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PRELIMINARY REPORT ON THE COMMERCIAL FIBERS OF THE PHILIPPINES
MEMORIA PRELIMINAR LAS FIBRAS COMERCIALES DE FILIPINAS

BY

POR

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PREPARED UNDER THE DIRECTION OF THE CHIEF OF THE BUREAU.

PREPARADA BAJO LA DIRECCION DEL JEFE DEL DEPARTAMENTO.

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LETTER OF SUBMITTAL.

MANILA, P. I., *August 26, 1902.*

SIR: I have the honor to submit herewith the manuscript of a paper entitled "A Preliminary Report on the Commercial Fibers of the Philippines," and to recommend that it be published as a Farmers' Bulletin.

The paper embodies brief general information upon the fibers which are at present exported from the Philippines, and also upon the most important of those which enter into the interisland trade and have a large and important use among the natives. The illustrations are from photographs taken by Mr. C. W. Dorsey, soil physicist.

Respectfully,

JOHN W. GILMORE,

Expert in charge of Fiber Investigations.

Prof. F. LAMSON-SCRIBNER,

Chief Insular Bureau of Agriculture.

REPORT OF THE

1880

OF THE

COMMISSIONERS OF THE LAND OFFICE
IN RESPONSE TO A RESOLUTION PASSED BY THE HOUSE OF REPRESENTATIVES
ON FEBRUARY 2, 1880, RELATIVE TO THE LANDS BELONGING TO THE
UNITED STATES IN THE TERRITORY OF ARIZONA
AND
A REPORT ON THE PROGRESS OF THE SURVEYS OF THE
LANDS BELONGING TO THE UNITED STATES IN THE TERRITORY OF ARIZONA
DURING THE YEAR 1879

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INTRODUCTION.

It is the object of this paper to set forth briefly some facts regarding the fiber plants and their products of the Philippine Archipelago which are at the present time receiving commercial attention. It is not now practicable to mention all those which are of economic importance; for, as this is one line of work which this Bureau is taking up, treatment of such plants and their fibers will be reserved for later publications.

Strictly speaking, Manila hemp and maguey are the only raw fibers exported from these Islands at the present time, and of these the former rank among the economic products of the Archipelago. The production and exportation of Manila hemp is indeed the most important industry of the Islands at the present time, both from a financial and a commercial point of view. Almost every ship that makes a trip to the south of Manila brings back a consignment of Manila hemp, which in turn is loaded into regular hemp-carrying steamers for American and European ports. Formerly the fiber was shipped to Manila, but during the past two years ocean-going vessels have loaded in Cebu with full cargoes for foreign ports.

Manila hemp came into notice in the early part of last century, but it was not recognized as a product of importance until about 1850. The following table shows the growth in production by decades:

	Tons.
1840.....	8,502
1850.....	8,561
1860.....	30,388
1870.....	31,426
1880.....	50,482
1890.....	67,864
1900.....	89,438

As a product of value Manila hemp ranks first among the resources of the Islands. During the fiscal year 1901 the total value of all exports from the Islands was \$23,197,367, and of this amount \$14,453,110 represents the value of hemp which is 62.3 per cent. Its relation in this regard to other products of the Islands is shown in the following table, which gives values for the fiscal year 1901:

Article.	Amount.	Per cent of total exports.
Manila hemp.....	\$14,453,110	62.3
Copra and cocoanuts.....	2,663,340	11.47
Sugar.....	2,293,075	9.88
Tobacco, cigars, and cigarettes.....	2,217,728	9.56
Coffee.....	6,616	.02

Cotton, pineapple fiber, and ramie are produced in the Philippines, but for the present they have dropped from the articles of export. They are used in the economy of the natives, and, with the exception of pineapple fiber, large quantities are imported.

The other products mentioned, pandan, burri, nipa, and rattan, are used more or less extensively throughout the Islands, and in some instances form articles of trade between island ports. All of these are extremely useful to the natives. Pandan and burri are used extensively in the fabrication of hats, mats, and coarse weavings. Nipa is used, wherever it can be obtained, for the roofs and sides of dwellings, and the rattan is a substitute for nails and pins in the construction of houses, a serviceable article for lashings and bindings, and is used extensively in furniture making.

As a whole the fibers and fiber products of the Philippines form an important source of wealth to the Islands, and at present the attention given to their economic production and preparation for market is inappreciable. It is believed that, by enlarging the fiber-producing area, by improving the present methods of cultivation and preparation for market, and by introducing such new fiber plants as would be adapted to the climatic and labor conditions of the Islands the fiber interests will easily retain their rank with the leading resources of the Islands.

MANILA HEMP OR ABACÁ.

This fiber, so well known in commerce, is produced by a species of the banana family (*Musa textilis*). *Musa* is quite a large and specialized genus, and some of the species comprise several varieties. Among the Filipinos the genus is divided into three groups—the plants which produce the edible banana of commerce (Visaya, saging); those which produce the fiber under consideration (abacá); and the wild banana (pacol), which has no recognized economic value. The plants of all these species produce a fiber of greater or less strength, and in tropical countries where the plants grow the fiber generally finds some use in the economy of the natives.

The name, "Manila hemp," by which the fiber under consideration is known, is a misnomer. Properly speaking, hemp is the product of another plant, *Cannabis sativa*, a native of western and central Asia, and it is a bast fiber or the fiber of the inner bark. But the Manila hemp is a structural fiber; that is, it forms a part of the structural system of the leaf sheath. Nearly all fibers first came into notice through their commercial uses, and as commerce and utility do not stop to inquire into scientific relationships, each fiber, as it came into extensive use, began to be known as hemp, qualified by a word signifying the place from which it came or the use to which it was put. Thus we have Manila hemp, Bowstring hemp, Bombay hemp, Calcutta hemp, Pita hemp, water hemp, and

PLATE I.—Field of abacá protected by numerous shade trees, Sorsogon Province, Luzon.

many others. However, since the name "Manila hemp" is so well established it would not be wise to attempt to change it.

Although the various species of the genus *Musa* flourish in nearly all tropical countries of the world, yet *Musa textilis* from which the Manila hemp is obtained seems to thrive to the best advantage only in the Philippines. Attempts have been made to introduce it into other countries where other species closely related grow, but these attempts have not been successful. The species was introduced into Calcutta in 1822 and into Madras in 1859. While the plants of these introductions produced fiber, yet it was of an inferior quality, and the cost of production exceeded the value. In 1873 the plant was introduced into the Andaman Islands. These trials were more successful than those in India, the best fiber being of about the same quality as the medium from the Philippines. Attempts have also been made to introduce the plant into Florida and the West Indies, but with unsuccessful results.

SOIL AND CULTIVATION.

