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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.

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THE NOMENCLATURE OF BALSA WOOD (*OCHROMA*)

By JOHN H. PIERCE

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There has been some question recently as to the application of certain specific names in the genus of Balsa wood. Until 1919, all specimens of *Ochroma* from the West Indies, Central America, and South America were referred to *O. lagopus* Sw. (Prodr. 98. 1788), except material from the Magdalena River, Colombia, which was referred to *O. tomentosa* Willd. In 1919, Rowlee (Journ. Wash. Acad. Sci. 9: 157. 1919) described eight new species from Central and South America and restricted the use of the name *O. lagopus* Sw. to the West Indian material.

In 1920, Urban (Fed. Rep. Beih. 5: 123. 1920) found what he believed was an earlier name for the West Indian material, *Bombax pyramidale* Cav. (in Lam. Enc. 2: 552. 1788) and

he made the new combination *Ochroma pyramidale* (Cav.) Urban. His basis for the priority of this name was the title page of Lam. Enc. which is dated 1786; however according to Woodward (Jour. Bot. Brit. & For. 44: 318. 1906) and others, pages 369–774 of the Enc. were not published until April 1788, the same year in which the name *O. lagopus* Sw. appeared in Swartz's Prodromus. Cavanilles also published *B. pyramidale* himself in June 1788 (Diss. Bot. 5: 294. 1788). The name *pyramidale* then appeared in two publications in April and June of 1788, while *lagopus* appeared sometime in 1788 before September.

There appears to be little possibility of determining the month of publication of Swartz's Prodromus and even if this were known there is so much discrepancy between title page dates and actual date of publication, in this period, that the priority would not be clear. Consequently, since the priority is uncertain, since Urban's combination was based on a mistaken date, and since *O. lagopus* Sw. is widely used in commercial literature, it would seem wise to maintain *O. lagopus* Sw. for the West Indian material and to reduce *O. pyramidale* (Cav.) Urban to synonymy under it.

It is not the purpose of this paper to evaluate the species described by Rowlee, but it should be pointed out that he worked with relatively little material and that his field work was confined to Panama, Costa Rica, Nicaragua, and Guatemala. It seems certain that a comprehensive study of ample material from all parts of the range would greatly clarify the species relationships of the genus.

LONCHOCARPUS, SUBGENUS *PHACELANTHUS* PITTIER, IN BRAZILIAN AMAZONIA

By Adolpho Ducke

The genera *Lonchocarpus* H.B.K. and *Derris* Lour., both Leguminosae-Papilionate-Dalbergieae, are receiving much attention because they include the best rotenone-yielding plants of the world, namely, *Lonchocarpus utilis* (= *? L. nicou*), *L. urucu*, and *Derris elliptica*. For lack of sufficient

herbarium material the two genera cannot now be sharply differentiated, but it is convenient to maintain them because of the large number of species they contain. Enough is already known, however, to make it certain that the American species attributed to *Derris* must be transferred to *Lonchocarpus*, their rightful place being in the subgenus *Phacelanthus* Pittier which corresponds with the section *Fasciculati* of Bentham. *Derris*, accordingly, remains restricted to the Old World tropics.

A very good explanation of this matter was given by Pittier in his "Middle American species of *Lonchocarpus*" (Contrib. U. S. Nat. Herb. 20: 40), as follows: "The characters above attributed to *Lonchocarpus* are shared by the so-called American species of *Derris*. These species differ only in a very secondary detail of the legume, *viz.*, the greater or less development of the vexillar margin, or of both margins. I have no hesitation in bringing into the former genus the Costarican species of *Derris* described recently by Capt. John Donnell Smith. They fit nicely into the classification and, considering the broad range of variation in the shape of the legume within the genus, I cannot but believe that respect for the authority of Bentham, which I myself share to a certain extent, is the only argument for keeping them apart. The fruits of *Derris nicoyensis*, *D. costaricensis*, and *D. peninsularis* do not differ more than does that of *Lonchocarpus neuroscapha* or *L. sericeus* from that of the typical *L. punctatus*."

The hylaean species described as *Derris* must, therefore, accompany their relatives of Middle America and occupy their natural place in the above-cited subgenus of *Lonchocarpus*, well characterized by its author in the following manner (*loc. cit.*, p. 45, note): "The section *Fasciculati* Benth. forms a natural group, characterized by having the flowers fasciculate on thick peduncles branching from the common rachis, by the peculiar shape of the flowers, and by the leaflets, the costa and veins of which are neatly reticulate and very prominent beneath. These characters appear sufficient to justify the elevation of the section to the rank of a subgenus, for which the name *Phacelanthus* is here proposed."

The species occurring in Brazilian Amazonia which pertain to the subgenus *Phacelanthus* of *Lonchocarpus* are as given below.

1. Lonchocarpus (*Phacelanthus*) urucu Killip & Smith. Vernacular names: Timbó urucú, timbó vermelho (red timbó).—This is the more common of the two Timbó species of commerce of Brazilian Amazonia. Unlike *L. utilis* (=*?L. nicou*) it grows in the form of a vine from its beginning. Other distinguishing characters are the denser and more reddish pubescence on the younger parts of the plant as well as the broader form of the leaflets, but these characters are not always easy to determine. The plants seldom flower and fructify in culture, and I have never seen a fertile individual in the forest where the species attains large size and is of frequent occurrence in some localities, for example, the uplands along the Solimões River. Such places often show vestiges of aboriginal habitations and it seems possible that the plants may be the remains of precolumbian culture. Several vernacular names for kinds of Timbó in local use probably refer to this species, but in the absence of fertile specimens one cannot be sure.

2. Lonchocarpus (*Phacelanthus*) utilis A. C. Smith (= *L. nicou* auctorum). Vernacular names: Timbó blanco (white timbó), timbó macaquino; there are others of infrequent use or doubtful.—This species is universally known, even in commerce, under the old name *Lonchocarpus nicou*, but A. C. Smith (Am. Journ. Bot. 24: 580) states that the nearly 200-year-old type material (fragments of leaves) is not comparable to recent herbarium collections and he therefore gives it a new name. The true *L. nicou* (Aubl.) DC. is said to be a Guiana plant not high in rotenone content. In Brazilian Amazonia *L. utilis* is less commonly cultivated and is always of slower development though generally considered richer in rotenone than *L. urucu*. The latter, however, is the principal, or perhaps the only, species grown for rotenone in Amazonian Peru, from whence large quantities of roots are exported under the trade name of Barbasco, which is but the popular designation in this country for all fish-poison plants. *L. utilis* is distinguished from the other Timbós by its erect growth in youth, being a treelet for several years before developing some high-climbing branches. It has not yet been found in spontaneous growth in Brazilian Amazonia and its flowers and fruits are unknown, unless those described by Aublet belong here.

3. Lonchocarpus (*Phacelanthus*) silvestris A. C. Smith. Vernacular name: Timbó-rana (false timbó).—A robust vine, hitherto found in the western and southwestern parts of Amazonia, from the Rio Madeira to Peru. I have not seen this plant, but have examined herbarium specimens collected by Ule and by Krukoff.

4. Lonchocarpus (*Phacelanthus*) rariflorus Mart. Vernacular names: Timbó-rana, timbó cururú.—A vine, always of small size, climbing on shrubs or creeping among the weeds of open places or the margins of forests. In general, widely distributed in the hylaea, but frequently only in certain localities of the middle Amazon, being very common near Manáos.

5. **Lonchocarpus (*Phacelanthus*) Killipii** Ducke, nom. nov. (=*Derris negrensis* Benth.). Vernacular name: Timbó-rana.—A rather robust vine of close affinity with the two following species, and, conforming to the shape of the fruit, also related to the preceding species. It grows in permanently flooded igapó on the Rio Negro. I have named it in honor of my esteemed friend, Ellsworth P. Killip, the well recognized authority on the fish-poisoning Leguminosae of South America and discoverer of the second species of Timbó with high rotenone content. A wood sample (Yale 39395; Ducke 348) with herbarium material is in the Yale collections.

6. **Lonchocarpus (*Phacelanthus*) longifolius** (Benth.) Ducke, comb. nov. (=*Derris longifolia* Benth.). Vernacular name: Timbó-rana.—Another vine of deeply flooded igapó in the State of Amazonas and the western part of Pará.

7. **Lonchocarpus (*Phacelanthus*) scandens** (Aubl.) Ducke, comb. nov. (=*L. ?pterocarpus* DC. =*Derris pterocarpus* Killip =*D. guianensis* Benth. =*Deguelia scandens* Aubl.). Vernacular names: Timbó-rana, timbó de jacaré, etc.—A high-climbing vine in upland rain forest as well as on river banks in the whole of Amazonia and Guiana. Not used as fish

poison in Brazil nor, probably, in the Guianas, and never indicated as a rotenone-yielding plant; the information of Aublet on this matter is evidently erroneous, owing to a confusion of that plant with other species of *Lonchocarpus*. This mistake was repeated for more than a century and a half by copying botanists who never saw the live plant. An analogous case is that of the drug "café-rana" which comes from *Picrolemma pseudocoffea* Ducke (Simarubaceae), but whose origin was attributed by Martius to *Tachia guianensis* Aubl. (Gentianaceae), a mistake perpetuated until the present time.

8. LONCHOCARPUS (*Phacelanthus*) NEGRENSIS Benth. (=*Derris amazonica* Killip). Vernacular name: Timbó-rana.—A vine, usually large, climbing on high trees of the upland rain forest throughout Amazonia and Guiana. This species is more closely allied to the following species (*L. floribundus*), but the margined pod resembles that of the preceding (*L. scandens*).

9. LONCHOCARPUS (*Phacelanthus*) FLORIBUNDUS Benth. (=*L. nitidulus* Benth.). Vernacular names: Timbó-rana, timbó de jacaré.—A vine of small size in open places, but robust and high-climbing when in virgin forest; always on sandy soil. Seldom used as a fish poison and scarcely even cultivated; Killip mentions seeing a planting near Manáos, and I found there some plants in an ancient culture. Near the municipality of Obidos, this species was pointed out to me as poisonous for cattle. It occurs in Amazonia with the Guianas, and southeastwards to Maranhão and Piauhy. A wood sample (Yale 39383; Ducke 336) with herbarium material is in the Yale collections.

10. LONCHOCARPUS (*Phacelanthus*) RUFESCENS Benth. Vernacular names: Timbó-rana, timbó cururú.—I attribute to this species a big vine of the upland forest of the upper Rio Negro, growing in moist places along the banks of the river and of streamlets, sometimes but not often used as fish poison; the determination is, however, uncertain, for I have not seen authentic specimens. The species is known, with certainty, from British Guiana and the upper Rio Branco (State of Amazonas, Brazil).

11. LONCHOCARPUS (*Phacelanthus*) ANGULATUS Ducke.—A robust vine of the inundable forest on the banks of the middle Tapajoz and Xingú basins.

12. LONCHOCARPUS (*Phacelanthus*) GLABRESCENS Benth.—A vine of flooded forest, widely spread but never on blackwater rivers.

13. LONCHOCARPUS (*Phacelanthus*) SPRUCEANUS Benth. Common name: Facheiro (Santarem, Obidos, etc.).—A small or nearly medium-sized tree growing on dry places in the low forest of campos regions or in second-growth. Of all the species of the subgenus *Phacelanthus*, this is the only one attaining tree size in Amazonia. It occurs in the State of Pará and eastern parts of the State of Amazonas.

AMERICAN TIMBERS OF THE FAMILY LAURACEAE

By SAMUEL J. RECORD *and* ROBERT W. HESS

This family consists of about 40 genera and 1000 species of trees and shrubs, widely distributed over the tropical and subtropical regions of the world, with a few representatives in the temperate zones. The leaves are simple, typically alternate, sometimes opposite, rarely lobed (*e.g.*, *Sassafras*); the flowers are generally small and fragrant and borne in axillary panicles; the fruit is a one-seeded berry or drupe, with an enlarged and persistent flower tube surrounding the base, frequently suggesting an acorn (*Quercus*).

The best known members of this family in the United States are the Sassafras, *Sassafras albidum* (Nutt.) Nees, and the Spice Bush, *Lindera Benzoin* (L.) Meissn. Many species are rich in aromatic substances and are the source of familiar products such as camphor (*Camphora*) and cinnamon (*Cinnamonum*). The common European Laurel, *Laurus nobilis* L., is grown in many countries for shade and ornament; the Alligator Pear-tree or Avocado, *Persea americana* Mill., is extensively cultivated in tropical and sub-tropical countries for its fruit.

The woods of all of the trees are suitable for industrial purposes, but comparatively few are known to commerce. The principal uses are for carpentry, general construction, and

ship-building, but some of them are valued because of their fragrant essential oils, attractive color and luster, great strength, or other special characteristics. The Chinese Nanmu tree, whose scented wood is highly prized for making caskets, is *Phoebe nanmu* (Oliv.) Gamble (=*Persea nanmu* Oliv.). The shavings of Pau Hoi, *Machilus* sp., are rich in mucilage and the watery extract is used by Chinese women to bandoline their hair. The South African Stinkwood or Cape Laurel, *Ocotea bullata* E. Mey., is considered the finest of native timbers for furniture. The Bois de Rose of French Guiana, *Aniba roseadora* Ducke, is the source of an essence used in the perfume industry. Demerara Greenheart, *Ocotea Rodiaei* (Rob. Schomb.) Mez, noted for its great strength and resistance to decay and marine borers, has been long and favorably known in the European markets. Some of the timbers, *e.g.*, *Mezilaurus*, have possibilities as substitutes for Teak (*Tectona*). There are numerous other kinds with commercial possibilities, but many of the trees, even of different genera, look so much alike in the forest that selection of a particular sort for market is at present very difficult.

Taxonomists are not in agreement as to the bases for classification, and all of the older species have several synonyms, usually involving generic transfers. Flowers are generally necessary for determination, and as the two sexes are often borne on different individuals, the collection of complete herbarium material to accompany wood samples is frequently impossible. The wood anatomist is thereby seriously handicapped in dealing with closely related genera. The woods of the family as a whole exhibit much variation in appearance and properties, but they have a fairly consistent structural complex, which, in combination with other features, makes the recognition of a lauraceous specimen comparatively simple. Within the family it is often easy to identify a species, but most of the generic concepts are very hazy.

The following description applies particularly to American species of 17 genera, namely, *Aiouea*, *Anaueria*, *Aniba*, *Beilschmiedia*, *Cryptocarya*, *Dicypellium*, *Endlicheria*, *Licaria*, *Lindera*, *Mezilaurus*, *Nectandra*, *Ocotea*, *Persea*, *Phoebe*, *Pleurothyrium*, *Sassafras*, and *Umbellularia*.

Heartwood in various shades of yellow, olive, brown, and reddish brown to nearly black; greenish tinge common; light colors tend to become brown on exposure; sapwood whitish, yellowish, or greenish, often thick and not sharply demarcated. Luster typically high and satiny, silvery or golden; some specimens oily and superficially dull. Scent and taste often highly distinctive, being or suggesting camphor, cloves, cinnamon, anis, sassafras, or cedar. Light and soft to very hard and heavy, but mostly medium; sp. gr. (air-dry) 0.50 to 1.23; texture rather fine to coarse, commonly medium; grain mostly straight, sometimes roey or otherwise irregular; technical properties usually excellent; durability low to very high.

Growth rings generally present; some woods ring-porous (*e.g.*, *Sassafras*). Pores small to large, typically medium-sized and fairly numerous; solitary and in small multiples, less often in clusters; mostly well distributed without pattern, sometimes in diagonal arrangement and ring-porous. Vessels with simple perforations exclusively or in part; scalariform plates with few to several bars fairly common; spiral thickenings apparently absent; tyloses common, often abundant, sometimes sclerotic in certain species of *Aniba*, *Licaria*, and *Ocotea;* pits rounded in outline, not crowded, alternate, mostly large, occasionally medium-sized (*e.g.*, *Umbellularia*), rarely small (*Lindera*). Rays 1 to 5, mostly 2 or 3, cells wide and up to 60, commonly less than 30, cells high; distinctly heterogeneous to nearly homogeneous; oil cells common; small crystals rather to very frequent; pits to vessels typically large to very large, rounded to much elongated and in scalariform arrangement, but sometimes medium-sized to small. Wood parenchyma generally coarse-celled, sparse to abundant; paratracheal (often not completely surrounding pore), sometimes short aliform and connecting adjacent pores diagonally, occasionally in distinct but irregular tangential or concentric bands; oil cells often present, frequently very abundant. Wood fibers generally septate; walls thin to very thick and gelatinous; pits simple or with vestigial borders, typically very small. Ripple marks absent in American species (see *Cryptocarya*). No gum ducts seen.

Aiouea (or *Ajouea*), with about 25 species of trees, shrubs, and woody climbers, is rather widely distributed in tropical America from southeastern Brazil and northern Peru to Trinidad and Costa Rica, but apparently is nowhere abundant. The trees are rarely over 50 feet tall, but may have stout trunks occasionally up to 36 inches in diameter. The timber is used locally for construction and furniture.

Only two specimens are available. One (Yale 38385) is of *Aiouea costaricensis* (Mez) Kosterm. (=*Bellota costaricensis*

Mez), a tree 40 feet high and 15 inches in diameter collected by Austin Smith at an elevation of 7000 feet in Costa Rica. The other (Yale 17532; Williams 1091) is of *A. tambillensis* Mez, collected in the Peruvian Amazon region by L. Williams who states (*Woods of northeastern Peru*, p. 148) that the tree is 45 to 50 feet high, with a straight cylindrical trunk 20 inches in diameter and free of branches for 30 feet. The lumber is used locally for making crates and sugar boxes.

Heartwood absent from samples, probably reddish brown, judging from knots; sapwood brownish. Luster rather high. Odorless and tasteless. Rather light but firm; texture medium; grain fairly straight. Very easy to work.

Growth rings poorly defined. Pores rather small to medium-sized (180μ), numerous; solitary and in small multiples, sometimes in diagonal arrangement. Vascular pits rather large (9μ), round, alternate. Rays 1 to 3, mostly 2, cells wide and up to 35, commonly less than 20, cells high; distinctly heterogeneous in part; no oil cells seen; pits to vessels very large. Wood parenchyma sparingly vasicentric, apparently without oil cells. Wood fibres septate; mostly thin-walled.

Anaueria *brasiliensis* Kosterm., the only species, is a large forest tree discovered in 1931 by Adolpho Ducke on non-inundated land near São Paulo de Olivença, Amazonas, Brazil, where it is known as Anauerá. (For botanical diagnosis and illustration see Kostermans' *Revision of the Lauraceae*. V.) The only wood sample available is from the type tree (Yale 21329; Ducke 70).

Heartwood brownish, darkening upon exposure; rather sharply demarcated from the lighter-colored sapwood. Luster fairly high. With mild spicy resinous odor and taste. Moderately heavy, hard, tough, and strong; texture coarse; grain straight; saws woolly when fresh, but finishes smoothly when dry; not difficult to season, holds its place well when manufactured; durability probably fairly high. A useful wood for general construction, but presumably scarce.

Growth rings apparently absent. Pores medium-sized (up to 180μ), rather few; solitary and in multiples of 2 to 4, mostly 2, well distributed. Vascular pits very large (16μ). Rays 1 to 3, mostly 2, cells wide and up to 60, commonly less than 30, cells high; homogeneous or nearly so; no oil cells seen; pits to vessels exceptionally large. Wood parenchyma abundant, very coarse-celled; mostly unilaterally paratracheal, short aliform, and locally confluent, uniting some of the pore groups diagonally, but not forming concentric bands; oil cells very large and numerous. Wood fibers with rather thick gelatinous walls.

Aniba, with about 55 species of trees and shrubs, has its center of distribution in the Guianas and the Brazilian Amazon region. There are few if any representatives on the North American continent and only two occur in the West Indies north of Trinidad. The useful products include medicinal seeds, fragrant bark, essential oil, and some lumber for furniture and building purposes.

The woods are typically yellowish with a greenish hue when fresh, becoming brown or olive on exposure, and range from rather light to moderately heavy. The one outstanding exception is *Aniba canelilla* (H.B.K.) Mez, an Amazonian tree sometimes over 100 feet tall, with a very dense, dark brown or blackish olive wood similar in structure and properties to *Licaria canella* (Meissn.) Kosterm. The timber is noted for its strength and durability, and the cinnamon-scented bark is used in powder form for perfuming linen and sometimes for making tea. The species is occasionally cultivated.

The best known timber accredited to this genus is the Comino or Laurel Comino of Colombia, *Aniba perutilis* Hemsl. (=*A. compacta* A. C. Smith). This species, which ranges through the Andes to Bolivia, attains a height of 100 feet, though often it is considerably smaller. The wood has a satiny luster, is moderately dense, has excellent technical properties, and is esteemed locally for high-grade furniture, interior trim, and durable construction. Some of the trees produce attractively mottled wood, called Comino Crespo, which is in demand for veneers for cabinet work and is exported in limited quantities. (According to Jesús M. Duque, *Rev. Acad. Col.* 4: 14: 231, this tree is not *Aniba* but an undetermined species of *Ocotea*, near *O. pretiosa* Nees.)

One of the most valuable woods of French Guiana is the Bois de Rose Femelle, *Aniba rosaeodora* Ducke, which was used by furniture makers in France for more than a century before the species was classified and named. The lustrous yellow wood becomes brownish and is not particularly attractive

in appearance, but it contains a fragrant volatile oil that made it desirable for chests and drawers in which linen and clothing were stored. In 1875 a Frenchman by the name of Samain succeeded in distilling the oil, known at first as "huile de linaloès" or "huile d'aloès" and later as "essence de bois de rose," with the result that the perfume industry eventually monopolized the timber supply. The distilling is done near the source of the timber to avoid loss of oil in transport. Billets are reduced to chips and placed in retorts of about 1000-liter capacity and the steam distillation process requires about 1½ hours. The distillate, which has a specific gravity of 0.86 to 0.88, is decanted from the surface of the water and shipped in tightly sealed copper-galvanized iron cans. On exposure to the air the essence soon loses its clarity and sweet fragrance, becoming yellow and syrupy and acquiring a turpentine odor. (See "Rosenhout, bois de rose femelle, uit Suriname," by J. W. Gonggrijp in *De Indische Mercuur*, April 23 and 30, 1920.)

Aniba rosaeodora is a tree upward of 100 feet tall with a straight cylindrical bole sometimes 36 inches in diameter. Though best known in French Guiana it also occurs in eastern Surinam and the lower Amazon region of Brazil, where it is now exploited to some extent for the oil, and possibly in Colombia and northeastern Peru. Ducke, who described the species, recognized a geographical variety, *amazonica*, which Kostermans considers a distinct species, *A. Duckei* Kosterm. The woods of the two are very similar in structure and properties and have the same taste and scent. The Pau Rosa or Louro Rosa of Santarem and Faro is *A. parviflora* (Meissn.) Mez, a little tree; the scent of the wood is mild and pleasant, but distinct from the others. The Pau Rosa of the Amazon estuary is *A. terminalis* Ducke, a medium-sized tree; its heartwood, which is said to be dark brown, aromatic, and highly durable, is used for construction but not for distillation.

The following description of the anatomy is based upon authentic samples of 17 species, including *Aniba canelilla*, which seems out of place in this genus. Growth rings often present, owing to narrow band of denser wood fibers in late wood. Pores medium-sized (120 to 180μ), fairly numerous; solitary or more often in small multiples, well distributed; pore clusters are numerous and there is a strong tendency to diagonal arrangement in *A parviflora*. Tyloses usually present; typically sclerotic in *A. canelilla* and rarely so (near injury) in *A. firmula* (Nees & Mart.) Mez, and *A. rosaeodora*; vascular pits large to very large (11 to 14μ). Rays 1 to 4, commonly 2, cells wide and up to 40, generally less than 25, cells high; heterogeneous, often decidedly so; large oil cells usually present, frequently abundant; pits to vessels large to very large. Wood parenchyma coarse-celled, not very abundant, mostly unilaterally paratracheal, sometimes joining a few pores diagonally; occasionally finely terminal in part; large oil cells usually present and resembling pores on cross section; cells often sclerotic in *A. canelilla*. Wood fibers commonly septate; walls rather thin in early wood to rather thick in outer late wood in most species; walls all thick in *A. firmula;* very thick and gelatinous, the lumina minute, in *A. canelilla*.

Beilschmiedia (including *Hufelandia* and *Nesodaphne*), with numerous species of trees and shrubs, occurs in the tropics of both hemispheres and extends into the south temperate zone. The Australian and New Zealand species belong to the *Nesodaphne* group; some of them supply commercial timber.

There are 15 American species with a combined range extending from the West Indies and southern Mexico to southern Brazil and Chile. The best known is *Beilschmiedia pendula* (Sw.) Benth. (=*Hufelandia pendula* Nees), a small to large tree sometimes up to 100 feet high and 36 inches in diameter, supplying some timber for local construction. Closely related to it is *B. mexicana* (Mez) Kosterm. (=*H. mexicana* Mez =*H. costaricensis* Mez & Pitt.), a large tree ranging from Mexico to Colombia. *B. anay* (Blake) Kosterm. (=*H. anay* Blake) of Guatemala and Colombia has a fruit resembling the avocado (*Persea*). *B. sulcata* (R. & P.) Kosterm. (=*H. sulcata* [R. & P.] Nees=*H. ovalis* Blake) extends from the highlands of Costa Rica to northeastern Peru, and is said to attain a maximum height of 130 feet. The only species in British Guiana is *B. curviramea* (Meissn.) Kosterm. (=*Aydendron curviramea* Meissn.). The genus is not represented in the Amazon region of Brazil, but there are five species between Rio de Janeiro and São Paulo. There are two Chilean species: *Beilschmiedia Berteroana* (Gay) Kosterm. (=*Cryptocarya Berteroana* Gay =*Bellota nitida* R.A. Phil.), is a tree 40 to 65 feet high, known as Ulmo, a name also applied to *Eucryphia cordifolia* Cav.; and the Bellota, *B. Miersii* (Gay) Kosterm. (=*Bellota Miersii* Gay), a tree occasionally 80 feet tall, supplying some timber for general construction and shipbuilding. The only authentic wood samples available are of *Beilschmiedia pendula*, which is of general distribution in the West Indies.

Heartwood not seen; said to be yellowish brown to blackish; sapwood pale brownish. Luster medium. Moderately heavy, hard, and strong; texture rather fine, uniform; grain straight; has good working properties; said to be highly durable. Of local utility, but of no possibilities for export.

Growth rings sometimes indicated by parenchyma bands. Pores of upper medium size (160 to 190μ), not very numerous; solitary and in multiples of 2 or 3, well distributed. Vascular pits large (12μ). Rays 1 or 2, sometimes 3, cells wide and up to 30, generally not over 15, cells high; decidedly heterogeneous, the numerous uniseriate rays composed entirely of upright and square cells; no oil cells seen; pits to vessels very large. Wood parenchyma abundant, coarse-celled, visible to unaided eye; irregularly paratracheal, short to long aliform, and confluent into bands, 2 to 3 cells wide, which may be rather closely spaced or at intervals suggesting seasonal growths; arrangement variable in same specimen, but general effect is the same as in many Leguminosae, though the pores are usually not completely surrounded; oil cells present, usually much elongated vertically, suggesting a member of one of the smaller vessels; pits to vessels very large, mostly elongated. Wood fibers with moderately thick walls and very small pits.

Cryptocarya, with many species of trees and shrubs, is a widely distributed genus having its center in the Indo-Malayan region. There are about seven American species with a combined range from French Guiana to southern Brazil and Chile. One of the best known is *C. moschata* Nees & Mart. of southeastern Brazil. It varies from a shrub to a tree 50 feet high, with a stout trunk 20 to 50 inches in diameter. The timber is useful for general construction, but chief interest is in the fruits which resemble nutmegs in appearance and pungent flavor.

The only wood sample at hand (Yale 5552) is of the Chilean Peumo, *Cryptocarya rubra* (Mol.) Skeels (=*Peumus rubra* Mol. =*Laurus Peumus* Mol. =*C. Peumus* Nees), a small to medium-sized tree with stiff branchlets and small, rigid, alternate to opposite leaves. The fruit is completely included in the reddish, thin and brittle enlarged flower tube. The tree occurs in the Andes Mountains from Santiago to Valdivia. The wood is used locally to a limited extent for interior construction and charcoal, and the bark is a minor source of tannin.

Color pale brownish throughout sample. Luster medium. Odorless and tasteless when dry. Of medium density, hard, and strong; texture rather fine, uniform; grain straight; easy

to work, finishing very smoothly. Of no commercial possibilities.

Growth rings distinct. Pores small, fairly numerous; solitary and in small multiples, well distributed. Rays 1 to 3, mostly 2, cells wide and up to 35, commonly less than 25, cells high; distinctly heterogeneous in part; oil cells common; pits to vessels very large. Wood parenchyma in terminal bands, 3 to 6 cells wide, occasionally doubled; oil cells sometimes present. Wood fibers with medium walls; not septate. (Two species of *Cryptocarya* in Madagascar have distinctly storied structure; see *Tropical Woods* 13: 1.)

Dicypellium *caryophyllatum* Nees, the only species, is a small tree of the central Amazon region of Brazil and ranging northward into French Guiana. The bark has a strong flavor intermediate between cinnamon and cloves. It is esteemed in native medicine and cookery and the distillate is used by the perfume industry. The species does not supply any timber of importance. The name Cayenne Rosewood is sometimes applied to it, but the real Rosewood of French Guiana is *Aniba rosaeodora* Ducke. The following description is based on a single specimen (Yale 23674; Ducke 212) obtained by Adolpho Ducke in the upland forest along the Rio Tapajoz, Pará.

Heartwood yellowish brown to dark olive; not sharply demarcated from the pale greenish yellow sapwood. Luster silky. Scent and taste spicy resinous. Moderately dense, hard, and strong; sp. gr. (air-dry) 0.78; weight 49 lbs. per cu. ft.; texture medium fine; grain straight; has excellent technical properties; durability high. Without possibilities for export because of the small size of the trees.

Growth rings present, owing to denser late wood. Pores medium-sized, not distinct without lens, fairly numerous; solitary and in multiples of 2 to 5, well distributed. Rays nearly all biseriate, occasionally uniseriate, and up to 35, generally less than 20, cells high; heterogeneous, frequently with single marginal rows of tall upright cells; large oil cells abundant; pits to vessels very large and elongated. Wood parenchyma sparingly vasicentric; no oil cells seen. Wood fibers septate; walls medium to thick (in late wood).

Endlicheria, with about 40 species of shrubs and small, medium-sized, or rarely large trees, is widely distributed throughout tropical South America; there is one species, *E. Browniana* Mez (=*Aydendron macrophyllum* Meissn.), in Panama, and one, *E. sericea* Nees, extending from Bolivia into

the Lesser Antilles. The last is said to attain a maximum height of 115 feet and to supply good timber for local construction and furniture. Another species with a wide range is *E. anomala* Nees (=*Goeppertia anomala* Nees), a low-branched tree rarely 50 feet tall, growing from British Guiana to Rio de Janeiro and northeastern Peru. *E. Williamsii* O. C. Schmidt is a medium-sized tree of common occurrence in lowlands of the Peruvian Amazon region; according to Williams (*Woods of northeastern Peru*, p. 151), the timber is sometimes employed in making canoes, furniture, and crating. *E. multiflora* (Miq.) Mez (=*Goeppertia multiflora* Miq.) is a tree of moderate size in the Guianas and Amazonas, Brazil; the single wood specimen of this name (Yale 9460; Persaud 49), which was described by Kribs (*Tropical Woods* 13: 22), differs so much from the others of the genus that its identification is considered very doubtful. The following description is based on 18 samples of eight species.

Heartwood not sharply demarcated from the grayish sapwood. Luster rather silky. Without distinctive scent or taste when dry. Of rather low to moderate density; texture medium; grain straight to variable; easy to work; durability doubtful. Apparently of no commercial importance.

Growth rings poorly defined. Pores medium-sized (115 to 195μ), not very numerous; mostly in small multiples or clusters, well distributed. Vascular pits large (10 to 11μ). Some vessels with scalariform perforation plates; tyloses sometimes present. Rays 1 to 3, mostly 2, cells wide and up to 50, generally less than 25, cells high; heterogeneous; oil cells present; pits to vessels large. Wood parenchyma very sparingly paratracheal; oil cells numerous. Wood fibers with medium walls, often with a thin gelatinous layer; septate, at least in part.

Licaria, or *Acrodiclidium* (including *Chenekia* and *Misanteca*), with about forty species of trees and shrubs, is distributed throughout tropical America. Judging from the wood samples available, the genus is in need of further revision.

The northernmost species is *Licaria triandra* (Sw.) Kosterm. (=*Misanteca triandra* [Sw.] Mez), a small to medium-sized tree of southern Florida and the West Indies. The greenish yellow wood is of medium density, very easy to work, and employed locally to a minor extent for general carpentry and interior construction.

There are about 10 species in Mexico and Central America, but the only one represented in the Yale collections is *Licaria campechiana* (Standl.) Kosterm. (previously included by Standley and others in *Ocotea*, *Chanekia*, *Misanteca*, or *Phoebe*). It is a tree sometimes 80 feet high and 18 inches in diameter. The wood is lustrous reddish brown, rather fine-textured, hard, heavy, and strong. The timber appears suited for general construction, but apparently it is not available in sufficient quantity to be commercially valuable.

There are many species in South America, but there is scant information concerning them. *Licaria armeniaca* (Nees) Kosterm. (=*Acrodiclidium armeniacum* [Nees] Mez) is a shrub or a tree up to 50 feet in height growing from Rio de Janeiro through the Amazon basin to northeastern Peru. The heartwood is brown to chocolate, sometimes streaked with black, the sapwood greenish yellow; of medium weight to rather heavy. No special uses are recorded. *L. limbosa* (R. & P.) Kosterm. (=*Misanteca Pittieri* Mez=*M. costaricensis* I. M. Johnston) is a small to medium-sized tree with a range extending from Bolivia and Peru to Venezuela and Costa Rica. The heartwood is probably brown (judging from knots), the sapwood grayish with a slight greenish hue; density rather low. The Aritú or Louro Aritú of the lower Amazon region, *L. Appelii* (Mez) Kosterm. (=*A. Appelii* Mez), occurs also in Matto Grosso and Minas Geraes, Brazil. The tree attains rather large size and yields a lustrous brown, more or less streaked, hard, strong, and durable timber suitable for furniture and heavy construction. The wood is similar to that of *L. polyphylla* (Nees) Kosterm. (=*Acrodiclidium guianense* Nees), a large Amazonian tree known as Louro Chumbo. *Acrodiclidium caryophyllatum* Ducke, a medium-sized tree of the upper Rio Negro, where it is called Puchury, has a lustrous brown, more or less striped, spicy-scented wood of medium density and excellent working qualities, which would make attractive furniture.

The Kaneelhart of Surinam is said to be *Licaria canella* (Meissn.) Kosterm. (=*Acrodiclidium canella* [Meissn.] Mez =*L. cayennensis* [Meissn.] Kosterm. =*A. cayennense* [Meissn.] Mez), and Yale specimens of the wood agree with Pfeiffer's

description (*De houtsoorten van Suriname*, p. 176). It appears to be identical with the Waibaima of British Guiana. The heartwood is a dark brown with a tinge of red or violet, and very dense, sp. gr. (air-dry) up to 1.15; it is further characterized by sclerotic tyloses and parenchyma cells. The structure is very similar to that of the Amazonian Casca Preciosa, which is said to be *Aniba canelilla* (H.B.K.) Mez, but the heartwood lacks the distinctive violet hue, being more of an olive-brown. The wood takes a high polish, is very strong, and noted for its resistance to decay.

The following description of the anatomy of the woods of *Licaria* is based on 25 specimens of 11 species. Growth rings, when present, due to slight differences in density and sometimes to a line of parenchyma. Pores medium-sized (130 to 180μ, sometimes to 200μ), rather numerous; mostly in multiples of 2 to 6, occasionally in little clusters, well distributed. Tyloses abundant, sclerotic in *L. canella;* vessel perforation plates rarely scalariform; vascular pits large (9 to 11μ). Rays 1 to 4, mostly 2 or 3, cells wide and up to 50 cells high; heterogeneous, often with high marginal cells; large oil cells few to abundant; pits to vessels variable, mostly large and often greatly elongated. Wood parenchyma coarse-celled; sparingly vasicentric, but typically not completely surrounding the pores, sometimes blunt aliform or joining adjacent pores, but without forming distinct bands; also occasionally finely terminal (or initial); some cells sclerotic in *L. canella;* large oil cells few to abundant. Wood fibers with rather thin to very thick and gelatinous walls; commonly septate.

Lindera, with numerous species of shrubs and trees, is well represented in eastern Asia and the East Indies, but in America by only one or two species of aromatic shrubs. The Spice Bush, *Lindera Benzoin* (L.) Meissn. (=*Benzoin aestivale* [L.] Nees), is common throughout most of the hardwood region of eastern United States. Its only use now is for ornamental planting, but pioneers in medicine prescribed tea made from the twigs, and during the Revolutionary War the fruit served as a substitute for allspice.

Growth rings distinct, owing to differences in density. Pores thick-walled, small (50 to 65μ), not very numerous; solitary and in small multiples, well distributed. Perforation plates in part scalariform with a few coarse bars; vascular pits small (5μ), not crowded. Rays 1 to 3 cells wide and up to 60 cells high; weakly heterogeneous; pits to vessels small, rounded; no oil cells seen. Wood parenchyma sparingly paratracheal. Wood fibers with medium-thick gelatinous walls.

Mezilaurus, or *Silvia*, with eight species of small to very large trees, has its center of distribution in the eastern and northern part of the Amazon basin, but is lacking in the western regions. The timber is valuable for durable construction and shipbuilding.

The only important extra-Amazonian species is the Tapinhoan, *Mezilaurus navalium* (Fr. Allem.) Taub. (=*Silvia navalium* Fr. Allem.), a tree usually medium-sized but sometimes up to 80 feet high and 36 inches in diameter, growing in the subtropical mountain forests of the State of Rio de Janeiro. The timber is of excellent quality and is used locally for furniture making, boat-building, and all kinds of durable construction. The bark is a source of tannin.

The Amazon species are known generally as Itaúba, but the principal source of the timber of that name is *Mezilaurus itauba* (Meissn.) Taub. (=*S. itauba* [Meissn.] Pax=*S. polyantha* Mez=*S. Rondonii* Mez=*S. anacardioides* [Spruce] Mez), a large tree, sometimes over 100 feet tall and 30 inches in diameter, ranging from the Guianas and eastern Amazonas to northwestern Matto Grosso. According to Ducke (*Tropical Woods* 42: 19), it furnishes the most useful timber of the lower Amazon, especially for naval construction.

The other species are as follows: *Mezilaurus crossiramea* (Meissn.) Taub., a small tree, sometimes shrubby, in Goyaz, Brazil; *M. decurrens* (Ducke) Kosterm. (=*S. decurrens* Ducke), a large tree on non-inundated lands of the upper Rio Negro; *M. Lindaviana* Schw. & Mez (= *S. Duckei* Samp.), a small to medium-sized tree on uplands in the lower Amazon, the upper Rio Branco, and on steep, rocky slopes along the Rupununi River, British Guiana; *M. Sprucei* (Meissn.) Taub. (=*S. Sprucei* [Meissn.] Mez), a small tree along the Rio Negro; *M. subcordata* (Ducke) Kosterm. (=*S. subcordata* Ducke), a small tree in upland forest near Pará; and *M. synandra* (Mez) Kosterm. (=*S. synandra* Mez), a medium-sized tree in the drier upland forests around Manáos. The following description is based upon samples of five species; the principal differences are in density and texture, *Mezilaurus itauba*, *M. navalium*, and *M. synandra* being the heaviest and finest.

Heartwood brownish yellow, becoming russet upon exposure; has oily appearance and feel; distinct but not sharply demarcated from the grayish sapwood. Luster generally low. Scent and taste mild and not distinctive in dry specimens. Moderately to decidedly hard and heavy; sp. gr. (air-dry) 0.75 to 1.00; weight 45 to 62 lbs. per cu. ft.; texture rather fine to coarse (*M. decurrens*); grain straight to somewhat roey; easy to work, seasons readily, holds its place well when manufactured; is highly durable. Has many of the properties of Teak (*Tectona*).

Growth rings poorly defined. Pores rather large to large (175 to 220μ), fairly numerous; solitary and in small multiples, occasionally in little clusters, well distributed. Tyloses abundant; vascular pitting coarse (pits 9 to 11μ, occasionally up to 14μ). Rays 1 to 3, mostly 2, cells wide and up to 50 cells high; more or less distinctly heterogeneous; large oil cells present; pits to vessels exceptionally large in part. Wood parenchyma coarse-celled, vasicentric, frequently joining some of the pores diagonally; oil cells numerous. Wood fibers septate, at least in part; walls medium to thick and gelatinous.

Nectandra, with about 100 species of trees and shrubs, is widely distributed throughout tropical America, most abundantly in South America. All of the trees produce timber of good quality for carpentry and general construction, but they are only of local importance and so far as known to the author do not enter the export trade. The woods are so much like some of the species of *Ocotea*, *Aniba*, and *Phoebe* that it is not now possible to separate them. Taxonomists appear to have equal difficulty with herbarium specimens, particularly if flowers are lacking. Under these circumstances no attempt is made to describe individual species.

Heartwood greenish yellow to dark olive-brown, the color deepening upon exposure; in some species (if correctly identified) becoming blackish brown; transition to sapwood gradual except in darkest material. Luster usually silky or silvery. Scent spicy resinous, taste mild to pronounced. Rather light and soft to moderately hard and heavy; sp. gr. (air-dry) mostly between 0.60 and 0.75; weight between 37 and 47 lbs. per cu. ft.; texture medium to somewhat coarse; grain straight to roey; seasons readily without splitting, easy to work, holds its place well when manufactured; darker specimens durable.

Suitable for many of the same purposes as Yellow Poplar (*Liriodendron*) and Birch (*Betula lutea* L.).

Growth rings usually present, owing to narrow to rather wide layer of denser fibers in late wood. Pores medium-sized to rather large (140 to 200μ), fairly numerous; solitary and in small multiples, well distributed. Tyloses common; vessel perforations occasionally scalariform, with several narrow bars; vascular pits medium-sized to large (9 to 14μ). Rays 1 to 5, in some species mostly 2, in others generally 2 or 3, cells wide and of variable heights up to about 50 cells; more or less distinctly heterogeneous; oil cells usually present, frequently large and numerous; pits to vessels large to very large. Wood parenchyma coarse-celled, paratracheal; oil cells often present. Wood fibers typically septate; walls thin to thick.

Ocotea. There are a few species of trees and shrubs in southern and eastern Africa and the Mascarenes, and about 200 of wide distribution in tropical America. The most highly valued timbers supplied by the genus are the South African Stinkwood, *O. bullata* E. Mey. (see *Forest trees of the British Empire* 3: 43–50), and Demerara Greenheart, *O. Rodiaei* (Schomb.) Mez, the first prized for fine furniture, the second for heavy and durable construction work. Two other American species with distinctive timbers are *O. caracasana* (Nees) Mez (=*Nectandra discolor* Nees, in part), the Angelino of Venezuela, and *O. rubra* Mez, the Determa, Wane, and Grignon of British, Dutch, and French Guiana, respectively; they are practically unknown to the export trade. All of the woods have good technical qualities, but with a few exceptions their identities are merged with members of *Nectandra* and other genera so that at present it is impossible to deal with them specifically. They belong in a group commonly called Laurier in French, Laurel in Spanish, Silverballi in British Guiana, and Louro in northern, Canella in southeastern, Brazil.

