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THE WOOD OF *SARCOSPERMA PANICULATUM*

By HERBERT F. MARCO

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In 1876, Hooker f. (Bentham & Hooker's *Genera Plantarum* II. 2. 655) segregated two species of *Sideroxylon* and one of *Reptonia* into a new genus which he named *Sarcosperma* (family Sapotaceae, near *Lucuma*).

In 1925, H. J. Lam (Bull. Jard. Bot. Buitenzorg III. 7. 248) proposed the monotypic family Sarcospermaceae to include the species of *Sarcosperma*, of which nine are now recognized. Of these species, five are known to occur in southeastern continental Asia (China, Hong Kong, Tonkin, Assam, and Sikkim) and four in the Malay Peninsula, Sumatra, Mindanao, and Ternate.

Sarcosperma paniculatum Stapf & King is a member of the second group and is widely distributed in the Malay Peninsula

and Archipelago. It was first discovered in the Philippines in 1909, and was considered to be a new species of *Diococalyx*, family Myrsinaceae. Subsequently a new genus, *Apoia*, was proposed for it by Merrill, who questioned its inclusion in the Myrsinaceae. Its identity with *Sarcosperma paniculatum* has recently been established by Lam (*Phil. Journ. Sci.* 49: 2: 143–146, Oct. 1932), who says: "The fact that *Sarcosperma* has been inserted not only in the Sapotaceae, but also in the Myrsinaceae, evidences both its close relation to those two families and its isolation from them, since its characters render it quite distinct from any genus in either of the orders mentioned."

The object of the present investigation is to find what evidence the wood affords for the proper systematic classification of the tree. The only material available is a single specimen of heartwood (Yale No. 21175) from the Museum voor Economische Botanie te Buitenzorg (No. 4952). In Heyne's *De Nuttige Planten van Nederlandsch Indië* (p. 1245) is the following description: Vernacular names, Njatoh Raboeng (Minangk.) and Koeriaba (Ternate). Tree up to 35 m. in total height and 80 cm. in diameter, occurring in the uplands at an elevation of about 1200 m. in Padang and 400–600 m. in Ternate; bole angular and rather crooked, with a clear length of 10–16 m.; heartwood brown, rather soft, not very durable (Class IV), used for beams and planks.

Description of the Wood

General features: Color pinkish brown, faintly streaked. Luster satiny. Odor and taste absent or not distinctive in dry material. Sp. gr. (thoroughly air-dry), 0.53; weight about 33 lbs. per cu. ft. Texture fine and uniform; grain straight. Wood easy to work, finishes smoothly, will probably hold its place well when manufactured, does not appear highly resistant to decay or insects.

Gross anatomy: Growth rings poorly defined by narrow bands deficient in parenchyma. *Pores* scarcely distinct without lens, occurring mostly in radial pairs or in short radial rows with the interior pores much flattened; pore groups scattered, without pattern, though sometimes tending to radial alinement; lustrous tyloses usually present. *Vessel lines* distinct in proper light as long scratches having the same color as the background. *Wood parenchyma* in very numerous, very irregular, narrow lines producing a fine, patternless network with the rays; not visible without lens and rather indistinct with it. *Rays* very fine, closely spaced, bending around pores; not visible without lens on cross and tangential sections, low and inconspicuous on the radial.

Minute anatomy: Solitary *pores* ovoid (radial diam. 77–216μ, av. 157μ; tang. diam. 77–216μ, av. 154μ); number of pores in radial groups, 2–7; walls very thin. *Vessel members* with simple perforations, distinctly rimmed; perforation plate slightly to steeply inclined; terminations abrupt to ligulate; bordered pits small, numerous, alternate, the aperture horizontally elongated but not extending beyond the border; tyloses common, very thin-walled. *Fiber-tracheids* compose the ground mass of the wood; often arranged in fairly definite radial rows (owing to the close spacing of the rays, which are only 2–4 fibers apart); walls thin, the secondary consisting of two layers, the inner one the thinner; septations (true walls) and false septations (gummy material) sometimes present; pits numerous in both radial and tangential walls, the aperture vertical, long-lenticular, and extending beyond the distinct border; fiber length 1.0–2.3 mm. *Wood parenchyma* abundant, without definite pattern, but tending to form irregular uniseriate, tangential lines, often interrupted; cells in one strand in contact with those of another (radially or tangentially) or with the larger cells of the rays have small clustered pits, but are not disjunctive. *Rays* heterogeneous; 1–30 cells (up to 0.93 mm., av. 0.63 mm.) high; uniseriate rays and uniseriate portions of the others are composed of many rows of square and upright cells, the marginal row palisade; portions composed of procumbent cells are 1–4 cells wide (15–46μ), mostly biseriate; cells all very thin-walled, abundantly pitted throughout; pits to fibers lenticular, simple, but showing the border in the fiber wall distinctly; pits to vessels irregular in size, shape, and arrangement, but mostly large to very large and often tending to scalariform arrangement; pits from square and upright cells to wood parenchyma very small, in radially ovate clusters with thickenings of the middle lamella showing distinctly above and below them (in stained sections); pits to other ray cells minute, numerous, not clustered; gum deposits common, granular; no crystals observed.

Systematic Considerations

The wood of *Sarcosperma paniculatum* is so different from that of any member of the Myrsinaceae that it seems unlikely that it would ever occur to a wood anatomist to relate it to that family. The resemblance to certain of the Sapotaceae, such as *Lucuma* and *Chrysophyllum*, is very noticeable both in

THE WOODS OF *RHABDODENDRON* AND *DUCKEODENDRON*

By SAMUEL J. RECORD

The two woods described below are from the Brazilian Amazon region. They are of special interest to the wood anatomist because each of them has been referred to more than one family. The purpose of the present investigation is to discover diagnostic characters in the woods.

Rhabdodendron amazonicum

The synonymy of *Rhabdodendron amazonicum* (Benth.) Huber is, according to Ducke (Archivos Jard. Bot. Rio de Janeiro, III. 181), as follows: *Lecostemon amazonicum* Benth., *L. crassipes* Benth., *Rhabdodendron crassipes* Huber, *R. Duckei* Huber, *R. paniculatum* Huber, *R. longifolium* Huber, and *R. Arirambae* Huber. The species exhibits considerable variation in the size, shape, and texture of the leaves and in the nature of the inflorescence. These differences were responsible for the multiplication of species and may account for the wide difference of opinion regarding the family to which the genus belongs. At present it is attached to the Rutaceae, but it has also been referred to the Rosaceae-Chrysobalanoideae and to the Phytolaccaceae.

Two good wood samples of *Rhabdodendron amazonicum* are available for study: Yale No. 21237 from the Ford Company, Tapajoz River, Brazil, through Field Museum of Natural History (No. 613237), and Yale No. 22061 collected by Dr. Adolpho Ducke (No. 41) in Parintins. The conspicuous feature of this material is the anomaly of successive development of secondary groups of wood and bast. According to Solereder (*Systematic Anatomy of the Dicotyledons*, pp. 667, 1030), this type of anomalous structure of the stem has been recorded for species of *Seguiera*, *Gallesia*, *Phytolacca*, *Ercilla*, *Barbeuia*, and *Agdestis*.

My own observations have been confined to the stems of two species of *Achatocarpus*, which have normal structure, and two species of *Phytolacca* and one of *Gallesia*, which have the laminated structure. The wood of *Rhabdodendron* is remarkably like that of *Gallesia Scororodendrum* Casar. (= *G. Gorazema* Moq.), the Páo d'Alho of the Bahia-Victoria region of Brazil (see *Timbers of Tropical America*, pp. 158–159). The outstanding anatomical difference is that the wood fibers of *Rhabdodendron* have many, small, distinctly bordered pits, while in *Gallesia* and all the other genera of the Phytolaccaceae known to have anomalous structure the fibers have fewer and smaller pits which are simple or indistinctly bordered. In the normal woods of the family small but distinctly bordered pits are common in the fibers.

The woods of the Rosaceae-Chrysobalanoideae and of the Rutaceae comprise homogeneous groups with normal and distinctive anatomy. There is little in common between the two groups, while there are many fundamental differences. *Rhabdodendron* is as unlike either group as they are unlike each other. On the other hand, there is a marked affinity of that genus to certain genera of the Phytolaccaceae.

Duckeodendron cestroides

Duckeodendron cestroides Kuhlmann (Archivos do Jardim Botanico do Rio de Janeiro, IV. 361. 1925) is a large tree with alternate simple leaves, gamopetalous flowers, 2-seeded drupaceous fruits, longitudinally fissured bark, and light yellow wood occurring in the forests along the Tapajoz River; local names, Muiracaúa and Pupanha-rana. It was discovered in 1923 by Dr. Adolpho Ducke, in whose honor the genus was named. Owing to the absence of mature fruits and to the resemblance of the flowers to those of *Cestrum*, the genus was referred to the family Solanaceae. Two years later the discoverer of the tree obtained good fruiting material which convinced the author of the genus that its rightful place was with the Borraginaceae (*idem* V. 209. 1930).

In the lot of woods most recently received from Dr. Ducke, a lot exceptionally rich in rarities, is a good sample of the wood of *Duckeodendron cestroides*, accompanied by herbarium material (Yale No. 22591; Col. No. 131). As a result of the usual inspection given all accessions to the Yale collections, this wood was set aside for special study as it appeared strikingly different from any known member of the Borraginaceae.

The conclusion reached from the study of the wood of *Duckeodendron* is that it is out of place in the Solanaceae and Borraginaceae and is a member of, or closely related to, the Apocynaceae.

COMMENT BY H. A. GLEASON

After the above conclusions had been reached, the matter was referred to the New York Botanical Garden for an opinion, to which Dr. H. A. Gleason, Head Curator, replied:

"In regard to *Duckeodendron:* Kuhlmann does not definitely say one style, but his use of the singular *stylus* infers as much. The fruit is drupaceous and indehiscent; ovary 2-celled. All of these characters exclude Euphorbiaceae from consideration, and this exclusion is confirmed by the general facies of the flowers, as shown in Kuhlmann's plate.

"I know of no Borraginaceae that have a 2-ovuled ovary. Drupaceous fruits occur in *Cordia* and related genera. Most of them have divided styles and I know of no genus with single style that fits with the description, nor of any genus with two ovules in the whole ovary. The family does have a disk and alternate leaves.

"In the Solanaceae, the fruit is a berry, not a drupe, and almost invariably has several to many seeds. *Duckeodendron* has a 2-seeded drupe.

"In the Apocynaceae, some plants have alternate leaves, and an inflorescence such as Kuhlmann pictures is common. Most of the family have two ovaries, but syncarpous ovaries exist, and Kuhlmann's figure, showing a distinctly flattened ovary, certainly points toward an apocynaceous condition. Drupes are found in various genera, with as few as 2 seeds in each.

"All in all, I am inclined to believe the plant fits the Apocynaceae better than any of the other three."[1]

[1] Dr. Gleason added as a postscript: "Have you compared the wood with the Loganiaceae?" It seems more than a coincidence that my attention had already been directed to that family because of the fact that in *Anthocleista nobilis* G. Don from Liberia some of the rays contain open intercellular canals appearing to the unaided eye as tiny dark specks on tangential surface. Examination of the woods of 12 genera of that family, however, served to convince me that it could be left out of further consideration.

NEW TREES FROM THE TAPAJOZ RIVER, BRAZIL, WITH A LIST OF VERNACULAR NAMES

By PAUL C. STANDLEY

Field Museum of Natural History

In Number 29 of *Tropical Woods* there appeared a list of vernacular names of trees collected in the Bôa Vista region on the Tapajoz River in the state of Pará, Brazil. During 1932, Field Museum has received from Mr. Roy Carr of the Companhia Ford Industrial do Brasil several further sendings of tree specimens of the Bôa Vista region. The collections were made by R. C. Monteiro da Costa and more recently by Senhor Capucho. Most of the later numbers have been accompanied by ample wood specimens.

Several of the trees represented in these collections have proved to represent new species, descriptions of which are published here. It is probable that further new species could be based on some of the specimens in such families as Myrtaceae and Sapotaceae, but it seems preferable to delay study of these for the present, in the hope that a specialist may undertake critical work upon these difficult groups.

Although lists of vernacular names of the trees of the Amazon Valley have been published by Huber and Ducke, it seems well worth while to publish the present list, based on the Bôa Vista collections. Some and probably the majority of these local names have not been recorded previously, and it is at least a matter of convenience to have available a list of the Fordlandia timber trees, many of which are or may become of commercial importance. None of the rather numerous herbaceous plants of the various sendings are listed on the following pages.

Ficus tapajozensis, sp. nov.

Arbor 16-metralis, trunco 20 cm. diam. omnino glabra; stipulae ovato-triangulares 8–10 mm. longae acuminatae caducae; folia parva petiolata subcoriacea, petiolo crassiusculo 10–15 mm. longo; lamina obovato-oblonga 8–11 cm. longa 3.5–4 cm. lata apice obtusa vel rotundata et abrupte cuspidato-acuminata, acumine brevi obtuso, basi cuneato-obtusa, nervis supra prominulis conspicuis, costa subtus elevata, nervis lateralibus utroque latere

c. 9 obliquis angulo latiusculo adscendentibus prominulis remote a margine conjunctis, venulis vix prominulis arcte reticulatis; receptacula geminata graciliter 7–8 mm. longe pedunculata globosa 1 cm. diam., involucro bilobo 3.5 mm. lato, lobis brevibus late rotundatis, ostiolo parvo plus minusve depresso.—Brazil: "Firm land," Bôa Vista, Tapajoz Region, State of Pará, August 16, 1932, *Capucho* 381 (Herb. Field Mus. No. 661, 023, type).

Vernacular name, Apuhy.

Inga Capuchoi, sp. nov.

Arbor 10-metralis, trunco 18 cm. diam., ramulis gracilibus ochraceis elevato-lenticellatis minute puberulis; folia mediocria, petiolo 1–1.5 cm. longo, rhachide 3–4 cm. longa; foliola 1–2-juga breviter crasse petiolulata anguste lanceolato-oblonga 12–16 cm. longa 4–5.5 cm. lata acute acuminata basi plus minusve obliqua acuta vel actiuscula supra lucida utrinque glabra vel glabrata; flores spicati, spicis axillaribus vel lateralibus 1.5–4 cm. longe pedunculatis 1.5–4 cm. longis dense multifloris, bracteis oblongis vel ovatis 1–1.5 mm. longis; calyx tubulosus supra paullo latior 7–8 mm. longus parce puberulus, dentibus late triangularibus subobtusis erectis 1.5 mm. longis; corolla 10–12 mm. longa in alabastro apice rotundata prope apicem sparse vel dense hispidula.—Brazil: Bôa Vista, Tapajoz Region, State of Pará, "firm land," August 23, 1932, *Capucho* 398 (Herb. Field Mus. No. 661, 021, type).

Local name, Ingaseira. "Flowers red and white, with no odor. Used only for firewood."

Bauhinia stenocardia, sp. nov.

Frutex 3-metralis, ramulis gracilibus teretibus ferrugineo-tomentulosis vel puberulis; folia majuscula simplicia integra brevissime petiolata subcoriacea, petiolo crasso vix 1 cm. longo; lamina ovata vel elongato-ovata 11–17 cm. longa 6–8 cm. lata longe attenuato-acuminata vel interdum subabrupte acuminata, basi breviter vel profunde cordata, supra sublucida tantum ad costam ferrugineo-pilosiuscula aliter glabra, subtus densiuscule pilis brevissimis subpatentibus pilosula, 7-nervia, nervis elevatis gracilibus, venulis prominentibus arcte reticulatis; flores magni in racemos terminales breves paucifloros dispositi, pedicellis crassis 1 cm. longis ferrugineo-tomentulosis, bracteis ovatis acutis adpressis 3–4 mm. longis; sepala linearia 6 cm. longa 2.5 mm. lata extus densissime ferrugineo-tomentulosa; stamina perfecta non visa, filamentis 8 cm. longis et ultra.—Brazil: Aramanahy, Tapajoz Region, State of Pará, high land, January 8, 1932, *R. C. Monteiro da Costa* 238 (Herb. Field Mus. No. 655, 840, type).

Local name, Mororosinho.

Drepanocarpus paludicola, sp. nov.

Frutex, ramulis dense foliatis sparse griseo-strigosis; stipulae parvae lineari-subulatae deciduae; folia brevipetiolata 5–9 cm. longa, rhachide

gracili dense albo-strigosa; foliola c. 10-juga brevissime petiolulata subcoriacea rhombeo-oblonga 11–16 mm. longa 4.5–8 mm. lata apice rotundata et brevissime apiculata basi inaequilatera rotundata supra sparsissime strigosa vel fere glabra venulis non elevatis, subtus pallidiora sparse albido-strigosa; flores racemosi, racemis simplicibus vel furcatis axillaribus vel lateralibus vulgo fasciculatis foliis duplo brevioribus laxe multifloris, floribus breviter pedicellatis; legumen lunato-falcatum monospermum curvum c. 2 cm. longum 8 mm. latum ubique crassum glabrum apice lateraliter apiculatum sessile.—Brazil: In inundated places, Aramanahy, Tapajoz Region, State of Pará, January 11, 1932, *R. C. Monteiro da Costa* 250 (Herb. Field Mus. No. 655, 830, type).

Known as Tucunaré envira. Remarkable for the numerous and very small leaflets. The fruit is similar to that of *D. lunatus*, but much less strongly curved and smaller.

Lueheopsis violacea, sp. nov.

Arbor 10-metralis, trunco 30 cm. diam., ramulis crassiusculis dense pilis fusco-fulvis rigidis adscendentibus longiusculis obtectis; stipulae oblongo-ovatae acuminatae 8–10 mm. longae; folia mediocria brevissime petiolata firme membranacea, petiolo crasso 7 mm. longo; lamina late ovalis vel obovato-ovalis 9–11 cm. longa 6–7 cm. lata apice late rotundata et brevissime triangulari-protracta, basi late rotundata praesertim versus apicem breviter inaequaliter serrato-dentata, supra glabrata lucida laete viridia, subtus ad venas minute stellatim ferrugineo-tomentosa, aliter minute densissime albido-tomentosa, trinervia; flores paniculati, paniculis lateralibus usque ad 13 cm. longis angustis fere spiciformibus multifloris, floribus breviter pedicellatis; involucrum 6–7 mm. longum dense albido-strigisum ad medium lobatum, laciniis lanceolato-triangularibus; sepala 12 mm. longa lanceolato-oblonga acuta extus dense ochraceo-strigosa, intus glabra vel sparsissime pilosa; petala violacea sepalis paullo longiora.—Brazil: Firm land, Bôa Vista, Tapajoz Region, State of Pará, August 19, 1932, *Capucho* 386 (Herb. Field Mus. No. 661, 022, type).

Vernacular name, Arapapá. Wood used only for fuel. The genus *Lueheopsis* is a group of five South American species, segregated from *Luehea* by Burret, on excellent characters. The present species is most closely related to *L. rosea* (Ducke) Burret, also of Pará, which has much smaller flowers and conspicuously different pubescence.

Lucuma paraensis, sp. nov.

Arbor 20-metralis, trunco 20 cm. diam., ramulis crassissimis ochraceo-sericeis apice dense foliatis; folia magna brevissime petiolata subcoriacea, petiolo crasso usque ad 1 cm. longo; lamina obovato-oblonga 19–30 cm.

longa 7–11.5 cm. lata apice acuta vel rotundata et brevissime obtuse apiculata, basin versus longe cuneato-attenuata, basi ipsa anguste rotundato-obtusa, supra lucida glabra, costis ut venulae prominulis, subtus glaucescens ubique dense minute griseo-sericea, nervis lateralibus utroque latere c. 20 subobliquis angulo latiusculo adscendentibus, venulis prominentibus arctissime reticulatis; flores (in alabastro tantum visi) in axillis dense aggregati dense sericei; fructus depresso-globosus subtrigonus basi et apice subtruncatus c. 6 cm. altus et 8 cm. latus ubique densississime fulvo-tomentulosus arcte sessilis.—Brazil: Bôa Vista, "firm land," Tapajoz Region, State of Pará, in 1932, *Capucho* 405 (Herb. Field Mus. No. 661, 510, type).

The local name is Abio Grande; wood used for firewood; fruit edible.

Amaioua Monteiroi, sp. nov.

Arbor 6-metralis, trunco 13 cm. diam., ramulis crassis dense ferrugineo-tomentosis; stipulae caducae non visae; folia maxima petiolata subcoriacea, petiolo crassiusculo 2–8 cm. longo ferrungineo-tomentuloso; lamina late oblonga, elliptica vel obovato-elliptica 27–60 cm. longa 12–26 cm. lata apice obtusa vel subrotundata et abrupte cuspidata, acumine angusto 1.5 cm. longo, basi obtusa vel subrotundata et saepe breviter decurrens, supra glabra lucida, subtus praesertim ad venas strigosa, nervis lateralibus utroque latere c. 20 elevatis, venulis creberrimis parallelis fere rectis elevatis; flores masculi dense corymbosi numerosi ad apices ramulorum dense congesti, pedicellis crassiusculis c. 1.5 cm. longis adpresso-pilosis, calyce tubuloso c. 2 cm. longo 7 mm. lato truncato dentato extus dense adpresso-piloso intus densissime sericeo, dentibus erectis subulatis 1 mm. longis.—Brazil: Highland forest, Aramanahy Plateau, State of Pará, January 31, 1932, *R. C. Monteiro da Costa* 290 (Herb. Field Mus. No. 655, 842, type).

Vernacular name, Puruhy Grande da Matta. The tree is remarkable for the huge leaves, larger than those of any other species of the genus.

ANACARDIACEAE

Anacardium giganteum Hancock. Cajú-assú. A tall forest tree, related to the common Cashew.

Astronium Lecointei Ducke. Muiracoatiara; Muiracoatiara preta.

ANONACEAE

Guatteria Poeppigiana Mart. Envira amarella.

APOCYNACEAE

Allamanda cathartica L. Camendara.

Couma rigida Muell. Arg. Itapeuá; Marfim.

Malouetia Duckei Markgraf. Tamanqueira de leite.

Malouetia tamaquarina (Aubl.) A. DC. Molongó de colher.

Plumeria sucuuba Spruce. Sucuhuba.

Tabernaemontana flavicans R. & S. Jasmim da matta.

BIGNONIACEAE

Arrabidæa sp. Carajurú da costa.

Martinella obovata (H. B. K.) Bur. & Schum. Gapuhy cipó.

Tabebuia serratifolia (Vahl) Nichols. Tamurá tuira.

Tabebuia sp. Pau d'arco.

BIXACEAE

Bixa arborea Huber. Urucurana da matta. Except for *B. Orellana*, perhaps the only distinct species of the genus. Unlike the common Anatto, this is a tall forest tree.

BOMBACACEAE

Bombax paraense Ducke. Mungubarana.

Pachira aquatica Aubl. Mamaorana.

BORAGINACEAE

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

Cordia multispicata Cham. Carú-cáo.

Cordia nodosa Lam. Uruasinho.

BURSERACEAE

Protium heptaphyllum (Aubl.) March. Breu branco do campo; Breu almacega.

Protium icicariba (DC.) March. Breu branco.

Protium Sagotianum March. Breu branco da matta.

CAPPARIDACEAE

Crataeva tapia L. Trapiá.

CARYOCARACEAE

Caryocar glabrum (Aubl.) Pers. Piquiárana; Piquiárana da varzea.

COCHLOSPERMACEAE

Cochlospermum orinocense (H. B. K.) Steud. Pacoté.

COMBRETACEAE

Buchenavia ochroprumna Eichl. Periquiteira do igapó.

COMPOSITAE

Wulffia baccata (L. f.) Kuntze. Cambará amarella.

EUPHORBIACEAE

Croton nervosus Klotzsch. GAIVOTINHA.
Hevea lutea (Benth.) Muell. Arg. SERINGUEIRA ITAUBA.
Mabea paniculata Benth. ABIORY.
Pera glabrata Baill. TATÁ-CÁA.

FLACOURTIACEAE

Casearia sylvestris Swartz. SARYTAN.

GUTTIFERAE

Symphonia globulifera L. f. ANANY.

HUMIRIACEAE

Saccoglottis guianensis Benth. ACHUÁ.

LAURACEAE

Because of the difficulty of making determinations in this complicated group, several of the specimens submitted remain without definite specific names.

Misanteca Duckei Sampaio. ITAÚBA ABACATE.
Ocotea costulata (Nees) Mez. LOURO CAMPHORA.

LECYTHIDACEAE

Chytroma jarana Huber. JARANA.
Couratari coriacea Mart.? TAUARY.
Lecythis sp. CUIÁRANA.

LEGUMINOSAE

The dominance of this vast family in the Amazon region is well illustrated by the following list of species, surpassing several times the representation of any other family.

Acacia glomerosa Benth. CUJUBA.
Bauhinia stenocardia Standl. MORORÓSINHO.
Calliandra surinamensis Benth. PAU DE SALSA.
Campsiandra laurifolia Benth. CUMANDA; ACAPURANA VERMELHA.
Cassia apoucouita Aubl. IRARY; PIXUNEIRARANA.
Cassia fastuosa Willd. FAVEIRINHA.
Cassia multijuga A. Rich. FAVEIRINHA BRANCA.
Crudia amazonica Spruce. FAVEIRA DO IGAPÓ.
Dalbergia monetaria L. f. VERONICA DE IGAPÓ.
Dialium divaricatum Vahl. JUTAHY POROROCA.
Dinizia excelsa Ducke. ANGELIM PEDRA.
Dioclea glabra Benth. MUCUNA FLOR BRANCA.
Drepanocarpus lunatus (L. f.) Mey. ATURIÁ.

Drepanocarpus paludicola Standl. TACUNARÉ ENVIRA.
Elisabetha paraensis Ducke. ARAPARY DA TERRA FIRME.
Erythrina xinguensis Ducke. MULUNGÚ.
Hymenæa palustris Ducke. JATOBAZINHO.
Hymenæa parvifolia Huber. JUTAHYSINHO.
Inga Capuchoi Standl. INGASEIRA.
Lonchocarpus Spruceanus Benth. AQUIQUY.
Macrolobium acaciifolium Benth. ARAPARY.
Macrolobium bifolium (Aubl.) Pers. JATOBARANA.
Macrolobium campestre Huber? INGARANA XIXY.
Mimosa orthocarpa Spruce. JUQUIRYSINHO.
Ormosia excelsa Spruce. JATOBAHY DO IGAPÓ.
Parkia ingens Ducke. FAVEIRA BRANCA; ARAPARY BRANCO.
Piptadenia peregrina (L.) Benth. ANGICO.
Pithecolobium acacioides Ducke. ARAPIRACA.
Pithecolobium racemosum Ducke. ANGELIM RAJADO.
Platymiscium Duckei Huber. MACACAÚBA DA TERRA FIRME.
Sclerolobium chrysophyllum Poepp. & Endl. TACHYRANA.
Sclerolobium paniculatum Vogel. TACHYSEIRO BRANCO.
Swartzia leptopetala Benth. MUIRAPIXUNA.
Swartzia polycarpa Ducke. GONÇALARE.
Sweetia nitens Benth. ITAUBARANA; PIRANHEIRA; ARAPICHUNA.
Tachigalia alba Ducke. TACHY DO IGAPÓ.
Tipuana fusca Ducke. AMARGOSO.
Zollernia paraensis Ducke. PAU SANTO.

LORANTHACEAE

Phoradendron platycaulon Eichl. HERVA DO PASSARINHO AMARELLO.
Psittacanthus biternatus (Hoffm.) Blume. HERVA ENCARNADA DE PASSARINHO.

MALPIGHIACEAE

Banisteria caapi Spruce. TIMBO BRANCO. Used as a fish poison.
Stigmaphyllon fulgens (Lam.) Juss. BATATA BRAVA.

MALVACEAE

Hibiscus mutabilis L. AMOR DOS HOMENS. Cultivated for ornament.
Hibiscus tiliaceus L. UACIMA DE MANGUE.
Urena lobata L. MALVA ROXA RECORTADA.

MELASTOMACEAE

Miconia ciliata (L. Rich.) DC. CHUMBINHO.
Miconia prasina (Swartz) DC. CAPITIHÚ.
Miconia stenostachya DC. CANELLA DE VELHA; PAPA TERRA.

MELIACEAE

Carapa guianensis Aubl. ANDIROBA.
Guarea paraensis C. DC. CIRICÓ.

MONIMIACEAE

Siparuna sp. CÁA-PITIÚ.

MORACEAE

Bagassa guianensis Aubl. TATAJUBA.
Ficus tapajozensis Standl. APUHY.
Noyera mollis (Poepp.) Ducke? IAWARA-PÓ.

MYRISTICACEAE

Iryanthera paraensis Huber. UCUHUBARANA.
Virola uaupensis (Spruce) Warb. UCUHUBA.

MYRTACEAE

Because of the lack of modern definitive works upon the classification of this family, it has been impossible to determine most of the rather numerous collections submitted.

Calyptranthes sp. ARAÇASINHO.
Eugenia flavescens DC.? ITAPEUA; FARINHA SECA.
Eugenia sp. PEDRA-HUME-CÁA.
Eugenia sp. HUMIRIRANA-CÁA.
Eugenia sp. MURTINHA.
Myrcia lanceolata Camb. MURTA CABELLUDA.
Myrcia sp. CUMATERANA.
Myrcia sp. UAPIXUNA.

NYCTAGINACEAE

Neea divaricata Poepp. & Endl. MARIA MOLLE.

POLYGONACEAE

Coccoloba paraensis Meissn. CAU-ASSÚ.
Symmeria paniculata Benth. MANGUIRANA.
Triplaris Martiana F. & M. TACHY VARZEA.

PROTEACEAE

Panopsis Sprucei Meissn. MALHEIA.

ROSACEAE

Couepia paraensis Benth. PIRÁ UCHY.
Licania incana Aubl. CARIPÉRANA.
Licania licaniaeflora (Sagot) Blake. PIANCHÍRANA.
Licania micrantha Miq. PAJURÁ-RANA.
Parinarium barbatum Ducke. MACUCÚ.

RUBIACEAE

The list of species of this family has been increased by the addition of certain species collected in the same general region by B. A. Krukoff, the specimens having been submitted to the writer for determination by the New York Botanical Garden.

Alibertia edulis (L. Rich.) A. Rich. PURUHYSINHO.
Amaioua Monteiroi Standl. PURUHY GRANDE DA MATTA.
Cephaelis colorata Willd. PERPETUA ROXA DA MATTA.
Genipa americana L. GENIPAPINHO.
Ixora Finlaysoniana Wall. BOQUET DE NOIVA. A shrub cultivated for ornament.
Machaonia spinosa Cham. & Schl. LIMÃORANASINHO.
Palicourea corymbifera (Muell. Arg.) Standl. BOTA.
Psychotria rubra (Willd.) Muell. Arg. JAPIHIM-CÁA.
Randia armata (Swartz) DC. LIMAORANA.
Randia formosa (Jacq.) Schum. AÇUCENA ESTRELLA.
Sabicea aspera Aubl. CIPÓ DE VAQUEIRO.
Sickingia tinctoria (H. B. K.) Schum. ASARAUBA; PAU D'ARARA.
Sphinctanthus rupestris Benth. JIMPAPINHO DE VARZEA.
Tocoyena formosa (Cham. & Schl.) Schum. PURUHY DA COSTA.

RUTACEAE

Rhabdodendron paniculatum Huber. MUIRACAÚA.

SAPINDACEAE

Sapindus saponaria L. SABONETE.
Toulicia bullata Radlk. PITAMBAIANA.

SAPOTACEAE

This is another group in which it has proved difficult to make determinations. Several of the collections submitted, although the specimens are in good condition, remain without satisfactory names.

Lucuma dissepala (Krause) Ducke. ABIORANA PRETA.
Lucuma paraensis Standl. ABIO GRANDE.
Lucuma sp. UAJARÁ; ABIORANA BRANCA.
Manilkara Huberi (Ducke) Standl., comb. nov. *Mimusops Huberi* Ducke. MASSARANDUBA.

SIMARUBACEAE

Simaba guianensis (Aubl.) Engler. CAJURANA.

STERCULIACEAE

Sterculia pruriens (Aubl.) Schum. CHICHA BRAVA.

TILIACEAE

Apeiba tibourbou Aubl. PENTE DE MACACO.
Lueheopsis violacea Standl. ARAPAPÁ.
Mollia lepidota Spruce. ENVIRA AMARGOSA.
Triumfetta Bartramia L. CARRAPICHINHO.

VERBENACEAE

Lantana Camara L. CAMBARÁ.
Vitex Agnus-Castus L. ALECRIM D'ANGOLA. A cultivated ornamental shrub.
Vitex cymosa Bert. JARAMANTAIA.

VIOLACEAE

Leonia glycicarpa Ruiz & Pav. TRAPIARANA.
Rinorea guianensis Aubl. AJARA.

VOCHYSIACEAE

Qualea parviflora Mart. COATÁ-QUIÇAUA.

CHECK LIST OF THE COMMON NAMES

Abio grande	*Lucuma paraensis* Standl.	Sapotaceae
Abiorana branca	*Lucuma* sp.	Sapotaceae
Abiorana preta	*Lucuma dissepala* (Krause) Ducke	Sapotaceae
Abiory	*Mabea paniculata* Benth.	Euphorbiaceae
Acapurana vermelha	*Campsiandra laurifolia* Benth.	Leguminosae
Achuá	*Saccoglottis guianensis* Benth.	Humiriaceae
Açucena estrella	*Randia formosa* (Jacq.) Schum.	Rubiaceae
Ajara	*Rinorea guianensis* Aubl.	Verbenaceae
Alecrim d'Angola	*Vitex Agnus-Castus* L.	Verbenaceae
Amargoso	*Tipuana fusca* Ducke	Leguminosae
Amor dos homens	*Hibiscus mutabilis* L.	Malvaceae
Anany	*Symphonia globulifera* L. f.	Guttiferae
Andiroba	*Carapa guianensis* Aubl.	Meliaceae
Angelim pedra	*Dinizia glabra* Benth.	Leguminosae
Angelim rajado	*Pithecolobium racemosum* Ducke	Leguminosae
Angico	*Piptadenia peregrina* (L.) Benth.	Leguminosae
Apuhy	*Ficus tapajozensis* Standl.	Moraceae
Aquiquy	*Lonchocarpus Spruceanus* Benth.	Leguminosae
Araçasinho	*Calyptranthes* sp.	Myrtaceae
Arapapá	*Lueheopsis violacea* Standl.	Tiliaceae
Arapary	*Macrolobium acacifolium* Benth.	Leguminosae
Arapary branco	*Parkia ingens* Ducke	Leguminosae
Arapary da terra firme	*Elisabetha paraensis* Ducke	Leguminosae
Arapichuna	*Sweetia nitens* Benth.	Leguminosae
Arapiraca	*Pithecolobium acacioides* Ducke	Leguminosae

Asarauba	*Sickingia tinctoria* (H. B. K.) Schum.	Rubiaceae
Aturiá	*Drepanocarpus lunatus* (L. f.) Mey.	Leguminosae
Batata brava	*Stigmaphyllon fulgens* (Lam.) Juss.	Malpighiaceae
Boquet de noiva	*Ixora Finlaysoniana* Wall.	Rubiaceae
Bota	*Palicourea corymbifera* (Muell. Arg.) Standl.	Rubiaceae
Breu almacega	*Protium heptaphyllum* (Aubl.) March.	Burseraceae
Breu branco	*Protium icicariba* (DC.) March.	Burseraceae
Breu branco da matta	*Protium Sagotianum* March.	Burseraceae
Breu branco do campo	*Protium heptaphyllum* (Aubl.) March.	Burseraceae
Cáa-pitiú	*Siparuna* sp.	Monimiaceae
Cajú-assú	*Anacardium giganteum* Hancock	Anacardiaceae
Cajurana	*Simaba guianensis* (Aubl.) Engler	Simarubaceae
Cambará	*Lantana Camara* L.	Verbenaceae
Cambará amarella	*Wulffia baccata* (L. f.) Kuntze	Compositae
Camendara	*Allamanda cathartica* L.	Apocynaceae
Canella de velha	*Miconia stenostachya* DC.	Melastomaceae
Capitihú	*Miconia prasina* (Swartz) DC.	Melastomaceae
Carajurú da costa	*Arrabidæa* sp.	Bignoniaceae
Caripérana	*Licania incana* Aubl.	Rosaceae
Carrapichinho	*Triumfetta Bartramia* L.	Tiliaceae
Carú-cáo	*Cordia multispicata* Cham.	Boraginaceae
Cau-assú	*Coccoloba paraensis* Meissn.	Polygonaceae
Chicha brava	*Sterculia pruriens* (Aubl.) Schum.	Sterculiaceae
Chumbinho	*Miconia ciliata* (L. Rich.) DC.	Melastomaceae
Cipó de vaqueiro	*Sabicea aspera* Aubl.	Rubiaceae
Ciricó	*Guarea paraensis* C. DC.	Meliaceae
Coatá-quiçaua	*Qualea parviflora* Mart.	Vochysiaceae
Cuiárana	*Lecythis* sp.	Lecythidaceae
Cujuba	*Acacia glomerosa* Benth.	Leguminosae
Cumanda	*Campsiandra laurifolia* Benth.	Leguminosae
Cumaterana	*Myrcia* sp.	Myrtaceae
Envira amarella	*Guatteria Poeppigiana* Mart.	Anonaceae
Envira amargosa	*Mollia lepidota* Spruce	Tiliaceae
Farinha seca	*Eugenia flavescens* DC.?	Myrtaceae
Faveira branca	*Parkia ingens* Ducke	Leguminosae
Faveira do igapo	*Crudia amazonica* Spruce	Leguminosae
Faveirinha	*Cassia fastuosa* Willd.	Leguminosae
Faveirinha branca	*Cassia multijuga* A. Rich.	Leguminosae
Frejôes	*Cordia alliodora* (R. & P.) Cham.	Boraginaceae
Gaivotinha	*Croton nervosum* Klotzsch	Euphorbiaceae
Gapuhy cipó	*Martinella obovata* (H. B. K.) Bur. & Schum.	Bignoniaceae

Genipapinho	*Genipa americana* L.	Rubiaceae
Gonçalare	*Swartzia polycarpa* Ducke	Leguminosae
Herva de passarinho amarello	*Phoradendron platycaulon* Eichl.	Loranthaceae
Herva encarnada de passarinho	*Psittacanthus biternatus* (Hoffm.) Blume	Loranthaceae
Humirirana-cáa	*Eugenia* sp.	Myrtaceae
Iawara-pó	*Noyera mollis* (Poepp.) Ducke?	Moraceae
Ingarana xixy	*Macrolobium campestre* Huber?	Leguminosae
Ingaseira	*Inga Capucboi* Standl.	Leguminosae
Irary	*Cassia apoucouita* Aubl.	Leguminosae
Itapeuá	*Couma rigida* Muell. Arg.	Apocynaceae
Itapeua	*Eugenia flavescens* DC.?	Myrtaceae
Itaúba abacate	*Misanteca Duckei* Sampaio	Lauraceae
Itaubarana	*Sweetia nitens* Benth.	Leguminosae
Japihim-cáa	*Psychotria rubra* (Willd.) Muell. Arg.	Rubiaceae
Jaramantaia	*Vitex cymosa* Bert.	Verbenaceae
Jarana	*Chytroma jarana* Huber	Lecythidaceae
Jasmim da matta	*Tabernaemontana flavicans* R. & S.	Apocynaceae
Jatobahy do igapó	*Ormosia excelsa* Spruce	Leguminosae
Jatobarana	*Macrolobium bifolium* (Aubl.) Pers.	Leguminosae
Jatobazinho	*Hymenæa palustris* Ducke	Leguminosae
Jimpapinho de varzea	*Sphinctanthus rupestris* Benth.	Rubiaceae
Juquirysinho	*Mimosa orthocarpa* Spruce	Leguminosae
Jutahy pororoca	*Dialium divaricatum* Vahl	Leguminosae
Jutahysinho	*Hymenæa parvifolia* Huber	Leguminosae
Limaorana	*Randia armata* (Swartz) DC.	Rubiaceae
Limãoranasinho	*Machaonia spinosa* Cham. & Schl.	Rubiaceae
Louro camphora	*Ocotea costulata* (Nees) Mez	Lauraceae
Macacaúba de terra firme	*Platymiscium Duckei* Huber	Leguminosae
Macucú	*Parinarium barbatum* Ducke	Rosaceae
Malheia	*Panopsis Sprucei* Meissn.	Proteaceae
Malva roxa recortada	*Urena lobata* L.	Malvaceae
Mamaorana	*Pachira aquatica* Aubl.	Bombacaceae
Manguirana	*Symmeria paniculata* Benth.	Polygonaceae
Marfim	*Couma rigida* Muell. Arg.	Apocynaceae
Maria molle	*Neea divaricata* Poepp. & Endl.	Nyctaginaceae
Massaranduba	*Manilkara Huberi* (Ducke) Standl.	Sapotaceae
Molongó de colher	*Malouetia tamaquarina* (Aubl.) A. DC.	Apocynaceae
Mororosinho	*Baubinia stenocardia* Standl.	Leguminosae
Mucuna flor branca	*Dioclea glabra* Benth.	Leguminosae

Muiracaúa	*Rhabdodendron paniculatum* Huber	Rutaceae
Muiracoatiara; M. preta	*Astronium Lecointei* Ducke	Anacardiaceae
Muirapixuna	*Swartzia leptopetala* Benth.	Leguminosae
Mulungú	*Erythrina xinguensis* Ducke	Leguminosae
Mungubarana	*Bombax paraense* Ducke	Bombacaceae
Murta cabelluda	*Myrcia lanceolata* Camb.	Myrtaceae
Murtinha	*Eugenia* sp.	Myrtaceae
Pacoté	*Cochlospermum orinocense* (H. B. K.) Steud.	Cochlospermaceae
Pajurá-rana	*Licania micrantha* Miq.	Rosaceae
Papa terra	*Miconia stenostachya* DC.	Melastomaceae
Pau d'arara	*Sickingia tinctoria* (H. B. K.) Schum.	Rubiaceae
Pau d'arco	*Tabebuia* sp.	Bignoniaceae
Pau de salsa	*Calliandra surinamensis* Benth.	Leguminosae
Pau santo	*Zollernia paraensis* Ducke	Leguminosae
Pedra-hume-cáa	*Eugenia* sp.	Myrtaceae
Pente de macaco	*Apeiba tibourbou* Aubl.	Tiliaceae
Periquiteira do igapó	*Buchenavia ochroprumna* Eichl.	Combretaceae
Perpetua roxa da matta	*Cephaelis colorata* Willd.	Rubiaceae
Pianchírana	*Licania licaniaeflora* (Sagot) Blake	Rosaceae
Piquiárana; P. da varzea	*Caryocar glabrum* (Aubl.) Pers.	Caryocaraceae
Piranheira	*Sweetia nitens* Benth.	Leguminosae
Pirá uchy	*Couepia paraensis* Benth.	Rosaceae
Pitambaiana	*Toulicia bullata* Radlk.	Sapindaceae
Pixuneirarana	*Cassia apoucouita* Aubl.	Leguminosae
Puruhy da costa	*Tocoyena formosa* (Cham. & Schl.) Schum.	Rubiaceae
Puruhy grande da matta	*Amaioua Monteiroi* Standl.	Rubiaceae
Puruhysinho	*Alibertia edulis* (L. Rich.) A. Rich.	Rubiaceae
Sabonete	*Sapindus saponaria* L.	Sapindaceae
Sarytan	*Casearia sylvestris* Swartz	Flacourtiaceae
Seringueira itauba	*Hevea lutea* (Benth.) Muell. Arg.	Euphorbiaceae
Sucuhuba	*Plumeria sucuuba* Spruce	Apocynaceae
Tachy do igapó	*Tachigalia alba* Ducke	Leguminosae
Tachyrana	*Sclerolobium chrysophyllum* Poepp. & Endl.	Leguminosae
Tachyseiro branco	*Sclerolobium paniculatum* Vogel	Leguminosae
Tachy varzea	*Triplaris Martiana* F. & M.	Polygonaceae
Tacunaré envira	*Drepanocarpus paludicola* Standl.	Leguminosae
Tamanqueira de leite	*Malouetia Duckei* Markgraf	Apocynaceae

Tamurá tuira	*Tabebuia serratifolia* (Vahl) Nichols.	Bignoniaceae
Tata-cáa	*Pera glabrata* Baill.	Euphorbiaceae
Tatajuba	*Bagassa guianensis* Aubl.	Moraceae
Tauary	*Couratari coriacea* Mart.?	Lecythidaceae
Timbo branco	*Banisteria caapi* Spruce	Malpighiaceae
Trapiá	*Crataeva tapia* L.	Capparidaceae
Trapiarana	*Leonia glycicarpa* Ruiz & Pav.	Violaceae
Uacima de mangue	*Hibiscus tiliaceus* L.	Malvaceae
Uajará	*Lucuma* sp.	Sapotaceae
Uapixuna	*Myrcia* sp.	Myrtaceae
Ucuhuba	*Virola uaupensis* (Spruce) Warb.	Myristicaceae
Ucuhubarana	*Iryanthera paraensis* Huber	Myristicaceae
Uruasinho	*Cordia nodosa* Lam.	Boraginaceae
Urucurana da matta	*Bixa arborea* Huber	Bixaceae
Veronica de igapó	*Dalbergia monetaria* L. f.	Leguminosae

THE YALE WOOD COLLECTIONS

Genera Added November 1, 1932—February 1, 1933

APOCYNACEAE
- Ambelania
- Geissospermum
- Lacmellia (?)

ARALIACEAE
- Macropanax

BOMBACACEAE
- Gossampinus

BORRAGINACEAE (?)
- Duckeodendron

COMPOSITAE
- Ericameria

ERICACEAE
- Ledum

EUPHORBIACEAE
- Joannesia

FLACOURTIACEAE
- Olmediella

GUTTIFERAE
- Haploclathra

HAMAMELIDACEAE
- Corylopsis
- Loropetalum
- Sycopsis

LECYTHIDACEAE
- Allantoma

LEGUMINOSAE
- Amblygonocarpus
- Elisabetha
- Geoffroya
- Heterostemon
- Lupinus
- Lysidice
- Pickeringia
- Poecilanthe
- Vatairea

LINACEAE
- Hebepetalum

MALPIGHIACEAE
- Burdachia

MALVACEAE
- Alyogyne
- Spaeralcea

MELASTOMACEAE
- Macairea

MORACEAE
- Olmedioperebea
- Poulsenia

OCHNACEAE
- Wallacea

OLACACEAE
- Aptandra
- Chaunochiton

PAPAVERACEAE
- Dendromecon

ROSACEAE
- Holodiscus
- Physocarpus
- Raphiolepis

RUBIACEAE
- Craterispermum
- Ferdinandusa
- Platycarpum

SAPINDACEAE
- Lecaniodiscus
- Tapiscia
- Toulicia

SCROPHULARIACEAE
- Diplacus

STERCULIACEAE
- Reevesia

THEACEAE
- Anneslea

URTICACEAE
- Debregeasia

VIOLACEAE
- Leonia
- Gloeospermum

Contributors

On December 31, 1932, the total number of catalogued samples in the Yale wood collections was 22,456, representing 2048 genera of 198 families. The accessions during the year were 2330 and were from the following sources:

AFRICA: Museum of Natural History, New York (*Congo*); Mr. C. Vigne (*Gold Coast*); Mr. Jas. D. Kennedy (*Nigeria*); Mr. Duncan Stevenson (*No. Rhodesia*); Mr. Nils B. Eckbo (*So. Afr.*); Imperial Forestry Institute, Oxford (*Tanganyika*).

ARGENTINA: Mr. Max Rothkugel, Darsena Norte, Buenos Aires.

BRAZIL: Messrs. J. G. Araujo & Co., Manáos; Companhia Ford Industrial do Brasil, Bôa Vista (through Field Museum of Natural History, Chicago); Dr. A. Ducke (Manáos).

BRITISH GUIANA: Forest Department, Mazaruni Station (through School of Forestry and Conservation, University of Michigan).

BRITISH HONDURAS: Forest Department, Belize.

