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A technical magazine 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 any articles therein, the authorship of which is not otherwise indicated, is SAMUEL J. RECORD, *Dean of the Yale University School of Forestry.*

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RANDOM OBSERVATIONS ON TROPICAL AMERICAN TIMBERS

By SAMUEL J. RECORD

The following notes are presented in the hope that they will not only prove useful to others interested in woods, but also that they will elicit the data and material necessary for answering at least some of the various questions raised.

Is the heartwood of *Taxodium mucronatum* fragrantly scented?

Mr. L. K. Small, President of the Marine Products Company, San Diego, California, recently obtained a plank of wood cut from a tree that grew rather high in the mountains of Sonora, Mexico, where it was known as Sabino. Local attempts to identify the wood being unsuccessful, the sample was sent to me for study. It has the typical appearance, oiliness, and structure of *Taxodium mucronatum* Ten., but has a distinct cedary fragrance entirely new to my limited experience with the species. The only Cedars native to that region are of the genera *Juniperus* and *Cupressus*. In these the bordered pits on the radial walls of the tracheids are all in a single vertical row, whereas in *Taxodium* they are frequently in pairs or threes in the early wood.

Note on *Bucida Buceras*

Late last year Dr. G. N. Walcott, an entomologist with the Agricultural Experiment Station of the University of Puerto Rico, found a fence post on the coastal plain, and subsequent tests of the wood showed considerable resistance to the attack by the local drywood-termite, *Cryptotermes brevis*. The post was submerged in brackish water, where it has presumably been for many years, and had acquired a salty taste and an olive-black color. It was recognized as one of the Combretaceae, but the exact identity was in doubt.

With one exception, the woods of the American Combretaceae are much alike anatomically and specific differences are frequently as great as the generic. The exception is *Bucida*, in which the rays are 1 to 4 cells wide, whereas in the others they are all uniseriate or partially biseriate. The wood in question has rays up to four cells wide and agrees in all other anatomical details with *Bucida Buceras* L. The natural color of fresh heartwood of that species is dark yellowish brown, with a tinge of olive, but any wood rich in tannin will turn black if submerged long enough in water containing even minute quantities of iron. It is not known if this chemical change increases the resistance of the wood to decay or insect attack. Dr. Walcott thinks the presence of salt may be an important factor.

Panama "Candle Wood" or "Sigua Canela"

Early in 1928, G. Proctor Cooper obtained specimens of the principal timbers used in Almirante, Bocas del Toro, Panama. Among them is one (Yale 12259; Cooper 626) called Sigua Canela or Candle Wood. Although extensive collections were made in the forests of that region, this species appears to have

been missed and its identity is still unknown, though undoubtedly it is one of the Rutaceae and not lauraceous, as the name Sigua Canela would indicate.

Among R. J. Seibert's recent collections in that locality are two pieces of this timber, both labeled Sigua Canela or Candle Wood. He writes that it is an extremely strong, light-colored wood which contains an oil and burns readily even when freshly cut, hence the name Candle Wood. It is used by the United Fruit Company for making boxcars, railway crossties, and various purposes requiring strength.

The wood is of a uniform pale yellow color and in general properties is comparable to Hard Maple (*Acer saccharum*), though not so fine in texture. It is slightly oily and has a spicy scent suggesting certain of the Lauraceae. The pores are small, numerous but not crowded laterally, and mostly in multiples of 2–5. The vessel perforations are simple, the pitting is fine, yellow gum is abundant. The rays are uniseriate and up to 20 (40) cells high; homogeneous, the cells slender-procumbent; the vessel-ray pitting resembles the intervascular. Parenchyma is mostly limited to very narrow concentric bands which are variable in spacing but usually far enough apart to appear to terminate growth rings; small crystals are common. The fibers are small, with thick walls and rather few, very small pits. There are no oil cells, such as characterize so many of the Lauraceae, but the ray cells have oily contents. Ripple marks are absent.

The anatomy and general properties indicate *Amyris* as the proper genus (see *Tropical Woods* 64: 5). In the Yale wood collections there are representatives of seven genera, namely, *Amyris balsamifera* L., *A. Brenesii* Standl., *A. diatrypa* Spreng., *A. elemifera* L., *A. lineata* C. Wr., *A. simplicifolia* Karst., and *A. sylvatica* Jacq., and they are all similar. They differ from the Panama material in their finer texture, much smaller pores (which are in more definitely radial arrangement), and lower rays. These and other differences may be of minor importance individually, but taken together they convince me that the Candle Wood of Panama, though probably a species of *Amyris*, is not in the section *Euamyris* Urb. to which the seven species listed above belong. I have not seen the wood of *A. trimera* Kr. & Urb., the Colombian species comprising the other section, *Amyridastrum* Urb.

"Cashier" of Bocas del Toro, Panama

For more than 20 years a piece of a plank from Panama remained undetermined in the Yale collections. It bore the label "Espava," presumably because the color and general appearance suggested *Anacardium excelsum* (Anacardiaceae). During the course of preparation of *Timbers of the New World*, the specimen (Yale 5967) was provisionally identified as *Chloroleucon*, probably near *C. mangense* (Jacq.) Britt. & Rose (=*Pithecolobium mangense* [Jacq.] Standl.). More recently another specimen of the lumber was received from R. J. Seibert who obtained it near Almirante, Bocas del Toro, where it is known as Cashier. He states that the timber is used by the United Fruit Company for general construction purposes and railway crossties.

In the absence of herbarium material it is not possible to check the accuracy of the generic determination. The wood is of a yellowish color when fresh, becoming brownish yellow upon exposure, and has a rather waxy appearance and feel. It is of medium-low density, rather fine-textured, cuts very easily, takes a glossy finish, and is durable. Presumably the trees attain rather large size and, if available in sufficient quantity, the lumber should be in demand for much the same purposes as Yellow Poplar (*Liriodendron*) in the United States.

Some Proposed Substitutes for Balsa (*Ochroma*)

The great demand for Balsa (*Ochroma lagopus* Sw.) for war purposes has stimulated the search for other light-weight woods which might serve as substitutes. Below are notes on a few of the various samples I have been asked to identify.

One is from Salvador and bears the name Flotadora. It is pale yellowish, with little luster; light in weight, suggesting Cottonwood (*Populus*), but relatively firm and tough. The pores are few and rather large, solitary and in small multiples. The vessels have simple perforations and coarse, alternate pitting. The rays usually have 1–3 strata of procumbent cells and marginal and interspersed strata of square and upright

cells; pits to vessels mostly large, oval to lenticular; crystals numerous. The parenchyma is abundantly reticulate. The fibers have thin walls and the pits have narrow apertures and rather large borders. Gum ducts are absent, but one radial channel was seen. This wood is evidently one of the Euphorbiaceae, but I have not been able to match it in the Yale collections. One possibility that, for lack of material, has not been explored is *Omphalea oleifera* Hemsl., which, according to Standley and Calderón (*Lista preliminar de las plantas de El Salvador*, p. 135), is a large tree of common occurrence in western Salvador and certain parts of the central departments.

Shipments of Balsa from Guatemala sometimes contain small amounts of *Heliocarpus*. Woods of this genus vary greatly in density, but the lightest pieces are mostly parenchyma with rather widely spaced narrow bands of wood fibers, the whole suggesting the pith of a cornstalk. The material would probably serve very well for insulating purposes. It is not likely to be confused with Balsa (*Ochroma*) if authentic specimens are available for comparison.

Some time ago, Mr. E. B. Ford, vice-president of George D. Emery Company, of New York, received a wood sample labeled Balsa, from Bahia, Brazil. I identified this as *Cavanillesia arborea* (Willd.) Schum., but owing to the insufficiency of authentic wood specimens of all kinds from extra-Amazonian Brazil, I took occasion to ask that herbarium material be procured. Leaves and fruits were forthcoming, along with the information that the tree is known locally as Barriguda (a Portuguese word meaning pot-bellied and referring to the swollen trunks). The fruits are highly characteristic, consisting mostly of five semicircular membranous wings which fold together when pressed and have a total spread of 7–8 inches. The wood is of a pale lemon color and lacks the satiny luster and feel of Balsa (*Ochroma*). Mr. Ford writes: "A piece of Balsa weighing as little as this wood does would be so soft that it could be crushed between the fingers. If it could be obtained in commercial quantities it might prove better for some purposes than Balsa, owing to its firmness in conjunction with extremely light weight." The other species of this genus, *Cavanillesia platanifolia* H. B. K., grows in Panama, where it is known as Bongo, Hamati, and Quipo, and in northwestern Colombia where the common name is Macondo (see Plate XVI, opposite page 92, Record and Hess' *Timbers of the New World*). The woods of the two species are similar.

Last August, Dr. William T. Cox, of the Office of Economic Warfare, sent me a piece of Pretina wood, with the following information concerning it: "The tree grows in the Province of El Oro, Ecuador, and in the northwestern corner of Peru. I obtained the wood specimen from a log that was in a truck at Tumbes, Peru. The log, which was about 14 inches in diameter, was peeled and probably had lain around several months or at least weeks since the tree was felled. Decay was evident in spots on it. The tree called Pretina is fairly common in the territory mentioned and is considered by the local residents as a substitute for Balsa and is sometimes so used. Other samples I had in Guayaquil were considerably lighter in weight than this specimen being sent to you, but this piece shows the grain, the pores, and other characteristics fairly well." I identified the material as *Pisonia* sp. (Nyctaginaceae). It is characterized by numerous strands of included phloem which disintegrate quickly and leave vertical channels suggesting large vessels. A cross section of the related genus *Neea* is illustrated in Plate LVIII of Record and Hess' *Timbers of the New World*.

Timbers naturally resistant to teredo

It is reported from Surinam that substantial shipments of Angélique or Basra Locus, *Dicorynia paraensis* Benth. (Leguminosae), are being made for use in the Panama Canal. Tests have indicated that the timber is considerably more resistant than Demerara Greenheart, *Ocotea Rodiaei* (R. Schomb.) Mez (Lauraceae), to the attack of teredos infesting brackish water, but complete immunity should not be expected.

In the Yale collections are specimens (Nos. 4954–4958) of five woods that had been submerged in the brackish waters of the Saramacca Canal in Surinam for various lengths of time. Only two showed no teredo injury. They are Foengoe or Vonkhout, probably *Parinarium campestre* Aubl. (Rosaceae-Chrysobalanoideae), which was undamaged after 20 months, and Manbarklak, probably *Eschweilera longipes* Miers (Lecythidaceae), which was untouched, except superficially by stone-boring mollusks, after 17 years. Mr. J. J. Gongryp, who supplied these samples, also contributed the following item concerning Manbarklak:

"Dr. Stahel has brought me some piles from the old town in Nickerie, which was washed away by the sea. The only thing left of this town are the remains of a wharf, some piles now standing in the ocean about a mile from the shore. They are of Manbarklak, at least 50 years old, perfectly sound, as hard as a nail, and quite untouched by teredo."

According to Prof. G. van Iterson (*De Ingenieur*, The Hague, 1911), the reason the foregoing timbers resist teredo is that they contain enough small particles of silica to wear off or blunt the teeth of the boring apparatus of the mollusk so that the animal cannot penetrate the wood. Subsequent investigations (see *Tropical Woods* 33: 51) confirmed that conclusion, but demonstrated that the resistance "is not dependent alone on the content of silica particles, but on a sufficiently large content together with a certain degree of compactness of the timber." Manbarklak and timbers of the Chrysobalanoideae group of the Rosaceae are more difficult to saw and less resistant to decay than Angélique, and will give their best service when kept completely submerged.

Oriental wood, *Endiandra Palmerstoni* (Bail.) White, of Queensland, Australia, is used successfully for sliced veneers, although the silica content may amount to 1 per cent of the total weight of the wood. An instance is known where six circular saws were required to cut ten feet of a flitch. According to M. B. Welch (*Tropical Woods* 20: 5): "Swage-set band saws, with plenty of water to cool them, give the best results, but even then after three or four deep cuts the saw dulls and must be changed at once. It is necessary to keep the saw moving forward through the wood steadily. . . . Whilst some yards have experienced the greatest difficulty in moulding the wood, others using specially hardened cutters have had comparatively little difficulty. Hand tools are not affected." From this last statement it is evident that the easiest way to shape structural timbers of high silica content is by hewing.

Humiriaceae in Central America

On March 27, 1943, Arthur Bevan, Director of the Latin American Forest Resources Project, wrote to me from San José, Costa Rica, in part as follows: "Under separate cover we are sending you a sample of wood which we are anxious to have identified. This sample came from the neighborhood of San Isidro del General, Costa Rica, and is known locally as Ira Chiricana. This species occurs fairly plentifully in at least the northern section of El General valley and is found up to 36 in., d.b.h., with clear lengths to 60 ft. . . . From a series of rather rough tests to determine the strength of local timbers that are available for the construction of temporary truss bridges on the Inter-American Highway, Ira Chiricana proved to be the strongest. It has a specific gravity of 0.62, based on oven-dry weight and green volume. Locally it is said to be durable." On April 5, I replied that the wood sample "is, in my opinion, *Humiria*, although the Humiriaceae are not known to occur in North America."

On June 11, 1943, W. A. Dayton and W. R. Barbour collected herbarium and wood specimens from a tree they believed to be the same as that supplying the wood sample Mr. Bevan had forwarded. This material provided the type of *Vantanea Barbourii* Standl., the diagnosis of the new species appearing in *Tropical Woods* 75: 5–6, Sept. 1, 1943. Standley added: "Here is referable also a specimen (No. 16822) in the herbarium of the Yale School of Forestry received 13 years ago from H. J. Marks of Golfo Dulce, Costa Rica, and believed to have come from the nearby mountains."

Standley's contribution was followed (*loc. cit.*, pp. 7–8) by one from Mr. Barbour, who related that he and John A. Scholten had obtained the original wood sample from the sawmill. To indicate that I was not convinced that the identity of this wood sample had been settled, I injected the following footnote: "I have not seen the wood of the type of *Vantanea Barbourii*, but the Marks' sample is of that genus. I have identified other woods from Costa Rica, including the one obtained at a sawmill by Scholten and Barbour, as *Humiria*."

In January of this year, I received a specimen of the wood

of the type tree (Dayton & Barbour 3129), and also one from a later collection (Barbour 1018). There is no question about both being *Vantanea*, but they definitely are not of the same genus as the original sample from the sawmill. The identity of the latter still remains to be determined. It is apparently the same as Yale 6912, labeled Saccal, collected in 1924 by Dr. Alvin G. Cox in Bocas del Toro, Panama; Yale 11243, obtained in 1927 by G. Proctor Cooper in the Guapiles District, Costa Rica; and Yale 11250, labeled Campana, obtained by Mr. Cooper in 1927, from the Carillo & Merino Lumber Company of San José, original source, Province of Puntarenas. No herbarium material accompanied these three wood samples. The name Saccal is applied also to a leguminous tree in Bocas del Toro, and Campano to *Guarea* and *Laplacea* in Costa Rica.

There are three known genera of Humiriaceae, namely, *Humiria*, *Sacoglottis*, and *Vantanea*. The wood of the last is characterized by very coarse vessel-ray pitting, whereas the other two have fine to medium pitting. There is no more reliable diagnostic feature than the type of pitting between the rays and vessels, and in the present instance the difference is recognizable at a glance. Distinguishing *Humiria* from *Sacoglottis* is not so simple, as the range of variation between different species of the same genus appears to be about as great as it is between the genera. *Humiria* grows nearby in Colombia, and the four wood samples in question appear to fit better in that genus than in *Sacoglottis*, of Amazonian Brazil and the Guianas, but I cannot match them exactly with any of the several authentic specimens in the Yale collections. Here then is another Central American timber, well known to local commerce, but unknown to the taxonomic botanist.

Miscellaneous determinations

A specimen from a western Colombian tree, known in the State of Nariño as Cuangare or Cedro Cuangare, appears to be *Dialyanthera otoba* (H. & B.) Warb. (Myristicaceae).

Another Colombian wood, obtained by R. J. Seibert at a sawmill on the Río Sucio, a northern tributary of the Atrato River, proved to be *Carapa guianensis* Aubl. (Meliaceae). The vernacular name is given as Huino.

A sample of Costero de Parota received by the Office of Economic Warfare from a sawmill operator in the State of Guerrero, west coast of Mexico, has been identified as ***Ceiba pentandra*** (L.) Gaertn. (Bombacaceae).

A COLOMBIAN SPECIES OF *STERIGMAPETALUM*

By JOSEPH MONACHINO

During Professor Record's visit to the Santa Marta region of Colombia in 1930, plans were made for future collecting in the Sierra Nevada range under the supervision of Henry Kuylen, of United Fruit Company. Ramón Espina, a local school teacher experienced in collecting herbarium and wood samples, was selected to head a small party which left for the mountains the latter part of December 1931, returning in February 1932. Sr. Espina's principal assistant was Juan Giacometto. More than 300 specimens were obtained from sea level to 3000 meters in the northeastern angle of the Sierra Nevada, the part nearest to the city of Santa Marta. (See *Tropical Woods* 30: 17–37; June 1, 1932.)

In this collection are two specimens which until now have remained undetermined. The type of the species described below came from the Río Jabalí (La Victoria) region. The terrain is much broken, the formations are all of sedimentary origin, and the top soil is rather thin. There is abundant rainfall from April to December and none at all during the remainder of the year. The other specimen is from the Río Toribio on the slope of San Lorenzo, where the humidity is greater and the vegetation more luxuriant.

Sterigmapetalum colombianum Monachino, sp. nov.—Arbor ca. 25 m. alta, 30–60 cm. diam; ramulis dense pubescentibus, pilis adpressis pallide fulvis, cicatricibus interpetiolaribus linearibus; foliis ternatis; petiolis 2–5 mm. longis (in typo), ad basin pubescentibus; laminis obovatis 4.5–6.0 cm. longis et 2–4 cm. latis (in typo), ad apicem rotundatis vel subemarginatis, ad basin acutis, utrinque glabris nitidisque, secundariis majoribus ca. 22, venulis valde reticulatis utrinque prominulis supra elevatis: inflorescentiis paucifloris in axillis foliorum superiorum subterminalibus; pedunculis ca. 3 mm. longis minute arcteque adpresso-pubescentibus; alabastro floris femini solitario pedunculum terninanti, ca. 3 mm. longo 5-mero, sepalibus extus parce adpresso-pubescentibus, intus densiore pubescentibus; apicibus petalorum crinitis (lobis ca. 12) et cum penicillo ornatis, aliter glabris; staminodiis 10 squamiformibus ad basin in annulum ca. 0.25 mm. altum connectiis; ovario ovato-spheroideo adpresso-pubescente obtuso 5-angulato; stylo ca. 0.4 mm. longo; stigmate 5-lobulato; loculis ovarii 5, ovilis 10 ad apicem placentae centralis affixis.

Dioecious tree, about 25 m. high and 30–60 cm. in diam.; branchlets densely pubescent with appressed pale-fulvous hairs, the interpetiolar scars linear; leaves in whorls of three, the petioles 2–5 mm. long (in the type), pubescent at base, the blades obovate, 4.5–6.0 cm. long and 2–4 cm. broad (in the type), rounded or slightly emarginate and obscurely minutely mucronulate at apex, cuneate at base, glabrous except for very sparsely scattered white-translucent hairs on midrib and veins of under side, shining on both sides, the principal secondaries about 11 pairs, the reticulation close and prominent on both sides and conspicuously raised on upper side, the leaf tissue subcoriaceous and sometimes with scattered minute blisters seen on undersides of blades; inflorescences axillary near ends of branchlets, sparsely flowered, the peduncles about 3 mm. long, minutely and closely appressed-pubescent; only the bud of female flowers seen, single on end of peduncle, about 3 mm. long, 5-merous, the sepals sparsely appressed-pubescent outside and more densely so within; petals fringed at apex with about a dozen lobes, beset with a tuft of erect bristles, otherwise glabrous; staminodes 10, squamiform, the anther-like bodies on short stalks which are united at base into a ring about 0.25 mm. high; ovary ovate-spheroid, pubescent with appressed hairs, bluntly 5-angulate, the style about 0.4 mm. long, the stigma lightly 5-lobulate; cells 5, the ovules 2 in each cell, attached at apex of the central axis.

Type: *Espina & Giacometto A31* (Yale No. 20806), Colombia, Río Jabalí region, 1000–1200 m. above sea level; common name Popa. (Type in the herbarium of the New York Botanical Garden.)

The type material consists of flowering branchlets with the leaves crowded near the apex. *Espina & Giacometto A90* (Yale No. 20865), collected in the Río Toribio region of Colombia, 1000–1200 m. above sea level, is probably of this species; it consists of sterile material and represents the lower, more widely spaced leaves. Its internodes are 22–45 mm. apart instead of mostly 8–12 (up to 37) mm. as in the type; petioles 11–20 mm. long; leaf blades 12.5–15.3 cm. long and 5.4–8.5 cm. broad, the underside with midrib more elevated and sharper, the reticulation more open. The tree is reported to grow to a height of 25 m. and 50–90 cm. in diam. It is called Mameicillo.

Sterigmapetalum colombianum, like *S. obovatum*, is a distinctive member of the Rhizophoraceae found growing on high lands; in the character of its branchlets it has a vague resemblance to species of *Terminalia*, and in the disposition of the leaves on the branchlets, leaf shape, and venation, a marked similarity to many members of *Vochysia*. *S. colombianum* is easily distinguished from the only other known member of the genus, *S. obovatum* Kuhlmann, found in Amazonas, Brazil, by the leaves which are essentially glabrous, the inflorescences much sparser-flowered, the sepals only slightly pubescent outside instead of densely sericeous, the ovary less densely pubescent, and the style although short yet clearly distinct.

Note on the Wood of *Sterigmapetalum colombianum*

Through some inadvertence, the wood sample accompanying *Espina & Giacometto A 31*, the type of *Sterigmapetalum colombianum* Monachino, does not correspond to the herbarium material, but is one of the Rubiaceae. The wood of A 90 (Yale 20865) is definitely *Sterigmapetalum*, as is also A 142 (Yale 20917) of the Cincinati hills, where its local name is Huesito del Diablo.—S. J. R.

NEW EUPHORBIACEAE FROM THE ISLAND OF MAURITIUS

By Leon Croizat
Arnold Arboretum, Harvard University

Some four years ago the writer received from Dr. R. E. Vaughan of the Royal College at Curepipe, Mauritius, a small but highly valuable collection of Euphorbiaceae. In it is *Croton Bonplandianus* Baill. (*Vaughan 610*), a perennial weed of South American origin, widespread in India (Croizat in Jour. Bombay Nat. Hist. Soc. 41: 573. 1940) and abundant in the lowlands of Mauritius, but as yet unreported for the locality; there is also material of three woody plants. These plants had been collected by Dr. Vaughan within a radius of five miles around the Black River Gorge, where still stand (Vaughan & Wiehe in Jour. Ecol. 25: 294, 342, maps. 1937) the remnants of the primitive upland climax forest once covering nearly the whole of Mauritius. As it is well known (Cordemoy Fl. Réun. xiv–xv. 1895; Vaughan & Wiehe in *op. cit.* 29: 137. 1941), the flora of the East African islands in the vicinity of Madagascar harbors the narrowly localized survivors of an ancient and well diversified plant world. It is not surprising, therefore, that intensive and purposeful exploration should still yield significant botanical discoveries from this region.

Hoping to secure comparative material from the herbaria of Kew, Paris, and Berlin within a reasonable length of time, the writer delayed the study of Dr. Vaughan's collection. This hope having proved futile, not only on account of the prolongation of the war, but also because of the factual or threatened destruction of European herbaria, the writer decided to work out the collection by the slower process of sifting the evidence at hand on the basis of published data. Classic specimens of Mauritian and Bourbonian plants available at the herbarium of the Arnold Arboretum, originally given to the writer by Prof. H. Humbert of the Paris Museum, greatly eased the task of interpreting the literature in the absence of actual *exsiccata* for certain species. It is a tribute to Dr. Vaughan's masterly knowledge of the flora of

Mauritius and to his discrimination as a collector that, barring *C. Bonplandianus*, a puzzling weed indeed, all his collections proved to be the types of unrecorded entities.

CROTON Linnaeus

Croton Vaughanii Croizat, sp. nov.—Arbuscula 4–7 m. alta, cortice (*fide collectoris*) levi griseo, coma patenti. Foliis (*fide collectoris*) integris ovato-rotundatis emarginatis, 9–12 cm. longis, 7–9 cm. latis (in specimine typico folia minora tantum adsunt juvenilia ad 4 cm. magna), venis subtus manifestis subpenninerviis ca. 6-jugis, lamina supra pilis stellatis albidis subargillaceis crebrius adspersa, subtus indumento confertiori subsimili subargillaceo-lepidota, glandulis 2 posticis ovoideis apice foratis, petiolo 1–2 cm. longo, subargillaceo-leproso, stipulis ovoideis atris. Inflorescentiis spicatis vel paniculatim subspicatis 2-sexualibus. Flore ♂: perianthio ca. 5 mm. magno, staminibus 15(16), pedicello ca. 5 mm. longo. Flore ♀ primo intuitu petalifero, petalis quam ovario multo longioribus: perianthio ca. 5 mm. lato, pedicello 5–8 mm. longo, interdum floribus ♂ circumdato, lobis 5 ovato-lanceolatis, ca. 2 mm. longis, petalis oblongis basi barbatis ca. 4 mm. longis, 1–2 mm. latis, disci glandulis 5 oppositilobis, ovario primum conferte tomentello, citrino, ca. 2 mm. magno, demum glabrato sub-3-dymo, stylis ca. 3 mm. longis bis 2-partitis, capsula (*fide collectoris*) 7–8 mm. magna.

Perrier, near the "Mare aux Vacoas," *Vaughan 863*.

The flora of Mauritius and La Réunion numbers under *Croton* several well-known woody exotics (*C. aromaticus* L., *C. lacciferus* L., *C. Tiglium* L.), and five endemics, *C. mauritianus* Lam. (misspelled *C. mauritanicus* by Baker Fl. Maurit. 320. 1877), *C. tiliaefolius* Lam., *C. fothergillaefolius* Baill., *C. grangerioides* Baill., and *C. Boutonianus* Muell.-Arg. The writer has seen authentic material of the first three endemics named, which in no way resemble his new species. According to available descriptions (Mueller-Argoviensis in DC. Prodr. 15(2): 520. 1866; Baker *loc. cit.*), *C. Boutonianus* carries an average of 25 stamens (20–30) in the ♂ flower. *Croton grangerioides*, on its part, is apetalous in the ♀ flower, or bears there only rudimentary ligulae as "petals" (Mueller-Argoviensis in *op. cit.* 584; Baker *loc. cit.*, 321; Léandri in Ann. Mus. Col. Marseilles 47: 36, 40. 1939). Neither of these species can be *C. Vaughanii*, which has no more than 16 stamens and unusually well-developed petals; the descriptions, in addition, clearly indicate that the foliage of *C. Vaughanii* is unlike that of *C. Boutonianus* and *C. grangerioides*. The indumentum of the young parts of this new species is peculiarly subargillaceous, only to some extent suggesting that of **C. Leandri** Croizat, nom. nov. (= *C. arenicola* Léandri in *op. cit.* 57. *Non Small*, 1905), of Madagascar.

CLAOXYLON A. de Jussieu

Claoxylon brachyphyllum Croizat, sp. nov.—Arbor vel frutex magnitudine ignota, floribus ut infra descriptis exceptis totus glaberrimus, cortice juvenili pallido ruguloso. Foliis sub apicem ramulorum confertis, rigidis, adpresso-erectis, 3–5 cm. longis, 2–2.5 cm. latis, lamina levissima luteo-olivacea, coriacea, subnitida, obovata, apice rotundata, basi subauriculato-truncata, margine revoluta, e tertio infero sursum sat distanter crenato-dentata (dentibus cicatricoso-callosis ad 3–4 per cm.), venis adscendentibus penninerviis ca. 5–6 jugis, costa subtus praesertim conspicua, petiolo ca. 0.5 cm. longo, glandulis nullis, stipulis subnullis. Inflorescentiis ♀ tantum notis, rigidis, subfiliformibus, glaberrimis, ad 8 cm. longis, bracteis late triangularibus minimis sub-1-floris. Perianthio ♀ 3-(4)-mero, anthesi vix ineunte ca. 2 mm. magno, lobis carnosulis, late triangularibus, ca. 1.5 mm. longis pilis strigulosis adpressis extus puberulis, petalis carnosis, ellipsoideis, pulchre roseis, ca. 0.7 mm. longis, centro impressis, ovario depresso, trigono, aequo more ac lobis induto, stylis (nondum evolutis) simplicibus vix 0.75 mm. longis, strigulosis.

Near Forest Station at Petrin, *Vaughan 1673*.

Barring mention of an exotic, *C. indicum* Hassk. (= *C. macrophyllum* Boj., *fide* Baker Fl. Maurit. 318. 1877), and an endemic, *C. Mezierii* Bout. ex Boj., Hort. Maurit. 285. 1837 ("Croît dans les forets qui séparent la Montagne Longue de celle de la Nouvelle Découverte, à la Glissoire. Arbuste."), known only as *nomen subnudum*, the flora of Mauritius and

La Réunion (Pax & Hoffm. in Engl. Pflanzenr. 4.147.7: 102–103. 1914) contains nine species of *Claoxylon: C. glandulosum* Baill., *C. grandifolium* Muell.-Arg., *C. parviflorum* A. de Juss., *C. racemiflorum* Baill., *C. dolichostachyum* Cordem., *C. linostachys* Baill., *C. macranthum* Muell.-Arg., *C. submembranaceum* Pax & Hoffm., and *C. Neraudianum* Baill. The writer has seen authentic material of the first four, which are not *C. brachyphyllum*. The next four mentioned are described in terms that do not involve nor even suggest this new species. *Claoxylon Neraudianum* does indeed have small leaves, 7 cm. long, 3.5 cm. broad (Baillon in Adansonia 1: 280. 1861; Mueller-Argoviensis in DC. Prodr. 15(2): 788. 1866; Baker *op. cit.* 318), but they are scabrid and entire. In addition, the rachis is puberulous, the styles plumose, the petals rounded and connate at the base. The sum of these characters argues convincingly against *C. brachyphyllum* and *C. Neraudianum* being conspecific. This new species apparently falls under Sect. *Euclaoxylon* Muell.-Arg., which, like the genus itself, is typified by *C. parviflorum*. Pax & Hoffmann, in *op. cit.* 122; in Engl. & Prantl Nat. Pflanzenf. 19(c): 112, 1931, ignore Mueller's Section, and bring *C. parviflorum* under their own Sect. *Parviflora*, in violations of the Rules of Nomenclature.

CLEIDION Blume

Cleidion (?) cafcaf Croizat, sp. nov. "Bois Caf-caf," Vaughan & Wiehe in Jour. Ecol. 29: 132, 134, 138, 147. 1941.—Arbor tota glaberrima, cortice lenticellato rugoso brunneo. Foliis 4–7 cm. longis, 2.5–4 cm. latis, lamina pallide brunnea, elliptica, firme chartacea ad subcoriacea, haud nitida, apice obtusa, basi latius cuneata, margine distanter crenato-serrata (dentibus ad 3 per 2 cm., apice sub lente subinvoluto-callosis), venis penninerviis alternis subopposi-tisve curvato-adscendentibus ca. 6-jugis, petiolo firmo ca. 0.5–1 cm. longo, apice glandulis anticis 2 subpapillosis in costa ipsa impositis ornato, caeterum glandulis 1–2 laterali-bus obscuris ad limbi basem sitis onusto. Inflorescentia ♂ deflorata tantum visa, habitu cymoso-capitata, gracili, rigida, ca. 5–6 cm. longa. Inflorescentia ♀ ramulum eufoli-

aceum vel bracteiferum lateralem optime terminante, parte florigera vera spicata quam 10 cm. breviore, floribus laterali-bus ca. 6–8, pedicello sat gracili ca. 1–2 cm. longo fultis, flore terminali subsessili (pedicello hoc crasso vix 2 mm. longo, inde flore primo intuitu exacte sessili). Perianthii lobis 5, margine subintegris nonnihil ceraceo-glandulosis, in serie duplici dispositis: externis 3 longius triangularibus ca. 2 mm. longis, reliquis 2 nonnihil minoribus sublineari-acuminatis, ligulis varia ratione dissectis vel subsimplicibus capitato-glandulosis (fere pro staminodiis salutandis) cum lobis al-ternis, disco nullo; ovario glaberrimo subovoideo sub-3-dymo ca. 3 mm. magno, coccis dorso rotundatis, columna stylari basi integra 3 mm. longa, dein in laciniis integerrimis sub-papillosis 3–4 mm. longis evadente, capsula submatura ca. 8 mm. longa, 7 mm. lata, semine submaturo ovoideo brunneo levi, hinc inde striato-maculoso ca. 5 mm. magno, caruncula nulla, raphe evidenti.

Macabé, above the Black River gorges, 550 m. alt., "a tree common in upland climax forest," *Vaughan 1910*.

The generic limits of *Cleidion* Blume, *Macaranga* Thou., *Mallotus* Lour., *Alchornea* Sw., and half a score petty genera in their vicinity, are so hazy that, in a final reckoning, a species falls under the one or the other rather on account of habit and intangibles than because of hard characters. In the absence of ♂ flowers, the crediting of this new species to *Cleidion* rather than to other genera entails an element of pure speculation. The foliage, the glands particularly, of *C. cafcaf* suggest the African species of the genus (*e.g.*, *C. gabonicum* Baill.) better than any species of *Mallotus* or *Macaranga* known from that continent. The habit of the inflorescence is indeed reminiscent of certain species of *Mallotus*, witness the Australian *M. claoxyloides* Muell.-Arg., but *C. cafcaf* bears no resemblance whatever to *M. integrifolius* Muell.-Arg. (treated by some as *Cordemoya integrifolia* Baill.), the lone species of *Mallotus* endemic to Mauritius and La Réunion. The Brazilian *C. tricoccum* Baill. has been recorded in cultivation in Mauritius (Baillon Ét. Gén. Euphorb. 408. 1858; in Adansonia 4: 370. 1864; Mueller-Argoviensis in DC. Prodr. 15(2): 985. 1866), but is certainly not this new species, as classic material shows. The evidence now at hand authorizes the final statement that *C. cafcaf* is an unrecorded species of unsettled position in the general affinity represented by *Cleidion* and *Mallotus*. Its characters suggest those of both genera, the sum of vegetative intangibles, however, favoring *Cleidion*. It might prove to belong to a distinct monotypic genus when the ♂ flower is known.

KEYS TO AMERICAN WOODS (CONTINUED)

By Samuel J. Record

These two keys are the eleventh and twelfth, respectively, in the series begun in *Tropical Woods* No. 72, December 1, 1942. Those in the preceding issues are: (No. 72) I. Ring-porous woods. II. Pores in ulmiform or wavy tangential arrangement. III. Pores in flame-like or dendritic arrangement. (No. 73) IV. Vessels virtually all solitary. V. Vessels with spiral thickenings. (No. 74) VI. Vessels with scalariform perforation plates. VII. Vessels with very fine pitting. (No. 75) VIII. Vessels with opposite or scalariform pitting. IX. Woods with conspicuous rays. (No. 76) X. Woods with storied structure. These keys are intended for use in connection with Record and Hess' *Timbers of the New World* wherein many of the anatomical features are well illustrated by photomicrographs (plates following p. 588).

XI. Woods with resin or gum ducts. These structures are intercellular canals with resinous, gummy, or oily contents. They may be of normal occurrence or traumatic, and either axial (vertical) or radial or both together. Traumatic axial ducts are typically in arcs or concentric series associated with parenchyma cells and their occurrence is sporadic; they are the only kind found in *Abies*, *Sequoia*, and *Tsuga*. Resin ducts are characteristic of *Pinus*, *Picea*, *Pseudotsuga*, and *Larix*, and are in both vertical and horizontal series.

In the Dicotyledons these intercellular canals, commonly called gum ducts, may be either axial or radial, but the two types do not occur in the same specimens, nor even in the same families. The key includes 52 genera of 17 families with

axial ducts and 22 genera of 6 families with ducts in the rays. The latter type is considered of normal occurrence though they do not always characterize every specimen of a species. Most of the others are traumatic, usually of the gummosis type, and when large and conspicuous are frequently called gum veins. In a few instances, *e.g.*, *Copaifera*, *Eperua*, *Prioria*, and *Simaruba*, they are characteristic, but usually they are sporadic. Gum ducts were not found in available material of native species of *Elaeagnus*, but they are common in some exotic species. Axial ducts probably occur in other species of *Zanthoxylum* than the one listed, but the range of variation in the woods of that genus is about as wide as for the entire family Rutaceae.

In some woods there are radial passages or channels which are typically open in dry specimens and without gummy or resinous contents. Their nature is not fully understood, as fresh material has not been available for study, but their position suggests leaf traces. Some of them are small and round, whereas others are large and lenticular (tang. sect.). They are of common occurrence in many genera of Apocynaceae, Euphorbiaceae, and Solanaceae; the same or similar structures have also been found in the Cactaceae, Koeberliniaceae, Thymelaeaceae, and Tiliaceae. Their presence affords a good diagnostic character, but owing to their irregular and often distant spacing they are likely to be absent from small specimens.

XII. Parenchyma reticulate. This key includes American representatives of 161 genera of 97 different families. The families with the most genera are Euphorbiaceae (24), Apocynaceae (15), and Bombacaceae (13). The feature also characterizes at least 21 genera of the Rubiaceae, but they are not treated separately here.

Parenchyma is said to be reticulate when it forms an irregular apotracheal network as seen on cross section, particularly with a hand lens. It merges into abundantly diffuse at one extreme and narrow concentric bands at the other, and the three forms may appear in the same specimen. Also, the irregular lines may be aggregated into loose bands, as in some of the Fagaceae and Sapotaceae. Reticulate parenchyma has proved to be a very useful character in identifying woods. Some of the forms are illustrated in Record and Hess' *Timbers of the New World*, Plates XLI and XLVII.

XI. WOODS WITH RESIN OR GUM DUCTS

1 a. Woods without vessels (Gymnosperms) 2
b. Wood with vessels (Dicotyledons) 10

2 a. Ray tracheids absent or uncommon. Ducts traumatic; axial (vertical) 3
b. Ray tracheids characteristic 4

3 a. Parenchyma strands numerous. Heartwood cherry red to reddish brown . . . . . . *Sequoia* (Taxodiaceae).
b. Parenchyma strands absent or very few. Heartwood brownish. *Abies* (Pinaceae).

4 a. Ducts traumatic; axial . . . . . . *Tsuga* (Pinaceae).
b. Ducts of regular occurrence; both axial and radial 5

5 a. Ducts with all the epithelial cells large and thin-walled 6
b. Ducts with all or nearly all of the epithelial cells small and thick-walled 9

6 a. Ray tracheids with upper and lower walls uniformly thickened. Pits present in the tangential walls of the vertical tracheids of the outer late wood 7
b. Ray tracheids with upper and lower walls irregularly thickened; dentate to reticulate. Tangential walls of the vertical tracheids unpitted 8

7 a. Ray parenchyma cells in early wood with 1 or 2 large simple pits in each cross-field . . . . . . White pines, *e.g.*, *Pinus Strobus* (Pinaceae).
b. Ray parenchyma cells in early wood with 3–6 small pits in each cross-field . . . . . . Foxtail and nut pines, *e.g.*, *P. edulis* (Pinaceae).

8 a. Ray parenchyma cells in early wood with 1 or 2 large simple pits in each cross-field . . . . . . Red or Norway pine, *P. resinosa* (Pinaceae).
b. Ray parenchyma cells in early wood with 3–6 small pits in each cross-field . . . . . . Yellow pines, *e.g.*, *P. caribaea* (Pinaceae).

9 a. Tracheids in early wood with spiral thickenings. *Pseudotsuga* (Pinaceae).
b. Tracheids in early wood without spiral thickenings. *Larix*, *Picea* (Pinaceae).

10 a. Gum ducts axial only 11
b. Gum ducts radial only 56

11 a. Ducts short (cysts) 12
b. Ducts long 13

12 a. Fibers abundantly septate. Small vessels with spirals. Rays heterogenous. Cyst contents yellow. Ripple marks absent. *Cnestidium*, *Connarus* (Connaraceae).

b. Fibers not septate. Vessels without spirals. Rays homogeneous. Cyst contents dark-colored. Ripple marks present. *Poincianella* (Leguminosae).

13 a. Perforations multiple (plates scalariform) 14
b. Perforations simple 15

14 a. Rays 1 or 2 (3) cells wide. Parenchyma sparingly diffuse. Vessels often with spirals in tips of members; pitting opposite to scalariform . . . . . . *Liquidambar* (Hamamelidaceae).
b. Rays 1–4 (7) cells wide. Parenchyma diffuse to reticulate. Vessels without spirals; pitting alternate . . . . . . *Styrax* (Styracaceae).

15 a. Vessels with spiral thickenings 16
b. Vessels without spiral thickenings 18

16 a. Pores medium-sized in part; late-wood pores and parenchyma in flame-like or zigzag pattern. Parenchyma not terminal. Fiber pits simple or indistinctly bordered . . . . . . *Fremontia* (Sterculiaceae).
b. Pores all small to minute; not in distinctive pattern. Parenchyma terminal in part 17

17 a. Fibers with very thick walls and minute simple pits. Vasicentric tracheids present. Ripple marks poorly defined. *Castela* (Simarubaceae).
b. Fibers with medium walls and distinctly bordered pits. Vasicentric tracheids absent. Ripple marks absent. *Prunus serotina* (Rosaceae).

18 a. Vessel-ray pitting coarse to very coarse and irregular, at least in part 19
b. Vessel-ray pitting very fine to medium 26

19 a. Parenchyma apparently absent or finely terminal. Intervascular pitting opposite. Ripple marks absent. Density high. *Sloanea* (Elaeocarpaceae).
b. Parenchyma abundant. Intervascular pitting alternate. Ripple marks present or absent 20

20 a. Parenchyma reticulate, at least in part. Density low to very low. 21
b. Parenchyma banded; not reticulate. Density medium to high . . 25

21 a. Septate fibers abundant. Ripple marks present 22
b. Septate fibers absent or few 24

22 a. Heartwood dark red or reddish brown, suggesting *Cedrela;* distinct from the sapwood. Texture medium, uniform; not stringy. *Bombacopsis* (Bombacaceae).
b. Heartwood dull grayish brown; not distinct from the sapwood. Texture very coarse and stringy 23

23 a. Consistency fairly uniform. Feel harsh . . . . . . *Pachira* (Bombacaceae).
b. Consistency not uniform, as early wood is generally much softer than late wood. Color somewhat lighter, pores larger, feel less harsh . . . . . . *Bombax* (Bombacaceae).

24 a. Ripple marks present; parenchyma cells in secondary seriation (200–220 markings per inch), distinct with lens. Wood fibers small, comparatively few, and often diffuse or in diffuse aggregates except in outer part of growth ring.
Cavanillesia (Bombacaceae).

b. Ripple marks absent. Wood fibers large and composing most of the ground mass . . . . *Ochroma* (Bombacaceae).

25 a. Ripple marks present; parenchyma cells often in secondary seriation. Parenchyma bands irregular in width and spacing; marginal crystalliferous strands absent. Intervascular pitting fine.
Catostemma, *Scleronema* (Bombacaceae).

b. Ripple marks absent. Parenchyma bands fairly uniform in width and spacing, often very numerous; marginal crystalliferous strands present. Intervascular pitting coarse.
Cariniana, *Eschweilera*, *Lecythis* (Lecythidaceae).

26 a. Vessel pits very small (not over 4μ) 27
b. Vessel pits larger 36

27 a. Oil cells present in the rays. Parenchyma sparingly paratracheal; not in bands . . . . *Euxylophora* (Rutaceae).
b. Oil cells absent. Parenchyma in terminal bands and otherwise . . 28

28 a. Gum ducts large and distinct. Largest pores distinct without lens. Fibers septate. Heartwood salmon, red, or brown 29
b. Gum ducts small. Largest pores not distinct without lens. Fibers not septate. Heartwood yellowish (exc. *Ravenia*) 30

29 a. Ripple marks usually present. Parenchyma bands uniform. Luster high, golden . . . . *Swietenia* (Meliaceae).
b. Ripple marks absent. Parenchyma less uniform. Luster only occasionally high and golden . . . . *Carapa* (Meliaceae).

30 a. Pores all very small to small (40–60μ); thick-walled 31
b. Pores larger (80–120μ); walls medium to thin 33

31 a. Rays 1–5 (6) cells wide and up to 60 cells high. *Pilocarpus* (Rutaceae).
b. Rays 1 or 2 (3) cells wide and less than 25 cells high 32

32 a. Rays with many upright cells. Parenchyma aliform in part. Heartwood pinkish or roseate brown . . . . *Ravenia* (Rutaceae).
b. Rays with square, but few upright, cells. Parenchyma not aliform. Heartwood yellowish . . . . *Helietta* (Rutaceae).

33 a. Rays 1 or 2 (3) cells wide and up to 20 (30) cells high; homogeneous or nearly so. Parenchyma sparse. Fibers with large lumen.
Zanthoxylum panamense (Rutaceae).
b. Rays 1–3 (6) cells wide and up to 25 (60) cells high; heterogeneous, at least in part. Parenchyma usually abundant. Fibers with small to minute lumen 34

34 a. Crystalliferous parenchyma cells globose. Parenchyma abundantly aliform and confluent. Rays without definitely upright cells . . . . *Citrus* (Rutaceae).

b. Crystalliferous parenchyma cells cubical. Parenchyma not abundantly aliform and confluent 35

35 a. Rays with few or no definitely upright cells.
Balfourodendron (Rutaceae).
b. Rays with numerous definitely upright cells.
Esenbeckia, *Metrodorea* (Rutaceae).

36 a. Ripple marks present, but not always clearly defined 37
b. Ripple marks absent 41

37 a. Rays in part large and conspicuous; up to 9 (20) cells wide and 200 (300) cells high 38
b. Rays not large, though often distinct; 1–6 cells wide and not over 100 cells high 39

38 a. Parenchyma reticulate. Pores small . . . . . *Theobroma* (Sterculiaceae).
b. Parenchyma coarsely paratracheal and confluent. Pores large in part . . . . *Basiloxylon*, *Sterculia* (Sterculiaceae).

39 a. Parenchyma conspicuous in irregular bands composing one-third to two-thirds of the ground mass. Fiber walls very thick. Vessel pits vestured. Rays up to 35 cells high . . . . . . *Andira* (Leguminosae).
b. Parenchyma not conspicuous. Fiber walls thin to medium. Vessel pits not vestured 40

40 a. Rays up to 100 cells high; sheath cells present. Parenchyma vasicentric to locally aliform. Gum ducts rare. Ripple marks 70–100 per inch. Heartwood olive to purplish . . . . *Hibiscus* (Malvaceae).
b. Rays generally less than 30 cells high; without sheath cells. Parenchyma long-aliform and confluent into narrow, irregular bands. Gum ducts common. Ripple marks 50–80 per inch. Heartwood yellowish . . . . *Simaruba* (Simarubaceae).

41 a. Rays all uniseriate or partially biseriate
Buchenavia, *Terminalia* (Combretaceae).
b. Rays often biseriate or wider 42

42 a. Fibers septate, at least in part 43
b. Fibers not septate 44

43 a. Parenchyma aliform in part. Heartwood not fragrantly scented; density medium . . . . *Senegalia* (Leguminosae).
b. Parenchyma not aliform. Heartwood fragrantly scented (cedary); density low . . . . *Cedrela* (Meliaceae).

44 a. Pores in part large (200μ or more). Tyloses often present in heartwood 45
b. Small to medium-sized (up to 150μ). Tyloses absent 48

45 a. Rays commonly with sheath cells and large interior cells. Fusiform parenchyma cells common. Vessel pits not vestured.
Cordia (Boraginaceae).
b. Rays without distinct sheath cells or large interior cells. Fusiform parenchyma cells absent or rare. Vessel pits vestured 46

46 a. Rays 2-sized, the larger 4 or 5 (8) cells wide and up to 40 (100)

cells high; heterogeneous . . . . *Vochysia* (Vochysiaceae).
b. Rays 1-3 (4) cells wide and infrequently up to 30 cells high; not distinctly 2-sized 47
47 a. Rays homogeneous . . . . *Qualea* (Vochysiaceae).
b. Rays heterogeneous . . . . *Salvertia* (Vochysiaceae).
48 a. Rays commonly with enlarged interior cells (tang. sect.) 49
b. Rays without enlarged interior cells 50
49 a. Rays with sheath cells; enlarged interior cells not crystalliferous. Vessel pits not vestured. Tyloses abundant in heartwood. *Cordia* (Boraginaceae).
already sorted on "Tyloses absent"
b. Rays without sheath cells; enlarged interior cells containing 1 to several crystals. Vessel pits vestured. Tyloses absent. *Bucida* (Combretaceae).
50 a. Gum ducts characteristic; exudations usually conspicuous 51
b. Gum ducts traumatic and of infrequent occurrence; exudations absent or not conspicuous 53
51 a. Ducts irregularly diffuse; resembling pores under lens; gummy exudations copious. Heartwood light to dark brown, often streaked; density medium . . . . *Prioria* (Leguminosae).
b. Ducts typically in tangential or concentric series 52
52 a. Rays 1-3 (4) cells wide and up to 40 (70) cells high. Ducts small; oily exudations not copious. Heartwood reddish brown, often with a coppery hue; sp. gr. (air-dry) 0.70-0.90 . . *Copaifera* (Leguminosae).
b. Rays 1-6, mostly 3 or 4, cells wide and up to 60 (100) cells high. Ducts rather large; oily exudations copious. Heartwood dull red to purplish brown; sp. gr. (air-dry) 0.75-1.04. *Eperua* (Leguminosae).
53 a. Parenchyma not distinct without lens. Fibers with starch in sapwood. More or less ring-porous. Heartwood orange. *Cercidiopsis* (Leguminosae).
b. Parenchyma fairly distinct without lens. Diffuse-porous 54
54 a. Heartwood yellow. Rays infrequently over 20 cells high. Pores not visible without lens. Fibers with starch in sapwood. *Diplokeleba* (Sapindaceae).
b. Heartwood not yellow. Rays frequently 40 or more cells high. Pores visible without lens. Fibers without starch 55
55 a. Heartwood russet to reddish brown, more or less streaked. *Hymenaea* (Leguminosae).
b. Heartwood grayish brown when fresh, becoming purplish brown to deep violet . . . . *Peltogyne* (Leguminosae).
56 a. Parenchyma abundant; diffuse, reticulate, or in bands. Fibers not septate 57
b. Parenchyma sparse; sometimes narrowly vasicentric. Fibers usually septate (exceptions below) 60
57 a. Parenchyma diffuse and sparingly paratracheal. Fibers with distinctly bordered pits. Ray-vessel pitting coarse. *Mammea* (Guttiferae).

b. Parenchyma otherwise. Fibers with simple or indistinctly bordered pits 58
58 a. Parenchyma aliform and confluent. Vessel-ray pitting fine. *Rheedia* (Guttiferae).
b. Parenchyma in apotracheal bands. Vessel-ray pitting coarse 59
59 a. Fibers thick-walled. Pores large. Ductless rays 1 or 2 (3) cells wide and up to 50 cells high. Ripple marks absent. *Moronobea* (Guttiferae).
b. Fibers thin-walled. Pores medium-sized. Ductless rays 1-4 or more cells wide and up to 100 or more cells high. Ripple marks present . . . . *Cochlospermum* (Cochlospermaceae).
60 a. Duct-bearing rays similar in shape (tang. sect.) to other multiseriate rays 61
b. Duct-bearing rays locally enlarged about ducts (tang. sect.) 64
61 a. Vessel perforations multiple, at least in part. *Dendropanax*, *Didymopanax Oreopanax* (Araliaceae).
b. Vessel perforation simple 62
62 a. Uniseriate rays numerous. Pores 3-9 per sq. mm. *Spondias* (Anacardiaceae).
b. Uniseriate rays few. Pores 20-35 per sq. mm. 63
63 a. Intervascular pitting fairly uniform; alternate. Rays 1-4 (5) cells wide . . . . *Bursera* (Burseraceae).
b. Intervascular pitting irregular; opposite to scalariform. Rays sometimes 6-8 cells wide. *Didymopanax*, *Oreopanax*, *Sciadodendron* (Araliaceae).
64 a. Vessel perforations multiple in part; scalariform plates with numerous narrow bars . . . . *Campnosperma* (Anacardiaceae).
b. Vessel perforations simple 65
65 a. Pores in ulmiform or wavy tangential arrangement. Vessels with spirals . . . . *Schinus* (Anacardiaceae).
b. Pores not so arranged. Vessels mostly without spirals (exceptions below) 66
66 a. Fibers non-septate 67
b. Fibers septate, at least in part 68
67 a. Vessels with spirals, at least in part. More or less distinctly ring-porous . . . . *Rhus* (Anacardiaceae).
b. Vessels without spirals. Diffuse-porous . . . *Malosma* (Anacardiaceae).
68 a. Rays 10 or more per mm. (tang. sect.) 69
b. Rays 3-7 per mm. (tang. sect.) 71
69 a. Ductless rays all uniseriate or uniseriate and biseriate. Tyloses absent or few. Heartwood orange-brown . . *Tetragastris* (Burseraceae).
b. Ductless rays 1-3, in some instances 4 or 5, cells wide. Tyloses abundant. Color reddish, uniform or with dark streaks 70
70 a. Solitary pores 3-7 times as numerous as the multiples. Wood of flinty hardness in cutting across the grain. *Schinopsis* (Anacardiaceae).

b. Solitary pores usually fewer than the multiples. Wood not difficult to cut across the grain .... *Astronium* (Anacardiaceae).

71 a. Ductless rays 1–6, mostly 4 or 5, cells wide.. *Juliania* (Julianiaceae).
b. Ductless rays 1 or 2 (3) cells wide 72

72 a. Parenchyma sparingly vasicentric and locally confluent; also finely terminal. Fiber walls thick .... *Metopium* (Anacardiaceae).
b. Parenchyma very sparse; not confluent or terminal. Fiber walls medium to thin 73

73 a. Pores 20–35 per sq. mm. Vessels with spirals. Ducts inconspicuous. Heartwood dull red .... *Schinus* (Anacardiaceae).
b. Pores 6–15 per sq. mm. Vessels without spirals. Ducts conspicuous because of dark exudations. Wood lustrous 74

74 a. Pores small. Heartwood pinkish .... *Tapirira* (Anacardiaceae).
b. Pores medium-sized in part. Heartwood brown or reddish brown, with dark laminations or streaks of varying width and regularity. *Loxopterygium* (Anacardiaceae).

XII. PARENCHYMA RETICULATE

1 a. Vessels virtually all solitary (pores rarely in contact radially) 2
b. Vessels not all solitary 58

2 a. Stems with included phloem .... *Doliocarpus* (Dilleniaceae).
b. Stems without included phloem 3

3 a. Woods with storied structure 4
b. Woods without storied structure 8

4 a. Ripple marks uniform and very fine (220–280 per inch); all elements storied. Density very high 5
b. Ripple marks irregular and not very fine; larger rays not storied. Density low 7

5 a. Rays uniseriate and one-storied. Pores in flame-like or dendritic arrangement .... *Porlieria Lorentzii* (Zygophyllaceae).
b. Rays frequently or mostly biseriate and more than one-storied... 6

6 a. Pores numerous; fairly evenly distributed without pattern. Enlarged crystalliferous parenchyma cells numerous. *Larrea* (Zygophyllaceae).
b. Pores few, the smaller ones tending to radial arrangement. Crystalliferous parenchyma cells apparently absent. *Bulnesia retama* (Zygophyllaceae).

7 a. Rays homogeneous or nearly so .... *Muntingia* (Elaeocarpaceae).
b. Rays definitely heterogeneous .... *Dicraspidia* (Elaeocarpaceae).

8 a. Rays in part large (usually more than 7 cells wide) and conspicuous 9
b. Rays not conspicuous, though often distinct 15

9 a. Perforations predominantly simple. Vasicentric tracheids abundant. Rays homogeneous .... *Lithocarpus*, *Quercus* (Fagaceae).

b. Perforations exclusively multiple. Vasicentric tracheids absent. Rays heterogeneous 10

10 a. Conspicuous rays few and consisting of aggregates of rays 3–5 (7) cells wide; other rays 1–3 (5) cells wide; vessel-ray pitting very fine .... *Kalmia* (Ericaceae).
b. Conspicuous rays numerous and solid 11

11 a. Rays not over 8 cells wide. Heartwood brown or reddish 12
b. Rays frequently more than 8, sometimes up to 20, cells wide. Heartwood yellowish 13

12 a. Rays less than 50 cells high; pits to vessels very small and opposite, sometimes narrowly elongated and parallel. *Cyrilla* (Cyrillaceae).
b. Rays up to 100, sometimes over 200, cells high; pits to vessels small, rounded, irregularly arranged....... *Ternstroemia* (Theaceae).

13 a. Vessel-ray pitting fine, alternate .... *Ottoschulzia* (Icacinaceae).
b. Vessel-ray pitting coarse, at least in part 14

14 a. Vessel-ray pitting opposite .... *Villaresia* (Icacinaceae).
b. Vessel-ray pitting mostly scalariform. *Metteniusa*, *Poraqueiba* (Icacinaceae).

15 a. Perforations exclusively or predominantly simple 16
b. Perforations exclusively or predominantly multiple 44

16 a. Vessel pits vestured 17
b. Vessel pits not vestured 27

17 a. Rays homogeneous or weakly heterogeneous 18
b. Rays definitely heterogeneous, at least in part 23

18 a. Rays not over 2 cells wide 19
b. Rays 1–4 (5) cells wide 22

19 a. Pores medium-sized in part. Enlarged parenchyma cells common. *Geissospermum sericeum* (Apocynaceae).
b. Pores all small to minute. Enlarged parenchyma cells absent... 20

20 a. Rays nearly all biseriate; height up to 20 (25) cells. *Aspidosperma peroba* (Apocynaceae).
b. Rays often uniseriate; height up to 40 cells 21

21 a. Stems deeply sulcate........ *Aspidosperma excelsum* (Apocynaceae).
b. Stems not sulcate. *Aspidosperma Curranii*, *A. domingensis* (Apocynaceae).

22 a. Rays up to 15 (25) cells high; uniseriates few. *Aspidosperma quebracho-blanco* (Apocynaceae).
b. Rays up to 40 (70) cells high; uniseriates numerous. *Campomanesia* (Myrtaceae).

23 a. Fibers with large bordered pits 24
b. Fibers with small bordered pits 26

24 a. Vasicentric tracheids absent .... *Vallesia* (Apocynaceae).
b. Vasicentric tracheids present 25

25 a. Vessels with spirals .... *Myrceugenia* (Myrtaceae).
b. Vessels without spirals .... *Eugenia* (Myrtaceae).

26 a. Rays 1 or 2 (3) cells wide and less than 40 cells high .... Rubiaceae.
b. Rays 1–5 (7) cells wide and up to 100 (200) cells high.
Elvasia, Ouratea (Ochnaceae).

27 a. Rays homogeneous or weakly heterogeneous 28
b. Rays distinctly heterogeneous, at least in part 34

28 a. Vasicentric tracheids abundant .... *Lithocarpus, Quercus* (Fagaceae).
b. Vasicentric tracheids apparently absent 29

29 a. Vessels and fibers with spirals 30
b. Vessels and fibers without spirals 31

30 a. Pores crowded, at least in early wood, becoming gradually smaller and less closely spaced during season's growth.
Heteromeles (Rosaceae).
b. Pores rather widely spaced, the larger ones scattered irregularly among the others .... *Cercocarpus* (Rosaceae).

31 a. Fiber pits indistinctly bordered. Rays 1–4 (5) cells wide and up to 65 cells high. Heartwood bright yellow.
Schaefferia (Celastraceae).
b. Fiber pits distinctly bordered. Rays 1 or 2 (3 or 4) cells wide and up to 15 (40) cells high 32

32 a. Vessel-ray pitting medium. Heartwood brown. *Crataegus* (Rosaceae).
b. Vessel-ray pitting very fine 33

33 a. Rays nearly all biseriate. Fiber pits rather large and few. Heartwood orange-yellow .... *Agonandra* (Olacaceae).
b. Rays 1–3 (4) cells wide, the uniseriates fairly numerous. Fiber pits small, very numerous. Heartwood dark brown, appearing oily or waxy .... *Rochefortia* (Boraginaceae).

34 a. Vessel-ray pitting very fine to medium 35
b. Vessel-ray pitting moderately to very coarse 42

35 a. Vessels with spirals 36
b. Vessels without spirals 37

36 a. Fibers with spirals.
Amelanchier, Lyonothamnus, Osteomeles (Rosaceae).
b. Fibers without spirals .... *Kageneckia* (Rosaceae).

37 a. Tall upright ray cells numerous. Fibers very thick-walled, at least in part 38
b. Tall upright cells absent or few. Fibers with thin to moderately thick walls 41

38 a. Pores medium-sized; diffuse-porous .... *Lacunaria* (Quiinaceae).
b. Pores very small to minute 39

39 a. Pores rather few; larger ones widely separated in a ring at beginning of season's growth. Rays 1–3 (4) cells wide. . *Quillaja* (Rosaceae).
b. Pores numerous; fairly uniform in size and distribution. Rays 1 or 2 cells wide 40

40 a. Vessel-ray pitting fine. Perforations all simple.
Rhacoma (Celastraceae).
b. Vessel-ray pitting coarse, often scalariform. Perforations sometimes multiple .... *Cassipourea* (Rhizophoraceae).

41 a. Diffuse-porous. Vessel-ray pitting medium ..... *Polylepis* (Rosaceae).
b. More or less ring-porous. Vessel-ray pitting fine.
Eriodictyon, Nama (Hydrophyllaceae).

42 a. Rays mostly 2 or 3 cells wide; pits to vessels distinctly 2-sized. Perforations all simple. Heartwood yellow .... *Liriosma* (Olacaceae).
b. Rays distinctly 2-sized, the larger 3–6 (7) cells wide. Perforations multiple in part. Heartwood brown or reddish brown 43

43 a. Pores medium-sized to large. Multiseriate rays with many long procumbent cells; pits to vessels large.
Hieronyma (Euphorbiaceae).
b. Pores small. Multiseriate rays with rather short procumbent cells; pits to vessels small and opposite to elongated and parallel.
Schizocardia (Clethraceae).

44 a. Vessel-ray pitting fine to medium; not scalariform 45
b. Vessel-ray pitting typically coarse; often scalariform 52

45 a. Rays homogeneous or with very few upright cells 46
b. Rays heterogeneous, typically with many upright cells 47

46 a. Rays mostly biseriate. Vessels with spirals, at least in tips of members. Oil cells absent ...... *Symplocos tinctoria* (Symplocaceae).
b. Rays all uniseriate or partially biseriate. Vessels without spirals. Oil cells present in parenchyma strands.
Capsicodendron (Canellaceae).

47 a. Perforation plates short-oval, with less than 15 bars 48
b. Perforation plates long, with very many bars 49

48 a. Perforations simple in part. Uniseriate rays composed mostly of square cells .... *Myrica* (Myricaceae).
b. Perforations all multiple. Uniseriate rays composed mostly of tall upright cells .... *Escallonia* (Escalloniaceae).

49 a. Multiseriate parts of rays fine-celled (tang. sect.); pits to vessels small. Fibers small 50
b. Multiseriate parts of rays coarse-celled (tang. sect.); pits to vessels medium-sized. Fibers large 51

50 a. Rays 1 or 2 cells wide; slender procumbent cells few or absent.
Viburnum (Caprifoliaceae).
b. Rays up to 6 cells wide; slender procumbent cells numerous.
Clethra (Clethraceae).

51 a. Rays 1–3 (4) cells wide and 25 (75) cells high; with fairly definite strata of procumbent cells; crystals apparently absent.
Styloceras (Buxaceae).
b. Rays 1–5 (6) cells wide and up to 100 or more cells high; without definite strata of procumbent cells; crystals numerous.
Calatola (Icacinaceae).

52 a. Largest rays 4–6 (8) cells wide 53
b. Largest rays 2 or 3 (4) cells wide 54

53 a. Multiseriate rays with strata of long procumbent cells; sheath cells absent; vessel-ray pitting scalariform.
Symplocos (Symplocaceae).
b. Multiseriate rays without strata of long procumbent cells; sheath cells present; vessel-ray pitting opposite to scalariform.
Viburnum (Caprifoliaceae).

54 a. Multiseriate rays without strata of long procumbent cells.
Heisteria (Olacaceae).
b. Multiseriate rays with strata of long procumbent cells 55

55 a. Ray-vessel pitting in part rather fine and opposite, in part finely scalariform .... *Myrceugenia apiculata* (Myrtaceae).
b. Ray-vessel pitting nearly all coarsely scalariform 56

56 a. Growth rings clearly defined.
Caldcluvia, *Weinmannia* (Cunoniaceae).
b. Growth rings absent or poorly defined 57

57 a. Pores very small to minute .... *Laplacea semiserrata* (Theaceae).
b. Pores medium-sized .... *Laplacea Brenesii* (Theaceae).

58 a. Woods with storied structure 59
b. Woods without storied structure 75

59 a. Vessel pits vestured .... *Dalbergia* (Leguminosae).
b. Vessel pits not vestured 60

60 a. Rays with small tile cells 61
b. Rays without small tile cells 62

61 a. Rays in part conspicuous. Vessel pits minute.
Guazuma (Sterculiaceae).
b. Rays not conspicuous. Vessel pits small .... *Luehea* (Tiliaceae).

62 a. Vessels with spirals .... *Tilia* (Tiliaceae).
b. Vessels without spirals 63

63 a. Woods with narrow to wide bands of unlignified (cottony) parenchyma, the cells elongated radially .... *Apeiba* (Tiliaceae).
b. Woods without such bands 64

64 a. Fiber pits with large borders; few. Ripple marks about 130 per inch .... *Gaiadendron* (Loranthaceae).
b. Fiber pits with small borders or simple; often numerous. Ripple marks less than 100 per inch 65

65 a. Vessel-ray pitting coarse to very coarse 66
b. Vessel-ray pitting fine to medium 70

66 a. Septate fibers abundant 67
b. Septate fibers absent or few 68

67 a. Heartwood rich reddish brown; distinct.
Bombacopsis (Bombacaceae).
b. Heartwood dull brown, merging into sapwood.
Bombax, *Pachira* (Bombacaceae).

68 a. Parenchyma cells flattened radially; in irregular uniseriate rows in a ground mass of rather large thin-walled fibers. Rays all multiseriate; cells not distinctly 2-sized (tang. sect.).
Bernoullia (Bombacaceae).
b. Parenchyma cells not flattened; fibers small, often thick-walled, and arranged in narrow bands or diffuse aggregates separated by much coarser bands of parenchyma. Ray cells distinctly 2-sized (tang. sect.) 69

69 a. Fibers comparatively few and often diffuse or in diffuse aggregates except in outer part of growth ring. Rays nearly all multiseriate .... *Cavanillesia* (Bombacaceae).
b. Fibers numerous in irregular bands throughout growth ring. Uniseriate rays common .... *Ceiba*, *Chorisia* (Bombacaceae).

70 a. Largest rays often more than 8, sometimes up to 20, cells wide 71
b. Largest rays rarely up to 8, sometimes only 1 or 2, cells wide 72

71 a. Pores small. Vessel pitting medium .... *Theobroma* (Sterculiaceae).
b. Pores medium-sized. Vessel pitting very fine .... *Goethalsia* (Tiliaceae).

72 a. Rays with sheath cells 73
b. Rays without sheath cells 74

73 a. Fibers with very thin walls. Heartwood yellowish brown or pinkish .... *Hampea* (Bombacaceae).
b. Fibers with medium to thick walls. Heartwood reddish brown or chocolate .... *Montezuma*, *Thespesia* (Malvaceae).

74 a. Pores rather few, variable in size; walls very thick. Fibers thick-walled. Rays one-storied .... *Diospyros virginiana* (Ebenaceae).
b. Pores numerous, fairly uniform in size; walls rather thin. Fibers thin-walled. Rays frequently more than one-storied .... *Bixa* (Bixaceae).

75 a. Perforations exclusively or predominantly multiple (plates scalariform) 76
b. Perforations exclusively or predominantly simple 87

76 a. Fiber pits inconspicuous 77
b. Fiber pits conspicuous 80

77 a. Perforation plates with numerous closely spaced bars. Intervascular pitting fine, opposite .... *Lacistema* (Lacistemaceae).
b. Perforation plates with few to several widely spaced bars. Intervascular pitting alternate 78

78 a. Intervascular pitting coarse. Rays 1 or 2 cells wide; pits to vessels very large, oval to elongated .... *Minquartia* (Olacaceae).
b. Intervascular pitting not coarse. Rays 1–4 (7) cells wide 79

79 a. Vessel-ray pitting all fine. Pores medium-sized in part. Perforations all multiple .... *Styrax* (Styracaceae).
b. Vessel-ray pitting coarse in part. Pores small. Perforations simple in part .... *Siparuna* (Monimiaceae).

80 a. Rays uniseriate or biseriate; cells nearly all square or upright 81
b. Rays 2-sized; procumbent cells numerous 82

81 a. Pores medium-sized. Perforation plates with numerous, closely spaced bars; intervascular pits large, opposite. Rays very high and very closely spaced. Fiber pitting apparently limited to parenchyma cells. . . . . *Peridiscus* (Flacourtiaceae).
b. Pores very small. Perforation plates with several, widely spaced bars; intervascular pits very small, alternate. Rays typically less than 30 cells wide; not very closely spaced. Fiber pitting not limited to parenchyma cells. . . . . *Pamphilia* (Styracaceae).

82 a. Pores frequently in radial multiples of 3–5 or more. 83
b. Pores infrequently in radial multiples. 85

83 a. Largest rays 6, sometimes up to 10, cells wide. Spirals present in vessels and fibers of temperate species. Heartwood chalky or bluish white. . . . . *Ilex* (Aquifoliaceae).
b. Largest rays 3 or 4 cells wide. Spirals absent. Heartwood pale brown with reddish tinge. 84

84 a. Intervascular pitting scalariform. Rays with distended crystalliferous cells. Pores uniformly distributed. *Aextoxicon* (Aextoxicaceae).
b. Intervascular pitting alternate to opposite; not scalariform. Rays without distended crystalliferous cells. Pores more numerous in early wood. . . . . *Halesia* (Styracaceae).

85 a. Perforation plates long. Pores small. Rays frequently with sheath cells; procumbent cells rather large. Heartwood yellowish. *Styloceras* (Buxaceae).
b. Perforation plates mostly short. Pores very small. Rays without sheath cells; procumbent cells small. Heartwood pale reddish brown. 86

86 a. Pores crowded. Vessel-ray pitting scalariform in part. Vessels and fibers without spirals. . . . . . *Myrceugenia apiculata* (Myrtaceae).
b. Pores not crowded. Vessel-ray pitting not scalariform. Vessels and fibers often with spirals. . . . . *Escallonia* (Escalloniaceae).

87 a. Intervascular pitting very fine (pits not over 4μ in diam.). 88
b. Intervascular pitting not very fine; sometimes very coarse. 109

88 a. Rays in part large and conspicuous. 89
b. Rays not conspicuous, though often distinct. 91

89 a. Rays with tile cells. . . . . *Mortoniodendron* (Tiliaceae).
b. Rays without tile cells. 90

90 a. Vessel-ray pitting all very fine. . *Matisia, Quararibea* (Bombacaceae).
b. Vessel-ray pitting 2-sized: very fine and coarse. *Gustavia* (Lecythidaceae).

91 a. Fibers with large bordered pits. 92
b. Fibers without large bordered pits. 95

92 a. Fibers with very thick walls and minute lumen. Radial channels absent. Heartwood dark olive-brown. . . . . . *Lacunaria* (Quiinaceae).
b. Fibers with thin to medium walls and large lumen. Radial channels common. Heartwood yellowish. 93

93 a. Rays 1–5 cells wide and 20 (40) cells high. Pores mostly not in radial multiples. . . . . *Rauwolfia* (Apocynaceae).
b. Rays 1 or 2 (3) cells wide. Pores mostly in radial multiples of 2–6. 94

94 a. Rays up to 20 (40) cells high; mostly uniseriate. *Zschokkea* (Apocynaceae).
b. Rays up to 80 cells high; mostly biseriate. *Malouetia* (Apocynaceae).

95 a. Vessel-ray pitting distinctly 2-sized: fine and coarse. 96
b. Vessel-ray pitting all fine, though sometimes unilaterally compound. 97

96 a. Vasicentric tracheids present. Rays typically uniseriate. Heartwood yellowish. . . . . *Cathedra, Ptychopetalum* (Olacaceae).
b. Vasicentric tracheids absent. Rays 1–3 cells wide. Heartwood reddish or purplish. . . . . *Erythroxylon* (Erythroxylaceae).

97 a. Fiber pits rather small, but distinctly bordered. 98
b. Fiber pits very small, simple or indistinctly bordered. 102

98 a. Pores all very small to minute. . . . . Rubiaceae.
b. Pores medium-sized in part. 99

99 a. Parenchyma banded in part. 100
b. Parenchyma not banded. 101

100 a. Fibers with thin to medium walls and rather large lumen. Rays in part with latex tubes. Heartwood pale brown. *Hancornia* (Apocynaceae).
b. Fibers with very thick walls and minute lumen. Rays without latex tubes. Heartwood dark brown. . . . . *Cameraria* (Apocynaceae).

101 a. Rays 1 or 2 (3) cells wide; not distinctly 2-sized; vessel-ray pitting often unilaterally compound. . . . . . *Ambelania acida* (Apocynaceae).
b. Rays 1–5 (6) cells wide; distinctly 2-sized; vessel-ray pitting not unilaterally compound. . . . . *Erblichia* (Turneraceae).

102 a. Uniseriate rays few. 103
b. Uniseriate rays numerous. 104

103 a. Rays mostly 2 or 3 cells wide and up to 50 (100) cells high; cells nearly all square or upright; vessel-ray pitting unilaterally compound. Pores often in long radial multiples. *Anacampta* (Apocynaceae).
b. Rays mostly 3 or 4 (5) cells wide and less than 25 (40) cells high; many cells procumbent, few upright; vessel-ray pitting not unilaterally compound. Pores mostly solitary, often tangentially arranged. . . . . *Bourreria* (Boraginaceae).

104 a. Rays distinctly 2-sized, the larger ones 3–5 (8) cells wide; vessel-ray pitting unilaterally compound. . . . . . *Tapura* (Dichapetalaceae)
b. Rays 1 or 2 (3) cells wide; not distinctly 2-sized; vessel-ray pitting not unilaterally compound. 105

105 a. Procumbent ray cells few. 106

b. Procumbent ray cells numerous 108

106 a. Pores very small and very numerous; mostly in long radial rows. *Savia* (Euphorbiaceae).
b. Pores medium-sized in part; not very numerous; solitary and in small multiples 107

107 a. Parenchyma lines 1–3 fiber-widths apart. . *Amanoa* (Euphorbiaceae).
b. Parenchyma lines 1 or 2 pore-widths apart. . *Diospyros* (Ebenaceae).

108 a. Pores small to minute. Perforations exclusively simple. Rays up to 15 (30) cells high .... *Malpighia* (Malpighiaceae).
b. Pores up to medium-sized. Perforations multiple in part. Rays up to 50 (100) cells high .... *Drypetes* (Euphorbiaceae).

109 a. Rays conspicuous 110
b. Rays not conspicuous, though often distinct 116

110 a. More or less ring-porous; late-wood pores in dendritic or ulmiform pattern 111
b. Diffuse-porous; late-wood pores not in distinctive pattern 112

111 a. Vessels with spirals. Ray cells mostly procumbent. *Fremontia* (Sterculiaceae).
b. Vessels without spirals. Ray cells mostly square or upright. *Fouquieria* (Fouquieriaceae).

112 a. Rays with large tile cells. Fiber walls very thin. *Ochroma* (Bombacaceae).
b. Rays without tile cells. Fiber walls not very thin 113

113 a. Vessel-ray pitting rather fine. Raphides common in parenchyma cells .... *Morinda* (Rubiaceae).
b. Vessel-ray pitting coarse, at least in part. Raphides absent 114

114 a. Cells of multiseriate rays rounded and fairly uniform (tang. sect.); uniseriate rays few. Fibers with very thick walls. *Grias* (Lecythidaceae).
b. Cells of multiseriate rays irregular in form (tang. sect.); uniseriate rays numerous 115

115 a. Pores large in part; scattered. Fibers with medium walls and rather large lumen...... *Gyranthera*, *Huberodendron* (Bombacaceae).
b. Pores small to nearly medium-sized; fairly numerous. Fibers with very thick walls and small lumen.......... *Discophora* (Icacinaceae).

116 a. Pores in distinctive diagonal, flame-like, or dendritic pattern 117
b. Pores not so arranged 120

117 a. Vessel-ray pitting coarse, at least in part ..... *Bumelia* (Sapotaceae).
b. Vessel-ray pitting fine 118

118 a. Large oil cells present in parenchyma strands. *Grabowskia* (Solanaceae).
b. Oil cells absent 119

119 a. Rays 1 or 2 (3) cells wide; uniseriates numerous; heterogeneous, though without tall upright cells. *Espadaea*, *Henoonia* (Solanaceae).

b. Rays mostly 3–5 cells wide; uniseriates few; homogeneous. *Ehretia anacuna* (Boraginaceae).

120 a. Vessels with spirals 121
b. Vessels without spirals 122

121 a. Pores medium-sized; few. Rays 1 or 2 (3) cells wide and up to 25 (40) cells wide. Heartwood orange. *Sarcomphalus* (Rhamnaceae).
b. Pores small to minute; numerous. Rays 1–4 (6) cells wide and up to 60 cells high. Heartwood pale brown.......... *Planera* (Ulmaceae).

122 a. Vessel-ray pitting fine to medium 123
b. Vessel-ray pitting coarse to very coarse, at least in part 137

123 a. Fibers with distinctly bordered pits. Pores commonly in long radial multiples. Vessel pits vestured. Open radial channels common 124
b. Fibers with simple or indistinctly bordered pits. Pores infrequently in long radial multiples (exc. certain Euphorbiaceae). Vessel pits not vestured. Open radial channels absent (exc. certain Euphorbiaceae) 128

124 a. Latex tubes present in some of the rays. *Parahancornia* (Apocynaceae).
b. Latex tubes absent 125

125 a. Pores all small 126
b. Pores medium-sized in part 127

126 a. Rays 1–3 cells wide and up to 70 cells high. Crystalliferous strands common. Density low .... *Macoubea* (Apocynaceae).
b. Rays 1 or 2 cells wide and less than 40 cells high. Crystalliferous strands apparently absent. Density medium. *Himatanthus* (Apocynaceae).

127 a. Rays 1–3 cells wide. Fibers thick-walled. *Plumeria* (Apocynaceae).
b. Rays 1 or 2 cells wide. Fibers thin-walled. *Neocouma* (Apocynaceae).

128 a. Rays homogeneous or nearly so. Pores up to medium-sized or larger 129
b. Rays distinctly heterogeneous. Pores typically small to minute... 132

129 a. Rays 1–5, mostly 3–5, cells wide; uniseriates few. Fibers not septate .... *Ehretia* (Boraginaceae).
b. Rays not over 3 cells wide; uniseriates numerous. Fibers septate.. 130

130 a. Rays 1–3 cells wide. Pores fairly numerous. *Thouinidium* (Sapindaceae).
b. Rays uniseriate or partially biseriate. Pores very few 131

131 a. Pores large. Vessel pits medium-sized....... *Toulicia* (Sapindaceae).
b. Pores up to medium-sized. Vessel pits small. . *Pseudima* (Sapindaceae). *Zizyphus* (Rhamnaceae).

132 a. Rays 1–3 (4) cells wide 133
b. Rays all uniseriate or partially biseriate ....

133 a. Pores mostly in long radial series. Ray and wood parenchyma cells conspicuously disjunctive 134

b. Pores mostly not in long series. Ray and wood parenchyma cells not conspicuously disjunctive 135

134 a. Heartwood yellow; Boxwood type.....*Lasiocroton* (Euphorbiaceae).
b. Heartwood dark orange-brown, streaked, waxy. *Senefeldera* (Euphorbiaceae).

135 a. Rays with many definitely procumbent cells. Pores small to medium-sized..........*Adelia Ricinella* (Euphorbiaceae).
b. Rays with few if any definitely procumbent cells 136

136 a. Pores small. Radial channels sometimes present. Heartwood olive-brown; oily..........*Mabea* (Euphorbiaceae).
b. Pores minute. Radial channels apparently absent. Heartwood yellowish; not oily..........*Ditta* (Euphorbiaceae).