Regarding the Brazilian Canellas, H. M. Curran says (*Timbers of Tropical America*, 178): "This group of trees includes a host of species, mostly of *Nectandra* and *Ocotea*, and in the present state of our botanical knowledge of the Brazilian forests it is impossible to specify which ones produce the timbers of commerce. The trees are very common, being most abundant perhaps in the transition zone between the tropical and higher sub-tropical regions. The trees as a rule occur in mixture with other hardwoods and sometimes comprise 50

per cent of the forest. They are generally of fairly good timber form, with diameters up to three feet or more and attaining heights frequently exceeding 100 feet, with clear lengths of 50 feet. The woods produced vary in color from very light to very dark, and in density from very soft to extremely hard. Many of them are highly durable and some are very resistant to insect attack, presumably on account of the presence of some resinous or oily deposits."

The Angelino of Venezuela is confused in the literature with a species of *Homalium*, but the commercial timber called Angelino or Laurel Angelino has been identified by Pittier as *Ocotea caracasana* (Nees) Mez (see *Bol. Cien. y Tech. Mus. Com. de Venez.* 1: 1: 14. 1927). The lustrous yellow to olive-colored wood is moderately heavy and hard; sp. gr. (air-dry) 0.75; weight about 47 lbs. per cu. ft.; without distinctive odor or taste; medium-textured, easy to work, finishes attractively, and is highly durable. It is considered one of the best furniture woods of the country and is also used in construction work.

Determa or Wane, *Ocotea rubra* Mez, which is widely distributed in the Guianas and lower Amazon region, is a tree 100 feet or more in height, with a long, well-formed trunk occasionally 50 inches in diameter. Timbers have been obtained that were 40 feet long and 30 inches square, without sapwood, and spars are available that are 70 to 80 feet long and 14 inches in diameter at the small end. The wood does not look like any of the other Lauraceae. It has a distinctive, rather light reddish brown color, with a subdued golden luster, suggesting some of the Meliaceae. It is rather coarse-textured and the vessel lines often show plainly; quartersawed lumber is sometimes attractively figured, owing to the fine but distinct rays and the presence of roe grain. It is fairly strong and hard, though its density is rather low; sp. gr. (air-dry) 0.55 to 0.65; weight 34 to 41 lbs. per cu. ft.; the working properties are excellent; it is said to be highly resistant to insects, moderately so to decay. It is used locally for furniture, interior construction, sugar boxes, and boat planking; the large trunks make good dug-out canoes.

Anatomy of *Ocotea rubra:* Growth rings absent or poorly defined. Pores large, fairly numerous; solitary and in small multiples, often arranged in long diagonal rows. Thin-walled tyloses abundant. Rays 1 to 4, generally 2 or 3, cells wide and up to 40 cells high; heterogeneous in part; oil cells few to numerous; some of the pits to vessels exceptionally large and rounded. Wood parenchyma very coarse-celled, fairly abundant; paratracheal, blunt aliform and uniting the pore groups diagonally; large oil cells numerous. Wood fibers septate; walls of medium thickness.

Greenheart, *Ocotea Rodiaei* (Rob. Schomb.) Mez (= *Nectandra Rodiaei* Rob. Schomb.), is a large evergreen tree 75 to 125, rarely up to 150, feet high, with a straight, cylindrical, nonbuttressed trunk sometimes 40 inches in diameter and free of branches for 50 to 75 feet. It is essentially a British Guiana tree, although small stands of it have been discovered along the upper Maratakka River in Surinam. Reports of its occurrence in other countries are without corroboration. According to the Conservator of Forests of British Guiana (*Official Gazette*, Georgetown, July 17, 1926), Greenheart "occurs in commercial quantities on the north central portion of British Guiana, behind the coastlands, and principally in the area drained by the Cuyuni, Essequibo, Demerara, and Berbice Rivers. In these areas it avoids the drier and poorer soils, growing largely on the slopes leading down to the streams. It is also found in the damp ground near the streams, provided the conditions do not approach too closely to true swamp, but in such situations the tree is not so big nor the quality quite so good as on the slopes, nor are the stands per acre anything like so great as a rule. There is a very large quantity of this wood remaining in the Colony, the former workings having been almost all in the vicinity of the navigable streams, and this large quantity awaits development by more modern methods of logging than have been adopted in the past. . . . The area of forest over which Greenheart is known to occur is approximately 20,000 square miles, while strip valuation surveys . . . have disclosed, on an area of 400 square miles, commencing at six miles from a port at which steamers up to 16 feet draught can load, a total stand of 77,000,000 cubic feet of sound mill timber 16 inches and over in diameter at breast height. . . . The triangle of land having Bartica as its apex, the Essequibo and Mazaruni Rivers as its sides, and a line drawn from

Tiboko to Potaro Mouth as its base, a total area of 2360 square miles, is estimated to contain above 300,000,000 cubic feet of sound merchantable Greenheart timber. . . . On the average, 19 per cent of the trees are unsound. Hewn logs of shipping specification are obtainable from 10 inches to 25 inches square, caliper measure, squares above 21 inches not being common and generally carrying a somewhat higher price. Log lengths are usually from 30 to 70 feet."

Through Bancroft's *History of the Guianas* the valuable properties of Greenheart first became known to timber merchants in England in 1769. Trade in the wood gradually developed until it became one of the foremost industries of British Guiana. The principal market has been in Europe, particularly the United Kingdom and, in smaller volumes, the Netherlands. There has also been a considerable demand in the West Indies, but almost none in the United States until recently. The exports to the U.S.A. for the years 1936 and 1937 were, respectively, as follows: hewn and round logs, 105,182 and 105,151 cu. ft.; sawn timber, 7501 and 21,541 cu. ft. The total exports during 1937 were 428,801 cu. ft. of logs and hewed timbers valued at $232,050, and 42,229 cu. ft. of sawed lumber worth $38,770; total, 471,030 cu. ft., value $270,820. There is no monopoly of the supply and exports of Greenheart are accompanied by a Government certificate of genuineness.

Greenheart is noted for its strength and durability. (For results of recent tests see *Mechanical properties of certain tropical woods, chiefly from South America*, by William Kynoch and N. A. Norton, Bul. 7, Univ. of Mich. School of Forestry and Conservation, 1938.) The heartwood varies in color from lustrous light to dark olive or blackish, often with intermingling of lighter and darker areas or irregular striping; not sharply defined from the thick, lighter-colored sapwood. It is very hard, heavy, and strong; sp. gr. (air-dry) 1.05 to 1.23; weight 66 to 77 lbs. per cu. ft. The texture is medium fine and uniform, the grain straight to roey. The fresh timber contains from 40 to 50 per cent moisture and requires careful seasoning, though it is less refractory than many other heavy structural timbers because the difference in radial and tangential shrinkage is exceptionally low, a fact which can perhaps be attributed to uniformity of texture and the gelatinous nature of the thick-walled fibers. The principal uses are in marine construction, especially for piling, piers, planking, lock and sluice gates, and heavy timbers in shipbuilding. Other uses are bench slats, picket fences, truck wheel spokes, board walks, paving blocks, and house posts. It is also employed in the manufacture of fishing rods and is somewhat confused with the Surinam Groenheart (*Tabebuia* sp.).

Large timbers are slow-burning because of their density. The high resistance of the heartwood to decay and insect injury is generally ascribed to the presence of certain alkaloids, but this has not been definitely determined. For a long time Greenheart had the reputation of being immune to marine borers, but experience has shown that it may be destroyed by certain species of teredo infesting brackish water, as in the Panama Canal. The Conservator of Forests of British Guiana (*loc. cit.*) says: "It can fairly be claimed that, whilst no timber in salt water is immune from attacks by teredo, the record of Greenheart is unsurpassed by any other timber, but it must be borne in mind that this applies in the tropics to *salt water only*, not to brackish water, and Greenheart has most undeservedly been given a reputation for failing in America in *salt* water because of a much advertised failure in *fresh and brackish water*. . . . It is seen that the teredos attacking Greenheart are both fresh and brackish water species, and are *not* the species which ordinarily occur in salt water, and that they are all tropical species. They cannot have any effect on Greenheart in salt water in the tropics, nor in water in temperate regions at all."

Anatomy of *Ocotea Rodiaei:* Growth rings absent or poorly defined. Pores medium-sized (mostly 140 to 190μ), fairly numerous; solitary and in small multiples, evenly distributed. Tyloses present, sometimes sclerotic; vascular pits rather large (8 to 11μ). Rays 1 to 3, mostly 2, cells wide and up to 40 cells high; heterogeneous in part, the marginal cells often square, rarely distinctly upright; no oil cells seen; pits to vessels large, oval to elongated to very large and rounded. Wood parenchyma coarse-celled, fairly abundant; paratracheal or blunt aliform, sometimes connecting adjacent pore groups; no oil cells seen. Wood fibers with very thick, gelatinous walls. Readily distinguishable

from other dense lauraceous woods of tropical America by the absence of oil cells.

Miscellaneous species: The following description is based upon specimens of 35 other American species of *Ocotea*. Growth rings often present, owing to somewhat denser late wood. Pores small to medium, rather numerous; solitary and in small multiples, sometimes clustered. Scalariform perforation plates occasionally present; tyloses common, sclerotic in part in *O. lanata* Mez. Rays 1 to 4, mostly 2, cells wide, rarely over 40, frequently less than 20, cells high; oil cells usually present; pits to vessels large to very large. Wood parenchyma coarse-celled; paratracheal, sometimes bluntly aliform or joining adjacent pore groups; oil cells usually present, sometimes large and abundant. Wood fibers commonly septate; walls rather thin to thick in different species and also in same growth ring.

Persea, with about 60 species of shrubs and small to large trees, is sparingly represented in the Far East, abundantly in tropical America, with a few extensions into the temperate zones. There are two species in southern United States, six in the West Indies, about a dozen in Mexico and Central America, two in Chile, the rest in tropical South America.

The only important tree is *Persea americana* Mill. (= *P. gratissima* Gaertn. f.), probably native to Mexico and Central America, but cultivated for centuries there and in other lands for its pear-shaped table fruit, which is known to Spanish-speaking people generally as Aguacate and anglicized to Avocado or Alligator Pear. It grows to a height of 30 to 60 feet, with a trunk 12 to 18 inches thick. The two principal horticultural types are the West Indian, with smooth, leathery-skinned fruit, and the Guatemalan, Mexican, or highland, with rough and warty, thin-skinned fruit, and leaves exuding an anise-like scent when bruised. The rich, pink or whitish pulp is eaten raw, usually as a salad with some dressing to compensate for the mildness of taste. The seeds are the source of a proprietary oil. The heartwood is pinkish to light reddish-brown, not sharply demarcated from the thick, cream-colored or pale brownish sapwood; it is light in weight, 35 to 40 lbs. per cu. ft., of medium to coarse texture, very easy to work, not very durable. The timber has no special uses and is not commercially important.

Persea Schiedeana Nees (= *P. Pittieri* Mez) is a medium-sized to large forest tree growing from Veracruz, Mexico, to Panama. The fruit is much like the common Avocado. The

rather hard, coarse-textured, unattractive wood is of the general type of the preceding species. It is utilized to a limited extent locally for interior construction, but is not resistant to insects and is of little economic value. Another Central American tree is *P. amplifolia* Mez & D.Sm. A flowering specimen collected by the author in northern Honduras has been identified with that species, but the lustrous greenish yellow, light and soft wood bears little resemblance in properties or structure to any other member of the genus so far as known. It would fit better in *Nectandra*.

Most attractive of the woods of this genus is the Ecuadorean Pacarcar, *P. sericea* H.B.K., judging from a specimen (Yale 24099; Rimbach 161) collected by A. Rimbach at an elevation of nearly 10,000 feet in the Western Cordillera. He says that it is a forest tree 65 feet high, with a broad flat crown and a stout trunk sometimes 40 inches in diameter. The pale reddish brown wood has a silky golden luster, and is rather hard, medium-textured, and roe-grained. The timber is available in logs 20 feet long and is used locally in joinery and house construction.

The only species of *Persea* supplying commercial timber is *P. lingue* Nees, a Chilean tree called Lingue, Liñe, or Litchi. Its botanical range extends from Coquimbo to Valparaiso and Santiago, but it is most abundant in the Provinces of Malleco, Cautín, and Valdivia, sometimes forming nearly pure stands. Mature trees are said to have an average height of 55 to 60 feet with erect trunks attaining a diameter of 40 inches. The bark is an important local source of tannin. The pale brown heartwood has a golden sheen, is of about the same consistency and uses as Birch (*Betula lutea* L.), is easy to work, except that it is inclined to be knotty, and highly esteemed locally for joinery, furniture, and interior construction.

There are four species of trees and shrubs native to southern United States. The Red Bay, *Persea borbonia* (L.) Spreng. (= *P. carolinensis* Née), is usually a small to medium-sized tree, sometimes up to 75 feet tall and 36 inches in diameter, growing mostly near streams and in swamps along the Atlantic and Gulf coast regions from southern Delaware

to Florida and eastern Texas, thence northward through Louisiana to southern Arkansas. The heartwood is bright red to reddish brown, sometimes with dark streaks, moderately hard, medium-textured, and easy to work. It is used to a minor extent for furniture and interior construction and formerly in ship-building, but the supply of large timber is very limited. The Swamp Bay, *P. palustris* (Raf.) Sarg. (= *P. pubescens* [Pursh.] Sarg.), is a slender tree rarely 40 feet high and a foot in diameter, inhabiting Pine-barren swamps, often almost to the exclusion of other plants, from the Dismal Swamp in southeastern Virginia to the Everglades of Florida and westward along the Gulf to eastern Louisiana; also in the Bahamas. The wood, which is similar to that of the other species, though less attractively colored, is of no commercial importance.

The following general description of the woods of *Persea* includes several other species not mentioned above. Heartwood brown, reddish, or pinkish, the darkest-colored sharply demarcated from the gray or cream-colored sapwood. Luster medium to high. Odor and taste absent or not distinctive in dry specimens. Rather light to moderately heavy; sp. gr. 0.60 to 0.75; weight 37 to 48 lbs. per cu. ft.; texture medium to coarse; grain straight to irregular; working properties good; durability low to fairly high. Of no export possibilities.

Growth rings often distinct, owing to slight differences in density. Pores mostly medium-sized (120 to 180μ, occasionally only 70μ), fairly numerous; solitary and in multiples of 2 or 3, sometimes up to 6, pores each, well distributed. Tyloses common; scalariform perforation plates with few to several bars sometimes present; vascular pits medium-sized (9 to 12μ). Rays 1 to 5, mostly 2 or 3, cells wide and of variable heights up to 50 cells or more; more or less distinctly heterogeneous; oil cells present; pits to vessels medium-sized and rounded to large and irregular. Wood parenchyma coarse-celled, variable in abundance; vasicentric, short aliform, and sometimes uniting a few to several pores diagonally; oil cells usually present. Wood fibers sometimes septate; pits very small; walls mostly thin, but sometimes thick in late wood.

Phoebe. There are about 85 species of shrubs and small to very large trees, some of them in the East Indies and Malaya, the majority in tropical America with a combined range extending from the West Indies and southern Mexico southward through Central America and the Andes to Argentina and Brazil, avoiding the Guianas and the Amazon hylaea.

There are four species in the West Indies, the best known being *Phoebe montana* (Sw.) Gris., usually a small tree but sometimes up to 65 feet high. Its light-colored, moderately hard, medium-textured timber is used to a minor extent for interior construction. There are about 25 species in the region from Mexico to Colombia, some of them stately trees of scattered occurrence in the forest and supplying easily worked timber for rafters, siding, ceiling, and flooring of houses. The wood is typically light olive-colored, lustrous, of medium to coarse texture, and only moderately resistant to decay.

The only highly important species is *Phoebe porosa* (Nees & Mart.) Mez (= *Oreodaphne porosa* Nees & Mart.) of southern Brazil, where it is known as Imbuia or Embuia. It grows in the moist *Araucaria* forest of Paraná and Santa Catharina, mostly at altitudes of 2500 to 4000 feet, and forms about 20 per cent of the stand. It attains a maximum height of 130 feet and a trunk diameter of about six feet. Although evergreen, it sheds most of its old leaves as the new ones appear in August to September. On the under side of the leaves in the axils of the median and certain secondary veins are little 2-lipped pockets (domatia) which are inhabited by minute insect parasites. The fruits mature in January and fall to the ground, where they provide mast for swine.

The Najer Lumber Company, Long Island City, N. Y., supplied the following information to the senior author in 1929 (*Tropical Woods* 18: 19): "This firm is distributing approximately 200,000 board feet of Imbuia or Brazilian Walnut annually. The first shipment of importance reached the United States about 1918 and amounted to 100,000 feet, although occasional small lots had come in mixed shipments before that time. In the States of Paraná and Santa Catharina and also in the cities of São Paulo and Santos, Imbuia is the most important wood for high-grade flooring, furniture, interior trim, and fixtures. Exports have been small in the past as the local demand for the lumber has been

about equal to the supply. The logs are shipped to mills in the cities where they are sawed by frame saws of small capacity. Lumber is not carried in stock, being supplied direct from the saw to purchasers who select the logs and have them cut to order. An American band mill at Tres Barras, Santa Catharina, operating in Paraná Pine, accumulates about a million feet of Imbuia a year. This lumber is shipped by rail about 200 miles to San Francisco du Sul, a small open harbor, and lightered to vessels beyond the bank in the open sea. Coffee is the only other commodity exported and sailings are very irregular." According to Karl Schmieg (*Tropical Woods* 5: 3), Imbuia can be selected for color to match any kind of Walnut and "is today practically the only wood obtainable in large planks so much needed for heavy carved work, such as table trusses and chair legs."

The following description applies particularly to Imbuia. Heartwood yellowish or olive to chocolate-brown, either plain or beautifully variegated and figured. Luster medium. Has spicy resinous scent and taste, losing most of it in drying. Moderately hard and heavy; sp. gr. (air-dry) 0.70 to 0.76; weight 43 to 47 lbs. per cu. ft.; rather fine-textured; easy to work, taking a high polish, holds its place well when manufactured, and is durable. The fine dust arising in sawing is irritating to some workmen and may cause dermatitis, though tolerance is usually developed. (See *Public health reports* [Washington, D. C.] 46: 33: 1938–1942; Aug. 14, 1931.)

Growth rings usually distinct, owing to denser late wood. Pores medium-sized (120 to 170μ), occasionally larger (up to 250μ), fairly numerous; occurring singly and in small multiples, uniformly distributed. Perforations typically simple (multiple in part in *Phoebe mexicana* Meissn.); vascular pits in upper medium size class (9 to 12μ). Rays 1 to 3, mostly 2, cells wide and up to 30, generally less than 20, cells high; definitely heterogeneous in part; oil cells present; pits to vessels medium-sized and rounded to much elongated. Wood parenchyma rather sparingly vasicentric; oil cells numerous. Wood fibers septate; those in late wood with thick gelatinous walls. The other species differ mostly in color and density; some have more parenchyma, with local tendencies to be vasicentric-confluent; scalariform perforation plates occasional.

Pleurothyrium, with about a dozen species of small to large trees, occurs in the upper Amazon region of Peru and Brazil. According to Macbride (*Flora of Peru* 2: 928) the genus is "doubtfully separable naturally from *Ocotea*." The timber is said to be used locally for carpentry and interior construction. The following description is based on one specimen each of *P. densiflorum* A. C. Smith (Yale 17860; Williams 2273), a tree about 60 feet high, and *P. Williamsii* O. C. Schmidt (Yale 17682; Williams 1766, from type tree), about 90 feet; both collected by L. Williams in Peru (see his *Woods of northeastern Peru*, p. 162).

Heartwood olive; not sharply demarcated from the greenish yellow sapwood. Luster silky. Odor mildly fragrant; taste not distinctive. Light and soft to moderately so; texture medium; grain straight; very easy to work.

Growth rings absent or poorly defined. Pores medium-sized (160 to 180μ), rather few; solitary and in small multiples, well distributed. Tyloses present; vascular pits moderately large (9 to 10μ). Rays 1 to 3, mostly 2, cells wide and up to 35 cells high; distinctly heterogeneous in part, with single marginal rows of upright cells; oil cells few; pits to vessels very large. Wood parenchyma vasicentric; also blunt-aliform in *Pleurothyrium Williamsii;* no oil cells seen. Wood fibers septate; with uniformly thin walls in *P. densiflorum;* bands of rather thick-walled fibers present in the other species, the thin-walled cells sometimes resembling parenchyma.

Sassafras, with a single species, *S. albidum* (Nutt.) Nees (= *S. officinale* Nees & Eberm. = *S. Sassafras* Kart. = *S. variifolium* Kuntze), is of general distribution throughout the eastern half of the United States and southern Ontario, Canada. Throughout much of its range it varies in size from little more than a crooked shrub to a slender tree less than 40 feet tall; at its best on rich well-drained soil it attains a height of 75 to 90 feet and a trunk diameter of 2 to 5 feet; the branches are short, stout, and more or less contorted. The leaves are entire, 3-lobed, or mitten-shaped. All parts of the tree are aromatic, and the bark of the roots is the source of the commercial oil of Sassafras used to scent or flavor various products; the small roots in asparagus-like bundles are a common article of local commerce and are used in making Sassafras tea, a beverage with reputed medicinal virtues, particularly as a spring tonic. The center of these industries is in the southern states where the tree

often takes possession of abandoned fields and develops a wide-spreading root system. The wood has the general appearance of Ash (*Fraxinus*) or Chestnut (*Castanea*) and is used to a limited extent in inexpensive furniture, boxes, and slack cooperage, and on farms for posts, fence rails, and kindling.

Heartwood pale brown, deepening to dull orange-brown upon exposure; not very sharply demarcated from the thin yellowish white sapwood. Luster medium. With characteristic but mild scent and taste. Light, fairly soft, brittle; sp. gr. (air-dry) about 0.52; weight 33 lbs. per cu. ft.; texture coarse; grain straight; very easy to season and to work, holds its place well when manufactured; is rather highly resistant to insects and decay.

Wood ring-porous. Early wood pores visible, in rather wide, loose band; late wood pores small to minute, thick-walled, fairly numerous, solitary or in small multiples, well distributed. Vessels mostly with simple perforations; scalariform plates with a few coarse bars sometimes present in smallest vessels; tyloses abundant; vascular pits medium-sized to large (7 to 14μ, mostly 9 to 11μ). Rays 1 to 4, mostly 2 or 3, cells wide and up to 40 cells high; more or less distinctly heterogeneous; large oil cells common; pits to vessels large, rounded to much elongated. Wood parenchyma fairly abundant, paratracheal and more or less confluent in late wood; oil cells present. Wood fibers thin-walled.

Umbellularia *californica* (H. & A.) Nutt., the only species, is a pungently aromatic tree common along water courses in southwestern Oregon, where it is generally known as Myrtle, and southward through the mountains of western California, where its usual name is Laurel. On rich soils in the Coos River valley of Oregon it forms dense stands in association with Maple (*Acer macrophyllum* Pursh.), sometimes attaining a height of 150 to 175 feet, with a straight bole 3 to 6 feet in diameter. Open-grown trees usually have a short stout trunk divided near the ground into several coarse, diverging stems forming a broad, round-topped crown. In southern California it is much smaller and at high altitudes becomes shrubby and sometimes forms broad mats of prostrate stems. The shoots lengthen and new leaves appear throughout a long growing season and some of the leaves persist for 5 or 6 years. When the leaves and green bark are crushed they give a volatile oil as pungent as camphor. The timber is of excellent quality and is locally important for making furniture. Burls and gnarly trunks are sliced into veneers for cabinetwork, generally under the name of Oregon Myrtle. Lumbermen say that the light color of the wood can be darkened by placing the fresh logs in water and leaving them submerged for a long time, producing the so-called Black Myrtle so highly esteemed for furniture and interior trim.

Heartwood yellowish brown or olive, often variegated; not sharply demarcated from the very thick pale brownish sapwood. Luster medium. With mild scent and taste when fresh. Of medium density, hard, and strong; sp. gr. (air-dry) 0.55 to 0.66; weight 34 to 41 lbs. per cu. ft.; texture medium; grain straight to wavy or contorted; very easy to work, finishing very smoothly, holds its place well when manufactured; heartwood durable.

Growth rings distinct. Pores thick-walled, medium-sized (100 to 160μ), not very numerous; solitary and in multiples of 2 to 5, well distributed. Vascular pits medium-sized, occasionally small (7 to 9μ). Rays 1 to 3, mostly 2, cells wide and up to 40, usually less than 20, cells high; more or less distinctly heterogeneous; oil cells commonly present; pits to vessels moderately large, rounded. Wood parenchyma rather abundant; vasicentric, occasionally joining a few pores diagonally; oil cells sometimes present. Wood fibers septate in part; thick-walled in narrow band in outer late wood, elsewhere with medium walls.

THE YALE WOOD COLLECTIONS

Accessions

At the end of the calendar year 1941 the total number of catalogued wood samples in the Yale wood collections amounted to 40,317, representing 11,729 named species of 2788 genera of 230 families. There were 881 accessions during the year. The largest single contribution was from Bolivia (378), collected by Mr. B. A. Krukoff of the New York Botanical Garden. The sources of all the wood samples received are as follows:

Argentina: Mr. W. J. Hutchinson, New York City.

Australia: Mr. H. E. Dadswell, Council for Scientific and Industrial Research, South Melbourne.

Bolivia: Mr. B. A. Krukoff, New York Botanical Garden, through the Field Museum of Natural History, Chicago.

Brazil: Dr. Adolpho Ducke, Jardim Botanico, Rio de Janeiro; Field Museum of Natural History, Chicago; Mr. W. J. Hutchinson, New York City; Mr. B. A. Krukoff, New York Botanical Garden; Serviço Florestal, Rio de Janeiro.

Chile: Mr. W. J. Hutchinson, New York City.

Cuba: Rev. Brother León, Colegio de La Salle, Havana.

British Honduras: Mr. J. B. Kinloch, Belize.

Java (D. E. I.): Mr. W. J. Hutchinson, New York City.

Mexico: Mr. W. D. Durland, New Orleans, La.

New Zealand: Mr. W. J. Hutchinson, New York City.

Paraguay: Mr. W. J. Hutchinson, New York City.

Tasmania: Mr. W. J. Hutchinson, New York City.

U. S. A.: Mr. Bess, Midland City, Ala.; Mr. T. S. Buchanan, Athens, Ga.; Prof. R. A. Cockrell, Berkeley, Calif.; Dr. Ray Dawson, Columbia, Mo., Prof. Emanuel Fritz, Berkeley, Calif.; Dr. A. H. Graves, Brooklyn Botanic Garden; Prof. R. W. Hess and Prof. H. J. Lutz, New Haven, Conn.; Mr. Henry W. Hicock, Cheshire, Conn.; Mr. M. R. Jacobs, New Haven, Conn.; Dr. M. T. Record, Storrs, Conn.; Mr. J. S. Stearns, Washington, D. C.; Mr. H. D. Tiemann, Madison, Wis.; Dr. Irma E. Webber, Riverside, Calif.

Virgin Islands: Prof. R. H. Woodworth, Bennington, Vt.

Sections for Microscopic Study

During 1941 there were added to the slide collections, cross, radial, and tangential sections of 323 specimens representing 93 named species and 6 genera, making a total of 19,313 slides of 10,966 specimens of 6479 named species, 2600 genera, and 217 families.

Specimens Distributed

There were distributed during the year 1087 wood specimens, mostly for use in connection with specific scientific projects now under way or in preparation.

To the American Museum of Natural History, New York City, 1006 samples: Aceraceae (14), Amygdalaceae (6), Anacardiaceae (23), Anonaceae (6), Apocynaceae (1), Aquifoliaceae (4), Betulaceae (10), Bignoniaceae (5), Bombacaceae (7), Boraginaceae (2), Burseraceae (21), Cactaceae (2), Capparidaceae (1), Caprifoliaceae (4), Celastraceae (4), Combretaceae (20), Cornaceae (9), Corylaceae (8), Cupressaceae (17), Dipterocarpaceae (241), Ebenaceae (15), Ericaceae (8), Euphorbiaceae (10), Fagaceae (68), Gonystylaceae (6), Guttiferae (6), Hamamelidaceae (10), Hippocastanaceae (2), Juglandaceae (13), Koeberliniaceae (2), Lauraceae (18), Leguminosae (41), Leitneriaceae (2), Liliaceae (3), Loganiaceae (1), Lythraceae (1), Magnoliaceae (10), Malvaceae (1), Meliaceae (21), Moraceae (16), Myricaceae (8), Myristicaceae (6), Myrtaceae (5), Nyctaginaceae (1), Nyssaceae (5), Ochnaceae (8), Olacaceae (9), Oleaceae (16), Palmaceae (1), Pinaceae (60), Platanaceae (6), Podocarpaceae (1), Polygonaceae (13), Rhamnaceae (25), Rhizophoraceae (2), Rosaceae (21), Rubiaceae (7), Rutaceae (14), Salicaceae (19), Sapindaceae (18), Sapotaceae (18), Simarubaceae (5), Sterculiaceae (1), Styracaceae (3), Symplocaceae (3), Taxaceae (2), Taxodiaceae (4), Theaceae (4), Thymelaeaceae (1), Tiliaceae (2), Ulmaceae (13), Zygophyllaceae (7).

To Prof. I. W. Bailey, Harvard Biological Laboratories, 36 samples: Anonaceae (21), Eupomatiaceae (1), Flacourtiaceae (5), Hamamelidaceae (1), Magnoliaceae (2), Monimiaceae (1), Simarubaceae (4), Winteraceae (1).

To Mr. George F. Beck, Ellensburg, Wash., 3 samples: Cupressaceae (2), Pinaceae (1).

To Prof. E. S. Harrar, Durham, N. C., 28 samples: Bignoniaceae (1), Campanulaceae (1), Compositae (1), Ebenaceae (1), Euphorbiaceae (3), Flacourtiaceae (1), Guttiferae (3), Leguminosae (9), Melastomaceae (1), Moraceae (1), Rubiaceae (1), Rutaceae (1), Simarubaceae (1), Sterculiaceae (2), Ulmaceae (1).

To Mr. B. A. Krukoff, New York Botanical Garden, 7 samples of 4 species of 2 genera of Leguminosae.

To Dr. Harry R. Muegel, Cincinnati, Ohio, 5 samples of 4 species of *Podocarpus*.

To Mr. J. L. Stearns, Washington, D. C., 1 sample of *Leitneria floridana*.

To Dr. Oswald Tippo, University of Illinois, 1 sample of *Rhoiptelea*.

CURRENT LITERATURE

Wood structure of *Thuja occidentalis*. By M. W. Bannon. *Botanical Gazette* 103: 2: 295–309; 43 figs.; December 1941.

"Studies of samples from different parts of the tree, from trees of different sizes, and, in the case of roots, from roots growing under different environmental conditions, revealed much variation in the structure of the secondary xylem. Some features usually recognized as variable, namely, size of tracheids, number and size of crossing-field pits, height and distribution of rays, and height and width of ray cells, were found to vary widely; but in some cases definite trends were recognizable in different parts of the tree. Other characters more generally regarded as diagnostic, such as the arrangement of the intertracheary pits on the radial walls of tracheids, the degree of development of the torus, the presence or absence of crassulae, the size and shape of the apertures in the crossing-field pits, and the thickness of the walls of ray and wood parenchyma cells, also varied greatly, often within the same piece of wood. In view of such variability it is obvious that caution must be exercised in the selection of diagnostic characters for the identification of woods."—*Author's summary.*

The Caribbean Forester. Pub. quarterly by the Tropical For. Exp. Sta., U. S. Forest Service, Río Piedras, Puerto Rico. Vol. III: 1: 1–45; October 1941.

Contents

***Acrocomia*—Preliminary paper.** By L. H. Bailey. *Gentes Herbarium* (Ithaca, N. Y.), vol. 4, fasc. 12, Sept. 1941.

This is the first attempt at a comprehensive treatment of the genus *Acrocomia* Mart. since Beccari's résumé in the Palms of Cuba (1912) in which 15 species were listed. With nine new species, mostly Antillean, added by Prof. Bailey, the number is brought to twenty five, for which he furnishes a useful key, based as far as possible on characters of fruit and pinnae, the only parts of *Acrocomia* ordinarily taken by collectors, but also of spathe, rachis of leaf, and, for its main division, on characters of the stem, the lack of persistence of spines and remains of leaf bases. New species described and figured are *A. panamensis*, *A. ierensis* (Trinidad), *A. belizensis*, *A. hospes* (of unknown origin, planted in Florida), *A. karukerana* (Guadeloupe), *A. quisqueyana* (Haiti), *A. pilosa* León (Cuba), *A. subinermis* León (Cuba), and *A. armentalis* (Morales) Bailey, new comb. (=*A. crispa* Baker ex Becc.). *A. fusiformis* (Swartz) Sweet, which has not been described since its original brief diagnosis (as *Cocos*) by Swartz in 1797, is redescribed on the basis of new collections from Jamaica.

The only recent South American accession to the genus is *Acrocomia chunta* Covas & Ragonese in *Revista Argentina de Agronomia*, March 1941. Our knowledge of *A. sclerocarpa* Mart. (1827) remains as unsatisfactory as ever and may, according to Prof. Bailey, represent a mixture of *Acrocomia* and *Astrocaryum*. *A. Wallaceana* (Drude) Becc. is also imperfectly known, while *A. lasiospatha* Mart. seems to be based only on a wooly spathe in Herb. Paris.—B. E. Dahlgren, *Field Museum.*

Supplementary notes on the American species of *Erythrina*. By B. A. Krukoff. *American Journ. Botany* 28: 8: 683–691; 2 plates; October 1941.

"Considerable progress has been made recently in the chemical and pharmacological studies of the alkaloids derived from seeds of various species of *Erythrina*. . . . In connection with this continuous interest in *Erythrina* alkaloids, a number of specimens have been received for identification which extend our knowledge of certain species previously known

from incomplete material. Extensions of ranges are here noted for a number of species, and one species [*E. guatemalensis* Krukoff] is described as new."

El cocotero (*Cocos nucifera* L.). By M. Acosta Solís. Pub. by Instituto de Ciencias Naturales, Quito, Ecuador, August 1941. Pp. 18; 8 x 11; 18 text figs.

An interesting account, with summaries in English and German, of the Coconut Palm with particular reference to the Province of Esmeraldas. The work is divided into three parts, the first dealing with the problems and methods of cultivation, the second with the commercial products and local uses of the tree, the third with the desirability of encouraging the planting of new groves.

O licuriseiro (*Cocos coronata* Mart.) e suas possibilidades na economia brasileira. By Gregorio Bondar. Bol. No. 2, Instituto Central de Fomento Economico da Bahia, June 1938. Pp. 18.

A brief account of the botany and economic importance of the Brazilian palm *Syagrus coronata* (Mart.) Becc. Formerly esteemed mainly for its small fruits, a source of fodder for goats and cattle, and its kernels for oil, this palm has recently come into prominence as the source of the wax marketed under the name of Ouricury—a misnomer, since in Bahia whence the wax emanates, the palm is commonly called Licury, while the Ouricury is a palm of the Amazon region, namely, *Scheelea Martiana*, well known for the use of its fruits for smoking rubber.—B. E. Dahlgren, *Field Museum.*

Palmeiras na Bahia genero *Cocos*. By Gregorio Bondar. Bol. No. 4, Inst. Centr. Fom. Econ. da Bahia, 1939. Pp. 19; figs. 13.

The author deals with three previously described palms of the genus *Cocos* in the State of Bahia, namely, *C. coronata* Mart., *C. botryophora* Mart., and *C. schizophylla* Mart., and describes and illustrates three new ones discovered by himself: *C. vagans* Bondar, *C. Tostata* Bondar, and *C. Matafome* Bondar. The author rejects Beccari's generally accepted

treatment of *Cocos* under which his new species would be relegated to the genus *Syagrus* Mart.

Both *Cocos vagans* and *C. Matafome* are said to be of local economic importance. The leaves serve as fodder for cattle and yield material for hats and similar articles, the fruits serve as food for domestic animals and, at least at times of scarcity, for man also, as indicated by the vernacular name Matafome. The kernels of both species are employed as a source of oil. The leaves of *C. vagans* have a sparse coating of wax.—B. E. Dahlgren, *Field Museum.*

Importancia economica das palmeiras nativas do genero *Cocos* nas zonas seccas do interior bahiano. By Gregorio Bondar. Bol. No. 5, Inst. Centr. Fom. Econ. da Bahia, 1939. Pp. 16; 5 plates.

An account of the climate, geology, soil, and economy of the Municipio of Sta. Therezinha, a typical, fairly well-inhabited section of the dry region in the interior of the State of Bahia, where two species of native palms, Licuriseiro, *Cocos coronata* Mart., and Ariri, *C. vagans* Bondar, furnish the inhabitants a large proportion of their sustenance, as well as food for domestic animals.—B. E. Dahlgren, *Field Museum.*

Palmeiras da Bahia. By Gregorio Bondar. Bol. No. 6, Inst. Centr. Fom. Econ. da Bahia, 1939. Pp. 32; 6 plates.

A continuation of the author's accounts of Bahia palms of the genus *Cocos* and others, with description of a new species. *C. Romanzoffiana* Cham., abundant in the south of Brazil, and extending into Uruguay, Paraguay, and Argentina, has not been known to occur in Bahia, except as planted, but is found to exist there in considerable numbers, attaining the northern limit of its range on the right bank of Rio de Contas. A new species intermediate between *C. Romanzoffiana* and *C. coronata* is named *Cocos Campos-Portoana* Bondar (section *Syagrus* B.R.). Like the other species of *Cocos* described by the author, this one, according to the generally accepted Beccari treatment of the genus, would be placed in *Syagrus* Mart. The author would reduce

Cocos picrophylla Barb. Rodr., the Pati of Bahia (erroneously placed by Barb. Rodr. in the section *Acuma*) to synonymy in favor of *C. botryophora* Mart. (undoubtedly that of 1826, which Beccari, excluding parts of the original description, reduced to the rank of a variety of his *Arecastrum Romanzoffianum* [Cham.] Becc.).

The remainder of the issue deals with the three species of *Diplothemium* found in Bahia: *D. caudescens* Mart., *D. littorale* Mart., and *D. campestre* Mart. There are good illustrations of the first-named and of its fruit.—B. E. Dahlgren, *Field Museum.*

Palmeiras do genero *Cocos* e descripção de duas especies novas. By Gregorio Bondar. Bol. No. 9, Inst. Centr. Fom. Econ. da Bahia, 1941. Pp. 54; 13 plates.

The author passes in review briefly the results of the work of botanists who are responsible for our present-day knowledge of the Cocos palms of Brazil, *viz.*, Martius, Drude, Barbosa Rodrigues, and finally Beccari, whose universally accepted subdivision of the genus he rejects almost *in toto*. His reason for refusing to recognize Beccari's genera *Arecastrum*, *Barbosa*, *Butia*, *Syagrus*, etc., is his conviction that they produce an entirely artificial segregation, since the characters on which they are based are not the ones most indicative of true relationships. For the same reason he rejects the *Arikuriroba* of Barbosa Rodrigues. Since Drude's once very useful key to the species of *Cocos* is no longer adequate and the subsequent more extensive one of Barb. Rodr. is too confusing for practical use, Bondar presents a new key, covering, however, only thirteen species actually known by him from S. Paulo, Espirito Santo, and Bahia.

A few pages and excellent illustrations are given to the Coco de Quarta of Espirito Santo, *Cocos picrophylla* Barb. Rodr., syn. *C. Martiana* Drude, which Beccari erroneously assigned to *C. botryophora* Mart. (1826), in its turn reduced by him to a variety of *C. Romanzoffiana*. With his knowledge of *C. picrophylla* and of *C. botryophora* which Bondar finds to be a perfectly legitimate species exactly as described by Martius, the author clears up one of the most perplexing puzzles of Beccari's synonymy, his disposition of *C. botryophora* Mart. of 1826, that of the Palm. Orbign. (1847) still being in doubt.

Coco de Vaqueiro, *Cocos campestris* Mart., not hitherto recorded from Bahia, was found growing in the Municipio of Contendas in the neighborhood of Serra do Sincora. Noteworthy among Cocos palms for its cespitose habit, this species responds with new basal lateral shoots to the inroads of cattle and fire, and is one of the relatively few palms that may be propagated easily by offshoots.

Two new species are described: *Cocos Getuliana* Bondar (pp. 35–43, f. 7–9) and *Cocos Ruschiana* Bondar. The former, dedicated to President Getulio Vargas, is a tall-stemmed palm of the section *Langsdorfia* Mart. It is closely related to *C. macrocarpa* Barb. Rodr., but taller, with longer leaves, greater number of branches in the spadix, more numerous and much smaller, elongate, elliptical fruit with endocarp marked by three high longitudinal ridges, a unique character among American palms. The sheath of the leaf-stem produces an abundance of the fiber known as "piassava." Source, Municipio of S. Mateus, State of Espirito Santo.

Cocos Ruschiana Bondar (pp. 45–49, f. 10–13) is a cespitose species characterized by slender stems with a bulbous base from which shoots are given off. Trunks and petioles are smooth, the globose fruit has ruminate albumen. It is an ornamental species readily propagated by offsets or seed, and may be important also for oil production. Collected (*Bondar*) at Colatina, State of Espirito Santo.—B. E. Dahlgren, *Field Museum.*

***Polygonanthus*, genre de Saxifragacées.** By Charles Baehni and Pierre Dansereau. *Bull. Soc. Bot. France* 86: 183–186; 1939.

In 1929, Adolpho Ducke discovered a small Amazonian tree which he made the type of a new genus, *Polygonanthus*, and referred to the family Euphorbiaceae. Later Croizat noted a resemblance to *Heisteria* and concluded that the genus should be included with the Olacaceae. The present authors propose a transfer to the Saxifragaceae.

Secagem da madeira em estufa. By FREDERICO ABRANCHES BROTERO. Bol. 27, Inst. Pesquisas Techn. de São Paulo, Brazil, July 1941. Pp. 47; 7 x 10¼; 20 text figs., 1 pl.

A treatise on the principles and practices of kiln-drying lumber. It includes a table listing 94 species grown in Brazil and giving for each wood the specific gravity at 15 per cent moisture and the ratios of radial, tangential, and volumetric shrinkage.

Les Lacistémacées des Andes et des régions avoisinantes. By CHARLES BAEHNI. *Candollea* (Geneva) 8: 35–46; April 1940.

This paper deals with two species of *Lozania* and nine of *Lacistema*, three of the latter being new. The author proposes a new basis for separating the species of the section *Eulacistema* into two nearly equal groups which coincide with geographical divisions, particularly in the Guianas, Brazil, and Paraguay.

Revision des Violacées péruviennes. By CHARLES BAEHNI and R. WEIBEL. *Candollea* 8: 190–222; May 1941.

The 53 Peruvian species of Violaceae treated here are of 11 genera, namely, *Rinorea* (8), *Rinoreocarpus* (1), *Gloeospermum* (2), *Paypayrola* (1), *Amphirrox* (4), *Hybanthus* (5), *Corynostylis* (1), *Anchietea* (4), *Noisettia* (1), *Leonia* (2), and *Viola* (24).

El pehuen, araucaria o pino del Neuquén en la Argentina. By JOAQUIN L. ALFONSO. Reprinted from *Ingeniera Agronómica* 3: 14; May–June 1941. Pp. 14; 8 x 11½; ill.

This is a valuable contribution to the knowledge of *Araucaria araucana* (Mol.) Koch (= *A. imbricata* R. and P.), a very large subantarctic tree of limited natural distribution, but widely planted for ornamental purposes. All aspects of the subject are covered and fully illustrated.

Stem anatomy and phylogeny of the Rhoipteleaceae. By CARL L. WITHNER. *Am. Journ. Botany* 28: 10: 872–878; 2 plates; December 1941.

"The family Rhoipteleaceae, from southwestern China and Tonking, was described by Handel-Mazzetti in 1932. At that time Handel-Mazzetti suggested that the family might belong to the Urticales or to the Juglandales. Wettstein (1935) includes the family in the Urticales, as do Engler and Diels (1936). Tang (1932) believes, on the basis of the anatomy of the wood, that the Rhoipteleaceae are more closely similar to the Ulmaceae than they are to the Juglandaceae. On the other hand, Tippo (1938) says, 'The fact that the perforation plates are exclusively scalariform and that the vessel elements are so long makes it obvious that this family does not belong in the Urticales.' He makes, however, no phylogenetic placement of the family. Accordingly, the purpose of the present study was to investigate more fully the stem anatomy of the Rhoipteleaceae with the hope that such a study might aid in determining the phylogenetic position of the family."

The author also considers the external morphology and the anatomy of the bark and concludes that *Rhoiptelea* should be considered a primitive member of the Juglandaceae.

Studies of Pacific island plants. I. By A. C. SMITH, *Bull. Torrey Bot. Club* 68: 6: 397–406; June 1941.

"This paper [which deals with *Myristica*] is the first of a series in which it is proposed to discuss new and noteworthy plants from the Pacific area and to revise limited groups of plants as occasion rises. The geographic area under consideration includes the Polynesian, Micronesian, and Melanesian groups, although the Solomon Islands, being floristically so intimately related to New Guinea, may as a rule be excluded from treatment in this series." There are descriptive accounts of eight species of *Myristica* and a key for their determination. *Myristica Guillauminiana* is described as new.

Cinchona cultivation and the production of totaquina in the Philippines. By JOAQUIN MARAÑON and HARLEY H. BARTLETT. *U. of P. Nat. and App. Sci. Bull.* (Manila) 8: 2: 111–142; 25 plates; March 1941.

"The cultivation of Cinchona in the Philippines was started in 1912 when the Bureau of Forestry introduced this plant in Baguio, Mountain Province. In 1927 the project was transferred from Baguio to Mindanao. A station was first established at Impalutao, Bukidnon, but when this was found to be unsuited for large-scale cultivation, a new site at Kaatoan was selected. The plantings used are *Cinchona succirubra*, *C. Ledgeriana*, '*C. hybrida*,' '*C. officinalis*,' and a collection of seedling variations from *C. succirubra*. Detailed instructions on methods of planting which have been found successful in Bukidnon are given and some important disease problems are discussed.

"The production of totaquina in the Philippines was started in June 1936 at the experimental pilot plant of the Bureau of Science. The totaquina prepared from three species of Philippine-grown Cinchona conforms in composition with the requirements set forth for this product by the Malaria Commission of the League of Nations. Studies made on the therapeutic efficacy of Philippine totaquina have shown that the product compares favorably with quinine. No untoward effects have been observed following its administration."—*Authors' summary.*

Timber tests. Merewan jangkang (*Hopea nervosa* King). By A. V. Thomas. *Malayan Forester* 10: 3: 106–110; July 1941.

"The timber of *Hopea nervosa* is not likely to be of commercial importance as the trees are usually comparatively small and of very scattered occurrence. Moreover, larger trees, where found, are usually hollow. The timber, however, could quite safely be sold for the same purposes as that of *Hopea sulcata*, which appears to be much more abundant. The results of these tests indicate that Merawan Jangkang is somewhat stronger in all respects than *Hopea sulcata*, but as the weight per cubic foot of random samples of the latter timber was less than that of random samples of Merawan Jangkang (at the same moisture content), it is possible that the test material of either one or other of the species was not typical of the general quality of the species. The Merawan Jangkang from the five logs cut up for these tests was only slightly attacked by borers and in narrow widths it would make a good flooring timber. It is undoubtedly suitable for all purposes for which Merawan Meranti was recommended."

Timber tests. Resak daun runching and resak mempening, *Vatica cuspidata* (Ridl.) Sym. and *V. Stapfiana* (King) V. Sl. By F. S. Walker. *Malayan Forester* 10: 4: 150–155; October 1941.

"The results of these mechanical tests indicate that in most properties *Vatica cuspidata* is intermediate between the weaker forms of Balau and Damas Laut Merak. It is distinctly weaker than Balau of equivalent weight and very much less resistant to shock. There is also a marked inability to support load after initial failure in bending, denoting lack of toughness. The results for *V. Stapfiana* indicate a similarity in strength properties to Merbau. It is not as tough as that timber but it is very much better in this respect than the heavier timber of *V. cuspidata;* the ability to support loads after failure was a marked feature. The similarity between *V. Stapfiana* and Merbau is, of course, in strength properties only; the anatomical features are very different. The timber of *V. cuspidata* can safely be used for heavy constructional purposes, but it is likely to check badly unless carefully seasoned. It is probably as durable as most forms of Balau but it is not as strong. The timber of *V. Stapfiana* is suitable for medium-heavy constructional purposes, being equivalent in strength properties to, and at least as durable as, the light or medium-heavy Keruings, but the small size of the tree limits its uses. Both timbers are suitable for house-posts and, with other species of Resak, are popular for that purpose with the rural Malay population."

Resistance of timbers to marine borer attack. By F. S. Walker. *Malayan Forester* 10: 4: 145–149; October 1941.

An account of tests carried out on treated and untreated timbers exposed to marine borer attack at Port Swettenham, with recommendations regarding the use of wood in such situations. "The results show clearly that only a very few of

the timbers tested had any appreciable natural resistance to marine borer attack at Port Swettenham. Seven pieces of 5 by 5 in. timber were serviceable for about three years. Billian [*Eusideroxylon Zwageri*, from Borneo] gave the best results, but there was very little to choose between this species and Greenheart [*Ocotea Rodiaei*, from British Guiana], Keledang, Kemalau, and Merbau; Kulim and Tempinis lasted almost equally well. Billian and Greenheart have a wide reputation for resistance to marine borers; the remaining five are Malayan timbers, but only one, Merbau [*Intsia*], is available on the market in large quantities."

The principles of log manufacture, together with notes on some of the useful timber trees of the Gold Coast. By L. C. Rowney. Bull. No. 1, G. C. Forestry Department, Accra, 1941. Pp. 16; 6 x 10; 8 plates.

"The object of this pamphlet is to give producers and exporters from this country a few hints on the manufacture of logs in order that quality may be improved. This will result in increased financial returns. It has been thought advisable to add short notes on a number of Gold Coast timbers in addition to Mahogany [*Khaya*] and Odum [*Chlorophora excelsa*].

"The Gold Coast up to the present time has suffered from what may be termed a Mahogany-Odum complex, not only on the export market but on the local market also. It is, therefore, hoped that these notes will induce producers to get into touch with consumers in an endeavor to increase the number of saleable species. This will be to the former's advantage, since it will permit them to work a greater number of trees on the same area, thereby reducing overhead expenses. One word of warning, however, is necessary. It is essential that logs of any new timber introduced to the market, especially the export market, should be first class in every way. To attempt to sell inferior logs will kill any trade before it has properly started and will from the commencement depress the selling price."

Gold Coast timbers. By R. C. Marshall. Government Printer, Accra, 1941. Pp. 57; 5½ x 8½. Price 1s. 6d.

Contains descriptions of 43 kinds of Gold Coast trees with reference to their size, distribution and frequency, and the properties and uses of the timber. The local and trade names are correlated with the scientific, and there is a table of densities and a summary of the local uses of the woods.

The story of wattle (or mimosa), the world's modern tanning material. By S. G. Shuttleworth. Sci. Bull. No. 168, Dept. Agr. and Forestry, Pretoria, South Africa, 1941. Pp. 28; 7 x 9¾; 7 figs. Price 3d.

"The most modern and scientific development has been the selection and growth of a tanning material specially for the requirements of the tanner, cultivated and developed with the sole purpose of supplying the tanner with a raw material most suited to his special requirements.

"This modern development has brought about the cultivation of Wattle in South Africa, which has been selected as one of the richest in tannin, the tree reaching maturity in about eight years and yielding per acre from three to six tons of air-dry bark of approximately 35 per cent tannin content. According to the Imperial Institute, six tons of Wattle bark of 37 per cent tannin can be produced per acre in 7–10 years, while 80 years are required to produce four tons of Oak or eight tons of Hemlock bark of only about 12 per cent tannin. The Wattle was introduced into South Africa from Australia and a number of species tried out. Of these, one type, the Black Wattle, has been selected as most suitable for the tanners' requirements and only this type is grown commercially in South Africa."

Systematic anatomy of the woods of the Burseraceae. By Irma E. Webber. *Lilloa* (Tucumán, Arg.) 6: 2: 441–465; 4 plates.

"The author describes the anatomy of the wood of the Burseraceae and compares it with that of the Anacardiaceae,

Rutaceae, Simarubaceae and Meliaceae. The similarities in structure of their woods suggest the probability of common extraction of these families. The woods of the Meliaceae show the most specialization, and those of the Simarubaceae and Rutaceae show somewhat more specialization than those of the Burseraceae and Anacardiaceae. Traumatic intercellular cavities in the rays of the Simarubaceae and Rutaceae suggest the origin of these families from plants such as the Burseraceae and Anacardiaceae that have normal intercellular canals in their rays."—*Author's summary.*

M.M.C

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 70 JUNE 1, 1942

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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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SOME PHYSICAL PROPERTIES OF MODERN CABINET WOODS—II. SCREW-HOLDING POWER

By ELLWOOD S. HARRAR

School of Forestry, Duke University

This paper is the second of a series dealing with pertinent physical properties of modern cabinet woods (for the first see *Tropical Woods* 68: 1–11; December 1, 1941). It reports the results of a number of comprehensive screw-extraction tests on these timbers.

The screw-holding capacity or power of a timber may be defined as the measure of the ability of a given wood to resist the forceful extraction of a screw. This is, of course, equal to the actual tensile stress applied axially to a screw

necessary to effect its displacement. It is obvious, however, that the screw-holding power of any wood is dependent upon several factors and that these must be either known or determined before data of this sort may have any comparative significance. For example, it has been adequately demonstrated (*1*) that dry wood offers greater resistance to screw removal than does wet wood; hence moisture content is an important consideration. In this series of tests only kiln-dried wood of uniform moisture content was used, the variation for all samples being less than 3 per cent. The type of screw and the pitch of its thread, the size of lead holes, the depth of screw penetration into the specimens to be tested, and speed of extraction are all variables which must be standardized.

The blocks employed in this phase of the work were cut from the same group of boards used in obtaining samples for the hardness determinations previously described (*3*). In this instance, however, no effort was made to procure material of uniform size, but rather to obtain a sufficient number of suitable pieces to make two series of extractions, using screws of two sizes. Hence, because of the rather heterogeneous nature of the test specimens for any one species, few truly radial or tangential faces were obtainable, so that comparisons of screw-holding efficiency between the longitudinal surfaces were not attempted. Cockrell (*1*) has shown, however, that such differences do exist, particularly in woods of uneven texture.

Only common flathead, one-inch screws were used in this study since this type is the one most commonly employed in cabinetry. In the initial series of extractions No. 6 screws were used, while No. 10 screws were chosen for the second series. Fifty screws of each size were properly embedded and then withdrawn from the longitudinal faces of each timber; similarly for the end sections.

The screws were let into previously drilled lead holes which were made with a power drill in order to assure uniform depth and alignment. None was placed any nearer than one-half

inch from any edge nor were they ever closer than two inches center to center. In accordance with Fairchild's (*2*) general recommendations, the width of the lead holes was fixed at 90 per cent of the root diameter of the screw. Each screw was turned into the wood to a depth of three-fourths of an inch. In this manner the threaded part of the screw was completely embedded, yet there was left sufficient clearance below the head for the screw extraction tool to take up firmly about it.

The extractions were made in a 20,000-pound capacity Olsen Universal testing machine having a sensitivity of two pounds. The test blocks were placed on top of the head of the pulling panel with the exserted part of the screw extending downward in the well. The screw extraction tool was properly locked into the pulling head and the grip taken up about the exserted part of the screw. All extractions were made with a constant machine speed of 0.05 inch per minute.

From a number of pieces selected entirely at random it was ascertained that the moisture content of these materials had not changed appreciably since they were first examined at the time the data on hardness were being accumulated. Accordingly, it was not considered necessary to repeat this procedure.

A few general observations made during the progress of this study are:

1. Ring-porous woods exhibited greater variation between side and end extractions than did those of the diffuse-porous type. Furthermore, screws were invariably more easily withdrawn from the radial faces than from the tangential.

2. There appears to be closer correlation between hardness and screw-holding power than between specific gravity and screw-holding capacity. This is probably attributable, at least in part, to the greater tenacity of interlocked grain, a characteristic of many cabinet woods.

3. Woods of high density exhibited no more variation in screw-holding power between faces than that observed for any single face.

Species	No. 6 Screws (*Values in pounds*)						No. 10 Screws (*Values in pounds*)					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
Aboudikro (Iv. Coast) *E. cylindricum?*	682	740	606	546	662	444	748	806	688	590	714	496
Alder, Red *Alnus rubra*	456	494	410	366	440	314	496	542	444	410	466	384
Allacede (Phil. Is.) *W. celebicum*	630	704	552	510	588	464	784	862	696	480	568	404
Almon (Phil. Is.) *Shorea eximia*	432	492	386	356	408	310	514	610	432	404	522	344
Amaranth (Trop. Am.) *P. paniculata*	872	960	786	796	906	718	984	1122	918	866	994	778
Amarello (Brazil) *Pl. reticulata*	744	862	638	682	804	556	888	1028	736	828	964	710
Andiroba (Trop. Am.) *Car. guianensis*	628	732	546	424	478	366	748	830	636	474	556	396
Aracá (Brazil) *T. januarensis?*	590	682	478	440	506	390	688	808	570	512	592	448

Ash, Japanese *Fraxinus* sp.	656	766	532	388	436	306	788	872	644	410	486	338
Ash, Silver (Austr.) *Fl. Scbottiana*	440	512	396	292	386	236	540	590	506	372	436	294
Ash, White (2nd gr.) *F. americana*	712	844	666	365	448	326	874	1012	768	416	530	356
Aspen (Maryland, pl.) *Populus canescens*	334	392	296	222	276	178	396	464	308	292	346	226
Avodiré (W. Afr.) *Turr. africana*	488	556	424	416	476	350	560	636	496	504	574	428
Ayous (W. Afr.) *Tr. scleroxylon*	332	426	256	234	344	178	390	482	296	340	426	248
Beech, American *F. grandifolia*	652	788	534	484	578	396	784	946	644	510	634	456
Birch, Black *Betula nigra*	688	764	612	560	688	494	782	908	702	614	682	556
Birch, Yellow *Betula lutea*	656	694	608	436	558	364	720	844	636	562	622	504
Blackbean, Austr. *Cast. australe*	720	806	656	582	638	504	886	1008	804	666	782	554
Blackwood, Austr. *Ac. melanoxylon*	704	782	656	564	660	484	852	1026	786	644	790	514

Species	No. 6 Screws (*Values in pounds*)						No. 10 Screws (*Values in pounds*)					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
Bossé (W. Afr.) *Guarea cedrata*	530	600	486	392	438	336	640	776	528	466	572	368
Boxwood, Indian *B. sempervirens*	920	1072	766	788	894	612	1056	1228	988	878	1018	764
Bubinga (W. Afr.) *C. Tessmannii*	884	1006	742	662	820	522	984	1116	844	774	932	640
Butternut *Juglans cinerea*	336	412	276	266	344	188	388	454	326	312	390	252
Capomo (Trop. Am.) *Br. Alicastrum*	884	1016	752	712	858	592	1010	1176	870	782	908	704
Cherry, African *Mim. Heckelii*	652	730	544	514	608	440	804	866	762	664	726	610
Cherry, Black *Prunus serotina*	580	665	514	436	540	366	766	816	704	516	592	456
Cocobolo (Cent. Am.) *Dalbergia retusa*	972	1102	866	762	898	660	1112	1278	904	906	1064	744

Ebony, Macassar *Dios. macassar*	1014	1266	878	926	1164	868	1168	1336	968	980	1110	808
Fir, Douglas (old) *Ps. taxifolia*	446	512	384	362	446	306	514	586	468	396	484	320
Framerie (W. Afr.) *Term. ivorensis*	356	392	302	268	312	208	446	518	382	376	458	322
Gaboon (W. Afr.) *Auc. Klaineana*	626	704	538	464	532	408	762	844	658	516	662	452
Garapa (Brazil) *Apuleia praecox*	572	644	516	406	486	378	712	818	688	482	544	414
Gonçalo Alves (Braz.) *A. fraxinifolium*	974	1116	856	792	876	722	1128	1304	1036	818	994	756
Greenheart (Br. G.) *Ocotea Rodiaei*	866	988	754	662	734	616	1010	1166	962	686	774	566
Guapinol (Trop. Am.) *Hymenaea courbaril*	858	942	736	644	724	540	942	1138	846	668	754	576
Gum, Red *L. styraciflua*	266	312	218	218	284	168	344	382	276	268	322	224
Hackberry *C. occidentalis*	426	584	378	248	314	196	504	636	462	292	358	246
Harewood, English *A. pseudoplatanus*	544	592	486	388	466	360	678	766	604	444	512	402

Species	No. 6 Screws (*Values in pounds*)						No. 10 Screws (*Values in pounds*)					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
Holly, American *Ilex opaca*	540	672	458	486	612	404	596	684	518	536	588	468
Iroko (W. Afr.) *Chl. excelsa*	550	612	524	412	482	366	612	676	556	448	514	394
Koa (Hawaii) *Acacia koa*	662	746	594	514	686	454	776	858	654	540	592	484
Koko (And. Is.) *Alb. Lebbeck*	590	678	466	422	486	376	686	812	618	474	566	384
Lacewood (Austr.) *Card. sublimis*	422	460	374	316	354	288	492	544	452	388	466	312
Lauaan, Red (P. I.) *Sh. negrosensis*	568	686	448	472	530	412	682	776	602	512	654	468
Laurel, California *U. californica*	570	612	522	446	518	378	646	722	584	504	646	438
Laurel, E. Indian *Term. tomentosa*	814	906	782	736	842	658	1012	1136	976	876	954	808

Limba (W. Afr.) *Term. superba*	644	686	604	472	558	402	762	812	728	544	636	478
Macacaúba (S. Am.) *P. polystachyum*	728	844	616	612	734	514	886	1048	794	762	906	652
Mahogany, African *Khaya ivorensis*	568	630	484	484	552	418	666	736	590	538	616	464
Mahogany (Colombia) *Sw. macrophylla*	540	626	474	424	516	346	624	710	564	514	588	442
Mahogany (Cuba) *Sw. mahagoni*	676	702	638	456	534	382	788	842	668	578	676	494
Mahogany (St. Jago) *Sw. mahagoni*	778	856	688	614	676	572	884	972	812	746	822	678
Mahogany (Peru) *Sw. macrophylla*	506	540	458	394	448	358	594	614	542	484	578	378
Mahogany (San Dom.) *Sw. mahagoni*	582	644	482	464	548	410	684	776	562	526	640	514
Mansonia (W. Afr.) *Man. altissima*	662	712	586	544	598	424	786	878	668	632	710	568
Maple, Australian *Fl. Brayleyana*	674	790	568	588	676	472	788	918	684	606	718	526
Maple, Bird's-eye *Acer saccharum*	744	836	678	616	676	572	870	998	792	644	726	584

Species	No. 6 Screws (*Values in pounds*)						No. 10 Screws (*Values in pounds*)					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
Maple, Curly *Acer saccharum*	712	788	664	590	664	542	824	974	762	628	704	566
Maple, Hard (str. gr.) *Acer saccharum*	756	850	664	638	684	594	884	1028	822	668	742	594
Movingui (W. Afr.) *D. Benthamianus*	772	852	684	626	710	566	890	1076	774	802	912	746
Oak, Red (2nd gr.) *Quercus* spp.	600	684	510	316	360	282	720	888	636	378	434	318
Oak, White (2nd gr.) *Quercus* spp.	630	688	558	344	386	306	765	910	662	384	468	336
Oak, Eng. brown (old) *Quercus robur*	314	372	258	166	212	128	386	442	324	194	236	156
Orientalwood (Austr.) *E. Palmerstoni*	706	794	656	572	632	522	842	966	762	654	804	562
Padouk, African *Pt. Soyauxii*	804	914	738	736	804	678	982	1104	936	864	936	812

Padouk, Andaman *Pt. dalbergioides*	832	966	718	754	832	642	1006	1122	954	892	1002	816
Paldao (Phil. Is.) *Dracontomelum dao*	696	818	606	536	624	482	806	918	746	624	744	522
Palosapis (Phil. Is.) *Anisoptera thurifera*	530	556	482	476	520	426	648	686	612	508	562	458
Pearwood (Europe) *Pyrus communis*	688	770	606	534	680	484	816	946	734	644	786	522
Pecan (U.S.A.) *Carya pecan*	746	838	662	528	642	472	814	976	734	628	802	554
Peroba, White (Braz.) *Paratecoma peroba*	578	624	548	486	548	438	712	846	658	536	618	478
Poplar, Yellow *L. tulipifera*	466	532	408	392	466	324	546	588	480	432	520	368
Primavera (Cent. Am.) *C. Donnell-Smithii*	490	576	418	412	486	344	568	648	508	456	578	388
Redcedar, Eastern *J. virginiana*	484	564	432	418	464	324	534	628	504	452	518	394
Rosewood, Brazilian *Dalbergia nigra*	794	916	706	616	712	534	918	1052	844	732	892	584
Rosewood, E. Indian *Dalbergia latifolia*	826	896	764	688	756	618	1018	1248	946	814	944	762

Species	No. 6 Screws (*Values in pounds*)						No. 10 Screws (*Values in pounds*)					
	Side			End			Side			End		
	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
Rosewood, Fr. (Mad.) *Dalbergia Greveana*	904	1036	880	794	882	724	1112	1304	956	866	1048	768
Sapele (W. Afr.) *Ent. cylindricum*	516	568	462	456	510	416	580	712	504	508	580	444
Satinwood, Ceylon *Chlor. Swietenia*	782	854	706	664	712	610	916	1088	780	744	860	648
Satinwood, West Ind. *Zanthoxylum flavum*	714	784	644	568	630	508	844	1018	684	686	772	548
Satiny, Red (Austr.) *Syncarpia Hillii*	566	678	474	472	566	408	690	814	556	518	604	476
Sycamore *P. occidentalis*	418	464	372	306	360	258	508	592	426	388	476	318
Tabasara (Trop. Am.) *Prioria Copaifera*	494	558	434	376	444	294	576	648	508	462	538	420
Taku (Trop. Am.) *D. guianensis?*	788	918	684	642	776	540	930	1068	796	744	886	574

Tangile (Phil. Is.) *Shorea polysperma*	566	644	504	464	532	376	684	748	618	512	592	428
Teak (Java) *Tectona grandis*	420	512	316	222	318	162	480	528	428	286	344	204
Tigerwood (W. Afr.) *Lovoa Klaineana*	606	684	540	476	566	412	716	828	634	512	588	436
Tulipwood, So. Am. *D. variabilis?*	944	1062	874	734	978	654	1144	1344	974	886	1160	772
Walnut, Black *Juglans nigra*	640	716	582	564	608	414	766	842	688	628	764	584
Walnut, Circassian *Juglans regia*	588	654	576	406	482	338	716	862	684	588	624	516
Yuba (Calif., pl.) *Euc. globulus*	564	618	534	438	510	382	654	712	588	518	582	422
Zebrawood (W. Afr.) *Macrolobium* sp.	732	826	678	604	724	536	882	978	814	766	868	634

Relative Screw-holding Power of Cabinet Woods

(Based upon averages for No. 6 screws)

Low
(250–500 pounds)
Alder, Red
Almon
Ash, Silver
Aspen
Avodire
Ayous
Butternut
Fir, Douglas
Framerie
Gum, Red
Hackberry
Lacewood
Oak, Eng. brown
Poplar, Yellow
Primavera
Redcedar
Sycamore
Tabasara
Teak

Intermediate
(501–750 pounds)
Aboudikro
Allacede
Amarello
Andiroba
Araçá
Ash, Japanese
Ash, White
Beech, Am.
Birch, Black
Birch, Yellow
Blackbean
Blackwood
Bossé
Cherry, Afr.
Cherry, Black
Gaboon
Garapa
Harewood
Holly
Iroko
Koa
Koko
Lauaan, Red
Laurel, Calif.
Limba
Macacaúba
Mahogany, Afr.
Mahogany, Col.
Mahogany, Cuba
Mahogany, Peru
Mahogany, San D.
Mansonia
Maple, Austr.
Maple, Bird's-eye
Maple, Curly
Oak, Red
Oak, White
Orientalwood
Paldao
Palosapis
Pearwood
Pecan
Peroba, White
Sapele
Satinwood, W. Ind.
Satiny
Tangile
Tigerwood
Walnut, Black
Walnut, Circa.
Yuba
Zebrawood

High
(Over 750 pounds)
Amaranth
Boxwood
Bubinga
Capomo
Cocobolo
Ebony, Macassar
Gonçalo Alves
Greenheart
Guapinol
Laurel, E. Ind.
Mahogany, St. Jago
Maple (Str. gr.)
Movingui
Padouk, Afr.
Padouk, And.
Rosewood, Braz.
Rosewood, E. Ind.
Rosewood, French
Satinwood, Ceylon
Taku
Tulipwood, S. Am.

Additional Hardness Tests on Cabinet Woods

Since the appearance of the initial paper of this series, there have been requests for data on still other species. These are listed below together with data on specific gravity and hardness at moisture contents indicated. Their screw-holding power appears in the tables at appropriate places.

Species	Moisture content (*Per cent*)	Specific gravity (*Oven-dry wt. and vol.*)	Av. and Comp. Hardness	
			Average (*Pounds*)	Compared to Black Walnut (*Per cent*)
Macacaúba (Brazil) *Platymiscium polystachyum.*	6.4	0.74	1380	109
Mahogany, African *Khaya ivorensis*.....	5.3	0.56	1215	97
Pecan (U. S. A.) *Carya pecan*.....	6.6	0.67	1330	106
Teak (Java) *Tectona grandis*.....	4.7	0.54	1305	105

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2. Fairchild, I. J. Holding power of wood screws. *Technologic Papers of the Bureau of Standards* (U. S. Dept. Commerce), No. 319; 1926.
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UTILIZATION OF LATIN AMERICAN FORESTS

By Samuel J. Record

Most of Latin America lies within the tropics, but owing to differences in topography and climate there are all conditions from treeless wastes to dense rain forests. After deductions are made for deserts, open savannas, and cultivated fields, there remain enormous areas of potentially commercial forest. Taken as a whole, these forested regions are still in primeval condition, the great bulk of their timber unknown to the trade and apparently unwanted. Why?

There are really two separate problems, one concerned with local utilization, the other with the development of export trade. It is only in the larger centers of population that there is much demand for lumber, and at least a part of this is always supplied locally. In the vicinity of old towns and villages the forests are in poor condition as a result of overcutting. Supplies must come from constantly retreating sources with a corresponding increase in cost. If transportation facilities are poor, as they usually are in undeveloped regions, the timber chosen must be light in weight in order that the logs can be floated out or so the rived or hand-sawed boards can be carried or dragged over rough trails. To ease of transport and working must be added natural durability if the lumber is to be used in the tropics where termites and decay are a menace.

Coastal cities obtain a large proportion of their lumber from overseas, even if there are great virgin forests in the hinterlands. This is a matter of convenience and often also of cost. Lumber from the coniferous regions of the United States and Canada is dry, well manufactured, easy to work, and in many ways better suited for use in a modern city than the unseasoned, poorly manufactured product of small local mills. Large companies operating in the tropics, but owned or controlled in the United States, prefer coniferous lumber because its sizes and condition are standardized and its strength and other properties are known. To use native timber for anything but crude temporary work is usually considered of more trouble than it is worth.

The normal timber exports from Latin America to the United States and Europe consist almost entirely of cabinet and fancy woods. Making up the greatest volume is Mahogany, which occurs in commercial amounts in the West Indies, southern Mexico, Central America, Colombia, Venezuela, and the upper Amazon regions of Peru, Bolivia, and Brazil. Closely related to Mahogany is the Spanish Cedar, a large tree of very wide distribution throughout most of Latin America. Probably no other timber has as many desirable properties to meet the native demand for lumber that is attractive in appearance, light and soft but comparatively strong, very readily worked, and noted for its natural resistance to decay and

insect attack. Large amounts were formerly used in the northern hemisphere for the making of cigar boxes, but that demand is mostly a thing of the past. Overseas the wood had one specialized market and never found another of any importance.

The demand for other Latin-American specialty woods is subject to fluctuation. Dyewoods gave way to coal-tar derivatives, but assumed temporary importance during the first World War. The trade in Lignum-vitae, the very dense wood whose chief use is for the self-lubricating bushings of propeller shafts, is still a barometer of the ship-building industry, although plastic linings of stern tubes are coming into use. The furniture woods are at the mercy of the prevailing fashions. In a few fields there is a constant search for new woods to take the place of others whose supply is low, such as Teak, French Briar, Boxwood, and Dogwood. The rare and fancy woods are not very numerous and comprise only a small fraction of the tropical vegetation. They have little to do with the big problems of utilizing the immense quantity of mixed hardwoods such as characterize the evergreen rain forests.

The term hardwood is here used in the technical sense, meaning broadleaf or dicotyledonous species. Some of the timbers are extremely heavy and hard, others correspondingly light and soft, with all intermediates. There is an equally wide range in color, texture, and technical properties. One is impressed with the variety of species in mixture, although the number is greatest in the undergrowth and understories. Pure stands are rare, but certain species and genera may predominate over fairly large areas.

A Mahogany stand is considered good if it contains an average of one merchantable tree per acre, but only a high-priced timber will repay the cost of such selective logging. The occurrence of any single kind of timber may be equally infrequent and the cost of extraction prohibitive. Mahogany and Spanish Cedar logs will float and can be left in the forest for months without serious deterioration. Many other timbers are too heavy to float and lighter kinds may be quickly attacked by beetles or are subject to sapstain and decay.

The big problem in utilization is how to reduce selectivity

in logging and remove, not one, but several to many kinds of timber at the same time. This is the dream of every owner and operator of a tropical forest property. Success or failure of a private enterprise will be determined by the law of supply and demand. Most tropical timber ventures have failed because the promoters were concerned primarily with the supply and took the demand for granted. This is a fatal mistake, since for the great bulk of the timber comprising the tropical forest there is no existing demand.

The reasons for this lack of demand for tropical lumber are not difficult to determine. Near the top of the list is the fact that tropical timbers are different from those growing in the north temperate zone. Being different is not the same as being inferior in technical properties, but it does imply unfamiliarity on the part of the consumer. All woods have their defects and peculiarities, but years of practical experience and long series of laboratory tests have demonstrated how most of the shortcomings of northern species can be overcome. Few private concerns are willing to take the trouble and incur the expense involved in trying out strange woods from overseas. Hence it is fallacious to assume because of a shortage of well-known timbers that unknown and untried kinds can be readily substituted for them. Trade practices and prejudices are involved and often prove too stubborn to be overcome except by a long process of education.

It must be kept in mind that the woods in question are of the general utility class and must compete in trade where the margin of profit is small. Until a special field is found for a new wood it must remain in a low-priced group. Low prices and high selling costs over a long period are likely to bankrupt any private concern before it gets well established. A prospective customer may be impressed with the possibilities of a wood for his business, but hold back because of the uncertainty of getting a continuous supply. When he realizes that the producer may fail, or lose his concession, or lack shipping facilities during times of war, he is likely to conclude that the new business is too risky. Why try to build up a trade without reasonable assurance that it can be maintained?

Such are some of the many problems involved in the utilization of Latin American forests. How can the situation be remedied? France, before the present war, afforded a good example of the proper procedure. Through coöperating organizations, every step from the forest to the factory was guided or controlled. Government laboratories made pilot tests on each wood to indicate its sphere of usefulness, after which it was given practical trial in industry. Every difficulty encountered was analyzed and, if possible, corrected. This might require the combined efforts of wood technologists, chemists, engineers, mechanics, and other technicians and experts, but the work was continued until the desired results were obtained. If the logs arrived in poor condition the trouble was traced to its source and the necessary steps taken to avoid it in future. Technical and popular articles were published to educate the trade with regard to manufacturing processes and to create a public demand for the use of woods from French colonies and mandated territories, and thus avoid imports from other countries.

No comparable organization exists with respect to Latin America. The Imperial Forestry Institute in England has made pilot tests on certain kinds of timber from the British Colonies in America, and similar tests on numerous Latin-American woods have been made in forestry schools and government laboratories in the United States. Considerable experimental work has also been done in some of the Latin-American countries, notably Brazil and Argentina. Greater progress has been made in identifying the different species comprising the forests and in correlating the data available concerning the woods. These are important contributions to scientific knowledge, but they fall far short of solving the great and complex problem of properly utilizing the Latin-American hardwood forests. The task is too big for individual or private enterprise, but calls for coöperative effort on a large scale and sustained long enough to accomplish its purpose. Science and engineering together can find a way to use the tropical forest as a whole and make it a perpetual source, not only of plywood and lumber, but also of unlimited quantities of cellulose, a basic material with a myriad actual and potential applications in industry.

AN EVALUATION OF THE TYPE MATERIAL OF *OCHROMA*, THE SOURCE OF BALSA WOOD

By JOHN H. PIERCE

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In a previous paper (*Tropical Woods* 69: 1) the author suggested that an evaluation of the type specimens of *Ochroma* might answer the question of how many valid species there are in this genus. Such workers as Standley and Macbride have suggested that there are probably fewer species than have been described. Record (*Tropical Woods* 59: 15) states that "some botanists claim to recognize 10 or more species but for all practical purposes there is only one." Commercial workers complain that they are unable to distinguish the described species, and after finding that one of Rowlee's types can easily be keyed into nine different species, I can understand why. The question of what constitutes a good species is far beyond the scope of this paper. Suffice it to say that segregation differences should not be based on ontogenetic variations or ecological adaptations. The differences should be relatively constant from one generation to another and throughout a population. Applying these criteria we find that the described species are segregated upon characters which are all either ontogenetic variations or ecological adaptations.

The following types have been examined and in the case of the last two, where no types are available, representative material was examined: *O. concolor* Rowlee, Cook & Doyle 82, US; *O. limonensis* Rowlee, Rowlee 1, NY; *O. grandiflora* Rowlee, Rose 22604, NY; *O. velutina* Rowlee, Tonduz 13498, US; *O. bicolor* Rowlee, Rowlee 10, NY; *O. boliviana* Rowlee, Bang 1501, NY; *O. obtusa* Rowlee, H. H. Smith 829, NY; *O. peruviana* Johnston, Kanehira 354, GH; *O. tomentosa* Willd. and *O. lagopus* Sw.

Calyx.—The shape of the calyx tube, used to separate *limonensis* from *grandiflora*, is an ontogenetic variation. In the bud the calyx tube tends to be cylindric and as the flower matures the expansion of the petals causes the calyx to expand and become funnel-shaped. Rowlee describes the lobes of a single calyx as dissimilar; the two outer lobes acuminate and not keeled, the three inner oblong and keeled. This calyx condition is evident throughout the type material, yet Rowlee separates species on minor differences in the shape of the lobes. In this connection he has also misused descriptive terms. His *boliviana* is described as having "elliptic" lobes, while actually all the lobes of the type are distinctly broadest below the middle and range from ovate-lanceolate to ovate-oblong. The texture of the calyx and the leaves varies with the amount of pubescence but is otherwise constant and similar in all of the type material. The calyx lobes of Bang 1501 are clearly thick, coriaceous, yet Rowlee describes them as "herbaceous-membranaceous"! There is nothing in the genus which could be interpreted as an "herbaceous-membranaceous" calyx. The carination of the calyx which Rowlee uses as a major separation character is a function of the type of imbrication of the calyx lobes and not a specific character. The outer lobes are not carinate while the inner lobes imbricate in such a way that the center of the lobe, which is not subjected to pressure from overlapping, develops a ridge or keel. In general it appears that Rowlee mistook normal developmental variation of the calyx for specific differences.

Leaf.—The pubescence of the genus is deciduous, which means that relative amount is not a specific character but a function of the age of the plant part. The young leaf and petiole are densely pubescent with both simple and branched hairs. This mat of pubescence is gradually shed until at maturity the leaf is essentially glabrous with perhaps scattered hairs persistent along the midrib below. The shedding is irregular so that in some material (Rowlee 300) the lower surface is glabrous except for scattered patches of dense, matted pubescence. The range of differences on a single plant of *Ochroma* is as great as the range of differences exhibited by the Rowlee types. This, with the evidence presented above, suggests that Rowlee did not distinguish between normal variations and specific differences. The number of *Ochroma* species which he named but did not describe and publish would indicate that he perhaps planned to continue with more comprehensive studies but never got around to it.

There are three additional species described by other au-

thors. *Ochroma peruviana* Johnston was carefully studied by Macbride (*Tropical Woods* 17: 5) who could not distinguish it from *O. boliviana* Rowlee, and upon broader comparison I should say that there is nothing to separate it from the other types of the genus. *O. tomentosa* Willd. was originally separated on the basis of its repand leaves. In 1809, this character was sufficient to separate it from the very meagre amount of material available for comparison; however, since that time material from the entire range has been collected which shows that dentation is present in varying degrees in all the material and that single trees vary from entire-leaved to repand. Consequently this character does not now segregate *tomentosa* and since there are no other significant differences it becomes a synonym. *O. lagopus* Sw. does not differ in any essential respect from the rest of the material, although Rowlee separates it as being smaller.

It has been observed by some field workers that there are apparent differences in facies, tree size, and wood density between trees of different populations. If such differences could be correlated with morphological differences in flower, fruit, or leaf, there would be good basis for specific segregation. However, what information is available shows that such differences are rather to be correlated with differences in habitat and growing conditions. Record has pointed out (*Tropical Woods* 59: 15) that the rate of growth may markedly affect the structure, properties, and uses of the wood. Under ideal growing conditions the wood weighs 6 to 8 pounds per cu. ft., but in slow-growing trees up to 25 pounds per cu. ft. In all probability the differences in facies, such as size, branching habit, etc., are attributable to the same environmental factors that cause the variation in wood density. Ecological and physiological variation in this genus can only be defined by comprehensive field studies or controlled experimentation and until adequate data are available we have no basis for the use of such variations as specific characters.

Thus, since an examination of the type material shows that all the characters upon which the described species of *Ochroma* have been segregated are either ontogenetic variations or ecological reactions, and since there are no other significant

and constant morphological differences evident in the type material, it is here proposed that the described species should be reduced to synonymy under the oldest valid name *O. lagopus Sw.* (see *Tropical Woods* 69: 1).

OCHROMA LAGOPUS Sw. Prod. Veg. Ind. Occ. 98. 1788.

O. tomentosa Willd. Enum. Hort. Berol. 695. 1809.
O. concolor Rowlee Jour. Wash. Acad. Sci. 9: 161. 1919.
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O. bicolor Rowlee Jour. Wash. Acad. Sci. 9: 165. 1919.
O. boliviana Rowlee Jour. Wash. Acad. Sci. 9: 166. 1919.
O. obtusa Rowlee Jour. Wash. Acad. Sci. 9: 166. 1919.
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AMERICAN WOODS OF THE FAMILY THEACEAE

By SAMUEL J. RECORD

The Theaceae, also known as the Ternstroemiaceae and Camelliaceae, are shrubs and small to large trees of wide distribution in the tropics, particularly in the Malayan Archipelago and Latin America, and to a limited extent in China, Japan, and the United States. The leaves are typically alternate, simple, entire or serrate, evergreen in the tropical species and clustered at the ends of the branches; stipules are absent; the white or pinkish flowers are mostly solitary or in axillary clusters and frequently are showy and highly scented, thus making the plants desirable for cultivation in gardens; the fruit is either capsular and dehiscent or leathery or woody and indehiscent; in some genera the seeds are winged, in some others they are shaped like a horseshoe. The outstanding member of the family is the Tea plant (*Camellia sinensis* L. or *Thea sinensis* [L.] O. Ktze.). Several of the Asiatic trees supply useful timber for local uses and *Laplacea Brenesii* Standl. is a source of structural lumber in Costa Rica.

According to the classification of Melchior (*Pflanzenfamilien*, 2nd ed., 21: 109–154), the family is divisible into five tribes containing a total of 23 genera and about 380

species. In the New World there are representatives of 10 of these genera, of which three (*Franklinia*, *Gordonia*, and *Stewartia*) are limited to the southeastern United States. The tropical American species are of the following genera: *Archytaea*, *Bonnetia*, *Eurya*, *Laplacea*, *Patascoya*, *Pelliciera*, and *Ternstroemia*.

The present study is primarily concerned with the American woods, but for purposes of comparison and classification a survey has been made of the Old World material of the family in the Yale collections. The woods of *Hartia*, *Patascoya*, *Piquetia*, *Stereocarpus*, *Tutcheria*, and *Visnea* have not been seen; all are monotypic genera except *Tutcheria*, which has two species. On the basis of the wood anatomy, *Asteropeia*, *Pelliciera*, and *Tetramerista* should be excluded from the Theaceae. Thus reduced, the woods are homogeneous enough, although readily separable into three groups, the Bonnetieae (3 genera), the Ternstroemieae (2 genera), and the others; of these, the Bonnetieae are most distinct because of the simple perforations in their vessels. The following description applies particularly to the American genera and includes all of them but *Patascoya* (not available) and *Pelliciera* (described separately).

Heartwood light to dark brown or red, fairly uniform to more or less variegated, but typically dull and unattractive; usually merging gradually into the brownish or pinkish sapwood. Without distinctive odor or taste. Density variable, some specimens hard and heavy, others (even in the same genus) of comparatively low density, but firm and tough; consistency about that of Red Gum (*Liquidambar*); texture uniform, fine to medium; grain variable, sometimes very irregular; working properties good, though some specimens show a tendency to warp badly in drying; durability low to fairly good. Commercial possibilities absent or poor.