BRITISH NORTH BORNEO: Mr. E. L. Foster.

CHINA: Fan Memorial Institute of Biology, Peiping.

COLOMBIA: Mr. A. Dugand G., Barranquilla; Prof. Ramón Espina and Mr. Juan Giacometto, Santa Marta.

CUBA: Mr. G. C. Bucher, Santiago.

DUTCH GUIANA: Mr. R. H. G. McArthur, Paramaribo.

ECUADOR: Dr. A. Rimbach, Riobamba.

GREAT BRITAIN: Forest Products Research Laboratory, Princes Risborough.

GUATEMALA: Mr. J. G. Salas, Guatemala City (through Field Museum of Natural History).

HAWAII: Board of Agriculture and Forestry, Honolulu.

INDIA: Conservator of Forests, Rangoon; Forest Research Institute, Dehra Dun.

INDO-CHINA: Mr. J. Collardet, Paris, France.

JAPAN: Prof. M. Fujioka, Komaba.

JAVA: Dr. H. H. Janssonius, Amsterdam, Netherlands; Mr. C. Van de Koppel, Buitenzorg.

MELANESIA: Mr. J. H. L. Waterhouse, Bougainville.

MEXICO: Dr. Ramón Flores, Progreso, Yucatan (through Field Museum of Natural History, Chicago).

MICRONESIA: Dr. R. Kanehira, Fukioka, Japan.

NEW ZEALAND: Mr. Arnold Hansson, Waipoua Forest Experiment Station.

PHILIPPINE ISLANDS: Bureau of Forestry, Manila.

TRINIDAD: Forest Department, Port-of-Spain.

VIRGIN ISLANDS (U. S. A.): Mr. Arthur S. Fairchild, St. Thomas.

U. S. A.: Prof. Emanuel Fritz, Mr. H. R. Offord, and Dr. Irma Webber (*Calif.*); Mr. H. F. Marco (*Mass.*); Mr. D. N. Matthews (*Oregon*).

MISCELLANEOUS: Prof. Emanuel Fritz (Calif.); Forest Products Research Laboratory, Kew Gardens, and Mr. Alexander Howard (England); School of Forestry and Conservation (Mich.).

Specimens Distributed

The total number of wood specimens distributed during 1932 was 1401. With the exception of 32 in general exchange, all were for use in connection with definite scientific projects. The samples were, for the most part, cuttings large enough for sectioning. They were accompanied by copies of the index cards giving the Yale and collector numbers, scientific and common names, name of collector, original source, and certain other information. Since from forest to laboratory there are many opportunities for mistakes, all recipients of material are urged to report any actual or apparent inaccuracies in classification which come to their attention.

The following report is to supplement those published in *Tropical Woods* 22: 2, 25: 26, and 30: 39.

Anacardiaceae, Anonaceae, and Bombacaceae. To Dr. R. Kanehira, Kyushu Imperial University, Fukuoka, Japan, 7 samples of 5 genera of Anacardiaceae (see *Tropical Woods* 22: 3), 1 sample of *Anona*, and 3 samples of 2 genera of Bombacaceae.

Aristolochiaceae. To Dr. Josef Baas, Karlstrasse 38, Offenbach (Main), Germany, 4 samples of *Aristolochia*.

Coniferae. To Mr. Y. Tang, Fan Memorial Institute of Biology, Peiping, China, 2 samples each of *Dacrydium*, *Libocedrus*, and *Taiwania*.

Euphorbiaceae. To Dr. R. Kanehira (see Anacardiaceae), 41 samples of 24 genera.

Guttiferae and **Hypericaceae.** To Biological Laboratories, Harvard University, Cambridge, Mass, 213 samples of 19 genera of Guttiferae and 70 samples of 5 genera of Hypericaceae, for research project by graduate students under direction of Prof. R. H. Wetmore.

Lacistemaceae. To Dr. L. Chalk, Imperial Forestry Institute, Oxford, 4 samples of *Lacistema*.

Malvaceae. To Biological Laboratories, Harvard University, 60 samples of 22 genera.

The specimens were to be used in connection with a research project by a graduate student, but another problem was chosen when it was learned that similar investigations on the Malvaceae were already being made by Dr. Irma E. Webber, Riverside, California.

Menispermaceae. To Dr. Josef Baas (see Aristolochiaceae), 4 samples of *Abuta* and 5 of *Hyperbaena*.

Moringaceae. To Mr. Y. Tang (see Coniferae), 2 samples of *Moringa*.

Myristicaceae. Professor George A. Garratt, of Yale, is studying the comparative anatomy of the woods of the Myristicaceae. His material includes 70 species of 14 genera. Many important specimens have recently been supplied for this work by Forest Research Institute, Dehra Dun, through the Forest Economist; Imperial Forestry Institute, Oxford, through Dr. L. Chalk; Koloniaal Instituut, Amsterdam, through Dr. H. H. Janssonius; Museum voor Economische Botanie, Buitenzorg, through Mr. C. Van de Koppel; Philippine Bureau of Forestry, through Mr. Luis J. Reyes; Royal Botanic Gardens, Kew, through Mr. C. R. Metcalfe.

Rhizophoraceae. Mr. Herbert F. Marco, graduate student at Yale, is studying the comparative anatomy of the woods of the Rhizophoraceae. His material includes 23 species of 13 genera. Additional specimens are needed, especially of *Anisophyllea*, *Blepharistemma*, *Combretocarpus*, *Dactylopetalum*, *Kandelia*, *Macarisia*, *Pellacalyx*, and *Weihea*.

Miscellaneous. To Prof. I. W. Bailey, Bussey Institution, Forest Hills, Boston, Mass., in connection with his study of vestured pits, 498 samples of 29 families.

Sections for Microscopic Study

From the beginning of the Yale wood collections it has been the intention to build up a reference set of sections for microscopic study of all of the more important species and genera. For various reasons this work has not kept pace with the rapid accession of material, but special attention is now being given to it. So far 3152 different specimens have been sectioned, representing 1852 named species, 952 genera, and 131 families. The sections (stained, unstained, or both) are mounted permanently on glass slides which are placed in aluminum holders and filed alphabetically by families, genera, and species in ordinary card catalog cases.

Handling the Yale Collections

The interest shown by visitors in the details of handling the Yale collections has prompted the following account: The specimens are numbered serially as received and this number is given to all parts of the plant (wood, bark, herbarium, separate fruits, roots, etc.). If of sufficient size, the wood samples are sawed into boards ½″ thick, 7″ long, and not over 6″ wide. One sample, preferably showing heartwood, sapwood, and bark, and exposing the rays on one side, is chosen for the main collection, die-stamped with its serial number, and filed numerically with the others in drawers which line three sides of a large sky-lighted room to a height of 6 feet. On the front of each drawer is a label giving the inclusive numbers of the contents by countries of origin. The duplicates are stored similarly in the timber-testing laboratory on the ground floor.

Lists are prepared for each lot of specimens and on them are recorded the Yale serial number, the collector's number, and the common, scientific, and family names. After the index cards are made, these lists are attached to the collateral correspondence and other documents and filed by countries.

The card catalog is in four sections: (1) Numerical index, with each collection preceded by a guide card giving the country of origin, name of collector or donor, name of botanist who identified the specimens, and like information. (2) Generic index, arranged alphabetically, with a guide card for each genus. The species are listed alphabetically also, while different cards for a single species follow a numerical order. (3) Alphabetical index of the common or vernacular names. (4) Family index, in which all the cards for a given family are arranged by genera and species.

Whenever a specimen is sectioned that fact is noted on the proper card in the family index. As material is distributed the date and the name of the recipient are entered on the cards in the generic file, and separate accounts are kept both in the name of the recipient and according to the family or other classification of the specimens. If for any reason it is necessary to make important changes on cards corresponding to material that has been distributed, a note to that effect is immediately sent to the persons concerned.

The herbarium material accompanying wood samples is sent to systematic botanists at various institutions for determination; duplicates are mounted and filed in the same room with the woods. So far as possible, all identifications are carefully scrutinized and doubtful cases reconsidered with the aid of anatomical studies. Advantage is taken of every opportunity to have groups studied by specialists. All determinations are considered tentative and subject to change as new or more intensive investigations are made.

INTERNATIONAL ASSOCIATION OF WOOD ANATOMISTS

Additional Councilor Elected

Professor Lodovico Piccioli, Prof. ord. di Selvicoltura e Technologia nel R. Instituto Superiore Forestale, Firenze, Italy, has been elected a Councilor of the Association. This action was taken by the Council to increase its membership to twelve as authorized by a general vote of the Association a year ago (see *Tropical Woods* 30: 41).

Ten different countries are now represented in the Council, namely, Australia, Belgium, France, Germany, Great Britain, Italy, Japan, Netherlands, Switzerland, and the United States.

New Members Elected

Dr. Helen Bancroft, Oxford, England.

Mr. K. A. Chowdhury, Wood Technologist, Forest Research Institute, Dehra Dun, India.

Mr. H. W. Eades, Vancouver Branch of Forest Products Laboratories of Canada, Vancouver, British Columbia.

Mr. W. N. Edwards, Department of Geology, British Museum (Natural History), London, England.

Professor Doctor Richard Kräusel, Geologisch-Palaeontologisches Institut der Universität Frankfurt am Main, Germany.

Mr. E. W. J. Phillips, Forest Products Research Laboratory, Princes Risborough, Bucks, England.

Mr. Y. Tang, Fan Memorial Institute of Biology, Peiping, China.

Mr. William N. Watkins, Assistant Curator, Section of Wood Technology, U. S. National Museum, Washington, D. C.

Dr. Irma E. Webber, Citrus Experiment Station, Riverside, California.

The above additions bring the total number of members to 66, of which 2 are honorary. The representation by countries, 22 in all, is as follows: Algeria 1, Austria 1, Australia 4, Belgium 1, Brazil 2, Canada 3, China 1, Federated Malay States 1, France 5 (1 honorary), Germany 4, Great Britain 11, India 1, Italy 1, Japan 2, Netherlands 5 (1 honorary), New Zealand 1, Philippine Islands 1, Poland 1, Spain 1, Sweden 1, Switzerland 1, U. S. A. 17.

Committees

In recognition of the 20 years' work of Dr. Hans Meyer, of the Institut für Angewandte Botanik at Hamburg, in the assembling of common, vernacular, and scientific names of woods, the Council has approved his appointment as chairman of a committee to continue the compilation under the aegis of the Association.

The Committee on Terminology has submitted as its first report to the Council a glossary of 108 terms used in anatomical descriptions of woods.

CURRENT LITERATURE

Armouria. A new genus of malvaceous trees from Haiti. By F. L. Lewton. *Journ. Washington Acad. Sci.* 23: 63–64, Jan. 15, 1933.

Armouria beata is a tree 5–7 meters high, related to *Thespesia* and *Montezuma*, and bearing large white flowers. It was found on Beata Island, off the south coast of Haiti.

Ethnographical survey of the Miskito and Sumu Indians of Honduras and Nicaragua. By Eduard Conzemius. Bull. 106, Smithsonian Institution, Bureau of American Ethnology, Washington, D. C. 1932. Pp. 191; illustrated.

While primarily ethnological, this publication contains considerable matter of botanical interest. As so often is the case with ethnological publications, the technical names of some of the plants mentioned are open to question, and in certain instances clearly erroneous, but it is possible to extract a moderate amount of more or less reliable data. The Latin names employed below are those that the present writer believes are correct for the plants discussed.

The Miskito and Sumu Indians inhabit the Atlantic side of Honduras and Nicaragua, from the Black River (lat. 15° 50′ N.) to Río Punta Gorda (lat. 11° 30′ N.). "Immediately along the seashore the soil is sandy and there is little vegetation, but it is partly fitted for pastures owing to the annual overflow of the rivers. Beyond this region extends a strip of swampy land, about 15 to 20 miles wide, which is largely unfit for cultivation and is covered with a dense and impenetrable thicket of Mangroves, reeds, and coarse grasses. Then follows the real tropical forest with very fertile soil, consisting on the surface of vegetable humus.

"North of Río Patuca the fertile areas are characterized by the existence of extensive 'Cohune ridges,' that is, places dotted with the Cohune or Corozo Palm (*Orbignya cohune*). A great number of other palms are found in this region, but only two of them are cultivated and play an important part in the food supply, the Coco Palm and the Pejivalle (*Guilielma*

utilis). Among the other tree forms characteristic of the forest may be mentioned the following: Ceiba (*Ceiba pentandra*), Mahogany (*Swietenia macrophylla*), Spanish Cedar (*Cedrela*), Guayacán (*Tabebuia*), Santa María (*Calophyllum brasiliense*, var. *Rekoi*), and Balsa (*Ochroma*)."

"From Río Tinto to Río Grande the dense forest is at times interrupted by large areas of Pine ridges or savannas. These are undulating plains covered with gravel and coarse sand, overgrown with grass, Myrtaceae, Oaks, Nance (*Byrsonima crassifolia*), small Fan Palms, and Long-leaf or Pitch Pines. This Pine (*Pinus tenuifolia*) has its southern limit on the Atlantic side of Nicaragua, a little north of Bluefields Bluff, in latitude 12° 5′ north. Few big trees are to be found in these savannas; there is little underbrush, epiphytes and lianas are scarce, and the whole presents a park-like appearance. On the rich alluvial soil on both sides of the streams traversing the savannas grows a dense and luxuriant vegetation resembling the real forest."

The statement regarding the Pine is of special significance, for this locality, if the author's statement is correct, marks the southern limit of Pines on the coast of America, and is perhaps even south of the limit of Pines in the interior of Nicaragua. The Pine growing on the coast is not *Pinus tenuifolia*, but presumably the widely dispersed Cuban Pine, *Pinus caribæa*. The Pine of the interior of Nicaragua is a different species, probably *P. oocarpa*. In some places on the coast of Nicaragua, Pines grow on bluffs overhanging the sea, in plain view from passing ships, as the present writer has seen them south of Cape Gracias a Dios.

Bark cloth is still made by the Sumu Indians from the Tunu tree. Although the author does not give the Latin name of this tree, it is probably *Poulsenia armata* (Miq.) Standl. or *Naucleopsis naga* Pittier (Moraceae). Formerly this bark cloth furnished most of the clothing for rich and poor, but at present it is used chiefly for loin cloths and bed blankets.

Tunu bark is soaked in water for a few days, after which the sticky gum or milk adhering to it is scraped off. The bark is then dried in the sun and kept in the hut until the women find time to pound it into cloth. As it becomes hard and

shrinks considerably, it has to be submerged in a neighboring stream for a short time before the pounding begins. The latter operation is performed on a small log with the aid of a wooden mallet made from the stems of two species of small palms. The bark extends gradually upon being pounded and becomes soft and flexible. After being washed and dried it is ready for use, and has a brownish color. A similar cloth, almost white in color and of superior quality, is obtained by the same process from the inner bark of a species of *Ficus* and likewise from the Rubber Tree (*Castilla*), but in both cases manufacture of the cloth is more laborious.

The canoes of the region are made from Mahogany (Yulu), Spanish Cedar, *Enterolobium cyclocarpum* or Guanacaste (Tuburus), *Ceiba pentandra* (Sisin, Panya, Paniki), *Calophyllum* (Krasa), *Vochysia hondurensis* (?), and *Virola*. The Pejivalle Palm (Supa) is cultivated commonly for its edible fruit. This important food tree is said by the author to be cultivated on the Atlantic coast as far north as Río Tinto in Honduras, while on the Pacific side its northern limit is Lake Nicaragua.

Fish are caught by "poisoning" water of small streams with barbascos of several kinds, especially *Serjania*. The author naïvely states that the word barbasco is of Quichua origin, while, as a matter of fact, it is derived from the Latin plant name *Verbascum!* He also repeats the frequently, but apparently ineffectively, repudiated fable of the smoking of tobacco through the nostrils by the Haitians by means of a forked pipe, it having been demonstrated by Safford and others that such pipes were not employed for tobacco smoking but for inhaling a narcotic snuff made from the seeds of a leguminous tree, *Piptadenia peregrina*. The author's statement that "the chewing of coca was a current habit among the Nicarao of the Pacific coast of Nicaragua at the time of the conquest" probably is, also, of fabulous origin.

Elæis melanococca, the Oil Palm, is called Ohoñ or Uhuñ (suspiciously like Cohune, *Orbignya cohune*). The Miskito Indians prepare a nourishing drink from the pulp of the fruit, and from its seeds a favorite hair oil, called Batana on the Mosquito Coast. Palm wine is prepared from the felled

trunks of *Acrocomia vinifera* and *Orbignya cohune*.—PAUL C. STANDLEY.

Clasificación natural de las plantas, con especial mención de las familias más importantes de la flora de Venezuela y de las especies de interés económico. By H. PITTIER, Caracas, 1932. Pp. 140.

A synoptic account of the whole vegetable kingdom, arranged in accordance with the Engler sequence, with keys to the families and larger groups, and in a few cases to the genera. Under each family of the flowering plants, particularly, are mentioned the more important genera and species of Venezuela. There are numerous notes regarding uses of native and cultivated plants, mention of the vernacular names employed in Venezuela, and information upon other subjects. The publication is accompanied by indexes to all the Latin and vernacular names.

The work will be found exceptionally useful for all who are interested in the vegetation of any part of middle America, whether from a systematic or purely practical standpoint.—PAUL C. STANDLEY.

Contributions to the flora of tropical America. XIV. *Mora* and *Dimorphandra* in British Guiana. By N. Y. SANDWITH. *Bulletin of Miscellaneous Information*, Royal Botanic Gardens, Kew, 1932, No. 8, pp. 395–406.

A key is given for separation of the two genera, and others for recognizing the two species of *Mora* and six of *Dimorphandra* that grow in British Guiana, all of which are trees. *Mora excelsa* is one of the largest and most important timber trees of the region, known commonly by the Arawak name Mora. *M. Gonggrijpii* (Kleinh.) Sandw. likewise is a tall tree, called Morabukea, known also from Surinam. Mora forms forests chiefly in swampy places, Morabukea gregarious stands in places free from inundation.

Four of the *Dimorphandra* species are described as new. *D. congestiflora* Sprague & Sandw. is known by the Acawai name Hawakaiyek; *D. conjugata* (Splitg.) Sandw. is reported to bear the Arawak name Dakama.—PAUL C. STANDLEY.

The Polygonaceae, Guttiferae, and Lecythidaceae of Surinam. By P. J. EYMA. Amsterdam, Nov. 21, 1932. Pp. 223; illustrated: 1 map.

The paper is a doctorate thesis, containing treatments of these three families as they are to appear in the *Flora of Surinam* now in publication, prefaced by an introductory part containing descriptions of new species and many critical notes on old ones. These notes are often of considerable interest for regions rather remote from Surinam. They deserve high praise for their lucidity, attention to detail, and their references to the most recent literature; for instance, to articles that have appeared in *Tropical Woods* during the middle of 1932.

The introduction contains some information regarding local uses of woods, chiefly compiled from literature. There is an 8-page index to vernacular names. All the species and genera are described fully (in English), and there are keys for separating genera and species. The Polygonaceae are represented by 16 species, Guttiferae by 35, and Lecythidaceae by 18. The last group is of greatest interest from the standpoint of forestry, the local representatives including such important species as the Cannon-ball tree, *Couroupita guianensis*, one named and two uncertain species of *Lecythis*, and the Brazil-nut, *Bertholletia excelsa*. Eight species of shrubs and trees are described as new.—PAUL C. STANDLEY.

Flora of Surinam (Dutch Guyana). Edited by A. PULLE. Koninklijke Vereeniging Koloniaal Instituut te Amsterdam, Mededeeling No. XXX, Afd. Handelsmuseum No. 11, Apr.–May, 1932. 6¼ x 9¾; 1 map. Prices: Vol. I, pp. 1–48, f 1.95; II, pp. 1–112, f 4.55; III, pp. 1–64, f 2.60; IV, pp. 1–112, f 4.55.

Down to the present time, the only South American country with a published flora has been Brazil, and the old *Flora Brasiliensis* is now hopelessly out-of-date for many families of plants. Pulle now proposes to make known the flora of Surinam, where work in botany and forestry has proceeded actively for many years, and the first parts to appear indicate that his *Flora* will be of the highest value to all who work

with the plants of the Guianas or the Amazon Valley. When complete it will fill four volumes, and the arrangement of the subject matter departs from the conventional taxonomic sequence. While each volume includes a definite section of the usual sequence, the separate families appear in parts in the order of the receipt of manuscript. This permits prompt publication and enables the editor to utilize the service of specialists in various groups while they are actually available. Thus volume IV, devoted to the gaemopetalous families, opens with the Apocynaceae. While Dutch botanists will naturally contribute largely, many aliens have also been asked to co-operate, so that the taxonomic treatment represents the best available knowledge of the time. Keys to the genera and species and descriptions of the species are given in more detail than usual; generic synonyms are omitted; specific synonyms and citations are apparently included only so far as they are of direct aid to the understanding of the species. Herbarium material and collectors' localities are cited in full, together with vernacular names. Americans will be especially interested to know that the work is printed in English.—H. A. GLEASON, *New York Botanical Garden*.

Contribution à l'étude des bois de la Guyane française. By MAURICE RENAUD. *Bulletin de l'Agence Générale des Colonies* (Paris) 279: 970–1031; 280: 1120–1177; 281: 1265–1308; 282: 1372–1434; June–Sept. 1932. Illustrated.

Contains an account of the forests and forest industries, and descriptions of the principal timbers of French Guiana.

L'exploitation forestière à la Guyane française. By G. CHATELAIN. *Acts & Comptes Rendus de l'Association Colonies-Sciences* (Paris) 8: 90: 217–222, Dec. 1932.

A short account of the present exploitation of the forest products of French Guiana and suggestions for further development.

The rotenone content of derris root, cube root, and other plant materials. By HOWARD A. JONES. *Journ. Washington Acad. Sci.* 23: 36–46, Jan. 15, 1933.

Rotenone, a constituent of Derris root (*Deguelia* spp.) and of Cube root (*Lonchocarpus nicou*) recently has come into prominence as an insecticide of considerable value. The author gives the results of the extraction of rotenone by carbon tetrachloride and by ether, in the analysis of plants of the genus *Deguelia* from the Malay Peninsula and the East Indies, and of the genus *Lonchocarpus* from South America.

Nagai was the first to isolate rotenone from a Deguelia (*D. chinensis*), and it has been obtained also from *D. elliptica* and *D. malaccensis*. Reports have been published on the rotenone content of stems of *Lonchocarpus nicou* from French Guiana and Peru; of the Nekoe (*Lonchocarpus* sp.) of Surinam; of Haiari (*Lonchocarpus* sp.) of British Guiana; and on the occurrence of timboin, apparently an impure rotenone, in Brazilian Timbo root, probably a species of *Lonchocarpus*.

Among the conclusions reached by the author as a result of his experiments are the following: The rotenone content of 45 samples of Derris root ranged from none to 7 per cent; that of 23 samples of Cube root from less than one to about 11 per cent. The average of 31 samples of Derris root analyzed by the carbon tetrachloride method was 2.5 per cent rotenone; the average for 22 samples of Cube root 5.4 per cent. Brazilian Timbo root may afford an additional source of rotenone.—PAUL C. STANDLEY.

Los Pisonaes del Departamento de Cuzco. By FORTUNATO L. HERRERA. *Revista Chilena de Historia Natural* (Santiago) 35: 35–38, 1932. Illustrated.

In the Department of Cuzco, Peru, two trees with handsome scarlet flowers are known locally by the name Pisonay. One is *Erythrina falcata* Benth., which is cultivated commonly for ornament, and also forms dense forests on the mountain slopes at 1000–2300 meters. Some of the planted trees, a century old, have trunks as much as three meters in diameter at their base. They attain a height of 15–20 meters, but their wood is too soft to be of use even for firewood. The other species is *Erythrina Lorenae* Macbride, a tree of 7–8 meters, found near Cedrobamba, where it grows in association with *E. falcata*.—PAUL C. STANDLEY.

Los romerillos chilenos. By FRANCISCO FUENTES. *Revista Chilena de Historia Natural* (Santiago) 35: 86–91, 1932. Illustrated.

The names Romero and Romerillo are applied commonly in Chile to various shrubs, chiefly Compositae, which by their method of branching and their small narrow aromatic leaves have some resemblance to Rosemary (*Rosmarinus officinalis*). The name Romerillo has been reported for *Lomatia ferruginea*, usually known as Fuinque, and for *Margyricarpus setosus*, called more commonly Hierba de la Perlilla. The true Romeros or Romerillos, however, are the following shrubs of the Compositae; *Baccharis rosmarinifolia*, used commonly in country regions for fuel, the branches fed to cattle when pasture is scarce; *B. Bezanilleana* and *B. lycioides; Chiliotrichum diffusum* and *C. rosmarinifolium*, which are reported to be poisonous to sheep, although toxic properties have not been established for the plants.—PAUL C. STANDLEY.

Algo sobre a identidade botanica do "oiti" e do "pequiá" da Bahia. By F. C. HOEHNE. Reprinted from *Annaes da Academia Brasileira de Sciencias* 4: 1: 1–11, March 31, 1932. Illustrated.

A revision and amplification of the descriptions and a study of the synonymy and relationships of two imperfectly known species of Brazilian trees worthy of attention for their edible fruits, which might be capable of improvement in cultivation.

Moquilea Salzmanni Hook. f., of the Rosaceae-Chrysobalanoideae, is known in Bahia by the vernacular name of Oiti (Uiti, Guiti). The species was originally described by Hooker without a knowledge of its fruit, which is similar to that of various other species of *Moquilea* and *Couepia*, grouped by Arruda Camara as *Pleragina*, a name neglected by subsequent writers. As to the current vernacular names of these, the author questions whether Pajurá should not properly be applied to *Couepia* and Oiti to *Moquilea*, though the Oiti-Coró of Pernambuco is of the former genus. He refers to Ducke's treatment of the synonymy of this group, which includes two species of *Parinarium*.

Macoubea guianensis was first described by Aublet (1775) from Guiana as doubtful as to genus and species and, for lack of flowers, undetermined even as to family. For almost a hundred and fifty years its status remained questionable until Ducke (1922) obtained the Amapá Doce of Pará and Amazonas in flower and fruit and recognized in this Aublet's species, completed its description, and fixed its position in the Section Melodineae of the Apocynaceae. In 1931, fruiting material of Pequiá received from Bahia was found by Hoehne to be the *Macoubea* of Aublet and Ducke, while flowers received later were identified with *Tabernaemontana Sprucei* Mueller and *T. reticulata* De Candolle before it was realized that they belonged with the fruits previously received. The synonymy and range of the species was thus found to be more extensive than had been supposed, the *Macoubea* of French Guiana and Amapá Doce of Pará being identical with the Pequiá of Bahia. The fruits, about the size of an orange, have a hard shell containing a pulp that becomes liquid on maturity, and are compared by the author to honey-filled gourds.

The vernacular name Pequiá, otherwise associated with *Caryocar* and having reference to its spiny endocarp, appears to be a misnomer as applied to *Macoubea* and is probably to be attributed to the wholly superficial resemblance in size and shape of the fruits to those of *Caryocar villosum* (Aubl.) Pers.

In connection with this paper and that by Holland (reviewed below), it may be of interest to note the following description of Oiticica given by Arruda Camara in his *Utilidade de Jardins* etc. (1810) under the generic name *Pleragina*. "Oiticica or Catingueira, *Pleragina umbrosissima*, is a tree native to the Sertão where it grows at the margins of rivers and streams. It attains a height of fifty to seventy feet. Its branches are so diffuse and flexible that they reach within a short distance of the ground as if purposely to form a great dome, through whose stiff and thick leaves the rays of the sun cannot penetrate, forming a very extensive and agreeable shade. Its fruits are oblong drupes two inches or more in length, a half inch in thickness, green in color even when mature, its pit is not osseous and hard . . . but ligneous,

flexible and may break readily; it is covered externally by an astringent film; the kernel is a seed composed of two oily cotyledons, of a disagreeable taste, but rich in oil that some of the inhabitants know how to utilize."

From the description of the fruit there can be no question of the identity of his *Pleragina umbrosissima* and it is interesting to find that for well over a hundred years its oil has been known at least in the northeast of Brazil where the tree is native. It is now beginning to be manufactured on a relatively large scale and has attracted some attention by being compared with Tung oil. A correspondent who has investigated its properties and the possibilities of its application in his industry writes: "Its industrial importance appears not to be very great today, but it may mean something for the future."—B. E. Dahlgren. *Field Museum of Natural History*.

Oiticica (*Licania rigida*). By J. H. Holland. *Bulletin of Miscellaneous Information*, Royal Botanic Gardens, Kew, 1932, No. 8, pp. 406–411.

After various attempts, authentic material has been obtained of the tree producing kernels imported in small or sometimes large quantities into England under the name Oiticica, and it has been determined as *Licania rigida*. The tree grows to a height of 15 meters, and occurs in the States of Rio Grande do Norte, Ceará, and Piauhy, Brazil. The kernels yield about 60 per cent of oil, which has been used in Brazil for medicinal purposes and, because of its resemblance to Tung oil, is considered possibly suitable for use in varnish and similar preparations. Several plants have been established in Brazil for its separation. Other names reported for the tree and its products are Oticia, Brazilian Nuts, Hazel Nuts, and Oilizika. There is appended a bibliography of publications relating to the subject.—Paul C. Standley.

Revista Florestal. II: 3. Rio de Janeiro, Brazil, Oct. 1932.

The resumption of this publication and its designation as the official organ of the Forest Service of Brazil having been authorized by the Ministry of Agriculture, *Revista Florestal* enters upon a new phase. Its regular appearance assured, it may confidently be expected not only to fulfill its primary object of serving the public interested in matters of forestry in its own country, but to continue as before to be of value to a wider audience consisting of all those who have a scientific or practical interest in forestry and forest products, in reforestation, and in conservation of natural resources in many parts of the world.

Under the heading "Sylvae Montibus Restituendae" Humberto Gomes de Almeida recalls the ministerial decree of 1861 by which a forest service was first created, with immediate instructions for the conservation and replanting of the forests on the hills of Tijuca and at Paineiras near Rio. Some of the results of the activity of Major Manuel Gomez Archer, who was placed in charge of the work at Tijuca, were dealt with in Sr. Iglesias' article on the Rate of Growth of Forest Trees in the preceding issue, the anniversary number, of *Revista Florestal*, reviewed in *Tropical Woods* December 1, 1932, pp. 30–35.

E. d'Alessandro writes of the Object of Silviculture, and Godofredo dos Santos of The Forest and Reforestation. In the northeast of Brazil and in states such as Minas Geraes and São Paulo the present relative scarcity of woods is daily becoming more accentuated as the result of a growing consumption especially on the part of the railroads and industries, including the metallurgical, which consume great quantities of charcoal. The need for replanting, rational regulation of exploitation, and the importance of the activities of the Forest Service are emphasized.

Virginio Campello deals with the Cellulose and Wood Pulp Industry in Brazil. The present-day enormous importance that has been assumed by cellulose in all its forms, particularly cellulose from wood pulp, is indicated by a variety of statistics, *e.g.*, the world production of artificial silk in 1929 was 202,077 tons, partly from cotton linters, but also from wood pulp. U. S. A. imports 40 per cent of its wood pulp from Canada and must continue to do so until the results of reforestation become appreciable. In the normal year 1928 Brazil imported more than 160,000 tons of manufactured

paper, paste-board, and paper pulp of a total value of 82.265 contos or almost ten million dollars, besides cellulose products of approximately equal amount and value. To replace this importation by home production will require entire forests of soft-wooded trees, which must be provided. Thanks to the uninterrupted and rapid growth possible under the climatic conditions in Brazil this can be accomplished in a relatively short time. The many other available sources of cellulose, such as cornstalk, bagasse, straw, etc., which now go to waste, can be made to contribute to the total of raw material required. In Brazil the hulls of coffee, 33 per cent of the crop, deserve especial attention.

A large part of the number is devoted to a technical article by Fernando Romano Melanez on The Modifying Action of Calcium Oxalate on Cellular Structure, illustrated by drawings and by numerous photomicrographs. He reviews the physiological explanation of the presence in plant tissue of organic salts, such as oxalates, malates, and citrates, pointing out that they serve the purpose of rendering innocuous the excess of organic acids resulting from the respiratory activities and the calcium freed from absorbed calcium phosphate by the abstraction of the phosphorus required in protein synthesis. The crystals thus represent a residuum of the action of the meristem, and their presence in secondary tissue is to be explained by its derivation from the meristem of its cambium.

It is a common observation that a cell containing an oxalate crystal is generally isodiametric, instead of elongated. This is due to repeated transverse divisions of the elongate amyliferous mother cells and it is to be supposed that these divisions take place before the actual formation of the crystals, induced probably by the presence of oxalate not yet crystallized. At times this cell-division takes a longitudinal direction as to localization of the crystals. Woods may be divided into 3 groups: (1) crystals in the wood parenchyma (*e.g.*, most of the Leguminosae); (2) crystals in the wood parenchyma and also in the rays (*e.g.*, *Aspidosperma*); (3) crystals in the rays only (*Tapirira*). The wood of *Cordia* must be placed somewhere between the last two of these.

Among the most common secondary modifications due to the presence of calcium oxalate is the formation of a membrane enveloping the crystal. Of other cellular changes may be cited the occasional rupture of a cell wall as a result of pressure produced by the formation of a large crystal. The cell wall is often greatly thickened and may furnish attachment directly or by means of struts to the capsular envelope of the crystal.

Finally, calcium oxalate crystals are considered in relation to secretory canals, lacunae, and gum ducts serving the purpose of excretion. The contents of the gum ducts of *Simaruba* thus consist almost entirely of calcium oxalate crystals with some resin.—B. E. Dahlgren, *Field Museum of Natural History*.

A monotypic plant order new to the Philippine flora. By H. J. Lam. *Philippine Journal of Science* 49: 2: 143–146, October 1932.

"In 1909, the well-known plant collector, A. D. E. Elmer, discovered in the forests on the slopes of Mount Apo, Todaya, Davoa district, Mindanao, Philippine Islands, a tree which he considered to be a new species of the myrsinaceous genus *Discocalyx* . . . and described under the name *Discocalyx macrocarpa* Elmer. . . .

"Merrill pointed out that, in his opinion, the species in question could not belong to the genus *Discocalyx*, since it showed many features in which it is quite different from the other species of that genus. He, therefore, proposed to raise it to generic rank and created the name *Apoia* for the new genus, the specific name thus becoming *Apoia macrocarpa* (Elm.) Merr. . . .

"In December 1931, one of the ablest native clerks of the Buitenzorg Herbarium, Sapiin, . . . suggested that *Apoia* actually could not be placed in the Myrsinaceae and asked whether it could be related with the Sarcospermaceae. On comparing the specimens of *Apoia* with those of *Sarcosperma*, I elaborated several years ago, it stood clear at once . . . that *Apoia* must be identical with *Sarcosperma*, and *Apoia macrocarpa* with *Sarcosperma paniculatum* Stapf & King. . . .

The fact that *Sarcosperma* has been inserted not only in the Sapotaceae, but also in the Myrsinaceae, evidences both its close relation to those two families and its isolation from them, since its characters render it quite distinct from any genus in either of the orders mentioned."

Commercial timbers of India: Their distribution, supplies, anatomical structure, physical and mechanical properties and uses. By R. S. Pearson and H. P. Brown. Central Publication Branch, Government of India, Calcutta, 1932. Pp. xliv+1150; vols. 2; 7¼ x 10¾; 640 photomicrographs, 320 distribution maps. For sale at India House, Aldwych, London, W. C. 2, and booksellers, £5 net.

In discussing the object of this publication, the authors state that "the work has been undertaken with a view to bringing up to date and recording all available information on the uses and the qualities of the various timbers, and to make available . . . photomicrographs at low and high magnifications, so that the structure of the woods could be determined and identified. . . . The information given under the various headings has, as far as possible, been carefully restricted to such facts as have a direct bearing on the present or prospective uses of the wood in question . . ." The senior author is primarily responsible for the data on the distribution, strength, seasoning, durability, working qualities, uses, and available supplies of the timbers discussed, and the junior author for the information concerning their anatomical characteristics and identification.

Included in the introduction are brief discussions of such points as the area and distribution of the forests in British India, topographic and climatic conditions, geological formations, distribution of forests, general characteristics (physical features) of the wood, and structure of the wood. In the main body of the text the subject matter, covering the points enumerated in the subtitle and the preceding paragraph, is arranged according to families, genera, and species, following the general sequence used in Brandis' *Indian Trees;* only those families and genera which include woods of commercial value are listed. A total of 320 species, representing 53 families, are dealt with. A comprehensive list of references to the trees, woods, and other forest products is given under each family, genus and species. These deal mainly with the literature on the woods of the Orient, but are not restricted to that region. A complete list of references is given in the bibliography at the end of the text. The publication is profusely illustrated, the description of each of the 320 species being accompanied by a plate with 10 × and 110 × photomicrographs of the cross section of the wood and a small distribution map. Included as appendices are a classification of timbers according to uses and a glossary of scientific terms and phrases used in the text. Three separate indices are included at the end, one of trade and non-scientific names, a second of vernacular names, and the third of scientific names.

Under the discussion of each family the authors have included information with regard to the size of the family in terms of genera and species, its distribution throughout the world, and its economic importance. Following this is a discussion of the gross features of the woods of the family and a summary of their salient anatomical characteristics, in which the macroscopic and minute anatomical features are grouped together. The discussion is closed with a brief statement of the significance of the family in the Indian flora. Concerning the anatomical summary, the junior author states in the introduction that it "may be considered as characteristic but not specific for the woods of the family, for such is the parallelism in the structure of woods of different families, which are often widely separated in botanical classification, that no one anatomical character can be regarded as diagnostic for the woods of a given family." It is unquestionably true that the individual anatomical features may be duplicated in woods of other families, but the author apparently disregards the well-established fact that the combination of anatomical details (the structure as a whole) is characteristic of many individual families and not paralleled in others. Exceptions to this statement are to be found, especially in some of the large families as they are at present constituted, but in many such cases it is quite evident that the basic botanical classification is faulty.

The treatment of each genus includes a discussion of its size and general distribution, and in many cases botanical notes on the leaves, flowers, and fruit, an enumeration of the known Indian tree species, and finally a summary of the general features of the wood of the genus, including a discussion of the general gross characters, both physical and anatomical, and an enumeration of some of the minute anatomical details.

In the case of those genera which include two or more Indian species of sufficient importance to be described in the text, two keys to the identification of the woods of the species are included. The first of these is based on macroscopic characters, visible to the unaided eye or under a hand lens (10 ×), the second on microscopic features. This attempt to key the species is open to criticism, because the range of material upon which most of the species descriptions were based is inadequate for such a purpose. In a great many cases the description of the wood of a species was based on a single specimen. Further in the microscopic keys, the reviewer feels that too much dependence is frequently placed on the size of various elements in separating species. Unless the size of a given element in two species is distinctly and consistently different, it has little or no practical value in separating the woods; further, the amount of time required in applying such a feature in keying out species is also open to objection.

The discussion of the species includes a list of vernacular names, information relative to the habit and distribution of the tree and the supplies of the wood, brief consideration of the general physical characteristics of the wood, detailed information concerning the structure of the wood (both macroscopic and microscopic), and data on such factors as mechanical properties, seasoning, durability and adaptability to treatment, working qualities, and uses. The anatomical descriptions of the woods are particularly complete and thorough, and the detailed discussions are carried through for each species, even where there are two or more belonging to the same genus. This leads to considerable repetition in the descriptions and much space could have been saved had the generic anatomical features been covered more in detail and only the points of difference given for the individual species.

Throughout the text the emphasis has been placed on the species descriptions; since species are not as definitely marked as genera, it seems to the reviewer that the emphasis should have been on the latter.

This publication has much to commend it. It contains a great deal of original data concerning the important Indian timbers and the authors have also drawn freely upon the information available in various publications, chief of which are the forest memoirs, forest records, and bulletins published by the Forest Research Institute at Dehra Dun. The illustrations are excellent and in themselves constitute a very valuable contribution. The book should fill a very definite need, not only for those concerned in the utilization of Indian timbers, but for all whose interest lies in the field of wood anatomy.—George A. Garratt, *Yale University School of Forestry*.

The identification of important Indian sleeper woods. By K. A. Chowdhury. Forest Bulletin No. 77, Calcutta, 1932. Pp. 18; 5½ x 8½; 31 plates, 1 map. Price 5s. 3d.

"This bulletin is the first of its kind to be published by the Forest Research Institute at Dehra Dun, and aims at supplying forest officers, railway passing officers, and others with sufficient information to enable them to identify some of the more common Indian sleeper woods, in the field.

"It is the intention to publish similar bulletins from time to time, dealing with the timbers of individual Provinces. Railway sleepers have, however, always formed a very large proportion of the total production of timber from Indian forests, and as officers have for some time past been pressing the Forest Research Institute to produce a simple key for the identification of Indian sleeper woods, it was felt that a start could well be made by dealing with these woods first. In subsequent bulletins, it is the intention to deal with timbers according to localities rather than uses."

Following a short discussion of the anatomical and physical features of wood, is a dichotomous key to 59 species, all of which are illustrated with photomicrographs (negative prints) of cross sections magnified ten diameters. The use of

negatives instead of positive pictures of coniferous woods is likely to confuse the persons for whom the publication is intended as they make the late wood of a growth ring appear light and the early wood dark, which is the reverse of the true condition.

Timber tests: Meranti pa'ang (*Shorea bracteolata*). By F. S. WALKER. *The Malayan Forester* (Kuala Lumpur) 1: 6: 258–261, October 1932.

"The name Meranti Pa'ang is loosely applied to several species of *Shorea* yielding timber of the light-colored ('yellow') Meranti type, alternative Malay names being Meranti Langgong, Meranti Ketapak, and Samarupa-meranti. It is particularly liable to confusion with Meranti Temak (*Shorea hypochra*), but the next test in the series, though unfinished, indicates that *Shorea hypochra* is a distinctly stronger and better timber.

"The species tested is common in lowland forest generally throughout the Peninsula South of Latitude 7° N, often up to one tree per acre, on flat or slightly hilly land . . .

"The timber was only a little more difficult to work than the 'red' Meranti type with hand and machine tools, but the teeth of saws were quickly blunted. The finish of the surface after planing was not good, though it varied somewhat. Where interlocked grain not infrequently occurred the grain picked up considerably on planing . . .

"Heart rot was found to be a serious defect in this as in other Merantis, some 20 per cent of the test pieces being rejected on this account . . .

"The timber can advantageously replace Meranti Tembaga in all light construction particularly as, owing to toughness, it will continue to support a load after failure—a quality generally absent from Meranti Tembaga. It is suitable for furniture and joinery if color and finish are not of prime importance. Owing to quite considerable variation in strength from tree to tree, consignments need careful inspection.

"Like other Merantis it is not durable and needs protection from fungus and termite attack. It is apparently not difficult to impregnate with creosote mixtures by a somewhat drastic full-cell treatment."

The paper concludes with a table of results of mechanical and physical tests and there are percentage comparisons with Meranti Tembaga (*Shorea leprosula*), Seraya (*S. Curtisii*), Kapur (*Dryobalanops aromatica*), and Teak (*Tectona grandis*).

The damars of the Malay Peninsula. By T. A. BUCKLEY. *Malayan Forest Records* No. 11, 1932. Pp. 94; 7¼ x 10½. Price 3s. 6d.

This work is concerned with the resins found in Malayan forests. "It happens that they are almost entirely of the type known in the resin trade as 'dammar,' the name having long been applied to the chief sort of resin imported into Europe from the East Indies. A resin not of this type, *damar minyak*, or *damar kedondong*, would probably be denied the identity of a 'dammar' by a resin merchant or consumer, but in general, the vernacular and commerical terms are in agreement. Malaya produces no hard copals, no pine resins, nothing of the mastic or sandarac type, and no shellac. A form of shellac, *malau*, might be produced on a small scale, but inducement is lacking. Dragon's blood of good quality has been produced, without stimulating a demand.

"Natural resins, including damars, are being increasingly supplanted by synthetic materials, which have the advantages of superior cleanliness, uniformity and, it is said, durability; but while it would be idle to deny the desirability that industry should use the best materials available, it is thought that attempts should be made to use an existing natural asset to the greatest advantage. Elsewhere work is being done in search of means of improving the properties of damar, and this will need to be much extended if the damar industry is to continue."

Botanical results of a trip to the Anambas and Natoena Islands. By C. G. G. VAN STEENIS. **Notes on the vegetation of Djemadja.** By M. R. HENDERSON. *Bull. Jard. Botanique de Buitenzorg* (Sér. III) 12: 2: 151–211. Buitenzorg. Nov. 1932. Illustrated.

Anambas and Natoena Islands, lying in the South China Sea between 3 and 4° N and 106 and 109° E, form a link be-

tween the Malay Archipelago and Borneo. The largest island, Boengoeran, has an area of 1600 square kilometers. The islands are hilly, with elevations mostly of 400–500 meters, the highest peaks reaching 1000 meters. Although the islands are rich in fine timbers, especially dipterocarps, the forests have been little exploited because of difficulties in transportation and lack of suitable labor. In March and April 1928, the authors studied the vegetation, and describe it as divisible into the following belts:

Mangrove. Characterized by *Nipa fruticans*, *Rhizophora mucronata*, *Aleurites moluccana*, *Derris heteropbylla*, *Sonneratia acida*, *Bruguiera eriopetala*, *Lumnitzera racemosa*, *Pandanus*, etc.

Beach flora. The usual tropical strand plants, some of which are cosmopolitan: *Ipomoea pes-caprae*, *Canavalia maritima*, *Vigna marina*, *Scaevola frutescens*, and others.

Barringtonia formation. Now chiefly destroyed, and replaced by coconut palms. Among trees and shrubs are *Pandanus tectorius*, *Erythrina variegata*, *Terminalia Catappa*, *Premna integrifolia*, *Guettarda speciosa*, *Calophyllum Inophyllum*, and *Casuarina equisetifolia*.

Lowland forest and secondary growth up to about 100 meters. The vegetation consists chiefly of weedy herbs and shrubs, but there are some trees remaining from the original plant covering, such as *Pajanelia longifolia*, *Dipterocarpus*, *Oncosperma horrida*, *Quercus argentata*, *Strombosia*, *Koompassia*, *Durio zibethinus?* (probably introduced).

Mountain forest between 100 and 800 meters. This is not homogeneous, but the zonation is gradual; at 600 to 800 meters there is a gradual transition into the uppermost mossy forest. The large trees (50–60 meters high) disappear toward the higher regions, and are replaced by different species. The lowest zone is characterized by two very tall trees, *Koompassia malaccensis* and a *Strombosia* (called Balau). Other trees belong to the genera *Carallia*, *Litsea*, *Blumeodendron*, *Endospermum*, *Quercus*, *Diospyros*, *Evodia*, *Knema*, *Aglaia*, *Amoora*, *Prunus*, *Dysoxylum*, *Macbilus*, *Eugenia*, *Garcinia*, *Mangifera*, etc. The undergrowth of small trees and shrubs is composed of a large number of species of many families, a high percentage as to both species and individuals consisting of Rubiaceae.

Mossy forest of the summits between 800 and 1000 meters. This occurs here at a lower elevation than on larger islands. There is rain almost every day, and the tree trunks are covered with a thick coat of moss, in which orchids and ferns thrive. Among the trees and shrubs are *Astronia smilacifolia*, *Acronychia*, *Ixora javanica*, and a slender *Calamus*. The wind-swept rocky summits support a few low shrubs, of which *Rhododendron javanicum* is the most conspicuous.

Padang formation. Of limited distribution, and occupying sandy plains, the plants being chiefly herbs and low shrubs, the areas having a heath-like appearance.

An account is given of the geographic relationship of the flora, also descriptions of three new species and one new genus, *Enaulophyton*, of the Melastomaceae. There is appended a list of the timber trees, with their local names and notes upon their uses, a list of minor forest products, and one of the cultivated plants.—Paul C. Standley.

Stamtafels voor djamoedjoe (*Podocarpus imbricata Bl.*). By H. E. Wolff von Wülfing. *Korte mededeelingen van het Boschbouwproefstation* No. 25, Buitenzorg, 1932. Pp. 55: 6¼ x 9½.

"The investigations for the volume tables for Djamoedjoe were executed by the Forest Research Institute in cooperation with the Working Plans Service. . . .

"Djamoedjoe generally has a beautifully formed bole, while the tree can attain large dimensions. It occurs in the mountain regions of Java, principally at altitudes of 1400 to 1750 m. above sea level. Outside Java it is found in several other islands of the Indian Archipelago, in the Philippines, Upper Burma, etc. The wood is suited for light constructions under shelter, cheap furniture, boardings, and packing cases."

Gegevens betreffende een onderzoek naar Nederlandsch-Indische houtsoorten, welke tegen den paalworm bestand zijn. By J. W. Gonggrijp, pp. 1–100. **Nadere gegevens omtrent de aantasting van Nederlandsch-Indische houtsoorten door paalworm en andere in zee- en brakwater levende dieren.** By A. T. J. Bianchi, pp. 101–147. *Mededeelingen van het Boschbouwproefstation* No. 25, Buitenzorg, 1932. Pp. 147; 6½ x 9½; 80 figs.

"The first paper is a continuation and extension of an investigation commenced in Surinam with the purpose to discover new timbers resistent against *Teredo* and to test the correctness of the hypothesis that a certain content of silica particles renders timbers possessing a certain degree of firmness immune against attack."

"The shape in which the amorphous silicic acid occurs in wood is mostly in that of grains or more or less oblong bodies

in the cavity of special cells or fibers which are different with different species. Besides, certain timbers were found to contain silicified tyloses of a silicified membrane attached to the interior wall of tracheal elements and presenting an exact cast of the same with all its minute details. Sometimes the cavities of groups of fibers were observed to be filled with a vitreous mass of silica, while one case of a similar filling of isolated ray-cells was encountered.

"Because the resistance of wood against *Teredo* attack is not dependent alone on the content of silica particles, but on a sufficient large content together with a certain degree of compactness of the timber, it is certain that not all species in which the presence of amorphous silicic acid was ascertained can be considered as possessing a remarkable degree of immunity against *Teredo*.

"The last chapter treats the timbers of the Netherlands Indies archipelago which are mentioned in the literature as resistant against *Teredo*. Some of these are shown to be eliminated from such lists in future. Finally, 20 timbers or groups of timbers are mentioned with which further experiments to ascertain the degree of resistance against *Teredo* can be recommended with chances of success with a view to create a market for the timber for this special purpose. The timbers belong to the following genera: *Angelesia*, *Artocarpus*, *Beilschmiedia*, *Cotylelobium*, *Endiandra*, *Eusideroxylon*, *Gluta*, *Heritiera*, *Intsia*, *Melanorrhoea*, *Metrosideros*, *Mimusops*, *Parastemon*, *Parinarium*, *Protium*, *Stereospermum*, *Sloetia*, *Tarrietia*, *Tectona*, and *Vitex*."

"The second paper gives a compilation of the data about the resistance of Netherlands Indian timbers against the attack by marine borers, which have become known since Mr. Gonggrijp closed his investigation (1925). The data are derived from various sources."

The Styracaceae of Netherlands India. By C. G. G. van Steenis. *Bull. Jard. Botanique de Buitenzorg* (Sér. III) 12: 2: 212–272. Buitenzorg, Nov. 1932. Illustrated.

There are listed and described, with detailed synonymy, citation of specimens, and voluminous notes, *Bruinsmia*, with one species, and *Styrax*, with seven. The article concludes with several pages of "phytogeographical remarks," and four pages of bibliography.

Bruinsmia styracoides, a tree with average height of 25 meters, occurs in Sumatra, Java, Borneo, Celebes, and Papua. Timber of rather large dimensions obtained from it is used for building operations, but the tree is rare, and its wood not very durable.

Styrax Benzoin, of the Malay Peninsula, Sumatra, and western Java, is discussed at great length. Its chief product is the resin benzoin, used locally to perfume cigarettes and as incense, and exported for use in perfumes and medicine. In some regions the tree is cultivated for exploitation. Its wood is rather soft, not very durable, and not available in large dimensions, being used but rarely for bridge and house building. *Styrax parallelloneurus*, of the Malay Peninsula and Sumatra, also produces a kind of benzoin, chemically different from that of *S. Benzoin*.—Paul C. Standley.

De proefbaanmetingen in de panglonggebieden van Bengkalis (Sumatra's Oostkust) en Riouw. By F. H. Endert. *Korte mededeelingen van het Boschbouwproefstation* No. 28, Buitenzorg, 1932. Pp. 55; 6¼ x 9½; 1 map.

"The panglong (primitive Chinese exploitation) areas of the district of Bengkalis and the residency of Riouw, with a wooded area of about 2,000,000 ha., belong to the most productive commercial forests of the outer districts. Yearly they produce about 400,000 cubic meters of timber and great quantities of firewood and charcoal. The annual net profit for the Government amounts to about one million guilders.

"More than 90 per cent of the total output of timber comes from the peat-swamp forests (four-fifths of this volume from Bengkalis, and one-fifth from Riouw). By far the greater part of the output of the peat forests consists of soft species of poor durability (quality class IV). The forests on dry land on the islands of the Riouw-residency produce the better kinds of timber and large quantities of poles.

"The forest survey division has measured a great number of valuation strips in the panglong area. The strips outside the

Mangrove swamps, with a total area of about 546 ha., are analyzed in this article. . . . As the area of the valuation strips is only a very small percentage of the total area of the region, the results of the investigation bear the character of rough estimates.

"The principal kinds of timber are briefly discussed. As a whole, the volume per ha. of these forests is not high. That, nevertheless, such an extensive exploitation could develop in this region, finds its cause in the very favorable situation with regard to the Singapore market, the cheap Chinese labor, and the, as a rule, favorable composition, as regards wood species, of these forests."

Methods for the identification of the coloured woods of the genus *Eucalyptus*. By H. E. DADSWELL and MAISIE BURNELL. Bull. No. 67, Council for Sci. & Ind. Research; Tech. Paper No. 5, Div. of Forest Products, Melbourne, 1932. Pp. 50; 6 x 9½; 34 plates; 10 figs.

"The Division's Section of Wood Structure has begun the study of the commercial timbers of Australia with the idea of developing satisfactory keys for their identification. It is hoped eventually to establish a key covering the main genera and species, but in the first case the work is being restricted to the Eucalypts.

"A first subdivision was made into the colored and non-colored woods. It is recognized that this is not a sharp line of division, and that some species will occur on either side of the dividing mark. This, however, would hold no matter what criterion is selected as the first dividing factor. Nor is it a serious disadvantage. Overlap is unavoidable, and any key must take care of it. Similar overlap occurs at almost every stage in the development of the key, but in no way interferes with its efficiency as a means of determining the identity of any timber in the group.

"If a factor or factors could be found that are not subject to this disadvantage, the preparation and use of a key would be enormously simplified. So far, this has not proved possible. This first section of the project was, therefore, confined to colored Eucalypts of commercial or possible commercial

importance. There are other species which later will need to be fitted in to the key, but all those of any importance at present are included. A commencement has been made in the study of the uncolored Eucalypts, and this will form the subject of a later publication. Other genera will then be studied, and attempts made to fill in the gaps inevitable at this stage of the work.

"A feature of the programme of work has been the reduction of the number of diagnostic features used. Most published work contains a mass of microscopic measurements, of which very few have any diagnostic value, because of the wide variation within a species. At any early stage, a detailed study was carried out, but after some thousands of measurements were made, it was found that the greater number of the figures obtained were of no diagnostic value. As a result, the investigation was limited to those features which had proved of value. This not only allowed more rapid progress to be made, but greatly simplified the task of using the key. It is thought that this key, which is tentative only, and designed to be improved as further studies are made, will form a useful beginning to a general key to the identification of Australian timbers. It is the most ambitious attempt so far made in such work, and cannot claim to be by any means perfect.

"Another feature to be noted is that a minimum of 10 samples of each species have been examined. Further, samples have not been used unless botanical material accompanied them, so that no question of doubtful identification arises. . . .

"Experimental work with all samples has consisted of the determination of basic density (that is, based on oven-dry weight and volume when soaked), macroscopic examination, and microscopic examination of thin sections. Macroscopic examinations have covered the description of the color of the wood, its fissility, grain, and general external characteristics, the burning splinter test, and the determination of the size of pores and their number over a definite area. Microscopic examinations have included the preparation of transverse, radial, and tangential sections from each sample, and the examination of the pores, rays, and parenchyma cells as revealed in these sections.

"The results of all the experimental work have been tabulated, and from these a tentative key for the identification of the species listed above has been drawn up. . . . Photomicrographs depicting the typical appearance of the transverse and tangential sections of a number of the species examined have been included."

Les productions végétales du Sahara et de ses confins nord et sud. By AUG. CHEVALIER. *Revue de Botanique Appliquée & d'Agriculture Tropicale* (Paris) 12: 133–134: 669–924, Sept.–Oct. 1932.

The scope of this important work is indicated by the chapter headings of the four parts and three appendices, as follows: I. THE COUNTRY, THE VEGETATION, AND AGRICULTURE (pp. 669–710). (1) The Sahara and its vegetation. (2) Agriculture in the past. (3) Present conditions of agriculture and cultivation. II. PRINCIPAL CROPS AND VEGETAL PRODUCTS (pp. 711–824). (1) The Date and Doom Palms. (2) Cereals of the semi-desert regions and oases. (3) Fruit trees. (4) Cultivated forage plants. (5) Legumes and spices. (6) Plants yielding fibers and other industrial products (tobacco, henna, dye-stuffs, perfumes). (7) Native plants used for food. (8) Woods. III. ANNOTATED LIST OF THE INDIGENOUS AND INTRODUCED PLANTS USED BY THE NATIVES OF THE REGION (pp. 825–898). IV. FUTURE OF AGRICULTURE IN THE SAHARA, AND CONCLUSIONS (pp. 899–911). APPENDIX I. Sahara acclimatization gardens and experiment stations (pp. 912–916). II. Collection of scientific specimens for study (pp. 917–919). III. Biological research on desert vegetation in other countries (pp. 920–923).

Premier complément à l'étude physique et mécanique des bois coloniaux. *Actes & Comptes Rendus de l'Association Colonies-Sciences* (Paris) 8: 90: 222–233, Dec. 1932.

Part of the first supplement to *Étude physique et mécanique des bois coloniaux*, which was published in January 1931 (see *Tropical Woods* 26: 41). The report gives the results of tests, following the Monnin method, on 53 lots of timber of 44 different kinds, mostly of West African origin.

M. M. Chattaway.

Price 35 cents

Yale University School of Forestry

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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, *Professor of Forest Products, Yale University.*

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EDITHEA, A NEW GENUS OF MEXICAN SHRUBS OF THE FAMILY RUBIACEAE

By PAUL C. STANDLEY

Field Museum of Natural History

The state of Guerrero, whose high and precipitous mountains still are but little known botanically, has yielded to collectors many strange plants that have not been discovered elsewhere in Mexico, but none was less to be expected than the shrub described below. As generic characters are understood in the Rubiaceae, the plant represents a remarkably well-defined genus.

Edithea, gen. nov.

Frutices ramosi pubescentes; folia opposita membranacea mediocria petiolata; stipulae interpetiolares parvae deciduae; inflorescentia terminalis pedunculata cymosa multiflora, flores parvi pedicellati ebracteolati tetrameri; hypanthium turbinatum; calyx 4-partitus, laciniis angustis erectis; corolla

tubuloso-infundibularis extus pubescens, tubo crasso supra paullo dilatato intus glabro, lobis brevissimis suberectis in alabastro contortis; stamina 4 fauce corollae inserta, filamentis brevissimis linearibus compressis glabris, antheris linearibus basi sagittatis ad medium dorsifixis; discus depressus; ovarium biloculare, stylo gracillimo incluso glabro, stigmate bilobato, ovulis numerosis imbricatis placentis septo peltatim affixis; fructus capsularis.

The genus consists of a single species:

Edithea floribunda, sp. nov.

Ramuli graciles subteretes, novellis viridibus glabratis, internodiis brevibus; stipulae 3–4 mm. longae triangulares acuminatae villosulae; folia in sicco intense viridia, petiolo gracili 8–20 cm. longo villosulo vel fere glabro; lamina oblongo-ovata vel elliptica 7–13 cm. longa 3.5–6 cm. lata breviter acute acuminata basi obtusa vel rotundata, supra sparse minute villosula albido-punctículata costa nervisque prominulis, subtus fere concolor ad costam prominentem villosa aliter minute sparse villosula, nervis lateralibus utroque latere c. 10 angulo circa semirecto adscendentibus gracillimis prominentibus arcuatis prope marginem conjunctis, venulis obscuris laxe reticulatis; inflorescentia erecta 4 cm. longe pedunculata c. 4 cm. longa et 7 cm. lata subdense multiflora, ramis repetite dichotomis suberectis vel valde adscendentibus gracilibus dense cinereo-puberulis, bracteis minutis, pedicellis plerumque 4–7 mm. longis gracilibus; hypanthium 1.5 mm. longum et fere aequilatum puberulum, calycis laciniis anguste triangularibus erectis attenuatis puberulis 1–1.5 mm. longis; corolla rubrolutea extus sparse puberula vel minute pilosula in alabastro apicata 13 mm. longa, tubo ad faucem 3.5 mm. lato, lobis ovato-rotundatis apiculatis 1.5 mm. longis; antherae 4 mm. longae; stylus 1 cm. longus.—Mexico: Malinaltepec, Guerrero, March, 1930, *L. Schultze* 363 (Herb. Berol., type).

The relationship of *Edithea* is undoubtedly with the genus *Deppea*, which it simulates closely in general appearance. The leaves and the arrangement of the inflorescence are identical for the two genera, but all the species of *Deppea* agree in having a rotate or short-funnelform corolla in which the lobes are several times as long as the tube. Although the present plant is so similar to species of *Deppea*, it could not be referred to that group without upsetting the more or less conventional disposition of the tribe Rondeletieae.

This new genus of Mexican shrubs is named for Edith M. Vincent, Librarian of the Department of Botany in Field Museum of Natural History. In her years of work in the library of this institution and that of the Gray Herbarium, Miss Vincent always has been generous in aiding botanists and other persons in search of information, and in assisting them in perplexing bibliographic problems, for which she is exceptionally qualified because of her knowledge of botanical literature.

SYSTEMATIC ANATOMY OF THE WOODS OF THE MAGNOLIALES[1]

By Robert P. McLaughlin

This investigation was undertaken with the object of determining in what ways an examination of the systematic anatomy of the secondary woods of the natural order Magnoliales, as proposed by Hutchinson (*34*), might contribute towards the solution of a difficult taxonomic situation. The project involved a comprehensive study of the Magnoliaceae, Schizandraceae, Winteraceae, Trochodendraceae, Cercidiphyllaceae, Lactoridaceae, and Himantandraceae.

The botanical literature concerning the order is extensive, but there are few references to the anatomy, other than those recorded by Solereder (*44*). Since the publication of his *Systematic Anatomy of the Dicotyledons*, there apparently has been no attempt to correlate the morphological and anatomical characters of the members of this order.

The principal systems of classification of the group are those of Bentham and Hooker (*3*, *4*), based on the De Candolle system (*17*), of Engler and Prantl (*25*), and of Hutchinson (*35*). All of these have been considered in this study, but no one of them has been accepted in its entirety.

The first notable classification was that of De Candolle (*17*), who, in 1824, divided the Magnoliaceae, as this group was then designated, into two tribes: Illiceae, comprising the genera *Illicium*, *Temus*, *Drimys*, and *Tasmania;* and Magnolieae, embracing *Magnolia*, *Mayna*, *Michelia*, *Talauma*, and *Liriodendron*. *Canella* he excluded from the family and placed

[1] A portion of a dissertation presented to the Faculty of the Graduate School of Yale University in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The work was done under the supervision of Professors Record and Garratt, of the Department of Forestry.

in the Guttiferae. Later, Jussieu [2] included *Magnolia* and *Liriodendron* under Tiliaceae, and *Illicium* under Anonaceae. Adanson, [2] as a result of his observations, united *Skimni* (*Illicium*), *Magnolia*, *Champaca* (*Michelia*), and *Tulipifera* (*Liriodendron*) under Anonaceae. A further analysis and classification of the family by Jussieu [2] put *Magnolia*, *Talauma*, *Michelia*, *Liriodendron*, *Illicium*, and *Drimys* in one group and *Euranda* (*Tetracera*) and *Mayna* in another, while *Canella* was assigned to the Meliaceae.

In 1862 Bentham and Hooker (*3*, pp. 16–20) gave the following arrangement of the family:

Tribe I. WINTERAE: (1) *Drimys*, (2) *Illicium*.
Tribe II. MAGNOLIEAE: (3) *Talauma*, (4) *Magnolia*, (5) *Manglietia*.
Tribe III. SCHIZANDREAE: (8) *Schizandra*, (9) *Kadsura*.

The remaining genera, which had become associated with the family, they disposed of as follows: *Canella* and *Cinnamodendron* were transferred to Canellaceae; *Trochodendron* to Araliaceae; *Hortonia* to Monimiaceae; *Calycanthus* and *Chimonanthus* to Calycanthaceae; *Mayna* to Bixaceae; and *Temus* to Myrtaceae.

Hooker and Thompson (*33*), swayed by the arguments of Eichler (*21*) as well as by their own comparisons of *Trochodendron* and *Euptelea*, decided to place these genera under Trochodendreae as Tribe A, to be inserted before Tribe I in their preceding classification. Shortly after this Durand (*20*), using the system of Bentham and Hooker, added *Cercidiphyllum* to Trochodendreae and *Zygogynum* to Wintereae.

In 1894 Prantl (*40*, *41*) listed the following three tribes of the family, with their respective genera:

I. MAGNOLIEAE: (1) *Magnolia* (including *Manglietia*), (2) *Talauma* (including *Aromadendron*), (3) *Michelia*, (4) *Liriodendron*.
II. SCHIZANDREAE: (5) *Kadsura*, (6) *Schizandra*.
III. ILLICEAE: (7) *Illicium*, (8) *Drimys*, (9) *Zygogynum*.

For the three genera *Trochodendron*, *Euptelea*, and *Cercidiphyllum* he formed a separate family known as Trochodendraceae. At the same time Engler (*22*) segregated *Lactoris* by

[2] Referred to by Parmentier (*39*).

the formation of another family, Lactoridaceae. *Tetracentron*, at this period, was referred to as a doubtful genus of the Trochodendraceae. It had originally been described by Oliver in Hooker's *Icon.* (*32*) as being closely related to *Trochodendron* and *Cercidiphyllum*. Later, Harms (*30*) made of it a fourth tribe of the Magnoliaceae, Tetracentreae, on the basis of secretory cells in the leaves and the presence of a perianth. He divided Trochodendraceae into Eupteleoideae, containing *Cercidiphyllum*, *Euptelea*, and *Eucommia*, and Trochodendroideae, composed of the single genus *Trochodendron*.

Van Tieghem (*48*) subdivided the genus *Drimys* into five genera (*Drimys*, *Wintera*, *Bubbia*, *Belliolum*, and *Exospermum*), and, because of the peculiar vessel-less wood structure, united it with *Zygogynum*, *Trochodendron*, and *Tetracentron* to form a special taxonomic group, the Homoxylées, as opposed to the rest of the Dicotyledons, the Heteroxylées. Van Tieghem also took exception to Bailey's classification of *Galbulimima* (*Himantandra*) (*2*), claiming that, although the flowers are similar to those of *Drimys*, the fruit would exclude it entirely from the Magnoliaceae.

In 1903, Engler (*23*) presented a reclassification of the *Magnolia* group, in the following arrangement under the order Ranales:

Sub-order 2. TROCHODENDRINEAE
Trochodendraceae
Trochodendron
Cercidiphyllum
Sub-order 4. MAGNOLIINEAE
Magnoliaceae
Magnolieae
Illiaceae
Schizandreae
Magnoliineae (*cont.*)
Calycanthaceae
Lactoridaceae
Anonaceae
Myristicaceae
Gomortegaceae
Monimiaceae
Lauraceae
Hernandiaceae

Solereder (*44*) removed *Cercidiphyllum* from the Trochodendraceae and placed it as a monotypic tribe under Hamamelidaceae. In the opinion of Van Tieghem (*47*), however, this genus constituted a separate family, Cercidiphyllaceae, just as he had proposed a separate family, Eupteleaceae, for *Euptelea*. In the same manner, Van Tieghem would have had *Eucommia* as a sole representative of the Eucommiaceae,

while Solereder believed that it ought to be considered as a distinct tribe of Hamamelidaceae.

It was suggested by Hallier (*29*) that *Daphniphyllum*, which he regarded as a transition between Magnoliaceae, Hamamelidaceae, and the Amentiferae, be grouped with *Trochodendron* and *Rhodoleia* in a tribe to be known either as "Trochodendreen" or "Daphniphylleen." This would stand opposed to a tribe, "Bucklandieen," consisting of the genera *Bucklandia*, *Cercidiphyllum*, *Euptelea*, and *Eucommia*. It is true that in many respects *Daphniphyllum*, along with *Trochodendron* and *Rhodoleia*, does bear resemblance to the Magnoliaceae, which Hallier considered to be the oldest family of the Angiosperms.

Engler and Gilg (*24*), in 1912, made these changes within Engler's sub-order Trochodendrineae (*23*): the genus *Euptelea* was added to the family Trochodendraceae, and *Cercidiphyllum* was withdrawn from the latter and placed as a separate family, Cercidiphyllaceae, of the sub-order. The Magnoliineae were left unchanged.

In opposition to the generally accepted theory of classification, Diels (*19*) now advanced the idea of dissociating "Magnoliaceen, Illiaceen, Drymtaceen, and Schizandreen" from the Ranales and treating them as a part of the Anonales. With them he includes *Himantandra*, designating it as a monotypic family, Himantandraceae.

In 1921 Hutchinson (*34*) proposed "the establishment of the order Magnoliales as distinct from the Ranales." He emphasized this proposal in a later publication (*35*), justifying his new classification on the ground that he considered that these two orders "may have been evolved from separate primitive stocks and have developed along parallel lines." Hutchinson's classification of the Magnoliales is as follows:

I. Magnoliaceae
1. *Magnolia*
2. *Talauma*
3. *Michelia*
4. *Manglietia*
5. *Aromadendron*
6. *Liriodendron*

II. Winteraceae
7. *Illicium*
8. *Drimys*
Wintera
Belliolum
Bubbia
Exospermum
Winteraceae (*cont.*)
9. *Zygogynum*

III. Schizandraceae
10. *Kadsura*
11. *Schizandra*

IV. Lactoridaceae
12. *Lactoris*

V. Himantandraceae
13. *Himantandra*

VI. Cercidiphyllaceae
14. *Cercidiphyllum*

VII. Trochodendraceae
15. *Trochodendron*
16. *Euptelea*

It may be noted that in the above classification Hutchinson fails to include *Tetracentron* and *Eucommia*, which are usually associated with this group. The latter genus he accounts for by assigning it to Eucommiaceae (*35*), but completely ignores the former. At an earlier date (*34*) he stated that both of these genera were "better placed in Hamamelidaceae."

Those genera not included in this classification of Hutchinson's, which have been mentioned as having been associated with this group at one time or another, are listed in Index Kewensis among families of other orders, as indicated below:

Canellaceae:
Canella [3]
Cinnamodendron [4]
Dilleniaceae:
Tetracera (*Euranda*) [4]
Eucommiaceae:
Eucommia [3]
Euphorbiaceae:
Daphniphyllum [3]
Eupomatiaceae:
Eupomatia [3]
Flacourtiaceae:
Mayna [4]
Hamamelidaceae:
Bucklandia [3]
Rhodoleia [4]
Monimiaceae:
Hortonia [4]
Myrtaceae:
Myrtus (*Temus*) [4]

Index Kewensis also lists *Tasmania*, *Belliolum*, *Bubbia*, and *Wintera* as synonyms of *Drimys*, and *Exospermum* as a synonym for *Zygogynum*. *Belliolum*, *Bubbia*, *Wintera*, and *Exospermum* may be sub-genera of *Drimys* and *Zygogynum*, respectively, or they may possibly be distinct genera.

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[3] An examination of the wood of these genera indicated that they had been correctly excluded from Hutchinson's order Magnoliales.

[4] No wood of these genera was available, but their anatomical descriptions in Solereder's *Syst. Anat.* indicate that they also had been correctly excluded from the above order.

In the last few years Dandy (*10–16*), who has had at his disposal type specimens of practically every species of Magnoliaceae, as well as a wealth of additional material, has suggested the creation of four new genera under that family. These, according to his plan, are: the monotypic genera *Alcimandra* (formerly *Michelia Cathcartii* Hook. f. & Thoms.) and *Pachylarnax;* the genus *Kmeria*, with two species (type species being *Kmeria Duperreana* (Pierre) Dandy, formerly *Magnolia Duperreana* Pierre, syn. *Talauma Duperreana* F. & G.); and *Elmerrillia* with about seven species. He also suggested the formation of the tribe Liriodendreae, for the genus *Liriodendron*, and the tribe Magnolieae, to include the remaining genera of the family. He also reclassified many species of this family in new combinations, and has proposed several new species.

The history of the order is incomplete without some mention of its geological record, primitive features retained by its members, and the part it has played in the recent attempts to trace the origin of the Angiosperms.

The fossil record of the Magnolias is long and extensive. Only a brief résumé, therefore, will be presented here. No family is better represented in the forest flora of the Upper Cretaceous Period than Magnoliaceae, 25 species of *Magnolia* having been described for this era. Some of these may justifiably be questioned, but many of them seem to be authentic. These species have been found in western Greenland; along the Atlantic Coastal Plain, from Martha's Vineyard to Texas; in western interior North America; western Canada and Vancouver Island; Portugal; Moravia; and Bohemia. The Eocene records, with about 20 species, are all distinct from those of the Upper Cretaceous and equally widely distributed. Remains both of flower parts and of characteristic fruits, as well as leaves, have been found in the rocks of this age. Eight different species of this genus have been described from the Oligocene, all from Europe. In all probability there were representatives of the genus in North America during this period, but as yet no trace of them has been found. Sixteen Miocene species have been recorded from both Europe and North America. The closing days of the Tertiary have disclosed 11 species from North America, Europe, and Asia, while the Pleistocene records are as yet restricted to remains of *M. virginiana* L. from deposits in Southern Florida.

The case of *Liriodendron* is very interesting, for but two representatives of what was once a far-flung race, upon which the sun never set, and as ancient as *Magnolia*, now remain. One of these species is restricted to eastern, east central, and southern United States, and the other to an area of approximately equal size in China. The latter species so nearly resembles the former that until fairly recently it was considered merely as a variety.

The family Magnoliaceae and its allies have played an important part in recent attempts to trace the origin of the Angiosperms. In his original system Hallier (*28*) regarded the family as representing the most primitive existing member of this class, and compared the elongated axis of *Magnolia*, bearing numerous spirally arranged free sporophylls, with the sporophyll-bearing axis of Bennettites. A hypothetical group, Hemiangiosperms, combining the present primitive stem structure of *Drimys* with the acyclic arrangement of the sporophylls of *Magnolia*, was regarded as connecting Magnoliaceae and the other polycarpic families of the Dicotyledons with a Bennettites-like ancestor. This view has been developed by Wieland (*50, 51*), Arber and Parkin (*1*), Wernhams (*49*), and others. Hallier, however, has more recently revised his system and in this revision regarded Berberidaceae as the earliest existing family of the Angiosperms. He suggested the derivation of both the Dicotyledons and the Monocotyledons from a primitive type of this family, the Proberberideae. Finally comes Hutchinson's (*34*) proposal as previously mentioned, placing Magnoliales side by side with Ranales as the existing primitive orders of the class.

Considerable stress, from the viewpoint of phylogeny, has been placed on the conifer-like structure of *Drimys*, *Trochodendron*, and *Tetracentron* as indicating primitive origin. Thompson and Bailey (*45*), after a careful investigation of these genera and of others closely allied to them, responded to the theories held by Holden (*31*) and many other botanists and geologists, as follows: "There seems to be no evidence to

indicate that *Tetracentron*, *Trochodendron*, and *Drimys* once possessed vessels and have lost them. In fact, all the evidence at hand seems to indicate that these genera have retained a number of ancestral Gymnosperm characters. . . . The Magnoliaceae and allied families are extremely variable in their external and internal characters and show numerous transitions from apparently primitive to advanced and highly specialized types of structure. This is true of the flower, leaf, node, xylem, phloem, cortex, and other parts. It appears, accordingly, highly improbable that the members of this group are forms that have been reduced from advanced and more complex types of Angiosperms."

Shortly thereafter, Jeffrey and Cole (*36*) stated that they had discovered that, as a result of injury, peculiar tracheary structures are developed in the roots of several species of *Drimys*. They regarded this as a reversionary return of the vessels formerly occurring in the genus. They considered the absence of perforations in these elements as merely a technical distinction between vessels and tracheids. According to Mohl's (*37*) definition of a vessel, this was a major oversight on their part.

This work of Jeffrey and Cole spurred Thompson and Bailey (*46*, p. 510) to re-investigate the situation and their findings are as quoted here: "The scalariform tracheary elements that occur in injured roots of *Drimys coloratura* are not vessel-like in structure. They are typical tracheids, having transitional pitting, such as occur in many Pteridophyta, Gymnospermae, and Angiospermae. They occur in uninjured stems and roots of *Tetracentron*, *Trochodendron*, and *Drimys*, a point which Jeffrey and Cole did not mention. True vessels do not occur in the xylem of these genera and there appears to be no physiological or ecological evidence for supposing that these are degenerate Dicotyledons whose ancestors possessed true vessels in the secondary wood."

Wieland (*50*, *51*) has shown that scalariform pitting tends to predominate in the "cauline centrifugal xylem" of many of the Mesozoic Cycadeoideae. These transversely elongated pits often tend, on the one hand, to break up into smaller bordered pits of opposite or alternate arrangement, or, on the other hand, to contract into a single row of oblong, oval, or nearly circular bordered pits. Brown (*6*), on examining perfectly preserved specimens of *Cycadeoidea Dartoni* placed before him by Wieland, confirmed the presence of this scalariform pitting on the end and side walls of the tracheids. These reminded him at once of *Magnolia*. He says: "The evidence in support of the hypothesis that scalariform pitting is primitive is convincing. It is evident that the process of the breaking up of these pits into circular ones was in progress in the antecedent Cycads." He therefore agrees with Thompson and Bailey and disagrees with the theory of Jeffrey and Cole and Bliss (*5*) that scalariform pitting is the result of the fusion of circular pits. The recent investigations of Frost (*26*, *27*) substantiate the conclusions of Thompson and Bailey and of Brown. The latter attributes the discarding of the scalariform mode of pitting on the side walls to the fact that these pits lose their alignment because of the fact that they are in contact with a variety of cells differing in size and shape. Circular pitting is more adaptable under these circumstances and has thus come to prevail.

The primitive morphological features of this order, as described by Hutchinson (*35*) and others, are matched by many characteristics of the xylem. This study substantiates the fact that the following vessel characteristics, which Frost (*26*, *27*) indicates as primitive, are possessed by *Magnolia*, and, to a greater or less degree, by the other members of the order: great length; small diameter; polygonal outline; profusion; scalariform perforations with many bars, and the openings between the bars bordered at the ends, to the middle, or completely; highly inclined perforation plate; scalariform pitting; and walls uniformly thin. In addition, the fibers are long to extremely long and possess bordered pits, and the members of Winteraceae and Trochodendraceae possess considerable diffuse parenchyma.

For this investigation, wood of 16 species of *Magnolia*, 10 of *Talauma*, 9 of *Michelia*, and several specimens of each of the remaining polytypic genera, as well as of the monotypic genera, were available. No specimens were available for the three possible sub-genera (*Wintera*, *Belliolum*, *Bubbia*) of

Drimys, which are generally conceived to be synonymous with the latter and are so classified in Index Kewensis; the possible sub-genus *Exospermum*, which is listed in Index Kewensis as synonymous with *Zygogynum;* the two new monotypic genera (*Alcimandra* and *Pachylarnax*), recently proposed by Dandy (*11*); or his new *Kmeria*, which contains but two species. In most cases several specimens (often from different sources and localities) of each species were at hand. The writer considers the material representative enough to justify his conclusions.

Small sample blocks of what was considered to be an average for the specimen were treated in the usual manner of softening by means of hydrofluoric acid. Cross, radial, and tangential sections, about 15μ thick, were made from each block and mounted unstained in glycerine jelly. The macerated material, which was prepared with Schultze's solution, was also mounted in glycerine jelly. This medium has an index of refraction of 1.44 and when used on unstained material is frequently superior to stained sections for observing such minute details as the pitting of fibers or vessels, as well as for the broader details of outline. Added to the above feature is the facility with which material may be prepared with this medium, the rapidity with which it dries, and its permanence even when the mount is left uncemented.

The writer agrees with Desch (*20*) that "unqualified numerical values for the dimensions of wood elements are practically worthless and may be misleading," and that "where the sampling justified it, statistical methods provide a means of assessing significance." Where these values are merely used to supplement other features in the separation of two woods, statistical methods are not necessary or justifiable. In the latter case, the random measurements of 50 vessels, fibers, or the like, will give a clear idea of the predominant sizes of the element for the specimens, though more may be necessary where the range within the sample is wide. These measurements can be readily made and will be sufficient to determine the diagnostic importance of the matter of size for the case in question. This method, which has been given support by Chattaway (*7*), has been followed in this study, the 25 largest and the 25 smallest elements being measured in each case; Miss Chattaway's proposed terminology has also been used. The vessel members were measured from the top of one perforation to the bottom of the other. This distance is fairly constant, much more so than the total lengths, for the latter vary with the lengths of the tails that often are present.

Descriptions of the Trees and Woods

Magnoliaceae

The most recent work on the botanical classification of this family has been that of Dandy (*10–14*), who has had available for his studies type specimens of nearly all the species and a wealth of additional material. As a result of this critical analysis, he says: "I have come to the conclusion that much of the confusion which for a long time has existed in this group is due to the various interpretations of the limits of the genera. If the very distinct genus *Liriodendron* be left out of consideration—and, in my opinion, it should be set aside as the tribe Liriodendreae,[5] the remainder of the family, forming the true Magnolieae, is an extremely natural group, about the number of whose constituent genera there has never been any uniformity of opinion" (*24*, p. 257). In further discussing the Magnoliaceae he adds to the six genera previously recognized four new ones, *Kmeria*, *Pachylarnax*, *Alcimandra* and *Elmerrillia*.

According to this classification the family consists of ten genera and about 150 species. It is widely represented in North Temperate America, The West Indies, Brazil, and East Asia. Fossil species indicate that in Cretaceous and Tertiary times the area of distribution extended entirely across the north temperate zone, as far north as Greenland and Spitzbergen, and also included Australia. The present anomalous distribution of *Liriodendron* is explained by the existence of closely related fossil species in the Tertiary beds of Europe and Greenland.

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[5] Reichb. Handb.: 278 (1837). Spach. hist. Nat. Veg. Phan. 7: 486 (1839), also segregated this as Liriodendreae.

The family is composed entirely of trees or erect shrubs, with leaves alternate, simple, entire (lobed in *Liriodendron*); stipules large, deciduous, enclosing the young buds; flowers large, solitary, terminal or axillary, perfect; sepals and petals often similar, in several series, imbricate; stamens numerous; hypogynous, free; anthers long, 2-celled, opening lengthwise; pollination by insects; carpels numerous, 1-celled, spirally arranged on an often elongated axis, rarely consolidated in fruit; ovules 2 or more; fruit dry or succulent, opening by abaxial suture; seeds large; endosperm abundant, oily; embryo very small.

The woods of this family are moderately soft, rather fine-textured, generally straight-grained, easy to work, and thus well suited for interior woodwork and general carpentry. The sapwood is often white, while the heartwood is usually yellow to brown, sometimes greenish yellow to purplish.

The growth rings are sometimes indeterminable, because the wood parenchyma bands, which appear to terminate the seasonal growth in the temperate zone species, often lie close together in small complexes in the tropical species. Sometimes one of these bands ends blindly, again one may diverge into two or more layers. The bands are 1–10 cells wide radially and on cross-section the cells are arranged in radial rows which usually correspond to those of the fibers. Occasionally, single fibers are interspersed between the cells of these bands. The medullary rays are moderately numerous, moderately high and broad, heterogeneous.

The vessels are small to rather large, moderately to very numerous, solitary or in radial lines (or groups), fairly uniform in distribution. Vessel perforations are scalariform (rarely simple), with very few to numerous bars. The pits into the vessels are almost without border when adjacent to fibers; elongated (at right angles to the vessel axis); in a vertical row when adjacent to the wood parenchyma; often greatly elongated and with unilateral pit complex when adjacent to ray parenchyma; pit pairs half-bordered. The intervascular pitting is transitional to scalariform, rarely opposite.

Libriform fibers, usually in radial rows, comprise the ground mass of the wood. They are short to very long, slender, tapering gradually to a point, and having circular bordered pits with slit-like apertures.

Magnolia L.

The genus *Magnolia*, containing about 70 species of deciduous or evergreen trees or shrubs, is widely represented in temperate North America, temperate and tropical East Asia, and Japan. Fossil remains indicate clearly that the genus once occupied a very extensive range.

Leaves alternate, entire; stipules enveloping the bud and leaving conspicuous, encircling scars at each node; flowers solitary, terminal, appearing before or with the leaves; sepals 3, sometimes petal-like, deciduous; petals 6–18; stamens and pistils numerous, crowded on the receptacle, the stamens hypogynous; carpels dehiscent, opening on the back and exposing the seeds; seeds usually scarlet and suspended by slender, thread-like, stretching filaments; testa with outer wall fleshy and inner wall hard, bony, flattened, and more or less grooved; endosperm copious; embryo minute.

The Magnolias, with their large white, pink, or purple flowers and handsome foliage, are highly decorative and are accordingly much in demand for ornamental purposes. Several showy Oriental species, with flowers appearing before the leaves, have been introduced into general cultivation in Europe and America. Essential oils for perfumes are derived from several species, and decoctions of the flowers or seeds of many species are claimed to have medicinal properties. The general properties of the wood are similar to those described for the family.

Minute anatomy.—*Pores* very numerous, 50–150 per sq. mm., small, polygonal. *Vessel members* short to long; perforations scalariform, bars 1–20, or rarely simple; intervascular pitting scalariform to transitional, rarely opposite; vessel-ray pits horizontally elongated, unilaterally compound. *Fibers* short to long; pit borders small, circular; pit aperture oblique, slit-like, exceeding border outlines. *Parenchyma* in terminal lines 1–8 cells wide. *Rays* moderately high and moderately broad, heterogeneous, the multiseriate ones with 1–several marginal rows of upright cells; cell contents usually a brownish gum; oil cells absent or rare.

Michelia L.

This genus, containing about 30 species, confined to tem-

perate and tropical East Asia and Japan, is composed entirely of trees and shrubs.

The flowers are solitary, axillary or terminal; sepals and petals similar, 9–15 or more, 3 or more seriate; stamens as in *Magnolia;* gynophore stalked; carpels in a loose spike; stigma decurrent; ovules 2 or more; fruit a loose or dense elongate spike of coriaceous, dorsally dehiscing carpels; seeds as in *Magnolia*. The general properties and minute anatomy are similar to those of *Magnolia*.

Minute anatomy.—Pores moderately numerous to numerous, less than 40 per sq. mm.; moderate-sized to rather large (less than 250μ in diameter); round to oval. *Vessel members* long to very long; perforations always scalariform, bars very few, less than 8. *Fibers* very long, to 2.4 mm. *Parenchyma* similar to *Magnolia*. *Rays* rarely without oil cells dispersed among the upright marginal cells.

Elmerrillia Dandy

Trees with leaves entire; petioles unscarred; stipules free from the petiole; flowers solitary or in clusters of 2–3, perfect; bud enclosed in 2 bracts; peduncles elongated, slender. Sepals 9–15, sub-similar, the smaller ones inside, narrow at the base; stamens numerous, recurved; filaments short, anthers linear, introrse, dehiscent; connective drawn out into a short appendage; gynaecium sessile, subcylindrical; carpels numerous, crowded; ovules 2 or 4; fruit subcylindrical, with mature carpels free, coriaceous, dehiscent on the dorsal suture, or sub-oblong, with mature carpels concrescent, fleshy, indehiscent; seeds 1–4, free, completely arillate, suspended in a thread-like strand.

Minute anatomy.—Pores moderately few, 6–15 per sq. mm.; solitary or in radial lines of 2–6; radial diameter to 200μ; walls 2–5μ thick. *Vessel members* 0.6–1.1 mm. long; perforations scalariform, with 1–6 bars; intervascular pitting scalariform or sometimes transitional; spirals absent. *Fibers* up to 2.45 mm. long; walls 2–5μ thick; pit borders 3–6μ across. *Parenchyma* in terminal lines 2–5 cells wide; cell walls smooth. *Rays* up to 28 cells (850μ) high and 1–3 (mostly 2) cells wide (max. 56μ); oil cells average 150μ in diam.

No features were found to distinguish this genus from *Michelia*.

Talauma Juss.

A genus of about 50 known species, occurring generally throughout the tropics, exclusive of Africa. Mostly medium-sized trees or shrubs; occasionally attaining large dimensions.

Leaves and inflorescence of *Magnolia;* flowers usually large, white; sepals 3; petals 6 or more, in 2 or more whorls; stamens very numerous, in many whorls; anthers linear, introrse; gynophore sessile; ovaries indefinite, 2-ovuled, spiked or capitate; stigmas decurrent; carpels woody, separating from the woody axis at the ventral suture, and dehiscing so that the seeds are suspended from the central axis by elastic cords; seeds of *Magnolia*.

Minute anatomy.—Pores moderately numerous to numerous (10–40 per sq. mm.); solitary or in radial lines; moderate-sized to rather large (less than 250μ in diameter); round to oval. *Vessel members* very long; perforations always scalariform, bars very few to fairly numerous (max. 25). *Fibers* very long, max. 2.7 mm. *Parenchyma* in terminal lines, 2–13 (mostly 3–8) cells wide. *Rays* rarely without oil cells dispersed among the upright marginal cells.

The wood is otherwise similar to *Michelia*.

Aromadendron Blume

A genus of three species, confined to Java and the Malay Peninsula. It was referred by Miquel (Ann. Mus. Bot. Ludg.-Batav. 4: 70, 1880), Bentham and Hooker, and later by Prantl, to *Talauma*, but revived as a genus by Ridley (*42*), because of its numerous narrow petals (resembling those of *Michelia*), free stipules, elongated peduncle, long connective-appendage, and indehiscent, fleshy, connate, fruiting carpels.

Leaves lanceolate, coriaceous, small, finely reticulated, elliptic-acuminate at each end. Flowers solitary, large, terminal, white, fragrant. Sepals lanceolate, glabrous, narrow-acuminate. Petals numerous, narrow, linear-acuminate, white. Stamens numerous, half as long as the petals; carpels connate in a short cone; fruit 3" long, obovoid, rounded at the apex and base, pulpy, indehiscent, smooth, green outside, white inside; seeds pink.

Minute anatomy.—Pores 6–9 per sq. mm.; solitary or in radial lines of 2–4; walls average 3μ thick; diameter to 185μ. *Vessel members* up to 1.1 mm. long; fine spirals present or absent; perforations scalariform, with 3–10 or more bars; intervascular pitting scalariform. *Fibers* up to 2.5 mm. long and 48μ wide; walls 3–5μ thick; middle lamella much thickened at the corners, distinct; pit borders round, 4–6μ in diam-

eter; pit apertures oblique, slit-like, slightly exceeding borders. *Parenchyma* in terminal lines 2–8 cells wide; cell walls smooth. *Rays* up to 40 cells (1.5 mm.) high and 1–3 cells (up to 95μ) wide; with 1 or 2 marginal rows of upright cells; pits to vessels large, radially elongated, unilaterally compound; cell contents, brownish gum; few to numerous large oil cells (av. diam. 90μ) present.

Manglietia Blume

A genus of about 10 species, inhabiting the mountains of tropical Asia, comprising trees or shrubs with the foliage and inflorescence of *Magnolia*.

Sepals 3; petals 6 or more, 2- or more seriate; stamens very numerous, many-seriate; anthers linear, adnate, introrse; gynophore sessile; ovaries many, cohering in an ovoid head; stigma decurrent on the ventral suture; ovules 6 or more; fruit ovoid; carpels persistent, dehiscing dorsally; seeds as in *Magnolia*.

Minute anatomy.—Pores moderately few, 10 per sq. mm.; solitary or in radial lines of 2–6; walls 3μ thick; average diameter 135μ. *Vessel members* up to 1 mm. long; perforations scalariform, with 2–10 bars; intervascular pitting transitional; vessel-ray pitting unilaterally compound; no spirals or tyloses observed. *Fibers* up to 2.7 mm. long and 68μ wide; walls 3–4μ thick; middle lamella thickened at corners, distinct; pit borders round, 5–7μ in diameter; pit apertures oblique, slit-like, slightly exceeding borders. *Parenchyma* in terminal lines, 2–5 (3–4) cells wide; cell walls smooth. *Rays* up to 30 cells (1 mm.) high and 1–3 cells (up to 65μ) wide; upright cells in 1–4 (mostly 1 or 2) rows; pits to vessels long, narrow; no oil cells observed; contents, a brownish gum.

There is some uncertainty concerning the authenticity of the available wood specimens of this genus.

Liriodendron L.

There are but two species in this genus, one North American, the other Chinese. Both attain large dimensions.

Leaves deciduous, alternate, long-stalked, 2–6 lobed, nearly truncate or notched at the apex, never pointed; stipules enclosing the leaf in bud; twig encircled by a scar at each node; flowers solitary, terminal; sepals 2; petals 6; stamens numerous, surrounding the numerous pistils, imbricated in a cone-like axis; anthers linear, extrorse; carpels 1-celled, 2-ovuled, becoming dry, indehiscent and winged, gradually falling away from the central axis on maturity, outer scales persistent for some time; fruit erect, cone-like.

Minute anatomy.—Pores extremely small to small, tangential diameter 30–90μ; polygonal; numerous, 60–100 per sq. mm.; solitary or in radial groups of 2–5; walls 2μ thick. *Vessel members* short to very long (340–970μ); perforations scalariform, bars very few to few, 2–10; intervascular pitting opposite; vessel-ray pitting unilaterally compound; spirals absent; tyloses thin-walled. *Fibers* in radial rows, comprising ground mass of wood; fairly long to very long (up to 2.7 mm.); walls fairly thick (5–7μ), diameter up to 50μ; pit borders circular, 2μ or less in diam.; apertures slit-like, oblique, exceeding borders; middle lamella slightly thickened at the corners. *Parenchyma* in terminal lines 1–5 cells wide; tangential cell walls up to 21μ thick, deeply and irregularly pitted. *Rays* heterogeneous; uniseriate rays few, 1–6 cells (40–250μ) high, all cells upright; multi-seriate rays to 4 cells (60μ) wide and 6–33 cells high (160–860μ), with 1 (rarely 2 or 3) marginal row of upright cells; pits to vessels fairly large, simple; cell contents often a brownish gum; oil cells absent.

Schizandraceae

A very small and ancient family, comprising two genera, probably derived from Magnoliaceae but evidently a reduced type which, together with the separation of the sexes, has adopted a climbing habit; found throughout north tropical and subtropical regions, with the exception of Africa.

Leaves simple, alternate, often pellucid-dotted; stipules absent; nodes unilacunar; flowers unisexual, small, solitary, axillary; sepals and petals 9–15, scarcely distinguishable from one another, the inner gradually petaloid, imbricate; stamens numerous, short, partially or wholly united into a fleshy, globose mass; anthers small, 2-celled; carpels numerous, with 2–3 ovules, in fruit either spread on the much elongated axis or crowded into a fleshy mass; fruit baccate; seeds immerse in the fleshy pulp; endosperm oily, copious; embryo small.

Schizandra Michx.

A genus of about 6 species of glabrous or glabrate vines or

climbing shrubs occurring in India, Java, China, and North America.

Leaves deciduous, alternate, exstipulate, blades membraneous, entire or toothed, long-petioled, punctate; flowers monoecious, white, yellow, or crimson, solitary on axillary peduncles; sepals 5–6, imbricate in 2 series, petaloid, with scarious edges, the outer smaller, deciduous; petals narrower and thickened at the base, 5–6, imbricate in 1–2 series, deciduous; stamens 5, filaments very short, flat, united into a broad disk; anthers rather introrse; sacs widely separated; carpels distinct, imbricate in several series on an elongated receptacle; styles very short; ovules 2 in each cavity, pendulous; fruit a spike of berries on a much elongated receptacle; seeds 2 in each berry, reniform, with crustaceous testa.

Minute anatomy.—Pores very numerous, 62 per sq. mm.; solitary, round to oval, diameter up to 350μ; walls 2–3μ thick. *Vessel members* very short to short (170–520μ); perforations scalariform with 1–15 bars; intervascular pitting scalariform; spirals fairly distinct; pits to ray cells unilaterally compound; tyloses present. *Fibers* very short, less than 1 mm. long; walls 4–6μ thick; middle lamella slightly to noticeably thickened at corners; pit borders round, 6μ in diameter; pit apertures oblique. *Parenchyma* in terminal lines 1–3 cells wide; cell walls fairly smooth. *Rays* up to 30 cells (1 mm.) high and 1–3 cells (up to 90μ) wide; upright cells in 1–7 marginal rows; cell contents brownish; oil cells few (av. 100μ in diam.).

Kadsura Kaempfer

A genus of about 20 species of climbing, glabrous shrubs in temperate and subtropical Asia.

Leaves exstipulate. Flowers unisexual, white, yellow, or reddish, axillary, or in the axis of scales near the base of short, lateral, leafy branches. Sepals and petals 9–12, imbricate in about 3 series. Stamens 5–15 or more, in a spiral series; filaments very short, free, and subconnate, often fleshy; anthers free or sub-immerse in a fleshy head of confluent filaments; cells small, remote. Ovaries many, densely imbricated; stigma sessile; ovules 2–4. Fruit a globose head of indehiscent, fleshy, 1-seeded carpels. Seeds 1 or 2, suspended, albumen fleshy, testa crustaceous; embryo minute.

Minute anatomy.—Pores moderately numerous, 1–15 per sq. mm. *Vessel members* with perforations simple or scalariform with 1–7 bars; intervascular pitting opposite. *Fibers* short to long, to 1.7 mm.; pit borders 9μ in diameter.

Otherwise similar to *Schizandra*.

Winteraceae

A family of two genera (excluding *Illicium*) and possibly four subgenera, occurring in the Malay Archipelago to eastern Australia, New Caledonia, New Zealand, and Central and South America.

Trees or shrubs with exstipulate, alternate or rarely subverticillate, aromatic, pellucid-punctate, evergreen leaves; flowers rather small, in axillary or terminal fascicles or umbellate cymes, of various colors; floral axis very short, with the floral parts arranged more or less in whorls; perianth double; sepals 2–6, united and rupturing valvately; petals in 2–several series, imbricate, often conspicuous in the bud; stamens several, in 1 or several series, hypogynous; anthers introrse; carpels in a single whorl or rarely sub-biseriate, 1–many, free or rarely united, 1–many-ovuled; stigma sessile; fruit baccate; seeds with copious endosperm and minute embryo.

Wood moderately hard and heavy, straight-grained, fine-textured; vessels absent; growth rings indistinct; parenchyma diffuse, sometimes terminal; rays moderately high and very broad.

Drimys Forst.

A genus of about 35 species of shrubs and evergreen trees, occurring from the Malay Archipelago to East Australia, in New Caledonia, and Central and South America.

Leaves pellucid-dotted; peduncles 1–many-flowered, axillary at the base, though at first seemingly terminal; flowers perfect or polygamo-dioecious; sepals 2–3, membraneous, united into a globose calyx, irregularly split when open, deciduous; petals 6–numerous, in 2–numerous imbricate series; stamens with thick filaments; anther cells wide, parallel or divergent; carpels sometimes numerous, erect in a simple (or subduplicate) series, sometimes few; ovules many; fruit baccate, indehiscent; testa crustaceous, glistening.

Minute anatomy.—Vessels absent. *Tracheids* extremely long, up to 5.1 mm.; diameter up to 48μ; walls 7–8μ thick; pit borders round, 9–12μ in diameter; pit apertures oblique, slit-like, or lenticular, included; pits arranged in vertical rows of 2–3, rarely 4, very numerous at the ends, chiefly on the radial walls. *Parenchyma* diffuse and very scarce. *Rays* uniseriate, composed almost entirely of upright cells, and multiseriate,

up to 110 cells (5.1 mm.) high and up to 10 cells (195μ) wide, with 1–6 marginal rows of upright cells; cell contents light brown; no oil cells observed.

Zygogynum Baill.

This genus of 6 species, all native to New Caledonia, differs from *Drimys* in having the carpels more or less united, especially in the fruit.

Minute anatomy.—Vessels absent. *Tracheids* extremely long, up to 6.3 mm.; width up to 90μ; walls average 9μ thick; pit borders round, diameter 2–12μ; apertures oblique, lenticular, included; pits arranged in 1–2 vertical rows. *Parenchyma* diffuse and also in continuous terminal lines 1–4 (mostly 1 or 2) cells wide; cell walls smooth. *Rays* up to 90 cells (5.3 mm.) high and up to 8 cells (300μ) wide; pits rather few, round, 3μ in diameter, irregularly arranged; marginal rows of upright cells 1–20; cell contents light to very dark brown; oil cells marginal and interspersed, av. 140μ in diam.; their contents light greenish-yellow.

Illicium L.

A genus of about 20 species of evergreen aromatic shrubs or small trees in Indo-Malaya, China, Japan, and Florida. It is included in the Winteraceae by Hutchinson (*35*), but the present writer considers it out of place there.

Leaves leathery, entire, pellucid-dotted, exstipulate; nodes unilacunar; flowers perfect, solitary or fascicled, on axillary peduncles; sepals 3–6 petaloid, membraneous, imbricated in 2 series, deciduous; petals numerous, 3–many-seriate, inner petals gradually narrower, deciduous; stamens numerous, in several series; filaments thick; anthers adnate, introrse; carpels numerous, 1-ovuled; style recurved; fruit a whorl of hard, crustaceous, drupe-like follicles, finally dehiscent; seed solitary, compressed, with hard, shining testa; fleshy albumen and minute embryo.

Minute anatomy.—Pores extremely numerous, 160 per sq. mm.; solitary; polygonal; small, radial diameter up to 45μ. *Vessel members* extremely long, up to 1.3 mm.; slender with very oblique end walls; walls 2μ thick; perforations scalariform, with 30–150, often anastomosing bars; intervascular pitting opposite to transitional; vessel-ray pitting unilaterally

compound; spirals not observed; tyloses thin-walled. *Fibers* up to 2.21 mm. long; 70μ (average 30μ) diam.; walls thick, average 5μ in early wood and 7μ in late wood; pit borders 9μ in diameter; pit apertures oblique, slit-like to lenticular, exceeding borders, pits in an irregular, vertical row. *Parenchyma* diffuse, as single strands, also in broken, uniseriate, terminal lines; cell walls smooth; cells contain a brownish gum. *Rays* up to 25 cells (1 mm.) high and width 1–2, rarely 3, cells (up to 60μ) wide, with 1–6 marginal rows of upright cells; among which are some large, round to oval cells that apparently are not oil cells; cells contain a brownish gum.

Trochodendraceae

This family, according to Hutchinson (*35*), consists of two genera, *Trochodendron* and *Euptelea*, but the present writer agrees with Van Tieghem (*47*) in making the latter genus the type of a new family Eupteleaceae. *Tetracentron* has also been referred to the Trochodendraceae and will be considered in this connection, although the writer believes that it should be made the type of a monotypic family.

Trochodendron Sieb. & Zucc.

This oriental genus consists of a single species, *Trochodendron aralioides* Jungh, an evergreen tree attaining a height of 50 feet, occurring in eastern continental Asia, Japan, and Formosa.

Leaves alternate, evergreen, whorled, long-petiolate, serrate, with deciduous sheaths; nodes multilacunar; flowers perfect, shortly racemose from the perulate buds, rather small, with deciduous bracts; perianth absent; stamens numerous, hypogynous on the expanded torus; anthers short, linear, extrorse, on slender filaments; carpels 6–10, erect in a subsimple series, connate; ovules numerous, pendulous; fruit dehiscent; seeds with copious endosperm and minute embryo. The wood is similar to that of *Drimys* in that it possesses no vessels and has very broad rays.

Minute anatomy.—Vessels and *vascular tracheids* absent. *Tracheids* extremely long, up to 4 mm. or slightly more; width up to 50μ; square in cross section in early wood, radially flattened in late wood; walls 2μ thick in early wood, 6μ thick in late wood; pitting scalariform in early wood; pits in late

wood with lenticular, oblique apertures exceeding the circular borders which are 6μ in diameter. *Parenchyma* in numerous interrupted, irregular, uniseriate lines in the late wood; tangential walls with slight tendency to unevenness similar to those of *Liriodendron;* cells contain much brownish gum. *Rays* uniseriate, up to 15 cells high, and multiseriate, up to 10 cells wide (240μ) and 58 cells (1.85 mm.) high with 1–10 marginal rows of upright cells; cells contain much brownish gum; no oil cells observed.

Tetracentron Oliver

A genus of one species of Chinese trees superficially resembling *Cercidiphyllum* in habit and foliage and in the presence of the short, lateral spurs, but differing from it by the alternate leaves, the spiked inflorescence, and the 4-lobed, 4-spurred fruit. There is much difference of opinion among botanists as to the proper classification of this genus.

Leaves deciduous, alternate, ovate-elliptic, short acuminate, obtuse or subcordate at the base, glandular-serrate, palmately 5–7 veined, petiolate, without stipules. Inflorescence a many-flowered spike, produced with a single leaf on the end of a short, lateral spur. Flowers apetalous, perfect, small, yellowish, sessile with 4-lobed perianth; stamens 4, opposite perianth lobes and alternate with the carpels. Carpels 4, connate on the inner edge; styles 4, at first slightly recurved, then lateral, and, by the very oblique growth of the ovary, finally basal; ovules usually 4, pendulous. Fruit a deeply lobed capsule, depressed at the apex, with the 4 styles persistent as short, claw-like spurs at the base, loculicidally dehiscent, many on a pendulous spike.

Minute anatomy.—Vessels absent. *Vascular tracheids* (the "short tracheids" of Thompson and Bailey [*34*]) occurring occasionally in single or double radial rows of indeterminate length; are of the same shape (square or rectangular) in cross section as the other (fiber) tracheids but usually are considerably larger; abundantly pitted on all sides with round or oval, bordered pits and lenticular, included apertures; much shorter than other tracheids, 0.18–1.28 mm. (av. 0.47 mm.), and a vertical series of them resembles a vessel except for absence of perforations; walls of contact usually steeply inclined. *Tracheids* composing ground mass of wood extremely long, up to 4.5 mm., and up to 60μ square in cross section, gradually be-

coming smaller and radially flattened toward the late wood; pits apparently confined to radial walls, those between early wood tracheids being linear and arranged to resemble very long scalariform perforations (2–4 groups per tracheid), those in late wood with slit-like apertures exceeding the borders, which are 6μ in diam. *Parenchyma*, in late wood only, diffuse and in interrupted, irregular, uniseriate lines; tangential walls smooth; cell contents brownish. *Rays* heterogeneous and of two sizes: (a) uniseriate and up to 40 cells (1.2 mm.) high and (b) multiseriate 2–4 cells (up to 60μ) wide in median portion and up to 50 cells (1.5 mm.) high, with 1–20 marginal rows of upright cells; pits to fiber-tracheids numerous, small, circular to oblong, tending to scalariform arrangement in early wood; cell contents brownish.

Eupteleaceae

This family, as proposed by Van Tieghem (*47*), includes the single genus *Euptelea*, with 1 Japanese and 2 Chinese species of graceful, ornamental, small trees or shrubs.

Euptelea Sieb. & Zucc.

Leaves deciduous, alternate, simple, dentate, slender-petioled, exstipulate; nodes unilacunar; flowers in axillary clusters on branches of last year's growth, perfect and proterandrous; perianth absent; stamens indefinite; anthers large, red, linear; filaments short, slender; carpels many, on oblique, short stalks; fruit small, obliquely winged nutlet on a slender stalk, 1–4-ovuled; endosperm copious; embryo minute.

Minute anatomy.—Pores extremely numerous, 120–250 per sq. mm.; solitary; of small diameter, up to 85μ. *Vessel members* long, up to 1 mm.; perforations scalariform with 20–90 bars; intervascular pitting opposite to transitional, rarely alternate or scalariform; vessel-ray pitting unilaterally compound; spirals not observed; tyloses very thin-walled. *Fibers* up to 1.8 mm. long and 45μ wide; walls 6μ thick; pit borders circular, minute (2μ in diameter); pit apertures oblique, slit-like, much exceeding borders. *Parenchyma* in terminal lines 1 or 2 cells wide; cell walls smooth. *Rays* up to 192 cells (3.2 mm.) high, 8 cells (120μ) wide, with 1–6 marginal

rows of upright cells; no oil cells observed; cells contain a dense brownish gum.

Cercidiphyllaceae

This monotypic family, which is native to China and Japan, seems to the writer to be more closely allied to the Hamamelidales than to the Magnoliales.

Cercidiphyllum Sieb. & Zucc.

A genus of one species of trees, for a long time known only from Japan.

Leaves deciduous, opposite or alternate; nodes trilacunar; stipules adnate to the petiole, deciduous; flower dioecious, axillary, solitary or fascicled, female pedicellate; sepals 4, small; petals absent; stamens numerous; carpels 3–6, slightly stipitate; ovules in two rows, descending, anatropous; fruit a cluster of follicles dehiscent along the ventral suture; endocarp woody and shining within; seeds compressed, nearly square, winged at one end; endosperm copious; embryo medium-sized; cotyledons flat.

Minute anatomy.—Pores extremely numerous, 135 per sq. mm.; solitary, small, less than 100μ in diameter; walls 3μ thick. *Vessel members* extremely long, up to 1.6 mm.; extensions or tips with coarse spirals; perforations scalariform, with 20–50 bars; intervascular pitting opposite to transitional; vessel-ray pitting unilaterally compound; tyloses present. *Fibers* up to 2.7 mm. long and 48μ in diam.; walls 4–6μ thick; pit borders round, 6μ in diameter; pit apertures oblique, slit-like or lenticular, included. *Parenchyma* diffuse and also in interrupted, irregular, uniseriate, terminal lines; cell walls fairly smooth. *Rays* up to 35 cells (135μ) high and 1–2 cells (to 27μ) wide; with 1 or 2 marginal rows of upright cells; cells contain a brownish gum and occasionally calcium oxalate crystals.

Himantandraceae

This family consists of one genus, indigenous to northeastern Australia, New Guinea, and the Molucca Islands. Hutchinson (*35*) calls it "a small and curious *relic*, with petaloid stamens; remarkable in the order in having peltate scaly indumentum."

Himantandra F. v. Mueller

A genus of two known species of aromatic trees.

Leaves alternate, entire, penninerved; stipules absent, nodes unilacunar; flowers hermaphrodite, solitary or paired on short axillary branches, at first involucrate by two calyptriform, leathery, deciduous sepals; inner sepals the one within the other; petals about 7, lanceolate, very similar in size and shape to the numerous (about 40) stamens which have the anther-cells separated on each side towards the base, opening lengthwise; staminoides several, subulate; carpels 7–9, contiguous, free except at the base; ovule solitary in each, pendulous from the apex, anatropous; fruit globose, gall-like, fleshy, 7–10-celled by the coalescence of the carpels; seed pendulous, with oily endosperm and small embryo.

Minute anatomy.—Pores very few to few, less than 6 per sq. mm.; solitary or in radial pairs or threes; radial diameter up to 180μ. *Vessel members* very long, up to 1.1 mm.; perforations simple; intervascular pitting alternate, the pits small and crowded; spirals very indistinct. *Fibers* up to 2 mm.; diameter up to 60μ; walls 4–6μ thick; pits scattered or in 1–2 rather irregular vertical lines; pit border round, 3μ in diameter; pit aperture oblique, slit-like, exceeding borders. *Parenchyma* in concentric bands 2–20 (mostly 4–8) cells wide, about 0.6 mm. apart; cell walls smooth; cells contain brownish gum. *Rays* up to 41 cells (1.4 mm.) high and 1–4 (mostly 2 or 3) cells (up to 96μ) wide; marginal rows of upright cells 1, rarely 2; cells contain brownish gum; no oil cells observed; intercellular spaces frequent.

From a study of the wood, this genus and family would be more appropriately placed with the Anonales.

Lactoridaceae

Hutchinson (*35*) characterizes the Lactoridaceae as "a monotypic family closely related to the Winteraceae, of which it is probably a reduced derivative." It has also been referred to the Piperaceae (*4*).

Lactoris Phil.

This genus consists of a single species of shrubs indigenous to Juan Fernandez Island.

Leaves alternate, small, obovate, emarginate, entire, with numerous, minute, pellucid dots; nodes trilacunar; stipules large, interpetiolar, membraneous; flowers polygamo-monoecious, small, solitary or up to 3, axillary; sepals 3; petals absent; stamens 6, in 2 whorls; anthers short, extrorse, 2-celled; carpels 3, free; stigma beak-like; ovules 6 in each carpel, in 2 vertical series on the intruded placentae; fruit follicular, beaked; seeds 4–6; endosperm copious, oily; embryo minute.

Minute anatomy.—Pores moderately few to moderately numerous, up to 18 per sq. mm.; solitary, or arranged in radial rows or fans; small, less than 100μ in diameter. *Vessel members* very short, less than 300μ in length; perforations simple; intervascular pits small, alternately arranged; no spirals or tyloses observed. *Fibers* extremely short, up to 0.5 mm.; diameter up to 45μ; walls 3μ thick; pits very small, bordered, numerous, irregularly arranged. *Parenchyma* diffuse. *Rays* extremely high and as broad as the intervening areas of fibers and pores on cross section; composed entirely of upright cells.

The only material available for study was a slide of cross sections of 1-year-old stems, which Professor I. W. Bailey kindly loaned for observation, and two small pieces of 1-year-old twigs secured from the Gray Herbarium and the New York Botanical Garden.

ARTIFICIAL KEY TO THE GENERA, BASED UPON THE ANATOMY OF THE WOODS

1 a. Vessels present, diffuse, moderately few to very numerous, usually solitary or in radial lines (or groups) of 2 to 8, very small to rather large; perforations scalariform, rarely simple, with very few to extremely numerous bars; intervascular pitting opposite to scalariform, rarely alternate. Terminal parenchyma 1–20 cells wide, or rarely absent. Rays very low to moderately low and very fine to rather broad (moderately high and broad in *Lactoris*), heterogeneous, with 1–6 marginal rows of upright cells; oil cells often present among the marginal ray cells, rarely interspersed. Fibers very short to very long, up to 2.7 mm.; fiber pits with circular borders and oblique, slit-like apertures 2

b. Vessels absent. Terminal parenchyma rarely present and then usually uniseriate and discontinuous. Rays rather low to moderately high (up to 11 mm., 250 cells) and moderately broad to very broad (up to 300, 10 cells), heterogeneous, with 1 to very many marginal rows of upright cells; oil cells absent, except in *Zygogynum*. Tracheids composing ground mass of wood, very to extremely long, up to 6.8 mm.; pits with circular borders and oblique, slit-like apertures, those of the early wood sometimes horizontally elongated on radial surface and in scalariform arrangement 12

2 a. Vessel perforations rarely simple; bars very few to fairly numerous (less than 25); pores in radial lines (or groups) of 2–8, or solitary. Terminal parenchyma lines more than 2 cells wide, continuous. Oil cells present (in the rays) or absent 3

b. Vessel perforations never simple; bars numerous to very numerous, 25–150; pores solitary. Terminal parenchyma lines uniseriate, interrupted. Oil cells absent. Fibers with very thick walls and narrow lumina 10

3 a. Pores very small to rather large, maximum diameter 250μ. Fiber pit apertures exceeding borders 4

b. Pores rather large to large, maximum diameter 360μ. Fiber pit apertures included 9

4 a. Pores few to numerous, 7–36 per sq. mm., round to oval, moderate to rather large, maximum diameter 250μ 5

b. Pores very numerous, 45–150 per sq. mm., polygonal, very small to small, maximum diameter 135μ 8

5 a. Intervascular pitting alternate; vessel perforations exclusively simple 6

b. Intervascular pitting opposite to scalariform; vessel perforations rarely simple 7

6 a. Rays moderately broad to broad, as wide as the intervening zones of fibers, and moderately high to high, composed entirely of vertically elongated cells. Pores solitary, surrounded by parenchyma. Fibers extremely short (up to 0.5 mm.); pits fairly numerous, in 1 or 2 vertical rows ..... *Lactoris*

b. Rays moderately broad, and low, with only the marginal cells upright. Pores not surrounded by parenchyma, often in radial lines. Fibers short to long (up to 2 mm.); pits numerous, diffusely arranged ..... *Himantandra*

7 a. Vessel perforation bars very few, less than 7 (mostly 2–5). Fibers short to very long, up to 2.4 mm. *Michelia, Elmerrillia, Manglietia insignis*

b. Vessel perforation bars few to 25. Fibers long to very long, up to 2.7 mm ..... *Talauma, Aromadendron, Manglietia glauca*

8 a. Terminal parenchyma cell walls less than 10μ thick in tangential view, inner surface smooth to fairly smooth. Fibers long, up to 2 mm. Intervascular pitting scalariform to transitional, rarely opposite ..... *Magnolia*

b. Terminal parenchyma cell walls up to 21μ thick in tangential view, inner surface very irregular. Fibers very long, up to 2.7 mm. Intervascular pitting opposite ..... *Liriodendron*

9 a. Vessel perforations scalariform, with 1–15 bars. Fibers very short, less than 1 mm.; border of pits 6μ in diameter..... *Schizandra*
b. Vessel perforations both simple and scalariform (sometimes in the same segment), in the latter case with 1–7 bars. Fibers short to long, to 1.7 mm.; border of pits 9μ in diameter..... *Kadsura*

10 a. Rays very low to low, less than 135μ (35 cells), and very fine to moderately broad, less than 90μ (3 cells). Fibers very long, up to 2.7 mm.; borders of pits 3–6μ in diameter; apertures 8–10μ long. 11
b. Rays very high, up to 3.2 mm. (192 cells), and broad, up to 120μ (8 cells). Fibers long, less than 2 mm.; borders of pits 2μ in diameter, apertures up to 15μ. Vessel perforations with 20–90 bars..... *Euptelea*

11 a. Vessel perforations with 30–150 bars. Fiber walls comparatively thick, average 7–8μ; lumina comparatively wide. Rays very low, less than 1 mm. (25 cells), and moderately broad, up to 90μ (3 cells)..... *Illicium*
b. Vessel perforations with 20–50 bars. Fiber walls comparatively thin, average 5μ; lumina comparatively narrow, up to 10μ tangentially. Rays low, up to 1.35 mm. (35 cells), and very fine, up to 27μ (2 cells)..... *Cercidiphyllum*

12 a. Tracheids of early wood scalariformly pitted on radial faces; walls comparatively thin, averaging 4μ. Upright ray cells comparatively low, less than 90μ..... 13
b. Tracheids of both early and late wood with pits having circular borders and oblique, slit-like apertures; walls comparatively thick, averaging 7μ (4μ in *Drimys aromatica*)..... 14

13 a. Rays moderately broad to broad, up to 18μ (3 cells, or more), and very high, up to 4.4 mm. (156 cells), most of the cells upright. Vascular tracheids present. Transition from early to late wood gradual..... *Tetracentron*
b. Rays broad to very broad, up to 240μ (10 cells), and rather high, up to 1.85 mm. (60 cells), with 1–10 marginal rows of upright cells. Vascular tracheids absent. Transition from early to late wood abrupt..... *Trochodendron*

14 a. Terminal parenchyma 1–4 cells wide, continuous. Oil cells interspersed through rays. Tracheids up to 5.3 mm. long..... *Zygogynum*
b. Terminal parenchyma lines uniseriate, interrupted. Oil cells absent from rays. Tracheids up to 6.8 mm. long..... *Drimys*

Conclusions

The order Magnoliales, as proposed by Hutchinson (*34*) represents a heterogeneous grouping. In order to bring about a more natural classification of members of this group, the following changes are suggested:

1. That the monotypic family, Himantandraceae, be transferred to the Anonales.

This transfer is based on several characteristics of the secondary wood common to members of the latter order and not shared by the Magnoliales. These are the very small, crowded, alternately-arranged, intervascular pits; the extremely few pores (less than 6 per square mm.); and the simple vessel perforations (very rare among the Magnoliales). In addition, the tangential parenchyma bands are often very numerous, as characteristic of the Anonales and of rare occurrence in the Magnoliales. The essential morphological feature that has led to the exclusion of this genus from the Anonales by Hutchinson (*35*) and others, is its non-ruminate endosperm. There is a possibility that the latter may be slightly ruminate; in any event, it would bear further investigation. That *Himantandra* lies close to Anonaceae is substantiated by the fact that it was originally placed in that family by Mueller (*38*)—although incorrectly included by him under *Eupomatia*—and that it has been retained in the above family by many investigators.

2. That the monotypic family, Lactoridaceae, be transferred to the Piperales.

This is based on the possession of small, crowded, alternately-arranged intervascular pits; the extremely wide and high medullary rays (as wide as the intervening bands of fibers, on cross section), composed entirely of vertically elongated cells. The vessels, uniformly dispersed in these radial bands of fibers, are usually solitary, surrounded by parenchyma cells, extremely short (less than 300μ), and possessing simple perforations; fibers extremely short (less than .5 mm.), possessing very small, diffusely arranged pits, possessing slit-like apertures that exceed the borders. That *Lactoris* approaches the Piperales in its morphological characteristics is demonstrated by the fact that it was placed among the Piperaceae by Bentham and Hooker (*4*).

3. That *Illicium* be segregated from the Winteraceae and made the type of a monotypic family.

Illicium differs from the other members of Winteraceae, as illustrated by the following comparison:

Illicium	*Drimys* and *Zygogynum*
Peduncle 1-flowered.	Peduncle 1 to many-flowered.
Sepals 3–6, petaloid, imbricate.	Sepals 2–3, membraneous, valvate.
Carpels free, beaked, spreading, compressed laterally and stellately arranged in fruit.	Carpels more or less erect, free, or united.
Styles awl-shaped.	Styles not awl-shaped.
Fruit capsular.	Fruit baccate, indehiscent.
Ovules 1.	Ovules many.
Nodes unilacunar.	Nodes trilacunar.[6]
Wood with vessels.	Wood without vessels.
Fibers with thick walls and narrow lumina, very long (up to 2.5 mm.).	Fibers with thick walls and wide lumina, extremely long (up to about 5 mm.).
Fiber pits with small circular borders and slit-like apertures exceeding borders.	Fiber pits with large circular borders and slit-like, included apertures.
Rays fine (about 60μ) and very low (less than 1 mm.).	Rays very broad (up to 350μ) and moderately high (5 mm.–1 cm.).

4. That *Euptelea* be segregated from Trochodendraceae and made the type of a monotypic family, as suggested by Van Tieghem (*47*).

The basis of this separation may be seen in the following comparison:

Euptelea	*Trochodendron*
Leaves palmately veined, deciduous, without stipules or sheaths.	Leaves penninerved, evergreen, with deciduous sheaths.
Nodes unilacunar.	Nodes multilacunar.
Flowers proterandrous.	Flowers not proterandrous.
Carpels stipitate, not connate.	Carpels not stipitate, connate.
Fruit a small, obliquely winged nutlet on a slender stalk; 1–4 ovuled.	Fruit sub-drupaceous, with fleshy exocarp, inseparable from the carpels; ovules numerous in the small, bivalved, wingless nutlets.
Wood with true vessels.	Wood without true vessels.
Fibers with thick walls and narrow lumina; long (up to 2 mm.).	Fibers with thin walls and wide lumina; extremely long (up to 5 mm.).

[6] Sinnott (*43*) states that almost every family of the dicotyledons has a particular type of nodal structure which is extremely constant; *i.e.*, each family is either entirely unilacunar, trilacunar, or multilacunar.

Fiber pits with minute circular borders and slit-like apertures extending far beyond the border outlines.	Fiber pits in late wood similar to those of *Drimys;* in the early wood the pitting is scalariform on radial face.
No apparent transition between early and late wood.	Abrupt transition between early and late wood.
Wood parenchyma diffuse.	Wood parenchyma diffuse and in numerous unicellular, interrupted, tangential lines in the late wood.

5. That *Tetracentron* be made the type of a monotypic family.

This genus has been juggled among the Magnoliaceae, the Trochodendraceae, and the Hamamelidaceae. Hooker (*32*) placed it in proximity to *Trochodendron* and *Cercidiphyllum* but distinguished it from them by the occurrence of secretory cells in the bark as well as in the leaves and by the presence of a perianth. Prantl (*41*, p. 275) made of it a doubtful genus of Trochodendraceae, stating that the genus permitted support to the opinion that the family is closely related to Hamamelidaceae, but later (*41*, Nachtrage II, p. 158, 1897) placed it in a separate tribe, Tetracentreae of Magnoliaceae. Hutchinson (*34*, p. 185) says, "*Eucommia* and *Tetracentron* are better placed with the Hamamelidaceae," but in his *Families of Flowering Plants* (*34*) he omits the latter genus completely. Some of the confusion concerning this genus arises from such descriptions as that of Chun (*8*). At one point he says, "sepals 4"; a little later appears the description, "Flowers *apetalous*, . . . sessile with a 4-lobed perianth; stamens 4, opposite the *petals*." The wood of *Tetracentron* differs considerably from that of either Magnoliaceae or Hamamelidaceae, and from that of *Trochodendron* principally in that the latter has no vascular tracheids and the transition from early wood to late wood is as abrupt as in a hard Pine (*e.g.*, *Pinus palustris*). In addition, there are certain morphological variations between these two genera, among them the presence of a deciduous leaf-sheath and multilacunar node in *Trochodendron*, and the absence of stipules or sheaths and the presence of a trilacunar node in *Tetracentron*.

6. That *Cercidiphyllum*, *Euptelea*, and *Illicium* be transferred from the Magnoliales to the Hamamelidales.

These three genera certainly are allied to the latter orders, not only in their morphological characters, but also in the anatomical structure of their secondary wood. The first two of these genera have long been considered close to the Hamamelidaceae, in fact have been considered as members of that family by some investigators. *Illicium* shares many of their similarities to that family and many of their differences from the Magnoliaceae. The wood structure of these three genera bears greater resemblance to the Hamamelidales than to the Magnoliales, as is evident from the following comparison:

Illicium, Euptelea, Cercidiphyllum	*Magnoliaceae*	*Hamamelidaceae*
Pores solitary.	Pores solitary or in radial lines or groups.	Pores solitary.
Wood parenchyma diffuse.	Wood parenchyma terminal.	Wood parenchyma diffuse.
Fibers with thick walls and narrow lumina, flattened radially in a narrow band at the termination of growth.	Fibers with moderately thick walls and moderately wide lumina, not flattened at termination of growth.	Fibers with thick walls and narrow lumina, flattened radially in a narrow band at termination of growth.
Vessel perforation bars numerous to very numerous (25–100 or more).	Vessel perforation bars few to fairly numerous (less than 25).	Vessel perforation bars few to numerous (up to 50 or more).
Intervascular pitting opposite to transitional, sometimes with a tendency to alternate.	Intervascular pitting transitional to scalariform, rarely opposite and never alternate.	Intervascular pitting opposite to transitional.
Vessel members often with abrupt shoulders and short, overlapping tails.	Vessel members usually with gradually tapering or blunt ends.	Vessel members often with abrupt shoulders and short, overlapping tails.

In addition to the above features, the extensions or tips of the vessel members of *Cercidiphyllum* are marked with the coarse spiral thickenings that are characteristic of *Liquidambar* and *Hamamelis*, several species of *Corylopsis*, and *Rhodoleia Championi* Hook.

7. That Winteraceae, Trochodendraceae, and Tetracentron be differentiated from the Magnoliales (*sens. str.*) and designated, if not as a distinct order, at least as a sub-order.

This is the group which Van Tieghem proposed to segregate from the rest of the Dicotyledons, under the name of Homoxylées (*48*). Morphologically the genera included in this group lie on the border between the Magnoliales and the Hamamelidales, although seemingly closer to the latter. Anatomically, however, they are quite different from the members of either of these two orders, as indicated in the following comparisons:

Magnoliales (sens. str.)	*Winteraceae, Trochodendraceae, Tetracentron*	*Hamamelidales*
Vessels present.	Vessels absent.	Vessels present.
Fibers very short to long.	Fibers extremely long.	Fibers short to long.
Fiber pits in a single vertical row; pit apertures exceeding the circular border.	Fiber pits in 2–4 vertical rows; pit apertures included within the borders which are large and circular, except in the early wood tracheids of *Trochodendron* and *Tetracentron*, where the pitting in radial walls is scalariform.	Fiber pits in a single vertical row; pit apertures exceeding the small circular borders.
Fiber walls moderately thick; lumina moderately wide.	Fiber walls moderately thick to thick; lumina moderately wide to wide.	Fiber walls thick; lumina narrow.
Medullary rays very low to low, and fine to moderately broad.	Medullary rays rather low to high, and broad to very broad.	Medullary rays very low to rather low, and fine to moderately broad.

It is possible that sufficient botanical evidence may be found to justify the recognition of the group in question as a distinct order.

8. That the two remaining families, Magnoliaceae and Schizandraceae, which form a natural group both morphologically and anatomically, be retained as the order Magnoliales.

It was not found necessary to propose any alterations within Schizandraceae. In Magnoliaceae the genera *Magnolia*, *Michelia*, *Talauma*, and *Liriodendron* are unquestionably

natural groups. No marked characteristics were found, however, to distinguish *Aromadendron* and *Manglietia* from *Talauma*, or *Elmerrillia* from *Michelia*. It is possible that *Aromadendron* and *Manglietia* are but subgenera of *Talauma*; *Elmerrillia* and *Alcimandra*, of *Michelia*; and *Kmeria* and *Pachylarnax*, of *Magnolia*. As previously stated, no material of *Kmeria*, *Pachylarnax*, and *Alcimandra* was available for investigation.

In studying the species of Magnoliaceae, several instances were found in which two species under different generic names proved to be identical. Such apparent duplication was probably due to the fact that identification was made in one instance on the basis of flowers, in another upon the fruit or leaves, both determinations, possibly, made by the same investigator on different occasions. In order to clarify this situation, such synonymous species were accordingly assigned to the genus into which they fell naturally, according to their anatomical features. These species are listed below, with the preferable names given first and the synonyms following:

Magnolia Balansae Aug. DC.: *Michelia baviens* F. & G.; *Michelia Balansae* A. DC.

Magnolia compressa Max.: *Michelia compressa* Max.

Michelia celebica Kds.: *Magnolia celebica* Kds.; *Elmerrillia celebica* (Kds.) Dandy.

Michelia excelsa Bl.: *Magnolia excelsa* Bl.

Michelia mollis (Dandy): *Elmerrillia mollis* Dandy.

Michelia montana Bl.: *Magnolia montana* Bl.

Michelia platyphylla Merr.: *Talauma ovalis* Miq.; *Elmerrillia ovalis* (Miq.) Dandy.

Talauma Roxburghii G. Don: *Magnolia pterocarpa* Roxb.

Talauma splendens (Urb.): *Magnolia splendens* Urb.; *Talauma mutabilis* var. *splendens* Urb.

Dandy's statement (22) that *Talauma spongocarpa* King is a synonym for *Michelia Baillonii* F. & G. and that *Talauma Villariana* Rolfe is a synonym for *Talauma angatensis* F. Vill. was verified by this study. On the other hand, his transfer of *Michelia Kachirachira* K. & Y. and *Talauma* sp. ("Yoroconte") to *Magnolia* does not seem to be justified. There is every evidence that the former should be retained in *Michelia* and the latter in *Talauma*.

The assignments of synonyms in the above manner is substantiated by reference to the Index Kewensis.

After eliminating Himantandraceae, Lactoridaceae, Cercidiphyllaceae, *Euptelea*, and *Illicium*, previously explained, the remaining families, with their respective genera, fall naturally into the following classification:

MAGNOLIALES (*sens. str.*)	(SUB-ORDER OR NEW ORDER)
I. Magnoliaceae:	I. Winteraceae:
1. Magnolia	1. Drimys
Kmeria	*Belliolum*
Pachylanax	*Bubbia*
2. Michelia	2. Zygogynum
Elmerrillia	*Exospermum*
Alcimandra	II. Trochodendraceae:
3. Talauma	3. Trochodendron
Aromadendron	III. (Monotypic family):
Manglietia	4. Tetracentron
4. Liriodendron	
II. Schizandraceae:	
5. Schizandra	
6. Kadsura	

The genera in italics were not definitely classified because of the lack of sufficient material for investigation.

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NEW NAMES FOR TROPICAL AMERICAN TREES

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During recent work in the determination of current collections received for study it has been found necessary to employ for some of the material identified names that never have been properly published according to the International Rules. Since some of these names are needed for publications planned for the near future, or refer to trees of considerable economic importance, it is desirable to place them formally on record at the present time.

Pithecolobium pallens (Benth.), comb. nov. *Calliandra pallens* Benth. Lond. Journ. Bot. 5: 102. 1846. *P. brevifolium*

Benth. ex Gray, Pl. Wright. 1: 67. 1852.—A common shrub or tree of western Texas and northeastern Mexico.

Pithecolobium Englesingii (Standl.), comb. nov. *Inga Englesingii* Standl. Trop. Woods 17: 27. 1929; Field Mus. Bot. 4: 211. 1929.—It is not at all to the writer's credit that the true nature of the leaves was misunderstood in describing this Nicaraguan tree, which is really referable to the subgenus *Zygia* of *Pithecolobium*. It is slight consolation that earlier botanists have made the same error in describing other species of the same group.

Pithecolobium Donnell-Smithii (Britt. & Rose), comb. nov. *Cojoba Donnell-Smithii* Britt. & Rose, N. Amer. Fl. 23: 30. 1928. Known in British Honduras as John Crow Bead.

Pithecolobium erythrocarpum, nom. nov. *Cojoba Recordii* Britt. & Rose, N. Amer. Fl. 23: 31. 1928, non *P. Recordii* Standl. 1929.

Pithecolobium costaricense (Britt. & Rose), comb. nov. *Cojoba costaricensis* Britt. & Rose, N. Amer. Fl. 23: 31. 1928.

Pithecolobium glabrum (Britt. & Rose), comb. nov. *Cojoba glabra* Britt. & Rose, N. Amer. Fl. 23: 33. 1928.

Pithecolobium Nelsonii (Britt. & Rose), comb. nov. *Havardia Nelsonii* Britt. & Rose, N. Amer. Fl. 23: 41. 1928.

Mimosa Wherryana (Britt.), comb. nov. *Mimosopsis Wherryana* Britton, N. Amer. Fl. 23: 177. 1928.—A species of western Texas.

Calliandra Conzattiana (Britt. & Rose), comb. nov. *Anneslia Conzattiana* Britt. & Rose, N. Amer. Fl. 23: 72. 1928.

Calliandra sinaloana (Britt. & Rose), comb. nov. *Anneslia sinaloana* Britt. & Rose, N. Amer. Fl. 23: 54. 1928.

Swartzia Standleyi (Britt. & Rose), comb. nov. *Tounatea Standleyi* Britt. & Rose, N. Amer. Fl. 23: 346. 1930.

Cassia papillosa (Britt. & Rose), comb. nov. *Chamaefistula papillosa* Britt. & Rose, N. Amer. Fl. 23: 237. 1930.

Caesalpinia velutina (Britt. & Rose), comb. nov. *Brasilettia velutina* Britt. & Rose, N. Amer. Fl. 23: 322. 1930.

Caesalpinia Pringlei (Britt. & Rose), comb. nov. *Brasilettia Pringlei* Britt. & Rose, N. Amer. Fl. 23: 322. 1930.

Bauhinia Storkii (Rose), comb. nov. *Schnella Storkii* Rose, N. Amer. Fl. 23: 206. 1930.

Bauhinia Runyonii (Britt. & Rose), comb. nov. *Casparea Runyonii* Britt. & Rose, N. Amer. Fl. 23: 210. 1930.

Copaifera panamensis (Britton), comb. nov. *Copaiva panamensis* Britton, N. Amer. Fl. 23: 222. 1930.—The generic name *Copaifera* is conserved under the International Rules.

Muellera frutescens (Aubl.), comb. nov. *Coublandia frutescens* Aubl. Pl. Guian. 937. *pl. 356.* 1775. *Muellera moniliformis* L. f. Suppl. 329. 1781.

Aeschynomene nicaraguensis (Oerst.), comb. nov. *Brya nicaraguensis* Oerst. Kjob. Vid. Medd. 13. 1853. *A. Calderoniana* Standl. Journ. Wash. Acad. Sci. 14: 93. 1924.—The writer has examined recently the type of Oersted's species, received on loan from the University Botanical Museum of Copenhagen, through the courtesy of Dr. Carl Christensen. The Nicaragua plant is exactly the same as that described by the writer from Salvador.

Zanthoxylum paraguariense (Chod. & Hassl.), comb. nov. *Fagara paraguariensis* Chod. & Hassl. Bull. Herb. Boiss. II. 4: 1282. 1904.

Xylosma bahamensis (Britton), comb. nov. *Myroxylon bahamense* Britton, Bull. N. Y. Bot. Gard. 4: 141. 1906.

Manilkara amazonica (Huber), comb. nov. *Mimusops amazonica* Huber, Bol. Mus. Goeldi 4: 433. 1904.—The American species of balata-producing trees, referred heretofore to *Mimusops*, are properly referable rather to a distinct genus, *Manilkara*, as pointed out many years ago by Pierre.

Manilkara excelsa (Ducke), comb. nov. *Mimusops excelsa* Ducke, Arch. Jard. Bot. Rio Jan. 3: 235. 1922.

Manilkara Huberi (Ducke), comb. nov. *Mimusops Huberi* Ducke, Arch. Jard. Bot. Rio Jan. 2: 14. *pl. 2A.* 1918.

Manilkara paraensis (Huber), comb. nov. *Mimusops paraensis* Huber, Bol. Mus. Goeldi 4: 435. 1904.

Ladenbergia bullata (Wedd.), comb. nov. *Cascarilla bullata* Wedd. Ann. Sci. Nat. III. 10: 11. 1848.

Ferdinandusa chlorantha (Wedd.), comb. nov. *Gomphosia chlorantha* Wedd. Ann. Sci. Nat. III. 10: 14. 1848.—After study of a photograph of authentic material of this species, collected in Peru by Weddell, and of Weddell's various descriptions, I am inclined to believe that *Ferdinandusa Paxii* Winkl. is to be considered a synonym of *F. chlorantha*.

CURRENT LITERATURE

Die Palmengattungen *Reinhardtia* Liebm. und *Malortiea* H. Wendl. By M. Burret. *Notizblatt Bot. Gart. Berlin* 11: 551–556, Dec. 15, 1932.

Since no constant character is available by which the two palm genera *Reinhardtia* and *Malortiea* may be distinguished, the species published under the latter are transferred to *Reinhardtia*. Seven species are recognized, ranging from Oaxaca, Mexico, to Costa Rica. *Reinhardtia gracilior* is described as new, from the Stann Creek Valley, British Honduras.

L'exploitation forestière à la Guayane française. By G. Chatelain. *Actes & Comptes Rendus de l'Association Colonies-Sciences* (Paris) 8: 90: 217–222, Dec. 1932.

The forest products exploited in Guiana are varied, including (besides the woods to be used in furniture-making, carpentry work, building, and charcoal) Balata gum, essence of Bois de Rose, and tanning extracts. Recently there has been a decided slump in the market for all of these commodities, except charcoal, which, although exported only in small quantities, has shown no decline in demand.

Although in 1931 at least 6000 tons of wood for building were exported, scarcely 700 tons were sent out in the first six months of 1932, mostly made up of Angelique intended for maritime uses. The exports of Manilparcouri (*Symphonia globulifera* L. and *Platonia insignis* Mart.) and the Red Mangrove (*Rhizophora Mangle* L.), which are used in making planks and boards, have suffered an even greater falling off and are indeed almost entirely at a standstill.

Since 1928 the demand for Balata gum has greatly lessened, and it is also increasingly difficult and expensive to get this substance, as the easily exploitable regions have been almost exhausted.

The essence of Bois de Rose (*Aniba roseodora* Ducke) has followed the same fluctuations as the other commodities: a ready market and overproduction immediately after the war, then a sudden drop in prices and a lessening in demand. The reasons for the crisis in this case is partly attributable to competition from Brazil, where this substance is more readily accessible, and partly to the competition among the various Guiana exploiters. However, the situation has improved somewhat this last year and as the essence from Guiana is superior to that of Brazil it commands a better price, being used in perfumery rather than in soap-making.

The Red Mangrove, plentiful in French Guiana, has a bark rich in tannin. This was exported to the United States, there being no market for it in France. Although this business showed great promise, it has been discontinued, the sharp drop of 60 per cent in price forcing this step.

The author, who is Chief of the Forest Service for the Territory of Inini, concludes his article with a plea for a greater study and acquaintance with the Guiana woods, some of the most important of which he lists, with their uses. He is confident that the situation in Guiana will greatly improve in the future, if enough effort is given to it.—Mary E. Record, *Assistant in Wood Technology, Yale University.*

Die Gattung *Lozania* Mutis. By R. Mansfeld. *Notizblatt Bot. Gart. Berlin* 11: 592–597, Dec. 15, 1932.

The application of the generic name *Lozania* of Sinforoso Mutis (1810) has always been in doubt, but specimens collected long ago in Colombia by Celestino Mutis, and received recently from Madrid by the writer for study show that the tree so named is the same as that described in 1929 as *Monandrodendron* Mansf., and referred to the Flacourtiaceae. Study of the fruit now reveals that the tree is closely related to *Lacistema* and there is some doubt as to whether *Lacistema* and *Lozania* should be considered as constituting a separate family, or whether they should be united with the Flacourtiaceae. Two species of *Lozania* are known, *L. Mutisiana* Roem. & Schult. (*Monandrodendron Schultzei* Mansf., *M. peruvianum* Mansf.), of Colombia and eastern Peru; and *L. Klugii* Mansf. (*M. Klugii* Mansf.), of eastern Peru.—P. C. Standley.

Die Palmengattungen *Martinezia* und *Aiphanes*. By M. BURRET. *Notizblatt Bot. Gart. Berlin* 11: 557–577, Dec. 15, 1932.

The name *Martinezia* usually has been applied to the group of palms for which the name *Aiphanes* Willd. is used here; but the genus *Martinezia* as described by Ruiz and Pavón includes no species referable to the *Martinezia* of current authors. Synonyms of *Aiphanes* are *Marara* Karst. and *Curima* and *Tilmia* of O. F. Cook.

Of *Aiphanes* there are listed 26 accepted species, among which may be mentioned *A. minima* (Gaertn.) Burret, known as Grigri, Chou Piquant, and Glouglou in Martinique; *A. erosa* (Linden) Burret, Macaw (Barbados); *A. caryotifolia* (H.B.K.) Wendl., Corozo (Colombia), Chonta Ruro (Ecuador); *A. Eggersii* Burret, Corozo (Ecuador); *A. deltoidea* Burret, Shicashica (eastern Peru); *A. Lindeniana* Wendl., Alvarico (Colombia).—P. C. STANDLEY.

Neue Arten aus der Hylaea Brasiliens. By A. DUCKE. *Notizblatt Bot. Gart. Berlin* 11: 579–591, Dec. 15, 1932.

Eight new species and varieties of trees and shrubs are described in various families, from Brazil and Peru, several new combinations are published, and notes are given upon old species. Among others may be mentioned *Inga brevialata* Ducke, of which *I. suturalis* Ducke is reported to be a synonym; *Clathrotropis nitida* (Benth.) Harms, known on the upper Rio Negro as Acapú, a tree with handsome dark brown heartwood; *Ormosia santaremnensis* Ducke, to which *O. faroensis* Ducke is reduced as a synonym; *Luetzelburgia auriculata* (Allem.) Ducke (*Tipuana auriculata* Allem., *L. pterocarpoides* Harms, *Bowdichia Freirei* Ducke); *Saccoglottis cuspidata* (Benth.) Urban, of which *S. excelsa* Ducke is a synonym; *S. macrophylla* (Benth.) Urban, with the synonym *S. Duckei* Huber; *Qualea acuminata* Spruce, in whose synonymy is placed *Q. speciosa* Huber; *Cunuria Spruceana* Baill., a tall tree, known on the Rio Negro as Cunury; *Caryocar glabrum* (Aubl.) Pers. and *C. microcarpum* Ducke, both of

which are called Piquiá-rana, the pericarp of the fruit of the latter species being used as a fish poison; *Lucuma dissepala* (Krause) Ducke (*Vitellaria dissepala* Krause), a tree whose large fruits sometimes are eaten, known as Abiu-rana Grande, Cutitiribá-rana, or Guajara, the last name being applied also to *Chrysophyllum excelsum* Huber.—P. C. STANDLEY.

Die Stammpflanzen der Droge Muira-puama. By ELISABETH ANSELMINO. *Notizblatt Bot. Gart. Berlin* 11: 623–626, Dec. 15, 1932.

Muira-puama is the native name of a drug derived from trees of the family Olacaceae, whose roots are employed in Brazil as a remedy for paralysis, dyspepsia, irregularities of menstruation, and impotence. Lignum Muira-puama is accepted as a drug in the appendix to the German Pharmacopoeia, and it is sometimes employed in the preparation of aphrodisiacs. Herbarium material of the trees furnishing Muira-puama, obtained in the Amazon region of Brazil by A. Ducke and G. Hübner, represents two trees, *Ptychopetalum olacoides* Benth. and a new species, *P. uncinatum* Anselmino, based on specimens collected at São Paulo de Olivença on the Rio Solimoes.—P. C. STANDLEY.

Fourth annual report of the Fan Memorial Institute of Biology. Peiping, China, Jan. 1, 1933. Pp. 21: 7½ x 10.

Of particular interest to wood technologists is the following reference to the work of Mr. Yao Tang, assistant in the Division of Botany, who recently was elected to membership in the International Association of Wood Anatomists:

"Mr. Y. Tang has devoted his whole time to the studies of Chinese timber trees with a view to both scientific and economic purposes. In the year, he has described, out of a rich collection of timbers from different parts of the country, the anatomy of 172 species under 117 genera, of which 22 are Gymnosperms. More than 500 permanent slides and over 100 microphotographs have been made. Besides, he has also studied the timber anatomy of some interesting trees, of which special mention may be made of *Rhoiptelea chiliantha*

Diels et Hand.-Mzt., *Bretschneidera sinensis* Hemsl., and *Pseudolarix Kaempferi* Gord. The studies on the relative density of various woods have been carried out at the same time. Eight hundred fifty specimens of timber have been added to the previous collection, thus bringing the timber collection up to 1200 numbers."

Timber studies of Chinese trees. III. Identification of some important hardwoods of South China by their gross structures. I. By Y. Tang. *Bulletin of the Fan Memorial Institute of Biology* (Peiping) 3: 17: 253–338, Nov. 24, 1932. Ill. with 18 plates, each with 4 photomicrographs.

Foreword

"This paper consists in the study on the identification of some important hardwoods of South China, treated in the same manner as in my previous study on the identification of some important hardwoods of North China. [See *Tropical Woods* 32: 37.] The specimens treated in this paper consist of 94 species belonging to 71 genera and 34 families, which were collected by Mr. C. L. Tso from Kwangtung; by Mr. F. T. Wang from Mt. Omei, Szechuan; by Mr. Y. Tsiang from Kweichow; and by Dr. H. H. Hu from Lu Shan, Kiangsi. As it is generally known that the main boundary line between the northern and southern floral elements in China is the Tsing-lin Range in Shensi, the writer uses this mountain range to group the sylvan species under two main categories, *i.e.*, the trees found north of this range are designated as belonging to North China, and those found south of it, to South China. The materials collected from more than one locality are also separately studied, so as to find out the range of variations in these specimens. The key to genera made for this paper includes all the genera studied in this paper and also those that have been treated in my previous paper so as to include those genera not collected in South China and to make this paper more useful, with a view to making eventually a complete key for important genera of Chinese woods. In later papers this plan will be always followed."

The properties of *Millettia*. By Hilderic Friend. *Gardeners' Chronicle* (London) 93: 118, Feb. 18, 1933.

An abstract of an article appearing in *Transactions of the Bose Research Institute*, vol. 7, London, 1933. The Lepcha fishermen in the vicinity of Darjeeling, India, capture fish by placing various plants in streams, the fish so taken or "poisoned" being used for food. *Millettia pachycarpa* (Leguminosae), a plant largely in use for the purpose, has been given special study by Bose. When fish were placed in a tank containing an extract of the root, they soon lost their balance, turned on their side, then upside down, and floated or sank without power of self control. It was found that the extract acted on the muscular system, the mouth, operculum, and gills refusing to function, so that oxygen could not be taken in. The heart was not affected, and if the fish were removed quickly enough and placed in properly oxygenated water, the effect of the poison was overcome, and they survived. It may be stated that *Millettia* extract causes death by asphyxiation, and that paralysis or drowning is a more correct expression than poisoning.—P. C. Standley.

The structure and botanical identity of some scented woods from the East. By C. R. Metcalfe. *Bulletin of Miscellaneous Information*, Royal Botanic Gardens, Kew, 1933, No. 1, pp. 3–15. Ill. with 4 plates of 3 photomicrographs each.

Within the last few years the Jodrell Laboratory has received for identification a number of scented wood specimens, some of them highly prized in their countries of origin, from India, Ceylon, Federated Malay States, China, Africa, and other regions. Many of these, variously known locally as Calambac, Kalamet, etc., were sent by Dr. A. Kerr of the Botanical Section, Ministry of Commerce and Communications, Bangkok. The author points out that in the course of examining these and other woods it appears that great confusion exists concerning their botanical identity, owing chiefly to a number of quite distinct species having acquired very similar vernacular and trade names.

The species described are: *Aquilaria Agallocha* Roxb., *A. malaccensis* Lamk., *Gonystylus bancanus* (Miq.) Baill. (Thymelaeaceae), *Excoecaria africana* Muell. Arg., *M. Agallocha* L., *Euphorbia antiquorum* L. (Euphorbiaceae), *Cordia fragrantissima* Kurz (Boraginaceae), *Mansonia Gagei* J. R. Drumm (Sterculiaceae), and *Cinnamosma fragrans* Baill. (Canellaceae).

In each instance there is given a description of the wood structure, accompanied by notes on the sources and the local uses and a list of the trade and vernacular names, of the species. There are photomicrographs of all different genera.—L. Williams, *Field Museum of Natural History*.

New or noteworthy trees from Micronesia (III). By Ryôzô Kanehira. *The Botanical Magazine* (Tokyo) 46: 669–674, Nov. 1932.

Fifteen species are enumerated, among which may be mentioned: *Columbia Burreti* Kanehira, nom. nov. (*Colona scabra* Burret; vernacular name, Uab in Palau); *Eugenia stelechanthoides* Kanehira, sp. nov. (Neis in Kusai, where it is a very common tree); *Schefflera pachyclada* Kanehira, sp. nov. (Urayau in Truk); *Sideroxylon micronesicum* Kanehira, sp. nov. (Sohs in Kusai); *Terminalia carolinensis* Kanehira, sp. nov. (Ka in Kusai and Keima in Ponape).

Nova Guinea. Résultats des expeditions scientifiques à la Nouvelle Guinée. Vol. XIV, Botanique, Livraison IV. Leiden, 1932. Pp. 517–570; pls. 88–129.

The five parts comprising this volume were printed separately from 1928–1931 and are as follows: Compositae, by Joh. Mattfeld; Dichapetalaceae, by K. Krause; Scrophulariaceae, by L. Diels and J. Lanjouw; Frullaniaceae, by Fr. Verdoorn; Enumeration of the Sapotaceae, thus far known from New Guinea, by H. J. Lam.

The publication is of chief interest for the account of the Sapotaceae, of which there are listed 47 species, 35 of which are endemic in New Guinea. Keys are provided for distinguishing the species and the 11 genera to which they are referred. Only the new species are described, but systematic notes are given upon many of the older species, and information as to their distribution in New Guinea and elsewhere. Among the new species is *Niemeyera papuana*, a tree 36 meters high, called Mafung-afung, whose wood is used for house building; the only other member of the genus grows in Northern Australia. There is described a new genus of trees, *Krausella*, consisting of two species endemic in the island.—P. C. Standley.

A supplement to C. T. White, "Ligneous plants collected in the territory of Papua (British New Guinea) in 1925–26 by L. J. Brass." By Alfred Rehder. *Journ. Arnold Arboretum* (Jamaica Plain, Mass.) 14: 62–67, Jan. 1933.

A brief list of woody plants, with a longer one of herbaceous species. Among the former are enumerated the following: *Allophylus micrococcus* Radlk. (vernacular names Odia and Pidi-Pidia); *Guioa rigidiuscula* Radlk. (Ete); *Cupaniopsis* sp. (Sisimana); *Harpullia cupanioides* Roxb. (Gari).

Contribution to the flora of the New Hebrides; plants collected by S. F. Kajewski in 1928 and 1929. Supplement. By A. Guillaumin. *Journ. Arnold Arboretum* (Jamaica Plain, Mass.) 14: 53–61, Jan. 1933.

Among the trees reported are the following: *Pittosporum naruaiao* Guill., sp. nov. (vernacular name, Naruaio); *Canarium aneityense* Guill., sp. nov. (Inyat), a large tree furnishing a valuable cabinet wood; *Melia Azedarach* L. (White Cedar); *Elattostachys vitiensis* Radlk. (Ne-el-lar-ru); *Spondias dulcis* Forst. (Nevie); *Dracontomelum vitiense* Engler? (Nar-ah); *Gyrocarpus americanus* Jacq. (Nep-bleb-le), with soft wood used for canoes; *Aleurites moluccana* Willd. (Inhatch).

Wood borers in Australia. Part 2. *Anobium*, or the furniture beetle. Trade Cir. No. 11, Div. of For. Products, Council for Sci. & Ind. Research, Melbourne, 1932. Pp. 14; 6 x 9½; 4 text figs.

"In the first publication of this series [Trade Circ. No. 6], reference was made to the common occurrence of borer-at-

tacked timber, and it was emphasized that all cases of apparent borer infestation may not be so serious as would appear at first sight. The details for distinguishing borers which live only in growing, freshly felled, or green timber, and which do not seriously continue their damage in seasoned or partly seasoned timber, were given. Three groups of beetles were mentioned as causing considerable economic damage in seasoned or partly seasoned timber, namely, the powder-post beetles (*Lyctus* spp.), the furniture beetles (*Anobium* spp.), and the auger beetles (*Bostrychids*). The *Lyctus*, or powder post beetle, which develops only in sapwood, was described in detail.

"The present circular deals particularly with the furniture beetle. There appears to be some misunderstanding with reference to the naming of these groups of wood-boring insects. The powder post beetle (*Lyctus*) was popularly so named because of its destruction of the wood to a fine white powder; the furniture beetle (*Anobium*) was so named because of its more frequent occurrence in articles of furniture. Although these two common names are used throughout the world, they do not indicate the only articles which may be damaged. Thus, although not called a furniture borer, the powder post beetle can attack any unprotected furniture which contains sapwood of a species of timber susceptible to attack, and, contrary to popular opinion, the furniture beetle (*Anobium*) also extends its attack to floorings, studs, rafters, etc. The common names are rather misleading, but their use is retained because of universal adoption."

Details of the life history of the furniture borer are given and methods for the treatment of infested woodwork are outlined, which, if carefully followed, give satisfactory results.

The chemistry of Australian timbers. Part 2: The chemical composition of the woods of the iron bark group. By W. E. Cohen, A. L. Baldock, and A. G. Charles. Technical Paper No. 4, Div. of For. Products, Council for Sci. & Ind. Research, Melbourne, 1932. Pp. 36; 6 x 9½.

A report on an investigation of the heartwood of five species of Ironbark (*Eucalyptus Sideroxylon*, *E. siderophloia*, *E. crebra*, *E. paniculata*, and *E. Fergusoni*) and two closely related Grey Gums (*E. propinqua* and *E. punctata*). Among other things "the study has indicated that species otherwise closely related may have regular differences in certain chemical factors and that these differences may be employed profitably to aid macroscopic and microscopic examinations in the identification of wood. The regular differences occurring between woods in their solubilities in various reagents may quite easily be used to develop additional simple chemical tests to assist the anatomist in identification."

Fibre boards, their uses and the possibilities of their manufacture in Australia. By R. F. Turnbull. Technical Paper No. 6, Div. of For. Products, Council for Sci. & Ind. Research, Melbourne, 1932. Pp. 51; 6 x 9½; 7 figs.

"The first steps towards manufacturing fiber boards from Australian woods were taken in 1930 by the Council for Scientific and Industrial Research, when, in coöperation with the Forestry Commission of New South Wales and the Forests Department of Western Australia, samples of three Australian timbers were tested as to their suitability for fiber board manufacture. The Council's Division of Forest Products deputed the author to witness the tests and furnish a report. The essential data in that report are set down in this publication and supplemented with details on various aspects of the industry and possibilities of commercial manufacture.

"During these tests, three species of Eucalypt timbers were converted successfully into homogeneous fiber boards in a semi-commercial laboratory. The important conclusion drawn from the results of the tests is that there are no insurmountable obstacles, at any rate from the technical point of view, to prevent commercial manufacture of 'insulating' and 'hard-pressed' classes of fiber boards from these timbers."

Les Monimiacées à l'Ile Maurice. By P. Koenig. *Revue de Botanique Appliquée & d'Agriculture Tropicale* (Paris) 12: 136: 1052–1053, Dec. 1932.

There are two genera of this family on Mauritius, namely,

Tambourissa and *Monimia*. The first is represented by seven species: *Tambourissa amplifolia* A.DC., *T. Sieberi* A.DC., *T. quadrifida* Son., *T. pedicellata* Baker, *T. peltata* Baker, *T. elliptica* A.DC., *T. tetragona* A.DC.; the second by two species: *Monimia ovalifolia* Thouars and *M. rotundifolia* Thouars.

Most important by far is the *Tambourissa quadrifida*, commonly known as Bois Tambour, which is the source of a durable wood that has been used on a large scale for staves, railway keys, etc. The logs are often found in the forest deprived of the sapwood, with the heart intact, having thus resisted for a decade or two the attack of insects and other destructive forces since the preceding cyclone.

When in flower this tree is a remarkable sight; all the branches and even the trunks are absolutely covered with bloom in all positions and directions. The filaments of the stamens are a beautiful purple color. The fleshy perianth, which is 6 inches deep and 3 to 12 inches across, holds rain water like a cup, so that the monkeys drink out of them. When the fruit ripens, the pericarp opens, letting the seeds fall inclosed in a red pulp that attracts the bats and rats, thus greatly hindering the natural reproduction of the tree, which is becoming more and more rare in the forests.

Bois Mapou is a name applied to several trees in Mauritius, including *Pisonia macrophylla* Choisy, *P. viscosa* Balfour, *P. calpidoa* Steud, as well as *Vitis Mappia* Baker.—Mary E. Record, *Assistant in Wood Technology, Yale University.*

Neue und seltene Arten aus dem südlichen Ostafrika (Tanganyika Territ.) leg. H. J. Schlieben, II. By J. Mildbraed. *Notizblatt Bot. Gart. Berlin* 11: 646–687, Dec. 15, 1932.

The majority of the species described as new or otherwise treated are herbaceous plants, but among the new trees and shrubs may be mentioned *Octoknema orientalis* and *O. aruwimiensis*, the former a tree 20–30 meters high, representatives of a small genus regarded as forming a separate family, Octoknemataceae, related to the Olacaceae, the five other

members of the genus occurring in Gabun, Kamerun, French Guinea, and Sierra Leone; *Erythroxylon Schliebenii*, vernacular name Mtenene; *Bersama gracilipes*, Batsamon; *Olinia discolor*, Kikimbiti.

Esquisse rapide de la végétation des bords lagunaires dans la région de Grand Bassam et de Bingerville (Côte d'Ivoire). By L. Hédin. *Bulletin Mensuel de L'Agence Économique d l'A. O. F.* (Paris) 13: 139, 140: 211–215, 251–255, July, Aug. 1932.

A description, based upon the author's personal studies at Grand Bassam and Bingerville during 1929–31, of the flora bordering the shallow brackish lagoons of the French Ivory Coast. It is divided into two parts, the first dealing principally with an examination of the various ecological factors of the district and the vegetational response or adaptation to these factors, while the second is concerned more especially with a description of the anatomical features and peculiarities of the species which make up the lagoon flora.

In treating the ecological study of the vegetation fringing the tidal lagoons the author distinguishes three associations, viz., the Mangrove association, the lagoon border association, and the meso-hygrophilous forest association. The first occurs for the most part actually in the lagoon, while the last is situated immediately behind the lagoon flora on land that is not subject to constant flooding. The vegetation of the banks of the lagoons is believed to represent a tree association with a characteristic floral composition that is relatively uniform within the ecological limits of the lagoon zone. The study is, therefore, one of zonation.

The extent to which the land along the banks of the lagoons is subjected to seasonal inundations and drying, and the degree of salinity of the water are specially noted as presenting important edaphic factors that characterize this special environment, which, in turn, is responsible for the presence of a definite kind of vegetation. Climatic factors are briefly described. Of these, two well-marked rainy seasons during the year (one from May to July and the other from October to December) are important.

The vegetation of the shores of the lagoons and that of the adjoining associations are next dealt with at some length. The flora of the lagoon banks is divided into the following species: exclusive (*exclusives*), selective (*électives*), preferential (*préférentes*), and accidental (*accessoires*). By exclusive is meant "species completely or almost completely confined to one community."[1] Only one species, *Ficus Goliath* A. Chev., is considered as worthy of this definition.

Selective species are those "found most frequently in a certain community, but also, though rarely, in other communities." A larger number of species are enumerated in this class. Among them it is interesting to find the following species occurring in tropical America: *Ecastophyllum Brownei*, *Lonchocarpus sericeus*, *Drepanocarpus lunatus*, and *Chrysobalanus Icaco*.

Preferential species are those "present in several communities more or less abundantly, but predominantly or with better vitality in one certain community." In the area under discussion they are represented chiefly by species that grow on the edge of the forest in situations of full sunlight, species that like swampy places and some species of the littoral zone.

Accidental species are "rare and accidental intruders from another plant community." In the lagoon association they are mostly intruders from the meso-hygrophilous forest.

This interesting ecological survey concludes with some observations regarding the periods of flowering and seed fall in the case of species found in the lagoon association. The regularity of climatic conditions is observed, a fact common to most parts of the tropics, and the response of the vegetation to such conditions is discussed. In most cases seed fall takes place during the dry season when the seedlings can germinate on the damp exposed mud.

The anatomical observations which compose the second part of M. Hédin's article are chiefly concerned with adaptations to climatic periodicity, and more especially to life in saline, wet, isolated conditions. The wood anatomy of the tree species is only just referred to, but the anatomical characteristics of the leaves of several species are described at length. No very definite conclusions are drawn from the anatomical features, which in some cases are characteristic of halophytes and in others of hygrophytes.

The article, which does not pretend to be more than a rapid survey, contains a number of interesting facts. One is impressed by the similarity between the vegetation of the Ivory Coast and that of similar coastal areas in other parts of the tropics.—WILLIAM M. MCNEILL, *Commonwealth Fund Fellow, Yale University*.

[1] This and the following definitions are taken from J. Braun-Blanquet's *Plant Sociology* (Eng. trans.), 1932.

Empire timbers from home and overseas for building and structural purposes. By J. R. COSGROVE. Forest Products Research Leaflet No. 5, Princes Risborough, Aug. 1931. Pp. 24; 7¼ x 9½. Price 1s. 3d.

"The object of this classification is to present in a form convenient for the use of architects, engineers and other designers or timber users, a description of those Empire timbers of home or oversea origin that are considered suitable for building and structural purposes, with an indication of the grades (when these are known) appropriate to the different uses; and in addition, to provide a means of dealing more rapidly with the inquiries reaching the Laboratory concerning the utilization of Empire timbers on a larger scale."

A handbook of empire timbers. By the Empire Marketing Board, London, 1932. Pp. 102; 7½ x 9¾.

"This book is chiefly intended for practical use by architects, engineers and builders and by the designers and makers of furniture and decorative wood-work. Its contents are limited accordingly. No attempt is made to review all the woods which grow in the Empire at home and overseas. It includes only some sixty woods of proven usefulness, which can generally be obtained here in commercial quantities either from actual stocks or, in some cases, to order, and which usually can be bought at prices comparable with the cost of similar woods from other sources."

M.M. Chattaway

M.M. Chattaway. Price 50 cents

Yale University School of Forestry

TROPICAL WOODS

NUMBER 35 SEPTEMBER 1, 1933

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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.

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

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NOTES ON *BUCHHOLZIA* AND *MANSONIA* IN THE GOLD COAST

By C. VIGNE

Assistant Conservator of Forests, Gold Coast

BUCHHOLZIA CORIACEA Engl.

This species, which had not previously been recorded from the Gold Coast, was recently collected in Western Ashanti. The native name is Eson-bossi, meaning Elephant's Cola, as the fruit has some resemblance to that of *Cola acuminata*.

It is a small-sized tree, 25–35 feet high and 3–4 feet in girth, occurring in the understory in high closed forest of semi-deciduous type very mixed in character, with *Triplochiton scleroxylon*, *Celtis* spp., *Sterculia rhinopetala* as the most common constituents of the upper story.

The bole is not buttressed, but often is irregular and sometimes fluted. The crown is very dense with dark green foliage.

The bark is smoothish, green-black, about 4 mm. thick, red-brown within and very bitter. Scrapings of the fresh bark have a pungent peppery scent and are used by the natives to cure earache.

The flowers appear in August–September in racemes from the axils of the large, simple, long-petioled leaves. There are no petals, but the stamens are numerous and conspicuous, with the ovary borne on a long gynophore extending beyond the stamens. Immature fruit, probably from the previous year's flowering, was noted.

The wood is moderately soft, fine-textured, yellow-white when fresh, with no color distinction between sapwood and heartwood. The pores are in short, scattered rows, and the parenchyma is in numerous, somewhat wavy, concentric bands considerably wider than the rays.

Mansonia altissima A. Chev.

The timber of *Mansonia altissima* has recently awakened interest in Europe as a possible substitute for American Black Walnut, and the Forest Products Research Laboratory at Princes Risborough has carried out preliminary tests on samples from Nigeria. This species is also found over a large part of the Gold Coast forest area and is well known to the natives as Pruno or Apruno.

Pruno is a tree of the deciduous forest type and is not found in the evergreen forest type in the southwest of the Colony. It is medium-large, buttressed, with a clear straight bole and a rather compact crown of small horizontal branches. It never grows to the size of the Khayas or Entandrophragmas, but is found up to 9 feet in girth and 120 feet high.

The bark is light brown, on young trees smooth and slightly furrowed vertically; on old trees the furrows deepen, and the surface becomes roughish. The bark is soft, 1–1.5 cm. thick, yellow when cut, but rapidly turning brown.

The timber is moderately hard and heavy, straight-grained, and of even texture. It is durable, and in a test bed exposed half-buried in soil has resisted termite attack and decay for 18 months. When dry it floats, but the logs are probably too heavy when fresh to allow of extraction by floating. The sapwood, which is upward of two inches in thickness, is white and sharply defined. The heartwood is a deep brown when fresh, but fades from exposure to the sun; water in which chips of it are soaked soon becomes brown. The timber, which is fairly fissile, is split into beams and used by the natives for building.

The tree flowers in July–August and the fruits ripen in October–January. From the limited information available it appears easy to establish in plantations, as the seed germinates well and the seedlings transplant successfully. Young plants with their large soft leaves are very susceptible to caterpillar attack, and mature trees are sometimes completely defoliated.

WAX YIELD OF THE CARNAÚBA PALM OF BRAZIL

By B. E. Dahlgren

Field Museum of Natural History

On a recent visit to Ceará, the center of the Carnaúba wax industry of northeastern Brazil, some actual production figures were obtained from the owner of a moderate-sized Carnaúba grove situated in the district of Fortaleza. These figures cover the production in one particular locality and only during those selected years, 1921, 1923, and 1931. While they add little to existing general information about yield, as summed up in the monograph of Antonio de Arruda Camara and others (Ministerio da Agricultura, etc., Rio de Janeiro, 1929), they are of interest as indicating in some detail the variation in yield to be expected from time to time with changes in pluviometric and other factors. Concerning the latter no data are at hand that would warrant an attempt at a definite correlation, nor would any be worth while on so limited a scale.

The quantity of wax obtained from a given number of leaves depends primarily, of course, on the quantity excreted and present in the form of a surface covering on the unexpanded leaves as well as on the young expanded leaves that

are cut, but it depends also to a considerable extent on the thoroughness with which the wax is removed and collected.

With the simple methods in use there is always an element of loss that cannot be completely avoided. The leaves are laid out in the open for several days to wilt and to dry partially in order to loosen the wax film which is firmly adherent to the surface of the fresh leaf. They are then gathered up and transported to the spot where the next step in the operation takes place, *viz.*, the slitting of the leaf and the beating. This may be performed in the open, or more often in a closed shed or room. In either case there is a certain loss of fine powdery wax which, floating like dust on the air, is dissipated by the slightest breeze. Even when a special building is used for the beating, openings must be maintained for ventilation and any draft carries out a stream of fine particles of wax.

At every step in the operation there is thus an opportunity for some loss, which may be great or small according to weather conditions and degree of care exercised. This loss, it is thought by those familiar with the prevailing practices and conditions of the Carnaúba industry, may at times amount to as much as 25 per cent.

The figures in the accompanying table were derived from data kindly furnished by Sr. Elpidio Lima of Barroso, at the suggestion of Sr. Humberto Rodrigues de Andrade, federal agricultural inspector in the State of Ceará. Being from a single source, they show results obtained under presumably rather uniform conditions of watchfulness and care. The loss factor may, therefore, be considered as constant and may be disregarded as a cause of the variations in yield.

The total cuttings of the three years, 184,200 leaves, yielded in all 1281 kg. of wax, corresponding to an average of 143.7 leaves per kilo of wax obtained, or an average wax production of 6.9 grams per leaf. The highest yield during the years in question was that of the third cutting in 1923, which gave 10.9 grams per leaf. The lowest yield was that from the expanded leaves of the first cutting in 1921 which yielded an average of only 4.3 grams per leaf.

In the record for 1931 no distinction is made between unexpanded and expanded leaves. The record of the other

two years show that three times out of five the yield per leaf from unexpanded leaves exceeded that from expanded leaves, the average yield of unexpanded leaves also being somewhat greater, 6.28 grams per leaf in comparison with 5.75 grams for expanded. Owing to the greater number of expanded leaves cut, the latter, in spite of a somewhat lower yield per unit, furnished 54 per cent of the total quantity of wax produced.

RESULTS OF TESTS ON CARNAÚBA WAX PALM

Cuttings	No. of leaves			No. of kgs. of wax yielded			No. of leaves per kg.		
	Unexpanded	Expanded	Total	Unexpanded	Expanded	Total	Unexpanded	Expanded	Av.
1921—Wet year									
1. Sept...	8,500	12,700	21,200	45	55.0	100.0	188.8	230.9	212.0
2. Nov...	9,600	11,700	21,300	51	58.5	109.5	188.2	217.1	194.5
Total..			42,500			209.5			202.9
1923—Average year									
1. Sept...	10,300	19,400	29,700	67	97.0	164.0	153.7	200.0	181.0
2. Nov...	8,900	6,800	15,700	53	53.5	106.5	168.0	127.2	147.5
3. Dec. ..	4,900	4,400	9,300	49	52.5	101.5	100.0	83.8	91.6
Total..			54,700			372.0			147.0
1931—Drier than average year									
1. Sept...			47,000			370.0			127.0
2. Nov...			40,000			330.0			121.2
Total..			87,000			700.0			124.3

Some of the figures, particularly those of the second and third cuttings in 1923, might suggest that under certain conditions an increase in the waxy covering may take place after the expansion of the leaf, though this is contrary to the general observation that after expansion of the leaf there is a gradual loss of wax so that the leaves left on the tree finally cease to yield any, for which reason older leaves are not cut.

SYSTEMATIC ANATOMY OF THE WOODS OF THE MYRISTICACEAE [1]

By GEORGE A. GARRATT

Associate Professor of Forest Products, Yale University

The members of the Myristicaceae or Nutmeg family are trees, or rarely shrubs, widely distributed in the American, Asiatic, and African Tropics. The timbers are of little or no commercial importance at present and the family is best known because the fruits of a single representative, *Myristica fragrans* Houtt., are the chief source of the world's supply of nutmeg and mace.

Taxonomists disagree about the internal division and arrangement of the plant group, and also in regard to the position of the family in the natural system. The present investigation was undertaken to determine to what extent a critical study of the anatomy of the secondary xylem of the Myristicaceae might prove of value in clearing up the disputable points concerning the internal organization of the family.[2]

General Description of the Family

The family Myristicaceae was proposed by Robert Brown in 1810, but the first complete description was by De Candolle in 1856, who based it on the Malayan species of *Myristica* published by Blume (1835), as well as on the information supplied by Bentham (1853) and by Hooker and Thomson (1855). De Candolle's work has been generally accepted in subsequent publications, although modified somewhat to conform to new data and material. The following summary of the anatomical features of the Myristicaceae is essentially that given by Hutchinson (1926).

[1] A portion of a dissertation presented to the Faculty of the Graduate School of Yale University in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The work was done under the supervision of Professor Record, of the Department of Forestry.

[2] An examination was also made of the anatomy of the woods of associated families for the purpose of determining the systematic position of the Myristicaceae in the plant kingdom. The results of this study will be published in a separate paper.

The family is composed primarily of trees [3] which often are large and frequently aromatic. Leaves are alternate, entire, penninerved, often with pellucid dots (resulting from secretory cells); stipules absent. Flowers small, dioecious, apetalous, fascicled, corymbose or capitate. Calyx 3- (rarely 2–5-) lobed, funnel-shaped to globose or saucer-shaped, lobes valvate. Male flower: Stamens 2–30; filaments united into a column; anthers 2-celled, free or united into a mass, dehiscing longitudinally; rudimentary ovary absent. Female flower: Staminodes absent; ovary superior, sessile, 1-celled; stigma subsessile; ovule 1, almost basal. Fruit fleshy, usually dehiscing by two valves. Seeds erect, with a thin or fleshy, sometimes laciniate, often colored aril; endosperm copious, replete with fat and often starch, mostly ruminate; embryo small; cotyledons ascending or spreading, sometimes connate.

The trees are recognized chiefly by their habit, aromatic leaves, small dioecious flowers, and seeds that often are rich in fat and conspicuously arillate. Most of them are also characterized by a reddish sap (kino), which exudes from wounds in the tree and also appears on the freshly cut wood. Because of this feature many of the trees are known locally under the native names for blood, such as "darah" in the East Indies and "sangre" in Central and South America. The fruits of all of the members of the family are nutmeg-like in appearance, and though most of them have no aromatic properties, virtually all are rich in fats, and in many regions are the source of vegetable waxes and tallows utilized locally for making soaps and candles and even for medicinal purposes.

One of the characteristic anatomical features of the family is the occurrence in various plant parts of specialized cells containing a strongly astringent, tanniniferous substance, which is aqueous or bright yellow in the living plant, but subsequently takes on a distinctive red color on exposure to the air. These structures, designated by Solereder (1908) as "elongated sacs" and by Warburg (1897) as "tubes" (Schläuche) or "tube cells" (Schauchzellen), are found chiefly at the margin of the pith and in the secondary bast, where they are generally distinguished from the neighboring cells by their

[3] The family has two shrubby representatives, *Virola sessilis* (A. DC.) Warb. and *V. subsessilis* (Benth.) Warb., in the savanna region of Brazil. Cooper and Record (1931) report the Liberian species, *Pycnanthus Dinklagei* Warb., as a woody climber, with a stout stem and often resembling a tree, while according to Thiselton-Dyer (1913) this is a tree about 30 feet high.

larger lumina. They have also been noted in other soft-celled tissues of the vegetative and even the generative regions; in the veins of the leaf (Solereder); in the inflorescence axis, the flower stalks, the pericarp, and the outer membrane of the seed husk (Busse); in the cotyledons (Tschirch); even in the perigone and the stamens (Hallström). These structures are not to be confused with secretory cells, which occur in the leaves of a large number of species (frequently giving rise to pellucid dots), and are also found in the pith, bast, and primary cortex. The secretory cells are spherical in shape, according to Solereder, and their contents vary from semi-fluid in some cases to solid, crystalline and doubly refractive in others; the color of the contents is usually yellowish or reddish, but may be deep brown or almost black at times.

In addition to the elongated sacs or tube cells cited by Solereder and Warburg, apparently related tube-like structures, presumably joining the tube cells in the pith and bark, have been found running through occasional rays in the secondary xylem of all of the specimens examined in this investigation; to these the term *tanniniferous tubes* has been applied. (See Minute Anatomy and Plate I, 3.) So far as is known, such tanniniferous tubes do not occur in the wood of any other family. They are generally distinguished from the adjoining ray parenchyma cells by their great length, complete lack of pitting, and other features; the color of their contents is also distinctive. When a tree is wounded, the tanniniferous substance, or *kino* as it is commonly known, flows out of the bark as a bright yellow (sometimes reddish) sap which becomes dark red on exposure to the air, hardening in a short time into a dark red mass resembling sealing wax. The myristicaceous kino is about the same as the commercial product, which is derived from a variety of plants.

Sadtler[4] states that the commercial kino is a tannin extract somewhat resembling cutch, as well as a natural dyestuff very similar to catechu. It is obtained from *Pterocarpus erinaeceous* Lam. (West African kino), *P. marsupium* Roxb. (East Indian kino), *Butea frondosa* Roxb. and *B. superba* Roxb. (Bengal kino), and *Eucalyptus corymbosa* Sm. and other *Eucalyptus* species

[4] Sadtler, Samuel P.: *Industrial organic chemistry*. 4th ed., 1912, pp. 359, 497. J. B. Lippincott Co., Philadelphia.

(Australian kino). It ordinarily forms small, angular, lustrous black fragments, which crumble to a brown-red powder. Sadtler reports that it contains 30 to 40 percent of a tannin (kinotannic acid), analogous to catechutannic acid, together with phlobaphene; its important dye principals are kinöin ($C_{14}H_{12}O_6$) and its anhydride, kino-red ($C_{28}H_{22}O_{11}$). Schaer[5] investigated the kino in several Asiatic species of *Myristica* and found that it differed little from *Pterocarpus* kino in its physical properties, and further that it corresponded chemically with the latter in all important points. He found, however, that the thickened fresh kino sap of *Myristica* can be easily distinguished from that of *Pterocarpus*, in that the former contains distinctly crystalline calcium salts (specific calcium tartrate), although in varying amounts. The general similarity of the kinos obtained from different families was also pointed out by Hooper.[6]

The significance of kino to the living plant is, like that of tannin, not definitely known. Warburg, in support of his contention that kino is not solely an excretion or a protective substance, cites a statement by Rumphius (*Herbarium Amboinense*, II, 1750) that the nutmeg loses vigor and is inferior as a result of being notched or otherwise bled.

One of the earliest records of this kino is a note by Camello[7] that in his time the substance was collected from a wild sort of nutmeg in the Philippines (probably *Myristica Cumingii* Warb.) and used as a kind of dragon's blood. The sap (kino) from several American species of the family has also been used in the past as a blood-staunching (styptic) agent. The thickening characteristic of the substance derived from an East African species (presumably *Cephalosphaera usambarensis* Warb.) is so pronounced that the tree is designated as "sealing wax tree."

Economic Importance

Most of the Myristicaceae are essentially sapwood trees, or form a heartwood that is not distinctive and is readily deteriorated by insects and fungi. The outstanding characteristics of this group of woods are their relative light weight and softness and good working qualities. Despite their low strength and lack of durability, many of them are used locally for planks and door posts and other items of native house construction, as well as for cheap furniture, household utensils, and the like. They also find some application in making boxes of various kinds, although the susceptibility of the wood to insect attack tends to discourage this type of use.

[5] On a new kino in species of *Myristica*. *Pharmaceutical Journal*, 1896. Reported by Warburg (1897).

[6] *Agricultural Ledger*, No. 5, 1900. Reported by Warburg.

[7] Ray's *Historiae Plantarum*. Supp. to Vol. 3, p. 58. London, 1704.

On the other hand, several species have a distinct and attractive heartwood that is fairly dense, strong, and durable and appears suitable for cabinet work, panelling, and interior trim. Its uses, which so far have been entirely local, are for better types of house construction and heavy carpentry in general, for boat-building, and for furniture.

Myristica fragrans Houtt. is indigenous to the Moluccas (Spice Islands) where it has long been cultivated for its fruit, of which the hard ruminated albumen is the nutmeg and the aril is the mace of the spice industry. Capus (1930) states that the Malay Archipelago exports about 1000 tons of nutmeg and mace annually. Reunion, India, the Guianas, and the Antilles also contribute to the supply.

The nutmeg has lost much of its vogue, especially in perfumery, since the 18th century. It is still employed as an aromatic spice, but finds its widest use in pharmacy, as a circulatory stimulant. The trade also recognizes what is known as the male nutmeg (muscade mâle), a product of *Myristica argentea* Warb. of New Guinea. This is a longer nut than the true nutmeg, and much less esteemed, being lighter and less aromatic. The so-called Madagascar nutmeg is not related to the true nutmeg, being the fruit of *Ravensara aromatica* Sonnerat., of the family Lauraceae.

The true mace (Banda mace) of commerce also finds its chief use as a spice and medicinal ingredient. Wiesner (1903) reports two other kinds of mace, namely New Guinea mace from *M. argentea* and Bombay mace from *M. malabarica* Lam., but says that only the first can be regarded as a serviceable substitute for the genuine.

According to Wiesner (1900) there are several types of fatty products derived from the fruits of the Myristicaceae. The best-known of these is the "nutmeg butter," expressed from the nutmeg of *Myristica fragrans*. This comes into the trade in cubical pieces of tallowy consistency, packed in palm leaves or paper. It is employed medicinally (as "oleum rusticae" or "balsamum rusticae") and also used in perfumes. "American nutmeg butter," or "otoba fat," has been made from the seeds of *Dialyanthera otoba* (H. & B.) Warb. in Colombia and used for the same purposes as that from *Myristica fragrans*. Other South American products of this type include "bicuhyba fat" from *Virola bicuhyba* (Schott) Warb., "oil nut fat" from *V. surinamensis* (Rol.) Warb., and "Virola fat" from *V. sebifera* Aubl. These fatty substances are commonly used locally for making candles and soap.

General Distribution

The Myristicaceae are rather widely distributed in the tropics of both hemispheres, although there are wide stretches in this extended region in which none is found. According to

Warburg's classification, no genus is common to any two of the three chief regions of distribution (America, Asia, and Africa). Upwards of 250 species have been described, by far the greatest number belonging to the Asiatic genera *Myristica*, *Horsfieldia*, and *Knema*; the fourth Asiatic genus, *Gymnacranthera*, is moderately well represented. Of the American genera, *Virola* is the only one with a considerable number of species; *Iryanthera* is very moderately represented, and only a few species are known of *Compsoneura*, *Dialyanthera*, and *Osteophloeum*. The African genera *Cephalosphaera*, *Coelocaryon*, *Pycnanthus*, *Scyphocephalium*, and *Staudtia*, and the two, *Brochoneura* and *Mauloutchia*, that are limited to Madagascar, are all small, endemic groups.

The southern limits of the family are set by one species in northeast Australia (Queensland) and one in the Province of Santa Catharina in southern Brazil, while the most northerly extensions occur in Bengal and Silhet and in southern Mexico. Warburg (1897) considers it noteworthy, from the point of view of plant geography, that the Myristicaceae have not been found in South China, Hainan, or Formosa, and attributes their apparent absence in Upper Siam to imperfect knowledge of the flora of that region.

While the family is mostly confined to the mainland in Central America, South America, and Africa, it is well developed in the East Asian-Polynesian Islands. It is abundantly represented in the entire Malay Archipelago, the Philippines, and Papua (New Guinea), and there are species in the Bismark (New Britain) Archipelago, Solomon Islands, New Hebrides, Fiji Islands, and in Tonga and Samoa.

In the Indian Ocean, members of the family are found in Ceylon and the Andaman and Nicobar Islands, but not on the coral Laccadive and Maldive Islands, nor on the Keeling Islands. Several species are native to Madagascar, but none has been reported from Mauritius, Reunion, or the Seychelle Islands. In the West Indies the family is represented by a single species that is widely distributed on the mainland and appears in the Windward Islands as far north as Martinique.

Warburg found that Wallace's Line, so named by Huxley who, upon the basis of Wallace's work, regarded it as the line

of separation between the Oriental and Australian biologic regions, was of secondary importance in the geographical distribution of this family. All four of the Asiatic genera and even individual species, such as *Horsfieldia irya* (Gaertn.) Warb., *Knema intermedia* (Bl.) Warb., and *K. laurina* (Bl.) Warb., overstep the line. East of Wallace's Line, *Horsfieldia* and *Knema* decrease more than *Myristica*.

The natural range of the family does not include the strictly oceanic islands, far distant from the mainland. Warburg attributes this fact to the lack of means for transporting the seeds across wide ocean expanses. The nut is too large to be carried far by birds, the embryo is perishable, the seed scale is not hard enough to withstand sea water for a prolonged period of time, specific gravity of the nut is too high (due to the abundant fat content) to permit floating, and there is no floating device on the fruits.[8] Even local distribution is dependent primarily upon birds large enough to carry the seeds.

The Myristicaceae seem unable to adapt themselves to cold conditions and in general do not extend beyond the foothills in the mountainous regions of South India, Ceylon, and Java, or in the South American Andes. Instances of trees reported at higher altitudes include *Dialyanthera otoba* (H. & B.) Warb., found by Humboldt and Bonpland at 2000 feet in the Andes; *Coelocaryon Preussii* Warb., recorded by Thiselton-Dyer at 2600 feet in Cameroons; and *Myristica speciosa* Warb. found by both Bernstein and Warburg at elevations of 2600 to 3800 feet on the Moluccan Island of Batjan. Warburg also discovered one species at a height of 3500 feet in the South Celebes and another between 3000 and 4000 feet on the Island of Sumbawa; he considers the Asiatic genera *Myristica* and *Horsfieldia* the most capable of adapting themselves to lower temperatures.

The Myristicaceae are not much more adaptable to drought than they are to cold. The American genus *Virola* seems best

[8] Warburg cites the hollow seeds of *Horsfieldia irya* as an exception and suggests that it is perhaps due to the floating ability attained in this way that this species has been able to secure a distribution from Ceylon to Siam and Malacca, which is exceptionally wide for the family.

able to endure a dry climate, since two of its species, *V. sessilis* (A. DC.) Warb. and *V. subsessilis* (Benth.) Warb., are found in the savanna region of Brazil (Provinces of Bahia and Matto Grosso); both are small and shrubby. Within the forest there are a number of species that live on relatively dry subsoil; Warburg reports that in the Buitenzorg district of Java certain species of *Knema*, *Horsfieldia*, and *Myristica* seem to prefer the limestone rocks (Kalkfelsen) which rise in the plains. However, the great majority prefer both dense forest shade and a moist subsoil, and accordingly are most abundant in the lower story [9] of the more or less evergreen forests of the plains and lower mountain regions.

The usual height range is from 20 to 60 feet, but Warburg cites as exceptions such trees as *Cephalosphaera usambarensis* Warb., *Myristica iners* Bl., *Pycnanthus microcephalus* Warb., *Virola bicuhyba* (Schott) Warb., and *V. rugulosa* Warb., which are sometimes 100 feet or taller. Among those less than 20 feet high are *Virola venosa* (Benth.) Warb., *V. elongata* var. *punctata* Warb., and *Compsoneura debilis* (A. DC.) Warb.

Taxonomy of the Genera and Sections

References to the nutmeg trees appear in the earliest botanical works dealing with the East Asian region, but it was not until 1742 that Linnaeus established the genus *Myristica*. During the ensuing 63 years, other closely related genera were recognized, namely *Virola* in 1775, *Knema* in 1790, and *Horsfieldia* in 1805. Following the establishment of the family Myristicaceae in 1810, the three last-named groups were recognized by some authorities as distinct genera, while others subordinated them to the position of sections under the genus *Myristica*. The latter stand was taken by Hooker and Thomson (1855), although with some reservations, as may be judged from their introduction to the discussion relating to the Myristicaceae, in which they state: "There are, no doubt, several very distinct genera among the nutmegs, but the structure (especially that of the female

[9] Den Berger and Endert (1925) state that in the Dutch East Indies the representatives of the family usually belong to the middle story of the forest (crown height 25 to 35 meters) and have a diameter seldom more than 70 to 80 cm.

flower) is so very little known, that the time has not yet come for establishing these genera on a secure basis."

The first comprehensive survey of the family was made by De Candolle (1856), who grouped the approximately 80 to 90 species then known into the following 13 sections of the single genus *Myristica:*

Section I: *Eumyristica* A. DC. Tropical Asia.
" II: *Caloneura* A. DC. Asia, and one species in Brazil.
" III: *Virola* Aubl. (as genus). South America.
" IV: *Sychnoneura* A. DC. South America.
" V: *Otoba* A. DC. South America.
" VI: *Compsoneura* A. DC. South America.
" VII: *Gymnacranthera* A. DC. East Indies and Philippines.
" VIII: *Horsfieldia* Willd. (as genus). Asia.
" IX: *Dictyoneura* A. DC. Madagascar.
" X: *Iryanthera* A. DC. South America.
" XI: *Irya* Hook. f. & Th. Asia.
" XII: *Pyrrhosa* Blume. Asia.
" XIII: *Knema* Blume. Asia.

Bentham and Hooker (1880) also recognized but one genus, *Myristica*, but reduced De Candolle's 13 sections to 7, discarding *Dictyoneura* and combining other sections as indicated below:

Section I: *Eumyristica* (*Eumyristica* and *Caloneura* A. DC.). Asia (one Australian species).
" II: *Virola* A. DC. America.
" III: *Pyrrhosa* Blume. Asia.
" IV: *Gymnacranthera* (*Gymnacranthera* and *Compsoneura* A. DC.). America.
" V: *Otoba* (*Sychnoneura*, *Otoba*, and *Iryanthera* A. DC.). America.
" VI: *Irya* (*Horsfieldia* and *Irya* A. DC.). Asia and Africa.
" VII: *Knema* Blume. Asia.

Bentham and Hooker's classification was generally accepted until 1897, when Warburg published his outstanding treatise on the family, in which the 235 species then known were assembled into 15 distinct genera, including the previously established *Myristica*, *Virola*, *Knema*, and *Horsfieldia;* an additional genus, *Cephalosphaera*, was recognized by Warburg in 1903. These genera, outlined below, show a definite geographical grouping, 5 being American, 4 Asiatic, and 7 African (and Madagascar).

A. American genera:
Genus I: *Iryanthera* Warb. (=sect. *Iryanthera* A. DC. and *Gymnacranthera* Bth. quoad sp. amer.).
" II: *Osteophloeum* Warb. (=sect. *Caloneura* A. DC. quoad sp. amer.).
" III: *Dialyanthera* Warb. (=sect. *Otoba* A. DC.).
" IV: *Compsoneura* Warb. (=sect. *Compsoneura* A. DC.).
Sect. 1: *Eucompsoneura.*
Sect. 2: *Coniostele.*
" V: *Virola* Aubl.
Sect. 1: *Oxyanthera* Warb.
Sect. 2: *Amblyanthera* Warb.
} (=sect. *Virola* Endl. and *Sychnoneura* A. DC.).

B. Asiatic genera:
Genus I: *Knema* Lour. (=sect. *Knema* Bl.).
" II: *Myristica* L. (=sect. *Eumyristica* Hook. f. and Th.;=sect. *Eumyristica* and sect. *Caloneura* A. DC.).
" III: *Gymnacranthera* Warb. (=sect. *Gymnacranthera* A. DC.).
" IV: *Horsfieldia* Willd.
Sect. 1: *Pyrrhosa* Bl. (=sect. *Pyrrhosa* Bl. pro parte).
Sect. 2: *Irya* Hook. f. & Th. (=sect. *Irya* Hook. f. & Th.).
Sect. 3: *Ortbanthera* Warb. (=sect. *Pyrrhosa* Bl. pro parte and sect. *Horsfieldia* A. DC.).

C. African-Madagascar genera:
Genus I: *Mauloutchia* Warb. (=sect. *Mauloutchia* Baill.).
" II: *Brochoneura* Warb. (=sect. *Dictyoneura* A. DC.).
" III: *Cephalosphaera* Warb.
" IV: *Staudtia* Warb.
" V: *Scyphocephalium* Warb. (=sect. *Irya* Benth.—non Hook. f. & Th.—quoad sp. afr. pro parte).
" VI: *Coelocaryon* Warb.
" VII: *Pycnanthus* Warb. (=sect. *Irya* Benth.—non Hook. f. & Th.—quoad sp. afr. pro parte).

Engler and Prantl (1891) at first accepted De Candolle's classification, but later (1897) adopted Warburg's subdivision of the family. In connection with their changed point of view they state, in effect, that the better knowledge of the family makes it possible to recognize a number of genera, which are well separated from one another and not combined through transitions; and that almost throughout these genera show distinct differences, not only in flowers and inflorescence, but in fruit and leaves as well. They also comment upon the fact that the groups are very sharply defined geographically.

Later investigators of the Myristicaceae have been divided

into two camps, namely, those who have accepted Warburg's classification *in toto* and those who more or less follow De Candolle or Bentham and Hooker and consider that all of the known species belong to the single genus *Myristica*, or at least to a much more restricted number of genera than Warburg established. American and African workers are largely of the first group, while many in the Asiatic field contend that, for the species of that region at least, there is no justification for recognizing more than the one genus, *Myristica*. Hutchinson (1926) evidently inclines toward Warburg's point of view, although he does not definitely commit himself, merely citing as examples of the family: "*Myristica*, *Pycnanthus*, etc."

In this investigation, Warburg's classification has been adhered to. This was done, not only because it seemed to be the logical procedure, but also because of its convenience. Almost all of the wood specimens in the Yale collections had already been assigned to the genera established by Warburg, and it was a simple problem to determine the appropriate genera for the small amount of unclassified material.

Notes on the Genera

In the following paragraphs are incorporated the salient facts concerning the distribution, uses, and other features of each of the 16 genera enumerated by Warburg. The genera are treated alphabetically by regions.

American Genera

Compsoneura Warb. (Ber. Deutsch. Bot. Ges. 13:94. 1895) is a small genus, native to southern Mexico, Central America, and northern South America.

It is represented by 5 species, 4 of which are apparently localized in distribution; the fifth, *C. Sprucei* (A. DC.) Warb., is found in southern Mexico and Central America and also in Rio Negro in northern Brazil. The Mexican representatives were originally designated as *Myristica mexicana* Hemsl., but Warburg (1897) regarded this as synonymous with *C. Sprucei*. Standley (1922: 284) contends that further study will probably show that the Mexican plant is a separate species. The members of the genus are reported by Warburg (*loc. cit.*) to be trees, although one species, *C. debilis* (A. DC.) Warb., is said to be dwarfed, attaining a height of but 3 to 10 feet, with a stem scarcely thicker than a finger; Standley (*loc. cit.*) states that *C. Sprucei* is a shrub or small tree.

The wood is variable from light and soft to more often medium light and soft [10] and without distinctive color. It is easy to work and split, and evidently not durable.

Dialyanthera Warb. (Nov. Act. Acad. Nat. Cur. 68: 126. 1897) is a South and Central American genus, with but 4 known species, all trees.

Three species are very restricted in their known range, two occurring in Panama and the other in the Peruvian Andes. The fourth species, *D. otoba* (H. & B.) Warb., was originally reported from Colombia and eastern Peru, and subsequently found in Panama. In its South American range it occurs on the mountain slopes, at about 3000 feet above sea level, where it attains a height of 40 to 50 feet. According to Bonpland,[11] attempts to plant the tree on the tableland at Bogatá were not successful.

The wood is light and soft and light reddish brown in color. That of *D. otoba* is reported as used principally for ceiling boards, and the seeds of the same species yield a fat which is widely used in Colombia as a domestic remedy for cattle parasites.

Iryanthera Warb. (Nov. Act. Acad. Nat. Cur. 68: 126. 1897), with 10 or more known species, is presumably confined to the northern end of South America, ranging from Peru, through Colombia and the Guianas, to northern Brazil. It appears to be best represented in Peru and the Amazon region of Brazil. The species are small to medium sized trees.

The wood is variable from light and soft to hard and heavy, is easy to work, and for the most part takes a good finish. The heartwood of some species has a distinctive and attractive reddish color and offers possibilities as a cabinet wood. The material is rather variable in strength and presumably in durability, depending on the density of the wood and the character of the infiltrated materials. Little information is available as to the uses of the wood, but according to Pfeiffer (1926: 164) that of *I. Sagotiana* (Benth.) Warb. is probably suitable for cheap furniture, base boards, box boards (such as cheap cigar boxes), etc.

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[10] The density and hardness classification used in this report is that suggested by Cooper and Record (1931: 129).

[11] Reported by Warburg (1897).

Osteophloeum Warb. (Nov. Act. Acad. Nat. Cur. 68: 127. 1897) is a monotypic genus, native to northern Brazil and Peru. In the former region its reported habitat is the secondary forest, but little or no information is available concerning the character of the tree or its uses. The wood is medium light and soft, and light brown in color.

Virola Aubl. (Pl. Guy. 904. 1775), with 34 or more known species, has the widest range of all the American genera, being distributed over most of northern South America and virtually all of Central America.

The watershed of the Amazon River, especially the upper region, and the Guianas are rich in species. Of the five species reported from Central America, none extends into the southern continent; three of them are found in Panama and one in British Honduras, while the other is distributed throughout all of Central America, from Panama to Guatemala and British Honduras. One extends from Dutch Guiana through the Windward Islands as far north as Martinique. The hot valleys of Colombia and Peru, lying toward Brazil, possess a number of species, but only two extend toward southern Brazil. The genus is only sparsely represented in Bolivia and unknown in Chile and Argentina.

The representatives of the genus are essentially small or large trees, some of which are only 12 to 20 feet high, while others attain a height of 100 feet or more. Two species inhabiting the western part of the savanna region of Brazil, namely *V. sessilis* (A. DC.) Warb. and *V. subsessilis* (Benth.) Warb., are small shrubs. Certain trees of this genus are reported to be sapwood trees. Record and Mell (1924: 169) state that "there are apparently two kinds of dalli trees [*V. surinamensis* (Rol.) Warb.], for although they are similar in appearance, one is a so-called sapwood tree and the other has a red-brown heart and is distinctly a heartwood tree." The same authors also report (p. 170) that different qualities are recognized in the wood of *V. bicuhyba* (Schott) Warb., although it is not definitely known whether such variations are associated with dissimilarities in conditions of growth, or are actually attributed to a difference in species.

The seeds of at least two species are used locally; those of *V. Warburgii* Pittier, of Panama, are highly resinous and burn readily with a luminous flame, being used for torches by the Indians, who fasten them on the ends of sticks; those of *V. surinamensis* yield a valuable vegetable wax or tallow, used in making candles and soap. The seeds of *V. sebifera* Aubl. are reported to yield 68 per cent fat.

The woods in general are easy to split and work, take a smooth finish, and hold their shape well; *V. sebifera* and *V. surinamensis* are reported to be difficult to finish because the wood is extremely fissile, especially in the radial direction,

strips of wood ripping out and exposing the silver grain in most unusual manner. For the most part the woods are evidently low in durability and subject to deterioration by various wood-boring insects; they are quite variable in strength, depending primarily on the density of the material. The better quality of wood is adapted to higher class carpentry, joinery, certain types of furniture, and general construction. The inferior material supplies some lumber for local use, especially light construction, but its utility is limited by its low strength and lack of durability; it has some use for coffins and boxes of varied kinds. Stevenson and Stevenson (1925) report the timber of *V. panamensis* (Hemsl.) Warb. as exported from British Honduras to the United States, mostly for the manufacture of veneer.[12]

Asiatic Genera

Gymnacranthera Warb. (Nov. Act. Acad. Nat. Cur. 68: 131. 1897), with 11 or more known species, is distributed from southern India to New Guinea, with Borneo and the Malay Peninsula as its chief centers.

In addition to these specifically designated regions, it has also been reported from the Moluccas and the Philippines. All species are medium-sized trees, attaining heights of 60 feet or more, and occur in the evergreen forests of the lowlands and lower mountain slopes up to an elevation of 2000 feet. Watt (1908: 791) reports that the seeds of *G. canarica* (King) Warb., designated by him as *M. canarica* Bedd., contain half their weight of a fat, consisting largely of myristicin, which is made into candles.

The wood is variable from medium light and soft to medium hard and heavy. The heartwood is generally considered as not clearly distinct from the light brown sapwood, but in one of the available specimens of *G. paniculata* (A. DC.) Warb. it has a distinctive deep chocolate brown color. The wood of *G. canarica* is reported by Pearson and Brown (1932: 815) as easy to work and finishing to a good surface. It is moderately durable under cover, but liable to attack by large borers. While not used locally, in southern India, it is a fair plank wood, somewhat similar, but superior, to those of the tea-box and packing-case class.

[12] For further information regarding *V. panamensis* see Stevenson and Stevenson (1925) and Anonymous (1923).

Horsfieldia Willd. (Spec. Plant. 4: 872. 1805), with approximately 51 known species, is rather widely distributed in the most moist parts of the Asiatic Monsoon region, from India to New Guinea and Micronesia (Japanese Mandate).

It is found, with 2 representative species, in the eastern Himalaya region,[13] and extends through the western part of Burma and Siam into the Malay Peninsula, where it reaches its greatest multiplicity with 18 species. It appears in Java with 3 species, in the Moluccas with 10, and in Papua (New Guinea) with 12; to the north it is rather sparsely represented in the Philippines and Micronesia. The genus is not found in southern India, although 2 species are known in neighboring Ceylon. Many of the species are more or less endemic, but one, *H. irya* (Gaertn.) Warb., extends throughout almost the entire generic range. The representatives of the genus are mostly medium-sized trees, attaining a height of 40 to 70 feet, although a few are relatively small and several grow to 100 feet or more.

Heyne (1927) reports the seeds of a number of species of *Horsfieldia* as having a high proportion of fat, which has been used to some extent in making candles; the natives of Aroe use the oil externally as a therapeutic heating agency. The bark and leaves of *H. glabra* (Bl.) Warb. are used as "aromatica," especially for intestinal complaints; the bark and kino of *H. valida* (Miq.) Warb. serve as a remedy against sprue. The mace of an undetermined species yields a fiery red dye principle which the natives of Amboyna use on their teeth.

The wood is variable from rather light and soft to medium hard and heavy. In most species the heartwood is apparently not distinct from the light (usually somewhat reddish) brown sapwood. In general the wood is not very strong or tough and is susceptible to decay and insect attack. It splits readily and is rather easy to work, taking a moderately good finish. From various sources it is reported that the material is not suited for building purposes because of its low durability, although it is occasionally used for light or temporary construction (as beams or planks) due to its ease of working. It is generally considered that the wood is best suited for boxes of various kinds.

Knema Lour. (Flora Cochinch. 609. 1790), with approximately 38 species, is distributed from India to the Philippines.

It has its chief seat in the Malay Peninsula (14 species) and adjacent Sumatra (9 spp.) and Borneo (13 spp.); many of the species are found in all

[13] Warburg (1897) considers that the inability of *Horsfieldia* to withstand marked dry periods is responsible for the fact that the genus has not spread toward the somewhat drier Middle and West Himalaya.

three regions. From there it extends in all directions, with rather regularly decreasing numbers, although it is fairly abundant in the Philippines (about 10 spp.). It has no representatives in Ceylon and Papua (New Guinea) and but one in southern India and Formosa, the latter species also being found in the Philippines. This genus, like *Horsfieldia*, is limited to the most moist parts of the Asiatic Monsoon region. The species are small to more often medium-sized, occasionally large, trees. The seeds of many contain a high proportion of fat, which has been used by the natives in some regions for lamp oil, in making candles, etc. Heyne (1927) reports that a decoction of scrapings of the bark of *K. palembanica* (Miq.) Warb. is taken for bowel trouble by the natives in the Dutch East Indies.

The wood is medium light and soft to about as often medium hard and heavy, with a heartwood which is scarcely or not at all distinguished from the light brown sapwood. It is often of more than moderate strength, splits easily and straight, and is easy to work, but is readily deteriorated by decay and insects. It is not generally adaptable for building purposes, on account of its insufficient durability, although it has occasionally been reported as used by the natives in various regions for light and temporary construction, cheap furniture, and household utensils. It has been suggested by a number of writers as a possible wood for boxes of various types, such as tea and cigar boxes.

Myristica Linn. (Gen. Plant. 2: 524. 1742), the largest genus of the family, has more than 80 species, widely distributed from India to the Philippines, Australia and Polynesia.

It is the predominating genus in southern India and Ceylon, but is completely lacking in the northern part of India and in Burma. It has but a single representative in the Andaman Islands, but appears more abundantly in the Malay Peninsula (10 species), the larger Sunda Islands (6 spp. in Sumatra, 3 in Java, and 7 in Borneo), and eastern Malaysia (3 spp. in Celebes and 6 in the Molucca Islands). It attains its greatest representation in the Philippines (18 spp.) and New Guinea (33 spp.). Four species in the Fiji Islands and two in Samoa and Tonga mark a gradual extinction of the Monsoon flora in the direction of the island projections from southeast Asia. The two species occurring in Australia and the single one reported from the island of Ponape in Micronesia (Japanese Mandate) represent other extremes of distribution of both the genus and the family. While *Myristica* is essentially an inhabitant of the more moist sections of the Monsoon region, some of its species are able to withstand at least short dry periods; this is evidenced by the occurrence of the genus in Queensland, Timor, Sumbawa, and Samoa. Its representatives are all trees, some very large.

The wood is variable from light and soft to medium hard and heavy (mostly medium light and soft). The heartwood has a characteristic dark reddish brown color in two specimens (*M. iners* Bl. and *M. litoralis* Miq.), but usually is not very distinct from the light brown sapwood. In general the wood splits rather readily and straight, is easy to work and finishes well, but is not strong. It is of low to moderate durability and rather quickly deteriorated by insects. It is used to some extent locally for building purposes, despite its lack of resistance to decay, and has some possibilities in the manufacture of boxes of various types.

African Genera

Brochoneura Warb. (Nov. Act. Acad. Nat. Cur. 68: 128. 1897), with 3 or 4 known species of good-sized trees, is endemic to Madagascar, although Warburg (1897) reports that *B. madagascariensis* (Lam.) Warb. has been cultivated in Mauritius.

Seeds of one species, provisionally named *B. Freneei* Heckel, are said to yield "oil of mafotra," valued by the natives for the treatment of itch and various sores, and also reputed to destroy vermin. The women use it for anointing their hair. An average tree yields about 30 kilograms of seeds, from which are extracted approximately 2½ liters of oil.

Little or no information is available concerning the uses of the wood, which is variable from medium light and soft to very hard and heavy and light grayish brown in color.

Cephalosphaera Warb. (Engl. Bot. Jahrb. 33: 383. 1903) is a monotypic genus, its single species, *C. usambarensis* Warb., being native to the Mozambique and Tanganyika districts of East Africa. Warburg (1897) originally included it in the genus *Brochoneura*, but subsequently (1903) segregated it. The tree is found in the virgin forest, about 3000 feet above sea level, where it attains a height of 160 feet. The wood is medium light and soft and light grayish brown in color. Its uses are not reported.

Coelocaryon Warb. (Notizbl. Königl. Bot. Gart. Berlin. 99. 1895) is distributed from French Guinea to Gaboon and Belgian Congo. The four species are trees, ranging in height from

about 30 to 50 feet (*C. Klainii* Pierre) to 100 feet tall and 4 feet in diameter (*C.* aff. *oxycarpum* Stapf). They are found at elevations ranging up to 1400 and 2600 feet.

The wood varies from light and soft to medium light and soft and is easy to work. The heartwood often has a faint reddish or yellowish tinge, but is not especially distinct from the pale brown sapwood. The timber of the Liberian *C.* aff. *oxycarpum* is reported by Cooper and Record (1931: 21) as capable of taking a smooth finish and holding its place well when put into use; it has little or no resistance to decay or to insect attack, but is employed locally for canoes, planks, and timbers. The fruits and leaves of this tree are sometimes used medicinally to overcome abnormal drowsiness.

Mauloutchia Warb. (Nov. Act. Acad. Nat. Cur. 68: 128. 1897) is endemic to Madagascar. The single species, *M. Chapelieri* (Baill.) Warb., is said to be a small tree, but there is little information available concerning it. Since there are no specimens of the wood in the Yale collections, it is not considered in the later discussions of the woods of the family.

Pycnanthus Warb. (Ber. Deutsch. Bot. Ges. 13: 94. 1895) is a widely distributed African genus, with 5 endemic species, three of which are reported as imperfectly known.

For the most part it is confined to the west coast of Africa, from French Guinea to Angolo, but one species (*P. Schweinfurthii* Warb.) is native to the Congo Free State (South Central Africa) and one variety (*P. kombo*, var. *sphaerocarpa* Stapf) is reported by Thiselton-Dyer (1913) as occurring in Nile Land in East Africa. All are tall trees, with the exception of *P. Dinklagei* Warb., which is reported as a tree about 30 feet high by Thiselton-Dyer (*loc. cit.*) and Unwin (1920) and as a "woody climber, with stout stem often resembling small tree" by Cooper and Record (1931). The best known and most widely distributed species is *P. kombo* (Baill.) Warb., a tree up to 80 or 100 feet in height and 3 to 4 feet in diameter, which is well represented in the evergreen forest, up to an altitude of 2400 feet in the mountain regions.

Cooper and Record (1931) report that the inner bark of *P. kombo* is used by the natives for treating toothache, being macerated and mixed with salt and then applied as a poultice, while the macerated bark of *P. Dinklagei* is employed in treating leprosy, being rubbed over the body and spread on the sleeping mat of the patient. The seeds of the former species have been sold for their oil on the Liverpool market, under the name of Kombo seed or Kafu seed. Thiselton-Dyer (1913) states that the seeds of *P. kombo* contain great quantities (up to 72 per cent) of a fat; according to Welwitsch they burn

like tapers even when fresh, and for that reason are used locally for illuminating purposes.

The wood of *Pycnanthus* is medium light and soft, and grayish brown in color. It is easy to work, finishes smoothly, and holds its place well in use. The material is not resistant to decay or to insect attack, but is used by the natives for making canoes, for light building purposes (planks, roof shingles, etc.), and to some extent for boxes.

Scyphocephalium Warb. (Ber. Deutsch. Bot. Ges. 13: 84. 1895) is a West African genus, of 3 endemic species, two of which are known to be large trees, sometimes 100 to 120 feet tall. They have been reported from southern Nigeria to Gaboon.

There is little information available concerning either the trees or the wood. The single wood specimen of *S. ochocoa* Warb. in the Yale collections is medium light and soft, and light brown in color, with irregular chocolate brown to black markings.

Staudtia Warb. (Nov. Act. Acad. Nat. Cur. 68: 128. 1897) is a West African genus, with 4 endemic species, one of which is imperfectly known. Its members are trees, the better known species of which range up to 100 feet or more in height. The genus is apparently rather restricted in its distribution, extending from southern Nigeria to Portuguese Congo, with the imperfectly known species, *S. pterocarpa* Warb., reported from the Island of St. Thomas.

Little is known about the wood of any of the species, except *S. gabonensis* Warb., although Unwin (1920) reports that of *S. stipitata* Warb. and *S. kamerunensis* Warb. as hard, and hard and reddish, respectively. This denotes a distinct similarity with the material available in the Yale collections, which is medium hard and heavy to hard and heavy and possessed of a light orange red to dark reddish brown heartwood, at times marked with a slightly darker stripe. Méniaud (1931) says that some trees furnish a more reddish heartwood than others.

According to Méniaud (*loc. cit.*), the wood of *S. gabonensis* is rather difficult to work, although it takes a beautiful finish, is rather fissile, with marked resistance to bending and compression, and moderately tough and stiff. It seasons fairly well, but is somewhat susceptible to shrinking and swelling in service, making it desirable to quarter-saw the material and to use it in narrow widths. The heartwood is said to be resistant to decay and insect attack. Suggested uses include frames and veneer for cabinet work and interior carpentry, heavy carpentry, special framing, stairs, flooring, and carriage and wagon building. Méniaud adds that the difficulties experienced in machining the wood have been one of the principal obstacles to its becoming popular. It is employed by the natives of Cameroon for making paddles and oars.

Description of the Woods of the Myristicaceae

Material

All of the wood specimens studied for this report are in the collections of the Yale School of Forestry. Many of them were contributed expressly for this investigation by members of the International Association of Wood Anatomists.[14] There are 165 specimens of mature secondary xylem, representing 82 species and 15 genera. No samples of the Madagascar genus *Mauloutchia* were available.

The amount of material for the different genera is as follows:

Brochoneura Warb.—1 specimen of 1 species; 2 unassigned.
Cephalosphaera Warb. (monotypic)—1 specimen.
Coelocaryon Warb.—5 specimens of 2 species.
Compsoneura Warb.—7 specimens of 3 species.
Dialyanthera Warb.—4 specimens of 2 species.
Gymnacranthera Warb.—6 specimens of 4 species.
Horsfieldia Willd.—22 specimens of 12 species; 3 unassigned.
Iryanthera Warb.—18 specimens of 7 species; 1 unassigned.
Knema Lour.—28 specimens of 18 species.
Myristica Linn.—19 specimens of 14 species; 1 unassigned.

[14] The writer wishes to acknowledge his indebtedness to the following members of the International Association of Wood Anatomists, from whom much of the material used in this investigation was obtained: Dr. Laurence Chalk, Imperial Forestry Institute, Oxford, England; Mr. Jean Collardet, Comité National des Bois Coloniaux, Paris; Mr. K. A. Chowdhury, Forest Research Institute, Dehra Dun, India; Mr. Harold E. Desch, Forest Research Institute, Kepong, Federated Malay States; Dr. H. H. Janssonius, Koloniaal Instituut, Amsterdam; Dr. C. R. Metcalfe, Royal Botanic Gardens, Kew; and Mr. Luis J. Reyes, Philippine Bureau of Forestry, Manila.

Osteophloeum Warb. (monotypic)—2 specimens.
Pycnanthus Warb.—3 specimens of 1 species.
Scyphocephalium Warb.—1 specimen.
Staudtia Warb.—3 specimens of 1 species; 1 unassigned.
Virola Aubl.—35 specimens of 14 species; 2 unassigned.

Macroscopic Features

General properties. With few exceptions, the woods of the family Myristicaceae are within the range of light and soft to medium hard and heavy, having a specific gravity (based on thoroughly room-dry weight and volume) of 0.35 to 0.77 and a weight of 22 to 48 lbs. per cu. ft.;[15] some of the specimens of *Staudtia gabonensis* and *Iryanthera tricornis* are hard and heavy, with a specific gravity ranging from 0.87 to 0.94 and a weight of 54 to 59 lbs. per cu. ft.; one specimen of *Brochoneura* (23625) had a specific gravity of 1.01 and a weight of 63 lbs. per cu. ft. The grain is predominantly straight, although in some cases it tends to be more or less interlocked; the texture is uniform and variable from fine to somewhat coarse.

The sapwood is primarily light brown in color, with an often pronounced grayish or pinkish cast. In many cases the heartwood is not particularly distinct, but in some of the available specimens (*Gymnacranthera paniculata*, *Iryanthera* pro parte, *Myristica* pro parte, *Staudtia*, and *Virola* pro parte) it is appreciably darker than the sapwood, varying from deep red to chocolate brown. In the lighter colored material the presence of definite bands of parenchyma may give rise to more or less distinct and somewhat reddish markings on the longitudinal surfaces; the definite heartwood specimens sometimes show a rather fine, light to dark striping, independent of the parenchyma lines.

With the possible exception of the deeply colored heartwood specimens, the woods are of general low durability,

[15] All values for weight per cubic foot have been computed from the determined specific gravities and, consequently, apply to material in the thoroughly room-dry condition only.
The density and hardness classification followed in this study is that used by Cooper and Record (1931: 129), which was chosen because it applies to material in the same thoroughly air-dry condition as the woods under consideration.

being readily deteriorated by wood-destroying fungi when used in contact with the ground; they are also subject to attack by wood-boring insects. For the most part the material is not strong and is relatively easy to split and to work with tools. It saws readily and usually planes to a smooth surface (in a few cases the fibers tend to pull out and the wood is difficult to finish smoothly); some of the dark colored heartwood specimens take a beautiful finish. The wood holds its shape well, except for some of the denser pieces, and has good nailing characteristics.

Growth Rings[16] present or absent. In majority of specimens delimited by concentric lines of wood parenchyma, which may be lighter than background and hence distinct to unaided eye, or more or less reddish and barely visible. In *?Brochoneura* sp. (23626), *Cephalosphaera*, *Horsfieldia canarioides* (?) (23601), and *Virola* (pro parte) occasional indefinite rings are noted, being demarcated by darker (denser) lines or narrow bands, formed by rows of flattened wood fibers. Growth rings are indiscernible and apparently lacking in *Coelocaryon oxycarpum*, *Dialyanthera*, *Horsfieldia canarioides* (?) (23602), *H. oblongata*, *Myristica simiarum*, *Pycnanthus*, *Staudtia gabonensis* (pro parte), and *Virola* (pro parte).

Parenchyma not visible in the material cited above. In the other available specimens occurs in concentric metatracheal or terminal lines or bands, more or less distinct to the unaided eye, depending on color contrast with background. These lines are usually variable in frequency, but mostly numerous, two to several often being close together; in addition they occasionally anastomose and at times are discontinuous. Paratracheal parenchyma present in all specimens, but not discernible without microscope.

Pores[17] very few to moderately few, or at times moder-

[16] Most of the woods examined show a certain periodicity of wood formation, due to the presence of concentric bands or lines of wood parenchyma cells or of flattened (or otherwise modified) wood fibers, which are more or less distinct from the ground mass of the wood. In this investigation these markings are considered to be growth ring boundaries.
[17] The designations of abundance and size of pores follow the classification proposed by Chattaway (1932).

ately numerous, and well distributed. Small to moderate-sized, or in a few specimens very small to small, and variable from fairly distinct to indiscernible to unaided eye. Occur singly or in radially flattened pairs; radial groups of 3 occasionally noted; in many specimens groups of 4 or 5 also found. In some cases solitary pores predominate, in others radial pairs are more abundant, and in still others the two are equally well represented.

Vessel lines straight, very fine to rather coarse, mostly somewhat darker than background, and distinct but not conspicuous in sapwood; in heartwood often about same color as ground mass and inconspicuous or barely discernible to unaided eye.

Vessel contents. Light-colored, often lustrous tyloses occasional to abundant in many specimens. Dark (red-brown) gum deposits noted in some samples of *Staudtia* and *Virola*, ranging from sparse to abundant.

Rays variable from indiscernible to fairly distinct to unaided eye on cross section (in some specimens not very distinct even with hand lens); somewhat lighter to a little darker than background, predominantly fine, moderately numerous to very numerous and closely spaced (often less than a pore's width apart), and at times somewhat wavy, being more or less sharply bent in contact with larger pores and pore groups. Uniformly low on radial section; in most specimens somewhat darker than background and distinct but not conspicuous to naked eye (in dark heartwood pieces usually somewhat lighter than background); usually produce "silver grain" about like that in Maple (*Acer*); heterogeneous character of rays usually noted under 10× lens on split radial surface, due to coarseness of often predominating squarish interior cells and more or less distinctly upright marginal cells. Mostly at or near limit of visibility with unaided eye on tangential section; very small and usually slightly darker than background; in *Scyphocephalium* distinct blackish contents were noted.

Tanniniferous tubes[18] visible in most specimens, appearing under lens as fine dark lines running through occasional rays; in a few cases discernible with the unaided eye; very sparse to rather frequent in occurrence.

Minute Anatomy[19]

Vessels, as seen on cross section (pores), chiefly solitary or in radial pairs; occasionally in 3's, sometimes in 4's or 5's. Isolated pores oval or ovoid; those in the groups decidedly compressed (usually radially). Size and number variable, the range being about as great in certain of the genera (especially the more abundantly represented ones) as it is throughout the entire family. Solitary pores and pore groups small to moderate-sized (based on tangential measurements); in a few cases (*Osteophloeum* and *Scyphocephalium*) moderate-sized to rather large, in others (*Compsoneura*, *Iryanthera Tessmannii*, *Knema laurina*, and *Virola* pro parte) very small to small. Groups usually slightly wider tangentially than isolated pores, but decidedly more elongated radially. Distribution fairly uniform, without definite pattern. (See Plate I, 1, 2.) Very few to moderately few in number (up to 10 solitary pores and pore groups per sq. mm.); in an occasional specimen of *Compsoneura*, *Iryanthera*, *Knema*, and *Virola* moderately numerous (up to 15 to 18 per sq. mm.). Walls thin to rather thin (0.003 to 0.005 mm. wide); in *Staudtia* often moderately thick (up to 0.007 mm.).

Vessel members very short to extremely long, mostly very long; commonly with short tips, occasionally up to 0.5 mm., rarely longer. Inclination of perforation plates from nearly horizontal (rare) to very oblique, usually intermediate.

[18] The term *tanniniferous tube* is applied in this study to the indeterminate, tube-like structures, found rarely to frequently in the rays of all specimens of Myristicaceae so far examined. These are described in detail in the following descriptions of the minute anatomy. So far as is known, precisely similar structures have not been reported as occurring in the secondary xylem of any other family, and for that reason they serve as a specific diagnostic feature for the Myristicaceae. (See Plate I, 3.)

[19] The class designations applied throughout this section to the abundance and size of the individual elements of the wood are those proposed by Chattaway (1932).

Perforations mostly simple or scalariform, sometimes reticulate or compound scalariform.[20] Reticulate type predominant in a number of specimens of *Iryanthera*. Scalariform type found in all woods examined, though extremely rare in some; characteristic of *Coelocaryon*, *Compsoneura*, *Dialyanthera*, *Gymnacranthera*, *Knema*, *Myristica*, and *Scyphocephalium*. Simple perforations predominant in *Brochoneura*, *Cephalosphaera*, *Horsfieldia*, *Osteophloeum*, and *Pycnanthus*. No single type consistently outstanding in all specimens of *Iryanthera*, *Staudtia*, and *Virola*. Predominance of any one type of perforation not necessarily even a specific character. Reticulate and compound scalariform perforations (see Fig. 1: 1–8) best developed in *Iryanthera;* the former present in virtually all specimens examined, predominating in more than one-third of them; the latter of rare to rather frequent occurrence. Reticulate perforations rare in *Knema* (except *K. glomerata*) and occasional in *Dialyanthera*. Bars of the scalariform perforations in a number of the other genera often so branched as to form more or less reticulated scalariform perforations. Compound scalariform openings infrequent in *Dialyanthera*, and rare to occasional in *Knema* and *Myristica*.[21]

Scalariform perforations generally with 1 to 10 bars (see

[20] *Compound scalariform perforations* have relatively few and moderately coarse main bars, with sets of fine secondary bars, sometimes reticulations, between them. (See Fig. 1: 1–5.) Perforations of this general type were found in *Epacris heteronema* and figured by Solereder (1908: 493), while Thomson (1923: 187) noted them in *Epacris coriacea*. Thomson states: "Careful examination of many vessels shows, however, that these [apparently compound scalariform perforations] are really due to scalariform bars inclined at different angles on the two sides of the wall. Frequently the bars on one side are larger and farther apart than those on the other side. Sometimes the finer bars can be traced right across the larger ones, but in other perforations they cannot be so traced." In the Myristicaceae, however, the secondary bars show distinctly in vessel members isolated by maceration; they are at times found to be definitely superimposed on openings of the normal scalariform type in the contiguous member; they frequently have a characteristic net-like or reticulate appearance; and in no instance were they found across the main bars.

[21] It is interesting to note that the reticulate and compound scalariform types are not found in the African genera, although in *Coelocaryon* the bars in some of the scalariform perforations branch to such an extent that the plates have a somewhat reticulate or compound scalariform appearance.

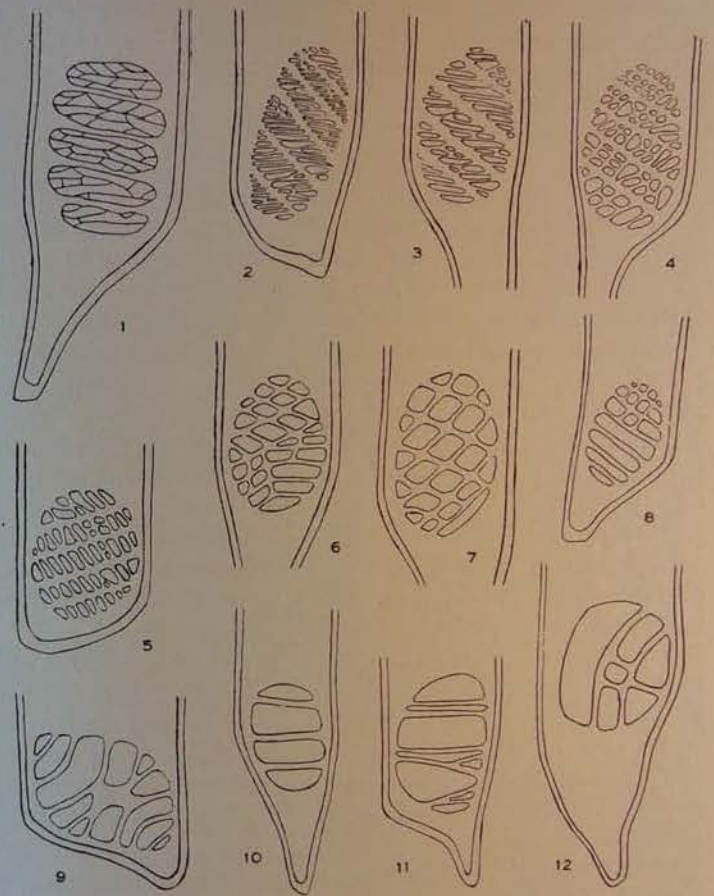

FIG. 1.—SOME TYPES OF VESSEL PERFORATION PLATES IN MYRISTICACEAE

Nos. 1–5.—Compound scalariform in *Knema Alvarezii* (1) and *Iryanthera leptoclada* (2–5). Nos. 6–7.—Reticulate in *Iryanthera leptoclada*. No. 8.—Reticulated scalariform in *Iryanthera leptoclada*. Nos. 9, 11, 12.—Special forms in *Gymnacranthera paniculata* (9) and *Coelocaryon* aff. *oxycarpum* (11, 12). No. 10.—Scalariform in *Coelocaryon* aff. *oxycarpum*. (No. 1, ×250; others, ×100.)

Fig. 1: 10), sometimes up to 20, rarely more. Bars variable from fine to coarse, mostly of moderate width; occasionally to frequently anastomosed or branched (Fig. 1: 9, 11, 12), in some cases appearing transitional to the reticulate or compound scalariform types.

Intervascular pit-pairs[22] rather small to fairly large (mostly of moderate size), numerous, somewhat crowded; arrangement usually alternate, but rather definitely opposite in *Cephalosphaera*, *Coelocaryon*, *Gymnacranthera* (pro parte), and *Iryanthera* (pro parte), and in some cases with a tendency to vertical alignment. Border outlines irregularly rounded to oval, or polygonal (3- to 5-sided) where crowded; sometimes, as in *Gymnacranthera paniculata* (22110), *Iryanthera tricornis* (21053), and *Knema intermedia* (21683), elongated horizontally and in more or less pronounced scalariform arrangement. Apertures narrowly oval or lenticular to slit-like, mostly horizontal, occasionally rather obliquely inclined, the aperture in one pit of a pair appearing to be crossed with that in the other; usually well included within border outline, but sometimes, *e.g.*, *Gymnacranthera*, *Iryanthera macrophylla*, and *Myristica guatteriaefolia*, extending beyond and coalescing into broken spiral or even scalariform striations.

Vessel-ray pit-pairs of two principal types: (*a*) Large and radially elongated (occasionally somewhat oblique), more or less gash-like in appearance and often extending almost the width of the cross-field in scalariform arrangement; borders complete, or sometimes covering only the ends or apparently absent; border outlines elongate-oval to broadly elliptical, sometimes flattened axially from crowding; apertures generally conforming to the shape of the border outline. (See Plate I, 4.) (*b*) Of the small, intervascular type; usually numerous, often crowded, arranged oppositely to irregularly; border outlines rounded to oval or more often irregularly angular; apertures fully included, slit-like or narrow-lenticular to broadly oval and horizontally inclined. The two types, together with intermediates, sometimes occur in same cell.

[22] A pit in the sense used in this report is not an intercellular structure, but is a recess or a gap in the main wall of an individual cell, with its external closing membrane. A pit in one cell and its complement in the cell adjacent constitute a *pit-pair*. A pit-pair may be simple, bordered, half-bordered, or incompletely half-bordered.

Vessel-parenchyma pit-pairs of the same types as the vessel-ray; the larger pits (radial section) shorter and with narrower apertures, but tending to scalariform arrangement; the small pits (tangential section) very abundant, of the intervascular type, although usually somewhat larger.

Tyloses sparsely to very abundantly developed; mostly thin-walled, more or less irregular, and brownish; sometimes more regular and thicker-walled, occasionally definitely sclerosed and distinctly pitted, *e.g.*, *Iryanthera paraensis* (22078), *I. tricornis* (21328), *Staudtia gabonensis* (4904), *Gymnacranthera canarica* (22127), *G. paniculata* (5698) (see Plate II, 6), and *Myristica iners* (22165).[23] Sparse to rather abundant deposits of yellowish, light brown, or dark (often reddish) brown deposits present in a number of heartwood specimens.

Wood fibers (cross section) comprising half to considerately more of ground mass of the wood; squarish to somewhat flattened radially, occasionally irregularly rounded or oval; arranged in definite radial rows between the often closely spaced rays; walls generally rather thin to very thin, although moderately thick in most pieces of *Iryanthera* and thick to very thick, with cell lumen sometimes almost closed, in *Brochoneura* sp. and *Staudtia*.

At times there is evidence of a rather indistinct and indefinite flattening of narrow zones of fibers in contact with the metatracheal or terminal bands of wood parenchyma. In *?Brochoneura* sp. (23626), *Cephalosphaera*, *Pycnanthus* (15211), *Horsfieldia canarioides* (?) (23601), *H. oblongata*, and about half the specimens of *Virola* investigated (all of which are devoid of parenchyma bands) growth rings are delimited by narrow bands of fibers, which are more or less indefinitely flattened radially and often relatively thicker walled than the normal cells; in *V. mollissima* these fibers are slightly enlarged. (See Plate I, 1.) In *Horsfieldia canarioides* (?) (23601), *H. oblongata*, *Virola mollissima*, and *V. officinalis* these bands demarcating the growth rings are comprised

[23] Record (1925) reports the occurrence of similar sclerosed, or stone cell, tyloses in various species of *Piratinera* and the "satiné" group of species of *Brosimum*, of the Moraceae; *Mespilodaphne* sp. (Brazilian sassafras) and *Eusideroxylon Zwagerii* T. & B. of the Lauraceae; *Pera arborea* Mutis, of the Euphorbiaceae; and an unidentified wood, called "guayabo," from Venezuela.

primarily of septate wood fibers (distinct on radial section), while occasional wood parenchyma cells are also present; in *Cephalosphaera*, *Pycnanthus* (15211), and *Virola venezuelensis* (6825) septate cells are more or less occasional among the flattened non-septate fibers at the growth ring boundaries, and it is likely that a similar condition prevails in some of the other woods so marked.

Fiber pits almost exclusively in radial walls; usually abundant (few in *Staudtia*); more or less inconspicuously bordered (simple or very inconspicuously bordered in *Virola*); apertures slit-like, vertical to somewhat oblique, slightly to decidedly exceeding the small to very small and frequently indistinct, rounded border outlines. Fiber-ray pits similar to fiber pits, but somewhat more numerous and sometimes with larger and more distinct borders.

Septate fibers present, though sometimes sparsely developed; occasionally distinct on cross section; localized in the immediate vicinity of the vessels (usually most abundant on the radial sides), except where in terminal bands (see above). Septa fine, one to several per fiber, commonly lined with brownish deposits, giving them the general appearance of horizontal resin plates.

Non-septate wood fibers containing deposits, usually light to dark brown, but sometimes yellow, green, or red, forming rather heavy horizontal plates or more or less completely filling the lumina, fairly common in *Staudtia*, but only occasionally occurring in *Gymnacranthera*, *Horsfieldia*, *Iryanthera*, *Knema*, *Myristica*, and *Virola*.

In one specimen of *Virola sebifera* (9501) a series of trabeculae (Sanio's beams) were noted on cross section, traversing a long radial series of fibers (approximately 60 contiguous cells being involved.)[24] These cross bars are variable from rather thin to quite thick, in the latter case being fully as wide as the combined thickness of adjoining fiber walls.

Isolated fibers (macerated material) mostly within the range of very short to long, rarely very long; fairly regular in outline, tapering gradually from indefinite and somewhat enlarged median portions to fairly sharp (sometimes blunt)

[24] This feature is without taxonomic significance, being of interest solely because of its rare occurrence in dicotyledonous plants.

ends; occasionally with bifurcated, bent, serrated, or otherwise malformed ends.

Wood parenchyma moderately developed in the great majority of the specimens examined, being (*a*) metatracheal or terminal, (*b*) paratracheal, and (*c*) diffuse; type (*a*) absent in *?Brochoneura* sp. (23626), *Coelocaryon oxycarpum* (22082), *Cephalosphaera*, *Dialyanthera*, *Horsfieldia canarioides* (?), *H. oblongata*, *Myristica simiarum*, *Pycnanthus*, *Staudtia gabonensis* (19408), and *Virola* (with possible rare exceptions).

Metatracheal or terminal parenchyma distinct on both cross and radial sections; bands usually numerous and irregularly spaced; occasionally 2 or 3 bands close together and at times branched or even discontinuous. Bands are 1 to 9, mostly 2 to 4, cells wide, though of 12 or more cells wide where two bands run together. Individual cells squarish to somewhat radially flattened, disposed in definite radial rows directly aligned with the rows of wood fibers. (See Plate I, 2.)

Paratracheal parenchyma usually as uniseriate vascular sheaths almost invariably interrupted by the rays, which contact one or both sides of the vessels, and also at times by isolated wood fibers, or small groups of fibers.

Such interruptions of the vascular sheaths are nearly always on the radial sides, with the result that the distinctive development of parenchyma (as seen in cross section) is normally at the tangential ends of the pores and pore groups, where it may be 2, or at times even 3, cells thick. In most of the specimens examined, one cell (at times two) at the extreme tangential limits of the pores is often distinctive, being relatively large and inclined to rectangular in outline, in contrast to the other cells which are more or less irregularly flattened.

Diffuse parenchyma present as occasional isolated cells, except in the vicinity of the discontinuous metatracheal bands, there tending to be more abundant and even assuming a broken tangential arrangement.

In those specimens in which growth rings are delimited by septate fibers, *e.g.*, *Horsfieldia canarioides* (?) (23601), *H. oblongata*, *Virola mollissima*, and *V. officinalis*, diffuse parenchyma is somewhat abundant at such points; occasional isolated cells are also found in association with the bands of flattened normal fibers in some of the specimens whose growth rings are so demarcated.

In *Knema Alvarezii* enlarged cells, devoid of contents but otherwise sug-

gestive of oil cells, are occasionally noted.[25] (See Plate II, 9.) In *Gymnacranthera paniculata* (5698) many of the parenchyma cells are distinctly sclerosed, the walls often being thickened to such an extent that the cavities are completely eliminated. Light (at times yellowish) to dark (often reddish) brown deposits are found in the wood parenchyma cells in many specimens. In most cases they are rather sparsely developed, partially filling the cavities or being concentrated at the end walls, but at times they more or less completely fill the cells.

Rays (on cross section) rather well distributed (1 to 12, mostly 2 to 5, fiber rows, or from somewhat less to somewhat more than an average pore's width, apart); almost invariably contacting the solitary pores and the pore groups on at least one side, and often on both; at times rather sharply bent in contact with the larger pores, with a resultant deformation of the cells of contact. Individual cells in the uniseriate portions generally rather coarse, being more or less rectangular in outline and usually variable from squarish to moderately elongated radially; those in the wider portions of the rays in most specimens relatively narrow and moderately to rather decidedly elongated radially. Rays not enlarged in the metatracheal parenchyma bands, but in some cases showing individual cells shortened.

Rays (tangential section) numerous to very numerous (6 to 15 per mm.); generally ranging from very fine to moderately broad and from extremely low to low (occasional vertically-fused rays rather low); predominantly uniseriate and biseriate or only locally triseriate; in some cases definitely wider (3 to 6 cells), *e.g.*, in *Pycnanthus*, *Staudtia* (pro parte), *Compsoneura costaricensis*, and occasional specimens of *Horsfieldia*, *Knema*, and *Virola*. Biseriate and wider rays commonly with short to rather long uniseriate tips at one or both apices; two or at times three rays occasionally to frequently fused vertically.

Individual cells of uniseriate rays and uniseriate portions of wider rays rather coarse and more or less rectangular in outline; usually characteristically squarish to very moderately elongated axially (in occasional specimens rather decidedly elongated); apical cells variable from slightly to decidedly elongated axially (moderately so in most cases) and from

[25] Distinctive oil cells are found in the rays of this and several other myristicaceous woods. See description of rays.

rather blunt to sharp-pointed. Cells in the biseriate and wider portions of the rays relatively small and irregularly rounded or oval (seldom noticeably elongated axially) to somewhat polygonal.

The two size classes (uniseriate and biseriate) vary in relative abundance in the different genera and to some extent even within the same species; in a few cases one or the other type of ray may be almost entirely lacking, but in general both are well represented. In most specimens the entirely uniseriate rays attain a maximum height of 10 to 20 cells, while those with occasional paired cells are usually somewhat higher (maximum up to 15 to 30 cells for the most part); in some samples in which these rays are very predominant, however, the strictly uniseriate ones may be 25 to 40 cells or more in height, and those with occasional paired cells up to 35 to 70 cells. The biseriate or wider rays are sometimes relatively short (maximum of 20 cells), but generally attain heights of 30 to 60 cells (rarely more); the uniseriate tips usually do not exceed 10 to 15 cells in length (maximum noted, 40 cells); in some cases the vertically-fused rays are no higher than the normal biseriate and wider ones, but more often they are made up of a somewhat greater number of cells (prevailing maximums 35 to 70 cells; in one specimen up to 110 cells).

Rays (on radial section) usually distinctly heterogeneous, with one row (occasionally two or even more) of squarish to decidedly upright (mostly moderately elongated) cells on the upper and lower margins; interior cells of uniseriate rays and uniseriate portions of wider rays usually rather coarse, being characteristically squarish or at times more or less upright; cells of biseriate and wider portions more or less distinctly procumbent, although mostly relatively short. Rays weakly heterogeneous or even homogeneous in a few cases (*Myristica* and *Virola*, pro parte), with marginal cells, as well as those in uniseriate portions, varying from squarish to slightly procumbent and those in biseriate and wider portions distinctly procumbent. Many ray cells distinctly sclerosed[26] in heartwood of *Gymnacranthera paniculata* (5698). (See Plate I, 5.)

Light to dark brown deposits (in some cases yellow, green, red, or almost black) either more or less completely filling the ray cells or tending to line the walls or to be concentrated at the ends. Crystals abundantly developed in a number of specimens of *Iryanthera* and in *Horsfieldia canarioides*(?).

[26] Sclerosed parenchyma cells have been noted by Record and Mell (1924) in the rays of *Brosimum paraense* Huber and *Piratinera guianensis* Aubl. and are figured by Wiesner (1903: 906) in the latter species.

Oil cells occasionally to commonly found in a few specimens (*Knema Alvarezii*, *Myristica elliptica*, *M. hypargyraea*, *M. guatteriaefolia*, *Virola merendonis* pro parte, and *V. panamensis* pro parte).

These distinctly enlarged cells are devoid of contents, except in *M. elliptica* and *M. guatteriaefolia*, where they are usually filled with a greenish yellow or dark reddish brown substance. As seen in tangential view, they are mostly restricted to the uniseriate portions of the rays; in *Knema Alvarezii* they are primarily apical, but in the other specimens are largely confined to the interior uniseriate sections. In radial view they are seen to be isolated from one another, although several are frequently found fairly close together in the same radial row of cells. (See Plate II, 7 and 8.)

Tanniniferous tubes (thin-walled, tube-like structures, associated with the rays) present in all specimens, although apparently very rare in a few cases; especially distinct on radial section, as a rule, because of their usually characteristic yellowish to reddish-brown contents, their apparent absence of end walls, their relatively thin lateral walls, and the absence of pits, either into the adjoining ray cells or the wood fibers. (See Plate I, 3.)

Tubes were noted in both uniseriate and biseriate (and wider) portions of rays, at times even apical. There is usually not more than one such tube in a given ray, but in some cases two, or even three, are found and, in rare instances, they may be in a vertical series. As seen on tangential section, the tubes are sometimes situated at the side of a ray, appearing as triangles between normal cells; this condition is found chiefly in the uniseriate portions of the rays. However, they usually appear in the position of normal ray cells, and are mostly of about the same size as the cells in the wider portions of the rays.

Identification of the Woods

As an aid to the identification of the woods of the Myristicaceae the following artificial key has been prepared, using both macroscopic and microscopic features. While in some instances the lines of separation are distinct enough to permit determination with a reasonable degree of certainty, there are others where segregation is doubtful, particularly if the country of origin of the material is unknown. Within the genus it rarely is possible to identify the different species by the wood alone.

Artificial Key to the Genera

I. Vessel perforations predominantly to almost exclusively simple;[27] reticulate and compound scalariform perforations apparently absent.

A. Growth rings demarcated by distinct wood parenchyma bands.[28] Rays uniseriate and biseriate; at times 3- and 4-seriate in *Horsfieldia* and *Staudtia*.

1. Heartwood orange-red to dark reddish brown; very distinct from sapwood. Sp. gr. (thoroughly room-dry) 0.73 to 0.94. *Staudtia* (West Africa).
2. Heartwood not distinct from light-colored sapwood. Sp. gr. seldom more than 0.64 (maximums noted, 0.74 in *Horsfieldia* and 1.01 in *Brochoneura*)..... *Brochoneura* (Madagascar); *Horsfieldia* (Asia); *Osteophloeum* (America).

B. Growth rings delimited by flattened wood fibers or entirely lacking.[29] Sp. gr. 0.35 to 0.69, mostly 0.46 to 0.63. Color of heartwood not distinctive, except for occasional dark reddish brown specimens of *Virola*.

1. Rays commonly 3- to 6-seriate. Growth rings absent. *Pycnanthus* (Africa).
2. Rays predominantly uniseriate and biseriate.
   a. Growth rings delimited by flattened wood fibers. Rays seldom locally triseriate... *Cephalosphaera* (East Africa).
   b. Growth rings delimited by flattened fibers or entirely lacking. Rays at times definitely triseriate and in some cases locally 4- to 5-seriate..... *Virola* (America).

II. Vessel perforations predominantly to exclusively scalariform[27] (or predominantly reticulate in some specimens of *Iryanthera*). Sp. gr. 0.35 to 0.89; mostly within limits of 0.43 to 0.70. Heartwood seldom distinct from sapwood. Rays mostly uniseriate and biseriate (occasionally locally triseriate); at times definitely triseriate and locally 4- or 5-seriate in *Compsoneura*, *Knema*, and *Virola*.

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[27] One specimen used in this study, designated as *Staudtia gabonensis*, is characterized by very predominantly scalariform perforations (80 per cent of total).

In *Virola* the simple and scalariform perforations vary rather widely in abundance in different specimens (90 per cent simple to 70 per cent scalariform). The simple type is slightly to very decidedly predominant in the majority of specimens.

[28] In occasional specimens of *Horsfieldia* and *Staudtia*, and possibly *Brochoneura*, growth rings may be delimited by flattened wood fibers, or absent.

[29] It is possible that certain specimens of *Virola* may possess growth rings which are demarcated by terminal parenchyma, but this can not be definitely established with the material available for study.

A. Growth rings delimited by definite bands of wood parenchyma.[30]

1. Vessel perforations exclusively scalariform or nearly so; number of bars chiefly within range of 1 to 6, except in *Compsoneura* with usually 5 to 9 bars. *Compsoneura* (America); *Gymnacranthera*, *Knema*, *Myristica* (Asia); *Scyphocephalium* (West Africa).

2. Vessel perforations frequently simple (*Coelocaryon*) or distinctly reticulate (*Iryanthera*).

   a. Simple perforations rare; reticulate type occasional to predominant and compound scalariform rare to occasional in most specimens; scalariform perforations mostly with more than 2 bars. Intervascular pits predominantly alternate..... *Iryanthera* (America).

   b. Simple perforations more or less common (10 to 40 per cent of total); reticulate and compound scalariform types entirely lacking; scalariform perforations usually with 1 or 2 bars. Intervascular pits mostly distinctly opposite *Coelocaryon* (West Africa).

B. Growth rings delimited by flattened wood fibers or entirely lacking.[29]

1. Vessel perforations almost exclusively scalariform, usually with 4 to 8 bars; simple perforations entirely lacking. Growth rings absent (except for rare, apparently pathological, parenchyma bands). Rays not definitely triseriate or wider. *Dialyanthera* (America).

2. Vessel perforations frequently simple (30 per cent or more of openings); scalariform type mostly with 1 to 6 bars. Growth rings often present; delimited by flattened fibers. Rays at times definitely triseriate and locally 4- or 5-seriate. *Virola* (America).

The Bearing of Wood Anatomy on the Internal Classification of the Family

One of the fundamental problems involved in this investigation has to do with the unity and distinctiveness of the groups which have been established within the family Myristicaceae. In other words, the study is concerned, in part, with the possibility of supporting one of the two general conceptions as to the internal classification of the family, namely, either the sectional arrangement of De Candolle or Bentham and Hooker, or the generic plan of Warburg. There is also an added consideration in the possibility that the generic conception may be applicable only in part, such as to one or

[30] Growth rings are apparently lacking in the single available specimens of *Coelocaryon oxycarpum* and *Myristica simiarum*.

two of the three geographical regions and not to the others. This, in effect, is the point of view taken by those botanists who contend that, while additional genera may be recognized in other parts of the world, the representatives of the family native to the Asiatic region are all properly classified as belonging to the single genus *Myristica*.

From the preceding artificial key, it is apparent that the existing differences in the anatomy of the secondary xylem of certain of the groups under consideration are without question sufficiently significant to warrant their being given generic rank. In fact, such groups as *Coelocaryon*, *Dialyanthera*, *Iryanthera*, *Pycnanthus*, and *Staudtia* are really more distinct from one another than are many of the well recognized genera in other families. The obstacle to an uncompromising support of Warburg's generic classification lies in the fact that in the other groups there is more or less overlapping in the structural features of the secondary xylem, with the result that these genera are not definitely and clearly separable on the basis of their wood anatomy alone. However, when the definite geographical limitations of the various genera are taken into consideration, the distinctions between the individual plant groups are seen to be much more significant, except in the case of the three Asiatic genera, *Gymnacranthera*, *Knema*, and *Myristica*.

In so far as the African and Madagascar genera *Brochoneura*, *Cephalosphaera*, *Coelocaryon*, *Pycnanthus*, *Scyphocephalium*, and *Staudtia* are concerned, marked variability is found between the woods of the several groups in the physical characters of density and color and more especially in such anatomical features as type of vessel perforation, presence or absence of growth rings and the nature of the elements demarcating them, and size (width) of rays. The differential characters between these six genera appear to be sufficiently constant and well-defined to permit definite separation of their woods, as is indicated in the key to the genera. A possible criticism of the indicated basis of separation of these genera lies in the fact that the number of wood specimens available for study was quite limited and, consequently, may not show the entire range of anatomical variability that actually

exists. However, the genera under consideration are such small endemic groups and the anatomical trends are so definite that it is believed that the distinctions are fundamental and valid. In consequence it would appear that Warburg's classification, as it applies to the genera of this region, is fundamentally sound.

Between the five American genera, *Compsoneura*, *Dialyanthera*, *Iryanthera*, *Osteophloeum*, and *Virola*, the variability in anatomical characteristics and physical factors is not as marked nor as consistent as is the case in the African groups, nor are there as many significant features to contend with. Unlike the African material, the factors of density and color can not be used to advantage as points of distinction. While certain species of both *Iryanthera* and *Virola* are inclined to be rather hard and heavy, and possessed of a characteristic dark-colored heartwood, most of the woods of these two genera are light and soft (or moderately so) and without color distinction, being in no wise separable on this score alone from representative material of the other groups. Dependence has to be placed, accordingly, on the strictly anatomical features, such as type of vessel perforation and presence or absence of growth rings, as well as the nature of the elements that demarcate such rings. In spite of these limitations, however, the several groups may be separated in at least a general way, and with sufficient certainty to support Warburg's classification.

The Asiatic genera of the Myristicaceae are, as a whole, much better represented numerically and more widely distributed geographically than the American and African groups. Despite that fact they appear to exhibit a decidedly greater similarity in the physical and anatomical characteristics of their secondary xylem than do the available representatives of the family from the other two regions. A study of the wood specimens of *Gymnacranthera*, *Horsfieldia*, *Knema*, and *Myristica* showed the four genera to be remarkably similar in most of those features which were found to vary in the woods of the American and African groups. Thus, they are alike in density and color of wood; in the presence of numerous and distinct terminal wood parenchyma bands;

and in the general width of their rays, which are primarily uniseriate and biseriate. Only in the matter of vessel perforations is there any marked distinction, but even in this characteristic only one genus, *Horsfieldia*, stands out from the others.

Thus, while the nature of the vessel perforations in *Horsfieldia* indicates a logical separation of that group from the other Asiatic representatives of the family, there is no evident way of separating the woods of the other three genera. This, however, does not necessarily support the contentions of the botanists who insist on grouping all the Asiatic Myristicaceae under the single genus *Myristica;* these investigators do not recognize the justification for giving generic ranking to *Horsfieldia*, yet the structure of the wood indicates this to be a natural group, distinct from *Myristica*, as well as from *Gymnacranthera* and *Knema*.

The anatomy of the secondary xylem is in no sense the major feature to be used in separating plant groups, being merely one of a number of significant characteristics. When the wood anatomy does substantiate plant group division, based on flower, fruit, or leaf characters, it simply lends added weight to the separation. However, under our present knowledge of wood structure it is frequently impossible to do more than to assign a wood to the family to which it belongs, despite the fact that the genera within the family in question may be definitely distinguished on the basis of other characteristics. This is essentially a reflection of the fact that the wood is inclined to be the most conservative part of the plant. Consequently, in cases such as the one under consideration, where the wood structure does not necessarily parallel anatomical differences in other plant parts, it does not follow that a classification founded on the other features is necessarily faulty. In view of the thoroughness of Warburg's work and the subsequent backing which his classification has received from a number of the later workers in the Asiatic field, there seems to be no definite reason for not accepting the generic ranking of the four established Asiatic groups. This feeling is heightened by the fact that Warburg's classification of the African and American Myristicaceae is so evidently sound.

Summary

Based on a study of 165 specimens of wood, representative of 82 species and 15 genera of the Myristicaceae, it was found that the secondary xylem presents an unusually unified structure throughout the family. The points of similarity include such striking features as the presence of tanniniferous tubes, a character so distinctive as to set the Myristicaceae apart from all the other known families; the general isomorphism of the intervascular pits; the consistent occurrence of characteristically elongate vessel-ray pit-pairs, which are commonly in definite scalariform arrangement; the more or less indistinctly bordered pits which characterize the wood fibers; the presence of septate fibers in the immediate vicinity of the vessels; the moderate development of paratracheal wood parenchyma; and the regular occurrence of coarse-celled heterogeneous rays. Against the distinctive uniformity found in these features, the variability in the vessel perforations and the nature of the growth rings, and the very minor size (width) differences noted in the rays carry relatively little weight.

In addition to the occurrence of tanniniferous tubes, which were noted in all the specimens studied, a number of other unusual anatomical features were found in occasional specimens. These include compound scalariform perforations, so far definitely reported in no other family; sclerosed tyloses and parenchyma cells, also noted in a few other woods, notably in *Brosimum* and *Piratinera* of the Moraceae; and oil (secretory) cells, previously reported only in the Anonaceae, Canellaceae, Lauraceae, Magnoliaceae, and Schizandraceae. In connection with this investigation, oil cells were also found in certain species of *Hernandia* (Hernandiaceae).

With regard to the internal classification of the family, the anatomy of the available wood specimens lends rather definite support to Warburg's organization of the Myristicaceae into a number of distinct genera, rather than to De Candolle's or Bentham and Hooker's monogeneric treatment. While there is a definite similarity in the structure of the wood in a number of cases, the distinctions between most of the genera become

clear when their natural geographical grouping is considered. This is especially true with the African and American Myristicaceae, the woods of which appear to be readily separable into the genera recognized by Warburg. Only among the Asiatic genera is there any consistent overlapping in anatomical features, and even there *Horsfieldia* stands distinctly apart from the other three genera, *Gymnacranthera*, *Knema*, and *Myristica*, by virtue of a distinct difference in the prevailing type of vessel perforation.

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Explanation of Plates

Plate I

No. 1. *Virola Warburgii* Pittier (Yale 3017). Cross section showing growth ring demarcated by flattened fibers. ×40.

No. 2. *Knema Alvarezii* Merr. (Yale 22113). Cross section showing growth rings demarcated by parenchyma bands. ×40.

No. 3. Tanniniferous tube in *Cephalosphaera usambarensis* Warb. (Yale 21676). Rad. sect. ×175.

No. 4. Vessel-ray pit-pairs in *Cephalosphaera usambarensis* Warb. (Yale 21676). Rad. sect. ×500.

No. 5. Sclerosed ray cells in *Gymnacranthera paniculata* (A. DC.) Warb. (Yale 5698). Tang. sect. ×115.

Plate II

No. 6. Sclerosed tyloses in *Gymnacranthera paniculata* (A. DC.) Warb. (Yale 5698). Rad. sect. ×115.

No. 7. Oil cells in rays of *Virola merendonis* Pittier (Yale 8838). Tang. sect. ×115.

No. 8. Oil cells in heterogeneous rays of *Knema Alvarezii* Merr. (Yale 22113). Rad. sect. ×115.

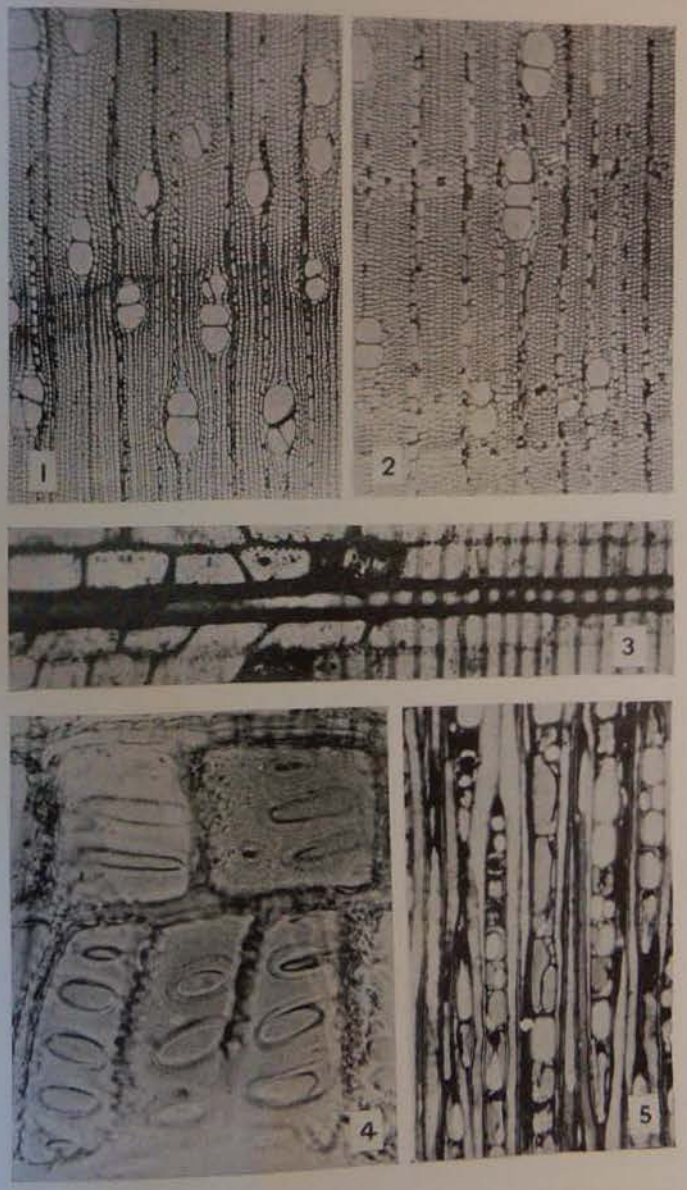
No. 9. Oil cells in wood parenchyma strands of *Knema Alvarezii* Merr. (Yale 22113). Rad. sect. × 115.

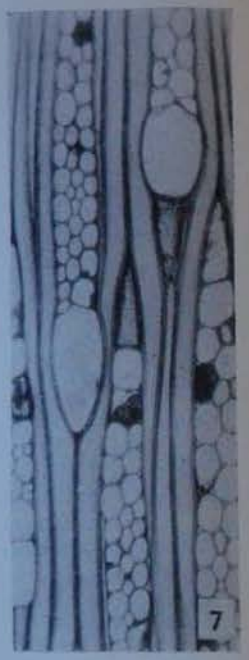
SIXTH INTERNATIONAL BOTANICAL CONGRESS

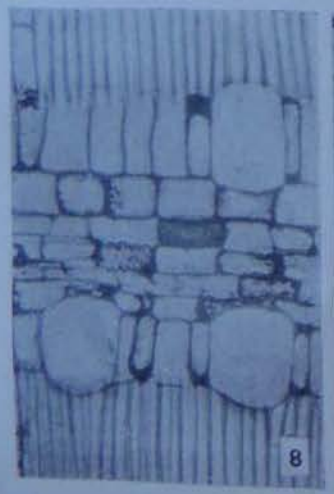
According to a decision by the Fifth International Botanical Congress at Cambridge in 1930, the Sixth Congress will be held in Holland in 1935. An Executive Committee has been formed, of which Professor Dr. F. A. F. C. Went (Utrecht) is President, Professor Dr. J. C. Schoute (Groningen) Vice-President, Dr. W. C. de Leeuw (Bilthoven) Treasurer, and Dr. M. J. Sirks (Wageningen) Secretary. The Committee has decided that the Congress will meet at Amsterdam, September 9–14, 1935.

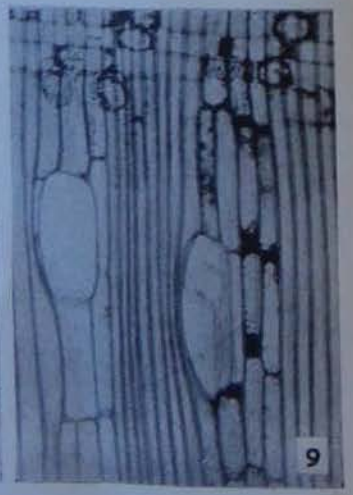
New Trade Names for Cativo

Cativo of Panama, *Prioria Copaifera* Gris., is finding a market in the United States and Canada. The brown-striped veneers are being sold in some instances as "Spanish Walnut"; also as "Floresa" and "Tabasara." (For a description of the tree and timber see *Tropical Woods* 14: 6–8, June 1928.)









CURRENT LITERATURE

Beiträge zur Kenntnis der Flora Westindiens. VI. By OTTO CHR. SCHMIDT. *Repertorium Specierum Novarum* (Berlin-Dahlem) 32: 73–94, March 1, 1933.

An enumeration of plants collected in Haiti and the Dominican Republic by Ekman, with descriptions of numerous new species, and extensions of range for many old ones. Among the woody plants listed are new species of *Coccoloba; Capparis amplissima* Lam., hitherto unknown except for Plumier's account 150 years ago, a large tree, called Matabecerro in the Dominican Republic; *Brunfelsia Abbottii* Leonard, called Manchú in the same country.

Report on forestry in Grenada. By R. C. MARSHALL. Govt. Printing Office, Grenada, 1932. Pp. 17; 8½ x 13; 2 maps. Price 1s. 6d.

Grenada forms the southern extremity of the row of volcanic islands which comprise the inner crescent of the Windward and Leeward groups of the West Indies. It is 21 miles long and 12 miles in greatest width, and has an area of approximately 120 square miles. The whole surface is mountainous or hilly and from the main ridges, with an elevation of 2000–2749 feet, numerous spurs radiate fanwise to the sea, being steep to the west and rather gradual to the east and south. The rock types are almost entirely volcanic, limestone occurring in only few isolated localities.

The rainfall, which varies with the elevation, exceeds 80 inches annually for the central half of the total area and is less than 60 inches in the coastal belt. The dry season is from January to May, the rainy season from June to December, with a break in September–October. There are numerous streams, the largest, known as Great River, taking its rise in the Grand Etang, a lake formed by the crater of an extinct volcano.

Almost all of the land is privately owned and about half of the total area is in regular cultivation, mostly cocoa and nutmegs. The remainder is largely subject to shifting agriculture, except for the high mountain lands and certain ridges

that some estates have retained under forest growth. Lands definitely and permanently reserved for protective purposes amount to only 2727 acres. The extent of the forests on private lands is about 15,000 acres. The population is about 60,000.

The vegetation of Grenada can be divided into five zones, namely, the mountain, the middle, and the dry belts, the sea beaches, and the mangrove swamps.

Mountain Type. "Occurs usually at elevations over 1500 feet, with a rainfall exceeding 100 inches (max. recorded 144 inches). It is definitely tropical rain forest, damp and mossy, but not particularly luxuriant as regards the general vegetation. The canopy is not very dense, and lianas, etc., not very numerous. Trees reach a height exceeding 100 feet, except in areas that are windswept. . . . Mountain Gommier (*Dacryodes hexandra* Gr.) is easily the dominant species. . . . The understory is largely composed of Mountain Palm (*?Euterpe* sp.); this palm also reaches the upper stories and in some areas is a conspicuous feature of the ridges when viewed from the lowlands through field glasses." Other trees listed are *Richeria grandis* Vahl (Bois Bandé), *Sloanea zinemariensis* Aubl. (Chantonier), *Licania ternatensis* Hook. f. (Bois Gris), *Simaruba amara* Aubl. (Marouba), *Guarea Perrottetii* Juss. (Bois Rouge), Lauraceae (Lauriers), *Byrsonima spicata* Rich. (Mussif), *Lucuma* sp. (Penny Piece), *Inga laurina* Willd. (Kakolay), *Erythroxylon impressum* O. E. Schulz (Kakapol), *Cecropia peltata* L. (Bois Canon), *Sapium aucuparium* Jacq. (Bois Lait), Myrtaceae (Gouaviers), *Myrodia turbinata* Sw. (Swizzle-stick Wood), *Meliosma Herbertii* Rolfe (Gros Grain), *Oreodoxa* sp. (Mountain Cabbage).

Middle Belt. "The middle belt comprises the area intermediate between the dry belt and the mountain lands, *i.e.*, with elevations varying from almost sea level up to something under 1500 feet and with a rainfall from 60–100 inches or more. Most of this area has been cleared at one time or another and it is very difficult without further examination to write on the original vegetation thereof. The majority of the cocoa and nutmeg estates of the Colony are in this zone.

"White Cedar, *Tecoma* (*Tabebuia*) *leucoxylon* Mart., is one of the dominant species and at the lower elevations and in the dryer areas, *Swietenia mahagoni* L. (West Indian or Spanish Mahogany). Whether or no Mahogany is indigenous it is difficult to say, but it is most certainly thoroughly naturalized over a large area. Other species occurring include *Andira inermis* H. B. K. (Angelin), *Hymenaea courbaril* L. (Locust), *Mimusops* sp. (Bullet Wood or Balata), *Guazuma ulmifolia* Lam. (Bois Zombre or Bois d'Orme), *Cedrela mexicana* Roem (Red Cedar), *Spondias mombin* L. (Hog Plum), *Hieronyma caribaea* Urb. (Tapana), *Tabebuia glomerata* Urb. (Poui), *Calophyllum antillanum* Britton (Galba)."

Dry Belt. "This [Logwood-Briar] type of forest growth occurs in the areas of low rainfall, particularly in the south of the island. All the areas visited were clearly second growth and there is no means of ascertaining what was the original type of forest. With a rainfall in the vicinity of 50 inches and exposure to coastal breezes one would not expect a very luxuriant type of vegetation and there is no reason to believe that these areas previously carried other than a rather xerophytic type of vegetation.

"The following species were noted: *Haematoxylon campechianum* L. (Logwood), *Acacia macracantha* H. B. K. (Briar), *Bursera simaruba* (L.) Sarg. (Lowland Gommier), *Genipa americana* L. (Juniper), *Tecoma leucoxylon* Mart. (White Cedar), *Citharexylum spinosum* L. (Fiddlewood), *Cordia collococca* L. (Manjak), *Albizzia caribaea* Urb. (Tantakayo), *Spondias mombin* L. (Hog Plum), *Chlorophora tinctoria* Gaud. (Fustic).

"The vegetation is scrublike, often thorny, with a height of 20–30 feet, and is practically all deciduous. It forms a light canopy. It is cut over periodically for fuel but if left untouched would doubtless grow to larger size—at present most of the trees are only a few inches in diameter. In the driest areas cacti come into prominence. These forests have a value for fuel purposes both for local supply and for export (in limited amounts) to Barbados."

Beach Type. "The seaside beaches carry a distinctive vegetation, the main species being *Coccoloba uvifera* L. (Seaside Grape), which reaches a height of 40 feet or so with a diameter of over a foot—it is often windswept and reduced to a low growing shrub. *Hippomane mancinella* L. (Manchineel) and *Paritium tiliaceum* (L.) Juss. (Seaside Mahoe) are also often present. In the vicinity of Point Saline Manchineel forms pure crops of limited extent.

Mangrove Swamps. "There are very limited areas of Mangrove at the mouths of some of the rivers, the species present being primarily *Rhizophora mangle* L. (Red Mangrove) and *Avicennia nitida* Jacq. (Black Mangrove). *Laguncularia racemosa* Gr. is also found. *Conocarpus erectus* L. (Button Mangrove) occurs in a few places on the northeast coast, but hardly in typical Mangrove swamp. The timbers are of value for fuel purposes."

Bactris cohune S. Watson = *Astrocaryum mexicanum* Liebm.

By M. Burret. *Repertorium Specierum Novarum* (Berlin-Dahlem) 32: 98–99, March 1, 1933.

The palm described by Watson (1886) as *Bactris cohune* is a synonym of *Astrocaryum mexicanum* Liebm. (1846), other synonyms being *A. rostratum* Hook. f., *A. chichon* Linden, and *A. ayri* Hort. The species ranges from Oaxaca and Chiapas, Mexico, to eastern Guatemala and British Honduras (the author of this abstract has reported it, as *A. cohune* [Wats.] Standl., also from eastern Honduras). Vernacular names reported are Chichón (Chiapas), Warree Cohune (Guatemala, British Honduras), Lancetilla (Guatemala; also in Honduras, according to the present writer's observations).—P. C. Standley.

El liquidámbar (*Liquidambar Styraciflua* L.). By Angel Roldán. *México Forestal* (Mexico City) 11: 4: 85–87; illustrated; 1933.

The tree produces a resin, called by the ancient Mexicans Xochiocotzo, which was an article of tribute for the support of the central government. This resin, in either liquid or solid form, was used chiefly in medicine and perfumes. At present the wood is employed in Mexico for packing cases, match sticks, and toothpicks. The tree grows in Veracruz, Chiapas, Oaxaca, and Michoacán, being known in the last state by several names, particularly Xochiocotzoquáhuitl. It occurs in subtropical regions, at elevations of 1000 to 1500 meters.

A new hybrid pine. By A. Bruce Jackson. *Gardeners' Chronicle* (London) 93: 152–153; figs. 68–71; March 4, 1933.

In the arboretum at Westonbirt, England, there is growing a Mexican pine, *Pinus ayacahuite*, 75 feet high and seven feet eight inches in girth, believed to have been planted in 1875. Other English trees of this species have attained even a slightly greater height. Many seedlings have been raised from the Westonbirt tree, and a few of these, now as much as 26 feet high, have been found to differ somewhat in their cones from normal *Pinus ayacahuite*. It appears that the cones are intermediate between those of *P. ayacahuite* and *P. excelsa*, the Bhotan Pine, individuals of which are growing near the parent tree, and the abnormal young trees represent a hybrid between these two species, native in widely separated continents. The hybrid is named *Pinus Holfordiana* A. B. Jackson.

Certain palms of Panama. By L. H. Bailey. *Gentes Herbarum* (Ithaca, New York) 3, fasc. 2: 32–116; figs. 20–88; March 15, 1933.

A detailed discussion of certain palms observed by the author in the field in the Canal Zone and adjacent parts of Panama. The paper is probably the most important and informative one ever published regarding palms of Central America, and will be of great service to one wishing to obtain

an idea of the classification of the palms of Central America and adjacent regions. Particularly helpful are the many admirable photographs and drawings illustrating details of the plants.

Much of the work was done on Barro Colorado Island in Gatun Lake, 20 species of palms (a few without specific names) being reported from that island. Among the palms discussed and illustrated are *Scheelea zonensis*, sp. nov., erroneously reported heretofore as *Attalea gomphococca; Raphia taedigera* Mart.; *Manicaria saccifera* Gaertn., the Monkey-cap or Sleeve Palm, known in Brazil as Bassú or Ubussú; *Corozo oleifera* (H. B. K.) Bailey, erroneously referred heretofore to *Elaeis melanococca* Gaertn., which probably is merely another name for the African Oil Palm; *Socratea durissima* (Oerst.) Wendl., the Jira or Stilt Palm, previously misidentified with *Iriartea exorrhiza; Oenocarpus panamanus*, sp. nov., called Maquenque; three species of *Geonoma; Chamaedorea Wendlandiana* (Oerst.) Hemsl.; *Synechanthus Warscewiczianus* Wendl.; *Astrocaryum Standleyanum*, sp. nov., the Chunga, Chonta, or Black Palm, with exceedingly hard, black wood; *Desmoncus chinantlensis* Liebm.; nine species of *Bactris*, including as new *B. superior* (Caña Brava), *B. barronis*, *B. coloradonis*, and *B. coloniata* (Uvito); *Acanthorrhiza Warscewiczii* Wendl., called Escoba.

The paper concludes with notes regarding the names of certain ornamental palms cultivated in the Canal Zone.—P. C. Standley.

Novitates taxonomicae I. By A. Pulle. *Med. Bot. Mus. Univ. Utrecht* 5: 1–22; figs. 1–3; 1933. (Extracted, with new pagination, from *Recueil des Travaux Botaniques Néerlandais*, vol. 30.)

New species and varieties of Surinam trees and shrubs are described in several families. Among them are *Capparis surinamensis* J. C. Went, with the vernacular names Warimiaballi (Arowak) and Oenbatappo (Carib); *Eperua stipulata* Kleinh., Baboen Walaba; *Lonchocarpus chrysophyllus* Kleinh., Nekoe, used as a fish poison.

New and critical Polygonaceae, Guttiferae and Lecythidaceae from Surinam. By P. J. Eyma. *Med. Bot. Mus. Univ. Utrecht* 4: 1–77; figs. 9; pls. 3; 1932.

Students of the Guiana and Lower Amazon flora will welcome the author's attempts to clear up some of the confusion in the classification and names of many important trees.

He fully agrees with Sprague that there is only one species of the Brazil-nut tree, *Bertholletia excelsa* H. B. K., of which *B. nobilis* Miers is a synonym.

"When Miers founded his genus *Allantoma* in 1874, he included 12 species, but, from the fact that the material of none of them was complete, his generic diagnosis is a mixture of characteristics belonging to plants which should be referred to very different genera."

The species considered by Eyma to belong to the genus *Allantoma* Miers, charact. emend., and their synonyms are as follows:

(1) **Allantoma torulosa** Miers, typus generis; (2) **A. corbula** Miers; (3) **A. dictyocarpa** (Mart.) Miers=*Couratari dictyocarpa* Mart. ap. Berg; (4) **A. lineata** (Berg) Miers=*Couratari lineata* Berg=*A. cylindrica* Miers=*?A. aulacocarpa* (Mart.) Miers=*?Couratari aulacocarpa* Mart. ap. Berg=*?A. macrocarpa* (Mart.) Miers=*?Couratari macrocarpa* Mart. ap. Berg=*?A. Burchelliana* Miers=*Goeldinia riparia* Huber=*G. ovatifolia* Huber; (5) **A. scutellata** Miers.

Eight species of *Couratari* Aubl., charact. emend., are listed, together with their synonymy, as follows:

(1) **Couratari guianensis** Aubl., typus generis; (2) **C. fagifolia** (Miq.) Eyma, nov. comb.=*Lecythis fagifolia* Miq. ap. Berg=*Allantoma fagifolia* (Miq.) Miers=*Allantoma subramosa* Miers p. p.=*?Couratari coriacea* Mart. ap. Berg=*?Couratari Vriesii* Miers; (3) **C. fumatoria** (Schrank) Eyma, nov. comb.=*Lecythopsis fumatoria* Schrank=*?C. Lecythopsis* Mart.; (4) **C. glabra** Camb.=*Lecythopsis glabra* (Camb.) Berg; (5) **C. multiflora** (Smith) Eyma, nov. comb.=*Lecythis multiflora* Smith=*Allantoma multiflora* (Smith) Miers; (6) **C. paraensis** Mart. ap. Berg; (7) **C. pulchra** Sandw.; (8) **C. rufescens** Camb.=*Lecythopsis rufescens* (Camb.) Berg=*Lecythis pyramidata* Vell., teste Miers.

Ten species of *Cariniana* are listed and the synonymy given as follows:

(1) **Cariniana estrellensis** (Raddi) OK.=*Couratari estrellensis* Raddi=*Cariniana excelsa* Casar., typus generis; (2) **C. legalis** (Mart.) OK.=*Couratari legalis* Mart.=*Car. brasiliensis* Casar.; (3) **C. decandra** Ducke; (4) **C. domestica** (Mart.) Miers=*Couratari domestica* Mart.; (5) **C. exigua** Miers; (6) **C. integrifolia** Ducke; (7) **C. Kuhlmannii** Ducke; (8) **C. micrantha** Ducke; (9) **C. pyriformis** Miers; (10) **C. rubra** (Gardn.) Miers=*Couratari rubra* Gardn. mss.

The species of *Eschweilera* Mart., sensu Niedenzu, are considered at considerable length, and three species and one variety are described as new. There are also some new combinations. The names and synonymy are as follows:

(1) **Eschweilera amara** (Aubl.) Ndz.=*Lecythis amara* Aubl.=*Chytroma amara* (Aubl.) Miers=*Eschweilera corrugata* auctt.; (2) **E. chartacea** (Berg) Eyma, nov. comb.=*Lecythis chartacea* Berg=*Chytroma chartacea* (Berg) Miers=*Lecythis marawynensis* Berg=*Chytroma marawynensis* (Berg) Miers =*Eschweilera marowynensis* (Berg) Ndz.; (3) **E. collina** Eyma, n. sp.; (4) **E. congestifolia** (R. Ben.) Eyma, nov. comb.=*Lecythis congestiflora* R. Ben.; (5) **E. corrugata** (Poit.) Miers=*Lecythis corrugata* Poit.=*L. salebrosa* Berg=*Chytroma salebrosa* (Berg) Miers=*Eschweilera salebrosa* (Berg) Ndz.=*Chytroma rubriflora* Miers=*Lecythis venusta* Miers; (6) **E. floribunda** Eyma, n. sp.; (7) **E. idatimonoides** (Berg) Miers=*Lecythis idatimonoides* Berg; (8) **E. labriculata** Eyma, n. sp.; (9) **E. longipes** (Poit.) Miers=*Lecythis longipes* Poit.; (10) **E. odora** (Poepp.) Miers=*Lecythis odora* Poepp.=*E. pallida* Miers=*E. matamata* Huber; (11) **E. simiorum** (R. Ben.) Eyma, nov. comb.=*Lecythis simiorum* R. Ben.; (12) **E. subglandulosa** (Steud.) Miers=*Lecythis subglandulosa* Steud.

In 1874 Miers separated from *Lecythis* several species that, together with those already described under *Eschweilera*, he grouped in three genera, two being new, viz. *Chytroma* Miers, *Eschweilera* Mart., and *Jugastrum* Miers, which were reduced by Niedenzu to sections of one genus, for which he retained the old name *Eschweilera*. Eyma says: "I do not think the value of even these sections, at least of the first two, sufficient to maintain them. Their chief character, the number of ovary cells, leads, as remarked by Sagot . . . , to the separating of species often very closely related in other respects. I could myself state the variability in several cases of the number of ovary cells among specimens of the same species or even among flowers of the same sheet."

The Lecythidaceae are among the largest and most important timber trees of northeastern South America. Although their woods exhibit a considerable range in color, structure, and technical properties they are sufficiently alike to permit

their ready separation as a family. Generic distinctions have always been uncertain, for reasons which are now obvious in the light of Dr. Eyma's investigations.

Apuntes de una excursión a Castillos, Departamento de Rocha, Uruguay. By C. Fiebrig. *Ostenia*[1] 187–192; Feb. 11, 1933.

As contrasted with Paraguay, this portion of Uruguay is noteworthy for the sparse representation of trees, these consisting chiefly of *Salix Humboldtiana*, which forms a dense growth along all streams. Associated with it are shrubs of *Pouteria neriifolia*, *Phyllanthus*, and other groups. Upon dry slopes are shrubs such as *Colletia*, *Heterothalamus brunioides*, *Eupatorium*, and *Baccharis*.

Most characteristic of the region is the southernmost American palm, *Butia capitata*, which forms continuous, monotonous, forest-like stands of great extent, in which there is scarcely any other vegetation except a poor growth of grasses. All the palm trees appear to be of the same age, no young ones being present. Many of them are infested by strangling figs (*Ficus*).

The eastern littoral region is most remarkable for its great sand dunes, the largest of which are bare of vegetation. At their base grow xerophytic shrubs that constitute almost the only woody vegetation of the area—*Iodina rhombifolia*, *Colletia cruciata*, *Celtis tala*, and species of *Berberis*, *Daphnopsis*, and *Scutia;* and trees such as *Lithraea brasiliensis*, *Schinus dependens*, *Rapanea laetevirens*, *Citharexylum*, and *Erythrina Crista-galli*.—P. C. Standley.

Apuntes sobre la flora del Palmar de Castillos, Departamento de Rocha, República Oriental del Uruguay. By Guillermo Herter. *Ostenia* 193–204; Feb. 11, 1933.

The article consists chiefly of a list of cryptogams and phanerogams observed in the region, whose elevation is 30 meters or less. The palm that forms the great palm forests of Uruguay and covers thousands of hectares in the Department

[1] "Ostenia" is a volume of 362 pages, with many illustrations, published at Montevideo, Uruguay, and dedicated to Cornelio Osten on the occasion of his seventieth birthday.

of Rocha is *Butia capitata*. The other Uruguayan palm is *Arecastrum Romanzoffianum*, which, however, occurs in very few places, and always in small numbers.

Excursión botánica a la Alta Cordillera de las Condes (Andes cerca de Santiago de Chile). By Gualterio Looser. *Ostenia* 217–246; illustrated; Feb. 11, 1933.

The article describes a journey made by automobile from Santiago to the Cordillera de las Condes, where an elevation of 3700 meters was reached, and concludes with an annotated list of the plants observed in the Cordillera, chiefly at altitudes of 2800–3700 meters. Among the trees and shrubs noted at less than 1200 meters are mentioned Maitén (*Maytenus boaria*), Quillay (*Quillaja saponaria*), Espino (*Acacia cavenia*), Litre (*Lithraea caustica*), Bollén (*Kageneckia oblonga*), Huingan (*Schinus dependens*), Guayacán (*Porlieria hygrometrica*), Palqui (*Cestrum parqui*), and Colliguay (*Colliguaya odorifera*).

Among the woody plants at 1200 to 1800 meters are species of *Azara*, *Valenzuelia*, *Ribes*, *Escallonia*, and the Peumo (*Cryptocarya*) and Maqui (*Aristotelia chilensis*). At the higher elevations mentioned the mountain sides support a vegetation abundant in species and individuals, but all the shrubs are low, the tallest plant being *Senecio rutaceus*, 120 cm. high. Among the shrubs are species of *Berberis*, *Tetraglochin*, and *Chuquiragua*.

Observações e quatro novas especies arborescentes do incipiente Jardim Botanico do Estado de São Paulo. By F. C. Hoehne. *Ostenia* 287–304; pl. 1–8 (part colored); Feb. 11, 1933.

The Parque do Estado, scarcely ten kilometers from the center of the city of São Paulo, is a highly interesting area of forest and fields. Although the fields were formerly pastured, and the forest has an age of probably only 30–100 years, the vegetation contains many of the plants characteristic of the region. There have been found here four trees, which are described as new, with colored or black and white illustrations. *Capsicodendron pimenteira* is a new genus of the family

Canellaceae; the tree is known locally as Pimenteira, because its bark has a taste similar to that of *Capsicum*. The other trees described as new are *Miconia cabucu*, called Cabucú; *Trichilia pauloensis;* and *Chrysophyllum cuspidatum*.

Beiträge zur Kenntnis der andinen südamerikanischen Lauraceen. I. By Otto Chr. Schmidt. *Repertorium Specierum Novarum* (Berlin-Dahlem) 31: 168–189; Jan. 31, 1933.

New species of trees and shrubs of the Laurel family are described from the Andean region, particularly from Peru, in the genera *Aniba*, *Endlicheria*, *Persea*, *Ocotea*, *Nectandra*, and *Pleurothyrium*. There is provided a key for separation of the 23 Andean species of the genus *Endlicheria*, for each of which full synonymy and distribution are reported. Among the species described or discussed are *Endlicheria columbiana* (Meissn.) Mez, known by the vernacular name Laurel Comino in Colombia; *Aniba perutilis* Hemsl., Laurel Comino; *Endlicheria Szyszyloviczii* Mez, Ishpingo (Peru); *E. sericea* Nees, Laurel Blanco (Bolivia); *E. Williamsii* Schmidt, Ismamuena, Pampamuena (Peru); *E. anomala* Nees, Canela (Peru).

Über die Verbreitung von *Sabal mauritiiformis* (Karst.) Gris. et H. Wendl. und andere Arten von *Sabal*. By M. Burret. *Repertorium Specierum Novarum* (Berlin-Dahlem) 32: 100–101; March 1, 1933.

According to material examined by the author, *S. mauritiiformis* (*Trithrinax mauritiiformis* Karst.), a tree 30–40 meters high, occurs on Lake Maracaibo, Venezuela; in Colombia west of the Sierra Nevada de Santa Marta, also at Turbaco and in the Cauca Valley; and in British Honduras. It has been reported from Trinidad, perhaps only in cultivation. The vernacular names are Chingale, Palma Amarga, and Palmiche in Colombia, Palma Redonda in Venezuela, and Bhotan and Bay Leaf in British Honduras. The palm is sometimes used in Colombia as coffee shade; its trunks are employed for house building and its leaves for thatch.

Sabal maritima (H. B. K.) Burret, nov. comb. (*Corypha maritima* H. B. K.) occurs in Cuba; *Sabal pumos* (H. B. K.) Burret. nov. comb. (*Corypha pumos* H. B. K.) is known only from plains at the base of the Volcano Jorullo in Mexico.—P. C. Standley.

Palmae Neogaeae. III. By M. Burret. *Repertorium Specierum Novarum* (Berlin-Dahlem) 32: 102–115; March 1, 1933.

Ten new palms are described from South and Central America. *Attalea apoda*, of Minas Geraes, Brazil, is known as Yoli. *Syagrus Tessmannii*, of eastern Peru, is called Inchaui, Intsháwui, and Punpunha Rana; its trunks are employed in house construction, its wood for lances, harpoons, and bows. *Bactris trichophylla*, a cespitose palm 7.5 meters high, is described from British Honduras.

Plantae Potosinae. Contribución al estudio de la flora del sud de Bolivia. Catálogo No. 1. By Martín Cárdenas. Potosí, Bolivia, 1932, pp. 26; illustrated.

A list of 95 plants collected by the author in southern Bolivia. Although most of the species enumerated are herbs, there may be noted among woody plants *Ephedra americana*, called locally Pingo-pingo; *Polylepis incana*, Kehuiña; *Prosopis ferox*, Churqui; *Carica lanceolata*, Oroko Kcaralawa, with edible fruit; *Cereus pasacanus*, Cardón, as much as 10 meters high, whose wood is employed for making doors, tables, and benches; *Azorella glabra*, Yareta; *Nicotiana glauca*, Karalawa, Karallanta; *Senecio clivicolus*, Huaycha; *Lepidophyllum quadrangulare*, Tola; *Lucilia flagelliformis?*, Koa. —P. C. Standley.

The parasitic habit of the sandalwood tree. By Charles S. Judd. *Proceedings Hawaiian Academy of Science*, Bernice P. Bishop Special Publication 20, Honolulu, 1932, pp. 5–6.

"The *laau ala* or fragrant heartwood of the Sandalwood tree enabled the first king of Hawaii to start a profitable trade with China with such success that in one generation he succeeded in leading his people from barbarism to civilization.

"The Sandalwood trade was at its height from 1810 to 1825 and ceased in 1840. It led to extravagant spending on the

part of the king, and to oppression of the common people and to the decimation of all the large trees in the islands, and finally ended in Boki's disastrous expedition to Eromanga from which only 20 people returned out of the 500 who originally set out.

"Contrary to general belief, the Sandalwoods in Hawaii were not exterminated but are still found on all the larger islands. Though in India there is only one species, which produces probably the most valuable wood in the world, botanists recognize in Hawaii 8 distinct species and 3 varieties.

"The commonest species (*Santalum freycinetianum*) is rather small and insignificant with curling leaves and brittle, drooping branchlets, and grows very slowly in well-drained soil in the drier regions. The only fragrant part of the tree is the oily heartwood.

"Very little is known about the parasitic habit of the Hawaiian Sandalwoods, but studies made in India throw considerable light on the subject. The actual transference of sap is made by means of a sucking organ, the haustorium, which attaches itself to the root of the host and by breaking down the cortical cells makes direct connection with the fibro-vascular cylinder and transfers the stream of salts and water through vascular strands to the Sandalwood. Studies now being conducted in Hawaii aim to determine whether the Hawaiian species are true parasites and how they may be propagated successfully and in quantity."

Notes on the distribution of *Neowawraea*. By GLEN W. RUSS. *Proceedings Hawaiian Academy of Science*, Bernice P. Bishop Special Publication 20, Honolulu, 1932, pp. 6–7.

"In 1912 J. F. Rock discovered on the island of Hawaii three trees which he considered representatives of a new genus, and which he described as *Neowawraea phyllanthoides*. These trees have been rediscovered with others in the same locality, and more have been found on Oahu and Molokai. The species should occur on Maui and Kauai as well. It is the most impressive tree in the Hawaiian forests, the largest one known on Oahu having a trunk circumference of 37 feet. The wood is impregnated with oil, hard, durable and straight grained. The sapwood is white and the heartwood rich brown.

As now known the tree is restricted to the upper forests of the Waianae Mountains of Oahu, except for the five or six trees on Hawaii and one on Molokai. In all about 25 living trees are known, most of them overmature. Large numbers of logs lie strewn over the ground in the Waianae Mountains, showing that not over 200 years ago the species was an important member of the Waianae forests.

"The species is of a very elemental type and became decadent probably through changing climatic conditions to which, like many relic species, it was unable to adapt itself. The introduction of new animals and weeds into the forests has broken up the balance which the species had maintained, and started the submergence of the less vigorous.

"Rock classed *Neowawraea* as being closely allied to *Phyllanthus* or *Bischofia*, but more recent studies of its characters, with fuller material, show it to be congeneric with *Drypetes*, a genus of probably African origin which is distributed throughout South Africa, Malaysia, the Philippines, the West Indies, and tropical America.

"The ancestors of the Hawaiian plants must have arrived here in very remote times, as the climatic conditions of the shores today could not sustain them. But that conditions suitable for their reception existed here ages ago is shown by the presence of fossilized wet forest plants intermingled with shore rushes, in situations very little above sea level. This time was possibly during some of the early periods of glaciation.

"Unless aided by human agencies the species will soon become extinct. Such aid is now being given and healthy young trees are already growing in the Territorial Nursery."

Identification of Corean woods (Fagaceae). By N. YAMABAYASHI. Pub. by For. Exp. Sta., Govt.-Gen. of Chosen, Kiejo, Japan, Feb. 1933. Pp. 82; 7½ x 10¼; 16 full-page plates with 4 photomicrographs each.

Contains descriptions, tables, and keys (in Japanese) pertaining to the woods of the Corean Fagaceae, namely, *Fagus multinervis* Nak., *Castanea crenata* S. & Z. and *C. mollissima* Bl., *Lithocarpus cuspidata* Nak., and 11 species of

Quercus. The tables and keys are also given in English. For each species there are four excellent photomicrographs. The author has previously published a similar report on the Gingkoales and Coniferae (see *Tropical Woods* 17: 43, March 1929).

On the ligneous flora of Formosa and its relationship to that of neighboring regions. By Ryôzô Kanehira. *Lingnan Science Journal* (Canton, China) 12: 2: 225–238, April 4, 1933.

"The island of Formosa, lying off the coast of China to the North of the Philippines, is of oblong shape, 244 miles long, 76 miles wide; its area being about 13,908 square miles. The island is very mountainous, with a central axis stretching from north to south with an average height of 2500–3000 m. The central range is composed of paleozoic rock, chiefly of clay slates. Mt. Morrison, the highest peak, situated on the Tropic of Cancer near the center of the island, is 3985 m. high. The island thus presents distinctly high altitudes, while abundant rainfall and high humidity support a very rich flora as compared with that of some neighboring regions.

"The vegetation or the flora of the island may be divided into Mangrove forests, strand forests, cultivated land, broad-leaved forests, and coniferous forests."

"The forest area of Formosa is about 1,882,000 hectares, of which 517,000 hectares are under systematic control. The timber products in 1931 totaled 166,000 cubic meters, the principal trees utilized being *Chamaecyparis obtusa* Sieb. et Zucc., *C. formosensis* Matsum, *Cunninghamia Konishii* Hay., *Taiwania cryptomerioides* Hay., and *Tsuga chinensis* Pritz. The exploitation is done by the government. The utilization of hardwood timbers is mostly local, the principal trees being *Machilus Kusanoi* Hay., *Michelia compressa* var. *formosana* Kanehira, *Quercus gilva* Bl., *Quercus uraina* Hay., and other kinds which are chiefly species of Lauraceae and Fagaceae. The consumption of lumber in Formosa is much larger than the supply, so a considerable amount is imported from China and Japan and some from the United States. Other than lumber, the most important forest product is camphor and its

by-products distilled from the wood of *Cinnamomum Camphora* Nees et Eberm. and various other species of the genus. These products are controlled by a government monopoly. Less important products are rattan (*Calamus Margaritae* Hance), rice paper (*Tetrapanax papyrifera* Vent), "awkeotsang" (*Ficus Awkeotsang* Makino), bamboo, bamboo shoots, dye-stuffs (*Dioscorea rhipogonoides* Oliv.), incense powder (*Machilus longipaniculata* Hay.), cork (*Quercus variabilis* Bl.), mushrooms, derris root (*Milletia taiwaniana* (Matsum.) Hay.), areca nuts, longan (*Euphoria longana* Lam.), and charcoal."

"It is a most striking fact that no representatives of the Dipterocarpaceae are found in Formosa, although five genera, namely, *Anisoptera*, *Hopea*, *Pentacme*, *Shorea*, and *Vatica*, extend northward into the Babuyan Islands between Luzon and Formosa, where each genus is represented by one species. This shows that the separation between Luzon and Formosa was earlier than the Pliocene, for the geological records show clearly that in Pliocene times representatives of this family were present and dominant in Luzon. . . .

"Since Formosa was connected geologically with China during the Pliocene, the flora of the two countries is closely related, as is clearly indicated by the distribution of the conifers. . . . The relationship of the flora of Japan and Formosa is very weak, there being no genera confined to these two regions excepting *Trochodendron*. . . .

"So far as the ligneous plants are concerned, Formosa seems to have been separated after Japan was detached from Asiatic continent."

"Elements of Malaya and tropical Asia are of recent introduction and most of them grow in the secondary forests. . . . Paleotropic trees of wide distribution often grow in tidal or Mangrove forests, most of them having been dispersed by the sea current. In Formosa they occur chiefly in the southern part of the island and on Botel Tobago and Kwashôtô Islands. . . . Australian elements are very weakly represented in Formosa, as compared with the Philippines. *Acacia*, *Dodonaea*, *Myoporum* may be mentioned. There seems to be no African element in Formosa."

"It is interesting to note that Euphorbiaceae, Lauraceae

and Fagaceae are the dominant families in the forest of Formosa, the latter two families being most important from the economic point of view, as they produce the most valuable hardwood timbers in the island.

"There is a certain amount of anomalous distribution of the following genera: *Oreopanax*, a genus not known elsewhere than South America; *Hugeria* of North America and Japan; *Blastus* of southern China and Borneo; *Anneslea* of India and the Malay Peninsula; *Coriaria* of Himalaya, Japan, Philippines, Mexico, Chile and New Zealand; *Perrottetia* of Mexico, Colombia, Hawaii, Australia, Molucca, Java, Sumatra, Borneo, Philippines and China."

The distribution of wild conifers in the Indian Empire. By KALIPADA BISWAS. *Journ. Indian Bot. Soc.* (Madras) 12: 24–47; pl. 2, map; Jan. 1933.

For the region there are listed 12 genera and 23 wild species, but two of the species are natives of the Malay Peninsula, and not of India proper. While most of the conifers are confined to the temperate regions of the Himalayas, several of those listed extend into the tropical zone, namely *Taxus baccata*, *Podocarpus neriifolia*, *P. latifolia*, *P. cupressina*, and *P. Wallichiana*, *Pinus Merkusii* and *P. khasya*, *Dacrydium elatum*, and *Agathis loranthifolia*. For each of these species there are recorded the general ranges and the Indian localities at which they are known to occur.

The liability of some Indian timbers to *Lyctus* attack. By K. A. CHOWDHURY. Reprinted from *Indian Forester* (Calcutta) March 1933, pp. 164–168; 2 plates (graphs).

SUMMARY

"A distinct correlation was found between tangential and radial diameters of vessels in the species studied, with a few exceptions.

"*Lyctus* can lay eggs only in those vessels whose tangential and radial diameters are each larger than the diameter of the eggs.

"Different timber species belonging to a genus show a marked difference in their vessel size."

Timber tests: Meranti temak (*Shorea hypochra* Hance). By F. S. WALKER. *The Malayan Forester* (Kuala Lumpur) 2: 1: 42–44, March 1933.

"Temak or Meranti Temak, now well known on account of its damar which is equal in quality to damar penak (*Malayan Forest Records*, No. 11), is best considered in comparison with Meranti Pa'ang (*Shorea bracteolata* Dyer), . . . from which it was not distinguished until recent years, both being light colored or 'yellow' Merantis with many characteristics in common. Temak was formerly named *Shorea crassifolia* Ridley, but its identity with *Shorea hypochra* Hance, known in Cochin China and Siam, has been established (*Malayan Forest Records*, No. 10). It is common in the Langkawi islands, Kedah, and is found in the Dindings and in Selangor and also in the Kuantan district of Pahang where it is known as Terbak or Meranti Terbak. . . .

"The timber proved very difficult indeed to saw, much more so than that of Meranti Pa'ang, although there was some variation between different logs. This may be due to the more abundant deposits of silica in the rays. In this connection the Wood Technologist writes: 'In specially prepared preparations the silica deposits in almost every ray cell were a very striking feature, the size of the deposits in Temak being much larger than those in Meranti Pa'ang'. . . .

"Meranti Temak is considerably superior to Meranti Pa'ang in all mechanical properties, a notable feature being its shock-resisting ability in which it is slightly superior to Kapur, as it is in toughness. There is a general similarity to the Keruings in mechanical strength but it is more resistant to shock and not so stiff. The weight, even though less than Keruing, is sufficient to detract from its value for such purposes as tool handles for which it is otherwise as well suited as any of the tested timbers of Malaya, all of which have hitherto proved really too stiff for such purposes.

"Shrinkage and the rate of drying in the seasoning shed are the same as in the case of Meranti Pa'ang. The average volume of sapwood was 33 per cent of the whole timber, which is almost as high as that of Meranti Pa'ang, but it is again not a mechanical disadvantage. The increase of strength

from the pith outwards noted in other Merantis was here very apparent. Variation in strength from tree to tree (up to 20 per cent from the mean) occurred again, the larger trees being the stronger.

"The timber is more suitable for heavier construction than that of other Merantis so far tested, but the difficulty of conversion will unfortunately limit its use. The durability is yet to be determined and may prove to be higher due to the high silica content. Preliminary attempts to impregnate with creosote mixtures show that treatment is more difficult."

The Burseraceae of the Malay Archipelago and Peninsula, with annotations concerning extra-Malayan species, especially of *Dacryodes, Santiria* and *Canarium*. By H. J. LAM. *Bull. Jardin Botanique* (Buitenzorg) Sér. III: 12: 281–561; pls. 1–13; Dec. 1932.

There are listed formally 98 species of the family, referable to the genera *Protium*, *Garuga*, *Triomma*, *Dacryodes*, *Santiria*, *Haplolobus*, *Scutinanthe*, and *Canarium*. The "general part" of the paper includes extensive notes on morphology, systematic relationships, and geographic distribution. In the systematic part, which comprises the greater portion of the publication, each species is described in great detail, with full citation of synonymy, detailed geographic distribution, notes on habitat, time of flowering and fruiting, native names, and "general remarks." The plants treated are chiefly trees, often of great size, usually resin-producing, and sometimes with edible fruits. There are but few notes regarding economic applications.

An appendix includes a list of specimens cited, arranged by collectors, and an index to the several hundreds of vernacular names mentioned in the body of the work.

Ligneous plants collected for the Arnold Arboretum in North Queensland by S. F. Kajewski in 1929. By CYRIL T. WHITE. *Contributions from the Arnold Arboretum of Harvard University* IV, 113 pp.; 9 pls.; April 1, 1933.

The paper is a systematic report upon a collection of woody plants from the rain forests of North Queensland, particularly

the wetter parts of the Atherton Tableland, Mt. Bartle Frere, and the Daintree River. The rain forests covering the greater portion of the Atherton Tableland are reported to be the finest of their kind in Queensland, consisting of large towering trees shading a huge variety of small trees, vines, ferns, and *Calamus* species. They yield the bulk of the cabinet woods produced in Queensland.

The rain forest plateau has an elevation of 2000–4000 feet, with a rainfall of 50 to 150 inches. The height of the forest is 90 to 120 feet. Important trees are *Cardwellia sublimis* (Silky Oak, Bull Oak), *Flindersia Pimenteliana* (Silkwood), *Endiandra Palmerstoni* (Black Walnut), *Dysoxylum Pettigrewanum* (Spurwood), *Eugenia* spp. (Water Gums); and there are in places patches of fairly tall *Eucalyptus* forest, with a tall Cypress Pine (*Callitris Macleayana*).

Mt. Bartle Frere, the highest mountain of Queensland, is more than 5000 feet high. Toward its summit the rain forest is reduced to small trees, some of them no more than dwarf shrubs, many of which, such as the red-flowered *Rhododendron Lockae*, have showy blossoms.

The vegetation of the Daintree River is decidedly tropical, suggestive of that of New Guinea and the Pacific Islands. The forest here averages 70 to 90 feet in height and is marked by a dense undergrowth of *Calamus* palms.

There is presented a long, annotated list of the species collected, some of which are described as new. Genera reported for the first time from Australia are *Rinorea*, *Corynocarpus*, *Microsemma*, and *Paratrophis*. Among the new or otherwise interesting woody plants listed are *Podocarpus dispermus* C. T. White; *Balanops montana* C. T. White; *Paratrophis australiana* C. T. White; *Grevillea pinnatifida* F. M. Bailey (White Oak, a commercial timber); *Austrobaileya scandens* White, a new genus of shrubs of the Magnoliaceae; *Lonchocarpus stipularis* White, the second member of the genus for Australia; *Erythroxylum ecarinatum* Burck., Brown Plum, "wood chops and saws easily, and is very durable in the ground"; *Synoum Muelleri* C. DC., Rosewood, the wood useful for fence-posts; *Dysoxylum Muelleri* Benth., Red Bean; *Corynocarpus australasica* White; *Hexaspora pubescens*

White, a new genus of Celastraceae; *Tarrietia peralata* Domin, Crow-foot Elm, a good timber for indoor work, taking a high polish; *Oreodendron biflorum* White, a new genus of Thymelaeaceae; *Eugenia kuranda* F. M. Bailey, Cherry Penda; *Syncarpia procera* Domin, Turpentine; *Xanthostemon pubescens* White, Penda, wood very hard to cut, durable and used for timber; *Tristania exiliflora* Mueller, wood very tough, used for mallets; *Cerbera floribunda* Schum., Milky Pine, wood used to make butter boxes; *Sarcocephalus orientalis* Merr., Leichhardt Tree, wood used for timber.—P. C. STANDLEY.

Experiments on the daily shrinkage and swelling of wood. By M. B. WELCH. Reprinted from *Journ. & Proc. Royal Soc. N. S. W.* (Sydney) 66: 498–508; 1933.

SUMMARY

"A series of measurements was made three times daily over a period of about fourteen months to determine the lateral shrinkage and swelling of short 'quarter-cut' and 'backed-off' sections of six different timbers. The wood samples were placed in eight different positions in order to obtain as variable conditions as possible. The variations in size and moisture content are correlated and tables show the maximum and minimum percentages of moisture found at each station, the mean moisture content at each period at which measurements were made, the maximum swelling and shrinkage and the corresponding alteration in moisture content between 9 a.m. and 1 p.m. in any one day, and the lateral movement corresponding to a change of 1.0 per cent in the moisture content of the wood.

"Since short sections were used the size variation was considerably greater than that likely to occur in boards, but even in such short sections the maximum daily movement for timber such as Baltic, stored inside, was not found to exceed 0.013" in 4", and 0.043" for timber stored outside, between 9 a.m. and 1 p.m., whilst in a timber such as Tallowwood the size variation did not exceed 0.002" and 0.007" for inside and outside positions respectively, an amount which is practically negligible."

The mukushi (*Baikiaea plurijuga* Harms) forests of Northern Rhodesia. By J. D. MARTIN. *Second Annual Bulletin of the Department of Agriculture*, 1932, pp. 71–76.

"The Mukushi, known locally as Rhodesian Teak or Rhodesian Redwood, is the principal tree exploited commercially in Northern Rhodesia. Typically gregarious in habit, it is known to form individual forests up to 40 square miles in extent. Its distribution within the Protectorate is limited to the Kalahari sand formations of the Upper Zambezi and Middle Kafue drainage basins. . . .

"The Mukushi is an erect full-boled tree with little taper, the form factor being 0.8 for mature trees. When growing in close stands it may reach a total height of 60 feet with a clean bole up to 30 feet. In open forest, height growth is poorer and the crown assumes a wide-spreading, heavily branched form. The average length of clear bole is 14 to 17 feet, but forking is frequent owing to damage to young trees by climbing undergrowth. Individual trees may attain large size and girths of 15 feet at breast height have been recorded; such specimens are usually fluted at the base. The bark varies in appearance from rough to smooth, the rough bark being grayish brown and the smooth having a light ash-gray to cream color. The rough bark is shed at intervals leaving smooth bark underneath, which in course of time cracks and becomes rough. This change appears to continue throughout the growing life of the tree. When injured by fire the bark becomes rust-colored, as on felled trees, and comes away from the stem. Epicormic branches are numerous on injured or suppressed trees. Mukushi is deciduous from the end of August until the middle of October, large trees in clearings retaining their leaves much longer and coming into leaf sooner than those in the forest."

"The wood of Mukushi is hard, heavy, close-grained, and durable, brown when first cut, and turning red-brown on exposure. It is moderately easy to work and takes a fine finish, which makes it suitable for all classes of furniture and ornamental manufactures where its weight (53 to 60 lbs. per cubic foot air dry, 12 per cent moisture content), is not a drawback. It is, however, difficult to nail and splits at the nail

hole. The heartwood, forming about 80 per cent of the mature log, is not attacked by borers or termites and is durable in contact with the soil, hence its utilization for purposes where durability is essential, such as railway sleepers, bridge timbers, mine shaft timbers and flooring.

"The most important market for Mukushi timber is the supply of sleepers for the South African and the Rhodesian Railways. The minimum diameter of log from which it is possible to cut a sleeper (6 feet 6 inches by 10 inches by 5 inches) is 12 inches, and the number of trees per acre having exploitable size varies between 12 and 14 in the uncut forests of the Machili area. Most of these trees have a sufficient height of bole to obtain two sleeper lengths. . . .

"Most sleepers are manufactured from trees 15 to 24 inches in diameter at breast height and, since an average of 19 per cent sapwood is found in logs exceeding 15 inches in diameter, all sapwood cannot be excluded from the sleepers. They are therefore subjected to a standard treatment, as sapwood is susceptible to the attacks of insects and fungi. The treatment consists of a 'hot and cold' bath, the preservatives used being a 1 per cent solution of arsenious oxide. The sleepers are soaked in this at high temperature for 24 hours and left in the cooling solution for a further period of two days, after which the liquid is run off. The sleepers after drying are then dipped in hot tar and allowed to drain before stacking. It has been estimated that sleepers of Mukushi treated in this way have a minimum life of 15 years in the road.

"In recent years the Zambesi Saw Mills have developed several side lines, such as the manufacture of furniture and blocks for parquet flooring, the latter being obtained from the off cuts of sleeper production. A seasoning kiln has been erected and the latest machinery for mass production of furniture installed. Tongue-and-groove flooring, beams, and mine timbers are also manufactured from Mukushi. Waste wood is utilized to fire the mill engines and logging locomotives and is also sold for fuel.

"During the last two years experiments have been carried out by the Imperial Institute in connection with tannin extract obtained from the bark of Mukushi. The extract

contains 59.5 per cent tannin, but unfortunately has a reddish coloration which is a serious obstacle to extended commercial use in overseas markets. The results of the experiments show that the red coloring matter in the extract is of a persistent nature and gave no indication that it can be satisfactorily reduced without removing at the same time so large a quantity of the tannin as to render the treatment uneconomical."

Sur quelques bois du Katanga. By G. DELEVOY. *Revue Internationale des Produits Coloniaux* (Paris) 8: 89: 201–202; May 1933.

Since 1928 the special Committee for Katanga has published a series of pamphlets on the systematic study of woods of Katanga, and Mr. Delevoy has, with the collaboration of Messrs. Dustin and Rosenthal, of the University of Brussels, used this information in an attempt to determine the physical and mechanical properties of some Katanga timbers, according to the Monnin method and following the working plan of Mr. Jean Collardet.

The studies show that many woods have possibilities of which advantage has not been taken, and that, on the other hand, the practice of employing a particular wood for a certain purpose does not always appear justified by the mechanical properties of the specimens studied. For example, while the wood of *Chlorophora excelsa* is in very general use, many others, such as *Albizzia sassa*, which would offer the same advantages are scarcely utilized at all.

Certain *Brachystegia* and *Berlinia* timbers also have the physical and mechanical properties essential to general utility, but they lack durability. If this can be remedied by impregnation or some other preservative method they may become valuable. Some timbers, for example *Parinarium* spp. and *Kigelia aethiopica*, were found to be scarcely or not at all utilizable.

Another interesting discovery made by Mr. Delevoy is that the qualities of a given species may exhibit pronounced variations according to its habitat. The fissility, durability, and, to some extent, the density of *Chlorophora* appear to increase in passing from Gaboon and Guinea to the Ivory Coast and Maniema.—MARY E. RECORD.

Palms and their characteristics. By L. H. Bailey. *Gentes Herbarum* (Ithaca, New York) 3, 1: 1–29; figs. 1–19; March 15, 1933.

A general, popular account of palms, discussing briefly their economic possibilities, their landscape and ornamental value, and the methods of studying them. Of particular value are the directions for making specimens for study, carelessly prepared herbarium specimens being of little value for the purpose. There is also a discussion of the terms used in describing the plants and a short account of the classification of palms.

Buch der Holznamen. I. A-Ca. By Hans Meyer. M. & H. Schaper, Hannover, Germany, 1933. Pp. xviii+108; 7 x 10. Price (parts I–IV) about RM. 25.

As a result of twenty years' activity on the part of the author in making investigations and giving information regarding timber, there is now available a comprehensive work of reference giving the species and plant families corresponding to the commercial, common and vernacular names of woody plants, and also the origin of the wood or the name.

This book includes the woody plants of the whole world and the title, preface, abbreviations and explanations are given in four languages, *viz.*, German, English, French, and Spanish. The book is useful not only to scientists, public institutions, students, and persons interested in the lumber trade and wood industry, but also to the dyeing, tanning, oil, paper, and textile industries, the medicinal and technical drug trade, and others whose raw materials are to a great extent furnished by woody plants.

The first part contains the preface, abbreviations, and explanations and about 6600 wood names in alphabetical order from "Aach-a-yong" to "Cazuela." The second part is already in print and the whole work will be ready about the end of this year.

Dr. Meyer is one of the founders of the International Association of Wood Anatomists and chairman of its Committee on the Compilation of Wood Names.

M.M.C.

M. M. CHATTAWAY. Price 50 cents

Yale University School of Forestry

TROPICAL WOODS

NUMBER 36 DECEMBER 1, 1933

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 36 December 1, 1933

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, *Professor of Forest Products, Yale University.*

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GLOSSARY OF TERMS USED IN DESCRIBING WOODS

By COMMITTEE ON NOMENCLATURE[1]

International Association of Wood Anatomists

WHOLE STEM

[Gymnosperms and (or) Dicotyledons]

1. **Wood** or **Xylem.**—The principal strengthening and water-conducting tissue of stems and roots. Characterized by the presence of tracheary elements. (See No. 71.)

[1] Members of the Committee: ARTHUR J. EAMES, Cornell University; IRVING W. BAILEY, RALPH H. WETMORE, and ROBERT H. WOODWORTH, Harvard University; GEORGE A. GARRATT and SAMUEL J. RECORD (Chairman), Yale University.

Terms in **bold-face** type have been approved, along with their respective definitions, by the Council of the I. A. W. A. as standard for the Association. Numbered terms in *italics* have not yet been acted upon by the Council.

2. **Primary Wood** or **Primary Xylem.**—First-formed xylem, differentiated from an apical meristem. (Ordinarily at edge of pith in the stem.)

3. **Protoxylem.**—First-formed primary xylem, with tracheary elements characterized by annular or spiral thickenings.

4. **Metaxylem.**—Later-formed primary xylem, with pitted tracheary elements.

5. **Secondary Wood** or **Secondary Xylem.**—Wood produced by cambium.

6. **Pith.**—Central parenchymatous cylinder in the stem and occasionally in the root.

7. **Cambium.**—Sheath of generative tissue ordinarily between xylem and phloem.

8. *Initial.*—An individual cell of the cambium or of other meristems.

9. *Fusiform Initial.*—A cambial initial giving rise to a vertical, or axial, element of xylem or phloem; it is fusiform as seen in tangential section.

10. *Ray Initial.*—A cambial initial giving rise to a ray cell; usually of a group and often more or less isodiametric as seen in tangential section.

11. *Storied Cambium.*—Cambium characterized by a horizontal seriation of the initials.

12. *Cambial Zone.*—A term of convenience for the layer of variable width composed of the initials and their undifferentiated derivatives.

13. **Bark.**—Tissues of stem and root outside of cambium layer. In older trees usually divisible into **Inner** (living) and **Outer** (dead) **Bark.**

14. **Phloem.**—The principal tissue concerned with the distribution of elaborated foodstuffs. Characterized by the presence of sieve tubes.

15. **Primary Phloem.**—The first-formed phloem, differentiated from an apical meristem.

16. **Secondary Phloem.**—Normally, the part of the bark formed by the cambium.

17. **Included Phloem.**—Phloem strands or layers included in the secondary xylem of certain dicotyledonous woods. (To replace *Interxylary Phloem.*) (See note.)

18. **Internal Phloem.**—Primary phloem internal to the primary xylem. (To replace *Intraxylary Phloem.*) (See note.)

19. **Ray.**—A ribbon-like aggregate of cells formed by the cambium and extending radially. Also called *Medullary Ray.* (See note.)

20. **Wood Ray** or **Xylem Ray.**—The part of a ray internal to the cambium; term used to distinguish it from *Phloem Ray.*

21. **Phloem Ray.**—The part of a ray external to the cambium.

Secondary Wood Only

[Gymnosperms and (or) Dicotyledons]

22. **Sapwood.**—Living (*i.e.*, physiologically active) wood, of pale color.

23. **Heartwood.**—Non-living and usually darker-colored wood surrounded by the sapwood.

24. **Included Sapwood.**—Masses or concentric zones included in the heartwood, which retain appearance and technical properties of sapwood.

25. **Growth Layer.**—A layer of wood produced apparently during one growing period; frequently, esp. in woods of the temperate zones, divisible into *Early Wood* and *Late Wood.* (See Nos. 30, 32.)

26. **Growth Ring.**—A growth layer as seen in cross section.

27. **Annual Ring.**—A growth layer of one year as seen in cross section. (Usually applicable in temperate zones only.)

28. **Double** (or **Multiple) Annual Ring.**—An annual ring consisting of two (or more) growth rings.

29. **False Annual Ring.**—One of the growth rings of a double (or multiple) annual ring.

30. **Early Wood.**—The less dense, larger-celled, first-formed part of a growth ring.

31. **Spring Wood.**—The early wood of an annual ring. (See note.)

32. **Late Wood.**—The denser, smaller-celled, later-formed part of a growth ring.

33. **Summer Wood.**—The late wood of an annual ring. Also called *Autumn Wood* (obsolescent). (See note.)

34. **Growth Ring Boundary.**—The outer limit of a growth ring. (Not to be confused with the growth ring itself.)

35. **Middle Lamella.**—A term of convenience for the compound layer between the secondary walls of adjacent cells. Consists of (*a*) two *Primary Walls* and (*b*) an *Intercellular Layer* of varying thickness.

36. **Intercellular Layer.**—The layer between adjacent cells, often merging insensibly into their primary walls; it is isotropic, and lacks cellulose.

37. **Primary Wall.**—The wall of the meristematic cell, modified during differentiation. (Not to be confused with the thin, markedly anisotropic, first-formed part of the secondary wall.)

38. **Primary Pit Field.**—A thinner area of the intercellular layer and primary walls within the limits of which one or more pit-pairs (No. 61) usually develop. (Not to be confused, in differentiation, with pit membranes.)

39. **Crassulae.**—Thicker portions of the intercellular layer and primary walls between primary pit fields. (To replace *Bars of Sanio* and *Rims of Sanio.*) (See note.)

40. **Secondary Wall.**—The wall formed inside the primary wall; varies markedly in thickness and in physical and chemical properties; is stratified, striated, and pitted. (See note.)

41. **Spiral Thickenings.**—Helical ridges on the inner face of, and a part of, the secondary wall. (Often called *tertiary spirals* to distinguish them from the spirals of primary xylem.) (See note.)

42. **Lumen.**—The cell cavity.

43. **Trabeculae.**—Rod-like or spool-shaped parts of a cell wall which project radially across the lumen. (Also called *Sanio's Beams* and sometimes *Bars of Sanio.*)

44. **Intercellular Spaces.**—Spaces between cells. Includes canals (No. 116) and cavities (schizogenous, lysigenous, and schizo-lysigenous) and **Interstitial Spaces**—actual openings between rounded corners of cells.

45. **Pit.**—A recess in the secondary wall of a cell, with its external closing membrane; open internally to the lumen. (Essential components are the *Pit Cavity* and the *Pit Membrane.*)

46. **Pit Membrane.**—The part of the intercellular layer and primary wall that closes a pit cavity externally.

47. **Pit Annulus.**—The outer, thicker rim of a bordered-pit membrane. (Has been confused with curved *Crassulae* (No. 39) or so-called *Rims of Sanio.*)

48. **Torus.**—A central, thicker part of a pit membrane.

49. **Pit Cavity.**—The entire space within a pit from the membrane to the lumen.

50. **Simple Pit.**—A pit in which the cavity becomes wider, remains of constant width, or only gradually narrows during increase in thickening of the secondary wall, *i.e.*, toward the lumen of the cell.

51. **Bordered Pit.**—Typically, a pit in which the cavity becomes abruptly constricted during the thickening of the secondary wall.

52. **Pit Border.**—The overarching part of the secondary wall.

53. **Pit Chamber.**—The space between the pit membrane and the overarching border.

54. **Pit Canal.**—The passage from the cell lumen to the chamber of any bordered pit. (Simple pits in thick walls usually have **Canal-like Cavities.**)

55. **Pit Aperture.**—The opening or mouth of a pit.

56. **Outer Aperture.**—The opening of the canal into the pit chamber.

57. **Inner Aperture.**—The opening of the canal into the cell lumen.

58. *Included Aperture.*—An inner aperture whose outline, in surface view, is included within the outline of the border.

59. *Extended Aperture.*—An inner aperture whose outline, in surface view, extends beyond the outline of the border.

60. **Coalescent Apertures.**—Slit-like inner apertures united into spiral grooves.

61. **Pit-pair.**—Two complementary pits of adjacent cells. (See note.)

62. **Half-bordered Pit-pair.**—An intercellular pairing of a simple and a bordered pit. (To replace *Half-bordered Pit.*)

63. **Blind Pit.**—A pit without a complement. (Common form opposite to an intercellular space.) (See note.)

64. **Vestured Pit.**—Bordered pit with its cavity wholly or partially lined with projections from the secondary wall. (See note.)

65. **Unilaterally Compound Pitting.**—A type of pitting in which one pit subtends two or more smaller pits in the cell adjacent.

66. **Ramiform Pits.**—Simple pits with coalescent, canal-like cavities, as in stone cells. (See note.)

67. **Scalariform Pitting.**—Type of pitting in which elongated or linear pits are arranged in a ladder-like series. (See note.)

68. **Opposite Pitting.**—Type of pitting in which the pits are in horizontal pairs or in short horizontal rows. (When the pits are crowded, the outlines of the borders become rectangular in surface view.)

69. **Alternate Pitting.**—Type of pitting in which the pits are in diagonal rows. (When the pits are crowded, the outlines of the borders tend to become hexagonal in surface view.)

70. **Sieve-pitting.**—Arrangement of small pits in cribriform clusters.

71. **Tracheary Elements.**—The principal water-conducting elements of the xylem, mostly vessel members and tracheids. (See note.)

72. **Tracheid.**—Imperforate cell with pits to congeneric elements bordered. (In primary wood, tracheids may have annular, spiral, or reticulate thickenings only.)

73. **Strand Tracheid.**—A tracheid of a vertical series (strand) of tracheids (or of mixed tracheids and parenchyma cells), each series originating from a single cambial initial. (To replace *Septate Tracheid.*)

74. **Ray Tracheid.**—A tracheid forming part of a ray. (Sometimes called *Marginal Tracheid* or *Marginal Ray Tracheid.*)

75. **Vascular Tracheids.**—Imperforate cells resembling in form and position the members of a small vessel. (Degenerate or imperfect vessel elements.)

76. *Vasicentric Tracheids.*—Short, irregularly-formed tracheids in the immediate proximity of vessels and not forming definite longitudinal rows or series. (See note.)

77. **Disjunctive Tracheids.**—Tracheids partly disjoined laterally during differentiation; contact is maintained by means of tubular processes. (To replace *Conjugate Tracheids.*) (See note.)

78. **Fiber-tracheid.**—A fiber-like tracheid; commonly thick-walled, with small lumen, pointed ends, and small bordered pits having lenticular to slit-like apertures. (See note.)

79. **Septate Fiber-tracheid.**—A fiber-tracheid with thin, transverse walls across the lumen. (In these elements the protoplast divides after the formation of the secondary wall. The septa are true walls.)

80. **Vessel.**—A vertical series of cells that have coalesced to form an articulated, tube-like structure of indeterminate length, whose pits to congeneric elements are bordered.

81. **Vessel Member** or **Vessel Element.**—One of the cellular components of a vessel. (To replace *Vessel Segment.*) (See note.)

82. **Perforation Plate.**—A term of convenience for the area of the wall (originally imperforate) involved in the coalescence of two members of a vessel.

83. **Perforation.**—An opening from one vessel member to another.

84. **Simple Perforation.**—A single and usually large and more or less rounded opening in the perforation plate. (In contrast to *Multiple Perforations.*)

85. **Perforation Rim.**—The remnant of a perforation plate forming a border about a simple perforation. (To replace *Annular Ridge.*)

86. **Multiple Perforations.**—Two or more openings in a perforation plate.

87. **Scalariform Perforation Plate.**—A plate with multiple perforations elongated and parallel. The remnants of the plate between the openings are called **Bars.** (See note.)

88. **Reticulate Perforation Plate.**—A plate with multiple perforations having a net-like appearance (as in certain Bignoniaceae).

89. **Ephedroid Perforation Plate.**—A plate having a small group of bordered, circular openings (as in *Ephedra*).

90. **Pore.**—A term of convenience for the cross section of a vessel element or of a vascular tracheid.

91. *Solitary Pore.*—A pore completely surrounded by other elements.

92. *Pore Multiple.*—A group of two or more pores crowded together and flattened along the lines of contact so as to appear as subdivisions of a single pore.

93. *Pore Chain.*—A series or line of adjacent pores that retain their separate identities.

94. *Pore Cluster.*—An isolated, rounded or irregular aggregate of pores surrounded by other elements.

95. **Diffuse-porous Wood.**—Wood in which the pores are of fairly uniform or only gradually changing size and distribution throughout a growth ring.

96. **Ring-porous Wood.**—Wood in which the pores of one part of a growth ring are in distinct contrast in size or number (or both) to those of the other part.

97. **Libriform Wood Fiber.**—Elongated, commonly thick-walled cell with simple pits. (Usually distinctly longer than cambial initial as inferred from length of vessel members and parenchyma strands.) (For similar cell with bordered pits see *Fiber-tracheid*, No. 78.)

98. **Septate Wood Fiber.**—A libriform wood fiber with thin transverse walls across the lumen. (In these elements the protoplast divides after the formation of the secondary wall.)

99. **Parenchyma.**—Tissue concerned primarily with the storage and distribution of carbohydrates; cells mostly short, with numerous simple pits. Usually in two systems: (1) vertical, or axial (*Wood Parenchyma* or *Xylem Parenchyma*), and (2) horizontal, or radial (*Ray Parenchyma*, No. 112).

100. **Wood Parenchyma** or **Xylem Parenchyma.**—Vertical parenchyma, composed of single cells (*Fusiform Wood Parenchyma Cells*) and (or) cell-series (*Wood Parenchyma Strands*), each of which corresponds in height to its cambial initial.

101. *Fusiform Wood Parenchyma Cell.*—A wood parenchyma cell derived from a cambial initial without subdivision. (To replace *Substitute* and *Intermediate Wood Fiber*. See note.)

102. **Wood Parenchyma Strand.**—A vertical series of two

or more wood parenchyma cells, which is derived from a single cambial initial.

103. *Diffuse Parenchyma.*—Single parenchyma strands or cells distributed irregularly among the fibrous elements of the wood, as seen in cross section.

104. *Terminal Parenchyma.*—Aggregated wood parenchyma forming a more or less continuous layer of variable width at the close of a season's growth.

105. *Metatracheal Parenchyma.*—Aggregated wood parenchyma forming concentric laminae, mostly independent of the vessels and vascular tracheids.

106. *Paratracheal Parenchyma.*—Aggregated wood parenchyma in association with the vessels or vascular tracheids.

107. *Vasicentric Parenchyma.*—Paratracheal parenchyma forming a vascular sheath of variable width, and circular or oval in cross section.

108. *Aliform Parenchyma.*—Vasicentric parenchyma with wing-like lateral extensions.

109. *Confluent Parenchyma.*—Coalesced aliform parenchyma, forming irregular tangential or diagonal bands.

110. *Conjunctive Tissue.*—A special type of parenchyma forming anastomosing concentric bands and rays in association with included phloem. (See No. 17.)

111. **Pith Fleck.**—Island (in cross section) of wound tissue composed of irregularly arranged isodiametric parenchyma cells occluding tunnels made in the cambium by larvae of certain insects. (Sometimes called *Pith-ray Fleck* and *Medullary Spot.*)

112. **Ray Parenchyma.**—Horizontal or radial parenchyma composing the rays wholly or in part. (For *Ray Tracheid*, see No. 74).

113. **Disjunctive Parenchyma Cells.**—Wood or ray parenchyma cells partially disjoined during the process of differentiation; contact is maintained by means of tubular processes. (To replace *Conjugate Parenchyma Cells*. See note No. 77.)

114. *Septate Parenchyma Cell.*—A wood or ray parenchyma cell with thin transverse walls across the lumen. (In these elements the protoplast divides after the formation of the secondary wall.)

115. **Tylosis.**—A proliferation of the protoplast of a parenchymatous cell through a pit-pair into the lumen of an adjacent vessel or tracheid. (Tyloses may be few or many crowded together; thin- or thick-walled; pitted or unpitted; with or without starch, crystals, resins, gums, etc.) (For *Tylosoid*, see No. 118.)

116. **Intercellular Canal.**—An intercellular space of indeterminate length, generally serving as a repository for resin, gums, etc., that are secreted or excreted by the epithelium; (1) vertical, or axial, or (2) horizontal, or radial (within a ray). (Usually called **Resin Duct** or **Resin Canal** in Gymnosperms, and **Gum Duct** in Dicotyledons.)

117. **Epithelium.**—The layer of parenchymatous cells surrounding an intercellular canal. (Cells may be thick- or thin-walled, pitted or unpitted.)

118. **Tylosoid.**—Proliferation of a thin-walled epithelial cell into an intercellular canal. (Differs from a tylosis in that it does not pass through the cavity of a pit.)

119. **Aggregate Ray.**—A group of small, narrow, xylem rays appearing to the unaided eye or at low magnification as a single large ray.

120. **Homogeneous Ray.**—A xylem ray composed of radially elongated cells.

121. **Heterogeneous Ray.**—A xylem ray composed of cells of different morphological types. (Typically, with the cells of the multiseriate part radially elongated and those of the uniseriate parts vertically elongated or square.)

122. **Procumbent Ray Cell.**—Ray cell with its longest axis radial.

123. **Upright Ray Cell.**—Ray cell with its longest axis vertical. (Such cells compose certain uniseriate rays and uniseriate parts, typically the margins, of heterogeneous rays.)

124. **Tile Cells.**—Special type of apparently empty upright or square ray cells of approximately the same height as the procumbent cells and occurring in indeterminate horizontal series usually interspersed among the procumbent cells. (Common in certain of the Tiliales and Malvales).

125. **Sheath Cells.**—Upright ray cells tending to form a sheath about the smaller cells of a multiseriate ray or the multiseriate part of a ray.

126. **Latex Tube.**—A laticiferous tube inclosed in a ray and connecting with vertical tubes in the cortex and (or) pith.

Explanation

The International Association of Wood Anatomists had its origin in a conference of scientists at Cambridge, England, in August 1930. An Organizing Committee was appointed, and the constitution proposed by it was adopted at a second conference, held at Paris, July 4, 1931. Membership is limited to persons, other than students, who are actively engaged in the study of wood anatomy. There are at present 67 members, representing 22 countries. The affairs of the Association are administered by a Council of twelve elected every three years. The members of the present Council are of 12 nationalities. Professor Record is the Secretary-treasurer.

One of the activities of the Association is "to work toward standard terminology and descriptions," but "all committee reports, standards for terminology and descriptions, manuals, etc., which may be approved by the Council are to be considered merely as recommendations or suggestions for the general guidance of the members."

Work on this glossary was begun at the Cambridge meetings and carried on informally by Professor Record until early in 1932 when it was placed under the aegis of the Association and referred to a special Committee on Nomenclature. Up to this time attempt had been made to give the equivalents of the English terms in five and subsequently seven other languages, but the Committee decided to limit its activities to the selection and definition of English terms, leaving the translations to scientists of the different nationalities concerned. The Committee's first report was submitted in May 1932 to the members who had collaborated, about 25 in all. The numerous suggestions received were considered at another meeting in October and a formal report on 108 terms was transmitted to the Council of the Association. Nearly all of the terms had been officially approved by April 1933, but the Secretary deferred their publication until certain queries by individual Councilors could be considered at a meeting of the Committee in October 1933.

Notes

The following notes are merely explanatory and were not included in the report made to the Council of the International Association of Wood Anatomists. The numbers correspond with those of the terms in the glossary to which the notes apply.

17, 18. The older terms *interxylary* and *intraxylary* are not distinctive and their usage by different authors is not consistent.

19. The use of the term *medullary ray* should be limited to primary tissue.

31, 33. Since the terms *spring wood* and *summer wood* are not of general application, the Committee recommends that their further use be discouraged.

39, 43. The terms *bars of Sanio*, *rims of Sanio*, and *Sanio's beams* having become hopelessly confused, the Committee is strongly opposed to their further use.

40, 41. The Committee does not recognize a *tertiary wall* of a cell. Spirals and gelatinous and unlignified layers, etc., are considered parts of the secondary wall.

61. The proper use of the term *pit-pair* will avoid the ambiguous application of *pit* to both a cellular and an intercellular structure.

63. The older term *air-pit* is disapproved because it implies a function that has not been established as a fact. *Half-pit* is not applicable because the pit is complete.

64. *Vestured pit* is a new term for *pit with cribriform membrane*, since the punctate appearance of such a pit is not due to the structure of the membrane. (See *Tropical Woods* 31: 46.)

66. *Ramiform pits* are sometimes called *branched pits*, but "branched" implies division instead of coalescence.

67. It should be noted that it is the *arrangement* of the pits, not the pits themselves, that is scalariform.

71. In the opinion of the Committee, *libriform fibers* are tracheary elements whose mechanical function has become emphasized.

76. *Vasicentric tracheids* is a new term for cells which previously had no more distinctive name than *short tracheids*.

77. The term *conjugate* (from Latin *conjugare*, to join together or unite) implies development in the wrong direction.

78. In the opinion of the Committee, the term *fiber-tracheid* is applicable to the late-wood tracheids of certain Gymnosperms as well as to the fibrous tracheids of Dicotyledons.

81. Further use of the term *segment* (from the Latin *secare*, to cut off) should be discouraged, since it implies the reverse of the actual process of vessel formation.

87. The term *scalariform perforation*, now in common use, is obviously incorrect, as it implies that the individual openings in a group are merely subdivisions of a single large opening. It is correct to say that the vessel members (not the vessels themselves) are *scalariformly perforated*.

101. The older terms, *substitute fiber* and *intermediate wood fiber*, are inappropriate since they obscure the fact that the cells are parenchyma.

THE COLOMBIAN SPECIES OF *ASPIDOSPERMA* AND *TABEBUIA*

By Paul C. Standley

Field Museum of Natural History

Aspidosperma

The genus *Aspidosperma* of the family Apocynaceae is represented by a rather large number of small or tall trees dispersed from southern Mexico to Argentina. The greater number of species is found in the drier regions of Brazil and Argentina, and only two extend to Mexico and Central America. Most of them are economically important because of their wood, which is employed for a wide variety of purposes.

In northern South America the genus is scarcely better represented than in Central America, only a few species being reported from Venezuela and the Guianas, and, until quite recently, only one (described as late as 1920) from Colombia. Recent collections obtained chiefly by or for Prof. Samuel J. Record show that at least four species of *Aspidosperma* grow in Colombia. Careful comparison with material or descriptions of the species recorded from Venezuela and the Guianas indicates that the Colombian trees are all distinct from those, and, in view of what is known of the distribution of the floras of northern South America, this is not at all surprising. The Colombian species, likewise, are quite unlike the single *Aspidosperma* known from Central America—*A. megalocarpon* Muell. Arg.

Key for Separation of the Species

Leaves, at least when young, densely tomentose beneath with soft, more or less spreading hairs, rounded at the apex. Corolla glabrous outside. ..... *A. Woronovii*

Leaves glabrous, or merely scaberulous beneath.

Leaves sparsely and minutely scaberulous beneath, at least when young, long-acuminate. Fruit densely tomentose. ..... *A. Curranii*

Leaves glabrous, at least in age.

Corolla glabrous outside; leaves obtuse or rounded at the apex. Fruit glabrous or nearly so ..... *A. elliptica*

Corolla sericeous, especially on the lobes; leaves acute, with obtuse tips ..... *A. Dugandii*

Aspidosperma Woronovii Standl. Field Mus. Publ. Bot. 8: 34. 1930. Known only from the original collection: Quebrada de Mambucá, Department of Huila, *G. Woronow* 7075. Type in the Leningrad herbarium; fragments in the herbarium of Field Museum.

Aspidosperma Curranii, sp. nov.—Arbor 30-metralis et ultra, trunco 60–100 cm. diam., ramulis novellis gracilibus puberulis, vetustioribus brunnescentibus; folia alterna breviter petiolata mediocria firme membranacea, petiolo gracili 7–13 mm. longo; lamina anguste lanceolato-oblonga 9–15 cm. longa 2.5–3.5 cm. lata subabrupte vel sensim attenuato-acuminata, acumine ipso acuto, basi acuta vel acuminata, supra viridis glabra, nervis vix manifestis, subtus glaucescens ubique in statu juvenili sparse minute scaberula serius fere glabra, costa gracili elevata, nervis lateralibus utroque latere c. 12 prominulis gracillimis angulo lato divergentibus fere rectis marginem attingentibus; inflorescentia ut videtur parva pauciflora breviter crasse pedunculata; folliculi immaturi obovoidei valde obliqui 2–2.5 cm. longi 10–12 mm. lati apice rotundati vel obtusissimi basin versus angustati ubique dense tomentosi.—Colombia: Non-flooded valley of Río Magdalena, Buenavista, Department of Caldas, alt. 170 m., July 11, 1917, *H. N. Whitford & J. Pinzón* 2 (Yale No. 405; Herb. Field Mus. No. 675965, type). Estrella, Caño Papayal, Department of Bolívar, in 1916, *H. M. Curran* 294.

Although known only from imperfect material, the leaf characters alone of this tree are so distinctive as to indicate that it is a valid species. The vernacular name is Carreto. The wood and the distribution of the tree are discussed at length in *Timbers of Tropical America*, pp. 514–515.

Aspidosperma ellipticum Rusby, Descr. S. Amer. Pl. 82. 1920. Type from Masinga Vieja, at 240 meters, and from Bonda, *H. H. