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BULLETINS AND CIRCULARS

ON

CHARCOAL, LUMBER, AND SAWMILLS

(Excerpt from Philippine Commission Report for 1906, Vol. 3, pp 609–711, 779–788.)

BUREAU OF INSULAR AFFAIRS

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BULLETINS

ON

CHARCOAL INDUSTRY, LUMBER AND SAWMILLS

IN THE

PHILIPPINE ISLANDS.

BUREAU OF FORESTRY.

(Bulletin No. 2.)

THE CHARCOAL INDUSTRY IN THE PHILIPPINE ISLANDS—NATIVE METHODS, JAPANESE METHODS, AND COMPARISON—WASTE IN MAKING—PRICES—SPECIES USED.[a]

By William M. Maule.

LETTER OF TRANSMITTAL.

Department of the Interior,
Bureau of Forestry,
Manila, March 23, 1906.

Sir: I have the honor to inclose herewith an article by Forester William M. Maule on "The Charcoal Industry in the Philippine Islands," together with a Spanish translation of same, and respectfully recommend that it be published as Bulletin No. 2.

Very respectfully,

George P. Ahern, *Director of Forestry.*

The Secretary of the Interior, *Manila, P. I.*

The charcoal industry in the Philippine Islands, while not one of the most important of commercial enterprises, is yet kept alive by certain market demands which can not be filled from other sources.

The call for charcoal in Manila, which is the leading market, is somewhat limited, but steady. Larger consumers are usually supplied by contract, while smaller users buy from the open market. Aside from the considerable amount used in the provinces for laundry purposes and for smelting ores, which, in the aggregate, probably falls but little below that used in Manila, the more varied uses in the latter place are for laundries, tailor shops, hatters, restaurants, bakeries, and metal workers.

The following table shows the amount of charcoal shipped to Manila by provinces during the fiscal year 1904–5:

Province.	From public lands.	From private lands.	Province.	From public lands.	From private lands.
	Cu. met.	*Cu. met.*		*Cu. met.*	*Cu. met.*
Zambales	2,591	.....	Tarlac	8	.....
Pampanga	608	1,170	Bulacan	2	.....
Bataan	544	.....	Tayabas	1	.....
Pangasinan	182	.....			
Mindoro	29	.....		3,984	1,182
Laguna	19	.....			
Batangas	.....	12	Sum total	5,166	

[a] The following illustrations accompany this report and are on file in the War Department:

Types of Philippine kilns:

Fig. 1. Native kiln (general use).

Fig. 2. Type of kiln, Masinloc, Zambales, P. I.

Fig. 3. Kilns in various stages: (1) Burning; (2) complete before burning; (3) nearing completion (not capped).

Fig. 4. Oven complete (clay dome and two vents).

Fig. 5. Medial transverse section of oven. Door on left and chimney on right. Flame starts upward from door, along top, and down to chimney.

Fig. 6. Floor plan of kiln. By being pear shaped it has better draft than if circular.

NATIVE METHODS OF MAKING CHARCOAL.

The native methods of charcoal burning as pursued in Zambales and Pangasinan provinces may be taken as typical:

The wood which is to be used, having been cut into 1-meter lengths, is piled on end about a central guide post or pole having the required height of the kiln, or about four wood lengths. Each tier decreases in diameter, and they finally converge to form a cone-shaped pile. (Figs. 1 and 3.)

There are no uniform dimensions in the kilns, but an average one will have a basal diameter of 2 meters by 3 in height.

In order to provide draft in burning, a small radial vent leads along the ground to the central axis, then upward to the apex of the cone. At the time of building, the lower portion of this chimney is filled with combustible materials—leaves or small dry branches.

At Masinloc certain burners employ another method of piling, whereby the wood is arranged in a horizontal radiating manner of from 2 to 3 concentric circles. Kilns of this type are but slightly conical and are rarely more than 1 meter high. The same system of draft is given as that of the former mehod. In either case, in order to complete the kiln, the surface is capped by a layer of clay or loam and during burning is constantly moistened.

In starting the burning, a fire is placed at the lower vent and, in order to distribute it properly, small openings are made on the surface of the cone. During the course of burning the fire works from below toward the openings above, and as carbonization of parts is complete, new drafts are made and old ones closed. Sufficient information is not at hand to show the comparative merits of the above methods, but as the former is more frequently used, it is no doubt preferable. One week is usually required to burn a kiln whose construction and burning require the services of three men for one week.

WASTE.

From a kiln whose volume is 12 cubic meters (which is an average size) the yield in charcoal never exceeds 9 cubic meters, the waste being divided between 1 cubic meter of partially carbonized wood and 2 cubic meters of ash. On an average but 7 cubic meters of charcoal are secured, and at times only 5.

The improperly carbonized wood is usually replaced in the following burning, thereby diminishing the waste.

Rarely is the oven protected by a roof, and in case of heavy rain the cap is washed off and the fire quenched.

From the upper Zambales coast charcoal is usually shipped by means of paraos, the owners of which buy either direct from the burners or secure a license and employ men under their supervision.

In the provinces, charcoal is usually bought and sold by the "batulán" (Tag.), which is 1 cubic yard (Spanish) or 0.584 m/3. In general, the price paid per batulán in the provinces is from 2 to 3 pesetas (40 to 60 centavos, Philippine currency).

The foregoing methods are used in producing charcoal on a commercial scale. By a third method, which is applied only to making small quantities for household use, the wood is embedded in rice hulls or chaff and the mass fired. This method requires about two days to burn, after which the fire is extinguished by water—a method observed to be in general use in Pampanga.

JAPANESE METHOD.

STRUCTURE OF KILNS.

In the vicinity of Subic, Zambales, and Moron, Bataan, several Japanese licensees have begun the manufacture of charcoal according to methods employed in Japan, and as such methods seem superior in many ways to those in general use, their introduction should meet with favor. Permanent kilns are constructed on a well-drained hillside, half the kilns being excavated from the bank, while the front, containing a door for filling, is built up from stone and clay.

Having constructed the kiln, which, on an average, is slightly more than 1 meter deep and having a capacity of about 5 cubic meters, a chimney, with diameter of 3 inches, is placed at the rear, having its inner opening at the bottom of the kiln. By filling the unfinished kiln with wood and rounding off the top a model is formed for the dome, which consists of a 6-inch layer of clay. In burning this first kiln, the clay is baked and, if of good quality and protected by roof, will last several years. Three small holes are made in the dome, which furnish draft.

In order to insure complete and even burning, the ground plan of the kiln is made pear shaped, with the neck portion near the door. Such shape insures a better draft than where the plan is round.

FILLING THE KILN.

In securing wood for burning, but little care is taken in selecting species, there being but few that are not suitable. Pieces are cut into lengths of height of kiln and range from very small to 10 inches in diameter, above which size they are split. The larger pieces are placed toward the center of the oven, and all are builded in as compactly as possible by a man within. Having thus filled the kiln to the door, a small pile of dry wood is placed in front, from which the interior is fired.

BURNING.

After burning some four hours, with all drafts open, or until about 4 inches of red coals appear over the top of the corded wood within, the door is closed or builded shut, with the exception of a small vent below, by means of cross logs cemented with clay.

The fire, beginning at the top, works downward, as shown in Fig. 5. In from three to four hours more, the fire being well distributed, the three small vents of the dome are closed by clay, leaving open only the small aperture at the bottom of the door and the chimney, by which further burning is regulated. The kiln requires frequent attention to see that the fire is not too strong or too weak.

Three days are required to carbonize the wood, after which all vents are closed, in order to smother out the fire, which requires an additional three days, so that, on an average, one week is required to produce one kiln of charcoal. On an average, three kilns are kept burning constantly, and require a crew of from 6 to 8 men and 1 foreman.

PRODUCT.

The charcoal comes from the kiln in excellent condition; rarely is there found any waste caused by under or over burning, and so perfect is the carbonization that the bark is not consumed. A kiln whose volume is 5 cubic meters will average 24 sacks of charcoal.

VOLUME OF KILN.

Five cubic meters contain 5.4 cubic meters of loosely piled wood and yield 4.30 cubic meters of charcoal, the approximate loss being 1 cubic meter. The foreman stated that a safe average of loss in burning would be two-fifths.

In summing up the advantages of Japanese methods over those employed by the natives, we find the following:

Kilns can be used repeatedly, with but little repair.

The burning is more easily regulated and results in less waste.

The product is not damaged by water, which is frequently used by natives in quenching the fire.

The charcoal comes out clearer than where the oven must be destroyed in removing it, and brings better prices.

In places where Japanese have been operating the natives have adopted their methods, working at first under a Japanese foreman, or employing him, and, seeing the advantage gained, they will no doubt adopt it generally.

Profits, Japanese method.

Charcoal gang, one month:	
8 laborers, at ₱0.60 per diem	₱144.00
1 foreman, at ₱2 per diem	60.00
Freight on 350 sacks of charcoal to Manila (average monthly production), at ₱0.30 per sack, by steamer	105.00
Loading on steamer, at ₱0.05 per sack	17.50
Discharging steamer, at ₱0.05 per sack	17.50
Government charge, at 10 per cent market price (at kiln)	28.00
Combined expenses of making and shipping	372.00
Contract price in Manila, at ₱3 per sack	1,050.00
Profit of one month	678.00

No account has been made of initial cost of sacks, which average ₱0.15 each, and are used a number of times.

Heretofore the source of timber used in charcoal making has been taken from the mangrove swamps. In many places near Manila the best of these mangrove species

are becoming rare or are of too small size to use in burning. In such cases species of the semiopen forests, or "parang," are selected, and in certain parts of Pampanga charcoal is made from cauayan (Bambusa), which has been planted for fuel purposes.

The following list includes species largely cut for charcoal:

MANGROVE.	SEMIOPEN, OR "PARANG."
Bacauan (*Brugiera*).	Agoho (*Casuarina equisetifolia*).
Tangal (*Rhizophora*).	Binayuyo.
Pagatpat (*Sonneratia pagatpat*).	Guayabas(*Psidium guayava*)introduced sp.
Culasi (*Lumnitzera*).	Madrecacao (*Gliricidia masculata*) introduced sp.
Tibigi (*Xylocarpus*).	
Dungon-late (*Heritiera littoralis*).	

MANAGEMENT OF FORESTS FOR CHARCOAL BURNERS.

The manufacture of charcoal from trees cut indiscriminately from the high forest is usually undesirable from a sylvicultural point of view, as clear cutting is generally practiced. In places where mangrove species have been exhausted, or where such do not exist, and where it is necessary that forest species be used, a simple plan of management can be devised whereby an "improvement cutting" can be made.

The forests in provinces adjacent to Manila are composed largely of third-group species, many of which are important from a timber standpoint, and can be lumbered profitably, owing to cheap rates of transportation. It is obvious that the reproduction of such species should be favored, with the view of timber producers.

Growing in association with these species are numerous second-story or even taller trees, which are generally of a hard character, but never attain merchantable size. Such trees will not only be valuable for charcoal purposes, but their removal from the forest will promote the growth of younger stages of the merchantable species.

In carrying out such plans, a list of prohibited species should be furnished the licensee as pertinent to his cutting locality. Owing to the frequence of the abovementioned species, it is believed that the adoption of this plan will not cause undue hardship to operators.

In order to show the importance of a safe and continuous supply of fuel, it may be of interest to state that the demand for fuel in certain of the Federated Malay States has assumed such proportions that a plan of management has been adopted for mangrove swamps.

BUREAU OF FORESTRY.

[Bulletin No. 4.]

I. MECHANICAL TESTS, PROPERTIES, AND USES OF THIRTY PHILIPPINE WOODS—II. PHILIPPINE SAWMILLS, LUMBER MARKET, AND PRICES.

By Rolland Gardner, *Manager of the timber-testing laboratory.*

LETTER OF TRANSMITTAL.

Department of the Interior,
Bureau of Forestry, Office of the Director,
Manila, September 7, 1906.

Sir: I have the honor to transmit herewith a manuscript entitled "I. Mechanical Tests, Properties, and Uses of Thirty Philippine Woods; II. Philippine Sawmills, Lumber Market, and Prices," by Rolland Gardner, manager of the timber-testing laboratory, bureau of forestry, and to recommend its publication as Bulletin No. 4 of the bureau of forestry.

Very respectfully,

George P. Ahern,
Director of Forestry.

The Secretary of the Interior, *Manila, P. I.*

INTRODUCTION.[a]

(By H. N. Whitford, forester, chief of division of forest products.)

This bulletin has been prepared in response to numerous inquiries concerning Philippine woods and milling operations in the Philippines. The results of the timber tests published represent the present knowledge of the subject and are not to be considered final, for such results can be obtained only from a large number of tests of properly identified botanical material from many localities and habitats. With two exceptions the woods tested have been representative of the commercial material found on the market, and are fair samples of those used by contractors and others. Indeed, in many instances they represent more approximately an average of the actual material used in construction than woods collected with botanical specimens might do. Nevertheless, the value of mechanical tests on properly determined material obtained from districts where logged is not underestimated, and such tests will be made as rapidly as possible.

Since the microscopic characteristics of Philippine woods have not been studied it is not always possible to check market material with properly identified museum specimens. It is probable that structural differences can not be detected between closely related species, so that with good microscopic sections it will not always be possible to identify closely related woods. In such cases botanical specimens alone will be the final test.

It seems almost superfluous to caution against the blind acceptance of the names of trees and woods given by native woodsmen. This error becomes even more grievous when, without any botanical knowledge or specimens, scientific names are attached as equivalents. It is true that many of the natives are keen in distinguishing trees, and can often point out with great skill the differences. While their help is essential to one who would have first-hand knowledge of timber trees in the forest, yet such information should be constantly verified with botanical material and wood specimens. By such methods the bureau is adding to its list of properly determined wood specimens.

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[a] The illustrations mentioned have been omitted from this report and are on file in the War Department.

Part I.

MECHANICAL TESTS, PROPERTIES, AND USES OF THIRTY PHILIPPINE WOODS.

POPULAR DISCUSSION OF THE QUALITIES OF WOODS AND MEANING OF TIMBER TESTS.

Every wood worker knows more or less of the properties of the various kinds of woods which come under his observation, but this knowledge is usually gained by long experience. He may know that certain woods are strong or stiff, but he seldom learns from his own experience how strong or stiff they are. For this reason the design of structures is often largely a matter of guesswork, the designer or builder not having experimental data regarding the strength, stiffness, and other properties of timber. In the timber-testing laboratory these various properties and characteristics are studied, and the results are collected in such form that others may use them to determine the fitness of woods for certain purposes.

Timber, as a material of construction, is required to resist various stresses. A short, thick column must resist simple compression along the grain. A railroad tie must resist compression across the grain where the rail rests upon it, and also shearing across the grain by the edges of the rail. Simple tension and shearing along the grain are not common in practice, although these stresses frequently occur in combination with other stresses, as in cross bending. It is possible to subject timber to any one of the above-mentioned stresses, but it is much more common in practice that timber must withstand a number of these stresses at the same time.

Timber also possesses such properties as stiffness, hardness, toughness, flexibility, etc., which are all important in determining the fitness of any wood for certain purposes. Strength and stiffness are measured in pounds per square inch, but no satisfactory units have yet been proposed by which such properties as hardness and toughness may be measured.

The beam is one of the most common members in general construction and the stresses involved are most complex. Suppose we have a beam 4 by 4 inches in section, 5 feet long, and supported at each end. At the middle of this beam a load of 500 pounds is applied and the beam bends one-sixteenth of an inch at the middle; another 500 pounds bends it one-sixteenth of an inch more, and so on until a point is reached where an added 500 pounds produces an additional deflection of more than one-sixteenth of an inch. Here the true elastic limit is reached, or, to state this a little more accurately, the true elastic limit is reached when deflection is no longer proportional to load. This is approximately the point where the material begins to be injured, and if a beam is loaded beyond this point it will not return to its original condition when the load is removed. Even small loads produce some permanent set or bend in beams, but the true elastic limit is important as showing approximately the point where injury begins. Thus the true elastic limit is located. Now what do the figures mean which are tabulated under "Fiber stress at the true elastic limit, pounds per square inch?" Evidently not the load on the beam when the true elastic limit was reached, for that would be applicable only to a beam of the same size, under exactly the same conditions as the one tested. To answer this question, it is necessary to examine the stresses produced.

As the beam is bent, its curve is approximately the arc of a circle. The bottom of the beam becomes longer and the top shorter, therefore the bottom is in tension and the top in compression. Upon the supposition that these stresses are equal, the stress at the extreme top and bottom of the beam is computed and is tabulated under "Fiber stress at true elastic limit, pounds per square inch."

Fiber stress at apparent elastic limit and modulus of rupture, as tabulated, are also approximate stresses at the extreme top and bottom of the beam. The apparent elastic limit is a point a little higher than the true elastic limit. It is located arbitrarily, as explained under "Methods of testing and results of tests," and has no particular significance, although it was used extensively in early timber tests. The true elastic limit may be considered as a limit of safety and the modulus of rupture as the greatest stress which the wood will stand in cross bending. In practice, the fiber stress is always kept much lower than the fiber stress at the true elastic limit.

No attempt is made to measure brittleness and toughness, but in cross-bending tests a brittle wood may be distinguished from a tough wood by the relation existing between the true elastic limit and rupture; for in brittle woods the amount of bending is small between the true elastic limit and rupture, while in tough woods it is great. Most Philippine woods are brittle, Dungon and Malugay being the only ones which have been investigated and found to possess the property of toughness to any considerable degree. These two, however, are quite tough, and compare favorably with white oak

for bending by steaming. Woods like Molave, Calantas, Ash, and Pine are brittle, while those like Malugay, Dungon, Elm, Hickory, and Oak are tough.

The modulus of elasticity is the measure of the stiffness of a material. If a beam of one kind of wood has a modulus of elasticity of 1,000,000 pounds per square inch and a second beam of another kind has a modulus of elasticity of 2,000,000 pounds per square inch the second wood is twice as stiff as the first, and if the two beams are of exactly the same dimensions the first beam will bend twice as far as the second under a given load. For example, Yacal and Guijo are among the stiffest Philippine woods, being approximately twice as stiff as woods like Banuyo and Calantas. (See Table I.)

Now consider two similar beams of the same material, supported at each end and loaded in the middle. If beam No. 1 is made twice as long as beam No. 2, other dimensions being the same, it will bend eight times as far under a given load but will be only half as strong. If beam No. 1 is made twice as high as beam No. 2, other dimensions remaining the same, it will bend only one-eighth as far under a given load but will be four times as strong. If beam No. 1 is made twice as wide as beam No. 2, other dimensions remaining the same, it will bend only one half as far but will be twice as strong. If the beams are of the same dimensions throughout and the load on beam No. 1 is double that on beam No. 2, beam No. 1 will bend twice as far.

A strong wood is not necessarily stiff, nor is a stiff wood necessarily strong, although in many cases these properties appear to be closely related. By referring to Table 1, it is seen that the Betis, from Tayabas, which was tested, was about 60 per cent stronger in cross bending than that from Ambos Camarines, although it was not quite as stiff. With few exceptions, timber is much stronger when dry than when green. The weight of moisture in timber just from the saw is often from 80 to 90 per cent of the weight of the wood itself. This amount of moisture may be reduced to 30 to 35 per cent of the weight of dry wood, without showing any increase in strength, but when the wood is dried beyond this point the strength usually increases quite rapidly, well-seasoned timber frequently being from 50 to 70 per cent stronger than green timber. The amount of increase in strength is shown for the various woods in Tables I and II.

As wood dries, the fibers become harder, stiffer, and stronger, but the wood also shrinks, which causes checks that tend to weaken the timber. In most woods this latter effect is much less than the former and the wood shows a decided increase in strength and stiffness, but in hard, brittle woods the checking effect is quite serious; for example, the Ipil and Molave which were tested showed a decrease in modulus of rupture when seasoned, as is shown by Table I. The tendency to check while seasoning may be overcome to a large extent by drying slowly and evenly, but in large timbers the outer surface dries months or even years before the interior, so that it is practically impossible to prevent checking. This is one reason why the strength values for large timbers are somewhat smaller than for small timbers.

Timber is thoroughly seasoned when it contains 10 to 12 per cent moisture throughout, and will arrive at that percentage of moisture in time if exposed to air but protected from rain and sun. If it is made drier than this by artificial means, it will reabsorb moisture from the atmosphere until it arrives at 10 to 12 per cent moisture. There is considerable variation in the moisture content of timber seasoned by artificial means. Usually timber whose moisture content is less than 20 per cent will pass for seasoned timber.

In tropical countries the most desirable quality sought in wood is durability. This is true because the destructive elements to timber are greater than in temperate regions. Because of continuous heat and moisture, fungus growth is undoubtedly more rapid in the tropics. The universal presence of the white ant is perhaps the most destructive element that makes the use of durable timber almost imperative for railroad ties and for general construction purposes. Such timbers as are used for ties in cold regions would not last nearly as long here as there, but some of the best native woods are extremely durable. In temperate zones ten years is considered a long life for an untreated tie, but in these islands the extremely durable woods, like Ipil and Molave, are known to have been in the ground for more than ten years without any sign of decay. The ravages of the sea worm (teredo) restrict the use of untreated timber, in contact with salt water, to those species that are especially adapted to resisting the attacks of this enemy. The softer Philippine woods, like Lauan, and imported woods, like Oregon Pine, are quickly destroyed when placed in salt water, while Aranga and Betis are highly valued because of their great durability under these conditions.

MATERIAL USED FOR TESTING—DESCRIPTION OF BEAMS.

MATERIAL USED FOR TESTING.

It being impracticable at the time these tests were started to secure timber which had been botanically determined, this series of tests was made almost entirely upon

timber purchased in the market. The Sacat and Balacat, which were obtained at the Lamao Forest Reserve, were the only woods which were not secured in the market. In buying care was exercised to select timber which well represented the quality generally used in construction. Most of the timber tested was clear and sound.

No standard rules for the inspection of timber are in use in Manila by which the quality and condition of the timber tested may be described. Where defective beams have been tested, the beams will be described whose moduli of rupture correspond to the average, maximum and minimum moduli of rupture as tabulated. All blocks used for compression and shear tests were clear and sound.

DESCRIPTION OF BEAMS.

The following is a list of the woods used where all the beams tested were clear and sound:

Name.	Locality.	Name.	Locality.
Lauan	Mindanao.	Ipil	Palawan.
Do	Zambales.	Dungon	Masbate.
Apitong	Mindanao.	Do	Mindanao.
Guijo	Ambos Camarines.	Supa	Locality unknown.
Do	Mindoro.	Betis	Tayabas.
Yacal	Ambos Camarines.	Do	Ambos Camarines.
Narra	Near Laguna de Bay.	Aranga	Do.
Do	Cagayan.	Balacbacan	Negros Occidental.
Tanguile	Locality unknown.	Mayapis	Laguna.
Sacat	Lamao Forest Reserve.	Malugay	Mindoro.

The following is a description of the beams used in testing that were more or less defective:

APITONG FROM ZAMBALES.

[Six beams contained slight defects.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	do	Do.
Minimum	One knot and check	Do.

MOLAVE FROM LAGUNA DE BAY.

Many beams contained knots and checks which are characteristic of Molave. There were no defects in the middle of beams which would seriously affect strength.

MOLAVE FROM AMBOS CAMARINES.

Many beams contained knots and checks which are characteristic of Molave. There were no defects in the middle of beams which would seriously affect strength.

TANGUILE FROM ZAMBALES.

Two beams contained slight defects. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

SACAT FROM TARLAC.

[Four beams contained slight defects.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear and sound.
Maximum	do	do	Do.
Minimum	do	Heart check full length	Do.

IPIL FROM AMBOS CAMARINES.

All beams clear and sound but slightly cross-grained.

IPIL FROM MINDORO.

[Eight beams contained slight defects.

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	do	Do.
Minimum	One knot in middle	Do.

DUNGON FROM AMBOS CAMARINES.

[Four beams slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear ano sound
Maximum	do	do	Do.
Minimum	One knot and check	do	Do.

MALASANTOL (LOCALITY UNKNOWN).

[Two beams slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear and sound.
Maximum	do	do	Do.
Minimum	do	do	One-third sap wood.

SUPA FROM TAYABAS.

[Five beams slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	do	Do.
Minimum	do	Large check in middle.

BALACAT FROM LAMAO FOREST RESERVE.

Small knots were quite common. There were three or four ¾-inch knots in each beam.

BALACAT FROM TARLAC.

[Ten beams slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear and sound.
Maximum	do	do	Do.
Minimum	do	One ½-inch knot	Do.

MACAASIN (LOCALITY UNKNOWN).

[Two beams slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear and sound.
Maximum	do	do	Do.
Minimum	Checked on side	do	Do.

CALANTAS FROM ALBAY.

Two beams were slightly defective. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

CALANTAS FROM MINDORO.

[Five beams were slightly defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	do	Do.
Minimum	One ½-inch knot in middle	One small knot and bad check.

TINDALO (LOCALITY UNKNOWN).

[One beam defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	do	Do.
Minimum	Slight check on top	Do.

TINDALO FROM AMBOS CAMARINES.

[Five beams defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Clear and sound.
Maximum	do	do	Do.
Minimum	Bad check in middle	Slight check and one knot	Do.

TINDALO FROM MASBATE.

Two beams were defective. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

AMUGUIS FROM MINDORO.

Eight beams were defective. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

ACLE FROM TARLAC.

[Two beams were defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.	Moisture under 20 per cent.
Average	Clear and sound	Clear and sound	Knotty in middle.
Maximum	do	do	Do.
Minimum	do	do	Do.

ACLE FROM ZAMBALES.

[Four beams were defective.]

	Moisture over 35 per cent.
Average	Slightly checked.
Maximum	Clear and sound.
Minimum	One knot.

BANSALAGUIN (LOCALITY UNKNOWN.)

One beam was defective. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

PALO MARIA FROM ZAMBALES.

[Three beams were defective.]

	Moisture over 35 per cent.
Average	Clear and sound.
Maximum	Do.
Minimum	Heart check on side.

BATITINAN (LOCALITY UNKNOWN.)

[Thirteen beams were defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	One small knot	Three 1-inch knots.
Maximum	Clear and sound	Two 1¼-inch knots.
Minimum	Two small knots	Three 1-inch knots.

BANUYO FROM MASBATE.

[Five beams were defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Clear and sound	Clear and sound.
Maximum	One 3-inch knot near end	Do.
Minimum	Clear and sound	Do.

SASALIT FROM ZAMBALES.

[Twenty-one beams were defective.]

	Moisture over 35 per cent.	Moisture 20 to 35 per cent.
Average	Small checks on two sides	Clear and sound.
Maximum	Clear and sound	Small checks on two sides.
Minimum	do	Checks on three sides.

LIUSIN FROM BATAAN.

[Four beams were defective.]

	Moisture over 35 per cent.
Average	Clear and sound.
Maximum	Do.
Minimum	Cross-grained.

LUMBAYAO FROM BASILAN ISLAND, MORO PROVINCE.

One beam was defective. All beams whose moduli of rupture correspond to those tabulated were clear and sound.

METHODS OF TESTING AND RESULTS OF TESTS.

The machine used in making the following tests is a Tinius Olsen testing machine with a capacity of 200,000 pounds.

CROSS-BENDING TESTS.

All beams used for cross-bending tests (Table I) were either 3½ by 3½ inches or 4 by 4 inches in section, with a span of 60 inches. The machine was operated at a speed of 0.3 inch per minute and the deflection was noted at various loads during the tests. The

curve was then plotted between deflection in inches and load in pounds, and upon this curve were located the true elastic limit, the apparent elastic limit, and the point at which failure occurred.

The fiber stress at the true elastic limit was calculated by the standard formula:

$$\text{Fiber stress at true elastic limit} = \frac{3\,W\,L}{2\,B\,H^2} \text{ where,}$$

W equals load in pounds at true elastic limit,
L equals span in inches,
B equals breadth of beam in inches,
H equals height of beam in inches.

The term "apparent elastic limit," as used in this bulletin, is defined by Johnson[a] as follows:

"The apparent elastic limit is the point on the stress diagram of any material in any kind of a test at which the rate of deformation is 50 per cent greater than it is at the origin."

The fiber stress at the apparent elastic limit and the modulus of rupture were determined by the same formula which was used to determine the fiber stress at the true elastic limit, viz:

$$\text{Fiber stress at the apparent elastic limit} = \frac{3\,W'\,L}{2\,B\,H^2} \text{ where,}$$

W′ equals load in pounds at the apparent elastic limit; and

$$\text{Modulus of rupture} = \frac{3\,W''\,L}{2\,B\,H^2} \text{ where,}$$

W″ equals load in pounds at rupture.

Plate I shows the true elastic limit and the apparent elastic limit as located upon a typical stress diagram.

After the stress diagram was drawn, a tangent was drawn to the curve at the origin and the modulus of elasticity was determined by the following well-known formula:

$$\text{Modulus of elasticity} = \frac{W\,L^3}{4\,D\,B\,H^3} \text{ where,}$$

W equals the load corresponding to some point on the tangent,
D equals the deflection in inches corresponding to the same point,
B equals the breadth of beam in inches,
H equals the height of beam in inches,
L equals the span in inches.

After the cross-bending test, the beams were cut up, as shown in fig. 1, Plate II, for compression tests, shear tests, and moisture determinations. The parts which are marked C′ represent the blocks for tests in compression along the grain, and those which are marked S represent the pieces for shear tests. At A, B, and C thin disks were cut for moisture determination.

COMPRESSION ALONG THE GRAIN.

The blocks for tests in compression along the grain (Table II) were either 3½ by 3½ inches or 4 by 4 inches in cross section and 8 inches high. The machine was operated at a speed of 0.06 inch per minute and the load was increased until the blocks showed signs of failure by wrinkling on the sides.

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[a] Johnson, J. B.: Materials of construction, p. 19.

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TABLE I.—*Cross-bending*

Name.	Locality.		Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
				Moisture over 35 per cent.					
Lauan	Mindanao	Average	38	51.8	0.444	2,630	4,570	6,870	1,464
		Maximum		75	.485	5,340	5,840	7,050	1,820
		Minimum		35.5	.405	1,410	3,160	5,340	975
Do	Zambales	Average	36	63	.478	5,200	6,410	8,040	1,438
		Maximum		86.4	.529	7,450	7,880	9,770	1,740
		Minimum		41.6	.412	2,810	4,510	4,510	1,050
Apitong	Mindanao	Average	52	53.9	.62	3,750	5,550	7,350	1,754
		Maximum		81	.715	6,330	8,720	10,550	2,580
		Minimum		36	.56	1,970	3,730	5,540	1,320
Do	Zambales	Average	30	55.8	.679	5,220	6,790	8,910	1,428
		Maximum		84.6	.721	7,030	8,430	10,470	1,740
		Minimum		48.8	.588	2,530	3,230	3,910	900
Guijo	Ambos Camarines.	Average	27	43.7	.677	6,330	8,660	12,050	1,915
		Maximum		56	.735	8,150	10,200	13,820	2,240
		Minimum		37.2	.629	4,920	7,180	10,380	1,635
Do	Mindoro	Average	49	57.8	.696	6,420	8,780	11,350	1,825
		Maximum		89.8	.806	9,140	11,450	14,200	2,210
		Minimum		41	.596	2,110	4,570	6,210	1,190
Molave	Near Laguna de Bay.	Average	47	45.5	.772	4,870	8,380	10,610	1,503
		Maximum		62	.858	9,150	13,600	14,600	2,000
		Minimum		36.4	.69	1,410	4,360	5,200	895
Do	Ambos Camarines.	Average	29	54.4	.782	6,840	8,640	10,380	1,381
		Maximum		72.5	.825	9,850	11,950	14,380	3,090
		Minimum		43.8	.712	2,100	2,460	3,820	1,050
Yacal	do	Average	21	43.3	.823	7,270	10,160	13,070	2,079
		Maximum		54.2	.906	9,850	11,600	15,350	2,650
		Minimum		35.3	.76	4,920	7,750	10,260	1,680
Narra	Near Laguna de Bay.	Average	11	79	.563	3,000	6,300	8,390	1,509
		Maximum		93	.59	4,500	8,100	11,300	1,850
		Minimum		65	.535	2,110	4,500	5,300	1,130
Do	Cagayan	Average	11	51.8	.63	6,020	7,960	10,220	1,352
		Maximum		81.7	.77	7,750	10,830	13,500	1,650
		Minimum		35.5	.475	4,360	6,050	7,190	1,050
Tanguile	Unknown	Average	8	39.9	.536	5,180	6,780	9,160	1,576
		Maximum		45.4	.565	5,900	7,600	10,210	1,685
		Minimum		35.5	.51	4,640	5,760	7,030	1,380
Do	Zambales	Average	27	47.7	.457	4,010	4,980	6,380	1,241
		Maximum		80	.54	5,620	7,170	9,450	1,660
		Minimum		38.9	.405	2,110	2,110	3,040	950
Sacat	Lamao Forest Reserve, Bataan.	Average	8	48.5	.561	3,340	5,030	6,960	1,584
		Maximum		54.4	.585	4,220	5,380	7,670	1,710
		Minimum		45.2	.54	2,110	4,120	4,840	1,240
Do	Tarlac	Average	42	55.2	.60	5,800	7,050	9,200	1,569
		Maximum		82.6	.657	7,740	9,000	12,450	1,920
		Minimum		35.3	.478	2,250	2,810	3,120	920
Ipil	Ambos Camarines.	Average	19	52.7	.79	4,360	6,690	7,960	1,295
		Maximum		76.1	.872	5,620	9,420	11,680	1,680
		Minimum		36.1	.68	2,670	5,620	5,620	1,000
Do	Mindoro	Average	44	63.1	.67	5,430	7,430	9,410	1,226
		Maximum		106	.77	9,150	10,820	13,640	1,840
		Minimum		35.6	.56	1,480	2,050	2,050	550
Do	Palawan	Average	41	52.2	.807	9,170	11,210	13,520	1,953
		Maximum		60.1	.867	12,220	13,750	17,000	2,210
		Minimum		46.6	.75	2,110	2,810	6,330	1,420
Dungon	Ambos Camarines.	Average	6	42.2	.824	5,660	7,400	11,770	1,680
		Maximum		66.4	.895	7,880	9,570	14,980	2,080
		Minimum		35.2	.723	1,410	2,540	4,370	1,050
Do	Masbate	Average	3	36.3	.827	4,730	6,420	10,250	1,593
		Maximum		37.2	.845	4,920	7,030	11,400	1,790
		Minimum		35.5	.816	4,360	5,620	8,640	1,470
Do.[a]	Mindanao	Average	21	49.4	.668	4,520	5,740	7,870	1,317
		Maximum		81.6	.707	5,900	6,890	9,520	1,690
		Minimum		35.5	.636	2,810	4,150	5,510	920
Malasantol	Unknown	Average	21	66.2	.633	4,500	6,480	8,690	1,518
		Maximum		84.5	.689	6,330	7,380	10,040	1,670
		Minimum		35.4	.608	2,810	5,280	5,870	1,420

[a] This is not the wood commonly known as Dungon but is often sold under that name.

strength of Philippine timber.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
21	29.8	0.442	3,350	5,300	7,200	1,462	14	10.4	0.457	5,730	8,240	9,760	1,653	73	0.446
	35	.47	6,190	7,740	8,920	1,790		17.5	.488	10,550	12,640	14,250	1,840		.488
	20	.40	1,550	3,520	4,220	1,050		3	.404	2,390	5,480	7,020	1,395		.40
														36	.478
															.529
															.412
10	26.8	.699	6,190	8,220	10,230	2,033	13	14	.706	7,340	9,760	11,620	2,144	75	.645
	33.6	.74	9,150	9,850	11,640	2,550		19.8	.825	10,550	12,480	15,600	2,425		.825
	22	.658	4,220	6,320	8,600	1,710		9	.618	4,920	6,050	6,050	1,900		.56
1	20.8	.93	2,950	4,150	5,100	1,000								31	.687
	20.8	.93	2,950	4,150	5,100	1,000									.93
	20.8	.93	2,950	4,150	5,100	1,000									.588
15	26.6	.72	7,820	9,940	12,860	2,077	13	13.7	.759	10,080	12,850	15,150	2,158	55	.708
	35	.776	9,850	12,380	14,600	2,370		18.6	.82	12,650	19,700	21,500	2,480		.82
	20.3	.673	4,920	7,800	10,540	1,660		7	.718	7,730	8,940	11,900	1,740		.629
1	23.3	.724	7,740	9,150	12,650	2,110								50	.697
	23.3	.724	7,740	9,150	12,650	2,110									.806
	23.3	.724	7,740	9,150	12,650	2,110									.596
11	31.8	.803	5,010	9,000	10,190	1,602	9	10.4	.824	8,240	8,580	8,580	1,614	67	.785
	35	.848	7,030	10,700	12,150	1,950		19.5	.88	10,550	13,600	13,600	1,980		.88
	24.8	.725	3,520	7,740	9,530	1,400		3.5	.79	4,920	4,920	4,920	1,240		.69
														29	.782
															.825
															.712
42	29.6	.846	8,180	10,700	14,090	2,368	17	15.6	.848	9,650	12,130	15,690	2,583	80	.843
	34.3	.94	11,250	13,600	17,650	2,870		19.8	.90	12,230	17,480	21,800	3,000		.94
	21.5	.77	4,220	5,480	7,700	1,680		11.4	.81	6,680	9,140	13,580	1,844		.76
															.563
														11	.59
															.535
7	26.9	.508	5,650	6,570	7,380	1,462	13	9.6	.487	6,440	7,070	7,560	1,510	31	.54
	32.7	.56	8,430	9,850	11,020	1,710		13.8	.531	10,550	10,680	11,730	1,670		.77
	22.9	.438	2,110	3,090	3,460	870		4.6	.384	2,810	2,810	2,960	1,050		.384
12	30.6	.487	5,310	6,960	9,110	1,456	16	13.7	.422	6,440	7,380	8,360	1,232	36	.469
	34.6	.524	6,740	7,600	10,230	1,685		18.7	.58	9,150	11,400	12,560	1,610		.58
	21.8	.38	4,220	6,190	7,030	1,050		5	.355	4,500	4,920	4,920	976		.355
1	34.5	.54	6,050	6,330	7,700	1,320		9.7	.535	6,430	7,470	8,570	1,594	47	.491
	34.5	.54	6,050	6,330	7,700	1,320	19	18.4	.606	10,550	11,520	13,220	1,950		.606
	34.5	.54	6,050	6,330	7,700	1,320		1.6	.478	2,110	2,110	2,300	1,120		.405
														8	.561
															.585
															.54
10	24.2	.606	5,930	7,290	9,050	1,637	16	12.8	.664	8,350	9,610	11,440	1,886	68	.616
	35	.677	7,600	9,140	12,470	1,900		19.3	.70	10,540	12,230	15,600	2,080		.70
	20.2	.485	2,110	2,390	4,220	1,160		4.2	.622	4,220	4,500	4,920	1,710		.478
14	25.8	.783	5,580	6,640	7,900	1,470	8	18.1	.816	6,000	6,440	6,980	1,383	41	.792
	34.6	.83	7,730	9,420	12,600	1,730		19.6	.99	7,580	7,740	9,040	1,630		.99
	21	.685	3,520	5,070	5,620	1,260		16	.713	4,780	4,780	4,780	1,180		.68
2	34.5	.743	7,530	9,520	13,040	1,750								46	.673
	34.5	.77	7,740	9,700	13,520	1,840									.77
	34.4	.717	7,320	9,350	12,560	1,660									.56
														41	.807
															.867
															.75
40	26.4	.878	6,870	8,940	13,510	1,947	26	11.6	.845	10,160	13,460	17,110	2,209	72	.857
	33.9	.924	9,850	11,400	16,900	2,260		17.6	.985	14,760	18,300	22,700	2,500		.985
	20	.788	3,800	5,910	7,900	1,240		6.5	.796	5,770	7,180	9,770	1,500		.723
21	30.1	.854	4,960	6,910	10,600	1,442								24	.85
	34.5	.89	6,330	8,440	13,150	1,900									.89
	26.3	.822	3,520	4,220	7,260	1,050									.816
2	30.7	.685	5,060	6,540	9,070	1,525								23	.669
	31.9	.69	5,200	7,040	9,200	1,530									.707
	29.5	.68	4,920	6,050	8,940	1,520									.636
2	26.3	.663	5,840	7,180	10,310	1,595	5	12.1	.694	5,760	7,630	10,880	1,754	28	.646
	27.1	.68	6,330	7,600	10,550	1,610		18.2	.712	7,730	9,000	13,540	2,290		.712
	25.6	.646	5,350	6,760	10,080	1,580		5.3	.66	3,520	4,220	4,800	1,320		.608

