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Yale University School of Forestry

TROPICAL WOODS

TROPICAL SERIES, NO. 1 March, 1925

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INTRODUCTORY NOTE

In 1916 the activities of the Yale School of Forestry were extended to include Tropical Forestry. Particular attention has been given to investigations as to the identity, properties, and uses of tropical woods, with special emphasis on those of the New World. Field explorations have been made by members of the School staff in the West Indies, Central America, Colombia, Venezuela, the Guianas, and Brazil, and the coöperation of various persons and agencies, both at home and abroad, has been enlisted in the collection of material and data of value to both science and industry.

There are now in the Yale collections nearly 8,000 catalogued wood samples, and new material is constantly being added. In a great many instances the collectors secure wood and herbarium specimens from the same trees, and the identification of this botanical material is made possible through the coöperation of eminent systematists in the Smithsonian Institution, the U. S. Department of Agriculture, the New York Botanical Garden, the Gray Herbarium, and the Field Museum of Natural History. Such authenticated specimens

serve as the basis for classifying the woods for scientific purposes and for identifying the timbers of commerce. The information gained in this way is also essential to discriminatory use and compilation of the literature.

There is also in the Yale School of Forestry the nucleus of a herbarium of important tropical trees; an excellent collection of books, pamphlets, and manuscript reports; also hundreds of microscopic slides of representative woods of the various natural families.

This material is being studied by, or under the direction of, the Professor of Forest Products, and it is planned to enlarge the scope of the work in the immediate future. Results already published include a book of 610 pages, entitled *Timbers of Tropical America* (Yale University Press, 1924); two bulletins in the School of Forestry series, one on Lignum-vitae, the other on Cocobolo; a mimeographed bibliography of foreign woods, with supplement; also several contributions to various journals. Two contributions by advanced students have been published abroad, one by Dr. F. B. H. Brown on Hawaiian woods, the second by Professor George A. Garratt on New Zealand woods. A study of the boxwoods of commerce, to be issued as a bulletin in the School of Forestry series, is nearly complete and various other projects are under way.

In the course of the investigations new facts come to light which, it is felt, should be made promptly available to other investigators; also many problems arise upon which assistance is needed in solution. It is for this reason that this new series of publications, *Tropical Woods*, has been instituted. It is planned to issue succeeding numbers at such intervals as available funds and material will permit.

DISTRIBUTION OF THE SPECIES OF *SWIETENIA*

True mahogany is the product of the genus *Swietenia*, of which five species have been described, namely, *S. Mahagoni* (L.) Jacq. (1760), *S. humilis* Zucc. (about 1836), *S. macrophylla* King (1886), *S. Candollei* Pittier (1920), and *S. cirrhata* Blake (1920).

Blake (Revision of the true mahoganies (*Swietenia*). *Jrl. Wash. Acad. Sci.* 10:10:288, May 19, 1920) summarizes the distribution of these species as follows: "*Swietenia Mahagoni* is the only species known from the West Indies, Bermuda, and the Bahamas, as well as the Keys of southern Florida. It has been introduced into Trinidad, Venezuela, and the Hawaiian Islands, and is recorded by Casimir DeCandolle from Peru, but the latter record is certainly very questionable. *Swietenia Candollei* is a native of Venezuela. *Swietenia macrophylla* is the mahogany of the eastern coast of Central America, from Tabasco to Honduras, and is also cultivated in botanic gardens at Trinidad, Buitenzorg, and Calcutta. *Swietenia cirrhata* is known in the wild condition from Sinaloa, Michoacan, Oaxaca, and El Salvador, and has been introduced into cultivation in the Botanic Garden at Victoria in Camerun. *Swietenia humilis* is known as a wild species from the coast of Guarrero, Oaxaca, and northwestern Guatemala. . . . It remains to determine the identity of the mahoganies growing between Honduras and Colombia, and also that of the mahogany recorded from Peru as *S. Mahagoni* when only two species of the genus were known from America."

Pittier (*Bol. Com. e Ind.* 18:583, Sept. 1921) gives the range of *S. macrophylla* as Yucatan, Honduras, Nicaragua, Costa Rica, Panama, and Colombia. Leaves and fruits collected in 1917 by Dr. H. N. Whitford on low hills in the valley of the Rio Negro, Boyaca, Colombia, were identified by MacBride (*Contr. Gray Herb.* n. s. 56:54, Dec., 1918) as *S. macrophylla*. Recent investigations of true mahogany in Panama by Mr. C. D. Mell leave no doubt in his mind that this is the species of commercial importance there.

In a memorandum on the trees of Salvador, which Dr. Paul C. Standley furnished the writer, it is stated that both *S. cirrhata* Blake and *S. humilis* Zucc. occur in some localities in Salvador, but he expresses a doubt as to these two being distinct species.

Dr. Herrera (*Contribucion a la flora del Departmento del Cuzco*, 1921, p. 115) listed *Swietenia Mahagoni* among the trees indigenous to Peru. In a letter of June 30, 1924, however, he says that his authority for the occurrence of the species in eastern portion of the Department of Cuzco was Pro-

fessor Raymondi (*Botanicá elemental*, p. 259), but that he is now convinced that this was an error.

The occurrence of a species of *Swietenia* in the Peruvian Amazon seems to be fully established by recent shipments of logs from that region. The writer has examined various specimens of the wood said to be of that origin and there is no doubt as to their being true mahogany. Through the courtesy of Mr. Harold S. Fuller, President of the Fuller-Thurber Company, mahogany importers of Boston, it is hoped that botanical specimens of this tree and information as to the distribution can be secured. The specimens of the wood examined by the writer appear very similar to authentic samples of the Venezuelan mahogany supplied by Mr. H. Pittier of the Museo Comercial, Caracas.

RAILWAY CROSSTIES IN SALVADOR

In reply to a request for information as to the woods used in Salvador for railway crossties, Dr. S. Calderón, of the Laboratorios de la Direccion General de Agricultura, submitted the following data as to the kinds of woods, their classification, and the prices prevailing during the latter part of 1924. The information was secured from officials of the Salvador Railway, an English company. The Salvador Division of the International Railways of Central America, an American company, uses the same woods. The classification for crossties is not to be taken as a criterion of the usefulness of the timbers for other purposes.

Classification	*Names of woods*	*Price per tie*
Extra fine	Balsamo	$2.50
Superior	Guachipilín, Nispero, Mora, Guaje, Cicahuite, Guayacan	$2.25
Quality 1a	Quebracho, Madrecacáo, Funera, Granadillo, Cortez prieto	$2.00
Quality 2a	Copinol, Tempisque, Laurel macho or prieto	$1.50
Quality 3a	Caoba, Cedro macho, Chapulaltapa, Chicipate, Iguano, Memble, Mezcal, Nacascolo, Tepemiste, Zope, Roble	$1.25

The following botanical classification of the woods listed above is based for the most part upon a collection of Salvador woods forwarded by Dr. Calderón.

Local Name	*Botanical Name*	*Family*
Balsamo	*Myroxylon toluiferum* H. B. K.	Leguminosae
Caoba	*Swietenia humilis* Zucc.	Meliaceae
Cedro macho	*Cedrela fissilis* Vell.	Meliaceae
Chapulaltapa	*Lonchocarpus rugosus* Benth.	Leguminosae
Chicipate	*Sweetia panamensis* Benth.	Leguminosae
Cicahuite	*Lysiloma auritum* (Schlect) Benth.	Leguminosae
Copinol	*Hymenaea Courbaril* L.	Bignoniaceae
Cortez prieto	*Tecoma chrysantha* DC.	Leguminosae
Funera	*Dalbergia lineata* Pittier	Leguminosae
Granadillo	?	Leguminosae
Guachipilín	*Diphysa robinioides* Benth.	Leguminosae
Guaje	*Leucaena brachycarpa* Urb.	Leguminosae
Guayacan	*?Myrospermum* sp.	Leguminosae
Iguano	?	?
Laurel macho, Laurel prieto	*? Cordia* sp.	Borraginaceae
Madrecacáo	*Gliricidia sepium* (Jacq.) Steud.	Leguminosae
Memble	*Poeppigia procera* Presl.	Leguminosae
Mezcal	?	Leguminosae ?
Mora	*Chlorophora tinctoria* (L.) Gaud.	Moraceae
Nacascolo	*Caesalpinia coriaria* (Jacq.) Willd.	Leguminosae
Nispero	*Achras Zapota* L.	Sapotaceae
Quebracho	*Lysiloma divaricata* (Jacq.) Steud.	Leguminosae
Roble	*Quercus* sp.	Fagaceae
Tempisque	*Sideroxylon Tempisque* Pittier	Sapotaceae
Tepemiste	*Poeppigia procera* Presl.	Leguminosae
Zope	*Ichthyomethia grandifolia* (D. Smith) Blake	Leguminosae

Notes

Poeppigia procera Presl. has the following vernacular names in different parts of Salvador: "Tepemiste" (Ixtepeque), "quebracho blanco" (La Unión), "memble" (Cerro del Guayabal), "frijolillo" (Jocoro). (See Standley and Calderón's *Flora de El Salvador*, p. 106.)

The name "chapulaltapa" is applied to at least three trees other than the one mentioned, namely *Pithecolobium discolor* Pittier, *Sobralobium excelsum* Vogel, and *Machaerium latifolium* (Benth.) Pittier. The specimen examined is *Lonchocarpus*. "Mezcal" is the usual vernacular name in Salvador for the Mexican elm, *Ulmus mexicana* Planch. (=*Chaeloptelea mexicana* Liebm.), but the wood sample bearing this name is distinctly not of the elm family, but seems to be one of the Leguminosae.

The name "quebracho" is applied to various hard woods in tropical America which are unrelated to the well-known tanwood (*Schinopsis*) from

southern South America. In Salvador it refers to *Lonchocarpus Michelianus* Pittier and *Piptadenia constricta* (M. & R.) Macbride, as well as to *Lysiloma divaricata* (Jacq.) Steud. given above. The wood specimen available is of *Lysiloma*.

Platymiscium polystachium Benth. is known as "granadillo" in Salvador, but the wood sample studied is from some other leguminous tree.

No specimens of "laurel macho" or "laurel prieto" are available for study. In some portions of Latin America the name "laurel" is applied to woods of the Lauraceae.

COCOBOLO

In Record and Garratt's *Cocobolo* (Bull. No. 8, Yale School of Forestry, New Haven, 1923) it is shown that this wood is the product of three known species of *Dalbergia* (*Amerimnon*), section *Miscolobium*, namely, *D. retusa* Hemsley, *D. hypoleuca* Pittier, and *D. Granadillo* Pittier. There were no available wood specimens of the two other species listed by Pittier in this section, namely *D. calycina* Benth. and *D. lineata* Pittier.

The latter species occurs in Salvador where it is known as "funera," and the writer recently received a specimen of the heartwood from Dr. S. Calderón, of San Salvador. Shortly afterward he obtained from the same source a portion of a branch, without heartwood, of *Amerimnon cuscatlanicum* Standley. This is a new species described by Dr. Paul C. Standley (New species of plants from Salvador. II. *Jrl. Wash. Acad. Sci.* 13:20:442, Dec. 4, 1923), who states that the tree, which is also known as "funera," is related to *Dalbergia lineata* and *D. retusa*, but differs from both in its perfectly glabrous leaflets, which are also more numerous and narrower. Standley has transferred the two species of *Dalbergia* to *Amerimnon lineatum* (Pittier) Standley and *Amerimnon retusum* (Hemsley) Standley, respectively.

Both of these Salvadorean species have the typical wood structure of cocobolo. It is thus shown that five of the present six described species of the section *Miscolobium* yield cocobolo. If, as seems likely, the same should prove to be true in the case of *Dalbergia calycina*, of Guatemala, there would appear to be good reason for raising the section to generic rank.

LAPACHOL

Lapachol ($C_{15}H_{14}O_3$) is a crystalline substance of a golden yellow color and forming intensely colored salts. It is found in an impure state in the vessels of the heartwood of *Avicennia* (Verbenaceae) and more especially in certain members of the family Bignoniaceae. The compound is sometimes so abundant as to give woods the appearance of having been dusted with sulphur. The application of 1 per cent solution of caustic soda gives a characteristic pink color reaction. Common woods of this group are the "lapacho" of Argentina, the "ipé tobaco" of Brazil, the "pui" of Trinidad, the "washiba" of British Guiana, the Surinam "groenhart" or "bethabara," and the yellow "guayacan" of Central America, all of which are species of *Tecoma* (or *Tabebuia*).

Not all the species of *Tecoma*, however, have woods characterized by such deposits, a notable example being the common "roble," *Tecoma pentaphylla* Juss. (=*Tabebuia pentaphylla* Hemsl.). In the "ipé peroba," *Tecoma Peroba* Record, of the coastal region of northeastern Brazil, lapachol occurs only sparingly and sometimes is apparently absent. This is the only light-colored wood in which lapachol has been reported.

One of the principal woods described by Matthes and Schreiber (Über hautreizende hölzer. Sonderabdruck, *Berichte d. deutschen Pharm. Gesell.*, Berlin, 1914) as producing dermatitis is called "moahholz" or "edelteakholz." From a consideration of these names, rather than from a study of the wood structure, the authors provisionally identified the material in question as a species of *Illipe* (*Bassia*) of the family Sapotaceae. The fact that some of the vessels contain deposits of lapachol and lapachonon aroused the interest of Dr. Samuel C. Hooker, of Brooklyn, the noted authority on these substances, who procured a specimen of the wood from Dr. Matthes and submitted it to the writer for identification. It proved to be the "ipé peroba" of Brazil.

A collection of 16 woods of the Bignoniaceae forwarded from Dehra Dun by Dr. H. P. Brown, temporarily of the Indian Service, was submitted to Dr. Hooker for study. The species were: *Oxoxylum indicum* Benth., *Tecoma stans* Juss. (So. Am.), *T. undulata* G. Don, *Spathodea campanulata* Beauv.

(Afr.), *Dolichandrone arcuata* Clarke, *D. crispa* Seem., *D. falcata* Seem., *D. Rheedii* DC., *Stereospermum chelonoides* DC., *S. xylocarpum* Wight, *S. fimbriatum* DC., *S. suaveolens* Kurz, *Kigellia pinnata* DC., *Heterophragma Roxburghii* DC., *Panjanelia multijuga* Kurz, and *Millingtonia hortensis* L. Dr. Hooker reports: "I have examined them all very carefully and have been unable to detect lapachol. There is, however, a yellow deposit in *Panjanelia multijuga* Kurz which gives a characteristic test with a 1 per cent solution of caustic soda. The substance first dissolves to a yellow-brown which soon passes to a pure violet; then in a short time the violet fades and gives place to yellow-brown again. The quantity present is very small and the test was made under the microscope with material removed with the point of the needle."

In the *Album des bois de Madagascar* prepared by M. Louvel, Inspecteur des Eaux et Forêts, for the Première Foire Officielle de Tananarive, 1923, there are two wood specimens with abundant deposits of lapachol. One is the "zahana," which, according to the booklet accompanying the album, is *Phyllarthron Bojerianum* DC. It is undoubtedly one of the Bignoniaceae, though the wood described by Perrot (*Les bois de Madagascar*, II, No. 35) under these vernacular and scientific names is not the same, having much more abundant parenchyma, considerably lower density, and lacking in vessel contents.

The other Madagascar specimen bears only the vernacular name of "sofintsoy," but it belongs unquestionably to the family Bignoniaceae. The structure and general appearance of both these woods are much like the tropical American species of *Tecoma* having abundant lapachol deposits, the most noticeable difference being the absence of ripple marks (storied structure) in the Madagascar specimens. Since *Tecoma* and *Tabebuia* are not known to occur outside of tropical America it is obvious that the distribution of this interesting substance, lapachol, must be extended to at least one new genus of the Bignoniaceae.

The presence of lapachol in a wood of normal structure may be taken as fairly conclusive evidence that the material belongs to the Bignoniaceae. The wood of *Avicennia* is of anomalous structure and consequently very distinct. The occurrence of lapachol in this wood was discovered by Dr. Bournot and subsequently confirmed by Dr. Hooker on material supplied by the writer.

SECRETORY CELLS IN DICOTYLEDONOUS WOODS

Large, thin-walled parenchyma cells with oily or resinous contents have been observed in certain woods of five families, namely, Magnoliaceae, Anonaceae, Canellaceae, Lauraceae, and Lythraceae.

Magnoliaceae.—Solereder (*Systematic Anatomy of the Dicotyledons*, II, p. 1096) mentions the occasional occurrence of resin cells in the wood of this family. According to Moll and Janssonius (*Mikrographie des holzes der auf Java vorkommender baumarten*, I, 84, 97–106), large thin-walled cells, often with resinous contents of a pale yellow collor, were found in the rays of the four species of *Michelia* they examined.

Anonaceae.—Solereder (*loc. cit.*) states that resin cells are occasionally found in the wood. Moll and Janssonius (*loc. cit.*, pp. 125–7) found them in both the wood parenchyma strands and the rays of *Canangium odoratum* Baill., and the variety *velutina* K. & V.

In the wood of the type tree of *Duguetia vallicola* MacBride, the "solera" of Colombia, the writer finds that the rays are homogeneous except for occasional very large thin-walled sac-like oil or resin cells; such cells also occur in some of the parenchyma strands. They were not found in *Anona*, *Oxandra*, *Rollinia*, *Unonopsis*, and *Xylopia*.

Canellaceae.—Secretory cells have been found in the parenchyma strands and in the rays of *Cinnamosma fragrans* Baill., wood specimens of which were supplied by the Governor General of Madagascar and Dependencies, through the courtesy of American Consul J. G. Carter. The vernacular name of this tree is given as "metrobeantina."

This wood agrees in all important details with the "taggar wood" used by the Parsees of Bombay in their religious ceremonies, judging from a specimen of this material supplied the writer by Mr. Wilfred H. Schoff, secretary of the Commercial

Museum of Philadelphia. It also corresponds with the description and illustrations given in the report of the Museum of the Pharmaceutical Society of Great Britain for the years 1895–1902 (London, 1903, pp. 42–45), from which the following is taken:

"This dark brown wood is exported from the north of Madagascar (where the tree is known as 'hazo-mainty,' i.e., black wood) to Zanzibar, whence it reaches Bombay. The vessels are usually isolated, their joints perforated in a scalariform manner, their walls have relatively large pits, and they are only sparingly surrounded with parenchyma fibers, which are either isolated or form short transverse series between the fiber-tracheids, which are thick-walled and furnished with large pits. Large oil cells, with yellow contents, are also present, and the medullary rays consist of one or two rows of cells. The oil cells and scalariform vessels indicate that it is probably derived from a Lauraceous tree."

The last statement fails to take into account the fact that the wood fibers of the Lauraceae have simple pits, while those of the Canellaceae are abundantly pitted with very distinctly bordered pits. No secretory cells were found by the writer in the wood of *Canella Winterana* Gaertn.

Lauraceae.—According to Von Höhnel, Felix, and Knoblauch (see Solereder, *loc. cit.*, pp. 703–4), secretory cells are present in the wood of *Sassafras* and various other members of this family, and Felix also met with them in fossil woods. Knoblauch reports their occurrence in the rays and parenchyma strands in species of *Cryptocarya*, *Beilschmiedia* (*Hufelandia*), *Aydendron*, *Acrodiclidium*, *Litsea*, *Umbellularia*, and *Laurus*.

Kanehira (*Anatomical characters and identification of Formosan woods*, 1921, p. 171) states that secretory cells are always present in *Cinnamomum* and of sporadic occurrence in *Actinodaphne*, *Lindera*, *Tetradenia*, *Machilus*, *Phoebe*, *Litsea*, and *Cryptocarya Konishii* Hay.

Kräusel and Schönfeld (Fossile hölzer aus der braunkohle von Süd-Limburg. *Abh. d. Senckenberg. Naturfosch. Gesell.* 38:3:274–276, 1924) describe and figure secretory cells in *Laurinoxylon nectandrioides* Kr. & Sch., and attach considerable diagnostic value to them. They recognize, however, that the absence of these cells, particularly in young stems, is not conclusive.

Gonggrijp (Rosenhout, bois de rose femelle, uit Suriname. *De Indische Mercuur*, Apr. 23, 30, 1920, pp. 19–22) describes the oil cells of the "bois de rose" and illustrates his paper with photomicrographs showing the cells in both the rays and the parenchyma strands. He identifies the wood as *Aniba panurensis* Mez (= *Aydendron panurensis* Meissn.). The present writer has examined specimens of this wood; the oil cells are very large and thin-walled, and appear on cross section as intercellular canals.

Lythraceae.—The only known reference to oil cells in any wood of this family is by the writer (*Timbers of Tropical America*, 1924, p. 456) in the case of *Physocalymma scaberimmum* Pohl. "A highly characteristic feature is the presence of large oil or resin cells located at intervals along the margins of the rays and also in the wood parenchyma strands; they are very thin-walled, have yellowish contents, and are distinct on all three sections." The specimen described was collected in Bolivia by Mr. R. S. Williams and was taken, along with herbarium material, from the stem of a tree 10 inches in diameter and 35 feet high. (The sheet is No. 1474 in herbarium of the New York Botanical Garden.) The commonly accepted statement that this tree produces the wood known to the trade as South American tulipwood is erroneous.

Comparative anatomy of the woods

Magnoliaceae.—Vessels with scalariform (rarely simple) perforations and commonly with scalariform bordered pits. Fiber pits bordered. Pits of the rays often covering two or more of vessel. Parenchyma usually terminal.

Anonaceae.—Vessels with simple perforations and minute bordered pits. Fiber pits minute; indistinctly bordered. Pits in the rays usually rather large and covering two or more of vessel. Parenchyma in fine, rather evenly spaced concentric lines.

Canellaceae.—Vessels with scalariform perforations and with a tendency to scalariform bordered pits. Fiber pits large and distinctly bordered. Vessel-ray pits half-bordered and usually elongated.

Lauraceae.—Vessels with either simple or scalariform perforations, or both; pits not scalariform. Fiber pits simple. Vessel-ray pits varying from bordered to large and elongated simple and more or less scalariform.

Lythraceae.—Vessels with simple perforations and large bordered pits. Fiber pits simple. Vessel-ray pits much the same as in Lauraceae.

SOME TRADE NAMES OF WOODS

Amboyna = burl of some leguminous tree from the Moluccas.
Bagac = *Dipterocarpus grandiflorus* Blanco (Phil. Is.).
Bob wood = balsa, *Ochroma* sp. (Trop. Am.).
Boxwood, Brazilian = *Euxylophora paraensis* Huber (Amazon).
Briar, American = burl of *Kalmia* or *Rhododendron* (S. E. U. S.).
Burletta = burl of maple, *Acer* sp. (U. S.).
Caya = in boxwood trade, *Sideroxylon* sp. (Santo Domingo).
Comino wood = burl of *Aniba* sp. (Colombia).
Corla = burl of redwood *Sequoia sempervirens* (Lamb.) Endl. (Calif.).
Harewood = gray-stained wood of maple, *Acer* sp. (Europe).
Hazel pine = in English market, sapwood of red gum, *Liquidambar* (So. U. S.).
Jennie wood = freijo, *Cordia Goeldiana* Huber (Braz. Amazon).
Kyonix = red gum, *Liquidambar* (So. U. S.).
Lily wood, Swedish = burl of birch, *Betula* sp. (Europe).
Mexican cherry = same as corla.
Mousewood = harewood.
Nagaed wood = Honduras rosewood, *Dalbergia* sp. (Brit. Hond.).
Noibwood = bethabara, *Tecoma leucoxylon* Mart. (Dutch Guiana).
Palm, black = *Astrocaryum* sp. (Panama).
Rakuda = possumwood, sandbox, *Hura crepitans* L. (Dutch Guiana).
Secoya = yellow poplar, *Liriodendron tulipifera* L. (U. S.).
Teledo wood = manbarklak, *Eschweilera corrugata* Miers (Dutch Guiana).
Tisswood = thuya burl, *Tetraclinis articulata* Masters (Algiers).
Tonquine wood = East Indian satinwood, *Chloroxylon Swietenia* DC. (Ceylon).
Vencola = roble colorado, *Platymiscium polystachium* Benth. (Venez.).
Venesia = vera, *Bulnesia arborea* Engl. (Venez.).
Zercotte = A red and black wood of Mexico and Central America of the type of *Astronium Conzattii* Blake.