137 a. Vessel-ray pitting distinctly 2-sized: fine and coarse together 138
b. Vessel-ray pitting variable, but not distinctly 2-sized 140

138 a. Large vessel-ray pit-pairs elongated, tending to scalariform arrangement. Pores small. Perforations multiple in part. *Siparuna* (Monimiaceae).
b. Large vessel-ray pit-pairs rounded, resembling small simple perforations. Pores medium-sized. Perforations all simple.......... 139

139 a. Rays 1 or 2 cells wide and less than 25 cells high. *Aptandra Spruceana* (Olacaceae).
b. Rays 1–3 (4) cells wide and up to 50 (70) cells high. *Chaunochiton* (Olacaceae).

140 a. Rays frequently 3 or 4 (or more) cells wide 141
b. Rays 1 or 2, infrequently 3, cells wide 149

141 a. Fibers with large lumen and thin walls 142
b. Fibers with medium to minute lumen and moderately to very thick walls 144

142 a. Fibers very short..........*Wercklea* (Malvaceae).
b. Fibers long 143

143 a. Pores few; medium-sized to large. Multiseriate parts of rays fine-celled (tang. sect.). Parenchyma strands separated by several fibers..........*Alchorneopsis*, *Hevea* (Euphorbiaceae).
b. Pores rather numerous; small to medium-sized. Rays coarse-celled throughout (tang. sect.) Parenchyma strands separated by only 1 or 2 fibers (rad. sect.)..*Omphalea trichotoma* (Euphorbiaceae).

144 a. Parenchyma strands usually separated by only 1 or 2 fibers (rad. sect.) 145
b. Parenchyma strands usually separated by several fibers (rad. sect.) 147

145 a. Pores large in part; rather few. Perforations all simple. Fibers with moderately thick walls..........*Gyranthera* (Bombacaceae).
b. Pores not large; typically small to very small; numerous. Perforations multiple in part. Fibers with very thick walls.......... 146

146 a. Cells of multiseriate parts of rays fairly uniform in size and shape. Multiple perforations in reticulate plates. *Richeria* (Euphorbiaceae).
b. Cells of multiseriate parts of rays very irregular in size and shape. Multiple perforations in scalariform plates. *Discophora* (Icacinaceae).

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b. Rays 10–25 (35) cells high. Crystalliferous parenchyma apparently absent..........*Huberodendron* (Bombacaceae).

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b. Perforations all simple. Fibers not septate 154

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b. Crystalliferous parenchyma absent or sparse. Heartwood brown or reddish......*Calocarpum*, *Chrysophyllum*, *Dipholis* (Sapotaceae).

156 a. Fusiform parenchyma cells abundant. Crystals few or absent. Radial channels absent..........*Tournefortia* (Boraginaceae).
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157 a. Intervascular pitting coarsely scalariform. *Euphorbia* (Euphorbiaceae).
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158 a. Rays up to 100 cells high .... *Aparisthmium* (Euphorbiaceae).
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161 a. Radial channels common .... *Sapium* (Euphorbiaceae).
b. Radial channels apparently absent 162

162 a. Rays less than 25 cells high. Wood very light and spongy. *Jatropha* (Euphorbiaceae).
b. Rays frequently nearly 50 cells high. Wood light, but firm. *Tetrorchidium* (Euphorbiaceae).

THE YALE WOOD COLLECTIONS

Accessions

At the end of the calendar year 1943 the total number of catalogued wood samples in the Yale wood collections amounted to 40,717, representing 11,899 named species of 2797 genera of 232 families. There were 75 accessions during the year. The sources of all the wood samples received are as follows:

Brazil: Prof. M. W. Bannan, University of Toronto, Canada.

Cuba: Mr. B. A. Krukoff, New York Botanical Garden; Rev. Brother León, Colegio de la Salle, Havana.

Guatemala: The East Asiatic Co., Ltd., of Copenhagen, San Francisco, Calif.

British Honduras: Mr. B. A. Krukoff, New York Botanical Garden.

Mexico: Mr. Wm. N. Watkins, U. S. National Museum, Washington, D. C.; The Tree-Ring Laboratory, University of Arizona, Tucson, Ariz.

Misc. Cult. (Origins: Africa, Asia, Europe, West Indies): Dr. A. H. Graves, Brooklyn Botanic Garden.

Peru: Prof. M. W. Bannan, University of Toronto, Canada; Merck & Company, Inc., Rahway, N. J.

Surinam: Prof. M. W. Bannan, University of Toronto, Canada.

Trinidad: Prof. M. W. Bannan, University of Toronto, Canada.

Trop. Am. Misc.: Prof. M. W. Bannan, University of Toronto, Canada.

U. S. A.: Mr. C. D. Gilbert, Houston, Texas; Mr. B. A. Krukoff, New York Botanical Garden; Merck & Company, Inc., Rahway, N. J.; Mr. Harold Nogle, Port Arthur, Texas; Mr. W. F. Opdyke, Cleveland Heights, Ohio.

Venezuela: Prof. M. W. Bannan, University of Toronto, Canada.

Sections for Microscopic Study

During 1943 there were added to the slide collections, cross, radial, and tangential sections of 233 specimens representing 207 named species, 38 genera, and 2 families, making a total of 19,945 slides of 11,305 specimens of 6713 named species, 2654 genera, and 220 families.

Specimens Distributed

There were distributed during the year 234 wood specimens, mostly for use in connection with specific scientific projects.

To Prof. I. W. Bailey, Harvard Biological Laboratories, 63 samples: Escalloniaceae (24), Monimiaceae (39).

To Prof. D. A. Kribs, Pennsylvania State College, 27 samples: Amygdalaceae (1), Anacardiaceae (1), Anonaceae (1), Apocynaceae (1), Boraginaceae (1), Combretaceae (1), Leguminosae (14), Meliaceae (2), Moraceae (1), Myrtaceae (1), Rutaceae (1), Sterculiaceae (1), Tiliaceae (1).

To Dr. Harry R. Muegel, University of Cincinnati, 121 samples of 110 species of 37 genera of Anacardiaceae.

To Mr. Harold Nogle, Port Arthur, Texas, 9 samples: Bombacaceae (1), Boraginaceae (1), Dipterocarpaceae (2), Leguminosae (1), Meliaceae (1), Rhamnaceae (1), Rutaceae (1), Ulmaceae (1).

To Dr. Wm. N. Watkins, U. S. Nat'l Museum, Washington, D. C., 11 samples: Burseraceae (2), Flacourtiaceae (9).

To Mr. Roy H. Wisdom, Camden, N. J., 3 samples of *Laguncularia racemosa.*

CURRENT LITERATURE

Supplementary notes on the American species of *Erythrina*, II. By B. A. KRUKOFF. *Bull. Torrey Bot. Club* 70: 6: 633–637; November 1943.

Gives the results of a study of some collections of *Erythrina* not previously seen by the author. Extensions of range are noted for several species. No changes in the nomenclature were proposed.

Plantae Austro-Americanae, I. Novae notiones conjunctionesque generis *Herrania*. By RICHARD EVANS SCHULTES. *Caldasia* (Bogotá, Col.) 2: 6: 11–26; 5 figs.; March 15, 1943.

Some new species and new combinations are published as a result of revisionary studies of the sterculiaceous genus *Herrania*.

Plantae Colombianae, III. Investigationes specierum Saurauiae. By RICHARD EVANS SCHULTES. *Caldasia* 2: 6: 27–45; 7 figs.; March 15, 1943.

Nine Colombian species of *Saurauia* are described as new and there are notes on several others.

Revalidación de *Bombax Ceiba* L. como especie tipica del genero *Bombax* L. y descripción de *Pseudobombax* gen. nov. By ARMANDO DUGAND. *Caldasia* 2: 6: 47–68; March 15, 1943.

According to the author, *Bombax* is typified by *Bombax Ceiba* L., a tropical American species which is the same as *Bombax quinatum* Jacq. The species of *Bombacopsis* Pittier then become synonyms for *Bombax Ceiba*. The type of the proposed new genus, *Pseudobombax*, is *Bombax septentatum* Jacq. (synonyms: *B. heptaphyllum* L., *B. barrigon* Decne., *B. carabobense* Pittier, *Pachira barrigon* Seem., and *Pachira alba* Decne.). The author does not mention the woods, but those of *Bombacopsis* might well be the product of a single species and are readily separable from those of the other species of *Bombax* (*Pseudobombax*) and *Pachira*.

Nuevas especies colombianas del genero *Inga*. By LORENZO URIBE-URIBE. *Caldasia* 2: 8: 241–250; 3 figs.; Sept. 20, 1943.

Describes four new Colombian species of *Inga*. One of them, *Inga coragypsea* L. Uribe, known in Santander del Sur as Guamo Gallinazo, is noted for the disagreeable odor of its leaves and branches.

Nuevas nociones sobre el genero *Ficus* en Colombia. By ARMANDO DUGAND. *Caldasia* 2: 8: 265–283; 3 figs.; Sept. 20, 1943.

An account of 28 Colombian species of *Ficus*, of which three are new.

Noticias botánicas colombianas, II. Especies nuevas y criticas. By ARMANDO DUGAND. *Caldasia* 2: 8: 285–299; 4 figs.; Sept. 20, 1943.

Notes on species of Palmaceae, Meliaceae, Euphorbiaceae, and Apocynaceae. *Orbigyna Cuatrecasana*, *Trichilia lamellulata*, and *Pseudobombax subandinum* are described as new. *Peschiera cymosa* (Jacq.) Dugand is a new combination (= *Tabernaemontana cymosa* Jacq. = *T. psychotrifolia* H. B. K.).

Ecuador's balsa. By FRANCISCO BANDA C. *Bull. Pan American Union* (Washington, D. C.) 77: 11: 626–630; 5 text figs.; November 1943.

Ecuador supplied an average of 99 per cent of the Balsa used by the United States and Great Britain during the period 1935–41. "The Balsa trees line the banks of the Guayas, Babahoyo, and Daule Rivers and their tributaries, as well as the Río Verde, Esmeraldas, Chone, and other streams which penetrate the hinterland. Moreover, the Santo Domingo de los Colorados region in the Province of Pichincha has some virgin forests of Balsa yet untouched." "Under War Production Board orders, Balsa lumber may now be utilized only for the manufacture of life preservers, life floats, other buoyant apparatus, airplane construction, and other specified purposes necessary to the prosecution of the war."

Balsa, its growth, characteristics, and uses. By JOSEPH L. STEARNS. *Southern Lumberman* (Nashville, Tenn.) 167: 2105: 216–220; 7 half-tones, 2 graphs; Dec. 15, 1943.

An interesting, well illustrated account of the production of Balsa (*Ochroma lagopus*), chiefly in Ecuador, and the seasoning, grading, and utilization of the timber.

A piassaveira e outras palmeiras Attaleinas na Bahia. By GREGORIO BONDAR. Bol. No. 13, Instituto Central do Fomento Económico da Bahia, 1942. Pp. 76; 22 figs.

A review, with new keys, of the genus *Attalea* with special reference to the species existing in Bahia. Of these, two were described by Martius, *A. funifera*, the Piassaba palm, type species of the genus, and *A. compta*. A third, *A. monosperma*, an acaulous species from the Rio São Francisco was described by the well-known Brazilian author of *Sertum Palmarum*. To these three species, all that were recorded from Bahia until 1938, four more were added by Dr. Bondar in "New Palms from Bahia" (Bot. Ser. Field Mus. 22: 9: 457–63), namely, *A. piassabossu*, *A. Burrettiana*, *A. pindobossu*, and *A. concentrista*. All of these, like *A. funifera*, are heavy-stemmed majestic palms from a region familiar to Martius as well as to Barbosa Rodrigues, but were overlooked by both. The botanical features and economic importance of these and other Attaleas were described by Bondar in a paper presented at the American Botanical Congress in Rio, 1938. They are treated more fully here, with excellent full-page illustrations. To them the author adds a detailed description (in Portuguese) of a new stemless palm from the Municipio of Bahia. The formal diagnosis, which was not included in Boletim 13, is as follows:

Attalea Borgesiana Bondar, sp. nov.—Palma acaulis. Folia plana pectinata pinnatisecta, foliolis inter se regulariter 2 cm. distantibus, marginibus foliorum inferiore albescentibus. Inflorescentia grandis, brevi-pedunculata, floribus masculinis validis usque ad 4 cm. longis, invariabile 6. Fructi 50 ad 60 in spadicibus voluminosis, seminibus 1–3 (vulgo 2). Drupa 6–9 cm. longa, diametro 5–6 cm., a calyce medio vel tercio tecta.—The species differs from *A. humilis* Mart. in its larger flowers and by its fixed number of stamens; from *A. monosperma* B. Rodr. by its more closely spaced leaflets and several-seeded drupe.—B. E. DAHLGREN, *Chicago Natural History Museum.*

Flora of Peru. By J. FRANCIS MACBRIDE. *Bot. Ser. Field Mus.* (Chicago) 13: 3: 1–507; Oct. 11, 1943.

Contains descriptions of all of the known Peruvian species of 73 genera of Leguminosae and one species of *Krameria*. There are diagnoses of new species in *Acacia* (3), *Adesmia*, *Astragalus*, *Bauhinia* (4), *Brownea* (2), *Calliandra* (2), *Canavalia*, *Cassia* (5), *Centrosema*, *Coumarouna*, *Dalbergia*, *Dalea* (2), *Derris*, *Diplotropis*, *Galactea* (2), *Inga* (8), *Lecointea* (2), *Lupinus* (2), *Machaerium* (2), *Macrolobium*, *Mimosa*, *Ormosia*, *Ormosiopsis*, *Piptadenia*, *Pithecolobium* (2), *Sclerolobium*, *Stylosanthes*, and *Swartzia*. There are also several new varieties and numerous new combinations, ten of the latter resulting from transfers from *Lonchocarpus* to *Derris*.

Las hormigas cortadoras del Uruguay. By CARLOS S. CARBONELL MAS. *Revista Asoc. Ings. Agrónomos* (Montevideo) 15: 3: 30–39; 3 plates; September 1943.

A contribution to the study of leaf-cutting and fungus-growing ants with particular reference to the habits, nesting, and means of control of the common species in Uruguay.

Los bosques argentinos en la industria del papel de diarios. By LUCAS A. TORTORELLI. Pub. by Instituto de Frutiviticultura y Silvicultura, Univ. Buenos Aires, July 8, 1943. Pp. 58; 7 x 10½; 12 plates.

The author concludes that the best local source of chemical paper pulp is Pino de Misiones (*Araucaria angustifolia*). The second best, Araucaria de Neuquén (*A. araucana*). For ground wood he recommends Sauce Alamo (*Salix alba*, var. *caerula*), which grows rapidly in the delta of the Río Paraná; others are Rabo Macaco (*Lonchocarpus albiflorus*), Laurel Blanco (*Nectandra angustifolia*), Loro Blanco (*Bastardiopsis densiflora*), and Laurel Amarillo (*Ocotea lanceolata*), which grow in Misiones. He estimates that the present forests of Pino de Misiones would supply the pulp industry for 18 years, while the plantations of Sauce Alamo are good for 10 years. He advises the planting of land to meet the demand of the newspapers which at present consume 136,000 tons of wood pulp annually.

The genus *Stachyurus*. By HUI-LIN LI. *Bull. Torrey Bot. Club* 70: 6: 615–628; 14 figs.; November 1943.

Stachyurus, with twelve species and four varieties of shrubs or small trees native to eastern Asia, was first (1835) included in the Pittosporaceae, later (1862) transferred to the Ternstroemiaceae, and finally (1893) made the type of a family, Stachyuraceae. The present work summarizes the information available about the genus and provides a key to the species and varieties.

Emergency food plants and poisonous plants of the islands of the Pacific. By E. D. MERRILL. Technical Manual 10-420, U. S. War Department, Washington, D. C., 1943. Pp. 149; 4¼ x 6¾; 113 text figs. For sale by Supt. of Documents, U. S. Govt. Printing Office, price 15¢.

"The purpose of this manual is to aid the individual who becomes separated from his unit by illustrating and describing the edible and poisonous plants so that this individual can live off the land. . . . This manual covers all of Polynesia, Micronesia, and Melanesia, as well as the entire Malay Archipelago including the Malay Peninsula and the Philippines. For all practical purposes it also covers Indo-China, Thailand (Siam), Burma, and eastern India." The headings of the fourteen sections are: I. Purpose and scope. II. Reassurance and warning. III. Assistance and advice of natives. IV. Miscellaneous information. V. Edible ferns. VI. Edible herbs. VII. Edible palms. VIII. Edible grasses. IX. Edible tubers. X. Plants eaten as greens. XI. Edible fruits. XII. Edible seeds. XIII. Poisonous plants. XIV. Plants used to stupefy fish.

Some West African substitutes for well-known timbers. By M. H. SCOTT. *Journ. So. Afr. For. Assn.* (Pretoria) 10: 29–39; April 1943.

"At the outbreak of war, imports of timber into the Union amounted to approximately 30,000,000 cu. ft. of sawn softwoods and 3,000,000 cu. ft. of hardwoods. The former were obtained mainly from Europe and North America and the latter from Europe, North America, India, the Philippines, Dutch East Indies, Australia, and Japan. . . . Outbreak of war and the spreading of hostilities closed most of the country's accustomed sources of supply entirely and heavily reduced supplies from occasional sources. . . . Supplies of sawn timber from the Belgian Congo leapt from 7000 cubic feet in 1938 to 600,000 in 1941, the latter figure being exceeded within the first five months of 1942. French Equatorial Africa and Nigeria also contributed as far as shipping would allow. . . . The Government decided to send a small survey committee of four members to examine the position with regard to trade in general with the West African territories. As the member of this committee most concerned with timber supplies, the writer had an opportunity of investigating the position at first hand and was able to collect much data not elsewhere available."

The report contains notes on 47 woods and includes check lists of the common and scientific names. Iroko (*Chlorophora excelsa*) "is an excellent substitute for Burmah Teak (*Tectona grandis*) and is second to none among hardwoods for general purposes. It is very durable, of medium weight (40 lb.), and its yellowish color when freshly sawn darkens to a pleasant brown or dark brown on exposure. . . . It is particularly suitable for furniture and good quality fittings, for panelling and general construction, including flooring and decking." Limba (*Terminalia superba*) and Idigbo (*T. ivorensis*), can replace Oak in some grades of furniture. "Barrel staves for wine casks, usually made from highly selected quartered Oak, were being made in the Cameroons, for export to France, from Mangrove (*Rhizophora racemosa*)."

"Mansonia (*Mansonia altissima*) might well replace Walnut." Lovoa wood (*Lovoa Klaineana*) "ought to be used to a greater extent in the Union. Its grain is more like Mahogany but the coloring is Walnut. It is undoubtedly one of the premier furniture woods." Douissie (*Afzelia africana*) "resembles Iroko insofar as it is of a rather coarse appearance and brownish color and is stated to be very durable. It is heavier (47 lb.) and turns a rather redder color after exposure, but can be used for the same purposes, more particularly for joinery and construction work."

"There is a class of very light, soft woods weighing less than 28 lb. The best known of these is Obeche (*Triplochiton scleroxylon*), a particularly suitable substitute for clear Pine previously imported from America for pattern-making. It is a clean, very easily worked wood which seasons exceptionally well. It weighs 24 lb. [See *Tropical Woods* 18: 43–54.] Ilombo (*Pycnanthus kombo*) and Sindru (*Alstonia congensis*) are two easily worked woods suitable for shelving, light carpentry, toy-making, and boxes. Both weigh 26 lb. Very common trees on the West Coast are Ceiba (*Ceiba pentandra*), 22 lb., and Sanga (*Musanga Smithii*), the lightest of all, weighing only 14 lb., which is suitable for special purposes such as veneer cores, floats, certain types of corks, and mounting boards. In fact, it is a good substitute for Balsa wood."

The genera of the living Euphorbieae. By Louis Cutter Wheeler. *American Midland Naturalist* (South Bend, Ind.) 30: 2: 456–503; September 1943.

"The purpose of this paper is to elucidate the genera which have been proposed in the tribe Euphorbieae of the family Euphorbiaceae. Fossil genera are excluded. The need for this study is evident when it is revealed that since 1753, the beginning date of modern botanical nomenclature, there has been no treatment of this subject which has attempted to identify accurately the many genera proposed as segregates of the genus *Euphorbia* L. . . . It is in the hope of elucidating these many genera and thus making a contribution to the understanding of botanical nomenclature that this paper is published. The basic bibliographic and taxonomic synopsis organizes and interprets the widely scattered material relating to these genera."

The comparative morphology of the Winteraceae, III. Wood. By I. W. Bailey. *Journ. Arnold Arboretum* (Jamaica Plain, Mass.) 25: 1: 97–103; 4 plates; January 1944.

"Increasing evidence accumulated by many investigators during the last 100 years indicates that the Winteraceae (excluding *Illicium*), *Trochodendron*, and *Tetracentron* are the only known living representatives of the dicotyledons that have a primitive vesselless type of secondary xylem. This is not indicative necessarily of close genetic relationship between the Winteraceae, *Trochodendron*, and *Tetracentron*, as assumed by Van Tieghem, but rather the occurrences are to be regarded as retentions of a primitive ranalian type of wood by three families which exhibit diverse trends of specialization in their other vegetative characters and in their reproductive organs."

Supplement to "Studies of the identification of timbers." By Alexander L. Howard. London: Macmillan & Co., Ltd., 1943. Pp. 19 (17 plates and preface); 6 x 9¾. Price 5 s.

In 1942, the author published 504 photomicrographs showing cross sections of woods at a uniform magnification of 10 diameters. These were to illustrate his "Manual of the timbers of the world," which describes 1060 kinds. This supplement adds 153 photomicrographs to the list and " it is confidently expected that at a short date a further supplement will be available." "The results to date . . . have proved that the claim that 'the transverse section of wood under magnification will serve in the majority of cases as a sure means of identification' has been substantiated."

Photomicrographs also serve the important purpose of illustrating descriptions. In some instances one may question whether the picture is of the wood described in the "Manual." For example, No. 416, Goity Coro, and No. 426, Guanandirana, look very much alike, yet the first is said to have "exceedingly minute" pores and "concentric bands of loose tissue at varying intervals," while the other has pores "of moderate size . . . surrounded by a halo of bright tissue." No. 745, Pao Setim, and No. 753, Pao Amarello, are given the same scientific name (*Euxylophora paraensis*), but obviously the pictures are of entirely different woods.

To meet the author's purpose it is essential that the photomicrographs be made from authentic specimens. In the reviewer's opinion, No. 618 is not of Mangrove, *Rhizophora mangle;* No. 867 is not of Brazilian Rosewood, *Dalbergia nigra;* and No. 910, called Silky Oak, is not of any of the genera of Proteaceae listed. No. 746, labeled Papaw, cannot be *Carica papaya*, as its stem is herbaceous in character, the xylem consisting of wedges of very soft, watery tissue which shrinks away from the bark in drying.

Errata in Record & Hess' *Timbers of the New World*

Page	*Col.*	*Par.*	*Line*	*change*	*to read*
19	2	3	8	8000	800
97	2	2	7	41:45	37:52
119	2	2	10	(Gr.G.)	(Br.G.)
199	2	2	8	million	thousand
249	2	3	2	*trifoliata*	*trifoliolata*
430	1	1	3	beet	(delete)
457	2	3	8	*Retinophyllum*	*Retiniphyllum*
468	1	2	4	(Br.G.)	(Br.H.)
559	1	3	11	*P.*	*P. angustifolia*
639	3	–	29	yao	yew

Page 171. Transfer the two paragraphs in the middle of column 2 (beginning with COMMON NAMES: and **Banara**, resp.) to between the last two lines of column 1 (following par. beginning with **Azara**).

M. M. CHATTAWAY. Price 30 cents

Yale University School of Forestry

TROPICAL WOODS

NUMBER 78 JUNE 1, 1944

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Yale University School of Forestry

TROPICAL WOODS

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A technical magazine 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 any articles therein, the authorship of which is not otherwise indicated, is SAMUEL J. RECORD, *Dean of the Yale University School of Forestry.*

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MAHOGANY DISCOVERED IN THE STATE OF PARÁ, BRAZIL

By RICARDO DE LEMOS FROES

Belem, Pará, Brazil

Exportation of Mahogany from Peruvian Amazonia to the United States of America was begun about twenty years ago and several important firms in Manáus subsequently started the same business along the Peruvian-Brazilian border. Timbermen in Brazil have canvassed the upper streams of the Amazon tributaries and thousands of logs of Mahogany have gone down to the sawmills in Manáus and thence to the U. S. markets. In 1936, the rivers Purús, Juruá, Tarauacá, Envira, and Jurupary had many Mahogany crews working for Pereira Cia., De Vris, and J. G. de Araujo, shippers of Magohany, connected with the Astoria and other companies in New York dealing with Brazil and Peru. French, German, and American money was invested in this industry. The Booth Line boats coming down the Amazon were loaded with logs and planks destined for the United States. But despite this large production from within Brazil's boundaries, the product was always marked as coming from Peruvian territory.

In 1936, I made an expedition to the Territory of Acre, the Madeira River, and other points in the upper Amazon. We left Manáus and ascended the Solimões and Juruá Rivers to the Foz do Envira by river steamer, thence by motor boat, and finally by canoe to Porto Leopoldina, the last point of navigation on the upper Jurupary, where a stop of two days was made. High up the Tarauacá, Envira, and Jurupary Rivers were seen many rafts of Mahogany logs ready to float down to Manáus. Large trees were located at Porto Leopoldina, and leaves, fruits, and wood samples were secured from one of them for the New York Botanical Garden.

In the belief that Mahogany existed elsewhere in Brazil beside the Acre Territory, I sought for it later along the Madeira, Negro, Vaupés, and Solimões Rivers. Although none was found, I decided to continue the search in other localities. In June of 1943, while employed by the Rubber Development Corporation, I had occasion to go up the Tocantins River to study Castilloa and other rubber plants in the Marabá district. On this trip it was possible to note the change from the lowland type of vegetation of the Amazon River to that of the highlands. This was particularly noticeable in the country approaching Alcobaça, where swampy or marshy soil, with palms and soft-wooded trees, gives way to high, hilly land, composed of an ancient sedimentary soil of red, sandy clay, and supporting high forests of valuable trees. Upon encountering this entirely different type of flora I kept a sharp lookout and soon located a Sapium, which was new to me, as well as the Mahogany. The Sapium began to be evident at Jacundasinho and the Mahogany at Rio Itacayunas, which is a tributary of the Tocantins.

Entering a shop in Marabá by chance one day, I found a canoe paddle for sale. From my previous experience I decided that it was Mahogany wood. Soon after, with the aid of a local

timberman, I located a young Mahogany tree near Marabá on the Itacayunas River. Lack of time prevented search for more trees, so it was necessary to collect leaf and wood specimens from the single, small tree. This occurrence of Mahogany in the State of Pará was an important fact, so the specimens were shipped to Dr. F. C. Camargo, Director of the Instituto Agronómico do Norte, at Belém. Upon receiving the material, Dr. Camargo made a special trip to Marabá where he located a large number of the trees, including several huge ones. He collected more material of the wood and also found young fruits, as well as old fruits on the ground. From this material it was decided that the species was the same as that growing in the Territory of Acre. In addition to the herbarium of the Instituto Agronómico do Norte, material has been deposited with the Division of Plant Exploration and Introduction, Washington, D. C., and the Yale School of Forestry.

On later trips more of the Mahogany was found along the Xingú River, where it has the common name of Cedrohy just as it does on the Tocantins. This extension of range for the tree is interesting from the botanical standpoint and also may indicate a new source of revenue for the State of Pará.

Comment by Dr. B. E. Dahlgren

The news of the finding of *Swietenia* at Marabá is interesting but not surprising to me. Several years ago at a boat-building establishment in Santarem I saw some boards that I believed to be Mahogany, though I was told that they were Cedro (*Cedrela*). I spoke of the matter to Dr. R. Monteiro da Costa and he gave me a piece of wood from an old "ubá" or dugout canoe which had come down the Xingú River from above Altamira. A part of this sample (Field Museum No. 614922) was sent to the Yale School of Forestry (Yale No. 40000) because of its bearing on the distribution of *Swietenia* in Brazil. The eastern part of the range indicated on Map 7, page 371, of Record and Hess' *Timbers of the New World* should be closer to the main channel of the Amazon. Perhaps the species crosses the Tocantins, since the hylaea extends into Maranhão to the Rios Pindaré and Guajahú.

A NEW SPECIES OF *LICARIA* FROM BRAZIL

By Caroline K. Allen

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Licaria Duartei Allen, spec. nov.—Arbor magna, cortice aromatico, ramis griseis glabris, ramulis angulatis striatis minutissime dense ferrugineo-puberulis demum glabratis. Folia alterna late lanceolata vel elliptica, ad 9 cm. longa et 3 cm. lata, subcoriacea, acuminata vel caudata, cauda 1–1.5 cm. longa, basi cuneata saepe obliqua, supra opaca, olivacea vel brunnea, dense adpresse pilosa, nervis exceptis mox glabrata, costa impressa et leviter prominula, nervis impressis obscuris, subtus pallida adpresse pilosa, costa nervisque elevatis, nervis lateralibus 3 vel 4, sub angula 45° divergentibus, secus marginem confluentibus, basi saepe pseudotriplinerviis, minute prominenterque reticulata, petiolis gracilibus canaliculatis 1–1.2 cm. longis minute ferrugineo-puberulis. Inflorescentia axillaris, racemoso-paniculata, brevis, ad 3.5 cm. longa, minutissime adpresse ferrugineo-puberula. Flores ad 3 mm. longi, suburceolati, minute puberuli demum glabrescentes, lobis subaequalibus ellipticis centro incrassatis margine subhyalinis, apice rotundatis, ± 0.6 mm. longis, extus glabrescentibus intus basi sparse pubescentibus; staminodiis ser. I, II plus minusve petaloideis valde variis oblongis ovatis subrotundatisve ± 1 mm. basi plus minusve constrictis; staminibus ser. III inclusis subrectangularibus crassis ± 1.25 mm., antherae locellis parvis extrorso-apicalibus, filamentis indistinctis biglandulosis, glandulis parvis subrotundatis subsessilibus, ovario ovoideo basi pubescente. Fructus immaturus in cupula urceolata atrata glabrescente subinclusus, pedicello incrassato ± 6 mm. longo glabrescente.

Brazil: Rio de Janeiro (Minas Geraës Boundary): National Park of Itatiaya, in forest, alt. 1000 m., Dec. 27, 1941 (fl.), May 13, 1942 (fr.), *W. Duarte de Barros 530* (*Herb. Jard. Bot. Rio de Janeiro, No. 1429*), wood specimen *130* (fl., fr. type, Arnold Arboretum; isotype, Yale); large tree, wood with strong fragrance; "Canela."

This large tree is very near *Licaria Appelii* (Mez) Kostermans, from Minas Geraës, according to the description of the latter. It differs from *L. Appelii* in its rusty-puberulous, rather than tomentellous, branchlets. Its leaves are acuminate or caudate as opposed to the acutish or shortly acuminate obtuse leaves of *L. Appelii*. The leaves of the latter are densely aureo-sericeous below, with erect-patent arcuate lateral nerves and rather thick tomentellous petioles; whereas the leaves of *L. Duartei* are appressed-pilose below, with lateral nerves erect, diverging from the midrib at an angle of about 45°, the lowest pair often simulating the triplinerved condition frequently found in other genera of the Lauraceae. The flowers of the above species are puberulous becoming glabrescent, suburceolate, up to 3 mm. long, bearing elliptic perianth lobes rounded at the apex, thickened at the center and becoming more or less hyaline at the margin; the first and second series of staminodia are thin and petaloid and the fourth series is lacking altogether. The flowers of *L. Appelii*, on the other hand, are densely rusty-sericeous, subglobose, up to 2 mm. long and hardly constricted, with perianth lobes broadly ovate-acute; the first and second series of staminodia are ligulate, not petaloid, and the fourth series stipitiform and pilose. The cupule of *L. Appelii* is described as mature, whereas the fruit of *L. Duartei* is in a younger stage and it is impossible to say how it may develop.

THREE NEW AMAZONIAN SPECIES OF *PHYLLANTHUS* L.

By Leon Croizat

Arnold Arboretum, Harvard University

Phyllanthus L., according to the best available sources, is the second largest genus of the Euphorbiaceae, being preceded by *Euphorbia* L. and immediately followed by *Croton* L. and *Acalypha* L. It ranks not less than 750 pantropic species, for which the ♂ flower frequently offers reliable characters of determination. This is against the rule prevailing in this large family, the ♀ flower being usually more important for the taxonomist.

Nothing of organic nature has been done on the genus following the publication of Martius' *Flora Brasiliensis* 11 (2), 1873, in which Mueller Argoviensis monographed to a large extent the tropical and subtropical species of South America, following an earlier and more extensive study in De Candolle's *Prodromus* 15 (2), 1866. Considering that the characters of the ♂ flower widely vary in species which are similar in their gross morphology, the photographs of type specimens available in our herbaria can be trusted only up to a point. The original description and general considerations of range afford the basic data upon which new entities can be ascertained, or guessed at, in the absence of type specimens stored in European institutions, possibly destroyed, certainly now out of reach.

The task immediately facing a student of the genus, consequently, is that of building up the record in order to clarify the ranges as far as possible, and to do so on the strength of descriptions. The three species here published as new have an interesting and ill-understood range and characters which do not seem to be matched by any other species so far known for the region.

Phyllanthus microcarpoides Croizat, sp. nov.—Frutex totus ligneus rigidulus ramis flexuosis glaberrimis. Foliis firmius membranaceis ellipticis vel obovato-ellipticis, apice late rotundatis, deorsum sensim cuneatis, basi subtruncato-cordatis, 1.2–5 cm. longis 5–12 mm. latis, venis gracilibus adscendentibus ca. 5–8-jugis, ultimis reticulatis, petiolo vix 0.5–1 mm. longo, stipulis magnitudine ludentibus setaceo-triangularibus. Floribus utriusque sexus in brachyblastiis squamulosis lateralibus vel, rarius, ex axillis ramorum lateralium eufoliaceorum. Perianthio ♂ ca. 2–3 mm. lato 6-lobo, lobis ellipticis vel ovato-ellipticis bene costatis integris, disco tenui subintegro integrove, staminibus 3 liberis, ca. 1 mm. longis, antheris extrorsis transversim dehiscentibus, pedicello capilliformi haud clavato ca. 5 mm. longo. Perianthio ♀ 5-lobo, vix 1.5–2 mm. lato, lobis ut in ♂ sed brevioribus latioribusque, disco tenui quam ovario latiore subintegro, ovario ca. 1.5 mm. magno vel minore glaberrimo, rotundato-trigono, apice plus minusve pyramidato, stylis 3 quove ad

basem imam 2-partito, cruribus vix 1.5 mm. longis capilliformibus, pedicello ca. 2 mm. longo.

VENEZUELA: Amazonas, mouth of the Río Sanariapo, *L. Williams 13054* (type in U. S. Nat. Herb.).

To judge from authentic material and/or descriptions, this species is wholly unlike *P. hyssopifolius* H.B.K., *P. rupestris* H.B.K., *P. Anderssoni* Muell.-Arg., *P. pycnophyllus* Muell.-Arg. and *P. vacciniifolius* Muell.-Arg. so far known for this range and its vicinity.

Phyllanthus biantherifer Croizat, sp. nov.—Frutex glaberrimus, innovationibus subligneis, cortice levi rubro-brunneo exfoliante, in ramis adultis rugoso. Foliis 3–6 cm. longis, 2–3 cm. latis, supra pallide brunneis, subtus (videtur) glaucescentibus vel pallidioribus, firme chartaceis, apice abrupte acuminatis, basi plus minusve cuneatis, nervis ca. 6-jugis, gracilibus at manifestis, subadscendentibus, nervulis valde obscuris, petiolis brevissimis ad 0.5–2 mm. longis, stipulis inconspicuis. Inflorescentiis 2-sexualibus axillaribus glomeratis, interdum submonoeciis. Floribus ♂: perianthio 3–3.5 mm. lato, pedicello capillari flexuoso 5–7 mm. longo, lobis 4 late ovatis costulatis, basi cum disco arcte connatis ca. 2 mm. longis 1.75 mm. latis: disco e glandulis 4 sat magnis foveolatis cum lobis alternantibus, in pulvinulo carnoso insidentibus: columna staminali 2-antherifera. Floribus ♀: perianthio 4–6 mm. lato, lobis 6 late ovatis vel rotundatis, ca. 2.5 mm. longis, 2 mm. latis, disco integro margine tanto crenulato, ovario globuloso ca. 2 mm. magno, stylis 3 bifido-cornutis adpressis.

BRAZIL: Amazonas, Municipality Humayta, near Livramento, *Krukoff 6691* (in herb. Arnold. Arb.).

The type was collected on "terra firma," and is described as a shrub 18 ft. high. It was distributed as *P. jacobinensis* Muell.-Arg., the lone species assigned by Mueller-Argoviensis (in DC. Prodr. 15 [2]: 334. 1866; in Mart. Fl. Bras. 11 [2]: 29. 1873) to *Phyllanthus* Sect. *Ciccopeltandra*. The characters of *P. jacobinensis*, to judge from description, are wholly at variance with those of *P. biantherifer*.

Phyllanthus madeirensis Croizat, sp. nov.—Arbor ad 46 ped. alta, glabra, innovationibus gracilibus subherbaceis, saltem interdum caulocarpicis, ramis adultioribus brunneis, rugulosis. Foliis 2.5–4 cm. longis, 1.5–2 cm. latis, supra brunneis vel olivaceis, elliptico-lanceolatis, primum membranaceis dein firme chartaceis, nervis adscendentibus ca. 5–6-jugis, petiolo ca. 2 mm. longo gracili, stipulis triangularibus vix ultra 1 mm. longis. Inflorescentiis, ut videtur 2-sexualibus, e floribus 10–25 in ramulis abbreviatis bracteolatis subherbaceis (brachyblastiis) impositis. Floribus ♂: perianthio vix 2 mm. lato, pedicello capillari 4–7 mm. longo, lobis 6, 1.5 mm. longis, 1 mm. latis, albicantibus, carnosulis, glandulis 6 erectis puncticulatis liberis, stamina 3 circumdantibus fere libera (i.e., macerata facillime secedibilia, at primo intuitu in columna connatis). Floribus ♀: perianthio 3–3.5 mm. lato, pedicello porrecto ca. 6–7 mm. longo, lobis 5–6, illis florum ♂ similibus, glandulis 6 connatis vel subconnatis, ovario ca. 1 mm. magno, loculis 4–5, quove stylo brevi erecto integro coronato.

Brazil: Amazonas, Municipality Humayta, on plateau between Rio Livramento and Rio Ipixuna, *Krukoff 7163* (type in herb. Arnold. Arb.); same locality and date, *Krukoff 7164*.

Distributed as *P. almadensis* Muell.-Arg. (in Mart. Fl. Bras. 11 [2]: 38. 1873), but quite disagreeing with the description of that species. Some of its characters suggest *P. rupestris* H.B.K., from northern Brazil and Venezuela, which, however, has a different foliage. It seems probable that its nearest affinities are with *P. attenuatus* Miq. from the Guianas.

Note on Phyllanthoid Inflorescence

In a recent study on the concept of inflorescence (in *Bull. Torr. Bot. Club* 70: 496–509. 1943), the writer has emphasized floriferous structures representing the evolution along structural lines of a basic pattern which, in its intermediate stages at least, defies characterization. *Phyllanthus* L. and its next of kin afford excellent illustrations of such structures, most of which are significant to a taxonomist.

In its simplest form, the phyllanthoid inflorescence may be visualized as an axis, bearing in the axils of its leaves single flowers. This axis may undergo one of the following developments: (1) It may be borne in the axil of a leaf appearing on what is, as such, a normal vegetative shoot. Its leaves may persist without change or become bract-like, and be caducous. The primary meristem yielding one flower may yield several of them, arranged in a pulviniform, racemose, or cymose pattern. Depending upon the nature and degree of its adaptations, the floriferous axis is to be described as an inflorescence (pulvinus, raceme, brachyblast, cyme, and the like) subtended by a normal leaf. (2) It may be borne in the axil of a leaf on a vegetative shoot, which leaf is reduced as a bract, usually triangular, and often confused in descriptions with the adjacent stipules. In this case assimilating functions and the like are transferred from the much-reduced leaf to the leaves appearing on the floriferous axis proper, which immediately subtend the flowers. In certain cases, the floriferous axis may be aphyllous at the upper tiers, where the flowers appear.

Of these two patterns, the first is characteristic for *Drypetes* Vahl, but is not unknown in what may be assumed to be the archetypes of *Phyllanthus* L. The second appears almost exclusively on the herbaceous forms of the Linnean genus, and is well represented as a rule throughout its species.