Growth rings present or absent; often poorly defined. Pores very small to medium-sized, not distinct without lens; typically numerous, sometimes crowded, but rarely in contact radially; distribution uniform and without pattern, though the pores may be somewhat larger in the early wood of trees growing in temperate regions. Vessels with simple perforations only in *Archytaea* and *Bonnetia;* otherwise with scalariform perforation plates having 15 to 100 bars (bordered only at the ends, if at all) crowded together or rather

widely spaced, sometimes anastomosing; spiral thickenings absent except in some of the overlapping tips of the members in *Franklinia*, *Gordonia*, and *Stewartia;* tyloses sometimes present. Rays all uniseriate or locally biseriate and less than 30 cells high in *Franklinia* and *Gordonia;* 2-sized in the others, the larger usually 2 or 3, occasionally 4, cells wide and less than 50 cells high, except in *Ternstroemia*, where they are frequently 4 to 6, sometimes to 8, cells wide and up to 100, rarely to 200, cells high; heterogeneous, often with most of the cells square or upright; crystals sometimes present; cells often very thick-walled in part and abundantly pitted; pits to vessels small to very large and irregular, frequently elongated and in scalariform arrangement. Wood parenchyma sparse to fairly abundant, not visible without lens; mostly diffuse to finely reticulate; crystals occasionally present. Wood fibers with thick to very thick walls and minute to moderately large lumina; pits numerous in both radial and tangential walls, the apertures lenticular or slit-like, the borders large and circular. Ripple marks absent. No gum ducts seen.

Archytaea, with two species of little trees or shrubs, occurs along river banks in northern Brazil and the Guiana and Venezuelan hinterlands. The leathery leaves are clustered near the ends of the branches; the reddish flowers are borne in axillary clusters; the fruit is a 5-celled septicidally dehiscent capsule. The following description is based on a small specimen of *A. multiflora* Benth. (Yale 40408; Pinkus 48) collected at an altitude of 4200 feet in the Mt. Roraima district of Venezuela.

Color (of sapwood) pale brown. Luster medium. Odorless and tasteless. Hard, heavy, and strong; texture fine and uniform; grain straight; durability unknown. Of no commercial possibilities.

Growth rings absent. Pores small, rounded; solitary; numerous but not crowded; well distributed. Vessels with simple perforations. Rays uniseriate and biseriate and not over 30 cells high (probably larger in old stems); decidedly heterogeneous, with many of the cells square or upright; pits to vessels large, mostly long-oval with tendency to scalariform arrangement. Wood parenchyma sparingly paratracheal. Wood fibers with thick walls and a very small lumen; pits exceedingly numerous, the borders large and circular, the apertures narrow-lenticular.

COMMON NAME: Hitchiaballi (Br. G.).

Bonnetia, with nine species of shrubs and small trees, occurs along the seacoast and river banks in South America, particularly eastern Brazil and the Amazon basin. The leathery leaves are entire and finely feather-veined; the scented, roseate flowers are borne singly or in short racemes in the leaf

axils; the fruit is a 3-celled, septicidally dehiscent capsule; the seeds are slender and winged.

Heartwood red; sapwood pinkish, sometimes with sulphur-yellow coloration. Luster low. Odorless and tasteless. Mostly hard, heavy, and strong; texture fine and uniform; grain fairly straight; not difficult to work, finishing smoothly; appears durable. Presumably without commercial possibilities.

Growth rings poorly defined. Pores rounded; largest ones medium-sized (115 to 145μ, sometimes to 195μ); numerous; solitary; irregularly distributed, without pattern. Vessels with simple perforations; tyloses abundant. Rays 1 to 3, occasionally 4 or 5, cells wide and few to 30 cells high; decidedly heterogeneous; all cells abundantly pitted; cells of multiseriate parts mostly squarish, the others often very tall; pits to vessels simple, generally very large and irregular. Wood parenchyma sparingly developed; mostly in short rows touching only inner face of pore or occasionally diffuse; pitting very coarse. Wood fibers with very thick walls and small lumen composing entire ground mass or in association with irregular bands or patches of fibers with larger cavities; pits large, exceedingly numerous, conspicuously bordered, the apertures lenticular to slit-like. Dark gum deposits abundant in all parenchyma cells, including the tyloses. The structure is characteristic of the section Bonnetieae (*Archytaea*, *Bonnetia*, and *Ploiarium*).

COMMON NAMES: Cascarilla, c. legitimo (Peru).

Eurya, with about 80 species of shrubs and trees, is widely distributed throughout the Asiatic and American tropics. Four subgenera are recognized and some botanists have given them generic rank. (See *Journ. Arnold Arboretum* 22: 395–416, 457–496; July, October 1941). The two with American species are *Cleyera* and *Freziera*.

Of the first, the only one represented in the Yale collections, is *E. theoides* (Sw.) Blume, a tree occurring in the West Indies, southern Mexico, and Central America. Its leaves are thick, crenulate, and persistent; the flowers are small and yellowish; the fruit is small, green, and indehiscent; the seeds are horseshoe shaped. Regarding a specimen (Yale 38382) from Palmira, Province of Alajuela, Costa Rica, the collector, Austin Smith, says the species is a characteristic and beautiful tree of that locality (elevation 7000 feet), growing in half shade on clay loam and sometimes attaining a height of 50 feet with an indented trunk two feet in diameter at the base, the bark grayish and corrugated. The wood is hard, heavy, brittle, and

fine-textured, the heartwood dull brown, more or less streaked. The grain is irregular and the working properties are not very good.

In the *Freziera* group the available material represents six species of trees with a combined range in uplands from Cuba and Costa Rica to Ecuador and Bolivia. Some of them are said to be 90 feet tall and nearly three feet in basal diameter. The leaves are finely serrate, sometimes silky pubescent on the under surface; the flowers are small and borne in axillary clusters; the small dry fruits are indehiscent; the seeds are reniform. The woods are dull brownish or reddish brown throughout (in dry specimens), and ranging in density from hard and heavy to moderately so, having about the consistency of Red Gum (*Liquidambar*). The timber is of the general utility class but apparently is not utilized. Some of the foreign species are said to be employed in general construction, furniture, and shipbuilding.

Growth rings absent or poorly defined. Pores small (up to 100μ); numerous, but not crowded; virtually all solitary, well distributed. Vessels with long perforation plates having many closely spaced bars. Rays sometimes only 1 or 2, in some specimens 3 or 4, cells wide and up to 50 cells high; decidedly heterogeneous, with many square and upright cells; pits to vessels showing distinct vascular borders, oval to elongated in mixture, usually opposite, with local tendencies to scalariform arrangement. Wood parenchyma mostly diffuse, not distinct with lens. Wood fibers with thick walls and a fairly large lumen; pits numerous, large, and conspicuous, the borders circular, the apertures lenticular. The structure throughout is similar to that of *Adinandra*.

COMMON NAMES: Wild damson (Jam.); teta prieta (P.R.); capulincillo (Mex.); barratillo, durazno del monte (Guat.); coral, tito (C.R.); sajinillito, sajinillo (Pan.); avispo, cerezo del monte, motilón (Col.); huiscaparun (Ec.).

Franklinia, with a single species, *F. alatamaha* Bartr. (= *Gordonia alatamaha* Sarg. = *G. pubescens* L'Herit.), is a small tree discovered on October 1, 1765, along the Altamaha River near Fort Barrington, McIntosh County, Georgia, by John Bartram and his son William, both noted American botanists. In 1777, William Bartram found the plant growing abundantly in the same locality and collected living specimens and seeds for introduction into the Bartram garden at Philadelphia. The species has not been found in a wild state since

axils; the fruit is a 3-celled, septicidally dehiscent capsule; the seeds are slender and winged.

Heartwood red; sapwood pinkish, sometimes with sulphur-yellow coloration. Luster low. Odorless and tasteless. Mostly hard, heavy, and strong; texture fine and uniform; grain fairly straight; not difficult to work, finishing smoothly; appears durable. Presumably without commercial possibilities.

Growth rings poorly defined. Pores rounded; largest ones medium-sized (115 to 145μ, sometimes to 195μ); numerous; solitary; irregularly distributed, without pattern. Vessels with simple perforations; tyloses abundant. Rays 1 to 3, occasionally 4 or 5, cells wide and few to 30 cells high; decidedly heterogeneous; all cells abundantly pitted; cells of multiseriate parts mostly squarish, the others often very tall; pits to vessels simple, generally very large and irregular. Wood parenchyma sparingly developed; mostly in short rows touching only inner face of pore or occasionally diffuse; pitting very coarse. Wood fibers with very thick walls and small lumen composing entire ground mass or in association with irregular bands or patches of fibers with larger cavities; pits large, exceedingly numerous, conspicuously bordered, the apertures lenticular to slit-like. Dark gum deposits abundant in all parenchyma cells, including the tyloses. The structure is characteristic of the section Bonneticae (*Archytaea*, *Bonnetia*, and *Ploiarium*).

COMMON NAMES: Cascarilla, c. legitimo (Peru).

Eurya, with about 80 species of shrubs and trees, is widely distributed throughout the Asiatic and American tropics. Four subgenera are recognized and some botanists have given them generic rank. (See *Journ. Arnold Arboretum* 22: 395–416, 457–496; July, October 1941). The two with American species are *Cleyera* and *Freziera*.

Of the first, the only one represented in the Yale collections, is *E. theoides* (Sw.) Blume, a tree occurring in the West Indies, southern Mexico, and Central America. Its leaves are thick, crenulate, and persistent; the flowers are small and yellowish; the fruit is small, green, and indehiscent; the seeds are horseshoe shaped. Regarding a specimen (Yale 38382) from Palmira, Province of Alajuela, Costa Rica, the collector, Austin Smith, says the species is a characteristic and beautiful tree of that locality (elevation 7000 feet), growing in half shade on clay loam and sometimes attaining a height of 50 feet with an indented trunk two feet in diameter at the base, the bark grayish and corrugated. The wood is hard, heavy, brittle, and

fine-textured, the heartwood dull brown, more or less streaked. The grain is irregular and the working properties are not very good.

In the *Freziera* group the available material represents six species of trees with a combined range in uplands from Cuba and Costa Rica to Ecuador and Bolivia. Some of them are said to be 90 feet tall and nearly three feet in basal diameter. The leaves are finely serrate, sometimes silky pubescent on the under surface; the flowers are small and borne in axillary clusters; the small dry fruits are indehiscent; the seeds are reniform. The woods are dull brownish or reddish brown throughout (in dry specimens), and ranging in density from hard and heavy to moderately so, having about the consistency of Red Gum (*Liquidambar*). The timber is of the general utility class but apparently is not utilized. Some of the foreign species are said to be employed in general construction, furniture, and shipbuilding.

Growth rings absent or poorly defined. Pores small (up to 100μ); numerous, but not crowded; virtually all solitary, well distributed. Vessels with long perforation plates having many closely spaced bars. Rays sometimes only 1 or 2, in some specimens 3 or 4, cells wide and up to 50 cells high; decidedly heterogeneous, with many square and upright cells; pits to vessels showing distinct vascular borders, oval to elongated in mixture, usually opposite, with local tendencies to scalariform arrangement. Wood parenchyma mostly diffuse, not distinct with lens. Wood fibers with thick walls and a fairly large lumen; pits numerous, large, and conspicuous, the borders circular, the apertures lenticular. The structure throughout is similar to that of *Adinandra*.

COMMON NAMES: Wild damson (Jam.); teta prieta (P.R.); capulincillo (Mex.); barratillo, durazno del monte (Guat.); coral, tito (C.R.); sajinillito, sajinillo (Pan.); avispo, cerezo del monte, motilón (Col.); huiscaparun (Ec.).

Franklinia, with a single species, *F. alatamaha* Bartr. (= *Gordonia alatamaha* Sarg. = *G. pubescens* L'Herit.), is a small tree discovered on October 1, 1765, along the Altamaha River near Fort Barrington, McIntosh County, Georgia, by John Bartram and his son William, both noted American botanists. In 1777, William Bartram found the plant growing abundantly in the same locality and collected living specimens and seeds for introduction into the Bartram garden at Philadelphia. The species has not been found in a wild state since

1790, despite many searches for it, and apparently it exists now only in cultivation. Its leaves are deciduous, turning scarlet in autumn; the large white flowers appear in September from the axils of the crowded upper leaves; the fruit is a globose woody capsule, the five valves splitting (loculicidally) downward for about half their length and separating (septicidally) upward from the base for an equal distance; the seeds are not winged. The following description of the wood is based on a specimen (Yale 37880) obtained from a tree growing in Arnold Arboretum.

Heartwood brownish; fairly distinct from the yellowish or whitish sapwood. Luster medium. Odorless and tasteless. Hard, moderately heavy, strong, suggesting White Birch; texture very fine and uniform; grain straight; easy to work, finishing very smoothly. Of no commercial possibilities.

Growth rings present. Pores very small (up to 50μ); very numerous and somewhat crowded, but infrequently in contact radially; well distributed, though fewer in narrow band in outer late wood. Vessels with scalariform perforation plates having 15 to 20 narrow bars; tips of vessel members with fine spiral thickenings; thin-walled tyloses present; intervascular pitting occasionally present, scalariform. Rays very numerous (20 per mm.); uniseriate and up to 25 cells high; weakly heterogeneous, with occasional marginal rows of large squarish cells; pits to vessels much elongated and in scalariform arrangement, mostly confined to the square cells. Wood parenchyma very sparse, the few cells paratracheal and diffuse. Wood fibers with very numerous pits, the borders fairly large and circular, the apertures lenticular.

Gordonia includes about 30 species of trees and shrubs, but they are all Asiatic except *G. Lasianthus* (L.) Ellis, which grows in swampy lands along the coast region of the United States from southern Virginia to Florida, thence westward to the Mississippi River, and inland to Augusta, Georgia. This species is an evergreen tree, sometimes up to 80 feet high and 20 inches in diameter, with thick, reddish brown, heavily furrowed bark; often much smaller and sometimes reduced to a shrub. The serrate leaves are 4 to 5 inches long, narrowed at the base, and finely serrate; the large, pungently fragrant flowers are borne singly on long pedicels; the fruit is a loculicidally dehiscent capsule splitting from above but not from the base; the squarish, dotted seeds are winged.

Heartwood pinkish, not sharply demarcated from the pale

brownish sapwood. Luster medium. Odorless and tasteless. Rather light in weight but firm and tough; texture fine and uniform; grain straight; working properties excellent; durability rather low. Has occasionally been used locally for making furniture but has no commercial importance.

Growth rings present. Pores small (up to 65μ), angular; very numerous; occasionally in contact radially; overlapping tips of vessels frequently with spiral thickenings; perforation plates usually long, with numerous, fine, closely spaced bars; intervascular pitting, when present, scalariform. Rays uniseriate or locally biseriate and up to 30, usually less than 20, cells high; heterogeneous, many of the cells squarish but rarely definitely upright; pits to vessels much elongated and in scalariform arrangement, confined to square cells. Wood parenchyma sparingly diffuse; crystals sometimes present. Wood fibers with thick walls and fairly large lumen; pits fairly numerous, the borders rather large and circular, the apertures slit-like and extended.

COMMON NAMES: Bay, black laurel, holly bay, swamp laurel, tan bay (U.S.A.).

Laplacea. Of the 30 species of this genus, eight occur in Malaysia, the others in tropical America. The American species are mostly small trees or shrubs, but several attain a maximum height of 100 feet and a basal diameter of 36 inches. The leaves are serrate or crenate in part, sometimes with silky pubescence beneath; the flowers, which are white or pinkish and rather showy, are solitary in the leaf axils; the fruit is a loculicidally dehiscent capsule with a persistent axis and winged seeds.

The Bloodwood or Ironwood of Jamaica, *Laplacea haematoxylon* (Sw.) G. Don (= *Haemocharis haematoxylon* [Sw.] Choisy), is a tree 25 to 40 feet high, said to have a handsome dark red, hard and heavy, fine-textured timber, durable under exposure and suitable for heavy construction and articles of turnery. The only specimen available (Yale 10893) agrees with the general description, but the anatomical features suggest *Ternstroemia* rather than *Laplacea* and are not included in the description below.

The most widely distributed species is *Laplacea semiserrata* (Mart. & Zucc.) Cambess., a medium-sized to large tree, occasionally 100 feet tall, growing in uplands throughout most of continental tropical America from Costa Rica to Peru and southern Brazil. It is known to be used for common lumber in

eastern Peru, but there is no information as to its employment elsewhere, though it is suitable for about the same purposes as Red Gum.

One of the best known local timbers on the market in the Cartago region of Costa Rica is known as Campano. According to a letter from C. L. Lankester, it is abundant in the locality and is in demand for scantlings for house and mill construction, but does not make good boards because it warps badly in seasoning. The wood is brown or brownish, with little contrast between heartwood and sapwood. The texture is uniform, but appreciably coarser than that of any of the authentic specimens of the genus in the Yale collections except one (Yale 34784; Williams 9170), which was collected by L. Williams in the Isthmus of Tehuantepec, Mexico. This was determined by R. E. Schultes (*Bot. Mus. Leaflets Harvard* 9: 9: 180, May 1, 1941) as *Laplacea semiserrata*. Believing this to be wrong, I wrote to Paul C. Standley, who replied on April 8, 1942, as follows: "*L. semiserrata*, as represented by ample specimens in Field Museum Herbarium, has *very* different leaves. It is mostly South American, but does extend into Panama and Costa Rica. The Williams material is, I think, the same as the common tree of Costa Rica that I named *Laplacea Brenesii* Standl. I once thought the Mexican collection was a new species, but later changed my mind, not being able to separate it satisfactorily from *L. Brenesii*."

Growth rings absent or poorly defined. Pores typically small (50 to 80μ), but medium-sized in *L. Brenesii;* numerous; solitary; evenly distributed. Vessels with rather long scalariform perforation plates having fine and typically rather widely spaced bars. Rays 1 or 2, infrequently 3, cells wide and up to 50 cells high; decidedly heterogeneous, with many square and upright cells; pits to vessels large, much elongated (often wider in central part and showing vascular border only at ends), and in scalariform arrangement. Wood parenchyma diffuse to reticulate. Wood fibers with thick walls and screw-head pitting.

COMMON NAMES: Bloodwood, ironwood (Jam.); almendro (Cuba); maricao, niño de cota (P.R.); nanche-ahuatosa (Mex.); campano, c. chile, ira colorada, llorón, yoro (C.R.); nispero macho de tierra fría, vara de león (Col.); florecillo, pedralejo (Venez.).

Patascoya *Stuebelii* (Hieron.) Urb. (= *Taonabo Stuebelii* Hieron.), the only species, is a small tree apparently limited in distribution to the mountains of northern Colombia. The twigs are woolly; the leaves are small, cordate at the base, stiff, and finely serrate; the flowers are solitary and subtended by bracts; the fruit is unknown. The wood has not been studied.

Pelliciera *rhizophorae* Planch. & Trian., the sole species of the genus, is an evergreen tree 15 to 25 feet high growing in Mangrove swamps along the Pacific coast from Costa Rica to Colombia. The thick, leathery, oblong-lanceolate leaves are clustered near the ends of the branches; the large, solitary, sessile, white or pink flowers are subtended by two colored bracts which are as long as the petals; the fruit is a ribbed and beaked woody nut. The following description is based on a small stem (Killip 5222) from Buenaventura, Colombia, and a prepared section from Harvard University.

Growth rings absent. Pores very small, thick-walled, rounded; arranged in radial rows of 2 to 8; not very numerous. Vessels with exclusively simple perforations; intervascular pitting very fine, the pits usually subcircular and alternate, but sometimes finely scalariform. Rays uniseriate; all cells tall, upright; slightly distended upright cells filled with long raphides common; pits to vessels very small and rounded to narrow-elongated and in scalariform arrangement. Wood parenchyma very sparingly paratracheal. Wood fibers small, thick-walled, and septate; pits minute, indistinctly bordered. Ripple marks absent. No gum ducts seen.

COMMON NAMES: Mangle piñuela (C.R.); palo de sal (Pan.).

Stewartia (or *Stuartia*) includes six species, four of them in China and Japan, two in southeastern United States. They are deciduous trees or shrubs with membranous, usually serrate leaves; the white or roseate flowers are axillary and showy; the fruit is a woody, loculicidally dehiscent, two-seeded capsule. The American species are *S. Malachodendron* L. (= *S. virginica* Cav.), growing in woods and along hillsides from Virginia to Alabama and Florida, and *S. pentagyna* (Dunn) L'Her. (= *Malachodendron pentagynum* [L'Her.] Small), occurring along mountain streams from Kentucky to Georgia. The following description is based upon one small specimen of each species from the herbarium of the New York Botanical Garden.

Growth rings present. Pores very small (30 to 50μ), thin-walled and angular; solitary; numerous and evenly distributed. Vessels with many-barred scalariform perforation plates; overlapping ends of members sometimes with spiral thickenings. Rays uniseriate and biseriate, sometimes triseriate, and up to 50 cells high; decidedly heterogeneous, with many of the cells square or upright; ray-vessel pitting scalariform. Wood parenchyma diffuse to somewhat reticulate. Wood fibers with thick walls and comparatively large lumen; pits very numerous, the borders round, the apertures narrow-lenticular.

Ternstroemia, with about 85 species of trees and shrubs, is well represented in tropical Asia, very sparingly in Africa, and abundantly (60 species) in tropical America. The leaves are leathery, entire or crenate, persistent, subverticillate, often clustered on short twigs; the flowers small, mostly white, solitary, and scented; the fruit is coriaceous, indehiscent, usually beaked and containing a few horse-shoe shaped seeds which often are covered with scarlet papillae. The trees are usually small or of medium-size, rarely 75 feet tall and 24 inches in diameter. The timber apparently is not utilized for any special purposes, although it appears suitable for furniture, as it has a fairly attractive silver grain on the radial surface. The following description is based on 16 specimens of eight species.

Heartwood in various shades of brown, merging gradually into the sapwood. Luster low. Without distinctive odor or taste. Of medium density, but hard and strong; texture medium, fairly uniform; grain variable; not difficult to work, finishing smoothly; durability doubtful.

Growth rings absent or poorly defined. Pores small (65 to 100μ); numerous; solitary; fairly evenly distributed. Vessels with rather long perforation plates having numerous, fine, closely spaced bars. Rays definitely 2-sized, the largest 4 to 8 cells wide and variable in height to 100, sometimes to over 200, cells; decidedly heterogeneous, many of the cells squarish or upright; pits to vessels small, rounded or oval (usually showing a distinct vascular border and narrow aperture), irregularly arranged. Wood parenchyma diffuse to finely reticulate, often distinct with lens. Wood fibers with thick walls, moderately large lumen, and numerous pits with circular borders and lenticular apertures. The structure throughout is similar to that of the tropical Asiatic genus *Anneslea*.

COMMON NAMES: Scarlet seed, wild mammee sapota (Jam.); mamey del cura, palo colorado (P.R.); botoncillo (Dom. R.); hierba del cura, limoncillo, tepezapote, tepezapotl, trompillo (Mex.); trompillo (Salv.); manglillo (Pan.); carne asada, uva de orso (Venez.); kaiarima, mamusaru omirir (Br. G.).

KEY TO THE WOODS OF THE AMERICAN GENERA

1 a. Perforations simple 2
b. Perforations multiple 3

2 a. Pores solitary. Wood fibers with large bordered pits *Archytaea* and *Bonnetia*.
b. Pores in radial rows. Wood fibers with minute pits; septate ... *Pelliciera*.

3 a. Tips of vessel members with spiral thickenings 4
b. Vessels without spiral thickenings 5

4 a. Rays uniseriate or only locally biseriate and less than 30 cells high; without definitely upright cells ..... *Franklinia* and *Gordonia*.
b. Rays uniseriate and biseriate, sometimes triseriate, and up to 50 cells high; many of the cells upright ..... *Stewartia*.

5 a. Vessel-ray pitting fine, not scalariform; larger rays 4 to 6 (8) cells wide and up to 100 (200) cells high ..... *Ternstroemia*.
b. Vessel-ray pitting coarser, opposite to scalariform; larger rays 2 or 3 (4) cells wide and not over 50 cells high 6

6 a. Vessel-ray pitting coarsely scalariform; borders absent or only at ends of pits. Perforation bars rather widely spaced ..... *Laplacea*.
b. Vessel-ray pitting opposite, with local tendency to scalariform; pit borders distinct, frequently entire. Perforation bars closely spaced. *Eurya*.

CURRENT LITERATURE

Inter-American Forestry. *Journal of Forestry* 40: 2: 160–172; February 1942.

Papers presented at a symposium on Latin American forests and forestry at one session of the 41st annual meeting of the Society of American foresters at Jacksonville, Florida, December 1941.

SUBJECTS

The significance of forestry in inter-American relations (pp. 161–165), by C. L. Forsling.
Factors in the utilization of Latin American timbers (pp. 165–168), by Samuel J. Record. (Abridged in this issue of *Tropical Woods*).
Tropical forest research (pp. 169–172), by Arthur Bevan.

The impact of the war on forest industries. A preliminary review. By EGON GLESINGER. *Journal of Forestry* (Washington, D. C.) 40: 1: 6–11; January 1942.

The author is the Secretary-General of the Comité International du Bois and is in a position to write authoritatively on the scope and fundamental character of what is taking place in European forestry and forest industries and to supply some practical illustrations of the problems at issue. The following paragraph (p. 10) is of particular interest to Latin America:

"If the forest resources of North and South America are to meet the increased requirements of Europe and other continents, additional sources of supply may have to be developed. These might be made available by a more systematic exploitation of virgin forests in the U.S.A. or Canada. Otherwise, this may be the moment to attack the systematic exploitation of the enormous forest resources of the Latin American countries. It can be conceived that financial arrangements for the development of these resources might appear more desirable than additional American deliveries to European nations on a credit basis. The pressing post-war demand for housing relief will provide a particularly appropriate occasion for the introduction of the unknown species and grades of South American timber, which, according to many experts, has constituted so far one of the major difficulties connected with the development of Latin-American forest industries. It is important, therefore, that the preliminary investigations of that problem should be completed as soon as possible, because the development of any new source of wood supply takes a rather long time and it is, of course, vital that the new supplies should be available at the very moment when they will be needed."

The Caribbean Forester. Pub. quarterly by the Tropical For. Exp. Sta., U.S. Forest Service, Río Piedras, Puerto Rico. Vol. III: 2: 47–90; January 1942.

CONTENTS

Notes on the American flora, chiefly Mexican. By CORNELIUS H. MULLER. *American Midland Naturalist* (Southbend, Ind.) 27: 2: 470–490; March 1942.

"Collections of plants made by the author in northern Mexico in 1939 and by Dr. Ivan M. Johnston with the author in 1940 contain several novelties and other noteworthy species, some of which are here treated. Various items from other sources which have from time to time come to the author's attention are also included. The bulk of the material here presented concerns the genus *Quercus*."

An item of particular interest to the reviewer is in connection with a sterile specimen collected in Nuevo León (Muller 2710) and determined by Paul C. Standley as *Meliosma alba* (Schlecht.) Walp. The species (p. 487) "is locally an important timber tree, but is rapidly being depleted. Specimens up to 50 feet in height and four feet in diameter were observed in several moist canyons in the vicinity of Potrero Redondo. Felled trees are sawed by hand into timbers about 8 by 10 inches and about 5 feet in length. As late as 1935 these were hauled a distance of 15 miles over narrow mountain trails on miniature four-wheeled carts drawn by oxen. In 1939 the timbers were being packed over the same trails on burros. The wood is used in Villa Santiago in the manufacture of furniture for which it is said to be highly prized. The tree is known locally as Ayón."

A study of the wood (Yale 37935; Muller 2710) reveals that it is distinct in aspect and structure from all others of the Sabiaceae so far as known. It has about the same consistency and appearance as Soft Maple (*Acer rubrum* L.); the vessel perforations are simple; the rays are homogeneous and not over three cells wide and 30 cells high; the ray-vessel pit-pairs are medium-sized and confined to the marginal cells; the wood parenchyma is terminal and in narrow bands which become

progressively more closely spaced near the periphery of the growth ring; the wood fibers are thin-walled and septate, and the numerous pits have slit-like apertures and very small borders. The only feature in common with other specimens of *Meliosma* examined concerns the wood fibers. Attempts to find a more appropriate family for this wood have not been successful and no other samples of *Meliosma alba* are available for comparison.

Marine bearings. By H. C. Irvin. *Modern Plastics* (New York) 19: 8: 33–34, 120; 2 figs.; April 1942.

"The use of laminated plastic for marine bearings, particularly in stern tubes, is not new. The advantages of these materials have been known for years to marine engineers and those responsible for ship maintenance. With American ship construction at low ebb, however, and shipping activity below normal over a period of years, the demand for plastic marine bearings was relatively small. Their progress, therefore, was relatively slow until the war emergency stirred new interest and activity.

"Lignum-vitae [*Guaiacum*] is, of course, the classic material for stern-tube bearings. It held its place in this field for generations, because it was hard enough to serve its purpose, because it functioned satisfactorily with water lubrication, and because no better material had been developed on a commercial scale. Laminated plastic stern-tube bearings came into use, though not widely, six or seven years ago. Within the last three years, they have gained rapidly in popularity, largely as a result of revived shipping activity and increased interest in better materials and methods."

Collecting chicle in the American tropics. By John S. Karling. *Torreya* 42: 2: 38–49; 8 half-tones; March–April 1942.

This, the first instalment of an interesting address before the Torrey Botanical Club, is principally concerned with "Chicleros and the present native method of tapping and preparing raw chicle." The introductory paragraphs are as follows:

"The principal source of chicle, the basic ingredient of

chewing gum, is the latex of *Achras zapota*, a species of the family Sapotaceae which occurs in abundance in southern Mexico and Central America. The Sapodilla or Chicle tree is generally regarded as indigenous to southern Mexico, Central America, northern South America, and the West Indies, but because of its delicious fruit it has been planted extensively and may now be found under cultivation in limited quantities as a fruit tree in most tropical and subtropical countries. It is principally in southern Mexico and Central America, however, that it grows in sufficient quantity, size, and height to make tapping for chicle profitable. Here the trees may occasionally attain a height of a hundred feet with straight smooth boles, sometimes as much as eight to twelve feet in circumference; and in these regions during the past half century has sprung up the extensive and unique industry of gathering crude chicle which has no parallel in any other part of the world.

"Although the natives in tropical America had been using small amounts of chicle for various purposes in pre-Columbian times (Melendez, 1920), it was not until the discovery of chicle as a suitable base for chewing gum that this product became economically important. This discovery more than half a century ago is said to have been the result of attempts to vulcanize the gum of the Sapodilla tree in the same manner and as a possible substitute for rubber. The similarity of chicle to spruce and cherry gums, the best chewing gums in use at that time, and its adaptability to chewing and compounding with adulterants, sugars, and flavors were soon recognized, and from these first modest experiments and an initial outlay of fifty-five dollars the extensive present-day chewing gum industry is said to have had its beginning. Hand in hand with the spread of the gum-chewing habit grew the demand for raw chicle, and within a few years a new enterprise sprang up in the jungles of southern Mexico and Central America. Rival American contractors began to push into the jungles to obtain large concessions of virgin forests and to offer unheard-of inducements to the natives for gathering chicle. Raw chicle thus soon became one of the principal exports of several Mexican and Central American states, and in 1930 the import of chicle into the United States had risen to nearly fourteen

million pounds (U.S. 1932). In its half century of growth the chewing gum industry has made phenomenal progress, and at the present time ranks among the big American industries. The manufactured output in 1930 was valued at more than seventy million dollars, representing a retail business of over a hundred million dollars."

Plant science in Latin America. *Chronica Botanica* (Waltham, Mass.) 6: 17–20: 395–410, 443–452; 7: 1–2: 15–27, 71–77; November 1941–March 1942.

CONTENTS

Arboles, arbustos y pastos forrajeros. By CIRO MOLINA GARCES. *Tierras y Aguas* (Bogotá, Colombia) 3: 17: 8–30; 18: 8–13; January, February 1940.

A descriptive account of several species of trees, mostly Leguminosae, with particular reference to the use of their leaves and fruits for forage and fodder for domestic animals.

Arboles del vivero de Bogotá. By JESÚS M. DUQUE J. *Tierras y Aguas* 3: 18: 26–36; February 1940.

Various species of trees, native and exotic, are considered with reference to their value for planting for forestry purposes in the uplands of Colombia. They are of the genera *Cedrela*, *Juglans*, *Casuarina*, *Acacia*, and *Cupressus*.

Meliaceas colombianas. By JESÚS M. DUQUE J. *Tierras y Aguas* 3: 21; 27–32; 22: 3–10; May, June 1940.

An account of the Colombian Meliaceae, namely, *Cedrela*, *Guarea*, and *Swietenia*, with reference to their botanical characters, properties and uses of their woods, and possibilities for commercial planting. As an appendix there is a note on Palisandro or Cocobolo, *Dalbergia retusa* Hemsl., which is said to grow along the coast of Chocó.

Una nueva Lecitidácea colombiana. By ARMANDO DUGAND. *Caldasia* (Bogotá) 3: 31–32; 1 fig.; Dec. 15, 1941.

The species described as new, *Grias foetidissima* Dugand, is a tree 20 to 25 feet high discovered in rain forest along the Río Orteguaza, Comisaría de Caquetá, Vencia, Colombia. The wood is noted for its exceptionally strong fetid odor.

Tratamiento forestal y caracteres xilológicos del maitén (*Maytenus Boaria*), arbol forrajero de la Patagonia. By LUCAS A. TORTORELLI. *Revista de la Facultad de Agronómia y Veterinaria* (Buenos Aires) 9: 2: 19–32; 3 plates; September 1941.

The Maitén, *Maytenus Boaria* Mol., is an evergreen celastraceous tree of central Chile and the subantarctic forests of Argentina. In the territories of the Río Negro and Chubut it

varies in height from 20 to 65 feet and often has a stout trunk, sometimes 36 inches in diameter, free of branches up to the level reached by browsing animals. Its principal value is as a source of forage and green fodder for livestock and for this reason trees are frequently left standing in cultivated fields. The species forms natural groves when given the opportunity and reproduces by sprouts and root suckers as well as from seed. The present methods of obtaining leafy branches are very destructive and the author suggests that the trees be pollarded during the winter, as in this way they can be kept productive. The wood is similar in appearance and properties to Birch (*Betula*) and is suitable for the same uses. The anatomy is described and illustrated.

El quillay. *La Chacra* (Buenos Aires) 12: 133: 40; November 1941.

The Quillay, *Quillaja saponaria* Mol., is an evergreen tree growing in the foothills of the Andes Mountains of Argentina and Chile, frequently forming small nearly pure stands because of its ability to reproduce by sprouts and root suckers as well as by seeds. Its leaves are persistent and attractive to browsing animals, especially in winter when other forage is scarce. The flowers are fragrant and provide excellent bee pasturage. The bark is rich in saponin and is much used locally in making soap for washing woollen and silk garments. An extract is also employed medicinally and for mixing with kerosene to make an insecticide spray. The present method of stripping the bark during the hot, dry season usually results in the death of the trees so that the accessible stands are being completely destroyed. It is suggested that the trees be felled between January and March, leaving stumps at least a meter high. The wood is used for fuel and charcoal.

Journal of the Arnold Arboretum (Jamaica Plain, Mass.) 23: 1; 1–131; January 1942.

CONTENTS (in part)

The exploitation of the indigenous forests of South Africa. By N. L. KING. *Journ. So. Afr. For. Association* (Pretoria) 6: 26–48; 1 map, 4 plates; April 1941.

"Our indigenous forests, exclusive of scrubs and savannah, occupy an area of less than 0.2 per cent of the total extent of South Africa. The forests are confined to a belt along the south and east sides of the country. Although their area is insignificant in relation to that of the country, they have nevertheless played an important role in its development by yielding timber for housebuilding, for the manufacture of wagons and carts, and for the needs of the gold and diamond mines at a time when other sources of supply were not available. Speaking generally it may be said that exploitation has taken place at a rate far beyond that on which a sustained yield could be maintained, with the result that the accumulated increment of centuries of growth has been used up in a relatively short space of time and has left many forests in an exhausted condition.

"A sketch of the exploitation, as far as it is known to the writer, may not only be of interest but may also prove helpful at some future date to the coming generations of foresters. With these objects in view the following notes have been put together. The writer has made free use of official reports and is also indebted to those who have kindly furnished information which would otherwise not have been available. For the sake of clarity the forests in each Conservancy have been treated separately."

"Plantations established by the state in various parts of the country are now coming into bearing and are already yielding much more wood per annum than was ever derived from the forests. Seventeen privately owned and four state mills are now operating on softwoods derived from these plantations

and consume over six million cu. ft. a year. The quantity is steadily increasing and 25 to 30 years hence is expected to reach about 60 to 70 million cu. ft. per annum. In addition to softwoods, the plantations annually yield several million cubic feet of hardwoods. These hardwoods consist mainly of Eucalypts from which high class strip flooring and floor blocks can be manufactured. The erection of a hardwood mill is now under consideration. The object of this mill is to deal not only with hardwoods from plantations but also indigenous timbers which are not readily saleable in the local markets. Mention should also be made of the fact that roughly 500,000 acres of Wattles and 300,000 acres of Eucalypts have been established by private enterprise for commercial purposes. It may safely be said that plantation-grown wood has very considerably lessened the drain on the natural timber resources of the country and prevented the complete annihilation of the forests."

South African wattle bark and wattle extract with special reference to the American market. By I. J. CRAIB. *Journ. So. Afr. For. Association* 6: 71–88; April 1941.

This account of the South African Wattle industry includes a general survey of the whole field of vegetable tannins and the world trade in them, with particular reference to their competition with Union bark and extract.

The significance of X-rays in studying the orientation of cellulose in the secondary wall of tracheids. By I. W. BAILEY and EARL E. BERKLEY. *Am. Journ. Botany* 29: 3: 231–241; 18 figs.; March 1942.

"The most reliable means at present of studying the fibrillar orientations of cellulose in individual layers of tracheids are microscopically visible striations and crystals that may be induced to form in the elongated porosities of the cellulosic matrix of unswollen walls. The over-all average or dominant arrangement of the crystalline cellulose may be best obtained from X-ray diffraction patterns.

"Careful drying, delignification and maceration of wood produce minor changes in the orientation of fibrils but no

pronounced deviations in orientation, such as from longitudinal to transverse or from right-handed to left-handed helices, etc. There is a close correlation between fibrillar orientation, optical anisotropy, swelling anisotropy, predetermined planes of hydrolysis and X-ray diffraction patterns. This indicates that the chain molecules and crystallites of cellulose are oriented within fibrils with their long axis parallel to the long axis of the fibrils.

"The fibrillar orientations of cellulose in the secondary walls of tracheids fluctuate markedly, not only in wood from different parts of the same tree but also in different layers of the same cell wall and frequently also in different lamellae of the same layer. The fibrillar orientations of the inner and outer layers fluctuate between transverse and helices of comparative low pitch (45°–90°), whereas those of the central layer usually deviate between longitudinal and helices of relatively steep pitch (0°–45°). Uniform orientation of cellulose throughout the successive lamellae of a wall layer is exceptional rather than typical of tracheids.

"The use of the polarizing microscope and of X-ray diffraction patterns alone may lead to serious misconceptions regarding the orientation of cellulose in cell walls, unless the numerous morphological, histological, chemical and other variables in plant materials are accurately visualized and accounted for."—*Authors' summary.*

The sliding, gliding, symplastic or the intrusive growth of the cambium cells and their derivatives in higher vascular plants. By GIRIJA P. MAJUMDAR. *Jour. Indian Bot. Soc.* 20: 4: 161–171; 11 figs., 1 plate; July 1941.

The author discusses the methods of readjustment of the cambial cells and their derivatives. The fiber-cells, particularly the phloem and xylem fibers, grow many times the length of their mother cells. In Conifers and in less specialized Dicotyledons, such as *Drimys* and *Trochodendron*, which have non-stratified cambia, the increase in the periphery of the cambium results primarily from the elongation and adjustment of the derivatives of transversely or pseudo-transversely dividing fusiform initials. Only in the rare cases of highly

specialized Dicotyledons with stratified cambia (*e.g.*, *Heracleum Sphondylium*) have radial longitudinal divisions of cambium cells been observed, thus maintaining the peripheral extension. The problem is how the elongating cells in the cambia of Conifers and less specialized Dicotyledons and the elongating fiber-mother-cells in the more highly specialized Dicotyledons adjust their position so as to come in contact side by side in the peripherally extending cambial ring.

Three suggestions have been made to explain this mechanism: (1) The theory of the gliding, or sliding growth (Krabbe, Bailey), (2) symplastic (Priestley), and (3) intrusive (Sinnott and Bloch) growth movement of the cambial initials or the fiber-mother-cells. Majumdar finds that the *sliding* or *gliding* growth movement is very difficult to comprehend under the conditions existing in the developing and differentiating tissues, and also in the absence of definite evidence.

The adjustment due to *symplastic* growth, without any slip between two walls, as elaborated by Priestley from data in the apical meristem, assumes that the protoplasts are separated from one another by extremely plastic, semifluid walls, which become deformed under pressure. Observations by Kleinmann, Beijer, Teodorosco, and Popesco seem, according to Majumdar, to support such a possibility, but it is doubtful whether the fiber-mother-cells remain sufficiently plastic to account for the enormous increase in the length of adult fibers.

Sinnott and Bloch have suggested that the so-called sliding growth is really *intrusive* growth resulting from localized, active differential growth confined to the two ends of a cambium initial or a fiber-mother-cell. The author produces evidence in this paper that this method of readjustment is actually operative in higher and highly specialized Dicotyledons. Thus in *Laburnum*, during differentiation of a cambium cell into a fiber, the cells are growing by advancing tips until their tapering ends meet, and in *Heracleum Sphondylium* similar intrusive growth of the cambial initials takes place.—Robert Bloch, *Yale Dept. Botany*.

M. M. Chattaway. Price 30 cents

Yale University School of Forestry

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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.

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MACROULE, A NEW GENUS OF THE LEGUMINOSAE (SOPHOREAE)

By JOHN H. PIERCE

New York Botanical Garden

Ormosia, in the Western Hemisphere, is a well defined, closely knit genus with the exception of *O. Coutinhoi* Ducke and *O. cinerea* R. Ben. With these two species excluded, the genus is uniform in having small flowers, pubescent ovary, dissimilar wing and keel petals, and seeds 1–1.5 cm. long with a circular or elliptic hilar scar never over 6 mm. long. Since *O. Coutinhoi* has much larger flowers, glabrous ovary, similar wing and keel petals, and seeds 3–4 cm. long with a linear hilar scar 40–50 mm. long, it seems wise to segregate it as a new genus.

MACROULE Pierce, gen. nov.—Arbor media; foliola 5–9, petiolulo crassissimo, rigide coriacea glabra, ovata vel oblongo-ovata, 10–30 cm. longa, 5–12 cm. lata, costis subtus prominentibus, secundariis 5–8, dissitis; calix circa 1 cm. longus, crasse coriaceus, nigrescens atque argenteo-sericeus; petala glabra, violacea, vexilli centro albido vel flavidis; vexillum 1.5 cm. longum ac latum fere orbiculare, apice medio profunde emarginatum; alae et carinae inter se subaequales, liberae, curvato-convexae obliquae, breviter unguiculatae; staminum 5 longiora, 5 breviora, antheris dorsifixis; ovarium glabrum, stylo apice recurvo, stigmate laterali; legumen ligneum, compressum, sutura carinali incrassata; semen compressum 3–4 cm. longum ac latum, 1.5–2 cm. crassum, brunnescenti-rubrum, hilo 40–50 mm. longo.

Generic name from the Greek for "long scar." Type species: *Ormosia Coutinhoi* Ducke.

Macroule Coutinhoi (Ducke) Pierce, comb. nov. *Ormosia Coutinhoi* Ducke Arch. Jard. Bot. Rio 3: 136. 1922.—Description as given for the genus above.

Specimens examined: BRAZIL: Para: Belem, Ducke H.J.B.R. 16188 (F), Ducke 352[1] (NY, Y), Ducke H.J.B.R. 16798 (US, F), Ducke H.J.B.R. 16572 (US, F); Breves, Ducke H.J.B.R. 17093 (US). BRITISH GUIANA: Bartica, Potaro Rd., Forestry Dept. 2013 (NY).

This tree, locally known as Buiussu, grows along the periodically inundated margins of the Amazon. The seeds are frequently found floating in the rivers and sometimes are confused with *Mucuna altissima* (Jacq.) DC. because of the long hilum.

Probably to be referred to this genus is *Ormosia cinerea* R. Ben. All the available material is sterile, but the original description of the flower and fruit would fit *Macroule*. Whether it is synonymous with *M. Coutinhoi* or a distinct species cannot be determined until better material is available. For the present, since the status of the species is uncertain, no new combination is made for this name.

[1] For note on the wood of *Macroule*, see page 32.

STUDIES IN THE SAPOTACEAE: A NEW GENUS FROM EASTERN CUBA AND A NEW SPECIES FROM HAITI[1]

By CHARLES L. GILLY

New York Botanical Garden

In the course of revisionary work on the American Sapotaceae, certain specimens from eastern Cuba, although clearly referable to the subfamily Mimusopoideae, were found to possess floral characters of such a nature that they are here proposed as a new genus:

SHAFERODENDRON Gilly, gen. nov.—Arbores parvi; folia alterna exstipulata; flores hermaphroditi pedicellati, in axillis foliorum solitarii; perianthium biseriatum, lobis exterioribus valvatis (sepalis ?) 2 vel 3, lobis interioribus imbricatis (petalis ?) 2 vel 3; androecium coroniforme tubulatum; staminodia exteriora 12 vel 18, coronae tubo multo breviora, in consortiis 4 vel 6 terna conjuncta, lobo medio lobis lateralibus minora; stamina 4 vel 6, ad medium tubum coronae inserta; antherae extrorsae, thecis longitudinaliter dehiscentibus; staminodia interiora cum staminibus alternantia et totidem vel 0; ovarium pubescens 4- vel 6-loculare, loculis 1-ovulatis; fructus non visus. Species typica: *Shaferodendron moaensis* Gilly.

This genus, named in honor of J. A. Shafer who collected material of the type species, differs from *Manilkara* Adans. (which is included in *Mimusops* L. by many botanists) in the general vegetative facies, by the more nearly complete fusion of the outer androecial segments (the flower thus appearing tubular), and by the insertion of the stamens at the middle of the androecial tube, whereas in *Manilkara* they are inserted on its summit. Despite the fact that the number of members per floral cycle is sometimes used as a generic criterion in the

[1] Specimens examined in the preparation of this paper are deposited in the following herbaria: Arnold Arboretum (A); Gray Herbarium (G); New York Botanical Garden (NY); U. S. National Herbarium (US); Yale School of Forestry (Y).

family, the following two species (the type with flower parts in multiples of two, the other with flower parts in multiples of three) are fundamentally so similar that I have not hesitated to refer them to a single genus.

1. ***Shaferodendron moaensis*** Gilly, sp. nov.—Lamina foliorum coriacea integra subrevoluta canaliculata, 4.5–10 cm. longa, 1.2–2 cm. lata, supra glabra subnitida vel opaca, infra brunneo-pubescentia; costa prominens infra, impressa supra; nervis lateralibus et reticulatibus impressis supra, subprominentibus infra; petiolus 5–8 mm. longus; pedicellus 2–3 cm. longus; lobi perianthii exteriores 2, triangulari-ovati acuti vel subacuti glabri, 7 mm. longi, ad 4.5 mm. lati; lobi perianthii interiores 2, anguste ovati pubescentes, subconstricti ad basim, obtusi ad apicem, 7.5–8 mm. longi, ad 4 mm. lati; tubus coronae cylindricus, ad 7.5 mm. longus; stamina exteriora 12 in consortiis 4 terna ad basim conjuncta, lobo medio lobis lateralibus breviori lineari-oblongo vel spatu-lato, lobis lateralibus oblongis vel anguste elliptico-oblongis, ad 2 mm. longis; stamina 4, filamenta breva, antherae anguste lanceolato-oblongae, ad 2.5 mm. longae; staminodia interiora lineari-lanceolata, ad 1 mm. longa, cum staminibus alternantia et ad summam coronam inserta 4 (in specimina typica) vel 0; ovarium 4-loculare; fructus ignotus.

Specimens examined: CUBA: Oriente: Moa Bay, east of Rio Moa, January 1911, Shafer 8298 (NY—type, US); valley of Rio Yamaniguey, February 1910, Shafer 4214 (NY, US); Baracua, August 1917, Roig 1550 (NY). The Roig specimen, though sterile, is certainly referable here; Shafer 4214 differs from the type only by the absence of interior staminodes.

2. **Shaferodendron mayarensis** (Ekman) Gilly, comb. nov. *Mimusops mayarensis* Ekman ex Urban, Symb. Ant. 9: 418. 1925.—This species differs from *S. moaensis* by the following characters: Leaves smaller (at least in specimen examined); perianth segments in two whorls of 3; outer perianth segments narrowly oblong-ovate, 6 mm. long and 3 mm. wide; inner perianth segments elliptic, 7 mm. long and 3.5 mm. wide, acute at apices and gradually tapered to a narrow base; exterior staminodes 18; interior staminodes (when present) 6; stamens 6, anthers broadly ovate-sagittate; ovary 6-locular.

Ekman's original description specifies 6 staminodes inserted with the stamens, but in the specimen examined (CUBA: Oriente; Sierra de Nipe, Rio Piloto, ca. 350 m., September 1922, Ekman 15053 [NY, US]) the staminodes are lacking. The presence or absence of staminodes appears to be one of the variable characters in both species of the genus.

Several collections from Haiti, previously referred to *Muriea albescens* (Griseb.) Baillon (=*Mimusops albescens* [Griseb.] Baillon), are recognizable as specifically distinct; the following new species is, therefore, proposed:

Muriea Eyerdamii Gilly, sp. nov.—Arbor parva; folia ad apicem ramorum aggregata; lamina oblongo-elliptica vel anguste elliptica, obtusa vel emarginatula ad apicem, cuneato obtusa ad basim, 9–15 cm. longa, 3.5–5 cm. lata, opaca vel subglauca supra, aurea vel brunnea appresso-pubescentia infra; petiolus ad 2 cm. longus; lobi perianthii exteriores ovato-rotundi subacuti vel obtusi, 4 mm. longi et lati; lobi perianthii interiores rotundi vel subrotundi, ad basim constricti, ad apicem obtusi; tubus coronae ad 1.5 mm. altus; staminodia exteriora in consortiis 6 terna aggregata nec conjuncta, lobus medius lobis lateralibus parvior lineari-spatulatus, ad 4.5 mm. longus, lobi laterales late triangulato-ovati divergentes lobo medio longitudine aequantes; stamina 12, ad 3 mm. longa, filamenta triangularia attenuata; ovarium pubescens 6-loculare; fructus ignotus.

Specimens examined: HAITI: Dept. du Nord: Massif du Nord, near Pt. Michel on road to La Lome, ca. 500 m., June 1927, Ekman H8347 (US). Ile de la Gonave; trail to Anse à Galets, August 1927, Eyerdam 233 (A, G, NY—type, US).

The following sterile specimens, may also be referable here: HAITI: Dept. de l'Ouest: Massif des Matheux near l'Archaie, February 1925, Ekman H3317 (US). Dept. de l'Artibonite: Plaine de l'Artibonite, Riv. Este near Riv. de l'Artibonite, March 1925, Ekman H3363 (US). DOMINICAN REPUBLIC: without exact locality, Scarff *s. n.* (Y), 9 (Y), and 18E (Y). The disposition of Buch 704 from Gonave Island, Haiti, cited by Pierre and Urban (Symb. Ant. 5: 176. 1904) under *M. albescens*, is uncertain in the absence of an available specimen; it is probably referable, however, to *M. Eyerdamii*.

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1. ***Shaferodendron moaensis*** Gilly, sp. nov.—Lamina foliorum coriacea integra subrevoluta canaliculata, 4.5–10 cm. longa, 1.2–2 cm. lata, supra glabra subnitida vel opaca, infra brunneo-pubescentia; costa prominens infra, impressa supra; nervis lateralibus et reticulatibus impressis supra, subprominentibus infra; petiolus 5–8 mm. longus; pedicellus 2–3 cm. longus; lobi perianthii exteriores 2, triangulari-ovati acuti vel subacuti glabri, 7 mm. longi, ad 4.5 mm. lati; lobi perianthii interiores 2, anguste ovati pubescentes, subconstricti ad basim, obtusi ad apicem, 7.5–8 mm. longi, ad 4 mm. lati; tubus coronae cylindricus, ad 7.5 mm. longus; stamina exteriora 12 in consortiis 4 terna ad basim conjuncta, lobo medio lobis lateralibus breviori lineari-oblongo vel spatu -lato, lobis lateralibus oblongis vel anguste elliptico-oblongis, ad 2 mm. longis; stamina 4, filamenta breva, antherae anguste lanceolato-oblongae, ad 2.5 mm. longae; staminodia interiora lineari-lanceolata, ad 1 mm. longa, cum staminibus alternantia et ad summam coronam inserta 4 (in specimina typica) vel 0; ovarium 4-loculare; fructus ignotus.

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Several collections from Haiti, previously referred to *Muriea albescens* (Griseb.) Baillon (=*Mimusops albescens* [Griseb.] Baillon), are recognizable as specifically distinct; the following new species is, therefore, proposed:

Muriea Eyerdamii Gilly, sp. nov.—Arbor parva; folia ad apicem ramorum aggregata; lamina oblongo-elliptica vel anguste elliptica, obtusa vel emarginatula ad apicem, cuneato obtusa ad basim, 9–15 cm. longa, 3.5–5 cm. lata, opaca vel subglauca supra, aurea vel brunnea appresso-pubescentia infra; petiolus ad 2 cm. longus; lobi perianthii exteriores ovato-rotundi subacuti vel obtusi, 4 mm. longi et lati; lobi perianthii interiores rotundi vel subrotundi, ad basim constricti, ad apicem obtusi; tubus coronae ad 1.5 mm. altus; staminodia exteriora in consortiis 6 terna aggregata nec conjuncta, lobus medius lobis lateralibus parvior lineari-spatulatus, ad 4.5 mm. longus, lobi laterales late triangulato-ovati divergentes lobo medio longitudine aequantes; stamina 12, ad 3 mm. longa, filamenta triangularia attenuata; ovarium pubescens 6-loculare; fructus ignotus.

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The only other species of this genus, *Muriea albescens* (Griseb.) Baillon, endemic in western Cuba, differs from this new species in having the under-leaf surface silvery pubescent, the perianth segments narrower and more acute, the exterior staminodes basally united into groups of three for 1 mm., and the lateral members of each exterior staminodial group linear-oblong and approximately parallel with the median staminode. Specimens examined: CUBA: Pinar del Rio: El Retiro (locality *fide* Grisebach and Pierre and Urban), 1860–1864, Wright 2919 [type collection!] (G, NY); Boca de Galafre, March 15, 1911, Britton 10006 (NY); Sierra de los Organos, Grupo del Rosario, Pinar de Lechuza, June 30, 1921, Ekman 12982 (NY). Habana: Cojimar, near Rio Cojimar, Ekman 13707 (US).

Mimusops azulensis Urban, from the Sierra del Cristal, Oriente, Cuba, described on the basis of a completely sterile specimen, Ekman 15866 (NY), will probably prove, when flowering material is available for study, to be a third species of the genus *Muriea*.

KEY TO AMERICAN GENERA OF MIMUSOPOIDEAE

The following generic key may be used as an aid in the identification of western hemisphere material of the subfamily Mimusopoideae:

Perianth segments 8; exterior staminodes 24; stamens and interior staminodes 8 (*introduced species*) ..... MIMUSOPS.

Perianth segments 6 or 4; exterior staminodes 18, 12, or 6; stamens 12, 6, or 4; interior staminodes 6, 4, or 0.

Stamens 12; interior staminodes 0; exterior staminodes 18 ..... MURIEA.

Stamens 6 or 4; interior staminodes as many as the stamens, or 0; exterior staminodes 18, 12 or 6.

Exterior staminodes much shorter than the corona tube; stamens 4 or 6, inserted at middle of corona tube; perianth segments 4 or 6 ..... SHAFERODENDRON.

Exterior staminodes essentially as long as or longer than the corona tube; stamens 6, inserted at summit of corona tube; perianth segments 6 ..... MANILKARA.

NEW AND NOTEWORTHY SAPOTACEAE OF BRAZILIAN AMAZONIA

By ADOLPHO DUCKE

Sapotaceae occupy one of the most prominent places in the forest flora of tropical America, but their natural classification into genera is very difficult. "Moins que toute autre famille, les Sapotacées se prêtent à la classification en série linéaire; les formes s'enchaînent les unes dans les autres, de manière à constituer un vaste réseau, à travers les mailles duquel les coupures sont particulièrement délicates à pratiquer."—Dubard, in Rév. Gén. de Bot. 29: 292 (1907), cited by Baehni, Candollea 7: 394 (1938). This difficulty is increased by other factors: Most of the species are confined to sparsely settled forest countries where no botanical institutions exist; most of them are high trees which flower at intervals of several years and independently of a definite season and nearly all bear fruits that, because of their size and consistency, are difficult to preserve in herbaria. In consequence of these factors, herbarium collections now available are nearly always incomplete; also, when complete, the collection usually represents only a single plant. Even the best herbarium specimens are mere fragments of trees; when they are not supported by field observations our knowledge will never be so complete as it is in the countries whose forest flora is studied from living plants.

The type specimens of the new species described in this paper are preserved in the herbarium of the Jardim Botanico do Rio de Janeiro. Co-types will be distributed.

CASCA DOCE OR PÁO DOCE TREES

These trees have in common the sweet but afterwards astringent taste of their bark, which, according to P. Le Cointe, is attributable to the presence of glycyrrhicin. Most of them have a smooth bark of light yellowish gray color, sometimes with darker spots. The soft fleshy mesocarp of the fruits is sweet and edible. The wood is highly esteemed as firewood.

The three species I first observed in Amazonia have opposite or subopposite leaves; with these species I created the (untenable) genus *Glycoxylon* (1922). An additional species (1925) often bears branchlets with alternate or ternate leaves. I afterwards discovered near Manáos a fifth species of Casca Doce with alternate and subverticillate leaves. All five are more or less closely allied with the only South Brazilian Sweet Bark, *Pradosia glycyphloea*. This species had been placed in the genera *Chrysophyllum* and *Lucuma*, but Kuhlmann, who studied complete botanical material on live trees, recognized it as related to *Pradosia lactescens* of the same country, notwithstanding the non-sweet taste of the bark of the latter. A new species, from Manáos, is closely allied to *lactescens*, having the same dark violet flowers and non-sweet bark, but it differs in various characters, chiefly its verticillate leaves which show some affinity with one of the above-cited Sweet Bark species. These two species form one group in the genus *Pradosia*, while a second group is composed of the six above-mentioned Sweet Bark trees.

There exists a seventh species of Sweet Bark, but this does not belong to the genus *Pradosia*. It has a sweet bark and is known as Casca Doce, but its appearance is like that of some of the so-called *Lucuma-Pouteria* group. Its leaves are widely alternate; the flowers also suggest *Pouteria*, but on the available material they are anomalous and degenerate and do not permit a positive determination of the genus. It grows in flooded forest along the Rio Aramá in the Amazon estuary.

There was recently discovered near Manáos another new *Pradosia*, whose bole, bark, flowers, and fruits resemble the Sweet Bark trees of the same locality, only the leaves are very different and the bark is not sweet.

From the above discussion we conclude that opposite leaves and sweet bark are not such valuable generic characters as I previously believed. Consequently, *Glycoxylon* (and also the two other genera, namely, *Barylucuma* and *Syzygiopsis*, which I proposed on the basis of their opposite leaves) cannot be maintained. The problem of placing these plants in "good" genera still remained unsolved.

It is evident that with the suppression of the genus *Glycoxylon* its species must be transferred to the genus *Pradosia*. Baehni (*l.c.*) and Eyma (Rec. Trav. Bot. Neerl. 33: 156; 1936), however, extinguished not only *Glycoxylon* but also *Pradosia*. But Eyma placed the species of both in *Chrysophyllum* and Baehni in *Pouteria*, and because of such a divergence of opinion of the two most eminent authorities on the taxonomy of American Sapotaceae, I think it would be preferable to include *Glycoxylon* in *Pradosia* and to conserve this genus, at least provisorily. It would be characterized chiefly by the combination of such characters as folded stamens, lack of staminodes, and exalbuminous seeds. The bark of the species of *Pradosia sensu latiore* can be sweet or non-sweet, but it is always astringent; the leaves can be alternate, opposite, or verticillate; the corolla is always radiate at the end of the anthesis, and of green, white, or dark violet color; the fruit in all the species has an oblique-ovoid shape and bears a seed (rarely two) with a long and narrow scar.

If *Pradosia* is suppressed its species cannot be included in *Pouteria* nor in *Chrysophyllum*, in the actual sense of these genera, but should be referred to a large genus *Chrysophyllum* composed of both of these genera. *Chrysophyllum* L. (1753) would have the priority over *Pouteria* Aubl. *mixtum compositum* (1775) and *Lucuma* Molina *typo incerto* (1782). As a consequence, *Chrysophyllum sensu latiore* would correspond to the numerous species of Abiu and Abiu-rana (false Abiu) of Brazilian Amazonia, as *Manilkara-Mimusops* would correspond to the trees known as Massaranduba or Maparajuba. The only deplorable consequence of this rearrangement would be the necessity for a large number of new combinations which might require the activity of a botanical bureaucrat such as the late O. Kuntze.

The true Abiu is *Pouteria* (or *Lucuma*) *caimito*, very commonly cultivated through Brazilian Amazonia, while the name Abiu-rana includes all the numerous forest species of both *Pouteria* and *Chrysophyllum* and is frequently also given to trees of other genera of Sapotaceae, with the exception of the above-cited *Manilkara*. Except the Sweet Barks (*Pradosia*), very few species of this family have indigenous names,

for example, the Pariry (*Pouteria pariry* or *Lucuma pariry* Ducke), the Guajará or Uajará (*Chrysophyllum excelsum* Huber), the Maiá (*Chromolucuma rubriflora* Ducke), and Ucuquy (genus?), but even these are often called Abiu-rana. When certain species of Abiu-rana acquire special interest in commerce they are often designated by new vernacular names. For instance, *Ecclinusa balata* Ducke was formerly a mere Abiu-rana, but now that it is being exploited for its valuable balata-yielding latex, it is known as Ucuquirana in Amazonas, Coquirana in Pará.

The Species of the Genus *Pradosia* Liais

The two South-Brazilian species of this genus had been mixed and confused by authors until Kuhlmann (Arch. Jard. Bot. Rio 5: 206 t. 26. 1930) defined the position of both in the system and illustrated them by good diagnoses and drawings. Authors may still discuss what species should be the type of the present genus, but that will not affect the value of the genus.

Synopsis of the Species of *Pradosia*

With non-sweet bark and dark violet flowers

Leaves small, alternate, with few and distant primary lateral nerves and obsolete venulae. Flowers in clusters on trunk and old branches.....
.....1. *P. lactescens* (Vell.) Kuhlmann.

Leaves large, at least on the superior part of the branchlets, in verticils of five, separated by long internodes; primary lateral nerves numerous and approximated, connected by very conspicuous obliquely transverse venulae. Flowers on the older part of branchlets, below the leaves or after their fall.....2. *P. verticillata*, sp. nov.

With non-sweet bark and white flowers. Leaves medium-sized to rather large, alternate, with distant primary lateral nerves and obsolete venulae. Flowers on branchlets below the leaves.....9. *P. decipiens*, sp. nov.

With sweet bark and green or white flowers. Flowers on the older part of the branchlets.

Leaves rather large, sub-verticillate, at least on the upper part of the branchlets. Primary lateral nerves numerous and approximated, not connected by venulae; lesser lateral ones lacking. Flowers green.....
.....3. *P. subverticillata*, sp. nov.

Leaves small, opposite or sub-opposite, or infrequently alternate or ternate, their primary lateral nerves few and distant, but connected by uninterrupted reticulate venulae; lesser lateral nerves lacking.

Leaves not rarely alternate, oblong-obovate with long cuneate base. Corolla very small (diameter 4–6 mm.), green, more or less silky on the outside.....4. *P. praealta* Ducke.
Leaves nearly always opposite, oblong or oblong elliptic, with acute or obtuse base. Corolla not so small (diameter 7–8 mm.), white, glabrous.
.....5. *P. Huberi* Ducke.

Leaves small, opposite. Primary lateral nerves straight and parallel, alternating with lesser ones, and not connected by uninterrupted venulae. Flowers green.

Peduncles rather long (7–10 mm.).....6. *P. pedicellata* Ducke.
Peduncles very short (0.5–2 mm.).....7. *P. inophylla* (Mart. ex Miq.) Ducke.

Leaves small, alternate, seldom sub-opposite. Primary lateral nerves not connected by uninterrupted venulae, but lesser lateral nerves present. Flowers green.....8. *P. glycyphloea* (Casar.) Kuhlm.

1. *Pradosia lactescens* (Vell.) Kuhlm. (= *Pometia lactescens* Vell.) was often confounded with the Sweet Bark trees, from which it differs by non-sweet bark, by inflorescences clustered on trunk and old branches, and by the dark violet color of its flowers.

This species has nothing to do with the southern Sweet Bark, *Pradosia glycyphloea*, with which it has been confused for a century. According to Eyma (*l.c.*), "the species *lactescens* and *glycyphloeum* had been confounded by all authors. Nomenclatural history of these species is highly complicated, and Kuhlmann's interpretation is chiefly based on the sweet bark of *glycyphloeum*, that of *lactescens* being bitter." Since a field botanist, however, never devotes his time to deciphering nomenclature puzzles, I accept without discussion the interpretation of Kuhlmann, the greatest authority on the forest trees of tropical southern Brazil. It is also probable that the authors of these species knew the live trees and not herbarium specimens only. Accordingly, the name *glycyphloeum* must necessarily be reserved for the one with sweet bark and *lactescens* for the other, whose cauliflorous inflorescences were sufficiently characterized by Velloso.

Pradosia lactescens is a small tree inhabiting hill forests

near the city of Rio de Janeiro. It was also observed in Minas Geraes. A complete description with a drawing was given by Kuhlmann (*l.c.*), and herbarium specimens were distributed by him (Jard. Bot. Rio 15812).

2. ***Pradosia verticillata*** Ducke, sp. nov.—Arbor usque ad 35 m. alta, trunco cylindrico, cortice griseo-rufescente vix rugoso sapore adstringente malo nec dulci, latice copioso albo viscido. Ramuli crassi, vetustiores glabrati cinerei rimosi et lenticellosi, juniores ut innovationes omnes dense rufotomentosi. Folia in ramulorum parte superiore vulgo in verticillis 10–30 mm. distantibus, 5 per verticillum, solum in ramulorum parte inferiore saepe nonnulla alterna; petioli 15–40 mm. longi basi depresso-dilatati supra sat tenues et anguste canaliculati, vetusti glabrati; laminae 150–250 mm. longae et 50–110 mm. latae, oblongo-obovatae, basin saepe breviter plicatam versus longe cuneatae, apice plus minus obtusae et in medio brevissime acuminatae vel rarius retusiusculae, margine tenuissime revolutae, rigide coriaceae, supra glabrae, subtus tomento minuto subaureomicantes et in nervis rufotomentosae, costis lateralibus e costa centrali subtus crassa utrinque 25–30 inter se parum distantibus (vix ultra 5 mm. in foliis minoribus, ad 10 mm. in maioribus) supra tenuiter impressis subtus valide prominentibus, a basi usque ultra medium subrectis, ante marginem attenuatis et secus marginem sursum curvatis, costulis lateralibus tenuioribus nullis, venis oblique transversis et flexuosis costas laterales conjungentibus numerosis et subtus evidentissime prominentibus. Flores in ramulis omnino defoliatis vel infra folia novella sub foliorum delapsorum cicatricibus, in fasciculis densis et multifloris saepe in verticillis regularibus vel irregularibus, nonnunquam in annulum ramum cingentem confluentibus; pedunculi vix 1 mm. longiores crasse obconici; calices vix ultra 2 mm. longi campanulati, supra in phylla 5 imbricata ovata sat profunde partiti, extus rufotomentelli intus glabri; corollae nigroviolaceae intus glabrae extus praeter tubum et loborum margines fulvosericeae, in alabastro adulto calicem duplo superantes et supra calicem subgloboso-inflatae, sub anthesi plena radiatae diametro circiter 6 mm., tubo brevissimo, lobis 5 vel 6 oblongis obtusis; stamina 5 vel 6, loborum

basi inserta, anthesi corollam superantia, glabra, filamentis atroviolaceis praefloratione in tertio superiore extrorsum deflexis et ad insertionem in connectivum reflexis, antheris extrorsis ovatis albidis; ovarium dense fulvohirsutum, 5-loculare, stilo brevi glabro viridi alabastro incluso. Fructus in pedunculo crasso usque ad 8 mm. longo, calicis phyllis persistentibus parum augmentatis, maturus glabratus luteus, 40–50 mm. longus et 22–30 mm. crassus, oblongo-obovoideus basi oblique attenuatus apice obtusus, uno latere rectus altero curvatus, intus crasse carnosus luteus; semen (in fructibus examinatis) unum, in pulpa albida adhaerente dulci, nigrum vel fuscum, zona umbilicali pallida lineari-oblonga a basi usque ad apicem elongata.

Habitat circa Manáos in silva terris altis argillosis, 14–10–1941 florifera fructibusque nonnullis maturis, Ducke n. 811. Arbores duae visae. Florum et fructuum structura et corollae colore speciem meridionalem *P. lactescens* approximat; valde divergens foliorum characteribus omnibus, imprimis dispositione verticillata inter omnes orbis terrarum Sapotaceas hucusque notas unica.

This new species resembles in many aspects the South Brazilian *P. lactescens* which also has dark violet corollas. Its leaves, however, are very different in size, form, and nervation. The most striking character of our species, however, is the disposition of the leaves in whorls of five, which gives to sterile branchlets an appearance somewhat like certain Apocynaceae or Rubiaceae (genus *Henriquezia*).

3. ***Pradosia subverticillata*** Ducke, sp. nov.—Arbor mediocris (12–18 m. alta) trunco cylindrico, cortice flavescenti-cinereo saepe sublaevi, sapore dulci demum adstringente. Ramuli sat robusti, cinerei, lenticellosi, glabri innovationibus solis canotomentellis. Folia ad ramulorum apices dense congesta, vulgo 5 vel 6 subverticillata internodiis brevissimis, nonnulla dissite alterna; petioli 20–30 mm. longi sat tenues supra canaliculati vix minime tomentelli; laminae 70–190 mm. longae et 35–65 mm. latae, cum minoribus et minimis nonnullis intermixtis plus minus oblongo-obovatae, basi brevius vel longius acutatae, apice obtusae vel subrotundatae, basi apiceque vulgo oblique plicatae, margine tenuiter revo-

lutae, firme coriaceae, plus minus obsolete rugulosae, glabrae, nitidulae, subtus pallidiores flavescentes, costis lateralibus e costa centrali utrinque circiter 15 ad 20 inter se parum distantibus (in foliis minoribus 3–5 mm., in maioribus 5–7 mm.), supra impressis subtus valide prominentibus, ante marginem subito arcuatis margine evanidis, costis lateralibus tenuioribus nullis, venulis reticulatis in utraque pagina obsoletis vel subnullis. Flores ad ramulos infra folia in fasciculis multifloris dense congestis; pedunculi 3–5 mm. longi, ut calices extus dense canescenti- vel rufescenti-sericei; calices 3–4 mm. longi campanulati, solum dimidio superiore in lobos 5 obtusos intus praeter basin pilosam glabros divisi; corollae laete virides, in alabastro adulto calicem subduplo superantes, anthesi incipiente subcampanulatae, demum radiatae diametro circiter 12 mm. (cito caducae), glabrae lobis (5 vel 6, oblongis, obtusis; extus marginibus exceptis tenuiter albidosericeis, tubo vix 2 mm. longo; stamina 5 vel 6 a loborum basi libera, glabra, corollam anthesi parum superantia, filamentis in praefloratione ut in reliquis speciebus flexuosis, antheris ovatis extrorsis; ovarium pallide flavido-hirsutum, 5 (interdum 6?) loculare, stilo glabro alabastro incluso. Fructus in pedunculo valido, ad 8 mm. longo, super basin stipitiformem oblique inclinatus, subfalcato-oblongus, apice acuminatus vel apiculatus, adultus 25–40 mm. longus et 16–22 mm. latus, subglabrescens, uno latere rectus super basin sinuosus, altero fortiter convexoarcuatus; semen fuscum area umbilicali oblonga pallida basin non attinente.

Habitat prope Manáos in silva humida non inundabili circa caractam minorum fluminis Tarumá, in solo arenoso, mensibus Junio ad Octobrem florifera, Martio ad Maium fructifera, Ducke 812 et Herb. Jard. Bot. Rio 22145, 35544, 35545. Arbores vidi plurimas.

This species of Sweet Bark can easily be distinguished from the others by its rather large and sub-verticillate leaves with straight and parallel nerves. These nerves do not alternate with lesser ones and are not connected by transversal venulae. Fruit and seed resemble those of *P. glycypbloea*, but the fruit is more oblique than in that and all other species of the present genus.

4. ***Pradosia praealta*** Ducke, comb. nov. (=*Glycoxylon praealtum* Ducke, Arch. Jard. Bot. Rio 4: 165 t. 20. 1925,= *Glycoxylon grande* Ducke ex Bouillenne, nomen nudum).—This is one of the biggest trees of the upland rain forest around Belem do Pará; the largest are at least 50 meters high and have three or four enormous buttresses. The bark is smooth and light in color like most of the other species of Sweet Bark. The leaves on some branches are more or less opposite, but on others they are sub-opposite, ternate, or even alternate. Photographs of the base of a very large trunk are shown by R. Bouillenne in "Un Voyage Botanique dans le Bas Amazone" (*Une Mission Belge au Brésil* 2: t. 10, figs. 561, 562. 1930) under the unpublished name of *Glycoxylon grande*. Specimens were distributed to the principal botanical institutions, proceeding from Belem do Pará.

Pradosia praealta Ducke, var. ***subsessilis*** Ducke, var. nov. —A speciei forma typica divergit floribus subsessilibus. Foliorum insertio saepius alterna. Arbores inter maximas silvae circa Manáos, locis altis in solo argilloso. Octobre vel Novembre florens, fructibus maturis saepius Maio. Specimina florifera Ducke 825, fructifera Herb. Jard. Bot. Rio 35546 et cum ligno 276 (Yale 32652).

This variety may eventually be a geographical form of the present species whose typical form is rather frequent in the upland rain forests around Belem but has not been observed more westward. The aspect of the trees is very similar in both forms, but the typical form is distinguished by well evolved peduncles, 1 to 4 mm. long, whereas in var. *subsessilis* the flowers and fruits are sub-sessile. The trees of the variety do not reach the enormous size of some individuals of the typical form, but they are among the largest of the forest trees in the environs of Manáos.

The fruit is the same in both forms of the species, and not unlike that of *P. verticillata*, except that it is less oblique and sub-pyriform-attenuated at the base. The ripe fruit is yellow, glabrous, thick-fleshy with scarce pulp, and of sweet taste. Its size varies from 25 to 50 mm. by 12 to 30 mm. It contains one seed, exceptionally two. The seed is variable like that of *P. verticillata* but is always straighter; its scar is broader and does not reach the apex.

5. ***Pradosia Huberi*** Ducke, comb. nov. (=*Glycoxylon Huberi* Ducke, Arch. Jard. Bot. Rio 3: 235, 6. 16. 1922; 4: 164 t. 20. 1925).—This species is also known by the name of Pracuúba Doce (Sweet Pracuúba), because of the resemblance of its bole to that of the common Pracuúba of the Amazon estuary (*Mora paraensis* Ducke, fam. Leguminosae-Caesalpinioideae). The large trees are frequent on swampy and often flooded land along some of the rivers and "furos" (channels) of the central part of the Amazon estuary (Breves, Rio Aramá, Furo Macujubim) and are some of the most characteristic trees of the forest. Floriferous specimens have been distributed to the principal botanical institutions.

6. ***Pradosia pedicellata*** Ducke, comb. nov. (=*Glycoxylon pedicellatum* Ducke, Arch. Jard. Bot. Rio 3: 235. 1922; 4: 164 t. 20. 1925).—A small tree in open land (campinas), but of middle to rather large size when in tall forests; always found on white sand with black humus and chiefly in swampy places. Known on the southern side of the mouth of the Amazon and the Pará estuary: Porto de Moz (on the mouth of the Xingú) and Gurupá, on sandy campinas; Belem do Pará and Mosqueiro, in the forest. Herbarium specimens have been distributed to the principal botanical institutions.

7. ***Pradosia inophylla*** (Mart. ex Miq.) Ducke, comb. nov. (=*Chrysophyllum inophyllum* Mart. ex Miq.=*Glycoxylon inophyllum* Ducke, Arch. Jard. Bot. Rio 3: 254 t. 16. 1922; 4: 163 t. 20. 1925).—A small tree or shrub of sandy campinas with black humus, found in the western part of the State of Pará (Rio Mapuera tributary of the Trombetas; Faro) and in the State of Amazonas (sandy campinas on the lower Rio Negro and near Borba on the lower Madeira). Occurs also in the form of a nearly middle-sized tree, in "catinga" woods of the upper Rio Negro Basin: Rio Curicuriary (with wood sample Ducke 264, Yale 32640).

8. *Pradosia glycyphloea* (Casar.) Kuhlm. (= *Chrysophyllum glycphloeum* Casar. = *Lucuma glycyphloea* Mart. et Eichl. ex parte).—This species, the only Casca Doce of southern Brazil, is also known by the indigenous name of Buranhem, which seems to be a corruption of "merecem" or "muiracem" (sweet wood). It is a large tree growing in hill or mountain rain forests of tropical southeastern Brazil (Rio de Janeiro, Minas Geraes). A complete description with a drawing was given by Kuhlmann (*l.c.*), and herbarium specimens were distributed by him (Jard. Bot. Rio 22231).

I believe that there should be no doubt that the Sweet Bark of Rio is the true *Chrysophyllum glycyphloeum* Casar., because Casaretto in his description refers to the sweet and afterwards astringent taste of the bark. This is the most important differential character in spite of its not being available when studying exclusively herbarium "types." The old authors whose herbaria are still preserved did not select "types" for their diagnoses because nomenclatural types in the modern sense were not in use at that time. In many cases the old diagnoses may have been made upon specimens which no longer exist in herbaria, and the same author may have replaced the original specimens by others of the same species.

9. ***Pradosia decipiens*** Ducke, sp. nov.—Arbor magna (30 m.), trunco cortice sublaevi pallide flavido, cicatricibus parum discoloribus notato, basi radicibus tabularibus modice altis fulto, cortice sapore solum adstringente nec dulci. Ramuli vetustiores cinerei, juniores rufobrunnei, glabri innovationibus solis tomentellis. Folia alterna, vulgo sat dissita; petiolus 15–40 mm. longus validus superne profunde canaliculatus, minime tomentellus; lamina vulgo 80–150 mm. longa et 45–80 mm. lata, plus minus obovato-eliptica basi saepissime acuta, apice obtusa vel rotundata, basi apiceque vulgo plicata, margine plus minus revoluta, firme coriacea, adulta glabra nitida supra glaucescens subtus magis flavescens, costis lateralibus in utroque latere 12 ad 15 sat remotis supra tenuibus impressis subtus valide prominentibus ante marginem subito arcuatis margine evanidis, venulis recitulatis obsoletis vel nullis. Flores ad ramulos infra folia dense fasciculati, pedunculis 6–8 mm. longis glabris; calix fere usque ad basin solutus in phylla 5 rotundata glabra vix marginibus minime ciliatula; corolla alba glabra in alabastro adulto calicem subduplo superans, anthesi incipiente circiter 6 mm. longa demum radiata diametro 9–11 mm., lobis 5 vel rarissime 6 tubo duplo vel triplo longioribus elliptico-ovatis obtusis; stamina 5

(vel 6) apici tubi inserta, corollam vulgo ¼ excedentia, glabra; ovarium rufopilosum stilo glabro in alabastro non exserto. Fructus (fere adultus) e pedunculo robusto 8 mm. longo inter calicis phylla persistentia, glabratus, 34 mm. longus 15 mm. latus (in sicco), oblique oblongo-obovoideus, basi attenuatus apice obtusus, uno latere fere rectus altero curvatus; semen nondum bene evolutum.

Habitat prope Manáos ad ripam altam cataractae minoris fluminis Tarumá, florifera Novembre et Decembre, fructifera Martio, leg. A. Ducke Herb. Jard. Bot. Rio de Janeiro 24860, cum ligno Ducke 385.

This is a highly interesting species in having a trunk perfectly similar in form and color to that of *Pradosia praealta* but without any sweet taste to its bark. Flowers and fruits also are like those of the true Sweet Barks. It is, however, easily distinguished from its congenerics by some characters of the leaves. A single tree was observed, now dead in consequence of erosion of the soil. A wood sample with herbarium material will be forwarded to Yale.

Chrysophyllum oppositum Ducke, comb. nov. (=*Glycoxylon oppositum* Ducke, Arch. Inst. Biolog. Veg. Rio 2: 68. 1935).—Because of its opposite leaves and its exalbuminous seeds, I was formerly inclined to place this species in the genus *Glycoxylon* (now included in *Pradosia*), but its affinity is not with that genus. The aspect of the tree and of the leaves, the flowers in all of their parts (inclusive of the non-folded stamens), as well as the shape of the fruit, are those of some of the genuine Chrysophyllums, and there is no doubt that the place of the species is here. The bark is not sweet. I found some individuals in the upland rain forests near Manáos, and have distributed herbarium specimens (Ducke 308, H. J. B. Rio 24902).

Chrysophyllum cyanogenum Ducke, sp. nov.—Arbor 25 ad 35 m. alta, partibus omnibus acidum cyanhydricum fortiter redolentibus, trunco cylindrico cortice fusco regulariter et valde conspicue rimoso, ramulis fertilibus parum robustis, novellis rufosericeis. Folia ad apices ramulorum congesta; petiolus 20–40 (rarius 50) mm. longus parum robustus

supra canaliculatus, junior rufosericeus, demum canescens; lamina 100–150 (rarius 170) mm. longa et 40–75 (rarius 85) mm. lata, oblongo-obovata, basi sat longe in petiolum attenuata, apice obtusa et in medio abrupte breviterque acuminata, subcoriacea, supra glabra valde nitida, subtus tomento sericeo-micante tenui at denso primum laete rufescenti-aureo demum rufocupreo et in vetustis canescente induta, margine tenuiter revoluto, costis lateralibus e costa mediana utrinque 4 ad 8 adscendentibus marginem versus arcuatis, supra vix prominentibus at bene distinctis, subtus fortiter elevatis, costis lateralibus tenuioribus nullis, venulis numerosis subparallelis costas connectentibus supra magis quam subtus conspicuis. Flores in ramulo infra folia e nodis fasciculati, circiter 10–20 per fasciculum; pedunculi anthesi 8–9 rarius 10 mm. longi, rufosericei; calix phyllis quinque 3 ad 4 mm. longis latiuscule ovatis extus rufotomentellis intus albidosericeis marginibus longe et dense ciliatis; corolla 4 ad 4.2 mm. longa breviter campanulata viridis glabra, usque ad medium 5-lobata lobis ovatis obtusis, post anthesin sub fructu novello persistens; stamina 5 corollis sub-breviora, glabra, filamentis e tubi medio liberis, in praefloratione rectis, quam anthera sublongioribus, antheris mediocribus, extrorsis; ovarium 5-costatum 5-loculare rufosericeum, stylo brevi crasso. Fructus e pedunculo 15–20 mm. longo robusto; novellus rufotomentosus late subglobosus basi in collum contractus apice conspicue depressus et circa styli rudimentum concavus; maturus sphaericus diametro 30–50 mm., glabratus nitidus flavescens, pericarpio crasse et sat rigide coriaceo-carnoso; semina in fructu vulgo 2–4 rarius 5, in pulpa flavida dulci adhaerente, 15–30 mm. longa 10–15 mm. lata 4–7 mm. crassa, obovato-oblonga valde compressa, testa fusca rugulosa parum nitidula, zona umbilicale pallidiore lineari apicem non attinente, embryone albumine abundanti incluso.

Habitat circa Manáos in silva primaria solo argilloso non inundabili, ubi florebat 27–7–1941, Ducke 813 et cum ligno 386; circa Belem do Pará visum. Inter hujus generis species amazonicas foliis subtus auratis ornatas pulcherrima, dignoscenda petiolis quam pedunculi floriferi multo longioribus,

foliorum laminis supra nitidissimis, floribus parvis, corolla post anthesin persistente, fructibus longe pedunculatis.

This tree is remarkable, not only for its beautiful foliage, but also for the strong hydrocyanic scent from every wounded part (except the ripe fruit), chiefly from bark and sapwood. Its flowers appear at intervals of several years. The stem is covered with a very regularly wrinkled bark; the branchlets are crowned by the foliage and bear the flowers exclusively on the inferior, aphyllous, part. The leaves have a brilliant and very dark green upper surface and a golden or bright cupreous under side; they have a remarkably long petiole, much longer than the peduncle of the flowers. The corollas are persistent under the young fruit, unlike nearly all the other Sapotaceae, where they are very caducous, falling soon after the opening of the flower. A wood sample with herbarium material will be forwarded to Yale.

The Genus *Chromolucuma* Ducke

Eyma (*l.c.*) does not mention this monotypic genus, but Baehni (*l.c.*) includes it in *Pouteria*. I do not know whether Baehni had ever seen living trees of *Chromolucuma;* it has its own "facies" and better differential characters than those distinguishing *Pouteria* from *Chrysophyllum*. It is evident, therefore, that *Chromolucuma* should not be suppressed without suppressing *Pouteria* also and including the species of all in a very large genus *Chrysophyllum*.

Chromolucuma rubriflora Ducke.—This tree is one of the prettiest Sapotaceae of the Amazon; it inhabits swampy upland forests along little streams, in the middle parts of the region, from Santarem to the Rio Negro. The large stipules, rather persistent on sterile branches, and the dry spongy mesocarp of the ripe fruit are very characteristic of this tree, which is also remarkable for its large leaves and bright red flowers. During the wet season the fruits can be found in large quantities floating in streamlets. The tree is one of the numerous species of Abiu-rana in Amazonian language, but, on the Upper Rio Negro, it has its own indigenous name, Maiá. A wood sample with herbarium material, from Manáos, is in the Yale collections (Ducke 12; Yale 20693).

Manilkara Adans. or *Mimusops* L.