LECYTHIDACEAE

One of the representatives of this family is known in eastern Brazil as "biriba" or "biribi," names more commonly applied to some of the Anonaceae. The trees occupy a strip five to ten miles wide along the coast and have straight slender boles 50 feet or more in length and 18 to 24 inches in diameter. The timber is hard, heavy, strong, and durable, and is much used in the Bahia region for poles and posts. Material collected by Mr. H. M. Curran in Ilheos has been identified by Dr. S. F. Blake, Washington, D. C., as *Eschweilera Luschnathii* (Berg) Miers.

The Colombian "mahogany," *Cariniana pyriformis* Miers, locally known as "albarco," entered the foreign market about 45 years ago, the early shipments being principally to France. The wood has not met with favor in the United States as it is said to be difficult to work on account of grit in the cells. The known range of this species has recently been extended by the explorations of Mr. H. Pittier, Caracas, Venezuela, who says that it is one of the largest and most conspicuous trees in the flat country of the Rio Santa Ana, above the belt of perennially flooded forest on the western side of Lake Maracaibo. The vernacular name of the tree is "bacú."

ESCALLONIA

Escallonia floribunda H. B. K. (Saxifragaceae) is a rather common tree at elevations of 4,000 feet and above near Caracas, Venezuela, and is known as "jarillo" (little jar), a reference to the shape of the fruit. At Colonia Tovar the trees are from 25 to 45 feet in height and 14 to 16 inches in diameter and supply timber used locally for building purposes and for fuel. Because of the peculiar stench of the fresh wood the vernacular name there is "cochinito," while in the Venezuelan Andes it is "puerquito," both names meaning little pig.—From letter of Mr. H. Pittier, Caracas.

PRELIMINARY CHECK LIST OF BRITISH HONDURAS WOODS

Common name	*Botanical name*	*Family*
Axemaster	?	?
Balsam	*Myroxylon toluiferum* H. B. K.	Leguminosae
Banak	*Myristica* aff. *panamensis* Hemsl.	Myristicaceae
Barba jolote	*Cassia* aff. *emarginata* L.	Leguminosae
Barbed wood	?	Anonaceae
Bay cedar	*Guazuma ulmifolia* Lam.	Tiliaceae
Billbird	?	?
Billbird patter	*Ouratea pyramidalis* Riley	Ochnaceae
Billy Webb	*Sweetia panamensis* Benth.	Leguminosae
Birch wood	*Bursera gummifera* L.	Burseraceae
Blue blossom	?	?
Bob wood	(Same as barbed wood)	
Boy Job	?	?
Breabri	*Inga spectabilis* Willd.	Leguminosae
Breadnut	*Brosimum alicastrum* Swartz	Moraceae
Bull hoof	*?Drypetes* sp.	Euphorbiaceae?
Bullet tree	*Terminalia Buceras* Wright	Combretaceae
Buttonwood	*Conocarpus erecta* L.	Combretaceae
Cabbage bark	*Andira inermis* H. B. K.	Leguminosae
Cacho venado	*Mouriria parviflora* Benth.	Melastomaceae
Calabash	*Crescentia Cujete* L.	Bignoniaceae
Capache	?	Burseraceae
Casada wood	*Ilex* sp.	Aquifoliaceae
Cedar	*Cedrela mexicana* Roem.	Meliaceae
Chewstick	*Symphonia globulifera* L. f.	Guttiferae
Chuckem	*Pithecolobium albicans* Benth.	Leguminosae
Coapma wood	*Erythrina* sp.	Leguminosae
Coco plum	*Chrysobalanus Icaco* L.	Amygdalaceae
Cogotone	*Tabernaemontana citrifolia* L.	Apocynaceae
Cortez	*Tecoma* sp.	Bignoniaceae
Cottonwood	*Ceiba pentandra* Gaertn.	Bombacaceae
Craboo	*Byrsonima crassifolia* (L.) DC.	Malpighiaceae
Cypress	*Podocarpus coriaceus* Rich.	Taxaceae
Dogwood	*Ichthyomethia piscipula* Hitch.	Leguminosae
Emeri or emery	*Vochysia hondurensis* Sprague	Vochysiaceae
Fiddle wood	*Tecoma pentaphylla* Juss.	Bignoniaceae
" "	?	Verbenaceae?
Fig, wild	*Ficus glabrata* H. B. K.	Moraceae
Glassy wood	*?Guettarda* sp.	Rubiaceae
Gombolimbo	(Same as birch wood)	
Grande Betty	*?Cupania* sp.	Sapindaceae
Grape, wild	*Sloanea* sp.	Elaeocarpaceae
" , "	*Coccoloba barbadensis* Jacq.	Polygonaceae

Common name	*Botanical name*	*Family*
Guava blossom	*Lonchocarpus* sp.	Leguminosae
Hog plum	*Spondias lutea* L.	Anacardiaceae
Ironwood	*Dialium divaricatum* Vahl	Leguminosae
Jug	*Mouriria* sp.	Melastomaceae
Lime, wild	?	Sapotaceae
Logwood	*Haematoxylon campechianum* L.	Leguminosae
Madre cacao	(Same as guava blossom)	
Mahogany	*Swietenia macrophylla* King	Meliaceae
" , white	(Same as emeri)	
Mangrove, black	*Avicennia nitida* Jacq.	Verbenaceae
" , red	*Rhizophora Mangle* L.	Rhizophoraceae
" , white	*Laguncularia racemosa* Gaertn.	Combretaceae
Mapola	*Luehea* sp.	Tiliaceae
May flower	(Same as fiddle wood)	
Moho	*Belotia* sp.	Tiliaceae
Mountain cow	(Same as chewstick)	
My lady	?	?
Nargusta	*Terminalia obovata* (R. & P.) Eichl.	Combretaceae
Negrito	*Simaruba glauca* DC.	Simarubaceae
Oak	*Quercus* sp.	Fagaceae
Old William	*Vismia ferruginea* H. B. K.	Guttiferae
Pal malata	*Lacistema aggregatum* (Berg) Rusby	Lacistemaceae
Palm, cabbage	*Oreodoxa oleracea* Morris	Palmaceae
" , cohune	*Attalea Cohune* Mart.	Palmaceae
" , monkey tail	*Chamaedorea* sp.	Palmaceae
Palomulatto	*Astronium Conzattii* Blake	Anacardiaceae
Pigeon plum	*Licania hypoleuca* Benth.	Amygdalaceae
Pine	*Pinus caribaea* Mor.	Pinaceae
" , Waika	*Amyris* sp.	Rutaceae
Poison wood, black	*?Mauria* sp.	Anacardiaceae
Polack, bastard	*Belotia Campbellii* Sprague	Tiliaceae
Polewood	*Xylopia frutescens* Aubl.	Anonaceae
Prickly yellow	*Zanthoxylum* sp.	Rutaceae
Provision	*Pachira aquatica* Aubl.	Bombacaceae
Quamwood	*Schizolobium Kellermani* Pittier	Leguminosae
Redwood	*Erythroxylon affine* A. Rich.	Erythroxylacese
Redwood, ridge	*Mosquitoxylum jamaicense* K. & U.	Anacardiaceae
Rosewood	*Dalbergia* sp.	Leguminosae
Rubber	*Castilla elastica* Cerv.	Moraceae
Santa maria	*Calophyllum Calaba* Jacq.	Guttiferae
Salm wood	*Cordia Gerascanthus*	Borraginaceae
Salom	*?Lysiloma* sp.	Leguminosae
Sapodilla	*Achras Zapota* L.	Sapotaceae
" , black	*?Genipa* sp.	Rubiaceae
" , bastard	(Same as billbird patter)	
Silly Young	*?Chrysophyllum* sp.	Sapotaceae

Common name	*Botanical name*	*Family*
Star apple	*Chrysophyllum Cainito* L.	Sapotaceae
Sul sul	*Mouriria* sp.	Melastomaceae
Tamarind, wild	*?Pithecolobium* sp.	Leguminosae
Tea bark	?	?
Tubroos	*Enterolobium cyclocarpum* Gris.	Leguminosae
Turkey victuals	?	?
Turtle bone	?	Combretaceae?
Waika chewstick	(Same as chewstick)	
Walk-naked wood	?	Myrtaceae
Walnut, Honduras	(Same as black poison wood)	
Water wood	*Cassipourea elliptica* Poir.	Rhizophoraceae
" " , bastard	*Miconia pteropoda* Naud.	Melastomaceae
Whykee chewstick	(Same as chewstick)	
Wycot	" " "	
Yaya	*Curatella americana* L.	Dilleniaceae
Yellow mixed wood	*?Enterolobium Schomburghii* Benth.	Leguminosae
Yemeri	(Same as emeri)	
Ziricote	*Cordia Sebestena* L.	Borraginaceae

The sources of information of this check list are as follows: (1) A set of 76 wood samples supplied by the Conservator of Forests, of which over half carried more or less complete botanical names, presumably from identifications by Kew Botanical Gardens. (2) A set of 45 wood specimens collected, with botanical material, near Riversdale by Mr. H. C. Kluge, Schenectady, N. Y. The determinations of the botanical specimens are by Dr. Paul C. Standley, Smithsonian Institution. This material was used as a check on the preceding, since the wood samples in (1) were not taken from the same trees as the herbarium material identified at Kew. (3) Samples of nine veneers supplied by Mr. J. W. Powell, of the Tidewater Lumber Company. (4) Leafy twigs and wood specimen of the Honduras rosewood, procured by Mr. W. N. Bourne, Punta Gorda.

Yale University School of Forestry

TROPICAL WOODS

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CHEMICAL ANALYSIS OF BALSA BARK

Logs of the balsa wood (*Ochroma* sp.) are shipped with the bark on, and as this bark is one-half inch or more in thickness it accumulates very rapidly at the mill. Being heavy with moisture and slow in drying it is poorly suited for fuel.

In seeking for means to dispose of this by-product the J. H. Monteath Company, 202 Lewis Street, New York, had a chemical analysis made of the bark. The results, given below, show that the material is without value as a source of tannin.

ANALYSIS

	As received	*Dry basis*
Water	10.00	....
Insolubles	0.26	0.29
Non-tannins	3.35	3.72
Tannin	1.10	1.22
Non-extractive	85.29	94.77
	100.00	100.00
Total extractive	4.71	5.23
Soluble extractive	4.45	4.94

SCHIZOLOBIUM: A PROMISING SOURCE OF PULPWOOD

The various species of this genus of the Leguminosae are tall soft-wooded trees having a combined range from southeastern Brazil to southern Mexico. They have large doubly pinnate leaves, with numerous small leaflets, and flowers that are in showy racemes. They are noted for their rapid growth and are worthy of consideration for planting and managing on short rotation to supply pulpwood.

Schizolobium parahybum (Vell.) Blake (*Cassia parahyba* Vellozo and *Schizolobium excelsum* Vogel) was collected in flower and fruit by Mr. H. M. Curran in the Rio Grongogy Basin, Bahia, Brazil, in 1915, under the vernacular name of "páo de vintem." This tree was about 90 feet high and 18 inches in diameter, and a sample of the wood of it is in the Yale collections (No. 1791). Respecting the new combination in the name, Blake (*Contr. U. S. Nat. Herb.* 20: 7: 241, 1919) says "it may be observed that the figure of Vellozo is unusually good for the work in which it appears, and thoroughly characteristic of the species. The specific name, obviously derived from the habitat of the species, 'ad ripas fluvii Parahyba dicti,' is written by Vellozo with a lower-case initial and is consequently to be treated as an adjective requiring modification in termination under the new combination here proposed."

Corrêa (*Flora do Brazil*, Rio de Janeiro, 1909, p. 20) says that *S. excelsum* Vog., which has a range from Rio de Janeiro to São Paulo and bears the vernacular name of "bacurubú," supplies timber for canoes, interior uses, sheathing boards, and paper pulp, while the bark is employed in tanning. The specific gravity of the wood is given as 0.302. Löfgren (*Manual das familias naturaes phanerogamas*. Rio de J., 1917, p. 245) states that it is a magnificent tree for ornamental purposes. Ducke (*Archivos Jardim Botanico do Rio de Janeiro* 3: 117, 1922) states that the Amazon species, *Schizolobium amazonicum* Ducke, occurs in the primary and secondary non-inundated forests of both the Lower and Upper Amazon region. Its flowers and fruits are about half the size of those of the other Brazilian species and there are minor floral differences.

Two Central American species* have been described by Pittier (*Contr. U. S. Nat. Herb.* 18: 6: 231–2, 1917). *Schizolobium Covilleanum* Pittier is said to be a large deciduous tree, 25 to 30 meters high, the trunk over one meter in diameter and covered with a grayish and shaggy bark. The crown is rounded-depressed; the larger limbers are horizontal. The author's statement that "the wood is yellow, fine-grained, and hard" is evidently in error. The type tree was collected in the Province of Coclé, Panama, at about 40 meters above sea level.

Schizolobium Kellermanii Pittier (*loc. cit.*, p. 232) is described by the author as a large tree collected near San Felipe, Pacific Coast of Guatemala. In 1919, Dr. H. N. Whitford and Mr. L. R. Stadtmiller collected botanical and wood specimens of this species near Izabal, on the Atlantic watershed of Guatemala. The vernacular names are "plumajillo" and "zorra." Blake (*Contr. U. S. Nat. Herb.* 24: 4: 98, 1922) says it is "a tall, handsome tree, with slender white trunk and a feathery head of foliage." Whitford (MS. report), in describing the hardwood forests of the valley and slopes of the Motagua drainage basin, says that the higher bottom lands, which are rarely if ever flooded, support the climax forests of the region and that at least three-fifths of the stand in this type is composed of five species, namely, (1) "tamarindo" (*Dialium divaricatum* Vahl), (2) "naranjo" (*Terminalia* sp.), (3) "masico" (*Brosimum terrabanum* Pittier), (4) "plumajillo" (*Schizolobium Kellermanii* Pittier), and (5) "ceiba" (*Ceiba pentandra* Gaertn.).

The following information regarding *Schizolobium* in British

* After this was in type the writer received the following information from Dr. Paul C. Standley, of the Smithsonian Institution: "The common species, *Schizolobium parahybum*, occurs in Salvador, but I doubt that it is native. I have seen only a few cultivated trees. The genus does occur in Atlantic Guatemala, near Quiriguá, where it is very conspicuous, but when I was there neither flowers nor fruits were obtainable. So far as I can tell, only this one species occurs in Central America. The one named by Pittier from Pacific Guatemala, *S. Kellermanii*, was based upon extremely fragmentary material, and does not seem distinct from *S. parahybum* (*S. excelsum*)."

Dr. Standley further states that *Schizolobium Covilleanum* Pittier is a synonym of *Caesalpinia eriostachys!* He says: "Pittier collected flowering specimens just outside the Canal Zone, and I have collected from the same tree, which is probably the only one in the region. It grows along a road outside Panama City, and was probably planted there. In his description, Pittier used the flowering specimen of *Caesalpinia* and a detached fruit of *Schizolobium*, but makes the *Caesalpinia* the type specimen."

Honduras is supplied by Mr. J. N. Oliphant, Conservator of Forests. He says that the timber known as "quamwood" has been identified at Kew as "*Schizolobium*, apparently *S. Kellermanii*, a species recently described from Guatemala." The particular specimen identified came from Hillbank, at the southern end of the New River Lagoon. This location is believed to be near the northern limit of the tree's range, which includes all portions of the Colony to the southward. The species occurs typically in the cohune palm association, and in favorable conditions grows to fair size, though never very large. It is generally associated with "moho" and "polak" as regrowth on "huamil" land (abandoned shifting cultivation), but is less abundant than those two species. It is apparently intolerant of shade and is of only sporadic occurrence in the climax forest.

Doreys (dugouts) are sometimes made from the trunks of the larger trees and last for about two years. The wood is soft, white, and not resistant to insects and decay, but finishes smoothly and might serve for interior work. Tests made by the Imperial Institute (*Bulletin* 24: 4: 401, 1924) on its value as timber were not very encouraging, but later tests for pulp indicate that it is well adapted to the soda process. The consumption of soda is moderate, and the pulp, although rather short-fibered, is somewhat similar in character to commercial poplar pulp and produces paper of fairly good strength. It is only slightly inferior to that of the "moho," a tree related to basswood.

Mr. Oliphant hopes to develop a pulp industry in the Colony, using "moho," "quamwood," and possibly "polak." All three species grow rapidly and could be managed on very short rotation, perhaps five years or less. There are fairly large tracts of "huamil" land available, particularly the sites of banana plantations which have been abandoned on account of the Panama disease. Those interested in a future supply of soda pulp might find the proposition well worth investigation. It would probably involve the location of a mill near the source of the pulpwood, owing to the difficulties of shipping the logs long distances.

DESCRIPTION OF THE WOOD

Schizolobium Kellermanii Pittier — *Quamwood*

Common names: Quamwood (B. G.); plumajillo, zorra, sora (Guat.). OTHER SPECIES: Chapulaltapa (Salv.); bacurubú, páo de vintem (Braz.).

General properties: Color nearly white, with streaks of reddish brown. The sapwood is either very thick or there is no distinct heartwood. Luster satiny.

Odor and taste absent or not distinctive.

Light and soft to moderately so. Softest specimens rather spongy, but tough. Grain variable from straight to decidedly roey. Texture rather coarse, not harsh. Wood saws rather woolly; is rather difficult to finish smoothly; nails without splitting; is perishable in contact with the ground.

Growth rings: Terminated by a fine line of wood parenchyma. Sometimes distinct, due to differences in density or color, or both combined.

Parenchyma: In irregular halos about the pores, sometimes in diamond-shaped patches, which are occasionally more or less confluent; not very distinct. Also in fine, widely spaced concentric lines, usually not visible without lens.

Pores: Resembling small pin holes fairly uniform in size; scattered; mostly single, but sometimes sub-divided two to several times; most distinct in the darker zones; open.

Vessel lines: Coarse; very distinct in darker zones; show as black lines in infected material.

Vessel contents: Some gum deposits in darker zones.

Rays: Very fine; faintly visible without lens on cross and tangential sections; distinct, but low and not conspicuous, on radial surface, where they appear somewhat lighter than background.

Ripple marks: Absent.

Gum ducts: None observed.

Minute anatomy: Vessels thin-walled; segments irregular in shape and length; perforations simple, with prominent annular ridges; pits crowded, rather large, of screw-head type, distinctly cribriform. Rays one to six cells wide and few to 25 cells high; homogeneous; pits into vessels closely resemble intervascular pits; small rhombohedral crystals common. Wood parenchyma thin-walled; cells adjacent to vessels very irregular; crystals common. Fibers without definite radial arrangement; walls variable in thickness, many with gelatinous layer; pits simple, slit-like or lenticular, inconspicuous. (Material, Yale No. 7397.)

Remarks: The specimen from Guatemala is considerably denser than those from Brazil and British Honduras.

A specimen of this wood was collected in Southern Mexico by Mr. Thomas H. Gill and he states that the Indians call the tree "juan acosta." From his description of the tree, however, it would appear that there is confusion with *Enterolobium cyclocarpum* Gris.

Material: Yale No. 7397 (Brit. Hond.); 3685 (Guatemala); 7726 (Tobasco, Mexico).

FOREST CONDITIONS IN SOUTHEASTERN BAHIA, BRAZIL

By Hugh M. Curran

In going from the coast to the interior of southeastern Bahia, one meets with four more or less distinct types of forest. The coastal zone, which is from 20 to 30 miles wide, is a sunburnt and windswept region with poor soil supporting a growth of a few species of shrubs and small trees. Here and there, however, are protected areas with better developed and more complex stands extending from the interior rain forests beyond.

The transitional zone, five to ten miles in width, is a foggy and rainy belt with the slopes and valleys in second-growth of medium to large size and occasional patches of apparently first-growth forest. There is a commingling of species from both the coastal and rain forests, but there is also a development in quantity of species which form only a minor part of the other forests. The trees are 50 to 100 feet in height, the stands are dense and the undergrowth is heavy.

Beginning with the first high ridges are the rain forests, occupying a zone 50 to 100 miles in width and extending to the dry catingas beyond. The country is similar in topography to the western portions of Maryland and Carolina, and is the home of such well known timbers as rosewood, cedar, and brazilwood.

The writer has made a careful study of a tract of 75,000 acres in the Rio Grongogy basin. In general this area consists of a rather narrow valley with southerly branches between which are narrow rough flat-topped ridges 500 to 1000 feet above the central valley. Outside of the river valley itself there is a scarcity of water and the stream beds are practically dry for most of the year. Back in the higher ridges there are some small streams, but for the most part they flow for only a mile or two and disappear. This scarcity of water has been the principal factor in restricting settlement and most of the tract remains in its virgin condition.

The clearings are confined to the vicinity of the river and consist of brush and pasture land and from five to ten acres in

cultivation. The people are mostly negroes or uneducated whites who support themselves by raising vegetables, cacáo, and livestock, as well as through hunting, fishing, and canoe-making. They are poor, but have plenty of food and are independent; in their general character and habits of life they resemble the mountaineers of Kentucky and Tennessee. Quarrels and feuds are common and the unfriendliness of the wandering bands of Indians is a constant source of anxiety. The typical dwelling for a family of five or more is a small round mud-and-wattle house with tile or palm-thatched roof and dirt floor.

The heaviest rains occur between January and June. The cool months are from May to August and many of the forest trees drop their leaves during this period. Many trees were found in September and October which were just coming into flower and new leaf.

The tract may be divided into three site classes as follows: (1) The dry exposed ridges, with shallow sandy soil overlying rock and supporting a poor and open stand of timber. Such areas comprise about 17 per cent of the total and the average stand is about 6000 board feet per acre. (2) Upper slopes, with medium quality red clay soil and a fair amount of humus, comprising about 42 per cent of the tract. The average stand is estimated at 10,000 board feet. (3) Lower slopes and valleys with deep, moist, well-drained soil comprising 35 per cent of the tract and having a stand of 13,000 board feet per acre.

The estimates are based upon measurements of typical areas with volumes computed from sample trees. For defects not visible to the eye, an allowance of 10 per cent was made for the ridge type and 20 per cent for the other, such allowances being based upon experience with similar tracts and checked by examination of the sample trees felled. About 6 per cent of the total area is occupied by watercourses and clearings.

There are on the tract more than 100 different kinds of trees ranging in diameter from 12 to 48 inches and in height from 75 to 125 feet. Clear lengths of 30 to 50 feet are common, extending in exceptional cases to 60 or 75 feet. The timbers of principal commercial importance are not over 20 in number,

and fully 50 per cent of the total cut will be from 10 species, as follows:

Jequitibá	*Cariniana legalis* (Mart.) Kuntze.
Araçá d'agua	*Terminalia* aff. *januarensis* DC.
Páo d'alho	*Gallesia Scorododendrum* Casar.
Mucuri	*Lucuma procera* Mart.
Massaranduba	*Mimusops* sp.
Pimenteira	*Trichilia alta* Blake.
Oleo	*Copaifera* sp.
Viroity	*Quararibea* sp.
Moçitahyba branca	Unidentified
Páo sangue	*Pterocarpus* sp.

