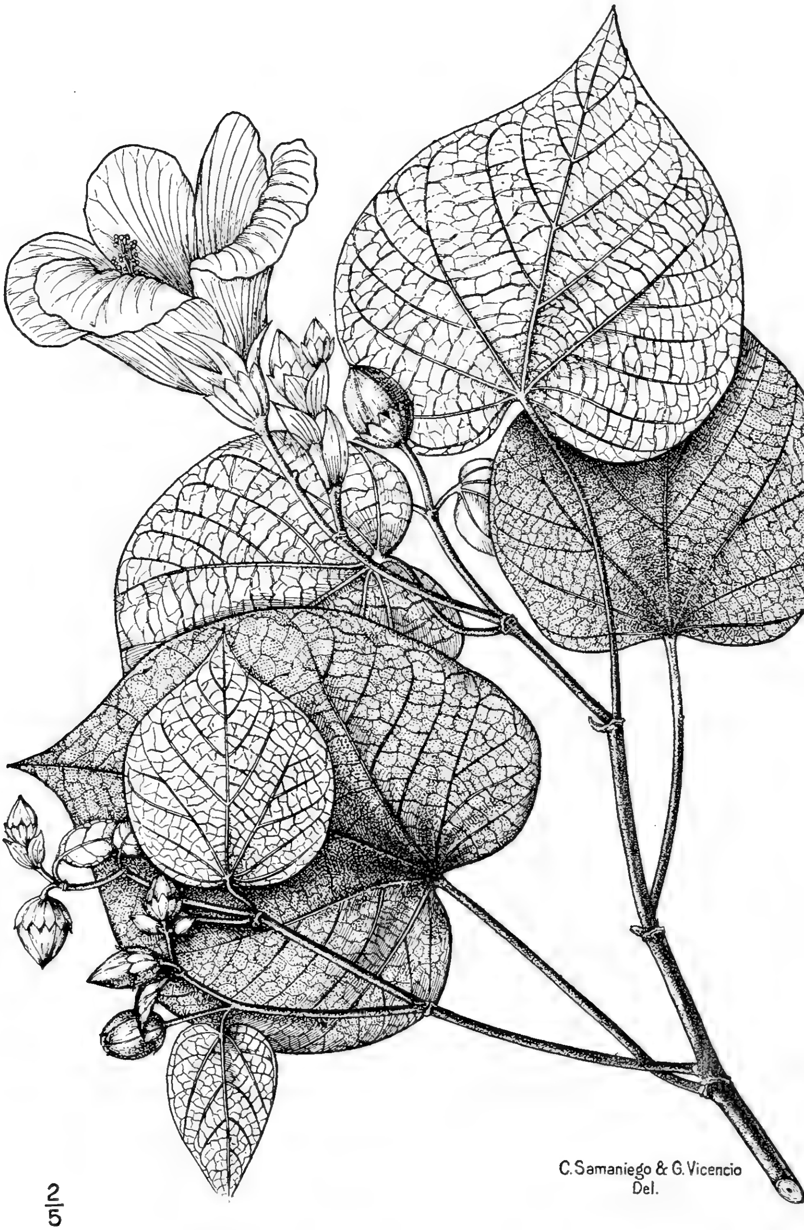

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PLATE XXV. HIBISCUS TILIACEUS (MALUBAGO).

Genus SIDA

SIDA ACUTA Burm. f. TAKLING-BÁKA.

Local names: *Attái-na-báka* (Ibanak); *basbásot* (Bontoc); *escobílla* (Laguna, Bisaya); *herbara* (Ilocos Sur); *kastúle* (Bulacan); *maratakkim-báka* (Iloko in Tarlac); *salík* (Basilan); *surusighíd* (Camarines); *takkim-báka* (Ilocos Norte, Abra, Isabela, Pangasinan, Union); *taking-báka* (Tarlac); *takling-báka* (Pangasinan); *uaualísin* (Bulacan); *ualis-ualísan* (Tarlac, Nueva Ecija, Bulacan).

The fiber of *Sida acuta* is very pretty; its color marguerite yellow. It is fine, filamentous, soft, and very lustrous, having an appearance like silk. It possesses only medium strength, but makes a handsome rope. Ilokos consider this rope a superior product on account of its durability, its pleasing color, and its gloss. It is used for general purposes and particularly where nonstaining fiber is desired. King tested rope made from fiber which had been retted about ten days in fresh water and subsequently cleaned. He found it to have a tensile strength of 475 kilos per square centimeter, which wetting increased about 6 per cent.

The stems are used for making brooms and baskets.

Sida acuta is a slender shrub reaching a meter in height. It has elongated, slender branches. The leaves are alternate, 3 to 5 centimeters long, and with toothed margins. The flowers are yellow and about 1.3 centimeters in diameter.

This species is abundant in wet places throughout the Philippines.

SIDA CORDIFOLIA L.

Local name: *Albahāca* (Spanish in Surigao).

According to Watt,* this plant yields a fine, white fiber.

Sida cordifolia is an erect, half-woody shrub, 0.4 to 1 meter in height. It is covered with soft, velvety hairs mixed with which are numerous longer hairs. The leaves are alternate, heart-shaped at the base, somewhat rounded at the apex, with toothed margins, and from 1.5 to 4.5 centimeters in length. The flowers are yellow and occur in the axils of the leaves.

This species occurs in open waste places and is common and widely distributed in the Philippines.

SIDA MYSORENSIS W. & A. LAGKÍTAN.

Local names: *Damong-mabáho, lagkítan, márbas* (Rizal); *márabas* (Bataan); the last two corruptions of Spanish "malvas".

The bast fiber from this species is used for making rope.

Sida mysorensis is a hairy shrub about a meter in height.

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* Watt, Commercial products of India.

The leaves are alternate, 5 to 8 centimeters long, somewhat heart-shaped, and with notched margins. The flowers are yellow and about 1 centimeter in diameter.

SIDA RHOMBIFOLIA L. UALIS-UALÍSAN.

Local names: *Basbásot* (Bontoc); *singítan, takkit-váca, nangnangisit* (Union); *sinutan* (Cagayan); *takim-váca* (Pangasinan); *takling-váca* (Pangasinan, Batanes Islands); *ualis-ualísan* (Bataan).

This species yields a good fiber to which considerable attention has been paid in India and other countries. It is claimed that the fiber is too good to be used as a substitute for jute. For the literature on this subject see Watt's "Commercial products of India" and the bulletins of the Imperial Institute.

Sida rhombifolia is an erect, branched shrub 0.5 to 1.3 meters in height. The leaves are alternate, 1 to 4 centimeters long, the apex pointed or rounded, the lower surface covered with very short, pale hairs, the margins toothed. The flowers occur singly in the axils of the leaves; the corolla is yellow and 1.5 to 1.8 centimeters in diameter.

This species is common in open waste places throughout the Philippines.

Genus THESPESIA

THESPESIA LAMPAS D. and G. MARAKÁPAS.

Local names: *Amagóng* (Nueva Ecija); *bulak-bulákan* (Tagalog); *dal-dallupang, marataróng* (Iloko, Abra, Itneg); *kapas-kápas* (Union); *kastúle* (Tagalog); *marakápas* (Amburayan, Abra, Zambales).

Rope made from the bast of this species is very weak. King says that it moulds readily. He found it to have a tensile strength of 268 kilos per square centimeter, which wetting increased about 8 per cent.

Thespesia lampas is an erect, slightly branched shrub, 2 or 3 meters in height. The leaves are alternate, somewhat three-lobed or nearly entire, 10 to 20 centimeters long, and somewhat hairy. The flowers are large, 6 to 8 centimeters long, and yellow with a purple center. The fruit is an ovoid capsule about 3 centimeters long.

This species is widely distributed in Luzon and the Visayan Islands.

Genus URENA

URENA LOBATA Linn. (Plate XXVI). KOLLOKOLLÓT.

Local names: *Afulut* (Gaddan in Nueva Vizcaya); *anonongkót, barang-gót* (Bikol); *dalupan, kalut-kalútan, kolot-kolótan, kulutkulútan* (Bataan, Tagalog, Bisaya, Culion Island); *kollokollót* (Amburayan, Ilocos Sur, Pangasinan, Nueva Vizcaya, Tarlac); *kollolót* (Abra); *kulát, kulét* (Pangasinan); *kullukullúk* (Iloko in Isabela); *mangkít* (Tayabas); *poot-si-nuang* (Isinai in Nueva Vizcaya); *puriket* (Abra).

The bast fiber of *Urena lobata* is of the jute type and is said to be more easily extracted than the latter. It has been repeatedly recommended as a substitute and has been sold in London at prices equal to those paid for jute. A large mill for the treatment of this fiber was put up in Brazil. In this case the wild supply proved to be wholly insufficient, and it is said that under cultivation the plant lost a great part of its fibrous nature.

In India considerable attention has been paid to the fiber of *Urena lobata,* and various writers have expressed the opinion that when as much care has been spent on it as on jute, *Urena* may be equally as valuable or more valuable than jute.

References to the literature on this subject are given by King.* The bulletins of the Imperial Institute should also be consulted.

Rope made from the fibers of *Urena lobata* is fairly strong. In India and other countries the product is used as a cordage material. In the manufacture of coffee bags it is said to be an excellent substitute for jute, because the fiber has no influence on the aroma of the coffee. *Urena lobata* fibers can be made into exceedingly strong paper, said to be almost twice as strong as Bank of England note pulp.

Urena lobata is an erect, branched, somewhat hairy shrub 0.6 to 2.5 meters in height. The leaves are alternate, pale beneath, 3 to 9 centimeters long, heart-shaped at the base, usually lobed, and with toothed margins. The flowers are pink or purplish and about 1.7 centimeters in diameter. The fruits are about 7 millimeters in diameter and are covered with short, barbed spines.

This species is common in waste places throughout the Philippines, and thrives under adverse conditions.

Family BOMBACACEAE

Genus BOMBAX

BOMBAX CEIBA Linn. MALABÚLAK.

Local names: *Bobór, taroktók* (Iloko); *búbui-gúbat* (Rizal, Mindoro); *malabúlak* (Nueva Ecija, Bataan, Manila, Rizal, Laguna).

The bast of this tree is colored orange buff and is used for making ropes. It has a fair degree of tenacity, but is too scarce to be commonly used for rope making. Ropes made from it are said to be suitable for use in the dry season. King found the rope to have a tensile strength of 405 kilos per square centimeter, which was decreased 13 per cent by wetting.

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* King, A. E. W., Mechanical properties of Philippine bast fiber rope. Philippine Journal of Science, Volume XIV (1919).