TABLE I.—*Cross-bending*

Name.	Locality.		Moisture over 35 per cent.						
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
Supa	Unknown	Average	5	37.3	0.673	6,410	8,180	10,050	1,435
		Maximum		40.8	.692	8,440	8,870	11,150	1,530
		Minimum		35.6	.61	4,920	7,180	8,630	1,370
Do	Tayabas	Average	12	38.7	.755	4,890	7,170	8,700	1,415
		Maximum		46.7	.843	6,720	8,920	10,500	1,650
		Minimum		35.1	.70	2,810	4,920	6,490	1,160
Balacat	Lamao Forest Reserve, Bataan.	Average	9	56.1	.517	5,120	6,280	8,540	1,293
		Maximum		86	.57	6,190	6,750	9,200	1,450
		Minimum		45.7	.478	4,220	5,780	7,730	1,105
Do	Tarlac	Average	21	45.4	.56	5,210	6,200	7,780	1,221
		Maximum		59.8	.62	6,330	7,390	9,370	1,420
		Minimum		36.5	.515	3,520	3,940	4,790	870
Macaasin	Unknown	Average	35	68.4	.695	4,370	6,120	8,660	1,416
		Maximum		87.9	.734	8,440	8,790	10,880	1,750
		Minimum		36.3	.667	1,546	3,550	5,180	1,070
Calantas	Albay	Average	15	75.4	.357	3,000	4,240	5,650	961
		Maximum		94	.379	3,940	4,920	6,600	1,185
		Minimum		61	.336	1,970	3,100	4,400	738
Do	Mindoro	Average	10	57.3	.511	3,560	4,900	6,250	940
		Maximum		67	.54	5,620	6,180	7,950	1,160
		Minimum		38	.492	2,110	3,020	3,060	580
Tindalo	Unknown	Average	6	40.4	.747	8,090	10,770	15,000	2,226
		Maximum		44.6	.77	9,140	11,940	16,980	2,340
		Minimum		35.8	.734	6,330	8,430	12,300	2,050
Do	Ambos Camarines.	Average	12	44.7	.808	7,070	9,700	11,330	1,588
		Maximum		55	.86	10,400	12,400	14,200	1,750
		Minimum		37.7	.757	5,350	5,350	8,600	1,130
Do	Masbate	Average	10	59	.77	5,290	7,690	11,200	1,536
		Maximum		71.8	.813	7,460	9,480	13,240	1,710
		Minimum		50.7	.70	2,950	4,500	8,420	1,160
Amuguis	Mindoro	Average	31	46.1	.692	4,490	6,800	9,780	1,697
		Maximum		61.1	.76	9,110	9,300	12,670	2,160
		Minimum		35.7	.621	1,548	3,520	5,630	1,160
Acle	Tarlac	Average	41	92.5	.632	3,920	6,000	7,270	1,069
		Maximum		103	.707	5,280	7,730	8,920	1,395
		Minimum		77	.598	2,460	4,780	5,250	895
Do	Zambales	Average	6	96.8	.579	5,900	7,010	9,080	1,213
		Maximum		111	.604	7,030	8,720	11,560	1,360
		Minimum		83.6	.553	4,080	4,570	5,810	1,080
Betis	Tayabas	Average	7	38.1	.849	5,780	8,460	11,920	1,768
		Maximum		42.5	.882	7,380	10,130	13,680	2,055
		Minimum		35.1	.82	3,160	6,330	10,010	1,293
Do	Ambos Camarines.	Average	30	61.6	.725	3,670	5,620	7,450	2,035
		Maximum		100	.798	5,240	7,750	9,340	2,400
		Minimum		45	.615	2,090	2,830	3,660	1,050
Bansalaguin	Unknown	Average	18	46.2	.841	6,820	9,420	11,740	1,702
		Maximum		57.8	.883	8,440	10,550	14,150	2,050
		Minimum		40	.784	3,800	7,310	9,510	1,480
Palo Maria	Zambales	Average	24	56	.623	5,840	7,040	8,930	1,461
		Maximum		105	.708	8,790	9,500	12,450	1,680
		Minimum		36.6	.488	2,950	4,080	5,500	810
Batitinan	Unknown	Average	10	54.4	.777	4,540	6,350	9,320	1,427
		Maximum		61.2	.795	5,620	7,600	10,600	1,630
		Minimum		49.1	.76	2,540	4,080	5,900	1,200
Aranga	Ambos Camarines.	Average							
		Maximum							
		Minimum							
Banuyo	Masbate	Average	16	82	.522	2,900	4,170	5,140	881
		Maximum		115	.572	5,070	6,880	7,390	1,120
		Minimum		47.7	.455	1,400	2,860	4,080	575
Balacbacan	Occidental Negros.	Average	9	40	.538	5,410	6,320	8,180	1,280
		Maximum		45.8	.584	6,330	6,900	9,030	1,550
		Minimum		35.2	.481	4,220	4,500	5,960	1,090
Mayapis	Laguna	Average	20	67.7	.399	4,070	5,320	6,760	1,133
		Maximum		91	.456	4,920	6,330	8,300	1,420
		Minimum		48	.343	3,510	3,510	3,510	870

strength of Philippine timber—Continued.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
23	29.3	0.117	7,360	10,070	12,390	1,907	18	14.5	0.722	10,060	11,670	13,100	1,863	46	0.711
	34.4	.835	11,250	12,660	16,450	2,870		19.7	.808	15,500	15,800	16,850	2,280		.835
	20	.644	4,220	7,450	9,140	1,370		10.2	.625	7,040	7,730	7,810	1,475		.61
49	30.1	.827	5,280	7,520	9,050	1,510								61	.813
	34	.955	9,250	11,010	13,220	1,930									.955
	26.6	.712	1,680	2,410	3,230	750									.70
														9	.517
															.57
7	26.6	.579	5,710	6,060	7,010	1,204	32	10.4	.589	6,050	7,600	8,270	1,271	39	.478
	30	.602	6,330	8,090	10,000	1,310		18.7	.66	8,440	11,250	11,720	1,520		.578
	24.1	.561	3,800	4,220	4,690	1,110		2.6	.54	4,220	4,670	4,670	1,080		.66
8	26.7	.77	5,200	8,130	10,560	1,778	4	15.7	.79	6,260	9,650	11,010	1,825	47	.515
	30.4	.81	5,910	10,400	13,130	1,950		19.1	.82	8,450	11,980	13,240	2,030		.717
	23	.734	3,870	6,330	8,940	1,630		12.3	.76	3,240	6,690	7,750	1,530		.82
							4	11.1	.363	5,300	7,260	8,980	1,255	19	.667
								14.6	.37	6,320	8,160	9,300	1,340		.358
								8.6	.355	4,220	6,320	8,670	1,160		.379
8	28.9	.547	3,460	4,500	5,210	801								18	.336
	34.5	.583	4,920	6,330	7,200	1,050									.527
	23.7	.505	1,410	1,410	1,610	580									.583
4	28.9	.787	9,490	12,750	16,570	2,182								10	.492
	35.5	.864	11,250	14,340	17,650	2,230									.763
	23.3	.756	8,440	11,380	15,100	2,160									.864
16	26.6	.802	5,800	7,470	8,680	1,445	1	19.5	.808	7,180	9,140	11,200	1,570	29	.734
	33.4	.866	9,710	11,250	12,830	1,580		19.5	.808	7,180	9,140	11,200	1,570		.805
	20.6	.72	2,890	2,890	3,030	1,180		19.5	.808	7,180	9,140	11,200	1,570		.866
	22.5	.785	6,370	8,160	9,050	1,273		18.9	.766	5,990	8,220	8,920	1,180		.72
3	24.6	.788	7,020	8,300	10,000	1,320	5	19.9	.808	7,450	9,770	11,020	1,370	18	.772
	20.3	.784	5,340	8,080	8,080	1,180		17.7	.68	4,920	7,170	7,680	950		.813
	33.6	.75	5,620	8,590	12,050	1,760									.68
1	33.6	.75	5,620	8,590	12,050	1,760								32	.694
	33.6	.75	5,600	8,590	12,050	1,760									.76
	27.9	.635	5,630	6,830	7,550	1,138									.621
5	34.5	.67	6,330	8,870	9,750	1,210	1	15.7	.684	3,660	4,920	5,400	880	20	.635
	21	.607	4,640	5,340	5,980	1,060		15.7	.684	3,660	4,920	5,400	880		.707
								15.7	.684	3,660	4,920	5,400	880		.598
															.579
														6	.604
13	31.8	.86	4,930	8,090	10,850	1,593									.553
	34.4	.886	7,380	10,550	14,060	1,950									.856
	27.1	.82	2,110	5,380	7,030	1,080								20	.886
1	34	.806	4,190	5,660	7,580	2,020									.82
	34	.806	4,190	5,660	7,580	2,020									.728
	34	.806	4,190	5,660	7,580	2,020								31	.806
1	33.3	.88	6,750	7,030	7,740	1,740	6	15.5	.87	8,670	11,870	14,480	2,311		.615
	33.3	.88	6,750	7,030	7,740	1,740		17	.905	10,250	13,350	18,200	2,530	25	.85
	33.3	.88	6,750	7,030	7,740	1,740		14.3	.85	6,330	8,780	12,400	2,100		.905
															.784
															.623
														24	.708
															.488
								5	.836	6,850	8,400	9,630	1,655		.795
							4	6.2	.85	8,860	11,100	12,300	1,910	14	.85
								4.1	.821	4,920	5,770	7,030	1,450		.76
19	31.4	.826	7,970	11,070	13,440	2,061		5.6	.882	12,530	16,230	17,920	2,419		.859
	34.8	.86	10,200	12,660	16,900	2,350	26	7.5	.942	16,880	21,350	24,450	2,800	45	.942
	29.3	.796	4,790	8,860	10,300	1,740		2.9	.832	7,740	9,850	11,630	2,060		.796
1	29.3	.52	4,220	5,340	5,940	1,105	3	17	.538	4,030	5,530	6,000	1,070		.525
	29.3	.52	4,220	5,340	5,940	1,105		18.9	.546	5,200	6,040	6,270	1,105	20	.572
	29.3	.52	4,220	5,340	5,940	1,105		13.4	.523	2,810	5,200	5,800	1,000		.455
5	22.8	.565	5,960	6,980	8,650	1,358	4	17.4	.533	6,190	7,400	9,000	1,550		.543
	25.5	.67	6,750	7,740	9,320	1,500		19.1	.54	6,890	8,170	9,440	1,770	18	.67
	20.7	.504	5,060	6,120	7,800	1,190		16.7	.525	5,060	6,750	8,380	1,330		.481
															.399
														20	.456
															.343

TABLE I.—*Cross-bending*

Name.	Locality.		Moisture over 35 per cent.						
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).
Malugay	Mindoro	Average	18	57.2	0.635	4,780	6,930	10,280	1,627
		Maximum		72	.713	6,680	8,570	12,700	1,920
		Minimum		48.2	.553	2,810	5,200	6,900	1,290
Sasalit	Zambales	Average							
		Maximum							
		Minimum							
Liusin	Bataan	Average	14	60.9	.71	5,430	8,120	11,360	1,896
		Maximum		63	.73	7,720	10,200	14,150	2,180
		Minimum		57.6	.70	2,390	5,900	7,160	1,340
Lumbayao	Basilan Island, Moro Province.	Average	2	37.1	.545	5,620	6,460	7,790	1,160
		Maximum		38.7	.56	6,740	6,890	8,060	1,210
		Minimum		35.5	.53	4,500	6,040	7,520	1,110

strength of Philippine timber—Continued.

Moisture 20 to 35 per cent.							Moisture under 20 per cent.								
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch.	Modulus of elasticity (1,000 pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Fiber stress at true elastic limit (pounds per square inch).	Fiber stress at apparent elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
7	22.4	0.656	5,790	7,530	10,530	1,732	15	12	0.686	7,730	11,220	13,980	1,788	40	0.658
	26.4	.693	6,900	8,080	11,740	2,150		19.8	.75	9,850	14,900	19,830	2,180		.75
	21	.625	3,800	6,900	8,850	1,530		7.5	.62	4,090	6,810	10,040	1,480		.553
21	26.4	.901	9,990	11,420	14,050	2,120	18	12.4	.839	8,010	10,260	11,310	1,837	39	.872
	30.2	.995	13,350	15,480	18,720	2,480		19.2	.87	12,650	13,980	15,820	2,270		.995
	22	.742	7,030	7,460	8,770	1,240		9	.807	4,080	4,220	5,310	1,120		.742
														14	.71
															.73
															.70
30	26.1	.552	6,550	7,620	10,090	1,416	22	12.7	584	7,800	9,110	11,390	1,570	54	.565
	33.9	.603	8,870	10,000	12,180	1,630		19.5	.671	10,140	12,380	14,920	1,870		.671
	20.5	.483	3,510	4,150	4,430	950		5.3	.53	4,220	4,220	7,810	1,340		.483

TABLE II.—*Compressive strength along*

Name.	Locality.		Moisture over 35 per cent.			
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Lauan	Mindanao	Average	67	52.4	0.444	3,840
		Maximum		73	.485	5,490
		Minimum		38.4	.408	3,262
Do	Zambales	Average	70	59.5	.478	4,180
		Maximum		76	.529	4,980
		Minimum		35.2	.412	3,220
Apitong	Mindanao	Average	98	53	.617	4,350
		Maximum		71.8	.715	5,740
		Minimum		36	.56	3,350
Do	Zambales	Average	60	53.4	.679	5,010
		Maximum		93	.721	5,710
		Minimum		46.4	.588	2,810
Guijo	Ambos Camarines	Average	50	41.8	.675	6,070
		Maximum		59.6	.73	6,610
		Minimum		36	.629	5,180
Do	Mindoro	Average	98	55.7	.697	6,070
		Maximum		79.6	.806	7,300
		Minimum		40.9	.596	3,660
Molave	Near Laguna de Bay	Average	78	46.4	.772	6,680
		Maximum		66	.85	8,470
		Minimum		37	.69	4,770
Do	Ambos Camarines	Average	50	50.5	.784	6,530
		Maximum		61.5	.822	8,300
		Minimum		40.3	.712	3,900
Yacal	do	Average	34	46.7	.828	7,490
		Maximum		75	.85	8,400
		Minimum		38.6	.77	6,200
Narra	Near Laguna de Bay	Average	20	77.7	.563	5,780
		Maximum		93	.69	6,900
		Minimum		66.5	.535	4,180
Do	Cagayan	Average	18	55.9	.619	5,300
		Maximum		75.5	.68	6,530
		Minimum		35.5	.482	3,770
Tanguile	Unknown	Average	18	40.5	.53	4,750
		Maximum		47.4	.565	5,270
		Minimum		35.2	.47	3,650
Do	Zambales	Average	54	44.1	.46	3,980
		Maximum		58.6	.54	4,780
		Minimum		35.6	.405	3,050
Sacat	Bataan	Average	14	49.8	.561	4,530
		Maximum		53.8	.585	4,740
		Minimum		46.2	.54	4,280
Do	Tarlac	Average	74	53.1	.60	5,260
		Maximum		89.7	.657	9,150
		Minimum		35.2	.478	3,140
Ipil	Ambos Camarines	Average	36	52.9	.796	5,650
		Maximum		78.7	.872	6,390
		Minimum		43.5	.714	4,980
Do	Mindoro	Average	84	60.4	.666	5,450
		Maximum		89	.75	7,150
		Minimum		37.5	.56	2,390
Do	Palawan	Average	79	51.4	.807	8,090
		Maximum		61.2	.867	9,470
		Minimum		44.8	.75	5,350
Dungon	Ambos Camarines	Average	6	44.1	.803	6,160
		Maximum		58	.846	6,520
		Minimum		37.1	.723	5,900
Do	Masbate	Average	6	36.9	.825	4,540
		Maximum		37.5	.84	5,030
		Minimum		36.2	.816	3,830
Do.[a]	Mindanao	Average	38	50.7	.669	4,000
		Maximum		82	.707	4,740
		Minimum		35.5	.636	3,080
Malasantol	Unknown	Average	40	64.4	.631	4,660
		Maximum		86	.68	5,410
		Minimum		37.4	.608	3,390
Supa	do	Average	8	36.1	.677	6,480
		Maximum		36.3	.692	7,030
		Minimum		36	.644	5,750
Do	Tayabas	Average	10	37.2	.746	5,090
		Maximum		41.6	.855	6,090
		Minimum		35.1	.70	3,770
Balacat	Lamao Forest Reserve, Bataan.	Average	16	52.6	.517	4,020
		Maximum		61.6	.57	4,510
		Minimum		39.5	.478	3,540

[a] This is not the wood commonly known as Dungon but is often sold under that name.

the grain of Philippine timber.

Moisture 20 to 35 per cent.				Moisture under 20 per cent.					
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
	30.5	0.44	4,040		12.4	0.458	6,180		0.448
40	35	.47	4,550	32	19.4	.488	9,270	139	.488
	25	.40	3,470		3.3	.404	4,730		.40
									.470
								70	.529
									.412
	27.2	.711	5,740		14.4	.688	7,250		.645
24	34	.825	6,770	28	19.4	.735	9,400	150	.825
	20	.664	4,740		7.8	.618	5,270		.56
					15.2	.93	4,190		.687
				2	15.2	.93	4,220	62	.93
					15.2	.93	4,160		.588
	28.8	.719	6,160		14.6	.748	7,940		.708
24	35	.76	7,220	36	19.8	.82	11,400	110	.82
	23.2	.673	4,900		7.5	.68	3,980		.629
									.697
								98	.806
									.596
	29.7	.794	7,080		12.7	.818	8,330		.783
20	34.6	.858	8,800	17	18.8	.88	10,300	115	.88
	20.2	.725	6,100		5.2	.728	6,800		.69
									.784
								50	.822
									.712
	29.5	.832	8,340		13.4	.849	9,220		.843
94	35	.94	9,510	29	18.1	.90	11,280	157	.94
	21.8	.76	6,250		10.7	.814	7,580		.76
									.563
								20	.59
									.535
	28.5	.534	5,290		7.5	.484	6,740		.54
18	34.2	.77	7,060	24	9.7	.531	8,600	60	.77
	21.1	.438	4,160		4.8	.384	4,540		.384
	30.6	.485	5,030		13.7	.424	5,230		.469
22	35	.52	5,450	32	19.9	.58	6,521	72	.58
	27.2	.355	3,752		8.8	.376	3,825		.355
					9.6	.535	6,900		.491
				38	19.2	.604	8,670	92	.606
					1.7	.478	4,150		.405
									.561
								14	.585
									.54
	26.6	.592	5,500		12.4	.661	7,140		.616
22	34.8	.677	5,910	38	19.7	.70	9,020	134	.70
	20	.485	3,990		4.2	.601	4,970		.478
	25.9	.779	6,250		17.7	.807	6,570		.792
30	31.7	.855	7,600	16	19.9	.99	8,020	82	.99
	21.6	.68	4,280		14.8	.713	3,650		.68
	32.5	.77	6,030		19.8	.77	6,540		.673
4	33.4	.77	6,470	2	19.8	.77	6,570	90	.77
	31.5	.77	5,530		19.8	.77	6,510		.56
									.807
								79	.867
									.75
	25.2	.88	6,440		10.7	.839	9,420		.858
54	34	.985	7,970	48	16.4	.882	11,970	108	.985
	20	.788	4,050		8	.796	6,410		.723
	29.5	.854	4,690						.85
40	34.8	.89	6,670					46	.89
	25.1	.822	3,460						.816
	32.6	.67	4,600						.669
6	35	.69	5,200					44	.707
	29	.657	4,090						.636
	30.7	.684	4,840		13.5	.694	6,580		.646
4	34.3	.689	5,040	10	17.1	.712	8,040	54	.712
	27.2	.679	4,660		10	.66	5,140		.608
	30.2	.711	7,100		14.5	.713	8,700		.711
42	33.4	.835	8,510	42	19.5	.808	10,340	92	.835
	26	.61	5,790		8.3	.625	7,046		.61
	28.3	.819	5,980						.813
112	34.7	.955	7,700					122	.955
	22.5	.712	4,000						.70
									.517
								16	.57
									.478

TABLE II.—*Compressive strength along the*

Name.	Locality.		Moisture over 35 per cent.			
			Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).
Balacat	Tarlac	Average	40	44.7	0.56	4,150
		Maximum		63	.62	4,710
		Minimum		36.8	.515	2,920
Macaasin	Unknown	Average	76	63.9	.703	4,350
		Maximum		81.5	.81	6,260
		Minimum		35.2	.667	2,610
Calantas	Albay	Average	28	77.3	.357	2,960
		Maximum		89.6	.379	3,450
		Minimum		62.9	.336	2,330
Do.	Mindoro	Average	18	57.3	.51	3,810
		Maximum		64.7	.54	4,960
		Minimum		46	.492	3,230
Tindalo	Unknown	Average	12	41.9	.747	7,400
		Maximum		44.8	.77	9,150
		Minimum		38.3	.734	5,620
Do.	Ambos Camarines	Average	23	43.9	.80	7,140
		Maximum		58.1	.86	8,960
		Minimum		37	.72	5,850
Do.	Masbate	Average	20	56.7	.77	5,930
		Maximum		70.1	.813	7,030
		Minimum		50.7	.70	4,270
Amuguis	Mindoro	Average	54	45.2	.692	5,210
		Maximum		57.8	.76	6,490
		Minimum		36	.621	2,660
Acle	Tarlac	Average	27	84.5	.631	4,550
		Maximum		101	.707	5,440
		Minimum		39.2	.598	3,790
Do.	Zambales	Average	12	94.9	.579	5,330
		Maximum		106	.604	5,880
		Minimum		81	.553	4,900
Betis	Tayabas	Average	14	38.2	.854	6,540
		Maximum		42.7	.882	7,540
		Minimum		31.6	.82	5,640
Do.	Ambos Camarines	Average	60	59.5	.725	4,330
		Maximum		79.3	.798	4,930
		Minimum		42.8	.615	3,380
Bansalaguin	Unknown	Average	34	43	.841	6,960
		Maximum		53.6	.88	8,140
		Minimum		35.1	.784	5,410
Palo-Maria	Zambales	Average	40	50.2	.618	4,770
		Maximum		103	.704	6,220
		Minimum		35.1	.488	3,150
Batitinan	Unknown	Average	18	54.9	.777	4,650
		Maximum		61.6	.795	5,180
		Minimum		48.5	.76	3,950
Aranga	Ambos Camarines	Average				
		Maximum				
		Minimum				
Banuyo	Masbate	Average	30	77.9	.527	3,290
		Maximum		110	.572	4,470
		Minimum		35.3	.46	2,550
Balacbacan	Negros Occidental	Average	4	43	.546	4,410
		Maximum		46.6	.578	4,640
		Minimum		39.5	.514	4,160
Mayapis	Laguna	Average	40	63.5	.399	3,530
		Maximum		85.4	.456	4,080
		Minimum		44.1	.343	2,780
Malugay	Mindoro	Average	34	55.8	.635	5,120
		Maximum		70.8	.713	6,040
		Minimum		46.6	.553	3,960
Sasalit	Zambales	Average				
		Maximum				
		Minimum				
Liusin	Bataan	Average	8	60.9	.71	5,220
		Maximum		63	.73	5,640
		Minimum		57.6	.70	4,860
Lumbayao	Basilan Island, Moro Province.	Average				
		Maximum				
		Minimum				

grain of Philippine timber—Continued.

Moisture 20 to 35 per cent.				Moisture under 20 per cent.					
Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Number of tests.	Moisture (per cent).	Specific gravity of dry wood.	Stress at rupture (pounds per square inch).	Total number of tests.	Specific gravity of dry wood, all tests.
12	24.9	0.588	4,650	66	9.8	0.587	5,530	118	0.578
	30.7	.66	5,320		19.2	.638	7,590		.66
	20	.561	3,770		2.2	.54	4,020		.515
10	26.2	.776	5,880	6	17.1	.793	6,860	92	.717
	30.5	.78	6,600		18	.82	7,650		.82
	20	.774	4,960		15.7	.76	5,980		.667
				8	9.7	.363	4,420	36	.358
					12.8	.37	4,830		.379
					7.1	.355	3,230		.336
12	26.3	.537	3,820	6	12.5	.557	3,520	36	.527
	32.2	.583	4,320		19.1	.573	4,360		.583
	23.8	.505	3,360		9.1	.531	2,890		.492
8	28.8	.787	8,770					20	.763
	32.4	.864	9,680						.864
	23.6	.756	6,890						.734
26	27.4	.806	7,310	6	16.9	.819	7,710	55	.805
	32.7	.866	9,010		17.6	.83	8,650		.866
	22.5	.742	3,530		15.7	.802	7,040		.72
8	22	.753	6,340	8	18.6	.794	6,780	36	.772
	23	.788	7,350		19.4	.808	7,660		.813
	20.1	.68	5,150		16.9	.784	5,950		.68
6	32.9	.707	4,920					60	.693
	34.8	.75	6,140						.76
	30	.641	3,980						.621
10	30.2	.647	5,050					37	.635
	34	.684	5,820						.707
	25	.607	4,400						.598
								12	.579
									.604
									.553
24	31.5	.857	6,410					38	.856
	34.8	.886	7,330						.886
	28.3	.82	5,000						.82
2	34	.806	4,410					62	.728
	34	.806	4,540						.806
	34	.806	4,290						.615
2	32.8	.883	7,140	12	14.5	.87	8,630	48	.85
	32.8	.883	7,310		16.5	.905	9,560		.905
	32.8	.883	6,980		12.1	.85	7,800		.784
2	34.2	.674	5,720					42	.623
	35	.708	6,240						.708
	33.4	.64	5,340						.488
				8	5	.836	9,290	26	.795
					5.6	.85	10,640		.85
					4.4	.821	7,190		.76
36	31.2	.826	8,020	52	4.9	.882	12,420	88	.859
	34.5	.86	8,730		6.4	.942	14,920		.942
	27.7	.796	6,840		3.4	.832	9,290		.796
4	24.2	.50	3,990	4	15.5	.534	4,150	38	.525
	28	.546	4,470		17.8	.545	4,470		.572
20	20.5	.455	3,400	10	13.3	.523	3,530	34	.455
	28.8	.544	4,720		17.4	.539	5,220		.543
	35	.67	5,540		19.9	.56	5,660		.67
	20.4	.481	3,980		14.8	.525	4,530		.481
								40	.399
									.456
									.343
18	22.1	.666	5,740	26	11.2	.683	8,080	78	.658
	35.9	.71	7,270		18.8	.75	10,930		.75
	20	.625	5,160		7.4	.62	4,830		.553
42	25.7	.89	9,290	34	11.3	.849	9,100	76	.872
	31.1	.984	11,890		15.8	.995	11,180		.995
	21.5	.742	6,600		8.7	.815	6,400		.742
								8	.71
									.73
									.70
54	25.2	.551	5,480	52	12.5	.58	6,410	106	.565
	31.5	.603	6,390		19.7	.671	8,100		.671
	20.1	.483	4,520		5.3	.53	3,550		.483

SHEAR ALONG THE GRAIN.

The form of the piece used for shear tests is shown in fig. 2, Plate II. The pieces were either 1½ or 1¾ inches thick, 3 inches wide, and 18 inches long. Just 1 inch from one end of the piece a hole was cut five-eighths inch by 1 inch, through which a rectangular steel bar was placed. The opposite end of the test piece was then gripped in the upper jaws of the machine and the load was applied on the steel bar until the material directly under it was sheared out. It will be seen that this arrangement produces double shear, the area being either 3 or 3½ square inches, depending upon the thickness of the piece. For these tests the machine was operated at a speed of 0.3 inch per minute.

TABLE III.—*Shearing strength along the grain of Philippine timber.*

[Results averaged regardless of moisture content.]

Name.	Locality.		Number of tests.	Specific gravity, dry wood.	Stress at rupture (pounds per square inch).
Lauan	Mindanao	Average	142	0.446	557
		Maximum		.488	934
		Minimum		.40	326
Do	Zambales	Average	69	.478	525
		Maximum		.529	873
		Minimum		.412	292
Apitong	Mindanao	Average	150	.645	669
		Maximum		.825	1,203
		Minimum		.56	240
Do	Zambales	Average	62	.687	757
		Maximum		.93	1,212
		Minimum		.588	298
Guijo	Ambos Camarines	Average	110	.708	915
		Maximum		.82	1,324
		Minimum		.629	366
Do	Mindoro	Average	98	.697	824
		Maximum		.806	1,500
		Minimum		.596	561
Molave	Near Laguna de Bay	Average	129	.784	914
		Maximum		.88	1,362
		Minimum		.69	357
Do	Ambos Camarines	Average	51	.784	839
		Maximum		.825	1,323
		Minimum		.716	403
Yacal	do	Average	150	.843	849
		Maximum		.94	1,665
		Minimum		.76	427
Narra	Near Laguna de Bay	Average	20	.563	678
		Maximum		.59	844
		Minimum		.535	456
Do	Cagayan	Average	59	.54	660
		Maximum		.77	1,225
		Minimum		.384	291
Tanguile	Unknown	Average	70	.471	647
		Maximum		.58	928
		Minimum		.355	326
Do	Zambales	Average	86	.491	555
		Maximum		.606	1,068
		Minimum		.405	288
Sacat	Lamao Forest Reserve, Bataan.	Average	14	.561	776
		Maximum		.585	1,055
		Minimum		.54	550
Do	Tarlac	Average	132	.616	850
		Maximum		.70	1,584
		Minimum		.478	466
Ipil	Ambos Camarines	Average	79	.793	904
		Maximum		.99	1,310
		Minimum		.68	458
Do	Mindoro	Average	90	.673	948
		Maximum		.77	1,445
		Minimum		.56	410
Do	Palawan	Average	80	.807	753
		Maximum		.867	1,226
		Minimum		.75	525
Dungon	Ambos Camarines	Average	98	.852	1,253
		Maximum		.985	1,854
		Minimum		.723	672
Do	Masbate	Average	46	.85	1,298
		Maximum		.89	1,560
		Minimum		.816	925
Do.[a]	Mindanao	Average	44	.669	855
		Maximum		.707	1,102
		Minimum		.636	563
Malasantol	Unknown	Average	54	.646	720
		Maximum		.712	1,110
		Minimum		.608	409

[a] This is not the wood commonly known as Dungon, but is often sold under that name.

TABLE III.—*Shearing strength along the grain of Philippine timber*—Continued.

Name.	Locality.		Number of tests.	Specific gravity, dry wood.	Stress at rupture (pounds per square inch).
Supa	Unknown	Average	86	0.71	898
		Maximum		.835	1,480
		Minimum		.61	520
Do	Tayabas	Average	118	.813	852
		Maximum		.955	1,380
		Minimum		.70	293
Balacat	Lamao Forest Reserve, Bataan.	Average	16	.517	486
		Maximum		.57	638
		Minimum		.478	300
Do	Tarlac	Average	117	.578	692
		Maximum		.66	1,281
		Minimum		.515	253
Macaasin	Unknown	Average	92	.717	916
		Maximum		.82	1,390
		Minimum		.667	376
Calantas	Albay	Average	34	.358	526
		Maximum		.379	870
		Minimum		.336	289
Do	Mindoro	Average	35	.527	778
		Maximum		.583	1,049
		Minimum		.492	455
Tindalo	Unknown	Average	20	.763	1,004
		Maximum		.864	1,460
		Minimum		.734	685
Do	Ambos Camarines	Average	56	.805	911
		Maximum		.866	1,507
		Minimum		.72	299
Do	Masbate	Average	36	.772	905
		Maximum		.813	1,226
		Minimum		.68	496
Amuguis	Mindoro	Average	60	.692	824
		Maximum		.75	1,762
		Minimum		.621	396
Acle	Tarlac	Average	36	.63	686
		Maximum		.707	1,270
		Minimum		.598	420
Do	Zambales	Average	11	.579	778
		Maximum		.604	1,190
		Minimum		.553	443
Betis	Tayabas	Average	38	.856	1,168
		Maximum		.886	1,555
		Minimum		.82	598
Do	Ambos Camarines	Average	61	.728	819
		Maximum		.806	1,243
		Minimum		.615	474
Bansalaguin	Unknown	Average	48	.85	1,098
		Maximum		.905	1,865
		Minimum		.784	695
Palo Maria	Zambales	Average	46	.623	856
		Maximum		.708	1,581
		Minimum		.488	528
Batitinan	Unknown	Average	26	.795	859
		Maximum		.85	2,195
		Minimum		.76	535
Aranga	Ambos Camarines	Average	82	.863	1,038
		Maximum		.942	2,324
		Minimum		.796	355
Banuyo	Masbate	Average	38	.525	596
		Maximum		.572	1,065
		Minimum		.455	287
Balacbacan	Negros Occidental	Average	34	.543	689
		Maximum		.67	1,048
		Minimum		.481	423
Mayapis	Laguna	Average	40	.399	472
		Maximum		.456	790
		Minimum		.343	288
Malugay	Mindoro	Average	78	.658	980
		Maximum		.75	1,885
		Minimum		.553	464
Sasalit	Zambales	Average	75	.872	1,176
		Maximum		.995	1,938
		Minimum		.742	708
Liusin	Bataan	Average	8	.71	886
		Maximum		.73	1,388
		Minimum		.70	543
Lumbayao	Basilan Island, Moro Province.	Average	104	.565	827
		Maximum		.671	1,306
		Minimum		.483	353

COMPRESSION ACROSS THE GRAIN.

Compression across the grain, as it usually occurs in practice, is a combination of simple compression over a given area, and shearing and bending of the material along the edges of that area. It was desired, if possible, to determine just what part of the load went into simple compression and what part was used in shearing and bending the material along the edges of the area compressed. The following method was adopted and has proven very satisfactory.

Pieces 4 by 4 inches by 6 feet were used. The piece to be tested was laid upon the table of the machine and the load was applied to cast-iron blocks laid across the test piece. (See fig. 3, Plate II.) Two tests were made upon each piece; one with an iron block 2 inches wide and one with an iron block 6 inches wide, the material under the iron block being compressed 0.6 inch unless it showed a decided point of failure before that deflection was reached. If no point of failure could be detected, 0.6 inch deflection was assumed arbitrarily as the point of failure.

Let W equal the load necessary to apply on the 6-inch block to produce a given deflection, and let W′ equal the load necessary to apply on the 2-inch block to produce the same deflection, then W—W′ equals the load which would produce that deflection upon an area 4 by 4 inches by simple compression—that is, without the support usually given by the material along the edges of the area over which the load is applied; therefore, $\frac{W-W'}{16}$ equals the stress of simple compression in pounds per square inch. This quantity will be called P.

Now, to determine the part of the load which is used in bending the material along the edges, the test with the 2-inch block will be considered.

The area under compression is 8 square inches; therefore, 8P equals the part of the load which produces simple compression, and since W′ equals the total load applied, W′—8P equals the part of the load which bends and shears the fiber along the edges of the block, and $\frac{W'-8P}{8}$ equals the stress in pounds per linear inch, which produces bending and shearing of the fibers and will be called p.

For small deflections and large areas, p may usually be neglected, but it increases rapidly as the deflection increases, and for large deflections and small areas which have their greater dimension extending across the grain, p is a very important factor, often much more important than P. P and p are very nearly independent of the area under consideration, and may therefore be used in all ordinary cases of compression across the grain.

In the following plates values of P are represented by curves A, and values of p by curves B. All specimens which were tested were clear and sound.

MOISTURE DETERMINATIONS.

As previously stated, moisture disks were cut at A, B, and C. (See fig. 1, Plate II.) These disks were about three-eighths of an inch thick. They were weighed as soon as cut and then placed in a small, steam dry kiln, having a temperature of 110° C., until they were dried to constant weight and then weighed again. The difference between the original weight and the weight after drying was considered as the weight of the moisture, and the percentage of moisture was determined with reference to the dry weight.

SPECIFIC GRAVITY.

In all cases the specific gravity was determined from the full-sized beam. After the moisture content was determined at A, B, and C (see fig. 1, Plate II), the results were averaged to obtain the average percentage of moisture for the entire beam and the specific gravity was determined for dry wood. For this paper, the following arbitrary classification for heaviness is made: Light, less than 0.50; moderately heavy, 0.50 to 0.70; heavy, 0.70 to 0.90; very heavy, over 0.90. Thus Lauan would be classed as light; Apitong, moderately heavy; Yacal, heavy; and Ebony, very heavy.

HARDNESS.[a]

While hardness is an important property of all materials of construction and has received considerable attention by technologists, there is great diversity of opinion as to how this property shall be defined, tested, and measured. No measure of hardness has yet been proposed which is entirely satisfactory for all materials. The

[a] For discussion of hardness of materials and hardness test, see Martens's Handbook of Testing Materials, p. 288.

wood worker says a wood is hard if it resists penetration by wood-working tools. This is probably as satisfactory a definition as can be given, and the tests made by this bureau are based upon this conception of hardness. For lack of a better method, a scale of hardness for woods has been arranged in the following manner: Representative samples of the various species were selected for this test. The pieces were seasoned and one surface of each was carefully smoothed. Across the grain of each smoothed surface a hardened steel point was drawn, with a pressure of 3.3 pounds. The depth of the scratch produced was considered a measure of hardness. On such woods as Ebony and Bansalaguin the steel point had very little effect, while on California Redwood and Calantas it made a ragged scratch one thirty-second of an inch or more in depth. No claim is made for great accuracy by the above method, and it is possible that the order of hardness may be altered slightly if a more satisfactory test can be devised.

California Redwood and Oregon Pine are placed in the following list to give an idea of the relative hardness of American and Philippine woods:

Woods arranged in order of hardness.

Museum No.	Kind of wood.	Remarks.	Museum No.	Kind of wood.	Remarks.
1001	Ebony	Very hard.	1024	Supa	Hard.
1003	Bansalaguin	Do.	1027	Acle	Do.
1004	Sasalit	Do.	.....	Apitong	Moderately hard.
1005	Liusin	Do.	1031	Malasantol	Do.
1006	Betis	Do	1037	Banuyo	Do.
1007	Dungon	Do.	1038	Tanguile	Do.
1010	Aranga	Do.	1040	Sacat	Do.
1011	Guijo	Hard.	1041	Narra	Do.
1013	Tindalo	Do.	1043	Lumbayao	Soft.
1014	Yacal	Do.	1044	Balacat	Do.
1015	Molave	Do.	1046	Oregon Pine	Do.
1016	Batitinan	Do.	1047	Lauan	Do.
1017	Macaasin	Do.	1049	Mayapis	Do.
1019	Amuguis	Do.	1053	Balacbacan	Very soft.
1020	Palo Maria	Do.	1054	California Redwood	Do.
1021	Ipil	Do.	1056	Calantas	Do.
1023	Malugay	Do.			

STRUCTURAL QUALITIES, APPEARANCE, USES, PROVINCES LEADING IN PRODUCTION, SIZES, AND COMMON AND BOTANICAL NAMES.[a]

LAUAN.

Structural qualities.—Lauan is a light and soft wood that takes a fair polish. It is not durable in the ground or when exposed to the sun and the rain. It seasons well, is usually free from defects, and is not inclined to split or check.

Appearance, color, and grain.—Both the heartwood and sapwood of Lauan are nearly white. The wood has a straight but rather coarse grain.

Uses.—Lauan is used in light and temporary construction. It is also used in cabinetmaking, in inferior furniture, and for small boats.

Provinces leading in production.—Negros Occidental, Bulacan, Bataan, Leyte, and Zambales.

Sizes.—On a coastal plain in Mindoro the average diameter of 575 trees over 16 inches (40 centimeters) of Lauan (*Shorea contorta* Vid.) is 26 inches (66 centimeters). On the lower slopes of Mount Silay, in Negros Occidental, the average diameter of 885 trees over 16 inches (40 centimeters) of Almon is 28 inches (71 centimeters). The average merchantable length of 15 measured trees of this species is 88 feet (27 meters). The Lauan of Tayabas has a maximum diameter of 35 inches (89 centimeters) and a clear length of 102 feet (31 meters).

Common names.[b]—T., Lauan, Lauaan, Bayucan, Sandana; Cag., Balabas; Il.,

[a] All information here given regarding sizes and common and botanical names was collected and arranged by H. N. Whitford, forester, chief of the division of forest products.

[b] In connection with the common names, the dialects of the names, or the provinces where they are used, are shown by the following abbreviations: T., Tagalog; Cag., Cagayan; Il., Ilocano; Pamp., Pampanga; Neg., Negrito; V., Visayan; B., Bicol; N. V., Nueva Viscaya; Isa., Isabela; Pang., Pangasinan; Z., Zambales.

Apuit Duyong, Ligamen, Anting, Bayucan; Pamp., Lauayan; Neg., Bayucan; V., Lauaan; B., Malasinoro, Hapnit.

Remarks.—Several different kinds of woods are marketed under the name of Lauan. They are classified as red and white Lauan. The red Lauans are allied to Balacbacan and Tanguile in structural qualities. (See under these names.) There are at least two white Lauans. *Shorea contorta* Vid., found in the provinces of Mindoro, Bataan, and Zambales, is the true white Lauan. *Shorea squamata* from the island of Negros is known under the Visayan name of Almon or Lauaan. It is probable that the true Lauan (*Shorea contorta*) and Almon (*Shorea squamata*) are known on the market from other provinces under other names.

APITONG.

Structural qualities.—Apitong is a moderately heavy, hard wood that is fairly durable and usually clear and sound. It shrinks considerably in drying, but does not check badly.

Appearance, color, and grain.—Apitong has a reddish color. It is straight but rather coarse grained.

Uses.—Apitong is used in ordinary construction, in shipbuilding, and for inferior furniture.

Provinces leading in production.—Bataan, Zambales, Negros Occidental, Ambos Camarines, Tayabas, Bulacan, and Mindoro.

Sizes.—On a coastal plain in Mindoro the average diameter of 73 trees over 16 inches (40 centimeters) of Apitong (*Dipterocarpus* sp.) is 26 inches (67 centimeters). In Negros the average diameter of 1,051 trees over 16 inches (40 centimeters) is 24 inches (60 centimeters), and the average merchantable length of 13 measured trees is 62 feet (19 meters). These dimensions are for *D. grandiflorus* Blanco. The sizes given are thought to be low, for a large percentage of the Negros trees measured had been injured by tapping for resin.

The Apitong (species not known) of Tayabas has a maximum clear length of 100 feet (30 meters) and a maximum diameter of 45 inches (114 centimeters).

On a coastal plain in Mindoro the average diameter of 161 trees over 16 inches (40 centimeters) of Hagachac (*Dipterocarpus lasiopodus* Perk.) is 26 inches (67 centimeters). In a similar habitat in Baler, Tayabas, the average diameter of all the trees on 31 acres, 8 inches (20 centimeters) and over, of Hagachac is 21 inches (53 centimeters). The maximum diameter is 53 inches (134 centimeters), and the average clear length is 86 feet (26 meters).

Common names.—Apitong: T., Apitong, Hapiton, Apiton, Balao; B., Anahaon; V., Hapitan, Mapitan; Cag., Camuyao, Duco; Il., Canunyao. Panao: T. Bulay (Batangas), Balao, Malapao, Malapaho, Panao, Panuo. Hagachac: T., Hagachac.

Remarks.—At least four species are placed on the market as Apitong. They are the true Apitong (*Dipterocarpus grandiflorus* Blanco), Panao (*Dipterocarpus vernicifluus* Blanco), Hagachac (*Dipterocarpus lasiopodus* Perk.), and an undescribed species from Mindoro that has the common name of Apitong (*Dipterocarpus* sp.). The woods of these four species differ but little in appearance.

Better grades of Apitong are sometimes sold as Guijo.

GUIJO.

Structural qualities.—The wood of Guijo is moderately heavy, hard, strong, brittle, fairly durable, and usually free from defects. It is inclined to warp and check in drying.

Appearance, color, and grain.—Guijo has an ashy red color and is straight grained.

Uses.—Guijo is used in general construction and shipbuilding, for carriage wheels and shafts, for flooring and girders of houses, and for inferior furniture.

Provinces leading in production.—Mindoro, Tayabas, Leyte, Ambos Camarines, Misamis, and Sorsogon.

Sizes.—On a coastal plain in Mindoro the average diameter of 168 trees over 16 inches (40 centimeters) of *Shorea guiso* Blume is 25 inches (63 centimeters). For Baler, Tayabas, the average diameter for trees over 8 inches (20 centimeters) of Guisoc, measured on 81 acres, is 13 inches (33 centimeters), the maximum diameter 35 inches (89 centimeters), and the average clear length 39 feet (12 meters). In southern Tayabas there is a reported maximum diameter for Guijo of 40 inches (101 centimeters) and a maximum clear length of 88 feet (27 meters).

Common names.—T., Guiso, Guijo, Guisóc, Guisihang, Betic (Laguna); Cag., Sáray, Zitan; N. V., Cotópang, Curucat, Curyao; Il., Yamban, Niquet, Zimaya, Saray, Zilan; B., Guisoc, Guiso, Yamban; Pamp., Yamban.

Remarks.—So far as is known, there is only one species placed on the market as Guijo. This is *Shorea guiso* Blume, though better grades of Apitong are sometimes sold as Guijo.

MOLAVE.

Structural qualities.—The wood of Molave is hard, heavy, and brittle. It is almost impervious to decay and is not attacked by the anay (white ant). It checks slightly in seasoning. Heart checks and small knots are quite frequent.

Appearance, color, and grain.—The heartwood of Molave is pale yellow and the sapwood is only slightly lighter in color. The wood is very fine and usually cross-grained.

Uses.—The wood of Molave is most highly valued for general building purposes, where durability is essential. It is used in shipbuilding; for posts, sleepers, and interior trim of houses; and in cabinetmaking and turnery.

Provinces leading in production.—Tayabas, Leyte, Misamis, Negros Occidental, Ambos Camarines, Cagayan, and Iloilo.

Sizes.—There is a reported maximum diameter of 45 inches (114 centimeters) and a maximum clear length of 24 feet (7.3 meters) for Molave in Tayabas. The tree is usually irregular in shape, with heavy large branches, a part of which may be utilized.

Common names.—Spanish-Filipino, Molave; T., Molauin, Lanahan; V., Aguherao, Bongabon, Bulaon, Hamoraun, Mauraun, Tugas, Tuigan, Agubarao; Il., Amuganan, Danigga, Sagad, Sagat; B., Amoraun, Hamuraon; Pamp., Bulaun, Bulauen; Neg., Yangal; Cag. and Isa., Amuganan; Surigao, Amuyaon (boards), Buyog-tongon (construction), Tugao.

Remarks.—*Vitex littoralis* Decne. is the principal species from which Molave is obtained, though how much of the wood on the market comes from a closely related species, *Vitex pubescens* Vahl., is not known. (See "Sasalit.")

YACAL.

Structural qualities.—The wood of Yacal is heavy, hard, strong, elastic, and quite durable. It breaks in long splinters.

Appearance, color, and grain.—Yacal has a dirty yellow color and is rather coarse but straight grained.

Uses.—Yacal is used in general construction and in shipbuilding, and is particularly valuable for beams, on account of its stiffness and high modulus of rupture.

Provinces leading in production.—Tayabas, Misamis, Surigao, and Cagayan.

Sizes.—There is a reported maximum diameter of 33 inches (84 centimeters) and a maximum clear length of 52 feet (16 meters) for Yacal from Tayabas. The tree attains sizes considerably larger than this in other provinces. One tree was measured at Santa Maria, Zamboanga, that had a diameter of 48 inches (122 centimeters).

Common names.—T., Yacal, Dilao, Yacal puti, Papolongan, Saplungan; Il., Taggay, Pangi, Banutan, Seggay, Paniggayen, Callot, Sallapugud; V., Linap; Pamp., Siacal; N. V., Banutan.

Remarks.—The wood of Yacal is obtained from *Hopea plagata* Vid. While it is very probable that other species are placed on the market as Yacal, yet it is not positively known what these species are.

NARRA.

Structural qualities.—The wood of Narra is moderately heavy, moderately hard, very durable, and is seldom, if ever, attacked by the anay (white ant). It seasons well when properly treated and takes a fine finish.

Appearance, color, and grain.—The heartwood of Narra is white, yellow, or red, and the sapwood nearly white. The grain is rather fine, but irregular, and very beautiful when quarter-sawn.

Uses.—Narra is used principally for fine furniture, cabinetmaking, and interior house trim.