All of the above timbers are practically unknown to commerce, but they will eventually prove very acceptable to the trade, once their properties are fully known. There are in addition the following kinds in commercial quantity, some of which are better known:

Jacarandá (rosewood)	*Dalbergia nigra* Fr. Allem.
Cedro (Spanish cedar)	*Cedrela* sp.
Coracão de negro	*Cassia Apoucouita* Aubl.
Páo roxo (purpleheart)	*Peltogyne* sp.
Sapucaia (monkey-pot)	*Lecythis ollaria* L.
Vinhatico castanho	*Plathymenia reticulata* Benth.
Vinhatico de espinho	*Pithecolobium Vinhatico* Record.
Piquiá	*Aspidosperma* sp.
Páo brazil (brazilwood)	*Caesalpinia echinata* Lam.
Peroba do Bahia	*Sweetia* sp.
Carne d'anta	*Maytenus obtusifolia* Mart.
Páo parahyba	*Simaruba versicolor* St. Hil.
Caroba	*Jacaranda* sp.
Oitiçica	*Clarisia racemosa* R. & P.
Estriveira	*Luehea divaricata* Mart.
Páo ferro	*Caesalpinia* sp.
Páo d'arco	*Tecoma* sp.
Barriguda	*?Cavanillesia* sp.
Buranhem	*Pradosia latescens* (Vell.) Radlk.
Bicuiba	*Virola Bicuhyba* Warb.

Wood specimens and botanical material were obtained of all of the foregoing and added to the Yale collections. Most of the woods have been described by Professor Record in *Timbers of Tropical America*.

In consideration of the widely accepted belief that the tropical forest is composed almost exclusively of hard and heavy woods, a typical acre was examined in detail, with the following results: Very hard woods, 28 per cent; medium, 30 per cent; soft, 42 per cent. The bulk of the timber of the region exhibits much the same range in properties as one finds in the common American woods, such as oak, gum, yellow poplar, birch, basswood, and maple. Only a few are in the class of cabinet and fancy woods, the great majority being plain woods of general utility. The best markets for such lumber are in Brazil and Argentina.

FLOWERS OF THE BRAZILIAN ROSEWOOD

In the description of the "jacarandá" tree, *Dalbergia nigra* Fr. Allem., in *Timbers of Tropical America*, no mention is made of the flowers. I saw the trees growing in Melbourne, Australia, and the blossoms are among the most exquisite of any tree I have ever seen. As I recall them, they are of a lovely light bluish violet color and in thick clusters, suggesting the wistaria, though of finer texture. Combined with the lovely acacia-like compound feathery leaves, they are exceedingly ornamental.—From letter of Mr. H. D. Tiemann, Madison, Wisconsin.

RANGE OF PHYLLOSTYLON

The writer has received from Mr. C. D. Mell some photographs of a group of trees of *Phyllostylon brasiliensis* Capanema which he found growing near the edge of Lake Managua, Nicaragua, a short distance from Buqueron Station on the railway between Granada and Corinto. He says that the trees were easily recognized at a distance and looked exactly like those of the same species in Mexico and Haiti. Leaf specimens were collected and deposited in the herbarium of the New York Botanical Garden.

This species, the only one of the genus, produces one of the minor boxwoods of commerce, known in New York as San Domingan boxwood or "baitoa." Its present known range included portions of Argentina, southern Brazil, Cuba, the Island of Haiti, Venezuela, Nicaragua, and southern Mexico.

PITS WITH CRIBRIFORM MEMBRANES

There are a number of dicotyledonous woods in which the intervascular and vascular-parenchymatous pits exhibit a dotted appearance suggesting sieve-plates of the phloem. These dots are minute perforations in the pit membrane and they vary in number and distinctness. Various investigators have observed them in members of 20 families, though in all but six or seven of these they are too sporadic or indistinct to have much value for diagnostic purposes. They are likely to be obscured by deposits in heartwood.

The first extended account of these structures was by Dr. Bengt Jönsson, of Lund, Sweden, in his paper entitled, "Siebähnliche poren in den trachealen xylemelementen der Phanerogamen, hauptsächlich der Leguminosen" (*Ber. d. Deutschen Bot. Gesellschaft* 10: 494–513, 1892). In addition to the Leguminosae, where they were found in every species examined, the author reports them as occurring, with varying degrees of regularity and distinctness, in a few members of the following families: Amygdalaceae, Araliaceae, Asclepiadaceae, Compositae, Fagaceae, Hippocastanaceae, Myrtaceae, Oleaceae, Rhamnaceae, and Scrophulariaceae.

Jönsson reviews the literature concerning the structure of pits and the protoplasmic bridges between cells, but he found only one reference to the particular feature under consideration. This was a paper by Dutailly entitled, "Sur l'existence de ponctuations criblées dans le bois de la racine legumineuse" (*Bul. de la Soc. Linn. de Paris*, 1874 and 1877). Therein the author described what he considered a unique type of pit occurring in the radial walls of the wood parenchyma and in the longitudinal walls of the vessels, the structure corresponding very closely with that of the sieve-plates of the ploem.

The year following Jönsson's paper, Dr. Heinrich Heiden published a paper entitled, "Anatomische charakteristik der Combretaceen" (*Botanisches Centralblatt* 55: 353 *et seq;* 56: 1 *et seq;* 1893) in which he states that Solereder had, prior to 1892, observed cribriform pits in various members of the Leguminosae, Combretaceae, Melastomaceae, Vochysiaceae, and Onagrariaceae, but had not published his findings.

Moll and Janssonius, in their splendid work entitled, "*Mikrographie des holzes der auf Java vorkommenden baumarten*" (3 vols. Leiden, 1906–1918), mention the occurrence of cribriform pits in members of the Leguminosae, Hamamelidaceae, Combretaceae, Myrtaceae, Melastomaceae, Lythraceae, and Cornaceae.

The present writer has found such pits in several of the families already enumerated and has extended the list through the addition of the Polygonaceae.

THE FAMILIES

Amygdalaceae.—Cribriform pits reported by Jönsson as distinct in *Cerasus serotinus* hort., but indistinct and sporadic in *Prunus brigantinea* Vill.

Araliaceae.—Reported by Jönsson as indistinct and sporadic in *Hedera Helix* L.

Asclepiadaceae.—Reported by Jönsson as distinct in *Asclepias verticillata* L.

Combretaceae.—Reported by Heiden in species of *Terminalia, Calycopteris, Conocarpus, Ramatuella, Anogeissus, Guiera, Laguncularia,* and *Cacoucia;* by Moll and Janssonius in *Terminalia* and *Lumnitzera.* They have been observed by the present writer in *Terminalia, Conocarpus,* and *Laguncularia.* Some of the woods of this family have a structure suggesting the Leguminosae.

Compositae.—Reported by Jönsson as indistinct and sporadic in *Helichrysum moniliferum* hort.

Cornaceae.—Reported by Moll and Janssonius as of occasional occurrence in the vessel-ray pits of *Mastixia trichomata* Blume.

Fagaceae.—Reported by Jönsson as distinct in *Quercus Cerris* L., but sporadic and indistinct in *Q. alba L., Q. obtusiloba* Michx., and *Q. pedunculata* L.

Guttiferae.—Reported in *Calophyllum Inophyllum* L. by Ursprung (*Anat. u. jahresbild. trop. holzarten.* Diss., Basel, 1900, pp. 8–10), and in *C. Calaba* Jacq. by the present writer (*Timbers of Tropical America*, p. 441). Moll and Janssonius investigated five species of *Calophyllum* (including *C. Inophyllum*) and six species of *Garcinia,* but do not mention cribriform pits.

Hamamelidaceae.—Reported by Moll and Janssonius as rather indistinct and sporadic in *Altingia excelsa* Nor.

Hippocastanaceae.—Reported by Jönsson as distinct in *Aesculus rubicunda* hort., but sporadic and indistinct in *A. Hippocastanum* L.

Leguminosae.—Reported by Jönsson in 33 genera and 16 species; by Solereder (according to Heiden) in 15 genera and 16 species; by Moll and Janssonius in 26 genera and 52 species and varieties; a total of 53 different genera. The present writer has examined the woods of over 50 genera and found cribriform pits in all of them. No exceptions have been noted by any investigator.

For illustrations of the pits, see plate accompanying Jönsson's article; Miller's "The wood of *Machaerium Whitfordii*" (*Bul. Torrey Bot. Club* 47:

78, March, 1920); Record and Garratt's "*Cocobolo*" (Bul. No. 8, Yale School of Forestry, 1923, p. 9).

Lythraceae.—Reported by Moll and Janssonius as distinct, or almost always so, in all of the material examined of four genera, namely, *Crypteronia*, *Lagerstroemia*, *Duabanga*, and *Sonneratia*.

The present writer has observed them in *Physocalymma scaberrimum* Pohl, of Bolivia. The vessel-ray pits are large and the membranes are abundantly dotted.

Melastomaceae.—Reported by Moll and Janssonius as distinct in the woods of five genera examined, namely, *Melastoma*, *Medinilla*, *Astronia*, *Kibessia*, and *Memecylon*. According to Heiden, Solereder observed them in the following: *Astronia*, *Blakea*, *Medinilla*, *Meriania*, *Osbeckia*, *Ossaea*, *Oxyspora*, *Rhexia*, *Rynchanthera*, and *Sonerila*.

The present writer failed to find them in *Mouriria pseudo-geminata* Pittier, but this may have been due to the smallness of the pits in this species.

Myrtaceae.—Reported by Jönsson as distinct in *Callistemon Cunninghamii* hort.; by Moll and Janssonius as more or less distinct, and sometimes sporadic, in *Leptospermum*, *Eugenia*, *Chydenanthus*, *Planchonia*, and *Aphanomyrtus*, but not recorded for *Decaspermum*, *Rhodamnia*, and *Barringtonia*.

Oleaceae.—Reported by Jönsson as distinct in *Olea europaea* L. The present writer found them in *O. lanceolata*, but they were indistinct.

Onagrariaceae.—Reported by Solereder, according to Heiden, in *Fuchsia fulgens* M. & L. and *Jussiaea erecta* L.

Polygonaceae.—The writer has found cribriform pits in *Coccoloba barbadensis* Jacq., *Triplaris caracasana* Chams., and *Ruprechtia* spp.; they are distinct or fairly so.

Rhamnaceae.—Reported by Jönsson as distinct in *Phylica ericoides* L.

Scrophylariaceae.—Reported by Jönsson as distinct in *Veronica Anderssonii* hort.

Vochysiaceae.—Observed by Solereder, according to Heiden, in *Callistene fasciculata* Mart., *Erisma violaceum* Mart., and *Vochysia divergens* Pohl. The present writer has seen them very distinctly in *Vochysia guatemalensis* J. D. Smith.

CONCLUSION

Pits with cribriform or sieve-like membranes have been reported in the secondary wood of members of 20 families of dicotyledonous plants. In some instances they have been found in only a single species, perhaps a horticultural form, in others they are apparently characteristic of an entire family. It is not unlikely that all pit membranes are perforate, but that in most cases the perforations are too fine to be seen. Jönsson believes that their size and distinctness may be affected by the conditions of growth of the individual plant.

The families in which these structures are seen to the best advantage in identification are the Combretaceae, Leguminosae, Lythraceae, Melastomaceae, Polygonaceae, Vochysiaceae, and, in a more limited sense, the Myrtaceae. When the perforations are distinct they are valuable aids in identification, but too much significance should not be attached to their apparent absence.

MONTANOA

According to Mr. M. T. Dawe (*Account of a journey through the western portion of Colombia.* Publ. by Col. Bu. Inf. and Trade Propaganda, London, 1919, p. 10.), *Montanoa Moritiziana* Sch. (Compositae) is a common tree growing gregariously near Manizales, Colombia, where it is known as "arboloco" (mad tree). It is said to be about 35 feet high with an erect, hollow stem supplying wood that is very durable and much in demand for house building, especially as flooring beams; also that it is highly prized for the manufacture of billiard cues.

Mr. Jorge Pinzón de Castilla, of Bogotá, forwarded a section of the stem of "arboloco," together with fruits of the same tree which have been identified as a species of *Montanoa*. The wood is light brown, rather hard and heavy, and has very narrow rays that are conspicuous on radial surface. It appears tough and strong, but there is nothing to indicate that it would be durable when exposed to decay, while the general appearance is so plain and ordinary that it seems very unlikely that there would be a demand for it for billiard cues. The stem examined by the writer is not hollow, but has a pith an inch and a half thick.

WOODEN COMBS

During the course of an investigation of boxwood, some attention was given to the use of wood for combs. The Metropolitan Museum of Art, New York City, placed at the writer's disposal 16 fragments of combs from the tombs of the Early Egyptians. In this collection there were about 10 different kinds of woods, five of which were determined with reasonable accuracy without seriously mutilating the specimens. These five were: *Tamarix*, *Acacia?*, *Argania*, *Cordia*, and *Buxus*.

In the Haskell Oriental Museum of the University of Chicago is a Graeco-Roman comb that is 1700 years old. It is of boxwood, measures about 3 x 3½ inches, and has 12 coarse teeth 1¼ inches long on one side and 36 fine ones of the same length on the other. This comb is in an almost perfect state of preservation, and fragments of the bark are still in place on the sides.

Boxwood is still used for combs throughout the entire region of its growth. Some of the finest examples of the comb-maker's art are produced in Japan where they are worn by the women. In the Philippine Islands wooden combs are a staple article on the market. The best grade is made out of the beautiful dark-colored heart of the "camagon" (*Diospyros discolor* Willd.), the cheaper ones from the sapwood of the same tree. Another wood occasionally used is the coppery red heart of "alupag" (*Euphoria didyma* Blanco).

The Yale collections are indebted to Dr. S. Calderón, of San Salvador, for some combs from San Julian, Salvador. Except for their shorter teeth, they are very similar in appearance to the Graeco-Roman one referred to above that was excavated in the Faiyum in 1901–02 by the Egypt Exploration Society. These Salvadorean combs are made of "salamo" (*Calycophyllum candidissimum* DC.), a pale brownish wood that is the same as that known on our markets from Cuba under the name of "degame."

SPIRAL GRAIN IN TREES

In a letter of June 25, 1911, the writer recommended to the U. S. Forest Service that experiments be made to determine whether or not spiral grain in trees is an inheritable character, since if such were found to be the case it would have an important bearing upon silvicultural practice. In response to that suggestion, Mr. George B. Sudworth, Dendrologist, prepared a memorandum from which the following is taken:

"The possibility that some individual pine trees may have an acquired or inherent tendency to develop twisted stems would, in my opinion, justify the study of a sufficiently large number of plants, raised from seed of different twisted trees,

to test this hereditary tendency theory. I think that a study also of the conditions under which twisted old trees are growing, including determinations of whether the twisting was common throughout the life of the tree, would possibly throw further light upon the theory that wind produces spiral trunk growth.

"There seems to be ground for suspecting that wind may have an influence on this spiral development. I have cut old *Larix laricina* which had developed spirally twisted annual layers after the trees were 30 to 40 years old, when, unprotected by associated trees, they were subjected to heavy winds. The wood laid on in the earlier years was not twisted. I do not know by actual examination that this periodic twisting is peculiar to any of the pines, but I suspect that it may be true of *Pinus ponderosa* and of *P. albicaulis*. But I cannot recall having seen any spirally grown trunks of *Pinus flexilis*, on which certainly wind should have such an effect, if the theory is correct. . . . I would personally like to see a study of this sort begun for the practical bearing its results may have on seed selection."

Apparently nothing further came of this suggestion and the occasion for recalling it is the receipt of Vol. XI, Part II, of *The Indian Forest Records*, containing H. G. Champion's "Contributions towards a knowledge of twisted fibre in trees." This is an article of 70 pages, well illustrated, and divided into two parts: I. The phenomenon of twisted fibre with special reference to *Pinus longifolia* Roxb. II. Investigations of the possible inheritance of twisted fibre in *Pinus longifolia* Roxb. The summary of conclusions is as follows:

"(i) It is a character common to all trees to produce a varying but small proportion of individuals with twisted fibre, the twist being L [left] at first but changing to R [right] with passage of a period of time varying greatly in length with the species. These characteristics are best developed in coniferous species.

"(ii) There is probably a certain amount of fluctuating variation in the direction of the fibre accounting for occasional exceptions to this general rule, others being perhaps traceable to special inhibitive influences.

"(iii) In areas where twist is exceptionally frequent, twisted

fibre, or a tendency to produce it, is unquestionably capable of being transmitted from one tree generation to the next.

"(iv) Conditions found in existing forests make the inheritance of twist as an acquired character difficult to accept as a satisfactory explanation.

"(v) In such areas, a twisted variety may have originated, possibly by a simple loss mutation of a factor controlling the orientation of the growing cells. Such mutation must have originated independently in many localities, its survival being favoured by the continued selection of the straighter trees for removal.

"(vi) Sound forest management on the generally accepted lines especially as regards seed-selection and thinning, should result in time in the elimination of twisted trees."

Since twisted fibre, in some instances at least, "is unquestionably capable of being transmitted from one tree generation to the next," is there not herein a suggestion for those who would propagate figured mahogany and other fancy cabinet woods?

"MELÓN" AND "RONRÓN" OF SALVADOR

"Recently I have received from two sources specimens of the 'melón' or 'roldán' of Salvador. This turns out to be *Amyris elemifera* L., at least I cannot separate the Salvadorean specimens from some of the West Indian forms. It is also known in Salvador as 'ocotillo.'"

"Dr. S. Calderón has forwarded sterile specimens of the 'ronrón,' and this is a species of *Astronium*, very likely *A. graveolens* Jacq. Sterile specimens of what is probably the same species keep turning up from Central America, all the way from Panama to Yucatán, but flowers or fruits have never been collected. The tree is common about the Canal Zone and along the Atlantic coast of Guatemala, where I have collected it myself. Both 'ronrón' and 'melón' are important lumber trees in Salvador."—From letter of Dr. Paul C. Standley, Smithsonian Institution.

L. C.

M.M. CHATTAWAY.

Yale University School of Forestry

TROPICAL WOODS

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Yale University School of Forestry

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THE CHINESE "PAU HOI"

The "pau hoi" is a Chinese wood which is so mucilaginous that the water in which chips of it have been soaked is used in hairdressing in the Orient. The tree has been introduced into Formosa and the peculiar use of the wood is also in vogue there.

The tree was identified by Dr. Tutcher, late Director of the Botanical Garden at Hongkong, as *Machilus Thunbergii*, but Dr. Kanehira, Taihoku, Formosa, is of the opinion that it is a species of *Cinnamomum*. He bases this conclusion on the minute anatomy of the wood, particularly the abundance of the oil cells.

Dr. Kanehira has kindly forwarded a sample of this interesting wood. It has the general appearance of white birch (*Betula papyrifera*). The application of water has much the same effect as in the case of the inner bark of slippery elm (*Ulmus fulva*). Water in which shavings have been soaked remains transparent, but acquires a ropy consistency like the fresh white of an egg. The writer does not know of any other wood that behaves in this manner.

AFRICAN ZEBRA WOOD AND "BUBINGA"

These two cabinet woods, which are fairly well known to European and American trade, have their source in French Equatorial Africa. Their identities are in doubt, although both are members of the Caesalpinioideae group of the Leguminosae.

Zebra wood is so called because of the dark brown or blackish stripes on a pale brown background, different specimens showing considerable variation in the spacing and relative proportion of the alternating bands. (The writer is indebted to Mr. George W. Dailey, New Albany, Ind., for a number of samples illustrating this variability.) The wood is of medium density, easy to work, finishes smoothly, and takes a high polish. The rays are exceedingly fine and the pores are small, though very distinct because of the circles of parenchyma about them. Ripple marks are absent or local and irregular. According to Chevalier (*La forêt et les bois du Gabon*, Paris, 1916, p. 201), the tree is common in the region about Lake Fernan-Vaz, and the vernacular names are "bois zébré" and "zingana." He lists it as "Legumineuse indéterminée No. 7. Probablement voisine de *Macrolobium*."

The "bubinga" bears considerable resemblance to the darker-colored specimens of Brazilian tulipwood. The writer has seen only one specimen (Yale No. 4795) and it is not unlikely that others would show a considerable variation in the proportions of rose-purple and rose-yellow. The wood is about as dense as hickory (*Carya*) and takes a beautiful polish. The rays are visible, and the pores, which are small and not very numerous, are distinct because of the diamond-shaped patches of parenchyma. There are also concentric lines of parenchyma apparently limiting growth rings. Ripple marks are absent.

Only two references to "bubinga" have been found in the available literature. Bertin (*Les bois de la Guyane française et du Brésil*, Paris, 1920, p. 309), in discussing the Brazilian tulipwood, or "páo rosa," says that it is well known in France under the name of "bois de rose" and is much more beautiful than the "bois de rose d'Afrique: kévasingo et bubinga." Chevalier (*loc. cit.*, p. 169) states that "bubingô," imported into Europe under the name of "faux bois de rose du Congo," for use in cabinet work, originates in the Fernan-Vaz region, where the trees attain a height of 80 to 100 feet, with trunks 24 to 32 inches in diameter and free of limbs for upward of 65 feet. He describes the wood as follows: "Bois d'un beau rouge amarante, avec des zones longitudinales plus foncées, dense. Aubier d'un blanc rougeâtre, assais épais. D.=0.851." The tree is classified as *Brachystegia* sp.? (Leguminosae).

It is to be hoped that the identities of these two African woods, as well as that of the Brazilian tulip, can soon be fully determined.

COLOMBIAN "NATO"

The writer recently received from the Bureau of Foreign and Domestic Commerce, Washington, D. C., a specimen of wood obtained by Mr. H. Bentley MacKenzie, American Commerical Attaché at Lima, Peru. He states that the sample is from a shipment from the vicinity of Tumaco, Colombia, and is known as "nato."

"It is a heavy wood," writes Mr. MacKenzie, "and it is said that the ordinary tie of 8′ x 6″ x 8″ has an average weight of 76 kilos or 177 pounds. Most of the ties purchased by the Peruvian Government railways and the Lima street car company are either of this wood or 'roble pellin' [*Nothofagus obliqua* Mirb.] from Chile. The purchase of California redwood ties is practically confined to the privately owned railways of Peru."

"Nato" has been identified by the present writer as *Dimorphandra oleifera* Triana. This is the same as the "alcornoque," a large tree characteristic of the inner tidal belt of the Pacific coast of Panama and very abundant along some of the rivers of that region. The wood is much like that of the mora (*D. Mora* B. & H.) of the Guianas, one of the most useful timbers of those colonies and one of the very few woods which have proved satisfactory for railway ties in northern countries.

The specimen of "nato" examined by the writer has a specific gravity of 0.92 (thoroughly air-dry); weight about 57.5 pounds per cubic foot. The color is reddish-brown, more

or less streaked; deepening upon exposure. The wood is easy to cut, is not flinty or gritty, and its consistency and composition indicate that it is not likely to warp or check badly in drying. It has every appearance of being durable in contact with the ground, but according to report it is not resistant to marine borers. Attempt is being made to interest consumers of crossties in the United States, and the writer believes that the wood is well worthy of trial.