The separation of *Mimusops* L. into two genera seems to have been accepted by most modern authors, for example, Baehni (*l.c.*), Eyma (*l.c.*), and Pulle ("Flora of Surinam"). I have observed, however, that of all the differential characters cited by the authors, only those of the seeds and of the leaves are constant, and not those of the flowers as alleged by Eyma. No difference was found in the structure of the woods. "In reference to your problem concerning the classification of certain members of the Sapotaceae, I have failed to find any anatomical character that will justify the separation of *Manilkara* and *Mimusops*. On the contrary, the woods of the two groups appear sufficiently homogeneous in appearance, properties, and structure to warrant their inclusion in a single genus. In fact the differences noted in the woods of the two genera are less pronounced than in those of different species of the same genus."—From letter of Professor Samuel J. Record, November 12, 1934.

The greatest difficulty in studying species of *Manilkara* on herbarium specimens is the high variability in size and shape of the leaves which often appear successively on the same tree in two very different season-forms. At the principal flowering period, usually at the end of the rainy season, branchlets densely covered with flowers have comparatively small and stiff leaves, often with rounded apex. At all other seasons, however, on the same tree few-flowered branchlets are sometimes observed with leaves similar to those of the sterile branches, namely comparatively large and thin and often a little acuminate at the apex. That was the case of *M. amazonica* Huber, whose herbarium type belonged to the second form, while *M. maparajuba* of the same author is nothing but a specimen proceeding from a tree in full flowering stage. The following species of *Manilkara* have hitherto been observed in Brazilian Amazonia:

1. *Manilkara Huberi* (Ducke) Chev.—Upland rain forest through the State of Pará, up to the eastern half of the State of Amazonas and northern Matto Grosso; Dutch and British Guiana, and Venezuela. Wood sample and herbarium material (Ducke 140; Yale 22600).

2. *Manilkara bidentata* (A.DC.) Chev.—Hill and mountain forest, in Brazil till now observed only in the extreme north of the state of Amazonas (certainly present also in the correspondent part of the State of Pará), Guiana, Venezuela.

3. *Manilkara excelsa* (Ducke) Chev.—State of Pará: middle course of Rio Tapajoz, chiefly along the cataracts in not too deeply flooded forest.

4. *Manilkara inundata* (Ducke).—Western and southern parts of the State of Amazonas, and northwest Matto Grosso, certainly also in the Acre Territory and in the Amazonian parts of Peru and Bolivia. "Varzea" forest, seldom in upland forest on moist and fertile clay loam.

5. *Manilkara amazonica* (Huber) Chev.—States of Pará and Amazonas, and parts of the State of Maranhão, in upland rain forests and in "varzea" forest, but exclusively on sandy soil. Also on sandy "campinas," and in this case occurring in a shrubby form with short and often broader leaves. Wood sample with herbarium material (Ducke 88; Yale 21347).

6. *Manilkara paraensis* (Huber) Chev.—Eastern part of the State of Pará, in swampy forests.

7. ***Manilkara longiciliata*** Ducke, sp. nov., vel ***Mimusops longiciliata*** Ducke, sp. nov.—Arbor ramulis crassis glabris, junioribus evidentissime pallido-lenticellosis, innovationibus resina incolore glutinosis. Foliorum petiolus vulgo 30–50 mm. longus, modice robustus, glaber; lamina vulgo 70–160 mm. (rarius 50–200 mm.) longa et 35–80 mm. lata, crasse coriacea at satis elastica, obovato-oblonga vel obovata, basin acutam versus longe cuneata, apice rotundata vel obtusa et saepe leviter emarginata, in utraque pagina glabra, solum in novissimis subtus tomento conglutinato microscopico sub lente inter venulas reticulatas glabras rufescentes pallidiore apparente, supra nitida, subtus vix pallidior plus minus nitidula, costa mediana subtus crasse prominente, costis lateralibus et venulis in utraque pagina tenuissimis et non raro parum conspicuis. Folia in exsiccatis praesertim subtus saepe strato albo ceroso siccitate exsudato induta. Flores cum foliis in parte terminali ramulorum in fasciculis densis et numerosis, albidi, praeter sepala interiora glabri, in alabastro glutinosi; pedicelli sub anthesi vulgo 18–25 mm. longi, patentes, tenues, apicem versus vix incrassati, lenticellati; sepala circiter 6 mm. longa, longe deltoidea, interiora in latere externo tenuiter canotomentella; corolla sepalis aequilonga, tubo brevi, lobis et appendicibus integris oblongis; staminodia angusta, longe bifida segmentis apice in ciliam longissimam et tenuissimam vulgo plus minus contortam protractis, denticulo laterali praesente vel absente; ovarium in floribus examinatis 6–8-loculare, glabrum. Fructus in pedicello vulgo 30–35 mm. longo valde robusto, suboblongo-globosus diametris circiter 30 × 25 mm., maturus subaurantiaco-luteus pulpa albida dulci sapida; semina 1 vel rarius 2 per fructum, brunnea, nitida, cicatrici ventrali brevi (circiter dimidium seminis longitudinis metiente), lineari, fortiter compressa, dorso carinata, dimensionibus 20–25 mm. × 12–13 mm. × 2–4 mm.

Esperança ad ostium fluminis Javary in civitate Amazonas, loco alto in relictis silvae. Mense Februario 1942 fructificabat, Maio florebat. Ducke 941.

This new species is at first view distinguishable by its large, coriaceous, glabrous, and shining leaves. Its flowers are glabrous (except for the inner sepals) like those of *M. amazonica*, but are considerably larger. The young branches are spotted with pale lenticels. The two lobes of the staminodes are long acuminate and the acumen is protracted in a very long and highly characteristic filiform appendix. The ripe fruit is of pretty orange color. The seeds resemble those of *M. Huberi*.

8. *Manilkara* sp., Ducke Herb. Jard. Bot. Rio de Janeiro 34989, from the swampy banks of the Macacuni, tributary of the Rio Negro on the Brazilian-Colombian boundary, is apparently the same species as Spruce 3351, from the Cassiquiare, described by Miquel under the name *Mimusops surinamensis*, in mixture with a specimen from Surinam. Eyma attributed the Surinam specimen to *M. bidentata*, but this is a hill-forest tree well known everywhere for yielding the best quality of balata and never found in swampy lowlands. Specimens of n. 34989 have been distributed under the name of *M. surinamensis*.

9. ***Manilkara Siqueiraei*** Ducke, sp. nov., vel ***Mimusops Siqueiraei*** Ducke, sp. nov.—Inter species *M. amazonica* et *M. longiciliata* intermedia, a prima differt foliis floribusque multo maioribus et foliis obovatis, ab ultima foliis saepe aliquanto minoribus et minus crassis, et praesertim staminodiorum laciniis apice non ciliatis. Arbor mediocris vel sat magna. Ramuli modice robusti, glabri. Folia glabra, petiolo saepe minime resinoso-squamuloso, in floriferis 30–40 mm. (rarius 50 mm.) longo modice robusto, lamina saepius 100–150 mm. (rarius 60–180 mm.) longa et 35–80 mm. lata, oblongo-obovata vel obovata, basi longe cuneata acuta, apice rotundata vel emarginata, coriacea subelastica, utrinque glabra plus minus concolore et nitida, nervatione ut in speciebus affinibus supra citatis. Cera exsudata in speciminibus nostris non adest. Flores et dimensionibus et characteribus caeteris similes iis speciei *M. longiciliata*, at staminodia simpliciter bifida ut in *M. amazonica*, cilia longa non ferentia; pedicelli insigniter lenticellosi. Fructus mihi hucusque non notus, dicitur edulis maturitate rubescens demum nigrescens.

Habitat in silva minus profunde inundabili secus ripas paludosas fluminum circa Belem do Pará et in insulis aestuarii amazonici, ubi cum speciebus allis "maparajuba" appellatur. Specimina florifera lecta ad flumen Magoary prope Belem, 15–6–1942, D. 945; specimina recentius deflorata prope flumen Aramá aestuarii amazonici, Augusto 1926 lecta.

This new species was hitherto confused with the common *M. amazonica* which occurs in the same region and is known by the same vernacular name, Maparajuba. *M. Siqueiraei*, however, seems to occupy a very limited geographical area, while *M. amazonica* is widely distributed through the hylaea. Two trees of *M. Siqueiraei*, in the garden of the Pará Museum, were introduced by the late Dr. J. Huber who cultivated them under the name of *M. amazonica* together with true exemplars of the last. It was Mr. Rodolpho Siqueira (botanical collector of Dr. Huber's who made valuable collections along the Bragança Railroad) who first noted the diversity of these trees and called my attention to the subject. The new species, therefore, has been named in honor of this old friend. Floriferous specimens were recently obtained from a tree growing on the flooded shores of the Rio Magoary in the Granja Magoary, through the kindness of one of its owners, Dr. F. Coutinho de Oliveira.

Although this species has been confused with *M. amazonica*, it is more closely allied to *M. longiciliata* of the western part of the hylaea. It is, however, easily distinguishable from that species by the lack of the long hair-like appendage of lacinies of the staminodia. Other differential characters will probably be discovered when fruits become available. The timber is good for fuel like that of *M. paraensis*, but is not so valuable for construction as that of *M. Huberi*.

The species of *Manilkara* or *Mimusops* of Brazilian Amazonia are known under the vernacular names Massaranduba and Maparajuba. The only exception is *M. bidentata*, whose name is Balata (sometimes Balata Grande, to distinguish it from the other, inferior, sorts of Balata trees appertaining to the genera *Ecclinusa* and *Micropholis* = *Sideroxylon*). *M. Huberi* is always called Massaranduba, and perhaps *M. longiciliata* is also; *M. paraensis* and *M. Siqueiraei*, always Maparajuba; *M. amazonica*, *M. excelsa*, and *M. inundata*, Massaranduba or Maparajuba, according to the local usage. The Massaranduba timber of the highest commercial value, exported from Pará, comes from *M. Huberi*.

Identity of Acana, Almique, or Doncella Wood

In *Tropical Woods* 59: 40 doubt was expressed as to the identity of the sapotaceous tree supplying the Cuban wood sold in small quantities in New York under the name of Acana and also as Doncella and Almique. The species listed there as possible sources are *Manilkara albescens* (Gris.) Standl., *Mimusops Wrightiana* Pierre, *M. discolor* Ekman, and *Manilkara jaimiqui* (C. Wr.) Dubard.

In the Yale collections there are two specimens of the wood in question that have sterile herbarium vouchers. The latter have been examined by Charles L. Gilly of the New York Botanical Garden, in connection with his study of *Muriea*, and he has determined them definitely as *Manilkara jaimiqui*. This is the wood described in *Timbers of Tropical America* (pp. 488–9) under the scientific name of *Labourdonnaisia albescens* Benth. — S. J. R.

SOME PHYSICAL PROPERTIES OF MODERN CABINET WOODS—III. DIRECTIONAL AND VOLUME SHRINKAGE [1]

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Every user of wood is conscious of the fact that fluctuations in atmospheric moisture affect the volume of dried wood. Window frames that rattle in the winter winds but which have to be forced open in hot, sultry summer weather, and floors which periodically open and close between the joints are familiar examples attesting to this phenomenon. The degree of shrinkage or swelling varies with different woods between rather broad limits, although the general behavior with respect to the relative magnitude in directional change is similar. Thus, dimensional changes along the grain for all woods are uniformly small, often negligible, except in a few instances. Changes across the grain, on the other hand, vary from 2 or 3 per cent to as much as 20 per cent when green wood is conditioned to an oven-dry state. Under identical conditions greater dimensional changes occur on tangential faces (flat-grain) than on radial sections (quarter-grain), with the latter usually about one-half to three-fifths that of the former.

In the accompanying table is set forth the per cent of directional and volume shrinkage for modern cabinet woods. The values for each species are based upon green dimensions and each is an average of 100 measurements made on 10 carefully prepared but randomly selected samples, 1″×1″×8″.

[1] For the first two papers in this series see *Tropical Woods* 68: 1–11, Dec. 1, 1941, and 70: 1–15, June 1, 1942.

PER CENT DIRECTIONAL AND VOLUME SHRINKAGE FROM GREEN TO OVEN-DRY CONDITION

Species	Longitudinal	Radial	Tangential	Volume
Aboudikro (Ivory Coast) *Entandrophragma cylindricum?*.	0.20	5.63	9.45	15.69
Alder, Red (U.S.A.) *Alnus rubra*	0.39	4.48	7.27	12.58
Allacede (Phil. Is.) *Wallaceodendron celebicum*	0.29	4.65	6.97	12.48
Almon (Phil. Is.) *Shorea eximia*	0.26	6.99	7.69	15.54
Amaranth (Trop. Amer.) *Peltogyne paniculata*	0.16	3.78	5.80	10.17
Amarello (Brazil) *Plathymenia reticulata*	0.18	6.07	6.31	12.94
Andiroba (Trop. Amer.) *Carapa guianensis*	0.28	5.44	8.23	14.57
Araçá (Brazil) *Terminalia* aff. *januarensis*	0.25	3.01	4.89	10.64
Ash, Japanese *Fraxinus mandschurica* and/or *F. Sieboldiana*	0.81	6.10	14.11	20.49
Ash, Silver (Australia) *Flindersia Schottiana*	0.22	5.76	8.27	13.58
Ash, White (2nd growth) (U.S.A.) *Fraxinus americana*	0.19	5.37	8.66	13.94
Aspen (Maryland, planted) *Populus canescens*	0.40	3.78	8.64	12.88
Avodiré (West Africa) *Turraeanthus africana*	0.24	4.03	6.19	10.64
Ayous (West Africa) *Triplochiton scleroxylon*	0.15	2.49	5.11	7.84
Beech, American *Fagus grandifolia*	0.39	4.23	9.88	15.84

Species	Longitudinal	Radial	Tangential	Volume
Birch, Black (U.S.A.) *Betula lenta*	0.34	6.23	8.47	15.69
Birch, Yellow (U.S.A.) *Betula lutea*	0.29	7.21	9.18	17.04
Blackbean, Australian *Castanospermum australe*	0.15	2.76	7.04	10.07
Bossé (West Africa) *Guarea cedrata*	0.20	3.50	5.96	9.83
Boxwood, Indian *Buxus sempervirens*	0.54	5.05	10.76	16.48
Bubinga (West Africa) *Copaifera* aff. *Tessmanii*	0.24	4.13	9.56	15.38
Butternut (U.S.A.) *Juglans cinerea*	0.46	3.31	6.47	10.34
Capomo (Trop. Amer.) *Brosimum Alicastrum*	0.25	5.12	9.40	15.36
Cherry, West African *Mimusops Heckelii*	0.19	5.30	7.80	13.72
Cherry, Black (U.S.A.) *Prunus serotina*	0.51	3.14	7.16	11.08
Coccobolo (Cent. Amer.) *Dalbergia retusa*	0.21	2.65	4.26	7.20
Ebony, Macassar (Dutch E. I.) *Diospyros macassar*	0.09	5.20	9.14	14.89
Fir, Douglas (old growth, yellow) *Pseudotsuga taxifolia*	0.28	4.91	7.82	12.88
Framerie (West Africa) *Terminalia ivorensis*	0.23	4.63	6.18	14.18
Gaboon (West Africa) *Aucoumea Klaineana*	0.39	5.63	6.10	12.62
Garapa (Brazil) *Apuleia praecox*	0.91	4.53	8.11	13.95
Gonçalo Alves (Trop. Amer.) *Astronium fraxinifolium*	0.23	5.63	8.33	14.70

Species	Longitudinal	Radial	Tangential	Volume
Greenheart (Br. Guiana) *Ocotea Rodiaei*	0.22	3.41	4.22	8.00
Guapinol (Trop. Amer.) *Hymenaea courbaril*	0.27	3.00	5.22	8.65
Gum, Red (U.S.A.) *Liquidambar styraciflua*	0.32	5.61	10.31	15.34
Hackberry (U.S.A.) *Celtis occidentalis*	0.41	5.21	9.11	14.22
Harewood, English *Acer pseudoplatanus*	0.38	3.31	8.45	12.46
Holly, American *Ilex opaca*	0.33	8.25	11.56	20.77
Iroko (West Africa) *Chlorophora excelsa*	0.21	3.44	4.77	8.49
Koa (Hawaii) *Acacia koa*	0.49	5.47	6.19	12.39
Koko (Andaman Is.) *Albizzia Lebbeck*	0.14	2.78	6.62	9.74
Lacewood (Australia) *Cardwellia sublimis*	0.28	3.79	7.20	11.47
Lauaan, Red (Phil. Is.) *Shorea negrosensis*	0.29	3.27	8.04	11.86
Laurel, California *Umbellularia californica*	0.31	3.04	8.26	12.14
Laurel, East Indian *Terminalia tomentosa*	0.31	5.87	8.98	15.43
Limba (West Africa) *Terminalia superba*	0.27	5.13	8.06	14.37
Macacaúba (Brazil) *Platymiscium polystachyum*	0.18	4.63	6.42	11.51
Mahogany, African *Khaya ivorensis*	0.28	4.96	8.36	16.88
Mahogany, Colombian *Swietenia macrophylla*	0.18	2.46	3.80	6.53

Species	Longitudinal	Radial	Tangential	Volume
Mahogany, Cuban *Swietenia mahagoni*	0.23	2.43	4.47	7.14
Mahogany, St. Jago *Swietenia mahagoni*	0.19	3.19	4.13	7.89
Mahogany (Peru) *Swietenia macrophylla*	0.14	3.15	4.39	8.07
Mahogany (San Domingo) *Swietenia mahagoni*	0.26	2.06	2.91	5.22
Mansonia (West Africa) *Mansonia altissima*	0.16	4.63	6.42	11.51
Maple, Australian *Flindersia Brayleyana*	0.32	3.74	8.36	15.47
Maple, Bird's-eye (U.S.A.) *Acer saccharum*	0.58	5.61	9.18	15.89
Maple, Curly (U.S.A.) *Acer saccharum*	0.44	5.32	9.56	12.40
Maple, Hard (Straight-grained) *Acer saccharum*	0.49	5.17	9.32	14.32
Movingui (West Africa) *Distemonanthus Benthamianus*	0.26	3.08	5.18	10.66
Narra (Phil. Is.) *Pterocarpus indicus*	0.44	2.54	3.63	6.81
Oak, American red (2nd growth) *Quercus* spp.	0.37	4.02	8.14	14.76
Oak, American white (2nd growth) *Quercus* spp.	0.31	4.93	9.18	15.14
Oak, English brown (old growth) *Quercus robur*	0.48	4.27	9.25	14.26
Orientalwood (Australia) *Endiandra Palmerstoni*	0.30	4.54	8.55	13.74
Padouk, African *Pterocarpus Soyauxii*	0.14	3.81	4.41	8.52
Padouk, Andaman *Pterocarpus dalbergioides*	0.18	3.50	4.06	7.94

Species	Longitudinal	Radial	Tangential	Volume
Paldao (Phil. Is.) *Dracontomelum dao*	0.26	4.15	8.55	13.31
Palosapis (Phil. Is.) *Anisoptera thurifera*	0.20	4.65	7.61	13.37
Pearwood (Europe) *Pyrus communis*	0.18	4.30	14.65	19.79
Pecan (U.S.A.) *Carya pecan*	0.23	5.04	9.26	14.18
Peroba, White (Brazil) *Paratecoma peroba*	0.12	3.41	6.20	9.82
Poplar, Yellow (U.S.A.) *Liriodendron tulipifera*	0.19	4.04	7.11	11.89
Primavera (Central Amer.) *Cybistax Donnell-Smithii*	0.13	4.23	5.05	9.62
Redcedar, Eastern (U.S.A.) *Juniperus virginiana*	0.16	2.48	4.27	8.92
Rosewood, Brazilian *Dalbergia nigra*	0.10	3.41	7.70	12.31
Rosewood, East Indian *Dalbergia latifolia*	0.11	2.10	5.71	7.18
Rosewood, French (Madagascar) *Dalbergia Greveana*	0.09	3.25	5.38	9.17
Sapele (West Africa) *Entandrophragma cylindricum*	0.19	5.91	7.42	13.99
Satinwood, Ceylon *Chlorophora Swietenia*	0.12	5.71	8.51	14.94
Satinwood, West Indian *Zanthoxylum flavum*	0.17	6.12	9.18	15.18
Satiny, Red (Australia) *Syncarpia Hillii*	0.57	7.06	7.96	16.93
Sycamore, American *Platanus occidentalis*	0.33	4.96	7.84	14.77
Tabasara (Trop. Amer.) *Prioria Copaifera*	0.29	2.21	7.31	9.87

Species	Longitudinal	Radial	Tangential	Volume
Taku (Trop. Amer.) *Diplotropis guianensis?*	0.24	1.21	2.63	3.86
Tangile (Phil. Is.) *Shorea polysperma*	0.37	4.47	7.84	12.53
Teak (Java) *Tectona grandis*	0.15	6.36	9.55	16.34
Tigerwood (West Africa) *Lovoa Klaineana*	0.34	5.32	8.78	13.64
Tulipwood (Brazil) *Dalbergia* aff. *variabilis*	0.12	4.53	13.03	18.32
Walnut, Black (U.S.A.) *Juglans nigra*	0.23	5.14	8.34	12.08
Walnut, Circassian (Europe) *Juglans regia*	0.29	6.04	9.91	13.58
Yuba (California, planted) *Eucalyptus globulus*	0.62	8.33	17.69	28.28
Zebrawood (West Africa) *Macrolobium* sp.	0.40	4.87	10.24	15.90

Note on the Wood of *Macroule*

According to Ducke (*As Leguminas da Amazonia brasileira*, p. 106), the wood of *Ormosia Coutinhoi* (which Pierce makes the type of a new genus, *Macroule*) is gray, coarse-textured, fibrous, and moderately dense (sp. gr. 0.70). This applies to the specimen he obtained (Yale 40083; Ducke 352), which apparently is all sapwood.

Two samples of Korokororo from the British Guiana Forest Department were collected with herbarium material determined by Sandwith at Kew as of this species. The heartwood is orange-brown, with darker striping, a waxy appearance, and a golden luster in proper light. It is moderately hard and heavy and bears some resemblance to *Bowdichia*. It appears suitable for furniture but is not utilized locally. In a recent letter the Conservator says:

"The species occurs frequently in Wallaba forest on the white sand peneplain and even semi-gregariously in the eastern districts in a type of semi-monsoon forest which is widespread in the Maicony area. The tree grows to a height of 110 feet and a diameter of three feet, unbuttressed, but with a swollen base." — S. J. R.

RETENTION OF CREOSOTE OIL IN THE WOOD OF *PINUS OCCIDENTALIS* SWARTZ

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The Duke University School of Forestry in collaboration with the United States Tropical Forest Experiment Station in Puerto Rico has initiated a program of research dealing with the determination of pertinent physical-mechanical properties of important tropical American timbers. One phase of this program is concerned with the behavior of certain of these woods in the treating cylinder. This paper reports the results of a series of oil impregnation experiments using wood of *Pinus occidentalis* Swartz from Haiti.

Selected trees were felled and bucked into four-foot lengths and then sawn into flitches in accordance with A.S.T.M.[1] recommendations. After coding, the flitches were wired into bolt form and end-coated with tar to minimize drying and checking during shipment. The flitches, upon their arrival, were sawn and dressed into pieces of standard dimensions used in ascertaining strength data. The surplus heartwood was cut into 3″×3″×24″ columns, numbered, painted with a 2 per cent solution of mercuric chloride to prevent the activity of blue stain fungi, and then stacked in open cribs for two months to permit drying.

Using Tippett's random sample numbers, four sets of four pieces each were drawn from the air-dried stock for use in the pressure cylinder. The moisture content (12 to 16 per cent) of each piece was determined with a Tag-Hepenstal

[1] American Society for Testing Materials. Standard Methods of Testing Small Clear Specimens of Timber, D143, 1927.

TABLE I. TREATING SCHEDULES

Process	Run	Preliminary vacuum		Preliminary air pressure		Oil pressure		Final vacuum	
		Time in hours	Inches of mercury	Time in hours	Pounds per square inch	Time in hours	Pounds per square inch	Time in minutes	Inches of mercury
Bethel	1	1	28	–	—	4	200	5	26
Rueping	2	–	—	1	150	2	200	30	27
Bethel	3	1	28	–	—	2	200	5	27
Rueping	4	–	—	1	150	2	200	30	27

resistance meter. Four experimental runs, simulating industrial practices as nearly as possible, were made using No. 1 creosote oil with schedules as indicated in Table I.

Table II presents the observed physical data for each specimen treated, together with calculated oil retention per cubic foot of material.

Results of this study indicate that the wood of Haitian Pine will accept adequate amounts of oil using standard industrial practices. Specimens treated by means of the Bethel process absorbed oil to the point of refusal suggesting that a shorter pressure period could have been used and that suitable penetration in materials of larger dimensions may be anticipated. The average oil retention for the four pieces of Run No. 1 was 30.48 lbs./cu. ft. and that for Run No. 3 26.32 lbs./cu. ft., retentions far above those specified as minimum by the American Wood-Preservers' Association. The average retention, however, for the two runs in which the Rueping process was employed, was only 7.46 and 5.68 lbs./cu. ft., respectively. These are minimum and it is recommended that somewhat longer pressure periods should be used than those currently employed.

Acknowledgements are due Mr. L. R. HOLDRIDGE, Société Haitiano-Américaine de Développement Agricole, Port-Au-Prince, Haiti, for his kindness in supplying the timber used in this study.

TABLE II. SPECIMEN DATA

	Run No. 1 Bethel Process				Run No. 2 Rueping Process				Run No. 3 Bethel Process				Run No. 4 Rueping Process			
Specimen number	4	11	17	27	10	20	7	14	25	12	18	5*	23	6	8	13
Moisture content %	14	14	12	12	16	14	12	12	14	11	12	14	12	13	12	12
Air-dry weight in lbs.	5.49	6.21	5.28	5.30	6.02	5.61	5.98	4.83	5.51	6.08	5.67	6.01	5.49	5.93	6.06	4.95
Vol. of specimen in cubic feet	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Oil retention in lbs.	3.77	3.55	3.78	4.13	0.81	0.89	0.78	1.25	9.54	9.65	9.57	7.66	0.59	0.66	0.82	0.71
Calculated oil retention, lbs./cu. ft.	30.16	28.40	30.32	33.04	6.48	7.12	6.24	10.00	32.24	28.56	31.20	13.20	4.72	5.28	6.56	6.24

NOTE.—Specimens in runs No. 3 and No. 4 were encased between steel end plates to minimize end penetration.

CURRENT LITERATURE

Itinéraires botaniques dans l'île de Cuba (première série). By Frère Marie-Victorin and Frère Léon. *Contrib. Inst. Bot. Univ. Montréal* 41: 1–496; 287 figs., 1 folded map; 1942.

The two authors are phytogeographic taxonomists, one the Director of the Botanical Institute of the University of Montreal and of the Botanical Garden of Montreal (Canada), the other the Director of the Botanical Laboratory of La Salle College (Havana). Their copiously illustrated report is in the form of a journal of botanical excursions of about sixteen weeks (1938–39) in the most favorable localities in Cuba, or those with the richest flora. The objectives were to collect herbarium specimens for La Salle College and living plants for the Botanical Garden of Montreal and to photograph the vegetation. There are two introductory chapters by Brother Léon, entitled "Indications géographiques, physiographiques et géologiques" (pp. 4–8) and "Aperçu phytogéographique" (pp. 9–17). The "Journal de Route" was written by Brother Marie-Victorin, who also made the photographs, but the taxonomic work was done by Brother Léon. The authors express the hope that the account of their botanical excursions will serve as a sort of hand book for travelling botanists who wish to visit the same localities and will give them a foretaste of "the voluptuous and fecund life which animates the tropical world."—Mary Record.

A new genus of Rubiaceae from Mexico. By Maximino Martinez. *Bull. Torrey Bot. Club* (New York) 69: 6: 438–441; 11 figs.; June 1942.

Balmea Stormae Martinez is a shrub 13 to 30 feet tall and 6 to 8 inches in diameter growing in dry stony places near Uruapan, Michoacán, Mexico. "This plant, with its brilliant scarlet-red flowers, has long been a favorite of the people of the region and is locally known as Ayuque." It is closely related to *Cosmibuena* and *Blepharidium*. The following description of the wood is supplied by the reviewer.

Wood whitish or slightly yellowish throughout specimens (Yale 40,400; Martínez 3400). Fairly lustrous. Without distinctive odor or taste. Light in weight, but firm, having about the consistency of White Pine (*Pinus strobus* L.); texture medium-fine, uniform; grain straight; very easy to work; poorly resistant to decay and subject to sapstain. Presumably of no commercial importance because of the small size of the stems.

Growth rings indistinct. Pores small (10μ); rather few; mostly in small multiples, well distributed. Vessels with simple perforations; pits vestured, small (4μ), alternate. Rays 1 to 3 cells wide and up to 20 cells high, sometimes vertically fused; decidedly heterogeneous, the procumbent cells occupying a low central stratum with tall margins of mostly upright cells; ray-vessel pitting very fine, frequently unilaterally compound. Wood parenchyma sparingly paratracheal. Wood fibers with large cavities and very numerous small bordered pits. Ripple marks absent. No gum ducts seen.

A new genus of the Anacardiaceae from Colombia. By Fred A. Barkley. *Bull. Torrey Bot. Club* (New York) 69: 6: 442–444; 2 figs.; June 1942.

Ochoterenaea colombiana Barkley is a tree about 65 feet tall growing in dense forests in the mountains of El Valle, Colombia. "The pith is thick, similar to that of *Rhus*. The branches are densely puberulent, as are the leaves and inflorescences. The flowers have five persistent sepals, five caducous petals, five stamens, a prominent disk, and a tricarpillary pistil. The fruit is outstanding, being a samara-like drupe remindful of *Pseudosmodingium*, but bearing long violet-colored hairs similar to that of the fruit of *Actinocheita*, but limited to the margins of the fruit much as in *Heliocarpus*."

Contribuciones a la geobotanica ecuatoriana. Anotaciones sobre la vegetación del norte de Quito) desde Cotocollao y San Antonio hasta el Río Guayllabamba. By M. Acosta Solís. Imp. de la Universidad Central, Quito, March 25, 1942. Pp. 120; 7 x 10¼; 2 maps, 30 plates with 41 photos.

This work (with summaries in Spanish, English, French, and German) is based on several excursions by the author during 1937–1938. Part I deals with the natural vegetation

and the various factors affecting it, with classified lists of the plants and many illustrations. Part II is concerned with agriculture of the region, with suggestions for its advancement.

La balsa: árbol de la floresta ecuatoriana. By Rodrigo Orellana B. Pub. by Sucursal Mayor del Banco Hipotecario del Ecuador, Quito, 1942. Pp. 23; 7½ x 11½; 12 text figs.

An illustrated account of Balsa (*Ochroma*) under the following headings: Historical notes on the wood; regions of production; economic importance; characteristics and uses; botanical features; conditions affecting growth of the trees—climate, soil, planting, cultivation, "macho" and "hembra" kinds, associated plants, felling; seasoning the lumber; commercial grading; enemies and defects; statistics of exports; cost of reforestation; and laws for conservation of Balsa and Kapok.

Uma Bignoniaceae pouco conhecida. By J. G. Kuhlmann. *Rodriguesia* (Rio de Janeiro) 5: 14: 365–366; 2 plates; 1941.

A large liana, previously known as *Adenocalymma elegans* Vell., proves, upon examination of the fruit, to belong to the genus *Pseudocalymma*.

Journal of the Arnold Arboretum (Jamaica Plain, Mass.) 23: 2: 133–265; April 1942.

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A list of diagnostic characteristics for descriptions of dicotyledonous woods. By Oswold Tippo. *Trans. Illinois Acad. Sci.* 34: 2; December 1941.

"During the course of investigations of the wood anatomy of a number of dicotyledonous families, the writer has had occasion to compile an extensive list of the important diagnostic features of wood. In the belief that this compilation may be of use to beginners, and perhaps of some interest to professional wood anatomists, the writer has prepared it for publication. This catalogue includes the important phylogenetic features as well as those whose phyletic value is not yet established, but which have proven to be of taxonomic import. As far as the writer knows, but two other lists of this character have been published. Clarke has designed a short list for a card sorting device and Record and Chattaway have published a more extensive list for the same purpose."

Comparative anatomy of the secondary xylem in the "Gruinales" and "Terebinthales" of Wettstein with reference to taxonomic grouping. By Charles Heimsch, Jr. *Lilloa* (Buenos Aires) 8: 83–198; 17 plates with 110 photomicrographs; 1942.

A comprehensive survey of the wood structure of 37 families of the Geraniales and Sapindales with special reference to their natural relationships. A few of the author's conclusions are: The Burseraceae and Anacardiaceae are closely related. The Julianiaceae are close to the Anacardiaceae, but the Juglandaceae are apart from both groups. The Simarubaceae may not be a natural group. *Rhabdodendron* does not belong in the Rutaceae. *Akania* and *Didierea* should not be placed in the Sapindaceae. *Ctenolophon* can be placed in the Linaceae but is nearer to the Humiriaceae. The Erythroxylaceae should not be united with the Linaceae. *Balanites* seems out of place in the Zygophyllaceae. *Krameria* and

Diclidanthera belong to the Polygalaceae, but *Xanthophyllum* differs from others of that family. Following are the author's general conclusions:

"Engler's division of the Geraniales and the Sapindales on the basis of the nature of the ovule attachment is not supported by wood structure of the families involved in that closely related families are separated by drawing such a distinction.

"Wettstein's orders Gruinales and Terebinthales agree with evidence from xylem structure more closely, but the families Tremandraceae, Polygalaceae, Xanthophyllaceae, and Vochysiaceae of the Terebinthales are closest to certain of those in the Gruinales; as indicated, other families of the Terebinthales could belong in the group but their relationships to the basic families are vague, and still other families should be excluded.

"Hutchinson's subphylum 'Pinnatae' contains families which show no apparent relationship on structural grounds to the principal families of the complex.

"Hallier's group Terebinthinae includes, among others, all of the major families under consideration with pinnate leaves except the Sapindaceae, and his system stands favorably in contrast to the other systems in that many small families whose relationships to these larger families is debatable, both from the standpoint of anatomical and morphological evidence, are not included in the Terebinthinae."

F. T. Chattaway

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AMERICAN TIMBERS OF THE GENERA *DALBERGIA* AND *MACHAERIUM*

By SAMUEL J. RECORD

About 200 species of *Dalbergia* have been described and some 15 of them yield timbers with excellent technical qualities, attractive color and grain, and a mild rose-like fragrance. Most, if not all, of the true Rosewoods known to the cabinetmaker are of the genus *Dalbergia;* to what extent species of *Machaerium* in southeastern Brazil are concerned is yet to be determined.

The Rosewood of Thailand and Cochin China is *Dalbergia cochinchinense* Pierre; the two principal kinds from Madagascar are *D. Greveana* Baill., exported from Majunga and Morandava, and *D. Baroni* Baker, from Tamatave. Other Old World timbers supplied by species of *Dalbergia* are: Blackwood, famed in oriental furniture and said to be the

same as the Rosewood of southern India, *D. latifolia* Roxb.; and African Blackwood or Senegal Ebony, *D. melanoxylon* G. & P., which is used in making musical instruments and in carving.

In South America there are at least four, probably more, species of *Dalbergia* of economic value for their timber, and they are all Brazilian. Rosewood from the coastal forests is *D. nigra* Fr. Allem.; that from the lower Amazon is *D. Spruceana* Benth. Tulipwood is undoubtedly a *Dalbergia*, but the species is uncertain. According to the best information available, Kingwood is *D. cearensis* Ducke.

The other American species known to commerce are practically confined to Central America, although the botanical ranges extend into southwestern Mexico and probably into northwestern Colombia. Best known is Cocobolo, typified by *Dalbergia retusa* Hemsl., of the Pacific coast, principally of Panama, Costa Rica, and Nicaragua. Honduras Rosewood, which is used in the United States for the bars of marimbas and xylophones, is *D. Stevensonii* Standl. of southern British Honduras. The Rosewood of eastern Guatemala and Honduras is *D. cubilquitzensis* (D. Sm.) Pitt.; it is esteemed locally for furniture and cabinet work, but apparently is not exported. There are other species in the uplands of Central America and southern Mexico and their woods are of excellent quality, but they appear to be rare and have only domestic utility.

Although most of these Dalbergia woods have been in use for a long time and are well known to the trade, the determination of their botanical identities has been slow and difficult and the task is still far from ended. *Dalbergia retusa* was described by Hemsley in 1898, but the fact that the tree was the source of the Cocobolo of commerce was discovered by Dr. H. Pittier about 1911 and published in 1918. Similar timber from Costa Rica and Nicaragua was exported as Rosewood and for a considerable time was not accepted by the trade as genuine Cocobolo. Through botanical material supplied by exporters in those countries it was determined that the woods in question were from the same species as the original and that there was no basis for the discrimination against

them. Subsequently the principal demand shifted to Costa Rica and Nicaragua because the logs available were larger and better formed. Later laboratory studies at Yale served to extend the range of Cocobolo north into Mexico.

In Timbers of Tropical America (1924) I stated (p. 278) that *Dalbergia* produces, among others, Honduras Rosewood and "probably, also, the true Kingwood of Brazil." This opinion was based on a study of the woods, for it later developed that both were undescribed species. Violete, which is believed to be the Kingwood of commerce, was named *D. cearensis* by Dr. Adolpho Ducke in 1925 (see *Tropical Woods* 6: 25). Honduras Rosewood was designated *D. Stevensonii* by Mr. Paul C. Standley in 1927 (see Tropical Woods 12: 4) in honor of Mr. Neil S. Stevenson who was the first to collect flowering specimens. Leaves of the Honduran tree had been procured for me in 1923 by Mr. W. N. Bourne of Punta Gorda, but taxonomists were unable to distinguish them with certainty from *D. retusa*, although the woods of the two species are readily separable.

My efforts to identify the tree supplying Brazilian Tulipwood began in 1918 and have continued intermittently ever since, still without complete success. My greatest help was from Messrs. Mauderli & Co., Bahia, who, at the suggestion of Mr. Pearson, President of the C. H. Pearson & Son Hardwood Company, of New York and Brooklyn, sent me wood and leaf specimens in September 1929. The latter were determined by Mr. Standley as being near to, if not identical with, *Dalbergia variabilis* Vog. This species is usually described as a climber, but this does not rule it out, since in some species of *Dalbergia* (*e.g.*, *D. melanoxylon*) certain individuals are known to be small erect trees whereas others are more or less scandent.

The identification of the Rosewood of eastern Guatemala and northern Honduras as *Dalbergia cubilquitzensis* (D. Sm.) Pitt. is based upon material that Mr. Henry Kuylen and I collected in 1926 and 1928. This tree was first described by Mr. John Donnell Smith as a mere variety of *D. variabilis*. There is a question as to the identity of a purple-and-black wood from southwestern Mexico, where it is known as Grana-

dillo. A sample of it accompanied some herbarium material determined as *D. granadillo* Pitt., but this is probably incorrect, as this species appears to produce a kind of Cocobolo and may not be specifically different from *D. retusa*.

The American tree species of *Dalbergia* have odd-pinnate leaves, usually with few to several medium-sized to rather large alternate leathery leaflets, or sometimes (*e.g.*, *D. nigra*) numerous small ones. The flowers are white or yellow and are borne in clustered or panicled racemes which are axillary or terminal. The fruit is a thin, flat, somewhat leathery, indehiscent pod, commonly with one centrally located seed.

The woods have many features in common, but appear to be readily separable into species or specific groups, the most noticeable differences being in the color variegations and the nature of the gummy or resinous material of the heartwood. Fresh heartwood has a rather pronounced rose-like scent, and even old specimens have a mild fragrance when worked. The sapwood is white or yellowish and sharply demarcated. The timber is typically hard, heavy, and strong, though frequently brittle. Specific gravity is materially affected by the amount of resinous infiltrations and ranges from 0.75 to 1.22, mostly 0.85 to 1.10 (air-dry); equivalent weights 47 to 75, mostly 53 to 69, pounds per cubic foot. The texture ranges from fine to rather coarse and the grain varies from straight to irregular. The waxy nature of the cell contents permits ease of working and polishing, reduces response to atmospheric changes, and provides high resistance to decay.

Brazilian Rosewood (*Dalbergia nigra* Fr. Allem.) has been known to commerce for about three centuries. It was formerly in considerable demand in the United States for making piano cases and other kinds of fine furniture and cabinet work, but in recent years its principal uses have been carpenters' spirit levels and plane handles, and the backs of hair brushes. The species is of scattered occurrence and large trees are very scarce in the more accessible localities of the States of Bahia, Rio de Janeiro, Espirito Santo, and the adjoining rain forest of Minas Geraes, but there are still considerable quantities further inland. Heartwood is slow in forming and the sapwood is thick and valueless for furniture. The deeply colored, richly

variegated lumber with the most pronounced fragrance is the product of old, often defective stems, whereas the heartwood of young, sound trees is brown and not attractively figured. The usual local generic names are Jacarandá and Caviuna, and there are many qualifying terms to indicate the prevailing color or other attributes of the wood.

Growth rings present but not always distinct without lens; color bands, not corresponding to seasonal growths, often conspicuous. Pores large in part, rather few, and irregularly scattered. Some of the vessel lines prominent because of their size. Rays mostly 2 or 3 cells wide and 8–10 cells high; heterogeneous in part, the marginal cells often enlarged, square or irregular in shape. Parenchyma very uneven in abundance and arrangement even in the same specimen; in part loosely aliform and confluent, merging into reticulate; also finely terminal. Wood fibers in dark-colored parts often completely filled with gum. All elements storied; ripple marks fairly uniform; about 125 per inch.

COMMON NAMES: Brazilian rosewood, palisander (Engl.); caá-biuna, cabeuna, cabiuna, c. parda, c. preta, c. roxa, cabiuva, camboré, camboriuna, caviuna, jacarandá, j. branco, j. cabiuna, j. preto, pau preto, uraúna (Braz.).

Amazon Rosewood. The Rosewood of the lower Amazon (*Dalbergia Spruceana* Benth.) is known in Brazil as Jacarandá do Pará. It grows on comparatively dry land and supplies a limited amount of moderately large timber of good quality. The heartwood of the only authentic specimen in the Yale collections (Yale 22610; Ducke 150) is a rich golden brown with a fine striping of red or violet, darkening upon exposure to the air and light. It is mildly scented, weighs 63 lbs. per cu. ft., is not difficult to work, and finishes attractively. It is an excellent cabinet wood, but is probably too scarce to be important in the export trade.

Growth rings marked by fine layer of parenchyma. Pores few, nearly all fairly large, mostly solitary, unevenly distributed. Rays 1 or 2 (3) cells wide and not over 8 cells high; commonly homogeneous. Parenchyma very finely reticulate; also irregularly vasicentric and terminal. Ripple marks about 130 per inch; all elements storied.

COMMON NAMES: Jacarandá, j. do Pará, saborana (Braz.).

Brazilian Kingwood has been familiar to the cabinetmakers of Europe and the United States for a long time, but there is still some question as to its scientific name, though it

appears to be *Dalbergia cearensis* Ducke (see *Tropical Woods* 28: 1–3. 1931). The tree, which is slender and of low stature, occurs in the dry country of Ceará. The timber is exported in sticks 3–6 feet long and 3–8 inches in diameter, with the sapwood removed, and is used for inlays, marquetry, and small articles of turnery. The heartwood is finely striped, being composed of alternating layers of violet-brown and black or blackish violet, the darker bands so narrow and uniform as to give the appearance of late wood in seasonal growth rings. It weighs about 75 lbs. per cu. ft. (air-seasoned) and is very hard and heavy, but brittle. The texture is fine and uniform and the working properties are good.