It may be added that the second pattern is not depending for its oncoming upon the appearance of flowers. Perfectly sterile axes are borne for years in the axils of leaves reduced to stipules in *Phyllanthus Emblica* L., for instance. It is difficult to see how these sterile axes, universally described as branches, differ from the compound "leaves" of leguminous plants, which they closely resemble in every respect.

Dermatitis caused by various representatives of the Anacardiaceae. By E. D. Merrill. *Journ. Am. Med. Assn.* 124: 222–224; Jan. 22, 1944.

"My object in this paper is to record the fact for the benefit of medical men assigned to positions in the Old World tropics that in most parts of the region certain plant species do occur that, on contact, cause a distinct and often severe dermatitis corresponding exactly to Rhus dermatitis in the United States. . . . The active principle is the same in all cases. . . . The indicated treatment is exactly the same."

ECONOMIC PRODUCTS OF PALMS

By B. E. Dahlgren

Chicago Natural History Museum

The economic products of palms, as of all other kinds of plants, fall naturally into two main categories. One comprises the materials derived from structural parts or elements of the plant, such as wood, leaf-splints, fibers, and the like. The other includes substances elaborated by metabolic processes, such as sugar from the sap, starches and oils stored in the plant for future use, and alkaloids, waxes, gums, and resins. The most distinctive palm materials are those in the first group; some of those in the second are not essentially different from similar products derived from other kinds of plants. A few alkaloids, waxes, and resins are characteristic of certain genera and species rather than of palms in general. Some fruits, such as the coconut, yield both kinds of material. Both categories furnish raw material for conversion into more useful forms by means of distillation or other physical and chemical processes.

As an aid to interpreting the structural materials of palms, other woody plants offer little for comparison. Except for some of the smaller species, which may be collected like herbs and dried almost entire, palms are poorly represented in most herbaria. This well-known fact is readily explained. Whereas from a dicotyledonous tree, as from a conifer, it is usually possible to gather flowering or fruiting leafy twigs and thus obtain representative specimens for the plant press, anyone who has attempted to collect herbarium specimens of palm trees will have realized the impossibility of achieving anything at all comparable by a similarly facile operation. The usual herbarium fragment of one of the larger palms is therefore seldom the equivalent of the ordinary sterile specimen. Nevertheless some palm fragments are unmistakable and serve a useful purpose in a collection, and the same may be said of many fragments of palm products. Others require for their interpretation a measure of acquaintance which can be acquired only by much close and practical contact with the plants in the field.

Some 2500 to 3000 species of palms, about equally divided

between the Old World and the New, have been described under perhaps twice or three times as many names. Even in the best explored regions more are being found continually, as attested, for example, by Hermano León's numerous additions to the palms of Cuba. Some of the largest and most striking species of this hemisphere have become known to science for the first time within the last few years when they were described from Bahia by Bondar.

Structure of Palms

As a family of woody monocotyledons with numerous fossil representatives since the Cretaceous, the palms constitute a well-defined group. A few not entirely conformist species and one or two somewhat anomalous ones, such as the now exclusively East Indian Nipa, with fossil fruits in the London Clay, do not alter the picture of characteristic structure and habitus. The general pattern is typically that of a cylindrical woody stem well anchored by a mass of simple unbranched roots and bearing at its tip a crown of large leaves. The leaves, either fan-shaped or pinnately divided, are borne on stout leaf stalks attached by a broad clasping or sheathing base, either fibrous, or woody, or both. The general position of the leaves is radial, the youngest, immediately surrounding the flowering tip, being most erect. Actually they are disposed in several series of close spirals, their bases overlapping, the oldest which are the lowest, being most external. The flowers are produced in branched, or rarely unbranched, spadices growing from the leaf axils, and protected during their development by substantial woody, fibrous, or membranous spathes. The appearance of the flowering spadices is delayed in some genera until after the respective leaves have been shed; in a few the flowering is delayed until after the completion of the entire vegetative cycle of the plant. One aberrant genus has a terminal inflorescence and loses all its leaves as this expands.

Details of the floral structure, except the usually trilocular ovary, are not of special interest in connection with economic products. The fruit is important. It is typically a drupe varying in size from a currant to a coconut, but in one monotypic genus (*Lodicea*) is much larger, producing the most voluminous of all seeds. The pericarp may be pulpy or predominantly fibrous, with or without enclosed oily or starchy or sugary material, or it may be densely woody. Its inner layer, endocarp, may be a hard and horny "putamen" as in the coconut, or may be thin and membranous, enclosing a single, often oily, sometimes hard, stony seed.

The above rather stereotyped pattern of construction prevails through the family, but is capable of a surprising extent of variation, especially in respect to the dimensions, relative and absolute, of stem and leaves as well as of fruit. The smallest of palms are the tiny, almost herb-like Reinharditias of Central America. With low reed-like stems and small simple perforated leaves, they have the herb-like appearance of some diminutive terrestrial aroid. The largest are the massive Orbignyas, Scheeleas, and Attaleas of South America, with thick trunks up to 60 feet in height, surmounted by a crown of huge leaves, 30 to 40 feet in length; even these are sometimes surpassed in height by the Old World Raphias and Coryphas, and in length of stem are vastly exceeded by the climbing rattans. In various genera there are so-called stemless or "acaulous" species having the leaf-bearing portion of the stem very short and virtually concealed underground. A few others, such as the North American Scrub Palmetto, have prostrate or creeping stems; a horizontal underground stem is characteristic of the Nipa palm. A considerable number of palms form vegetative shoots at the base and thus produce clumps of many stems, as in various species of *Bactris*, *Rhapis*, *Chrysalidocarpus*, *Pinanga*, and others.

Economic palm material of structural origin may be divided most conveniently for purposes of discussion, into material derived from (1) the stems, (2) the leaves, including leaf stalk and sheath as well as lamina, and (3) the spadix and fruit. They will be considered in this order.

Uses for Palm Stems

Palm stems in general are especially remarkable for their uniformly straight cylindrical form. In diameter they range

from less than half an inch, in small Chamaedoreas and Geonomas, to two feet or more in some of the large, massive palms. Superficially they are ringed by more or less distinct leaf scars, which may be broad or linear, close or remote, but are negligible for most purposes for which palm stems are used. The most essential characteristic of the palm stem is its woody structure, which is monocotyledonous and lacking a continuous cambial layer and is thus incapable of growth in thickness by the addition of peripheral layers, such increases in thickness as take place being interstitial. Within the epidermis and the usually thin cortex the woody structure of palms consists of separate fibro-vascular bundles scattered in a pith-like ground tissue of parenchyma cells. In a transverse section of palm stems the latter, thin-walled and of general hexagonal outline, are seen to fill all spaces between the conspicuous fibro-vascular bundles. These, with their thick horny purplish brown sclerenchyma, stand out vividly like dark shiny spots against the uniform dull yellow or whitish ground substance. The classical description and figures are in the chapter on the structure of palms contributed in 1831 by H. Mohl to the first volume of Martius' *Historia Naturalis Palmarum*.

Comparison of cross sections of palm stems of different genera reveals considerable differences in appearance. These are produced chiefly by differences in number, distribution, and thickness of the fibro-vascular bundles—the main variable factors determining the strength, density, durability, and other physical properties of palm stems and governing their suitability for various purposes. In some such cross sections the bundles are very thin, widely and uniformly scattered (*Serenoa*); in others coarser and more numerous and less widely spaced (*Thrinax*); in still others they are progressively more numerous nearest the periphery and fewer in the center (*Cocos*); or they are practically lacking in the center but very coarse and densly crowded in the peripheral zone, indicating the existence of an external cylinder of dense and extremely hard wood as in *Borassus*, *Guilielma*, and *Astrocaryum*. The appearance of such wood in longitudinal section is suggested by the name "porcupine wood," usually said to be the wood of the Coco palm, but apparently applied with equal frequency to the similarly dense and less scanty wood of the Palmyra palm and other eastern species.

Medium-sized palm stems of a diameter of four to six or eight inches, according to species, are common in many places and offer convenient-sized timbers for a great variety of construction purposes. They are especially appreciated where other lumber is not available, either because of sparseness of the natural vegetation or because of a primitive or backward state of the wood-using industries. In the dry regions of northeastern Brazil, stems of the Carnaúba palm, much too valuable to be cut for its wood, have long been standard construction timber in rural districts. They furnish excellent strong and durable posts, beams and rafters for substantial buildings, often constructed partly of stone or brick, floored and roofed with tiles manufactured on the spot. There is a common local saying to the effect that all that is needed in building a house are some Carnaúba stems and a clay pit. For less substantial types of construction many palms are used in the tropics in preference to other woods, in some places to such an extent that especially favored species have become almost extinct, at least locally. Split and flattened stems of rather slender palms like *Euterpe* are much used for rough flooring in the tropics of both hemispheres. Some species, such as *Borassus* in India, are recommended for bridge building; some, including *Sabal* in Florida, are said to be useful for piers and may be resistant for a short time to salt water and toredo. Recently excavated old water pipes in Bahia were found to consist of hollowed-out palm stems, said to have been in use for many generations.

The dense woody cylinder of the spiny *Guilielma* or Peach palm is a favorite wood of the Amazonian Indians, serving them as material for bows, spearshafts, and arrows. Carefully bored stems of smaller Bactridae serve as the outer casing for blow pipes. The hard outer part of the stems of "Palma brava," *Livistona* spp., has been used in the Philippines for making the shafts of golf clubs, and similar material from the Panama Black palm, *Astrocaryum Standleyanum* Bailey, is consumed in limited amount in the United States for the manufacture of fishing rods. Thin cross sections of large palm stems are occasionally employed in marquetry.

Rattans

A kind of palm stem widely different from the usual columnar type is that of the climbing rattans of farther India, the East Indies, and the Philippine Archipelago. There are two principal genera, *Calamus* and *Daemonorops*, both with very numerous species, characterized by slender, enormously elongated stems. In contrast to most other palms, which generally prefer a rather open terrain, the rattan palms are truly forest inhabitants. Except for the stem itself, all parts of the plant, leaves, bracts, and sheaths, are plentifully supplied with spines. The greatly prolonged rachis of the leaf, converted into a meters-long tendril with sharp effective hooks or grapples, enables these palms to climb readily over other vegetation and to overtop the tallest tree. The stems in some species attain a length of 500 or 600 feet; and since many species have the habit of producing basal off-shoots and thus several or numerous stems, the rattan production from a single plant may be extraordinary. The quite unrelated climbing palms of the American tropics, of the genus *Desmoncus*, are also spiny and thin-stemmed, and are useful locally for tying and baling, but their stems lack the length, the even thickness, and the suppleness which place the best species of rattan among the most valuable of palm materials.

Rattan is gathered in the forest by pulling down the long stems, an operation which is not without hazard and calls for strength, fortitude, and experience. The stems, completely covered by spiny persistent leaf-bases, are then cleaned and cut into lengths, dried and sorted, after which they are tied, once bent, into bundles. The work of rattan collecting is mostly in the hands of licensed operators, in Malaya chiefly Chinese, who make advances of provisions or money to the actual gatherers and re-sell the product to agents of wholesale buyers. Singapore was long the chief export center for canes from the Malay Peninsula and the East Indies, Hongkong for canes from Cochinchina and islands of the Philippine Archipelago and Borneo.

The qualities expected of the best types of rattan are, first of all, tensile strength and toughness or resistance to breaking or splitting when twisted or bent, a combination of lightness, stiffness, and flexibility when dried, uniformity of thickness, and smoothness of surface coupled with inconspicuous nodes and length of internodes; also, for appearance, a light yellow color when dried. Preferred diameters range from about 1 cm. for export canes, which are usually desired for splitting, but thin canes of less than lead-pencil size, and large ones, an inch or more in thickness, find special applications, the latter particularly for bent-wood furniture, polo sticks, and skiing stocks. Strength, toughness, and elasticity are the chief requirements of rattans desired for use as rope and tow-lines, cables for small suspension bridges, or for manufacture into ship's fenders or buffers. Thin canes may be split and used for tying posts and rafters in house construction, for baling and wrapping, and for some types of baskets.

Rattan "canes" for splints call for all the desirable qualities of the best grades. The cutting of the splints from the outer hard and smooth layer of the cane is generally performed in special factories in the importing countries, the rattan being exported in bundles of canes in the round, with or without previous removal of the silicified epidermis. Preferably, this is removed more or less completely, since it is likely to break off in fragments on bending the dry canes and cause injury to the fingers of workmen and users. The chief use of rattan splints is for cane seats and backs of chairs and the manufacture of cane fabric for covering seats in street cars and railway coaches. The core remaining after the outer layer is removed is generally smoothed and used for the making of so-called reed furniture, light-weight baskets, and matting.

The selected cane suitable for making fine rattan walking sticks, known as Malacca canes, are in a special category. They are all derived from one species of rattan, *Calamus Scipionum* Lour., found in the Malay Peninsula, Cochin-China, Sumatra, and Borneo. Ordinarily they are obtained incidentally to the gathering of other kinds and grades of rattans and, when found, are laid aside to be prepared and sold separately. They require the utmost care in stripping and drying and to be valuable must have clear "internodes" long enough to furnish one-joint or "whole bark" sticks. They must also be

without scratch or blemish and be capable of being bent to produce the curved handle required without creases of the epidermis on the inner, or cracks on the outer, perimeter of the curve. Short joints and lengths from the base with some root attachments make special canes and umbrella handles. The other famous palm canes are the more ordinary "Pinang Lawyers" obtained from the stems of the small-leaved fan palm, *Licula acutifida* Mart.

In the vicinity of the principal centers of rattan collecting the natural supply has become reduced to such extent that replenishment by planting has been encouraged, and successful private rattan plantations exist in Malaya. The species selected for this purpose in Malaya is *Calamus caesius* Blume and some of its closest allies. Except for a few specimens existing in some of the botanic gardens of the tropics, and there generally planted in unsuitable spots, the introduction of rattans has apparently not been attempted on the American continent.

Use of Leaves for Thatch

The leaves of palms furnish many types of useful materials and products quite as distinctive as those obtained from the stems. As to general form and appearance they are divided into fan-shaped leaves as in the Palmetto; simple feathery or pinnate as in the Coco palm; and bipinnate as in the Fish-tail palms (*Caryota*), where the symmetrical leaflets are borne on lateral branches of the main rachis of the leaf. In the simple feathery leaves the leaf lamina is usually split into pinnately arranged segments, pinnae, or "leaflets," each with its firm supporting midrib; but it may also be undivided as in *Manicaria* and, like the broad lamina of a banana leaf, become split in time and frayed by the wind, or may remain permanently quite entire as in some Chamadoreas, or very little divided as in some species of *Geonoma*. Small fan-shaped leaves of various species furnish ready-made shapes for fans. The large leaves of the Indian Palmyra palm, *Borassus*, are made into punkahs, often painted or lacquered. The use of fan-shaped leaves for thatch is not unusual in the southeastern states where the

Blue Stem, *Sabal minor* (Jacq.) Pers., and others are locally available, and in southern Florida the Thatch palm, *Thrinax* spp. Leaves of the latter of various species are commonly used in Cuba, though most roofs of the simple Cuban "bohio," or country house, are thatched with leaves of Cabbage palms, *Sabal* spp., "Guano cana," or "Palma cana."

Simple pinnate palm leaves furnish ready material for temporary shelters as well as thatch for huts and even for well-constructed rustic buildings, on which a great deal of care and good workmanship is sometimes expended. On the lower Amazon one sees boatloads of the large banana-like leaves of the Bussú palm, *Manicaria*, being transported for thatch. Being entire and extremely convenient to use they are greatly esteemed for this purpose throughout northern South America and are much in demand among builders of huts and owners of roofs in need of repairs in a region where in the rainy season tropical downpours are frequent, torrential, and often prolonged.

Most pinnately divided leaves of the larger palms have the pinnae too obliquely placed to be serviceable for thatch as they are. The often yard-long pinnae are therefore detached from the leaf rachis and made into large and close "shingles" by fastening them at right angles to a thin stick, a few inches of the base of each leaflet being folded over the stick and stitched. Laid close and well overlapping, they are tied to the rafters and provide a waterproof and more or less durable roof according to the quality of the leaf employed. In the eastern tropics the favorite material for such shingles is the leaves of the Nipa palm. This is abundant and easily obtained, forming pure stands over large stretches of low ground along the lower rivers, but roofs made with its thatch have the disadvantage of being highly combustible and are therefore excluded in the neighborhood of towns. Walls are sometimes made of the same material prepared in the same manner, or are covered with mats made of palm pinnae. The result is a type of construction which, like Japanese bamboo and paper houses, would in most places be permissible only for temporary camps, but has the advantage of being inexpensive to erect and easy to replace if accidentally reduced to ashes.

Leaf Paper and Fiber

Some of the larger palms, such as Indian Palmyra palm, *Borassus flabellifer* L., and the Talipot of Ceylon, *Corypha umbraculifera* L., have stout leaves with a thick lamina and broad divisions that, when freed from their midribs, supply high-class leaf strips, especially the central ones from the unexpanded leaves which have not yet been exposed to light and have not begun to turn green. Such strips are prepared for use by a more or less elaborate treatment that usually includes boiling. Cut into short lengths and smoothed, the leaves of Borassus furnish writing tablets that may be used repeatedly by washing off the soluble ink employed. The broader strips of Corypha are used for more permanent manuscripts, the strips being held together by cords passed through holes in one or both ends. The writing is done with a metal style and made more visible by color rubbed in. Elaborate and handsome books are produced in Ceylon in this manner, with lacquered strips of wood for top and bottom covers.

Leaf strips, entire or split, of these and many other fan-shaped palms are used as material for the making of hats, mats, and bags in almost all tropical countries. Coarse strips of the lamina of the Philippine Corypha, the Buri palm, serve for making sugar bags. The Cuban Yarey, *Copernicia* spp., furnishes a high-class material for many kinds of mats, bags, and baskets. Splints from pinnae of *Attalea* are used likewise in Bahia.

The epidermis peeled from the upper surface of the pinnae of the unexpanded young leaves of the Madagascar *Raphia ruffia* Beauv. furnishes the soft and pliable material known as "raffia" which is employed locally for handsome mats and other soft fabrics, but is best known as an export article for its usefulness to horticulturists and nurserymen as a "bast" or tape for tying plants. The Philippine Corypha yields a similar "raffia." Unopened leaves of the Eta, Moriche, or Murity palm, *Mauritia flexuosa* Mart., of northern South America, are the source of an equivalent material, known in British Guiana as "tibisiri," which is twisted into cord and used for Indian slings and hammocks, extremely pliable and durable.

The midribs of many kinds of palms, separated from the pinnae, furnish material for basketry (*e.g.*, *Arenga*) and rough brooms (*Cocos*). The split midribs of unopened leaves of the Buri palm furnish material for the Calasio hats of the Philippines. Pinnae of many palms also yield fine leaf fibers that may be variously extracted, mechanically or by maceration. The excellent fiber known in the Guianas and Brazil as "tucum" is obtained from the leaf of *Astrocaryum*, and related palms give a similar fiber useful because of its strength for fish-lines and rope. Many kinds of roughly prepared leaf fiber serve for upholstery material. The best known of these is so-called vegetable horsehair, "crin végétal," obtained from the fan-leaved dwarf palm of northern Africa, *Chamaerops humilis* L., resembling in many respects our Scrub Palmetto, *Serenoa*, of Florida and the Gulf States which has also been used as a source of such material.

Uses for Leaf Stalks

The petioles or leafstalks of palms are rarely utilized as they are, but in arid regions, where close economy prevails and every kind of available material is closely scanned for utility, they are not allowed to go to waste. In northeastern Brazil the hard spiny-edged, about two-inch-wide leafstalks of the local Carnaúba or Wax palm find a large variety of uses as material for fences, gates, seats for benches, and even for bed slats. Wherever the Date palm grows its petioles must serve to fill a variety of needs, especially as splints for articles like baskets and crates. The spongy parenchymatous tissue within the large and externally very hard and siliceous petioles of the Jupati palm of the lower Amazon, *Raphia taedigera* Mart., becomes stiff and light on drying and furnishes a pith-like "wood," lighter than Balsa, and is sometimes used for very light small articles such as toy airplanes. Cut into rectangular blocks of suitable size, it is sometimes sold in the native markets for razor hones.

The hard and fibrous external layer within the epidermis of the petioles of many large palms, such as *Arenga*, may be split off and furnishes excellent tough splints for basketry, varying in coloring with age and species of leaf from which taken. The interior of the petioles of very many species in all parts of the

world furnish fiber utilized for many purposes, such as coarse upholstery material, fiber for plastering, calcimine brushes, whisk-brooms, rough cordage, and matting. The Florida Cabbage palm at one time supplied material for more than one fiber factory, and whisk-brooms of such Sabal fiber are commonly sold. One of the most interesting uses of petiole fiber is found in the Philippines where the so-called Buntal fiber is extracted from the leafstalk of the Buri palm. The external hard layer of the petiole being first removed in part and the whole structure mashed, the fresh white fibers are exposed and pulled out one by one by hand, and are then cleaned by soaking in acidulated water and boiled. The fiber serves for the manufacture of the well-known Bangkok hats distinguished for their open texture and lightness, and of the equally well-known, more serviceable "balibuntals," with different, much closer weave.

Uses for Leaf Sheaths

The leaf sheaths constitute one of the most characteristic structures of palms and are a source of important fibrous material of various kinds. In the arecoid palms the petioles proper may be said to begin at the top of the erect tubular leaf sheaths which, in many concentric layers, form a smooth green cylindrical shaft at the top of the stem and have the appearance of being its terminal portion. Professor Bailey calls this structure the "crown shaft." It is a conspicuous feature of the well-known Royal palms. In most palms, however, the lower strong portion of the leafstalk is expanded into a more or less clasping base forming part, often the major part, of the cylindrical leaf sheath which for the rest is completed by a thin fibrous web continuous with the margins of the expanded, often decidedly woody, leaf base. Sections of the basal part of the petiole of the larger palms exhibit the same massing toward the periphery of the same fibro-vascular bundles with horny sclerenchyma noted in the sections of the trunk where they represent a continuation of the petiole fiber.

In the course of the many months that the leaves or their bases remain attached to the trunk, the brown fibrous portion of the sheath remains wrapped about the trunk, its interlacing fibers forming a natural loose webbing, conspicuous in palms like the Coco palm. It is gathered from species of *Cocos*, *Trachycarpus*, *Copernicia*, *Sabal*, etc., and employed for rough saddle pads, rope, matting, and upholstery material. That of *Trachycarpus excelsus* Wendl., as carefully prepared in Japan, consists of fine, straight, dark brown fibers. Those gathered from species of *Caryota* are fine, tough, and black and useful for rope making. They are said to be extremely durable and much prized for thatch where obtainable in quantity. The sheath fibers of *Arenga* are also dark in color, but coarse and long, and might well be excellent for coarse mattress fiber. In some woody species the sheath fibers are plainly of the nature of the tough fibro-vascular elements of the petiole and trunk, and when eventually the web comes apart they remain for a long time draped like a tangled six-foot fringe from the woody margins of the leaf bases. Such fibers are known as "piassava." The most substantial and valuable material of this kind is from the Bahia Piassava palm, *Attalea funifera* Mart., of the coast of Bahia, mainly from the bay southward to Ilheos. A less stiff fiber, by way of distinction called Pará piassava, is produced by a very different palm, *Leopoldiana piassaba* Wallace, of the Rio Negro and upper Orinoco. Its finer and more flexible fiber was formerly much in favor for cables. On Venezuelan territory it is known as "chique-chique." So-called African piassava is the product of one of the Raffia palms. Besides the tough sheath fiber known as "kitool," species of *Caryota* yield, from the edge of the leaf base, also a short, fine, soft fiber useful for tinder. The Black Sugar palm has the fiber of the sheath mixed with long, black, thick, and stiff spines, probably formed like palm wood by the union of many sclerenchymatous fibers. The blunt spines on the edges of the leaf bases of some Orbignyas are extremely stiff and tough, and if they could be gathered would doubtless find applications such as bristles for rotary snow-brooms usually made of pencil-thick rattan. The two- to five-inch sharp black spines on the trunks of species of Tucum, such as *Astrocaryum tucuma* Mart. and *A. murumuru* Mart., supplied with a tuft of cotton, served the Amazonian Indians as darts for their blow pipes.

Uses for Flower Spathes

The flowering spadices of the palms are subtended by two or more spathes. When these are only two, one of them is generally insignificant in size, serving as a protection to the emerging and developing spadix during its earliest stages only. It is soon outstripped by the rapidly growing structure of the flower spadix, protected by an inner, much stouter spathe, which continues to grow and keeps pace with the spadix within until this reaches almost its full development. In certain large palms among the Cocoineae, such as the Orbignyas, this inner spathe is woody and may reach eight inches in diameter and a length of eight to ten feet, including a long slender tip. The construction of the spathe is such that, under the pressure of the growing spadix within, it finally splits lengthwise along its weakest longitudinal line, freeing the expanding spadix. Other types of palms develop a whole series of rather small membranous or papery spathes on the stalk of the spadix which becomes free at an early stage in its development and continues to grow as a free-hanging unprotected flower cluster, *e.g.*, in *Arenga* and *Caryota*. Repeatedly branched spadices, like those of *Sabal* and allies, have numerous small spadices on the branches. In the case of *Manicaria*, which has only two spathes, both are thin and fibrous; the second, large one, being very elastic, remains unsplit, though with mesh distended, throughout the flowering and fruiting period. These curious brown sheaths, distensible like a Christmas stocking, provide ready-made bags and practical peaked caps of a close texture. In the rustic and primitive economy of the Indians and caboclos, the broad and woody, rather short spathes of *Maximiliana* are often utilized as ready-made shallow bowls and trays.

Pacaya and Cabbage

The unexpanded staminate spadices of some species of *Chamaedorea*, resembling small or large ears of corn in the husk, are edible when cooked. They are sold in the markets, enclosed in their spathes, under the name of "pacayas" in Central American countries. A similarly edible product is palm "cabbage," also displayed in many markets in the tropics, enclosed in several layers of leaf sheaths, one or more of which must generally be removed before cooking. The really edible part of palm cabbage is the central tender white core from the growing tip of the palm. Almost all palms yield an edible cabbage, but its removal involves the destruction of the plant. Just as several species of Pacaya palms are planted for their edible spadices, certain species of palms, such as *Euterpe edulis* Mart., might well be planted for their cabbage, as suggested by Bondar who, in one of his papers on the useful palms of Bahia, discusses at some length the economic possibilities of this in places where land values are not too inflated.

Edible Fruits

Among palms planted for their edible fruit the foremost is doubtless the Date palm, *Phoenix dactylifera* L., which has been cultivated for ages as "The Tree of Life of the Arabs," and exists in numerous well-established varieties. A few of these have been introduced in North America and are successfully grown in southern Arizona and California and now well marketed in competition with imported dates. Much less known is the Peach palm, *Guilielma Gasipaes* (H.B.K.) Bailey, of the American tropics, already mentioned for its dense wood. This is often planted in small numbers as a dooryard tree, even by the Indians, in southern South America, and its fruit appears in the markets in attractive orange-and-red clusters or spadices weighing on an average three to five pounds. The starchy fruit with a large seed must be cooked. It is eaten as a vegetable and has an agreeable chestnut-like flavor. Another palm cultivated for its fruit is the large fruited *Borassus flabellifer* L. of India. It bears a mass of handsome brownish red or orange-red fruit, the size of large egg-plant, in clusters weighing fifty to a hundred pounds each. A single tree will sometimes furnish a cartload. It is appreciated by the Hindoos for its mango-like, but oily, pulp which encloses several very large seeds.

Wild palms bearing edible fruit are numerous, but the fruits must be rated as second or third class. One of the best is furnished by *Euterpe oleracea* Mart., the slender Manicole palm or Assai of the Guianas and the Amazon. The dark blue or

purplish fruits, the size of cherries, are borne in large numbers in slender-branched, rather brown-like spadices. The fruits are generally prepared by bruising in a wooden mortar to liquefy the pulp, which is then strained to remove the skin, some fiber, and the large round seeds. The result is a somewhat oily, blueberry-colored, thick liquid, not unlike blueberries in taste. A bowl of this, with mandioca meal added, is a standard lunch for many people on the Amazon. The oily pulp of the Bacába palm, *Oenocarpus* spp., and of *Jessemia Bataua* (Mart.) Burret, similarly prepared, but boiled, makes an acceptable hot chocolate-like beverage, the color of coffee with cream. With the ever-present farinha this also makes at least an emergency meal for a traveler. Another common palm of the same region, with a sizable fruit which furnishes a thin layer of edible pulp (mesocarp), is the Moriche palm, *Mauritia flexuosa* Mart. The yellow pulp forms a layer immediately under the reddish brown, thin, scaly pericarp. It has an agreeable acid flavor and, with the addition of some sugar, is made into a sweet-acid paste. Among the many other wild palms with fruit having an edible and more or less palatable pulp are rattans with a gelatinous pulp within a scaly pericarp, various kinds of the spiny Bactridae, and many Cocos palms, such as *Syagrus comosa*.

Edible Nuts

Palm fruits with an edible seed or kernel, the so-called palm "nuts," are equally, if not even more, numerous. They include all of the Cocoineae and a large number of others as diverse as the Brazilian Airi palm, *Astrocaryum aculeatissimum* (Schott) Burret, and the Ivory Nut palm (*Phytelephas* spp.) with a normally hard and edible seed which in its immature state is soft and gelatinous like that of a green coconut. The liquid content of the fully grown but immature fruit in the early stages of endosperm formation is well known as coconut water. The endosperm, which in its mature state is the familiar coconut "meat," is edible also in its early gelatinous form. In the early stages of germination the entire cavity of a coconut becomes filled with a spongy white mass formed by the conversion of the cotyledon into a large absorptive organ which gradually breaks down the endosperm, converting it into food for the germinating plant. This spongy mass is also edible and is considered a delicacy.

PALM OILS

The chief utility of the coconut is of course for oil production and is dependent on the large oil content of the endosperm. Where the Coco palm exists, oil for local consumption is usually produced from fresh coconuts. These are split to permit the removal of the kernel, either entire or in a few large pieces, and are then grated, usually on a revolving drum. The resulting liquid, consisting of a mixture of water, oil, and pulp, is boiled, skimmed, and the oil separated as far as possible by rather rough methods. For shipment or export for oil production at distant points, the coconut meat is dried. In this form it is known as "copra." Copra is one of the world's main sources of vegetable oil and constitutes the principal export article of many oceanic islands and tropical shores, a source of income for producers, traders, sailors, and ship owners. The statistics of the world production and commerce in copra are expressed in terms of thousands of tons and millions of dollars.

The coconut itself is worth examining for comparison with other palm fruits of its group that likewise have kernels yielding oil. The general shape of the coconut bears witness to its origin from a tri-locular ovary. The fact that only one of its three cells is developed has also influenced the shape of the fruit in spite of its relatively large size. The external bulk is made up of pericarp. The hard, siliceous outer layer, usually referred to as outer skin (ectocarp), encloses a thick fibrous layer (mesocarp), light and brown in the mature dry fruit. Its fibers are firmly attached both to the external skin and to the hard and horny egg-shaped "shell" (endocarp or "putamen") which covers the seed with its oily endosperm. To comply with plant quarantine regulations, coconuts imported into the United States are required to have the husk, *i.e.*, the two external layers of the pericarp, removed. It is this fibrous husk of the fruit which is the source of all so-called coconut fiber, known in the trade as "coir," but familiar to the public in the form of manufactured articles such as the coarse brown matting used as hall runners and the thick bristly doormats. There are varieties of Coco palms bearing fruit in which the fibrous layer is altogether preponderant and, since the fiber tends to rival the copra in value, such varieties are sometimes planted especially for coir. The brownish black shell of the coconut is hard and dense, but brittle. It is often cut and polished to make a variety of simple and primitive articles such as buttons, cups, and ladles.

In volume and value of oil produced, the African Oil palm, *Elaeis guineensis* Jacq., rivals or exceeds the Coco palm, though the use of its products as an edible oil was for a long time limited to Africans. It is a large pinnate palm of the Guinea Gulf region extending eastward to the great lakes of Africa, occurring sometimes in pure stands. It is found also in Zanzibar and is widely planted elsewhere in the tropics, especially where there are people of African origin who like to use its oil for cooking. It is seldom planted on a large scale except in the East Indies and Malaya, where it was introduced about one hundred years ago and became well established in the course of the latter half of the last century. The fruit is borne in short, thick, erect bunches (spadices), tightly wedged in the leaf axils. Climbers cut the entire bunches and drop or lower them to the ground, where they are then allowed to wilt to loosen the fruits, which are not easily picked from the crowded maze of stiff zigzag branches composing the compact spadix. The individual fruits are plum-like, dark yellowish brown, and shiny, appearing somewhat translucent, with thick skin, a soft but tough oily pulp (mesocarp), and a fairly large hard endocarp containing the seed. The oil from the pulp is obtained by a combination of maceration, crushing, and boiling with water. This was formerly performed in a messy manner beginning with partial decomposition of the fruit in pits in the ground, with a resulting odoriferous product mixed with foreign matter. The early African palm oil thus acquired a bad reputation and the exported article could be used only for industrial purposes, such as soapmaking, axle grease, and machine oil. It is now extracted expeditiously with the use of modern equipment and a considerable part of it is utilized in margarine manufacture. The endosperm of the kernels, which were formerly discarded, are the source of the African kernel oil, or simply kernel oil. This differs in chemical composition from the oil of the pulp, or "palm oil," and is of much better grade, being equivalent to kernel oils of other palms, exemplified by that of the Coco palm and its near relatives, the large Brazilian Babassú palms, the Central American Cohune and Scheelea palms, as well as a large number of smaller Cocoineae. All of these have fruits much smaller than the coconut but of an essentially similar structure, though considerably varied in detail in different genera and ranging in size from a large goose egg to a small plum.

The most important of these oil-yielding Cocos relatives is the Babassú, *Orbignya* spp. (chiefly *O. Martiana* Barb. Rodr.). Its main center of distribution is to the southeast of the south of the Amazon in the Brazilian State of Maranhão. There it covers thousands of square miles and sometimes forms extensive pure stands. It is a large palm with a thick trunk and huge pinnate leaves with broad woody petioles and leaf bases. The fruit, of large goose-egg size, is produced in great quantity in spadices from the axils of the lower leaves, a single bunch containing several hundred fruits and weighing from 100 to 200 pounds. The fruit contains four to six kernels of finger thickness or less, often somewhat triangular in section and slightly curved, with tapering rounded seeds. These kernels yield an oil superior to coconut oil, but they are difficult to extract from the fruit, as they are contained in separate cavities in a tough woody endocarp which must be split several ways to free them. The usual local manner of accomplishing this is to hold the nut with one hand over the upturned edge of an axe while it is given a few sharp blows with a short heavy piece of wood. Most of the Babassú kernels used locally or exported have long been obtained in this manner. Machines have been invented to split the nuts lengthwise into six segments, but they have been less successful than expected. In spite of the prevailing primitive method, Babassú kernel production has been considerable, amounting to about 50,000 tons in 1939. The export center is the old city of São Luis. The United States, Germany, and Denmark were the chief importers. Babassú fruits have been used as emergency fuel for steamers and the

split husks make excellent fuel and produce a high grade of charcoal as well as a large range of wood-distillation products. With millions of tons of fruit going to waste, there is abundant room for improvement and expansion of the industry, but various primitive conditions in a sparsely settled region, especially lack of roads, have been unfavorable factors.

The Cohune palms of the Mexican west coast and the east coast of Central America from British Honduras southward has been known as a favorable source of high grade palm kernel oil. Closely related to the Babassú and of the same genus, *Orbignya*, the Cohune palm bears somewhat smaller fruits, usually with single kernel much more readily extracted than those of the Babassú. The mesocarp layer of the husk is decidedly fibrous and the woody endocarp not so thick and hard as in the Babassú fruit. Satisfactory machinery is said to have been developed to expedite the extraction of the kernels.

Very similar fruits are produced by species of the related genus *Scheelea*, large palms of Central America and northern South America. The Central American species, known as Corozo palms, have been investigated recently for oil. Their fruits are somewhat smaller than that of the Cohune which they resemble in having but one kernel yielding a white kernel oil. The woody endocarp is thinner and surrounded by a fibrous mesocarp with sufficient oil content to be worth extracting separately as yellow "palm oil." Four or five species are local in separate areas extending from the east coast of Mexico to the west coast of Central America into Panama. Of the many smaller species of Cocos palms that are actually used for production of kernel oil on a commercial scale, the most important, because of its abundance, is the so-called Licuri palm of eastern Brazil. It is estimated that there are about a billion of these palms in the State of Bahia, the chief area of distribution. In the north of Brazil the fruits of two species of *Astrocaryum*, known as Tucum and Murumurú, are available in considerable quantities and used for oil production, the former especially in the State of Piauhy, the latter particularly in Pará.

The Acrocomias of the American tropics, the Coyol palms of Central America and Mucaja or Mocaya of South America, are of interest and importance here as a source of yellow palm oil from the mesocarp as well as of white kernel oil from the seed. Kernel oil of all palm species being similar in nature to coconut oil, is treated as such in the trade, the term "palm oil" being reserved for the yellow oil from the mesocarp or pulp, as of the African Oil palm, the differences in properties of the two classes being correlated with differences in chemical composition. A clear edible oil from the pulp, suitable as a substitute for olive oil, is yielded by the fruit of South American palms of the genera *Oenocarpus* and *Jessenia*, Bacába and Batauá palms, respectively. It is only recently that their importance as a potential source of edible oil has been recognized.

Of palm kernels that are not edible the Betel-nut should be mentioned first. It is widely known and used as a masticatory by millions of people of southern Asia and the East Indies. It is produced by a rather small but tall-growing pinnate palm, *Areca Catechu* L., of Malaysian origin. It is generally planted in the region where it is used. It begins to bear small spadices of fruit after five years and continues to produce for fifty.

Ivory Nuts

At least two genera of palms are well-known for the utility of the extremely hard endosperm of their seeds, namely, *Phytelephas* of the Andean and adjoining hylaea region of northern South America and *Coelococcus* of the Caroline Islands. The former, the Ivory Nut palms, were made known first from Peru by Ruiz and Pavón and were called Pulipuntu. There exist several or perhaps many species, all with fruit in the form of large rough syncarps which contain seeds extremely hard and durable when mature and furnishing a highly esteemed material for button-making. *Coelococcus* is much more rarely seen. It is a pinnate palm related to the Raphias, bearing long clusters of scaly fruit about the size of an orange, with a thin pericarp enclosing a large globose seed with a broad pit-like depression. The dense and homogeneous endosperm is brown, takes a fine polish, and furnishes an ideal material for small carvings. The seeds are seldom offered in this country, the few that are exported being sent to China and Japan. A somewhat remotely similar palm material is

furnished by the tough, brown, very homogeneous endocarp of the Bahia Piassava palm, *Attalea funifera* Mart. This is sometimes exported to Europe as material for small articles of turnery.

Uses for Palm Sap

The woody stems of certain climbers are known to furnish a measure of pure water when cut. In the eastern tropics rattans are said to be an ever ready source of such liquid. Palm sap is esteemed in many places for its potable sweet quality either fresh or fermented, and that of certain species is regularly employed as a source of sugar. In India the Wild Date palm, *Phoenix sylvestris* Roxb., is commonly tapped by cutting a cavity in the stem near the top, after clearing away the leaves from the spot. The sap will collect in the cavity and, if the edges are pared daily, will continue to flow and can be collected for many weeks. If permitted to ferment, it quickly becomes converted into "toddy," or fermentation can be prevented or delayed by the use of lime and the sap boiled down for palm sugar. The Black Sugar palm, *Arenga pinnata* Mart., better known as *A. saccharifera* Labill, is a favorite source of toddy or sugar in the East Indies and the Philippines, where it grows about the villages rather than in the forest. The sap is obtained from the stalk of the male spadices, first bruised somewhat by a gentle beating or malleting repeated over several days. If the stalk is cut just above the branching point and kept pared, the sap continues to drip for weeks from the cut surface and collects in joints of bamboo tied in place and emptied twice a day. The African Wine palm, *Raphia vinifera* Beauv., is tapped in the same manner for the preparation of palm wine. This may be obtained also from the Coco palm by fermenting the sap that will flow from a cut unexpanded flowering spadix, still enclosed within its spathe, following a preliminary bruising as in tapping the Arenga palm. By distillation of the fermented sap from any of these sources, a more potent liquor is obtained called "arrack."