"PALMA BRAVA" FOR SHAFTS OF GOLF CLUBS

The writer has received various requests for information regarding the wood of a Philippine palm known as "palma brava." According to a news item in the *Timber Trades Journal* (London, Jan. 24, 1925, p. 273), a concern located in Tarlac, P. I., is turning out golf club shafts of this material at the rate of a thousand a month, and selling at one-third the cost of hickory. The qualities of the material are given as follows:

"The grain runs true from end to end. The steel-like wood fibers minimize the liability to breakage and multiply the strength and resiliency. Palma brava has the same diameter above as below, so no weakness results as from the taper of ordinary woods. A perfect tortion or twist, so necessary in distance clubs, is secured without the resultant warp evident in ordinary shafts."

Through the courtesy of Mr. Arthur F. Fischer, Director of Forestry, there have been added to the Yale collections a section of the trunk of this palm, known officially as "anahau," and a golf club shaft as turned out by Mr. Leon von Haverback of Tarlac, Tarlac, P. I. Mr. Fischer also forwarded descriptions of the tree and wood, the work of Mr. Luis J. Reyes, Wood Technologist of the Bureau of Forestry. The following information is taken from Mr. Reyes' report.

There are two species of the palm, namely, *Livistona rotundifolia* Mart., var. *luzonensis* Becc. and *L. Merrillii* Becc. The former, which supplies the wood for golf club shafts, is widely, though somewhat sporadically, distributed in the forested areas throughout the Archipelago, being fairly

abundant in Negros, Tayabas, Mindoro, and northern Mindanao. The trunk is straight and smooth, 50 to 65 feet tall and 6 to 8 inches in diameter. The bark is thin and varies in color from light brown to nearly black, sometimes mottled with lichens.

The cross section of a stem shows the typical palm structure —a large core of fibrous pith surrounded by a hard layer of closely compressed horn-like fiber bundles. This dense layer varies in thickness from three-fifths to four-fifths of an inch, is dark brown to nearly black in color, straight grained, and of fairly fine texture. In the densest portions there are between 500 and 700 fiber bundles per square inch, being more numerous and slightly smaller than in the other species. The parenchyma between the bundles is of a dark brown color and occupies from 15 to 40 per cent of the area in the dense regions.

The whole trunks serve locally for pillars in houses, while the outer hard shell is used by the natives for house floors, spear shafts, bows, ax handles, carrying poles, and walking sticks.

Local names.—Abiang (Pampanga and Pangasinan); anau (Cagayan, Isabela); anahau (Ilocos Norte and Sur); anahau (Manila, Rizal, Laguna, Tayabas, Camarines, Masbate, Albay, Sorsogon); bagsang (Samar); bahi (Samar, Leyte, Antique, Capis, Iloilo, Cebu, Occidental and Oriental Negros, Bohol); balak (Moro); balla (Bagobo); ballang (Cagayan); bulno (Bicol); labig (Ilocos Norte and Sur, Pampanga); luyong (Pampanga, Zambales); pilig, tikal (Tagalog); tikis (Zambales); palma brava (Spanish-Filipino).

TWISTED PLANE-TREES

The discussion of spiral grain in trees (*Tropical Woods* 2:14–16) recalls the interest that I took in this subject when living in the cañons of Arizona and New Mexico in the early eighties. The plane-trees of those cañons, I think *Platanus Wrightii* Wats., displayed the twisted trunk condition more strongly than any other trees that I have ever observed. Our general use of those trunks for firewood forced the peculiarity on our attention. As I now recall, the trunk of this tree was always twisted. I tried at the time to secure evidence that it

was caused by the wind, but could find none. When the trees were in the bottom of a deep cañon they would be uniformly twisted, no matter in what direction the cañon extended. *Alnus oblongifolia* and other trees growing with them would not be twisted, which seemed to indicate an acquired tendency in this direction on the part of the *Platanus*.—From letter of Dean H. H. Rusby, College of Pharmacy of the City of New York, Columbia University.

JACARANDA COPAIA IN BRITISH GUIANA

Mr. James Heydon, Plantation "Leonora," West Coast, Demerara, has recently forwarded a section of a stem and some leaf material of a tree which he says is known throughout British Guiana as "samarupa." The wood has been identified by the writer as *Jacaranda Copaia* (Jacq.) D. Don, and this determination has been confirmed from a study of the botanical material by Dr. Paul C. Standley, of the Smithsonian Institution.

According to the available literature the usual name for this species in British Guiana is "fotui," "futi," or "phootee," while in French Guiana the names, as recorded, are "copaïa," "coupaïa des chantiers," "bois à pian," and "faux simarouba." The name "copaïa" is from the language of the Galibis. The writer assumed that "samarupa" was simply a variant of "simarupa," the common designation in the Guianas for *Simaruba*, but in reply to a query on this point, Mr. Heydon says that the tree is universally known in the Colony as "samarupa" and not "simarupa."

There is ample evidence, however, that the *Jacaranda* and the *Simaruba* are frequently confused. There is in the Yale collections a wood specimen of *J. Copaia* (No. 5084), supplied by the Forestry Branch of the British Guiana Department of Lands and Mines (No. 134A), which is incorrectly labeled "Simarupa, *Simaruba officinalis*." Huber (*Bol. Mus. Goeldi*, 6:202, 1909) states that *J. Copaia*, a tall tree of the upland forest of the Amazon region and known locally as "caroba do matto" and "parapará," has bipinnate leaves, very showy red flowers, and supplies a soft and white wood often mistaken

for the "marupá" (*Simaruba amara* Aubl.). Inasmuch as the wood of *Simaruba* is beginning to assume some importance in the markets of the United States, confusion of it with a less desirable species would be unfortunate.

The wood of *Jacaranda Copaia* is light and soft, weighs 25–30 lbs. per cubic foot, is about the color of oatmeal, is without distinct heartwood, and has no pronounced odor and taste. The pores resemble small pinholes and are rather evenly distributed about 1 mm. apart; the vessel lines show distinctly on longitudinal sections, being darker than the background. Parenchyma extends from each pore, usually from the inner edge, and may be in the form of narrow wings or of more or less continuous concentric lines. The rays are near the limit of vision on cross and tangential sections, but distinct on the radial surface because they are of darker color than the fiber background. Ripple marks are absent, though local tendencies to their formation may be noted. Gum ducts were not observed. The inner bark is composed of stiff flat strands, readily separable when dry.

The distinguishing features of the wood of *Simaruba* are as follows: The color is a uniform yellowish white, though subject to sapstain. There is no odor, but the taste is bitter. Vertical gum ducts are usually present in every specimen and the oily exudations collect dust and produce dark streaks on the lumber. All elements are storied, producing ripple marks which are fairly regular, visible, 50–60 per inch of length. In regard to the minute anatomy, the vessel-ray pits are rather large and round, the rays are 1 to 5 cells wide and few to 100 cells high, and the fibers have bordered pits, while in the *Jacaranda* the vessel-ray pits are small, the rays 1 to 2 cells wide and few to 20 cells high, and the fiber pits are simple.

Mr. Heydon supplies the following information concerning the occurrence and size of the trees and the quality and use of the wood of *Jacaranda Copaia:*

Locality.—The tree is common in the mixed hardwood forests throughout British Guiana. It makes its best growth on the coastal reefs and along the banks of the Essequebo, Demerara, Berbice, and Corentyne Rivers, particularly near their mouths.

Soils.—The flat reefs, which vary in length from one to seven miles, are usually composed of sand with a mixture of clay, and have a layer of humus on top. The approaches to reefs have more pegas mixed with the clay and less sand, while along the creek and river banks there is a thick layer of pegas underlaid with clay. The change noticeable in the color of this, and of other woods as well, is due in large measure to the different soil conditions, though the age of the tree is also involved.

Size.—A total height of 80 feet is common and is often exceeded. The distance from the root to the first large branch varies from 18 to 48 feet, occasionally more. The diameters range from 6 to 30 inches. Some of the tallest trees are often very slender, while those with the largest diameter may be comparatively short. The leaves, which are doubly pinnate, are often 2½ feet long.

Uses of the wood.—Owing to the lightness of the wood the logs are used by the Indians (or bucks, as they are commonly known) and others to add buoyancy to rafts of heavier timber. Other uses are for making corials, or buck shells, cheap coffins, match sticks or splints, boxes, and houses. The wood is perishable in contact with the ground or exposed to the weather, but is suitable for all sorts of interior work where a cheap material is required. A suggested use is paper pulp. The supply of the timber is abundant and the growth is rapid. The prevailing price of the logs is 16 cents per cubic foot.

MOISTURE CONTENT, DENSITY, AND SHRINKAGE OF MEXICAN MAHOGANY

(Specimens from commercial sources.)

	Moisture content. Per cent of oven-dry weight.	*Sp. gr. Air-dry.*	*Weight. Lbs. per cu. ft.*	*Sp. gr. Oven-dry.*	*Shrinkage. Per cent of air-dry vol.*
1	15.5	0.542	33.5	0.485	4.25
2	17	0.540	33.7	0.487	5.40
3	15.5	0.583	36.4	0.525	4.20
4	26	0.565	35.3	0.475	5.80
5	13	0.500	31.2	0.456	3.60
6	12.6	0.595	37.2	0.550	3.85

CUBAN "SABINA" FOR ARCHERY BOWS

In a search for woods suitable for archery purposes tests have been made on the Cuban "sabina," *Juniperus* sp. Mr. Phillip Rounsevelle, of the Archers Company of Indian Hill, New Orleans, writes in this connection as follows: "We got two logs of this wood, which seems to be a kind of pencil cedar, and the bows from one of them are equal to the best Spanish yew. The other log, however, although cut at the same time and in the same locality, was worthless for this purpose. We are unable to detect any difference in the appearance of staves from the two logs."

SOME TRADE NAMES OF WOODS

Bagac = apitong, *Dipterocarpus grandiflorus* Blanco, or panao, *D. vernicifluus* Blanco. (Phil. Is.)

Bataan = tanguile, *Shorea polysperma* (Blanco) Merr. (Phil. Is.)

Birma = mahban (see below).

Boone wood = dalli or baboen, *Myristica surinamensis* Warb. (Dutch Guiana.)

Duali = palosapis, *Anisoptera thurifera* (Blanco) Blume. (Phil. Is.)

Lamao = white lauan, *Pentacme contorta* (Vid.) Merr. & Rolfe. (Phil. Is.)

Laurac = degame, *Calycophyllum candidissimum* DC. (Cuba.)

Limay = miscellaneous *Dipterocarpaceae*. (Phil. Is.)

Mahban = banak, *Myristica* aff. *panamensis* Hemsley. (Brit. Hond.)

Orion = guijo, *Shorea Guiso* (Blanco) Blume. (Phil. Is.)

Pondosa pine = western yellow pine, *Pinus ponderosa* Laws. (Western U. S.)

Red wood = Scotch pine, *Pinus sylvestris* L. (No. Europe.)

Trac wood = *Dalbergia cochinchinensis* Pierre. (French Indo-China.)

White wood = Norway Spruce, *Picea excelsa* Link. (No. Europe.) Also possum wood or rakuda wood, *Hura crepitans* L. (Dutch Guiana.)

CYSTOLITHS IN WOOD

Cystoliths are of very rare occurrence in wood and are apparently limited to a single family—the Opiliaceae. This family, according to Engler (*Pflanzenfamilien*, N. III, 1, pp. 142–143), embraces seven genera, namely, *Opilia*, *Rhopalopilia*, *Cansjera*, *Champereia*, *Melientha*, *Lepionurus*, and *Agonandra*. Most of these have previously been referred to other families—the Olacaceae and Santalaceae.

Cystoliths in wood were first observed by Van Tieghem in *Cansjera* (*Annales des Sciences Naturelles*. 7e série, Botanique, Paris, 1893, pp. 249–257). He says (p. 252): "Le bois, primaire et secondaire, est normal, avec des rayons formés de une à quatre séries de cellules à section carrée, dans lesquelles on observe çà et là, mais assez rarement, des cystolithes géminés disposés dans le plan du rayon. C'est la première fois, croyons-nous, qu'on signale la presénce de cystolithes dans le bois."

Van Tieghem also found cystoliths in the rays of *Opilia*, *Lepionurus*, *Melientha*, and *Agonandra*. He says (*loc. cit.*, p. 254): "Dans les rayons du bois secondaire de la tige, notamment, ils sont plus nombreux que chez les *Opilia celtidifolia*, *Lepionurus silvestris* et *Melientha suavis*."

The writer has examined two specimens of the wood of *Champereia manillana* Merrill. One of these (Yale No. 5623) was supplied by the Philippine Bureau of Forestry (No. 27924 B. F.), the other by Dr. R. Kanehira, Director of the Forest Experiment Station, Taihoku, Formosa. Kanehira gives a brief description of this wood in his *Anatomical characters and identification of Formosan woods* (Taihoku, 1921, p. 189. Pl. XXXVI, Figs. 212, 213), in which occurs the following statement: "Pith rays heterogeneous, 1–5 fibers distant from each other, 1–5 cells wide, 10–30 cells high; cystolith-like cavities present in great number, with crystals of calcium oxalate, diameters of cavities being 40–60 μ." Again (p. 290), he says: "In *Champereia manillana* cystolith-like structures occur and they contain crystals of calcium oxalate." There is evidently some confusion here between the cystoliths and the cells which contain them. Furthermore, the cystolith bodies are composed of calcium carbonate, not calcium oxalate.

The specimens examined by the writer are of a uniform yellow or brownish yellow color and have somewhat the same consistency as sugar maple (*Acer saccharum*). The pores are small, rounded, mostly solitary, fairly evenly distributed. Parenchyma is in exceedingly numerous, fine, irregular, tangential lines, faintly visible with the lens. The rays are about as coarse as in maple and, particularly on radial surface, the large cystolith-bearing cells can be seen distinctly with a hand lens (10x). They are more numerous in the Formosan specimen than in the one from the Philippines.

Under the compound microscope these cells are conspicuous in the rays of all three sections. On the tangential they bear a close resemblance to resin ducts. Their true nature is shown to the best advantage on the radial, where they are seen to be large, thin-walled cells, scattered irregularly among the others, mostly in the interior of the ray, but occasionally marginal. Without contents they look like the oil cells in the Lauraceae. In the Philippine specimen only single cells were found, but in the Formosan one about 20 per cent of them were paired radially. The size of the cells varies from 0.078 mm. x 0.045 mm. to 0.15 mm. x 0.07 mm.; in general they are about twice as long (radially) as high. The individual cells of the pairs are of the same size and appearance as the single ones.

The cystoliths consist of a stalk (a proliferation of the vertical cell wall) and a body of calcium carbonate. They are usually smooth and look like a clam in miniature; sometimes they are aggregates of crystals and have the appearance of a morel mushroom. They are horizontally inclined, and, in the case of the single cells, the stalk is always attached to the wall toward the cambium. In the case of the antipodal cystoliths, the stalks spring from the common wall of contact, which is appreciably thickened. The average size of the clam-shaped bodies was found to be about 0.07 mm. x 0.04 mm. The cells are full size from the time of their formation, but the mature bodies were first observed at a considerable distance (about 3 mm.) from the cambium. The cystoliths in the Philippine specimen appear to be much more irregular in shape than those in the Formosan specimen.

The cystoliths observed in the bast (Formosan specimen) were all antipodal. Only rarely do they occur in the rays, in which case they are attached to the common vertical end

wall of the two cells, the same as in the xylem rays. They are abundant in the phloem parenchyma and the common wall of attachment is horizontal instead of vertical. The bast cystoliths and cells are smaller than those of the wood, and the bodies are mostly aggregates of crystals. (For illustrations see Solereder's *Systematic anatomy of the dicotyledons*, p. 736.)

SPIRAL TRACHEIDS AND FIBER-TRACHEIDS

The elements of the protoxylem of both Gymnospermae and Angiospermae have thin primary walls which are strengthened by local thickenings of annular or spiral form. There are no true pits, since communication between contiguous cells is had through the unthickened portions of the wall. In secondary xylem there is, in effect, a merging of the local thickenings into a pitted wall continuous throughout the cell.

This continuous secondary wall may be (1) smooth, (2) striate, (3) dentate, or (4) spirally thickened. The first is the usual condition, the walls being fairly uniform except for the pits. These pits may be (a) more or less isodiametric, in which case their arrangement is either alternate or opposite, or (b) much elongated, and arranged in a scalariform manner. Alternate pits are arranged spirally, while the opposite and scalariform pits are in horizontal series. In alternate pitting the condition is such as might have been produced through the merging of spirals. When the apertures of the pits are slit-like, as is not infrequently the case in vessels, they often extend beyond the borders and tend to coalescence into spiral striations. Opposite and scalariform pits are closely related and suggest a development from annular thickenings. They represent the more primitive condition.

Striate cells exhibit spiral slits in the wall. They are mostly fibrous, such as the tracheids of conifers, particularly in the late wood, and to less extent the libriform and fiber-tracheids of dicotyledonous woods. The pitch of the striations is usually so steep that this feature alone serves to distinguish them from true spirals. In so-called compression wood or "red" wood (rotholz), found in both the Angiospermae and Gymnospermae, the cells have a thick laminated secondary wall, slit into

a large number of closely compressed spiral lamellae. The pitch of the spiral in this case is usually much lower than in ordinary striation. The excessive lengthwise shrinkage of compression-wood cells in drying may be attributed to their peculiar spiral structure.

Dentate cells are of uncommon occurrence and the most conspicuous examples are the ray tracheids in woods of the pitch pine group. Finer dentations, mostly sections of true spirals, are found occasionally in the ray tracheids of *Larix*, *Picea*, and *Juniperus*, and commonly in *Pseudotsuga*. Vertical tracheids with true spirals characterize the wood of *Pseudotsuga*, *Torreya*, *Taxus*, and *Cephalotaxus*. In the last three they occur in all of the tracheids, while in *Pseudotsuga* they are less highly developed and may be absent in the outer portion of the late wood of the growth ring. Spiral wood tracheids are sporadic in *Picea* and *Larix*, but in some instances are highly developed. In a specimen (Yale No. 3851) from India, said to be *Picea Morinda* Link., the structure closely approximates that of *Pseudotsuga;* in places, especially in the late wood, the thickenings give place to striations.

In dicotyledonous woods, spiral vessels have been observed in representatives of many families; Solereder (*1*, p, 1140) enumerates 76, but states that the feature is generally only a specific character. Where there is a decided difference in the size of the vessels in a wood, spiral thickenings may be confined to the smaller ones and to the vascular tracheids; occasionally, as in the Hamamelidaceae, they are found only in the overlapping tips of the vessel segments.

A vascular tracheid differs from a vessel segment in not being perforated; i. e., development ceased before cell fusion took place. At least a few such tracheids probably exist in every wood, consequently it is only when their number is large or they represent distinct modifications from the vessel-segment type that they have diagnostic value. Fiber-tracheids on the other hand, resemble libriform fibers, but have bordered pits. Sometimes these pits are very distinctly bordered, sometimes indistinctly; there is no sharp line of division between libriform fibers and fiber-tracheids. True spirals do not occur in libriform fibers, just as true septations do not occur in fiber-tracheids. From the tracheid there has been a develop-

ment in one direction to the vessel; in another to wood parenchyma, with libriform and substitute fibers as intermediates.

Spirals in fiber-tracheids have more or less diagnostic value, but in only one known instance is the feature a generic character, namely, in *Ilex*. In some species of *Symplocos* spirals are as well developed as in *Ilex*, but in others they are rather indistinct or entirely wanting. In both of these genera the vessels are spiral, their pits are opposite or tending to scalariform, and their perforations are scalariform with many bars. The rays of both are decidedly heterogeneous and the pits into the vessels tend to scalariform. In *Ilex*, however, the rays are of two classes, fine and coarse, while in *Symplocos* they are all fine. These characters have been employed by the writer in identifying as *Ilex* specimens of "naranjuelo" of Colombia (Yale No. 2580), "kakataraballi" of British Guiana (Yale No. 3043), "casada wood" of British Honduras (Yale No. 7565), and "jsing-p'i-hsiang" of Amoy, China, (Yale No. 7658).

Following is a brief account by families of the occurrence of spiral fiber-tracheids. Further investigation will probably extend the list, particularly of cases where such elements are of limited or sporadic occurrence. Janssonius and Kanehira both call attention to the fact that spiral cells are less common in tropical woods than in those of temperate regions.

THE FAMILIES

Aquifoliaceae.—Spiral fiber-tracheids characteristic of all species of *Ilex* so far studied.

Borraginaceae.—Reported by Solereder (*1*, p. 561) in *Lithospermum fruticosum* L., and by Kanehira (*2*, p. 162) in *Ehretia glaucescens* Hay.

Caprifoliaceae.—Reported by Solereder (*1*, p. 442) in certain species of *Abelia*, *Leycesteria*, *Lonicera*, *Symphoricarpus*, and *Viburnum;* by Kanehira (*2*, p. 125) in *Viburnum propinquum* Hemsl. and (*3*, p. 36) *V. Awabucki* Koch.

Celastraceae.—Reported by Kanehira (*3*, pp. 15–16) in *Euonymus alata* K. Koch and *E. Sieboldiana* Bl.; by Moll and Janssonius (*4*, II, p. 263) in *E. europaea* L., but absent in *E. javanicus* Blume.

Cornaceae.—Reported by Solereder (*1*, p. 437) in *Aucuba*, *Garrya*, and *Cornus oblonga* Wall. Striation (streifung) noted by Moll and Janssonius (*4*, III., p. 736) in the fiber-tracheids of *Nyssa sessiflora* Hook. f. & Thoms.

Elæagnaceae.—Reported by Kanehira (*3*, p. 49) in *Elæagnus multiflora* Thunb.

Epacridaceae.—Reported by Solereder (*1*, p. 493) in *Epacris microphylla* R. Br., and (*1*, p. 972) in *E. paludosa* R. Br.

Ericaceae.—Reported by Record (*5*, p. 137) in *Arbutus* and *Arctostaphylos*.

Hamamelidaceae.—Reported by Solereder (*1*, p. 331) in *Hamamelis chinensis* R. Br.

Oleaceae.—Reported by Solereder (*1*, p. 525) in species of *Jasminium*, *Forsythia*, *Syringa*, and *Fontanesia*.

Proteaceae.—Reported by Garratt (*6*, p. 16) in the narrow tips of many of the fibers of *Knightia excelsa* R. Br. Garratt is incorrect in calling such fibers libriform, since they have bordered pits, as he states.

Rosaceae.—Reported by Solereder (*1*, p. 309) as occasional in species of *Stephanandra*, *Rosa*, *Cydonia*, *Chaenomeles*, *Mespilus*, and *Crataegus*. In reference to *Crataegus Oxyacantha* L., Jones (*7*, p. 52) says: "Contrary to common belief, the vessels may, at least occasionally and locally, show very faint spiral thickenings, and similar markings are quite distinct in many of the prosenchymatous cells."

Saxifragaceae.—Reported by Solereder (*1*, p. 318) in *Philadelphus coronarius* L.; by Kanehira (*2*, p. 102) in *Deutzia taiwanensis* Hay. From a casual reading of Kanehira's statement ("Wood fibers mostly septate; inner surface of the wall with spiral thickenings.") one might infer that he found spiral libriform fibers, but since elsewhere (p. 288) he indicates that the spirals are of only occasional occurrence, and as Holle (*8*, p. 7) says that both libriform fibers and fiber-tracheids occur in *Deutzia*, the explanation is clear. Kanehira (*3*, p. 31) also found such cells in *Deutzia scabra* Thunb.