Growth rings delimited by narrow band of parenchyma, and sometimes by differences in porosity. Pores fairly numerous, the largest medium-sized. Vessel lines fine and inconspicuous. Rays 1 or 2 (3) cells wide and ranging in height up to 25 or more cells; nearly homogeneous. Parenchyma paratracheal, irregularly confluent, and more or less reticulate, but scarcely distinct with lens; also finely terminal. Ripple marks very fine, about 175 per inch; all elements storied, but many of the rays occupy more than one tier.

COMMON NAMES: Kingwood, Brazilian kingwood (U.S. trade); violete (Braz.).

Brazilian Tulipwood was a favorite in the composition of French furniture, especially of the Empire period, and is still employed in a small way for inlays, marquetry, brush backs, and articles of turnery. The tree has a short irregular trunk, slender branchlets, and odd-pinnate leaves with about seven leaflets, and is probably a form of *Dalbergia variabilis* Vog. Flowers and pods are necessary for its final determination. Some of my Brazilian friends have suggested that the name *D. cearensis* may belong to this tree instead of to Kingwood, but no material evidence has been produced in substantiation. At least one thing is certain: Tulipwood is not *Physocalymma* (Lythraceae) as so generally stated in literature.

The timber is brought by rail to Bahia, the chief port of shipment for that region, in the form of logs or billets, mostly less than 6 feet long and 2–8 (12) inches in diameter, free of sapwood. The heartwood is irregularly striped, the prevailing colors being yellow, rose, and violet, usually with the yellow predominant. It is beautiful when freshly manufactured, but

the colors gradually fade. Dry heartwood weighs from 56–69 lbs. per cu. ft., and is very hard and strong. It is not easy to work and tends to be splintery, but it takes a high natural polish and is durable.

Growth rings distinct, with local tendencies to ring-porous structure. Larger pores visible, few, solitary, and more or less zonate; others small, fairly numerous, uniformly or irregularly distributed. Vessel lines inconspicuous. Rays 1 or 2 cells wide and usually less than 10 cells high; nearly homogeneous. Parenchyma variable in same specimen; vasicentric, aliform, diagonally confluent, diffuse, locally reticulate, and finely terminal. Ripple marks very fine, about 160 per inch; all elements storied.

COMMON NAMES: Tulipwood, Brazilian tulipwood (Eng.); cego machado, grão do porco (?), pau cravo, p. rosa, p. rosada, sebastião de arruda (Braz.).

Cocobolo has been in use in the United States, particularly for handles of cutlery, for more than 65 years. It was first introduced into trade from Panama, but the principal sources now are western Costa Rica and Nicaragua. It also grows in western Honduras and Guatemala, Salvador, and southwestern Mexico, and has recently been reported from northwestern Colombia (see *Tropical Woods* 70: 39. 1942). Several doubtfully distinct species have been described (see *Tropical Woods* 65: 41. 1941), but so far as the anatomy, properties, and utility of the timber is concerned, Cocobolo throughout its range may be considered as a single species, *Dalbergia retusa* Hemsl. The woods from different countries do not exhibit greater differences than can be found in several specimens from the same region. Dealers profess no difficulty in distinguishing the source of a given lot of logs, but they do so through observance of such features as size, shape, defects, and manner of hewing.

The color of the heartwood is subject to wide variations. Some pieces of it are veritably rainbow-hued, but upon exposure to sunlight the yellow and orange lose their brilliance and merge into deep red with purplish black stripes and mottling. Kitchen knife handles are usually dark red with more or less striping at first, becoming nearly black eventually from frequent submerging in soapy water. The coloring matter of fresh wood tends to leach out and cause stains, but some specimens

seem much worse in this respect than others. The fine dust arising in manufacturing carries small particles of oil which may produce a rash or dermititis on exposed parts of the body of susceptible workmen, but there is no evidence that there is the slighest danger in handling the solid wood.

Cocobolo is a dense, uniform-textured wood, weighing (air-dry) 60–77, av. about 69, lbs. per cu. ft. Because of its oily nature, it is easy to work and to polish, holds its shape well when manufactured, and is highly durable, but is unsuited for gluing. If a smooth surface is rubbed with a cloth it acquires a waxy, natural finish without the application of oil, wax, shellac or filler. Besides knife scales, its uses include small tool handles, brush backs, inlay work, parts of musical and scientific instruments, and many articles of turnery. (For a comprehensive report, see Yale School of Forestry Bull. No. 8, *Cocobolo*, by Record and Garratt.)

Growth rings present; variations in color are independent of seasonal growth. Pores rather few; variable in size from fairly large and distinct to small and indistinct; mostly solitary. Vessel lines usually prominent, especially in light-colored areas; lustrous gum deposits abundant. Rays nearly all uniseriate in some specimens, 1 or 2 (3) cells wide in others; height typically less than 10 cells; homogeneous or nearly so. Parenchyma finely reticulate; also narrowly vasicentric and terminal. Ripple marks 110–160, av. 130, per inch; all elements storied.

COMMON NAMES: Cocobola, cocobolo, Nicaragua rosewood (Eng.); granadillo (Mex.); funera (Salv.); granadillo, palo negro (Hond.); ñambar, ñ. legitimo (Nic.); cocobolo, c. ñambar, c. negro, ñabma, ñambar, nnambar (C. R.); cocobolo, c. prieto (Pan.); cocobolo, palisandro (Col.).

Honduras Rosewood. The Rosewood of British Honduras (*Dalbergia Stevensonii* Standl.) has been an article of commerce for more than a century as there is a record of 118 pieces being exported in 1841. The tree attains a height of 50–100 feet and its trunk, which often is fluted, commonly divides at about 20–25 feet above the ground. The present known range is restricted to the moist forests in the Toledo District from the Sarstoon River northward to Monkey River.

The sapwood of mature trees is 1–2 inches thick, white with yellow vessel lines when first cut, but soon turning yellow. The heartwood is not oily and is of a pinkish brown or purplish color, with alternating light and dark zones. When thoroughly air-dry it weighs 58–68 lbs. per cu. ft. Its principal use is for making the bars of percussion musical instruments and the trade prefers light-colored, straight-grained wood in bolts 4–6 feet long and not less than 10 inches in diameter, hewn free of sapwood. Incidently, the wood used in marimbas in Guatemala is not Rosewood (*Dalbergia*) but *Platymiscium*, which is much the same as the Roble Colorado of Venezuela. Honduras Rosewood is tough and strong and highly durable. "The heart portion of a house post in use in Punta Gorda for 37 years was found to be as sound as when it was put in, but the sapwood, of course, had entirely disappeared" (*Tropical Woods* 12: 3. 1927).

Growth rings indistinct without lens. Pores few to fairly numerous, large in part and mostly solitary; distribution irregular. Rays 1 or 2 cells wide and commonly 6–8 cells high; homogeneous or nearly so. Parenchyma abundant, but variable in arrangement from numerous narrow concentric bands to diffuse and reticulate; also vasicentric and finely terminal. Ripple marks 115–140 per inch; all elements storied.

COMMON NAMES: Honduras rosewood (Trade, U. S. A.); nagaed wood (J. G. Deagan, Inc.); rosewood (Br. H.).

Guatemala Rosewood. The Rosewood of eastern Guatemala and the Republic of Honduras, *Dalbergia cubilquitzensis* (D. Sm.) Pitt., is a large tree, sometimes more than 100 feet tall, with a well-formed trunk unbranched for three-fourths of its length and having an average diameter of 30 inches at maturity. The heartwood is lustrous orange with more or less pronounced violet striping when fresh, but upon exposure the color deepens to various shades of brown, sometimes with a purplish hue. It looks somewhat waxy and bears considerable resemblance to the Rosewood of the lower Amazon (*D. Spruceana*). It is nearly scentless, of medium density, but tough and strong. It is considered one of the best timbers in the country and is used for the axles and tongues of wagons, spokes of truck wheels, and for durable construction, as well as for good furniture. It is suitable for cabinet work, interior trim, and brush backs.

Growth rings present or absent, sometimes distinct. Pores very small to large, few to rather numerous; frequently in multiples, occasionally in clusters. Rays mostly biseriate and less than 10 cells high; heterogeneous in part, the marginal cells often enlarged, square or irregular in form. Parenchyma coarsely reticulate to loosely aggregated into tangential concentric bands; also irregularly vasicentric and aliform. Ripple marks 115–135 per inch; all elements storied, though through vertical fusions some of the rays may occupy more than one tier.

COMMON NAMES: Rosewood (Eng.); granadillo, junero (Guat.); granadillo, rosul (Hond.).

MACHAERIUM

According to Hoehne (*Flora Brasilica* 25: 3. 1941), there are 121 valid species of the genus *Machaerium*. They are upright or scandent shrubs and small to medium-sized, or sometimes large, trees of general distribution throughout tropical America, though most abundant in Brazil. The leaves are odd-pinnate, typically with alternate leaflets which are either comparatively few (3–11) and medium-sized to rather large or numerous (up to 70) and small. The flowers are purple, violet, or white, commonly small, and borne in axillary or terminal racemes or panicles. The fruit is indehiscent and samara-like, the single seed being at the end, thus differing from *Dalbergia*, which has a flat pod with a centrally located seed. The sap is red as in *Centrolobium*, *Etaballia*, *Platypodium*, and *Pterocarpus*.

The large trees are of about a dozen species, several of which, particularly in southeastern Brazil, are reported to be the source of commercial timber of high quality and suitable for the same purposes as Rosewood (*Dalbergia*). The genus is represented in the Yale collections by 37 wood samples obtained with herbarium material identified with 22 different species and there are at least six others that have been determined as *Machaerium* sp., but only three of the entire lot contain normal heartwood. There are also numerous samples obtained from industrial sources in southern Brazil under the names Caviuna and Jacarandá, but in no instance has it been possible to match them with authentic specimens from the same region. The wood most like Rosewood (*Dalbergia*) is walnut-scented. Of the named species available for comparison the nearest approach to it is a small sample (Yale 11070; Pittier 12484), probably a piece of a limb, of *Machaerium acutifolium* Vog. from Venezuela. Since the range of this species extends from Venezuela to Paraguay, Bolivia, and southern Brazil, it may be the source of the Jacarandá timber in question. According to Hoehne (*loc. cit.*), the species producing the best timber is *Machaerium firmum* Benth., but the wood has not been studied.

The other authentic woods of *Machaerium* are of two general types, namely, (1) rather light, soft, coarse-textured, and containing widely spaced concentric laminations of included phloem; (2) hard, heavy, fine-textured, and of a fairly uniform light yellow throughout, or with a purplish brown, rather waxy looking heartwood. The timbers of the latter group appear of good quality but they are readily distinguishable from the Dalbergias by their absence of large pores and the fact that the parenchyma is in compact wings or concentric bands instead of being diffuse, reticulate, or loosely aggregated. Crystalliferous strands are common in both genera, but in *Machaerium* they often form a sheath about the ordinary parenchyma; in the soft woods the cells just inside the sheath are very thin-walled. Ripple marks are distinct under lens and vary in number per inch from 95 in the first group to 150 in the second.

The principal purpose of this brief account of *Machaerium* is to call attention to the lack of scientific information concerning the Brazilian species yielding commercial timber, hoping thereby to stimulate the collecting of adequate wood and herbarium specimens for a comprehensive study.

THE AMERICAN SPECIES OF *DAUBENTONIA* (LEGUMINOSAE)

By JOHN H. PIERCE

New York Botanical Garden

Recent collections of the Wild Coffee Bean (*Daubentonia*) in Texas have raised certain problems of identity and nomenclature which are in need of clarification. *Daubentonia* is accepted as a valid genus by the present author until such time as a careful study of the world-wide material of the entire subtribe *Sesbanianeae* is practicable.

Daubentonia DC. Mem. Leg. 6: 285. 1825.—Shrubs or trees; leaves pinnate, with small caducous stipules and many leaflets; flowers in axillary racemes; calyx rounded, broader than high, shallowly 5-lobed; corolla yellow to purple, standard orbicular, reflexed, wings shorter, obliquely oblong to spatulate, keel petals obliquely arcuate-lunate; stamens diadelphous (9 and 1); pod linear-oblong, stipitate, 4-winged, the seeds separated by cross partitions; seeds subglobose.

Type species: *Piscidia punicea* Cav. Ic. 4: 8. 1797. Distribution: temperate South America and southern United States.

Pod tapering gradually at both ends; leaflets glabrous to pubescent, venation clearly visible below, midrib impressed above, petiolule conspicuously thicker than the midrib; flowers usually purple, or orange when immature. . . . . 1. *D. punicea.*

Pod sharply acuminate at both ends; leaflets sparsely to densely pubescent, venation obscured below, midrib raised above, petiolule equaling or thinner than the midrib; flowers usually yellow, or pink when young. . . . 2. *D. texana.*

1. *D. punicea* (Cav.) DC. Mem. Leg. 5: 286. 1825.—The type specimen is plate 316 in Cav. Ic. 4: 1797. Native of South Brazil and Argentina and introduced into the southern United States.

Cavanilles' description was made from trees growing in the Royal Botanical Gardens at Madrid. The original locality was given as New Spain, which has been interpreted as Mexico by some authors and as "tropical" America by Rydberg (N. Am. Fl. 24: 207. 1924). According to Hooker (Curt. Bot. Mag. 50: t.7353. 1894) the original locality was southern Brazil and Argentina. To date the species has not been reported from Mexico and has its main center of distribution in temperate southern Brazil and Argentina. At an early date it was supposedly introduced into Florida and has spread westward along the coast to Texas. In Florida it has become well enough established to appear indigenous, while in Texas it occurs sparingly and is obviously introduced.

2. ***D. texana*** Pierce, sp. nov. *D. Drummondii* Rydb. N. Am. Fl. 24: 207, nomen confusum. 1924.—Frutex gracilis usque ad 2–6 m. altus; ramuli maturi glabri, fere teretes; stipulae lanceolatae, 3–4 mm. longae; folia 1–2 dm. longa, rachis glaber vel pauce pubescens; foliola 20–50, oblongo-linearia, basi acuta vel obtusa, apice rotundata et mucronata, 1.5–3 cm. longa, 4–6 mm. lata, pauce vel valde tomentosa; inflorescentia racemosa, 5–10 cm. longa, pedicellis tenuis circiter 1 cm. longis; bracteae minutae, 1–2 mm. longae, mox caducae; calyx 3 mm. longus, 4 mm. latus, lobis triangularibus, acutis; vexillum flavum, late orbiculatum, apice emarginatum, 12–15 mm. longum; alae oblique spatulatae, 10 mm. longae, 4–5 mm. latae; carinae subaequales; legumen 5–6 cm. longum, 11 cm. latum, basi et apice abrupte acuminatum, late 4-alatum; semina brunnea, quadrato-orbiculata, 3 mm. lata, 5 mm. longa.

Type specimen: H. Nogle 100 from Port Arthur, Texas, deposited in the herbarium of the New York Botanical Garden. It is known from the coastal plain of Texas and inland along the rivers, up the Mississippi to southeastern Arkansas and eastward along the Gulf coast to western Florida. I have seen no authentic specimens from Mexico.

The following synonyms listed by Rydberg under *Drummondii* should be referred to synonymy under *Daubentoniopsis longifolia* (Cav.) Rydb.:

Daubentonia longifolia DC. Mém. Leg. 286. 1825.

Daubentonia longifolia? Torrey & Gray, Fl. N. Am. 1: 293. 1838.

Sesbania Cavanillesii S. Wats. Proc. Am. Acad. 17: 342. 1882.

Daubentonia Cavanillesii (Wats.) Standley, Contr. U. S. Nat. Herb. 23: 476. 1922.

Rydberg (Am. Jour. Bot. 10: 498. 1923) originally published the specific epithet *Drummondii* for this species without description stating that it was based on *Daubentonia longifolia?* of Torrey & Gray (Fl. N. Am. 1: 293. 1838), which was also published without description. The name *Drummondii* is, therefore, a hyponym which was validated the following year by publication with description. It is evident that the name *Drummondii* is either based on the Torrey and Gray name as Rydberg stated, or on the Drummond sheet (s.n. NY) which they cite. In either case the name is a source of error and confusion and should therefore be discarded. On page 293, Torrey & Gray expressed doubt about the identity of the Drummond sheet, but in the appendix on page 687 they removed the question mark by definitely referring the plant to *D. longifolia* (Cav.) DC. Since this latter name is based on Cavanilles' plate (Cav. Ic. 4: t. 315. 1797) which Rydberg cites as the type of *Daubentoniopsis longifolia* (Cav.) Rydb., it follows that the name *Drummondii* must become a synonym of *Daubentoniopsis longifolia* (Cav.) Rydb.

If Rydberg based his species on the Drummond sheet cited by Torrey & Gray, then the application of the name *Drummondii* is still uncertain. This specimen consists only of pods and since the Rydberg description includes the flower it is obvious that this cannot be the type specimen. If it is a cotype, we have no way of knowing from what other material the flower was described. Of the flowering material labelled *Drummondii* by Rydberg, some specimens belong to the closely related genus *Glottidium*. This is not surprising since I have received fresh material of *Glottidium vesicarium* (Jacq.) Harper which was collected in flower for *Daubentonia*. Moreover, the pods of the Drummond sheet are in poor condition and might well be those of *D. punicea* (Cav.) DC. Hence the application of the name *Drummondii* is entirely uncertain. The best way to clear up this situation, then, seems to be to treat *Drummondii* as a nomen confusum, to rename and describe the plant as new and designate a type specimen which will hereafter fix the application of the new specific epithet.

A third species *Daubentonia virgata* (Cav.) Rydb. should, in my opinion be excluded from the genus. An examination of the original description and plate (Cav. Ic. 3: 47. 1794) upon

which the species is based indicates that it is *Glottidium vesicarium* (Jacq.) Harper. The pod figured by Cavanilles is wingless and almost identical with young fruiting material of *Glottidium*. This perhaps explains why the *D. virgata* covers in the larger American herbaria are empty.

When a careful study of the world-wide material is practicable I believe it will confirm the treatments of Bentham & Hooker (Gen. Pl. 1: 502. 1865) and Phillips and Hutchinson (Bothalia 1: 40. 1921) who consider the subtribe *Sesbanianeae* (excl. *Glottidium*) of Rydberg as a single genus, *Sesbania*.

The Woods of *Daubentonia*

By S. J. R.

In the Yale wood collections there are two samples each of the two species of *Daubentonia*. Those of *D. punicea* (Cav.) DC. were given by Mr. J. L. Stearns of Laurel, Maryland, who collected one in western Florida, the other in southeastern Georgia; the herbarium material was determined by Mr. E. C. Leonard, U. S. National Museum. Those of the other species are from the vicinity of Port Arthur, Texas, and were supplied by Mr. W. F. Opdyke of Cleveland Heights, Ohio, who collected one of them himself and obtained the other from his friend, Mr. Harold Nogle, distribution manager for the "Port Arthur News." These three men collect woods as a hobby and desire to have their specimens rightly labeled. There was some question as to the correct name for the Texas plant and to settle the matter I referred it to Mr. John H. Pierce, whose findings are published above.

Daubentonia punicea: Heartwood pinkish; rather sharply demarcated from the yellowish sapwood. Luster medium. Without distinctive odor or taste. Hard, heavy, and tough; has about the consistency of *Gleditsia;* texture coarse, and somewhat irregular; grain fairly straight; not difficult to work, finishing smoothly; durability doubtful.

Growth rings distinct; ring-porous structure. Pores of two sizes: those in early wood medium-sized and arranged in small multiples in an open band of

varying width; those in late wood small to minute, mostly in clusters of several pores each, surrounded and joined by parenchyma into irregular diagonal to ulmiform pattern. Vessels without spiral thickenings; gum deposits common in early wood; pits medium-sized, sometimes more or less elongated; pit apertures lenticular. Rays 1–4 cells wide and variable in height up to 50 cells; heterogeneous, with many square and comparatively few upright cells; pits to vessels rather coarsely lenticular. Wood parenchyma vasicentric and vasicentric-confluent; distinct without lens. Wood fibers with thick walls and very small pits. Ripple marks absent. No gum ducts seen.

Daubentonia texana Pierce: Heartwood (probably traumatic) grayish brown; sapwood grayish. Luster medium. Rather light in weight and of a "cheesy" consistency; texture coarse; grain irregular; saws woolly, but the feel of the roughened fibers is not harsh; durability probably low. The principal anatomical differences are as follows:

Ring-porous structure poorly defined. Pores mostly medium-sized, solitary and in small multiples, except near outer margin of the growth ring where they are very small and in little clusters. Rays very numerous; 1–5, rarely 7, cells wide and up to 50 cells high; decidedly heterogeneous and irregular. Wood parenchyma vasicentric, but tending to vasicentric-confluent in outer part of growth ring; not distinct without lens. Wood fibers small; walls medium.

TWO NEW SPECIES OF CARYOCARACEAE FROM NORTHERN SOUTH AMERICA

By CHARLES L. GILLY

New York Botanical Garden

In the course of identification of specimens of Caryocaraceae recently received at the herbarium of the New York Botanical Garden, it became apparent that two undescribed species were represented by some of the material already on file. These may be characterized as follows:

Anthodiscus mazarunensis Gilly, sp. nov.—Arbor ad 20 m. alta; foliis alternis digitatim trifoliolatis; petiolis subteretibus 1–2.5 cm. longis; petiolulis ad 1 cm. longis; laminis subcoriaceis glabris obovatis, ad basim cuneatis, ad apicem rotundato-emarginatis, ad marginem subcrenatis, terminali 7–9 cm. longa et 3.5–5 cm. lata, lateralibus subaequalis; racemis

terminalibus ad 7 cm. longis, rhachidibus cum pedicellis pulverulentis; pedicellis 4–7 mm. longis; calyce cupuliformi, 2.5–3.5 mm. diametro, margine obscure 5-dentata; petalis flavis elliptico-ovatis, ad 9 mm. longis; staminibus numerosis, in anthesi ad 6 mm. longis; filamentis flavis inaequalibus gracilibus etuberculatis; antheris oblongis, 0.75 mm. longis; ovario glabro ovoideo, in anthesi 2 mm. diametro, loculis circiter 12; stylis circiter 12, glabris vel subpuberulentis, 2.5 mm. longis; fructu immaturo glabro ovoideo, ad 1 cm. diametro.

Specimens examined: BRITISH GUIANA: Mazaruni River basin: Arubaru River, Feb. 3, 1939, A. S. Pinkus 280 (NY—type); Membaru Creek, Feb. 16, 1939, A. S. Pinkus 233 (NY).

This species appears to be most closely allied to *Anthodiscus montanus* Gleason, of Colombia, and *A. amazonicus* Gleason & Smith, from the basin of the Rio Madeira in Brazil. From both of these species, however, *A. mazarunensis* differs in its much larger leaflets with distinct petiolules, and in the much larger flowers. The two specimens cited above have been referred to *A. obovatus* Benth. (A. C. Smith, Bull. Torrey Club 67: 293. 1940), but examination of a sheet of the type collection of that species (Spruce *s. n.*, from the Rio Negro, Brazil) deposited in the Gray Herbarium reveals that they are specifically distinct.

Caryocar Krukovii Gilly, sp. nov.—Arbor ad 30 m. alta; foliis oppositis digitatim trifoliolatis; petiolis subteretibus 2–3.5 mm. longis, petiolulis ad 4 mm. longis; laminis glabris tenuiter coriaceis obovato-ellipticis vel obovatis, 3.5–6 cm. longis, 2–4 cm. latis (terminalibus et lateralibus subaequalibus), ad basim acutis vel cuneatis, ad apicem obtusis vel obtuse et minute cuspidatis, ad marginem integris vel subundulatis; racemis terminalibus, rachidibus ad 15 cm. longis; pedicellis in anthesi 10–15 mm. longis; calyce cupuliformi 3–4 mm. diametro, lobis ciliolatis semiorbiculatis circiter 1–1.5 mm. longis et 1.5–2 mm. latis; petalis roseis rotundato-obovatis, in anthesi 8–10 mm. longis, 2–3 mm. latis; staminibus numerosissimis; filamentis coccineis, exterioribus fertilibus ad 10 mm. longis, interioribus brevioribus sterilibus clavatis; antheris globosis ad 0.25 mm. longis; ovario pubescente, loculis circiter 4; stylis filamentis brevioribus.

Specimens examined: BRAZIL: Amazonas: Basin of the Rio Solimoes, Municipio São Paulo de Olivença, Igarape (Creek) Belem, Oct.–Dec., 1936, B. A. Krukoff 8838 (NY—type) and 8872 (NY).

This species appears to be most closely related to *Caryocar parviflorum* A. C. Smith, of the Rio Madeira basin, but differs from that species by its smaller and essentially entire-margined leaflets, and in its smaller flowers with minute calyx lobes and extremely short filaments.

Letter from Imperial Institute, London

8th September 1942

Dear Professor Record:

I have read with much interest your article on the "Utilization of Latin-American Forests" which appeared in *Tropical Woods* No. 70, 1 June 1942. On page 19 you refer to the lack of adequate organization for investigating the properties of the timbers derived from these forests, but observe that, in addition to some work done in the United States, Brazil, and Argentina, the Imperial Forestry Institute in England has made pilot tests on certain kinds of timber from the British Colonies in America.

At the desire of the Director I am writing this brief note to mention that some years ago the Imperial Institute, London, tested the strength values and working qualities of a series of timbers from British Honduras, the results of which were published in the *Bulletin of the Imperial Institute*, 1923, 1924, 1925; a number of British Guiana woods were also tested as paper-making materials, the results appearing in the *Bulletin of the Imperial Institute*, 1924, 1928, 1930. This work is of course but a fraction of what remains to be done and in one way only emphasizes the point you make in your article.

In recent years our experimental work on timbers has ceased, consequent upon the concentration of timber investigations at the Forest Products Research Laboratory, Princes Risborough.

Yours sincerely,

S. E. CHANDLER

KEYS TO AMERICAN WOODS

By SAMUEL J. RECORD

Ability to identify a wood specimen from a study of its anatomy is a matter of scientific interest and frequently of practical importance also. In the case of the less common species the task may be long and difficult. As aids in this work I have from time to time published keys to certain groups of woods and in *Tropical Woods* 47: 12–27 I presented several classified lists of families and genera. More recently Robert W. Hess and I have prepared new and additional classifications of American genera with reference to the occurrence of significant anatomical features, the information being assembled from the results of a study of all of the woods of the western hemisphere (exclusive of the islands of the Pacific) that are represented in the Yale collections. I am now attempting to make keys to each group and so far have 18 of them in final or tentative form. Three based on vessel arrangement or pore patterns are presented below, and suggestions for their betterment are solicited.

I. Ring-porous woods. This feature is for the most part limited to trees and shrubs growing in temperate and subtropical climates. Within certain genera, and sometimes within a single species, specimens from different trees or even different parts of the same tree may exhibit all gradations from ring-porous to diffuse-porous. Included in the key are not only woods that are definitely ring-porous, but also those with more or less pronounced tendencies to such structure.

II. Pores in ulmiform or wavy tangential arrangement. In this group the pore pattern of *Ulmus* is taken as the type, but the term "wavy tangential" permits considerable latitude in application. The pattern may occur throughout a growth ring or, particularly in ring-porous woods, be limited to the late wood, sometimes appearing only in the outer part of wide growth rings. Parenchyma may have a considerable part in making the pattern, but it was not the predominant factor in the selection of woods for this group. In other woods, emphasis is on the arrangement of the pores and pore groups rather than on the parenchyma pattern.

III. Pores in flame-like or dendritic arrangement. Some of the best examples of this type of structure are *Rhamnus* (subgenus *Eurhamnus*), *Osmanthus*, *Prunus ilicifolia*, and *Quercus alba*. The pattern is closely associated with the ulmiform, with which it often intergrades. Rate of growth is a factor, since in wide rings the diagonal pore arrangement in the middle part tends to develop into irregularly concentric in the outer late wood. On this account some genera appear in both keys. Also there is no sharp line of distinction between long radial rows or series of pores and the flame-like pattern, hence a few woods are included in the key which may appear to have no better right there than some that have been omitted.

I. RING-POROUS WOODS

1 a. Pores in late wood in ulmiform or wavy tangential arrangement. 2
b. Pores not so arranged. 20

2 a. Ripple marks present. 3
b. Ripple marks absent. 7

3 a. Vessels with spirals; pits not vestured. 4
b. Vessels without spirals; pits vestured. Parenchyma abundantly confluent. 6

4 a. Rays virtually all multiseriate, mostly 4–8 (12) cells wide: homogeneous or nearly so. Pores all small (few) to minute (numerous). Parenchyma absent or very sparse. Sapwood bright yellow. *Berberis* (Berberidaceae).
b. Rays variable in width, mostly 1–4 (6) cells wide. Sapwood white. 5

5 a. Rays heterogeneous. Pores small to minute, the pore ring usually poorly defined. Parenchyma abundantly paratracheal; not terminal. *Baccharis* (Compositae).
b. Rays homogeneous. Pores medium-sized in band few to several pores wide in early wood; other pores very small. Parenchyma sparingly paratracheal and finely terminal. *Cercis* (Leguminosae).

6 a. Rays all uniseriate or partially biseriate and mostly less than 10 cells high; homogeneous. Ripple marks 160–200 per inch; all elements storied. *Gourliea* (Leguminosae).
b. Rays 1–6 cells wide and up to 50 cells high; heterogeneous. Ripple marks about 150 per inch; larger rays not storied. *Dalea* (Leguminosae).

7 a. Vessels without spirals. 8
b. Vessels (at least in part) with spirals. 11

8 a. Parenchyma abundant, vasicentric to confluent into bands. Rays 1–4 (5) cells wide and up to about 50 cells high; heterogeneous. Tyloses absent. 9
b. Parenchyma sparingly paratracheal and sometimes terminal. Tyloses abundant. Fibers often septate. 10

9 a. First formed pores of pore-ring smaller than others; late-wood pores minute and in many-pored clusters; vascular pits vestured. Rays without tall upright cells. Fibers not septate. *Daubentonia punicea* (Leguminosae).
b. Typically diffuse-porous, but with local tendencies to ring-porous; late-wood pores small and in few-pored clusters; vascular pits not vestured. Rays often with tall upright cells. Fibers often septate. *Aegiphila* (Verbenaceae).

10 a. Rays 1 or 2, sometimes up to 4, cells wide and variable in height to 50 cells; heterogeneous; pits to vessels medium-sized and round or short oval. Deposits of calcium carbonate sometimes present in vessels. *Citharexylum* (Verbenaceae).
b. Rays 1–5 (7) cells wide and up to 50 (80) cells high; more or less heterogeneous; pits to vessels large, often elongated and in scalariform arrangement. Deposits of calcium carbonate apparently absent. *Vitex* (Verbenaceae).

11 a. Pores in part medium-sized to large. Ring-porous structure usually distinct to unaided eye. 12
b. Pores all small to minute. Ring-porous structure not distinct without magnification. 15

12 a. Ulmiform pattern occurring throughout late wood. Rays 1–6 (8) cells wide. Ulmaceae.
b. Ulmiform pattern limited to outer late wood of fairly wide growth rings. 13

13 a. Vascular pits vestured. Rays 1–8 (12) cells wide; homogeneous. Wood fibers with thick walls. Tyloses absent. *Gleditsia* (Leguminosae).
b. Vascular pits not vestured. Rays rarely over 4 cells wide; weakly heterogeneous. Wood fibers with rather thin walls. Tyloses abundant. 14

14 a. Rays 1–3 cells wide and up to 25 (70) cells high; uniseriates fairly numerous. Pores in part medium-sized, barely visible without lens. *Chilopsis* (Bignoniaceae).
b. Rays mostly 2–4 cells wide and up to 15 (30) cells high; uniseriates few. Pores in part large and distinct to unaided eye. *Catalpa* (Bignoniaceae).

15 a. Rays 1 or 2 (3) cells wide. 16
b. Rays often 4 (or more) cells wide. 18

16 a. Rays up to 25 (30) cells high; heterogeneous. *Buddleia globosa* (Loganiaceae).
b. Rays rarely up to 15 cells high; mostly homogeneous. 17

17 a. Oil cells present in parenchyma strands.....*Grabowskia* (Solanaceae).
b. Oil cells absent.....*Lycium* (Solanaceae).

18 a. Rays nearly all of one width (4 cells) and variable in height to 300 cells; decidedly heterogeneous. Fibers with large lumen. *Dendromecon* (Papaveraceae).
b. Rays variable in width to 5 (8) cells and in height to 30 (50) cells; heterogeneous in part. Fibers with small lumen..... 19

19 a. Pore band uniseriate; largest pores about 50μ; vascular pits up to 4.5μ; spirals coarse and distinct. Upright ray cells numerous. *Colletia* (Rhamnaceae).
b. Pore band irregularly multiseriate; largest pores about 90μ; vascular pits up to 7.5μ; spirals very fine. Upright ray cells very few. *Discaria* (Rhamnaceae).

20 a. Pores in late wood in flame-like or dendritic arrangement..... 21
b. Pores not so arranged..... 38

21 a. Vessels (at least in part) with spirals..... 22
b. Vessels without spirals..... 34

22 a. Parenchyma reticulate..... 23
b. Parenchyma not reticulate..... 25

23 a. Vasicentric tracheids present. Rays 1 or 2 (4) cells wide and up to 30 cells high; pits to vessels large, oval to elongated. Ring-porous structure local, pores small to minute.....*Bumelia* (Sapotaceae).
b. Vasicentric tracheids absent. Ray-vessel pitting fine. Ring-porous structure normal..... 24

24 a. Rays 1–10 cells wide and up to 100 cells high; uniseriates and biseriates numerous. Late-wood pores all very much smaller than those in the early-wood pore ring.....*Fremontia* (Sterculiaceae).
b. Rays mostly 3–5 cells wide and not over 60 cells high; uniseriates and biseriates few. Late-wood pores in part not much smaller than those in the early-wood pore ring....*Ehretia anacuna* (Boraginaceae).

25 a. Ripple marks present though usually irregular. Pore ring usually poorly defined. Parenchyma rather abundantly paratracheal. Rays 1–4 (6) cells wide.....*Baccharis* (Compositae).
b. Ripple marks absent. Pore ring usually distinct..... 26

26 a. Fibers with thin walls and large lumen..... 27
b. Fibers with thick walls and small lumen..... 29

27 a. Included phloem present in narrow terminal bands. Vascular pits vestured.....*Dirca* (Thymelaeaceae).
b. Included phloem absent. Pits not vestured..... 28

28 a. Early-wood pores in short arcs; late-wood pore groups few and widely spaced. Rays all uniseriate. Narrow band of terminal parenchyma present.....*Leitneria* (Leitneriaceae).

b. Early-wood pores in continuous band; late-wood pore groups numerous. Rays 1 or 2 (3) cells wide. Parenchyma not in terminal band. *Calycanthus* (Calycanthaceae).

29 a. Rays in part broad (sometimes up to 8–10 cells)..... 30
b. Rays all narrow..... 31

30 a. Rays poorly defined on cross and tangential sections because the cells are all upright or irregular; uniseriates numerous. *Salvia* (Menthaceae).
b. Rays clearly defined; most of the cells procumbent. Uniseriates very few.....*Jodina* (Santalaceae).

31 a. Rays all uniseriate; nearly all of the cells square or upright. Early-wood pores small, often widely spaced.....*Choisya* (Rutaceae).
b. Rays 1–3 (4) cells wide..... 32

32 a. Early-wood pore band composed of 1 or 2 continuous or interrupted rows of small to medium-sized solitary pores followed by a multiseriate band of very small pores. Vascular pits vestured. Rays mostly homogeneous.....*Chionanthus* (Oleaceae).
b. Early-wood pore band narrow to rather wide; pores all small to minute. Vascular pits not vestured..... 33

33 a. Rays all decidedly heterogeneous.....*Ceanothus* (Rhamnaceae).
b. Rays homogeneous in part.....*Rhamnus* (Rhamnaceae).

34 a. Pores large in part; ring-porous structure usually very distinct. Vasicentric tracheids abundant..... 35
b. Pores all small to minute; ring-porous structure local, often indistinct..... 37

35 a. Rays very coarse in part. Pores all solitary. *Quercus*, *Lithocarpus* (Fagaceae).
b. Rays all uniseriate..... 36

36 a. Early-wood pores in a single row. Pores all solitary. *Castanopsis* (Fagaceae).
b. Early-wood pores in multiseriate band. Pores often in contact radially.....*Castanea* (Fagaceae).

37 a. Very fine ripple marks present (240–280 per inch). Rays all fine; uniseriates numerous; pits to vessels small. Vasicentric tracheids sometimes present.....*Bulnesia* (Zygophyllaceae).
b. Ripple marks absent. Rays 1–5 (10) cells wide; uniseriates few; pits to vessels large in part. Vasicentric tracheids absent. *Myoschilos* (Santalaceae).

38 a. Pores virtually all solitary..... 39
b. Pores not all solitary..... 49

39 a. Vessels with scalariform perforation plates..... 40
b. Vessels with simple perforations..... 43

40 a. Vessels with spirals. Fiber pits small. 41
b. Vessels without spirals. Fiber pits large. 42

41 a. Pores medium-sized in part. . . . . *Lyonia* (Ericaceae).
b. Pores very small to minute. . . . . *Rhododendron* (Ericaceae).

42 a. Rays 1 or 2 cells wide and up to 15 cells high. Perforation bars thick and widely spaced. . . . . *Fendlera* (Hydrangeaceae).
b. Rays 1–4 (5) cells wide and up to 70 (100) cells high. Perforation bars rather fine, usually closely spaced. *Philadelphus* (Hydrangeaceae).

43 a. Vessels with spirals. 44
b. Vessels without spirals. 47

44 a. Rays 1–7 cells wide and up to 100 cells high. Pores medium-sized in part. . . . . *Koeberlinia* (Koeberliniaceae).
b. Rays 1–2 cells wide and up to 15 (25) cells high. Pores all small to minute. 45

45 a. Ground mass of wood composed of vessels; fibers few. Rays decidedly heterogeneous. . . . . *Pachystima* (Celastraceae).
b. Ground mass of wood composed of fiber-tracheids. Rays nearly homogeneous. 46

46 a. Parenchyma abundantly diffuse. . . . . *Canotia* (Celastraceae).
b. Parenchyma absent or very sparse. . . . . *Mortonia* (Celastraceae).

47 a. Very fine ripple marks present (200–280 per inch). . . . Zygophyllaceae.
b. Ripple marks absent. 48

48 a. Rays 1–6 cells wide and up to 55 cells high; very closely spaced. Parenchyma sparingly paratracheal. Fibriform vessel members numerous. . . . . *Crossosoma* (Crossosomataceae).
b. Rays 1–3 cells wide and up to 30 cells high; not very closely spaced. Parenchyma abundantly diffuse to reticulate. Fibriform vessel members apparently absent. . . *Eriodictyon*, *Nama* (Hydrophyllaceae).

49 a. Rays all or in part very coarse (up to 15–20 cells wide). 50
b. Rays mostly narrow, but occasionally up to 8 (12) cells wide. . . . 52

50 a. Pores small to minute. Intervascular pitting very fine, alternate. Rays all broad (6–20 cells). Fiber pits simple or indistinctly bordered. . . . . *Jacquinia* (Theophrastaceae)
b. Pores very large in part. Intervascular pitting coarse, tending to scalariform. 51

51 a. Rays all broad and very high (full length of internodes). Fibers with conspicuous bordered pits. . . . . *Aristolochia* (Aristolochiaceae).
b. Rays variable in width and height. Fibers with simple or indistinctly bordered pits. . . . . *Vitis* (Vitaceae).

52 a. Vessels (at least in part) with spirals. 53
b. Vessels without spirals. 73

53 a. Parenchyma in late wood in numerous fine lines to more or less reticulate. 54
b. Parenchyma otherwise. 55

54 a. Pores medium sized to minute. Rays 1–8 (10) cells wide and 100 cells high; vessel-ray pitting medium. Parenchyma lines often biseriate. Color greenish. . . . . *Asimina* (Anonaceae).
b. Pores small to very small. Rays 1–4 (6) cells wide and up to 60 cells high; vessel-ray pitting rather fine. Parenchyma lines uniseriate. Color pale brown. . . . . *Planera* (Ulmaceae).

55 a. Fibers with distinct to conspicuous bordered pits. 56
b. Fibers with simple or indistinctly bordered pits. 60

56 a. Rays 1–5 (10) cells wide and up to 100 cells high; pits to vessels rather large. Parenchyma finely terminal. . *Prunus serotina* (Rosaceae).
b. Rays all very fine; pits to vessels small. Parenchyma very sparse, not terminal. 57

57 a. Fibers with spirals. Rays uniseriate and up to 15 (25) cells high. Pores in late wood often in contact. . . . . *Evonymus* (Celastraceae).
b. Fibers without spirals. Rays 1 or 2 (3) cells wide and up to 15 (30) cells high. Pores in late wood nearly all solitary. 58

58 a. Semi-ring-porous. Spirals mostly limited to tips of vessel members. Fiber pits exceedingly numerous. . . . . *Elliottia* (Ericaceae).
b. Definitely ring porous. Spirals general. Fiber pits rather few. . . . 59

59 a. All rays composed largely of square cells. Pore ring typically uniseriate. Gum ducts apparently absent. *Shepherdia* (Elaeagnaceae).
b. Multiseriate rays composed almost entirely of very slender, thick-walled procumbent cells. Pore ring typically multiseriate. Vertical gum ducts sporadic. . . . . *Elaeagnus* (Elaeagnaceae).

60 a. Parenchyma sparse to apparently absent. Pores all small to very small (except *Toxicodendron*). 61
b. Parenchyma rather to very abundant, paratracheal to confluent; sometimes terminal. Pores large in part. 67

61 a. Rays all uniseriate. Pore ring uniseriate. Fibers not septate. *Hypericum* (Guttiferae).
b. Rays multiseriate in part. Pore ring sometimes uniseriate (*Arbutus* and *Thamnosma*), but typically multiseriate. Fibers septate in some genera. 62

62 a. Different types of ray cells not stratified, but various sizes and forms intermingled (tang. sect.); sheath cells numerous; pits to vessels rather small, rounded. Fibers all abundantly septate. *Anisacanthus* (Acanthaceae).
b. Different types of ray cells (when present) in fairly definite strata, sheath cells absent or few. 63

63 a. Fibers not septate. Vascular pits rounded 64
b. Fibers septate in part. Vascular pits often elongated 66

64 a. Intervascular pitting coarse. Spirals only in minute vessels. Rays 1 or 2 (3) cells wide; decidedly heterogeneous. *Calycanthus* (Calycanthaceae).
b. Intervascular pitting fine. Spirals general. Rays 1–4 (5) cells wide. 65

65 a. Pore ring uniseriate; minute late-wood pores in radial multiples. Ray cells mostly square or upright . . . . . *Thamnosma* (Rutaceae).
b. Pore ring often multiseriate; minute late-wood pores arranged like paratracheal parenchyma. Ray cells often square or irregular, but not definitely upright . . . . . *Ptelea* (Rutaceae).