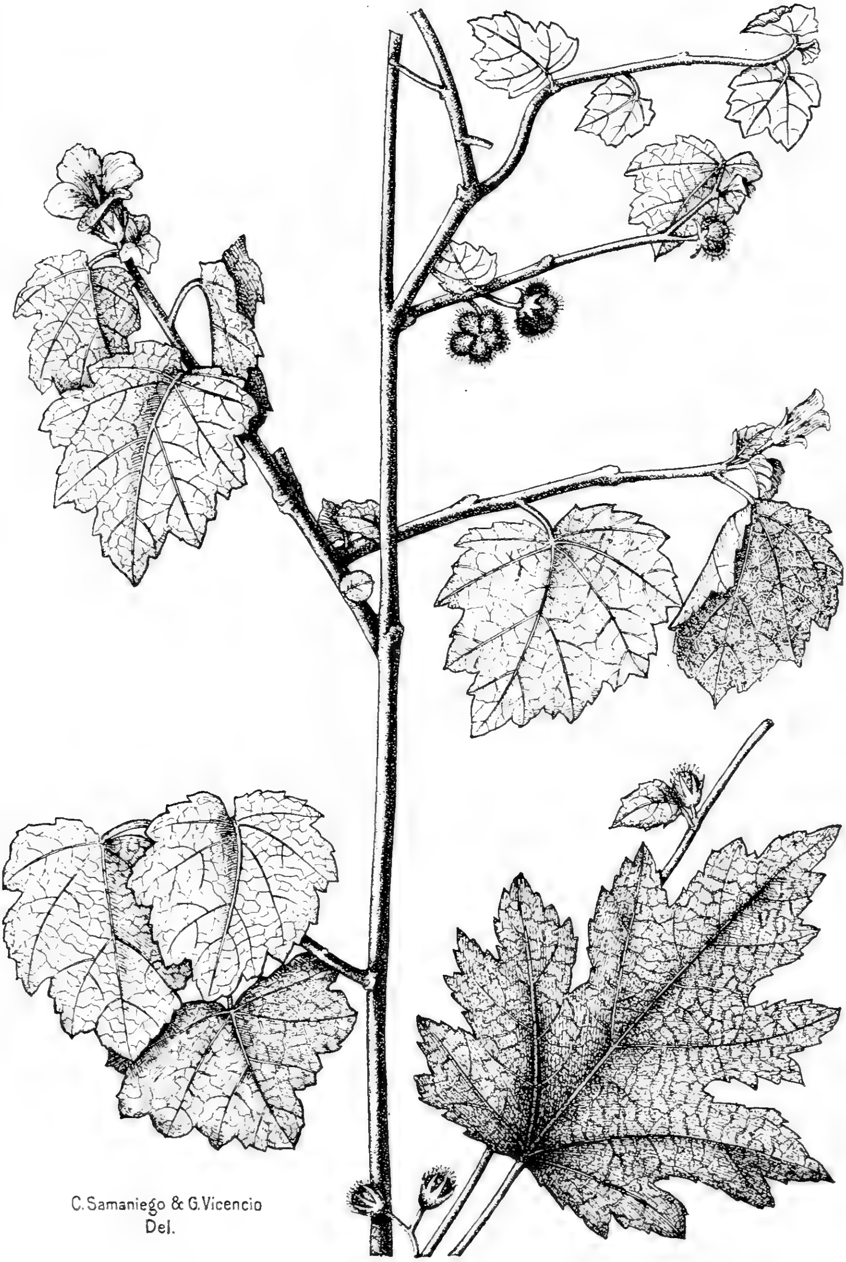

PLATE XXVI. URENA LOBATA (KOLLOKOLLóT).

The seeds are surrounded by silky hairs which are similar to kapok from *Ceiba pentandra*, but whiter. The fiber is often confused with kapok and has been shipped from Indo-China to France under that name. A very detailed account of this fiber is given by Crevost and Lemarié.* They say that it is less waxy than that of *Ceiba pentandra* and so does not behave in the same way in the presence of water.

Dodge † also mentions the use of the hairs for stuffing pillows.

Bombax ceiba is a very large tree, leafless in the dry season. The trunk is covered with large pyramidal spines. The leaves are palmately compound with five to seven leaflets, which are smooth, oval, pointed at both ends, and from 10 to 20 centimeters in length. The flowers are 8 to 10 centimeters long, red, and appear while the tree is leafless. The capsules are about 15 centimeters long.

This species is found at low altitudes throughout the Philippines.

Genus CEIBA

CEIBA PENTANDRA (L.) Gaertn. KÁPOK OR SILK COTTON TREE.

Local names: *Balios* (Bulacan); *basanglái* (Ilocos Sur, Abra); *bobói, bubúi* (Bulacan, Bataan, Cavite, Batangas, Rizal, Laguna, Tayabas, Mindoro); *boibói* (Capiz); *búlak* (Abra, Zambales, Pampanga, Bulacan, Cavite, Batangas, Rizal, Manila, Laguna, Tayabas, Mindoro); *búlak-dondól* (Cebu); *búlak-kastíla* (Pampanga); *búlak-síno* (Bulacan, Bataan, Cavite, Batangas, Rizal, Laguna, Tayabas, Mindoro); *dogdól* (Cebu); *doldól* (Leyte, Samar, Iloilo, Antique, Capiz, Bohol, Cebu, Cuyo Islands); *dondól* (Cebu); *gápas* (Misamis); *kápah* (Zambales); *kápak* (Bulacan, Rizal, Bohol); *kápas* (Ilocos Norte and Sur, Zambales); *kápas-sanglái* (Ilocos Norte and Sur, Abra); *kápok* or *kapók* (Tarlac, Sorsogon, Masbate, Davao and other parts of Mindanao, Basilan, Sulu group); *kapös, kasanglái* (Pangasinan); *káyo* (Camarines, Albay, Sorsogon, Samar, Leyte, Capiz, Antique, Iloilo, Cebu, Bohol); *sanglái* (Abra).

The fibers from the seed pod of this tree are very extensively used for stuffing pillows and mattresses, and are excellent for these purposes. They are also employed in making life preservers. During the past three years, 56,632 kilos of this material, valued at 20,194 pesos, have been exported from the Philippines.

Ceiba pentandra is a slender, erect tree, 15 meters or less in height. The trunk is usually armed with scattered, large spines.

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* Crevost, Ch. and Lemarié, Ch., Plantes et Produits filamentaux et textiles de L'Indochine. Bulletin Economique de L'Indochine, No. 137, New Series, July–August, 1919.

† Dodge, C. R., A descriptive catalogue of useful fiber plants of the world. U. S. Department of Agriculture. Fiber investigations. Report No. 9.

The branches are in distinct whorls and spread out horizontally. The leaves are compound with five to eight leaflets which are borne at the end of the petiole. The leaflets are 6 to 15 centimeters long and pointed at both ends. The flowers are numerous, whitish, and about 3 centimeters long. The capsule is pendant, about 15 centimeters long, 5 centimeters thick, and contains very abundant fiber surrounding the seeds.

This species is distributed at low altitudes throughout the settled areas of the Philippines. It is probably a native of tropical America.

Family STERCULIACEAE

Genus ABROMA

ABROMA FASTUOSA Jacq. (*A. augusta* L.) ANABÓ.

Common names: *Abroma, devil's cotton* (English); *abrome* (French); *kakaomalve, abrome* (German).

Local names: *An-nabó, anabó* (Apayao, Ilocos Norte, Ilocos Sur, Benguet, Abra, Union, Tarlac, Zambales, Bataan, Manila, Rizal, Laguna, Tayabas, Negros); *anabú* (Pampanga); *anafú* (Nueva Vizcaya); *anabong* (Rizal, Oriental Negros, Bohol); *labon* (Oriental Negros, Bohol); *sayapó* (Cotabato); *ambóng* (Bulacan, Batangas, Cavite, Bataan, Laguna, Rizal, Tayabas); *bágo* (Sorsogon); *bodobodó* (Ilocos Norte); *nabó* (Cagayan, Negros, Bohol); *negegan* (Batanes Islands); *pakalkál* (Pampanga); *sayapú* (Moro).

The bast fiber of *Abroma fastuosa* is silky and very strong. It is used in the Philippines for making rope, twine, fish lines, pouches, etc. The rope is valued on account of its strength, and is used for clotheslines because it does not stain.

King tested rope made from crude strips of bast and also from fibers that had been retted in water for about 10 days. In the first case the tensile strength was 545 kilos per square centimeter and in the second, 643 kilos. Wetting lowered the strength of the rope made from crude strips nearly 50 per cent.

A number of writers have believed that this plant offers considerable possibilities in agricultural and industrial enterprises.* It grows vigorously under adverse conditions. Mendiola found that a plant one year old yielded 67 grams of fiber. He believed that *Abroma* should be planted as close as 2 meters and that on this basis one hectare should produce 115 kilos of fiber. The fiber is sold in considerable quantities in Cotabato, Mindanao, at from three to ten pesos a picul. In Cebu it is quoted at from 6.50 to 10.00 pesos a picul. However, extensive

* See Watt, G., The commercial products of India. John Murray, London, 1908.

attempts in India to make this fiber a commercial success have not succeeded.

Abroma fastuosa is a shrub or small tree. The leaves and stems are covered with stiff, irritating hairs. The leaves are alternate, heart-shaped, 10 to 30 centimeters in length, and with toothed margins. The flowers are yellow and about 5 centimeters in diameter. The fruits are thin-walled, five-angled capsules.

This species is widely distributed at low and medium altitudes in the settled areas and brush lands of the Philippines. It is sometimes cultivated.

Genus COMMERSONIA

COMMERSONIA BARTRAMIA (L.) Merr. KAKAÁG.

Local names: *Anitap* (Itneg); *kakaág* (Iloko).

The crude bast strips examined by King "varied from light ochraceous salmon to a warm buff." Rope made from this plant is said to be used considerably for general purposes. King found the dry rope to have a mean tensile strength of 392 kilos per square centimeter. Wetting the rope decreased its strength 32 per cent. However, King says that the residents of Benguet state that this rope is more durable during the rainy season than any of the other bast ropes which are commonly used.

Commersonia bartramia is a small tree. The leaves are alternate, hairy, heart-shaped at the base, pointed at the tip, 12 to 18 centimeters long, and with toothed margins. The flowers are small, white, and are borne on compound inflorescences. The fruits are rounded capsules which are densely covered with slender, soft, hairy processes.

This species occurs at low altitudes throughout the Philippines.

Genus HELICTERES

HELICTERES HIRSUTA Lour. TONGTONGKÍNG.

Local names: *Balibágo, bulbúlin* (Pampanga); *buntot-usá* (Rizal); *danglin-áso* (Bisaya); *danglin-kalabáu* (Abra, Nueva Ecija); *kakaáb, kakaág* (Union, Abra, Pangasinan); *kollokollót ti baó* (Benguet); *lailaiginan* (Rizal); *malamansaníta* (Ilocos Norte, Tagalog); *malatakón* (Abra); *pakin-bákir* (Iloko); *sagiñgsagíñgan* (Tagalog); *sarnugár á dadakkél* (Ilocos Sur); *talakau* (Negrito in Pampanga); *talósan* (Tayabas); *tolósan* (Iloko); *tongtongkíng* (Amburayan).

The crude strips of this fiber are light buff, and harsh and stiff. King found that the tensile strength of rope made from them averaged 438 kilos per square centimeter. Immersion in water for twenty-four hours decreased the strength about 10 per cent. The rope appears to be durable during the rainy season.

Helicteres hirsuta is a shrub with alternate, pointed, hairy leaves, 10 to 15 centimeters in length, the bases of which are obliquely heart-shaped and the margins toothed. The flowers are pink or purplish, slender, and about 2 centimeters long. The fruits are cylindrical, pointed, 3 to 4 centimeters long, and covered with numerous hairy protuberances.

This species occurs at low altitudes throughout the Philippines and is locally very abundant.

Genus KLEINHOVIA

KLEINHOVIA HOSPITA L. TAN-ÁG.

Local names: *Apung-ápung* (Basilan); *bafé ñga bunsúng* (Nueva Vizcaya); *biknóng* (Union, Zambales); *biluáng* (Negros); *bi'nóng* (Nueva Ecija, Abra, Pangasinan); *bitanág* (Agusan, Surigao, Basilan); *bitnóng* (Cagayan, Benguet, Ilocos Norte, Ilocos Sur, Abra, Nueva Vizcaya, Tarlac); *bitonog* (Lanao); *butnóng* (Ilocos Norte); *hamitanágo* (Albay, Samar, Leyte, Cebu, Iloilo, Antique, Capiz, Occ. and Or. Negros, Bohol); *hunung* (Cagayan); *malibágo* (Palawan); *malobágo, lapnís* (Negros); *marakápas* (Ilocos Sur); *palong-manók* (Culion); *pampár, panampát* (Pampanga); *taág, tang-ág* (Rizal); *tagnág* (Zamboanga); *tamanág* (Cotabato, Davao); *taloktók* (Ilocos Norte); *tan'ág* or *tan-ág* (Nueva Ecija, Bulacan, Bataan, Tarlac, Rizal, Laguna, Tayabas, Camarines, Albay, Sorsogon, Capiz, Iloilo); *tanák* (Tayabas).

The bast fiber is widely used for tying bundles. It is also made into rope which is used for tethering carabaos and horses, and for making halters. King found it to have a tensile strength of only 309 kilos per square centimeter. However, immersion in water for twenty-four hours decreased the strength only 7 per cent. The rope is said to be durable during rainy weather.

Kleinhovia hospita is a small or medium-sized tree with large, alternate, heart-shaped leaves which have toothed margins. The flowers are small, pink, and are borne in panicles terminating the branches. The fruit is a thin-walled, inflated capsule about 2 centimeters long. The young leaves are eaten as greens.

This species is found at low altitudes throughout the Philippines and is locally very abundant.

Genus MELOCHIA

MELOCHIA UMBELLATA (Houtt) Stapf. LABÁYO.

Local names: *Anabióng* (Rizal); *anabó* (Nueva Ecija); *baliknóng, bunot-bunót, siapó* (Mindoro); *bignon* (Pangasinan); *binúnga* (Cagayan, Negros Occidental); *biñgábing, lapnís* (Laguna); *labáyo* (Laguna); *malaachuéte* (Bataan).

The bark of this tree is used for making string or rope.

Melochia umbellata is a small tree, and is one of the most rapidly growing species in the Archipelago. The leaves are 12 to 20 centimeters long, heart-shaped, and have toothed margins. The flowers and fruits occur in dense clusters.

This species is very abundant in second-growth forests throughout the Philippines.

Genus PTEROCYMBIUM

PTEROCYMBIUM TINCTORIUM (Blanco) Merr. (Plate XXVII). TALÚTO.

Local names: *Abigón, taóto, taútu* (Bataan, Leyte); *bañgát* (Zambales); *bayaó, takung* (Surigao); *balulau* (Agusan); *duidúi* (Tayabas); *huligáno* (Nueva Ecija); *libtúk* (Cagayan); *malasapsáp* (Pampanga); *marakápas* (Calayan Island, Ilocos Sur, Benguet); *mayuo* (Manobo); *talóto* or *talúto* (Nueva Ecija, Bataan, Laguna, Tayabas, Camarines, Mindoro, Negros, Palawan, Cotabato); *tagungtúngan* (Cebu); *takung* (Surigao).

The bast of this tree is pale orange-yellow. King found that rope made from it had a tensile strength of 381 kilos per square centimeter. Immersion in water for twenty-four hours increased the strength about 7 per cent.

Pterocymbium tinctorium is a tall tree reaching a height of from 45 to 50 meters and a diameter of 90 centimeters. It has a straight, regular trunk from 25 to 30 meters in length. It occurs in the virgin forests and usually on the drier soils. For a short period during the dry season it is leafless. Typical leaves are heart-shaped. The fruits are oval, over a centimeter long, and with prominent wings 7 to 10 centimeters in length. The wood is white, light, and very soft.

Genus PTEROSPERMUM

PTEROSPERMUM DIVERSIFOLIUM Bl. BAYÓK.

Local names: *Báloi, bároi* (Ilocos Sur, Pangasinan, Benguet, Itneg); *bayóg, bayók* or *bayúk* (Nueva Ecija, Pampanga, Zambales, Bataan, Rizal, Cavite, Laguna, Batangas, Tayabas, Camarines, Catanduanes Island, Mindoro, Masbate, Ticao, Negros, Cotabato, Zamboanga, Palawan); *bayóg-bayóg* (Zamboanga); *bayóng, biyúg* (Tayabas); *dibuál* (Basilan); *kabislák* (Davao); *taliñgá'an* (Ilocos Norte).

The bast of this species has very little tensile strength and is not commonly used for rope making. The color of the bast is pinkish cinnamon. King found rope made from it to have a tensile strength of 263 kilos per square centimeter, which wetting did not affect. The bark is also used for dyeing purposes.

Pterospermum diversifolium is a tree reaching a diameter of 50 centimeters. The leaves are alternate, hairy, oblong, heart-shaped at the base, abruptly pointed at the tip, and 11 to 25 centimeters in length. The flowers are white, 12 to 14 centimeters long, and occur either singly or in pairs in the axils of the leaves. The fruit is a woody, five-angled capsule about 15 centimeters long.

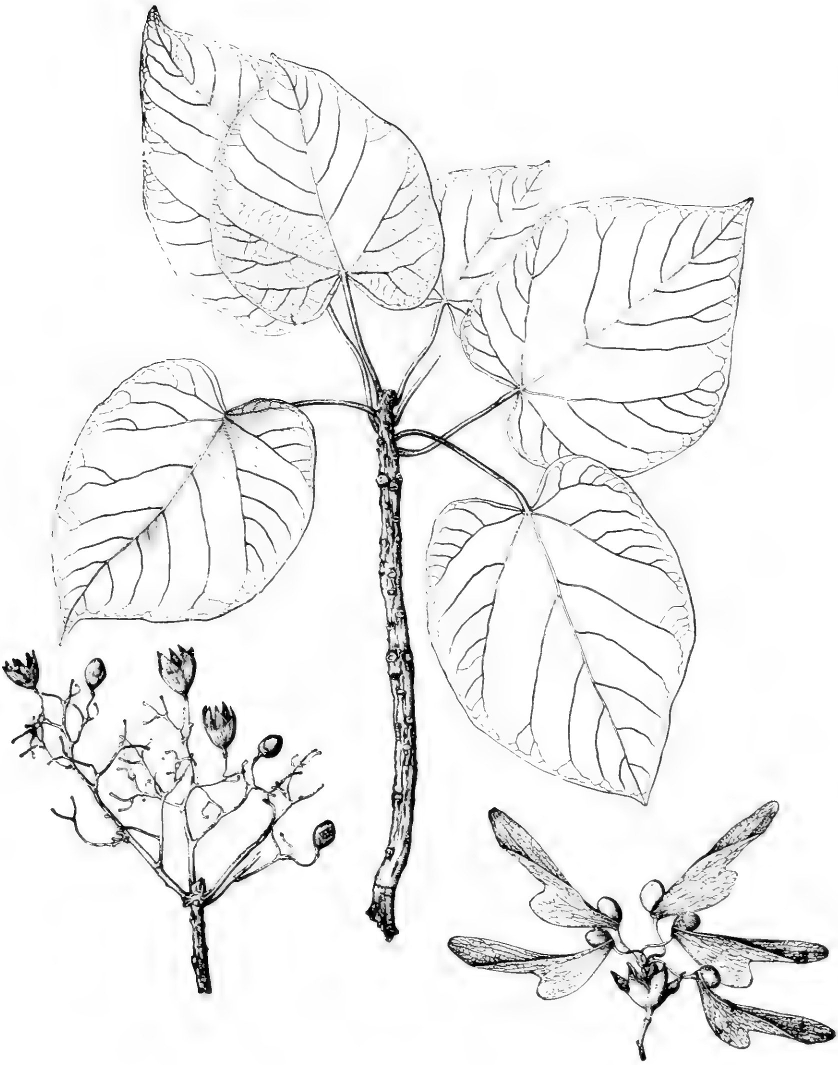

PLATE XXVII. PTEROCYMBIUM TINCTORIUM (TALÚTO).

This species is common and widely distributed in the Philippines.

PTEROSPERMUM NIVEUM Vid. BAYÓK-BAYÓKAN.

Local names: *Bároi* (Abra, Pangasinan, Tarlac); *bayóg* (Zambales, Bataan, Rizal, Laguna, Camarines, Mindoro); *bayók* (Nueva Ecija, Pampanga, Bataan, Laguna); *bayok-bayókan* (Camarines); *bayugtín* (Tayabas); *kantíñgan* (Mindoro); *tamók* (Bataan); *tiñgantíñgan* (Tayabas).

The bark of this species is used for making rope and for tying purposes.

Pterospermum niveum is a tree reaching a diameter of 60 centimeters. The leaves are alternate, hairy, oblique at the base, pointed at the tip, and 7 to 17 centimeters in length. The flowers are large, white, and fragrant. The fruit is oval, pointed, 6 to 8 centimeters long, splits into four or five segments, and contains winged seeds.

This species is widely distributed in the forests of the Philippines.

Genus STERCULIA

STERCULIA CRASSIRAMEA Merr. TAPINÁG.

Local names: *Adupong* (Benguet); *balínad* (Ticao, Palawan); *baníkad* (Mindoro); *banílad* (Rizal, Mindoro, Guimaras Island); *baniakalau* or *bannakalau* (Benguet, Ilocos Norte, Ilocos Sur, Abra); *kalukalumpángan* (Rizal); *palak-pálak* (Bulacan); *malakapái, malapapáya, tapinág* (Bataan).

Rope made from the bast of this tree is fairly strong. King found the tensile strength to be 398 kilos per square centimeter. Wetting decreased it about 23 per cent.

Sterculia crassiramea is a large tree reaching a diameter of 60 centimeters. The smallest branches are much thickened. The leaves are very large, usually more than 35 centimeters long, heart-shaped at the base, and very hairy. The flowers are yellow and 4 millimeters long. The fruits are large, red, and inflated.

This species is widely distributed in forest areas of Luzon.

STERCULIA CUNEATA R. Br. MALABONÓT.

Local names: *Balínad* (Palawan); *bayáyat, tambobonót* (Isabela); *bulákan, malakakáo* (Laguna); *kakao-kakáo, sulimbubú* (Mindoro); *kalukalumpángan* (Rizal); *kalumpáng, úpak* (Pampanga); *malabonót* (Nueva Ecija, Rizal, Manila); *marataróng* (Ilocos Sur); *opong-ópong* (Camarines).

The bark of this tree is used for making rope.

Sterculia cuneata is a tree reaching a height of 15 meters and a diameter of 35 centimeters. The leaves are alternate, very hairy, heart-shaped at the base, pointed at the tip, and from 12 to 28 centimeters long.

This species is widely distributed in the Philippines.

STERCULIA FOETIDA Linn. KALUMPÁNG.

Local names: *Bangár* (Iloko and Itneg); *bóbo, bóbog, bó-bog, búbog* (Panay, Balabac Island, Palawan, Negros); *bóbor, búbur* (Ilocos Sur); *bongóg* (Cagayan); *kalumpáng* (Pampanga, Nueva Ecija, Bataan, Manila, Rizal, Laguna, Tayabas, Polillo, Camarines, Mindoro, Iloilo, Palawan, Cotabato, Apo Island); *kurumpáng* (Davao).

The bast of this species is made into a weak rope which King found to have a tensile strength of only 200 kilos per square centimeter. Immersion in water for twenty-four hours did not affect the strength. The bast is light salmon-orange.

The seeds are edible, but are purgative if eaten raw. They yield an oil used locally for illuminating, and which could be used for culinary purposes.

Sterculia foetida is a large tree reaching a diameter of 100 centimeters. The leaves are palmately compound with seven to nine leaflets, which are smooth, sharply pointed at the apex, and 12 to 18 centimeters long. The flowers are dull yellowish or purplish, 2 to 2.5 centimeters in diameter, and have a very fetid odor. The seeds are borne in very large, red capsules. They are edible and yield a valuable oil for which the tree is sometimes cultivated. The wood is gray, soft, and little used.

This species is widely distributed in the Philippines.

STERCULIA LUZONICA Warb. MALAKALUMPÁNG.

Local names: *Anagás* (Masbate); *balínad, kadlíhan* (Ticao Island); *bóboi-gúbat* (Mindoro); *kalupáng* (Negros); *lapnít* (Cagayan); *malakalumpáng* (Camarines); *talúto* (Guimaras Island); *lontóng* (Zamboanga).

The inner bark of this species is used for making rope.

Sterculia luzonica is a tree reaching a diameter of 60 centimeters and a height of about 30 meters. Its leaves are somewhat heart-shaped at the base, pointed at the apex, and 10 to 20 centimeters in length. The flowers are small, greenish, and are borne on compound inflorescences. The fruits are red and usually occur in groups of from three to five.

This species is widely distributed in the Philippines.

STERCULIA OBLONGATA R. Br. MALABÓHO.

Local names: *Bakán* (Mindoro); *balínad* (Camarines); *banílad* (Rizal, Mindoro); *búnga, malabúnga* (Tayabas); *hanták* (Batanes Islands); *malakakáo* (Bataan, Laguna); *malabanílad* (Samar); *lapnít* (Calayan Island, Babuyanes Islands); *malabóho* (Bataan); *saripongpóng* (Camarines); *sinalígan* (Benguet, Abra); *óos* or *úos* (Camarines).

Most of the strips of bast of *Sterculia oblongata* are salmon-buff in color, some are tawny and others are light salmon orange. Rope made from this fiber is of medium strength. King found it to have a tensile strength of 398 kilos per square centimeter.

Wetting decreased the strength 27 per cent. However, according to King, the residents of Disdis, Benguet state that the rope is preferably used during the rainy season.

Sterculia oblongata is a small or medium-sized tree reaching a diameter of 70 centimeters. The leaves are alternate, smooth, oval, 12 to 30 centimeters long, rounded at the base, and pointed at the tip. The flowers are yellowish white, 5 to 6 millimeters long, and are borne on compound inflorescences. The fruits are inflated, hairy, about 5 centimeters long, 3.5 centimeters wide, with a leathery covering, and contain four to six seeds which are about 1.5 centimeters long.

This species is widely distributed at low altitudes in the Philippines.

STERCULIA PHILIPPINENSIS Merr. BANÍLAD.

Local names: *Bannakálau* (Ilocos Sur); *banílad, banikad,* (Mindoro, Guimaras); *malagasáha* (Laguna).

The bark of this tree is used for making rope.

Sterculia philippinensis is a tree reaching a height of 30 meters and a diameter of 65 centimeters. It has very large, heart-shaped leaves up to 35 centimeters in length. The flowers are small, pink or red, and are borne in considerable numbers on compound inflorescences. The fruits are large and red.

This species is widely distributed in Luzon and the Bisaya Islands.

STERCULIA STIPULARIS R. Br. BONÓTAN.

Local names: *Bisóng* (Nueva Vizcaya); *bonótan, rapók* (Ilocos Norte); *bungát* (Cagayan); *labnái* (Itneg, Abra); *malagasáha* (Tayabas).

The strips of bast of this species are perforated with small holes so that they have a sieve-like appearance. The color is uniform ochraceous-buff. Rope made from it has very little strength, but is used considerably. It is said to be durable during the wet season and is employed particularly for making hog traps. King found the rope to have a tensile strength of 268 kilos per square centimeter, increased 37 per cent by wetting.

Sterculia stipularis is a medium-sized tree. The leaves are alternate, hairy, pointed at the tip, rounded at the base, wider near the apex than near the base, and 10 to 30 centimeters long. The flowers are white and purple, and are borne on compound inflorescences. The fruit capsules are large, red, and inflated.

This species is widely distributed at low altitudes in the Philippines.

Family THYMELAEACEAE

Genus AQUILARIA

AQUILARIA MALACCENSIS Lam.

According to Heyne * this tree furnishes a beautiful, silvery bast used for making rope and cloth. The bast is highly prized for its strength and durability.

Aquilaria malaccensis has been collected only once, and then in Camarines.

Genus PHALERIA

PHALERIA CUMINGII F.-Vill. SALÁGONG-GÚBAT.

Local names: *Bari* (Mindoro); *butígan* (Masbate); *malakakáo, salágong-babáe, salágong-gúbat* (Rizal); *salágo* (Camarines); *tuka* (Cagayan).

The bark of this tree is very strong, and is used as twine or for making rope.

Phaleria cumingii is a tree reaching a height of 8 meters. The leaves are opposite, smooth, pointed at the tip, rounded or pointed at the base, and 8 to 25 centimeters long. The flowers are white, about 3.5 to 4.5 centimeters long, and occur in small clusters. The fruits are red.

This species is widely distributed in Luzon and the Bisaya Islands.

PHALERIA PERROTTETIANA F.-Vill. TUKA.

Local names: *Aligpagi* (Davao); *bágo* (Bataan); *tuka* (Cagayan).

The bark is used as a tying material.

Phaleria perrottetiana is a small tree usually about 2 or 3 meters in height. The leaves are opposite, smooth, oval, pointed at the tip, rounded or pointed at the base, and from 10 to 24 centimeters in length. The fruits are bright red and about 1.5 centimeters long.

This species is distributed from northern Luzon to southern Mindanao.

Genus WIKSTROEMIA

WIKSTROEMIA spp. SALÁGO.

The different species of *Wikstroemia* are shrubs which are found scattered in thickets throughout the Philippines. The common species are *Wikstroemia indica, W. lanceolata, W. meyeniana,* and *W. ovata.*

The bark is collected in considerable quantities and exported to Japan, where it is said to be used in the manufacture of

* Heyne, K., De Nuttige Planten van Nederlandsch-Indië, Volume 3, page 332.

bank notes and other strong paper. Most of the bark collected comes from the vicinity of Mount Mayon and from Mindanao. The bast is light colored and has a somewhat silky appearance. The bark is used for tying purposes and for making rope.

WIKSTROEMIA INDICA (L.) C. E. Mey. SMALL-LEAF SALÁGO.

Local names: *Baleo* (Ilocos Norte); *salágo* or *tálo* (Albay); *titipúho* or *palúpo* (Batanes Islands).

Wikstroemia indica is a shrub 1 to 3 meters in height. The leaves are opposite, somewhat leathery, widest near the middle, somewhat rounded at the tip, pointed at the base, and 1.5 to 7 centimeters long. The flowers are small and yellow; the fruits small and red.

This species is distributed from northern Luzon to southern Mindanao.

WIKSTROEMIA LANCEOLATA Merr. LANCE-LEAF SALÁGO.

Local names: *Salagip* (Batangas); *salágo* (Abra, Tayabas); *tuka* (Ilocos Sur).

Wikstroemia lanceolata is a shrub 1 to 2 meters in height. The leaves are opposite, smooth, pointed at both ends, and 4 to 8 centimeters in length. The flowers are small, light colored, and borne in small clusters. The fruits are red and less than a centimeter long.

This species is found in northern and central Luzon.

WIKSTROEMIA MEYENIANA Warb. (Plate XXVIII). LARGE-LEAF SALÁGO.

Local names: *Ságu* (Laguna); *salágo* (Albay).

Wikstroemia meyeniana is a shrub 1 to 2 meters in height. The leaves are opposite, pointed at the tip, rounded at the base, and 6 to 12 centimeters in length. The flowers are greenish yellow, about 1.5 to 2 centimeters in length, and borne in small clusters. The fruits are red and about a centimeter in length.

This species is common and widely distributed from northern Luzon to southern Mindanao.

WIKSTROEMIA OVATA C. E. Mey. ROUND-LEAF SALÁGO.

Local names: *Dapnít* (Iloko, Bontoc); *salágo* (Bulacan, Laguna).

Wikstroemia ovata is a shrub 1 to 3 meters in height. The leaves are opposite, smooth, rounded at the base, pointed at the apex, and from 5 to 10 centimeters long. The flowers are yellow, about 1.5 centimeters long, and borne in small clusters. The fruits are red and about 1 centimeter long.

This species is distributed from Luzon to Mindanao.

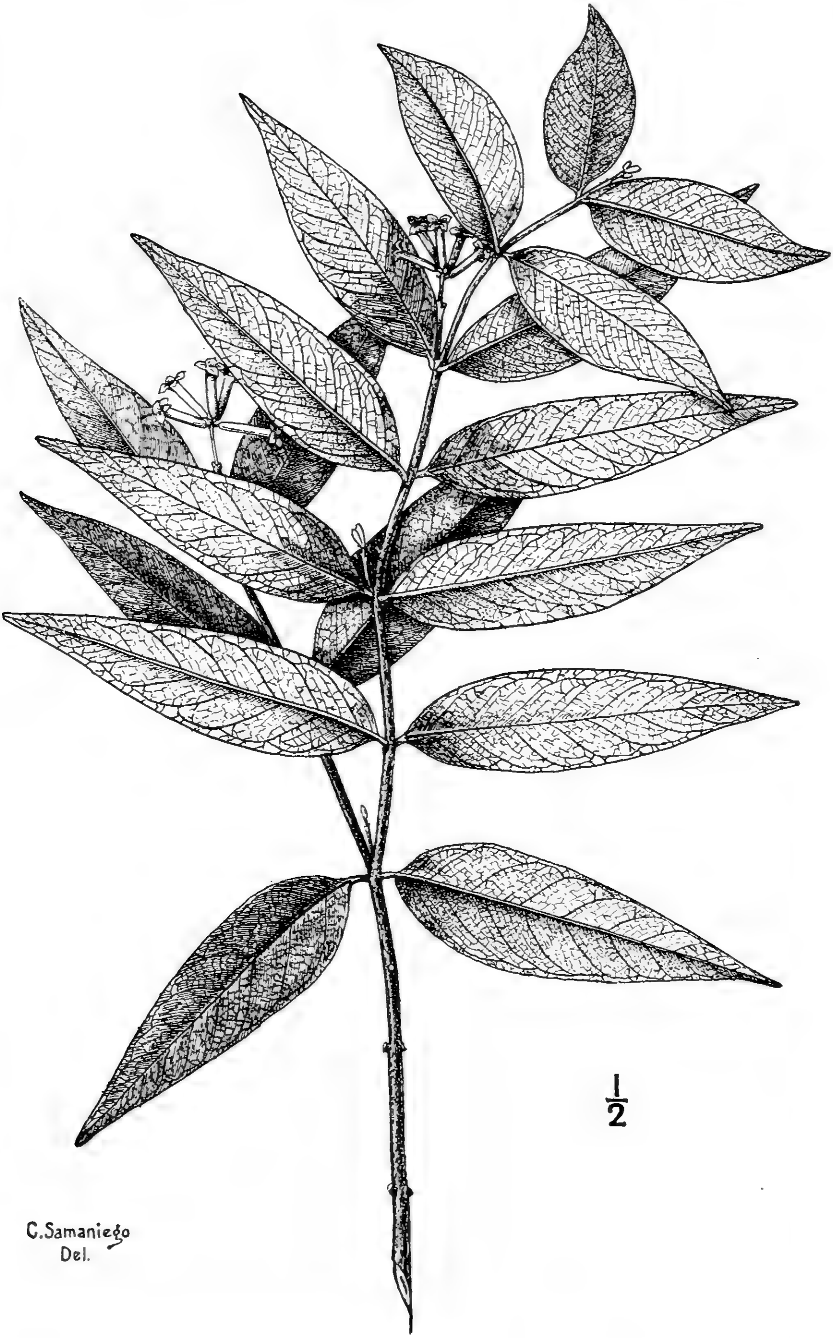

PLATE XXVIII. WIKSTROEMIA MEYENIANA (LARGE-LEAF SALÁGO).

Family MYRSINACEAE

Genus MAESA

MAESA CUMINGII Mez. KATIPUT.

Local names: *Hanópol* (Tayabas); *katiput* (Rizal); *malalapí* (Zambales); *suliman* (Bulacan).

This vine is used for tying purposes.

The leaves of *Maesa cumingii* are alternate, smooth, rounded at the base, pointed at the tip, and from 6 to 12 centimeters long. The flowers occur in considerable numbers on long flowering shoots. The fruits are small and rounded.

This species is widely distributed in the Philippines.

Family LOGANIACEAE

Genus STRYCHNOS

STRYCHNOS MULTIFLORA Benth. BUKÚAN.

Local names: *Abukobukó* (Apayao); *bukúan* (Cagayan); *tibanglán* (Laguna).

This vine is used for tying purposes.

The leaves of *Strychnos multiflora* are opposite, smooth, rounded at the base, pointed at the tip, and from 10 to 18 centimeters long. The flowers are small, white, and borne on compound inflorescences. The fruit is round, bright orange-red, and contains one flat seed.

This species is distributed from Luzon to Mindanao.

Family APOCYNACEAE

Genus ICHNOCARPUS

ICHNOCARPUS OVATIFOLIUS A. DC. SIGÍD.

Local names: *Hinggíu* (Cavite, Pangasinan, Rizal, Laguna, Mindoro); *sadák* (Pangasinan, Ilocos Sur); *sig-íd* (Zambales, Mindoro); *uakák* (Cagayan).

This species is used for tying purposes, especially in making fences, and also for ropes.

Ichnocarpus ovatifolius is a woody vine, 4 meters or more in length. The leaves are opposite, smooth, rounded or pointed at the base, pointed at the tip, and from 5 to 14 centimeters long. The flowers are white, fragrant, about 6 millimeters long, and borne on compound inflorescences. The fruits are cylindrical, 5 to 18 centimeters long, about 3 millimeters in diameter, and densely covered with brown hairs when young.

This species is common and widely distributed in the Philippines.

Genus PARAMERIA

PARAMERIA PHILIPPINENSIS Radlk. DUGTONG-ÁHAS.

Local names: *Dugtong-áhas* (Rizal); *ikdíng-ñga-puráu* (Igorot); *inggíu-na-putí* (Bataan); *karkarsáng* (Benguet); *kuni-na-putí* (Pampanga); *lupí-it* (Ilocos Sur); *parugtong-áhas* (Bulacan, Zambales, Rizal); *partían* (Ilocos Sur); *pulang-pulang* (Zambales); *sadák* (Benguet); *taguláuai* (Rizal).

The bark of this vine is used for making rope and for tying rice bundles.

Parameria philippinensis is a large, woody vine. The leaves are from 7 to 10 centimeters in length, somewhat oval in outline, and pointed at both ends. The flowers are fairly small, white, and occur in clusters. The fruits are very long and slender; the parts containing the seeds are swollen, while the parts between the seeds are very narrow. The seeds are crowned with long, hairlike projections.

This species is common and widely distributed in the Philippines, and is one of the rubber-producing plants in the Archipelago.

Genus URCEOLA

URCEOLA IMBERBIS (Elm.) Merr. HINGGÍU-KALABÁU.

Local name: *Hinggíu-kalabáu* (Laguna).

This vine is used for tying purposes.

Urceola imberbis is a woody vine. The leaves are opposite, smooth, rounded at the base, pointed at the tip, and 8 to 14 centimeters long. The flowers are pale, yellowish green and borne in considerable numbers on compound inflorescences. The fruits are cylindrical, long, and slender.

This species is found in Luzon.

Family ASCLEPIADACEAE

Genus ASCLEPIAS

ASCLEPIAS CURASSAVICA L. BÚLAK-DAMÓ.

Local names: *Anibong, pasangláì* (Bontoc); *bu-buyan, búlak-damó* (Tayabas); *búlak-kastíla, kalalauán* (Bataan); *chile-manúk* (Bataan); *coronitas* (Span., Camarines); *daldál* (Batanes Islands); *kamantíging-lináu* (Batangas); *kápas de Francia* (Pangasinan); *maismaísan* (Rizal).

The silky hairs of the seed are sometimes used for stuffing pillows.

Asclepias curassavica is an erect, simple or slightly branched, smooth, perennial herb 40 to 60 centimeters in height. The leaves are opposite, narrow, pointed at both ends, and 7 to 13 centimeters in length. The inflorescences are umbrella-shaped, and occur in the axils of the leaves or terminate the branches.

The flowers are red and yellow, 1.2 to 1.4 centimeters in length. The fruits are somewhat pointed at both ends, 6 to 8 centimeters in length, and 1 to 1.3 centimeters in diameter at the middle. They contain numerous, flat seeds to which are attached numerous, long, silky hairs.

This species is very common and widely distributed in open places in the Philippines. It is a native of tropical America, but is now a weed in most tropical countries.

Genus STREPTOCAULON

STREPTOCAULON BAUMII Decne. HINGGÍU-NA-PUTÍ.

Local names: *Duktung-áhas* (Rizal); *hiñggíu-kalabáu* (Bulacan); *hinggiu-na-putí* (Manila); *mara-ipus* (Union); *sibut-sibútan* (Rizal).

This vine is used for tying purposes.

Streptocaulon baumii is a woody vine. The leaves are opposite, round or heart-shaped at the base, pointed at the tip, and from 7 to 13 centimeters long. The flowers are numerous and very small. The fruit is about 6 centimeters long and 5 millimeters in diameter, cylindrical, and pointed at the tip. It contains numerous black seeds crowned with silky hairs.

This species is widely distributed in the Philippines.

Family CONVOLVULACEAE

Genus MERREMIA

MERREMIA NYMPHAEIFOLIA Hall. f. BULÁKAN.

Local names: *Bulak-bulákan* (Camarines); *bulákan* (Tayabas, Laguna, Mindoro); *burákan* (Camarines); *tampinita* (Misamis).

This vine is sometimes used for tying purposes.

Merremia nymphaeifolia has alternate, heart-shaped leaves, which are from 8 to 25 centimeters in length. The flowers are large and yellow.

This species is distributed throughout the Philippines.

Genus OPERCULINA

OPERCULINA TURPETHUM (L.) Manso.

Local names: *Burákan* (Ticao); *kamokamotéhan* (Rizal).

This vine is used for tying purposes.

Operculina turpethum is a pubescent vine reaching a length of 5 meters or more. The stems are often purplish, prominently 2- to 4-angled, and narrowly winged. The leaves are alternate, 5 to 15 centimeters long, the apex pointed, the base somewhat heart-shaped or straight. The corolla is white and 4 centimeters long and wide. The capsule is rounded and 1 to 1.5 centimeters in diameter.

This species is found throughout the Philippine Islands.

Family BORAGINACEAE

Genus CORDIA

CORDIA CUMINGIANA Vid. ANÓNANG-LALÁKI.

Local names: *Anónang-laláki* (Mindoro); *maratarόng* (Iloko).

The strands of bast fibers vary considerably in size and color. Rope made from them possesses only a medium degree of tenacity.

Cordia cumingiana is a small tree reaching a height of about 7 meters. The leaves are alternate, hairy, heart-shaped, and 8 to 16 centimeters long. The flowers are white, about 4 millimeters long, and borne on compound inflorescences. The fruits are about 1 centimeter long.

This species is of local occurrence at low altitudes in Luzon.

CORDIA MYXA Linn. ANÓNANG.

Local names: *Anónang, anúnang, anúnong* (Ilocos Sur, Benguet, Union, Pangasinan, Zambales, Pampanga, Bataan, Manila, Rizal, Laguna, Nueva Ecija, Cavite, Tayabas, Batangas, Camarines, Albay, Sorsogon, Mindoro, Masbate, Leyte, Guimaras Island, Palawan, Surigao, Cotabato, Misamis); *anónang-bákir, sinalígan* (Ilocos Sur); *guma* (Balabac Island); *salúyong* (Tagalog).

Rope is made from the bast of this tree. This rope is relatively weak and is said to be unsuited for use in a wet condition. The bast is brown. King found the tensile strength of the rope to be 324 kilos per square centimeter. Wetting decreased the strength 19 per cent.

A white, gelatinous substance obtained from the fruits is used as glue.

Cordia myxa is a tree usually 5 to 10 meters in height. The leaves are alternate, smooth or nearly so, pointed at both ends, and 6 to 15 centimeters long. The flowers are white or yellowish white, about 7 millimeters long, and borne on compound inflorescences. The fruits are yellowish white, 10 to 13 millimeters long, and soft, with a hard stone in the center.

This species is very common and widely distributed in second-growth forests and open places at low altitudes in the Philippines.

Family CAPRIFOLIACEAE

Genus LONICERA

LONICERA PHILIPPINENSIS Merr. BUALTÍK.

Local name: *Bualtík* (Benguet).

This vine is used entire in Benguet for tying fences.

The leaves are opposite, pointed at the tip, rounded at the base, and from 3.5 to 5 centimeters in length. The flowers are white, occur in axillary or terminal clusters, and are about 2 centimeters in length. The fruit is a small, black, fleshy berry.

This species has been reported only from Benguet.

LIST OF SPECIES USED FOR VARIOUS PURPOSES

The following list gives the principal wild species which are employed in making different articles. No attempt has been made to include ordinary uses of the cultivated species. The sections on bamboos and palms should also be consulted, as fibers from these plants are not included in the present section.

BAGS

Musa textilis
Pandanus radicans
Pandanus simplex
Scirpus grossus
Typha angustifolia

BASKETS

Agave cantala
Dendrobium crumenatum
Donax cannaeformis
Dryopteris pteroides
Epipremnum spp.
Flagellaria indica
Gleichenia linearis
Lygodium spp.
Musa textilis
Nephrolepis hirsutula
Pandanus copelandii
Pandanus luzonensis
Pandanus radicans
Pandanus simplex
Pandanus tectorius
Pericampylus glaucus
Pothos spp.
Raphidophora spp.
Rhynchospora corymbosa
Scirpus grossus
Stenochlaena palustris
Typha angustifolia

BELTS

Gleichenia linearis
Musa textilis

BOXES

Lygodium spp.

BROOMS

Andropogon zizanioides
Malvastrum coromandelinum
Oryza sativa
Phragmites karka
Phragmites vulgaris
Saccharum spontaneum
Thysanolaena maxima

CORDAGE

Abroma fastuosa
Abrus precatorius
Agelaea everettii
Allaeanthus glaber
Alphitonia excelsa
Amomum sp.
Anamirta cocculus
Artocarpus communis
Artocarpus integra
Artocarpus rubrovenia
Bauhinia cumingiana
Boehmeria nivea
Bombax ceiba
Bombycidendron vidalianum
Columbia blancoi
Columbia lanceolata
Columbia mollis
Commersonia bartramia
Corchorus capsularis
Corchorus olitorius
Cordia cumingiana
Cordia myxa
Cyperus malaccensis
Donax cannaeformis
Elaeocarpus calomala
Ficus benjamina
Ficus forstenii
Ficus pachyphylla
Ficus palawanensis
Flagellaria indica
Gnetum gnemon
Gnetum indicum
Gnetum sp.

Goniothalamus amuyon
Grewia acuminata
Grewia bilamellata
Grewia eriocarpa
Grewia multiflora
Helicteres hirsuta
Hibiscus tiliaceus
Ichnocarpus ovatifolius
Ischaemum angustifolium
Kleinhovia hospita
Lonicera philippinensis
Maesa cumingii
Malachra capitata
Malachra fasciata
Malaisia scandens
Melochia umbellata
Muntingia calabura
Parameria philippinensis
Phaeanthus ebracteolatus
Phaleria cumingii
Phaleria perrottetiana
Polyalthia flava
Pongamia pinnata
Pterocymbium tinctorium
Pterospermum diversifolium
Pterospermum niveum
Raphidophora spp.
Rourea volubilis
Sapindus saponaria
Sida acuta
Sida cordifolia
Sida mysorensis
Sida rhombifolia
Stenochlaena palustris
Sterculia crassiramea
Sterculia cuneata
Sterculia foetida
Sterculia luzonica
Sterculia oblongata
Sterculia philippinensis
Sterculia stipularis
Streptocaulon baumii
Strychnos multiflora
Thespesia lampas
Trema orientalis
Triumfetta bartramia
Typha angustifolia
Urceola imberbis
Urena lobata
Wikstroemia spp.

CRADLES

Raphidophora spp.

FABRICS

Agave cantala
Ananas comosus
Boehmeria nivea
Corchorus capsularis
Corchorus olitorius
Malachra capitata
Musa textilis
Musa sp. (a wild banana)
Sida rhombifolia
Urena lobata

FANS

Andropogon zizanioides

FANCY ARTICLES

Abroma fastuosa
Fimbristylis diphylla
Fimbristylis globulosa
Lygodium spp.
Musa textilis
Pandanus simplex
Saccharum spontaneum

HAMMOCKS

Raphidophora spp.

HATS

Andropogon halepensis
Andropogon zizanioides
Cyperus malaccensis
Donax cannaeformis
Fimbristylis globulosa
Imperata exaltata
Lygodium spp.
Musa textilis
Nephrolepis hirsutula
Oryza sativa
Pandanus radicans
Pandanus sabotan
Pandanus simplex
Pandanus tectorius
Phragmites vulgaris
Saccharum spontaneum
Scirpiodendron ghaeri
Sporobolus elongatus

MATS

Cyperus malaccensis
Cyperus radiatus
Imperata exaltata
Musa textilis
Nephrolepis hirsutula
Pandanus copelandii

Pandanus dubius
Pandanus luzonensis
Pandanus radicans
Pandanus sabotan
Pandanus simplex
Pandanus tectorius
Rhynchospora corymbosa
Scirpus grossus
Scirpus lacustris

PAPER PULP

Imperata exaltata
Saccharum spontaneum
Wikstroemia spp.

PICTURE FRAMES

Saccharum officinarum
Saccharum spontaneum

PILLOWS

Asclepias curassavica
Bombax ceiba
Ceiba pentandra
Typha angustifolia

SCREENS

Cyperus radiatus
Miscanthus sinensis
Rhynchospora corymbosa
Saccharum spontaneum

SLIPPERS

Agave cantala
Cyperus malaccensis
Fimbristylis diphylla
Fimbristylis globulosa
Ischaemum angustifolium
Oryza sativa
Pandanus simplex
Rhynchospora corymbosa
Typha angustifolia

THATCHING

Andropogon zizanioides
Imperata exaltata

TYING FISH TRAPS

Malaisia scandens
Pothoidium lobbianum
Rourea volubilis
Stenochlaena palustris

WINDOW SHADES

Miscanthus sinensis

PHILIPPINE FOREST PRODUCTS AS SOURCES OF PAPER PULP

By WILLIAM H. BROWN and ARTHUR F. FISCHER

PHILIPPINE FOREST PRODUCTS AS SOURCES OF PAPER PULP

By William H. Brown and Arthur F. Fischer

INTRODUCTION

The increasing difficulty of obtaining wood pulp for paper has led to the examination of a great variety of substances to be used as substitutes. The possibilities for paper pulp in the Philippines have been investigated by Richmond and reported on in a series of articles in the Philippine Journal of Science.*

Since Richmond's articles appeared very little information has been obtained concerning paper, except in regard to supply and yield of materials. The Philippines offer a particularly favorable site for the establishment of a paper industry, as raw material of good quality and at cheap prices is available. There is, moreover, a very considerable local market in addition to that which can be obtained by export. The Philippine Legislature has passed a law guaranteeing for a paper plant an interest of four per cent per annum for three or six years. The local demand is considerable, as can be seen from the fact that during the year 1917 paper and paper products to the value of 3,778,373 pesos were imported into the islands. In Manila alone there are eleven daily and eight weekly papers, besides numerous monthlies and quarterlies. Richmond has shown that there is not only a considerable amount of material for paper pulp to be derived from forest products, but that besides there are other very considerable sources. In the Philippines, clothes are made largely from cotton which is not mixed with wool, and by far the largest part of this cotton is white, so that cotton rags offer considerable possibilities for the manufacture of paper. Among the agricultural products may be mentioned abaká (Manila hemp) waste, banana fiber, sisal, and maguey waste. In the process of stripping commercial fiber from abaká as much or more waste fiber is left in the stalk than is extracted. Richmond has found that this material makes an excellent paper. The abundance of this waste is shown by the fact that 171,148 metric tons of abaká were exported from the Philippine Islands

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* Richmond, G. F., Philippine fibers and fibrous substances: Their suitability for paper-making, *Philippine Journal of Science*, Vol. I, p. 433; Part II, Vol. I, p. 1075; Part III, Section A, Vol. II, p. 81.

——Philippine fibers and fibrous substances: Their suitability for paper-making, *Philippine Journal of Science*, Section A, Vol. V (1910), p. 233.

during the past year. The growing of sisal and maguey is increasing rapidly and these sources should soon offer considerable material for paper. Richmond has also shown that banana fiber makes an excellent paper. He calculated that 33,913 hectares in the Philippines were used for raising bananas. When a banana stalk once bears fruit, the stalk is then cut down and usually allowed to decay so that this possible source of paper pulp is now entirely wasted, except when used as food for stock. Besides the cultivated bananas there are large tracts of wild bananas in the Philippines.

Among the forest products which offer immediate prospects for paper pulp are three plants: one a bamboo (*Schizostachyum lumampao*), and two grasses, kogon (*Imperata exaltata*) and talahib (*Saccharum spontaneum*). The other sources will be mentioned later.

BAMBOO FOR PAPER

Perhaps the most promising source of paper material is offered by the moderate-sized, thin-walled bamboo, *Schizostachyum lumampao*. For a description of this plant and its production, see the section on bamboos.

As is well known, bamboo has long been used for making paper in China. In fact, it is the chief material in use for this purpose in that country. Various species of bamboo in other countries have also been made into good paper as will be seen by referring to Richmond's articles.

The following excerpt communicated by Consul Henry D. Baker, of Trinidad, British West Indies, in the United States Commerce Reports No. 57 of March 9, 1918, shows how favorably bamboo is considered as a paper material.

The publishing house of Thomas Nelson & Sons, of Edinburgh, Scotland, has an important project under way for manufacturing paper from bamboo in Trinidad. About 1,000 acres of land near St. Joseph (7 miles from the capital at Port of Spain) have been planted in bamboo, and a concession has been obtained giving the firm the right to cut bamboo from the Government forests.

It appears that Thomas Nelson & Sons, foreseeing a paper famine throughout the world within the next few years, have been giving very serious consideration to the problem of providing adequate paper reserves for themselves for the future; and although realizing that paper can be manufactured from any vegetable material containing cellulose, nevertheless, it seemed to them that bamboo was most suitable for the purpose. They selected Trinidad for their bamboo-paper project, as the bamboo grows here very quickly, having sufficient development within three or four years for making paper. Moreover, Trinidad is within a reasonably short distance by sea from Edinburgh, being, of course, much nearer to their headquarters than are the bamboo forests of Asia.

Raitt * in discussing the paper sources in India describes bamboo as an excellent paper material.

As has been shown in the section dealing with bamboo, *Schizostachyum lumampao* covers extensive, accessible areas in the Philippines. A combination of the data given in Bulletin 15 for this bamboo and Richmond's figures for yield of pulp will enable us to form an estimate of the amount of pulp that can be secured from a given area. In the discussion of this species, it was shown that an average hectare of *Schizostachyum lumanpao* contains approximately 9,000 canes. Richmond found that an average green stem weighed 7.2 kilograms; an air-dried stem, 4 kilograms; and an air-dried one without the nodes, 3.75 kilograms. Using this last figure it will be seen that there would be 33.75 metric tons of dried material per hectare. Richmond calculated that 2 metric tons of dried material would give about 1 short ton of pulp. A hectare should therefore produce about 17 tons of pulp.

No exact figures concerning the cost of collection of *Schizostachyum lumampao* can be given. It is sold in Orani, Bataan Province, at from 8 to 12 pesos per thousand stems. Richmond calculated that a thousand canes could be cut and transported a distance of 1 to 2 kilometers at a cost of between 6.33 and 8.16 pesos. All of these figures apply, of course, only to the crude, primitive method at present employed in collecting this material. However, even at a price of 10 pesos per thousand stems, the material for a ton of pulp would cost only 2.50 pesos.

Concerning the preparation of paper pulp by the soda process from *Schizostachyum lumampao,* we may quote the following from Richmond:

> It was found as the result of repeated trials with caustic soda liquors under varying conditions of strength, pressure and duration of cooking, that bamboo chips prepared as outlined above invariably yielded 43 to 45 per cent of air-dry, unbleached fiber under the following conditions:
>
> (*a*) Upright cylindrical stationary digestors.
>
> (*b*) Direct live-steam heat.
>
> (*c*) Fifteen to 20 per cent of 76 per cent caustic soda calculated on the air-dry weight of the raw material.
>
> (*d*) A duration of cooking of four to six hours.
>
> (*e*) A maximum temperature of 160° C. (320° F.) corresponding to a steam pressure of 45 kilos (90 pounds).
>
> Fiber thus prepared bleached to a splendid white with 12 to 15 per cent of bleaching powder. The fiber was strong, of good felting capacity, and it made a more bulky sheet than wood pulp. Bamboo fibers average 2.5 to 3 millimeters in length, so that they are somewhat longer and materially narrower than spruce fibers.

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* Raitt, Wm., New fibers for paper, *The Indian Forester,* Vol. 36 (1910), p. 34.

That bamboo is readily resolved by the soda process of treatment to a fiber which is easily blended has been proved beyond doubt, and further experiment in this direction is scarcely necessary. The fiber possesses the requisite length, strength, and felting capacity to meet the paper maker's demands, and the quantity of resistant cellulose per unit weight of the raw material is sufficient to warrant its extraction.

The following quotations, also from Richmond, give information concerning the sulphite process on *Schizostachyum lumampao:*

Bamboo chips prepared as described above, in lengths varying from 1.270 to 2.540 centimeters, but uncrushed, were well screened from dust and dirt and packed into a stationary, upright, lead-lined digester and heated with direct fire in the presence of sulphite liquors of different concentration and under varying conditions of temperature and time. Thirty-seven separate digestions were made, but in no instance was I able to produce from bamboo a pulp easy to bleach with bleaching powder, the universal bleaching agent employed in the industry at the present time.

The process yields fully 50 per cent of unbleached pulp and with a much lower sulphur consumption than is required in commercial practice for wood. Well prepared, but uncrushed chips pulped readily with liquors of ordinary strength in six to eight hours, but the unbleached fiber was not as light in color as sulphite spruce and could only be used in the unbleached condition for wrappings, tags, etc., where strength, rather than color, is the important consideration. It is needless to say that I varied all the conditions of the treatments in every conceivable manner with the main point in view of producing a pulp which would bleach readily, and with a reasonable consumption of bleaching agent, but without success. If bamboo pulp were most suited for use in an unbleached state, then the sulphite process should be adopted by all means, but the material is not sufficiently light in color to be mixed with mechanical wood pulp in preparing news print paper, besides it is too good a fiber for the latter or for wrappings, for which it is entirely suited so far as color is concerned. In my opinion, bamboo fiber is eminently fitted for paper for books and for certain grades of writing and lithographic papers, either alone or when blended with rag or sulphite wood pulp.

A few data selected from the more successful sulphite experiments are given: [Table I.]

TABLE I.

Experiment No.	Composition of the liquor.				Conditions of time and temperature.			Yield of unbleached pulp.	Bleach consumed.	Sulphur consumed per ton of pulp.	Color.
	Lime.	Total acid.	Combined acid.	Free acid.	Time to reach maximum.	Total time.	Maximum temperature.				
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Hrs.*	*Hrs.*	°*C.*	*Per ct.*	*Per ct.*	*Metric.*	
1	1.17	3.87	1.34	2.52	$3\frac{1}{2}$	7	145	52.4	30	149.6	Poor white.
2	1.28	4.53	1.47	3.04	3	7	150	50.2	27.6	240.0	Do.
3	1.09	3.39	1.25	2.14	4	9	145	50	24.12	240.0	Do.
4	1.12	3.71	1.28	2.43	3	8	145	51	28.5	223.5	Do.

It will be noted that from 24 to 30 per cent of bleaching powder was required to produce at best a poor white, that is, 12 to 15 kilos of bleaching powder of the standard strength (35 per cent available chlorine) are required for 50 kilos of unbleached pulp. This consumption is excessive, and it forms the greatest objection to placing bamboo pulp prepared in this way on the market. . .

Aside from the poor bleaching properties of bamboo sulphite fiber prepared under the above conditions, there are other factors, both local and general, which tend to preclude the use of the sulphite process of treating bamboo at the present time.

1. Bamboo fiber appears better suited for book printing and lithographic papers than for wrapping or news printing paper. This being the case, bulk, softness, and opacity, which are the chief features of soda fiber, are what is desired. . .

2. It is undoubtedly true that the sulphite process costs less than the other for chemicals. Sulphur, at present quotations, can be converted into sulphite liquor and thrown away after use at less expense than the cost of soda actually consumed plus the cost of its recovery. However, the local supplies of limestone are better adapted for making soda than sulphite liquor. . .

The other chemicals, sulphur on the one hand and soda on the other, used in the two processes, are not produced locally, hence would have to be imported from the most favorable foreign source.

Richmond also investigated *Bambusa spinosa* as a source of paper pulp, and found that this species gave a smaller yield of cellulose than *Schizostachyum lumampao* and required an excessive amount of bleach (20 to 25 per cent) to produce at best a poor white.

GRASS FOR PAPER

Indications are that approximately the whole Archipelago was originally covered with forest. However, a shifting system of cultivation has reduced large parts of forested areas to waste grassland until at the present time about 40 per cent of the total land surface of the Archipelago is covered by grass, particularly the two species, kogon (*Imperata exaltata*) and talahib (*Saccharum spontaneum*). These grasslands originated in the following manner. When a forest is clear cut and cultivated by primitive metnods, grass and weeds invade the area. In order to remove these, it is a common practice to cut all plants and burn. This effectually kills the tree seedlings and shrubs, but does not harm the grass, which grows from strong underground stems. The result of several such fires is that the land is left in the possession of the grass, which is hard to eradicate by primitive methods of cultivation. Grass areas once established are usually burned over every dry season and so remain almost indefinitely in grass. If these grasses were cut for paper-pulp manufacture the cutting would have much the same effect as fire in keeping out other vegetation. Burning or cutting these grasses seems to have no injurious effect on the stand but rather causes an increase in the rate of growth. From the foregoing, it will be seen that abundant grass areas can be found for the production of tremendous quantities of raw material.

Richmond has investigated both kogon and talahib as sources of paper pulp and concluded that both species would make excellent paper.

Kogon is a rank-growing, sod-forming grass about 1.5 meters in height. The study of kogon was carried on in connection with esparto grass, which has long been in use for the manufacture of paper. Comparative analyses of these two species are given in Table II. Table III indicates the yield of paper cellulose to be expected under factory conditions, and the treatment and amount of soda necesary to produce a well-boiled paper. All four of the pulps produced by the experiments in Table III were light gray, clear, and appeared to be well reduced. An investigation of kogon also showed that no preliminary treatment was necessary, but that after being dried and hand picked or machine cleaned, it was ready for immediate digestion.

TABLE II.—*Analysis of kogon and esparto grass.*

Ash, alkaline hydrolysis, and cellulose calculated on dry material.

	Kogon grass.	Esparto grass (Spanish).
	Per cent.	*Per cent.*
Moisture	9.32	8.68
Ash	4.53	3.71
Hydrolysis (a)	25.77	19.75
Hydrolysis (b)	40.00	37.16
Cellulose	50.11	55.16

Chemical composition of kogon and esparto grass.

	Kogon.	Esparto.
	Per cent.	*Per cent.*
Cellulose	46.68	48.25
Fat and wax	1.16	2.07
Aqueous extract	10.80	10.19
Pectous substances	26	26.39
Water	11.33	9.38
Ash	4.03	3.72

[a] Figures from Richmond, G. F., *Philippine Journal of Science*, Vol. 1 (1906), p. 458.

TABLE III.—*Experiments on kogon grass, showing amount of caustic soda used and yield of pulp.*[a]

Percentage of—	Experiment 1.	Experiment 2.	Experiment 3.	Experiment 4.
Soda liquor	2	2.4	2.5	3
Caustic calculated on weight of material	10	12	12	15
Yield of pulp	47.34	45.5	45.42	44.25

[a] Figures from Richmond, G. F., *Philippine Journal of Science*, Vol. 1 (1906) p. 458.

Talahib is a taller grass than kogon and frequently reaches a height of more than 3 meters. It is a bunch grass and usually occurs in moister situations than kogon and forms denser stands.

TABLE IV.—*Analysis of talahib grass.*[a]

Moisture	10.23
Ash	5.46
Hydrolysis (a)	27.44
Hydrolysis (b)	40.53
Cellulose	53.90

[a] Figures from Richmond, G. F., *Philippine Journal of Science*, Vol. 1 (1906), p. 458.

In Table IV, from Richmond's publication, is shown the percentage of cellulose obtained from this species. The pulp bleached to a good white with only 2.3 per cent loss in weight by the use of 5.7 per cent of bleaching powder calculated on the original weight of the material digested.

Raitt * says that *Saccharum sara* of India yields an excellent, easily bleached paper similar to that of wheat straw.

MISCELLANEOUS PRODUCTS

Several species of palms, including rattans, nipa, buri, and coconut, are widely distributed throughout the Archipelago and contribute to the local demands of the people for food and shelter. A discussion of their distribution is given in the section on palms. The fibrous products of some of these palms might offer a considerable source of paper. Richmond † made unbleached paper from buri-palm rope and found it to be strong and fairly free from shive.

The bark of *Wikstroemia ovata, W. indica, W. meyeniana*

* Raitt, Wm., New fibers for paper. *The Indian Forester*, Vol. 36 (1910), p. 34.

† Richmond, G. F., *Philippine Journal of Science*, Vol. I, p. 1084.

and other species of the same genus is collected in considerable quantities and exported to Japan where it is said to be used for the manufacture of bank notes and other strong papers. These plants are small bushes which are scattered in thickets throughout the Philippines. Most of the bark collected comes from the vicinity of Mount Mayon and from Mindanao.

In the Philippine Islands there are large numbers of plants with strong bast fibers. Some of these might be useful for high-grade paper or for strengthening paper made from weaker material. These barks are discussed in the section on fibers.

In Table V are given the dimensions of the ultimate fibers of some of the plants previously discussed.

TABLE V.—*Dimensions of the ultimate fibers of some Philippine fiber plants.*

[Taken by Dr. E. B. Copeland. All measurements in millimeters.]

Name.	Length.			Diameter.					
				Total.			Lumen.		
	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.
Abacá (*Musa textilis*)	6.00	3.98	2.45	0.021	0.017	-------	0.009	0.0066	-------
Plantain (*Musa sapientum var. paradisiaca*)	7.30	5.49	4.15	.026	.020	0.018	.016	.0106	0.007
Maguey (*Agave cantula*)	4.93	2.38	1.00	.026	.018	.005	.013	.007	.004
Cogon grass (*Imperata exaltata*)	1.82	0.99	0.46	.021	.011	.005	.013	.0044	.001
Talahib grass (*Saccharum spontaneum*)	2.82	1.59	0.80	.020	.015	.012	.010	.0043	.1115
Bamboo (*Bambusa blumeana*)	-------	1.81	-------	-------	.0075	-------	-------	-------	-------
Dwarf bamboo (*Bambusa lumampao*)	4.10	2.57	1.20	.028	.0156	.005	.025	.018	.001
Rice straw (*Oryza sativa*)	-------	0.88	-------	-------	.0025	-------	-------	-------	-------
Buri palm (*Corypha elata*)	2.80	2.11	1.10	.015	.013	.010	.007	.0034	.002

As far as we now know, the Philippine forests in general do not offer particularly favorable conditions for the gathering of pulp material. This is due to the fact that the composition of the forests is very complex. On one quarter of a hectare of virgin forest on Mount Maquiling there were 92 different tree species. In an over-cut area of the same size there were 129 different species. However, conditions are not always as unfavorable as these figures would indicate, as frequently the bulk of the timber is comprised in only a few species, these species being usually of the same family. In some forests the composition is probably uniform enough and the volume of timber sufficient for pulpwood to be collected economically. However, the wood in these forests commands such a price that it is doubtful if it would be profitable to use the wood for paper pulp. The most feasible means of producing pulp from wood would probably be in connection with large sawmill units in using the waste for pulp. In large forests there is always a considerable proportion of defective timber and besides in the operations of cutting there is always a large amount of waste produced. Trees which do not produce commercial lumber could, moreover, be cut and taken in at the same time as other logs. Richmond * has investigated several species of trees as a source of paper pulp. His figures on lauan, palosapis, and kupang are interesting, as these trees occur in large numbers. The first two form dense stands and produce a large part of the lumber cut in the Philippines. Palosapis and lauan are very similar in structure to other Philippine woods which occur in large quantities. The length of the ultimate fibers of these woods is given in Table VI. The figures in this table are taken from a longer table by Dr. F. W. Foxworthy. The approximate analyses of these woods is given in Table VII, taken from Richmond. In Table VIII are given data on experiments with the soda process on lauan, palosapis, and kupang; and in Table IX are data on the sulphite process.

TABLE VI.—*Dimensions of the ultimate fibers of some Philippine woods.*

[Figures from table by Dr. F. W. FOXWORTHY.]

Name.	Length.			Diameter.					
				Total.			Lumen.		
	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Lauan (*Pentacme contorta*)	2.28	1.94	1.13	0.026	0.022	0.017	0.017	0.014	0.009
Palosapis (*Anisoptera thurifera*)	2.62	1.92	1.16	0.030	0.023	0.019	0.0092	0.0058	0.0031
Kupang (*Parkia javanica*)	1.80	1.15	0.86	0.038	0.029	0.021	0.026	0.020	0.014

* G. F. Richmond, *Philippine Journal of Science*, Section A, Vol. II, 1907, p. 81.

TABLE VII.—*Proximate analyses of Philippine woods.*

[Data from RICHMOND.]

Kind of wood.	Water.	Aqueous extract.	Alcohol ether extract.	Cellulose.	Incrusting matter.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Lauan	11.23	3.85	2.72	61.71	19.57	0.89
Palosapis	11.50	4.50	1.20	55.73	28.24	0.83
Kupang	13.33	3.45	1.17	60.56	19.41	2.03
Dita	10.41	4.19	0.60	49.91	33.87	0.99

TABLE VIII.—*Experiments with soda process on Philippine woods.*

[Data from RICHMOND.]

Kind of wood and experiment No.	Caustic soda solution.	Caustic soda calculated on weight of material.	Duration of digestion.	Pressures carried.	Yield of pulp. Unbleached.	Yield of pulp. Bleached.	Bleaching powder consumed.	Loss of weight in bleaching.
Lauan:	*P. ct.*	*P. ct.*	*Hrs.*	*Atmospheres.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1	10	25	9	6	40.9			
2	7.5	22.5	11	6	42.37	40	17.1	5.69
3	5	20	5	5 (7½)	45.2	40.3	18.8	10.8
4	3.75	15	10	6-8	45.28			
5	3.5	12.5	10	6-8	48.6			
Kupang:								
1	7.5	25	8	7	41.91			
2	6	20	10	6	43.71	40.3	16.5	7.8
3	4.7	20	8	7	44.97	40.2	18.4	10.6
4	3.75	15	8	6-8	48.4			
5	3.5	12.5	8	6-8	50.4			
Palosapis:								
1	10	22	5-6	5	38.5			
2 [a]	6.25	20	10	6-7	41.85	40.7	9.9	2.74
3 [b]	5	20	5	6-7	42.5	41	12	3.53
4	4	17.5	5	6-7	44	41.19	15.4	2.81

[a] Good white color.

[b] Yellowish color.

TABLE IX.—*Experiments with sulphite process on Philippine woods.*

[Data from RICHMOND.]

Kind of wood and experiment No.	Composition of liquor.			Duration of digestion.		Maximum temperature carried.	Yield of pulp.		Bleaching powder consumed.	Screenings.
	Total SO_2.	Combined SO_2.	Available SO_2.	Time to reach maximum temperature.	Total time.		Unbleached.	Bleached.		
Lauan:	*P. ct.*	*P. ct.*	*P. ct.*	*Hrs.*	*Hrs.*	°*C.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1	3.6	1.6	2.0	4	12	160	42.2	--------	--------	1.8
2	3.5	1.2	2.3	5½	11	150	44.4	43.3	13.4	--------
3	3.75	1.78	1.97	4½	11	155	46	--------	--------	1.75
Palosapis:										
1	3.52	1.63	1.89	4½	9	154	47.27	--------	--------	--------
2	3.45	1.35	2.10	5½	11	150	44.75	42.35	14	--------
3	3.75	1.78	1.97	4½	11	155	46	--------	--------	1.4
Kupang:										
1	3.6	1.2	2.4	4	10	145-155	40.76	43.2	8.51	--------
2	3	--------	--------	4	16	160	49.4	--------	--------	3.0
3	3.75	1.78	1.97	4½	11	155	47	--------	--------	0.0

ABRIDGED INDEX

[This index includes only the botanical and the official local names mentioned in Volume I. As the information concerning a species is frequently distributed in several sections, and even in different volumes, the complete index should be consulted for all references to any given species.]

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B

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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.*

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

Bulletin No. 3 (1906).—A compilation of notes on India rubber and gutta-percha. *Out of print.*

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

Bulletin No. 5 (1906).—A preliminary working plan for the public forest tract of the Insular Lumber Company, Negros Occidental, P. I. By H. D. Everett and H. N. Whitford. *Out of print.*

Bulletin No. 6 (1906).—A preliminary working plan for the public forest tract of the Mindoro Lumber and Logging Company, Bongabon, Mindoro, P. I. By M. L. Merritt, and H. N. Whitford. *Out of print.*

Bulletin No. 7 (1907).—A preliminary check list of the principal commercial timbers of the Philippine Islands. By H. N. Whitford. *Out of print.*

Bulletin No. 8 (1908).—The forests of Mindoro. By Melvin L. Merritt. *Out of print.*

Bulletin No. 9 (1908).—A Philippine substitute for lignumvitae. By W. I. Hutchinson. 60 centavos.

Bulletin No. 10 (1911).—The forest of the Philippines. I. Forest types and products. II. The principal forest trees. By H. N. Whitford. 2.50 pesos.

Bulletin No. 11 (1912).—The uses of Philippine woods. *Out of print.*

Bulletin No. 12 (1912).—Volume tables for round timber. Compiled by William Klemme. *Out of print.*

Bulletin No. 13 (1915).—Ipil-ipil. A firewood and reforestation crop. By D. M. Matthews. 50 centavos.

Bulletin No. 14 (1916).—Commercial woods of the Philippines; their preparation and uses. By E. E. Schneider. 2 pesos.

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Bulletin No. 20 (1920).—Philippine resins, gums, seed oils, and essential oils. By Augustus P. West and William H. Brown. 3 pesos.

Bulletin No. 21 (1920).—Wild food plants of the Philippines. By William H. Brown. 2 pesos.

Bulletin No. 22 (1920).—Minor products of Philippine forests. This bulletin contains the material in Bulletins 15–21, and also considerable additional material. Edited by William H. Brown. 10 pesos.

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