Styraceae.—Reported by Kanehira (*2*, pp. 148–153) in 13 species of *Symplocos* in Formosa, but entirely absent in *S. eriobotryæfolia* Hay and *S. neriifolia* S. & Z.; also by same author (*3*, pp. 40–41) in two Japanese species. The present writer has observed spiral fiber-tracheids in two Formosan species and in a specimen (Yale No. 7665) of "pê-ya" from Amoy, China, but failed to find them in the following: *S. chiriquensis* Pittier, *S. martinicensis* Jacq., *S. tinctoria* L'Her., *S. oblongifolia* Vid., and *S. polyandra* (Blanco) Brand.

Theaceae.—Reported by Kanehira (*2*, p. 39) as occasional in *Stachyurus himalaicus* Hook. f. & Thoms.

Tremandraceae.—Reported by Solereder (*1*, p. 95) as of occasional occurrence in *Tetratheca*.

SUMMARY

1. Spiral thickenings of secondary origin are typical of the vascular elements of the protoxylem.

2. Spiral thickenings of tertiary origin characterize the tracheids of *Pseudotsuga*, *Torreya*, *Taxus*, and *Cephalotaxus*, and are sporadic in *Picea* and *Larix*.

3. Spiral thickenings of tertiary origin have been found in the fiber-tracheids of certain members (nearly all of them shrubs or small trees) of 16 families. In many instances their occurrence is sporadic. They have their highest diagnostic

value in *Ilex*, when they form a generic character, and secondly in *Symplocos*, where they are typical of many, but not all, species. Their systematic worth in other instances has not been clearly determined.

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INFORMATION AND MATERIAL WANTED

The writer is collecting material to continue the series of short papers dealing with special anatomical features of wood. The coöperation of all persons interested in these subjects is earnestly solicited to the end that the articles published may be as comprehensive as possible. A partial list of the subjects now under consideration follows:

1. Intercellular canals in dicotyledonous woods.
2. Deposits of silica and calcium carbonate in vessels.
3. Crystals and starch grains in libriform fibers.
4. Sclerosed or stone-cell tyloses.
5. Scalariform bordered pits between vessels.
6. Scalariform bordered pits between vessels and parenchyma.
7. Scalariform perforations with anastomosing bars.
8. List of woods with storied or tier-like structure.
9. Occurrence of interxylary bast.

CURRENT LITERATURE

Boxwoods. By Samuel J. Record and George A. Garratt. Bulletin No. 14, Yale School of Forestry, August, 1925. Pp. 81; 6 x 9; 8 full page plates and 2 text figures. Price 50 cents, postpaid.

This is the third publication on woods in the Yale School of Forestry series, and is along the same lines as *Lignum-vitae* (Bul. No. 6) and *Cocobolo* (Bul. No. 8). The woods described are as follows: *Buxus sempervirens* L., *B. balearica* Lam., and the various Indian, Chinese and Japanese species of *Buxus;* also *Buxella Mac-Owanii* (Oliv.) Van Tiegh. and *Notobuxus natalensis* Oliv., of the Buxaceae; the West Indian boxwood, *Casearia praecox* Gris. (Flacourtiaceae); Knysna boxwood, *Gonioma Kamassi* E. Mey., and "amarillo," *Apidosperma Vargasii* D. C. (Apocynaceae); Siamese boxwood, *Gardenia* sp. (Rubiaceae); San Domingan boxwood, *Phyllostylon brasiliensis* Cap. (Ulmaceae); "atata," *Esenbeckia Atata* Pittier (Rutaceae); flowering dogwood, *Cornus florida* L. (Cornaceae); and Florida boxwood, *Schaefferia frutescens* Jacq. (Celastraceae).

Attention is given to distribution of the trees, and the structure, properties, and uses of the woods. The wood descriptions include both gross features and minute anatomy, and are illustrated with detail drawings and photomicrographs. There are also plates showing a stand of box trees; leaves and flowering twigs of *Casearia praecox;* trees of *Phyllostylon* in Argentina, Haiti, Costa Rica, and Mexico; an engraver's block; a Græco-Roman boxwood comb 1700 years old and one from an old Egyptian tomb; and five stages in the manufacture of a shuttle.

Three keys are included, based upon bark characters, macroscopic features, and minute anatomy. Anatomical features of special interest are ray tracheids in *Gonioma*, and the group pitting and "cells-within-a-cell" appearance produced by the conjugate condition of the wood parenchyma and marginal ray cells in *Gardenia* and certain others.

Timbers of Tropical America. By SAMUEL J. RECORD and CLAYTON D. MELL. New Haven: Yale University Press, November, 1924. Pp. xviii+610; 6½ x 10; 51 full-page plates. Price $10.

Part I. The countries and their forests. (Mr. Mell.) Describes the forests and the conditions attending their utilization in the West Indian Islands, Mexico, and each of the countries of Central America and South America.

Part II. The trees and their woods. (Prof. Record.) Describes the trees and representative woods of 75 families. Reference is made to better known kinds to show their relationships. There are included in the description the range and size of the trees, the scientific and vernacular names, figures of weight and specific gravity of the woods, notes on durability and other technical properties, present and prospective uses of the timbers, and information as to important by-products. The detailed descriptions of the woods are based upon a study of authentic specimens in the Yale collections.

Timbers: their structure and identification. By W. S. JONES. Oxford: Clarendon Press, 1924. Pp. 148; 7½ x 10; illustrated with 165 photomicrographs and drawings.

This well printed volume is intended primarily as a handbook for students of forestry. Considerable space is devoted to "a general discussion of the formation and structure of woody tissue and to the consideration of fundamental principles applicable to the anatomical study of all timbers."

The contents are as follows: Introduction, sources of timbers, some salient features of timbers, histological features, some less common anatomical features, factors of diagnostic value, European broad-leaved timbers, Indian broad-leaved timbers, American broad-leaved timbers, coniferous timbers, some methods and reagents, and photomicrography as applied to timber study.

The book is well written, the descriptions are condensed but lucid, the illustrations are good, and the keys are usable. The chapters on Indian timbers are a valuable contribution to our knowledge of tropical woods.

The author does not clearly differentiate between libriform

wood fibers and fiber-tracheids, the only essential distinguishing feature being that in the former the pits are simple, while in the latter they are bordered. According to this definition two of the fibers shown in the drawing on page 21 are fiber-tracheids. The prosenchymatous tissue of *Buxus sempervirens* consists of fiber-tracheids and not of libriform fibers as stated (p. 57); also the "extraordinarily deep pits" in the cross walls of the marginal cells of the rays in these woods are in reality not pits, but conjugations. It seems hardly appropriate to include vascular tracheids as part of the wood prosenchyma as is done in the case of *Ulmus campestris* (p. 57). It is also doubtful if the term "marginal" is as expressive as "terminal" when applied to parenchyma limiting a growth ring. These are minor points, however, to which attention would not be drawn in the case of a book less carefully written.

Tropical light weight woods. By KARL C. HYDE. *Botanical Gazette* 79: 4: 380–411, June, 1925. Illustrated with photomicrographs and detail drawings.

The woods described in detail are *Heliocarpus popayanensis*, *H. appendiculatus*, and *Apeiba aspera* (Tiliaceae); *Wercklea insignis* (Malvaceae); *Pachira Barrigon* and *Cavanillesia platanifolia* (Bombacaceae); and *Cordia heterophylla* (Borraginaceae). The work was done at Cornell University under the direction of the late Professor W. W. Rowlee, who collected the material in Central and South America. The paper is illustrated with photomicrographs and drawings.

Two distinct types of wood are recognized, namely, the homogeneous and the laminated. The latter are heavier than the others and are characterized by concentric bands of unlignified tissue. The homogeneous kinds are considered preferable for commercial purposes of insulation and buoyancy. The wood of *Pachira Barrigon* is, according to the author, the most likely substitute for balsa wood (*Ochroma* spp.).

"A distinct difference between the wood produced near the pith and that nearer the periphery is noted in all species investigated; the latter being harder, heavier, and generally more fibrous than the former.

"The walls of the individual elements do not vary in thick-

ness in different regions of the stem; but the thicker walled lignified wood fibers become relatively more abundant toward the circumference, while the number of thinner walled parenchymatous elements correspondingly increases toward the pith."

Lista preliminar de las plantas de el Salvador. By PAUL C. STANDLEY and SALVADOR CALDERÓN (with the collaboration of 20 other scientists). San Salvador, 1925. Pp. 274; 6 x 9.

This is an exceedingly useful publication to all who are interested in the flora of Central America. While it is designed primarily for botanists, it contains considerable information regarding the trees and the uses for their products. One of the most helpful features is the inclusion of the vernacular names along with the scientific, all of which are fully indexed.

Mikrographie des holzes der auf Java vorkommenden baumarten. By H. H. JANSSONIUS. Leiden: E. J. Brill, 1925. Pp. 289–576; 5½ x 9; figs. 254–271.

This, the seventh part of the work as a whole, is the second part of Vol. IV. This volume, the first number of which was issued in 1920, is concerned, so far as completed, with the following families: Caprifoliaceae, Rubiaceae, Compositae, Vacciniaceae, Myrsinaceae, Sapotaceae, Ebenaceae, Styraceae, Oleaceae, and Apocynaceae.

The first volume of this great undertaking was published in 1906. The descriptions follow a very complete outline prepared by Dr. J. W. Moll and are noted for their thoroughness. The work is of inestimable value to all who are interested in the structure of woods.

Identification of Philippine woods by anatomical characters. By RYOZO KANEHIRA. Taihoku, Formosa, 1924. Pp. 73; 7½ x 10¼; pls. 2.

This is a second supplement to the author's *Anatomical characters and indentification of Formosan woods*, and the purpose of the work is to provide a basis for comparing the woods of the Philippine Islands with those of Formosa. The

material studied was obtained from the Philippine Bureau of Forestry and consisted of 155 species, representing 108 genera and 41 families of Dicotyledons, and 5 species and 4 genera of Gymnosperms. Part I is devoted to descriptions of the woods. Part II is a key based upon anatomical characters. Part III is devoted to a summary of the results of the investigation.

Anatomical notes on Indian woods. By RYOZO KANEHIRA. Bul. No. 4, Dept. of Forestry, Govt. Research Institute, Taihoku, Formosa, 1924. Pp. 40; 6 x 9; pl. 1.

The object of this work is to compare the anatomical characters of Indian woods with those of Formosa and also to assist in the determination of some foreign woods on the Japanese market. The material for study was a collection of small samples supplied by the Forest Research Institute at Dehra Dun and comprising 34 families, 76 genera, and 105 species. The methods followed are the same as used by the same author in his *Anatomical characters and identification of Formosan woods*.

Part I consists of brief descriptions of 105 woods. Part II is an analytical key to Indian woods. Part III contains a summary of the features observed, such as fluorescence, ripple marks, intercellular canals, etc. In the appendix are described five foreign, or "karaki," woods, namely, *Santalum album* L., *Guaiacum officinale* L., *Aquilaria Agallocha* Roxb. (?), *Eusideroxylon Zwageri* T. & B., *Intsia* sp. ("mirabau"), and *Dryobalanopsis* sp. ("kapor").

Some New Zealand woods. By GEORGE A. GARRATT, in collaboration with the New Zealand State Forest Service. Professional Paper No. 1, N. Z. State Forest Service, Wellington, 1924. Pp. 56; 6 x 9¾. Price 1 s.

This study was based upon a set of wood specimens supplied to the Yale School of Forestry by the New Zealand State Forest Service. The collection contains representatives of 28 species of trees indigenous to New Zealand, members of 14 families, namely, Fagaceae, Proteaceae, Monimiaceae, Lauraceae, Saxifragaceae, Meliaceae, Elæocarpaceae, Malva-

ceae, Myrtaceae, Epacridaceae, Oleaceae, Verbenaceae, Taxaceae, and Pinaceae.

There are notes on the importance and distribution of each family and a general characterization of the woods. The species are introduced with a list of the vernacular names and a statement as to the size and occurrence of the trees and uses of the woods. Then follows the wood descriptions in two parts, the first based upon the macroscopic features, the second upon the minute anatomy. At the beginning of the publication are two descriptive keys to the dicotyledonous woods, corresponding to the two classes of descriptions.

Following is a list of the densities as determined by the author. They are based upon thoroughly air-dry material.

SPECIFIC GRAVITY OF NEW ZEALAND WOODS

Agathis australis Steud.	0.515
Beilschmiedia Taraire	0.699
Beilschmiedia Tawa	0.635
Dacrydium sp.	0.605
Dacrydium cupressinum Soland.	0.583
Dacrydium westlandicum T. Kirk.	0.647
Dracophyllum latifolium A. Cunn.	0.742
Dysoxylum spectabile Hook. f.	0.634
Elæocarpus dentatus Vahl.	0.611
Elæocarpus Hookerianus Raoul.	0.623
Knightia excelsa R. Br.	0.737
Laurelia Novae-Zelandiae A. Cunn.	0.434
Leptospermum scoparium Forst.	0.893–0.904
Libocedrus Bidwillii Hook. f.	0.413
Litsea calicaris Kirk.	0.649
Metrosideros lucida A. Rich.	1.186–1.210
Metrosideros robusta Forst.	1.137
Nothofagus fusca Oerst.	0.757–0.762
Nothofagus Solanderi Oerst.	0.707
Olea lanceolata Hook. f. (?)	1.180
Phyllocladus trichomanoides D. Don.	0.645
Plagianthus betulinus A. Cunn. or *Hoberia populnea* A. Cunn.	0.703
Podocarpus dacrydioides A. Rich.	0.438–0.487
Podocarpus ferruginea G. Benn.	0.571
Podocarpus spicatus R. Br.	0.682
Podocarpus Totara G. Benn.	0.577
Vitex lucens T. Kirk.	1.024
Weinmannia racemosa L.	0.686–0.703

Pan American coöperation in forestry conservation. *Bulletin of the Pan American Union*, Washington, D. C., February, 1925, pp. 161–169.

This article is divided into three parts. The first gives the text of a questionnaire which has been addressed to the department of agriculture of each of the Latin American republics. The second is entitled, "A lesson in tropical forest development from the Philippine Islands," and is by Geo. P. Ahern, former Chief of the Philippine Bureau of Forestry. The third part, "A forest devastation warning," is by Gifford Pinchot. "Just as the forests of Europe have pointed the way for the development of the forests of the United States, so the present forest conditions of the United States should serve as a warning to Latin American countries."

The United States as a market for tropical forest products. By Wm. B. Greeley. *Bulletin of the Pan American Union*, April, 1925, pp. 332–349.

An interesting and informative statement of the importance of tropical forests to the United States. The fact that the author is Chief of the U. S. Forest Service gives unusual weight to his conclusions. "Even if the most approved methods of handling our forests could be instituted at once and our vast areas of denuded waste lands planted with forest trees, there would be a long period before those measures would show results. This period of shortage, already being felt, can be met only in part by more efficient methods of utilization. More wood must be secured from outside sources to bridge the shortage or else we must turn to materials other than wood for many purposes for which wood is now being used with entire satisfaction. . . . The United States is an enormous potential market for tropical woods, and the near-by countries with large supplies of these woods seem the logical place from which to get it.

"The first and very necessary step in expanding the United States as a market for tropical woods is to provide for a study of the distribution, quantity, and accessibility of these woods and the collection and shipment of authentic and representative material to the United States for tests of various kinds.

Tests will enable the properties of South American woods, such as strength, hardness, stiffness, ease of working, ability to stay in place after drying, etc., to be compared with similar properties of our native woods, and will form from the standpoint of both buyer and seller a very necessary basis for the selection of tropical woods to fit various requirements of use."

Why the United States is interested in Latin American forest development. By W. N. Sparhawk. *Bulletin of the Pan American Union*, June, 1925, pp. 552–558.

Mr. Sparhawk, Forest Economist, U. S. Forest Service, and one of the authors of *Forest resources of the world* (New York, 1924), is well qualified to write this article, the substance of which is indicated by the sub-headings: Depletion of old growth hardwoods in the United States; Our requirements for hardwoods are not diminishing; A shortage of domestic hardwoods is inevitable; Latin America's opportunity; The need for study of the tropical forest resources.

"The points to be emphasized are: First, if our hardwood manufacturing industries are to survive, they must eventually utilize large quantities of timber from the Tropics; and, second, the present is none too soon to commence laying the necessary foundations for such utilization in the future."

International coöperation by scientific agencies in tropical forestry. By Henry S. Graves. *Bulletin of the Pan American Union*, July, 1925, pp. 682–689.

The author, who is Provost of Yale University and Dean of the School of Forestry, introduces his subject thus: "Every discussion of tropical forestry leads to the same conclusion—that we lack the information essential to create a market for products of the forest and essential to attract capital for the development of large forest industries in the tropical countries. The key to the solution of the problem of tropical forestry lies in scientific research and exploration."

Yale University School of Forestry

TROPICAL WOODS

NUMBER 4 December 1, 1925

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Yale University School of Forestry

TROPICAL WOODS

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A technical journal devoted to the furtherance of knowledge of tropical woods and forests and to the promotion of forestry in the Tropics.

The editor of this publication and the writer of all articles therein, the authorship of which is not otherwise indicated, is SAMUEL J. RECORD, *Professor of Forest Products in Yale University.*

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AN ENUMERATION OF THE SAPOTACEAE OF CENTRAL AMERICA

By PAUL C. STANDLEY, *U. S. National Museum*[1]

The Central American plants of the family Sapotaceae form a comparatively small group of trees and large shrubs, but among them are found a surprisingly large number of species of economic importance. Several are well known for their edible fruits and others as a source of gum. The sapodilla tree (*Achras Zapota*) is the chief source of chicle, the principal ingredient of chewing gum. The commercial product comes chiefly from northern Guatemala, Tabasco, and the Yucatán Peninsula and constitutes one of the most valuable exports of that region.

It too often happens that plants whose products are important articles of commerce are unknown from a technical scientific standpoint, or at least but imperfectly known, and

[1] Published by permission of the Secretary of the Smithsonian Institution.

this is the case with the group under consideration here. It is evident that several other trees that produce "chicle" gum are unknown to botanical science. Some of these are described here for the first time, and there is reason to believe that others await description.

In connection with the necessary publication of several new species of Central American Sapotaceae, whose names are needed for use in economic work, it has seemed worth while to present for reference purposes a tentative list of the Central American representatives of the family. Several extralimital species have been included from Yucatán, since this state is closely related economically to the chicle-producing regions of Central America.

It will be noted that a large proportion of the Central American Sapotaceae have been described in recent years, chiefly by Mr. H. Pittier. There are at hand herbarium specimens of some additional species, but the material is not in condition to permit their description. There is no doubt that a substantial number of other trees of the family will be discovered in the region. It seems to be difficult to find the trees in flower, the state in which their relationships may best be studied, and often the trees are so large that it is difficult to obtain specimens of them. Collectors can not be urged too strongly to make every effort toward procuring adequate material of any of the Central American Sapotaceae that they may find. It is surprising to learn how few herbarium sheets are available of even the most commonly planted fruit trees of the group.

It is unnecessary to state that the list given here is only a provisional one. It is believed that all species reported heretofore from Central America, including Panama, and from Yucatán, have been included. There is reason to believe that a few of the species listed as distinct will have to be combined when a more careful study is made of their characters.

Chrysophyllum L.

Chrysophyllum Cainito L. Sp. Pl. 192. 1753. The common star-apple, cultivated nearly everywhere in Central America for its fruit, but not a very popular fruit tree. It makes a handsome shade tree, and is planted abundantly for this purpose in the Canal Zone. Known everywhere as "caimito." The tree is native in the lowland forests of Panama, where it attains a large size, and it is probably indigenous also in other parts of Central America, at least along the Atlantic Coast. Widely distributed in tropical America.

Chrysophyllum mexicanum T. S. Brandeg.; Standl. Contr. U. S. Nat. Herb. 23: 1114. 1924. Veracruz, Oaxaca, Yucatán, British Honduras, Guatemala (?), Salvador. A large tree, with edible fruit. Known in Salvador as "caimito," "zapotillo," and "guayabillo"; in British Honduras as "wild star-apple." Closely related to *C. argenteum*.

Chrysophyllum argenteum Jacq. Enum. Pl. Carib. 15. 1760. Costa Rica and Panama; also in the West Indies. Called "caimito cimarrón" in Costa Rica.

Chrysophyllum panamense Pittier, Contr. U. S. Nat. Herb. 18: 165. 1916. Lowland Atlantic forests of Panama.

Lucuma Molina

Lucuma campechiana H. B. K. Nov. Gen. & Sp. 3: 240. 1819. Yucatán; Campeche. Reported by Hemsley from Honduras. This and *L. salicifolia* are probably not distinct.

Lucuma salicifolia H. B. K. Nov. Gen. & Sp. 3: 241. 1819. Southern Mexico; Pacific slope of Costa Rica and Panama. A tree with edible fruit. Known in Mexico as "zapote amarillo," "zapote borracho," "zapote de niño," "cozticzapotl," and "atzapotl"; in Costa Rica as "zapotillo"; in Petén, Guatemala, as "aceitunillo."

Lucuma Palmeri Fernald, Proc. Amer. Acad. 33: 87. 1897. Pacific slope of Mexico, from Colima to Oaxaca; Salvador. Large tree with edible fruit. "Huicón" (Mexico); "güicume," "ulozapote" (Salvador).

Lucuma obovata H. B. K. Nov. Gen. & Sp. 3: 241. 1819. A Peruvian species, cultivated at San José, Costa Rica.

Lucuma serpentaria H. B. K. Nov. Gen. & Sp. 3: 242. 1819. A Cuban species, planted in Balboa, Canal Zone.

Lucuma sclerocarpa Pittier, Contr. U. S. Nat. Herb. 18: 166. 1916. San Blas Coast, Panama.

Lucuma hypoglauca Standl., sp. nov.

Medium-sized tree with broad crown, the young branchlets densely leafy, covered with a dense pubescence of minute, closely appressed, brownish hairs; petioles very stout, 6–12 mm. long, pubescent like the branchlets; leaf blades oblong or narrowly elliptic-oblong, 8–14 cm. long, 2.5–5 cm. wide, obtuse, at base obtuse or acutish, glabrous above or nearly so, beneath grayish, sericeous with fine, closely appressed, lustrous hairs; flowers clustered in the leaf axils, subsessile, the pedicels less than 1 mm. long; sepals 5, broadly elliptic, 3 mm. long, obtuse or rounded at apex, densely ochraceous-sericeous outside and sparsely sericeous within; corolla 2 mm. long; glabrous, the 5 lobes short, broader than long, broadly rounded or truncate at apex; staminodia ovate, alternate with the corolla lobes and half as long; stamens 5, inserted toward the base of the corolla tube, the filaments equaling the broadly oval anthers; ovary densely hairy; fruit oval-globose, 7 cm. long, 5 cm. thick, smooth, glabrous, rounded at each end, the shell very thick and hard; seeds 4, nearly white, smooth, 4 cm. long, 2.5 cm. thick, rounded on the back and marked with an elliptic-linear scar 2.5 cm. long.

Type in the U. S. National Herbarium, No. 1,169,948, the specimens taken from a tree growing in the plaza of the Villa del Guayabal, El Salvador, January, 1924, by Salvador Calderón (No. 1935).

In its hard-shelled fruit this Salvador tree resembles *L. sclerocarpa* Pittier, of Panama, but there is little similarity in the leaves and flowers of the two species.

Lucuma hypoglauca has been noted also at Santa Tecla (*Calderón* 1114) and San Salvador, and is said to grow wild in the mountains near Guayabal. The vernacular names are "pan de la vida" (Guayabal) and "chicosapote."

The fruit is esteemed highly as an article of food. The pulp is described as fragrant.

Besides the Salvadorean specimens, I should refer here material collected at Izamal, Yucatán, by G. F. Gaumer (No. 23,299).

Lucuma glabrifolia Pittier, Contr. U. S. Nat. Herb. 20: 481. 1922. Southern Darién, Panama.

Lucuma laeteviridis Pittier, Contr. U. S. Nat. Herb. 20: 482. 1922. Department of Izabal, Guatemala. "Zapotillo calenturiente," "ingerto de montaña."

All the species of *Lucuma* described below are based upon imperfect material, and their generic position is therefore uncertain. In several cases the specimens are decidedly unsatisfactory, but since the trees are all of economic importance, chiefly as sources of gum, it is desirable to have names

under which they may be discussed. Their description and provisional reference to *Lucuma*, therefore, seems justified. From the leaf specimens available, in most cases accompanied by seeds, it is evident that they can not be referred to any of the Sapotaceae reported previously from Central America.

Lucuma amygdalina Standl., sp. nov.

Branchlets slender, terete, reddish brown, with faint traces of brownish sericeous pubescence; petioles slender, 17 mm. long, shallowly sulcate above, glabrous; leaf blades narrowly oblong, 13–15 cm. long, 3.5–4 cm. wide, acuminate, with obtuse tip, at base abruptly rounded, subcoriaceous, deep green and slightly lustrous above, paler beneath, glabrous, at least in age, the costa slender and prominent, the lateral nerves about 15 pairs, divergent at an angle of 60° or more, slightly arcuate or the lower ones straight, irregularly anastomosing near the margin; seeds oval-ellipsoid, 1 cm. long and 8 mm. thick, rounded at each end, smooth, brown, very lustrous, the area about the hilum oblong, 4 mm. wide, acute at each end, roughened, dull, pale brownish; endosperm none.

Type in the U. S. National Herbarium, No. 1,208,269, collected at El Paso, Petén, Guatemala, in 1925 by W. D. Durland.[2]

The tree contains a white latex. The local name is "zapote faisán." The form of the leaves is distinctive and somewhat suggestive of peach leaves.

Lucuma Durlandii Standl., sp. nov.

Tree, the young twigs sparsely sericeous with slender hairs; petioles stout, 10–17 mm. long, shallowly sulcate above, minutely sericeous at first, in age glabrous or nearly so; leaf blades lance-oblong or sometimes obovate, broadest at or above the middle, long-acuminate or abruptly short-acuminate, attenuate to obtuse at base, 17–25 cm. long, 4.5–8.5 cm. wide, coriaceous, lustrous on both sides, slightly paler beneath, the venation prominent on both surfaces, the lateral nerves about 10 pairs, divergent at an angle of 60°, arcuate, irregularly anastomosing near the margin, the ultimate nerves prominent beneath and finely reticulate; fruits lateral, short-stalked, ovoid, 1.2–1.8 cm. long; seed subglobose, 12 mm. long, brown, smooth, the area about the hilum covering about half the seed, roughened, whitish, shallowly sulcate beyond the hilum.

Type in the U. S. National Herbarium, No. 1,208,271, collected at El Paso, Petén, Guatemala, in 1925 by W. D. Durland.[2]

[2] William Davies Durland, M.F. Yale School of Forestry 1922. Mr. Durland's collections were made in connection with investigations for the Chicle Development Co., Inc., New York City. It is through the cooperation of the Company that the publication in this journal of Dr. Standley's paper is made possible.—S. J. R.

The tree yields a white latex. The vernacular name is "zapotillo." Specimens that apparently represent the same species were collected at Chunohuitz, Petén.

Lucuma izabalensis Standl., sp. nov.

Tree 18–25 m. high, the trunk 40–90 cm. in diameter, the branchlets terete, grayish, glabrate; petioles stout, 1–1.7 cm. long, shallowly channeled above, glabrate; leaf blades narrowly elliptic-oblong, about 22 cm. long and 6 cm. wide, abruptly narrow-acuminate, acute at base, coriaceous, glabrous in age, paler beneath, the venation prominulous above, prominent beneath, the lateral nerves stout, about 9 on each side, divaricate at an angle of 50° or more, arcuate, extending nearly to the margin and forming an irregular intramarginal nerve, the ultimate nerves irregularly and closely reticulate.

Type in the U. S. National Herbarium, No. 1,037,016, collected at Las Playitas, Department of Izabal, Guatemala, May 13, 1919, by H. N. Whitford and L. R. Stadtmiller[3] (No. 35; Yale No. 3700).

The type material consists of a sterile branch. Here probably is to be referred the same collectors' No. 65, from Sinchado. This collection consists of very young seedlings and of seeds. The seeds are subglobose, slightly over 2 cm. long and nearly 2 cm. in diameter, dark brown, and very lustrous. The area about the hilum covers nearly half the seed, and is rough and pale, with a shallow broad channel extending through its middle.

The vernacular name is "silión." The wood is reported to be used for railroad ties. The leaves of this tree are strikingly similar to those of *L. sclerocarpa*.

Lucuma belizensis Standl., sp. nov.

Tree, the twigs terete, when young obscurely and minutely sericeous; petioles 7–10 mm. long, sulcate above, sparsely and very minutely sericeous; leaf blades elliptic-oblong, 6–8 cm. long, 3 cm. wide, acute, with obtuse tip, at base acute or acutish, subcoriaceous, in age glabrous or with a few minute appressed hairs beneath, thin, deep green above, the venation not elevated, paler beneath, with prominulous venation, the lateral nerves about 14 on each side, divergent at an angle of about 60°, near straight, irregularly anastomosing near the margin.

[3] Harry Nichols Whitford, Ph.D., formerly Assistant Professor of Tropical Forestry in Yale University, and Louis Roemmer Stadtmiller, M.F. Yale School of Forestry 1911. The collections were made in connection with the Guatemala-Honduras Economic Survey Expedition under direction of the Department of State, U. S. A.—S. J. R.

The type, in the U. S. National Herbarium, No. 1,207,759, consists of sterile leafy twigs collected in British Honduras in December, 1924, by H. C. Kluge[4] (No. 41; Yale No. 7595).

The vernacular name is "Silly Young," which almost certainly is a corruption of the Spanish name "silión," reported for *L. izabalensis*.

Seeds of a tree called "Silly Young" were collected on the Ixpop road, Petén, Guatemala, in 1925 by W. D. Durland. They are oval-oblong in outline, 22 mm. long and 12 mm. in diameter, nearly terete, brown and shining, the area about the hilum slightly narrower than the diameter, rounded at each end, slightly roughened and pale, and not evidently sulcate. It is, of course, quite uncertain that these seeds belong to the same species as the type of *L. belizensis*.

Sideroxylon L.

Sideroxylon Gaumeri Pittier, Contr. U. S. Nat. Herb. 13: 460. 1912. Known only from Izamal, Yucatán.

Sideroxylon Tempisque Pittier, Contr. U. S. Nat. Herb. 13: 461. 1912. Chiapas, Guatemala, Salvador; doubtless also in Honduras, and probably in Nicaragua. A tree of large or medium size, with edible fruit. Known in Guatemala and Salvador as "tempisque."

Sideroxylon Capiri (A. DC.) Pittier, Contr. U. S. Nat. Herb. 13: 462. 1912. Western Mexico; Pacific slope of Panama. Known in Mexico as "capire," "capiri," "tempisque," "huacux," "zapote de ave," "tototzapotl," and "cosahuico." As with the other species, the fruit is edible.

Sideroxylon hondurense Pittier, Contr. U. S. Nat. Herb. 20: 483. 1922. Known only from the Chamelecón River, Department of Copán, Honduras.

Sideroxylon uniloculare Donn. Smith, Bot. Gaz. 35: 5. 1903. Described from Tucurrique, Costa Rica. Not seen by the writer.

[4] Mr. Kluge's collections in Central America were made under the direction of the Yale School of Forestry and were in connection with his work as a tropical forest engineer. They consist of 45 wood specimens with botanical material from near Riversdale, British Honduras, and 53 wood specimens with botanical material from the Bayano River watershed, Panama.—S. J. R.

LABATIA Swartz

Labatia Standleyana Pittier, Contr. U. S. Nat. Herb. 20: 481. 1922. (*Lucuma Standleyana* Pittier, 1916.) Atlantic lowlands of Panama, in the vicinity of the Canal Zone.

Labatia sambuensis Pittier, Contr. U. S. Nat. Herb. 20: 481. 1922. (*Lucuma sambuensis* Pittier, 1916.) Southern Darién, Panama.

ACHRAS L.

Achras Zapota L. Sp. Pl. 1190. 1753. (*A. Sapota* L., 1762; *Sapota Achras* Mill.) Native in the Yucatán Peninsula, Tabasco, eastern Guatemala, and adjoining regions; planted in most regions of tropical America. This tree is the principal source of chicle gum. The fruit is one of the best of all tropical fruits. In most parts of Central America the fruit is called "níspero." The names employed in Mexico are "zapote," "chicozapote," "ya" (Maya), and "zapotillo."

Achras calcicola Pittier, Journ. Washington Acad. Sci. 9: 438. 1919. Panama. Known as "níspero," and among the West Indians living in Panama as "sapodilla."

Achras Chicle Pittier, Journ. Washington Acad. Sci. 9: 436. 1919. Atlantic slope of Guatemala; sterile specimens from Salvador are probably referable here. Known in Guatemala as "zapotillo," and as a source of chicle; in Salvador called "níspero de montaña."

BUMELIA Swartz

The species of this genus are shrubs or small trees, often armed with spines, and of little or no economic importance.

Bumelia spiniflora A. DC. in DC. Prodr. 8: 191. 1844. Coast of Salvador; also in Mexico, Florida, Texas, and the Bahamas. Known in Mexico as "coma."

Bumelia retusa Swartz, Prodr. Veg. Ind. Occ. 49. 1788. Yucatán; also in Jamaica. "Putzmucuy" (Yucatán, a Maya name).

Bumelia obovata (Lam.) A. DC. in DC. Prodr. 8: 191. 1844. Honduras (?), Nicaragua, Panama; also in the West Indies.

Bumelia leiogyna Donn. Smith, Bot. Gaz. 18: 4. 1893. Pacific slope of Guatemala and Salvador. Known in Salvador as "limoncillo," "ispundio," and "zapotillo de peña."

Bumelia megaphylla Blake, Contr. Gray Herb. 52: 76. 1917. British Honduras. Not seen by the writer.

Bumelia pleistochasia Donn. Smith, Bot. Gaz. 18: 4. 1893. Guatemala.

Bumelia Hayesii Hemsl. Biol. Centr. Amer. Bot. 2: 297. 1881. Type from San José, Guatemala. Not known to the writer, but perhaps a form of *B. obovata*.

Bumelia guatemalensis Standl., sp. nov.

Tree, the branchlets slender, terete, dark reddish brown, on the younger parts very sparsely and minutely sericeous; petioles slender, 7 mm. long, sulcate along the upper side, glabrous in age; leaf blades oblong-elliptic, 5.5–7.5 cm. long, 2.5–3 cm. wide, acutish at base and slightly unequal, at apex rather abruptly acute, with obtuse tip, subcoriaceous, nearly concolorous, lustrous above and glabrous, beneath nearly glabrous but with a few minute, closely appressed, scattered hairs; flowers lateral or axillary, the pedicels 4 mm. long, slender, glabrate; sepals 5, oval-elliptic, 2.5 mm. long, minutely and thinly sericeous, obtuse or rounded at apex; corolla glabrous, 4.5 mm. long, the tube 1.5 mm. long, the 5 lobes 3-parted into linear segments, the lateral segments narrower and slightly shorter than the middle one; staminodia oblong-lanceolate, alternate with the corolla lobes and equaling them; filaments linear; ovary glabrous.

Type in the U. S. National Herbarium, No. 1,208,272, collected at El Paso, Petén, Guatemala, July, 1925, by W. D. Durland.

The tree yields a white latex. The vernacular name is "ávalo."

The material available is scanty, and includes only a single imperfect flower. The condition of the flower is such that its details may not have been interpreted properly. Because of the absence of seeds, it is uncertain whether the tree should be referred to *Bumelia* or *Dipholis*, but it seems more probable that it is a member of the former genus.

Bumelia panamensis Standl., sp. nov.

Tree, the short trunk about 60 cm. in diameter, the branches armed with stout spines 1 cm. long, the branchlets terete, reddish brown, when young densely and minutely brownish-sericeous; petioles 4–6 mm. long, sericeous; leaf blades lance-oblong to elliptic-oblong, 5–7 cm. long, 2–2.7 cm. wide, acute or acutish at base, acute or acuminate at apex, with obtuse tip, thin, bright green, lustrous above, when young sparsely sericeous with minute brownish lustrous hairs, in age glabrous, the costa salient beneath, the lateral nerves very slender, about 18 pairs, divergent at an angle of 50° or more,

nearly straight, anastomosing near the margin; flowers numerous, in dense fascicles in the leaf axils and on naked branches, the pedicels about 3 mm. long; sepals 5, oval, 2.5–3.5 mm. long, rounded at apex; finely sericeous; corolla 4.5 mm. long, the tube short, the 5 lobes 3-parted, the middle lobe oblong, the 2 lateral ones linear-attenuate; staminodia 5, equaling the corolla lobes, ovate-oblong, the margins lacerate; stamens equaling the corolla lobes, the filaments linear; ovary glabrous.

Type in the U. S. National Herbarium, No. 1,206,418, collected near Chepo, Province of Panama, Panama, in 1924 by H. C. Kluge (No. 12; Yale No. 7126).

Related to *B. leiogyna* Donn. Smith, but differs in that the sepals are glabrous.

The fruit is said to be about 2.5 cm. long and half as thick, with black skin. The vernacular name is "limoncillo."

Dipholis A. DC.

Dipholis minutiflora Pittier, Contr. U. S. Nat. Herb. 13: 464. 1912. Copey, Costa Rica. A small tree.

Dipholis salicifolia (L.) A. DC. in DC. Prodr. 8: 188. 1844. Yucatán; southern Mexico, West Indies, and southern Florida.

Mimusops L.

Mimusops darienensis Pittier, Contr. U. S. Nat. Herb. 18: 249. 1917. Panama. Known as "níspero." This tree is of great importance as the source of the Panama "balata" or "gutta-percha." The wood also is valuable for lumber.

Minusops spectabilis Pittier, Contr. U. S. Nat. Herb. 13: 465. 1912. Atlantic coast of Costa Rica. Known as "níspero," or among the West Indies as "bully tree." The wood is used for railroad ties.

Calocarpum Pierre

Calocarpum mammosum (L.) Pierre in Urban, Symb. Antill. 5: 98. 1904. (*Achras mammosa* L.) Perhaps native in southern Mexico; cultivated throughout Central America, and in tropical America generally. The tree furnishes one of the best of tropical American fruits, the sapote. The fruit is known generally in Central America as "zapote," but in Panama it is called "mamey."

Calocarpum viride Pittier, Contr. U. S. Nat. Herb. 18: 84. 1914. Guatemala and Salvador; reported by Pittier from Honduras and Costa Rica. Known in Guatemala and Salvador as "ingerto" or "zapote ingerto."

NOTE ON AMAZON WOODS FOR TIGHT COOPERAGE

Consul Samuel H. Wiley, Oporto, Portugal, recently reported that a Brazilian wood known as "friejo" [*Cordia Goeldiana* Huber] is imported into Portugal for the manufacture of staves, though its importation has declined owing to the poor quality received and to the fact that it imparts a flavor to the wines. Another Brazilian wood known as "itaúba" [Lauraceae] is also imported for the manufacture of "balseiros," which are large casks used for storage purposes. Casks made from this wood are said to last as long as those made from oak if they remain stationary, but they cannot be used for shipping purposes, as the wood is of such an oily nature that the hoops will not hold the staves together if the cask is subjected to jarring or violence.—*Commerce Reports* (Washington, D. C.), Aug. 17, 1925, p. 378.

NOTE ON SCLEROSED OR STONE-CELL TYLOSES

The writer would appreciate information regarding the range of occurrence of the stone-cell type of tyloses which are so characteristic of letterwood (*Piratinera* spp.). He has seen them in various species of *Piratinera* and the "satiné" group of species of *Brosimum*, of the Moraceae; *Mespilodaphne* sp. (Brazilian sassafras) and *Eusideroxylon Zwageri* (Borneo ironwood), of the Lauraceae; *Pera arborea*, of the Euphorbiaceae; and an unidentified wood, called "guayabo," from Venezuela. Credit is due to Doctor Kanehira, Taihoku, Formosa, for calling attention to these structures in *Eusideroxylon*.

SOME SECONDARY TIMBERS OF BRITISH HONDURAS

By DUNCAN *and* NEIL S. STEVENSON, *Assistant Conservators of Forests*

Banak (*Myristica panamensis* Hemsley = *Virola panamensis* Warb.).—This tree, the most important secondary timber now being exploited in British Honduras, grows fairly abundantly on granite and rich porous alluvial soils in that part of the Colony lying southwards from the Sibun River. It is tolerant of shade, and makes fairly rapid growth, especially in the immediate riverain tracts. It responds quickly to girdling and soon rots and falls.

Measurements of a typical, though not fully matured, tree in the Sibun-Stann Creek Forest Reserve were as follows: Total height, 115 ft.; distance to first branch, 70 ft.; girth above buttresses, 8⅓ ft.; height of buttresses, 7 ft.

The buttresses are usually not very marked, and there is generally one large spur, which, on sloping ground, is on the higher side. The trunk is straight and cylindrical and free of branches for 50 feet or more. The limbs are given off horizontally in irregular whorls and when viewed from below look like the spokes of a rimless wheel. The bark is smooth, about three-fourths of an inch thick, and, particularly in the case of trees growing on the riverain alluvium of the Sibun valley, has a decidedly red color. When the bark is wounded a dark red sap exudes, hence the Spanish name of "sangre palo" or "palo de sangre."

The branchlets are covered with a dense hirsute ferruginous tomentum. The leaves are large, dark green above, with a lighter rusty hirsute undersurface. The venation is distinct, especially on the underside, and there is a definite submarginal vein.

The flowers are presumably small and inconspicuous; specimens have not yet been obtained. Fruit is borne in May and June and, when ripe, the seed drops from the fleshy capsule, which opens by two sutures only and remains on the tree for some time. The round seeds are about one-half inch in diameter and, when fresh, are within a kind of web, bright red or pink in color, which indents the testa. The albumen of the seed is split up by zigzag intrusions of the inner seed coat. Germination is epigeous, the cotyledons in the testa being carried above ground on the elongating plumule.

The wood is light-colored when freshly cut, but the surface darkens later to a red brown. The sapwood is not distinguishable from the heart. The wood resembles Spanish cedar when manufactured and is sometimes passed off as such. It is easily worked and, inasmuch as it splits very easily, it might make good rived shingles. It is occasionally used locally for doreys, and has been employed for furniture and indoor work. Its principal commercial use is understood to be for veneers. It is not very durable for outdoor work and if so used would probably require preservative treatment.

The freshly cut timber is very susceptible to damage by an insect, locally known as pinworm, which attacks both through the bark and exposed wood surfaces and bores deeply into the wood. The damage is materially lessened by leaving the crowns on the felled trees for some time after felling, but the only effective method of prevention so far discovered is prompt immersion of the logs in water.

Exploitation of Banak timber was begun by the Tidewater Lumber Company in September, 1924. Two or three logs per tree are obtained and the crowns are not utilized. The average volume per log is 300 ft. B.M. The exports of Banak logs up to June 31, 1925, have amounted to 306,596 s. ft., of a declared valuation of $8059.

NOTE.—For information regarding tests on the strength and working properties of Banak and Santa María, see "British Honduras timbers. Part I." *Bulletin of the Imperial Institute* (London) 21:4:569–575, 1923.

Santa Maria (*Calophyllum Calaba* Jacq.).—This is probably the commonest large tree in the mixed rain forests throughout the Colony and is found on all types of soil. It attains a height of 120 feet and, except in some of the Broken Ridge country, has a clean, straight bole. A girth of 10 feet is common and individual trees measuring over 20 feet in circumference are occasionally found. Boles 50 feet in length and squaring 24 inches are common.

The bark varies in color from yellowish green on the young

trees to yellowish gray on the older ones. It is marked with diamond-shaped fissures, rendering the trees easily distinguishable in the bush, and becomes more corrugated with age. When the bark is cut or crushed a yellow gum is obtained.

The leaves are long and are characterized by the close parallel transverse venation typical of the genus *Calophyllum*. The young leaves are of much lighter color than the old ones. Short racemes of white, scented flowers appear in February and March. The fruits, which are round green drupes, ripen in June. The seeds produce a good burning oil. Germination is epigeous.

Santa María is tolerant of shade and natural regeneration is very abundant. The tree is one of the chief suppressing rivals of mahogany. When girdled, a tree will die within one month. The wood, however, remains sound for some time afterward.

Three classes of timber are recognized locally, namely, the "white" and the "red," which are of a very light to pink color and floatable, and the "dark" which is of a reddish color and non-floatable. No way of distinguishing these classes before cutting has as yet been found.

The wood is sometimes mistaken for mahogany, being somewhat similar in color and often showing good figure, but it is heavier, stronger, and more lasting. On account of its durability it is used for the construction of logging trucks for hauling mahogany and logwood. It is also utilized for shingles, bridge stringers, trestle work and planking, beams, masts, heavy machine work, building construction, and indoor trim. It is one of the best timbers for dugouts, or doreys, and gives long service. On the island of Ruatan, in the Bay Islands, it forms the principal wood for boat timbers; crooked trees of the Broken Ridge type are used, affording a natural bend.

The timber ordinarily has a tendency to warp and split, unless mature and well seasoned. At a small mill on the Temash River, where fair quantities of Santa María have been cut, the sawn timber, when properly stacked in the shade, has been found to behave fairly well. Rotary veneers have been obtained which give very handsome figure, but there is a tendency to flake which has not yet been overcome.

The lumber would probably make excellent flooring, particularly if a successful system of seasoning were evolved.

One or two cargoes of Santa María were shipped to Hamburg just prior to the war and are said to have found a good market. The timber is now being cut by the Tidewater Lumber Company and the exports between September, 1924, and June 30, 1925, amounted to 116,482 s. ft., valued for customs purposes at $3018.

Yemeri (*Vochysia hondurensis* Sprague).—The Yemeri, which is also known as Emery, Emeri, White Mahogany, and in Spanish Honduras as San Juan, grows all over the Colony, though it is rare in the New River-Northern River Tract and commonest in the South. It is typical of the transition stage from Pine Ridge to Broken Ridge and occurs extensively in the "huamil," or second growth on abandoned cultivation, on soils of the poorer type. It grows in almost pure stock on the sandy clay mud soils of the coast, as at Riversdale and Regalia, and in profusion on the Toledo beds, but will not grow on very swampy land. It attains large size in the Cohune Ridge, but is not as thickly stocked as the Santa María.

A young tree measured on the Sibun-Stann Creek Forest Reserve had the following dimensions: Total height, 110 ft.; height to first branch, 72 feet; girth at 4½ ft. from ground, 7¼ ft.; height of spurs, 1½ ft.

The habit of the tree is characteristic. Branches are given off in a manner suggesting a hand bunched up with the fingers fully extended. This is repeated throughout the crown. In the majority of cases the bark is smooth, though it may be slightly fissured when young or scaly when old. It is about half an inch thick, and upon scraping away the whitish gray membranous outer surface a characteristic yellow with white edges is exhibited.

The leaves are of a light green color and quite smooth. The tree blossoms in April and May and the bright yellow flowers make it conspicuous when viewed from a distance.