Musa textilis requires a uniformly moist and warm climate for its best growth and development. While it may be found almost throughout the entire Archipelago, yet it grows to the best advantage in the Provinces of Albay, Camarines Norte and Sur, Sorsogon, and in the Islands of Masbate, Mindoro, Marinduque, Samar, Leyte, Cebu, southern Negros, and parts of Mindanao. In these regions there is an abundant rainfall and a high relative humidity of the atmosphere. The following table gives a general idea of the annual rainfall and average temperature of these regions:

Province.	Number of years averaged.	Temper- ature.	Days rain.	Rainfall.
		° C.		Inches.
Albay	6	26.05	218.5	118.42
La Carlota (Negros)	10	26.5	154.3	103.65
Mamburao (Mindoro)	2		147.5	124.65
Zamboanga	2	27.12	110	35.44
Iloilo	4		152.6	71.84
Cebu	6		161	58.88
Tamontaca (S. Mindanao)	2		121.3	76.38
Davao	2		187	79.82

The relative humidity of the atmosphere also has an important bearing upon the growth and development of *Musa textilis*, but as a general rule in the Philippines the relative humidity follows the rainfall in its variations, and during the entire rainy season there are many days of excessive humidity when there is no actual rainfall, and so far as the effect on the growth of the plant is concerned, these would have almost the same effect as seasons of rain.

In selecting a site for a plantation four considerations are to be borne in mind, the rainfall, the humidity of the atmosphere, the soil in particular reference to exposure and drainage, and protection from excessive sun and wind. Sufficient has been shown in the table above to indicate the

necessity of an abundant rainfall and high relative humidity of the atmosphere. These characteristics of any situation to be devoted to *Musa textilis* insure a more vigorous development of the plant and consequently a greater production and a better quality of fiber. But it must not be supposed that the plant requires a wet soil. Moisture is what it demands and not water. The plant will not thrive in marshy land, no matter what the rainfall and protection from wind and sun may be. In its natural choosing the plant selects the well-drained mountain slopes and the sloping valleys lying between their spurs. In these situations sufficient trees grow or are left to grow to protect the fiber plants from the fullest rays of the sun and from the strong winds. In addition to this the soil is naturally well drained, is rich in humus, and in such places there are usually washings and other movements of the soil sufficient to answer for a sort of cultivation.

In many sections even where rainfall is sufficient much land could be profitably devoted to the growing of *Musa textilis* and the production of Manila hemp by giving the land sufficient drainage. Drainage by surface ditches is one method which might be practiced. It is not the most practical method, but under the present conditions of labor and the difficulty of obtaining tiles it can be made to serve broad purposes. This method has another point favoring it, in that the ditches can be made between every other row, and the rows are wide enough apart, the ditches will not materially interfere with the crop. This method is almost exclusively followed by the coffee growers in Java and the tea growers in Asam and India. But looking forward to better labor conditions, a greater development of the hemp industry, and the perfection of the means for making drain tiles here in the Islands, for which there is abundant material, drainage by underground conduits is the most practicable, and, in the end, the cheapest method of draining land.

The cultivation of *Musa textilis* is not a difficult matter; though judicious care and shading will bring good harvests. The plants are set in rows from 5 to 8 feet each way, and until they reach maturity it is necessary to keep the weeds in subjection. The plants reach maturity in from two and one-half to three and one-half years, when they are usually left to themselves with the exception that coarse weeds are kept out. It is quite necessary that the ground be kept covered with some herbage, for the land is usually so rolling that otherwise washing would do much damage. No better scheme could be employed, either on rolling or level land, than that of sowing in the plantation some of the clovers or other leguminous crops that grow well in the Philippines, which would not only bind the soil to prevent washing, but would add to the soil a most useful element, nitrogen. In most situations trees are either left growing in the plantations or are afterwards planted for the purpose of shading the plants to some extent from the glaring rays of the sun and to break the force of the winds which would tear the leaves to pieces and retard the

PLATE II.—Laborer's house surrounded by abaca plants, Mount Iriga, Camarines Sur, Luzon.

development of the plant. This is especially desirable on young plantations. These trees, however, should have small leaves in order that a dark shade may not be produced, and they should have deep feeding roots in order that the fiber plants be not robbed of their plant food.

In the Philippines no systematic attempt has been made to determine the best tree for this purpose. In most localities the best tree nearest at hand is left growing or is planted. Members of the genera *Erythrina* and *Sterculia* are perhaps more used than others, and it is suggested that the *Pithecolobium*, a tree extensively planted because of its shade, might answer the purpose.

It is said that these trees are primarily for the purpose of shade, but if they possess the proper deep feeding qualities they serve not only the purpose of shade and the conserving of moisture in the upper layers of soil, but as wind breaks also. From the nature of the structure of all banana leaves these plants are very poorly adapted to withstand the force of strong winds. In such winds the leaves are soon torn into shreds, and hence their function as assimilators of plant food is very much diminished. Therefore the necessity of choosing situations as free as possible from strong unobstructed winds.

Unlike many of the edible bananas, *Musa textilis* produces seed-bearing fruits. These seeds may be planted for the reproduction of new plants; but except where very extensive plantings are wanted a better method is to plant the small suckers which spring from the root of the parent plant. After the plantation has reached its maturity and harvesting is in process the old plants are cut near the roots and the suckers are left to grow up. After the plants reach maturity, the crop is constantly renewing itself so that harvesting can go on almost continuously. The plant is in the best condition for producing fiber about the time the flower bud reaches the top of the plant. The stalk is then cut as near the root as possible and the leaf-sheaths are stripped off. The fiber is the so-called fibro-vascular bundles which make up part of the structural substance of the leaf-sheath surrounding the flower stem from the ground to the expansion of the leaves. The length of the leaf-sheath determines to some extent the length of the fiber. This leaf-sheath is thicker along the center than it is at the sides, and in order to facilitate the stripping of the fiber it is split longitudinally into strips 2 to 3 inches wide. The strips from the thicker portion of the sheath are then torn tangentially, inasmuch as the fiber is contained mainly in the outer part of the sheath, and the inner portion of the thick strips which are torn off consist mainly of the valueless pulp.

EXTRACTION OF FIBER. (X)

For stripping the fiber the method almost universally in use is to draw these prepared strips between the edge of a knife or bolo and a hard smooth block. The apparatus can be set up at frequent intervals in the vicinity of the plants to be cut. A nipa shed is constructed, though sometimes the protection and shade of a large tree is chosen. To two uprights

set in the ground a horizontal pole is attached with "bejuco" or rattan canes. A short strong knife or bolo with a wooden handle is firmly attached on a pivot or fulcrum upon the upper surface of the horizontal pole. The handle is attached by a rattan cane to a bamboo spring arranged in the roof of the shed or to a branch of the tree, while another rattan cane runs from the handle to a treadle on the ground, which can be worked by the foot of the operator. The spring in the roof above holds the knife upon the pole, or in some cases a block, with a uniform pressure while the strip of the leaf-sheath is being drawn between its edge and the pole or block. By placing the foot upon the treadle the pressure is released and the fiber may be redrawn or a new strip inserted.

When it is not the desire of the operator to produce a fiber of fine texture and white color a knife with finely serrated edge may be used. By using a knife of this kind there is less waste of the fiber, but at the same time more of the undesirable pulp and, consequently, fresh juice is left with the fiber. This residue of pulp and juice drying upon the fiber gives it an undesirable color, and if too much is left on, the strength of the fiber is injured and the market value is much reduced. The whitest fiber is drawn under a knife with a smooth edge and immediately after the plant is cut. If the stalks and strips are allowed to lie in the sun for any length of time before the fiber is drawn the fiber will be colored more or less yellow. As a means of increasing the fineness and whiteness of the fiber the strips may be drawn several times when they are fresh. Of course the greater the number of times the fiber is drawn and the greater the pressure upon the knife the more is the waste, but the increased value of white fiber will compensate for a certain amount of waste.