Provinces leading in production.—Cagayan, Mindoro, Tayabas, Albay, Isabela, and Sorsogon.

Sizes.—On a coastal plain in Mindoro the average diameter of 137 trees 16 inches (40 centimeters) and over of Narra (*Pterocarpus indicus* Willd.) is 29 inches (74 centimeters). In a similar habitat in Baler, Tayabas, the average diameter of all Narra trees 8 inches (20 centimeters) and over, on 31 acres, is 25 inches (63 centimeters), the maximum diameter is 50 inches (127 centimeters), and the average clear length is 25 feet (7.6 meters). In southern Tayaba Narra has a recorded maximum diameter of 40 inches (101 centimeters) and a maximum clear length of 40 feet (12.2 meters).

Common names.—T., Narra, Asana; Pamp., Asana, Apalit, Daitanag; Cag., Tagga, Antangan, Taygat; Isa., Tagga, Antagan, Dungon (Calingan Igorot); B., Naga; V., Sangque, Narra; Il., Sangque, Magalayao.

Remarks.—There are two well-known species of Narra, *Pterocarpus indicus* Willd. and *P. echinatus* Pers. Botanically there are a number of other species, but little, if any, wood on the market comes from these.

Narra is divided commercially into two varieties, called Red and Yellow. So far as is known this division is not a specific one, but a difference due to the habitat in which the tree grows. Both species, *Pterocarpus indicus* and *P. echinatus*, have the red and yellow varieties. The red grows in the hilly country, near the streams generally, and the yellow is found in the flats near the seacoast.

Slabs are obtained from the buttresses of Narra, from which large one-piece table tops are made. These are sometimes 6 feet and over in diameter. Narra wood is often finished in its natural color and sometimes stained brown or dark red.

TANGUILE.

Structural qualities.—Tanguile is a light, moderately hard structural timber that varies considerably in quality. It is not durable in the ground or when exposed to the sun and rain. The heartwood of Tanguile is frequently unsound.

Appearance, color, and grain.—Tanguile is light reddish brown in color and is rather coarse grained.

Uses.—The wood is used in light and medium grade construction and is highly prized for small boats.

Provinces leading in production.—Surigao, Bataan, Cagayan, Cebu, Tayabas, and Bohol.

Sizes.—See "Balacbacan" for size.

Common names.—T., Tanguile, Tanguili, Panonsongin, Tangile, Tangili; V., Balacbacan, Babanganon; Il., Bunga, Tamug, Araca; B., Adamuy.

Remarks.—*Shorea polysperma* Merr. is the botanical name of Tanguile. There is very little doubt that a portion of the lumber that is put on the market as Balacbacan (see p. 644) is Tanguile.

SACAT.

Structural qualities.—Sacat is a moderately heavy and moderately hard wood. It is not very durable in the ground or when exposed to sun and rain.

Appearance, color, and grain.—Sacat is yellow and gray in color, and is coarse but straight grained.

Uses.—Sacat is used in light construction.

Provinces leading in production.—Pangasinan, Tarlac, Bulacan, and Pampanga.

Common names.—T., Sacat, Pangsaquet; Il., Saquet.

Remarks.—The tree that yields the wood Sacat is *Terminalia nitens* Presl. *Terminalia edulus* Blanco (Calumpit) yields a wood very much like Sacat.

IPIL.

Structural qualities.—Ipil is moderately heavy to heavy, hard, strong, almost impervious to decay, and is seldom, if ever, attacked by the anay (white ant).

Appearance, color, and grain.—Ipil is light yellow to dark brown in color. The grain is usually straight. It takes a beautiful dark-brown finish.

Uses.—Ipil is used for general first-class construction, especially posts of houses; for sleepers, and for furniture and cabinetmaking. Sleepers made of this wood have been buried for more than ten years without showing any signs of decay; consequently, it is highly valued for railroad ties.

Provinces leading in production.—Palawan, Cagayan, Mindoro, Masbate, and Ambos Camarines.

Sizes.—On a coastal plain in Palawan the average diameter of 60 trees 18 inches (45 centimeters) and over for *Intsia bijuga* is 24 inches (61 centimeters), and the average clear length of 20 trees is 29 feet (9 meters).

Common names.—T., Ipil, Camantatali (Laguna), Taal; Il., Sangay; V., Ipil; Guam, Ipil; Samoa, Ifi-lele; Pang., Obien, Ubien; Z., Nala.

Remarks.—The principal species that yield the timber Ipil is *Intsia bijuga* O. Kuntze. *Intsia acuminata* Merr., however, furnishes some of the wood, and the Ipil of Mindanao comes from a third unidentified species.

DUNGON.

Structural qualities.—Dungon is moderately heavy to heavy, strong, tough, durable, and very hard. It is difficult to work, is inclined to warp, and heart checks are numerous

Appearance, color, and grain.—Dungon has a chocolate-brown color and a fine, close grain.

Uses.—Dungon is used in first-class construction where strength and durability are essential, in naval construction, and as piles and posts. It is also valued in construction where bending by steaming is necessary, as for boat ribs.

Provinces leading in production.—Ambos Camarines, Zambales, Abra, Nueva Viscaya, Negros Occidental, and Masbate.

Sizes.—There is a recorded maximum diameter of 34 inches (86 centimeters) and a clear length of 47 feet (14.3 meters) for Dungon found in Tayabas Province.

Common names.—T., Dungon, Dongon, Dungol; Il., Paronapin, Palogapig; Z., Palonapim, Palonapoy.

Remarks.—The tree that yields Dungon is *Tarrietia sylvatica* Merr. This should not be confused with the wood known as Dungon-late (*Heritiera littoralis* Dry.), which grows near the upper limits of high tide. The Dungon of Mindanao is evidently another (unknown) species. (See tests in Tables I, II, and III.)

MALASANTOL.

Structural qualities.—Malasantol is a moderately heavy structural timber. It is moderately hard and fairly durable.

Appearance, color, and grain.—Malasantol is reddish brown in color, and straight but coarse grained.

Uses.—Malasantol is used in general construction.

Provinces leading in production.—Leyte, Pampanga, Pangasinan, and Bulacan.

Common names.—T., Malasantol; Il., Panantalen.

Remarks.—*Sandoricum vidalii* Merr. is the only tree that is known to yield the wood Malasantol.

SUPA.

Structural qualities.—Supa is a good structural timber, being heavy, hard, strong, and fairly durable. It is easily worked and seasons well.

Appearance, color, and grain.—Supa is yellow and brown in color and is fine grained.

Uses.—Supa is used in general construction, in flooring, in interior house trim, and for furniture and cabinetmaking.

Provinces leading in production.—Tayabas, Ambos Camarines, Union, Sorsogon, and Ilocos Sur.

Sizes.—Near Baler, Tayabas, the average diameter of all trees 8 inches (20 centimeters) and over, on 81 acres, is 15 inches (38 centimeters), the maximum diameter is 38 inches (97 centimeters), and the clear length is 40 feet (12.2 meters) for Manapo (*Sindora supa* Merr.).

Common names.—T., Malipáho, Supa, Yacal-diláo; B., Manápo; Cag., Paimo, Panalalián, Pancalían.

Remarks.—The only species that is known to yield the timber called Supa is *Sindora supa* Merr.

BALACAT.

Structural qualities.—Balacat is a moderately heavy, soft, inferior wood, which is not durable when exposed.

Appearance, color, and grain.—This wood is white to light brown in color, and is coarse grained.

Uses.—Balacat is used in light or temporary construction.

Provinces leading in production.—Tarlac and Bulacan.

Common names.—T., Ligaa; Pamp., Balacat.

Remarks.—*Zizyphus zonulatus* Blanco is the only species that is known to yield the timber known as Balacat. Very little of it is now being used.

MACAASIN.

Structural qualities.—Macaasin is a good structural timber, being moderately heavy, hard, strong, and fairly durable. It seasons well.

Appearance, color, and grain.—Macaasin is brown in color and rather fine grained.

Uses.—Macaasin is used in general construction; as flooring, joists, and rafters of houses, and in cabinetwork.

Provinces leading in production.—Tayabas, Ambos Camarines, Sorsogon, Laguna, and Leyte.

Common names.—T., Macaasin, Macasin, Macasim; B., Binolo; V., Saguimsimlumbajon, Batuan.

Remarks.—A number of species of *Eugenia* yield the wood known as Macaasin.

CALANTAS.

Structural qualities.—Calantas is moderately heavy, very soft, and not very strong, but is quite durable. It is easy to work and takes a good polish. It seasons well and is not inclined to shrink, warp, or check.

Appearance, color, and grain.—Calantas has a reddish color and is fine grained.

Uses.—Calantas is highly valued for cigar boxes. It is also used for small boats; in furniture, cabinet and pattern making, and for carving.

Provinces leading in production.—Mindoro, Ambos Camarines, Misamis, and Pangasinan.

Sizes.—In Mindoro a recorded maximum diameter of 90 inches (228 centimeters) and a total height of 180 feet (55 meters) is given for Calantas. Few trees are found, however, that have a diameter of more than 60 inches (152 centimeters). The boles are usually straight and cylindrical.

Common names.—T., Calantas; V., Lanigpa, Lanigda, Lanipga; B., Lanigpa, Lanigda; Il., Catingin, Danipra, Porac; Pamp., Calantad.

Remarks.—The specific name (or names) of the tree that produces the wood known as Calantas is not known. It is, however, known that one or more species of the genus *Toona* (*Cedrela*) yields this wood. The wood somewhat resembles the Red Cedar (*Juniperus*) in color and odor. It is closed to the West Indian *Cedrela odorata* L., the East Indian *Cedrela toona* Roxb., and the Australian *Cedrela australis*, both botanically and in the structure and quality of the wood. The general name of Red Cedar is applied to all species of Cedrela. They are known in India under the general name of "Toon."

TINDALO.

Structural qualities.—The wood of Tindalo is heavy, hard, stiff, strong, and durable above ground. It is prized for beams because of its high modulus of rupture. It seasons well and breaks in long splinters.

Appearance, color, and grain.—Tindalo is yellowish red in color. It is fine and usually straight grained, but occasional pieces are found having the appearance of bird's-eye maple. It takes a beautiful finish.

Uses.—Tindalo is highly valued for fine furniture and cabinetmaking. It is also used for construction purposes above ground.

Provinces leading in production.—Masbate, Negros Occidental, Iloilo, Ambos Camarines, Rizal, and Pangasinan.

Sizes.—In Baler, Tayabas, the average diameter of all trees of *Pahudia rhomboidea* Prain 8 inches (20 centimeters) and over, on 81 acres, is 12 inches (30 centimeters) and the maximum diameter is 24 inches (61 centimeters). The tree attains much larger sizes in other provinces.

Common names.—T., Tindalo, Balayong, Tindolo; Cag., Magalayao; Il., Magalayao, Uris; B., Barayon, Balayon, Baraya, Balayong; V., Barnion, Balayon, Barion, Balaon, Barayon; Pang., Ipel.

Remarks.—*Pahudia rhomboidea* Prain (*Afzelia rhomboidea* Vid.) yields the wood known as Tindalo.

AMUGUIS.

Structural qualities.—Amuguis is a structural wood of medium quality, being fairly strong, brittle, moderately heavy and hard.

Appearance, color, and grain.—Amuguis is reddish brown in color and is rather fine grained.

Uses.—Amuguis is used in ordinary construction and in cabinetwork.

Provinces leading in production.—Ambos Camarines, Mindoro, Albay, Tayabas, Tarlac, and Masbate.

Sizes.—On a coastal plain in Mindoro the average diameter of 185 trees of *Koordersiodendron pinnatum* Merr. 16 inches (40 centimeters) and over is 25 inches (63 centimeters), and the average clear length of 10 trees is 33 feet (10 meters). In Baler, Tayabas, the average diameter of all trees of Amuguis, on 81 acres, 8 inches (20 centimeters) and over is 13 inches (33 centimeters) and the maximum diameter is 31 inches (79 centimeters.)

Common names.—T., Amuguis, Amoguis, Ambogues, Palosanto; V., Danguila, Sambaluyan, Amoguis, Ambogues, Muguis, Sambulauan, Calumanog; Il., Bancalari; B., Carugcog; Neg., Twi.

Remarks.—*Koordersiodendron pinnatum* Merr. is the only species that yields the wood Amuguis.

ACLE.

Structural qualities.—The wood of Acle is moderately heavy and hard, quite durable, and seasons well.

Appearance, color, and grain.—This is one of the most beautiful Philippine woods. It has a rich dark-brown color and is fine grained. It resembles English walnut and

is usually given a walnut finish. When plain sawn it presents a large irregular figure, but when quarter sawn the grain appears finer.

Uses.—Acle is highly valued for fine furniture and cabinetmaking. Plain sawn lumber is preferable for large surfaces and quarter sawn for small surfaces and panels. This wood is considered as good as walnut for gunstocks, but has not yet been used commercially for that purpose.

Provinces leading in production.—Masbate, Zambales, Tayabas, Union, Cagayan, and Pangasinan.

Sizes.—Acle is a tree with a short irregular bole.

Common names.—T., Acle; Il., Anaguep, Quitaquita; V., Tabalangi, Langit.

Remarks.—*Pithecolobium acle* Vid. is the only tree that yields the wood known as Acle.

BETIS.

Structural qualities.—Betis is a high grade structural timber, being very hard, heavy, strong, and durable. It lasts well in the ground and is fairly resistant against the attack of sea worms (teredo).

Appearance, color, and grain.—Betis is a light brown to purplish color and is very fine grained.

Uses.—Betis is used in general high-grade construction, where strength and durability are essential. It is used in shipbuilding and for piles and posts.

Provinces leading in production.—Leyte, Ambos Camarines, Tayabas, Isabela, and Cagayan.

Common names.—T., Betis, Pailan, Bayacao, Betes, Bétis laláque, Bitis; Cag., Pagpagan, Pailan, Pappagay; Pang., Bacayao; B., Baniti; V., Banicac; Il., Bacayao.

Remarks.—*Illipe betis* Merr. is the only tree that is known to yield the wood Betis.

BANSALAGUIN.

Structural qualities.—Bansalaguin is a valuable structural timber, being very hard heavy, strong, brittle, and durable. Large sizes of it check somewhat in seasoning, and it is hard to saw.

Appearance, color, and grain.—Bansalaguin has a dull reddish color and is very fine grained.

Uses.—Bansalaguin is a first-class construction timber and is used for posts, for shipbuilding, as tool handles, and in turnery.

Provinces leading in production.—Tayabas, Ilocos Sur, Pangasinan, Cagayan, Abra, and Masbate.

Common names.—T., Bansaláguin, Bansalágin, Bansalágon, Bansalágue, Cabiqui, Pasac; V., Bansalague, Bansalogue, Talipópo; Z., Pasac; B., Bansalagui.

Remarks.—*Mimusops elengi* L. is the only tree that is known to yield the wood Bansalaguin.

PALO MARIA.

Structural qualities.—Palo Maria is a good construction timber; is hard, moderately heavy, and fairly strong and durable. It is inclined to warp slightly.

Appearance, color, and grain.—Palo Maria has a reddish color, is fine grained, and takes a beautiful finish. It has an irregular figure, which is caused by part of the fibers running perpendicular to the surface.

Uses.—Palo Maria is used in general construction, for masts, and for hubs and turnery. It is very valuable for fine furniture.

Provinces leading in production.—Ilocos Sur, Ilocos Norte, Isabela, Pangasinan, and Mindoro.

Common names.—Palo Maria de la Playa: T., Bitanhol, Bancalan, Dancalan, Dingcalin, Palo Maria, Palo Maria de la Playa, Tamauian; Il., Bitog, Bitaog, Pamitaoguen, Pamitlaten, Bitaosy, Biroy, Vitog, Bansangal, Pamitlain, Pamitclaten, Sarumayer; Z., Bitoc, Birog, Bitaoi; Cag., Dancalan; V., Bitaog, Dancalan, Bitanghol, Pamitaogon, Bitaob; Pamp., Bitaog, Palo Maria, Bitaob; B., Dancalan. Palo Maria del Monte: T., Batinan-amo.

Remarks.—There are two species, used indiscriminately, that produce the wood known as Palo Maria, and which resemble each other very closely. *Calophyllum inophyllum* L. is known as Palo Maria de la Playa and grows only on the seacoast. *Calophyllum wallichianum* Pl. et Tr., found inland, is known as Palo Maria del Monte. The latter has a straighter grain and is not so beautiful as the former in finished work. Palo Maria del Monte, however, is more easily polished.

BATITINAN.

Structural qualities.—Bitatinan is a structural timber of good quality, being hard, durable, and heavy.

Appearance, color, and grain.—Batitinan is light yellow to olive green in color and has a fine and straight grain.

Uses.—Batitinan is used in general construction and for posts and sleepers.

Provinces leading in production.—Tayabas, Ilocos Sur, Ambos Camarines, Rizal, and Misamis.

Common names.—T., Batitinan; B., Tinaan; Il., Magatululung, Lasila, Bingas; V., Miao, Saguimsim; Pamp., Batitian; Pang., Baticalag; province unknown, Nathubo, Lumate, Bugaron, Mañglate.

Remarks.—The only species known to yield the timber called Batitinan is *Lagerstrœmia batitinan* Vid.

ARANGA.

Structural qualities.—Aranga is very hard, heavy, strong, and durable. It is one of the most valuable woods in sea water, for it withstands well the action of the sea worm (teredo). It is usually clear and sound, and seasons without difficulty.

Appearance, color, and grain.—Aranga is light yellow in color and fine grained.

Uses.—Aranga is used as piling and in construction in sea water almost exclusively. It is, however, a very valuable timber for high grade construction.

Provinces leading in production.—Ambos Camarines and Tayabas.

Common names.—T., Aranga, Arangan; V., Arang, Puyot, Ampupuyot; Il., Arangin, Cuela.

Remarks.—*Homalium luzoniense* F. Vill., *H. panayanum* F. Vill., and *H. villarianum* Vid. are the three species that probably yield the timber known as Aranga. *H. panayanum* is known among the Visayans as Puyot.

BANUYO.

Structural qualities.—Banuyo is moderately heavy and moderately hard, but is not very strong. It is easily worked.

Appearance, color, and grain.—The wood of Banuyo is golden brown in color and has a fine grain, similar to that of Acle. It is often finished in its natural color and sometimes stained a dark brown and given an Acle finish.

Uses.—Banuyo is used in making fine furniture and in cabinetwork. Its beauty is only beginning to be appreciated. It is used to some extent in light construction.

Provinces leading in production.—Masbate, Negros Occidental, and Ambos Camarines.

Common name.—T., Banuyo.

Remarks.—The scientific name of the tree that yields the wood known as Banuyo is not known.

BALACBACAN.

Structural qualities.—Balacbacan is moderately heavy, very soft, and brittle. It seasons well and is easily worked.

Appearance, color, and grain.—Balacbacan is reddish brown in color and coarse grained.

Uses.—Balacbacan is used in light or temporary construction and for inferior cabinetwork.

Province leading in production.—Negros Occidental.

Sizes.—In the island of Negros the average diameter of 620 trees 16 inches (40 centimeters) and over is 27 inches (69 centimeters), and the average merchantable length of 6 trees is 69 feet (21 meters) for Balacbacan or Tanguile (*Shorea polysperma* Merr.). In the same stand, for the tree known as Mangachapuy (see below) measurement of 1,142 trees 16 inches (40 centimeters) and over shows the average diameter to be 34 inches (86 centimeters), and the merchantable length (average of 23 trees) is 72 feet (22 meters).

Common names.—T., Tanguile, Panonsongin, Tangili, Tanguili, Tangile; Il., Bunga, Tamug, Araca; V., Balacbacan, Mangachapuy, Babanganon; B., Adamuy.

Remarks.—The wood that is sold on the market for Balacbacan comes from two species of *Shorea*. A small portion of it comes from *Shorea polysperma* Merr., and is known by the Visayan name of Balacbacan. The larger portion of it, however, comes from a tree known by the Visayans as Mangachapuy, which is an unidentified species of *Shorea*. Both woods have also the common name of Tanguile (see p. 640) and Red Lauan.

MAYAPIS.

Structural qualities.—Mayapis is a light, soft wood and is not durable.

Appearance, color, and grain.—Mayapis is white and gray in color and coarse grained.

Uses.—Mayapis is used in light or temporary construction.

Provinces leading in production.—Laguna, Tayabas, Bataan, and Cagayan.

Sizes.—In Baler, Tayabas, measurements of all trees 8 inches (20 centimeters) and over in diameter, on 31 acres, show that Mayapis has an average diameter of 26 inches

(66 centimeters), a maximum diameter of 75 inches (190 centimeters), and an average merchantable length of 68 feet (21 meters).

Common name.—T., Mayapis.

Remarks.—The tree that yields most of the lumber known as Mayapis is probably *Anisoptera vidaliana* Brandis, though other species of *Anisoptera* and some species of *Shorea* are known as Mayapis.

MALUGAY.

Structural qualities.—The most important property of Malugay is toughness, a quality quite uncommon among Philippine woods. It bends well when steamed, is fairly strong and stiff, and has long fibers. It is moderately heavy and moderately hard, but easily worked. It is usually free from defects and shrinks considerably while seasoning, but does not check badly.

Appearance, color, and grain.—Malugay ranges in color from reddish to white and is fine grained.

Uses.—Malugay is used for ribs and planking for small boats; in interior trim; for cabinetwork, and for general construction.

Provinces leading in production.—Malugay is abundant in Mindoro but is not marketed from other parts of the Archipelago..

Common name.—T., Malugay.

Remarks.—This wood has only recently been introduced into the Manila market and at present is not used extensively. It is an excellent wood in many respects and will undoubtedly come into greater favor. The scientific name of the tree that yields Malugay is not as yet known. From imperfect botanical material it is known to be a member of the *Anacardiaceæ*, and probably belongs to the genus *Dracontomelum*.

SASALIT.

Structural qualities.—Sasalit is a very hard, heavy, close-grained, and durable wood. Small knots and checks are quite common.

Appearance, color, and grain.—It has the color of Molave—that is, a pale-yellow color—and is fine grained.

Uses.—Sasalit is used for posts, general house construction, and is considered as good as Molave for these purposes.

Provinces leading in production.—Zambales, Bataan, and Negros Occidental.

Sizes.—In the island of Negros the average diameter of 173 trees 12 inches (30 centimeters) and over of Dungula (*Vitex aherniana* Merr.) is 15 inches (37 centimeters). In Baler, Tayabas, the average of all trees of Igang (*Vitex aherniana*) 8 inches (20 centimeters) and over, on 81 acres, is 12 inches (30 centimeters), the maximum diameter is 38 inches (96 centimeters), and the clear length is 33 feet (10 meters).

Common names.—Z., Sasalit; Baler, Tayabas, Igang; V., Dungula.

Remarks.—The tree that yields the timber known as Sasalit is *Vitex aherniana* Merr. It is a wood very similar to Molave in quality, but trees of it do not reach very large dimensions.

LIUSIN.

Structural qualities.—Liusin is a very hard, heavy, strong, and durable wood. It withstands well the action of the sea worm (teredo).

Appearance, color, and grain.—Liusin is white and reddish in color, and is fine grained.

Uses.—Liusin is used in piling, for wharf construction, and for shipbuilding. It is considered one of the best woods for construction exposed to sea water.

Provinces leading in production.—Bataan and Zambales.

Common names.—T., Liusin; V., Sampinit.

Remarks.—The only tree that is known to yield Liusin is *Parinarium griffithianum* Benth.

LUMBAYAO.

Structural qualities.—Lumbayao is a soft and moderately heavy wood of medium quality. It seasons well and is usually free from defects.

Appearance, color, and grain.—Lumbayao has a reddish-brown color and is coarse grained.

Uses.—Lumbayao is used in general construction.

Province leading in production.—Moro.

Remarks.—This wood is marketed in Zamboanga, Iloilo, and Cebu, but is not brought to Manila. The scientific name of the tree that yields the wood is unknown.

TABLE IV.—*Summary of mechanical tests on thirty-two species of American woods.*

[From Tables I, II, IV, V, and VI, Circular No. 15, Division of Forestry, United States Department of Agriculture.]

Kind of wood.	Specific gravity of dry wood.	Fiber stress at relative (apparent) elastic limit (pounds per square inch).	Modulus of rupture (pounds per square inch).	Modulus of elasticity (1,000 pounds per square inch).	Stress at rupture compression along the grain (pounds per square inch).	Stress at rupture shearing along the grain; not reduced for moisture (pounds per square inch).
Reduced to 15 per cent moisture.						
Longleaf Pine	0.61	8,500	10,900	1,890	6,900	700
Cuban Pine	.63	9,500	11,900	2,300	7,900	700
Shortleaf Pine	.51	7,200	9,200	1,600	5,900	700
Loblolly Pine	.53	8,200	10,100	1,950	6,500	700
Reduced to 12 per cent moisture.						
White Pine	.38	6,400	7,900	1,390	5,400	400
Red Pine	.50	7,700	9,100	1,620	6,700	500
Spruce Pine	.44	8,400	10,000	1,640	7,300	800
Bald Cypress	.46	6,600	7,900	1,290	6,000	500
White Cedar	.37	5,800	6,300	910	5,200	400
Douglas Spruce[a] (Oregon Pine)	.51	6,400	7,900	1,680	5,700	500
White Oak	.80	9,600	13,100	2,090	8,500	1,000
Overcup Oak	.74	7,500	11,300	1,620	7,300	1,000
Post Oak	.80	8,400	12,300	2,030	7,100	1,100
Cow Oak	.74	7,600	11,500	1,610	7,400	900
Red Oak	.73	9,200	11,400	1,970	7,200	1,100
Texan Oak	.73	9,400	13,100	1,860	8,100	900
Yellow Oak	.72	8,100	10,800	1,740	7,300	1,100
Water Oak	.73	8,800	12,400	2,000	7,800	1,100
Willow Oak	.72	7,400	10,400	1,750	7,200	900
Spanish Oak	.73	8,600	12,000	1,930	7,700	900
Shagbark Hickory	.81	11,200	16,000	2,390	9,500	1,100
Mockernut Hickory	.85	11,700	15,200	2,320	10,100	1,100
Water Hickory	.73	9,800	12,500	2,080	8,400	1,000
Bitternut Hickory	.77	11,100	15,000	2,280	9,600	1,000
Nutmeg Hickory	.78	9,300	12,500	1,940	8,800	1,100
Pecan Hickory	.78	11,500	15,300	2,530	9,100	1,200
Pignut Hickory	.89	12,600	18,700	2,730	10,900	1,200
White Elm	.54	7,300	10,300	1,540	6,500	800
Cedar Elm	.74	8,000	13,500	1,700	8,000	1,300
White Ash	.62	7,900	10,800	1,640	7,200	1,100
Green Ash	.62	8,900	11,600	2,050	8,000	1,000
Sweet Gum	.59	7,800	9,500	1,700	7,100	800

[a] Actual tests on "dry" material not reduced for moisture.

TABLE V.—*Results of tests on thirteen Borneo woods.*

Kind of wood.	Number of beams tested.	Average per cent of moisture.	Average specific gravity of dry wood.	Average fiber stress at apparent elastic limit (pounds per square inch).	Average modulus of rupture (pounds per square inch).	Average modulus of elasticity (1,000 pounds per square inch).	Average stress at rupture compression along grain (pounds per square inch).	Average stress at rupture shearing along grain (pounds per square inch).
Selangan Batu (Borneo Yacal)	4	27.6	0.689	9,595	12,325	2,027	7,420	755
Penagah	4	11.6	.594	7,880	8,860	1,140	6,020	880
Merabau (Borneo Ipil)	3	21	.965	14,000	18,830	2,505	9,035	1,030
Camphor	4	21.2	.61	8,455	11,490	1,900	6,540	557
Billian (Ironwood)	4	22.5	.96	16,500	19,660	2,384	11,290	895
Kruen	4	22.7	.542	5,985	8,700	1,604	4,840	653
Seraiah Mira (Borneo Cedar)	4	16.2	.507	5,650	7,450	1,299	4,920	614
Seraiah Putch	4	28.1	.493	6,600	9,390	1,554	5,195	547
Selangan Kacha	4	27.4	.563	8,090	11,040	1,731	6,530	612
Oba Suluk	3	18.1	.582	6,620	9,780	1,283	5,270	840
Rungus (Borneo Rosewood)	1	28.6	.55	7,700	8,700	1,890	5,555	633
Gagil	2	31.6	.43	5,875	8,070	1,385	4,960	715
Griting (Borneo Oak)	4	25.7	.706	9,280	11,860	1,586	7,590	906

NOTE.—All beams were clear and sound.

TABLE VI.—*Comparison of selected Philippine, Borneo, and American woods.*

Name.	Locality.	Compression. along the grain.		Cross-bending.			
		Average per cent moisture.	Average stress at rupture (pounds per square inch).	Average per cent moisture.	Average modulus of rupture (pounds per square inch).	Average modulus of elasticity (1,000 pounds per square inch).	Average specific gravity of dry wood.
Aranga	Philippine Islands	4.9	12,420	5.6	17,920	2,419	0.859
Billian (Borneo Ironwood).	Borneo	22.5	11,290	22.5	19,660	2,384	.96
Pignut Hickory	United States	12	10,900	12	18,700	2,730	.78
Dungon	Philippine Islands	10.7	9,420	11.6	17,110	2,209	.857
Yacal	do	13.4	9,220	15.6	15,690	2,583	.843
Merabau (Borneo Ipil)	Borneo	21	9,035	21	18,830	2,505	.965
White Oak	United States	12	8,500	12	13,100	2,090	.80
Molave	Philippine Islands	12.7	8,330	10.4	8,580	1,614	.785
Guijo	do	14.6	7,940	13.7	15,150	2,158	.708
Selangan Batu (Borneo Yacal).	Borneo	27.6	7,420	27.6	12,325	2,027	.689
Apitong	Philippine Islands	14.4	7,250	14	11,620	2,144	.645
Longleaf Pine	United States	15	6,900	15	10,900	1,890	.61
Ipil	Philippine Islands	17.7	6,570	18.1	6,980	1,383	.792
Lauan	do	12.4	6,180	10.4	9,760	1,653	.446
Oregon Pine	United States	12	5,700	12	7,900	1,680	.51
California Redwood	do	13.3	5,560	12.3	9,110	1,320	445

PART II.

PHILIPPINE SAWMILLS, LUMBER MARKET, AND PRICES.

Manila is the principal lumber market of the Philippine Islands. Here are located five of the most important mills. Timber is being shipped to them from all parts of the islands. Three of these mills are equipped with heavy band saws and other modern machinery. The other mills are equipped with vertical gang and circular saws. The combined sawing capacity of the five mills is about 100,000 board-feet per day. One mill has a capacity of 30,000 board-feet, two of 20,000 board-feet, and two of 15,000 board-feet per day.

During the early operations of the mills in Manila they had to contend with numerous difficulties; Filipino labor was unreliable; many of the hard woods were difficult to saw, and it was impossible to secure a sufficient supply of logs from the provinces with regularity. Conditions have improved, however, during the past two years, and the

mills are now operating in a very satisfactory manner. They now saw all commercial woods without difficulty, and are depending more and more upon their own cuttings to supply logs to meet their requirements. With proper training, Filipinos are found to be apt in handling machinery. Two of the mills have recently been running at night to fill orders.

Some confusion exists in the market regarding the identity of a few of the leading commercial woods. This is especially true of Lauan. At least six different woods are now being marketed under that name. From the commercial standpoint this is not important, however, as all of these woods resemble the true Lauan (*Shorea contorta*) closely and are of about the same quality. There are several different kinds of wood being sold for Apitong, and occasionally Apitong is sold for Guijo. Lauan, Apitong, and Guijo are used to a larger extent than any other fifteen native woods.

Logs are bought and sold by the Spanish cubic foot. One Spanish cubic foot equals 0.765 of an English cubic foot. Lumber is bought and sold by the thousand English board-feet.

In sawing the average-sized logs that are brought into the market, between 5 and 6½ board-feet are obtained from 1 Spanish cubic foot, but in the large-sized logs sometimes as high as 8 board-feet are cut from 1 Spanish cubic foot.

Until quite recently it has been practically impossible to obtain well-seasoned lumber in the market. The mills have been accustomed to sawing to order; consequently lumber was seldom in the yards a sufficient length of time to become seasoned. There were no facilities for kiln drying lumber in large quantities. Two small kilns were erected several years ago, but they were of small capacity and have not been used extensively. One of the leading mills has recently installed a kiln of about 50,000 board-feet capacity, which is operating very satisfactorily. This kiln is capable of drying 100,000 board-feet or more of native lumber per month, the amount depending upon the texture and thickness of the lumber. This concern is now using kiln-dried native lumber in its cabinet factory and is preparing to kiln dry Oregon Pine and Califronia Redwood for use in its planing mill.

A considerable amount of imported lumber is still used in the islands. Most of this is Oregon Pine and California Redwood. During the period from July 1, 1904, to June 30, 1905, 29,679,644 board-feet of lumber and timber, and 9,261 pieces of timber (dimensions not known) were imported. During the same period 139,148.77 cubic meters of native timber were cut. If this were all sawn into lumber it would make about 40,000,000 board-feet.

The price of logs fluctuates from day to day. The following table gives the Manila market prices on August 1, 1906.

Manila market prices.

[Philippine currency.]

Kind of wood.	Logs per Spanish cubic foot.	Sawing per 1,000 English board-feet.	Lumber per 1,000 English board-feet.
Lauan	₱0.30–0.35	₱13.00–15.00	₱70.00– 90.00
Apitong	.35– .37	16.00–18.00	90.00–115.00
Guijo	.50– .65	16.00–18.00	98.00–140.00
Molave	.80– .90	21.00–23.00	215.00–300.00
Yacal	.65–1.00	21.00–23.00	160.00–200.00
Yellow Narra	.70– .80	16.00–23.00	225.00–275.00
Red Narra	.75–1.00	16.00–23.00	250.00–300.00
Tanguile	.33– .45	13.00–18.00	95.00–120.00
Sacat	.40– .75	15.00–18.00	100.00–150.00
Ipil	.76– .85	21.00–23.00	180.00–225.00
Dungon	.80– .90	38.00–40.00	220.00–300.00
Supa	.65– .70	21.00–23.00	140.00–220.00
Balacat	.40	18.00	100.00
Macaasin	.40– .75	15.00–18.00	110.00–150.00
Calantas	.65–1.20	13.00–15.00	180.00–200.00
Tindalo	.78–1.00	21.00–23.00	250.00–300.00
Amuguis	.40– .75	18.00–21.00	110.00–150.00
Acle	.85–1.20	16.00–23.00	280.00–350.00
Betis	.70–1.00	38.00–40.00	250.00–300.00
Bansalaguin	.45– .85	. 23.00	150.00–260.00
Palo Maria	.75– .80	18.00	175.00–185.00
Batitinan	.65– .75	21.00–23.00	150.00–280.00
Aranga	.50– .75	21.00–23.00	150.00–160.00
Banuyo	.55– 75	16.00–18.00	140.00–220.00
Malugay	.60– .65	16.00–23.00	95.00–130.00
Balacbacan	.35	13.00–18.00	70.00– 90.00
Mayapis	.35	15 00	90.00

The government stumpage charges in the provinces where large stands of timber are found range from $1 to $5 gold per 1,000 board-feet.

Aside from the logging which is carried on to supply the Manila mills, there is some logging in connection with mills located in the provinces.

The operations of one company in Negros Occidental are probably more extensive than those of any other company in the provinces. Their mill has a capacity of about 20,000 board feet per day, but the daily cut is less than 10,000 board feet. The trees known by the Visayan names of Balacbacan, Mangachapuy, and Almon are being cut principally; the first two are sold in Iloilo and Manila as Red Lauan or Balacbacan. Almon has the market name of White Lauan. This company has recently purchased a narrow-gauge railway for use in logging and contemplates putting in a new mill, with a much larger capacity, in the near future. Another company has a mill located on the island of Basilan, which is cutting about 6,000 board feet of lumber per day. This lumber is marketed in Zamboanga, Iloilo, and Cebu. The Zamboanga prices quoted by this company are as follows:

	Per 1,000 board-feet.
Lumbayao	₱72.00
Guijo	80.00
Calantas	80.00
Yacal	140.00
Camagon	300.00
Tindalo	180.00
Ipil	180.00
Lauan	50.00
Narra	200.00

Planing, ₱7 extra per 1,000 board-feet.

Another company, a branch of a Manila milling company, has recently installed in Mindoro a circular-saw mill, with a capacity of 5,000 to 10,000 board-feet per day. In the near future this company will have the mill operating at full capacity and will ship lumber to Manila.

Near Baguio, Benguet, there is a mill for sawing Benguet pine, which sells in Baguio and vicinity for ₱85 to ₱95 per 1,000 board-feet. The maximum capacity of the mill is 3,000 board-feet per day, and the average daily cut is 2,000 board-feet. In the near future this company will have a new sawmill in operation in the same locality.

A small mill has recently been installed at Gattaran, Cagayan, which supplies Aparri and the towns up the Cagayan River with lumber. This mill charges ₱0.80 per English cubic foot for first-group timber in the log, and ₱20 per 1,000 board-feet for sawing.

About 2,500 board-feet per day is the capacity of a mill which is cutting Agoho (*Casuarina equisetifolia* Forst.) almost exclusively at San Antonio, in the province of Tarlac. This is put on the market at Manila for ₱100 per 1,000 board-feet.

BUREAU OF FORESTRY.

(Bulletin No. 5.)

A PRELIMINARY WORKING PLAN FOR THE PUBLIC FOREST TRACT OF THE INSULAR LUMBER COMPANY, NEGROS OCCIDENTAL, P. I.[a]

By H. D. EVERETT, *forester, in charge of forest district No. 8*, and H. N. WHITFORD, Ph. D. *forester, chief of the division of forest products.*

LETTER OF TRANSMITTAL.

MANILA, *September 24, 1906.*

SIR: I have the honor to submit herewith a manuscript entitled "A Preliminary Working Plan for the Public Forest Tract of the Insular Lumber Company, Negros Occidental, P. I.," by H. D. Everett, forester, in charge of forest district No. 8, and H. N. Whitford, forester, chief of the division of forest products, and respectfully recommend its publication as Bulletin No. 5.

Very respectfully,

GEORGE P. AHERN,
Director of Forestry.

The SECRETARY OF THE INTERIOR, *Manila, P. I.*

INTRODUCTION.

The following working plan has been prepared:

First. To furnish a prescribed plan for the regulation and management of the large tract of public forest in the island of Negros granted to the Insular Lumber Company for a period of twenty years.

Second. To secure accurate information concerning the timber of an important forest region of the Philippine Islands.

Third. To give the native rangers employed in the bureau of forestry needed training in forest field work.

Field work was begun May 1, 1906, and completed June 15, 1906. Two foresters, one assistant forester, three native rangers, and a constantly changing force of six to fifteen laborers were engaged in the work. Owing to the short time available for the field work, some interesting information was not secured which would add to the completeness and detail of the report.

The field work divided itself into three parts: First, forest map; second, botanical survey; third, collection of data for forest management.

There were made 135 acres of valuation surveys of standing timber, 15 reproduction plots, volume measurements of 57 felled trees, measurement of area logged, valuation surveys in logged area, sylvicultural studies of the principal species, a study of the logging operation, collection of log specimens of the principal species, and a general botanical collection of trees and other plants growing on the tract.

Two base lines were run through the concession 8 kilometers long and 5 kilometers apart, with stations marked every one-half kilometer. Then from each kilometer

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[a] The following illustrations accompanying this report have been omitted and are on file in the War Department:

Plate I. Cutting a large Almon tree. (Frontispiece.) II. Mangachapuy seedlings in the forest. III. Clearing on logged land. IV. Characteristic caingins under rude cultivation. V. Hauling engine at the landing. VI. Bridge on the hauling road. VII. Yarding engine at the end of the hauling road. VIII. Cutting up a large Mangachapuy tree. IX. Forest in good condition after logging. X. Forest in poor condition after logging. XI. General view of the sawmill site. XII. Sawmill of the Insular Lumber Company.

Map of the forest tract on the Himugaan River, Negros Occidental, P. I., operated under a twenty-year license agreement by the Insular Lumber Company.

station, valuation survey lines were run east and west of the base line. The trees 5 meters, or 1 rod, each side of these survey lines were calipered as nearly as possible at the point just above the main buttresses. In this manner about 29 per cent of the total area of the tract was surveyed with the actual measurement of the trees on 1 per cent of this area. The figures for stand of timber in the report are based on this measurement. Since the merchantable forest on the tract is remarkably uniform in composition and density, it is believed that the figures can be applied to the entire area of upland or merchantable forest. However, it is better to confine their application to the area lying between the Himugaan and Hitalon rivers, where the surveys were made.

This working plan is provisional only and should be revised as soon as complete data in regard to the tract is secured. It will serve as a guide for the next few years, while the Insular Lumber Company is initiating extensive operations. As much field work as possible should be done on the tract each year, with the revision of the plan in mind.

Part I.

STATEMENT OF THE FACTS UPON WHICH THE WORKING PLAN IS BASED.

GENERAL DESCRIPTION OF THE TRACT.

SITUATION AND AREA.

The tract of the Insular Lumber Company is situated in the municipalities of Cadiz and Sagay, province of Negros Occidental, island of Negros, P. I., approximately in latitude 10° 50′ north and longitude 123° 30′ east of Greenwich. Its area is 69 square miles, or 44,160 acres (18,000 hectares), of which approximately 39,660 acres (16,060 hectares) are forested and the remaining 4,500 acres cultivated, waste land, and recent clearings. The tract lies on the lower slopes of Mount Silay, just back of the coastal strip of sugar lands, here about 6 miles wide, and consists of two adjoining parts, the upper and smaller of which lies to the south of the lower along the Himugaan River. It is a part of the large and similar forest which extends from Escalante to Silay, some 50 miles, lying 6 to 15 miles back from the coast and extending far into the interior. In some places, as on the Himugaan River, it occupies rolling and hilly lands, and in others, as near Silay, it has been driven back to the steep foothills.

BOUNDARIES.

Lower tract.—Beginning at a point on the left bank of the Himugaan River, at the mouth of Lumbunao Creek, about 6 miles south of the coast line; thence the boundaries run east-southeast for about 6 miles to a point 1 mile due south of Baobao Hill; thence south-southwest 5 miles; thence west-northwest 12 miles; thence north-northeast 5 miles; thence east-southeast 6 miles to the starting point; in all, an area of 60 square miles.

Upper tract.—Beginning at a point on the southern boundary of the lower tract, 1½ miles east-southeast of the Himugaan River, the boundaries run south-southwest 3 miles; thence west-northwest 3 miles; thence north-northeast, 3 miles; thence east-southeast along the southern boundary of the lower tract to the starting point; in all, an area of 9 square miles.

The boundary lines are not marked in any way. They are bordered by dense forest on the east, south, and west, and by alternating patches of forest, waste land, and cultivated land on the north.

PHYSIOGRAPHY.

The land is characterized by gentle slopes, with alternating ridges at the base of Mount Silay. The elevation ranges from 100 feet at points on the northern boundary to 1,200 feet at the highest point on the southern boundary. Small streams and arroyos are scattered profusely over the tract.

Four large rivers drain the tract and small tributary streams are numerous. The Himugaan River, flowing in a deep, winding valley through the middle, drains about 65 per cent of the area. It is the largest of the four rivers and is navigable by small steamers as far as the company's sawmill, about 6 miles from its mouth. The Hitalon and Talabon rivers drain the extreme western and the Tanoa River the eastern parts of the tract.

SOIL AND UNDERLYING ROCK.

The rock and soil are practically uniform throughout the tract. The former is a black igneous rock, which rapidly disintegrates, forming a deep, stiff clay soil, brown in color. The soil is evidently fertile, as it yields good crops of corn and sugar cane where it is now under cultivation. The rock outcrops along the streams and frequently occurs as bowlders on the surface of the ground.

CLIMATE.

The climate of this region is tropical. Extreme heat, however, is moderated by the influence of the surrounding waters and by the cool sea breezes, which blow almost constantly. These are the northeast monsoon, which prevails from about June to November 1, and the southwest monsoon, from November 1 to June 1, with short periods of variable winds at the times when the monsoons change. The coolest time of year is from November to March, and the hottest from March to June. The following table gives the average monthly maximum and minimum temperatures for 1903 at Bacolod, Negros Occidental. They are probably slightly higher than they should be for the immediate neighborhood of the tract.