66 a. Perforations exclusively simple. Tyloses abundant. Radial gum ducts sometimes present (exc. *Cotinus*). Texture medium to very coarse (*Toxicodendron*). Color variegated olive and orange. *Cotinus*, *Rhus*, *Toxicodendron* (Anacardiaceae).
b. Perforations sometimes multiple in smallest vessels. Tyloses absent. Radial gum ducts absent. Texture fine. Color brown to reddish brown . . . . . *Arbutus*, *Arctostaphylos* (Ericaceae).

67 a. Tyloses abundant. Sapwood white 68
b. Tyloses absent 70

68 a. Vascular pits vestured. Fresh heartwood olive to bright yellow; sapwood thick to thin . . . . . *Robinia* (Leguminosae).
b. Vascular pits not vestured. Fresh heartwood bright yellow, sometimes with reddish streaks; sapwood very thin 69

69 a. Rays conspicuous on radial surface and readily visible without lens on cross section. Wood not horn-like . . . . . *Morus* (Moraceae).
b. Rays inconspicuous on radial surface and indistinct without lens on cross section. Wood horn-like . . . . . *Maclura* (Moraceae).

70 a. Pore ring indefinite; structure often semi-ring-porous to diffuse-porous 71
b. Pore ring distinct, typically broad 72

71 a. Parenchyma confluent into bands. Heartwood rich dark brown, faintly scented; sapwood thin, yellow. *Prosopis odorata* (Leguminosae).
b. Parenchyma not confluent into bands. Heartwood yellow or orange, unscented; sapwood thin, white . . . . *Cladrastis* (Leguminosae).

72 a. Late-wood pores scarcely visible with lens. Rays 1–8 (12) cells wide. Heartwood light reddish brown or bronze; sapwood thick, yellowish . . . . . *Asacara*, *Gleditsia* (Leguminosae).
b. Late-wood pores fairly distinct with lens. Rays 1–5 cells wide. Heartwood light cherry red or reddish brown; sapwood thin, greenish white . . . . . *Gymnocladus* (Leguminosae).

73 a. Ripple marks present 74
b. Ripple marks absent 80

74 a. Definitely ring-porous. Ripple marks local, not typical. Vascular pits vestured . . . . . *Fraxinus* (Oleaceae).
b. With only local tendencies to ring-porous. Ripple marks typical. 75

75 a. Parenchyma more or less reticulate 76
b. Parenchyma not reticulate. Vascular pits vestured 77

76 a. Parenchyma uniformly distributed. Ripple marks 70–80 per inch. Vascular pits not vestured. Heartwood not scented. *Diospyros virginiana* (Ebenaceae).
b. Parenchyma irregularly distributed. Ripple marks 110–180 per inch. Vascular pits vestured. Heartwood scented. *Dalbergia* (Leguminosae).

77 a. Rays 1–3 cells wide; heterogeneous. Ripple marks 100–110 per inch. Parenchyma not forming bands 78
b. Rays all uniseriate; homogeneous 79

78 a. Ripple marks 100–110 per inch. Rays decidedly heterogeneous; margins with vertical series of crystalliferous cells; each series resembling a septate upright cell . . . . . *Myrospermum* (Leguminosae).
b. Ripple marks 140–160 per inch. Rays not decidedly heterogeneous, but with numerous square cells in part; crystals common, but not in vertical series . . . . . *Eysenhardtia* (Leguminosae).

79 a. Pores rather large in part. Ripple marks 120–135 per inch. Parenchyma confluent into irregular bands in outer late wood. *Tipuana* (Leguminosae).
b. Pores small to very small. Ripple marks about 150 per inch. Parenchyma narrowly aliform and short confluent. *Cascaronia* (Leguminosae).

80 a. Oil cells present in rays and parenchyma strands. *Sassafras* (Lauraceae).
b. Oil cells absent 81

81 a. Rays all uniseriate or locally biseriate. Pores small. Intervascular pitting fine. Parenchyma sparse 82
b. Rays not all uniseriate or locally biseriate. Other features various. 84

82 a. Rays nearly homogeneous; height 25 (40) cells. Crystalliferous strands common. Tendency to ring-porous . . . *Hypelate* (Sapindaceae).
b. Rays decidedly heterogeneous. Crystalliferous strands few or absent 83

83 a. Definitely ring-porous, though pore band is irregular. Vascular pits vestured. Rays very closely spaced; up to 100 (200) cells high. *Cephalanthus* (Rubiaceae).
b. Not definitely ring-porous, but with local tendency. Vascular pits not vestured. Rays rarely 15 cells high, nearly all of the cells upright . . . . . *Beloperone* (Acanthaceae.)

84 a. Apotracheal parenchyma in numerous, uniform to irregular, concentric bands 1–3 cells wide; also finely terminal. Pores large in part 85
b. Parenchyma otherwise 86

85 a. Pore ring usually distinct; late-wood pores few and small and, when in multiples, with walls of contact greatly thickened. *Carya* (Juglandaceae).
b. Pore ring poorly defined; usually only semi-ring-porous; late-wood pores often not much smaller than others and, when in multiples, without walls of contact greatly thickened . . . *Juglans* (Juglandaceae).

86 a. Rays nearly all multiseriate (3–6 cells wide); uniseriates and biseriates very few 87
b. Rays of various sizes; uniseriates and biseriates numerous 92

87 a. Intervascular pitting very coarse, irregularly opposite to scalariform. Parenchyma sparingly paratracheal, at least in late wood . . 88
b. Intervascular pitting fine to medium, alternate 89

88 a. Pores medium-sized in part; pore band multiseriate. *Aralia* (Araliaceae).
b. Pores small to minute; pore band uniseriate. *Pseudopanax* (Araliaceae).

89 a. Pores medium-sized to minute. Ray cells very irregular in form without being stratified; pits to vessels 2-sized: small and round to narrow-elongated in scalariform arrangement. Parenchyma sparse. *Perymenium* (Compositae).
b. Pores large in part. Different types of ray cells (if present) typically in separate strata; pits to vessels fairly uniform in size and shape. Parenchyma rather to very abundant 90

90 a. Parenchyma confluent into very coarse bands sometimes composing a third of the ground mass. Rays homogeneous. *Sapindus* (Sapindaceae).
b. Parenchyma aliform to confluent in outer late wood, but not in coarse bands. Rays heterogeneous 91

91 a. Definitely ring-porous. Rays decidedly heterogeneous. *Auxemma* (Boraginaceae).
b. Not definitely ring-porous, but with local tendencies. Rays heterogeneous in part . . . . . *Cordia* (Boraginaceae).

92 a. Parenchyma in wide terminal (or initial) band 93
b. Parenchyma, if terminal, in very narrow band 95

93 a. Pores small to minute; numerous. Rays 1 or 2 cells wide and up to 60 cells high; decidedly heterogeneous; pits to vessels very small. Fibers with very thick walls . . . . . *Erythrochiton* (Rutaceae).
b. Pores large in part; rather few except in pore zone. Rays 1–5 cells wide and up to 25 (50) cells high; more or less heterogeneous, but without definitely upright cells. Fibers with thin walls 94

94 a. Vascular pitting very fine. Fibers not septate. Color yellowish. Not fragrantly scented . . . . . *Zanthoxylum* (Rutaceae).
b. Vascular pitting fine. Fibers often septate. Color pinkish to reddish brown. Fragrantly scented . . . . . *Cedrela* (Meliaceae).

95 a. Rays homogeneous or nearly so. Parenchyma variable in abundance; often abundantly paratracheal to confluent and also finely terminal. Vascular pits vestured 96
b. Rays decidedly heterogeneous 99

96 a. With tendency to ring-porous structure; pores mostly small. Vascular pits medium-sized to rather large. Tyloses absent. Leguminosae. 97
b. Definitely ring-porous 97

97 a. Parenchyma of two types in pore band: (a) strands of short, thick-walled cells in contact with vessels, and (b) thin-walled fusiform cells resembling wood fibers; parenchyma in late wood vasicentric (*Fraxinus nigra*) to aliform and confluent into narrow bands; also finely terminal; crystalliferous strands absent or few. Large vessels with tyloses; vascular pitting fine. Rays 1–3 cells wide. *Fraxinus* (Oleaceae).
b. Parenchyma not of two types in pore band; very abundant throughout growth ring, but not in concentric bands nor definitely terminal; crystalliferous strands very numerous. Vessels without tyloses; vascular pitting medium 98

98 a. Rays 1–4 cells wide and 15–30 cells high. Fibers septate. *Senegalia Greggii* (Leguminosae).
b. Rays 1–8, mostly 4–6, cells wide and up to 50 (100) cells high. Fibers not septate . . . . . *Sophora affinis* (Leguminosae).

99 a. Definitely ring-porous; pore band rather wide and compact; pores in late wood few; vascular pits vestured. Parenchyma rather abundantly paratracheal and more or less confluent. *Pinckneya* (Rubiaceae).
b. Not definitely ring-porous, though with local tendencies; pores in late wood rather numerous; vascular pits not vestured. Parenchyma sparingly paratracheal and often finely terminal. Verbenaceae.

II. WOODS WITH PORES IN ULMIFORM OR WAVY TANGENTIAL ARRANGEMENT

1 a. Radial gum ducts present . . . . . *Schinus* (Anacardiaceae).
b. Gum ducts absent 2

2 a. Rays conspicuous, at least in part 3
b. Rays not conspicuous, though often distinct 11

3 a. Perforations multiple. Broad rays with slender procumbent cells sheathed by upright or square cells. Fibers septate. *Ribes* (Grossulariaceae).

b. Perforations exclusively or predominantly simple. Rays without sheaths 4

4 a. Fibers mostly septate. Vessel-ray pitting coarse. Parenchyma sparingly paratracheal; sometimes also finely terminal.
Vitex (Verbenaceae).

b. Fibers not septate. Vessel-ray pitting various. Parenchyma various, but not terminal 5

5 a. Ripple marks present. Vessels with spirals 6
b. Ripple marks absent 7

6 a. Rays virtually all coarse. Ripple marks distinct under lens. Parenchyma absent or very sparse ..... *Berberis* (Berberidaceae).
b. Rays of various widths up to 8 cells. Ripple marks rather poorly defined. Parenchyma abundant in association with pore groups.
Baccharis (Compositae).

7 a. Parenchyma finely reticulate. Vessels without spirals. Rays up to 8 cells wide; heterogeneous ..... *Fouquieria* (Fouquieriaceae).
b. Parenchyma associated with pores and pore groups 8

8 a. Rays often 15 or more cells wide; uniseriates heterogeneous, multiseriates homogeneous. Vessels without spirals (exc. *Guevina*). Pores (and parenchyma) in distinct festoons between the large rays. Vascular pitting fine ..... Proteaceae.
b. Rays less than 10 cells wide; homogeneous to more or less distinctly heterogeneous. Vessels (at least in part) with spirals. Pores (and parenchyma) sometimes locally festooned in late wood (*Ulmus*); vascular pitting medium to coarse 9

9 a. Pores all small to minute. Parenchyma rather sparse.
Colletia, *Discaria* (Rhamnaceae).
b. Pores large in part. Parenchyma usually abundant 10

10 a. Bands of pore groups (and parenchyma) limited to outer late wood of rather wide growth rings. Vascular pits vestured.
Gleditsia triacanthos (Leguminosae).
b. Bands of pore groups throughout late wood. Vascular pits not vestured ..... Ulmaceae.

11 a. Ripple marks present 12
b. Ripple marks absent 17

12 a. Parenchyma reticulate. Ripple marks about 130 per inch; rays (mostly 3–5 cells wide) not definitely storied. Fibers with rather large, distinctly bordered pits ..... *Gaiadendron* (Loranthaceae).
b. Parenchyma not reticulate. Fibers with simple or indistinctly bordered pits 13

13 a. All elements storied. Rays all uniseriate or 1 or 2 (3) cells wide and up to 10 or 15 (rarely 25) cells high 14
b. Some elements (especially larger rays) not storied 15

14 a. Vascular pits small; not vestured ..... Bignoniaceae.
b. Vascular pits medium-sized to large; vestured.
Gourliea (Leguminosae).

15 a. Vessels without spirals; intervascular pitting very fine; pits not vestured. Rays 1 or 2 cells wide and up to 15 cells high; apparently not storied; pits to vessels 2-sized, mostly very small, some rather large. Ripple marks produced by horizontal seriation of parenchyma cells ..... *Schoepfia parviflora* (Olacaceae).
b. Vessels with spirals; intervascular pitting medium to coarse; pits vestured (exc. *Cercis*). Rays 1–4 (6) cells wide and 50 (100) cells high 16

16 a. All elements storied except large rays.
Cercis, *Dalea*, *Edwardsia* (Leguminosae).
b. Ripple marks apparently confined to parenchyma layers.
Zuccagnia (Leguminosae).

17 a. Vessels (at least in part) with spirals 18
b. Vessels without spirals 23

18 a. Vascular pits vestured ..... *Gleditsia amorphoides* (Leguminosae).
b. Vascular pits not vestured 19

19 a. Pores in part medium-sized to large; tyloses abundant; ulmiform pattern in outer late wood only. Parenchyma fairly abundant. Rays weakly heterogeneous ..... *Catalpa*, *Chilopsis* (Bignoniaceae).
b. Pores all small to minute, the latter resembling parenchyma (under lens); tyloses absent or few. Ulmiform pattern more or less throughout growth ring. Parenchyma sparse. Rays heterogeneous, often decidedly so 20

20 a. Uniseriate rays few; others mostly 4 cells wide and up to 300 cells high ..... *Dendromecon* (Papaveraceae).
b. Uniseriate rays numerous 21

21 a. Rays 1–3 cells wide and up to 25 (30) cells high. Vascular pits vestured. Fibers not septate ..... *Buddleia* (Lagoniaceae).
b. Rays often 2-sized, the larger ones 3–6 cells wide and up to 50 cells high. Vascular pits not vestured. Fibers sometimes septate 22

22 a. Fibers thick-walled. Large oil cells present in parenchyma strands.
Grabowskia (Solanaceae).
b. Fibers with moderately thick walls. Oil cells apparently absent.
Lycium (Solanaceae).

23 a. Vascular pits vestured. Wood distinctly ring-porous.
Daubentonia punicea (Leguminosae).
b. Vascular pits not vestured. Wood typically diffuse-porous, but sometimes with tendency to ring-porous 24

24 a. Rays all uniseriate; homogeneous. *Jacaranda coerulea* (Bignonicaceae).
b. Rays not all uniseriate; more or less distinctly heterogeneous 25

25 a. Vessel-ray pitting medium to coarse. Pores medium-sized in part; not in definite bands ..... Verbenaceae.
b. Vessel-ray pitting fine. Pores all small to very small 26

26 a. Pores with tendency to diagonal or concentric arrangement. *Tecoma* (Bignoniaceae).
b. Pores (and parenchyma) definitely banded 27

27 a. Rays definitely heterogeneous. Wood rather light and soft; grayish ..... *Jacaranda caroba* (Bignoniaceae).
b. Rays weakly heterogeneous, the marginal cells usually peaked. Woods dense; dark brown, variegated. *Patagonula*, *Saccellium* (Boraginaceae).

III. WOODS WITH PORES IN FLAME-LIKE OR DENDRITIC ARRANGEMENT

1 a. Included phloem present 2
b. Included phloem absent 4

2 a. Included phloem in association with terminal parenchyma. Fibers very thin-walled ..... *Dirca* (Thymelaeaceae).
b. Included phloem in strands fairly uniformly distributed throughout growth ring. Fibers thick-walled 3

3 a. Rays 1–3 cells wide ..... *Mouriria pseudogeminata* (Melastomaceae).
b. Rays 2-sized, the multiseriates 4–8 (12) cells wide. *Strychnos* (Loganiaceae).

4 a. Vessels without spiral thickenings 5
b. Vessels (at least the smallest ones) with spiral thickenings 13

5 a. Ripple marks present 6
b. Ripple marks absent 9

6 a. Ripple marks about 130 per inch; rays not storied. Rays 1–6, mostly 3–5, cells wide. Fibers thin-walled. *Gaiadendron* (Loranthaceae).
b. Ripple marks over 200 per inch; all elements storied. Rays 1 or 2 (3) cells wide. Fibers thick-walled 7

7 a. Pores all solitary, fairly uniform in size; arranged in wavy radial rows. Rays 1 or 2 cells wide, occupying single tiers. Parenchyma sparingly vasicentric. Fibers with minute indistinctly bordered pits ..... *Bulnesia arborea* (Zygophyllaceae).
b. Pores not all solitary; 2-sized 8

8 a. Pores numerous, small to minute; vasicentric tracheids abundant. Rays 1 or 2 cells wide, occupying single tiers. Parenchyma aliform to confluent. Fibers with minute indistinctly bordered pits. *Bulnesia Sarmienti* (Zygophyllaceae).

b. Pores rather few, decreasing in size during seasonal growth, the larger ones often in interrupted initial rows, the others only locally in radially arranged groups. Rays 1–3 cells wide, the taller ones occupying 2–4 tiers. Parenchyma diffuse to reticulate. Fibers with small distinctly bordered pits ..... *Bulnesia retama* (Zygophyllaceae).

9 a. Pores large in part. Vasicentric tracheids abundant 10
b. Pores small to minute. Vasicentric tracheids apparently absent .. 12

10 a. Rays very coarse in part. Pores solitary. *Quercus*, *Lithocarpus* (Fagaceae).
b. Rays all uniseriate 11

11 a. Pore ring uniseriate. Pores nearly all solitary .. *Castanopsis* (Fagaceae).
b. Pore ring multiseriate. Pores often in contact radially. *Castanea* (Fagaceae).

12 a. Rays 1 or 2 cells wide and up to 10 (20) cells high; pits to vessels small. Fibers with simple or indistinctly bordered pits. *Cneoridium* (Rutaceae).
b. Rays 1–3 cells wide and up to 15 (30) cells high; pits to vessels large. Fibers with distinctly bordered pits .. *Myoschilos* (Santalaceae).

13 a. Parenchyma reticulate 14
b. Parenchyma not reticulate 19

14 a. Aggregated rays present ..... *Carpinus* (Corylaceae).
b. Rays not aggregated 15

15 a. Rays 1 or 2 (4) cells wide 16
b. Rays often over 4 cells wide 18

16 a. Large oil cells present in parenchyma strands. Vasicentric tracheids apparently absent ..... *Grabowskia* (Solanaceae).
b. Oil cells absent. Vasicentric tracheids present 17

17 a. Vessel-ray pitting fine ..... *Henoonia* (Sapotaceae).
b. Vessel-ray pitting coarse ..... *Bumelia* (Sapotaceae).

18 a. Rays mostly 3–5 cells wide and less than 60 cells high; uniseriates few. Parenchyma strands nearly all 2-celled. *Ehretia anacua* (Boraginaceae).
b. Rays 1–10 cells wide and up to 100 or more cells high; uniseriates numerous. Parenchyma strands often more than 2-celled. *Fremontia* (Sterculiaceae).

19 a. Rays virtually all uniseriate 20
b. Rays often 2 or more cells wide 23

20 a. Early-wood pores in short arcs; late-wood pore groups few. Fibers large and very thin-walled ..... *Leitneria* (Leitneriaceae).
b. Early-wood pores in concentric zones; late-wood pore groups numerous. Fibers small; walls medium to very thick 21

21 a. Vessel-ray pitting coarse, more or less scalariform. Tyloses abundant. ..... *Rhus* (Anacardiaceae).
b. Vessel-ray pitting fine. Tyloses absent. 22

22 a. Parenchyma very sparingly paratracheal. Procumbent ray cells very few. ..... *Choisya* (Rutaceae).
b. Parenchyma diffuse and in occasional concentric lines. Procumbent ray cells numerous. ..... *Lycium* (Solanaceae).

23 a. Ripple marks present but poorly defined, as most of the rays are not storied. 24
b. Ripple marks absent. 27

24 a. Parenchyma confluent into multiseriate bands, sometimes concentric. ..... *Castela*, *Holacantha* (Simarubaceae).
b. Parenchyma not confluent into definite bands. 25

25 a. Pores rounded; vascular pits vestured. Crystals abundant in rays and parenchyma strands. ..... *Zuccagnia* (Leguminosae).
b. Pores angular; vascular pits not vestured. Crystals apparently absent or few. 26

26 a. Many rays 1–3 cells wide. ..... *Baccharis* (Compositae).
b. Very few rays 1–3 cells wide, mostly 4–8. ..... *Artemisia* (Compositae).

27 a. Definitely diffuse-porous. 28
b. Ring-porous or with distinct tendency. 31

28 a. Rays homogeneous or nearly so. ..... *Rhamnus* (Rhamnaceae).
b. Rays decidedly heterogeneous. 29

29 a. Vessel-ray pitting coarse and irregular in part; rays 1 or 2 cells wide. Parenchyma in closely spaced, coarse, concentric bands 1–3 cells wide. Spirals limited to smallest vessels. *Paralabatia* (Sapotaceae).
b. Vessel-ray pitting fine. Parenchyma bands typically terminal. Spirals not limited to smallest vessels. 30

30 a. Rays 1–3 cells wide and less than 25 cells high. Vascular pits vestured. ..... *Osmanthus* (Oleaceae).
b. Rays 1–6 cells wide and up to 40 (60) cells high. Vascular pits not vestured. ..... *Prunus ilicifolia* (Rosaceae).

31 a. Fibers with thin walls and large lumen. 32
b. Fibers with medium to very thick walls and small to minute lumen. 33

32 a. Fibers in definite radial rows; pits small. Upright ray cells numerous. Parenchyma very sparse. ..... *Calycanthus* (Calycanthaceae).
b. Fibers not in definite radial rows; pits large. Upright ray cells few. Parenchyma rather abundantly diffuse. ..... *Ovidia* (Thymelaeaceae).

33 a. Vessel-ray pitting scalariform in part. Radial gum ducts sometimes present. ..... *Rhus* (Anacardiaceae).
b. Vessel-ray pitting not scalariform. Radial gum ducts absent. ... 34

34 a. Rays up to 8, sometimes 10 or more, cells wide. 35
b. Rays 1–3, sometimes 4 or 5, cells wide. 36

35 a. Rays clearly defined on all sections; most of the cells procumbent; uniseriates very few. ..... *Jodina* (Santalaceae).
b. Rays poorly defined on cross and tangential sections because the cells are all upright and irregular; uniseriates numerous. *Salvia* (Menthaceae).

36 a. Early-wood pore band composed of 1 or 2 continuous or interrupted rows of small or medium-sized pores followed by a multiseriate band of very small pores. Vascular pits vestured. Rays mostly homogeneous. ..... *Chionanthus* (Oleaceae).
b. Early-wood pore band not in two definite parts. Vascular pits not vestured. Rays heterogeneous. 37

37 a. Pores medium-sized in part. Rays 1–4 (5) cells wide and up to 50 cells high. ..... *Campsis* (Bignoniaceae).
b. Pores all small to minute. Rays 1–3 cells wide and less than 25 cells high. ..... *Ceanothus* (Rhamnaceae).

CURRENT LITERATURE

A revision of the genus *Bumelia* in the United States. By Robert Brown Clark. *Ann. Missouri Bot. Garden* (St. Louis) 29: 3: 155–182; 1 map; Sept. 18, 1942.

Bumelia, with 35–40 species of shrubs and small trees, frequently with milky sap and spinescent branches, is confined to the New World, where it is distributed from central United States southward to Mexico, Central America, the West Indies, and South America as far as northern Argentina. The genus differs from the other members of the Sapotaceae in its adaptation to a temperate climate. The author recognizes and describes 14 species and four varieties occurring in the United States and proposes a few changes in the nomenclature.

The Caribbean Forester. Pub. quarterly by Tropical Forest Exp. Sta., U. S. F. S., Río Piedras, Puerto Rico. Vol. III: 3, 4: 91–184; April, July 1942.

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Trees of Puerto Rico. Volume I. By L. R. HOLDRIDGE. Occ. Paper No. 1, Tropical Forest Experiment Station, Río Piedras, Puerto Rico. Pp. 105; 8 x 10½; 50 multilithed plates; March 1942.

"Despite the many interesting and attractive native and introduced trees in the island of Puerto Rico, of which there are reported to be in the neighborhood of 600 species, no reference work has been available that permits identification by those interested but not trained in technical botany.

"The Tropical Forest Experiment Station some time ago started to assemble material for such a publication. Realizing that it will take a long time to complete such a task, it has been decided to publish the descriptions and drawings as they are completed in this preliminary form and thus make them available to the public. The first issue contains 50 species and will be followed by future volumes of similar size until the work is completed. Corrections, criticisms, and revisions are solicited so that ultimately the complete series can be edited and printed in one volume.

"The illustration and description of each species have been so arranged that it is possible to compare them without turning a page. The order of the species and the nomenclature are taken from Britton and Wilson's 'Botany of Porto Rico and the Virgin Islands.' The common names presented come from the literature and from local usage. To make the descriptions

best serve their purpose every effort was made to simplify them as much as possible. Technical terms were used only where they were vital to the accuracy of the description. A short glossary is included for the definition of these terms."—*From Foreword.*

The American species of *Strychnos*. By B. A. KRUKOFF and J. MONACHINO. *Brittonia* (N. Y. Bot. Gard.) 4: 2: 248–322; September 1942.

An account of 49 species of *Strychnos*, of which eight are described as new. "The species of *Strychnos* are distributed in all continents except Europe, being limited to the tropics and subtropics. A cursory survey of the available specimens and the literature on the genus in the Old World indicates, in our opinion, that the number of valid species extant has been greatly exaggerated. We estimate very roughly that the genus consists of approximately 200 distinct species, or only about half of the number described, of which 49 species and 1 variety (or less than half of the number proposed for the New World) are confined to the Americas. None of the American species occurs in Africa, Asia, or Australia.

"All species of *Strychnos* begin life as erect plants, and species which are erect and bushy in open situations may become more or less scandent when growing in moist woods. . . . Old bush-ropes usually reach out 10–30 meters before attaching themselves to a tree. . . . The majority of gigantic bush-ropes of *Strychnos* in the Amazon basin . . . for years grow in the shade of trees and at this stage in their development they have but few branches, widely spaced internodes, and very scarce foliage. When they reach the tops of the trees to which they are attached . . . they undergo considerable changes. Internodes become very short; branches and branchlets at the crowded nodes develop in all directions giving the appearance of excess branching or 'witches' broom' . . . and then the plant begins to flower year after year, regularly and in quite a definite season. . . . The dispersal of seeds in *Strychnos* is still a matter of speculation. . . . We believe that toucans may be responsible. . . .

"Note should be made that, although several American

species of *Strychnos* are of potential economic value, no attempt has been made to date to introduce any of them into cultivation even in botanical gardens. In our study of the group we could find no evidence that the human element at any time has contributed to the geographical distribution or to the complexity of the species. Neither is there any evidence that interspecific hybridization has occurred in the wild."

Monograph of *Malvaviscus*. By ROBERT WALTER SCHERY. *Ann. Missouri Bot. Garden* 29: 3: 183–245; 5 maps, 2 tables, 11 text figs., 17 plates; Sept. 18, 1942.

The genus *Malvaviscus*, family Malvaceae, consists of shrubs and woody vines occurring indigenously from southern United States and the West Indies to Peru and northern Brazil. The author recognizes only three species, namely, *M. candidus* DC. of central Mexico, *M. palmatus* Ulbrich of western Brazil, and *M. arboreus* Cav. of general distribution.

In the *Malvaviscus arboreus* complex "there is tremendous variation, even with separate branches on the same plant. . . . As a result of such manifest variation, innumerable species have been described, with descriptions based on a single specimen. If this were to be the general practice there would be almost as many species of *Malvaviscus* as there are specimens." The author decides upon placing the numerous forms into a "few well-marked species with varietal classification for those groups which are distinct at their extremes but do intergrade with all or most other groups." There are accounts of 11 such varieties of *M. arboreus*, one being new and six being new combinations.

Studies in the Theaceae. XII. Notes on the South American species of *Ternstroemia*. By CLARENCE E. KOBUSKI. Journ. Arnold Arboretum 23: 3: 298–343; July 1942.

An account of 49 species, of which 16 are described as new. "Although this brief study may not take on the noble title of monograph, I hope that the amplified descriptions with notes on specific relationships, the citations of literature and specimens, and the synonymy may prove of assistance to workers in the various regions of South America. A second paper will

be published in the near future dealing with the North American species of the genus."

Studies of the Icacinaceae. IV. Consideration of the New World genera. V. A revision of the genus *Citronella* D. Don. By RICHARD A. HOWARD. *Contrib. Gray Herbarium* (Cambridge, Mass.) 142: 1–60, 60–89, resp. Sept. 10, 1942.

In the New World there are 70 species of 12 genera of Icacinaceae. One genus is pantropical, two are monotypic, and three have no New World affinities and are either related to the Old World genera or are considered anomalous. The plants are trees, shrubs, or lianas and occur in a variety of habitats. "They are most commonly found on the edges of clearings in primary forests or on land liable to inundation.The genera *Poraqueiba* and *Humirianthera* are cultivated by the Indians of Brazil and may be found in plantations. *Mappia* frequents dry, rocky outcrops in Havana province of Cuba, but occurs in dense forests at higher elevations in the province of Santa Clara. *Ottoschulzia cubensis* is a shrub of salt marshes, while *O. domingensis* is limited to limestone outcrops. Species of *Citronella* have been collected on dry, barren soil as well as dense, moist forests. *Calatola* and *Dendrobangia* are commonly found in rain forests. Altitudinal ranges of genera may vary from sea level for *Ottoschulzia* to 6000 feet for *Emmotum* and *Calatola*."

"*Poraqueiba* is cultivated in Brazil, near Pará, for the oil that may be extracted from the sarcocarp and for the copius starchy endosperm of the seed. Fresh fruits are sold in local markets, although their use is not general and a taste must be developed for them. *Humirianthera* has large fleshy tubers which contain a large amount of starch. This genus is cultivated for the tubers or rootstocks and for the starchy seeds. . . . *Citronella* is also found under cultivation in southern South America. The leaves of *C. gongonha* are used as a substitute for those of *Ilex paraguayensis* in the preparation of maté. This usage was traced by Lambert . . . to the period when Dr. Francis was dictator of Paraguay and declared an embargo on the leaves of *Ilex*. *Citronella gongonha* was tried as a substitute, probably because of the close similarity in appearance of the two plants.

Other species of *Citronella* lack the essential oils necessary for maté and cannot be used. *C. gongonha* and *C. mucronata* frequently have spinose-margined leaves and for this reason are often used as ornamentals or for hedging. Both are planted as park shade trees as well as being used as greenhouse or hothouse plants. The fruits of several species of *Calatola* are edible either raw or roasted and serve as local food products. No record was found of this plant being under cultivation. The bark, leaves, and fruits of *Calotola* all contain a pigment which is used as a blue dye. Only two genera are reported as toxic to humans. The fruits of *Calatola mollis*, if eaten, cause extreme nausea and often violent stomachic and intestinal pains. The other species of this genus are apparently harmless. The starchy material in the rootstocks and fruits of *Humirianthera* is toxic and must be washed thoroughly before it can be used."

Dos adiciones as las especies nuevas colombianas del genero *Ficus*. By ARMANDO DUGAND. *Caldasia* (Bogotá) 5: 37–39; Aug. 1, 1942.

The two new species described are *Ficus chaponensis* Dugand and *F. soatensis* Dugand. Both are small trees; the latter is known locally as Chipio.

Lauraceas nuevas de Venezuela. By T. LASSER. Bol. Técnico No. 3, Min. Agr. y Cria, Caracas, 1942. Pp. 19; 9 x 12½; 15 plates.

Fifteen new species of Lauraceae are described and figured. The genera are *Beilschmiedia* (1), *Endlicheria* (1), *Nectandra* (6), *Ocotea* (5), and *Pleurothyrium* (2).

Chaves para determinação de gêneros brasileiros e exôticos das dicotiledôneas mais cultivadas no Brasil. By LIBERATO JOAQUIM BARROSO. Bull. No. 1, Vol. 1, Secção de Botánica, Serviço Florestal, Rio de Janeiro, 1942. Pp. 126; 7¼ x 10½; 9 plates.

Contains 144 family keys to the genera (837 in all). The arrangement of the families is alphabetical. The distinguishing features are simplified as much as possible and further clarified by 114 drawings composing the nine plates. A second volume of this useful work is in preparation.

New and critical Chinese and Indo-Chinese Myrsinaceae. By EGBERT H. WALKER. *Journ. Arnold Arboretum* 23: 3: 344–355; 2 text figs.; July 1942.

Contains a few corrections for the author's "*Revision of the Eastern Asiatic Myrsinaceae*, needed changes in J. Pitard's treatment of this family in Lecomte's *Flore Générale de l'Indo-Chine*, and new species and additional records from the collections of W. T. Tsang made for Lingnan University and the Arnold Arboretum in southern Kwangtung and adjacent Tonkin, Indo-China."

***Upuna*, a new genus of the Dipterocarpaceae.** By C. F. SYMINGTON. Reprint from *Bull. Bot. Gard. Buitenzorg*, ser. 3, Vol. XVII, August 1941.

This new genus and species, *Upuna borneensis* Sym., is only known to occur in Borneo, and apparently is not very closely related to any other member of the Dipterocarpaceae.

Plantae Papuanae Archboldianae. IX. By E. D. MERRILL. *Journ. Arnold Arboretum* 23: 3: 267–297; July 1942.

This paper, concluded from p. 265 of the *Journal*, is devoted to descriptions of new species and varieties of the genus *Syzygium* from New Guinea and the Solomon Islands.

New species of *Croton* L. from New Guinea. By LEON CROIZAT. *Journ. Arnold Arboretum* 23: 3: 369–376; July 1942.

"This is the first of a proposed series of papers on the Euphorbiaceae of New Guinea prepared in connection with a study of various other Malaysian species of *Croton*." Ten species are described as new.

Degeneriaceae, a new family of flowering plants from Fiji. By I. W. BAILEY and A. C. SMITH. *Journ. Arnold Arboretum* 23: 3: 356–365; 5 plates; July 1942.

"In 1934 the junior author collected specimens of a fruiting tree on the Fijian island of Vanua Levu, but efforts to place the plant in a family failed. Neither fruit nor foliage suggested any plant previously known from the Pacific. Although wood from the trunk was available, no definite suggestion of a

family could be made by those who examined the specimen. Recently, a re-examination of the wood and a study of the internal structure of the twigs and leaves indicated that the plant is related to the Magnoliaceae, and it has subsequently been ascertained that the plant is conspecific with a tree collected in flowering condition in the interior of Viti Levu by Mr. Otto Degener in 1941. This Fijian plant, which is now represented by ample foliage, flowers, fruits, and wood, is definitely a member of the ranalian complex. It exhibits close similarities to the Magnoliaceae, particularly in the internal structure of its vegetative organs, in its pollen, and in the vascularization of its stamens. However, we cannot place it in the Magnoliaceae . . . without expanding the current concept of that family to an unwarranted degree."

The wood of the only species, *Degeneria vitiensis* Bailey & Smith, is described as follows: "In the secondary xylem of the young stem, narrow multiseriate rays extend outward from the gaps in the dictyostele. These rays flare outward through the secondary phloem, which is stratified into alternating strands of hard and soft bast. The thin-walled, angular vessels of the secondary xylem occur singly or in small, usually radially oriented, clusters. The vessel members have numerous scalariform perforations and the pitting between vessels and between vessels and parenchymatous elements is typically scalariform. The thin-walled imperforate tracheary cells have pits with minute borders. The parenchyma distribution is dominantly banded apotracheal with a low percentage of scanty paratracheal. The multiseriate rays in the later-formed secondary xylem are of typically fusiform outline as seen in tangential longitudinal sections. The infrequently occurring uniseriate rays are low and are composed of upright cells, such as are present on the margins of the multiseriate rays. Oil cells are of sporadic occurrence in the rays of the secondary xylem."

A nomenclatural note on the Himantandraceae. By A. C. Smith. *Journ. Arnold Arboretum* 23: 3: 366–368; July 1942.

"The family Himantandraceae, proposed by Diels in 1917, is now generally accepted by botanists as a distinct family of the order Ranales, related to the Magnoliaceae. However, there has been disagreement as to the correct name for its single genus, whether *Himantandra* F. v. Muell. or *Galbulimima* F. M. Bailey." The author reviews the literature and decides that *Himantandra* has priority.

A note on the distribution of *Chlorophora excelsa* in Uganda. By A. S. Thomas. *Empire Forestry Journal* (London) 21: 1: 42–43; 1942.

Chlorophora excelsa, which is so characteristically a West African species, is also widespread in Uganda where it occurs outside the dense forests. "This species, therefore, seems to be adapted to a considerable range of climate; the trees growing in the drier parts are vigorous and healthy, although, on account of their more branching habit in the open, they do not yield so good a timber as that from the boles of trees grown under forest conditions. Yet, despite the vigor of wild trees, the growth of planted trees has often been disappointing in Uganda, as in other countries. The young trees remain stunted and badly attacked by the gall insect (*Phytolyma lata*) for some years until they have reached a height of 15 or 20 feet, when the growth becomes more vigorous."

In one locality where scattered specimens and groups were growing naturally but where plantations had made poor progress it was found that mature trees were located on or near termite mounds and that natural regeneration was confined to soil that is slightly alkaline. "Both termite mounds and old settlements cause a local accumulation of bases, which is reflected in their reaction, and it seems probable that the supply of bases has a marked effect on the growth of *Chlorophora excelsa*." It is suggested that the supply of potassium, rather than of calcium, may be the limiting factor, and experiments have been started by the Uganda Forest Department to determine the effect of lime and wood ashes on the growth of young trees planted in mildly acid soil.

The damping capacity of timber. By W. L. Greenhill. Reprint No. 80, *Journ. Council Sci. & Ind. Research* (Melbourne) 15: 2: 146–153; May 1942.

The term "damping capacity" is used to describe the ability of a solid to convert mechanical energy of vibration into internal energy, which causes vibrations to die out. "When a solid is subjected to a periodic force, the damping capacity prevents the amplitude of vibration from becoming infinite when the frequency of the applied force approaches a natural frequency of the solid. Damping capacity is of considerable importance in certain branches of engineering and, consistent with other properties, it is generally agreed that materials of high damping capacity are superior to those of low damping capacity. Take, for example, the wings of aeroplanes. Under certain circumstances these are subject to resonant vibrations, the amplitude of which depends essentially on the damping properties of the materials of construction. The same thing applies with special force to the blades of aeroplane propellers which are liable to vibrate violently at certain critical speeds of rotation. The amplitudes of vibration are great or small according to the material of which the blades are made. It is stated by experts that the endurance of the blades depends far more on the damping capacity of the material than on its fatigue strength."

"A comparison of the damping capacity of timber as found in either of the present series of tests with published results for metals shows that timber has a much greater damping capacity than any of the metals commonly used for aircraft construction. . . . There does not appear to be any significant difference between the behavior of backsawn and quartersawn specimens. . . . The effect of increasing the moisture content of a specimen is to increase its damping capacity, the relation being practically linear within the range tested. . . . The results on improved wood indicate clearly that with an increase either in resin or density the damping capacity is reduced and the rigidity modulus increased."

Geographical guide to the floras of the world. Part I. By S. F. Blake and Alice C. Atwood. Misc. Pub. No. 401, U. S. Dept. Agr., Washington, D. C., June 1942. Pp. 336; 5¾ x 9. Price (Supt. of Documents) 75 cents.

"The primary purpose of this publication is usefulness, not bibliographical completeness. Its aim is to furnish an annotated catalog of all the now useful floras and floristic works, including those in periodical literature, that list or describe the complete vascular flora (or the phanerogams only) of any region or locality, and to include as well all publications dealing on the same scale with useful and medicinal plants, vernacular names, and botanical bibliography. In general, only the later works relating to a given region or subject are included, although earlier publications are usually mentioned under the titles of works that have replaced them. Publications dealing with only a part of the flora, such as a single family or larger group of the flowering plants or the pteridophytes only, or a single group of useful plants, such as those producing dyes, resins, or forage, are excluded, except for complete papers on edible, medicinal, or woody plants. Occasional titles relating to weeds and poisonous plants, chiefly from the botanical point of view, have been included, although no attempt has been made to include all papers on these subjects. In the case of little-known regions without complete floras, some publications of an incomplete nature, such as lists of species obtained by individual collectors or expeditions, have been inserted, as have also some miscellaneous papers not falling strictly within the scope of the list as defined. In general, no attempt has been made to evaluate the titles listed, but references to critical reviews are given when available. Papers that are primarily ecological have been excluded unless they contain fairly complete lists of the plants of the areas discussed. Works of the 'popular' type, intended for beginners in botany, have been omitted, as well as works that are now only of historical value. The list is intended to be complete through 1939, and no later titles have been inserted."

"The part of this list now published, covering all the world except Europe and Asia and the islands closely associated with them (namely, those north of 40° north latitude in the Atlantic Ocean and north of 30° north latitude in the Pacific), includes about 2,597 primary titles and 428 subsidiary titles (supplements, reviews, etc., as well as the few works listed as

not available for examination). At least as many more papers have been examined and rejected as not fulfilling the promise of their titles."

A key to the genera of the Anacardiaceae. By FRED A. BARKLEY. *Am. Midland Naturalist* (Notre Dame, Ind.) 28: 2: 465–474; September 1942.

A key to 73 living and fossil genera of the Anacardiaceae, together with a table of synonymy.

Studies of the identification of timbers, with a note on the seasoning of wood. By ALEXANDER L. HOWARD. Macmillan and Co., Ltd., London, 1942. Pp. 110; 6 x 9 ¾; 504 photomicrographs; numerous text figs. Price 36 shillings.

The contents of this book are as follows: Introduction (pp. 1–5); photomicrographs, nine to a page (7–62); seasoning and conversion of timber (63–79); progressive dryers (80–84); compartment dryers (85–92); control of drying plants (93–97); working procedure (98–101); indexes (103–110).

The author is well known for his book, "Manual of the timbers of the world," and the present volume is closely associated with his larger work. The photomicrographs were made by Mr. G. R. Keen and each is about 1⅛ x 2¼ inches. The magnification is 10 x throughout. Every half-tone reproduction is identified by its common and/or scientific name and bears a number corresponding to that of the "Manual." "In those cases where a number has been omitted, it is because at time of going to press an authentic specimen of the timber in question, of a size required for the microtome section, has not been available, but it is hoped that in a later edition most of these will be included, together with the remainder of the timbers reported in that volume."

"An experience of half a century has shown that there are a great number of people who are interested in the identification of different kinds of woods and although they may have studied the various authorities they have not met with much success. Included in this category are engineers and architects, students of wood structure and forestry, and members of the public. On more than one occasion a decision has been challenged in the Law Courts. In these cases it has been found impossible to produce convincing evidence which could be placed before the legal mind in that necessary form required by the learned judge.

"It is common knowledge that human finger prints display a variation which can be relied upon for identification, no two being alike. In some such manner it is found that the transverse section of wood under magnification will serve in the majority of cases as a sure means of identification, and in all cases be of great assistance in helping to come to a decision, although instances will occur which are confusing. With this knowledge before us we shall be better able to understand the photomicrographs of the transverse sections we are examining. All that is necessary is for the student to have a pocket lens . . . and a sharp knife, when with a clean-cut portion of the transverse section of the particular wood he wishes to identify, comparison can be made with the photomicrograph."

GENERAL INDEX

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