In yield *Musa textilis* varies considerably. In Albay, Sorsogon, and Masbate, where the rainfall is heavy and the humidity of the atmosphere is high, the yield ranges from 12 to 16 piculs of dry fiber per hectare each year (687.5 to 967.6 pounds per acre). In other provinces where the climate is dryer the yield may not exceed 6 piculs per hectare. In some localities the quality of the fiber is injured by the work of borers. Wherever these insects work the fiber is either cut entirely or it is injured in color and strength.

Several attempts have been made to perfect machines for extracting this fiber economically, but these machines have either fallen far short of their requirements or have not met with favor among the natives who have had occasion to use them. The most essential feature at the present time of a machine for this work is that it be light and portable. The greater part of Manila hemp is produced on the mountain or volcano sides or on very rough ground, and as the plant stalks are quite heavy all planters have found it most economical to transport their apparatus rather than the material. It is hoped, however, that some apparatus can be devised to avoid the great waste which renders the present method objectionable. It is variously estimated that from 20 to 30 per cent of the

PLATE III.—Unloading loosely bound bundles of abaca fiber from sailing vessels and spreading it to dry in front of large warehouses Tacloban, Leyte.

fiber is wasted by this crude process of drawing, and this fiber, too, is fine and of good quality. The thought is at once suggested that this waste fiber might be used as a paper stock if it is not too much injured by the juice and pulp with which it is mixed and if it can be economically separated from them. This is a line of investigations which will be subsequently taken up.

CLASSIFICATION AND USES.

For commercial purposes the fiber is classified into several groups according to color, texture, and strength. Length plays a less important part in the commercial grades. The great lightness, combined with strength, is the characteristic of this fiber which gives it its great value. The qualities usually recognized are the superior, current, second, and red. Then there are numerous gradations in each of these groups. The fiber for export is usually tied in small wisps or hanks, and these are put up in bales weighing 2 piculs (275 pounds).

In all countries to which this fiber is exported the greater part of it is used for cordage and ropes. In the United States immense quantities are made into binder twine, and because of its lightness, strength, and comparative durability it is very serviceable for ship's ropes and cables. From old and disintegrated ropes our valuable Manila paper is made. In the Philippines the finer qualities are used in the manufacture of textile fabrics. Throughout the entire Archipelago these weavings are worn extensively by both men and women, and when the fiber is mixed with cotton a durable fabric is produced which is well adapted to the climatic conditions of the Islands. It is believed that the demand for the better qualities of these fabrics will increase in the United States and Europe. A small use is made of the fiber in upholstery, packing, and brush making.

Enough has been said in the general statement above to show the commercial importance of this fiber and the quantities which are being consumed. It may be that, as the wood pulp now being used so extensively for the cheaper grades of paper becomes more scarce, certain qualities of the Manila hemp may take its place.

MAGUEY.

Maguey is a name usually given to the various varieties of *Agave americana*, or century plant, but sometimes, as here in the Philippines, the same name is applied to the fiber of these plants also. The name is in general use in Mexico and Central America, where the varieties of this species grow most abundantly, but it is often used also to refer to any species of *Agave* or its fiber growing in a particular locality.

This plant has a rugged, hardy appearance which is in harmony with the dry climate and stony or sandy soil conditions in which it is most usually found. During the greater part of its life, which varies from eight to twenty years, it is without a stem, having a rosette of twenty to forty strong, fleshy leaves rising from the ground. These leaves bear

spines along the edges and the ends are hardened into a strong, horny point. The leaves are from 3 to 7 feet long, and are made up of hard, pulpy material through which the fibers run as vascular bundles for conveying the sap. Except in the variegated variety the leaves are light green with a whitish powdery covering or bloom. When the plant is of mature age its flower stalk grows up very rapidly, sometimes to the height of 15 feet. The plant flowers only once and then dies; however, it produces both seed and suckers as means of reproduction.

Nearly all of the agaves produce fiber, and many of them are of commercial importance. Notable among the commercial fibers are maguey, sisal, and ixtle, or Tampico fiber, produced by different species of agave and their varieties. The *Agave americana* in Mexico and Central America is quite extensively grown for the production of the intoxicating beverages pulque and mescal, and for soap. The aggregate of all fibers produced by these plants is a large item in the world's output of fibers. In 1891 about 80,000 tons of raw fiber, valued at about \$9,000,000, entered the United States alone.

CULTIVATION.

In the Philippines maguey, *Agave americana*, is cultivated in the Islands of Panay, Cebu, Mactan and in the northern provinces of Luzon, notably in Zambales, Union, and Ilocos Sur. The plant has been introduced into these Islands from Mexico or Central America, as in all parts where it is cultivated it bears its Mexican name, maguey, or slight variations. P. Delgado, who wrote about 1775, says that it is not indigenous, but no note is given as to when and by whom it was introduced.

As stated above, these plants will grow in soils varying widely in texture and content of moisture. In many places, indeed, they thrive under conditions unsuitable to any other crop. Their long fleshy leaves render them capable of withstanding long droughts. They are not, however, averse to the rich soils and humid climate of the Philippines; in the more humid climates, indeed, a longer and more elastic fiber is obtained.

In no country where these plants grow have they received much care in cultivation. Unless planted very far apart they can not be cultivated by draft animals because of the strong sharp spines which tip the leaves. In general practice they are planted in rows 8 feet apart and 6 feet apart in the row, though in Mexico it is said that they are planted only 3 feet apart each way and when the leaves grow long they are tied up. However, about the only cultivation they receive is weeding. The leaves reach maturity in about three years. From this time until the plant flowers, which varies from 12 to 30 years, the leaves are harvested as they reach maturity. Each plant will yield about twenty-five leaves a year, which, in turn, produce about $1\frac{1}{2}$ pounds of dry fiber. This is not a very great yield in comparison with Manila hemp, but the fact that the plant accepts climatic conditions which would not be tolerated by any other plant renders it an economic product.

PLATE IV.—Drying extracted abaca fiber, Sorsogon Province, Luzon.

As the plant reaches maturity suckers may grow out from the axils of the lower leaves. These are best for reproduction, as they are large enough by the time the plant dies to take its place. However, as a general rule, they are not produced in sufficient abundance to supply the need of large plantations. The plant does not produce seed abundantly, but upon the flower spikelets are borne numerous small slips or suckers which fall to the ground as the stem ripens. The flowering usually takes place during the dry months, and these little slips may be collected and set out in rows 1 foot apart and 6 inches apart in the row until they take root. They do not need watering or shading, as they are extremely hardy. They can be shipped long distances if kept dry. New plantations are started and old ones are renewed by propagating these slips. The seeds are only used for the production of new species.

EXTRACTION OF FIBER AND YIELD.

The method of extracting the fiber varies somewhat in different localities, but the essential principles are the same, that is, maceration in water (sometimes in salt water), then rubbing and scraping. Oftentimes the leaves are gathered and crushed or beaten and then piled in bundles to ferment. When fermentation has ceased, the masses are thrown into water until the pulpy material has further deteriorated, when the crushed leaves are separated, rubbed and scraped, and then put out to dry. In other instances the leaves are thrown into the water without being crushed and fermented, but by this method the fiber is much damaged because the leaves are so thick and impenetrable that the whole mass partially rots.