TABLE I.—*Temperature at Bacolod, Negros Occidental, 1903.*

Month.	Average monthly temperature.		Month.	Average monthly temperature.	
	Maximum.	Minimum.		Maximum.	Minimum.
	°*F.*	°*F.*		°*F.*	°*F.*
January	86	72.6	July	86.8	73.8
February	85.6	71.8	August	87.8	73.2
March	88.5	70.5	September	86.8	73.2
April	91.6	73	October	86.5	73.4
May	91.8	74.6	November	87	73.8
June	88.8	74.6	December	85	73.2

There are two general seasons, wet and dry. From January 15 to May 15 the weather is dry, although showers are often frequent during the latter part of January and the beginning of May. From May 15 to January 15 it is generally wet, with the greatest amount of rainfall in July, September, and October. The following table of monthly rainfall in Bacolod, Negros Occidental, and in Iloilo, Iloilo, is applicable in a general way to this tract, although it is important to remember that the northeast monsoon, bearing rain at the time most needed, strikes with more force on the north and northeast coast of Negros, where the tract is situated, than at Bacolod or Iloilo, and hence the dry season is probably considerably less pronounced than it is at Bacolod. The vegetation is, in consequence, much more luxuriant than in parts of the islands where the dry season is more extended. In the forest in question the trees are not without leaves at any time of the year. In other words, it is a typical evergreen tropical forest.

TABLE II.—*Rainfall.*

Month.	Iloilo, Iloilo.		Bacolod, Negros Occidental.	
	1903.	1905.	1903.	1905.
	mm.	*mm.*	*mm.*	*mm.*
January	5.5	2.8	51.3	31.4
February	1.5	8.9	13	3.1
March	3.3	0	6.3	1.6
April	4.8	32.4	2.8	1.1
May	165.6	60.7	91.3	112.1
June	244.3	175.8	178.1	145.9
July	427	603.1	334.6	388.7
August	186.2	277.5	200.2	425.5
September	146.3	148.8	298.4	227.6
October	245.6	342.8	223.3	362.5
November	124.5	60.6	149.7	165.5
December	528.3	48	429.2	158.7
Total (millimeters)	2,082.9	1,761.4	1,978.2	2,023.7
Total (inches)	82	69	78	80

ROADS AND TRAILS.

The tract is crossed by numerous foot and carabao trails, generally running in a north and south direction. They are used for the transport of bejuco and poles from the forest, and should be useful in the management and protection of the tract. Outside of the forest they unite with the main trails or roads leading to the towns and barios on the coast. These are uniformly bad foot and horse trails, almost impassable in the rainy season.

SOCIAL AND ECONOMIC CONDITIONS.

The Filipinos of the region are Visayans, who live on the cleared land along the coast but seldom in the forest, and a few roaming families of Negritos in the interior. About forty-five Visayan families, exclusive of the employees of the company, live within the tract, nearly all of whom are in its northwest corner and in the valley of the Himugaan River. They live on small farms, or caiñgins, 5 to 50 acres in area, on which they grow corn, tobacco, and camotes. Generally they are also collectors of bejucos, which they sell in the neighboring sugar haciendas or in the coast towns.

The chief occupations of the people of the costal strip of cleared land are fishing and farming. The principal agricultural products are sugar, corn, and tobacco. Sugar is grown on large estates, or haciendas, and requires considerable capital for its cultivation. Corn and tobacco are mostly grown by the poorer people on small farms or caiñgins. Owing to losses during the revolution and insurrection and to the destructive epidemic among the draft animals, many farms are abandoned at the present time. Nevertheless, the country is well settled. The municipality of Cadiz had a population of 16,429 and Sagay of 8,311 persons by the census of 1903. In general intelligence and industry the population is equal to that of any other agricultural region in the islands.

The forest needs of the population are limited. The mangrove swamps on the coast supply most of the necessary firewood and small timbers. From the mountain forest they gather bejucos, vines, resins, palm leaves, small poles, and a few large trees, from which they shape their bancas, or dugouts. For their legitimate personal needs, which should be satisfied, an insignificant amount of forest products is required from the tract.

OWNERSHIP OF THE LAND.

The timbered area of the tract, comprising 39,660 acres, is public land. All of the remaining 4,500 acres of cultivated and waste lands are either owned or claimed by private persons. Their titles, or claims, are based principally on possession. In no known case has any title to this land been registered in the court of land registration. However, the claim should be recognized as far as possible and all residents left in possession of the land which they now occupy.

THE COMPOSITION AND CONDITION OF THE FOREST.

CHARACTERISTIC TYPES.

On the tract there are three characteristic vegetative types. They are as follows: Waste-land type, river-valley forest type, and upland forest type. The two latter are natural; the first is the result of clearings made in the forest types.

Waste-land type.—In the Philippines the vegetation that occupies clearings or partial clearings has the general Tagalog name of "parang."[a] The kind of woody vegetation that springs up quickly in clearings is known by the Tagalogs as "calaanan" and by the Visayans as "laté," and is merely a subtype of the "parang." The "parang," or waste-land type, together with a small amount of cultivated land, comprises about 4,500 acres. A greater part of this is occupied by the "laté," the vegetation of which is composed of quick-growing weed trees that have little or no value. The following species are the most characteristic: *Trema amboinensis* Blume (Janagdon), *Psidium guayava* L. (Bayabas), *Homalanthus populneus* Pax. (Balanti), *Mallotus ricinoides* Muell. (Himlaamo), *Breynia rhamnoides* Muell. (Tulugtulug), *Ficus hauili* Blanco (Labnug), *Musa* sp. (Wild hemp), and many others. This type is only temporary and if protected from fire will gradually return to the original forest condition.

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[a] See Vidal, D. Sebastian: Catálogo Metódico de las Plantas Leñosas Silvestres y Cultivadas observadas en la Provincia de Manila (1880), 9–10, for the original definition of "parang;" also H. N. Whitford: The vegetation of the Lamao Forest Reserve, *Phil. Journ. Sci.* (1906), 1: 388–398, and W. W. Maule: Parang and Cogonales in the Philippines, *Forestry and Irrigation* (1906), 12: 311–317, for more detailed accounts of "parang" vegetation.

River-valley type.—At the lower limits of the tract the Himugaan River is winding and distinct terraces have been formed. As the stream is ascended these terraces become more narrow until finally on the upper half of the tract they disappear entirely, the river itself occupying a deep, narrow canyon. The terraces are valuable for agricultural purposes and, as shown by the map, the original forest has been cleared from a large portion of them. Probably there are 2,000 acres that are still in original forest. This estimate, which is liberal, includes the forest on the terraces near the mouths of the principal branches. A hurried examination of this type shows it to be in a poor sylvicultural condition. It is characterized by many species, most of which are small, crooked, and defective. The undergrowth is a dense mass of climbing bamboo, bejucos (rattan), wild hemp, vines, and shrubs. The commercial unimportance of the trees makes it doubtful if the Insular Lumber Company will ever find it advisable to log them. The land is better suited for agricultural than for forest purposes, consequently it may be found best to grant homesteads and permit caingins on it without consideration of the present forest growth.

Upland-forest type.—The commercial forest of the tract is of the upland type and has an area of about 37,600 acres (15,200 hectares), or 85 per cent of the entire tract. The merchantable timber which is being lumbered is on this type. The upland forest type, ranging from 150 to 1,200 feet elevation, covers the broad gentle slopes and ridges which lead up to the foothills and peaks of Mount Silay. The slopes are cut up by a number of small streams and numerous arroyos.

The forest itself is characterized by a numerous dominant stand of large overmature trees belonging to the family *Dipterocarpaceæ*, with an undergrowth of many small trees, making a forest remarkable for its density and yield.

The dominant trees important numerically and commercially are six in number, all Dipterocarps. They are Apitong (*Dipterocarpus grandiflorus* Blanco), Almon (*Shorea squamata* Dyer), Balacbacan (*Shorea polysperma* Merr.), Mangachapuy[a] (*Shorea* sp.), Lauan-dunlog (*Shorea contorta* Vid.) and Lauan-bagtican (*Shorea* sp.). Of the 32.9 trees per acre 40 centimeters (16 inches) and over in diameter, 29.4, or nearly 90 per cent, are the above species. They occur well mixed on every acre of upland forest. The average diameter of trees 40 centimeters and over is 71 centimeters (28 inches). The largest is Mangachapuy and the smallest Apitong. They are all tall, clear trees, with large buttresses, which attain a diameter of more than 150 centimeters (60 inches), a height of more than 60 meters (200 feet), and sometimes have a clear length of 30 to 40 meters (100 to 130 feet).

The minor species, though they occur in large numbers, are too small and too varied in quality to be of any great importance commercially. The average diameter of trees 40 centimeters and over is 49 centimeters (19 inches). Those which occur in largest numbers and for which a commercial use may be found are Ata-ata (*Diospyros* sp.), Dungula (*Vitex ahcrniana* Merr.), Guisoc-guisoc (*Hopea philippinensis* Dyer), Bulog (*Eugenia* sp.), and Moabog (*Canarium* sp.).

On the banks of small streams and in arroyos there is usually a very narrow fringe of small, unimportant trees. Here certain species are uniformly found. The most common are *Astronia cumingiana* Vid. and *Kayea* sp.

The upland forest, compared to most tropical timber forests, is lacking in dense underbrush. (Pl. II.) Climbing bamboos, bejucos, palms, and vines are regularly distributed through the forest, but only in a few spots, where an opening has been made admitting the light, do they form dense tangles, almost impossible to penetrate. As a rule, one can travel easily and steadily through the forest, cutting an occasional bamboo or bejuco from the path. The most common plants in the undergrowth are a *Pandanus* sp., bejucos, palms, climbing bamboos and vines, and numerous shrubs of the families *Rubiaceæ*, *Euphorbiaceæ*, *Melastomaceæ*, and others.

The heavy shade prevents a dense herbaceous growth in the ground cover. The most common plants are vines, herbaceous plants and seedlings of trees, bejucos, and palms. The characteristic species are a *Pandanus* sp. and a large sedge (*Mapania humilis* Naves).

The ground itself is remarkably free from litter. Heavy rains, insects, and fungi rapidly remove débris from the ground, leaving the soil bare, except for the scanty growth of small plants.

The silvical condition of the forest is bad. Most of the dominant trees are overmature and almost invariably diseased. The forest is balanced between growth and decay, with a big annual loss of increment which should be utilized. The mature and overmature trees should be removed as soon as possible to reduce the loss to a minimum and to enable the production of a second timber crop through the growth of the small trees and seedlings, which are abundant in the forest.

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[a] It should be stated here that this species is not the Mangachapuy of commerce.

Reproduction of the tree species is abundant and well distributed in the upland forest. (Pl. II.) There is a regular assortment of seedlings, saplings, small poles, large poles, and small trees to take the place of the large trees as they drop out. The deep shade beneath the large trees aids germination by keeping down a rank suffocating growth of vines, herbs, and grasses, which spring up in abundance in openings. On the other hand, this lack of light makes it difficult for the seedlings and saplings to survive and grow. Only a few of the millions of seedlings in the virgin forest finally reach a size where growth to maturity is practically assured. In short, the ground is usually a good seed bed. Seedlings of all species are sufficiently abundant and well distributed. Few seedlings reach the pole size, but enough do so to provide for the future of the forest.

The six principal species are well represented in the reproduction and evidently will continue to predominate in the forest in about the same proportions as in the past. They appear to seed periodically and abundantly. Seedlings of Mangachapuy and Almon are especially abundant at present, pointing to a recent heavy seeding of those species. The seeds of all appear to have germinated well. The seedlings endure considrable shade, and poles and small trees of all are present in satisfactory numbers. The advantage in shade endurance and persistency of growth under unfavorable conditions seems to lie with the Apitong and Almon.

Table III gives the total number of seedlings and saplings of trees and all other plants entering into the underbrush and ground cover ascertained by actual count on 15 plots, of one square rod each, regularly distributed through the upland forest in block 4.

TABLE III.—*Tree reproduction and ground cover on 15 square rods (375 square meters).*

Scientific name.	Common name.	Seedlings.	Saplings.
Dipterocarpus grandiflorus	Apitong	4	5
Shorea squamata	Almon	169	7
Shorea polysperma	Balacbacan	41	5
Shorea sp	Mangachapuy	896	1
Hopea philippinensis	Guisoc-guisoc	8	2
Vitex aherniana	Dungula	1	6
Diospyros sp	Ata-ata	19	6
Other tree species		57	20
Palmæ [a]	Palms	155	50
Calamus spp	Bejucos, or rattans	45	39
Pandanus sp	Pandan	29	1
Mapania humilis	Sedge	215	.....
Unknown plants [b]		583	65
Dinochloa sp	Climbing bamboo	(c)	(c)
Total		2,222	207

[a] Species of the genera Livistona, Pinanga, Oncosperma, and others.
[b] Mostly vines, some trees, with a few herbs and ferns.
[c] Abundant but not counted.

Table IV gives the average number per acre and hectare of poles and small trees of the six principal species, based on valuation surveys of 135 acres of upland forest in blocks 3, 4, 5, and 6.

TABLE IV.—*Stand of the small trees of the six principal species.*

Diameter above buttresses.		Stand per acre.						Stand per hectare.[a]					
		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.	Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.
Inches.	*Cm.*												
4.7– 7.5	12–19	3.43	3.47	1.01	1.29	0.65	9.85	8.47	8.58	2.51	3.18	1.61	24.35
7.9–11.4	20–29	3.89	3.34	1.56	1.81	1.14	11.74	9.61	8.25	3.86	4.48	2.82	29.02
11.8–15.7	30.39	2.18	1.86	.94	.94	.56	6.48	5.38	4.59	2.32	2.32	1.39	16
Total		9.50	8.67	3.51	4.04	2.35	28.07	23.46	21.42	8.69	9.98	5.82	69.37
Percentage		33.8	30.9	12.5	14.4	8.40	100	.....	.....	.....	.....	.....	.....

[a] 1 hectare=2.471 acres.

Sylvic treatment of the upland forest for its perpetuation and the production of timber is not difficult. The composition of the forest and the sylvics of the trees render a selection system of cutting, with protection of the reproduction, safe and certain to secure the desired results.

STAND AND YIELD OF UPLAND FOREST.

The merchantable timber on the concession is practically all in the 37,600 acres of upland forest, which is about 85 per cent of the total area of the tract. The valuation surveys and other measurements made to determine the volume of merchantable timber were confined to this type of forest. It is this type that the company will log, and to it that the chief provisions of the working plan apply.

Stand.—One hundred and thirty-five acres of the timber land in blocks 3, 4, 5, and 6 (mostly in 4 and 5), between the Hitalon and Himugaan rivers, were surveyed and the trees classified and measured according to species and diameter outside of the bark just above the main buttresses. From this data Tables V, VI, and VII were constructed, showing the average number of trees per acre and hectare. Although the surveys were made in a part of the tract comprising but 29 per cent of the total area, owing to the homogeneous character of the forest and the conservative nature of the figures, it is believed that they can be applied to the entire area of upland forest without serious error. It is safer, however, to confine their application to blocks 3, 4, 5, and 6.

Tables V, VI, and VII show the number of merchantable trees per acre and per hectare—that is, trees 40 centimeters and over in diameter. The six principal species are separated, except the two Lauans, which are comparatively few and nearly alike in all respects. The scarcity of the other species makes it inadvisable to separate them in this table. A tree 16 inches in diameter, besides its use for sawn lumber, will also serve for railroad ties and skids in road construction.

TABLE V.—*Number of trees per acre 40 centimeters and over in diameter.*

[Average of 135 acres in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.	Other species.	Grand total.
Inches.	*Cm.*								
16	40	1.303	0.800	0.548	0.652	0.400	3.703	1.185	4.888
18	45	1.334	.792	.518	.496	.260	3.400	.970	4.370
20	50	.933	.622	.446	.526	.185	2.712	.526	3.238
22	55	.740	.511	.303	.474	.170	2.198	.260	2.458
24	60	.763	.474	.385	.422	.111	2.155	.148	2.303
26	65	.659	.407	.429	.466	.140	2.101	.126	2.227
28	70	.451	.326	.266	.422	.133	1.598	.066	1.664
30	75	.446	.303	.237	.400	.096	1.482	.059	1.541
31	80	.260	.378	.223	.437	.074	1.372	.066	1.438
33	85	.244	.355	.244	.370	.059	1.272	.037	1.309
35	90	.207	.185	.185	.281	.052	.910	.022	.932
37	95	.103	.133	.126	.318	.052	.732	.015	.747
39	100	.059	.207	.163	.289	.089	.807	.007	.814
41	105	.126	.260	.111	.446	.082	1.025	.007	1.032
43	110	.052	.170	.066	.393	.029	.710	.....	.710
45	115	.015	.155	.052	.289	.037	.548	.....	.548
47	120	.022	.163	.066	.370	.022	.643	.....	.643
49	125	.022	.044	.066	.274	.015	.421	.....	.421
51	130	.015	.044	.074	.237	.029	.399	.....	.399
53	135	.007	.066	.037	.215	.022	.347	.....	.347
55	140	.....	.066	.....	.281	.007	.354	.....	.354
57	145	.007	.037	.022	.103	.....	.169	.....	.169
59	150	.....	.037	.015	.118	.....	.170	.007	.177
61	155	.....	.....	.....	.052	.....	.052	.....	.052
63	160	.....	.007	.007	.096	.007	.117	.....	.117
65	165	.....	.....	.....	.....	.....	.....	.....	.....
67	170	.....	.007	.....	.030	.....	.037	.....	.037
Total		7.768	6.549	4.589	8.457	2.071	29.434	3.501	32.935
Percentage		23.6	19.9	13.9	25.7	6.3	89.4	10.6	100

TABLE VI.—*Number of trees per hectare*[a] *40 centimeters and over in diameter.*

[Average of 54.65 hectares in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.	Other species.	Grand total.
Inches.	*Cm.*								
16	40	3.22	1.98	1.35	1.61	0.99	9.15	2.92	12 07
18	45	3.29	1.96	1.28	1.22	.64	8.39	2.40	10.79
20	50	2.30	1.54	1.10	1.30	.46	6.70	1.30	8
22	55	1.83	1.26	.75	1.17	.42	5.43	.64	6.07
24	60	1.88	1.17	.95	1.04	.27	5.31	.36	5.67
26	65	1.63	1	1.06	1.15	.35	5.19	.31	5.50
28	70	1.11	.81	.66	1.04	.33	3.95	.16	4.11
30	75	1.10	.75	.59	.99	.24	3.67	.14	3.81
31	80	.64	.93	.55	1.08	.18	3.38	.16	3.54
33	85	.60	.88	.60	.91	.14	3.13	.091	3.221
35	90	.51	.46	.46	.69	.13	2.25	.054	2.304
37	95	.25	.33	.31	.78	.13	1.80	.037	1.837
39	100	.14	.51	.40	.71	.22	1.98	.018	1.998
41	105	.31	.64	.27	1.10	.20	2.52	.018	2.538
43	110	.13	.42	.16	.97	.071	1.751	.....	1.751
45	115	.037	.38	.13	.71	.091	1.348	.....	1.348
47	120	.054	.40	.16	.91	.054	1.578	.....	1.578
49	125	.054	.11	.16	.68	.037	1.041	.....	1.041
51	130	.037	.11	.18	.59	.071	.988	.....	.988
53	135	.018	.16	.091	.53	.054	.853	.....	.853
55	140	.....	.16	.....	.69	.018	.868	.....	.868
57	145	.018	.091	.054	.25	.....	.413	.....	.413
59	150	.....	.091	.037	.29	.....	.418	.018	.436
61	155	.....	.....	.....	.13	.....	.13	.....	.13
63	160	.....	.018	.018	.24	.018	.294	.....	.294
65	165	.....	.....	.....	.....	.....	.....	.....	.....
67	170	.....	.018	.....	.074	.....	.092	.....	.092
Total		19.158	16.178	11.32	20.854	5.114	72.624	8.626	81.25

[a] 1 hectare = 2.471 acres.

TABLE VII.—*Number of trees of the six principal species 12 centimeters (4.7 inches) and over in diameter.*

[Average of 135 acres (54.65 hectares) in blocks 3, 4, 5, and 6.]

	Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.
Per acre.....	17.26	15.22	8.11	12.50	4.42	57.51
Per hectare.....	42.6	37.6	20	30.8	10.9	141.90
Percentage.....	30	26.5	14.1	21.7	7.7	100

Volume tables.—To ascertain the volume of the timber in these trees and on each acre, measurements of 57 felled trees of Apitong, Mangachapuy, Almon, and Balacbacan were made. The following measurements were taken: Height of stump, diameter outside the bark on the stump, diameter outside the bark every 5 meters as far as the tree was merchantable, thickness of bark, and the clear length of the tree. The diameter on the stump is in nearly all the trees the point where the large buttresses end, and corresponds with the diameters measured in the valuation surveys. The total length could not be measured because of the great breakage of the tops in falling, which would have made such measurements too uncertain. A 5-meter log section in measuring the diameter was found very convenient, as it is equivalent to 16 feet, the standard log length.

From the measurements of the 57 trees, the volume of each in cubic meters and in feet, board measure, by the Doyle rule, was computed. Since so few trees were measured, it was not advisable to make a separate volume curve and table for each species. They happen, however, to have a similar habit of growth, being all large, clean-boled trees, with small taper. Consequently, all measurements were combined to make one

volume curve in cubic meters and one in feet, board measure, to be applicable to all of the principal species. The following volume table was constructed from the volume curves. In this table no allowance is made for defects in logs that are merchantable, but unmerchantable logs were not measured. Allowance for defects in individual trees can not be made from the data collected. Small trees are usually very slightly defective, while large trees are almost always attacked by heart rot.

The tree in the United States which most closely resembles in shape and volume the large Dipterocarps on the tract is the Yellow Poplar (*Liriodendron tulipifera* L.). The actual number of board feet sawed out of Yellow Poplar trees of the different diameters is given in Table VIII for purposes of comparison.[a] The Dipterocarps are more defective than the Yellow Poplar, and allowance for these defects will overcome the difference in their favor shown in the table.

TABLE VIII.—*Volume table for the six principal species, based on measurements of 57 trees*[a] *compared with Yellow Poplar.*[b]

Diameter above buttresses.		Apitong, Almon, Balacbacan, Mangachapuy.		Yellow Poplar (feet B. M).	Diameter above buttresses.		Apitong, Almon, Balacbacan, Mangachapuy.		Yellow Poplar (feet B. M).
Inches.	Centimeters.	Feet B. M., Doyle rule.	Cubic meters.		Inches.	Centimeters.	Feet B. M., Doyle rule.	Cubic meters.	
16	40	150	1.12	191	43	110	3,950	13.13	3,146
18	45	250	1.50	276	45	115	4,400	14.50	3,470
20	50	400	2	380	47	120	4,950	16	3,801
22	55	580	2.50	507	49	125	5,550	17.46	4,144
24	60	800	3.18	657	51	130	6,100	19	4,497
26	65	1,050	3.84	832	53	135	6,550	20.40	4,844
28	70	1,310	4.60	1,035	55	140	6,900	21.70	5,154
30	75	1,600	5.40	1,250	57	145	7,200	22.80	5,435
31	80	1,880	6.26	1,359	59	150	7,450	23.70	5,700
33	85	2,200	7.27	1,585	61	155	7,630	24.40	5,944
35	90	2,500	8.40	1,832	63	160	7,780	25	6,174
37	95	2,820	9.40	2,149	65	165	7,900	25.50	6,394
39	100	3,150	10.57	2,478	67	170	8,000	25.80	6,604
41	105	3,500	11.80	2,827					

[a] No allowance for defects.
[b] Actually sawn from the trees of Yellow Poplar cut in Tennessee, United States.

Yield.—With the average number of trees per acre and per hectare of the principal species and their average contents, the total volume per acre and per hectare, without allowance for defects, is computed in feet, board measure, and cubic meters for Tables IX and X. The minor species are not included in this estimate because of their small numbers, small size, and unimportance. Further investigation may show that somd of them can be introduced into the markets, but at present they are not exploited.

[a] See Braniff, E. A.: Grades and Amount of Lumber Sawed from Yellow Poplar, etc., *U. S. Dept. Agr., For. Ser.* (1906), Bull. 73.

TABLE IX.—*Volume per acre of the six principal species.*

[No allowance for defects. Feet B. M., Doyle rule.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.
Inches.	*Cm.*						
16	40	195	120	80	95	60	550
18	45	335	200	130	125	65	855
20	50	375	250	180	210	75	1,090
22	55	430	295	175	275	95	1,270
24	60	610	380	310	340	90	1,730
26	65	690	425	450	490	145	2,200
28	70	590	425	350	555	175	2,095
30	75	710	485	380	640	155	2,370
31	80	490	710	420	820	130	2,570
33	85	530	780	535	815	130	2,790
35	90	520	460	460	700	130	2,270
37	95	290	375	355	895	145	2,060
39	100	185	650	515	910	280	2,540
41	105	440	910	390	1,560	285	3,585
43	110	205	670	260	1,550	115	2,800
45	115	65	680	230	1,270	160	2,405
47	120	110	805	325	1,830	110	3,180
49	125	120	240	365	1,520	85	2,330
51	130	90	270	450	1,445	175	2,430
53	135	50	430	240	1,410	145	2,275
55	140	.....	455	.....	1,940	50	2,445
57	145	50	265	160	740	.....	1,215
59	150	.....	275	110	880	.....	1,265
61	155	.....	.....	.....	395	.....	395
63	160	.....	55	55	770	55	935
65	165	.....	.....	.....	.....	.....	.....
67	170	.....	60	.....	240	.....	300
Total		7,080	10,670	6,925	22,420	2,855	49,950
Percentage		14.2	21.4	13.9	44.8	5.7	100

TABLE X.—*Volume per hectare of the six principal species.*

[No allowance for defects. Measurement in cubic meters.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.
Inches.	*Cm.*						
16	40	3.60	2.21	1.51	1.80	1.10	10.22
18	45	4.93	2.94	1.92	1.83	.96	12.58
20	50	4.60	3.08	2.20	2.60	.92	13.40
22	55	4.57	3.05	1.87	2.92	1.05	13.46
24	60	5.98	3.72	3.02	4.45	.86	18.03
26	65	6.26	3.84	4.07	4.41	1.34	19.92
28	70	5.10	3.72	3.03	4.78	1.52	18.15
30	75	5.94	4.05	3.18	5.34	1.30	19.81
31	80	4.00	5.82	3.44	6.76	1.12	21.14
33	85	4.36	6.39	4.36	6.61	1.02	22.74
35	90	4.28	3.86	3.86	5.79	1.09	18.88
37	95	2.35	3.10	2.91	7.33	1.22	16.91
39	100	1.48	5.39	4.23	7.50	2.32	20.92
41	105	3.66	7.55	3.18	12.98	2.36	29.73
43	110	1.70	5.51	2.10	12.73	.93	22.97
45	115	.54	5.51	1.88	10.29	1.32	19.54
47	120	.86	6.40	2.56	14.56	.86	25.24
49	125	.94	1.92	2.79	11.87	.65	18.17
51	130	.70	2.09	3.42	11.21	1.35	18.77
53	135	.37	3.26	1.85	10.81	1.10	17.39
55	140	.....	3.47	.....	14.97	.39	18.83
57	145	.41	2.08	1.23	5.70	.....	9.42
59	150	.....	2.15	.87	6.87	.....	9.89
61	155	.....	.....	.....	3.17	.....	3.17
63	160	.....	.45	.45	6.00	.45	7.35
65	165	.....	.....	.....	.....	.....	.....
67	170	.....	.46	.....	1.90	.....	2.36
Total		66.63	92.02	59.93	185.18	25.23	428.99

For a safe and conservative estimate of the merchantable timber per acre, an allowance for defects should be made of about 20 per cent for Apitong, 40 per cent for Mangachapuy, and 30 per cent for Balacbacan, Almon, Lauan-bagtican, and Lauan-dunlog. This allowance is made in Tables XI and XII. Since it may be advisable to place the merchantable diameter or cutting limit at 20 inches instead of 16 inches, the merchantable stand and yield for trees above those two diameters, respectively, are given in those tables for the purpose of comparison.

TABLE XI.—*Summary of stand and merchantable yield of the six principal species 40 centimeters (16 inches) and over in diameter.*

[Allowance for defects: Apitong, 20 per cent; Mangachapuy, 40 per cent; others, 30 per cent.]

Species.	Stand.		Yield.	
	Per acre.	Per hectare.	Doyle rule, feet B. M. per acre.	Cubic meters per hectare.
Apitong	7.77	19.16	5,670	53.3
Almon	6.55	16.18	7,470	64.4
Balacbacan	4.59	11.32	4,850	42.0
Mangachapuy	8.45	20.85	13,460	111.1
Lauan-bagtican and Lauan-dunlog	2.07	5.11	2,000	17.7
Total	29.43	72.62	33,450	288.5

TABLE XII.—*Summary of stand and merchantable yield of the six principal species 50 centimeters (20 inches) and over in diameter.*

[Allowance for defects same as in Table XI.]

Species.	Stand.		Yield.	
	Per acre.	Per hectare.	Feet B. M. per acre.	Cubic meters per hectare.
Apitong	5.13	12.65	5,140	44.8
Almon	4.96	12.24	7,150	59.3
Balacbacan	3.52	8.69	4,640	38.6
Mangachapuy	7.31	18.02	13,240	107.5
Lauan-bagtican and Lauan-dunlog	1.41	3.48	1,880	15.7
Total	22.33	55.08	32,050	265.9

The data from which the volumes and yields are obtained is clearly insufficient to permit of an accurate estimate. This is not claimed for the above tables. They will, however, be found approximately correct and will serve as a basis for management until they can be revised. They apply to blocks 3, 4, 5, and 6, but are generally applicable to the entire area of upland forest.

This tract, having about 32,050 feet B. M. of merchantable timber (over 20 inches in diameter) per acre on 37,660 acres of forest land, therefore contains a total merchantable stock of 1,207,000,000 feet B. M., if the above yield will hold for the entire area of commercial forest, which is probable. This should be cut as rapidly as possible. It is sufficient to supply a mill cutting 100,000 feet per day for forty-two years of three hundred working days per year.

DESCRIPTION OF TREES.

Principal species.—Apitong (Dipterocarpus grandiflorus): Apitong is an important timber tree of the third group, found generally in the hill forests throughout the islands, the timber of which comes into the market in large quantities. On this tract Apitong occurs in abundance, singly, in mixture with other species, or in small groups. It is most numerous on the slopes of the upland forest, where it is often found in almost pure groups on the tops of hills and ridges. Apitong rarely occurs above 1,800 feet elevation on Mount Silay. It prefers a deep, well-drained soil.

Apitong is a smaller tree than any of the other five principal trees, although it reaches a diameter of 145 centimeters (57 inches), with a clear length of 25 to 30 meters

(80 to 100 feet). The majority of the trees, however, are small. This probably is not due altogether to natural conditions, but more to the long-continued and injurious boxing of the trees for the balao, or pitch, which it yields.

In the forest the Apitong is a clean-looking, tall tree, with a straight cylindrical trunk, short, compact crown, and low moderate butresses, or none at all. Apitong endures shade remarkably well, but thrives best in the stronger light on the upper slopes or tops of hills. Although seedlings are comparatively few, saplings, small poles, and large poles are present in a proportion sufficient to provide for the future of the species in the forest. Apparently it seeds well, but intermittently. No 1-year-old seedlings were observed during the field work of the past year.

Apitong is the freest from defect of the six principal species. It is sound except when it has been subjected to boxing. That the boxing is injurious and responsible for the death of many trees was proven by the observations of the various stages of decay and death of trees which, without exception, had been boxed. Notches 8 to 12 inches deep are hollowed out below to catch the pitch as it oozes out of the wood. Trees of only 40 centimeters diameter are often tapped, and large trees frequently on two sides. The balao is collected and the box is burned out every two weeks. In a short time insects and fungi take hold and the decay is rapid.

The wood of the Apitong is heavy, moderately hard, and fairly durable. It is reddish brown in color and has a straight but coarse grain. It is used in ordinary construction, in shipbuilding, and for inferior furniture. Apitong sells in Manila for ₱90 to ₱115 per 1,000 feet B. M.

Almon or *White Lauan* (*Shorea squamata*): Almon is one of the important timber trees, the timber of which enters the market as White Lauan.[a] (Pl. I, frontispiece.) It occurs in mixture with other species throughout the tract, most numerous on the rich gentle slopes.

It is a very large, tall, clear tree, attaining a diameter of 170 centimeters (67 inches), a height of more than 65 meters (210 feet), and a clear length of 35 meters (115 feet). In the forest it is straighter and clearer than the other species and is characterized by less taper. A tree 135 centimeters in diameter on the stump had the following diameters outside the bark at the small end of each 5-meter log: 114, 112, 111, 103, 101, 96, and 93 centimeters, a total taper in 35 meters (115 feet) of 42 centimeters (16 inches), 21 centimeters (8 inches) of which was in the first 5-meter log.

The crown of Almon is short, sturdy, and compact. Large, high buttresses are almost invariably found on the big trees, sometimes 3 meters high and reaching from 3 to 4 meters from the base of the tree.

Almon may be classed as a fair shade endurer, although its clear, tall habit of growth shows a strong desire for light. Seedlings are not numerous in the forest, but the number of saplings and small and large poles is only exceeded by that of the Apitong.

The large trees of Almon and many of the small ones are very defective. The principal defect is a punk or rot in the heart, which varies from a small doty spot, making the heart boards useless, to large hollows extending the full length of the tree. This has probably been caused by injuries to the tops, which have permitted the entrance of destructive fungi.

The wood of Almon is light brown in color, rather soft, and not heavy. It is used mostly for interior work in the construction of houses. It is also substituted for Balacbacan for interior finishing and for furniture. Almon does not endure exposure to moisture or weather, and is very susceptible to the attacks of anay, or the white ant. It is sold in Manila for ₱70 to ₱90 per 1,000 feet B. M.

Balacbacan or *Tanguile* (*Shorea polysperma*): Balacbacan, the timber of which is now well known in the market, occurs well distributed on the tract in mixture with the other species. It prefers deep soil on the slopes of the hills and is more numerous above 500 feet elevation. It is found on Mount Silay to an elevation of about 2,500 feet.

Balacbacan is a large timber tree not reaching the magnificent sizes of the Mangachapuy, but attaining a diameter of 160 centimeters (63 inches), a height of more than 50 meters (165 feet), and a clear length of 30 meters (100 feet). It is characterized by a stout spreading crown and a straight cylindrical trunk, with prominent buttresses at the base. It, as well as the other species of the genus Shorea in the forest, is defective at the heart. In general, however, it is less so than the others.

Reproduction of Balacbacan is fairly well distributed in the forest. Seedlings and saplings are not so numerous as those of Mangachapuy. The tree endures shade about as well as the Almon.

The wood of Balacbacan is porous, light in weight, and red or reddish brown in color. It is used extensively for interior finish and for furniture, and is now received with favor in Manila, where it is sold for ₱70 to ₱90 per 1,000 feet B. M. The wood

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[a] This wood should not be confused with that of *Shorea contorta*, the White Lauan of Mindoro, Zambales, and other provinces.

closely resembles that of Mangachapuy, which has been sold in the markets under the name of Balacbacan.

Mangachapuy or *Red Lauan* (*Shorea* sp.): Mangachapuy, known in the market as Red Lauan and Balacbacan, is both the largest and the most important timber tree on the concession. It occurs throughout the tract in mixture with other species, most numerous on the rich, moist, lower slopes and nearly level land of the upland forest.

Mangachapuy here reaches magnificent sizes. Trees 150 to 180 centimeters (60 to 70 inches) in diameter, towering to a height of more than 65 meters (215 feet), with clear lengths of 30 to 35 meters (100 to 115 feet), are not uncommon. It is characterized by stout, long, cylindrical trunk, immense buttresses, and sturdy spreading top.

The Mangachapuy endures shade well. Seedlings, saplings, and small and large poles are abundant. (Pl. II.) It is evident from the abundance of small seedlings that a heavy seeding of this species occurred one or two years ago.

The Mangachapuy is the most defective of the principal species. The large trees are all subject more or less to dote, or rot, at the heart, and it is difficult to find a small specimen which is not already slightly affected.

The wood of Mangachapuy is sold in the markets as Balacbacan or Red Lauan. It is porous, red in color, and light in weight. Locally it is used in the construction of houses and bancas, or dugouts. It is now being used extensively for interior finish and furniture. It is sold in Manila for ₱70 to ₱90 per 1,000 feet B. M.

Lauan-dunlog (*Shorea contorta*) and *Lauan-bagtican* (*Shorea* sp.): These two trees are relatively few on the tract. Lauan-dunlog is the White Lauan of commerce. Both occur in mixture, preferring the moist, steep slopes in the upland forest near streams, and are also scattered in the river-valley forests. The close resemblance between the two species and the difficulty of distinguishing them in the woods makes it advisable to treat them as one. Both are large trees, attaining a diameter of 150 centimeters (60 inches). They resemble in general form the Almon already described, and are subject to heart rot and other diseases to about the same degree as Almon. In proportion to their numbers in the forest, reproduction is satisfactory. Their wood has, in general, the same characteristics and uses as Almon, but is a trifle harder and heavier. They are sold in the markets as White Lauan.

Minor tree species.—The many minor tree species scattered over the tract in small numbers and sizes are of little or no importance commercially. The following list includes the larger and the more numerous: *Diospyros* sp. (Ata-ata), *Vitex aherniana* (Dungula), *Hopea philippinensis* (Guisoc-guisoc), *Canarium* spp. (Moabog), *Eugenia* spp. (Bulog), *Kurrimia luzonica* Vid., and *Livistona* sp. (Palma brava). These trees are so well distributed through the forest that large numbers of no one species can be found within a prescribed area. There are but 2.55 trees per acre 40 centimeters and over in diameter. They are all small, dominated trees, growing in the shade of the large Dipterocarps. Although many of them doubtless possess value for some purposes, only three (Dungula, Ata-ata, and Palma brava) can have any importance at present to lumbermen.

Dungula,[a] which belongs to the same genus as Molave, is a small tree, seldom exceeding 60 centimeters (24 inches) in diameter, and occurs well distributed throughout the forest, but is most numerous on moist, gentle slopes and near streams. It is a small, rather crooked, ill-formed tree, growing in the shade of the dominant Dipterocarps. It is a true shade endurer and reproduces well.

The wood of Dungula is very hard and heavy, resembling Molave so closely that it is often substituted for that species in the Manila market. It is extremely durable in the ground. Fallen Dungula trees in the forest, after the narrow sapwood has rotted off, remain hard and sound, although it is evident that they have laid on the ground for a long time. Dungula is gladly used by the inhabitants of northern Negros for barigues, or house posts. It has not, however, because of its relative scarcity and small size, which makes logging costly, been introduced into the timber market on any scale. There is no doubt that it is a very satisfactory timber for small house posts, railroad ties, and mining timbers, especially for the latter.

Ata-ata is a small tree belonging to the same family as the valuable Ebony and Camagon. It resembles very closely Bolongeta (*Diospyros pilosanthera* Blanco). Ata-ata seldom forms more than 1 to 2 inches of the black heartwood which makes species of the ebony family valuable for cabinetwork. For construction purposes it is hard and strong. Ata-ata occurs throughout the forest in the lower dominated story. It is more numerous on the lower gentle slopes. It is a straight, well-formed tree, often slightly rectangular in cross section at the base. Its deep blue-black bark gives it a striking appearance in the forest. It reproduces well and endures heavy shade.

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[a] This tree is known in Manila markets as Sasalit, the common name for it in Zambales. In portions of Tayabas it is called Igang.

The following table shows the sizes and number of trees per acre and hectare of Dungula and Ata-ata:

TABLE XIII.—*Stand of Dungula and Ata-ata.*

[Average of 135 acres in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Number of trees per acre.		Number of trees per hectare.	
		Dungula.	Ata-ata.	Dungula.	Ata-ata.
Inches.	*Centmeters.*				
12	30	0.511	0.407	1.262	1.005
14	35	.385	.644	.950	1.590
16	40	.082	.289	.203	.714
18	45	.155	.178	.383	.439
20	50	.082	.059	.202	.146
22	55	.022	.029	.054	.072
24	60	.022	.0073	.054	.018
26	65	.0073	.....	.018	.....
28	70	.....	.....	.....	.....
30	75	.0073	.....	.018	.....
31	80	.0073	.....	.018	.....
33	85	.....	.0073	.....	.018
35	90	.....	.....	.....	.....
37	95	.....	.....	.....	.....
Total 40 centimeters and over		.3849	.5696	.950	1.407
Total 30 centimeters and over		1.2809	1.6206	3.162	4.002

Palma brava, or Anahao, is a very useful tree locally, although it reaches no large size. Its poles are used in house construction, usually split for flooring. Its large leaves are used extensively for thatching. It occurs generally on the moist slopes, but the better trees have been badly thinned out in the lower edge of the tract. Farther back it occurs in considerable amounts as a very tall, clear tree, up to 30 centimeters in diameter.

The minor species will be generally used in railroad and skid-road construction. Dungula, however, should be exploited and introduced into the market. As fast as investigation shows that any other of the minor species possesses a commercial value, it should be exploited by the company.

INJURIES TO WHICH THE FOREST IS LIABLE.

The forest is subject to damage from natural and artificial causes. To the former belongs the damage caused by insects, fungi, and winds; to the latter the damage caused by logging, fires, and caingins. The latter are by far the most important.

Damage from natural causes.—The amount and importance of the insect damage are not yet known. There is a beetle (*Crossotarsus* sp.) which bores into the log soon after the trees are felled, making it inadvisable to cut the trees more than a few days ahead of the skidding. The injury is greatest during the wet months of March and April. Since it is impossible to remove all the bark from the logs in the woods, peeling them immediately after cutting is ineffectual. It will always be necessary to remove the logs from the woods within a week after felling. The damage done by this insect appears in the lumber as small black pin holes.

Fungi, though useful in cleaning the forest, inflict great injury. The prevalent heart rot in the various species of Shorea is due to a number of fungi not yet determined. Apparently the spores of fungi enter through some injury in the tops of the trees. The disease then rapidly works down through the soft heart. Year by year the work continues, until the tree is only a hollow shell. All large trees of the genus *Shorea* are affected in this way to a certain extent. The only remedy now possible is to cut the diseased trees as soon as possible, thus removing the centers of infection and lessening the loss of timber. Since the entire tract is covered by mature timber almost equally damaged by this disease, the entire area should be logged off as soon as possible.

The damage from windfall is here negligible. The only trees observed blown down by the winds were overmature and diseased. Wind thus merely assists the ants, anay, and fungi in removing the dead trees from the forest.

Damage from artificial causes.—Forest fires in the untouched timber are impossible, because of the evergreen, moist character of the forest, and the lack of dry under-

growth and litter. In the cutting area after logging, however, there is considerable danger during the dry months of March and April, when the great quantity of tops and other débris is well dried out, that a fire will sweep through, destroying the reproduction and killing many of the remaining trees. Yet, even in the cuttings a fire must be set at the opportune time, with a favoring wind, in order to spread over any large area. A moderate degree of watchfulness will prevent accidental fires in the slash.

The principal and important injury to the forest is caused by caiñgins, or clearings. (Pls. III and IV.) Caiñgins are a system of shifting agriculture. They are small clearings, rarely exceeding 25 acres in area, made in timber or brush land by ignorant, irresponsible persons. The undergrowth, small trees, and some of the large trees are cut during the months of January, February, and March. In April, just before the spring rains, the dried mass is fired. If the weather has been favorable, the fire burns eagerly and leaves only charred trunks and stumps to hinder planting. Crops of corn, camotes, and sometimes tobacco are carelessly cultivated for one, two, or three years, until grass and other weeds make cultivation difficult. Then the auther of the caiñgin abandons it to find another spot in the forest in which to repeat the operation.

The problem of protecting the tract against this danger is made more difficult by the attitude of the owners of several sugar plantations adjacent to the northern boundary, who evidently encourage and inspire many of the clearings in the public forest, with the object of securing the land after it is abandoned by the authors of the caiñgins. Recently they have attempted to secure the land through homesteads made by persons dependent upon them. Where such applications have been made for land which is suitable for agriculture, and on which there is little or no merchantable timber, it has been certified as more valuable for agricultural than for forest purposes. In many cases, however, applicants for heavily timbered land have made clearings immediately after, if not before, making their applications and before receiving the approval or disapproval of their applications. In this way, much valuable and accessible timber within the tract granted the Insular Lumber Company has been destroyed. From this a difficult problem has arisen in regard to the land suitable for agriculture. On such lands covered with timber which will be exploited by the Insular Lumber Company, it is evident that homesteads should not be allowed until the timber has been removed, or should only be granted under the condition that no clearings be made until the land has been logged by that company. But if the applicants have entered the forest and made clearings on the land prior to its examination by the forest officer, there is then no reason why the homesteads should not be approved. The forest officer can, however, have the applicants punished for making the caiñgins without permission, but this will not affect the final disposition of the land nor compensate for the timber destroyed. This problem was met during the past year in heavily timbered land in block 7, adjoining a neighboring plantation.