Two classes of timber are distinguished after felling, namely "white" and "red." The former is not lasting, dries more quickly than the other, and is difficult to work when dry on

account of grittiness. It is not so hard on tools when wet and is good for inside house construction work. Red Yemeri is considered slightly less durable than Santa María, is easy to work, and is suitable for the same purposes as poplar. It is used extensively in the South for boards and for the construction of doreys.

Yemeri is being cut and exported by the Tidewater Lumber Company. The amount shipped between September, 1924, and June 30, 1925, was 25,450 s. ft., valued at $644. A mill to cut Yemeri has recently been constructed at Regalia on Sittee River.

Tamarind.—There are three trees in British Honduras known as Tamarind. There is the tame Tamarind, a low tree known only for its edible fruits. The two forest trees probably derive their name from the resemblance of their leaves to those of the cultivated plant.

The Black Tamarind has been indentified as *Pithecolobium arboreum* (L.) Urban. It is also known as Turkey Gill and Barba Jolote, though the latter name is also applied to a species of *Cassia*. This timber is not being exported from here, though material of this species is said to have been imported by the United States from the West Indies under the name of Bahama Sabicu, and used for cabinet work and furniture.

The White or Wild Tamarind has been identified as *Acacia glomerosa* Benth. The tree reaches large size and occurs scatteringly in the dense forest. Two trees cut by the Tidewater Lumber Company were scaled at 2,119 superficial feet. The wood is moderately hard and heavy, tough and strong, and the color is nearly white. The veneers bear considerable resemblance to those of White Yemeri.

Acknowledgment

The Yale collections have recently been enriched by gifts of wood specimens from the Proefstation voor het Boschwezen, Buitenzorg, Java; the Museo Comercial de Venezuela, Caracas; and the Laboratorios de la Direccion General de Agricultura, San Salvador, El Salvador.

OCCURRENCE OF INTERCELLULAR CANALS IN DICOTYLEDONOUS WOODS

These structures, commonly known as gum ducts, have proved so useful to the writer in the identification of tropical woods that special attention has been given to the matter of their distribution. Since the publication of two earlier papers,[1] considerable new information and material have become available. Acknowledgment is especially due to Mr. L. C. den Berger, of Buitenzorg, Java, and Dr. Ryozo Kanehira, of Taihoku, Formosa, for their valuable coöperation. There are several points which remain to be clarified, and one of the purposes of this paper is to call the attention of other investigators to them. For instance, are the small ducts reported in the rays of certain Apocynaceae and Moraceae intercellular canals or latex tubes? And what is the significance of the large open radial canals in the Apocynaceae, Euphorbiaceae, and a few others?

The canals under consideration are of two kinds with respect to position in the tree, viz. (1) vertical, or axial, and (2) horizontal, or radial. Vertical canals are of two types, as regards their origin, viz. (1) normal, or natural, and (2) pathological. The latter are of more common occurrence than the others and appear to result from the breaking down (gummosis) of the wood structure. Such canals presumably arise as a consequence of injury to the cambium and are, therefore, in tangential series. They provide a valuable diagnostic feature, but inasmuch as their presence is accidental, little or no significance can be attached to their absence in a given specimen. The other type of vertical canals characterize all, or nearly all, of the Dipterocarpaceae, *Drimycarpus* (Anacardiaceae), *Mastixia* (Cornaceae), *Copaifera*, *Daniellia*, *Eperua*, *Kingiodendron*, *Prioria*, *Oxystigma*, and *Sindora* (Leguminosae), and *Simaruba* (Simarubaceae).

Radial canals are also of two types, which, for lack of a better classification, are herein designated as (1) large and

[1] Record, Samuel J.: Intercellular canals in dicotyledonous woods, *Journal of Forestry* 16: 4: 428–441, Apr. 1918; Further notes on ——, *idem* 19: 3: 1–12, Mch. 1921.

(2) small. The latter seem to be of normal occurrence in all cases. They vary considerably in size, but usually are large enough to be seen with a hand lens (10 x) and not infrequently with the unaided eye. These canals have oily or gummy contents which are likely to exude and stain the specimen, thus adding decidedly to their visibility.

Radial canals of the second type are empty and dry, and they vary in size, roughly, from that of a pin or point of a lead pencil to one-half inch in height and one-eighth inch across. The writer's attention was first called to them by Mr. den Berger, who, in a letter dated August 9, 1921, said: "In *Alstonia scholaris* and other species of that genus and of *Dyera*, two kinds of latex canals may be found, one occurring in the medullary rays and so small as to be indistinguishable with a hand lens, the others, of a size up to 1.5 cm. high and 3 mm. wide, arranged in stories at a distance of several decimeters." (See *Mededeelingen van het Proefstation voor het Boschwezen*, No. 7, 1922, Pl. 2, fig. 9.) The present writer has observed large canals of this class in *Alstonia* and *Dyera* (Apocynaceae), *Cereus* (Cactaceae), *Alchornea*, *Croton*, *Mabea*, *Pera*, and *Sapium* (Euphorbiaceae), and two unidentified woods from northern South America. In a specimen of *Pera arborea* Mutis some of them can be traced from the pith to the cortex, widening outward, and in another portion of the same material a vertical group of them arose from an injury about two inches out from the pith. From the nature and limited amount of material available the writer has not been able to determine the significance of these structures. In some cases, as for example in *Eupatorium lanceolatum* (Compositae), leaf traces in the wood have a superficial resemblance to resin ducts, but the canals in question are not of such origin.

The occurrence of both normal radial and vertical canals in the same specimen seems to be exceedingly rare in dicotyledonous woods, and the only authentic instances are in *Shorea* and possibly one or two other genera of the Dipterocarpaceae growing in Java. This condition has not been reported for any of the Philippine woods. Radial canals are said to have been found in woods of two genera of the Hamamelidaceae and one of the Leguminosae, in which cases

there were also vertical canals, but the latter were of the traumatic or gummosis type.

THE FAMILIES AND GENERA

Anacardiaceae.—Vertical canals reported only in *Drimycarpus*. Radial canals in *Astronium*, *Buchanania*, *Campnosperma*, *Dracontomelum*, *Gluta*, *Koodersiodendron*, *Melanorrhœa*, *Odina*, *Parishia*, *Pistacia*, *Rhus*, *Schinopsis*, *Schinus*, *Spondias*, *Swintonia*, and *Tapirira*.

Apocynaceae.—Radial canals of two kinds, large and small, in *Alstonia* and *Dyera*. (Are the small ones latex tubes?—S. J. R.)

Araliaceae.—Radial canals in *Arthophyllum*, *Cheirodendron*, *Didymopanax*, *Heptapleurum*, and *Sciadodendron*.

Bombacaceae.—Vertical canals, gummosis type, in *Bombacopsis*, *Ceiba*, and *Durio*.

Borraginaceae.—Vertical canals, gummosis type, in *Cordia*.

Burseraceae.—Radial canals in *Boswellia*, *Bursera*, *Canarium*, *Elaphrium*, *Garuga*, *Protium*, and *Santiria*.

Cactaceae.—Large radial canals in *Cereus*.

Combretaceae.—Vertical canals, gummosis type, in *Terminalia*.

Cornaceae.—Normal vertical canals in *Mastixia*.

Dipterocarpaceae.—Normal vertical canals said to be present in all genera except *Ancistrocladus*, *Lophira*, and *Monetes*. Both vertical and radial canals in certain species of *Shorea* (mostly Javanese).

Elæocarpaceae.—Vertical canals, gummosis type, in *Elæocarpus* and *Sloanea*.

Euphorbiaceae.—Radial canals, small, in *Euphorbia* and *Homalanthus;* large canals in *Alchornea*, *Croton*, *Mabea*, *Pera*, and *Sapium*.

Guttiferae.—Radial canals in *Mammea*, *Ochrocarpus*, and *Rheedia*.

Hamamelidaceae.—Vertical canals, gummosis type, and (rarely) radial canals also, in *Altingia* and *Liquidambar*.

Leguminosae.—Vertical canals of two classes. Normal in *Copaifera*, *Daniellia*, *Eperua*, *Kingiodendron*, *Prioria*, *Oxystigma*, and *Sindora*. Gummosis type in *Andira*, *Hardwickia*, *Herminiera*, *Hymenæa*, and *Peltogyne* (?).

Both vertical and radial canals reported by Tschirch in *Herminiera*. Radial canals reported by Kanehira in *Hardwickia pinnata* Roxb.

Lythraceae.—Radial canals in *Crypteronia*.

Malvaceae.—Vertical canals, gummosis type, in *Hibiscus* and *Thespesia*.

Meliaceae.—Vertical canals, gummosis type, in *Carapa*, *Cedrela*, *Entandrophragma*, *Khaya*, *Melia*, *Sandoricum*, and *Swietenia*.

Moraceae.—Radial canals reported in *Castilla*, *Ficus*, *Gymnartocarpus*, and *Sloetia*. (Probably latex tubes and not intercellular canals.—S. J. R.)

Moringaceae.—Vertical canals, gummosis type, in *Moringa*.

Myrtaceae.—Vertical canals, gummosis type, in *Angophora*, *Eucalyptus*, and *Rhodamnia*. Radial canals in *Eugenia* and *Leptospermum*.

Rosaceae.—Vertical canals, gummosis type, in *Prunus* and *Pygeum*. Radial canals in *Pygeum*, but not reported in same specimens with vertical canals.

Rutaceae.—Vertical canals, gummosis type, in *Balfourodendron*, *Citrus*, *Esenbeckia*, *Euxylophora*, and *Zanthoxylum*.

Sapindaceae.—Vertical canals, gummosis type, in *Dilodendron.*

Simarubaceae.—Normal vertical canals in *Simaruba;* gummosis type (?) in *Ailanthus.*

Sterculiaceae.—Vertical canals, gummosis type, in *Brachychiton, Heritiera, Sterculia, Tarrietia,* and *Theobroma.*

Vochysiaceae.—Vertical canals, gummosis type, in *Qualea* and *Vochysia.*

SUMMARY OF DISTRIBUTION OF INTERCELLULAR CANALS

(Figures in parentheses refer to number of genera)

Vertical Canals

Normal

Anacardiaceae (1)
Cornaceae (1)
Dipterocarpaceae (all?)
Leguminosae (7)
Simarubaceae (1)

Vertical and Radial Together

Dipterocarpaceae (1)
Hamamelidaceae (1)
Leguminosae (1)

Gummosis Type

Bombacaceae (3)
Borraginaceae (1)
Combretaceae (1)
Elæocarpaceae (2)
Hamamelidaceae (2)
Leguminosae (5)
Malvaceae (2)
Meliaceae (7)
Moringaceae (1)
Myrtaceae (3)
Rosaceae (2)
Rutaceae (5)
Sapindaceae (1)
Sterculiaceae (5)
Vochysiaceae (2)

Radial Canals

Small

Anacardiaceae (16)
Apocynaceae ? (2)
Araliaceae (4)
Burseraceae (7)
Euphorbiaceae (2)
Guttiferae (3)
Hamamelidaceae (2)
Leguminosae (2)
Lythraceae (1)
Moraceae ? (4)
Myrtaceae (2)
Rosaceae (1)

Large

Apocynaceae (2)
Cactaceae (1)
Euphorbiaceae (5)
Hamamelidaceae (1)

Large and Small Together

Apocynaceae ? (2)
Hamamelidaceae (1)

CURRENT LITERATURE

Report on forestry in Trinidad and Tobago. By R. C. MARSHALL. Trinidad, 1925. Pp. 20; 8 x 13; 2 colored maps.

Of a total area of 1976 square miles (Trinidad, 1862; Tobago, 114), 51 per cent of the land is covered by forest, of which 800 square miles are merchantable and 204 square miles are at present inaccessible. About 338 square miles are included in forest reserves, 31 in number. The preservation of these forests has been largely due to a realization of their effect on the climate, on preserving the humidity of the air so necessary for agriculture, in preventing erosion, and in acting as windbreaks.

"The main purpose of this report is to ensure that the direct utility of these reserves as sources of timber be more thoughtfully considered and that a definite policy be laid down on the lines developed in this report. Possibly the strongest argument in favor of such a course is that with a population of under 400,000, the annual imports of timber from the United States of America and Canada approximate to £200,000, or over 10s. per head. With a properly carried through forest policy the whole of this timber could be produced in the Colony and then leave an exportable surplus."

The forests of Trinidad and Tobago may be classified as tropical rain forests. The main types are: (1) MANGROVE FORESTS (area, 15 sq. mi.), consisting of *Rhizophora, Avicennia, Xylocarpus*, etc., occupying flat muddy ground between high and low water mark. (2) CEDAR FORESTS (area, forest reserve, 200 sq. mi.; Crown land, 391 sq. mi.), in which the most important species is *Cedrela mexicana* Roem.; associated trees, all approximately 100 feet high, are cypre (*Cordia alliodora* Cham.), balata (*Mimusops globosa* Gaertn.), balsam (*Copaifera officinalis* Willd.), roble (*Platymiscium platystachium* Gris.), acoma (*Sideroxylon foetidissimum*), purpleheart (*Peltogyne porphyrocardia*), fustic (*Chlorophora tinctoria* Gaud.), and bois lezard or black fiddlewood (*Vitex capitata* Vahl). (3) MORA FORESTS (area, forest reserve, 50 sq. mi.; Crown lands, 70 sq. mi.), "characterized by the presence of the one naturally gregarious tree of the Colony—*Dimorphandra Mora* B. & H."

Two varieties of Mora are recognized, namely, the "red" and the "white," the distinction lying in the amount of buttress and the character of the bark. Many thousand red mora sleepers have been imported from British Guiana while the native timber remains without demand. (4) PSEUDO SAVANNAH FORESTS (area, forest reserve, 40 sq. mi.; Crown lands, 150 sq. mi.), patches of high forest in meadow-like areas which are subject to fire in the dry season and almost impassable during the rain. The principal trees are crappo (*Carapa guianensis* Aubl.), galba (*Calophyllum Calaba* Jacq.), and poui (*Tecoma serratifolia* G. Don). (5) ARENACEOUS FOREST (area, forest reserve, 18 sq. mi.; Crown lands, 40 sq. mi.), or that growing on pure sand. The principal tree is the poui. (6) HILL FOREST (area, forest reserve, 30 sq. mi.), lying at elevations of 1500 to 3000 ft. Balata and cedar go well above 2000 ft. Tree ferns grow in abundance and species of *Clusia* are common.

At the end of 1922 the area of Government plantations amounted to 1248 acres. The trees most extensively planted are cedar, poui, cypre, balsam, locust (*Hymenæa Courbaril* L.), and teak (*Tectona grandis* L. f.). Teak was introduced from Burma in 1913 and better success has been had with it than with the other species because its silvicultural requirements are better understood. One of the worst mistakes has been too wide spacing of the trees, thus entailing heavy expense for cleanings or resulting in suppression of the young trees by the rank growth of weeds. Cedar and cypre need careful treatment in their young stages, but given the right conditions make excellent growth. Planting under shelterwood promises better results than in the open.

The best substitutes for American white pine are cedar and cypre, the only native woods with which most of the inhabitants are familiar. Next to these are "laurier canelle" (*Oreodaphne strumosa* Gris.), "laurier cypre" (*O. Cernue* Nees), and "laurier mattack" (*Aniba megacarpa*). "There is in addition a large number of soft woods of which but little is known, but which would be suitable for many of the purposes to which white pine is put," particularly for box shooks. Various substitutes for American pitch pine (southern yellow pine) are discussed, prominent among them being galba and crappo. The favorite native woods for railway crossties are poui and balata.

The author emphasizes the necessity of seasoning native timber if progress is to be made in its exploitation. "It can safely be asserted that *nowhere* in this Colony is native timber properly stacked for seasoning. At the worst the tree is felled, sawn up, and used absolutely green; at the debatable best it is allowed to lie in the log for a year or so, often exposed to full sun and rain, and is then, when split, etc., sawn up." It is recommended that the Forest Department conduct experiments to determine the best methods of seasoning.

The statement is made that Nelsons, Limited, intends to erect a paper pulp plant within easy reach of Port-of-Spain. The raw material will consist of bamboo and native hardwoods.

British Guiana. Report of the Lands and Mines Department for the year 1924. Georgetown, 1925. Pp. 22 + x; 8 x 13.

The quantity of greenheart (*Nectandra Rodioei* Schomb.) declared as having been removed from Crown lands during 1924 totaled 510,816 cu. ft., an increase of 33.9 per cent over the production of the previous year. Of this amount 168,257 cu. ft. were exported, the balance (342,559 cu. ft.) being absorbed by the local market.

The quantity of mora (*Dimorphandra Mora* B. & H.) declared was 38,296 cu. ft., an increase of 42 per cent over 1923. Hardwoods other than greenheart and mora amounted to 32,885 cu. ft. Of the softer varieties of woods of all kinds the production was 66,150 cu. ft., of which crabwood (*Carapa guianensis* Aubl.) comprised 85.5 per cent; nearly all of this material was used locally.

The number of railroad crossties exported was 39,238, of which 13,233, valued at $5,509 were shipped to the British West Indies; 25,595, valued at $25,595, to South Africa; 260, valued at $208, to the United Kingdom; 150, valued at $207 to the Dutch West Indies. Tests on mora ties are being made by the Imperial Institute, London.

The number of shingles manufactured was nearly two and one-half millions, of which 1,278,200 were exported. Over

eight million pounds of charcoal were manufactured from licensed Crown lands. The value of all timber and wood products exported was $209,851, while the imports of lumber were valued at $235,405. The amount of balata gum exported was 1,370,212 lbs., valued at $822,162. The total royalty from all forest products was $51,511, an increase of 10 per cent over that of the preceding year.

Verslag van een dienstreis tot het onderzoeken van de mogelijkheid tot afzet van Surinaamsch hout vooral in Midden-Amerika. By J. W. GONGGRIJP. Bul. No. 46, Dept. v. Landbouw, Nijverheid en Handel in Suriname, Paramaribo, June, 1924, pp. 25.

The first sixteen pages of this publication are devoted to an account of a personal investigation by the author, at that time Conservator of Forests of Dutch Guiana, of the shipworm problem in Central America with reference to the utilization of timbers from Surinam. Attention is called to the fact that the Demerara greenheart (*Nectandra Rodioei* Schomb.) is not always as resistant to the attack of teredo as it is reputed to be. The species of borers which seem to be the chief offenders in the Panama Canal are *Bankia* (*Neobankia*) *Zeteki* and *Teredo* (*Neoteredo*) *Miraflora*, while in the Saramacca Canal (Surinam) the greatest damage is done by *Teredo* (*Neoteredo*) *Reynei;* all three are recently discovered species.

The author recommends the trial of certain Surinam woods which have gained a local reputation for resistance to marine borers. These are "manbarklak" (*Eschweilera longipes* Miers), "angelique" or "basra locus" (*Dicorynia paraensis* Benth.), "anaura" (*Couepia* sp.), "sponsehoedoe" (*Licania macrophylla* Benth.), "ingibarki" (*Licania heteromorpha* Benth.), and "foengoe" or "vonkhout" (*Parinarium campestre* Aubl., and other species).

According to a copy of a letter, attached to the copy of the bulletin sent to the reviewer, test samples of the above-named woods were placed in sea water at the Pacific end of the Panama Canal locks September 17, 1923. "An examination was made on November 26, 1924," says the writer, Executive

Secretary McIlvaine, "and all specimens were found to be free from teredo attack. A sample of yellow pine similarly placed had been attacked to a considerable extent."

Pages 17–25 of the bulletin are devoted to a more general article (in English) entitled, "The protection of timber against shipworms or teredo." There is a survey of the damage done and a discussion of the factors involved in protection. Evidence is presented to substantiate the hypothesis that "all timbers possessing a certain amount of silica particles and a certain hardness must be proof against teredo." The content of silica grains necessary to complete immunization is considered to be about 0.50 per cent, though the basis for this percentage and the method of determination are not given. In certain of the species of timber the silica content is so variable that while one specimen may be immune, another may be more or less readily attacked.

The Surinam woods which are least subject to damage from marine borers are unfortunately not highly resistant to decay, thus tending to limit their employment in untreated condition to structures which are permanently submerged. The presence of silica in sufficient quantity to keep out teredo makes the wood difficult to work with tools, especially after the timber has become dry. To what extent these handicaps will militate against the commercial utilization of the woods remains to be seen.

Maderas preciosas de el Salvador. By SALVADOR CALDERÓN *Revista de Agricultura Tropical* (San Salvador) 3: 2: 89–94, Apr.–June, 1925.

A review of Record and Garratt's *Cocobolo* (Bul. No. 8, Yale School of Forestry), with particular reference to the occurrence and importance of this wood in Salvador. The vernacular name there is "funera" and there are two species. (See also *Tropical Woods* 1: 6, March, 1925.)

Balsa boxes carry perishables safely. *Southern Lumberman* (Nashville, Tenn.), April 18, 1925, p. 44.

Owing to its insulating properties and lightness in weight, combined with sufficient strength, balsa wood (*Ochroma* spp.)

has been used for the past two years by the Fleischmann Company to make boxes for the transportation of yeast without ice jackets. The wood is given a preliminary treatment by "a patented process of sealing the air cells." The boxes are dovetailed and glued at the corners and the lid is held in place with an iron strap. Two sizes are used, one containing fifty pounds, the other eighty. It has been found that one of these boxes will remain serviceable for over one hundred round trips.

Balsa is being experimented with for containers of various other perishables. "One test has shown the feasibility of transporting ice cream without ice. Test shipments of perishable pre-cooled goods have been made from New York to San Francisco successfully. Commodities forwarded at a given temperature will not vary more than 10 to 15 degrees when in transit 48 to 60 hours, these experiments have shown. . . . Numerous shippers of fruits, candy, mayonnaise, dairy products, fresh meats, sea foods, and drugs have adopted the balsa box."

Balsa wood from British Honduras. *Bulletin of the Imperial Institute* (London) 23: 1: 4–8, Apr. 1925.

A report on the properties of some specimens of balsa (*Ochroma* sp.), one of the woods known locally as "polak." The material tested was from a log about 17 inches in diameter and 5 feet long.

The following variations were noted in the weight per cubic foot of the dry wood at different distances from the pith: Center up to 3 in. radius, 7.5 lbs.; from 3 to 6 in. radius, 16.5 lbs.; 6 in. radius to outside of log, 21.5 lbs. The volumetric shrinkage in drying increased from about 4 per cent near the pith to 7.9 per cent at a distance out of 6¾ inches, and then decreased to 5.9 per cent.

A squared log 10 inches in diameter, previously received from British Honduras, was tested for comparison, and the weight per cubic foot of the dry wood varied only from 6.8 lbs. near the center to 10.8 lbs. at the outside.

Some British Honduras woods as paper-making materials. *Bulletin of the Imperial Institute* (London) 23: 1: 4–8, Apr. 1925.

This report supplements the one entitled, "British Honduras timbers," which appeared in the *Bulletin* last year (pp. 401, 406), as well as that mentioned above. The three woods tested were "quam wood" (*Schizolobium* sp.), "white moho" (*Hibiscus* sp.), and "polak" (*Ochroma* sp.).

"The results of the investigations of these three timbers indicate that when treated under suitable conditions, 'quam wood' and 'white moho' give satisfactory yields of pulp of good strength and quality. The former can be reduced with a rather smaller consumption of soda than the latter, but, on the other hand, 'white moho' pulp is composed of somewhat longer fiber than the 'quam wood' pulp, is of rather better quality, and is more easily bleached. Both pulps would furnish paper of satisfactory quality."