The fiber extracted is fine and soft, having a wavy appearance which renders a bunch more fluffy than a similar bunch of Manila hemp or sisal. Its whiteness depends largely upon the method and care in extracting it. If produced in accordance with the best method, it is quite white and brilliant. Another characteristic of this fiber is its elasticity, which renders it adaptable for ropes and cordage for uses where sudden strains are expected.

Although the plant is quite widely distributed throughout the Archipelago, yet the fiber is not produced for export on a very large scale. During 1901 there was shipped from Manila, the only port from which the fiber is exported, 875 tons (2,240 pounds each), valued at about \$100 per ton, and for the the past six months of this year 867 tons have already been shipped, while for the same period last year (1901) only 562.5 tons were shipped. This would show a decided increase for this year, and in connection with the figures it must be stated that this fiber is almost all marketed before the beginning of the rainy season.

The fiber is used very largely in Europe and the countries of both North and South America for making ship's ropes and cables and for ropes in mines, for lines, nets, and weavings for hammocks. In Mexico

it is extensively used for saddle cloths. The cloths are not woven, but matted and stitched. It is used also in upholstery.

A number of machines have for several years been used extensively in Mexico and Central America and the West Indies for extracting sisal fiber from *Agave sisalana*. This plant, though producing a coarser fiber than the maguey, is so nearly like it in the size and texture of its leaves that no doubt some of these machines could be adapted to extract the maguey fiber. These machines vary much in capacity, cleaning from 75,000 to 120,000 leaves per day. The essential principle of these machines is that the pulpy material is scraped from the fiber without being fermented or macerated, thus saving considerable time and labor.

PINEAPPLE FIBER.

(*Ananas sativus*.)

Few of our economic plants have become more widely disseminated since their discovery than the pineapple. It is, to the best of our knowledge, a native of Brazil, and was first introduced into Europe in 1513. Now it is grown in nearly all tropical and subtropical countries. In nearly all countries where the plant is of economic importance it is cultivated for its delicious fruit, but at the same time the leaves produce a fiber which for fineness and comparative strength is not equaled by any other vegetable fiber. The value of this fiber has long been known to natives of countries where the plant flourishes for its strength, fineness, and durability in water. It has long been used in India and China for lines and thread and as an adulterant in silk and woolen fabrics. Pineapples are grown quite extensively in Singapore, mainly for their fruit, but some fiber is produced for export to China, where it is used for thread and woven into cloth.

The pineapple is quite extensively distributed throughout the Philippines. In some places it grows wild; in others it is cultivated, or rather husbanded, for its fruits. In the Luzon Provinces of Laguna, Tayabas, Ambos Camarines, and Albay, throughout the Island of Panay, and to some extent in Cebu, it is grown for the production of fiber. It is claimed by Mr. Perouttel that the pineapple grown in the Philippines is a distinct species which he calls *Bromelia pigna*, but sufficient material has not been collected by us to verify this. However, in many parts, either because it is a different species, or because of climatic conditions, the plant can hardly be praised for its fruit-bearing qualities. The fruits of these are small, fibrous, and not easily digestible. There are localities, however, where fruits of superior quality are produced.

Ananas sativus will flourish on soils varying greatly in texture and fertility. It is particular, however, that the soil in which it grows be well drained and porous. In the Florida Keys it produces profitable crops upon soils not more than an inch thick covering the coral rock, and analyses of good pineapple soils show very small percentages of the food

elements essential to plants. The pineapple plant is capable of withstanding long droughts. However, if the soil is porous and well drained, it will adapt itself to the more humid climates where rainfall is abundant.

The pineapple produces seed, but it requires, according to Weber, from ten to twelve years to mature plants from these. The best method of reproduction is by replanting the suckers which grow out from the parent plant near the ground. The plant may also be propagated by crowns, slips, and suckers. These are slow to mature. Besides, the crowns are usually left on the fruit, and the rattons are left to take the place of the old plant. When the pineapple is propagated by the buds in the axils of the leaves it requires a year or a year and a half longer for the plants to reach maturity. In preparing land for a pineapple plantation it is well to remove all stumps, brush, and weeds and plow deeply. If the subsoil is hard and has a tendency to hold water, the land should be subsoiled. The rainfall in the Philippines is so heavy that drainage, either by surface ditches or by underground conduits, should be provided. This is quite essential, for the plants will not thrive in a wet soil.

As a general rule, but light surface cultivation is all that is needed, and in such cases the plants are set from 30 to 36 inches apart in rows each way. In localities where the climatic and soil conditions require deeper and more thorough cultivation, they may be planted 30 inches apart in the row and the rows $4\frac{1}{2}$ to 5 feet apart. This practice is followed in the Hawaiian Islands. Pineapple plantations should not be exposed to strong winds, as the leaves are easily chafed or broken, and this, in turn, diminishes the yield and quality of the fiber.

The plants from suckers will produce mature leaves in from nine months to a year. When pineapple plants are grown for fruit the quality is much improved by judicious fertilizing.

EXTRACTION OF FIBER AND USES.

In the provinces of the Philippines, where the plants are grown for fiber, the fruit is cut shortly after flowering, in order that the leaves may develop more fully. When the leaves are mature they must be cut before they become old and worked as soon as possible after cutting. The fiber is so fine that it can not be separated from the pulp when the leaves are old and dry. As in the extraction of Manila hemp and maguey, the pineapple fiber is also extracted in a simple and primitive way. The fiber is too light and fine to admit of being drawn as Manila hemp is drawn, so the natives in Southern Luzon and Panay resort to a method of scraping. The freshly cut leaves are spread upon a narrow bench, and with light short strokes of an iron scraper, the edge of which is not too sharp, the epidermis is scraped off. Sometimes a bamboo or wooden scraper is used, and while this method is slower, yet there is less waste, and a softer quality of fiber is produced. This exposes a layer of fiber which is lifted

by the fingers or a small spatula. The scraping is then continued until another layer of fiber is exposed, and this in turn is lifted away. The process continues until all the fibers of the leaf are separated out. As the fiber is separated it is washed in clear water, and laid out in the sun to dry and bleach. The washing and drying may be repeated until the fiber possesses the texture and whiteness desired.

A mature plant has about 40 leaves from $1\frac{1}{2}$ to 3 inches broad and ranging from 2 to 5 feet long. In the Provinces of Iloilo and Antique, where pineapple plants are grown largely for their fiber, a ton of leaves, about 22,000, produces from 50 to 65 pounds of dry fiber. This is a small yield when we take into consideration the number of leaves which have to be handled and the labor of extracting the fiber. Before the pineapple fiber can become a very important commercial product machines will have to be devised for extracting the fiber on plantations more extensive than those worked at present. Two machines have been used, the Van Buren and the Sanford Mallory, but they have not yet been able to produce a quantity of fiber sufficient to make their use economical.

The pineapple fiber has not yet been produced in quantities sufficient to give it commercial importance. But no doubt it is destined to a more extensive use than at present, as it possesses unique qualities. The fabrics called "piña" and "rengue," manufactured from it here in the Philippines, are constantly becoming more popular in both Europe and America, and there is a growing demand for these fabrics for embroidery. The rengue and piña are now valued at from 25 to 75 cents per yard, and the fiber in the London market has been adjudged worth £30 per ton.

The fiber is also used for small cordage where great strength is required. In Calcutta a rope $3\frac{1}{4}$ inches in circumference was tested and bore a strain of 5,700 pounds. It has been suggested that the dried leaves from the fruit plantations could be used for paper stock, but as yet no trials along this line have been made.

COTTON.

There is hardly an intelligent person in the world who is not acquainted with cotton as a fiber, and to both the student and general reader it would seem only necessary to refer to the many excellent books and papers which have already been written upon this subject. Among the most recent books is Bulletin 33, United States Department of Agriculture, Office of Experiment Stations. This work discusses at length the history, botany, chemistry, cultivation, and varieties of cotton.

The influence of cotton upon the commercial and social interests of the people of the world is far reaching. Cotton and its products form one of the greatest items, both in tonnage and value, in the carrying trade of the world. What the bamboo and cocoanut are to people of the Tropics cotton is to people of the world in even a broader and a larger sense, and it is almost unique in the sense that the variety of its products and their

usefulness and beauty are more perfectly wrought by the use of machinery. The growth in the quantity of cotton consumed, and the development of the cotton industries during the past century have been most striking. This growth is due primarily to the invention of the cotton gin in 1793, which made it possible for the fiber to take its place as an essential in the economy of mankind. During the first decade of the nineteenth century the production reached 300,000 bales. The production then gradually increased during the next forty years until more than 2,000,000 bales were produced, while at the present time more than 13,000,000 bales are required to supply the world's demand.

The cotton plant is a member of the Malvaceæ or mallow family. It belongs to the genus *Gossypium*, of which there are a number of species. These plants have been cultivated for so many hundreds of years, and hence are so subject to modification by climatic and soil influences, that it is very difficult to determine the type of the species and varieties. Among the recognized species of economic importance are *G. herbaceum*, *G. barbadense*, *G. brasiliense*, and *G. arboreum*. *G. herbaceum*, with its varieties, is the species most extensively cultivated in the United States, where it grows as far north as latitude 36°. The staple of this cotton is not so long and soft as the Sea Island kinds, but because of its adaptability to the soil and climate of the United States it contributes more largely to the quantity and value of the world's product than any other species. The well-known Sea Island cotton is included in the *G. barbadense* and its varieties. This kind produces a longer staple than perhaps any other economic species, but the yield is less and it is more limited in its geographical distribution. The plant flourishes south of latitude 26° N., and as a general rule requires a humid climate, though irrigation will sometimes compensate for this. The famous Egyptian cotton belongs to this class.

The other two species mentioned, *G. arboreum* and *G. brasiliense*, are for the most part inhabitants of tropical countries and are of lesser economic importance than the preceding. *G. arboreum*, however, with its variety *neglectum* is planted in India and forms the Decca and Bengal cotton of commerce. The fiber of these varieties is generally long and fine, but the yield is not large. All species of cotton are naturally perennials, but in cultivation they are sometimes annuals or biennials. They grow as perennials in most of the islands of the Philippines, where they are flowering and fruiting nearly all the year round.

Unlike the fibers previously considered, the cotton is what we call a surface fiber; that is, it is the unicellular filaments growing upon the surface of the seeds, and not entering into the structural substance of the plant. The staple of the different varieties of cotton varies. The average length of the Sea Island varieties is 1.65 inches, and that of the Brazilian 1.25 inches, that of the herbaceous varieties 1.10 inches and that of the arboreum 0.9 inch. When the cotton fiber is ripe each filament has a

flattened twisted appearance, and the wall is much thicker in proportion to the size of the cavity than in the green filaments. Cotton should not be picked until the bells have ripened and the lint thoroughly dried in the sun.

Gossypium herbaceum, and its varieties, is the species most usually cultivated in the Philippines for its fiber, although *G. arboreum* occurs. The former species is grown more or less extensively in the Provinces of Ilocos, Union, Pangasinan, Abra, Bulacan, Batangas, Camarines, and Laguna and in the Islands of Panay and Cebu and parts of Mindanao.

Although cotton is grown throughout a large area in the Philippines, yet the fiber has never been produced in sufficient quantities for foreign export. Some years ago a small interisland trade existed, but the coming of cheap cotton prints and yarn from Europe, India, and China has caused a decrease in both the production and trade between ports. The production for 1893 in some of the northern provinces of Luzon is shown in the following table:

Province.	Area.	Total production.	Kilograms per hectare.
	<i>Hectares.</i>		
Ilocos Norte.....	362	103,349	396
Ilocos Sur.....	60	21,678	359
Abra.....	9	2,953	321
Union.....	177	68,159	384
Pangasinan.....	17	5,528	312

The average is 354 kilograms per hectare, or 315 pounds of lint cotton per acre. Yet this is not the average of production in the Islands. It is safe to say that the average is not more than 165 pounds of lint cotton per acre.

The production of raw cotton, or of cotton manufactures, on a commercial scale is inseparable from the use of machinery. The employment of cotton in weaving dates back into the centuries before Christ, but if it had not been for the invention of the cotton gin perhaps the fiber would not be as much used to-day as it was then. The perfection of weaving machinery has greatly extended the value and usefulness of this fiber. Two machines have been used for the separation of lint from the seed from time immemorial in China and India. The most simple and probably the oldest consists of a piece of iron in the form of a double cone, large in the center and tapering towards the ends (sometimes a simple cone is used). For its use the seed cotton is spread upon a flat stone or heavy board, and this cone, used as a roller, pushes the seed from the lint as it revolves. A little pressure may be exerted by the hands or feet of the operator. This implement can be used only with the naked and hard-seeded varieties. By this method only from 4 to 6 pounds of lint cotton per day can be turned out by each operator. The other of these which has found its way into the Philippines, probably through China, consists of two wooden rollers arranged horizontally one above the other (sometimes the lower

one is of iron), and the lower one is usually smaller than the upper. The lower roller is turned by a foot treadle and the upper one by one hand while the cotton is fed into them by the other. The revolving rollers draw the lint away from the seeds. By this method from 6 to 8 pounds of lint cotton can be separated per day. In many of the cotton-growing districts of the Philippines, however, the lint is separated from the seed by hand.

SOIL AND CLIMATIC CONDITIONS.

Climatic conditions have a greater influence over the production of cotton than do soil conditions. The plant will grow in almost any soil of good texture and fertility. Cotton is a deep feeding plant, and arable soils which are sufficiently loose and deep to give the roots a free growth and which are not scaked with water will be likely to produce well.

Throughout the Archipelago the conditions of rainfall and temperature have a greater effect upon the cotton crop than does the soil. The land in which the seeds are planted should be warm and moist. A cold, wet soil will be almost sure to rot the seeds, therefore the seeds should germinate, and the plants begin to obtain their food from the soil between rains if possible. After this and during the growing period the rains may be frequent, provided the land is drained, without serious detriment to the crop. From the time the bolls begin to set until the crop is harvested a dryer atmosphere, with a greater variation between the day and night temperature, will be of great advantage. Rains during the season of ripening are prejudicial to the crop, as the falling rain knocks the cotton from the bolls and the color and quality of the fiber is damaged. The cotton plant demands a large amount of sunshine, especially during the latter period of its growth.

In preparing the land for cotton hard and compact soils should be plowed deeply enough to facilitate penetration by the roots. It must be remembered, however, that deep plowing may result in the disadvantage of heavy leaching, or, in a few localities, the turning of sterile soil to the surface.

The best time for planting cotton has not been satisfactorily determined for the Philippines, but uniformly good results have been obtained by planting during the latter half of the rainy season. By this method the plant gets its growth during the remainder of the rainy season, and has the dry season with the cool nights and warm days during which to mature.

For planting the land should be laid off into rows from 3 to 4 feet apart. In the wetter soils slight ridges may be thrown up to give the young plants drainage. Much time and money has been spent in constructing machines for planting cotton seed, but perfection has not yet been reached. However, in large cotton-growing sections of the United States these machines are used in preference to the old methods of hand planting. In the Philippines it is usual to plant the seed thickly in the

row in order that a good stand may be obtained and that seeds which are not permitted to grow may act as a fertilizer for the young plants. When the plants are well up they are thinned to 15 to 18 inches apart in the row. During the growth of the plants such cultivation is given as will keep down the weeds and grass and keep the soil in good tilth.

The bolls do not all ripen at the same time, thus necessitating several pickings before the crop is harvested. The picking must be done by hand, as no machine has yet been devised which will gather the fiber free from the leaves and bolls.

USES AND YIELD.

The uses of cotton are numerous. Indeed, it is more extensively used than any other fiber. It is most extensively used for cloth, thread, ropes, pillows, and cushions. In Ilocos blankets are made which, though not of the finest finish, are very durable. Most of the cotton of the Philippines, however, is used for weaving into coarse cloth for shirts and pantaloons. The entire cotton plant is useful. Aside from the lint, the seeds are valuable for the oil they contain, and they are very valuable for cattle feed and as a soil fertilizer, being rich in nitrogen. A valuable fiber is produced in the bark of the plant which will be useful when a machine can be made to extract it. The roots contain medicinal properties.

The proportion of cotton grown in the Philippines to that consumed is very small. As none is exported it is difficult to know the exact production, but it is safe to say that not more than 100 tons has ever been produced in a single year. The importations for the twelve months ending June 30, 1900, and for the twelve months ending June 30, 1901, are shown in the following table:

Article.	1900.		1901.	
	Pounds.	Value.	Pounds.	Value.
Raw cotton.....	412, 722	\$37, 145	-----	\$69, 240
Cloths.....	-----	439, 398	-----	7, 033, 825
Yarn and thread.....	1, 615, 578	517, 506	5, 684, 839	1, 160, 583
Total value.....	-----	993, 949	-----	8, 263, 648

This does not include many of the finer weavings, laces, carpets and the like.

The Philippines offer many advantages for cotton raising. It may be that in many localities there is not enough sunshine for that part of the rainy season during which the cotton is growing, but the labor conditions, the good soil, and the demand for the fiber and its products are strong arguments for a more extensive industry.

RAMIE.

Two plants, *Boehmeria nivea* and *B. tenacissima*, belonging to the family *Urticaceæ*, produce fibers which, in commerce, are recognized indiscriminately by the names China grass and ramie or rhea. It has been proposed by Dr. Morris, of the Kew Gardens, that the name ramie refers

to the fiber of *B. tenacissima* and that of China grass to *B. nivea*. This suggestion has been adopted by recent writers. Neither of these fibers is now produced on a commercial scale in the Philippines, and we have not collected material by which to determine the species grown here. Neither has it been determined which fiber possesses the more qualities and characteristics of usefulness. *Boehmeria nivea*, however, is easily distinguished from *B. tenacissima* in that the lower surface of its leaves is whitish. This species also grows farther north than the *B. tenacissima* and is not so robust in appearance.

These plants are herbaceous, with perennial roots. Under favorable conditions they grow in clusters of 4 to 12 stalks from one root to a height of 3 to 7 feet. They are in all probability natives of Java and Sumatra, though they have been cultivated in China and India for many centuries. This fiber differs from those previously considered in that it occupies a different position in the plant's structure. Ramie is a bast fiber; that is, it is produced between the epidermis of the bark and the woody substance of the stalk, but it serves the same purpose of conducting the sap that the structural fibers serve. When the plants are grown without branching the fiber is strong and durable. It can be very finely divided and the ultimate cells are 120 mm. in length. It is similar to flax in many of its qualities, except, perhaps, it is not so elastic. When degummed it can be combed to almost the fineness and softness of silk. It is not readily affected by moisture and therefore it is preëminently suited to weaving into cloths. The well-known Canton linen is made from this fiber. Ramie fiber takes dyes readily, and besides the finer cloths and textiles made from it, it is used extensively for cordage nets and lines.

PRODUCTION AND USES.

The greatest quantities of this fiber are produced in China and Japan, where it is extracted by hand. Indeed, the supply is limited to those countries where labor is cheap and abundant, for as yet no machine has been constructed which can produce a fiber as clean and white as that produced by hand. Moreover, the fiber extracted by hand is in a much better state for degumming and combing than that extracted by machinery, because the hand process removes a considerable part of the gum, which is rendered difficult of removal if permitted to dry on the fiber. This gum is not soluble in water, as is that of flax and hemp, so that it must be submitted to chemical treatment, and the conditions under which it must be treated create an expense of about 4.9 cents per pound above the hand-extracted fiber. The fiber may also be extracted by boiling the stalks in water or alkaline solutions, but this has little advantage over the simple hand-cleaning method.

Where the fiber is cleaned by hand the stalk is grasped about 3 or 4 inches above the ground and with a skillful jerk the stalk is broken so

that it may be stripped from the bark at one motion. The bark is the stripped of its leaves and a second jerk detaches it from the root. By this method the leaves and stalks are left in the field, which are of great advantage to future crops. The ribbons of bark are kept straight and piled up in a shed to ferment slightly. When the epidermis is in a suitable state to peel, the operator takes a few ribbons at a time in the left hand, and with the right hand, the thumb of which is armed with a small metal scraper, the epidermis is stripped off. The fiber is then put out to dry. In China and Japan most of the fiber is exported in this state. That which is retained for local use is submitted to a treatment of alkali in order to remove the gum. This renders the fiber more pliable and it can be more finely separated. In Europe the process of degumming and combing is carried to a high state of perfection, so that a fiber is produced which is suitable for mixing with silk or linen. I do not know that the process of degumming is practiced at all in the Philippines.

The uses to which ramie may be put are quite as general as the uses of cotton, the cost of production alone preventing it from entering into a more extensive consumption. That which is produced in the Islands is used for the most part for mixing with abacá, silk, and the pineapple fiber in the manufacture of a great many varieties of fabrics, but the production does not supply the demand. In 1900, 563 pounds, valued at \$39, and in 1901, 8,308 pounds, valued at \$415, entered the port of Iloilo. This shows a considerable increase in quantity for 1901, but according to the figures the price dropped almost two cents per pound.

PLANTING AND CULTIVATION.

Inasmuch as the ramie plant has a perennial root and does not require to be planted every year, it is quite necessary that the land chosen for the plantation be put in good tilth by deep plowing and thoroughly fining the soil. The plants have to be set so thickly in order to prevent branching and to cause the stalks to grow stright that after cultivation is not an easy matter. This deep plowing is quite important also that the soil may drain well, as the plant will not thrive in a wet soil. For climatic conditions, this plant requires a humid atmosphere, with frequent rains or irrigation and a warm temperature so that the growth may be rapid and luxuriant. Vast areas in the Philippines possess just such characteristics of soil and climate as this plant desires, and every effort should be made to promote its cultivation.

The ramie plant may be propagated by seeds, by cuttings, or by divisions of the roots. The last is the best method when it is convenient, as the seeds are sometimes not produced in abundance and the seedlings require some care. Propagation by cuttings requires longer to mature a crop. When it is necessary to plant seeds they should be sown in loose loam and lightly covered with fine soil. The seed beds should be shaded with nipa or a bamboo matting to protect the young plants from the direct

rays of the sun. When the young plants are from 3 to 5 inches high they may be transplanted in the field.

Cuttings should be taken from the upper half of the stem of the plant when mature, and cut from four to six buds. They should be rooted in porous soil containing a goodly amount of sand, and shaded until the leaves begin to grow. Plants from cuttings or from seed do not produce a crop of good fiber the first year.

The root divisions may be transplanted in the field at once, and if the season be good the plants will produce a small crop of fiber from the first cutting of stalks, but the succeeding crops will be heavier.

In general the plants are placed in rows 18 inches to 2 feet apart and from a foot to 18 inches apart in the row. Thick planting is necessary in order that the plants grow tall and without branches, for upon both of these characteristics does the value of the fiber depend. If the soil is of good depth and contains a sufficient amount of humus the plants should grow to a height of 6 to 8 feet and produce two or three crops a year. On the best lands in the northern provinces of Luzon, about the only district in the Philippines where ramie is produced, four crops can be taken each year.

It is a common practice in some parts to burn over the field after each successive crop. While the ashes are valuable constituents of the soil, yet the humus which would result from incorporating the leaves and stalks in the soil would be of far more lasting benefit. When the crop is removed the land should be cultivated by plowing, if possible, to loosen up the soil, and light cultivation should be continued until the plants become too high to be worked. The application of nitrogenous and potassic fertilizers usually produces good results, and the application of barn yard manures will always result in much advantage to the soil.

It is estimated that an acre of three cuttings per year produces 25 tons of stalks. From careful estimates in France it has been determined that a ton of green stalks will produce $46\frac{1}{2}$ pounds of dry fiber (DeLandtsheer). This would give a yield for these Islands of about 1,162.5 pounds of dry fiber per acre. This in turn would yield about 625 pounds of degummed fiber.

At the present time the untreated fiber is worth from 5 to 7 cents a pound or from \$100 to \$140 a ton. At this price and with favorable climatic conditions and cheap labor the production of this fiber ought to become a resourceful industry.

PANGDAN.

(*Pandanus*.)

This genus embraces some thirty species, 17 of which are reported from these Islands. The common name by which these plants are known is "screw pine," a name suggested by the spiral arrangement of the leaves around the stem. Because of this arrangement and the peculiar aerial roots the plants are highly prized for their ornamental effect.

Of the species which grow in the Philippines four are worthy of mention: *Pandanus dubius* Spreng, *P. odoratissimus* L., *P. radicans* Blanco, and *P. montanus* Miq. These species vary but little, except perhaps *P. odoratissimus*, which is more tree-like, being much branched. I have seen this species growing in considerable abundance in the poor, dry soil south of Bacolod, Negros. The leaves of all of them are from 4 to 5 feet long and $1\frac{1}{2}$ to 3 inches wide and spiny along the edges. They bear a fruit which is somewhat similar in appearance and size to a pineapple.

These plants are of economic value because of their thin fibrous leaves. While they are not cultivated anywhere in the Islands, yet their leaves are harvested in large quantities for the manufacture of bags and mats. Much of the sugar which is produced in Panay and Negros is put up in bags made from the leaves of these plants, mainly in the Provinces of Capiz and Antique. Sleeping mats and mats for the floor and wall are also made from these leaves, and these are of value because when folded they do not break.

In making these articles the leaves are gathered when mature and split into fillets of desired width. These are then woven into whatever shape and pattern desired, and the ends are not tied but lapped. The material dyes readily, and by the use of fillets of different colors ornamental as well as useful weavings may be made. One plant during the year will produce enough leaves for about two sugar bags or a bed mat.

In India the leaves have been used for paper stock, but no trials for this purpose have thus far been made in the Philippines.

The aerial roots of these plants contain a fiber, though it is seldom extracted at the present time. The roots are frequently cut, however, and after removing the pulp from the ends by pounding they are used for paint and whitewash brushes. In some species this root fiber is fine, and it is suggested that it might be useful in brush making.

BURRI OR TALIPOT PALM.

(*Corypha umbraculifera*.)

This plant, a member of the *Palmaceæ*, grows in greater or less abundance in all parts of the Archipelago. It is said that the Island of Burias takes its name because of the abundance of these plants growing there. Although these palms are nowhere cultivated, yet they are of great utility to the natives. They bear large fan-like leaves, with all the leaflets radiating from the end of the long stem—in themselves very ornamental. These leaflets, sometimes 3 or 4 feet long, are used for practically the same purpose as those of the Pandan, only they produce a coarser grade of matting, baskets or hats because the fillets are less pliable and coarser. Hats of good quality are made from the leaves of the burri, and the coarser mats and cushion covers are usually of this material. The fillets may be stripped very finely and they dye readily.

This palm thrives in almost any soil except marshes and grows to a height of 30 to 50 feet. They bear hard, scaly fruits on a raceme which terminates the stem, and after fruiting die. They are natives of Ceylon and the Malabar coast.

The Filipinos make sugar, sirup, and wine from the sap of the burri, and it also possesses medicinal properties.

NIPA.

(*Nipa fruticans*, Thumb.)

It has been said that nipa ranks next to the bamboo as a plant of usefulness to the Filipinos. The plant belongs to the *Palmaceæ* and grows almost exclusively in the marshy lands along the shores and in the deltas of rivers. It does not grow tall, and the leaves are very similar in structure and color to those of the cocoanut.

When the leaves are mature they are cut and the leaflets are stripped from the stem. While these leaflets are still green they are bent in the middle over a small piece of bamboo about two yards long, or shorter if the particular use to which they are to be put demands it, and sewed near this bamboo rib or stay with rattan or fine strips of bamboo, thus forming a small mat with the ends of the leaflets loose. These are laid on the roofs and sides of houses in the manner of placing shingles upon a roof. Almost everywhere in the Philippines, when durability and cheapness are considered, perhaps no better substitute can be found. In situations where the wind is not strong for a large portion of the year this material will last five or six years on a roof of one-half pitch. On roofs of slighter pitch the period of duration is less. Usually for siding the small mats are battened down with small strips of bamboo. In this way they will last for many years.

An acre of marsh land well planted will yield about 50,000 of the small mats per year.

The young leaves of the nipa are used for making mats, hats, sails, and rain coats. The leaflets are stripped into fillets and braided or woven in the same way that pandan and burri are worked.

Juice taken from the flower stem produces a wine or alcohol called tuba highly esteemed by the natives, and the fruit is edible.

RATTAN.

(*Calamus*.)

Species of rattan are found in great abundance throughout the mountainous and forest regions of the Philippines. They are climbing palms, growing sometimes to a height or length of 300 feet. Almost no investigations have been made upon these plants in the Philippines, but specimens of both the "cane" and body rank well with those obtained in Ceylon and the Malay peninsula.

Rattan has not yet reached the importance of an article of export for the Philippines, but no doubt, as the better species become known and

means for obtaining them are improved they will take their place as one of the articles of export. To the Filipinos they are almost all very useful. Both the cane and the body are extensively used in the manufacture of furniture, baskets, and mats. The vine entire is used for ropes, draw lines for ferry rafts, walking sticks, and for numerous other purposes. The cane used for seating chairs, beds, and the like is the outside hard and resistant portion stripped off. These strips are inelastic, though very pliable, but care must be taken in bending or tying them that the smooth outside be on the convex, otherwise they will break easily. Because of their inelasticity they are very useful for lashings, especially in the construction of houses. In Negros and Panay they are extensively used for binding bags of sugar, cacao, and copra.

Rattan will probably always remain a product of the forest, for, from the nature of the plant's growth, tall trees are required for it to run upon. Advantage will result, however, from training them upon the trees so that they will not become cramped and crooked.

The most useful species at the present time found in the Philippines is *Daemonorops melanochaetes* Blume. While this does not produce the finest canes, yet they serve the greatest number of purposes, and the plant entire is most commonly used for draw lines for ferry rafts. The flowers produce a nectar from which the bees render a superior grade of honey.

CONCLUSION.

In the rich vegetation of the Philippines many fiber-producing plants occur, the fiber of which is of local use and importance, but whose properties have not been brought to the notice of buyers and consumers. In determining the value of a fiber for economic and commercial purposes the question need not be carried further than the determination whether the new fiber can be used as a substitute for any of the well known commercial fibers or whether some new economic use can be established for it. If these considerations are established, then the demand will in time regulate the questions of production and extraction. The world's present demand for fibers is supplied from only about forty species of plants, and while some of these are less valuable from the standpoint of strength and durability than some less commonly known ones, yet their use has become established and machines and methods have been adapted to their manufacture. Against these, new fibers must compete though superior utility may be in their favor.

Among the little known fibers of the Philippines which are of high quality and promising value may be mentioned the Eruc from *Corypha urens*, which is a strong fiber, nonresistant in water, the bow-string hemp, similar to sisal, and fibers from the species of *Hibiscus*. Investigations of these and other economic species are now under way, and it is expected that their value and utility may be more fully established.

Partial list of fibrous plants of the Philippine Islands.

Scientific name.	Native name.	Where found.	Uses, etc.
<i>Abroma alata</i> L	Ambong		
<i>Abroma augusta</i> L	Nabo	Occidental Negros	For cords and ropes. ✓
<i>Agave americana</i> L	Maguey	Ilocos, Union, and Abra.	For ropes, cords, and to a small extent for fabrics.
<i>Ananas sativa</i> Schult.	Piña	Southern Luzon and Panay.	For thread and fabrics.
<i>Artocarpus incisa</i> L	Imagdong	Occidental Negros	For ropes and cords. ✓
	Antipolo	do.	Do.
	Banuacalao	Tarlac	Do.
	Baroy	do	Do.
	Barinas	do	Do.
	Banos	Tayabas	Do.
	do	do	Do.
<i>Bauhinia cumingiana</i> F.Vill	Amiray	Ilocos	For cords, threads, and fabrics.
<i>Bauhinia scandens</i> L	Maracapas	Tarlac	For ropes and stuffing.
<i>Boehmeria nivea</i> Hook.	Bulobulo	Bulacan	For cordage, etc. ✓
<i>Bombax ceiba</i> Linn	Locoan	Masbate	For bindings and lashings.
<i>Calamus</i> sp.	Lambotan	Tayabas	Do.
<i>Calamus</i> sp.	Palasan	Masbate	Do.
<i>Calamus albus</i> Pers.	Talola	Tayabas	Do.
<i>Calamus buroënsis</i> Mart.	Ouay-na-pula	Zambales	Do.
<i>Calamus concinnus</i> Mart.	Balinanay	Bataan	Do.
<i>Calamus discolor</i> Mart.	Quay	do	Do.
<i>Calamus equestris</i> Willd.	Ditaan	Zambales	Do.
<i>Calamus haenkaenus</i> Mart.	Apis	do	Do.
<i>Calamus javensis</i> Blume	Yatoc Iimoran	Bataan	Do.
<i>Calamus piscarpus</i> Blume	Ditaan	Zambales	Do.
<i>Calamus rhomboideus</i> Blume	Buton	Masbate	Do.
<i>Calamus seipionum</i> Lour.	Idyoc erne	Tayabas, Negros	For ropes and thatch. ✓
<i>Caryota urens</i> L		All coasts	For brushes, ropes, and coarse weavings.
<i>Cocos nucifera</i> L			For cordage. ✓
<i>Columbia analao</i> Blanco.	Analao	Union	Do.
<i>Corchorus acutangulus</i> Lam.	Saluyot	Camarines Sur	Do.
<i>Corchorus capsularis</i> L	Pasao-na-bilog	do	Do.
<i>Corchorus olitorius</i> L	Pasao	Batangas	Do.
<i>Cordia myxa</i> Linn.	Ananong	do	Do.
<i>Corypha umbraculifera</i> L	Silac, Burri	Union, Negros	For mats, hats, and bags.
<i>Dacmonorops melanochaetes</i> Blume.	Parasan	Leyte, Samar	For bindings and lashings.
<i>Gnetum scandens</i> Roxb	Colias	Tarlac	For cordage. ✓
<i>Gossypium herbaceum</i> L	Bukac	Ilocos	Do.
<i>Grewia laevigata</i> Vahl	Dauglin	Batangas	Do.
<i>Grewia multiflora</i> Juss.	do	do	Do.
<i>Hibiscus abelmoschus</i> L	Castuli	Bulacan	Do.
<i>Hibiscus tiliaceus</i> L	Balibago	Tayabas, Masbate	For mattings, ropes, and paper.
<i>Hibiscus tiliaceus</i> L	Impid	Camarines	For cordage. ✓
<i>Kleinhovia hospita</i> L	Tanag	Bulacan	Do.
<i>Lygodium scandens</i> Sw	Nito	Camarines	For hats, mats, and ropes.
<i>Melochia arborea</i> Blanco.	Malasap sap	Bulacan	For cordage. ✓
	Balicnong	do	Do.
	Maratarong	Tarlac	Do.
<i>Musa paradisiaca</i> L	Saging	All provinces	Do.
<i>Musa textilis</i> L	Abaca	Camarines, Albay, Mindoro, Cebu, and others.	For ropes, cords, and fabrics, largely exported.
<i>Napea scabra</i> Blanco	Anabo		
<i>Nipa fruticans</i> Thumb	Ogpooy	Zambales	For ropes, hats, and mats.
	Nipa	All coasts	For mats and thatch.
<i>Pandanus dubius</i> Spreng.	Bariu	Leyte, Samar, Negros, No. Luzon, Mindanao.	
<i>Pandanus odoratisimus</i> L	Pangdan		
<i>Pandanus radicans</i> Blanco.	Olang		For mats, hats, bags, baskets, sails, and the like.
<i>Pandanus montanus</i> Miq	Mingo		
<i>Phaleria</i> sp.	Salagos	Camarines	For cordage. ✓
<i>Pterospermum diversifolium</i> Blume.	Bayog		
<i>Sida frutescens</i> Cav	Queddeng	Tarlac	Do. ✓
<i>Wilkstroemia ovata</i> C.A. Mey	Escobang naba		
<i>Zanthoxylum avicennae</i> DC	Salago	Nueva Ecija	For cordage. ✓
	Casay		

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