The punishment of men making caiñgins without permission in the public forests, as provided in article 25 of the Forest Law, will not alone serve to remedy the evil. Imprisonment has no great terror for the offenders, and they are seldom able to pay the fines imposed. During the fiscal year 1905 about 300 acres of caiñgins were made in heavily timbered forest along the northern boundary of the tract, which destroyed about 7,000,000 feet B. M. of merchantable timber. Ten offenders were arrested and punished with from five to thirty-five days' imprisonment each, but no fines could be collected for the timber destroyed. On their release from prison they returned to their clearings, which they are now cultivating. It is absolutely necessary to protect this tract against caiñgins in order to initiate even the simplest plan of forest management and regulation. Prevention is the only means. This can be done by—

First. Marking and posting warning notices along the northern boundary line.

Second. Patrolling the forest where there is danger of caiñgins.

Third. Marking the boundaries of existing clearings within the tract to prevent their extension by means of caiñgins.

Fourth. Permitting caiñgins on the partially timbered land outside of the tract.

Injuries from logging are unavoidable. Small trees will be crushed in felling large ones, and seedlings will be destroyed. It is necessary, however, that care be taken to make this injury as small as possible. Damage from logging will be treated more fully under a succeeding heading.

THE UTILIZATION OF THE FOREST.

TIMBER.

History of lumbering.—Lumbering in northern Negros previous to 1903 was carried on in a desultory manner by the Spanish and Filipino licensees. They hauled the timber to the nearest streams by carabao, where the logs were made into rafts and

towed to the Iloilo market, about 70 miles distant. It is reported that fine Molave and Narra were obtained in Spanish times along the coast in Cadiz and Sagay. The forest of third and fourth group trees, which covered most of the area, was gradually pushed back to its present position. The timber of this forest has always been in disfavor with the Spaniards and Filipinos, and doubtless very little of it in the destroyed forest of this type was utilized.

Lumbering on the tract itself has a brief history. Previous to 1903 practically no timber had been exploited, except for local needs, although clearings had made inroads along the northern side. In 1903 a license to cut 100,000 cubic feet of timber in the sitio of Sanghai, on both sides of the Himugaan River, was granted to the Iloilo Electric Company. This company installed the present small circular-saw mill, having a capacity of about 15,000 feet B. M. per day, and a logging outfit of one donkey engine, wire cable, etc.

This preliminary and experimental operation, though not a financial success at the time, owing to the difficulty of introducing species against which the markets were prejudiced, and to floods which caused considerable damage to the mill and carried off many logs, nevertheless demonstrated to the satisfaction of the promoters that a large and modern plant, operated on American principles, would pay, and that steam logging was the best method to use in exploiting the large timber of this forest.

In 1904 the Insular Lumber Company, incorporated under the laws of the State of New York, took over the plant of the Iloilo Electric Company and secured the present concession under a license agreement to exploit the timber on the tract for a period of twenty years. In return, it bound itself to comply with certain cutting rules and other regulations. It was its intention to install at once a new mill, of 100,000 or 200,000 feet capacity per day, but various difficulties prevented its accomplishment until the present year. The new mill is now being installed and will be completed in the near future.

The Iloilo Electric Company and the Insular Lumber Company have logged off about 250 acres from July 1, 1903, to July 1, 1906, most of which was cut over by the latter company. In 1903–4 the former company manifested about 300,000 feet B. M., for which they paid about $1.33, gold, per 1,000 feet B. M. The Insular Lumber Company has manifested in the first two years of its existence about 1,770,000 feet B. M., for which it paid about $1.06, gold, per 1,000 feet B. M. This amount manifested does not include a large amount of lumber used in the construction of the plant and on which no Government charge has been imposed.

The discrepancy between the large area cut over and the relatively small amount of timber manifested is accounted for by the unusual waste in logging, by the small size of the mill, which could not handle the largest trees, by leaving the White Lauans standing over a large part of the area because it was not marketable, and by the fact that the company had the free use of timber for construction purposes on the tract during the past two years.

Present lumbering operations.—General conditions: Differences in climate, transportation, and labor, as well as in the timber, make successful lumbering in the Philippines more difficult than in the United States. The Insular Lumber Company, under able management, has been meeting these difficulties and has gradually overcome them.

A lumberman in the Philippines has to choose between locating his mill near the forest or in one of the large towns or markets. The larger mills are found in Manila. The five largest mills in the Islands are in Manila and have a total daily capacity of 100,000 feet B. M., although the actual amount cut is less than half the capacity. Transportation of logs and lumber is entirely by water, and for long distances logs or lumber are not rafted. Mills which purchase their logs in the market are better located in the cities. The Insular Lumber Company, however, having an almost unlimited supply of available timber and the necessary means to log it, and having a a deep, navigable river penetrating almost to its timber, rightly decided to place its mill on this river as close as possible to the forest and to ship the sawn lumber to Manila and the other markets.

The great size and weight of the timber on the tract made it necessary to employ some other system in logging than the ordinary native method. Carabaos are scarce and expensive, and, in addition, are unable to haul the largest logs. Steam skidding and hauling seemed the only method available. The forest is one easily logged. The configuration of the ground is favorable to steam skidding and railroad transportation. Roads can be built with much less grading and bridging than in the forests of western Washington. The hot climate is not a hindrance in the mill or woods, and during the rainy season logs are more easily skidded.

A sufficient supply of good native labor is essential for a large lumbering operation, like that of the Insular Lumber Company. Fortunately, it has located in a populous

region, where there is a laboring population employed on large sugar estates. Consequently the company has not encountered great difficulty in securing a force of about 80 Filipino workmen. The efficiency of the labor, judged by American standards, is low, but compared with similar labor in other parts of the Islands, stands high. The men work fairly steadily, are docile, and easily taught. Among them the company now has some who do very good work in the woods and in the sawmill. They are treated well, furnished with good frame houses without rent, and are paid about ₱0.50 per day. Those who become skilled in special work receive slightly higher wages. As the ordinary wage paid on the sugar estates is ₱1 to ₱1.50 per week, with food, the company has little difficulty in securing and keeping its native labor. It is a more difficult problem to obtain and keep skilled American labor, which has to be secured from the United States. Only high salaries will bring suitable American sawyers or loggers to this country, and even then they will not make long-time contracts.

Logging: This company and the Iloilo Electric Company have logged about 250 acres of forest land since August, 1903. The logging camp still stands at the place where cutting was first begun on the bank of the Himugaan River, less than 1 mile from the sawmill. The logs are hauled to this point and rolled over the steep bank to the river. A group of houses for the employees, a machine shop, and the hauling donkey engine are also located at this place. From the landing a hauling road extends 1 mile west into the forest, where the cutting is now going on.

The method used in logging is an exact copy of the steam logging system used in western Washington. (Pls. V, VI, VII, and VIII.) The outfit consists of one large hauling donkey, of about 50 horsepower, about 1 mile of 1-inch hauling cable, about 1 mile of three-fourths-inch haul-back cable, one skidding or yarding donkey of about 40 horsepower, over 2,000 feet of three-fourths-inch yarding cable, and the necessary blocks, hooks, rollers, chokers, cant hooks, axes, saws, etc.

The rollway or landing is the almost perpendicular river bank, here nearly 100 feet high—much higher than is necessary or desirable. From the hauling donkey stationed at the top (Pl. V) a nearly straight road, about 10 feet wide, has been made into the forest. This is carefully graded and has strong bridges over the few arroyos or gulleys. (Pl. VI.) Across the road, and about 6 feet apart and buried about one-half in the earth, are placed skids or sleepers, 8 feet long and 14 to 20 inches in diameter, notched at the middle to about the level of the ground. The timber is hauled over these skids. From this main road radiate short skid roads or trails not more than 1,000 feet long. These are simple dirt roads, without grading. The hauling cable from a drum on the engine at the rollway runs on the ground along the hauling road and over iron rollers where a turn in the road makes this necessary. At the end of the road, where the yarding donkey is set up (Pl. VII), the hauling cable passes through a block and returns as the haul-back cable to another drum on the engine. The yarding cable runs from the yarding engine in a similar manner into the forest over a skid road, through a block and back again. Parallel to these cables are wires connected with the whistles on the engines, by which signals are given to the engineers.

The trees are felled with ax and saw by fellers working in pairs. A staging is built of small poles to enable them to get above the large buttresses. (Pl. I.) A tree is notched on one side, sawed on the other, and wedged over, if necessary, until it falls. One felling crew of two men cuts three or four large trees per day. Other men then cut up the tree into logs 16 and 32 feet long, and occasionally 12, 18, 20, and 24 feet long. (Pl. VIII.) The logs are then nosed at one end, and if very large are barked on one side to make hauling easier. The skidding crew place a choker (noose of cable) around the log and fasten it to the end of the skidding cable, signal the skidding engine, and the log is pulled out and hauled to the main road. When several logs (usually two when the skids are dry, and four or more when they are wet) lie on the main road, they are coupled together by hooks or grabs driven into their ends and connected by cable. The head log is fastened to the hauling cable, the signal is given, and the train of logs, or turn, as it is called, moves down the road to the rollway, where the logs are rolled into the river and confined within a boom until they are floated to the mill. As soon as the logs are hauled in, the engine reverses and the haul-back line pulls the hauling cable back into the woods.

The method will be changed when the new logging railroad is completed. The engines will then haul directly to the railroad track, where the logs will be loaded on cars and taken to the mill. At present the logs are floated down the river to the mill at high tide. With the exception of Apitong, they all float well, but the danger from floods and lack of water in the dry season, as well as the constantly increasing distance of the forest from the river, make this method of transportation less satisfactory than a logging railroad, which can be built at a moderate cost.

The men employed in logging and their wages are as follows:

Americans (2):	
1 logging superintendent, per year	₱4,200.00
1 assistant ..... per day	4.00
Filipinos (42):	
1 foreman .... per day each	1.50
1 engineer ..... do	3.00
1 engineer ..... do	1.50
2 firemen ..... do	.50
1 subforeman ..... do	.60
Filipinos (42)—Continued.	
4 fellers .... per day each	₱0.65
6 buckers ..... do	.50
7 cable men ..... do	.50
1 sled tender ..... do	.50
4 woodcutters for the engines ..... per day each	.50
4 road builders ..... do	.50
10 water carriers for the engines ..... per day each	.50

(₱2=$1 United States currency.)

This amounts to a daily labor cost of about ₱45. The logging crew handles on an average from 5,000 to 10,000 board feet of logs per day.

The above method, which has been employed since the commencement of the operations, is being supplemented by a railroad which is now being installed. The road is equipped with two locomotives and twelve logging trucks or cars. The gauge is 3½ feet. The donkey engines and cable system will continue to be used, but will haul the logs to the railroad track instead of to the river bank. This will give a great increase in the daily output of logs.

Waste and injury to the forest: The area thus far logged has been cut over without much restriction or regulation. About one-half of it has been burned over and is now partly under sugar cane. The remainder is slash as it has been left by the company. Since it is agricultural land, to a large extent homesteaded, it will not be managed for a second timber crop.

The trees cut have been almost entirely the six principal species, with an occasional large specimen of some other kind. Few trees less than 50 centimeters (20 inches) in diameter have been cut, and many larger ones have not been removed. The largest trees have been left because the mill could not handle them. On part of the area the Almon and White Lauans were not cut, because at the time there was no demand for that kind of lumber. The following table shows the number of saplings, poles, and trees remaining on one-half hectare of cut-over land. Many small trees are lacking which were destroyed but not utilized during the logging.

TABLE XIV.—*Saplings and trees remaining on one-half hectare (1.23 acres) of cut-over land.*

Size.	Apitong.	Almon.	Mangachapuy.	Balacbacan.	Dungula.	Atata.	Guisocguisoc.	Other trees and shrubs.	Total.
Sapling	30	8	5	4	14	13	8	84	166
Small pole	5		4		8	1	2	8	28
Large pole	3				3	3	1	3	13
30 centimeters	1					1		1	3
35 centimeters	1								1
40 centimeters	1	1	2						4
45 centimeters			2						2
50 centimeters	2		1						3
55 centimeters			2					1	3
60 centimeters		1							1
115 centimeters			1						1
130 centimeters			1						1
Total	43	10	18	4	25	18	11	97	226

The logging makes a bad slashing. The tops and rotten logs of the large trees piled on the small trees crushed by their fall form a dense and almost hopeless mass of débris. Some of this is unavoidable, but care in felling the large trees and the utilization of as much of the timber as is possible will reduce the damage. Plates IX and X show pieces of good and bad slash. Fire in the cuttings during the dry months of March and April would be destructive to the young growth. Fire, however, does not run readily until the brush is thoroughly dry and the wind favorable. This condition

obtains only for a few days in March and April. Sometimes the friction of moving logs upon the skids causes fires which might spread to the cuttings.

There is considerable waste in the felling and cutting up of trees. The Filipino fellers are usually not trustworthy and must be watched. Occasionally they leave stumps much higher than is necessary. High stumps can not be entirely avoided, because of the difficulty in sawing swell-butted logs in the present mill. With a new band-saw mill, capable of handling logs of any size, the stump height should be reduced. The average stump height of 23 Mangachapuy trees felled during the past year is 9 feet (2.8 meters) and of 13 Apitong trees 4.2 feet (1.3 meters). Apitong is much less buttressed than Mangachapuy and is a smaller tree. It is unreasonable at present to require that the large buttresses be chopped through in felling the trees, but it is practicable to cut at the point where the principal buttresses end. In cutting the trees into logs, it is difficult to determine when defective ones will repay handling. In cases of doubt the tendency is to leave them in the woods. Defective top logs are much more doubtful than butt logs, being knotty and diseased around the knots, which injures nearly all boards in the logs. However, when the company has gone to the expense of building a logging railroad and setting up donkey engines and cable, it is to their interest to remove every possible stick of timber from the area. Clear logs, not more than 50 per cent defective, should repay the cost of handling. They would also assist in bearing the expense of building roads.

Little sound saw material which is not excessively knotty is left in the tops. As a general rule, the trunks of fairly sound trees are utilized up to the large limbs. More than this is impracticable at present, as there is little sale for knotty lumber. Much of this material in the tops would make boxes. It may be found profitable for the company to manufacture box boards, in which case much timber now wasted could be utilized.

Another source of waste is the fuel used by the engines. This is usually secured from defective logs, which are hauled in and cut up into firewood. The tendency is to use logs which would be more valuable for lumber. Care should be taken to use no logs for this purpose which contain 50 per cent or more of good material.

A large number of trees are necessarily used for the construction of roads and bridges. One mile of hauling road requires over 100,000 feet B. M. for skids alone. Large amounts in the future will be necessary for ties, bridge timbers, etc. At present, Apitong, Ata-ata, and small trees of the principal species are used. Unmarketable trees and tops of felled trees, as far as possible, should be used for construction work, except on land which is to be cleared for agriculture, where small trees of all kinds can be used.

Logging does injury to the small trees and reproduction, which are to be the basis of the future forest. The large and overmature trees should be cut out to give the young growth an opportunity to take their places. Consequently, the logging must not destroy more than is necessary of the small growth. Much of this damage is unavoidable. The fellers, however, can be shown how to drop the trees where the damage will be least.

The sawmill: The present sawmill is located on the right bank of the Himugaan River, about 6 miles from its mouth and about 1 mile north of the logging operation, which is on the opposite side of the river. The location is at the head of navigation for small steamers, although high tide reaches nearly 2 miles farther up. The mill stands on the river bank, jutting slightly over the water. (Pls. XI and XII.) From the mill a short tramroad runs to the lumber yard, directly in front of which is the dock. (Pl. XI.) Surrounding the yards are the office and quarters of the employees. The mill is operated by a steam engine and is equipped with a circular saw, a top saw, a simple edger and trimmer, and a saw-filing machine.

The logs are boomed just below the mill in the river and are brought up into the mill by a bull wheel and cable. They are then rolled on to the carriage by a chain and drum operated by the engine. The carriage is run by friction feed. The logs are sawn slowly and carefully. The sawn lumber passes to the edger on dead rollers, is lifted by men to the trimmers and from there to the truck, which bears it to the yard. The principal species cut present no great difficulties in sawing. Apitong is much harder on the saws than the others. The waste is large, owing not only to the defective character of the timber but also to the inadequacy of the mill and the unskilled labor at the edger and trimmer. The standard length of logs is 16 feet, but some 12, 14, and 18 foot logs are cut. The lumber is cut mostly in 1 and 2 inch thicknesses, with some 2 by 4's and special sizes. It is piled in the yard without cover other than a few boards, and without grading except by species and thickness. Most of it is shipped green to Manila, as the demand is greater than the supply. It is all clear lumber, and with careful

grading and seasoning its quality would be much improved. The mill has been subject to some shut downs, owing to floods, breakage, and lack of logs. The following is the average operating pay roll at the sawmill:

Americans (3):	
1 sawyer.....per year..	₱4,000.00
1 bookkeeper. per month..	150.00
1 setter.....per day..	4.00
Filipinos (28):	
1 dogger....per day each..	1.00
1 dogger..... do....	.65
1 engineer .....do....	2.00
1 fireman.....do....	.60
1 fireman's helper...do....	.50
1 offbearer .....do....	.50
1 offbearer's helper .do....	.50
2 men sawing logs in the water.... per day each..	.50
Filipinos (28)—Continued.	
2 men hauling logs into mill, per day each.....	₱0.50
2 edgers.....per day each ..	.75
2 trimmers.....do....	.50
2 men loading trucks, per day each	.50
1 man removing sawdust, per day each	.50
8 yard men, per day each..	.50
2 watchmen, per month each	15.00

₱2=$1 United States currency.

This is a daily labor cost of about ₱42.

Cost of lumbering: The estimated cost of logging and manufacturing lumber on this tract is only approximate and is intended as an indication of what can reasonably be expected under fair management.

The following is the cost per 1,000 feet B. M. of the lumber delivered in Manila, including deterioration, repairs, and interest on the investment at 10 per cent:

Cutting and hauling logs to the river	₱7.00
Floating logs to the mill	.30
Sawing and piling in the yards	6.00
Loading on barges at the dock	.40
Freight to Manila (about 400 miles)	10.00
Lighterage in Manila	2.00
Salaries of higher officials	9.00
Average Government charge, or stumpage	2.50
Total	37.20

It is certain that with a thoroughly modern mill and a logging railroad, which the company is now putting in, the cost per 1,000 feet will be reduced much below the above figure. Perhaps the pay rolls given above and the freight and Government stumpage charge will indicate better to lumbermen what the cost should be.

Markets and transportation: The markets for the lumber are the cities of Manila, Cebu, and Iloilo. The distance by water to Manila is about 400 statute miles, to Cebu about 140 miles, and to Iloilo about 70 miles. Very little lumber can be sold locally or outside of those towns. Manila is the chief market. In the past two years the company has sold about 1,300,000 feet B. M. of timber in Manila, 190,000 feet B. M. in Cebu, and 275,000 feet B. M. in Iloilo. About 7,300 feet B. M. only were sold to local consumers. At the beginning there was difficulty in selling large shipments of lumber because of the prejudice against Lauan. The demand has slowly increased until now what is known as Red Lauan is taken in large quantities, and the White Lauan finds a fair sale. Its principal competitor is Oregon Pine, which is about equally good for most purposes, and sells in Manila for about ₱75 per 1,000 feet B. M. The Insular Lumber Company should be able to manufacture their lumber and deliver it in Manila at a price which would gradually drive out the Oregon Pine. Manila would at the present time use 100,000 feet B. M. per day if it were available. It is possible that some of the clearest and best Balacbacan and Red Lauan can be exported, possibly to the United States. A small lot was shipped to New York, where it was received with favor.

Transportation of lumber is by water. Freight to Manila in barges (Pl. XI) towed by a small steamer is ₱10 per 1,000 feet B. M. To Iloilo and Cebu in lorchas the freight rate is about the same.

Prices and government charges: In the Philippine Islands the government charges for timber are usually levied on round logs. For timber cut in the province of Negros Occidental they are ₱2.50 per cubic meter for first-group timber, ₱1.50 for second group, ₱1 for third group, and ₱0.50 for fourth group, which is equivalent to about ₱10, ₱6, ₱4, and ₱2, respectively, per 1,000 feet B. M. In the license agreement with the Insular Lumber Company, however, provision is made that the charges be paid on the sawn lumber, plus 15 per cent for loss in sawing. Since the loss in sawing

is more than 15 per cent, the company has profited by the arrangement, as is shown by the following figures of cost per 1,000 feet B. M. of the sawn lumber. The timber cut by the Insular Lumber Company is almost exclusively of the third and fourth group. In the fiscal year 1904-5 they paid an average price of ₱0.64 per cubic meter, or ₱1.76 per 1,000 feet B. M., and in 1905-6 ₱0.87 per cubic meter, or ₱2.37 per 1,000 feet B. M. As the company receives on an average of more than ₱60 per 1,000 feet B. M. for their lumber in Manila, the above stumpage charges are low.

Prospects: It is apparent from the above that a modern lumber enterprise on this tract ought to be successful. Believing this, the Insular Lumber Company is now increasing its equipment and making improvements. A new modern double mill is being built, which will have a capacity of 100,000 feet B. M. per day. It will be equipped with a 9-foot wheel and 13-inch band saws. The logging railroad is already completed from the mill to the timber and will soon be in operation. The company is ready to install a tie-impregnating plant just as soon as it can make contracts with the new railroads to take the output. Profiting by the experience of the past two years, the company will put capable men in charge and will use every effort to make the operation as efficient as any similar one in the United States. Rightly conducted, the enterprise should pay a handsome profit, at the same time furnishing lumber to the people of the islands at prices lower than that of Oregon Pine. The railroad, which will soon be built with government aid in Negros Occidental from Escalante to Binalbagan or Ilog, will pass close to this tract, if it does not go through its lower side. The new railroad will naturally benefit the Insular Lumber Company by furnishing a market for railroad ties and construction timber and by making available the local markets of the province of Negros Occidental.

MINOR FOREST PRODUCTS.

Various minor forest products are collected on the tract by the inhabitants of this region. Chief of these is bejuco (rattan), which occurs throughout the concession. It is now rather scarce near the edge of the forest and in the more accessible parts of the tract, owing to the long-continued custom of collecting this product. To obtain good bejuco, it is now necessary to go 5 to 10 miles into the forest, although small specimens are abundant everywhere. The demand for the bejuco is strong in the sugar haciendas and towns of Negros, where its principal use is for tying up sacks of sugar. The prices are such as repay the collector, who usually builds a house in a good situation in the forest, and with the help of a few natives, Visayans or Negritos, collects the bejucos, putting them up in small bundles of 100 pieces, ten of which form large bundles, which are then carried out by men or carabaos. Three such camps were found on the tract. In addition, many persons enter the tract for a day or two to take bejuco for their personal use. The best bejucos on the tract are Gatasan, Yaming, Lontoc, and Calape. Split bejucos, used in tying up sacks of sugar, are worth ₱1.50 per 1,000; entire bejucos, 8 meters long, used in binding rafts, ₱15 per 100. Long bejucos for special purposes bring high prices.

Balao, the pitch obtained from the Apitong tree by a destructive system of boxing, heretofore described, has for some years been collected on the tract. It is a dirty-gray pitch, used locally to make torches and commercially to calk boats. Its value in Cadiz is from ₱0.50 to ₱0.75 per 5-gallon can. It is doubtful if one tree yields more than one such can per year under the present method of collecting. The product does not compensate for the damage done to the tree. Until a less injurious method of tapping the Apitong is devised, the collection of balao on the tract should be prohibited.

Two vines, Jagnaya and Sigid, which are collected to a limited extent, occur on the tract. They are small, about 1 centimeter in diameter, long, and very strong. They are used almost exclusively in the construction of fish corrals, and are worth in Cadiz from ₱0.60 to ₱0.70 per 1,000.

The firewood possibilities of the concession at present are small. Neighboring sugar haciendas use considerable wood for fuel, but prefer to get it from the mangrove swamps, or, if from the mountain forest, to cut it themselves. Neither is it probable that firewood cut on the tract can be shipped to the large towns of the islands in competition with the mangrove product.

The forest has few other minor products. There are scattered trees which yield gums and resins, but none of them occur in sufficient numbers to be of any commercial importance.

Minor products are not included in the concession granted to the Insular Lumber Company. With the exception of balao, they can best be utilized in satisfying the needs of the surrounding population. Consequently, no special recommendations are made for the regulation of their collection.

AGRICULTURAL POSSIBILILIES OF THE LAND.

Cleared land adjoining the tract, which has the same soil and general characteristics of the more level parts of the forest, is giving good results in agriculture. Sugar cane, hemp, and corn are the principal crops, all of which do well, although the sugar made from cane grown on this soil is discolored, and does not bring the best prices. For sugar cane the land is called third class. Corn grows well, and is the chief product of the poor people. At the present the price of the land is low. Probably considerable areas now covered by cogon grass and brush can be bought at less than ₱20 per hectare.

There are many acres of land on the tract suitable for corn, and a smaller area would give good results in sugar cane. About 300 acres in the northwest corner and in the valley of the Himugaan River are now under cultivation. The exact area of the tract which is better for agricultural uses after being lumbered is not definitely known. There are probably about 10,000 acres which would be classed as agricultural land, of which about 4,500 acres are either cleared or covered with brush. The largest single area of good agricultural land is in block 7, east of the Himugaan River. All of such land is confined to the northern side of the tract. The upper hilly portion is more valuable for forest than for agricultural purposes.

There is a strong desire for the land among the neighboring people. Often, however, they use poor judgment in selecting their clearings, choosing rough, stony places, when rich level land is available. Land suitable for agriculture should be given to the people for homesteads after it has been logged by the company.

Part II.

FUTURE MANAGEMENT.

BASIS OF PROPOSALS.

RELATION BETWEEN OWNER AND LICENSEE.

The owner of this tract of timber land is the government of the Philippine Islands. In order to secure a revenue from the heavy stand of timber which is balanced between growth and decay, a license agreement was made with the Insular Lumber Company, permitting that company, under restrictions, to exploit timber on the tract for a period of twenty years. The government requires that this be done without endangering the future supply of timber from the same forests, unless the land is more suitable for agricultural than for forest purposes, in which case the most benefit will be derived from its use for agriculture. On agricultural land the company should remove the greatest possible amount of merchantable timber before it is turned over to the farmer. On true forest land, which includes most of the tract, they should leave a sufficient number of trees to provide for the future stand and exercise care in the logging in order to prevent the destruction of an unnecessary amount of reproduction and small trees.

The company, on the other hand, must make their enterprise yield a considerable profit in order to repay them for the risk in establishing a modern lumbering operation in a tropical country, where there is no experience of others to assist them in avoiding disastrous mistakes. They have invested a large capital in the enterprise, setting an admirable example for those contemplating entering the lumber business in the Philippine Islands. Consequently many sylvic restrictions suitable and beneficial to the forest can not be imposed without excessive hardship to the company. The restrictions and regulations should be practicable, with due regard for the interests of both the government and the licensee.

DIVISION OF THE FOREST INTO BLOCKS.

To facilitate the management and protection of the forest, and to make the description of places on the tract more concise and definite, the tract is divided into eight parts or blocks, which are bounded by the important streams. They are shown on the map and described as follows:

TABLE XV.—*Description of blocks.*

Block.	Situation.	Approximate area.		Remarks.
		Hectares.	Acres.	
1	Southwest corner of the tract between the Talabon River and the boundary.	1,400	3,450	Hilly land; all heavily timbered.
2	Between the Hitalon and Talabon rivers.	1,800	4,450	Rolling and hilly land; considerable area of grass and brush land; contains barrio of Mabini.
3	Between the Panicion and Hitalon rivers.	2,100	5,150	Rolling and hilly land, mostly heavily timbered; some agricultural land.
4	Between the Pioc and Himugaan rivers on the east and the Panicion River on the west.	1,600	3,950	Rolling and hilly upland and some bottom land; clearings, cultivated land, and present cutting area near Himugaan River.
5	Between the Iglumgum and the Malugo rivers on the east and the Pioc River on the west.	1,200	2,950	Rolling and hilly land, mostly heavily timbered; little agricultural land.
6	Between the Himugaan and the Iglumgum rivers.	3,600	8,890	Do.
7	Between the Tanao and Himugaan rivers.	4,400	10,850	Rolling and hilly land, heavily timbered; large area of agricultural land.
8	East end of the tract between the boundary and the Tanao River.	1,900	4,700	Rolling and hilly land, heavily timbered.
	Total	18,000	44,390	

These blocks will furnish a useful basis for future investigations on the tract. The logging operations will probably be confined to blocks 3, 4, and 6 for several years, and consequently should receive as soon as possible a more careful and detailed study than has yet been given to them.

The principal trails in the forest have been surveyed and marks have been placed on them every one-half kilometer from their starting points. Each trail is given a letter--for example, 2 KC means that the mark is on Trail C, 2 kilometers from its beginning. The trails and their marks are on the forest maps. Places in the forest can be located easily and definitely. If a clump of large Apitong trees is discovered, one will pace to the nearest trail, down the trail to the first survey mark, and will then describe the location of the Apitong as follows: Block 4, B. F. 3 KC., S. W. 200 m., S. E. 300 m. The place is then definitely located with few words and can be marked accurately on the forest map. This method of description will be used by forest officers for future work on the tract.

SUMMARY OF MERCHANTABLE STAND AND YIELD.

The following is a summary of the number of merchantable trees and of the merchantable yield of the six principal species above 40 centimeters (16 inches) and 50 centimeters (20 inches) in diameter, respectively:

Diameter.	Stand.		Yield.	
	Number of trees per acre.	Number of trees per hectare.	Feet, board measure, per acre.	Cubic meters per hectare.
40 centimeters	29.4	72.6	33,450	288.5
50 centimeters	22.3	55.1	32,050	265.9

METHOD OF TREATMENT.

OBJECT TO BE ATTAINED.

The object to be attained is to make the best use of the land and forest by securing the largest possible yield from the latter without inflicting hardship upon the licensee or endangering a future timber crop on the forest land, and by putting the agricultural land to its best use.

METHOD OF TREATMENT ADOPTED.

It is evident that agricultural and nonagricultural lands must receive different treatment. The former will be turned over to the farmer after being logged; the latter will be kept in forest to provide for a future yield.

Agricultural land now covered with merchantable forest will be treated as nearly as possible under a clear cutting system—that is, all merchantable trees will be cut for lumber and as many of the unmerchantable trees as possible for road construction. No care need be taken to protect the reproduction, as the land will be immediately cleared for agriculture. The essential requirement is that no merchantable timber be left on the land. As the logging proceeds, the boundaries of the agricultural land must be determined.

Nonagricultural or forest land will be treated under the selection system, with a continuous yield of the six principal species in view. Care must be taken to leave sufficient small trees and reproduction to provide for the future yield. No provision is advisable at present for a regular rotation and sustained annual yield.

EXPLOITABLE SIZE.

On agricultural land, all trees are exploitable.

On forest land, none of the six principal species must be cut below a certain diameter limit. The diameter limit must be fixed so there will be sufficient seed trees and young growth to secure a good stand of the desired species. There should be as many trees as possible left standing without seriously affecting the merchantable yield. With a diameter limit of 40 centimeters (16 inches) there is a yield of about 33,450 feet B. M. per acre, leaving 28.1 trees per acre 12 to 40 centimeters in diameter. With a diameter limit of 50 centimeters (20 inches), there is a yield of about 32,050 feet B. M. per acre, leaving 35.3 small trees per acre 12 to 50 centimeters in diameter. Cutting to a 50-centimeter limit instead of to a 40-centimeter limit, there is a loss in yield of 1,400 feet B. M. per acre, or 4 per cent, and a gain in small trees of 7.2 per acre, or 25 per cent. The 50-centimeter diameter limit is clearly the better. Moreover, trees below 40 centimeters in diameter would probably not seed well, while trees between 40 and 50 centimeters in diameter would produce considerable seed under the influence of increased light and space. Since a part of the small growth is unavoidably destroyed by the logging, it is all the more necessary to fix the diameter limit higher than 40 centimeters. The company has, however, shown little desire to exploit the trees between 40 and 50 centimeters in diameter, using them only in road construction. Therefore, a 50-centimeter diameter limit will be found practicable. Whether it is sufficiently high to provide for a satisfactory second crop is not certain. It is proposed as a provisional diameter limit until that fact is learned.

THE LOGGING.

Cutting areas.—The areas chosen by the company for exploitation should be selected with the approval of the Bureau of Forestry, to avoid leaving uncut exposed strips of forest. The cutting should proceed as regularly and compactly as possible. It is not deemed advisable, in view of the condition of the forest and other factors, to place any restrictions upon the size of the annual cutting area.

General cutting rules.—The following cutting rules shall apply to both agricultural and forest lands.

(1) All felling and cutting shall be done with saws as far as possible.

(2) No trees shall be left lodged in the process of felling.

(3) No stumps shall be higher than the principal buttresses.

(4) Defective logs containing 50 per cent or more clear, sound lumber shall be utilized for lumber.

(5) No logs containing 50 per cent or more clear, sound lumber shall be used as fuel for the engines.

(6) No sound logs in the tops of the trees 8 feet and over in length and over 15 inches in diameter shall be left in the woods.

(7) Excessive quantities of timber cut for construction purposes in the forest and wasted shall be manifested and paid for by the company.

(8) Timber wasted in violation of the cutting rules shall be measured by the forest officers and paid for by the company.

Additional cutting rules for agricultural land.—(1) Agricultural land shall, as far as possible, be the first to be logged.

(2) All merchantable trees of the six principal species 40 centimeters (16 inches) and over in diameter shall be cut for lumber.

(3) For construction purposes in logging, trees of the minor species and unmerchantable trees of the principal species only shall be used.

(4) Small trees broken down by the large trees in felling shall be utilized.

(5) The railroad ties and skids for use in logging on the forest land shall be taken from the agricultural land whenever possible.

Additional cutting rules for forest land.—(1) No Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican, or Lauan-dunlog trees less than 50 centimeters (20 inches) in diameter shall be cut unless they stand in a proposed road, interfering with the logging, unless they have been damaged by the logging, or unless they have been selected for felling by the forester in charge of the district.

(2) No Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican, or Lauan-dunlog trees less than 50 centimeters (20 inches) in diameter shall be used in road or bridge construction unless they stand in a place interfering with the logging, where their removal is necessary.

(3) The workmen must not destroy seedlings or saplings of Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican, and Lauan-dunlog.

(4) Care must be taken to prevent fires on the cut-over land during the dry season.

SUPPLEMENTARY RECOMMENDATIONS.

GENERAL MANAGEMENT.

(1) The forest adjoining the tract on the north, which is especially liable to destruction by cainñgins, should be logged as soon as possible by the company under yearly license.

(2) The areas to be logged shall be selected by the company, after securing the approval of the bureau of forestry.

(3) Cut-over land suitable for agriculture shall be immediately opened to homestead entry.

(4) The boxing or tapping of the Apitong tree for balao shall be prohibited on the tract.

(5) The species of timber manufactured by the company shall be classified in the timber groups to which they properly belong as soon as possible.

(6) The company shall sell manufactured lumber to the residents of the municipalities of Cadiz, Sagay, and Escalante at prices which shall never exceed the wholesale price in Manila, less freight and lighterage.

(7) A ranger employed by the bureau of forestry shall be stationed permanently on the concession, whose duties shall be to protect the forest from cainñgins and trespass, to inspect the lumbering operations, and to make forest investigations under the direction of the chief of the forest district.

(8) The stumpage charges will continue to be paid on the manufactured lumber.

PROTECTION.

In order to put the above plan into effect, the forest must be protected before as well as after it is logged. The destruction of standing timber is a loss to the Government as well as to the company, but the loss to the latter is more serious, since such destruction is here confined to the most accessible part of the tract, where the profits from lumbering are correspondingly greater. The production of the future timber crop can not be provided for without protection of the forest, nor can sylvic restrictions be imposed on the company. The necessity and difficulty of protection against cainñgins have been shown in Part I. The benefits of protection being mutual, the company should cooperate with the bureau of forestry in carrying out the necessary measures.

The problem is to prevent the cainñgins, because after the damage is done there is no remedy. The following measures are necessary:

(1) The ranger of the bureau of forestry stationed on the concession shall engage himself principally with its protection.

(2) The company shall provide him with the necessary assistance to make his work effective.

(3) The ranger shall patrol the concession thoroughly and prevent cainñgins by means of warnings, and arrests if necessary.

(4) The northern boundary of the tract shall be surveyed and marked. Every one-half kilometer a painted board marked with the letters B. F. and the number of kilometers from the starting point should be nailed to a tree. Where trails cross the boundary, warning notices in the Visayan dialect should be posted, stating that cainñgins are prohibited on the tract and that permission to collect forest products must be obtained from the ranger in charge.

(5) The cleared lands within the tract bordering on or surrounded by forest shall be surveyed and marked in order to prevent their extension.

(6) Residents of the towns within which the tract is situated who desire to collect forest products for personal use shall obtain a written permission from the ranger in charge. Permission should be granted in all such cases, except for balao.

It is believed that the above measures are practicable and will in a short time bring the cainĝins under control.

REVISION.

This is a preliminary working plan, therefore it will naturally be found inadequate in many ways, and shall be amended from time to time.

ADMINISTRATION.

The forest officers who shall be charged with the administration of the plan shall be the forester in charge of district No. 8 and the ranger stationed permanently on the tract. Action taken by them to enforce the provisions of the plan shall be reported to the director of forestry for approval.

The forester in charge of district No. 8 shall have general supervision of the tract and shall make frequent inspections. The ranger stationed on the tract shall have immediate supervision, under the direction of the forester. In matters relating to the protection of the forest from fires and trespass, he shall take the necessary action, promptly reporting the facts to the forester. In matters concerning the compliance of the Insular Lumber Company with the provisions of the working plan, the ranger shall note the facts and report them to the forester. The forester will investigate and, if possible, arrange the matter with the representatives of the company, reporting the results to the director of forestry. New regulations and amendments to existing regulations shall be recommended by the forester to the director of forestry. The forest officers shall assist the company with information regarding the tract, which they have collected in their investigations. Every effort consistent with the wise use of the forest products on the tract should be made by the forest officers to assist the company in making this enterprise a financial success.

The sections relating to cutting rules, management, and administration have been submitted by the director of forestry to the Insular Lumber Company for suggestions, and after a discussion of a few features of the working plan, the sections mentioned were, after slight modifications, agreed upon.

Appendix.

LIST OF TREE SPECIES.

The following is a list of tree species mentioned in the text and includes, among others, all the commercial species found in merchantable quantities. Botanical specimens of about seventy tree species were collected. While the data at hand is too incomplete to make an estimate of the total number of tree species on the area, yet compared with other forests in the Philippines already examined, this one has a comparatively simple floristic composition. On the other hand, contrasted with the average hardwood forest of the Temperate Zone, it is more complex. It will be seen from the stand and yield tables that the six species of *Dipterocarpaceæ* are so far ahead of all others, both in number of trees and bulk of wood, that this may be regarded as a pure Dipterocarp forest. From a lumberman's standpoint, the yield of timber in this forest is equal to, or exceeds, the best American hardwood forest, and compares favorably with the best coniferous forests of the eastern United States.

At present there is much confusion among the commercial timbers in the Philippines which can not be avoided until more is known about them. A number of species are placed on the market under one name, and sometimes the same species has several different market names. For the sake of comparison, the fourth column of the list gives the known names under which the species are sold in the Manila market.

The authors wish to express their thanks to Elmer D. Merrill, botanist, bureau of science, for assistance in the identification of the botanical material.

List of the species mentioned in the text.

Scientific name.	Family.	Local common name.	Commercial name.
Astronia cumingiana Vid	Melastomaceæ		
Breynia rhamnoides Muell-Arg	Euphorbiaceæ	Tulug-tulug	
Canarium sp	Burseraceæ	Moabog	
Diospyros sp	Ebenaceæ	Ata-ata	Bolongeta.
Dipterocarpus grandiflorus Blanco	Dipterocarpaceæ	Apitong	Apitong.
Eugenia sp	Myrtaceæ	Bulog	
Ficus hauili Blanco	Moraceæ	Lalnug	
Homalanthus populneus Pax	Euphorbiaceæ	Balanti	
Hopea philippinensis Dyer	Dipterocarpaceæ	Guisoc-guisoc	
Kayea sp	Guttiferæ		
Livistona sp	Palmæ	Anahao	Palma brava.
Mallotus ricinoides Muell-Arg	Euphorbiaceæ	Himlaamo	
Oncosperma sp	Palmæ		
Pandanus sp	Pandanaceæ	Pandan	
Pinanga sp	Palmæ		
Psidium guayava L	Myrtaceæ	Bayabas	
Shorea contorta Vid	Dipterocarpaceæ	Lauan-dunlog	White Lauan.
Shorea polysperma Merr	do	Balacbacan	Balacbacan, Tanguile, Red Lauan.
Shorea sp	do	Mangachapuy	Red Lauan, Balacbacan.
Do	do	Lauan-bagtican	White Lauan.
Shorea squamata Dyer	do	Almon	Do.
Trema amboinensis Blume	Tiliaceæ	Janagdon	
Vitex aherniana Merr	Verbenaceæ	Dungula	Sasalit.

BUREAU OF FORESTRY.

(Bulletin No. 6.)

A PRELIMINARY WORKING PLAN FOR THE PUBLIC FOREST TRACT OF THE MINDORO LUMBER AND LOGGING COMPANY, BONGABON, MINDORO, P. I.[a]

By MELVIN L. MERRITT, *forester, in charge of forest district No. 5*, and H. N. WHITFORD, Ph. D. *forester, chief of the division of forest products.*

LETTER OF TRANSMITTAL.

MANILA, *November 5, 1906.*

SIR: I have the honor to submit herewith a manuscript entitled "A Preliminary Working Plan for the Public Forest Tract of the Mindoro Lumber and Logging Company, Bongabon, Mindoro, P. I.," by Melvin L. Merritt, forester, in charge of forest district No. 5, and H. N. Whitford, Ph. D., forester, chief of the division of forest products, and respectfully recommend its publication as Bulletin No. 6.

Very respectfully,

GEORGE P. AHERN,
Director of Forestry.

The ACTING SECRETARY OF THE INTERIOR, *Manila, P. I.*

A PRELIMINARY WORKING PLAN FOR THE PUBLIC FOREST TRACT OF THE MINDORO LUMBER AND LOGGING COMPANY, BONGABON RIVER, MINDORO, P. I.

INTRODUCTION.

The territory with which this report deals is held under a twenty-year license agreement by the Mindoro Lumber and Logging Company. This agreement, dated July 3, 1905, gives it "exclusive right to cut, collect, and remove timber, firewood, and bejuco" from the part of the public forest later described, on the condition that it complies with the rules and regulations of the bureau of forestry in cutting, collecting, and removing said forest products.

The work upon which this report is based was undertaken for the purpose of forming a preliminary plan of management to be put into operation, pending more complete investigation. Hence the present plan must be looked upon merely as provisional and subject to change when more definite information is obtained.

The field work was done by a party consisting of two foresters, one assistant forester, two native rangers, and from two to nine native laborers, working for a period of over four months. The tract was inspected, surveyed, and mapped, and notes were taken on the distribution of the different types of vegetation. Valuation surveys were then

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[a] The following illustrations accompanying this report have been omitted and are on file in the War Department:

Plate I. Interior view of the Hagachac forest. II. General view of the Narra forest type. III. Interior view of a Narra forest. IV. View of the beach forest type. V. Agoho growing along the Bongabon River. VI. View of a Calaanan forest. VII. Interior view of a Mangrove swamp. VIII. Narra. IX. Stump of Narra. X. Hagachac. XI. A young tree of Lauan. XII. Reproduction of Lauan. XIII. A young tree of Guijo. XIV. Apitong.

Map of public forest tract between the Sucol and Uasig rivers, Mindoro, P. I., operated under a twenty-year license agreement by the Mindoro Lumber and Logging Company.

made over approximately 2 per cent of the better part of the forest. The trees were calipered and listed on strips 10 meters wide along lines 500 meters apart. Owing to the poor condition of the rest of the forest, and to lack of time, the remainder of the tract was investigated more hurriedly. While engaged in this survey an extensive botanical collection was made, which is the basis of the scientific nomenclature of this paper.

Part I.

STATEMENT OF THE FACTS UPON WHICH THE WORKING PLAN IS BASED.

GENERAL DESCRIPTION OF THE TRACT.

SITUATION AND AREA.

The tract of land examined lies upon the east coast of the island of Mindoro, just north of the twelfth parallel of north latitude and east of the one hundred and twenty-first meridian east of Greenwich. The whole tract contains an area of about 85 square miles, while the part surveyed and examined includes approximately 55 square miles.

BOUNDARIES.

According to the terms of the license agreement, the tract is bounded as follows: "From the Sucol River south to the Uasig River, and 10 miles inland." Upon ascending the Sucol River it was found that the native name is changed to Inuman after a short distance, therefore this river has been taken as the north boundary. A short distance inland the Uasig River divides into two branches, a large one known as the Baroc, and a small, nearly dry stream called the Uasig. No investigations were made south of the Baroc branch.

PHYSIOGRAPHY.

As may be seen on the map, the part examined is more or less triangular in shape, having its broadest side toward the coast. Starting at sea level, the land rises slowly and evenly as a broad, flat plain until about 7 miles (11 kilometers) inland it reaches an altitude of nearly 30 meters (100 feet). Here are found a few scattering hills, although the country is still quite level for a short distance more, especially along the Boñgabon River. Back from this flat the foothills rise quickly into the broad and high mountain chain which runs north and south through Mindoro. To the south of the tract the foothills extend almost to the coast. To the north a low and less clearly defined range of hills reach nearly to the beach at a point about 4 miles north of the Sucol River.

The whole territory is drained mainly by the Boñgabon, Dangay, and Uasig rivers, all of which have rapid currents. The Boñgabon River is the largest of these and flows through a grassy flood plain about half a mile wide. During the wet season this valley is often flooded and the river is practically impassible. At such times there is an abundance of water for rafting, but the rapid current, which extends far out to sea, would necessitate very strong booms at the mouth of the river to stop logs. The Dangay and Uasig rivers are smaller and flow through tidal swamps which check their currents. The former could probably be utilized for floating logs for a short distance from its mouth. The Uasig (Baroc) River could also be used in this way a long distance into the interior during the heavy rains, as the river bed is quite free from obstructions.

GEOLOGICAL FORMATION AND SOIL.

The entire flat is probably of delta origin, having been formed by the action of the Boñgabon River. During this formative period there were a number of uplifts that have changed the shore line and the river course from time to time, resulting in the origin of different physiographic units. Corresponding to these there are distinct vegetative types which are adapted to the physical conditions of the topographic units upon which they are found.

The soil is, in general, a deep, fine clay, covered with a thin layer of humus. No underlying rock was found on the flats, although examinations were made in many places from 1 to 2 meters in depth. In the valley of the Bayangan River there is a subsoil of sand or sandy gravel at a depth of from 75 centimeters (30 inches) to 150

centimeters (59 inches) which appears to be more or less continuous. A more shallow sandy subsoil was also found north of the Boñgabon River on the grassy and poorly wooded flats. In almost all places the soil is rich and suitable for agriculture.

CLIMATE.

Formerly no records either of rainfall or temperature had been taken in Mindoro. The rainfall, however, is heavy and more or less distributed throughout the year. The period of heaviest rain comes during the months of July, August, September, and October, while the lightest is during January, February, March, and April. Notes regarding the rainfall, which were kept from January 16 to March 31, show the following number of rainy days:

Date.	Number of days with heavy rainfall.	Number of days with light rainfall.	Date.	Number of days with heavy rainfall.	Number of days with light rainfall.
January 16 to 31	2	5	March 1 to 14	3	6
February 1 to 14	0	1	March 15 to 31	0	4
February 15 to 28	0	0			

The coolest months are from September to February and the warmest from March to June. Although the warmest months are normally the driest, the northeast monsoon which prevails at this season brings some rain and moderates the heat.

ROADS AND TRAILS.

Extending from the beach just south of the Cauayan River to the sawmill of the company, about 1½ miles inland, there is a logging tramway, made with wooden rails laid upon cross-ties. Aside from this one tramroad there are only rude trails running through the tract. Nearly all of these are passable for horses or carabaos, although some are merely footpaths through the woods. With the exception of a few rude structures, made only for foot passengers, there are no bridges on the tract.

None of the present trails would be of any value in lumbering except for the passage of laborers and carabaos. All logging roads must be built especially for that purpose. This, however, is easily done outside of the swamps, it only being necessary to clear away the brush and small trees. All such roads are good during the dry and many of them fairly good in the wet season.

SOCIAL AND ECONOMIC CONDITIONS.

According to the last census report, the tract which includes the barrios of Anilao, Masaguisi, and Paclasan supports a population of about 650. In addition, the barrios of Boñgabon to the north and Uasig to the south, which have a combined population of nearly 450, draw approximately half of their support from the tract. The people live in or near villages, around which they practice a rude agriculture, the crops being corn, rice, and vegetables. The only landowners in this territory claiming more than a few acres are a Filipino, who pastures about 300 head of cattle near Paclasan, and an American at the sitio Cupang, who has planted several thousand hemp and cocoanut plants. The Filipinos depend for their forest products upon the forest adjacent to the settlements. They gather resin for torches from Pili and Pagsahiñgin trees, a limited amount of Buri palm leaves for mats, Nipa palm leaves for thatching, and bejucos for rope. The mangrove swamps furnish the firewood, and not much timber is used locally. For the most part these and other needs may be supplied without affecting the virgin forest.

OWNERSHIP OF THE LAND.

Practically all of the second growth and grass lands within a distance of about 2 miles from the coast are claimed by private persons. There are also a number of holdings farther back. None of these have titles, although some have Spanish titles. Practically all of the commercial and uncut noncommercial forest and swamp lands are parts of the public domain. Owing to the fact that no land surveys have been made, it was deemed impracticable to attempt to separate the public from the private lands except in this general way.

COMPOSITION AND CONDITION OF THE FOREST.

CHARACTERISTIC TYPES.

Several distinct natural and artificial types of vegetation are found, due principally to—

First. The influence of salt water.
Second. The effect of drainage.
Third. The action of rivers.
Fourth. Fire.
Fifth. The clearing of forests by man.
Sixth. The sylvicultural demands of the different species.

The effect of these factors will be noted as each type is discussed, both for the purpose of showing why that type is present and in order to indicate its possibilities for future development.

Since the vegetation of one type merges gradually into that of another, it has been impossible to fix the boundaries exactly and to locate the areas definitely on the map. The following is the classification, with the estimated per cent, of each type for the portion of the tract surveyed:

	Per cent.
Commercial forest areas:	
Narra type	10
Hagachac type	15
Mixed type	12
Beach type	1
Total commercial forest	38
Noncommercial forest areas:	
Guipa type	8
Calaanan type	19
Unclassified	7
Total noncommercial forest	34
Swamp forest areas:	
Mangrove and Nipa types	11
Buri type	2
Total swamp forest	13
Other areas:	
Grass land	13
Cultivated land	2
Total	15

COMMERCIAL FORESTS.

Narra type.—Most important of all the different types of forest is that in which Narra (*Pterocarpus indicus* Willd.) grows as the characteristic tree. This type extends from the swamp belt near the coast back over the newly made and poorly drained flats until it reaches a higher and better drained soil, where it gradually disappears. Over this tract the abundance of soil moisture and the comparatively open character of the forest furnish the conditions in which Narra reaches its best development.

The general appearance of the forest is much the same throughout. (Pls. II and III.) Usually there are twelve to fifteen large and tall-growing trees of perhaps half as many species scattered over an acre. These form a broken upper story to the forest. Scattered in among them are a great many smaller and lower-growing or younger trees that fill in the ground space, making a thick under story. Of the smaller trees there are from fifty to seventy species commonly reaching a size of over 10 centimeters (4 inches) in diameter when mature. In addition, there are many that do not reach this size.

Mixed with this lower growth, though often shooting up to greater heights, are numerous palms (Pl. II), while throughout the whole is a mass of climbing bamboo, bejuco (rattan), and other vines that extend to the tops of the tallest trees, as well as over the growth lower down, and often forms dense tangles on or near the ground. Herbs and shrubs are relatively unimportant. Taken as a whole, the undergrowth of brush and

vines, especially bejuco, is so thick that in walking through the forest it is necessary to use a "bolo" to cut one's way.

Principal species: Of the trees reaching a diameter of over 40 centimeters (16 inches), Narra constitutes 7.16 per cent. Other timber trees are Lauan (*Shorea contorta* Vidal), 22.23 per cent; Amuguis (*Koordersiodendron pinnatum* Merrill), 7.06 per cent; Guijo (*Shorea guiso* Bl.), 6.37 per cent; Apitong (*Dipterocarpus* sp.), 3.83 per cent; Hagachac (*Dipterocarpus lasiopodus* Perk.), 0.68 per cent, and three species of the genus *Terminalia*, Calumpit (*T. edulis* Bl.), Malagabi (*T. pellucida* Presl.), and Sacat (*T. nitens* Presl.), 1.98 per cent. These trees, which include practically all of the kinds that are lumbered at present, constitute a trifle less than one-half of the whole number which reach a size of over 40 centimeters (16 inches). Of the others, Agupanga (*Chisocheton* sp.), 7.07 per cent, Dao (*Dracontomelum mangiferum* Bl.), 5.10 per cent, and Malaguibuyo (*Celtis* sp.), 4.69 per cent, are most numerous, while the two Canariums—Pili (*C. luzonicum* A. Gray) and Pagsahingin (*C. villosum* Bl.), noteworthy because of the fact that they yield resins—make up 1.57 per cent. The remaining 32.26 per cent includes a number of trees, found in small numbers, some of which are valuable. Among these are Bolongeta (*Diospyros pilosanthera* Bl.), Ipil (*Intsia acuminata* Merr.), and Bansilac (*Pithecolobium lobatum* Bth.). The first named is fairly common in many places but does not reach any great size. Other large-growing species are Antipolo (*Artocarpus communis* Forst.), Baslayan (*Dehaasia triandra* Merr.), Punghan (sp. of *Lauraceæ*), Taloto (*Pterocymbium tinctorum* Merr.), Palusat Saling (*Endiandra coriacea* Merr.), Banilad (*Sterculia philippinensis* Merr.), Candol-candol (*Sterculia blancoi* Rolfe), Bancal (*Sarcocephalus cordatus* Miq.), Talimadon (*Gonystylus becanus* Gilg.), Nato (*Palaquium luzoniense* Vi.), Binuang (*Octomeles sumatrana* Miq.), Catmon (*Dillenia philippinensis* Rolfe), and Pahutan (*Mangifera altissima* Blanco).

Minor species: Butong Manoc (*Cyclostemon microphyllus* Merr.), Putat (*Barringtonia reticulata* Miq. and *B. racemosa* Bl.), and several species each of the genera *Canarium* and *Eugenia* are among the commonest of the smaller-growing trees. Near the clearings or in places where there have formerly been clearings are found Tula-tula (*Mallotus floribundus* Muell.), Alom (*Mallotus moluccanus* Muell.), Ylang-ylang (*Canangium odoratum* Baill.), a great many trees of the genus *Ficus*, and others.

Palms: Growing among the other trees are a large number of palms that seldom exceed 30 centimeters (12 inches) in diameter. The Anahao (*Livistona* sp.) (Pl. II) is widely distributed and grows to a height of 100 feet (30 meters). The Buri (*Corypha umbraculifera* L.) is seldom found except on the borders of the swamps or in very damp places. Bongan gubat (*Areca whitfordii* Becc.) is confined largely to wet places where the ground water level is very near the surface. Yroc (*Arenga saccharifera* Labill) is scattered quite generally and is a low-growing form found beneath the larger trees. The others, Sarauag (*Pinanga insignis* Becc.), Pugahan (*Caryota* sp.), and Sagasi (*Heterospathe elata* Scheff.) are usually scattered. Table I, which shows the stand of these species, was compiled while taking valuation surveys, and as time was not taken to count all seedlings the number is considerably underestimated. It is, however, approximately correct for the two larger classes:

TABLE I.—*Stand of palms per acre (Narra type).*

[Average of 70.15 acres.]

Species.	Seedlings (without stems).	Less than 10 meters (33 feet) high.	More than 10 meters (33 feet) high.	Total.
Anahao	9.47	4.97	3.89	18.33
Yroc	8.58	5.81	1.51	15.90
Bongan gubat	5.07	5.10	2.20	12.37
Sagasi and Sarauag	1.02	1.61	.52	3.15
Pugahan	.55	.91	.28	1.74
Buri	.77	.14	.....	.91
Total	25.46	18.54	8.40	52.40

Soil: The soil of this type is fairly uniform. It consists of a clay surface soil, more or less mixed with humus, 10 to 12 centimeters (4 to 5 inches) in thickness, and a yellowish blue subsoil, which usually extends to the underground water level. In a few places the subsoil is mixed with sand. As far as investigations show, the underground water level is uniformly 1.5 to 3 meters (5 to 10 feet) below the surface during the dry season, and much above this during the rainy season. It is always sufficiently near the surface to be within reach of the roots of the larger trees, and during extremely wet weather large areas are flooded.

Reproduction: The dense growth of vines, especially bejuco and bamboo, hinders reproduction. Many of the trees are tolerant and can exist in the forest if the shade is not too heavy. Lauan seedlings (Pl. XII), for instance, may be found in a shade density of 75 per cent. Here the undergrowth is comparatively scarce and open. However, such favorable conditions are scattered through the forest and may be temporary only, for the breaking of limbs or tree tops, due to the wind or the constantly increasing weight of the mass of bejuco and other vines, may bring this tangle of growth in the tree tops to the surface, forming thickets so dense that little or no sunlight can reach the ground. The falling mass may also injure the pole and seedling growth that has already been established. In such a manner, areas in the forest favorable for seedlings are destroyed and the former condition is established only after a number of years. In some places, the leaves of young palms, especially those of Anahao, produce a shade density of almost 100 per cent. For intolerant species, like Narra, reproduction is poor and it is only along trails and in open places that Narra seedlings are found at all. Table II, which shows the number of poles and young trees in the area, is a fair indication of the capacity of the forest to reestablish itself.

TABLE II.—*Stand of poles and small trees per acre on Narra type.*

[Average of 70.15 acres.]

Species.	Diameter.			
	10–19 centimeters (4–7 inches).	20–29 centimeters (8–11 inches).	30–39 centimeters (12–16 inches).	Total.
Narra	0.499	0.470	0.057	1.026
Lauan	2.922	3.150	1.169	7.241
Guijo	.955	1.211	.342	2.508
Amuguis	.713	.570	.427	1.710
Apitong	.884	.698	.228	1.810
Malagabi, Sacat, Calumpit	.142	.214	.042	.398
Hagachac	.156	.128	.071	.355
Pili and Pagsahingin	.769	.912	.285	1.966
Agupanga	1.553	2.309	1.098	4.960
Malaguibuyo	.415	.641	.442	1.496
Dao	.171	.356	.128	.655
Others reaching 30 centimeters (12 inches) in diameter when mature	19.187	17.505	10.306	46.998
Trees not reaching 30 centimeters when mature	28.467	13.043	.....	41.510
Total	56.831	41.207	14.595	112.633

Condition: The sylvical condition of the forest is poor. In it are many over-mature trees that should be removed as soon as possible. This is especially true of Narra. The dense undergrowth renders reproduction difficult.

Hagachac type.—On the slightly higher and better drained land adjacent to the Narra forest is a stand of timber which apparently has taken the place of Narra as the river delta has been extended. Contrasted with the Narra forest, the Hagachac type is characterized by the absence of Narra, by the presence of Hagachac (*Dipterocarpus lasiopodus* Perk.) (frontispiece), by a decrease of underbrush, and by an absence of climbing bamboo. While a consultation of the yield tables indicates that the yield is lighter in this than in the previous type, yet virgin stands of the Hagachac type are heavier. The lighter yield shown by the tables is due to the fact that some of the original forest has been cleared or cut over.

Since this type includes several detached areas, it was deemed advisable to distinguish between them for the purpose of calculating the yields separately. The main part of this description, while generally applicable to them all, will be based upon the part designated upon the map as Hagachac I, which is adjacent to the Narra type.

Hagachac Division II does not differ materially from the first except in having a smaller quantity of Guijo. While the average stand is poorer, in some places it is equally as good. Division III of the Hagachac type extends back into the low foothills, in which territory the Mangyanes, a non-Christian tribe, are found. These people have for a long time made their clearings in the forest unrestricted in any way, and have destroyed large amounts of timber. In some places the low hills have been rendered practically valueless from this cause. A single line of survey through this tract, and including a trifle over 19 acres of forest and clearings, shows a yield of

approximately 2,300 feet B. M. per acre, about half of which is Hagachac. These figures have not been placed in the tables of stands and yields, as they represent so small a per cent of the forest. Division IV is a small tract of forest which lies just north of the Boñgabon River. It is of about the same grade as Hagachac II, though it has a number of minor differences, due to its proximity to the river and to the surrounding cleared land.

Leading species: Hagachac makes up 17.45 per cent of the stand of timber trees over 40 centimeters (16 inches) in diameter; Lauan, 18.28 per cent; Amuguis, 6.01 per cent; Guijo, 5.54 per cent; *Terminalia* spp., 1.65 per cent; Narra, 0.95 per cent, and Apitong, 0.23 per cent. In this, as in the Narra type, Lauan is the predominant species, although nearly equaled by the Hagachac. As a matter of fact, the Hagachac is usually grouped in favorable spots, and in such places greatly outnumbers the Lauan, which is more evenly scattered. It is not uncommon to find groups where the total stand of timber would probably run as high as 20,000 to 30,000 feet B. M. per acre.

Of the other common species, the most numerous with percentages of stand of each are Agupanga, 10.5 per cent; Dao, 6.48 per cent; Malaguibuyo, 5.19 per cent, and Pili and Pagsahiñgin, 2.25 per cent. Of the remaining trees over 40 centimeters (16 inches) in diameter, Malugay (*Dracontomelum* sp.) and Calantas (*Toona* sp.) are found scattered here and there through the forest, but are not present in merchantable quantities.

Minor species: Putat, Bolongeta, and the many species of *Eugenia*, while still found, are not so plentiful as in the Narra forest. Near the Calaanan area there are present many kinds peculiar to that type, especially species of *Ficus* and *Mallotus*.

Palms: While all the palms growing in the Narra forest are present in this type, the total number per acre is less. Buri and Boñgan gubat are nearly absent; Anahao and especially Yroc are still abundant, and Sarauag, Pugahan, and Sagasi are scattered.

Undergrowth: Climbing bamboo has practically disappeared and bejuco and other vines, though still common, are not so plentiful in the heavier stands. The smaller growing tree species still continue to form an understory, many of these being found even in the densest places. Shrubs and herbs occur in small numbers, and are relatively unimportant.

Soil: The soil here is a yellowish clay, sometimes slightly sandy, and has a small amount of humus at the surface. A sandy layer was found at a depth of about 150 centimeters (59 inches) in a few places, but is not universally present. The area, contrasted with the Narra type, is better drained.

Reproduction: Reproduction is especially good of Hagachac, seedlings, saplings, and poles being common in all places where seed trees are found. No other tree seems to reproduce so well with so little light. The reproduction of Lauan, Amuguis, and Guijo is plentiful except in the more densely shaded places. Table III shows the stand per acre of trees from 10 centimeters (4 inches) to 40 centimeters (16 inches) in diameter. The number of trees in the next to the last column (those over 30 centimeters when mature) is below the actual number. This is due to the fact that it is difficult to properly classify all of these species, no doubtful ones being listed.

TABLE III.—*Stand of poles and small trees per acre on Hagachac type.*

[Average of 34.735 acres.]

Species.	Diameter.			
	10–19 centimeters (4–7 inches).	20–29 centimeters (8–11 inches).	30–39 centimeters (12–16 inches).	Total.
Hagachac	1.756	2.072	1.180	5.008
Lauan	1.497	1.727	.575	3.799
Amuguis	.345	.489	.547	1.381
Guijo	.575	.575	.288	1.438
Dao	.288	.431	.057	.776
Malagabi, Sacat, Calumpit	.086	.173	.115	.374
Pili and Pagsahiñgin	.460	.374	.115	.949
Narra	.029	.....	.029	.058
Apitong	.057	.086	.....	.143
Agupanga	2.015	2.762	1.698	6.475
Malaguibuyo	.201	.488	.575	1.264
Others which will grow to be larger than 30 centimeters (12 inches)	9.328	11.631	4.980	25.939
Total	16.637	20.808	10.159	47.604

Density: In a typical stand of Hagachac, the high crowns spread over half or often all of the surface. Sometimes, however, the forest is more open than this. In nearly all cases an understory of smaller growing trees gives a comparatively dense ground cover.

Condition: The silvicultural condition is poor owing to the presence of many overmature trees, to the unfavorable conditions for reproduction, and to the presence of many inferior species. The merchantable condition is fair.

Mixed type.—Situated along the upper waters of the Madugo, Uyao, and Bayangan rivers is a tract of forest characterized by the absence of both Narra and Hagachac and by a predominance of less important species. The area is flat, rich bottom land, and has a deep clay soil, with a layer of humus at the surface.

The forest is made up of scattering groups or individuals of large and tall growing trees, the most important of which are Lauan, Guijo, and Amuguis. Malugay and Calantas occur in places, while Malaguibuyo, Dao, Agupanga, and Candol-candol are very common. Growing in between and below this upper story of trees are a large number of smaller ones. All through the forest palms are common. Especially is this true of Yroc, which grows in fairly dense shade. An abundant growth of vines and bejuco is universally present. The condition of the forest is poor, because of clearings, the scarcity of valuable trees, and their poor reproduction.

Beach type.—Since the coastal line of the tract is open and exposed to the direct action of the waves, a narrow beach has been formed, separating the swamp portion from the sea. Near the mouths of the rivers this beach is broader than the average, while in some other especially open places it is being destroyed, thus exposing small patches of the mangrove vegetation which normally lie behind the frontal zone of beach plants.

The forest of the beach is distinct (Pl. IV). Agoho (*Casuarina equisetifolia* Forst.) and the Palo Maria de la Playa (*Calophyllum inophyllum* L.) are the two leading and distinctively characteristic trees. In places the former grows in nearly pure stands and extends inland along the Boñgabon River (Pl. V) for about a mile. Besides those mentioned, the usual beach plants of the Tropics are found. Among the trees, Botong (*Barringtonia speciosa* Forst.), Dap-dap (*Erythina indica* Lam.), Talisay (*Terminalia catappa* L.), and Balabago (*Hibiscus tiliaceous* L.) are the more common. Guijo, Amugius, Apitong, and Ipil are among the timber trees that occur, but not in merchantable quantities, on the landward side of the beach. Pandan (*Pandanus tectorius* Sol.), Cycad (*Cycas circinalis* L.), and many other shrubby plants are found. The Agoho reproduces well and rapidly in most places, but reproduction of Palo Maria is more scattered and in some places entirely absent.

Unclassified commercial forest.—This part of the forest was given very little examination, although it was seen to be of commercial importance. Both sides of the Boñgabon River valley along its upper waters were lined with tree growth. A strip taken to the north at a distance of 9 miles up this river showed a stand in which were found Lauan, Amugius, some Guijo, and many other large-sized trees. The country here is hilly. An elevation of 260 meters (850 feet) was reached within a mile of the river. Mangyan clearings have destroyed large quantities of timber, and the outlook from this hill and from others indicates that the same conditions exist over the major part of the foothill region, which makes up the back portion of the tract. Logging in this territory is not advisable under present conditions.

Noncommercial forests.—In addition to the types of commercial forest already named and described, there are considerable areas covered with tree growth not suited for lumbering under present conditions, and some of it not at all. While a complex classification of this part might be made, the part examined has been divided into two parts and the native names for these used. Naturally these grade into each other and lines of division are difficult to fix. Fundamentally, however, the distinction between them is clear. The first, or "Guipa" type, is uncut noncommercial forest, containing many large, though at present noncommercial, varieties of trees. The "Calaanan" type is the second-growth forest on land which has been cleared and used for agricultural purposes, and then abandoned.

Guipa type.—In most cases the Guipa forest appears to be the first high forest growth on areas where the underground water level is very near the surface. Such areas are usually abandoned river channels and flood plains, and, excepting along the Boñgabon River, are very near the coast.

Some idea of the stand and species of the larger trees may be obtained from a rapid count made over 1.7 hectares (4.2 acres) of land in the Guipa south and southeast of the Payang cogonal, where the following are found: Seventeen Dao, 4 Antipolo, 1 Cupang (*Parkia roxburghii* G. Don), 1 Lauan, 1 *Terminalia*, 1 Malaguibuyo, and 1 Bancal, as the more promising of the larger trees. In another place, on an area of 1.6 hectares (3.95 acres) running through the central part of the narrow strip of Guipa between the Anilao River and the barrio of Masaguisi, are found 9 Dao, 3 Amuguis, 5

Toog (*Bischofia trifoliata* Hook.), 3 Bancal, 3 Pagsahingin, 1 Antipolo, 1 Calantas, 1 Narra, 1 Pili, and a few other trees with diameters greater than 40 centimeters (16 inches). These two places represent two of the best portions of the Guipa forest. In both of them, as elsewhere in this type, Catmon is the most characteristic tree, although it rarely reaches a diameter of over 40 centimeters (16 inches).

Palms, especially Anahao and Yroc, are very plentiful. The undergrowth is composed of small trees, vines, and bejuco, and is generally quite dense. Reproduction is fair of the trees present, although in some places the lack of desirable seed trees prevents the reproduction of the better kinds. The soil is rich and varies from a loamy clay to a loamy sand.

Calaanan type.—The Calaanan stands in sharp contrast to all of the forest types thus far described (Pl. VI). While the others have been fundamentally natural divisions, this one is distinctly artificial and the direct result of the influence of man. It may be best understood by briefly describing its origin.

A long-standing custom for those raising agricultural crops has been to go into the forest at the commencement of the dry season, cut all of the trees over a small area, and leave them until near the end of the dry season. The slash is then burned, and upon the excellent seed bed left the desired crops are planted. After growing crops for two or three years, the lack of any kind of tools for working the land allows the entrance of weeds, grass, etc., so that it is easier to clear a new place than to clean out the old. As a result of these methods, large areas have been cut over, abandoned, grown up, and perhaps cut over again and again. Thus they have been rendered worthless for forest purposes.

The composition of the Calaanan varies considerably in different places. In portions bordering upon or near to the commercial forest, saplings and small poles of adjacent timber species are common. In other places, where the land has been worked for a longer time before abandonment, and where the clearings are near to grass lands, cogon grass (*Imperata exaltata* Brongn.) is mixed with the Calaanan. In still other places there is almost a pure stand of typical Calaanan trees. Taken as a whole, this type is made up of rapid-growing and quick-maturing varieties, which seed abundantly and at an early age. The first to come in, and one of the widest in distribution of these, is Binunga (*Macaranga tanarius* Muell.) (Pl. VI). This seeds at an early age, grows with wonderful rapidity, and while most of the trees die early, some reach the size of forest trees. Commonly growing with this are a number of species of the genera *Mallotus*, *Macaranga*, and *Ficus*.

Table IV gives the number of trees upon a plot one-fortieth of a hectare (one-sixteenth of an acre) taken in the midst of a young Calaanan forest situated so far away from the commercial forest as to be entirely unaffected by it. In this Calaanan there is an unusually large proportion of Binunga and Alom, the former being much the taller, having an average height of 14 meters (45 feet).

TABLE IV.—*Number of trees on one-fortieth of a hectare (about one-sixteenth of an acre) of young Calaanan not adjacent to the commercial forest.*

Species.	Seedlings less than 1 meter (3 feet) high.	Diameter.			
		1–5 centimeters (½–2 inches).	5–10 centimeters (2–4 inches).	10–15 centimeters (4–6 inches).	Total.
Macaranga tanarius Muell			43	27	70
Mallotus moluccanus Muell	1	22	1	1	25
Macaranga playfairii Hemsl		22	2	1	25
Ficus hauili Blanco		8	3		11
Leea sp	2	4	3		9
Ficus mindoriensis Merr	1	3	1		5
All others (8 species)	8	9	1		18
Dead trees		58	21	2	
Total live trees	12	68	54	29	163

As already stated, Calaanan near the forest usually contains a large number of forest tree seedlings, and would no doubt eventually produce excellent forest if left undisturbed. An old Calaanan near the Narra forest illustrates this point. Table V shows the number of trees found upon two plots, each one-fortieth of a hectare (one sixteenth of an acre) in area.

TABLE V.—*Number of trees on one-twentieth of a hectare (about one-eighth of an acre) of old Calaanan adjacent to the commercial forest.*

Species.	Seedlings less than 1 meter (3 feet) high.	Diameter.					Total.
		1–5 centimeters (⅓–2 inches).	5–10 centimeters (2–4 inches).	10–15 centimeters (4–6 inches).	15–20 centimeters (6–8 inches).	20–30 centimeters (8–12 inches).	
Lauan	30	19	6	1			56
Guijo	27	16					43
Amuguis	21	3	1				25
Pahutan	2						2
Bancal		2		1			3
Pili	2	1					3
Ficus (several species)	4	10	11	4	4		33
All others	71	55	18	3	2	4	153
Total	157	106	36	9	6	4	318

The following is a list of trees which are typical Calaanan trees, though they are often found in other forest types:

Ficus minahassae Miq. (Hagimit), *F. hauili* Blanco (Hauili), *F. nota* Merr. (Tibig), *F. variegata* Merr. (Tañgisang bayauac T.), *Macaranga tanarius* Muell. (Binuñga), *M. bicolor* Muell., *Mallotus barnesii* Merr., *M. playfairii* Hemsl., *M. floribundus* Muell., *M. riciniodes* Muell., *M. moluccanus* Muell. (Alom), *Stylocoryne macrophylla* Bartl. (Basa), *Trema amboinense* Bl. (Knugdon), *Mussaenda grandiflora* Rolfe, *Clerodendron macrostegium* Sch., *Laportea meyeniana* Ward. (Lipa), *Voacanga cumingii* Rolfe, *Phacanthus cumingii* Miq., *Callicarpa erioclona* Schauer, *C. blancoi* Rolfe, and *C. formosana* Rolfe.

Unclassified noncommercial forests.—Two small tracts of forest, one near the Sucol and one near the Uasig River, appear on the map under the above heading. These have not been examined carefully and hence no attempt has been made to classify them. It is believed that the part near the Sucol River contains small areas of commercial forest, otherwise they are apparently made up of a mixture of Guipa, Calaanan, and grass land.

SWAMP TYPES.

Mangrove type.—Behind the narrow strip of land along the shore that is occupied by the beach forest is a flat area, often quite wide, that is flooded at high tide. Here an excessive amount of salt water gives rise to the so-called mangrove vegetation (Pl. VII), which is composed of a dense stand of trees from 15 to 30 centimeters (6 to 12 inches) in diameter and from 8 to 12 meters (26 to 40 feet) in height. Many of these trees have long stilt roots, which form a very characteristic appearance, especially noticeable since the ground is free from undergrowth.

Members of the family *Rhizophoraceæ* compose this type almost to the exclusion of all others. The following species are characteristic: *Rhizophora mucronata* Lam., *R. conjugata* L., *Bruguiera gymnorrhiza* Lam., *B. parviflora* Lam., *B. eriopetala* Wanda., *B. caryophylliodes* Blume, *Ceriops candolleana* Arn., and *C. roxburghiana* Arn. While the species of *Rhizophora* and *Bruguiera* have the common names of Bacao or Bacauan, and those of the *Ceriops*, Tañgal, these names are often interchangeable and the different species of the genera have such a variety of individual common names that no attempt is made to collect them. Besides the *Rhizophoraceæ*, Pagatpat (*Sonneratia pagatpat* Blanco), Apiapi (*Avicennia officinalis* L.), and Nilad (*Scyphiphora hydrophyllacea* Gærtn.) are present. On the slightly higher areas Tabigue (*Xylocarpus obovatus* Juss. and X. *granatus* Koenig) and Dungonlate (*Heritiera littoralis* Dry.) are quite common.

The mangrove swamps are important commercially because they are the principal source of firewood in the Philippines and because species of Bacauan, Tañgal, and Tabigue furnish valuable tan barks and dye barks. While in many parts of the Philippines the mangrove swamps have been greatly damaged by long-continued cutting, those within this tract are in excellent condition and will furnish, with proper management, a constant supply of firewood, tan bark, and dye bark. Reproduction in them is good since the trees seed continuously and freely.

Nipa type.—Near the upper limit of high tide and on strips along the tidal portion of fresh-water streams the saline condition of the soil is less pronounced. These places are occupied by the Nipa palm (*Nipa fruticans* Wurmb.), which appears as the commonest and characteristic growth. Nipa is often found in nearly pure stands, though

occasionally it is mixed with the mangrove species. In the upper limits of the Nipa swamp considerable areas are occupied by the swamp fern, Lagolo (*Achrostichum aureum* L.) and by Doloarin (*Acanthus ilicifolius* L.). The former occurs most frequently. Evidently the Nipa would grow and do well on the land occupied by the mangrove vegetation, but is probably shaded out by it.

Buri type.—Behind the mangrove and Nipa swamp is a belt not flooded at any time by the tide, yet containing too much water for the growth of forest trees. Here is usually an almost pure stand of the Buri palm (*Corypha, umbraculifera* L.). Toward its higher limits it is mixed with shrubs and forest trees, and merges quickly into forest types. Reproduction is very plentiful, and large numbers of young plants are to be found. The Buri palm is not necessarily confined to the area bordering on the Nipa, but may form dense growth along the streams, especially if these run through or border on the grass areas.

OTHER AREAS.

Grass land.—The broad sandy and rocky flood plain of the Bongabon River is apparently natural grass land. In places where the action of the floods is strongest, scattered clumps of Talahib (*Saccharum spontaneum* L.) are practically the only vegetation found. Toward the outer edges of the flood plain this grass forms a dense jungle from 2 to 3 meters (7 to 10 feet) in height. Fires sweep through it periodically, partially burning the driest and killing the greenest portions. In this way there has accumulated at the base a dense mass of dead and partially burned grass that is often 1 meter or more in depth, which is sufficient to prevent the seeding of forest trees. In the thinner portions, where the seeding is possible, fires are instrumental in checking forest growth. Mention has already been made of the extension of the coastal belt of Agoho up the Bongabon River valley. It is believed from observations made in other parts of the islands that the habitat occupied by the Talahib is especially suited to Agoho, and were it not for fires this tree would form in places pure stands. At the upper limits of the extension of this tree an excellent advance zone of seedlings and young trees was observed. A later visit to the same place showed a fire destroying this stand.

A few ox-bow channels cut off from the main streams are filled with Tagpo (*Phragmites* sp.), and in places there is an extension of the grasss zone as peninsulas into the forest, which evidently marked the existence of old river channels. The Baroc River flood plain is similar to that of the Bongabon River, but on a much smaller scale. The banks of all the other rivers are clothed with forest, except where the clearings have allowed cogon to come in. At present these river-bottom grass lands are practically valueless, although they furnish pasturage for such wild game as timarau, deer, and wild carabao.

Cultivated lands.—Scattered in small areas along roads and trails in almost all parts of the tract are small cultivated fields. These are more numerous near the villages and along the river valleys. In the part of the tract near the mountains the Mangyanes have destroyed large portions of the forest by clearings. The portion of the tract actually under cultivation is estimated at 2 per cent. Since the areas are small, they are not indicated on the map.

STAND.

The stand tables given here for trees over 40 centimeters (16 inches) in diameter were computed for each type separately. Whenever possible diameters have been taken at breast height, but in case of trees having high buttresses the diameters were taken above the swell

NARRA TYPE STAND.

Table VI was computed from valuation surveys taken over 70.15 acres (28.388 hectares) or 2.035 per cent of the whole amount of the tract, which contains 3,447 acres. This type includes some territory around the mill which has been partially cut over and some bordering on inferior types of forest, consequently the main part of the tract contains a slightly heavier stand than that shown for the average acre.

TABLE VI.—*Stand per acre on Narra type (3,447 acres).*

[Average of 70.15 acres.]

Diameter above buttresses.		Narra.	Lauan.	Guijo.	Amuguis.	Apitong.	Malagabi, Sacat, Calumpit.
Inches.	*Centimeters.*						
16	40	0.042	0.627	0.242	0.128	0.099	0.071
18	45	.085	.669	.285	.156	.099	.028
20	50	.199	.613	.156	.128	.085	.042
22	55	.242	.513	.199	.285	.071	.099
24	60	.185	.556	.099	.299	.114	.057
26	65	.199	.470	.142	.199	.085	.028
28	70	.171	.456	.114	.213	.128	.028
30	75	.099	.313	.185	.156	.042	.042
31	80	.114	.256	.042	.099	.071	.014
33	85	.085	.456	.085	.071	.071	.014
35	90	.128	.228	.042	.085	.071	.042
37	95	.071	.156	.028	.042	.014	.014
39	100	.085	.142	.....	.014	.028	.028
41	105	.028	.142	.028	.014	.014	.....
43	110	.042	.156	.028	.....	.....	.014
45	115	.042	.057	.014	.014	.....	.....
47	120	.057	.057	.028	.....	.....	.....
49	125	.028	.071	.....	.....	.028	.014
51	130	.....	.....	.....	.....	.014	.....
53	135	.....	.042	.....	.....	.....	.....
55	140	.....	.014	.....	.....	.....	.....
57	145	.....	.....	.....	.....	.....	.....
59	150	.014	.....	.....	.....	.....	.....
78	200	.014	.....	.....	.....	.....	.....
Total:							
Per acre		1.930	5.994	1.717	1.903	1.034	.535
Per hectare		4.769	14.811	4.243	4.702	2.555	1.322
Per cent		7.16	22.23	6.37	7.06	3.83	1.98

Diameter above buttresses.		Hagachac.	Pili and Pagsahingin.	Agupanga.	Malaguibuyo.	Dao.	Others.	Total.
Inches.	*Centimeters.*							
16	40	0.042	0.156	0.826	0 199	0.085	2.409	4.926
18	45	.014	.057	.356	.299	.028	1.682	3.758
20	50	.....	.057	.299	.228	.099	1.040	2.946
22	55	.014	.014	.142	.156	.042	.841	2.618
24	60	.....	.042	.114	.128	.156	.841	2.591
26	65	.028	.042	.099	.128	.085	.441	1.946
28	70	.....	.014	.....	.057	.156	.413	1.750
30	75	.014	.028	.028	.028	.028	.199	1.162
31	80	.....	.014	.014	.014	.128	.213	.979
33	85	.014	.....	.014	.014	.114	.213	1.151
35	90	.....	.....	.014	.014	.085	.142	.851
37	95	.....	.....	.....	.....	.099	.028	.452
39	100	.....	.....	.....	.....	.085	.028	.410
41	105	.028	.....	.....	.....	.014	.028	.296
43	110	.014	.....	.....	.....	.057	.042	.353
45	115	.....	.....	.....	.....	.014	.....	.141
47	120	.....	.....	.....	.....	.057	.014	.213
49	125	.....	.....	.....	.....	.....	.042	.183
51	130	.....	.....	.....	.....	.028	.042	.084
53	135	.014	.....	.....	.....	.....	.....	.056
55	140	.....	.....	.....	.....	.014	.014	.042
57	145	.....	.....	.....	.....	.....	.....	.....
59	150	.....	.....	.....	.....	.....	.014	.028
78	200	.....	.....	.....	.....	.....	.014	.028
Total:								
Per acre		.182	.424	1.906	1.265	1.374	8.700	26.964
Per hectare		.450	1.048	4.709	3.126	3.395	21.498	66.628
Per cent		.68	1.57	7.07	4.69	5.10	32.26	100

HAGACHAC TYPE STAND.

Table VII was computed from surveys made over 34.73 acres (14.057 hectares) or 2.052 per cent of the territory of the part of the Hagachac type designated as Hagachac I, which contains 1,692 acres.

TABLE VII.—*Stand per acre on Hagachac I type (1,692 acres).*

[Average of 34.74 acres.]

Diameter above buttresses.		Hagachac.	Lauan.	Amuguis.	Guijo.	Malagabi, Sacat, Calumpit.	Pili and Pagsahingin.
Inches.	*Centimeters.*						
16	40	0.748	0.460	0.230	0.086	0.115	0.173
18	45	.403	.460	.115	.201	.057	.173
20	50	.374	.575	.115	.086	.057	.029
22	55	.489	.345	.173	.259	.086	.029
24	60	.288	.632	.374	.057	.029	.057
26	65	.230	.374	.144	.086	.....	.029
28	70	.316	.259	.057	.173	.....	.029
30	75	.144	.345	.115	.086	.....	.....
31	80	.230	.173	.029	.029	.029	.....
33	85	.144	.115	.057	.057	.....	.029
35	90	.201	.259	.029	.029	.....	.....
37	95	.144	.173	.029	.029	.....	.....
39	100	.173	.086	.....	.029	.....	.....
41	105	.115	.086	.....	.029	.....	.....
43	110	.057	.029	.....	.057	.029	.....
45	115	.057	.029	.....	.029	.....	.....
47	120	.057	.029	.....	.029	.....	.....
49	125	.029	.....	.....	.....	.....	.....
51	130	.029	.....	.....	.....	.....	.....
53	135	.....	.029	.....	.....	.....	.....
55	140	.....	.....	.....	.....	.....	.....
57	145	.....	.....	.....	.....	.....	.....
59	150	.....	.....	.....	.....	.....	.....
61	155	.....	.....	.....	.....	.....	.....
63	160	.029	.....	.....	.....	.....	.....
Total:							
Per acre.....		4.257	4.458	1.467	1.351	.402	.548
Per hectare...		10.519	11.016	3.625	3.338	.994	1.354
Per cent.....		17.45	18.28	6.01	5.54	1.65	2.25

Diameter above buttresses.		Narra.	Apitong.	Dao.	Agupanga.	Malaguibuyo.	All others.	Total.
Inches.	*Centimeters.*							
16	40	0.029	.....	0.144	0.720	0.173	2.015	4.893
18	45	.....	.....	.115	.575	.086	.892	3.077
20	50	.....	0.057	.057	.403	.374	.949	3.076
22	55	.....	.....	.086	.316	.201	.518	2.502
24	60	.029	.....	.230	.316	.115	.345	2.472
26	65	.057	.....	.173	.144	.115	.345	1.697
28	70	.....	.....	.086	.057	.144	.345	1.466
30	75	.....	.....	.029	.029	.....	.115	.863
31	80	.029	.....	.029	.....	.029	.230	.807
33	85	.057	.....	.144	.....	.....	.029	.632
35	90	.029	.....	.....	.....	.029	.115	.691
37	95	.....	.....	.173	.....	.....	.057	.605
39	100	.....	.....	.086	.....	.....	.057	.431
41	105	.....	.....	.....	.....	.....	.057	.287
43	110	.....	.....	.057	.....	.....	.029	.258
45	115	.....	.....	.057	.....	.....	.....	.172
47	120	.....	.....	.086	.....	.....	.029	.230
49	125	.....	.....	.....	.....	.....	.....	.029
51	130	.....	.....	.....	.....	.....	.....	.029
53	135	.....	.....	.....	.....	.....	.....	.029
55	140	.....	.....	.029	.....	.....	.029	.058
57	145	.....	.....	.....	.....	.....	.....	.....
59	150	.....	.....	.....	.....	.....	.057	.057
61	155	.....	.....	.....	.....	.....	.....	.....
63	160	.....	.....	.....	.....	.....	.....	.029
Total:								
Per acre.....		.230	.057	1.581	2.560	1.266	6.213	24.390
Per hectare..		.568	.141	3.907	6.326	3.128	15.352	60.268
Per cent.....		.95	.23	6.48	10.50	5.19	25.47	100

Table VIII is computed from valuation surveys made over 25.11 acres (10.16 hectares) or 1.254 per cent of the territory designated on the map as Hagachac II, which contains approximately 2,000 acres. The scattered and varied condition of this forest is such that the small per cent taken in these surveys must not be accepted as an absolute statement of the stand. It is believed, however, that the actual stand will exceed rather than fall below this estimate.

TABLE VIII.—*Stand per acre on Hagachac II type (2,000 acres).*

[Average of 25.11 acres.]

Diameter above buttresses.		Hagachac.	Lauan.	Amuguis.	Guijo.	Dao.	Malaguibuyo.
Inches.	*Centimeters.*						
16–19	40–49	0.477	0.477	0.318	0.079	0.199	1.991
20–23	50–59	.557	.438	.159	.079	.438	.677
24–27	60–69	.358	.796	.557	.079	.477	.796
28–30	70–79	.557	.278	.477	.040	.398	.238
31–34	80–89	.278	.159	.079	.040	.238	.....
35–38	90–99	.238	.119	.119	.040	.159	.....
39–42	100–109	.318	.040	.079	.....	.159	.....
43–46	110–119	.040	.040	.....	.....	.....	.....
47–50	120–129	.119	.040	.....	.....	.079	.....
Total:							
Per acre		2.942	2.387	1.788	.357	2.147	3.702
Per hectare		7.270	5.898	4.418	.882	5.305	9.148
Per cent		13.60	11.03	8.26	1.65	9.92	17.11

Diameter above buttresses.		Agupanga.	Candolcandol.	Malagabi, Sacat, Calumpit.	Others.	Total.
Inches.	*Centimeters.*					
16–19	40–49	1.353	0.597	.....	1.233	6.724
20–23	50–59	.836	.517	0.079	.717	4.497
24–27	60–69	.517	.199	.....	.637	4.416
28–30	70–79	.040	.119	.119	.557	2.823
31–34	80–89	.040	.....	.079	.278	1.191
35–38	90–99	.....	.....	.040	.199	.914
39–42	100–109	.....	.....	.....	.079	.675
43–46	110–119	.....	.....	.....	.040	.120
47–50	120–129	.....	.....	.....	.040	.278
Total:						
Per acre		2.786	1.432	.317	3.780	21.638
Per hectare		6.884	3.539	.783	9.340	53.467
Per cent		12.88	6.62	1.46	17.47	100

MIXED TYPE STAND.

Table IX is computed from valuation surveys made over 34.7 acres (14.07 hectares) or 0.82 per cent of the total area for this type, which is approximately 4,200 acres. The variable character of this forest is such as to render this small per cent insufficient data for certain conclusions. The general stand is poor and the forest more or less mixed with clearings and Calaanan. More complete data would no doubt show a considerable variation from these figures.

TABLE IX.—*Stand per acre on mixed type (4,200 acres).*

[Average of 34.7 acres.]

Diameter above buttresses.		Lauan.	Amuguis.	Guijo.	Dao.	Malagabi, Sacat, Calumpit.
Inches.	*Centimeters.*					
16–19	40–49	0.403	0.230	0.230	0.028	0.115
20–23	50–59	.720	.259	.201	.288	.....
24–27	60–69	.633	.230	.086	.259	.144
28–30	70–79	.259	.115	.259	.316	.086
31–34	80–89	.317	.172	.201	.259	.028
35–38	90–99	.057	.....	.057	.057	.....
39–42	100–109	.057	.057	.057	.316	.028
43–46	110–119	.....	.....	.....	.086	.....
47–50	120–129	.057	.....	.....	.086	.....
Total:						
Per acre		2.503	1.063	1.091	1.695	.401
Per hectare		6.185	2.627	2.696	4.188	.991
Per cent		15.80	6.71	6.89	10.70	2.53

Diameter above buttresses.		Malaguibuyo.	Agupanga.	Others.	Total.
Inches.	*Centimeters.*				
16–19	40–49	1.555	0.748	1.296	4.605
20–23	50–59	.748	.431	1.123	3.770
24–27	60–69	.662	.374	.691	3.079
28–30	70–79	.230	.201	.403	1.869
31–34	80–89	.086	.028	.345	1.436
35–38	90–99	.....	.....	.028	.199
39–42	100–109	.....	.....	.144	.659
43–46	110–119	.....	.....	.....	.086
47–50	120–129	.....	.....	.....	.143
Total:					
Per acre		3.281	1.782	4.030	15.846
Per hectare		8.107	4.403	9.958	39.155
Per cent		20.70	11.24	25.43	100

VOLUME TABLES.

Owing to the fact that almost no cutting was going on during field work on the tract, very few measurements of felled trees were made. These volume tables have been computed largely from data taken by Forester Everett in Negros, Forester Maule in Bataan, and Forester Klemme in Tayabas, and checked with a few measurements taken upon the tract. In every case, however, it has been the purpose to make conservative estimates. Three tables are given, one for Narra, a low-growing tree; one for Amuguis and species of *Terminalia*, which are of medium height; and one for *Dipterocarpaceæ*, which includes Lauan, Apitong, Guijo, and Hagachac. The latter trees are tall growing, and, while they differ from each other, it was thought best to use one table for them all. A comparison of this latter table with that given for the Yellow Poplar [a] (*Liriodendron tulipifera* L.) of the United States, which very much resembles in general form and habits of growth these *Dipterocarps*, shows a marked similarity between the two.

[a] See Braniff, E. A.: Grades and Amounts of Lumber Sawed from Yellow Poplar, etc. *U. S. Dept. of Agriculture, For. Ser., Bull. 73* (1906).

TABLE X.—*Volume table.*

Diameter.		Narra.		Amuguis, Malagabi, Sacat, Calumpit.		Lauan, Guijo, Hagachac, Apitong.	
		Board feet Doyle.	M³.	Board feet Doyle.	M³.	Board feet Doyle.	M³.
Inches.	*Cm.*						
16	40	140	0.500	210	0.875	210	0.875
18	45	195	.745	285	1.150	285	1.310
20	50	235	1.005	350	1.420	390	1.725
22	55	300	1.320	416	1.775	445	2.250
24	60	370	1.555	505	2.200	680	3.150
26	65	450	1.950	622	2.550	910	3.640
28	70	550	2.275	760	2.920	1,170	4.315
30	75	650	2.540	885	3.310	1,380	5.110
31	80	740	2.955	1,045	3.870	1,615	6.000
33	85	821	3.250	1,200	4.310	1,804	6.850
35	90	915	3.625	1,360	4.750	2,115	7.650
37	95	1,010	3.950	1,465	5.320	2,420	8.325
39	100	1,115	4.350	1,640	5.901	2,685	8.900
41	105	1,220	4.800	1,820	6.300	2,982	9.540
43	110	1,310	5.200	1,985	6.595	3,200	10.276
45	115	1,430	5.560	2,160	6.980	3,450	10.900
47	120	1,550	6.200	2,375	7.350	3,685	11.500
49	125	1,622	6.620	2,600	7.500	3,965	12.120
51	130	.....	.....	.....	.....	4,215	12.500
53	135	.....	.....	.....	.....	4,500	13.000
55	140	.....	.....	.....	.....	4,650	13.000

YIELD.

The yield tables have been computed for each type separately by applying the proper volume table to the number of trees of each diameter class which was found upon that type. While the yields can not be accepted as being accurate, owing to the nature of the volume tables used, it has been thought advisable to include them as being a conservative estimate of the yield.

TABLE XI.—*Yield in board feet on Narra type (3,447 acres).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per acre.	Total yield.	Average yield per acre.	Total yield.
Narra	1,249	4,305,303	1,224	4,219,128
Lauan	6,855	23,629,185	6,532	22,515,804
Guijo	1,582	5,453,154	1,450	4,998,150
Apitong	1,200	4,136,400	1,150	3,964,050
Amuguis	1,260	4,343,220	1,188	4,095,036
Malagabi, Sacat, Calumpit	408	1,406,376	385	1,327,095
Hagachac	285	982,395	272	937,584
Total	12,839	44,256,033	12,201	42,056,847
Per hectare	31,725	.....	30,148	.....

TABLE XII.—*Yield in cubic meters on Narra type (1,395 hectares).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per hectare.	Total yield.	Average yield per hectare.	Total yield.
Narra	12.50	17,437.50	12.28	17,130.60
Lauan	62.55	87,257.25	59.03	82,346.85
Guijo	14.90	20,785.50	13.46	18,776.70
Apitong	11.03	15,386.85	10.49	14,633.55
Amuguis	12.08	16,851.60	11.36	15,847.20
Malagabi, Sacat, Calumpit	3.75	5,231.25	3.52	4,910.40
Hagachac	2.39	3,334.05	2.24	3,124.80
Total	119.20	166,284.00	112.38	156,770.10
Per acre	48.24	.....	45.48	.....

TABLE XIII.—*Yield in board feet on Hagachac I type (1,692 acres.)*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per acre.	Total yield.	Average yield per acre.	Total yield.
Hagachac	4,815	8,146,980	4,543	7,686,756
Lauan	4,526	7,657,992	4,298	7,272,216
Guijo	1,497	2,532,924	1,421	2,404,332
Amuguis	798	1,350,216	711	1,203,012
Malagabi, Sacat, Calumpit	198	335,016	158	267,336
Narra	135	228,420	131	221,652
Apitong	22	37,224	22	37,224
Total	11,991	20,288,772	11,284	19,092,528
Per hectare	29,629	.....	27,882	.....

TABLE XIV.—*Yield in cubic meters on Hagachac I type (685 hectares).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per hectare.	Total yield.	Average yield per hectare.	Total yield.
Hagachac	43.28	29,646.80	40.36	27,646.60
Lauan	42.42	29,057.70	39.94	27,358.90
Guijo	13.71	9,391.35	12.87	8,815.95
Amuguis	7.89	5,404.65	7.06	4,836.10
Malagabi, Sacat, Calumpit	1.89	1,294.65	1.48	1,013.80
Narra	1.35	924.75	1.31	897.35
Apitong	.24	164.40	.24	164.40
Total	110.78	75,884.30	103.26	70,733.10
Per acre	44.83	.....	41.79	.....

TABLE XV.—*Yield in board feet on Hagachac II type (2,000 acres).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per acre.	Total yield.	Average yield per acre.	Total yield.
Hagachac	4,078	8,156,000	3,942	7,884,000
Lauan	2,410	4,820,000	2,234	4,468,000
Amuguis	1,328	2,656,000	1,237	2,474,000
Guijo	333	666,000	310	620,000
Malagabi, Sacat, Calumpit	256	512,000	256	512,000
Total	8,405	16,810,000	7,979	15,958,000
Per hectare	20,768	.....	19,716	.....

TABLE XVI.—*Yield in cubic meters on Hagachac II type (810 hectares).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per hectare.	Total yield.	Average yield per hectare.	Total yield.
Hagachac	36.46	29,532.60	34.92	28,285.20
Lauan	22.90	18,549.00	21.35	17,293.50
Amuguis	12.60	10,206.00	11.70	9,477.00
Guijo	3.26	2,640.00	3.01	2,438.10
Malagabi, Sacat, Calumpit	2.37	1,919.70	2.38	1,919.70
Total	77.59	62,847.90	73.35	59,413.50
Per acre	31.40	.....	29.68	.....

TABLE XVII.—*Yield in board feet on mixed type (4,200 acres).*

Species.	Cutting to a diameter limit of 40 centim ters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per acre.	Total yield.	Average yield per acre.	Total yield.
Lauan	2,466	10,357,200	2,351	9,874,200
Guijo	1,267	5,321,400	1,201	5,044,200
Amuguis	721	3,028,200	655	2,751,000
Malagabi, Sacat, Calumpit	280	1,176,000	257	1,079,400
Total	4,734	19,882,800	4,464	18,748,800
Per hectare	11,697	.....	11,020	.....

TABLE XVIII.—*Yield in cubic meters on mixed type (1,700 hectares).*

Species.	Cutting to a diameter limit of 40 centimeters (16 inches).		Cutting to a diameter limit of 50 centimeters (20 inches).	
	Average yield per hectare.	Total yield.	Average yield per hectare.	Total yield.
Lauan	23.84	40,528	22.54	38,318
Guijo	11.88	20,196	11.13	18,921
Amuguis	6.92	11,764	6.27	10,659
Malagabi, Sacat, Calumpit	2.67	4,539	2.34	3,978
Total	45.31	77,027	42.28	71,876
Per acre	18.33	.....	17.11	.....

TABLE XIX.—*Total yield in board feet on Narra, Hagachac, and mixed types (11.339 acres).*

[Cutting to a diameter limit of 40 centimeters (16 inches).]

Species.	Narra type.	Hagachac I type.	Hagachac II type.	Mixed type.	Total yield.	Per cent.
Narra	4,305,303	228,420	.....	.....	4,533,723	4.48
Hagachac	982,395	8,146,980	8,156,000	.....	17,285,375	17.07
Lauan	23,629,185	7,657,992	4,820,000	10,357,200	46,464,377	45.90
Amuguis	4,343,220	1,350,216	2,656,000	3,028,200	11,377,636	11.24
Guijo	5,453,154	2,532,924	666,000	5,321,400	13,973,478	13.80
Apitong	4,136,400	37,224	.....	.....	4,173,624	4.12
Malagabi, Sacat, Calumpit	1,406,376	335,016	512,000	1,176,000	3,429,392	3.39
Total	44,256,033	20,288,772	16,810,000	19,882,800	101,237,605	100

TABLE XX.—*Total yield in board feet on Narra, Hagachac, and mixed types (11.339 acres).*

[Cutting to a diameter limit of 50 centimeters (20 inches).]

Species.	Narra type.	Hagachac I type.	Hagachac II type.	Mixed type.	Total yield.	Per cent.
Narra	4,219,128	221,652	.....	.....	4,440,780	4.6⅓
Hagachac	937,584	7,686,756	7,884,000	.....	16,508,340	17.2
Lauan	22,515,804	7,272,216	4,468,000	9,874,200	44,130,220	46
Guijo	4,998,150	2,404,332	620,000	5,044,200	13,066,682	13.6⅓
Amuguis	4,095,036	1,203,012	2,474,000	2,751,000	10,523,048	11
Apitong	3,964,050	37,224	.....	.....	4,001,274	4.2
Malagabi, Sacat, Calumpit	1,327,095	267,336	512,000	1,079,400	3,185,831	3.3⅓
Total	42,056,847	19,092,528	15,958,000	18,748,800	95,856,175	100

DESCRIPTION OF TREE SPECIES.

Narra (*Pterocarpus indicus*).—This tree occurs throughout the forest on the lowlands back of the large mangrove swamp near Daihagan Point. It is a tree of the newly made flats and is seldom found in the higher and older forest farther back. It is known on the market as Yellow Narra.

Narra is a low-branching, spreading tree, usually producing a bole with a merchantable length of from 8 to 10 meters, or about 30 feet. (Pl. VIII.) The bole is angular and irregular in cross section. The average diameter of trees over 40 centimeters (16 inches) is 73.86 centimeters (27.07 inches). Many of the logs of Narra, especially of he old trees, are defective at the center. Narra has wide, flat buttresses, from which

table tops from 5 to 6 feet in diameter are often taken. (Pl. IX.) It demands considerable light and is never found in dense clumps. Reproduction is poor, excepting in a few open places. It sprouts freely from the stumps, and logs lying upon the ground send out both roots and shoots. It could probably be propagated from cuttings planted in the wet season.

Narra is, without question, the most valuable timber found on the tract. The wood of Narra is moderately heavy, moderately hard, very durable, and is seldom if ever attacked by the white ant. It is especially valuable for cabinet work, and is also a valuable construction timber.

Hagachac (*Dipterocarpus lasiopodus*).—Hagachac is found on the higher, better-drained portions in the older forests, upon the flats, and the low foothills. Growing more or less in clumps, it is usually the predominant species in places where it is found.

Hagachac produces a tall, even bole (Pl. X), almost round in cross section. A tree of average height, with a stump diameter of 70 centimeters (28 inches), which was felled and measured, had a clear length of 30 meters to the first branch, at which place its diameter was 38 centimeters. Often higher trees than this are found. An average diameter of 66.31 centimeters (26.1 inches) was found for trees over 40 centimeters (16 inches) in diameter. The tree has few exterior defects, and is usually sound throughout. It is not usually strongly buttressed, although on old trees there is a large root swell. Hagachac seeds plentifully and reproduces as well or better in shady places than any other timber tree. The young saplings and poles grow rapidly and soon shoot up above the surrounding vegetation, where they receive an abundance of light. Hagachac has been but little cut and is sold under the name of Apitong.

Lauan (*Shorea contorta*).—This is the most widely distributed tree in the forest. It is found in limited numbers in every type of lowland forest, except the swamps, and is also present in the foothills.

Lauan has a tall and regular bole, reaching a height nearly equal to that of Hagachac. (Pl. XI.) The average diameter of Lauan trees over 40 centimeters (16 inches) in diameter upon the Hagachac type is 64.88 centimeters (24.42 inches) and upon the Narra type 67.28 centimeters (26.48 inches). The young trees of Lauan are little buttressed, but old trees often have very large ones.

Lauan is tolerant, reproducing in places where there is only a small amount of light. (Pl. XII.) Mature trees stand above the surrounding vegetation, and when very large are sometimes hollow or defective at the heart. Lauan is used in construction and inside work, but does not stand well in contact with the soil, and is often eaten by the white ant.

Guijo (*Shorea guiso*).—This tree (Pl. XIII) occurs over all of the low flat country and on lower hillsides, usually as scattered individuals. It is a tall-growing tree, having a clear length of 20 to 26 meters (65 to 85 feet). It reaches a diameter of 120 centimeters (47 inches.) The average diameter of Guijo trees over 40 centimeters (16 inches) in diameter upon the Hagachac type is 66.4 centimeters (26.26 inches) and on the Narra type 61.99 centimeters (24.4 inches). The tree has small or medium-sized buttresses, though many have no more than a large root swell. In favorable places reproduction is good. The wood of Guijo is moderately heavy and hard, strong, brittle, fairly durable, and usually free from defects. It is a good general-construction timber.

Amuguis (*Koordersiodendron pinnatum*).—In almost all of the moist flats and hillsides Amuguis grows as scattered trees throughout the forest.

Although not so tall growing as Lauan, Guijo, or Hagachac, it usually reaches above most of the surrounding trees, having a clear length of from 12 to 15 meters (39 to 49 feet). The bole is evenly tapered and nearly round in cross section. The average diameter on the Narra type for trees over 40 centimeters (16 inches) is 64.03 centimeters (25.2 inches) and on the Hagachac type 58.2 centimeters (25.16 inches).

While not so tolerant as many of its associates, it nevertheless will grow and reproduce in partially shaded places. Reproduction is usually good. Broken branches are not uncommon, and hollows in the trunks of larger trees are frequently found. Amuguis is a structural wood of medium quality that is fairly strong, brittle, moderately heavy, and hard. It is used in ordinary construction and in cabinetwork. When used for rails on the logging tramway it gave excellent satisfaction, proving to be the best of any timber tried.

Apitong (*Dipterocarpus* sp.).—This tree is found only in the lower half of the Narra type. Apitong has a tall, regular bole (Pl. XIV) and reaches a height of 30 meters (98 feet), with an average diameter for trees over 40 centimeters (16 inches) of 67.8 centimeters (26.69 inches.) The tree is quite tolerant when young, and in favorable places has a good reproduction. It is known locally as Apitong, by which name it is sold upon the market. It very closely resembles the true Apitong (*D. grandiflorus*) and apparently is as good for construction purposes.

Sacat, Calumpit, and Malagabi (*Terminalia* spp.).—The tree species Sacat (*Terminalia nitens*), Calumpit (*T. edulis*), and Malagabi (*T. pellucida*) are too widely scattered to be of any great importance commercially, although they are found over almost all parts of the tract. They are tall growing and usually of large diameter. The average diameter of *Terminalia* trees over 40 centimeters (16 inches) upon the Narra type was 66.44 centimeters (26.15 inches). Reproduction is not plentiful and the trees are evidently quite intolerant of shade.

Dao (*Dracontomelum mangiferum*).—Widely distributed over the whole tract, Dao is the predominant tree in some of the poorer grades of forest and a common one in nearly all. It reaches a height of from 12 to 20 meters (39 to 65 feet) to the lowest branches and a diameter of as much as 150 centimeters (59 inches). The average diameter of trees over 40 centimeters (16 inches) on the Hagachac type is 75 centimeters (30 inches); in the Narra forest, 77.94 centimeters (30.68 inches). It has the largest buttresses of any common tree in the forest. Reproduction is not plentiful, for the tree is intolerant. Although never used, the wood appears to be of good quality. This is the most promising tree which has not been commonly used for lumber purposes.

Malaguibuyo (*Celtis* sp.).—A commonly distributed tree, having an average diameter on the Hagachac type for trees over 40 centimeters (16 inches) of 55.23 centimeters (21.74 inches) and reaching a height of 10 meters (33 feet), this tree may possibly prove to be of value, although it has never yet been used.

Agupanga (*Chisocheton* sp.).—This tree is one of the most widely scattered of any, and seeds and reproduces rapidly. Comparatively low growing, with a spreading top, it nevertheless is quite tolerant of shade. It seldom reaches a large size and probably will never make a valuable commercial wood.

INJURIES TO WHICH THE FOREST IS LIABLE.

Of all the injuries to which the forest is subjected, by far the largest part comes either directly or indirectly as the influence of man. Chief among these are caiñgins and grass-land fires. Forest fires, in the usual acceptance of the term, are unknown.

Caiñgins.—As already mentioned under the description of the Calaanan type, it has long been the custom with the natives to enter the forest and to fell all of the trees upon a certain area at the commencement of the dry season. This area is burned over at the end of the dry season and planted to crops. Such a clearing is called a "caiñgin."

In times past the damage done by these caiñgins has been very great. A consultation of the map will serve to illustrate this. The Calaanan area has been formed in this way from what was probably at one time good forest. The stand and yield tables show the same things. With the exception of the Narra type, which has largely escaped because it is less accessible and lacks an equally good running water supply, the yield of timber has been greatly reduced by the numerous caiñgins made. The loss is much greater near to and upon the foothills of the mountains, where the primitive Mangyans have for a long time worked unrestricted. While the damages has in recent years been largely checked, it still continues.

Under present conditions the demand for caiñgins will probably continue, for they are regarded by the people as a necessary as well as a natural right. This demand may be met by allowing caiñgins to be made upon the Calaanan, and, in exceptional cases, upon the Guipa type. A careful patrol of the tract during the first part of the dry season for the purposes of granting caiñgin permits and to punish those making unauthorized caiñgins will, it is believed, greatly lessen and eventually check this evil.

Grass-land fires.—Practically all of the grass land upon the tract is burned over every spring and summer. In many places this effectually keeps out all the trees and in others does serious injury to the few that are present. In the river bottoms, which are annually flooded by the excessive rains, and upon the pastured grass land near the villages, fires are not so important, since this land will probably continue to remain grass land in any event, but, in other places unaffected by floods, fires have done a great deal of damage. With the present force, and under the present conditions, it will be impracticable to entirely prevent these fires.

Natural causes.—A few trees, especially those growing in the more open places, lose branches or tops from wind, but, as a rule, the damage done from this source is unimportant.

Insects and fungi are destructive mainly to felled timber, and often logs of the poorer kind that are left in the woods for any time are quite seriously attacked by insects or fungi, or by both. To avoid this damage, as well as to prevent the injury of the young growth which might spring up while they were left, these logs should be removed to some dry open place as soon after cutting as possible.

THE UTILIZATION OF THE FOREST.

TIMBER.

History of lumbering.—The license agreement of the Mindoro Lumber and Logging Company is dated June 3, 1905. Table XXI, computed from data taken from the company's books, shows the amount of timber that has been marketed from that time to July 1, 1906.

TABLE XXI.—*Timber sold by the Mindoro Lumber and Logging Company during the year ended June 30, 1906.*

Name.	In the log (round).		Name.	In the log (round).	
	English cubic feet.	Cubic meters.		English cubic feet.	Cubic meters.
Guijo	20,284.04	574.35	Pahutan	189.19	5.36
Narra	8,648.67	244.89	Pili	44.59	1.26
Lauan	5,822.66	164.88	Malugay	52.54	1.49
Apitong	2,612.65	73.97	Ipil	40.20	1.14
Amuguis	1,279.79	36.24	Others	328.68	9.31
Candol-candol	651.37	18.45			
Palo Maria	429.48	12.16	Total	40,560.56	1,148.50
Pagsahiñgin	176.70	5			

Timber sawn on tract by company's sawmill.

	Feet B. M.
Lauan	24,219
Amuguis	10,535
Apitong	5,611
Guijo	5,503
Narra	2,112
Total	47,980

In addition to this, a small amount of timber is still at the mill which, with the amount that has been used for construction purposes on the tract, is approximately equal to the quantity of sawn timber sold.

Previous to July 3, 1905, a number of individuals or companies have from time to time held this tract, or portions of it, together with some adjacent forest. In no case did these concessions coincide with the present one, hence it is impossible to state the exact amount removed from it. It is believed, however, that only a small amount of timber had been cut from the forest south of the Boñgabon River. North of the Boñgabon River a larger number of logs have been taken from the scattered timber lands near the Tidiangan and Sucol rivers. It is stated by the natives that in former times a great many logs had been sold from the barrio of Paclasan from territory now occupied by Calaanan and grass.

Present lumbering operations.—A very primitive method of logging, similar to that employed by native lumbermen, has been used by the present company. The trees are felled and chopped by Filipino laborers into lengths 3 to 6 meters (10 to 20 feet) long. For this work American axes are used, although occasionally saws are substituted. The logs are then loaded upon rude sleds similar to the logging "dray" of the United States, and dragged by a team of from six to eight carabaos to the mill or to some point along the tramway which leads to the beach. The rough trails over which this hauling was done are made by merely cutting away the underbrush. These roads are passable, except at the lowest places, at almost any season of the year. At the tramway the logs are loaded upon small cars drawn by one or two carabaos and hauled one at a time to the beach.

The cost of such operations as this can only be given approximately. Ordinary wages and costs are about as follows:

Manager	per month	₱150.00
Head foreman	do	40.00 to 60.00
Gang foreman	per day	1.00
Choppers	do	.75 to 1.00
Others laborers	do	.50 to .75
Carabao, with driver	do	1.50 to 1.75
Carabao, value	each	100.00 to 150.00

₱2=$1 United States currency.

Two men can fell and cut into logs from two to four medium-sized trees per day, or from 300 to 500 English cubic feet. A team of six to eight carabaos, with a driver for each animal, will haul from three to six logs per day for an average distance of half a mile. Two carabaos and their drivers will haul about four logs per day on the tram car from the mill to the beach, a distance of 1½ miles.

Working upon this rude basis, the cost of cutting and delivering at the beach by the present method will vary from ₱0.07 to ₱0.13 per English cubic foot, depending greatly upon the length of haul, management, and kind of timber cut. Counting an English cubic foot equivalent to 7.2 feet B. M.,[a] this would be a cost of from ₱9.75 to ₱18 per 1,000 board feet. Contracts are sometimes made to cut and deliver logs to the beach when the average distance is one-half mile at the rate of ₱2 per average log of 40 or 50 cubic feet, the contractor being supplied with carabaos by the owner. This would mean about ₱6 per M feet B. M. in addition to the rental of the carabaos. In other cases, the contractor supplies his own carabaos and received from ₱0.08 to ₱0.10 per English cubic foot, or about ₱12 per M feet B. M. for logs delivered on the beach.

The present cost of logging could be greatly reduced by more careful organization and by providing cheaper methods of transporting the logs from the forest to the beach, which is by far the largest single item of expense. To do this it is suggested that iron rails be used upon the tramway, instead of wooden ones. This would permit the hauling of several logs instead of one at a time, would avoid breakage of rails and cars, and would greatly reduce the draft, thus permitting more trips per day. It is also suggested that wide-tired, two-wheeled logging carts be tried instead of the logging sled. These have a lighter draft, and, where tried in other parts of the islands, have given excellent satisfaction. A steam logging and skidding outfit, including two donkey engines and 2 miles of cable, could be used upon the tract and would greatly reduce the cost of logging.

A portable sawmill, having a capacity of about 10,000 feet B. M. per day, has been placed upon the tract. Owing to difficulties incident to the installation of this mill, it has not yet been operated sufficiently to allow any estimate of the cost of running.

In addition to the regular logging operations, the present company has cut a number of table tops from the large flat buttresses of Narra trees. These can be removed with saws and axes and can be secured up to 6 feet in diameter. Usually the buttresses vary from 4 to 12 inches in thickness, and may be hewed to an even thickness of about 3 inches. One of these tops, which measured 6 feet in diameter and 3 inches in thickness, was removed under the direction of the field party at a cost of a little less than than ₱18. In this case, the men were hired for this work alone. With a regular organized force, the cost should be reduced about one-half.

Markets and transportation.—Practically all of the logs and lumber is sent to Manila by means of steamers or sailboats. The cost of shipment from the tract to Manila (distance 200 miles) varies from ₱0.18 to ₱0.25 per English cubic foot, which would be, counting an English cubic foot equal to 7.2 feet B. M., ₱25 to ₱34.72 per M feet B. M. The cost of transportation is slightly less upon sailing vessels than upon steamers. The logs are floated to the ships, which, on account of the shallow water, are required to anchor nearly one-quarter of a mile from shore. The regular charge for this is ₱0.50 per log, which amounts to about ₱0.01 per English cubic foot, or ₱1.39 per M feet B. M. Weather conditions are an important factor to be considered in connection with transportation. Sometimes storms delay loading, hinder transit, or affect the shipper very seriously in a number of ways.

The following are the average prices now paid in Manila for logs and for sawn timber:

Name.	Per English cubic foot in the log.	Per Spanish cubic foot in the log.	Per M feet B. M., sawn timber.	Stumpage charges per M feet B. M. (United States currency).
Yellow Narra	₱0.92–₱1.05	₱0.70–₱0.80	₱225–₱275	$5.00
Hagachac	.46– .48	.35– .37	90– 115	1.00
Lauan	.39– .46	.30– .35	70– 90	1.00
Amuguis	.52– .98	.40– .75	110– 150	2.00
Guijo	.65– .85	.50– .65	98– 140	3.00
Apitong	.46– .48	.35 .37	90– 115	2.00
Sacat	.52– .98	.40– .75	100– 150	2.00

[a]Measurements made by the Gibson's Saw and Planing Mills Company upon a few Narra logs that were sawn with a band saw showed the following facts: Forty-three logs, containing 41.81 cubic meters (1,476.58 English cubic feet), yielded 15,199 feet B. M. of lumber not edged. Allowing for a waste in edging of 20 per cent, this would be a yield of 290.81 feet B. M. per cubic meter, or 8.24 feet B. M. per cubic foot. The above factor of 7.2 feet B. M. per cubic foot is therefore conservative.

Financial results and prospects.—Summarized, the cost, exclusive of taxes or stumpage charges of logging and delivery in Manila, should not exceed the following:

	Per English cubic foot.
Cutting and delivering on the beach	₱0.07 to ₱0.13
Loading upon shipboard	.01 to .01
Shipping to Manila	.18 to [a].25
Wages of officials, breakage, etc	.02 to .02
Total	.28 to .41

This cost, as with the calculations throughout, is estimated regardless of the groups to which the logs belong. As a matter of fact, it costs slightly more to remove Narra than other kinds of timber, for the trees are lower growing and the logs harder to handle on account of their angular shape. With the other kinds of timber there is but little difference in the cost of handling.

Taking into account the stumpage charges, the cost of delivery, and the selling prices, it will be seen that there is an excellent profit to be made upon the higher-group timbers, and a fair one upon all, even with the primitive methods in use. With improved methods and equipment, the cost should be so reduced that an assured profit could be made upon all timber taken from the forest.

MINOR PRODUCTS.

Firewood.—Almost all the trees which compose the thick mangrove swamps of the coast make an excellent firewood. Firewood is commonly cut into two general sizes. The small sizes, called "leñas," are less than 2 feet in length and 3 inches in thickness. The other size, known as "rajas," are about 5 feet in length and not over 6 inches in thickness. It costs from ₱6 to ₱9 to gather 1,000 rajas, while the Manila price varies from ₱20 to ₱50. The market prices and cost of gathering leñas is correspondingly less. The forest tax on rajas is ₱1 per 1,000 feet and on leñas ₱0.10 per cubic meter. As yet but little firewood has been cut from this tract, although the supply is very large.

Tan barks and dye barks.—The bark of a number of the mangrove-swamp trees is valuable both for tanning and dyeing. As previously stated, the general terms of Bacauan (Bacao) and Tañgal are applied to many species of the *Rhizophoraceæ*. Another species, Tabigue, produces a good quality of dye bark and is very common. Tan bark and dye bark are generally sold in bundles composed of pieces 3 feet long and 3 or 4 inches wide, weighing 1 picul (139.4 English pounds). The Manila price is about ₱2 per picul, while the local selling price is about ₱0.75 per picul.

Bejucos.—Large quantities of bejuco, or rattan, are found in the forest. These vary considerably in value, the smaller ones being usually the best. These are usually cut into lengths 6 meters long and tied into bundles of from 50 to 100 pieces each. One man with a bolo can cut and prepare in one day about 6 bundles of 50 pieces each.

Other minor products.—The leaves of the Nipa palm are very commonly used locally for roofing and thatching, but as yet little has been marketed.

The young leaves of the Buri palm are gathered just before they open, spread out in the sun, and allowed to wilt for about two days. They are then made into rolls, each about 1 foot in diameter and 2 inches thick, and used for making baskets, hats, mats, etc. The market for this product is as yet but little developed. The local selling price is ₱2.50 for 100 rolls.

The sap of the Pili and Pagsahiñgin is gathered after slashing the trees with a bolo and leaving the resin until it hardens. It is then made into torches of convenient size by wrapping in Anahao leaves. These are commonly used by the natives for lights, and sold locally for ₱0.02 each. The resin of Pili has the market name of Manila Elemi, and is a commercial product from some portions of the islands.

A number of vines, classed under the general name of Gogo, are gathered in pieces about 1 meter long, and sold locally for ₱3.50 per 100 pieces. These are pounded into a pulp and used as a soap for washing the hair. The principal species which produces this product is *Entada scandens* Benth.

A number of vines under the general name of Diliman are gathered and used in tying fish traps and other similar articles. The fruit of the Bongan gubat palm (a wild betel nut) is chewed by the natives very generally. The heart of the Yroc palm is commonly used for food, and has a taste very much like fresh cabbage. A flour called "Yuro" is also made from this palm. The leaves of the Yroc palm make excellent brooms, and are much used locally. Many other less important minor products are secured by the natives, and are locally of value.

[a] These figures, obtained from shippers, are thought to be high.

AGRICULTURAL POSSIBILITIES.

The soil over the larger part of the tract is well adapted to agricultural purposes. Table XXII contains a summary of the analyses of twenty-three soil samples taken from twelve widely separated places on the flat portion of the tract.

TABLE XXII.—*Chemical analysis of soil.*[a]

Sample.	Number of samples taken.	Loss on ignition.	CaO.	P_2O.	N.	K_2O.	Na_2O.	Fine earth through 40 mesh.
Surface to 20 centimeters (8 inches)	9	8.08	0.50	0.10	0.25	0.53	0.16	94.9
Subsoil from 20 to 120 centimeters (8 to 47 inches)	9	3.79	.48	.06	.06	.33	.25	95.9
Subsoil below 120 centimeters (47 inches)	5	3.73	1.01	.03	.03	.26	.21	91.1

[a] By L. A. Salinger, chemist, bureau of science, Manila, P. I.

While too much reliance should not be placed upon any chemical analysis of soils as an indication of their fertility, it is to be noted that the amount of nitrogen (N), phosphoric acid (P_2O), and potash (K_2O) found here is sufficient, under ordinary conditions, to supply the needs of plant growth, and compares favorably with analyses from other places. The vegetation, both cultivated and wild, is everywhere rank and dense, indicating that a sufficient quantity of this plant food is in an available form.

With few minor exceptions, the soil over the whole tract resembles quite closely that of the samples taken. Usually, the surface soil is from 5 to 25 centimeters (2 to 10 inches) in depth and contains a considerable amount of humus. A clay or sandy clay subsoil reaches to a depth of from 75 to 200 centimeters (28 to 78 inches). Below this no investigations were made.

Of equal importance is the question of rainfall and drainage. As already stated, the rainfall in this place is well distributed throughout the year. At no time during the dry season, while field work for this report was being done, was the soil dry, except at the surface in exposed situations or in pure sand or gravel. There is in most places a sufficient quantity of sand mixed with the clay to allow for drainage.

Probably the most suitable crop is Manila hemp or abaca. Considerable quantities of this have already been planted. In the foothills cacao is raised by the Mangyanes with success. Cocoanuts, rice, sugar cane, tobacco, corn, and various vegetables are the other principal crops.

PART II.

FUTURE MANAGEMENT.

BASIS OF PROPOSALS

RELATION BETWEEN OWNER AND LICENSEE.

The public forest on this tract is owned by the Philippine government and is in the charge of the bureau of forestry. It is held by the Mindoro Lumber and Logging Company under a twenty-year license agreement. This agreement grants them the exclusive right to cut, collect, and remove timber, firewood, and bejuco on the condition that they make use of their license privilege, pay the regular government charges on the products taken, and follow the bureau of forestry rules and regulations for gathering them.

It is important to the licensee, as well as to the bureau of forestry, that provision be made for a future yield from the tract.

SUMMARY OF STAND AND YIELD.

A review of Tables VI, VII, VIII, and IX shows that the heaviest stands are upon the Narra tract, with that upon the Hagachac type next. Of the timber trees, Lauan stands first, 46 per cent of the total yield; Hagachac second, 17 per cent; Guijo third, 13 per cent; Amuguis fourth, 11 per cent; Narra and Apitong, about 4½ per cent each, and *Terminalia* sp. less than 4 per cent.

It is thus noted that while the cheaper timber predominates, the total quantity of Guijo, Amuguis, and Narra constitute 28 per cent of the whole.

Altogether, the total yield of timber trees over 50 centimeters (20 inches) in diameter from the 11,339 acres estimated, is 95,856,175 feet B. M. If the sawmill were run at its full capacity of 10,000 feet B. M. per day, this amount, which includes only the seven species now being cut, is sufficient to last thirty-two years of 300 working days each. In addition to these kinds, there are a great many large trees of other species, some of accepted commercial value, which would no doubt be utilized by any permanently located lumber company. By the time the present stand is removed the poles and trees under 50 centimeters (20 inches) would in all probability supply a second crop.

METHOD OF TREATMENT.

OBJECT TO BE ATTAINED.

The object in view for the commercial forest area is (1) to regulate the cutting of timber in such a manner that the mature trees, together with such others as is consistent with good management, may be removed from the forest as soon as possible; and (2) to retain in the forest the young stock, and, if necessary, seed trees, and to assist natural reproduction so that future crops can be provided for.

The object in view for the noncommercial forest is (1) to supply the demand for agricultural lands, either as caingins or in some other form; and (2) to convert as much as possible of the Guipa type into commercial forests.

METHOD OF TREATMENT ADOPTED.

Owing to the lack of definite knowledge of the age of trees and of their habits of growth, and to the conditions under which this plan must be put into operation, the selection system of felling is the one which will be used for the commercial forest. The fellings should be so regulated as to remove all old and overmature trees, to protect the young growth, and to aid in every possible way natural regeneration.

EXPLOITABLE SIZE.

Since there are a large number of mature and overmature trees in the commercial forest which should be cut as soon as possible, the exploitable size of the trees has been fixed at 50 centimeters (20 inches) in diameter. Trees below that diameter should only be cut when marked by the forester in charge, and then only when the mature trees have been removed or when an especially heavy stand will admit of thinning.

Table XXIII, compiled from the stand tables previously given, shows the number of trees over 50 centimeters (20 inches) in diameter, compared with the number from 10 centimeters (4 inches) to 50 centimeters (20 inches) in diameter.

TABLE XXIII.—*Summary of stand of principal trees per acre.*

Species.	Narra type.			Hagachac type.		
	Diameter.		Total.	Diameter.		Total.
	10-50 centimeters (4-20 inches).	Over 50 centimeters (20 inches).		10-50 centimeters (4-20 inches).	Over 50 centimeters (20 inches).	
Narra	1.153	1.803	2.956	0.087	0.201	0.288
Lauan	8.537	4.698	13.235	4.719	3.538	8.257
Guijo	3.035	1.190	4.225	1.725	1.064	2.789
Hagachac	.411	.126	.537	6.159	3.106	9.265
Amuguis	1.994	1.619	3.613	1.726	1.122	2.848
Apitong	2.008	.836	2.844	.143	.057	.200
Malagabi, Sacat, Calumpit	.497	.436	.933	.546	.230	.776
Total	17.635	10.708	28.343	15.105	9.318	24.423

LOGGING.

Cutting areas.—Cutting areas should conform as nearly as possible to the wishes of the licensee. When, however, cuttings shall have been started from any one base and over an area approved by the forester in charge, it shall not be carried on outside of that area without the consent of the forester in charge or of the Director of Forestry.

For the present, logging operations should be continued from the present base until the north end of the Narra and adjacent parts of the Hagachac types shall have been cut over. Operations should then be started from the Dungay River as a base and a tramway extended back through the south end of the Narra type and the narrow strip of Hagachac adjoining it. The work upon this being completed, the remainder of the Narra and of the Hagachac I forests should be logged. Next, the tract designated on the map as Hagachac II should be cut, and, last of all, the mixed forest. In every case cutting on one part should be finished before it is commenced on the next. Thus a very primitive rotation is established, and, by the time the last area is cut over, the large poles and younger trees left upon the first part worked should be ready for a second crop.

Cutting rules.—(1) Felling of trees shall be permitted only over such areas as are approved by the forester in charge or by the Director of Forestry. In assigning cutting areas the forester shall follow as nearly as possible the plan suggested in the paragraph headed "Cutting areas."

(2) No Narra trees shall be felled except those marked by the district forester.

(3) No timber trees shall be felled which are less than 50 centimeters (20 inches) in diameter at breast height or, in cases of trees having buttresses at the lowest place, above the buttress swell, unless marked by the district forester.

(4) In cutting marked timber the marks upon the stumps shall not be destroyed or effaced.

(5) Trees shall not be cut higher above ground than the diameter of the tree, except in cases of trees having buttresses, which may be cut above the highest buttress.

(6) Buttresses shall not be cut for table tops or for any other purpose from any living tree.

(7) All merchantable timber shall be removed from the forest within two months from time of felling and placed upon some suitable skidway or landing.

(8) The licensee shall be held responsible for the destruction of, or serious injury to, young timber trees by careless felling and for all merchantable timber left in the woods.

(9) No Narra, Lauan, Amuguis, Guijo, Hagachac, Apitong, or other trees of equal value shall be used for the construction of roads or skidways.

(10) Minor species may be cut and used for the construction of roads, skidways, etc., without charge.

(11) None of these special rules shall be construed to excuse the licensee from the regular bureau of forestry rules and regulations or from the terms of the license agreement.

SUPPLEMENTARY RECOMMENDATIONS.

GENERAL MANAGEMENT.

All timber trees marked by the district forester shall be stamped in at least two places with the regulation marking hatchet in addition to such other distinctive marks as he may see fit to use. These marks shall be placed below where the tree is to be cut in felling.

If a reasonable advantage is not taken of the privilege to gather firewood and bejuco by June 30, 1907, the exclusive right to remove these products should be taken from the company and licenses to gather said products granted to such other party or parties as may apply for them.

PROTECTION.

Since the proper protection of the forest depends so much upon the attitude of the local inhabitants, every legitimate effort should be made by the forest officers to gain their confidence and cooperation.

A forest officer should go over the entire tract at the beginning of the dry season and see that all persons desiring caiñgin permits be granted them if they can not be persuaded to make homestead applications. The local inhabitants look upon the making of caiñgins as a natural right. Hence, it is deemed preferable to attempt to regulate caiñgins than to forbid them entirely. Every effort should be made to encourage the taking of homesteads and the occupying of permanent farms. Inspection should be made during the caiñgin season to locate and punish all persons violating the caiñgin law.

At present it will be impracticable to prevent the annual fires which burn over the grass lands, although forest officers should make every effort to gain the cooperation of the local inhabitants in preventing damage from this source.

REVISION.

As additional information is gained from time to time, the plan of management should be revised whenever such a revision will add to its effectiveness. A careful examination should be made of the tract south of the Baroc River and west of the small Uasig River some time within the next five years.

ADMINISTRATION.

The chief of the forest district in which the tract lies shall have charge of the administration of this working plan. He shall be assisted by such other forest officers who are under his direction as he shall assign to this work.

The district chief, or a subordinate, shall make trips of inspection to the tract whenever it is necessary to mark timber or to perform other duties. In addition to these periodic inspections, a forest ranger shall be placed upon the tract for such time as may be necessary during the caiñgin season to grant caiñgin permits, to prevent illegal caiñgins, and to perform such other duties as may arise regarding the regulation of caiñgins, as well as to report upon any special subject which the district forester may direct.

In cases of violation of the forest act or rules and regulations of the bureau, either by the licensee or by any other persons or persons, the forester in charge shall take the matter up with the offending parties in the manner authorized by law for such cases. He shall then report the facts to the Director of Forestry. The forester in charge shall render a special report of work done upon the tract at the end of each fiscal year.

SUMMARY.

(1) Practically all of the commercial forest on the tract examined lies south of the Boñgabon River.

(2) Narra is confined to a belt of forest varying from one-half to 2 miles in width immediately back of the tidal swamp.

(3) The timber on the foothills at the back part of the tract has been greatly diminished in value and in some places almost entirely destroyed by Mangyan clearings.

(4) The flat land of the tract is, for the most part, suited for agricultural purposes and will no doubt be eventually so used.

(5) The land south of the Boñgabon River, which contains commercial or Guipa types of forest, should be made to produce a second crop. The land north of the Boñgabon River will probably not be reforested, except a part of the Guipa type, but will be used for agricultural purposes.

(6) Caiñgin permits should be granted only upon the Calaanan land, after a personal inspection by a forest officer.

(7) The greatest source of expense in present lumbering operations is transportation. This could be reduced by providing a more permanent tramway, by installing a donkey engine and cable, or by using big-wheeled logging carts.

APPENDIX.

LIST OF PLANTS.

The first of the following tables is a list of tree species found on the tract that reach the size of 30 centimeters or over in diameter. The second list comprises all other species mentioned in the text, and includes some trees that are below 30 centimeters in diameter when mature. The first list of 88 tree species is fairly complete. In the second list no attempt has been made to enumerate all species under this size found in the forest. Compared with the *Dipterocarp* forest of northern Negros,[a] the floristic composition of this forest is very complex.

The scientific nomenclature used in this paper is based on collections made by the authors and deposited in the herbarium of the Bureau of Science. They wish to thank Elmer D. Merrill for assistance in the determinations.

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[a] See Everett, H. D., and Whitford, H. N.: A Preliminary Working Plan for the Public Forest Tract of the Insular Lumber Company, Negros Occidental, P. I., *Bur. For. Bull. No. 5*, 1906.

Tree species 30 centimeters and over in diameter when mature.

Scientific name.	Family.	Local name.	Commercial name.
Actinodaphne philippinensis Merr	Lauraceæ	Bacan	
Alangium meyeri Merr	Cornaceæ		
Alstonia macrophylla Wall	Apocynaceæ		Batino.
Artocarpus communis Forst	Moraceæ	Antipolo	Antipolo.
Avicennia officinalis L	Verbenaceæ	Apiapi	
Barringtonia luzonensis Vid	Lecythidaceæ	Putat	
Barringtonia racemosa Bl	do	do	
Barringtonia reticulata Miq	do	do	
Barringtonia speciosa Forst	do	Botong	
Bischofia trifoliata Hook	Euphorbiaceæ	Toog	
Buchanania nitida Engl	Anacardiaceæ		
Canangium odoratum Baill	Anonaceæ	Alangilang	Ylang ylang.
Canarium luzonicum A. Gray	Burseraceæ	Pili	Pili.
Canarium perkinsae Merr	do		
Canarium radlkoferi Perk	do		
Canarium villosum Bl	do	Palsahiñgin	Pagsahiñgin.
Calophyllum inophyllum L	Guttiferæ	Palomaria	Palomaria de la playa.
Carallia integerrima DC	Rhizophoraceæ	Bacauan gubat	
Casuarina equisetifolia Forst	Casuarinaceæ	Agoho	Agoho.
Celtis sp	Ulmaceæ	Malaguibuyo	
Champereia cumingiana Merr	Opiliaceæ		
Chisochiton tetrapetalus Harms	Meliaceæ		
Chisocheton sp	do	Agupanga	
Cryptocarya acuminata Merr	Lauraceæ	Malabacauan	
Dehaasia triandra Merr	do	Baslayan	
Dillenia philippinensis Rolfe	Dilleniaceæ	Catmon	Catmon.
Diospyros pilosanthera Bl	Ebenaceæ	Bolongeta	Bolongeta.
Dipterocarpus lasiopodus Perk	Diptocarpaceæ	Hagachac	Apitong.
Dipterocarpus sp	do	Apitong	Do.
Dracontomelum mangiferum Bl	Anacardiaceæ	Dao	Dao.
Dracontomelum sp	do	Malugay	Malugay.
Elaeocarpus oblongus Gaertn	Elaeocarpaceæ		
Endiandra coriacea Merr	Lauraceæ	Palusat saling	
Erythrina indica Lam	Leguminosæ	Dapdap	
Eugenia bordenii Merr	Myrtaceæ		
Eugenia sp	do		
Euphoria cinerea Radlk	Sapindaceæ	Alupay	Alupay.
Fagara integrifolia Merr	Rutaceæ	Salay	
Ficus barnesii Merr	Moraceæ	Tibig	
Ficus nota Merr	do	do	
Ficus minahassæ Miq	do	Hagaimit	
Ficus variegata Merr	do	Tangisang bayauac.	
Ficus sp	do	Balete	
Gonystylus bancanus Gilg	Gonystylaceæ	Talimadon	
Grewia stylocarpa Warb	Tiliaceæ		
Heritiera littoralis Dry	Sterculiaceæ	Dungon-late	Dungon-late.
Horsfieldia ardisifolia Warb	Myristaceæ	Duguan	
Horsfieldia merrillii Warb	do	do	
Intsia acuminata Merr	Leguminosæ	Tindalo	Tindalo.
Kayea paniculata Merr	Guttiferæ		
Koordersiodendron pinnatum Merr	Anacardiaceæ	Amuguis	Amuguis.
Lauraceæ indet	Lauraceæ	Punghan	
Litsea perrottetii F. Vill	do	Bacan	
Litsea sp	do	Busising cahoy	
Macaranga bicolor Muell	Euphorbiaceæ	Tabong	
Macaranga tanarius Muell	do	Binunga	
Mallotus barnesii Merr	do		
Mangifera altissima Blanco	Anacardiaceæ	Pahutan	
Myristica philippinensis Lam	Myristicaceæ	Duguan	
Neolitsea vidalii Merr	Lauraceæ	Lanotan puti	
Octomeles sumatrana Miq	Datisaceæ	Binuang	
Palaquium luzoniense Vid	Sapotaceæ	Nato	
Parkia roxburghii G. Don	Leguminosæ	Cupang	Cupang.
Pisonia umbellata Seem	Nyctaginaceæ	Anuling	
Pithecolobium lobatum Benth	Leguminosæ	Bansilac	Anagap.
Pterocarpus indicus Willd	do	Narra	Yellow Narra.
Pterosperumu niveum Vid	Sterculiacæ	Bayog	
Pterocymbium tinctorium Merr	do	Taloto	Taloto.
Pygeum latifolium Miq	Rosaceæ		
Radermachera banaibana Seem	Bignoniaceæ	Banaibanai	
Sarcocephalus cordatus Miq	Rubiaceæ	Bancal	Bancal.
Shorea contorta Vidal	Dipterocarpaceæ	Lauan	Lauan.
Shorea guiso Bl	do	Guijo	Guijo.
Sonneratia pagatpat Blco	Sonneratiaceæ	Pagatpat	Pagatpat.
Sterculia blancoi Rolfe	Sterculiaceæ	Candol-candol	Candol-candol.
Sterculia foetida L	do	Calumpang	
Sterculia philippinensis Merr	do	Banilad	
Stylocoryne macrophylla Bartl	Rubiaceæ	Basa	
Terminalia catappa L	Combreteceæ	Talisay	Talisay.
Terminalia edulis Bl	do	Calumpit	Calumpit.

Tree species 30 centimeters and over in diameter when mature—Continued.

Scientific name.	Family.	Local name.	Commercial name.
Terminalia nitens Presl	Combreteccæ	Malaruhat	Sacat.
Terminalia pellucida Presl	do	Malagabi	
Toona sp	Meliaceæ	Calantas	Calantas.
Trewia ambigua Merr	Euphorbiaceæ		
Xylocarpus granatus Koenig	Meliaceæ	Tabigue	
Xylocarpus obovatus Juss	do	do	
Xylopia dehiscens Merr	Anonaceæ		

Other species mentioned in the text.

Scientific name.	Family.	Local name.	Commercial name.
Acanthus ilicifolius L	Acanthaceæ	Doloarin	
Achrostichum aureum L	Polypodiaceæ	Lagolo	
Areca whitfordii Becc	Palmæ	Bongan gubat	
Arenga saccharifera Labill	do	Yroc	
Bruguiera gymnorrhiza Lam	Rhizophoraceæ	Pototan	Bacauan.
B. caryophylliodes Bl	do	Liray	
B. eriopetala W. and A	do	Pototan Busian	
B. parviflora W. and A	do	Jangalai	Hangaray.
Callicarpa blancoi Rolfe	Verbenaceæ		
Callicarpa erioclona Schauer	do		
Callicarpa formosona Rolfe	do		
Caryota sp	Palmæ	Pugahan	
Ceriops candolleana Arn	Rhizophoraceæ	Tangal	Tangal.
Ceriops roxburghiana Arn	do	do	
Clerodendron macrostegium Sch	Verbenaceæ		
Corypha umbraculifera L	Palmæ	Buri	
Cycas circinalis L	Cycadaceæ	Bitogo	
Cyclostemon microphyllus Merr	Euphorbiaceæ	Butong manoc	
Entada scandens Benth	Leguminosæ	Gogo	Gogo.
Ficus hauili Blanco	Moraceæ	Hauili	
Ficus banesii Merr	do	Tibig	
Ficus mindorensis Merr			
Heterospathe elata Scheff	Palmæ	Sagasi	
Hibiscus tiliaceous L	Malvaceæ	Balabago	
Imperate exaltata Brongn	Gramineæ	Cogon	
Laportea meyeniana Ward	Urticaceæ	Lipa	
Livistona sp	Palmæ	Anahao	Palma brava.
Macaranga hispida Muell	Euphorbiaceæ	Hamindan	
Mallotus floribundus Muell	do	Tula-tula	
Mallotus moluccanus Muell	do	Alom	
Mallotus playfairii Hemsl	do		
Mallotus ricinoides Muell	do		
Mussænda grandiflora Rolfe	Rubiaceæ		
Nipa fruticans Wurmb	Palmæ	Nipa	Nipa.
Pandanus tectorius Sol	Pandanaceæ	Pandan	
Phæanthus cumingii Miq	Anonaceæ	Lanotan	
Phragmites sp	Gramineæ	Tagpo	
Pinanga insignis Becc	Palmæ	Sarauag	
Rhizophora mucronata Lam	Rhizophoraceæ	Bacauan	Bacauan.
R. conjugata L	do	do	Do.
Saccharum spontaneum L	Gramineæ	Talahib	
Scyphiphora hydrophyllacea Gaertn	Rubiaceæ	Nilad	
Trema amboinense Bl	Ulmaceæ		
Voacanga cumingii Rolfe	Apocynaceæ		

BUREAU OF FORESTRY.

(Circular No. 1.)

OPPORTUNITIES FOR LUMBERING IN THE PHILIPPINE ISLANDS.

MANILA, P. I., *December 1, 1906.*

OWNERSHIP OF FORESTS.

The Philippine public forests cover an area of more than 40,000,000 acres. Less than half a million acres of forest are held by private owners. Under an act of Congress in 1902 the Philippine forests can not be sold, leased, or homesteaded unless the same are more valuable for agriculture than for forest purposes.

LICENSES TO EXPLOIT THE PUBLIC FORESTS.

Exclusive licenses may be granted for terms up to twenty years. These give the holders sole right to exploit certain forest products. The extent of the territory thus granted depends upon the size of the plant to be installed. No charge is made for such a license, and only stumpage charges are imposed. These charges range from ₱0.50 to ₱2.50 per cubic meter, or approximately from $1 to $5 (United States currency) per thousand feet B. M. Such an arrangement is preferable to buying the land, since no land taxes are incurred. There are a number of desirable tracts of public forest of large extent now unexploited.

TARIFF RATES.

There are no export duties on timber or on the manufactured product. Logs imported into the United States are admitted free. The import duty at Manila on sawmill and logging machinery is 5 per cent ad valorem.

FREIGHT RATES TO MARKET.

Freight rates from Manila to the Pacific coast amount to $7 (United States currency) per ton (logs), about 40 cubic feet, or $12 to $14 per thousand feet B. M. Freight rates from Manila to the Atlantic coast of the United States are $14 to $15 (United States currency) per thousand feet B. M., or $8 per ton of 40 cubic feet; light-weight material, $5 per 40 cubic feet.

Distances to market.

Distance from—	Manila, P. I.	Cebu, P. I.	Iloilo, P. I.	Hongkong, China.	Shanghai, China.	Sydney, Australia.
	Miles.	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*
Seattle, U. S. A.	6,400			6,300	6,200	6,800
Cadiz, Negros Occidental	400	140	70	800	1,300	3,370
Bongabon, Mindoro	200			700	1,200	3,570

CONSUMPTION OF LUMBER.

	Board feet.
Amount of lumber used in the Philippine Islands per year, approximately	100,000,000
Amount of American pine used in China during the past year	85,000,000
Amount of American pine used in Australia during the past year	63,000,000

PHILIPPINE TIMBERS.

In Bulletin No. 4 of the bureau of forestry thirty common Philippine timbers are discussed. In this bulletin extensive tests show the qualities of the timbers. There is also a brief description of the different woods. Common Philippine timber as good as American pine can be laid down at tide water for about the same price as pine on the Pacific coast. Difference in freight rates, low stumpage, and cheap labor should combine to make a low rate on the manufactured Philippine product in the Chinese and Australian markets and should gradually replace the American product.

STAND OF TIMBER.

In Bulletins Nos. 5 and 6 can be obtained the actual stand of timber on tracts in Negros and Mindoro. These show 10,000 to 32,000 board feet per acre. The lower slopes of Mount Silay in northern Negros are practically covered with merchantable timber. One block of this forest, 69 square miles in area, shows a stand of 32,050 board feet per acre of merchantable timber over 20 inches in diameter. A large area of similar forest on Mount Silay adjoins this tract and awaits the lumberman. In the southwestern part of this province (Negros Occidental) is a large area of valuable forest which will be close to the southern terminus of the new railway.

There are a number of regions in these islands where dense forests of valuable timber are found which have never been exploited for the market. The Agusan Valley, in Mindanao, 4,000 square miles in area, is almost entirely covered with virgin forest and drained by large streams. The dense forests on the east coast of Mindanao are also unexploited.

LABOR PROBLEM.

Labor is not difficult to secure. The wages range from ₱0.50 to ₱1.50 ($0.25 to $0.75, United States currency) per day. Filipinos are apt at handling machines of all kinds and work satisfactorily when treated with consideration. Skilled American loggers and lumbermen, assisted by Filipino crews, should get out logs and manufactured material at prices not far from those quoted for pine on the Pacific coast, especially in regions where we find 30,000 board feet of merchantable timber on each acre close to tide water, and where no special logging difficulties are encountered.

LOGGING.

Logging is carried on during the entire year in many provinces. In some places logging is suspended during the seasons of heaviest rains, a period of from two to four months. The logging methods are very crude.

Many of the native woods will float, and, if handled by the expert raftsmen of the Pacific coast, could be rafted 200 to 600 miles through the quiet inland seas to Manila, and possibly to China, which is about 660 miles from Manila. Not one of the lumber companies of the Pacific coast is actively interested in exploiting the Philippine forests.

LUMBER DEALERS.

The leading lumber dealers in the Philippine Islands are: John Gibson, Insular Lumber Company, Cadwallader & Co., Philippine Lumber and Development Company, Tuason & Sampedro, California-Manila Lumber and Commercial Company.

The offices of these companies are in Manila. For discussion of sawmills see Bulletin No. 4.

CAPITAL NECESSARY TO ESTABLISH LUMBERING OPERATIONS.

The question is often asked, "What capital is necessary to carry on a successful lumbering enterprise in the Philippines?" Such an enterprise should not be attempted unless the company intends to handle the product from start to finish, including transportation, lumber yards at the principal markets, supply stores for use of employees in the forest, etc. This would probably involve the employment of not less than $200,000 (United States currency). A company contemplating logging operations should send a practical logger to look over the ground with an officer of the bureau of forestry.

SUMMARY OF LUMBERING POSSIBILITIES ON ONE TRACT OF PUBLIC FOREST IN NEGROS OCCIDENTAL.

In Bulletin No. 5 of the bureau of forestry a description is given of the forests and lumbering operations near Cadiz, Negros Occidental. The summary of this bulletin is as follows:

Area of tract, 69 square miles; area in forest, 37,668 acres.

Stumpage charges on this tract are collected on manufactured lumber and average less than $1.20 (United States currency) per thousand feet B. M.

Six tree species constitute about 90 per cent of the total stand of merchantable timber on the entire tract.

Amount and value of merchantable timber on tract over 20 inches in diameter.

Species.	Stumpage charge, M feet B. M. (approximate).	Feet B. M. per acre.	Total yield, M feet B. M.	Manila price, M feet B. M.	Value per acre.	Total value.
Apitong	₱4	5,140	193,572	₱90–₱115	₱460	₱17,421,480
Almon	2	7,150	269,269	70– 90	500	18,848,830
Balacbacan	4	4,640	174,742	70– 90	325	12,231,940
Mangachapuy (Red Lauan)	2	13,240	498,618	70– 90	925	34,903,260
Lauan-bagtican and Lauan-dunlog	2	1,880	70,801	70– 90	130	4,956,070
Total		32,050	1,207,002		2,340	88,361,580

₱2 equals $1, United States currency.

SUMMARY OF LUMBERING POSSIBILITIES ON ONE TRACT OF PUBLIC FOREST IN MINDORO.

In Bulletin No. 6 of the bureau of forestry a description is given of the forest and lumbering possibilities of one tract on the east coast of Mindoro. The summary of this bulletin is as follows:

Area of tract, approximately 85 square miles; area of tract surveyed, 55 square miles; area of part of commercial forest (measured), 11,339 acres (not including mangrove swamps).

Stumpage charges on this tract average less than $2 (United States currency) per thousand board feet.

Seven merchantable tree species constitute about 50 per cent of the total stand on this tract.

Amount and value of merchantable timber on 11,339 acres of forest (trees over 16 inches in diameter).

Species.	Stumpage charge per M feet B. M. (approximate).	Yield M feet B. M.	Manila price.	Total value at lower prices.
Narra	₱10	4,534	₱225–₱275	₱1,020,150
Hagachac	2	17,285	90– 115	1,555,650
Lauan	2	46,464	70– 90	3,252,480
Amuguis	4	11,378	110– 150	1,251,580
Guijo	6	13,973	98– 140	1,368,354
Apitong	4	4,174	90– 115	375,660
Sacat	4	3,429	100– 150	342,900
Total		101,237		9,166,724

A total yield of 101,237,000 feet B. M. on 11,339 acres, or about 9,000 feet B. M. per acre. Lumber worth ₱810 per acre.

AID FROM THE BUREAU OF FORESTRY.

A study of Bulletins Nos. 5 and 6 of this bureau will indicate to the lumbermen what the bureau will do for them. Forest officers will use every effort to make such propositions succeed financially. Upon request samples of wood may be obtained at the office of the bureau of forestry.

GEORGE P. AHERN, *Director of Forestry.*

CIRCULARS

CONTAINING THE

LAWS AND INSTRUCTIONS CONCERNING THE LEASING OF PUBLIC LANDS AND HOMESTEADS.

BUREAU OF PUBLIC LANDS.

CIRCULAR CONTAINING THE LAWS AND INSTRUCTIONS CONCERNING THE LEASING OF PUBLIC LANDS, ISSUED NOVEMBER 7, 1904.

DEPARTMENT OF THE INTERIOR,
BUREAU OF PUBLIC LANDS,
Manila, P. I., October 11, 1904.

The following compilation of laws and instructions relative to leasing the public lands are issued under authority of section sixty-nine of "the public land act," act No. 926, for the information of the public and the guidance of public officers engaged in the administration of the laws.

LAWS.

ACT OF CONGRESS OF JULY 1, 1902.

SEC. 13. That the Government of the Philippine Islands, subject to the provisions of this Act and except as herein provided, shall classify according to its agricultural character and productiveness, and shall immediately make rules and regulations for the lease, sale, or other disposition of the public lands other than timber or mineral lands, but such rules and regulations shall not go into effect or have the force of law until they have received the approval of the President, and when approved by the President they shall be submitted by him to Congress at the beginning of the next ensuing session thereof and unless disapproved or amended by Congress at said session they shall at the close of such period have the force and effect of law in the Philippine Islands: *Provided*, That a single homestead entry shall not exceed sixteen hectares in extent.

* * * * * * *

SEC. 75. That no corporation shall be authorized to conduct the business of buying and selling real estate or be permitted to hold or own real estate except such as may be reasonably necessary to enable it to carry out the purposes for which it is created, and every corporation authorized to engage in agriculture shall by its charter be restricted to the ownership and control of not to exceed one thousand and twenty-four hectares of land; and it shall be unlawful for any member of a corporation engaged in agriculture or mining and for any corporation organized for any purpose except irrigation to be in any wise interested in any other corporation engaged in agriculture or in mining. Corporations, however, may loan funds upon real-estate security and purchase real estate when necessary for the collection of loans, but they shall dispose of real estate so obtained within five years after receiving the title. Corporations not organized in the Philippine Islands, and doing business therein, shall be bound by the provisions of this section so far as they are applicable.

ACTS OF THE PHILIPPINE COMMISSION.

[Act No. 926.]

CHAPTER III.—*Leases of portions of the public domain.*

SEC. 22. Any citizen of the United States, or of the Philippine Islands, or of any insular possession of the United States, or any corporation or association of persons organized under the laws of the Philippine Islands or of the United States or of any State, Territory, or insular possession thereof, authorized by the laws of its creation and by the laws of the Philippine Islands and the Acts of Congress applicable thereto to transact business in the Philippine Islands, may lease any tract of unoccupied, unreserved, nonmineral agricultural public lands, as defined by sections eighteen and twenty of the Act of Congress approved July first, nineteen hundred and two, providing a temporary government for the Philippine Islands, and so forth, not exceeding one thousand and twenty-four hectares, by proceeding as hereinafter in this chapter indicated: *Provided*, That no lease shall be permitted to interfere with any prior claim by settlement or occupation until the consent of the occupant or settler is first had and obtained, or until such claim shall be legally extinguished: *And provided further*, That no corporation or association of persons shall be permitted to lease lands hereunder

which are not reasonably necessary to enable it to carry on the business for which it was lawfully created and which it may lawfully pursue in the Philippine Islands.

SEC. 23. Leases made under the provisions of this chapter, of land previously surveyed, must be made of contiguous legal subdivisions. All lands leased hereunder, whether previously surveyed or not, in case the tract sought to be leased exceeds sixty-four hectares in area, must be taken, where possible, in the form of contiguous squares which shall contain at least sixty-four hectares each: *Provided*, That in connection with the lease of lands in one or more tracts of sixty-four hectares there may be leased one rectangular tract of thirty-two hectares, the longer side of which must be contiguous to the square tract of sixty-four hectares. or to one of such tracts if more than one be leased. In no case may lands leased under the provisions of this chapter be taken so as to gain a control of adjacent land, water, stream, shore line, way, roadstead, or other valuable right which in the opinion of the Chief of the Bureau of Public Lands would be prejudicial to the interests of the public.

SEC. 24. An application to lease land under this chapter must be executed under oath and filed with such officer as may be designated by law as local land officer of the district in which the land is situated, or in case there be no such officer then with the Chief of the Bureau of Public Lands, and must show the following facts: The citizenship and post-office address of the applicant; the location of the land, showing the province, municipality, and barrio in which the same is situated, and as accurate a description as may be given, showing the boundaries of the land, having reference to natural objects and permanent monuments, if any; a statement as to whether the land contains any improvements or evidences of settlement and cultivation, and a statement that it is nonmineral in character, more valuable for agricultural than for forestry purposes, and does not contain deposits of coal or salts. Corporations and associations shall be required to file evidence of their legal existence and authority to transact business in the Philippine Islands.

SEC. 25. All applicants for leases under the terms of this chapter must give notice, by publication and by such other means as may be required by the Chief of the Bureau of Public Lands, with the approval of the Secretary of the Interior, of intent to make application to lease the tract in question, which notice shall state the date when the application will be presented and shall describe as definitely as practicable the land sought to be leased.

SEC. 26. It shall be the duty of the Chief of the Bureau of Public Lands to examine all applications for leases under this chapter, and to determine whether the applicant has the qualifications required in section twenty-two hereof, and, from the certificate of the Chief of the Bureau of Forestry, to determine whether the land applied for is more valuable for agricultural than forestry purposes, and further summarily to determine from available records whether the land is nonmineral and does not contain deposits of coal or salts. He shall report his findings to the Secretary of the Interior, who, after proper consideration and approval of same, shall cause the lease to be executed.

SEC. 27. The rate per hectare per annum for lands leased under this chapter shall be fixed by the Chief of the Bureau of Public Lands, with the approval of the Secretary of the Interior, and shall in no case be less than fifty centavos, Philippine currency, per hectare per annum; said rent shall be paid yearly in advance, the first payment being deposited with the Chief of the Bureau of Public Lands before the delivery of the lease.

SEC. 28. Leases hereunder shall run for a period of not more than twenty-five years, but may be renewed for a second period of twenty-five years, at a rate to be fixed as above indicated, which rate shall not be less than fifty centavos per hectare and shall not exceed one peso and fifty centavos, Philippine currency, per hectare. Land leased hereunder shall not be assigned or sublet without the consent of the Chief of the Bureau of Public Lands and the Secretary of the Interior.

SEC. 29. No land shall be leased under the provisions of this chapter until the land has been surveyed under the direction of the Chief of the Bureau of Public Lands and an accurate plat made thereof, the cost of survey to be borne by the lessee.

SEC. 30. The lease of any lands under this chapter shall not confer the right to remove or dispose of any valuable timber except as provided in regulations of the Bureau of Forestry for cutting timber upon such lands. Nor shall such lease confer the right to remove or dispose of stone, oil, coal, salts, or other minerals, but the lease as to the part thereof which shall be mineral may be canceled by the Chief of the Bureau of Public Lands, with the approval of the Secretary of the Interior, whenever the mineral character of such part shall be made satisfactorily to appear, after due notice to the lessee.

SEC. 31. The commission of waste or the violation of the forestry regulations by the lessee shall work a forfeiture of his last payment of rent and render him liable to immediate dispossession and suit for damage.

The civil governor was advised by the chief of the Bureau of Insular Affairs, Washington, D. C., by cablegram dated May 4, 1904, that Congress had adjourned without amending or disapproving the public land act (act No. 926). On July 26, 1904, the civil governor issued his proclamation declaring the public land act to be in full force and effect from said date, as contemplated by section 13, Act of Congress of July 1, 1902, above stated.

INSTRUCTIONS.

LANDS SUBJECT TO LEASE.

All unoccupied, unreserved, nonmineral public lands, more valuable for agricultural than forestry uses, are subject to lease. Public lands are such lands of the government as are subject to disposal under general laws. Mineral lands are such lands as are chiefly valuable for the minerals they contain. Whether lands upon which there is growing timber are more valuable for agricultural than for forestry uses will be determined by the forestry bureau. (See sec. 18, act of Congress of July 1, 1902.)

Owing to the system of disposing of public lands which obtained under the Spanish Government in these islands, the present government has no maps showing the exact location of public lands; therefore, prospective lessees will be compelled to make inquiries as to the ownership of any particular tract desired of persons living in the vicinity thereof, and to consult the property register and record of tax returns, in the capital of the province in which the land is located, for evidence of ownership.

No lease will be permitted to interfere with any prior claim by settlement or occupation until the consent of the occupant or settler is first had and obtained, or until such claims shall be legally extinguished.

The provisions of the public land act relating to leasing public lands do not extend, at the present time, to the provinces of Lepanto-Bontoc, Benguet, Paragua, Nueva Vizcaya, and the Moro Province, but may at any time, by resolution of the Philippine Commission, be extended to said provinces.

PERSONS WHO MAY LEASE PUBLIC LANDS.

(1) Citizens of the Philippine Islands; (2) citizens of the United States; (3) citizens of any insular possession of the United States; (4) any corporation or other association of persons organized under the laws of the Philippine Islands or of the United States, or of any State, Territory, or insular possession thereof, authorized by the laws of its creation and by the laws of the Philippine Islands and the acts of Congress applicable thereto to transact business in the Philippine Islands. In this connection see section 75, act of Congress of July 1, 1902, supra, as to rights of corporations.

AMOUNT THAT MAY BE LEASED.

A qualified person may lease any amount not exceeding 1,024 hectares, equivalent to about 2,530 acres.

PERIOD OF LEASE.

Leases shall run for a period of not more than twenty-five years, but may be renewed for a second period of twenty-five years.

RENT.

Lessees will be required to pay an annual rent in advance, the amount of which will be fixed by the chief of the bureau of public lands, with the approval of the Secretary of the Interior, but it can in no case be less than 50 centavos, Philippine currency, per hectare, and during the second period can not exceed ₱1.50 per hectare. The first payment of rent is due on the date of the execution of the lease, and must be paid before the lease is delivered.

FORM IN WHICH LEASED LANDS MUST BE TAKEN.

Leased lands, in all cases where possible, must be taken in tracts compact in form as provided in section 23 of the public land act. Tracts to be contiguous must have one boundary in common. The purpose of this provision is to prevent the taking of land in long or irregular strips whereby adjoining public lands would be decreased in value.

PROCEDURE IN MATTER OF OBTAINING LEASE.

Prospective lessees are required to file an application for the land desired with the chief of the bureau of public lands. This application must show that the applicant is qualified to lease public lands; must describe the land desired to be leased, with respect to both its location and character, as definitely as practicable, and must be executed under oath. A proper form to be used in making application will be furnished on request by the bureau of public lands.

Applicants must give notice of intention to apply for a lease by publication for thirty days in two newspapers, one English and one Spanish. Said newspapers shall be of general circulation in the locality where the land is located. When the notice is published in a weekly newspaper, five consecutive insertions are necessary; when in a daily newspaper, the notice must appear in each issue for thirty-one consecutive issues. Said notice shall state the date when said application will be made, and shall describe as definitely as possible the land to be applied for; an approved form may be found at the close of this circular. Applicant must file a copy of the notice at the same date at which he begins the publication of same with the provincial secretary and municipal president of the province and municipality in which the land is located. In case the land is located within the city of Manila, said notice must be filed with the secretary of the municipal board.

Applicant must submit to the chief of the bureau of public lands with his application a copy of said notice, and must show by affidavit of the manager of the newspaper in which same was published that it was published for the required period.

The application will be examined in the bureau of public lands, and if found correct will be referred to the forestry bureau for report as to whether the land is more valuable for agricultural than for forestry purposes.

Upon return of the application to the bureau of public lands from the forestry bureau, with a report that the land is more valuable for agricultural than forestry uses, the chief of the bureau of public lands will, with the approval of the Secretary of the Interior, fix the rate per hectare at which the government will lease the land. He will then advise the applicant of the rate fixed, also of the probable cost of surveying the tract.

Upon deposit by applicant in the bureau of public lands of the amount of the estimated cost of survey the chief of said bureau will advise applicant of the date when he will cause the survey to be made, and will also send a copy of said notice to the secretary of the province and one to the president of the municipality in which the land is located, requesting said officials to post said notices in a conspicuous place in their respective offices.

Upon completion of the survey, in case there are no adverse claims to the land, a lease will be executed therefor as early as practicable.

MISCELLANEOUS.

A lessee of public lands has no right to remove timber except as authorized by the forestry bureau.

No minerals may be removed from public lands under a lease. In case it is made to appear that leased lands contain valuable mineral deposits, the chief of the bureau of public lands, with the approval of the Secretary of the Interior, is authorized to cancel the lease as to such lands.

Attention is invited to the fact that section 77 of the public land act prescribes a penalty for the presentation of false proof or affidavits in connection with applications or claims respecting public lands.

All necessary forms to be used in connection with the leasing of public lands may be had on application to the bureau of public lands.

WILL M. TIPTON,
Chief Bureau of Public Lands.

Approved, November 7, 1904.
DEAN C. WORCESTER,
Secretary of the Interior.

NOTICE OF APPLICATION TO LEASE PUBLIC LANDS.

The undersigned hereby gives notice that he will on the.....
day of....., 19.., file with the chief of the bureau of public lands, Manila, P. I., an application for a lease to the following-described public land, beginning.....
.....

[Here give description as definitely as possible.]

.....
.....
located in the barrio of....., municipality of....., province of.....,
and containing.....hectares, more or less.
Signature of applicant.....
Post-office address.....

BUREAU OF PUBLIC LANDS.

CIRCULAR CONTAINING THE LAW RELATING TO HOMESTEADS AND INSTRUCTIONS THEREUNDER, ISSUED NOVEMBER 7, 1904.

DEPARTMENT OF THE INTERIOR,
BUREAU OF PUBLIC LANDS,
Manila, P. I., October 12, 1904.

The following compilation of laws and instructions thereunder relative to the acquiring of public lands as a homestead, is issued under authority of section 69 of the public land act, act No. 926, United States Philippine Commission, for the information of the public and the guidance of public officials engaged in the administration of the laws.

LAWS.

ACT OF CONGRESS OF JULY 1, 1902.

SEC. 13. That the Government of the Philippine Islands, subject to the provisions of this Act and except as herein provided, shall classify according to its agricultural character and productiveness, and shall immediately make rules and regulations for the lease, sale, or other disposition of the public lands other than timber or mineral lands, but such rules and regulations shall not go into effect or have the force of law until they have received the approval of the President, and when approved by the President they shall be submitted by him to Congress at the beginning of the next ensuing session thereof and unless disapproved or amended by Congress at said session they shall at the close of such period have the force and effect of law in the Philippine Islands: *Provided*, That a single homestead entry shall not exceed sixteen hectares in extent.

ACTS OF THE PHILIPPINE COMMISSION.

[Act No. 926.]

CHAPTER I.

HOMESTEADS ON THE PUBLIC DOMAIN.

SECTION 1. Any citizen of the Philippine Islands, or of the United States, or of any insular possession thereof, over the age of twenty-one years or the head of a family, may, as hereinafter provided, enter a homestead of not exceeding sixteen hectaras of unoccupied, unreserved, unappropriated agricultural public land in the Philippine Islands, as defined by the Act of Congress of July first, nineteen hundred and two, entitled "An Act temporarily to provide for the administration of the affairs of civil government in the Philippine Islands, and for other purposes," which shall be taken, if on surveyed lands, by legal subdivisions, but if on unsurveyed lands, shall be located in a body which shall be as nearly as practicable rectangular in shape and not more than eight hundred meters in length; but no person who is the owner of more than sixteen hectares of land in said Islands or who has had the benefits of any gratuitous allotment of sixteen hectares of land since the acquisition of the Islands by the United States shall be entitled to the benefits of this chapter.

SEC. 2. Any person applying to enter land under the provisions of this chapter shall file with such officer as may be designated by law as local land officer, or in case there be no such officer then with the Chief of the Bureau of Public Lands, an application under oath showing that he has the qualifications required under section one of this chapter, and that he possesses none of the disqualifications there mentioned; that such application is made for his exclusive use and benefit; that the same is made for the purpose of actual settlement and cultivation, and not, either directly or indirectly, for the use or benefit of any other person, persons, corporation, or association of persons; that the land applied for is nonmineral, does not contain valuable deposits of coal or salts, is more valuable for agricultural than forestry purposes, and is not occupied by any other person; and showing the location of the land by stating the

province, municipality, and barrio in which the same is situated, and as accurate a description as may be given, showing the boundaries of the land, having reference to natural objects and permanent monuments, if any. Upon the filing of said application the Chief of the Bureau of Public Lands shall summarily determine, by inquiry of the Chief of the Bureau of Forestry and from the available land records, whether the land described is prima facie subject under the law to homestead settlement, and, if he shall find nothing to the contrary, the applicant, upon the payment of ten pesos, Philippine currency, shall be permitted to enter the quantity of land specified.

SEC. 3. No certificate shall be given or patent issued for the land applied for until the expiration of five years from the date of the filing of the application; and if, at the expiration of such time or at any time within three years thereafter, the person filing such application shall prove by two credible witnesses that he has resided upon and cultivated the land for the term of five years immediately succeeding the time of filing the application aforesaid, and shall make affidavit that no part of said land has been alienated or encumbered, and that he has borne true allegiance to the Government of the United States and that of the Philippine Islands, then, upon payment of a fee of ten pesos, Philippine currency, to such officer as may be designated by law as local land officer, or in case there be no such officer then to the Chief of the Bureau of Public Lands, he shall be entitled to a patent: *Provided, however*, That in the event of the death of an applicant prior to the issuance of a patent, his widow shall be entitled to have a patent for the land applied for issue to her upon showing that she has consummated the requirements of law for homesteading the lands as above set out; and in case the applicant dies before the issuance of the patent and does not leave a widow, then the interest of the applicant in the land shall descend and patent shall issue to the persons who under the laws of the Philippine Islands would have taken had the title been perfected by patent before the death of the applicant, upon proof by the persons thus entitled of compliance with said requirements and conditions.

SEC. 4. No lands acquired under the provisions of this chapter shall in any event become liable to the satisfaction of any debt contracted prior to the issuance of a patent therefor.

SEC. 5. If, at any time after the filing of the application as hereinabove provided and before the expiration of the period allowed by law for the making of final proof, it is proved to the satisfaction of the Chief of the Bureau of Public Lands, after due notice to the homesteader, that the land entered is not under the law subject to homestead entry, or that the homesteader has actually changed his residence, voluntarily abandoned the land for more than six months at any one time during the five years of residence herein required, or has otherwise failed to comply with the requirements of law, then in that event the Chief of the Bureau of Public Lands may cancel the entry, subject to appeal under proper regulations to the Secretary of the Interior, and the land thereupon shall become subject to disposition as other public lands of like character.

SEC. 6. Not more than one homestead entry shall be allowed any one person.

SEC. 7. Before final proof shall be submitted by any person claiming to have complied with the provisions of this chapter, due notice, as prescribed by the Chief of the Bureau of Public Lands with the approval of the Secretary of the Interior, shall be given to the public of his intention to make such proof, stating therein the time and place, and giving a description of the land and the names of the witnesses by whom it is expected that the necessary facts will be established.

SEC. 8. Any person may file an affidavit of contest against any homestead entry, charging that the land entered was not unoccupied, unreserved, or unappropriated agricultural land at the time of filing the application, alleging disqualification of the entryman, noncompliance with law as to residence or cultivation, or any other matter which, if proven, would be just cause for the cancellation of the entry, and upon successful termination of the contest, the contestant, if a qualified entryman, shall be allowed a preference right of entry for sixty days from said date.

The Chief of the Bureau of Public Lands or any public official becoming aware of the existence of any of the grounds above stated, for impeaching or canceling the entry, may file formal complaint against the entry on any such ground which, if proven, shall cause the cancellation of the entry.

SEC. 9. No patent shall issue under the provisions of this chapter until the land has been surveyed under the direction of the Chief of the Bureau of Public Lands and an accurate plat made thereof, the cost of which survey shall be borne by the Insular Government.

The civil governor was advised by the chief of the bureau of insular affairs, Washington, D. C., by cablegram dated May 4, 1904, that Congress had adjourned without amending or disapproving the public land act (act. No. 926). On July 26, 1904, the

civil governor issued his proclamation declaring the public land act to be in full force and effect from that date, as contemplated by section 13, act of Congress of July 1, 1902, above mentioned.

INSTRUCTIONS.

1. *Location of public lands.*—Owing to the system of disposing of public lands which obtained under the Spanish Government in these islands the present government has no maps showing the exact location of such lands; therefore, prospective homestead entrymen will be compelled to make inquiries, as to the ownership of any particular tract desired, of persons living in the vicinity thereof, and to consult the property register and record of tax returns, in the capital of the province in which the land is located for evidence of ownership.

2. *Land subject to entry.*—Only unreserved, unoccupied agricultural public land is subject to homestead entry. Land chiefly valuable for the mineral it contains must be purchased under the law relating to mineral land. Whether a particular tract is more valuable for forestry than agricultural purposes will be determined by the forestry bureau on request by the bureau of public lands.

The provisions of the public land act relating to homesteads do not extend at the present time to the provinces of Lepanto-Bontoc, Benguet, Paragua, Neuva Vizcaya, and the Moro Province, but may at any time, by resolution of the Philippine Commission, be extended to said provinces.

3. *Persons entitled to a homestead.*—The following designated persons are entitled to make a homestead entry:

(*a*) Citizens of the Philippine Islands.

(*b*) Citizens of the United States, or of any insular posession of the United States.

To be entitled to make an entry a person must be 21 years of age, or else the head of a family. Any person, male or female, who is the head of a family, and otherwise qualified, may enter a homestead, even though such person be less than 21 years of age.

A person who is the owner of more than 16 hectares of land, or has received from the government a gratuitous grant of 16 hectares, under Chapter IV of the public land act, is not entitled to make a homestead entry.

4. *Area of homestead and shape of tract.*—A homestead can not exceed 16 hectares in area, but any amount less than that may be entered.

Whenever land is sought to be acquired as a homestead which has been surveyed by the government under some plan for subdividing the public lands, such land must be taken by legal subdivisions. In case an entry is made on unsurveyed land, the tract entered must be in a single body, as nearly as practicable rectangular in shape, and not more than 800 meters in length.

5. *Procedure in making entry.*—An approved form on which to make an application for a homestead entry may be obtained by addressing the bureau of public lands, Manila, P. I. In executing the application care should be taken by the applicant to fill up all the blank spaces in the form. The best possible description as to the location and boundaries of the tract, without making a survey, should be given, and the corners of the tract should be carefully marked on the ground by using stones or stakes. The application should be filed with the chief of the bureau of public lands, Manila, P. I.

6. *Residence and cultivation.*—The applicant must continuously *reside* upon and *cultivate* the land for a period of five years from the date of the filing of his application. Failure to reside on the land for a period of six months will constitute an abandonment of the entry and subject it to cancellation.

7. *Contests and adverse claims.*—Any person, whether qualified to make a homestead entry or not, if he knows of any reason why an application should not be approved, or of any reason why an entry in which the application has been approved should be canceled, may initiate a contest against the applicant or entryman by filing an affidavit with the chief of the bureau of public lands, wherein is set out the reasons why the application should be denied or the entry canceled. Upon the termination of a contest, if the application has been disapproved or the entry canceled, the person initiating the contest, if he is qualified under the law to enter a homestead has a preference right of entry as to the land for sixty days from the date of the final decision on the contest.

8. *Procedure to obtain patent.*—At any time within three years after the expiration of the five years mentioned in paragraph 6, the applicant may submit proof showing that he has complied with the law in the matter of residence on the land and cultivation of same. An approved form on which to make this proof will be furnished by the bureau of public lands. In case the proof is satisfactory a patent will issue.

9. *Heirs of homestead settler.*—If the applicant is a married man, and should die after entry and before patent, his surviving widow, by complying with the requirements of the homestead law as to residence and cultivation, may submit proof of this

fact and obtain the patent in her name. If the applicant be not married, and should die after entry and before patent, such of his heirs as by law could inherit real estate from him, by complying with the above-mentioned requirements of the homestead law, may submit final proof and obtain the patent.

10. *Surveys.*—No homestead will be patented until the land has been surveyed and platted. The survey will be made as soon after the final proofs have been approved as it is possible for the surveyors to take up the work. This survey will be at the cost of the government.

11. *Fees.*—A fee of ₱10 is required to be paid to the officer with whom the application is filed at the date of filing the same. At the time of submitting final proof (see par. 8) the entryman must pay ₱10, as final fee, to the officer with whom the final proof is filed. These are the only fees that the government requires to be paid under the homestead law.

12. *Miscellaneous.*—Attention is invited to the fact that section 77 of the public land act prescribes a penalty for the presentation of false proof or affidavits in connection with applications or claims respecting public lands.

No land acquired as a homestead may be sold, by judgment of a court or otherwise, to satisfy any debt which may have been contracted by the applicant or patentee prior to the date of the patent therefor. (Sec. 4, act No. 926.)

Necessary forms to be used in obtaining a homestead may be had by addressing the bureau of public lands.

WILL M. TIPTON,
Chief Bureau of Public Lands.

Approved, November 7, 1904:

DEAN C. WORCESTER, *Secretary of the Interior.*