The most prolific source of palm sap for alcohol production is offered by the Nipa palm which forms extensive pure stands over vast swampy stretches on flooded land from India to

Australia and the Philippine Archipelago. This is the pinnate-leaved palm with underground horizontal stems, mentioned above as a source of thatch. Its fruit is formed in large heads (syncarps), supported by erect stalks two or three feet tall, appearing among the leaves. A stalk when cut yields a continuous flow of one or two liters of sap per day. No climbing is required for the operation and the collected liquid can generally be transported by water. This source of alcohol has been exploited on a large scale in a few places by distilleries operated in connection with sugar mills, otherwise idle between harvests. The potentialities of the Nipa swamps for alcohol production has been emphasized by the Philippine Bureau of Science.

The large and handsome pinnate palm, *Jubaea spectabilis* H.B.K., the only palm native to Chile and formerly plentiful, is becoming scarce since it was first described by Molina, and is said to be on the way to complete extermination as a result of destructive methods of tapping for syrup production. The Indian or native woodsman in tropical countries rarely hesitates to fell a tree for its fruit or other product. It is therefore not surprising that the regular procedure for obtaining palm wine from the Coyol palm, *Acrocomia*, of southern Mexico, is to chop down the tree and cut a large hole in the trunk in which the sap will gather and ferment. Sugar made by boiling down palm sap is generally poured in moulds to crystallize and harden. It usually appears in the local markets in the form of cakes or bars wrapped in palm or banana leaves.

Palm Starch

Many palms, especially those that flower and fruit only at maturity, accumulate starch in the parenchyma of the stem. In the so-called Sago palms, *Metroxylon sagus* Rottb. and the somewhat smaller *M. Rumphii* Mart., the starch accumulated in a palm during ten or fifteen years of its life before flowering begins may amount to several hundred pounds or even to as many kilos or more. It is obtained by felling the tree at the proper time. Sometimes a test hole is bored in the stem. The cortex of the felled trunk is removed from the upper half and then all the soft woody and starchy tissue is chipped away and

reduced by pounding or rasping to the consistency of sawdust. This is churned up repeatedly with water and the starch allowed to settle, to be gathered up and re-washed or passed through sieves until sufficiently clean. Locally this palm starch is "sago," but in trade this term has come to mean the familiar agglutinated grains produced by passing the mass of damp starch through sieves and drying the resulting grains in hot pans under constant stirring. The polished "pearl" sago may be produced by a process of shaking the glutinous mass in a kind of hammock to break it up into small round grains as it dries.

Several other palms yield a quantity of edible starch in the Eastern tropics, especially *Caryota*. As an emergency food in case of famine the South American Carnaúba palm is said to be cut down and the pithy parenchyma split into pieces which are chewed like cane for the small amount of starch they contain.

Vegetable Wax

One of the important materials obtained in large quantities from certain palms is vegetable wax. This is a natural, very special product of the metabolism of innumerable plants, usually produced as a thin external film covering the epidermis of green parts of the plant. In xerophytes, such as Cacti and some Euphorbs, the wax film doubtless serves as an effective aid in reducing surface evaporation. It is produced in varying quantities by the leaves of many palms which characteristically inhabit dry, warm, and often wind-swept regions.

The best known and economically most important vegetable wax is that of the Carnaúba palm, *Copernicia cerifera* Mart., of northeastern Brazil. In this species the large fan-shaped leaves are heavily coated with a film of wax, especially abundant in the young leaves even before they expand. When its leaves are cut and allowed to wilt and become somewhat dry, the wax film becomes loosened and can be removed in the form of fine flakes by shaking the leaf or, more effectively, by beating it. This is generally done in a small, poorly ventilated shed to prevent the wind from carrying off the light powdered wax, but more expeditiously on a large scale in closed drums with the aid of machinery. The wax has long been used locally for making candles and tapers. Its principal use now is as the most essential ingredient of floor, furniture, and automobile polishes, but it is in demand for many other purposes, including the manufacture of phonograph records and carbon paper and as a finishing material for certain types of textiles. The supply of this wax is restricted by the limited extent of the natural stands of these palms growing in the drought areas of Brazil. The natural enemies of the young plants are cattle and browsing goats. Some beginning has been made toward systematic planting.

Adjoining the Carnaúba region in an area of eastern Brazil where another source of a useful wax has been found in a Cocos palm locally called Licury, *Syagrus* (*Cocos*) *coronata* Mart., already mentioned as a source of oil for which it has long been known. The thin wax coating of the pinnate leaves of this palm is, however, not so readily removed. It does not loosen on drying the leaf, as in the case of the Carnaúba palm, but must be obtained by scraping the pinnae. The hard brownish wax has some properties in common with Carnaúba wax, but differs sufficiently in composition to have other characteristics of its own, and is finding special industrial uses.

Of various other palms known to yield wax for candles, the most famous is the Andean Wax palm, *Ceroxylon* spp., of Colombia and western Venezuela. The wax in this case is formed in a thick layer among the leaves on the upper part of the stem. It cannot be gathered without felling the trees, which are very tall and slender, not abundant, and yield only a small quantity per stem. The palms are therefore mostly spared, and the wax is not an article of trade except locally.

Other Products

There are many miscellaneous minor palm products. The well-known dye-resin, "dragon-blood," excreted by the fruits of *Daemonorops* spp., is now used mainly in the photo-engraving trade. Tannins are sometimes obtained from stems of *Arenga*, *Cocos*, *Sabal*, and *Serenoa*. Palmyra gum flows from injuries to the trunk of *Livistona rotundifolia* Mart. Areca

Catechu contains some alkaloids, one of them, arecolin, being known as a vermifuge. A poison from the sap from one of the rattans is said to be used for poisoning darts, and the seeds of the African *Raffia vinifera* Beauv. may be powdered and thrown into the water to stupefy fish.

It may be observed that while many palm materials, products, and uses have been enumerated, often only by way of examples, most of them are chiefly of local importance, particularly in countries in a somewhat primitive handicraft stage. Several products, however, are of sufficiently general utility to be factors in the export trade, and a few of them, notably oils, waxes, and rattans, rank high in world commerce.

KEYS TO AMERICAN WOODS (CONTINUED)

By Samuel J. Record

This key is the thirteenth in a series begun in *Tropical Woods* No. 72, December 1, 1942. Those in the preceding issues are: (No. 72) I. Ring-porous woods. II. Pores in ulmiform or wavy tangential arrangement. III. Pores in flame-like or dendritic arrangement. (No. 73) IV. Vessels virtually all solitary. V. Vessels with spiral thickenings. (No. 74) VI. Vessels with scalariform perforation plates. VII. Vessels with very fine pitting. (No. 75) VIII. Vessels with opposite or scalariform pitting. IX. Woods with conspicuous rays. (No. 76) X. Woods with storied structure. (No. 77) XI. Woods with resin or gum ducts. XII. Parenchyma reticulate. These keys are intended for use in connection with Record and Hess' *Timbers of the New World* (see *Tropical Woods* 73: 42) wherein many of the anatomical features are well illustrated by photomicrographs.

XIII. Woods with septate fibers. Such woods are virtually all of tropical or subtropical origin. The fibers function as parenchyma strands and usually, but not always, occur where parenchyma is absent or poorly developed. They are likely to be filled with starch in the sapwood, but not all starch-bearing fibers are septate (*e.g.*, *Acer*). In some woods all of the fibers appear to be septate, in others they may be localized about the vessels or form patches and bands visible under the lens. The pits in septate fibers are simple or provided with only narrow or vestigial borders; in some instances the associated fibers have distinctly bordered pits. Finely chambered crystalliferous fibers (*e.g.*, in certain Polygonaceae) are not readily distinguishable from crystalliferous parenchyma strands, but when macerated the fiber remains whole while the strand disintegrates into its short cellular components.

American woods with some or all of the fibers septate were found in 280 genera of 52 families. Only 142 of these genera are named in this key, mainly because of the present difficulty of separating closely related members of such families as Flacourtiaceae, Lauraceae, Leguminosae, Melastomaceae, Moraceae, Myrsinaceae, Rubiaceae, Verbenaceae, and Violaceae.

XIII. WOODS WITH SEPTATE FIBERS

1 a. Vessels virtually all solitary (pores rarely in contact radially) .. 2
b. Vessels not all solitary 12

2 a. Included phloem present .... Hippocrateaceae.
b. Included phloem absent 3

3 a. Septate fibers in parenchyma-like arrangement 4
b. Septate fibers not so arranged 9

4 a. Rays in part very large and conspicuous. Septate fibers in reticulate arrangement (cross sect.) 5
b. Rays not very large and conspicuous. Septate fibers in bands .. 6

5 a. Pores up to medium-sized; not distinct without lens. *Hemiangium* (Hippocrateaceae).
b. Pores mostly large and distinct .... *Hippocratea* (Hippocrateaceae).

6 a. Vessels with oval, scalariform, several-barred perforation plates. *Elaeodendron* (Celastraceae).
b. Vessels with exclusively simple perforations 7

7 a. Rays all uniseriate or biseriate. Vessels with fine spirals. *Austroplenckia* (Celastraceae).
b. Rays wider. Vessels without spiral thickenings 8

8 a. Pores irregularly distributed. Vasicentric tracheids absent. *Maytenus* (Celastraceae).
b. Pores in radial or diagonal chains. Vasicentric tracheids common. *Alvaradoa* (Simarubaceae).

9 a. Rays almost all very wide. Vessels with exceptionally long, fine-barred, scalariform perforation plates. *Hedyosmum* (Chloranthaceae).

b. Rays 1–5 (7) cells wide. Scalariform plates (if present) not long. 10

10 a. Vessels with fine spirals; perforations multiple in part. Parenchyma very sparse .... *Oxydendrum* (Ericaceae).
b. Vessels without spiral thickenings; perforations all simple. Parenchyma reticulate 11

11 a. Ripple marks present, but irregular. Uniseriate rays few. Fibers thin-walled .... *Dicraspidia* (Elaeocarpaceae).
b. Ripple marks absent. Uniseriate rays numerous. Fibers very thick-walled .... *Ouratea* (Ochnaceae).

12 a. Septate fibers in parenchyma-like arrangement 13
b. Septate fibers not so arranged 23

13 a. Rays heterogeneous, usually decidedly so 14
b. Rays homogeneous or nearly so 19

14 a. Vasicentric tracheids present 15
b. Vasicentric tracheids absent 16

15 a. Minute vessels and tracheids with spirals. Radial latex tubes and vertical gum cysts sometimes present. Parenchyma-like fibers terminal, vasicentric-confluent, or diffuse.. *Connarus* (Connaraceae).
b. Vessels without spiral thickenings. Latex tubes and gum cysts absent .... *Rourea* (Connaraceae).

16 a. Parenchyma-like fibers diffuse in ground mass of thick-walled non-septate fibers. Vessel pits not vestured.... *Marila* (Guttiferae).
b. Parenchyma-like fibers variously aggregated. Vessel pits vestured 17

17 a. Parenchyma-like fibers loosely aggregated into patches or irregular bands with large interstitial spaces .... Melastomaceae.
b. Parenchyma-like fibers not so arranged 18

18 a. Parenchyma-like fibers in numerous, narrow, concentric bands. *Ginorea* (Lythraceae).
b. Parenchyma-like fibers in vasicentric to aliform arrangement. *Lafoensia* (Lythraceae).

19 a. Ripple marks present; 80–90 per inch. Vessel pits vestured. *Poeppigia* (Leguminosae).
b. Ripple marks absent 20

20 a. Crystalliferous parenchyma strands numerous. Vessel pits not vestured. Parenchyma-like fibers in poorly defined bands. *Allophylus* (Sapindaceae).
b. Crystalliferous strands absent. Vessel pits vestured 21

21 a. Parenchyma-like fibers in rather sharply defined continuous or interrupted, regular to wavy bands.... *Physocalymma* (Lythraceae).
b. Parenchyma-like fibers in poorly defined bands 22

22 a. Fibers all abundantly septate; those in bands finely chambered. *Triplaris* (Polygonaceae).
b. Fibers rather sparingly septate, not finely chambered; those in bands thinner-walled and more loosely aggregated than the

others . . . . *Capparis* (Capparidaceae).

23 a. Gum ducts present in some of the rays 24
b. Radial gum ducts absent 36

24 a. Duct-bearing rays of the same shape (tang. sect.) as the other multiseriate rays 25
b. Duct-bearing rays locally enlarged about ducts (tang. sect.) . . . 28

25 a. Vessel perforations multiple, at least in part.
Dendropanax, *Didymopanax*, *Oreopanax* (Araliaceae).
b. Vessel perforations all simple 26

26 a. Uniseriate rays numerous. Pores 3–9 per sq. mm.
Spondias (Anacardiaceae).
b. Uniseriate rays few. Pores 20–35 per sq. mm. 27

27 a. Intervascular pitting fairly uniform; alternate. Rays 1–4 (5) cells wide . . . . *Bursera* (Burseraceae).
b. Intervascular pitting irregular; opposite to scalariform. Rays sometimes 6–8 cells wide.
Didymopanax, *Oreopanax*, *Sciadodendron* (Araliaceae).

28 a. Vessel perforations multiple in part; scalariform plates with numerous narrow bars . . . . *Campnosperma* (Anacardiaceae).
b. Vessel perforations all simple 29

29 a. Rays 10 or more per mm. (tang. sect.) 30
b. Rays 3–7 per mm. (tang. sect.) 32

30 a. Ductless rays all uniseriate or uniseriate and biseriate. Tyloses absent or few. Heartwood orange-brown . . *Tetragastris* (Burseraceae).
b. Ductless rays 1–3, in some instances 4 or 5, cells wide. Tyloses abundant. Heartwood reddish; uniform or with dark streaks . . . 31

31 a. Solitary pores 3–7 times as numerous as the multiples. Wood of flinty hardness in cutting across the grain.
Schinopsis (Anacardiaceae).
b. Solitary pores usually fewer than the multiples. Wood not difficult to cut across the grain . . . . *Astronium* (Anacardiaceae).

32 a. Ductless rays 1–6, mostly 4 or 5, cells wide. *Juliania* (Julianiaceae).
b. Ductless rays 1 or 2 (3) cells wide 33

33 a. Parenchyma sparingly vasicentric and locally confluent; also finely terminal. Fiber walls thick . . . . . . *Metopium* (Anacardiaceae).
b. Parenchyma very sparse; not confluent or terminal. Fiber walls medium to thin 34

34 a. Pores 20–35 per sq. mm.; in ulmiform arrangement. Vessels with spirals. Ducts inconspicuous. Heartwood dull red.
Schinus (Anacardiaceae).
b. Pores 6–15 per sq. mm.; not in ulmiform arrangement. Vessels without spiral thickenings. Ducts conspicuous because of dark exudations. Wood lustrous 35

35 a. Pores small. Heartwood pinkish . . . . *Tapirira* (Anacardiaceae).
b. Pores medium-sized in part. Heartwood brown or reddish brown,

with dark laminations or streaks varying in width and regularity.
Loxopterygium (Anacardiaceae).

36 a. Parenchyma reticulate 37
b. Parenchyma not reticulate 49

37 a. Ripple marks present; larger rays not storied 38
b. Ripple marks absent 41

38 a. Vessel-ray pitting coarse 39
b. Vessel-ray pitting fine 40

39 a. Heartwood rich reddish brown; distinct.
Bombacopsis (Bombacaceae).
b. Heartwood dull brown, merging into sapwood.
Bombax, *Pachira* (Bombacaceae).

40 a. Pores frequently in multiples. Rays with very numerous sheath cells . . . . *Hampea* (Bombacaceae).
b. Pores infrequently in multiples. Rays with comparatively few sheath cells . . . . *Dicraspidia* (Elaeocarpaceae).

41 a. Pores in distinctive diagonal, flame-like, or dendritic pattern . . 42
b. Pores not so arranged 43

42 a. Large oil cells present in parenchyma strands.
Grabowskia (Solanaceae).
b. Oil cells absent . . . . *Espadaea*, *Henoonia* (Solanaceae).

43 a. Rays homogeneous or nearly so 44
b. Rays decidedly heterogeneous 46

44 a. Rays 1–3 cells wide. Pores rather numerous.
Thouinidium (Sapindaceae).
b. Rays uniseriate or partially biseriate. Pores very few 45

45 a. Pores large. Vessel-ray pitting medium . . . . . *Toulicia* (Sapindaceae).
b. Pores up to medium-sized. Vessel-ray pitting fine.
Pseudima (Sapindaceae).

46 a. Vessel-ray pitting fine. Vessel pits vestured 47
b. Vessel-ray pitting very coarse in part. Vessel pits not vestured . . 48

47 a. Pores frequently in small multiples . . . . *Guettarda* (Rubiaceae).
b. Pores infrequently in contact radially . . . . *Ouratea* (Ochnaceae).

48 a. Pores small; very numerous. Perforations simple.
Caryocar (Caryocaraceae).
b. Pores large in part; rather few. Perforations multiple in part.
Belangera (Cunoniaceae).

49 a. Rays large and conspicuous, at least in part 50
b. Rays not large and conspicuous, though often distinct 69

50 a. Strands of unlignified parenchyma present.
Myriocarpa, *Urera* (Urticaceae).
b. Strands of unlignified parenchyma absent 51

51 a. Rays with aggregates of thin-walled resinous cells . . . . Myrsinaceae.
b. Rays without such aggregates 52

52 a. Open radial channels present . . . . Cactaceae.
b. Open radial channels absent 53

53 a. Late-wood pores in ulmiform arrangement 54
b. Late-wood pores not so arranged 55

54 a. Vessels with spirals; perforations simple. Rays homogeneous or nearly so . . . . *Berberis* (Berberidaceae).
b. Vessels without spirals; perforations multiple. Larger rays with complete multiseriate sheath of upright or square cells. *Ribes* (Grossulariaceae).

55 a. Parenchyma aliform and confluent into irregular broken and anastomosing bands . . . . . *Castilla, Olmedioperebea* (Moraceae).
b. Parenchyma otherwise (or absent) 56

56 a. Raphides in some of the ray cells 57
b. Raphides absent 58

57 a. Pores distinctly 2-sized, the small ones flattened in radial rows. Rays up to 15 cells wide; nearly homogeneous . . . . *Vitis* (Vitaceae).
b. Pores not distinctly 2-sized. Rays up to 8 cells wide; decidedly heterogeneous . . . . *Marcgravia* (Marcgraviaceae).

58 a. Perforations all multiple 59
b. Perforations exclusively or predominantly simple 61

59 a. Intervascular pitting coarse, typically scalariform. Rays sometimes 15 cells wide. Parenchyma sparingly diffuse. *Mollinedia* (Monimiaceae).
b. Intervascular pitting rather fine, rarely scalariform. Rays infrequently up to 8 cells wide. Parenchyma apparently absent 60

60 a. Pores radially arranged because of the close spacing of the rays. *Carpotroche* (Flacourtiaceae).
b. Pores not in distinct radial arrangement, the rays being more widely spaced . . . . *Amphirrox, Rinorea* (Violaceae).

61 a. Vessels with spirals . . . . *Boldea* (Monimiaceae).
b. Vessels without spirals 62

62 a. Intervascular pitting long-scalariform . . . . . *Clusia* (Guttiferae).
b. Intervascular pitting alternate 63

63 a. Rays virtually all multiseriate 64
b. Rays not all multiseriate 65

64 a. Rays homogeneous or nearly so. Vessel pits vestured. *Symmeria* (Polygonaceae).
b. Rays heterogeneous. Vessel pits not vestured . . . . Myrsinaceae.

65 a. Intervascular pitting medium to coarse; vessel-ray pitting tending to scalariform . . . . *Vernonia* (Compositae).
b. Intervascular pitting and vessel-ray pitting fine to very fine . . . 66

66 a. Pores crowded by the rays into long rows or series. Crystals common to abundant in the rays. *Casearia, Hecatostemon, Ryania* (Flacourtiaceae).

b. Pores not in distinct radial arrangement. Rays less numerous; crystals few or absent 67

67 a. Broad rays with many procumbent cells, rounded on tang. sect. Vessel pits vestured . . . . . *Elaeagia, Ferdinandusa* (Rubiaceae).
b. All rays coarse-celled, without distinctly procumbent cells 68

68 a. Ray cells all flattened hexagonal (tang. sect.). Vessel pits vestured . . . . *Coussarea* (Rubiaceae).
b. Ray cells not all flattened hexagonal (tang. sect.). Vessel pits not vestured . . . . *Eupatorium* (Compositae).

69 a. Intervascular pitting opposite or scalariform 70
b. Intervascular pitting typically alternate 90

70 a. Scalariform perforation plates present, at least in part, and not confined to the smallest vessels 71
b. Scalariform perforation plates absent or confined to the smallest vessels 81

71 a. Tanniniferous tubes common in rays. (See Key VI, 125–127.) Myristicaceae
b. Tanniniferous tubes absent 72

72 a. Vessels with spirals. Woods more or less ring-porous 73
b. Vessels without spirals. Woods diffuse-porous 75

73 a. Vessel spirals fine and inconspicuous. Small late-wood pores mostly not in multiples. Scalariform plates few. *Arctostaphylos* (Ericaceae).
b. Vessel spirals rather coarse and very distinct. Late-wood pores mostly in multiples. Scalariform plates few to many 74

74 a. Late-wood pores often in long multiples, with distinct tendency to form wavy bands . . . . . . *Azara microphylla* (Flacourtiaceae).
b. Late-wood pores in small multiples, without definite tangential arrangement . . . . *Arbutus* (Ericaceae).

75 a. Rays typically uniseriate . . . . *Brunellia* (Brunelliaceae).
b. Rays often 3 or 4 (5) cells wide 76

76 a. Pores rarely, if ever, in long multiples 77
b. Pores frequently in long multiples 78

77 a. Growth rings well-defined. Rays up to 30 cells high; procumbent cells long. Fibers sparingly septate . . . . . *Laurelia* (Monimiaceae).
b. Growth rings absent or poorly defined. Rays often over 100 cells high; procumbent cells short. Fibers abundantly septate. Violaceae.

78 a. Pores in long multiples much flattened radially. *Arechavaletaia* (Flacourtiaceae).
b. Pores in long multiples not much flattened 79

79 a. Ray crystals mostly in vertical pairs of cubical cells. Vessel perforations predominantly simple . . . . . *Hasseltia* (Flacourtiaceae).
b. Ray crystals of general occurrence. Vessel perforations predominantly multiple 80

80 a. Growth rings terminated by band of flattened fibers. *Hasseltiopsis* (Flacourtiaceae).
b. Growth rings poorly defined...... *Tetrathylacium* (Flacourtiaceae).

81 a. Ring-porous or nearly so.................................. 82
b. Diffuse-porous, though with pores sometimes decreasing in size during a season's growth.................................. 83

82 a. Pore ring multiseriate; late-wood pores in clusters with tendency to diagonal or tangential arrangement. Parenchyma rather abundant in early wood............. *Aralia spinosa* (Araliaceae).
b. Pore ring uniseriate; late-wood pores in small scattered multiples. Parenchyma sparingly paratracheal...... *Pseudopanax* (Araliaceae).

83 a. Intervascular pitting uniformly long-scalariform. (See Key VIII, 91–96.).. Guttiferae.
b. Intervascular pitting opposite, at least in part............... 84

84 a. Vessels with fine spirals.............. *Olmediella* (Flacourtiaceae).
b. Vessels without spirals.. 85

85 a. Rays 1 or 2 (3) cells wide and less than 50 cells high; not distinctly 2-sized.. 86
b. Rays frequently 3 or 4 (or more) cells wide and over 50 cells high; distinctly 2-sized... 87

86 a. Procumbent cells numerous in definite strata in multiseriate rays. *Crinodendron* (Elaeocarpaceae).
b. Procumbent ray cells few; not definitely stratified. *Vallea* (Elaeocarpaceae).

87 a. Pores often in long multiples. Procumbent ray cells few; not in definite strata.. 88
b. Pores not in long multiples. Procumbent ray cells numerous; in definite strata in multiseriate rays........................ 89

88 a. Pores thin-walled, angular. Density low. *Aristotelia* (Elaeocarpaceae).
b. Pores thick-walled, rounded. Density high. *Lindackeria* (Flacourtiaceae).

89 a. Pores small. Rays frequently over 5 cells wide; procumbent cells slender; sheath cells common........... *Sloanea* (Elaeocarpaceae).
b. Pores medium-sized. Rays infrequently over 4 cells wide; procumbent cells large; sheath cells absent or few. *Mahurea* (Guttiferae).

90 a. Vessel pits very small (not over 4μ)........................ 91
b. Vessel pits not very small, sometimes large................... 109

91 a. Ripple marks present.................... *Swietenia* (Meliaceae).
b. Ripple marks absent.. 92

92 a. Ring-porous..................................... *Auxemma* (Boraginaceae).
b. Diffuse-porous... 93

93 a. Vessels with spirals...................... *Xylosma* (Flacourtiaceae).
b. Vessels without spirals.. 94

94 a. Parenchyma in concentric bands.............................. 95
b. Parenchyma sparse or absent; not in concentric bands........ 98

95 a. Parenchyma bands within the growth ring and not terminal (or initial) only; definitely associated with the pores. *Guarea* (Meliaceae).
b. Parenchyma bands terminal (or initial), though sometimes doubled or tripled; typically apotracheal................... 96

96 a. Parenchyma bands wide; coarse-celled. Pores large in part. Rays 1–5 cells wide; heterogeneous....... *Carapa, Swietenia* (Meliaceae).
b. Parenchyma bands narrow; fine-celled. Pores small. Rays 1 or 2 (3) cells wide; homogeneous or nearly so.................... 97

97 a Raphides present in enlarged parenchyma cells. *Raputia* (Rutaceae).
b. Raphides absent................ *Cupania, Exothea* (Sapindaceae).

98 a. Septate fibers limited to immediate vicinity of vessels........ 99
b. Septate fibers of general occurrence......................... 101

99 a. Rays 1 or 2 (3) cells wide and less than 35 cells high. Pores medium-sized in part..................... *Wallacea* (Ochnaceae).
b. Rays 1–4 (7) cells wide and up to 60 or more cells high....... 100

100 a. Pores large in part. Vessel-ray pitting unilaterally compound. *Cespedesia* (Ochnaceae).
b. Pores small to minute. Vessel-ray pitting not unilaterally compound.................................... *Tyleria* (Ochnaceae).

101 a. Rays mostly uniseriate and low; occasionally biseriate........ 102
b. Rays often 2–4 (7) cells wide and up to 60 (100) cells high.... 104

102 a. Fibers frequently crystalliferous........ *Podopterus* (Polygonaceae).
b. Fibers not crystalliferous.................................... 103

103 a. Pores small; mostly in radial multiples and rows. *Beloperone, Pachystachys* (Acanthaceae).
b. Pores very small; mostly solitary........ *Stenosolen* (Apocynaceae).

104 a. Parenchyma sparingly paratracheal and diffuse........ Rubiaceae.
b. Parenchyma virtually absent.................................. 105

105 a. Marginal ray cells usually procumbent; interspersed rows of large cells (square on radial section, circular on tangential) common....................... *Gymnopodium* (Polygonaceae).
b. Marginal ray cells square or upright......................... 106

106 a. Marginal ray cells in part distended, resembling oil cells. Radial channels common.. 107
b. Distended ray cells and radial channels absent.............. 108

107 a. Latex tubes present in some of the rays. *Peschiera, Stemmadenia* (Apocynaceae).
b. Latex tubes absent... *Bonafousia, Tabernaemontana* (Apocynaceae).

108 a. Multiseriate rays with definite strata of procumbent cells. Taste not distinctive.................................. Flacourtiaceae.
b. Rays not definitely stratified; cells virtually all square or upright. Taste bitter.................. *Picramnia* (Simarubaceae).

109 a. Vessel-ray pitting coarse to very coarse, at least in part....... 110
b. Vessel-ray pitting rather fine to medium.................... 118

110 a. Perforations all multiple, the plates scalariform, reticulate, or foraminate.................. *Meliosma, Ophyocaryon* (Sabiaceae).
b. Perforations exclusively or predominantly simple............ 111

111 a. Latex tubes present in some of the rays.................... 112
b. Latex tubes absent.................................... 113

112 a. Vertically elongated gum cysts present. Rays 1 or 2 cells wide. *Cnestidium* (Connaraceae).
b. Gum cysts absent. Rays up to 5 (or more) cells wide....Moraceae.

113 a. Oil cells present in rays or parenchyma or both........Lauraceae.
b. Oil cells absent.................................... 114

114 a. Vessel pits vestured.................................. 115
b. Vessel pits not vestured............................... 116

115 a. Vessel-ray pitting distinctly 2-sized: fine and coarse. Intervascular pitting fine..................... *Glandonia* (Malpighiaceae).
b. Vessel-ray pitting variable, but not distinctly 2-sized. Intervascular pitting coarse................ *Fuchsia, Jussiaea* (Onagraceae).

116 a. Ray cells very irregular in size, form, and arrangement (tang. sect.); sheath cells common. Vessels apparently without tyloses. Acanthaceae.
b. Ray cells often variable in size, but in fairly definite arrangement; sheath cells uncommon. Tyloses usually abundant in heartwood.. 117

117 a. Ray pits to vessels in part narrowly elongated, often boomerang-shaped...Verbenaceae.
b. Ray pits to vessels large to very large, round to oval. Anacardiaceae, Burseraceae.

118 a. Vessel pits vestured.................................. 119
b. Vessel pits not vestured............................... 126

119 a. Rays homogeneous or nearly so.......................... 120
b. Rays definitely heterogeneous.......................... 123

120 a. Paratracheal parenchyma very sparse..................... 121
b. Paratracheal parenchyma abundant....................... 122

121 a. Diffuse crystalliferous parenchyma strands numerous. *Coccoloba, Neomillspaughia* (Polygonaceae).
b. Diffuse crystalliferous parenchyma strands replaced by finely chambered crystalliferous wood fibers...*Ruprechtia* (Polygonaceae).

122 a. Diffuse crystalliferous parenchyma strands common. Uniseriate rays numerous....................................Leguminosae.
b. Diffuse crystalliferous parenchyma strands absent or few. Uniseriate rays infrequent................*Crataeva* (Capparidaceae).

123 a. Rays 1 or 2 cells wide and up to 25 cells high............... 124
b. Rays 1–4 (6) cells wide and up to 40 (80) cells high.......... 125

124 a. Parenchyma apparently absent............*Adenaria* (Lythraceae).
b. Parenchyma terminal, sparingly paratrachael, and in diffuse crystalliferous strands..................*Spachea* (Malpighiaceae).

125 a. Pores distinctly 2-sized. Parenchyma vasicentric, short aliform, and sometimes confluent; diffuse crystalliferous strands common. *Banisteria, Banisteriopsis* (Malpighiaceae).
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CURRENT LITERATURE

The plant life of Cuba. By William Seifriz. *Ecological Monographs* 13: 4: 375–426; 64 text figs.; October 1943.

"The progress of ecology has been that common to every science: first the recording of obvious and general facts, then the careful analysis of local conditions, and, finally, experimental work. The ecology of Cuba has not yet reached a completion of the first stage, and until this is done detailed research cannot be fitted into a general scheme. The present survey of the vegetation of Cuba is primarily a geographical one. It is offered not only for its own intrinsic value, but as a background for future work.

"It is the writer's hope that physiological and ecological studies in the tropics will greatly increase. Both of these sciences are based on studies done primarily in temperate, especially north temperate, countries. . . . Plant succession and climax associations are as real in the tropics as in the north. Pure stands need not come into the picture. The general rule seems to be abundant species with few individuals of each in the tropics and few species with many individuals of each in the north."

"The vegetation of Cuba has been divided into nine major associations: 1. Coast. 2. Desert. 3. Thicket. 4. Limestones. 5. Savana, 6. Cultivated fields. 7. Communities and guilds. 8. Forests. 9. Alpine vegetation. To these a final chapter has been added on Maisi, at which locality there are, within a relatively short distance from coast to mountain top, five distinctive plant associations, and each typical of a part of Cuba. Maisi thus serves well as a final chapter, for it is a survey of the plant associations of all Cuba."

The writer adheres wholly to his own experiences in Cuba. Though this plan leaves some regions unmentioned, no major features of the island's vegetation are undescribed. "Such is the purpose of this monograph, to depict the geography of Cuba's plant life, not to detail it."

Nectandra coriacea. By Caroline K. Allen. *Addisonia* (New York Botanical Garden) 22: 1: 9–10, 12; 1 colored plate; April 1943.

This species, commonly known as Sweetwood, a rather small tree native to Florida, Yucatan, and the West Indies, is fully described and illustrated.

Exploración botánica de la Barranca de Tolantongo. By Ladislao Paray. *Bol. Soc. Bot. México* (México, D. F.) 1: 2–7; 4 text figs.; January 1944.

An interesting account of a 4-day visit to the Barranca de Tolantongo, a xerophytic region about 50 kilometers northeast of Ixmiquilpan, Hidalgo, Mexico. Among the trees and shrubs for which vernacular names were recorded are: Cristalillo, *Vallesia glabra* (Apocynaceae); Guayacán, *Helietta parvifolia* (Rutaceae); Manto de Coyote, *Morkillia mexicana* (Zygophyllaceae); and Olote, *Hoverdenia speciosa* (Acanthaceae).

Studies of Central American plants, IV. By Paul C. Standley and Julian A. Steyermark. *Bot. Ser. Field Museum* (Chicago) 23: 2: 31–109; Feb. 14, 1944.

"Almost all the new species described on the following pages are Guatemalan and were discovered during the four botanical expeditions to that country conducted on behalf of Field Museum of Natural History by the authors. The paper includes a few nomenclatorial changes found necessary in the course of preparation of the *Flora of Guatemala*, manuscript of which is now well advanced."

El hule y nuestra flora. By José Ignacio Aguilas G. *Revista Agricola* (Guatemala) 20: 10–12: 19–33; Oct.–Dec. 1943.

An annotated list of the latex-yielding trees and shrubs growing in Guatemala. They represent 16 genera of four families, namely, Moraceae (3), Apocynaceae (4), Euphorbiaceae (4), and Sapotaceae (5).

Por los predios de la flora regional. By H. Daniel. Medellín, Colombia, Nov. 1943. Pp. 15; 6¾ x 9½; 5 text figs.

An annotated list of 53 species of 17 genera of Colombian Melastomaceae, mostly native to the Department of Medellín and all represented in the herbarium of the Colegio de San José.

Caldasia. Boletín del Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, Bogotá. No. 9, Jan. 6, 1944.

CONTENTS (botanical)

El quishuar u olivo del páramo u olivo de los Incas, *Buddleia incana* H.B.K., fam. Loganiaceae. By M. ACOSTA SOLÍS. *Flora* (Quito, Ecuador) 3: 119–125; December 1943.

The Quishuar is a little tree rarely 15 feet high of common occurrence in the páramos of Ecuador where it frequently forms thickets. In early times the Incas preferred its wood for the carving of their idols which were lavishly adorned and burned during the fiestas of the R'aimi. Present inhabitants of the páramos and some of the interandine settlements like to use the wood in construction because of its great strength combined with high resistance to decay and insects. It also provides excellent fuel. The author recommends the establishment of many colonies of the trees in localities where they do not occur naturally in order to extend the range of the species over the páramos and thus supply additional sources of wood in the treeless regions.

***Joosia pulcherrima*, una nueva especie ecuatoriana de Rubiaceae.** By WILLIAM CAMPBELL STEERE. *Flora* 3: 195–198; December 1943.

The new species is a tree about 33 feet high and 10 inches in diameter discovered by the author at an elevation of 2000–2200 meters in Provincia de Napo Pastaza, Cantón Sucumbíos, Oriente, Ecuador. Because of its beautiful, jasmine-scented, roseate flowers it is recommended for cultivation in parks and gardens.

O pinho brasileiro. By GASTÃO DO NASCIMENTO CECCATTO. Pub. No. 850, Serviço de Informação Agrícola, Min. da Agr., Rio de Janeiro, 1943. Pp. 39; 6¼ x 9; 30 text figs.

A well illustrated account of the Paraná Pine, *Araucaria angustifolia*, with particular reference to growing it in forest plantations.

Breves informações sobre a *Piptadenia communis* ("jacare"). By Serviço Florestal, Min. da Agr., Rio de Janeiro, 1943. Pp. 8; 6¼ x 9; 4 text figs.

The Jacaré is a mimosaceous tree noted for its rapid growth and ability to regenerate itself by sprouts, hence valuable for planting for firewood. This leaflet (Serviço de Informação Agrícola No. 15) describes the tree and how to grow it.

A noz do Brasil (castanho do Pará). By HANNIBAL PORTO. Pub. No. 7, Serviço de Informação Agrícola, Min. da Agr., Rio de Janeiro, 1943. Pp. 19; 6¼ x 9; 9 plates.

An illustrated account of the collection, processing, and merchandising of Brazil nuts, the seeds of the large Amazonian tree, *Bertholletia excelsa*. These nuts are much better known in the United States and Great Britain than in southern Brazil, and the purpose of this pamphlet is to stimulate local interest in this valuable product.

Goma de mascar. Nova indústria extrativa para o Brasil. By GREGORIO BONDAR. Boletim No. 14, Instituto Central de Fomento Economico da Bahia, 1943. Pp. 28; 6 x 9; 8 figs.

Calls attention to the large number of Sapotaceae and a few Apocynaceae of Bahia, and of eastern Brazil in general, that deserve investigation as a potential source of chicle or chicle equivalent. Some of these are well known as fruit trees in Bahia, *e.g.*, *Lucuma torta* Mart., *Ecclinusa ramiflora* Mart., *Lucuma nervosa* A. DC., and *Pradosia lactescens* (Vell.) Kuhlm., while others are known only by their vernacular names or are still practically or completely unknown.—B. E. Dahlgren, *Chicago Natural History Museum*.

Recopilación tecnológica de botánica y de patología vegetal. By Julio C. Bertelli. *Rev. Asoc. Ing. Agr.* (Montevideo, Uruguay) 15: 4: 35–69; December 1943.

"The present work consists of a compilation of terms and concepts used in botany and phytopathology, according to the bibliography cited, with some suggestions of the author."

Euphorbiaceae argentinae: Phyllantheae, Dalechampieae, Cluytieae, Manihoteae. By A. Lourteig and C. A. O'Donell. *Lilloa* (Tucumán) 9: 77–173; 21 text figs., 2 maps, 18 plates; 1943.

"In the present revision the authors study the genera *Phyllanthus*, *Dalechampia*, *Cnidoscolus*, *Jatropha*, and *Mahihot*. They describe a new species, *Jatropha Peiranoi*, and two varieties, *J. excisa* var. *viridiflora* and *J. excisa* var. *pubescens*. *Dalechampia stipulacea* var. *minor*, *Cnidoscolus Löfgrenii*, *C. tubulosus* var. *triloba*, *Jatropha grossidentata*, *J. ribifolia* var. *breviloba*, and *Manihot multiflora* are mentioned for the first time in Argentina."

Malpighiaceae argentinae. By C. A. O'Donell and A. Lourteig. *Lilloa* 9: 221–316; 10 text figs., 4 maps, 18 plates; 1943.

"The authors study systematically the Argentine *Malpighiaceae*. They mention for the first time for Argentina the following species: *Tetrapterys ambigua*, *Banisteriopsis metallicolor* v. *subrotunda*, *Heteropterys hipericifolia*, *H. sylvatica*, *Stigmatophyllum Hasslerianum*, and *Aspicarpa linearifolia*, and they make the new combinations *Aspicarpa pulchella*

(Griseb.), *Banisteriopsis metallicolor* (Juss.) O'Don. et Lourt. var. *subrotunda* (Nied.), *B. m.* var. *sericea* (Nied.), and *B. nitrosiodora* (Griseb.)."

Lythraceae argentinae. By A. Lourteig. *Lilloa* 9: 318–421; 27 text figs., 1 map, 7 plates; 1943.

"The present paper is a revision of all the species of Lythraceae of Argentina. Here the author describes the new species, *Cuphea Bonplandii*, and the new varieties, *Cuphea racemosa* (L.f.) Spreng. var. *discolor*, *C. r.* var. *palustris*, and *C. mesostemon* Koehne var. *missionera*. The following species are recorded for the first time in Argentina: *Ammannia latifolia* L., *Cuphea costata* Koehne, *C. ingrata* Cham. & Schlecht., and *C. ianthina* Koehne."

A revision of *Couma* and *Parahancornia* (Apocynaceae). By Joseph Monachino. *Lloydia* (Cincinnati, O.) 6: 4: 229–247; December 1943.

"In this article *Couma* and *Parahancornia* are revaluated. *Couma oblonga* and *C. amara* are transferred to *Parahancornia*. Four names [*C. sapida* Pittier, *C. guatemalensis* Standl., *C. capiron* Pittier, and *C. caurensis* Pittier] are placed in synonymy under *Couma macrocarpa*, and three new species are described in *Parahancornia*. An attempt is made to summarize the more important taxonomic information concerning these genera and their species, whereas all outstanding non-taxonomic references are at least included in the bibliography."

Studies in the Simaroubaceae, I. The genus *Castela*. By Arthur Cronquist. *Journ. Arnold Arboretum* 25: 1: 122–128; January 1944.

Contains an historical account of the genus *Castela* Turpin and a catalogue and key to the twelve species. *Castela spinosa*, a spiny Cuban shrub, is described as new.

"There are several obvious species-groups in the genus *Castela*. *Castela erecta*, *C. galapageia*, and *C. tortuosa* are closely related and only doubtfully distinct. Presumably they had a common ancestor in relatively recent time. Three

Cuban and one Jamaican species form another closely knit group: *C. spinosa*, *C. jacquinifolia*, *C. calcicola*, and *C. macrophylla*. The characters on which these are separated are minor, and they too would seem to have had a recent common ancestor. A third group is formed by *C. Tweedii* and *C. coccinea*, of South America. Though obviously related, these two species are amply distinct. Of the three remaining species, *C. peninsularis* seems to be an offshoot of the *C. macrophylla* group, *C. retusa* forms a connecting link between the *C. macrophylla* and *C. erecta* groups, and *C. depressa* is evidently related to *C. erecta*."

Anisotropic contraction of wood and of its constituent cells. By R. D. Preston. *Forestry* (Oxford, England) 16: 32–48; 1942.

"As a result of observation of cell dimensions and wall structure in fibers of hardwoods and tracheids of softwoods, it appears that the anisotropic shrinkage of these cells on drying arises as a consequence of the anisotropic properties of their cellulose complex. A theoretical discussion is presented, admittedly in a very simple form, of the connection between swelling behavior of cellulose and of whole cells, and the experimental observations are found to agree closely with predictions. It therefore follows that anisotropic shrinkage in wood in bulk may also be connected with the properties of the cellulose complex, expressed in terms of the cell types composing the wood. As far as the data now available are concerned, longitudinal shrinkage in wood appears to be of the same order as that observed here in single cells and, further, yields a figure for the average micellar inclination of the constituent cells very close to that determined by direct observation. Various other features of anisotropic shrinkage of wood prove also to be in harmony with the present theory. Finally, it appears that the development of stresses in growing timber may not be unconnected with the swelling properties of its constituent cells, following the lines of the present theory."—*Author's summary.*

M. M. CHATTAWAY

Price 30 cents

Yale University School of Forestry

TROPICAL WOODS

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 79 September 1, 1944

A technical magazine 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 any articles therein, the authorship of which is not otherwise indicated, is SAMUEL J. RECORD, *Dean of the Yale University School of Forestry.*

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MISCELLANEOUS NOTES ON TROPICAL AMERICAN WOODS

By SAMUEL J. RECORD

Known range of *Phyllostylon* extended to Ecuador

Phyllostylon brasiliensis Cap., the only species of this ulmaceous genus, is a small to medium-sized tree with a wood sometimes used commercially as a substitute for Boxwood. It is known to occur in Cuba, Dominican Republic, Haiti, southern Mexico, Guatemala, Nicaragua, Colombia, Venezuela, southern Brazil, Paraguay, and northern Argentina. I have recently identified as this species a wood sample collected by members of the U. S. Forest Service in Ecuador. The local name is given as Candelo.

Billia in Ecuador

In June 1943 Dr. Elbert L. Little, Jr., while in Ecuador on the Latin American Forest Resources Project of the U. S.

Forest Service, collected specimens of a tree known as Capulí in the Province of Macuchi. The herbarium material, which is sterile, was not recognized at the U. S. National Herbarium, but a resemblance to *Caryocar glabrum* was noted.

The wood, which is of about the consistency of Birch (*Betula*), bears little or no resemblance to *Caryocar*. Since the rays are all uniserate, the wood accordingly belongs in Key No. 14, published in this issue, and it is readily located when the following characters are known: (1) Wood of normal structure; (10) vessel perforations simple; (25) vessel pits more than 4μ in diameter; (52) vessels not all solitary; (56) parenchyma not reticulate; (67) ripple marks absent; (70) fibers not septate; (87) vessels without spirals; (93) vessel-ray pitting similar to the intervascular; (98) parenchyma not in bands *within* the growth ring; (103) vessel pits not vestured; (107, 109, 111) parenchyma bands all apotracheal and terminal, and composed of several rows of cells—*Billia* (Hippocastanaceae). A detailed description of this wood appears in *Tropical Woods* 58: 1–2.

My determination of this wood as *Billia* has been confirmed by an examination of the herbarium material by Dr. Leon Croizat. The species is probably *B. columbiana* Planch. & Linden, which is known to occur from Gutamala to Venezuela and Colombia. I have no knowledge of its having been found in Ecuador before.

Humiria Discovered in Central America

In *Tropical Woods* 77: 8–9, March 1, 1944, I told of having identified a Costa Rican wood sample, labeled "Ira chiricana," as *Humiria*, one of the three genera of a family (Humiriaceae) not then known to occur outside of South America. This resulted in a search for the tree in the forest and the discovery by Dayton and Barbour of a new species of *Vantanea*, also of the Humiriaceae. I insisted, however, that this find did not settle the question as to the identity of the original sample, which I still believed to be *Humiria*.

It now appears that on May 7, 1943, about a month before they found the *Vantanea*, the same collectors had obtained a wood sample and sterile herbarium material (Dayton & Barbour 3004) of a tree known locally as Campana. The material was sent to Paul C. Standley who, not recognizing it, forwarded a small leafy twig to me for study. I replied on June 14, 1943, that "it seems to fit best in the Theaceae, though I cannot place it exactly." There the matter rested until the middle of May 1944 when I received a piece of the mature wood. This, and also Merker, Scholten & Dayton No. 3041, collected on the same date, I recognized as probably congeneric with the original sample obtained at a sawmill. Mr. Standley agreed with my identification of them as *Humiria* and added: "Both of the specimens are sterile and cannot be described as new, which I presume they are." Both collections were made in rain forest at an altitude of 750–900 feet in Limón Province. No. 3004, from "hills above La Florida," was 60 feet high and 12 inches in diameter, breast high. No. 3041, from "hills four miles south of Sequirres," was 80 feet tall, 28 inches, d. b. h., and had a usable bole length of 40 feet.

As previously stated (*Tropical Woods* 77: 9), the first Yale specimen of *Humiria* wood from Central America was obtained by Dr. Alvin G. Cox in Bocas del Toro, Panama, 20 years ago. Two Costa Rican samples were supplied by G. Proctor Cooper in 1927, one from the Guapiles District, the other originally from the Province of Puntarenas. All of these were from boards cut in local sawmills.

The wood of *Vantanea* is considerably denser than that of *Humiria*, and logs are better suited for hewing into structural timbers than for sawing into lumber. Dr. Alexander F. Skutch, in a recent letter from his home in San Isidro del General, says: "There is a good deal of Ira Chiricana among the heavy timbers of this house. It is so exceedingly hard that it is difficult to drive a nail into it without first drilling a hole."

Included Phloem in *Pera* Wood

In an excellent collection of about 200 Surinam wood samples sent, with herbarium vouchers, to the Yale School of Forestry by Dr. Gerold Stahel, Director of the Agricultural Experiment Station at Paramaribo, is one (No. 82) of Hatsiballi, *Pera bicolor* (Kl.) Muell. Arg., characterized by conspicuous, more or less concentric bands of included phloem. A disk from a trunk 40 cm. (16 in.) in diameter shows 6–10 of these bands, in part fairly regular, but mostly irregular and broken, with local anastomoses. Dr. Stahel says: "If not sawed immediately after cutting the tree, the wood dries and splits into many concentric pipes along the interxylary phloem layers."

In the Yale collections are wood samples of ten species of *Pera*, including three specimens of *P. bicolor*, and none shows any laminations of included phloem. Some of them, however, have peculiar radial growths which appear on tangential section as open ducts. For want of a better name, I have referred to them as "radial channels," and I have recorded the occurrence of the same or of similarly appearing structures in certain American species of *Alchornea*, *Conceveiba*, *Conceveibastrum*, *Croton*, *Euphorbia*, *Gavarretia*, *Mabea*, *Pera*, *Sapium*, and *Senefeldera*. In the Stahel specimen these structures are very numerous and appear to be phloem bridges or slender radial connections between the bands. Their exact nature cannot be determined from the study of dried material. I have noted radial phloem in fusiform rays of *Antonia* and *Bonyunia* (Loganiaceae).

The families in which open radial channels of one kind or another have been reported are: Apocynaceae, Cactaceae, Euphorbiaceae, Koeberliniaceae, Liliaceae (*Yucca*), Loganiaceae, Solanaceae, Thymelaeaceae, and Tiliaceae (*Heliocarpus*). Four of these families have one or more genera characterized by vertical strands or bands of included phloem, namely: Apocynaceae (*Lyonsia*), Euphorbiaceae (*Dalechampia*, *Pera*), Loganiaceae (*Antonia*, *Bonyunia*, *Logania*, *Strychnos*), and Thymelaeaceae (*Aquilaria*, *Brachythalamus*, *Dirca*, *Gyrinops*, *Gyrinopsis*, *Linostoma*, *Lophostoma*, *Synaptolepis*).

According to Solereder (*Systematic anatomy of the dicotyledons*, pp. 1160–1161) intraxylary phloem occurs in many families, including some or all of the members of the Apocynaceae, Euphorbiaceae, Loganiaceae, Solanaceae, and Thymelaeaceae mentioned above. "The term 'intraxylary phloem' is here taken in a general sense to include those groups of soft bast which are situated internally to the ring of vascular bundles; in their further course these phloem-groups bend out into

the leaves together with the leaf-trace bundles, on the inner side of which they are situated." Since these radial channels often suggest leaf traces, principally because of their position, perhaps they represent cavities which originally contained extensions of phloem from the outer edge of the pith to the leaves.

VIROLA GUATEMALENSIS (HEMSL.) WARB. IN MEXICO

By Charles Louis Gilly
New York Botanical Garden
(on leave-of-absence)

Although a small handful of oil-seeds, which was brought to my attention in Mexico several months ago, could be assigned with certainty to the family Myristicaceae, they could not be positively named at that time. Only Standley's "Trees and Shrubs of Mexico" was available to me as an aid to the identification of these seeds and, because of the very scant description published therein (Contr. U. S. Nat. Herb. **23**(1): 284. 1920) and, also, since the seeds had come from the Pacific slope of the State of Chiapas, it could not be decided whether they were referable to *Compsoneura Sprucei* (A. DC.) Warb., the only previously recorded member of the Myristicaceae in Mexico, which has been collected in the Gulf-coastal State of Tabasco.

The first lot of seeds had been collected in April or May of 1943 by Mr. Thomas MacDougall, of New York City, who has spent at least three months out of each of the last sixteen years exploring and collecting in Mexico, principally in the States of Oaxaca and Chiapas. In the early part of March 1944, MacDougall obtained additional seeds, together with capsules and leaves, from approximately the same location; and a month later Sr. Moises Mugüerza, of Cacaohatán, Chiapas, was able to furnish me with flowering branches from the same region.

The MacDougall material was collected near Cacaohatán, and very probably in the Municipio of Tuxtla Chico, State of

Chiapas, only a few air-line kilometers inside the Guatemala-Mexico boundary; exact date of this collection is not known, but a photograph of the trees, made at the time by MacDougall, indicates that the boles attain a diameter of at least 70 centimeters. The Mugüerza specimens were also obtained near Cacaohatán on April 11, 1944; Sr. Mugüerza has written me, in part and in the Spanish, as follows: "I am sending you the specimens from three different trees, in three different packages. No. 1 and No. 2 are from trees which are about 10 meters distant and their height is about 30 meters. No. 3 is from a tree which is about 400 meters distant from the other two and its height is about the same as that of the other two. The flowers are small and yellow in color. These trees are located on the left bank of the Río Cahuacán, about 50 meters from the edge of the river; there are some trees on the high level portion of the finca, but these have already finished blooming."

Reference to A. C. Smith's recent treatment, "The American Species of Myristicaceae" (Brittonia **2**(5): 393–510. 1938), and a study of the accumulated material now before me, indicate that a second species of the family Myristicaceae can now be listed as a member of the Mexican flora; *Virola guatemalensis* (Hemsl.) Warb. is the first representative of this genus to be found in Mexico. The previously known distribution of this species has been given by Smith (*l.c.*, p. 499) as Guatemala, Honduras, Costa Rica, and Panama. As presently known, then, the distribution of this species consists of five apparently disjunct areas: (1) from Huixtla and Cacaohatán, Chiapas in Mexico along the Pacific slope to somewhere in the Department of Suchitepequez, Guatemala; (2) in the Department of Alta Verapaz, which lies mainly within the Caribbean drainage of Guatemala; (3) in the Lancetilla valley of Caribbean-coastal Honduras; (4) on the slopes of the Volcán de Orosi in extreme northwestern Costa Rica; and (5) in the Chiriquí region of western Panama. Whether the distribution of the species might be more or less continuous between Chiapas and Chiriquí (no collections having as yet been reported between the disjunct areas listed above) cannot at present be determined. Altitudinal range of

the species is not completely known. Smith cites 350 meters for the Suchitepequez specimens and 1120 meters for the Costa Rica material; the Cacaohatán area lies between 400 and 450 meters above sea level.

The extension of range reported in this paper is, actually, not very great. The airline distance from Cacaohatán to the nearest point on the western boundary of the Department of Suchitepequez is only 75 kilometers, or about 45 miles. It can be logically assumed, I believe, that the species occurs in more than one locality within the intervening region; Dr. W. J. Martin, a field man of the U. S. Department of Agriculture, has informed me that this tree grows near Retalhuleu (capital of the Dept. of Retalhuleu, Guatemala, which adjoins Suchitepequez on the west), but specimens have not yet been obtained from this locality. MacDougall reports that colonies of the species are found westward from Cacaohatán at least as far as Huixtla (Km. 376.3 from Veracruz on the Veracruz-Suchiate railroad), a distance of approximately 40 kilometers, and perhaps further.

In both the Cacaohatán area and in Guatemala, as reported by Smith, *Virola guatemalensis* is called Cacao Bolador by the natives. The commonly interchangeable usage of *b* and *v* ("bolador" or "volador") is noticeable in the various renderings of this vernacular name. Because of the confusion thus created, it may be of more than just passing interest to note that the name Cacao Bolador is also applied, in Chiapas, to the seeds of *Licania arborea* Seem., a commercially important oil-seed of this and other parts of Mexico; however, the seeds of this latter plant, a member of the Amygdalaceae, are more commonly known by the vernacular names of Cacahuananche and Totopostle in the Mexican areas of commercial production. An unidentified oil-seed, which I have not as yet seen, from the State of Tabasco is also reported as Cacao Bolador; whether this will prove to be a *Licania* or *Compsoneura Sprucei*, or whether this is an indication that some species of *Virola* may grow there, cannot now be determined.

In *Virola guatemalensis* both the seed kernel and the aril which encloses the seed are sources of oil. I have before me a sample of the oil from the thick waxy aril, expressed in a crude native manner almost two years ago; despite the fact that this oil (which is used by the natives of the Cacaohatán region as a hair-dressing and for epidermal massages) was kept for more than a year in the warm and humid climate of southeastern Chiapas, it is in excellent condition and exhibits no evidence of rancidness or other form of deterioration. An analysis of the oil from the seed kernel, which seems to be of possible use in the preparation of fine cosmetics, is now being made.

Smith (*l.c.*, p. 395) records that wax obtained from the seeds of *Virola surinamensis* (Rol.) Warb. (a closely related species with a distribution from the northern Lesser Antilles to the Guianas and Atlantic-coastal northern Brazil) is used in making soap and candles, and that the oil or wax from the seeds of *Virola sebifera* Aubl. (which ranges from Nicaragua through northern South America as far as Peru and southern Brazil) is used medicinally.

In the principal details of leaves, inflorescence, and flower structure the Chiapas specimens agree with Smith's characterization of *Virola guatemalensis;* however, some of the leaves of the Mugüerza material are as much as 30 centimeters in length and the ultimate flower fascicles of the staminate inflorescence (with 15 to 20 flowers each) are apparently more floriferous than the specimens examined by Smith. Smith mentions color of aril for only one of the 35 species which he recognizes in the genus *Virola*, the aril of *V. macrocarpa* A. C. Sm. having been described as "red." Standley, in "The Forests and Flora of British Honduras" (Publ. Field Mus. Bot. **12**: 140. 1936) describes the aril of *Virola merendonis* Pittier (= *V. Koschnyi* Warb., according to Smith), a species closely related to *V. guatemalensis*, as white or pink. The multi-lobed, deeply laciniate fleshy arils which almost cover the seeds of the Cacaohatán material of *Virola guatemalensis* are a brilliant orange-scarlet (or almost vermilion) in color. And, in conclusion, it might be mentioned that the testa of the fresh seeds which I have examined is a glossy medium-brown and not blackish, as recorded by Smith for the herbarium material which he examined.

THE STATUS OF THE GENUS *LECOSTEMON* MOC. & SESSÉ

By PAUL C. STANDLEY

Chicago Natural History Museum

The history of the generic name *Lecostemon* Moc. & Sessé is an example of the comedy that sometimes intrudes into the normal prosaic paths of botanical nomenclatures. The genus was described in 1825 by De Candolle, who based it upon one of the celebrated drawings of Mexican plants prepared more than 175 years ago under the direction of the precursors of Mexican botanical exploration, Sessé and Mociño. The drawing (rather a copy of the original), of which there is a photograph in the Herbarium of Chicago Natural History Museum, is a good one and perfectly characteristic when one knows what the plant is that it represents. Without accompanying herbarium material it is not quite so easily understood.

De Candolle decided that the plant illustrated belonged to the family Rosaceae, which was a decided mistake in judgment, although as a matter of fact he listed the genus at the end of the Rosaceae in the *Prodromus* as one of three "genera Rosaceis affinia." The genus has been listed among the Rosaceae by all later writers upon Mexican plants, although no one ever found any Mexican plant of that family that agreed with the original description—for very good reasons.

In 1853 Bentham (in Hook. Journ. Bot. 5: 293) gave an "emended" description of *Lecostemon*, referring it definitely to the Rosaceae, and describing four new South American species. As a matter of fact, the plants he described have no resemblance whatever to the original *Lecostemon*, but he had become convinced for some reason that they were congeneric. He noted certain differences between his plants, De Candolle's original description, and the Sessé and Mociño drawing, but dismissed them lightly, stating that the drawing probably was carelessly made and De Candolle misled by an inaccurate representation of the plant. As a matter of fact it was Bentham and not De Candolle or Sessé and Mociño who was misled.

In 1905 Gilg and Pilger published a new genus, *Rhabdo-*

dendron, of the Rutaceae, with a single species. This later was found to be synonymous with one of Bentham's *Lecostemon* species. Eventually all his other South American species of *Lecostemon* were transferred to *Rhabdodendron* and some new ones described, principally by Huber. There are a good many pages in most floras between the Rosaceae and Rutaceae! The genus *Rhabdodendron* disposes of the South American *Lecostemon* species.

While studying some of the sheets of the Sessé and Mociño Herbarium, now at Chicago, the writer thought he recognized the *Lecostemon* drawing, and finally located a single herbarium specimen so like it that probably it is the specimen from which the drawing was made. There is no question that the plant is the one long known as *Sloanea quadrivalvis* Seem., a tree of the Tiliaceae (or Elaeocarpaceae) ranging from western and southern Mexico through all the Central American countries, chiefly along the Pacific coast, to Panama. *Lecostemon* Moc. & Sessé is therefore to be reduced to synonymy of the much older genus *Sloanea*, and the following new name is necessary:

Sloanea terniflora (Moc. & Sessé) Standl., comb. nov. *Lecostemon terniflorum* Moc. & Sessé ex DC. Prodr. 2: 639. 1825. *Sloanea quadrivalvis* Seem. Bot. Voy. Herald 85. *pl. 15.* 1853.

FORESTS OF EL GENERAL VALLEY, COSTA RICA

By William R. Barbour

U. S. Forest Service

Information included herein was obtained in 1943 by the writer while serving as a member of the Costa Rica party of the Latin America Forest Resources Project, and later in the same year while on detail with the U. S. Engineers. While only relatively small portions of El General Valley were actually covered on the ground, numerous aeroplane trips over the jungles gave a rather comprehensive bird's-eye view of the territory.

El General Valley is located in southwestern Costa Rica and is bounded on the northeast by the high Cordillera de Talamanca, a section of the continental divide nearly all of whose ridgeline is above 8000 feet and many of whose peaks reach elevations of 11,000–12,000 feet. The valley floor is about 2000 feet above sea level, gradually sloping to the southeast. It is separated from the Pacific Ocean by a low coast range whose crest seldom exceeds 3000 feet. The valley is drained by El General River (known in its lower courses as Río Térraba and Río Diquís) which breaks through the coast range to empty into the Pacific near Puerto Cortez. Tributaries rising near the Panama border flow northwest to join the main stream before it cuts through the coast range. The valley as a whole is some 80 miles long and averages about 25 miles wide between the crests of the cordillera and the coast range. Its total area is over 1600 square miles.

Until very recently, this was one of the least accessible and poorest known sections of Central America, being linked with the outside world only by primitive trails and a few rough oxcart roads across the coast range. Foresters have never before visited it and much of its area has never been studied by botanists.

A cross section of the El General Valley from southwest to northeast would show an abrupt drop from the crest of the coast range to the entrenched river channel, with gentle slopes extending for miles northeast from the river to a final sharp ascent to the crest of the cordillera. The route of the Pan American Highway runs southeast along the crest of the cordillera to Cerro de La Muerte, elevation about 11,000 feet, then loops down the ridges to the little town of San Isidro near the head of El General Valley, elevation 2100 feet. From San Isidro the highway route turns southeast, traversing the gentle slopes and crossing many streams that empty into El General River.

Along the crest of the Cordillera de Talamanca is a belt of cloud forest (see *Tropical Woods* 75:1–4) whose timber is mostly Oak (*Quercus* spp.) mixed with relatively unimportant amounts of other high-altitude trees, including species of such genera as *Podocarpus*, *Drimys*, *Magnolia*, and *Weinmannia*. At about 6000 feet Oak disappears and the cloud forests merge into the evergreen rain forests of the valley proper.

In the lee of the high cordillera one would expect to find the deciduous forest type in El General Valley, but such is not the case. Few of the trees shed their leaves during the relatively short mid-winter dry season and there is very little resemblance to (for example) the typical deciduous forests of Guanacaste Province in northwestern Costa Rica. The resemblance in stand density and composition is much closer to the evergreen rain forests on the Atlantic side of the continental divide.

Except for relatively small cleared areas around San Isidro and several smaller settlements in the valley and some natural savannas near Buenos Aires and Potrero Grande, most of the region is still in heavy first-growth timber. Until the coming of the Pan American Highway, the only lumbering in the valley was for local use: hewed timbers, whip-sawed planks, and limited production of a couple of small water-power sawmills. No forest products have been exported from El General Valley.

While many species of trees are found in commercial sizes and quantities in this region, very few of them are well known in world markets or even elsewhere in Costa Rica. Exceptions to this statement are María, Guanacaste, Cristóbal, and a limited amount of Spanish Cedar. Mahogany is not found in El General Valley, nor are Cocobolo and Fustic.

Following is an example of the unusual composition of the forests of the region. In the vicinity of San Isidro, eight species, found abundantly and in large sizes, were investigated and tested as possible bridge timbers for the highway. Only one of these, María, is at all well known elsewhere. Four species, Campana, Comenegro, Ira Rosa, and Bolador, are obscurely known. The botanical identity of two, Chancho Blanco and Alasán, is not positive, and one tree, Ira Chiricana (see *Tropical Woods* 75: 5–8), proved to be new to science.

A characteristic of the forests of El General Valley is the patchy distribution by species. Over areas of several acres, or sometimes hundreds of acres, one species elsewhere not abundant may make up the bulk of the stand. Examples in the smaller category include almost pure patches of Chancho

Blanco, Campana, or Ira Chiricana near San Isidro, and of Zapatero northwest of Buenos Aires. Among the large areas may be listed the forests southeast of the savanna near Buenos Aires, where Amarillón predominates. On the other hand, some species are uniformly distributed throughout much of the valley. Examples include Guanacaste and Gallinazo.

Until much more intensive studies have been made of the forests of El General Valley it will not be possible to give any reliable estimate of the total amount of timber in the area, much less to furnish figures as to amounts by species. Based, however, on what timber was seen close-hand plus bird's-eye views from planes, the writer believes El General Valley contains upwards of 10 billion board feet, the greater part of which consists of species whose woods are of present or potential commercial value.

As already noted, this section of Costa Rica, up until the present time very inaccessible, will be traversed from end to end by the Pan American Highway. From this highway, hard surface access roads are being constructed across the coast range to ports on the Pacific side. A large percentage of the area of the valley has climate and soils suited to diverse agricultural crops such as corn, upland rice, vegetables, fruits, and coffee. Much land, however, because of thin or stony soil or steep slopes, is sub-marginal for agriculture and should and probably will remain in forest.

The following list of trees of El General Valley omits cloud forest species and includes only trees actually encountered by the writer which attain a diameter of 24 inches and have a merchantable length of 32 feet or more. It is almost certain that further study of the region, which is unusually rich and interesting botanically, will add species new to the locality or even new to science.

ARALIACEAE

Didymopanax Morototoni (Aubl.) Dcne. & Planch. PAVO.

BIGNONIACEAE

Jacaranda Copaia (Aubl.) D. Don. GALLINAZO.

BORAGINACEAE

Cordia alliodora (R. & P.) Cham. LAUREL.

BURSERACEAE

Protium sp. COPAL.

COMBRETACEAE

Terminalia amazonia (J. F. Gmel.) Exell. AMARILLÓN.

EUPHORBIACEAE

Hieronyma alchorneoides Fr. Allem. ZAPATERO.
Hieronyma oblonga (Tul.) Muell.-Arg. COMENEGRO.

FLACOURTIACEAE

? CHANCHO BLANCO.

GUTTIFERAE

Calophyllum brasiliense Camb., var. **Rekoi** Standl. MARÍA.
Symphonia globulifera L. f. CERILLO.

HUMIRIACEAE

Humiria sp. CAMPANA.
Vantanea Barbourii Standl. IRA CHIRICANA, NÍSPERO.

LAURACEAE

Nectandra concinna Nees. COLORADO.
Nectandra sanguinea Rottb. IRA ROSA.
Nectandra sinuata Mez. QUIZARRÁ ZOPILOTE.
Ocotea palmana Mez & D. Sm. IRA ZOPILOTE.
Ocotea pedalifolia Mez. TIQUISSARÓ.
Ocotea veraguensis (Meissn.) Mez. SIGUA CANELA.
Persea Austin-Smithii Standl. BOLADOR.

LEGUMINOSAE

Enterolobium cyclocarpum (Jacq.) Gris. GUANACASTE.
Ormosia toledoana Standl. (?) ALASÁN.
Platymiscium pinnatum (Jacq.) Dugand. CRISTOBAL.
Schizolobium parahybum (Vell.) Blake.
Sweetia panamensis Benth. GUAYACÁN.

MELIACEAE

Carapa guianensis Aubl. CEDRO MACHO.
Cedrela mexicana Roem. CEDRO, SPANISH CEDAR.

MORACEAE

Brosimum utile (H.B.K.) Pittier. LECHERO.
Brosimum spp. MASTATE, OJOCHE.

PROTEACEAE

Roupala spp. DANTA, RATÓN.

THEACEAE

Laplacea semiserrata (Mart. & Zucc.) Camb. CAMPANA, CAMPANA CHILE.

ULMACEAE

Chaetoptelea mexicana Liebm. TIRRA.

VOCHYSIACEAE

Vochysia ferruginea. MAYO.
Vochysia sp. CHANCHO COLORADO.

NOTE ON RESISTANCE OF SPECIES OF *ANTIDESMA* TO MARINE BORERS

By C. H. EDMONDSON

Bernice P. Bishop Museum, Honolulu

Among more than 100 Hawaiian-grown timbers tested for their resistance to marine borers, two species of *Antidesma* have been found to excel all others examined.

Most woods subjected to the test are badly damaged or destroyed within periods of three or four months when in contact with sea water about Oahu. *Antidesma pulvinatum* Hillebrand, after being submerged for twelve months, shows no infestation by shipworms, and *A. platyphyllum* Mann, exposed for a shorter period (five months), responds in a similar manner.

In both species the surface is punctured by larvae of *Teredo* which penetrate to a depth of little more than the diameter of the larval shell and then perish. Occasionally a puncture 1 mm. in depth may be found but, during the periods of observation, borers have not been able to establish themselves in the wood. In none of the test blocks utilized was the bark intact, therefore the resistant properties apparently are in the wood itself.

Further tests of species of *Antidesma* are in progress.

PHILIPPINE MAPS WANTED

The Army Map Service, Corps of Engineers, is endeavoring to locate all available maps of the Philippines published by the Bureau of Forestry, Bureau of Lands, and the Bureau of Public Works of the Philippine Islands, or other mapping agencies. Detailed plans, blueprints, cadastral maps, forestry maps, survey notes, aerial photographs, or any other map information will be greatly appreciated. Kindly submit all material to:

Army Map Service, Attention: Captain H. L. Hyndman, Jr.
6101 MacArthur Blvd., Washington 16, D. C.

THE GENUS *CEDRELA* IN CHINA

By HUI-LIN LI

Arnold Arboretum, Harvard University

The genus *Cedrela* contains about twenty species in tropical America, and in the Old World extending from India to China southward through Malaysia to Australia. They are evergreen trees, or in the northern limits deciduous, many of them being important timber trees. This study summarizes the taxonomy of the species and varieties known to occur in China. It is based on the material preserved in the herbarium of the Arnold Arboretum of Harvard University, where the types of the few new forms herein described are deposited.

Four species occur in China, one of which is herein described as new. Two of the species, *Cedrela Toona* Roxb. and *C. microcarpa* A. DC., are species primarily of tropical Asia that extend to southern China. The first, *C. Toona* Roxb., is found in Yunnan, southern Szechuan, and Kwangsi. *Cedrela microcarpa* A. DC. is found in Yunnan, Kwangsi, Kwantung, and Hainan. The other two species are more or less of temperate distribution. *Cedrela Rehderiana* Li is found in Hupeh and northern Kwangsi only. *Cedrela sinensis* Juss. is a common tree widely distributed throughout China. It is an important timber tree and is frequently planted. It extends to Hopei and Shensi in the north, Kwangtung and Kwangsi in the south, Szechuan, Sikang, and Yunnan in the west, and Chekiang and Kiangsu in the east.

C. deCandolle, in a paper entitled "A revision of the Indo-Malayan species of *Cedrela*" (Rec. Bot. Surv. Ind. 3: 357–376. 1908), included also the Chinese representatives. Numerous varieties were recognized by him under *C. sinensis* Juss. and *C. Toona* Roxb. With a more extensive series of herbarium specimens from all parts of China now available, it seems that many of his varieties, at least those pertaining to Chinese species, are based on trivial and inconstant characters of little or no taxonomic significance. A few reductions are accordingly made.

Most authors follow C. deCandolle (in DC. Monogr. Phan. 1: 399–752. 1878, Rec. Bot. Surv. Ind. 3: 357–376. 1908) in

including the Asiatic species in the genus *Cedrela* P. Browne instead of placing them in the genus *Toona* Roemer (Fam. Nat. Syn. 1: 131. 1846) and adopted by Harms (in Nat. Pflanzenfam. 3(4): 269. 1896, ed. 2, 19 b 1: 40–47. 1940). The Asiatic species have in general a much shorter disk (the elongated receptacle along which petals are attached, which has also been named "column" by C. deCandolle) than the American ones. But this character, the relative length of one organ, alone, is scarcely sufficient to warrant generic segregations here especially as the seed-wing characters, also used by Harms, are inconclusive. Although I have chosen to reduce the Old World species to *Cedrela*, it does seem to be worth while to reproduce Harms' key by which he distinguishes the two genera, from his treatment of 1940:

Samen nur nach unten geflügelt, Diskuspolster länger als das Ovar, säulenförmig.—America . . . . 1. *Cedrela.*
Samen nach oben oder nach beiden Enden geflügelt, Diskuspolster ebensolang wie das Ovar oder kürzer.—Asien, Australien . . . . 2. *Toona.*

In the several keys to the genera based on wood characters, *op. cit.* 10–15, he apparently could detect no striking differences, for altogether *Cedrela* appears in several places, *Toona* is not mentioned. One may note in passing that the so-called Cigar-box Cedar is the product of various American species (*Cedrela*), but the wood of some of the Old World species (*Toona*) has the same general texture and appearance and the same characteristic odor.

KEY TO THE CHINESE SPECIES

A. Flowers containing 5 staminodes besides the 5 stamens. Leaflets entire or serrulate. Seeds winged at the upper end only . . . . 1. *C. sinensis.*

AA. Flowers containing no staminodes. Leaflets entire. Seeds winged at both ends.

B. Inflorescences much shorter than the leaves, the lower branches about 5–7 cm. long. Fruits 1.5–2 cm. long . . . . 2. *C. microcarpa.*

BB. Inflorescences about as long as the leaves, the lower branches 12 cm. or more long. Fruits 2–3.5 cm. long.

C. Leaflets ovate-oblong, up to 21 cm. long and 9.5 cm. wide, the apex short acute, the base rounded to subcordate. Fruits 2.5–3.5 cm. long . . . . 3. *C. Rehderiana.*

CC. Leaflets lanceolate to ovate- or oblong-lanceolate, up to 12 cm. long and 4 cm. wide, the apex long acuminate, the base tapering, subrounded above. Fruits 2–2.5 cm. long . . . . 4. *C. Toona.*

1. *Cedrela sinensis* Juss. Mém. Mus. Nat. Hist. Paris 19: 255, 294. 1830; Maxim. Mém. Div. Sav. Acad. Sci. St. Pétersb. 9: 469. 1859; David, Journ. Trois. Voy. Emp. Chin. 1: 154. 1875; Franch. Nouv. Arch. Mus. Paris II. 5: 220. 1883 (Pl. David. 1: 68); Hemsl. Journ. Linn. Soc. Bot. 23: 114. 1886; C. DC. Rec. Bot. Surv. Ind. 3: 360. 1908; Dunn & Tutch. Kew Bull. Add. Ser. 10: 58. 1912; Rehder & Wilson in Sargent, Pl. Wils. 2: 156. 1914; Hers, Journ. N. China Branch Roy. As. Soc. 103: 108. 1922; Chung, Mem. Sci. Soc. China 1: 128. 1924; Rehder, Journ. Arnold Arb. 7: 189. 1926. *Toona sinensis* Roemer, Fam. Nat. Syn. 1: 139. 1846; Diels, Bot. Jahrb. 29: 425. 1900; Schneider, Ill. Handb. Laubholzk. 2: 131. *f. 836, 84 1-q.* 1907. *Toona sinensis* var. *grandis* Pampanini, Nouv. Giorn. Bot. Ital. II. 7: 171. 1911. *Cedrela sinensis* var. *Hupehana* C. DC. Rec. Bot. Surv. Ind. 3: 361. 1908, syn. nov.

A tree, 10–30 m. high. Branchlets glabrous, dark reddish, with pale lenticels. Leaves pinnate, up to 50 cm. long; petioles terete, about 7 cm. long; rachis terete, puberulous; leaflets 5–9 on each side, opposite to alternate, petiolulate, chartaceous to coriaceous, ovate-oblong, up to 13.5 cm. long and 3.5 cm. wide, upper and lower ones gradually smaller, the apex long-acuminate, the base tapering below, longer and rounded above, the margins entire or remotely serrulate, glabrous on both surfaces, the secondary nerves about 16–20 on each side, subspreading; petiolules 7–10 mm. long. Inflorescences of terminal panicles as long as or longer than the leaves, pendulous, densely puberulous, the lower branches up to 20 cm. long, alternate, the upper ones opposite; flowers small; pedicels up to 0.75 mm. long. Calyx cupulate, membranaceous, sinuate-crenate when mature, glabrous without, appressed puberulous within, about 1 mm. long. Petals ovate-oblong, glabrous, 4–5 mm. long, 2–2.5 mm. wide. Stamens 5; filaments glabrous, 2–2.5 mm. long; anthers elliptic, cordate at base; staminodes 5, filamentous. Disk glabrous. Ovary glabrous, 5- or sometimes 4-celled; cells 8-ovulate. Capsule reddish, with pale lenticels. Seeds winged at upper end, about 12 mm. long and 5 mm. wide.

HOPEI: San-tun-ying, *F. N. Meyer 964*, May 1913; Chia Tang, *T. F. King 6*, June 1936.

HUPEH: Western Hupeh, *A. Henry 3657* (isotype of *C. sinensis* var. *Hupehana* C. DC.), *E. H. Wilson 2708*, June 1900; Ichang, *E. H. Wilson 585*, Sept. 1907; Kiu-ki-kou, *Sylvestri 3339* (syntype of *C. sinensis* var. *grandis* Pampanini, photo. and fragments); Chien-shih District, *H. C. Chow 1643*, Sept. 20, 1934.

SZECHUAN: Monkong Ting, *E. H. Wilson 585 A*, June 1908.

SIKANG: Mekong, Tsa-wa-rung, *C. W. Wang 66200*, Sept. 1935.

YUNNAN: Mengtze, *A. Henry 11131, 12807;* Tche-hai, *E. E. Maire 136, 371, 392, 491;* Wei-si District, *C. W. Wang 64114*, June 1935; Che-li District, Dah-meng-lung, *C. W. Wang 77632*, Aug. 1936.

KWANGSI: Ta-ho District, *Steward, Chiao, & Cheo 903*, Nov. 1931.

KWEICHOW: Sun-to District, Pa Yam Shan, *W. T. Tsang 23064*, Oct. 1933.

KWANGTUNG: Hongkong, *Ford s.n.;* Ying-tak District, *Y. K. Wang 523*, Jan. 1929.

FUKIEN: Foochow, *H. H. Chung 2500*, Sept. 1923, *3067*, Aug. 1924; no data, *H. H. Chung 7282*.

KIANGSI: Kiukinag, *E. H. Wilson 1543*, Aug. 1907.

CHEKIANG: Chun-an District, *Y. L. Keng 683*, July 1927.

ANHWEI: Chiu Hwa Shan, *S. C. Sun 1382*, Aug. 1933; Chien-shan District, *C. S. Fan & Y. Y. Li 204*, June 22, 1936.

KIANGSU: Tsing Leng Temple, *Wang 2677*, Aug. 1926.

This widespread species is confined to China. The leaves vary in size and in the number of leaflets. The margins of the leaflets vary from entire to remotely serrulate. It differs from other Chinese species of the genus in the presence of 5 staminodes besides the 5 stamens, and in the seeds being winged at the upper end only.

The var. *Hupehana* C. DC., represented by *Henry 3657*, is not distinguishable from the type and is here reduced to synonymy. The following two varieties are recognized:

1a. *Cedrela sinensis* var. *shensiana* C. DC. Rec. Bot. Surv. Ind. 3: 361. 1908.—Leaflets pubescent on both surfaces, the hairs long and more dense on the nerves beneath; mature inflorescences puberulous.

SHENSI: Kan-y-san, *G. Giraldi s. n.*, June 1897 (isotype).

1b. *Cedrela sinensis* var. **lanceolata** Li, var. nov.—A typo speciei differt foliolis subsessilibus, lanceolatis, ad 11.5 cm. longis et 2 cm. latis, longe acuminatis, basi aequilateraliter late cuneatis vel subrotundatis, margine serrulatis, utrinsecus 12–18-dentatis.

Leaflets subsessile, lanceolate, to 11.5 cm. long and 2 cm. wide, the apex long acuminate, the base equal, broadly cuneate to subrounded, the margins serrulate, with 12–18 teeth on each side.

Kweichow: West of Poseh, Bako Shan, *R. C. Ching 7482* (type), Sept. 1928.

This variety differs from the type in the narrowly lanceolate leaflets with distinctly serrulate margins. It approaches *Cedrela serrata* Royle, a species of Sumatra, Java, India, and Burma, in the serrulate leaflets, but does not agree closely in other characters. Hence it is here treated as a variety of the widely distributed Chinese species.

2. *Cedrela microcarpa* C. DC. in DC. Monogr. Phan. 1: 745. 1878; Chun, Sunyatsenia 1: 257. 1934; Merr. & Metcalf, Lingnan Sci. Journ. 16: 96. 1937. *Toona Sureni* sensu Merr. & Chun, Sunyatsenia 1: 62. 1930; non Merr. 1907.

A tree, 10–25 m. high. Branchlets puberulous when young, soon glabrous, dark rubescent. Leaves up to 50 cm. long; petioles 8–15 cm. long, terete; rachis terete. Leaflets 5–9 on each side, petiolulate, opposite or subopposite, coriaceous, obliquely oblong-ovate, up to 8–12 cm. long, 4.5–5 cm. wide, the apex acuminate, the base tapering below, rounded above, the margins entire, glabrous on both surfaces, the secondary nerves about 12 on each side, spreading-ascending; petiolules about 5 mm. long. Inflorescences of terminal panicles, shorter than the leaves, hirtellous, shortly branched; peduncles about 4.5 cm. long, the lower branches about 5–7 cm. long; flowers small; pedicels 1.5 mm. long, densely hirtellous. Sepals rounded, 1 mm. long, densely hirtellous without, ciliate at the margins. Petals oblong-obovate, 6 mm. long, 3 mm. wide, glabrous, ciliate at the margins. Anthers oblong, cordate at base. Disk densely hirsute. Ovary densely hirsute, 5-celled; style glabrous. Capsule globular to elliptic, 1.5–2 cm. long, brownish or blackish when dry, with or without lenticels; seeds winged at both ends.

Yunnan: Kien-shuei District, *H. T. Tsai 53307*, May 1933; Shih-ping District, *H. T. Tsai 53414*, May 1933; Fo-hai, *C. W. Wang 74868*, June 1936, *74974*, July 1936; Che-li District, Dah-meng-lung, *C. W. Wang 77679*, Aug. 1936; Chen-kang, *T. T. Yü 17464*, Aug. 1938; eastern Likiang, Tse-li on the Yangtze River, *R. C. Ching 20222*, April 1939.

Kwangsi: Without locality, *R. C. Ching 7454*, Sept. 1928.

Kwangtung: No precise locality, *C. Wang 36149*, Jan. 1934, *H. Y. Liang 65320*, Feb. 1934; Kan-en District, Chim Fung Ling, *S. K. Lau 3697*, April 1934; Bak-sa, *S. K. Lau 26237*, April 12, 1936.

India to southern China. The Kwantung and Hainan plants have slightly larger leaflets and fruits than the other specimens cited.

3. **Cedrela Rehderiana** Li, sp. nov. *Cedrela microcarpa* sensu Rehder & Wilson in Sargent, Pl. Wils. 2: 157. 1914; non C. DC.—Arbor 7–15 cm. alta; foliis ad 60 cm. longis, petiolis 10–15 cm. longis, rhachibus teretibus; foliolis utrinsecus 4–8, oppositis, petiolulatis, coriaceis, utrinque glabris, ovato-oblongis, ad 21 cm. longis et 9.5 cm. latis, apice breviter acutis, basi rotundatis vel subcordatis, superioribus longioribus magis rotundatis, margine integris, nervis lateralibus utrinsecus 14–20, patulo-adscendentibus, supra subconspicuis, subtus perspicuis, elevatis; petiolulis 5 mm. longis; paniculis magnis terminalibus folia aequantibus, longe ramosis, dense puberulis, ramis inferioribus 15–30 cm. longis; floribus parvis, pedicellis 0.5 mm. longis, puberulis; calyce 5-lobato, lobis orbiculari-rotundatis, circiter 0.75 mm. longis, extus puberulis, margine ciliatis; petalis 5, ovato-oblongis, glabris, 4 mm. longis, 2 mm. latis; staminibus 5, filamentis 2.5 mm. longis, pilosis, antheris oblongis; disco dense hirsuto; ovario dense hirsuto, 5-loculari, stylis glabris; capsulis ellipticis, 2.5–3.5 cm. longis, in sicco nigro-rubescentibus, pallide lenticellatis, seminibus utrinque membranaceo-alatis, circiter 1.5 cm. longis, 0.35 cm. latis, alis oblongo-ovatis, apice obtusis, superioribus paulo brevirioribus, inferioribus magis acutis.

A tree, 7–15 m. high. Leaves pinnate, up to 60 cm. long; petioles terete, 10–15 cm. long; rachis terete; leaflets 4–8 on each side, petiolulate, coriaceous, ovate-oblong, up to 21 cm. long and 9.5 cm. wide, the apex short acute, the base rounded to subcordate, the upper side longer and more rounded, the margins entire; glabrous on both surfaces; lateral nerves 14 to 20 on each side, spreading-ascending, slightly conspicuous above, prominent beneath; petiolules 5 mm. long. Inflorescences of large terminal panicles as long as the leaves, long branched, densely puberulous, the lower branches 15–30 cm. long; flowers small; pedicels 0.5 mm. long, puberulous. Sepals rounded-ovate, about 0.75 mm. long, puberulous without, ciliate at the margins. Petals ovate-oblong, glabrous, 4 mm. long, 2 mm. wide. Stamens 5, the filaments 2.5 mm. long, pilose; anthers oblong. Disk densely hirsute. Ovary densely hirsute, 5-celled, the style glabrous. Capsule elliptic, 2.5–3.5 cm. long, dark brownish when dry, with pale lenticels; seeds winged at both ends, about 1.5 cm. long and 0.35 cm. wide, the wings oblong-ovate, obtuse, the upper ones slightly shorter, the lower ones more pointed.

KWANGSI: Ping-yun District, Loh Hoh Tseun, *Steward & Cheo 612*, June 1933.

HUPEH: Southwest of Ichang, *E. H. Wilson 626 in part* (type), June and Nov. 1907; Changlo District, *E. H. Wilson 626 in part*, June 1907.

This species is related to *Cedrela microcarpa* C. DC. and *C. Toona* Roxb., differing from both by its larger leaflets with more numerous secondary nerves, less acute apices, and more rounded to cordate bases, as well as by the larger inflorescences with longer branches and larger fruits. *Cedrela microcarpa* C. DC., which extends from India to southern China, seems to be confined to the tropical and subtropical regions only.

4. *Cedrela Toona* Roxb. ex Rottl. Gen. Naturf. Fr. Schr. 4: 198. 1803, Pl. Corom. 3: 34. *t. 238.* 1819; C. DC. in DC. Monogr. Phan. 1: 744. 1878; Franch. Pl. Delav. 126. 1889; C. DC. Rec. Bot. Surv. Ind. 3: 372. 1908; Merr. & Chun, Sunyatsenia 5: 89. 1940. *Swietenia Sureni* Blume, Cat. Gew. Buitensorg 72. 1823. *Cedrela febrifuga* Blume, Bijdr. 180. 1825. *Toona ciliata* M. Roem. Syn. Hesper. 1: 139. 1846; Hand.-Maz. Symb. Sin. 7: 631. 1933. *Toona febrifuga* M. Roem. l. c.; Pellegr. in Lecomte, Fl. Gén. Indo-Chine 1: 793. 1911. *Cedrela Toona* var. *yunnanensis* C. DC. Rec. Bot. Surv. Ind. 3: 366. 1908; syn. nov. *Cedrela Toona* var. *Henryi* C. DC. l. c. 369; syn. nov. *Cedrela Toona* var. *pubescens* sensu C. DC. l. c. 369; non Franch. *Toona Sureni* Merr. Interpret. Herb. Amb. 305. 1917.

A tree, 10–25 m. high. Branchlets puberulous when young, soon glabrous, reddish, with pale lenticels. Leaves pinnate, up to 40 cm. long; petioles terete, 6–10 cm. long; rachis terete; leaflets 6–12 on each side, opposite or subopposite or occasionally alternate, petiolulate, chartaceous to coriaceous, lanceolate to ovate- or oblong-lanceolate, the base tapering, usually longer and rounded above, the margins entire; glabrous above, glabrous to pilose in the axils of the secondary nerves beneath; secondary nerves about 12–18 on each side, spreading-ascending; petiolules 8–12 mm. long. Inflorescences of terminal panicles about as long as the leaves, short pedunculate or nearly sessile, somewhat loosely long branched, puberulous, the lower branches up to 10–20 cm. long; flowers small; pedicels puberulous, 1 mm. long. Sepals rounded-ovate, about 0.8 mm. long, subacute, puberulous without, ciliate at the margins. Petals ovate-oblong to oblong, 3.5–4.5 mm. long, 2–2.5 mm. wide, glabrous on both surfaces, ciliate at the margins. Stamens 5; filaments glabrous, 1.5 mm. long; anthers oblong-cordate at base. Disk densely hirsute. Ovary densely hirsute, 5-celled, the cells 8–10-ovulate; style glabrous. Capsule elliptic-oblong, about 2–2.5 cm. long, blackish when dry, with or without lenticels; seeds winged at both ends, 15 mm. long, the wings oblong-ovate, obtuse, the upper ones slightly shorter.

YUNNAN: Szemao, *A. Henry 11963* (isotype of *C. Toona* var. *yunnanensis* C. DC.), *11963 A*, *13001* (isotype of *C. Toona* var. *Henryi* C. DC); between Mohei and Maokai, *J. F. Rock 2964*, March-April, 1922; between Chieng-haw and Muang Hun, *J. F. Rock 2383*, Feb. 1922; Tali, Tietsun, *Handel-Mazzetti 6340*, May 1915; Mong-ka, *H. T. Tsai 56316*, Feb. 1934; Keng-ma, *C. W. Wang 72856*, April 1936.

KWANGSI: San-chiang District, *Steward & Cheo 963*, Sept. 1933.

India to southern China, southward through Malaysia to Java and the Moluccas.

This widely distributed species is variable in the shape and size of the leaflets. It has been much confused with *C. microcarpa* C. DC. It differs from the latter by its much larger inflorescences as well as the much larger fruits. The inflorescence of *C. Toona* Roxb. is usually as long as the leaves with the lower branches measuring 12 cm. or more, while in *C. microcarpa* C. DC., it is shorter than the leaves and the lower branches are usually only 5–7 cm. long. The fruit of *C. Toona* is elongate-elliptic and 2–2.5 cm. long, while that of *C. microcarpa* is ovate-elliptic and 1.5–2 cm. long. In vegetative characters the two are not sharply differentiated, but in general the leaves of *C. Toona* are larger, more elongated and more acutely pointed, than are those of *C. microcarpa* C. DC.

C. De Candolle treated many varieties of this species. Among the Chinese plants, his var. *yunnanensis* and var. *Henryi*, based on very slight variations in the leaflets, etc., are scarcely worthy of varietal separation. He also treated *Henry 11963 A* as representing the var. *pubescens* Franch., but the almost glabrous adult leaflets do not agree with those of Franchet's variety, which are densely pubescent beneath. His var. *sublaxiflora* belongs to var. *pubescens* Franch. Franchet's variety is represented by the collections cited below.

4. a. *Cedrela Toona* Roxb. var. *pubescens* Franch. Pl. Delav. 126. 1889. *Cedrela Toona* var. *sublaxiflora* C. DC. Rec. Bot. Surv. Ind. 3: 369. 1908; syn. nov. *Cedrela mollis* Hand.-Maz. Sitz. Akad. Wiss. Wien 62: 266. 1920. *Toona ciliata* var. *pubescens* Hand.-Maz. Symb. Sin. 7: 631. 1933.

Differs from the typical form of the species in the leaflets being densely pubescent beneath when mature.

SZECHUAN: Kientschang, *H. Handel-Mazzetti 1101*, April 1914; Bei-Te-Chang, *C. Schneider 707*, April 1914.

YUNNAN: Tali, Tapintze, *Delavay 901*, May 1884 (holotype, phot. and fragments); Mengtze, *A. Henry 9486 A* (isotype of *C. Toona* var. *sublaxiflora* C. DC.); Yunnanfu, *H. Handel-Mazzetti 740*, March 1914 (holotype of *C. mollis* Hand.-Maz., photo. and fragments); Pien-kio, *S. Ten 337*, April 1917; Shun-nung, Lomawe, *T. T. Yü 15897*, May 1938.

KEYS TO AMERICAN WOODS (CONTINUED)

By SAMUEL J. RECORD

This key is the fourteenth in a series begun in *Tropical Woods* No. 72, December 1, 1942. Those in the preceding issues are: (No. 72) I. Ring-porous woods. II. Pores in ulmiform or wavy tangential arrangement. III. Pores in flame-like or dendritic arrangement. (No. 73) IV. Vessels virtually all solitary. V. Vessels with spiral thickenings. (No. 74) VI. Vessels with scalariform perforation plates. VII. Vessels with very fine pitting. (No. 75) VIII. Vessels with opposite or scalariform

pitting. IX. Woods with conspicuous rays. (No. 76) X. Woods with storied structure. (No. 77) XI. Woods with resin or gum ducts. XII. Parenchyma reticulate. (No. 78) XIII. Woods with septate fibers. These keys are intended for use in connection with Record and Hess' *Timbers of the New World* (see *Tropical Woods* 73:42) wherein many of the anatomical features are well illustrated by photomicrographs.

XIV. *Dicotyledonous woods with xylem rays virtually all uniseriate.* It is doubtful if there is any wood that has all its rays only one cell wide throughout. For convenience, however, rays are placed in the uniseriate category when only occasional cells are paired, producing a "partially biseriate" condition. Included in this key also are some woods having latex tubes in a few of the rays; such rays may or may not be multiseriate about the tube.

American dicotyledonous woods with virtually all of the rays uniseriate belong to nearly 200 genera of 50 families, though not all of the genera are named in the key. The families in the key with the largest number of genera are Leguminosae (34), Euphorbiaceae (26), Melastomaceae (23), and Sapindaceae (11). The feature frequently characterizes a whole genus, but, on the other hand, it may be inconstant in different species or even in different specimens of the same species. No other anatomical feature was found to be common to all of the woods with uniseriate rays.

XIV. DICOTYLEDONOUS WOODS WITH XYLEM RAYS VIRTUALLY ALL UNISERIATE

1 a. Woods with included phloem. 2
  b. Woods without included phloem 10
2 a. Included phloem in anastomosing bands of conjunctive tissue. Vessels virtually all solitary 3
  b. Included phloem in strands (islands on cross section), without conjunctive tissue 7
3 a. Bands of conjunctive tissue distantly spaced (1–5 cm.). Xylem parenchyma in narrow, uniform, concentric bands about one pore-width apart . . . . *Pera* (Euphorbiaceae).
  b. Bands of conjunctive tissue closely spaced. Bands of xylem parenchyma absent 4
4 a. Fibers in part septate and aggregated, appearing on cross section as aliform or confluent parenchyma . . . . . *Salacia* (Hippocrateaceae).

b. Fibers not septate 5

5 a. Pores few and very large. Raphides common in conjunctive tissue . . . . *Doliocarpus* (Dilleniaceae).

b. Pores rather numerous and very small. Raphides absent 6

6 a. Stone cells present in conjunctive tissue. *Diclidanthera* (Diclidantheraceae).

b. Stone cells absent . . . . *Simmondsia* (Buxaceae).

7 a. Vessels virtually all solitary; pits vestured. *Mouriria* (Melastomaceae).

b. Vessels not all solitary 8

8 a. Phloem islands at terminus of radial groups of pores and arranged in diagonal series; radial phloem bridges absent. Vessel pits not vestured . . . . *Neea, Pisonia, Torrubia* (Nyctaginaceae).

b. Phloem islands scattered irregularly without relation to pore arrangement; phloem bridges present in some of the rays. Vessel pits vestured 9

9 a. Xylem parenchyma limited to a few cells at margins of phloem strands and sparingly diffuse . . . . *Antonia* (Loganiaceae).

b. Xylem parenchyma in tangential or interrupted concentric bands. *Bonyunia* (Loganiaceae).

10 a. Vessel perforations exclusively or predominantly multiple (plates scalariform) 11

b. Vessel perforations exclusively or predominantly simple 25

11 a. Vessels virtually all solitary 12

b. Vessels not all solitary 20

12 a. Vessel-ray pitting fine to medium 13

b. Vessel-ray pitting coarse, often scalariform 18

13 a. Rays homogeneous or with very few upright cells 14

b. Rays heterogeneous, with many upright cells 15

14 a. Oil cells present in some of the parenchyma strands. *Capsicodendron* (Canellaceae).

b. Oil cells absent . . . . *Canella, Pleodendron* (Canellaceae).

15 a. Pores medium-sized to large in part. Perforation bars rather thick, widely spaced 16

b. Pores all small to minute 17

16 a. Vessel-ray pitting fine. Density medium . . . . *Humiria* (Humiriaceae).

b. Vessel-ray pitting medium. Density high . . *Sacoglottis* (Humiriaceae).

17 a. More or less ring-porous. Fibers with spirals. Perforation bars thick, widely spaced . . . . *Fendlera* (Hydrangeaceae).

b. Diffuse-porous. Fibers without spirals. Perforation bars thin, closely spaced . . . . *Columellia* (Columelliaceae).

18 a. Pores large, rather few . . . . *Vantanea* (Humiriaceae).

b. Pores small to minute, numerous 19

19 a. Vessels with spirals in tips of members. Rays with few or no definitely upright cells . . . . *Franklinia, Gordonia* (Theaceae).

b. Vessels without spiral thickenings. Rays usually with many definitely upright cells . . . . *Hamamelis* (Hamamelidaceae).

20 a. Vessel-ray pitting very fine. Fibers not septate 21

b. Vessel-ray pitting not very fine; mostly coarse and often scalariform. Fibers septate in part 22

21 a. Rays homogeneous; often aggregated. Intervascular pitting mostly opposite. Parenchyma sparingly diffuse . . *Alnus* (Betulaceae).

b. Rays heterogeneous; not aggregated. Intervascular pitting alternate. Parenchyma finely reticulate . . . . . . *Pamphilia* (Styracaceae).

22 a. Pores small. Intervascular pitting opposite or scalariform. Tanniniferous tubes absent. Parenchyma absent. *Brunellia* (Brunelliaceae).

b. Pores medium-sized to large in part. Intervascular pitting mostly alternate, with local tendencies to opposite or scalariform. Tanniniferous tubes present in some of the rays 23

23 a. Parenchyma in closely to widely spaced, narrow, concentric bands . . . . *Iryanthera* (Myristicaceae).

b. Parenchyma sparingly paratracheal and diffuse 24

24 a. Perforations all multiple. Growth rings normally absent. Septate fibers vasicentric . . . . *Dialyanthera* (Myristicaceae).

b. Perforations simple in part. Growth rings frequently demarcated by flattened fibers. Septate fibers vasicentric and sometimes in bands . . . . *Virola* (Myristicaceae).

25 a. Vessel pits very small (not over over 4μ) 26

b. Vessel pits not very small 52

26 a. Ripple marks present 27

b. Ripple marks absent 29

27 a. Ripple marks about 250 per inch. Vessels solitary. *Porlieria* (Zygophyllaceae).

b. Ripple marks less than 140 per inch. Vessels not all solitary . . . 28

28 a. Parenchyma in closely spaced uniseriate lines or reticulate. Pores large in part. Ripple marks 70–80 per inch. *Diospyros virginiana* (Ebenaceae).

b. Parenchyma narrowly vasicentric and diffuse. Pores small to minute. Ripple marks 100–130 per inch . . . . . *Suriana* (Surianaceae).

29 a. Vessels virtually all solitary 30

b. Vessels not all solitary 33

30 a. Rays homogeneous or weakly heterogeneous. *Aspidosperma, Geissospermum* (Apocynaceae).

b. Rays distinctly heterogeneous, at least in part 31

31 a. Parenchyma in apotracheal bands irregular in width, length, and spacing . . . . *Kotchubaea* (Rubiaceae).

b. Parenchyma otherwise 32

32 a. Parenchyma abundant; unilaterally paratreacheal, with occasional extensions. Vessel-ray pitting distinctly 2-sized. Pores medium-sized . . . . *Haploclathera* (Guttiferae).
b. Parenchyma very sparse. Vessel-ray pitting all very fine. Pores small . . . . *Gleasonia* (Rubiaceae).

33 a. Parenchyma reticulate 34
b. Parenchyma not reticulate 37

34 a. Vessel-ray pitting distinctly 2-sized. Vasicentric tracheids present . . . . *Ptychopetalum* (Olacaceae).
b. Vessel-ray pitting very fine, though sometimes unilaterally compound. Vasicentric tracheids absent 35

35 a. Pores all very small to minute; numerous. Crystalliferous parenchyma strands few or absent . . . . *Alibertia*, *Tocoyena* (Rubiaceae).
b. Pores larger in part; often few. Crystalliferous parenchyma strands numerous 36

36 a. Fiber pits distinctly bordered. Rays somewhat heterogeneous. Vessel pits vestured . . . . *Cameraria* (Apocynaceae).
b. Fiber pits indistinctly bordered. Rays definitely heterogeneous. Vessel pits not vestured . . . . *Diospyros* (Ebenaceae).

37 a. Vessels with spirals 38
b. Vessels without spirals 39

38 a. Fibers with spirals; bordered pits large . . . . *Evonymus* (Celastraceae).
b. Fibers without spirals; bordered pits small . . *Hypericum* (Guttiferae).

39 a. Parenchyma in concentric bands (at least at margins of growth rings) 40
b. Parenchyma otherwise or apparently absent 48

40 a. Parenchyma bands within the growth ring; not terminal only . . . 41
b. Parenchyma bands at growth rings' margins, but sometimes doubled or tripled; narrow 42

41 a. Fibers septate. Parenchyma bands coarse . . . . . . *Guarea* (Meliaceae).
b. Fibers not septate. Parenchyma bands fine . . . . *Trichilia* (Meliaceae).

42 a. Fibers septate . . . . *Cupania* (Sapindaceae).
b. Fibers not septate 43

43 a. Non-terminal parenchyma aliform to confluent 44
b. Non-terminal parenchyma otherwise or apparently absent 46

44 a. Rays nearly homogeneous. Vessel pits not vestured. Fibers with small bordered pits. Taste very bitter . . . . *Quassia* (Simarubaceae).
b. Rays heterogeneous, at least in part. Vessel pits vestured. Fibers with simple pits. Taste not distinctive 45

45 a. Non-terminal parenchyma abundant; distinct with lens. *Brownea* (Leguminosae).
b. Non-terminal parenchyma not abundant; indistinct without lens. *Elizabetha* (Leguminosae).

46 a. Rays homogeneous. Vessel pits not vestured. Heartwood

scented; more or less oily . . . . *Amyris* (Rutaceae).
b. Rays decidedly heterogeneous. Vessel pits vestured. Heartwood unscented; not oily 47

47 a. Pores very small, numerous; mostly in long radial rows. Rays with few or no procumbent cells . . . . *Plumeriopsis* (Apocynaceae).
b. Pores small, rather few; solitary and in small multiples. Rays with numerous procumbent cells . . . . . . *Heterostemon* (Leguminosae).

48 a. Rays all decidedly heterogeneous. Pores very small. Parenchyma sparse 49
b. Rays homogeneous or only locally heterogeneous. Parenchyma not sparse 51

49 a. Fibers thin-walled; septate . . . . *Beloperone* (Acanthaceae).
b. Fibers thick-walled 50

50 a. Fibers septate. Pores radially arranged. Vessel pits not vestured. *Pelliciera* (Theaceae).
b. Fibers not septate. Pores not radially arranged. Vessel pits vestured . . . . *Tocoyena* (Rubiaceae).

51 a. Pores mostly small. Fibers infrequently septate. Parenchyma mostly vasicentric, sometimes short aliform. *Capparis* (Capparidaceae).
b. Pores mostly medium-sized. Fibers septate. Parenchyma long-aliform to confluent . . . . *Guarea* (Meliaceae).

52 a. Vessels virtually all solitary 53
b. Vessels not all solitary 56

53 a. Rays homogeneous or nearly so. Wood ring-porous. *Castanopsis* (Fagaceae).
b. Rays decidedly heterogeneous. Wood diffuse-porous 54

54 a. Pores fairly uniformly distributed without pattern. Parenchyma in numerous, narrow, concentric bands. Wood fibers with large bordered pits . . . . Rosaceae-Chrysobalanoideae.
b. Pores in radial or diagonal arrangement 55

55 a. Parenchyma in coarse-celled, regular to irregular bands few to several cells wide. Fibers with small indistinctly bordered pits. Vasicentric tracheids present . . . . *Calophyllum* (Guttiferae).
b. Parenchyma unilaterally paratracheal and locally confluent. Fibers with distinctly bordered pits. Vasicentric tracheids apparently absent . . . . *Caraipa* (Guttiferae).

56 a. Parenchyma reticulate 57
b. Parenchyma otherwise or absent 67

57 a. Large pores in multiseriate band in early wood; late-wood pores in flame-like or dendritic arrangement. Vasicentric tracheids abundant . . . . *Castanea* (Fagaceae).
b. Pores not so arranged. Vasicentric tracheids apparently absent . . 58

58 a. Ripple marks present . . . . *Dalbergia* (Leguminosae).
b. Ripple marks absent 59

59 a. Vessel-ray pitting fine to medium 60
b. Vessel-ray pitting coarse to very coarse, at least in part 62
60 a. Fibers with distinctly bordered pits; not septate. Pores often in long radial mutiples. Vessel pits vestured. *Himatanthus* (Apocynaceae).
b. Fibers with simple or indistinctly bordered pits; septate. Pores not in long multiples. Vessel pits not vestured 61
61 a. Rays homogeneous or nearly so. Pores up to medium-sized or larger .... *Pseudima, Toulicia* (Sapindaceae).
b. Rays distinctly heterogeneous. Pores typically small to minute. (See Key XII, 133–136.) .... Euphorbiaceae.
62 a. Vessel-ray pitting distinctly 2-sized: fine and coarse together. *Aptandra, Cathedra* (Olacaceae).
b. Vessel-ray pitting variable, but not distinctly 2-sized 63
63 a. Pores large in part 64
b. Pores small or infrequently up to medium-sized 66
64 a. Parenchyma strands very unevenly spaced (rad. sect.). Rays decidedly heterogeneous. Fibers often septate. *Caryocar* (Caryocaraceae).
b. Parenchyma strands rather closely and evenly spaced (rad. sect.). Fibers not septate 65
65 a. Rays homogeneous or nearly so; fairly uniform in height. *Hura* (Euphorbiaceae).
b. Rays decidedly heterogeneous; heights uneven. *Alchornea, Conceveiba, Joannesia* (Euphorbiaceae).
66 a. Pores mostly in radial or oblique series of multiples. Fibers with thick walls and small lumen .... *Dipholis* (Sapotaceae).
b. Pores mostly in scattered multiples. Fibers with thin to medium walls and large lumen. (See Key XII, 157–159.) ...... Euphorbiaceae.
67 a. Ripple marks present 68
b. Ripple marks absent 70
68 a. Vessel pits vestured. (See Key X, 91–104.) .... Leguminosae.
b. Vessel pits not vestured 69
69 a. Pores very small; crowded. Vessels with fine spirals. Non-terminal parenchyma very sparingly paratracheal. *Aesculus* (Hippocastanaceae).
b. Pores up to medium-sized; not crowded. Vessels without spirals. Non-terminal parenchyma narrowly vasicentric to aliform and confluent .... *Tabebuia* (Bignoniaceae).
70 a. Fibers septate, at least in part 71
b. Fibers not septate 87
71 a. Septate fibers in parenchyma-like arrangement 72
b. Septate fibers not so arranged 75
72 a. Rays homogeneous or nearly so .... *Allophylus* (Sapindaceae).
b. Rays heterogeneous, usually decidedly so 73

73 a. Vasicentric tracheids absent. Parenchyma-like fibers loosely aggregated into patches or irregular bands with large interstitial spaces. Vessel pits vestured .... Melastomaceae.
b. Vasicentric tracheids present. Vessel pits not vestured 74
74 a. Minute vessels and tracheids with spirals. Parenchyma-like fibers terminal, vasicentric-confluent, or diffuse. . *Connarus* (Connaraceae).
b. Vessels without spirals. Parenchyma-like fibers in bands. *Rourea* (Connaraceae).
75 a. Radial gum ducts present .... *Tetragastris* (Burseraceae).
b. Radial gum ducts absent 76
76 a. Tanniniferous tubes present in some of the rays. *Virola* (Myristicaceae).
b. Tanniferous tubes absent 77
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CURRENT LITERATURE

Edible and poisonous plants of the Caribbean region. By B. E. Dahlgren and Paul C. Standley. Issued by Bur. Medicine and Surgery, Navy Dept., Washington, D. C., 1944. Pp. 102; 5 x 7¼; 77 text figs. For sale by U. S. Govt. Printing Office, price 20¢.

"This manual is designed to aid the serviceman to live off the land if he becomes separated from his unit. It illustrates and describes common edible and poisonous plants of the Caribbean region, chiefly of Central America and the West Indies."

"Included in each section of this manual are tables that will assist the serviceman in more quickly and easily identifying the food plants that he has located. . . . The *identification* table deals with the colored parts of the plant, a brief description of that part (leaf, fruit, flower, etc.), and the page of the text where that particular plant is illustrated and more fully described. The *location* table will help the serviceman to identify edible or poisonous plants by the places he finds them growing, that is, under cultivation, in thickets, on wet or dry soils, along the coast, and the various topographical locations peculiar to the Caribbean region." The master identification tables in the appendix are a compilation of all of the tables of the book.

Caldasia. Boletín del Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, Bogatá. No. 10, April 19, 1944.

Contents (botanical)

Plantae colombianae, VII. Novae notiones generis *Paullinia* (pp. 419–423), by R. E. Schultes.

Euphorbiaceae novae vel criticae colombianae, III (pp. 425–434), by Leon Croizat.

Bombacaceae: Descripción enmendada de *Bombax coriaceum* Mart. & Zucc. (pp. 435–437; 1 plate), by Armando Dugand.

Nuevas nociones sobre el género *Ficus* en Colombia, III (pp. 439–442), by Armando Dugand.

Palmas nuevas o criticas colombianas, II (pp. 443–458; 6 plates, 2 figs.), by Armando Dugand.

***Ochroma lagopus* Swartz, the name of the balsa of Ecuador.** By Elbert L. Little, Jr. *The Caribbean Forester* (Río Piedras, P. R.) 5: 3: 108–114; April 1944.

"The Balsa, or Palo de Balsa, of Ecuador is known by three scientific names. The lightest of commercial woods, Balsa is distributed in the American tropics from the West Indies and southern Mexico to Bolivia and Peru in northwestern South America, though more than nine-tenths of the Balsa now being lumbered comes from Ecuador. Ten species of *Ochroma*, the genus of Balsa, have been described, though some workers recognize only one.

"This article summarizes the nomenclature of the genus *Ochroma*. There has been a general tendency among recent workers to question the validity of the segregate species of *Ochroma*, though the Balsa of Ecuador was named a distinct species, *Ochroma grandiflora* Rowlee. Balsa was observed in its range in western Ecuador in field work from March to July 1943. Herbarium material from Ecuador is not specifically different from the original species of Balsa of the West Indies. The latter has two scientific names, both dating from 1788, *Ochroma lagopus* Swartz and *Ochroma pyramidale* (Cav.) Urban. As it is not known which name was published first, it seems best to retain for the Balsa of Ecuador the name published originally in the present genus, in universal use before 1920, and still generally adopted in botanical publications, *Ochroma lagopus* Swartz." — *Author's summary.*

Anatomia das principais madeiras brasileiras das Rutaceae. By F. R. Milanez. *Rodriguésia* (Rio de Janeiro) 7: 16: 5–22; 18 plates; 1943.

Contains a key to the woods of 17 genera of Rutaceae. This is followed by descriptions of the anatomy of 14 species of 12 genera, namely, *Adiscanthus*, *Balfourodendron*, *Citrus*, *Dictyoloma*, *Esenbeckia*, *Euxylophora*, *Fagara*, *Hortia*, *Nycticalanthus*, *Rhabdodendron*, *Raputia*, and *Sohnreyia*. The woods described are illustrated by photomicrographs (mostly × 50) showing cross and tangential sections.

Os paus rosa da indústria da essência. By Arthur de Miranda Bastos. *Rodriguésia* 7: 16: 45–54; 2 text figs., 5 plates; 1943.

An account of *Aniba rosaeodora* Ducke and *A. Duckei* Kosterm. with reference to the anatomy of the woods and to the industrial use of the timber as a source of essential oils.

O cabí do Pará. By Adolpho Ducke. *Arquivos do Servico Florestal* 2: 1: 13–15; 1 plate; November 1943.

Contains a description of a new genus and species, *Cabi paraensis* Ducke, a scandent shrub belonging to the subtribe Banisteriinae of the Malpighiaceae.

"This species is not rarely cultivated in and around the city of Bélem, Pará, where it also occurs sometimes spontaneously growing in hedges, etc. It is known under the name of Cabí, like *Banisteria caapi* Spruce which also is here cultivated but more rare. Both plants are used in popular medicine and sorcery, but I do not know if the species I am now describing has any narcotic property. If it has one, it is ignored by the people of Pará which also ignores the strong narcotic properties of the other Cabí, *Banisteria caapi*. The latter is the source of the famous 'capí' of the Brazilian State of Amazonas and of the 'yagé' or 'ayahuasca' of the Amazonian parts of Colombia and Peru, drunk by certain Indians of the northwestern part of the Amazon region.

"The two Cabís of Pará can easily be distinguished when flowering or with fruits. Our new species bears yellow flowers and large, thick, unwinged fruits; of *Banisteria caapi*, however, the flowers are pale rosy and the fruits have the form of small, large-winged samarae. Sterile plants can only be distinguished by the consistence of the leaves, herbaceous in both species but thinner in *B. caapi* than in the other."

Novas contribuicões para o conhecimento das seringueiras (*Hevea*) da Amazonia brasileira. By Adolpho Ducke. *Arquivos do Servico Florestal* 2: 1: 25–43; November 1943.

In this work the author brings up to date his series of important studies of the species, varieties, and hybrids of *Hevea* trees of the Amazon region.

Studies in the Simaroubaceae, III. The genus *Simaba*. By Arthur Cronquist. *Lloydia* (Cincinnati) 7: 1: 81–92; March 1944.

"*Simaba* is related on the one hand to *Quassia* and on the other to *Simarouba*. From *Simarouba* it is well separated by its perfect flowers and capitate or slightly lobed stigmas, *Simarouba* having unisexual flowers and long divergent stigmas. A helpful vegetative character is that the leaflets of *Simaba* are usually opposite, while those of *Simarouba* are almost always offset. *Quassia*, as represented by *Quassia amara* L., differs from *Simaba* in its broadly winged leaf rachis, ordinarily racemose inflorescence, erect petals which are glabrous except for a few hairs near the base within, and conspicuously joined pedicels. . . . I believe it is better to refer *Q. africana* to *Simaba*, as Baillon at first did, leaving *Quassia* as a monotype. Another African genus, *Odyendea*, is probably not to be separated from *Simaba*, the only distinctions ever having been brought out, residing in the aestivation of the corolla, being apparently fictitious."

"The genus includes species of very diverse habit, from good-sized trees to small shrubs or subshrubs, and suffruticose plants with the leaves all basal. Where information is available, I have included habit notes in the key, but these must be used with caution, since data are scanty, and several of the species may be either arborescent shrubs or trees. Precise limits of measurements of flower parts are likewise subject to change as more material is accumulated.

"It seems noteworthy that of the 24 species recognized in this paper, 19 were described by 1874, when Engler's excellent treatment appeared in the *Flora Brasiliensis*, and only five others, all valid, have been proposed since."

Notes on Polynesian *Glochidion* and *Phyllanthus*. By Leon Croizat. *Occ. Papers B. P. Bishop Museum* (Honolulu) 17: 16: 207–214; Apr. 28, 1943.

"Of all of the Polynesian euphorbiaceous genera, *Glochidion* Forster is probably the richest in forms and the most difficult to classify. . . . It is difficult to see how conservative taxonomists can avoid treating *Glochidion* as a section or subgenus of *Phyllanthus*, thus accepting the final disposition of Forster's genus made by Mueller of Argau. . . . To clarify these problems of inter-relationship in two large genera and to monograph the species, prolonged investigation is needed. In the meantime, I am accepting both genera, *Phyllanthus* and *Glochidion*. *Glochidion* is ultimately separable on the characters of the staminal column." The paper concludes with the description of a new species of Savaiian tree, *Glochidion Christophersenii*, "though the material is such that I am not certain whether *Phyllanthus* or *Glochidion* is involved."

The origin and distribution of inter- and intraxylary phloem in *Leptadenia*. By Balwant Singh. *Proc. Indian Acad. Sci.* 18: 1: sect. B: 14–19; 2 text figs., 2 plates; 1943.

"In *Leptadenia spartium* and *L. reticulata* there are three phloem regions: (*a*) the outer normal phloem, (*b*) the intraxylary or inner phloem, and (*c*) the interxylary phloem which forms inclusions in the wood.

"The patches of intraxylary phloem arise from the pith cells, but in later stages even the xylem parenchyma cells adjacent to the pith take part in their formation. In old stems a cambium is differentiated on the outer faces of these phloem groups and produces some secondary phloem centripetally.

"The interxylary phloem, present in the stem, becomes differentiated from groups of thin-walled cells produced centripetally by the cambium. Later the cambium resumes its normal activity with the result that the phloem groups become embedded in the secondary xylem."—*From author's summary.*

Classification and description of the vegetation types of the Niger Colony, French West Africa. By W. A. Fairbairn. Imperial Forestry Institute (Oxford) Paper No. 23, 1943. Pp. 38; 8 plates, 1 folded map. Price 4 s.

The author, who is Assistant Conservator of Forests of Nigeria, had a previous report, entitled "Ecological succession due to biotic factors in northern Kano and Katsina Provinces of Northern Nigeria," published in 1939 as Institute Paper No. 23. The territories in the two investigations are adjacent and the basic classification followed is the same. "The direction in which further study is now most needed is the determination of the ecological status of the communities described and the extent to which their tension lines can be controlled in the interests of conservation of fertility and optimum land utilization."

Development of trade in colonial timbers. Importance of research into problems of production, marketing, and forest engineering. By J. N. Oliphant. Reprint from *The Crown Colonist* (London), March 1944.

"The essential features of the present movement for the development of Colonial forest resources are the location of sawmills and other manufacturing plants in, or as close as possible to, the forests, so that transport costs on raw materials are reduced to a minimum; and the conduct of intensive and sustained 'production-*cum*-marketing' research aimed at finding uses for as many as possible of the miscellany of woods to which the plants have access. Because the variety of the raw material is so great, it is contemplated that there should be provision for its experimental manufacture into a correspondingly wide variety of forms, including not only primary products like sawn timber but secondary ones such as plywood, turnery, doors and windows, furniture, matches, and so on. Moreover, as logging, *i.e.*, the bringing of the raw material to the plant, is a particularly costly operation in the tropics, the economical plan, as full-scale industries develop, will be to locate a group of different wood-using industries at one center where they can share the same logging organization as well as such other common requirements as power and technical staff for supervision. Such an arrangement enables much material that would be treated as waste by one plant to be utilized by some other industry of the group."

The African oil palm: its history, cultivation, and importance. By DONOVAN S. CORRELL. *Lloydia* (Cincinnati) 7: 2: 101–120; June 1944.

"The palm oil of commerce is obtained from the oily, fibrous pericarp or outer layer of the fruit of numerous varieties and strains of the African Oil Palm (*Elaeis guineensis* Jacq.), the 'Palmier à huile' of commerce, a member of the coconut family (Palmae). Palm kernel oil is derived from the kernel of the African Oil Palm seed."

"Among the fats and oils imported into the United States, palm oil ranks next to coconut oil in point of volume. The world's largest exporters today are European colonial possessions in West Africa, mainly British West Africa (especially Nigeria), the Belgian Congo, and French West Africa, with a small amount exported from Latin America, primarily Brazil. Nigeria and the Belgian Congo, alone, have supplied approximately three-fourths of the world's production of palm oil and kernel oil. Before the present war, the Netherlands Indies and British Malaya supplemented greatly the palm oil and kernels imported from West Africa.

"In 1931, the United States imported 258 million pounds of palm oil and 39 million pounds of palm kernels and palm kernel oil. Following this there was a steady yearly increase of importations (with minor fluctuations) until a peak was reached in 1937, during which year 411 million pounds of palm oil (valued at about 23 million dollars) and 179 million pounds of palm kernels and palm kernel oil (valued at about 11 million dollars) were imported. The bulk of this oil and kernels came from the Netherlands Indies, Belgian Congo, and Nigeria. Since 1937, however, there has been a sharp decline in importations, and in 1939 only 288 million pounds of palm oil and a little more than two million pounds of palm kernels and palm kernel oil were imported."

M. M. CHATTAWAY.

Price 25 cents

Yale University School of Forestry

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NUMBER 80 DECEMBER 1, 1944

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NOTES ON TROPICAL TIMBERS

By SAMUEL J. RECORD

Aspidosperma Monteroi is *A. multiflorum*

In describing some species of *Aspidosperma* yielding woods of the Boxwood type I said ("Timbers of the New World," 1st printing, p. 61): "*A. Monteroi* Standl., from near Manáos, Brazil, belongs in this group." The specimen was obtained from Field Museum and bore the scientific name on the label. It was later discovered that the name was only provisional and had never been published. A photograph and fragments of the herbarium material were sent to Dr. Adolpho Ducke who informs me that he collected the same species in dry forests near Santarem and Monte Alegre and that, according to Dr. Kuhlmann, the correct name for it is *Aspidosperma multiflorum* DC. It also appears that the original source of the wood sample was not Manáos but Aramanahy, Lower Tapajoz, State of Pará, where it was collected by the late Dr. R. C. Monteiro da Costa.

Identifying *Laplacea Brenesii*

Following is a striking instance of the aid a wood anatomist may be able to give a taxonomist working with sterile herbarium material. Recently I received from Paul C. Standley, of the Chicago Natural History Museum, a small piece of wood collected by Mr. Steyermark in Guatemala. He wrote that he had at least seven collections of the same tree from different parts of Guatemala and some others from Honduras and Panama, and added that the leaves looked to him more like *Meliosma* than anything else.

Fortunately for my purpose the wood in question has solitary vessels and scalariform perforation plates so that it was a very simple matter to find it in two of the keys of the series I have been publishing. Furthermore, the exact species was indicated—*Laplacea Brenesii* Standley.

I reported my findings to Mr. Standley and by return mail received his confirmation of my diagnosis. "There is no question as to the correctness of the name, but the variations in foliage are extraordinary. The leaves of sterile young branches are *very* unlike those of fertile branches. We have just one fertile collection (in old fruit) from Guatemala, so weather-beaten that for some time I did not recognize the family. If it and the sterile specimens were put side by side, few botanists would recognize any connection between them, just as in my case.

"Incidentally, one of the sterile specimens from Honduras was written up once by [another botanist] as a new species of *Quercus*, but I realized that it was at least no *Quercus* and suppressed the description."

Laplacea Brenesii differs from the other species of the genus particularly in its coarser texture. According to C. L. Lankester (see *Tropical Woods* 70: 30), it is abundant in the Cartago region of Costa Rica and in demand for scantlings for house and mill construction, but warps too badly in seasoning to make good boards.

Driftwood in Nova Scotia traced to the South Seas

Last April Capt. Harry Peake, who is stationed at French Village, Halifax County, Nova Scotia, sent me for identification a bit of wood which he said had been taken from a larger piece that "came in on the tide." A description of the wood follows:

Color slightly pinkish. Luster rather high. Odorless and tasteless. Very light and soft, but tough; weight (air-dry) about 20 lbs. per cu. ft.; texture fine and uniform; grain straight; feel velvety. Very easy to work, but presumably of low durability.

Pores visible, rather few, fairly evenly distributed; occurring singly and less often in radial pairs or threes. Vessels with simple perforations; pits alternate, medium-sized, vestured; spirals and tyloses absent. Rays uniseriate and less than 25 cells high; homogeneous; pits to vessels medium-sized. Parenchyma narrowly vasicentric and in numerous diffuse crystalliferous strands. Fibers with thin walls and small simple pits. Ripple marks absent. No gum ducts seen.

The above combination of characters can be found only in the Leguminosae-Mimosaceae. The uniseriate rays and the exceptionally low density served to narrow the search to a very small group of genera and a few comparisons were sufficient to reduce the possibilities to a single genus—*Albizzia*. Available descriptions eliminated the American species. In the Yale collections there are representatives of about 30 Old World species and an examination of the slides soon reduced the quest to one—*Albizzia fulva* White & Francis. Our file specimen was collected by C. E. Lane-Poole (his No. 263) on the trail from Kokoda to Gap, in the Owen Stanley Range, Papua. The sample to be determined matched the other so perfectly that they appeared to be parts of the same piece. Obviously the board washed ashore in Nova Scotia must have been dropped from a ship on its return from the southwest Pacific.

Albizzia fulva is one of the largest trees in the forest, attaining a height of 150 feet. The soft wood saws woolly when fresh but takes a smooth finish when dry. It is suitable for boxboards and light construction not exposed to decay or insect attack. The vernacular names recorded are Gemona, Kerefere, and Haide.

Distinguishing *Cedrela* and *Swietenia*

I recently had occasion to examine a herbarium specimen which the collector believed to be an undescribed species of *Swietenia*. Since the material was incomplete there was some doubt as to whether it was Mahogany or Spanish Cedar (*Cedrela*). It required only a few minutes to make a free-hand section of a twig and place it under a compound microscope. One look was enough to convince me that the genus in question could not be *Swietenia*, and of the two genera in question, *Cedrela* was indicated.

The outstanding anatomical feature distinguishing these genera is the size of the vessel pits. In *Swietenia* they are minute, about 3μ, whereas in *Cedrela* they are fully twice as large, a difference so great and so consistent that it can be readily employed without measurements, particularly if specimens of both kinds are available for comparison. Very small pits are characteristic of most members of the family Meliaceae, some of the exceptions being *Aphanamixis*, *Azadirachta*, *Cabralea*, *Cedrela* (including *Toona*), *Ekebergia*, *Melia*, and *Pteroxylon*. They also occur in a wide range of families, and Key No. VII (*Tropical Woods* 74) includes American representatives of 50 families with some or all of the vessel pits not over 4μ in diameter.

In dealing with heartwood there is usually no occasion for confusing Mahogany and Spanish Cedar, as the fragrant scent of the latter is characteristic. Generally, too, the Cedar is softer and lighter in weight, a fact which probably misled Boulger into stating (*Wood*, London, 1908, p. 207): "The Mahoganies of the Central American mainland, which form the bulk of the rapidly shrinking American supply, and are known as Honduras, Tabasco, Baywood, Colombian, Panama, Mexican, or Bermuda, are probably the wood of species of *Cedrela*, a genus closely allied to *Swietenia*." It is now known that the mainland species is *Swietenia macrophylla* King. According to tests at Yale, the specific gravity (air-dry) of wood of the latter species ranges from 0.40 to 0.85, mostly between 0.50 and 0.60, whereas the lightest Cedar had a bulk density of 0.37 and the heaviest (*Cedrela salvadorensis* Standl.) 0.75, the average being between 0.40 and 0.50.

On a basis of pit size only the wood of *Swietenia* is not distinguishable from *Khaya*, *Entandrophragma*, *Pseudocedrela*, *Carapa*, and *Xylocarpus*, all of which resemble Mahogany more or less closely. Birch (*Betula*), which frequently is finished in imitation of Mahogany, has very fine vessel pitting but the anatomical resemblance goes no further. Dipterocarp woods have relatively coarse vascular pits which, unlike those in the Mahogany family, are distinctly vestured. The nature of the pitting of the several elements of wood constitutes one of the most reliable and readily used features in identification and deserves much more study and analysis.

Determining the Age of Mahogany Trees

The wood of *Swietenia* is characterized by concentric bands of parenchyma which clearly demarcate growth rings. Many, perhaps most, tropical woods exhibit growth rings more or less distinctly, but in comparatively few instances have they been correlated with definite periods of time. Collecting the necessary data is not a particularly difficult task for a scientist who has opportunity to study selected trees for a few years or can examine stumps in plantations of known age, but the subject has received little attention.

The best work of this kind has been done by K. A. Chowdhury of the Forest Research Institute at Dehra Dun, India. About four years ago he completed a series of observations on Mahogany (*Swietenia macrophylla*) planted in India. He concludes that a distinct parenchyma band is formed annually and completely encircles the tree. Hence the number of *complete* rings indicates the age of the tree in years. Since American Mahogany grown in India shows no essential difference in structure from that of the same species in its native habitat, it seems safe to assume that annual rings are produced throughout the range of the genus.

Many different kinds of woods have growth rings demarcated by bands of parenchyma. It has been customary to refer to such bands as "terminal parenchyma," the supposition being that they were formed at the conclusion of the growing season. It is now known that such bands may be formed at the commencement of seasonal growth, hence the term "initial parenchyma" has come into use (see *Tropical Woods* 49: 36). The parenchyma bands in *Swietenia*, for example, are initial and not terminal.

In examining a wood specimen, it is not always easy to decide whether a band belongs to one ring or to the next, and in such cases of doubt parenchyma is said to be "terminal or initial." This situation could be avoided by the use of the less specific term "marginal," which would indicate position without reference to the time of production.

Pseudocopaiva hymenaefolia

In the paper following, Dr. John D. Dwyer gives reasons for his believing that *Pseudocopaiva* is a valid genus, distinct from *Copaifera*. My interest in this subject is of more than 20 years' standing, as stated in *Tropical Woods* 37: 5:

"In my book, *Timbers of Tropical America*, published in 1924, I said that I could not understand why the Cuban 'Quiebrahacha' was named *Copaifera hymenaefolia*, since the wood is strikingly different from those of the other species of *Copaifera*, which are much alike. After three systematists had told me that the species was properly placed, I put the problem aside, but not out of mind. Some five years later, while visiting the New York Botanical Garden, I related my experience to Dr. N. L. Britton, who thereupon presented me with a manuscript he and Mr. Percy Wilson had prepared for their *North American Flora*, and in it they had set up a new genus, *Pseudocopaiva*, for *Copaifera hymenaefolia*. I published that description in our magazine, *Tropical Woods* (20: 28, Dec. 1, 1929) and, so far as I am concerned, the status of that plant is permanently fixed."

THE GENUS *PSEUDOCOPAIVA* BRITTON & WILSON

By John D. Dwyer

Union University, Albany College of Pharmacy

In 1929 Britton and Wilson described the genus *Pseudocopaiva* (Caesalpiniaceae) without critical notes in *Tropical Woods* 20: 28, basing it on the well-known species endemic to Cuba, *Copaifera hymenaefolia* described by Moric in 1833. That *Pseudocopaiva* has not been generally accepted by workers may be gleaned from a study of subsequent identifications of the species.[1] Recently I had occasion to survey the American and West Indian species of *Copaifera* and found many substantial reasons for upholding Britton and Wilson's genus. Restricting ourselves to the above range, we can definitely segregate the Cuban species from the majority of the species of *Copaifera* on the unijugate character of its leaves. Only four species, all of these South American, agree with it in this respect: *C. confertifolia* Benth., *C. Kuntzei* Harms, undoubtedly conspecific with *C. confertifolia*, *C. fissicuspis* Pittier, and a Paraguayan species, *C. chodatiana* Hassler. Of the quartet, *C. chodatiana* exhibits such a marked relationship that on superficial examination it can scarcely be distinguished from its Cuban counterpart. Assuming for the moment the validity of the genus *Pseudocopaiva*, it is expedient that a new combination be made: *Pseudocopaiva chodatiana* (Hassler) Dwyer.

The principal differences between *Pseudocopaiva* and *Copaifera* are to be found in the foliage, flowers, fruits, and wood.[2] The American and West Indian Copaiferas do not possess strongly falcate leaflets and the midveins are little eccentric as a result. These conditions account for the fact that the principal secondary veins are rather proximate and

[1] The Gray Herbarium, Harvard University, recently issued no. 1149 in its "Plantae Exsiccatae Grayanae" series, labelled *Copaifera hymenaefolia* Moric, based on material collected by R. A. Howard and F. Gonzales (6598). An excellent list of synonyms is included on the printed label.

[2] Professor Record appended notes on the comparative anatomy of the woods of *Pseudocopaiva* and *Copaifera*, following Britton and Wilson's description of the former genus.

as they approach the margin, parallel with each other. In *Pseudocopaiva* each half of the unijugate leaves is inequilateral with a conspicuous and eccentric midvein from which 4–8+ conspicuously and roughly parallel secondary veins emanate, those on the wider side of the lamina being 0.3–1.5 cm. apart. As the veins of *P. hymenaefolia* and *P. chodatiana* are widely spaced on the wider side of the falcate lamina and diverge sharply as they proceed toward the margin, the resulting pattern is striking. In fact, in *Pseudocopaiva* the disposition of the main secondary veins is more like that found in the closely related genus *Cynometra*, all of whose species are characterized by unijugate leaves.

On the basis of floral structure *Pseudocopaiva* shows marked floral differences from *Copaifera*. While the size, shape, and number of the sepals of both genera agree in general, the texture, pubescence, and coloration of the sepals of *Pseudocopaiva* are so strikingly unlike those of the latter genus that I think herein lies one of the strongest arguments for the retention of Britton and Wilson's genus. Its sepals are thick-crassate, bearing short white-woolly hairs inside and outside; this pubescence is set against a blackish, often glandular-punctate surface. The American and West Indian Copaiferas, on the other hand, have their sepals crassate, and should they be pubescent within, are always long-hirsute (under magnification), the corpus drying a golden brown to a deep dull red color. Both genera agree in the structure of the stamens and in the absence of petals. Examining the carpels of both genera we note that the styles differ appreciably in length, those of *Copaifera* being 2–4 (4.5) mm. in length, while those of *Pseudocopaiva* attain a length of 6.5 mm. at maturity. This disparity is significant when we consider that the figure of 4.5 mm. for *Copaifera* embraces over 20 American and West Indian species. In *P. chodatiana* particularly, the distinct unilateral position of the style with relation to the top of the ovary stands in contrast to the simply eccentric position of the style characterizing the Copaiferas. *P. hymenaefolia*, unlike any American or West Indian species heretofore described, except *C. confertifolia*, whose ovary is described as glabrous, has the carpellary hairs confined to the basal

stipe. It must be admitted that the ovary of *P. chodatiana* has hirsute hairs unmistakably similar to those of the Copaiferas. As in the case of the sepals, the often mottled and gray-black or virescent appearance of the boiled carpels of *Pseudocopaiva* scarcely resembles the golden brown, dull red or nigrescent, and vaguely or non-mottled surface of the dried carpels of the Copaiferas. Stigmatic structure and ovular pattern show little variation within the complex.

Since all of the available material of *P. chodatiana* is in flower or in very immature fruit, we may assume that the legumes of *P. hymenaefolia* are typical of the genus. Unlike the plump and smooth fruits (at maturity) of *Copaifera*, these are rather flat and papillate. The minute excrescences on the surface of the valves are more suggestive of the fruits of *Cynometra* which are superficially scurfy. The endocarp of *Copaifera* is uniformly smooth, lacking the thin oblique ridge found in *Pseudocopaiva*. This ridge, located at the distal end of the valve, marks the position of the edge of the widest side of the arillus. While agreeing in the possession of solitary seeds, both genera exhibit differences in the arillus. In *Copaifera* this covers three-quarters or the full length of the mature seed on one side; in *Pseudocopaiva* it forms a relatively small cap atop the seed. In the former genus the seeds are plump at maturity and rather dull black (in siccitate), while in the latter genus they are subplane and glistening red.

It is appropriate that we conclude with a discussion of the differences between *P. chodatiana* and *P. hymenaefolia*, heretofore not considered by workers to be related. The latter species is endemic to Cuba while the former has been reported only from Paraguay, in the region of the Río Apa (*Hassler 7984*, type collection of *C. chodatiana*; *Hassler 8046*, type collection of *C. chodatiana* var. *fruiticosa* Hassler), and between the Río Aquidaban and Río Apa (*Fiebrig 4934*). Structurally, the leaf blades of the Cuban species are more falcate, the broader side of the lamina being wider, more attenuate at the apex, and cordate at the base. On comparing the spacing of the more conspicuous and subparallel adjacent veins in the middle of the wider side of the lamina, I found those of *P. hymenaefolia* to be 0.5–1.5 cm. apart while those of *P. chodatiana* are 0.3–0.5 cm. apart. In the former species these veins are quite prominent and thick on the under side, while those of the latter are slender and somewhat evanescent. The critical floral differences are: the sepals of *P. hymenaefolia* are generally glandular-punctate (the punctations lacrimiform) while those of *P. chodatiana* are eglandulose; the carpels of the former species are glabrous except on the stipe, while the carpels of the Paraguayan species are hirsute on the ovary, on part of the style, and on the stipe; and lastly the style of the Cuban species is 4 mm. long while that of *P. chodatiana* measures 5.5–6.5 mm. in length. As the mature fruit of *P. chodatiana* has not been collected, we can make no comparison between it and the fruit of *P. hymenaefolia*.

KEYS TO AMERICAN WOODS (CONTINUED)

By SAMUEL J. RECORD

The following keys are the fifteenth and sixteenth in a series begun in *Tropical Woods* No. 72, December 1, 1942. Those in the preceding issues are: (No. 72) I. Ring-porous woods. II. Pores in ulmiform or wavy tangential arrangement. III. Pores in flame-like or dendritic arrangement. (No. 73) IV. Vessels virtually all solitary. V. Vessels with spiral thickenings. (No. 74) VI. Vessels with scalariform perforation plates. VII. Vessels with very fine pitting. (No. 75) VIII. Vessels with opposite or scalariform pitting. IX. Woods with conspicuous rays. (No. 76) X. Woods with storied structure. (No. 77) XI. Woods with resin or gum ducts. XII. Parenchyma reticulate. (No. 78) XIII. Woods with septate fibers. (No. 79) XIV. Dicotyledonous woods with xylem rays virtually all uniseriate. These keys are intended for use in connection with Record and Hess' *Timbers of the New World* (see *Tropical Woods* 73: 42) wherein many of the anatomical features are well illustrated by photomicrographs.

XV. *Fibers with conspicuous bordered pits.* This key is concerned with woods having a ground mass of fiber-tracheids characterized by pits that are conspicuous because of their number or size or both. Of the American woods studied, representatives of 152 genera and 54 families were found to

belong in this group. Only 28 genera of 21 families do not also have virtually all of their vessels solitary. Woods in the latter category are omitted and reference is made to Key IV in this series. Fibers with conspicuous bordered pits are in the class of tracheary elements and not directly associated with the storage of food, hence are never septate.

XVI. *Woods with oil (or similar) cells.* These elements are typically large thin-walled parenchyma cells with resinous, usually yellowish, contents. Cells similar in appearance, but without yellow contents, occur in certain Apocynaceae and *Batesia* (Leguminosae). Oil (and similar) cells are limited to the rays in Apocynaceae, Myristicaceae, Piperaceae, and Rutaceae; to the parenchyma strands in Canellaceae, Hernandiaceae, Leguminosae, Magnoliaceae, and Solanaceae. Only in Anonaceae (rarely) and Lauraceae have such cells been found in both rays and parenchyma strands in the same genus. Another type of distended cell has crystalline contents and is not considered here.

This key applies to American representatives of 33 genera of 11 families. Fifteen of these genera belong to the Lauraceae and, owing to taxonomic uncertainties in the classification of members of that family, the features used in separating some of the genera are of doubtful dependability.

XV. FIBERS WITH CONSPICUOUS BORDERED PITS

1 a. Vessels absent 2
b. Vessels present 4
2 a. Wood of normal appearance, suggesting *Fagus*. *Drimys* (Winteraceae).
b. Wood (of secondary growth) consisting of radially elongated fibro-vascular bundles (fiber-tracheids and phloem) surrounded by parenchyma (modified monocot structure) 3
3 a. Secondary wood laminated owing to periodic changes in the direction of the fibro-vascular strands .... *Yucca* (Liliaceae).
b. Secondary wood not laminated .... *Dracaena* (Liliaceae).
4 a. Vessels virtually all solitary .... Key IV (*Tropical Woods* 73).
b. Vessels not all solitary 5
5 a. Vessel pits vestured. Radial channels common 6
b. Vessel pits not vestured. Radial channels absent 9
6 a. Parenchyma in narrow concentric bands about 1 pore-width apart .... *Couma* (Apocynaceae).

b. Parenchyma finely reticulate 7

7 a. Rays 1–3 cells wide; without distended cells. *Macoubea* (Apocynaceae).

b. Rays up to 5 (6) cells wide; distended cells common 8

8 a. Fibers thick-walled. Pores mostly solitary. *Microplumeria* (Apocynaceae).

b. Fibers thin-walled. Pores frequently in multiples. *Rauwolfia* (Apocynaceae).

9 a. Vessel perforations exclusively or predominantly multiple 10

b. Vessel perforations simple 20

10 a. Rays in part conspicuous 11

b. Rays not conspicuous, though often distinct 12

11 a. Pores radially arranged. Parenchyma in short tangential rows and diffuse. Vessels and fibers often with spirals. Heartwood chalky white . . . . *Ilex* (Aquifoliaceae).

b. Pores not in definite radial arrangement. Parenchyma absent or very sparse. Vessels and fibers without spirals. Heartwood reddish or brownish . . . . *Turpinia* (Staphyleaceae).

12 a. Parenchyma reticulate 13

b. Parenchyma not reticulate 17

13 a. Rays all uniseriate or biseriate 14

b. Rays in part 3–4 (5) cells wide 15

14 a. Rays very high; pits to vessels very large. *Peridiscus* (Flacourtiaceae).

b. Rays typically less than 30 cells high; pits to vessels very small. *Pamphilia* (Styracaceae).

15 a. Multiseriate ray cells variable in form and not definitely stratified. Pores mostly solitary. Wood yellowish white . . . . *Styloceras* (Buxaceae).

b. Multiseriate rays with definite stratum of procumbent cells. Pores mostly in multiples. Wood brown 16

16 a. Intervascular pitting finely scalariform. Enlarged crystalliferous ray cells common. Pores uniformly distributed; crowded. *Aextoxicon* (Aextoxicaceae).

b. Intervascular pitting not scalariform. Enlarged crystalliferous ray cells absent. Pores crowded in early wood; tending to diagonal arrangement in late wood . . . . *Halesia* (Styracaceae).

17 a. Spirals common in tips of vessel members. Vertical gum ducts of sporadic occurrence . . . . *Liquidambar* (Hamamelidaceae).

b. Spirals absent or very rare. Gum ducts absent 18

18 a. Vessel-ray pitting coarse, usually scalariform. *Eucryphia* (Eucryphiaceae).

b. Vessel-ray pitting fine, opposite 19

19 a. Rays 1 or 2 (3) cells wide . . *Nyssa aquatica*, *N. sylvatica* (Nyssaceae).

b. Rays up to 4 or 5 cells wide . . . . *Nyssa biflora*, *N. ogeche* (Nyssaceae).

20 a. Rays all wide; not in contact with the pores. *Aristolochia* (Aristolochiaceae).

b. Rays not all wide, sometimes all narrow; often in contact with the pores 21

21 a. Vessels with spiral thickenings 22

b. Vessels without spiral thickenings 25

22 a. Rays all uniseriate. Fibers with spirals . . . . . . *Evonymus* (Celastraceae).

b. Rays not all uniseriate. Fibers without spirals 23

23 a. Definitely ring-porous. Rays 1–3 cells wide; homogeneous. *Elaeagnus* (Elaeagnaceae).

b. Not definitely ring-porous. Rays more or less heterogeneous in part 24

24 a. Rays rarely up to 5 cells wide. Pores in large groups, often radial. Fibers thin-walled . . . . *Ovidia* (Thymelaeaceae).

b. Rays often 5, sometimes up to 10, cells wide. Pores fairly uniformly distributed, though more crowded in early wood. Fibers rather thick-walled . . . . *Prunus serotina* (Rosaceae).

25 a. Ring-porous. Late-wood pores in flame-like arrangement. Vasicentric tracheids present . . . . *Castanea* (Fagaceae).

b. Diffuse-porous. Late-wood pores not in flame-like arrangement. Vasicentric tracheids absent 26

26 a. Vessel-ray pitting fine 27

b. Vessel-ray pitting coarse 29

27 a. Rays decidedly heterogeneous; pits to vessels not over 4μ. *Dichapetalum* (Dichapetalaceae).

b. Rays homogeneous or weakly heterogeneous; pits to vessels 6–7μ. 28

28 a. Ripple marks present; about 130 per inch; irregular; most of the rays not storied. Pores often clustered . . *Gaiadendron* (Loranthaceae).

b. Ripple marks absent. Pores mostly solitary. *Wigandia* (Hydrophyllaceae).

29 a. Gum ducts common in multiseriate rays . . . . . . *Mammea* (Guttiferae).

b. Gum ducts absent . . . . *Ancistrothyrsus* (Flacourtiaceae).

XVI. WOODS WITH OIL (OR SIMILAR) CELLS

1 a. Parenchyma in uniform concentric apotracheal bands 2

b. Parenchyma otherwise or absent 5

2 a. Parenchyma bands terminal. Intervascular pitting scalariform. Perforation plates scalariform . . . . *Magnolia* (Magnoliaceae).

b. Parenchyma bands closely spaced. Intervascular pitting fine and alternate. Perforations simple 3

3 a. Parenchyma bands uniseriate. Oil cells confined to rays. *Duguetia* (Anonaceae).

b. Parenchyma bands biseriate 4

4 a. Oil cells tall and slender; confined to parenchyma strands. *Cymbopetalum* (Anonaceae).
b. Oil cells subglobose; occurring mostly in rays, sparingly in parenchyma strands .... *Xylopia mirabilis* (Anonaceae).
5 a. Vessel-ray pitting fine to medium (sometimes unilaterally compound) 6
b. Vessel-ray pitting very coarse, irregular to scalariform 16
6 a. Vessel perforations exclusively multiple; plates scalariform with many bars. Oil cells in parenchyma strands only. *Capsicodendron* (Canellaceae).
b. Vessel perforations exclusively or predominantly simple 7
7 a. Rays all coarse and very high; rarely in contact with the pores. Oil cells in rays only .... *Piper* (Piperaceae).
b. Rays not all coarse and high; often in contact with the pores 8
8 a. Vessels with spirals. Wood ring-porous. Minute pores in parenchyma-like bands and patches in association with other pores. Oil cells in parenchyma strands only .... *Grabowski* (Solanaceae).
b. Vessels without spirals. Woods diffuse-porous 9
9 a. Parenchyma abundantly vasicentric, sometimes confluent. Pores not numerous 10
b. Parenchyma otherwise or absent. Pores numerous; very small to sometimes medium-sized. Oil cells in rays only 11
10 a. Vessel pits vestured. Pores large; mostly solitary. Rays homogeneous. Oil cells in parenchyma strands only. *Batesia* (Leguminosae).
b. Vessel pits not vestured. Pores medium-sized; often in multiples. Rays more or less distinctly heterogeneous. Oil cells mostly in rays, but sometimes in parenchyma strands also. *Umbellularia* (Lauraceae).
11 a. Rays nearly homogeneous. Vessel pits not vestured. Latex tubes and radial channels absent. Vertical traumatic gum ducts sometimes present .... *Euxylophora* (Rutaceae).
b. Rays very heterogeneous (exc. *Geissospermum*). Vessel pits vestured. Latex tubes and radial channels sometimes present. Gum ducts absent 12
12 a. Fibers septate; pits simple or nearly so. Parenchyma absent or very sparse. Pores mostly in multiples 13
b. Fibers not septate; pits distinctly bordered. Parenchyma abundant, reticulate to zonate. Pores mostly solitary 15
13 a. Latex tubes present in some of the rays. *Peschiera*, *Stemmadenia* (Apocynaceae).
b. Latex tubes absent 14
14 a. Radial channels common. *Bonafousia*, *Tabernaemontana* (Apocynaceae).
b. Radial channels absent .... *Anartia* (Apocynaceae).

15 a. Rays 1 or 2 cells wide; weakly heterogeneous. Crystalliferous parenchyma cells common .... *Geissospermum* (Apocynaceae).
b. Rays 2-sized, the larger 3 or 4 (6) cells wide; decidedly heterogeneous. Crystalliferous strands absent or rare. *Microplumeria* (Apocynaceae).
16 a. Tanniniferous tubes present in some of the rays. Oil cells in rays only .... *Virola* (Myristicaceae).
b. Tanniniferous tubes absent 17
17 a. Oil cells in either rays or parenchyma strands but not both 18
b. Oil cells in both rays and parenchyma strands 22
18 a. Oil cells in parenchyma strands only 19
b. Oil cells in rays only 21
19 a. Pores few and large. Wood very light and soft. Rays homogeneous; 1–4 (5) cells wide and up to 50 cells high. Fibers septate in part. *Hernandia* (Hernandiaceae).
b. Pores fairly numerous and up to medium-sized. Woods of medium density. Rays 1 or 2 (3) cells wide. Fibers not septate 20
20 a. Rays homogeneous or nearly so; up to 30 (60) cells high. *Anaueria* (Lauraceae).
b. Rays decidedly heterogeneous; up to 15 (30) cells high. *Beilschmiedia* (Lauraceae).
21 a. Pores rather small; thick-walled. Heartwood with spicy scent and taste .... *Dicypellium* (Lauraceae).
b. Pores medium-sized; thin-walled. Heartwood mildly fragrant; taste not distinctive .... *Pleurothyrium* (Lauraceae).
22 a. Wood ring-porous .... *Sassafras* (Lauraceae).
b. Woods diffuse-porous 23
23 a. Parenchyma in concentric bands 3–6 cells wide at margins of growth rings. Pores small. Fibers not septate. *Cryptocarya rubra* (Lauraceae).
b. Parenchyma otherwise. Pores medium-sized to large. Fibers commonly septate 24
24 a. Sclerotic tyloses and parenchyma cells common. *Aniba canelilla*, *Licaria canella* (Lauraceae).
b. Sclerotic tyloses and parenchyma cells absent 25
25 a. Parenchyma sparsely vasicentric. *Aniba*, *Endlicheria*, *Licaria*, *Nectandra*, *Phoebe* (Lauraceae).
b. Parenchyma frequently confluent diagonally. *Mezilaurus*, *Ocotea*, *Persea* (Lauraceae).

CURRENT LITERATURE

Riqueza forestal dominicana. By José Schiffino. *Revista de Agricultura* (Rep. Dominicana) 35: 153: 40–44; 4 text figs.; March-April 1944.

Contains accounts of three trees, namely, Cedro, *Cedrela odorata*, Caya Amarilla, *Sideroxylon foetidissimum*, and Caya Colorada, *Dipholis salicifolia*, which are useful for their timber in Dominican Republic. The author, who is Inspector Forestal y Encargado de Asuntos Botanicos, has had much experience with the forests and woods of his country.

Itinéraires botaniques dans l'île de Cuba (deuxième série). By Frère Marie-Victorin and Frère Léon. *Contrib. Inst. Bot. Univ. Montréal* 50: 1–410; 257 figs.; 1944.

This work, the second of a series on botanical excursions in Cuba, is a sequel to the first (reviewed in *Tropical Woods* 71: 36), by the same authors; it covers the work of collecting and exploring done during 1940, 1941, and 1942. Although much of the material is new, certain chapters treat regions already studied in the first volume, giving additional information and data not previously recorded. Various corrections and adjustments in the nomenclature of certain species mentioned in the first volume have been added, either in the main body of the text or in marginal notes in the index.

Frère Marie-Victorin, founder and director of the Botanical Institute of the University of Montreal, was killed in an automobile accident while returning from a botanical trip in Quebec, Canada, July 15, 1944.

Frère Léon is the Director of the Botanical Laboratory of La Salle College (Havana); the taxonomic work was done by him, while the photographs and "Journal de Route" are the work of the late Frère Marie-Victorin.

The taxonomy of the Mexican, Central American, and West Indian species of *Ouratea* (Ochnaceae). By John D. Dwyer. *Lloydia* (Cincinnati) 7: 2: 121–145; 4 figs.; June 1944.

"The Mexican, Central American, and West Indian species of *Ouratea* range from lianas to tall trees. *O. insulae* Riley may attain a height of 25 meters. As a rule, however, the Ourateas are small trees or shrubs. As is characteristic of the majority of the genera of the Ochnaceae, the lustrous leaf blades of *Ouratea* tend to be grouped and to persist at the apices of the twigs, thus giving the plants an attractive appearance."

"Of the 55 specific names in current use for the North American species of the Ourateae, 26 are valid, one is deserving of varietal rank, three are doubtful because of inadequate description and lack of material, and 25 are invalid." Two new species are described, both from Costa Rica.

Revision of the palmettoes. By L. H. Bailey. *Gentes Herbarum* (Ithaca, N. Y.) 6: 7: 367–459; figs. 186–251; July 21, 1944.

A new monograph of the genus *Sabal* including 26 species, of which five are named and described for the first time, and one, *S. bahamensis*, formerly treated as a variety of *S. Palmetto*, is given specific rank. The new species are *Sabal peregrina* and *S. viatoris*, native habitat of both unknown, *S. Alleni* of Panama, *S. yucatanica* of Yucatan, and *S. Questeliana* of St. Barts, F. W. I.

A full key, numerous excellent line drawings, and photographs serve to convey the kind of essential information that cannot be adequately communicated by any text and incidentally give emphasis to the author's announcement that bundles of sterile and fragmentary material in his own herbarium have been burned.—B. E. Dahlgren, *Chicago Natural History Museum.*

The Caribbean Forester. Pub. quarterly by the Trop. For. Exp. Sta., U. S. Forest Service, Río Piedras, Puerto Rico. Vol. V: 1–4: 1–212; October 1943—July 1944.

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The forests of Costa Rica. By C. A. MERKER, WILLIAM R. BARBOUR, JOHN A. SCHOLTEN, and WILLIAM A. DAYTON. Mimeographed. U. S. Forest Service, Washington 25, D. C., 1944. Pp. 84; 8 x 10½; 48 plates, 1 type map in color.

A general report on the forest resources of Costa Rica, Central America, by the U. S. Forest Service in cooperation with the Office of the Coordinator of Inter-American Affairs. There are three parts, as follows: I. The present situation: Geographical background; the forests; exploitation of the forests. II. The future use and management of Costa Rica's forests: General considerations; potential wood requirements and uses; some essential steps in a forestry program. III. Appendix: The more important forest trees; common and scientific names; strength and related properties of woods; lumber prices; wood exports; photographs and forest type map. The whole constitutes a valuable contribution to the knowledge of tropical American forests.

Caldasia. Boletín del Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, Bogotá. No. 11, July 20, 1944.

CONTENTS (botanical)

The development of vessels in angiosperms and its significance in morphological research. By I. W. BAILEY. *Am. Journ. Bot.* 31: 7: 421–428; 9 text figs.; July 1944.

"Vessels have originated independently in five distinct categories of the Tracheophyta, *viz.* Selaginellales, Filicales, Gnetales, monocotyledons, and dicotyledons. The origins and salient trends of specialization of vessels in the primary bodies of monocotyledons and in both the primary and secondary bodies of dicotyledons are clearly definable upon the basis of available evidence preserved in extant representatives of the angiosperms. The irreversible phylogenetic trends in the origins and specializations of vessels are so comprehensive and reliable that they deserve serious consideration in various lines of botanical research. Their significance in the fields of comparative and developmental morphology are discussed in this paper, leaving their significance in the discussion of physiological problems for future consideration." —*Author's summary*.

The formation of growth rings in Indian trees. Part III. A study of the effect of locality. By K. Ahmad Chowdhury. *Indian Forest Records* (n. s., Utilization) 2: 3: 59–75; 2 plates; Sept. 19, 1940.

Results of a study of the effect of local climate on diameter growth of Teak (*Tectona grandis*) and Mahogany (*Swietenia macrophylla*). Many interesting observations are recorded and many questions are raised which cannot now be fully answered.

Both of these species usually shed their leaves during the dry season, but leaf-fall may or may not start during the first dry month; nor is there any certainty that all the trees will remain leafless throughout the dry period. Diameter growth usually begins either in the last month of the dry season or immediately after the beginning of the wet season, when the temperature is at or near the highest for the year.

Teak, which is typically ring-porous, shows much variation in the pore zone, ranging from a compact biseriate or triseriate band of large pores to few scattered large pores touching the initial parenchyma layer but not forming a definite band. Throughout India and Burma these two extreme forms occur, along with intermediates.

The anatomy of Mahogany grown in India is virtually the same as that grown in tropical America, despite the fact that the trees become entirely leafless for a month or more each year. "Every year, at the commencement of cambial activity, an initial parenchyma band is produced which delimits the seasonal growth. This band completely encircles the tree and shows up distinctly on logs or stumps. One must not, however, confuse this initial band with the short discontinuous parenchyma bands that are sporadically distributed throughout the wood. It has been found during this investigation that these discontinuous bands have no relation either with the beginning or with the cessation of diameter growth. At present, the reason for their occurrence is not at all clear, for attempts to correlate them with climatic variations have not been successful. . . . The best method to determine the age of a Mahogany tree would be to count the initial bands on a log or stump. An incomplete disc or a boring taken out from a living tree will not always give a correct determination."

The first two parts of this series appeared in *Indian Forest Records* 2: 1 and 2; 1939 and 1940. The trees dealt with were Chir (*Pinus longifolia*), Teak (*Tectona grandis*), Laurel (*Terminalia tomentosa*), Cutch (*Acacia catechu*), Semul (*Bombax malabaricum*), Jaman (*Eugenia jambolana*), Sal (*Shorea robusta*), Toon (*Cedrela Toona*), Kokko (*Albizzia Lebbeck*), Sissoo (*Dalbergia sissoo*), and Champ (*Michelia champaca*). In most cases annual rings are formed which make possible an accurate determination of the age of the trees, "provided proper care is taken of the false rings that occasionally develop in them."

Testing of Indian timbers for veneers and plywood. By The Forest Research Institute, New Forest, Dehra Dun. *Indian Forest Records* (n. s., Utilization) 2: 4: 77–106; Nov. 26, 1941.

"This publication is supplementary to the first and second interim reports on the testing of Indian timbers for veneer and plywood, published by the Forest Research Institute in 1934 and 1936 respectively. The first report covered 48 species and the second report another 30 species. This third report describes the work done on another 34 species, and includes some further tests on species dealt with in the first and second reports. It is therefore complementary to the first two reports and should be read in conjunction with them. The qualities and peculiarities of each timber are recorded in detail, with special reference to its possibilities for rotary cut veneers and plywood."—*Author's summary*.

Notes on Indian timbers for aircraft and gliders. By V. D. Limaye. *Indian Forest Records* (n. s., Utilization) 2: 7: 168–177; 1942.

"Although long clear lengths as required for spars are not available from Indian Spruce and Fir, one or two of the lighter types of broad-leaved species such as *Michelia*, *Phoebe*, and *Polyalthia* appear to be suitable for aircraft work, and they have the added advantage that they are available in long lengths. Brief descriptions of several Indian species considered suitable for making aircraft plywood and propellers are also given."—*From author's summary.*

A note on the manufacture of plywood in India. By S. N. Kapur. *Indian Forest Records* (n. s., Utilization) 2: 11: 245–292; Dec. 2, 1942.

"A fairly complete compendium on the subject of plywood manufacture in India. It gives information on the prospects of the industry, on existing plywood mills in the country, on possible areas for exploitation, on glues, and the manufacture of plywood and tea boxes. It also discusses the machinery required for a plywood mill and the manufacturing costs. At the conclusion, there is a list of timbers considered suitable for plywood work in India, and another list of those timbers which are not recommended for this industry."—*Author's summary.*

Native woods for construction purposes in the western Pacific region. [By J. Hugo Kraemer.] Pub. by Bureau of Yards and Docks, U. S. Navy Dept., Washington, D. C., May 1944. Pp. 197; 4¼ x 6¾; 52 text figs., 1 folded map. Distribution restricted.

According to the Foreword: "This handbook has been prepared at the request of the Bureau of Yards and Docks, U. S. Navy, by the Supply and Resources Service, Foreign Economic Administration, for the use of personnel engaged in the production of wood construction material in the western Pacific region. The highly complex flora of the region covered and the necessity of producing a small, readily usable

field book in a minimum of time resulted in only about one per cent of the trees being included. The attempt was made to include trees of greatest importance to construction battalions, that is, those which occur near beaches and along water courses and those which produce wood with desirable characteristics for various types of construction purposes." This is considered a preliminary edition, covering the Solomon Islands, Papua, northeast New Guinea, and the Bismarck Archipelago.

From outside sources it is known that the book was compiled by Dr. J. Hugo Kraemer. "The list of species was prepared at Arnold Arboretum, and the illustrations were made at the Arboretum by an artist sent up by the Navy Department in Washington. Mr. L. J. Brass, who made very extensive botanical collections for the Arboretum in New Guinea and in the Solomon Islands, supplied many data and helped revise the manuscript." (Note from Dr. E. D. Merrill.)

GENERAL INDEX

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