"The 'polak' wood presents a difficulty owing to the variation in density in different parts of the trunk." "The hard portion is very suitable for paper-making, giving a fairly high yield of bleached pulp which furnished white paper of good strength and quality. The soft portion of the wood, however, is not so satisfactory, as it requires a larger quantity of soda for its conversion into pulp, and the parchment-like character of the bleached pulp is a disadvantage for the production of ordinary types of paper. It would, however, be impracticable to separate the two portions for pulping on a commercial scale."

Development of forestry in British Honduras. By J. N. Oliphant. *Empire Forestry Journal* 4: 1: 39–44, 1925.

The forest department originated in 1922 with the appointment to the position of Conservator of Forests of Mr. C. Hummel, who had examined and reported upon the forests in 1920–21. At the end of June, 1924, Mr. Hummel left the Government service for employment with the Belize Estate and Produce Co., of which he is now manager, and the author was appointed Conservator of Forests.

As a result of the work of the department three new forest industries are "showing signs of emergence from their early

difficulties." "These are, respectively, the pine industry, the secondary woods industry, concerned with the subsidiary timbers found in the mixed rain-forest in association with mahogany, and the project for growing the sapodilla by intensive forestry methods for the production of chicle. . . . Aside from these new departures, and perhaps even more important, has been the evolution of a successful technique for the intensive silvicultural treatment of mahogany."

"Of the total area of forest land in the Colony (some five million acres) approximately one half is privately owned, and, generally speaking, the alienated tracts include the best and most accessible forest lands, and furnish the bulk of the output of forest produce in the Colony. Furthermore, forest produce, of which the chief items are mahogany and chicle (sapodilla gum), represents, on the latest figures available, about 87 per cent by value of the total exports of the Colony. The importance, from the standpoint of forest policy, of encouraging scientific management and conservation of private forests, will, therefore, be obvious. It is hoped to evolve a scheme for systematic coöperation between the Government and private owners of forest land in the development of their respective estates."

La conservation des bois coloniaux. Les piqures. By ROGER SARGOS. *Revue de Botanique Appliquée et d'Agriculture Coloniale* (Paris), May 31, 1925, pp. 343–348.

One of the greatest difficulties attending the exploitation of tropical woods of ordinary kinds for everyday uses is the danger of deterioration of the timber during the interval between the felling of the tree in the forest and the utilization of the lumber in a distant country. The importation into France of certain highly useful tropical African woods, such as the "framiré," "fraké," or "limbo" (*Terminalia* sp.), has been practically suspended because of insect damage. Very soft woods, such as "fromager" or "parasolier," are likely to arrive in a completely riddled condition.

It is generally the larvae of the Platypids and Scolytids which live in the solid wood and whose cylindrical galleries, lined with the mycelium of a fungus, produce what is known as black worm-holed wood (piqûre noir des bois). In the Congo

the insects abound in the forest and attack immediately any tree that has been girdled, felled, barked, or incompletely immersed. Little piles of sawdust appear on the bark of logs within two to four hours after cutting; on girdled trees, the next day after the ringing operations; and on the part of the log above water, some hours after partial immersion. Removing the bark facilitates the work of the insects.

Various methods have been tried to reduce the damage from wood-boring insects. One is to increase the density of the outer portion of logs by pounding, but the results are not worth the effort, the treatment of a ton of wood requiring the labor of a crew of 12 men for four hours. The author's recommendations in regard to the white "limbo" are as follows:

1. Exploitation should be during the dry season, June to September, and only during the wane of the moon!
2. The logs should not be barked before removal, but the branches and stumps should be peeled to attract insects and later burnt with the felling refuse.
3. As soon as the logs are cut, an S-iron should be driven into each end and the exposed wood surfaces painted with creosote or hot coal tar, or seared with torches made from native resins.
4. The logs should be placed in water as soon as removed from the forest and kept completely submerged.
5. The logs, whether or not they have the bark on, should be gotten to the squaring yards as quickly as possible, and all débris at yards and landings should be burnt.
6. Delay in transporting the logs to the coast should be reduced to the minimum.
7. They should be shipped on deck, if possible, and not in the hold.

Boschbouwkundige aanteekeningen over een reis in Atjeh, Sumatra's Oostkust, Tapanoeli en Sumatra's Westkust. By F. H. ENDERT. Korte Med. No. 9, Proefstation voor het Boschwezen, Buitenzorg, Java, 1925. Pp. 160; 6 x 9½; 1 map, 11 x 14½.

This is a valuable report of a trip made by the author, in the interests of botany and wood technology, from Langsa,

through Medan, Lake Toba, Sibolga, Padang Sidempoean, Fort de Kock, Pajacoembo, and Solok, to Padang. The route is shown in detail on a map. Pages 109–114 are devoted to a summary in English, and pages 117–160, to two check lists, the first on the basis of the vernacular names, the second on the scientific; the lists serve also as indexes. The number of families listed is 78.

"The genera of Sumatra have much more in common with those of Malacca and of Borneo than with those of Java. . . . These differences are pronounced in the most marked degree in the forests of the plains and the undulating country."

"In the plains, properly speaking, Java has only one type of forest, covering a large area, which is of economic importance, i. e. the teak forests (*Tectona grandis* L. f., fam. Verb.). The other forests are not very valuable. They are heterogeneous in composition, the quality of the timbers is below a medium grade, and the stock of the better grades is small.

"Comparing with Sumatra, the absence of teak forests, the financial backbone of the Forest Service of Java, is striking. Large areas of Sumatra are covered with inferior forest, which, notwithstanding that the soil and the composing specimens may differ widely from the conditions of Java and also from other localities of Sumatra, can best be compared with the inferior forest type of the Javanese plains."

"A better picture is shown by the forests on dry soil which occur as islands in these extensive swamp areas and also by many forests in the undulating country of Tapanoeli and the West Coast of Sumatra as well as by those in the vicinity of Sidjoendjoeng, all of them on soils of Tertiary or older origin. The amount of wood per area is not very large, but the quality as a rule is, generally speaking, better, owing to the greater occurrence of representatives of the family Dipterocarpaceae. For many forests in the plains and undulating country of Sumatra it can be put down as a rule that their technical value at present is indicated by the part which the Dipterocarpaceae take in their composition. As known, the Dipterocarpaceae play a very subordinate rôle in the composition of the forests of Java. On Sumatra the part of this family in the forests increases from south to north. In the type of forest meant here it is represented mostly by soft or medium hard timbers ('maranti,' 'katoeko,' 'lagan,' and 'kapoer')."

"The forest types mentioned, which render large scale operations positively impossible, definitely contrast with the forests near Langsa and on the island of Morsala. . . . The main stock is composed principally of Dipterocarpaceae, in which first class timbers such as 'damar laoet,' 'simantok,' and 'rasak,' play an important rôle. . . . A great drawback to the working of these forests, however, is that the country is precipitous over large areas. . . . In Langsa and Tamiang these forests are worked on a pretty large scale with Chinese labor, but only on the best situated plots. The areas which are less steep more and more attract the attention of rubber cultivation, pushing forward from the East Coast of Sumatra to the North."

"The type of forest encountered on the undulating country to the south of Padang . . . can be considered as a transition to the mountain forests. The composition of the mountain forests has more in common with Java than the other types. . . . For working on a fairly large scale only such forests can be taken into account as are near large centers of population. . . . The principal importance of the mountain forests is, as on Java, in respect to their hydrological significance. The necessity of setting bounds to the shifting cultivation of the mountain people is clearly demonstrated by the desolate wastes, covered with grass, ferns, and shrubs, of the plateau of Toba, which results from the annihilation of the forests, followed by ever recurring fires."

Forestry in Sarawak. By J. P. Mead. *Empire Forestry Journal* 4: 1: 92–99, 1925.

"The independent State of Sarawak, which has been a British Protectorate since 1888 . . . is situated on the northwest coast of Borneo and comprises an area of about 50,000 square miles, with a coastline on the China sea of some 400 miles. . . . The native population, composed mainly of Malays, Dyaks, Milanos, and Chinese, is estimated at about 600,000.

"The forests of Sarawak are evergreen and may be roughly

divided into two classes, littoral and inland. The former may again be subdivided into mangrove swamps and dry forests.

"The inland forests may be divided into fresh-water swamp forests and dry forests. . . . In the Lawas district is situated a most remarkable forest of *Dacrydium elatum*. This is a fresh-water swamp forest, and the stand of *Dacrydium* is practically pure. From measurements made this forest runs to as much as ten thousand cubic feet per acre. It is a curious thing that *Dacrydium elatum* has hitherto been regarded as a mountain species, being found usually at altitudes of three or four thousand feet.

"The dry forests may be subdivided roughly into lowland forests up to two thousand feet elevation and hill forests. In these lowland forests it is usual to find that about 60 per cent of the growing stock is composed of species belonging to the Dipterocarpaceae. . . . The bulk of the timber of the country is produced by these lowland forests. . . . The hill forests are at present quite inaccessible and are likely to remain so for many years to come. . . . In addition to the forests already described there are many square miles of secondary jungle resulting from the shifting cultivation of the Dyaks and other tribes."

The best timbers of the country are "belian" (*Eusideroxylon Zwageri*), "merbau" (*Intsia Bakeri*, *I. bijuga*, and *I. retusa*), "penyiau" (*Shorea grandiflora*), "tampinis" (*Sloetia Sideroxylon*), "rengas" (*Melanorrhœa* spp.), "bedaru" (*Cantleya johorica*), "kapur" (*Dryobalanops aromatica* and *D. Beccariana*), "keruing" (*Dipterocarpus* sp.), "nyireh batu" (*Xylocarpus granatum*), and "resak" (*Vatica* spp. and *Cotylobiam* spp.).

"The recorded consumption of timber and fuel for the year 1923 was about 73,000 tons. This, however, does not include timber taken free by the natives nor that felled and burnt by cultivators. There is as yet practically no export of timber. Minor forest products are many and include camphor, canes, cutch, damar, gutta percha, jelutong, rubber, illipe nuts, and nipah sugar.

"The establishment of the Forest Department dates from August, 1919, when the writer was appointed Conservator. . . . In April, 1920, an order was published providing for the constitution and maintenance of reserved forests. . . . Forest revenue has increased steadily since the Forest Department was established. Revenue derived from royalties was, for 1923, 84,600 dollars. Revenue derived from export duties on forest produce was, for the same year, 386,350 dollars, making a grand total of 470,950 dollars. The total expenditure for that year, including the cost of collection of export duties, was 67,470 dollars."

Research in forestry in India. By A. Rodger. *Empire Forestry Journal* 4: 1: 45–53, 1925.

This is an interesting account by the president of the Forest Research Institute and College, Dehra Dun, "of the wonderful progress that has been made in recent years in the science of growing trees and in the science of utilising them. It must never be forgotten that one of the great difficulties in India, which is not met with as a rule in more temperate climates, is the great mixture of species. . . . Since about the year 1900 it has been realized that the proper development and utilization of the forests of India must depend on expert and scientific guidance, and that can only be obtained through a properly organized research institute."

"The area of the forests in connection with which the Research Institute has been doing work . . . is no less than one quarter of the area of British India, and the gross revenue realized in the year 1922–23 was £4,200,000. In the year 1911–12 the gross revenue was £2,000,000. This doubling of the gross revenue in eleven years may fairly be ascribed in part to the work done in forest research in India since 1906."

"Separate notes on thirty timbers, usually with pieces of the wood as a frontispiece, have been published. . . . During the last few years several sections of the economic branch have been established where all the important timbers are gradually going through every conceivable kind of test."

"Dr. H. P. Brown . . . has in the press a manual of wood technology for India, Dr. Brown describing the structure of all the important timbers, and Mr. Pearson contributing notes on quantities available, where found, uses and properties.

"Timber testing has been going on on a large scale at Dehra Dun for the last two years and a certain amount before that." One of the objects of such tests is to make it practical to build structures out of what are at present unknown, or little known, Indian timbers instead of expensive imported kinds, thus effecting a saving to the builder and a gain to the country.

"The task of the seasoning expert at Dehra Dun is to prove that timber may double its value if scientifically and carefully seasoned and that many timbers, even perishable soft woods, can be turned out in the most surprisingly good form if treated in this way. In one case in particular a soft perishable timber which usually becomes destroyed by fungus almost at once in a damp climate was turned out as an excellent white box wood. Hand in hand with seasoning goes preservation. . . . The task of the preservation expert is to find out how timber can best be treated with creosote, crude earth-oil, and other preservatives so that it may be as durable as it is mechanically strong.

"All the important Indian and Burmese woods are being used for carpentry, veneer, and other purposes at Dehra Dun. Many new facts have been recorded about these woods and the purposes for which they are best suited are gradually being discovered."

The report deals with other phases of the work than those covered by the above quotations. The whole serves as a valuable object lesson or precedent for the development and utilization of the forests of other tropical countries. The reviewer believes that one of the best investments Latin American countries could make would be the establishment of a Pan-American Forest Research Institute on the general plan of that at Dehra Dun.

The mangroves of South Tenasserim. By J. A. Pilgrim. *The Indian Forest Records*, Vol. X, Part X, 1924. Pp. 73. Price As. 15.

This is an account of an investigation of various products of the littoral forests of Southern Burma by the tannin expert to the Government of India. The species which are described and for which reports are given of the tannin content of the

leaves, barks of various portions, wood, and in some instances the fruit, are as follows: *Heritiera* spp. ("sundri" and "pinlékanazo"), *Carapa* spp. ("nyieri"), *C. obovata* ("pinlé on"), *C. moluccensis* ("kyat-hnan"), *Rhizophora* spp. ("bakau"), *R. mucronata* ("payon"), *R. conjugata* ("pyu"), *Ceriops Candolleana* ("tinga"), *Bruguiera gymnorhiza* ("saung"), *B. caryophylloides* ("knet"), and *B. parviflora* ("knet-ywethe"). Species not fully investigated are: *Aegialites rotundifolia* ("perta"), *Sonneratia Griffithii* ("lambu"), *Excoecaria Agallocha* ("tayaw"), and *Avicennia officinalis* ("thamè").

In the Tenasserim Circle there is an almost inexhaustible supply of mangroves and the trees are well developed, but their exploitation is handicapped by the dearth of labor. "The best of the tans, taken all round, is *Carapa moluccensis*. . . . The commonest is *Rhizophora mucronata*."

One of the points considered was whether or not "mangrove increased in its tannin value the nearer its situation to the equator." The results indicate "that as between the mangroves of Sundarbans [of Bengal] and those of Tenasserim, no very wide differences occur; in some cases the species show a little more tannin, in some cases a little less. Nevertheless, it certainly is noteworthy that (1) the *best* of the mangrove tans and (2) the commonest of these tans both show themselves richer in this more southern latitude."

The author describes a method he originated for curing or preventing the stiffening of leather of *Rhizophora* and *Ceriops* bark tannages, through the use of a brew of the powdered leaves of the "thingan" (*Hopea odorata*).

Regeneration with the assistance of "taungya" in Burma. By H. R. Blanford. *The Indian Forest Records*, Vol. XI, Part III, 1925. Pp. 41. Price 2s.

"Taungya" is the Burmese name for temporary cultivation on hill land. Regeneration of forest species with the assistance of "taungya" is similar to the well-known German system of "waldfeldbau," or cultivation of forest with field crops. "Sowing or planting of tree species is carried out with the sowing of the field crop, and the tree seedlings are tended by the 'taungya' cutter as long as the field crop is on the ground.

As soon as the crop has been reaped the land is taken over by the Forest Department and the tree seedlings are tended until the crop is established."

Summary of investigations on bamboos and grasses for paper pulp. By W. Raitt. Preface by R. S. Pearson. *The Indian Forest Records* (Economy series), Vol. XI, Part IX, 1925. Pp. 11; pl. 1. Price 9d.

This publication is printed on bamboo paper made at the paper pulp plant of the Forest Research Institute and gives an account of the activities of that plant. Some of the general conclusions are:

(1) Nature's rule in the case of grasses appears to be that the shorter the period available for lignification during growth, the less the quantity of lignin, but the greater its resistance.

(2) Crushing bamboo is preferable to chipping as it serves to get rid of much of the air in the sap canals, thus reducing the waste of pulp due to frothing.

(3) Water transport of bamboo is preferable to land transport, not only on account of lower cost and cleaner material, but also because of the soaking out of a considerable amount of the starchy constituents upon which boring beetles feed. Water seasoning of bamboo for structural purposes is commonly practiced in India to protect the material from insects and mildew, and bamboos thus treated can be stored without damage for two years, while untreated culms may be reduced to a mass of dust in nine months.

Report of the Forest Administration in the Bombay Presidency, including Sind, for the year 1923–24. Bombay, 1925. Pp. 221; 6 x 9¾. Price 1s. 9d.

This report shows that the Forest Department in Bombay is in healthy condition in spite of the general trade depression which followed the short-lived post-war boom.

An item of special interest has to do with experiments with a tractor and skidding winch imported from America for extraction work in place of buffaloes and elephants which

previously had been the only source of power for this purpose. "The selection of the plant and the cost involved have proved to be fully justified and the results have been an entire success. . . . The cost of working is less than has previously been obtained by animal power and its capacity is, of course, much greater. No logs proved to be too difficult for extraction by this outfit. . . . Improvements in animal power extraction have been started by the introduction of bullock winches. . . . Experiments show that this type of plant may prove very economical." A steam tractor and trailer were also tried out with success in replacing bullock carts in log transport.

Progress report of forest administration in Coorg for 1923–24. By V. G. Darrington, Bangalore, 1925. Pp. 15; 8½ x 13.

The total area of Coorg forest reserves is 520 sq. mi. The working plan calls for the selection system, combined with concentrated and repeated improvement fellings and cleanings. Transport difficulties are a perpetual source of embarrassment to forest exploitation.

"The continued dependence of forest finance on sandalwood gives ground for anxiety. The present rate of extraction cannot be continued indefinitely. It is hoped that if it is possible to make large sales of timber to the sleeper pool the necessity for the heavy exploitation of sandal may disappear. The enumeration of sandalwood and its propagation will continue to be a foremost point of policy. There is at present no danger of depletion."

"Attention is being given to possibilities of converting our raw materials into sleepers, big and small, in the forests. The matter is of interest as the local railway companies may be prepared to accept 'matti' (*Terminalia tomentosa*), 'nandi' (*Lagerstroemia lanceolata*), 'thadisalu' (*Grewia tiliæfolia*), etc., sleepers as well as teak; and these are precisely the timbers we have in great abundance."

Monkey apple timber from Sierra Leone. *Bulletin of the Imperial Institute* (London) 23: 1: 8–12, Apr. 1925.

A report on the mechanical and working properties and the commercial possibilities of the wood of *Anisophyllea laurina* R. Br. (Rhizophoraceae). This is a rather hard and heavy wood (sp. gr. 0.70 to 0.90; weight, 43.5 to 56 lbs. per cu. ft.), with prominent rays, which on quarter-sawn material are seen as "large, whitish-brown, dull flakes, sometimes over one-half inch broad, the ground tissue being lustrous orange brown." This ornamental figure is less pronounced when the wood is polished, owing to the reduction in contrast of the colors of the rays and ground. "The susceptibility of the wood to bad shakes (judging from the logs forwarded) and its readiness to 'check' are serious drawbacks to its use."

Crude rubber survey, No. 1. Marketing of plantation rubber. By J. J. Blandin. Trade Inf. Bul. No. 180. Sup. to *Commerce Reports*, Washington, Jan. 24, 1924. Pp. 24; 5¾ x 9; 1 map.

This report is the first of a series of publications to be issued as a result of the extensive investigation of the crude-rubber monopoly authorized by the 67th Congress. This investigation was under the direction of Dr. H. N. Whitford, formerly Assistant Professor of Tropical Forestry in Yale University.

The present report covers the marketing of crude rubber produced on plantations in the Far East, that is, south-eastern Asia and adjacent islands. Ninety-five per cent of the rubber produced in 1922 came from plantations of that region.

The two other reports which have appeared are on the Middle East and the Philippines, respectively. There are three more to follow, one dealing with the Amazon Valley, one with Central America, and one with Africa.

The plantation rubber industry in the Middle East. By David M. Figart. Trade Promotion Series No. 2, U. S. Bu. Foreign and Domestic Commerce, Washington, 1925. Pp. 317; 5¾ x 9; figs. 90; bibliography; index. Price 50c.

In this report, the second of the series, there is a discussion of the economic factors surrounding the industry in the Middle East ("Far East" of the first report), with special emphasis on the cost of production and the extent to which the future potential output from the existing planted area can be depended upon to meet the world's increasing demand.

"The plantation rubber industry in the Middle East originated from seeds of *Hevea brasiliensis*, otherwise known as Para rubber, collected in Brazil by Sir Henry Wickham in 1876, germinated in Kew Gardens, London, and sent from there to the East. Other rubbers, such as Castilloa (*Castilla* spp.), Ceara (*Manihot Glaziovii*), and Rambong (*Ficus elastica*) are not dealt with in this report, as they have practically disappeared from cultivation."

At the end of 1923, the total area of rubber plantations in the Middle East was 4,296,000 acres; on this area, trees ready for tapping in 1924, that is, that were 5 years old or older, occupied 3,850,000 acres. The British-owned plantations aggregate 3,230,000 acres, or 75 per cent of the total. The net exports of rubber for 1924 are estimated at nearly 387,000 tons of 2,240 lbs. The United States imports in 1923 were valued at $185,000,000, or about 72 per cent of the whole world's production.

"Rubber requires a warm, moist climate, with deep soil of good physical texture. A rainfall in 70 inches is sufficient; over 120 inches is considered high. Sixteen hundred feet is generally regarded as the highest altitude for rubber, though there are some good estates at a higher elevation. Provided soil conditions are right, a dry season of several months does not necessarily rule out a country for planting. Districts with winds of cyclonic force and frequent morning rains should be avoided. The rubber districts of the Middle East lie mainly in a belt 10° north and 10° south of the Equator; in this region temperature and rainfall are suitable and destructive winds practically unknown.

"The approved planting methods at the present time are clean clearing and removal of all timber and stumps; close planting — about 200 trees per acre — with early thinning

out, eventually to 70 or 80 trees per acre; and conservation of soil and rainfall on slopes by terracing, digging of pits, construction of bunds, cover crops, etc. Certain soils may not require clean clearing."

There is as yet no proven method of developing specially high-yielding strains. Tapping systems are still in the experimental stage. New developments in the preparation of plantation rubber (chiefly shipment in liquid form and spraying) may result in the scrapping of a great part of present plantation factory equipment. The economic life of a plantation has not been determined, but may be about 30 or 35 years. Comparatively little land suitable for rubber remains in Ceylon and Java. Large areas are still available in Malaya, Sumatra, Cochin China, and Borneo. There are compensating factors in all the rubber-producing countries, which show a trend, at the present time, toward a general equality in costs of production.

Possibilities for Para rubber production in the Philippine Islands. By C. F. Vance, A. H. Muzzall, J. P. Bushnell, and Mark Baldwin. Trade Promotion Series No. 17, U. S. Bu. Foreign and Domestic Commerce, Washington, 1925. Pp. 101; 5¾ x 9; figs. 32; bibliography. Price 20c.

This report, the third of the series, treats of the present small rubber industry in the Philippines and the possibilities of its expansion. The findings indicate that the climatic conditions there are as favorable for rubber planting as are those of the Middle East. There are large areas with better soil, topography, and accessibility than the lands now generally available for new plantations in Sumatra and Malaya. Although the present land laws operate against extensive plantations, nevertheless moderate-sized plantations are possible with foreign capital, and the small native planter might, with proper encouragement, become a producer of important further supplies. It is suggested that the "caiñgin" farmer might be induced to grow rubber and annual crops together and thus replace shifting cultivation, so destructive to the forests, with permanent agriculture and land ownership.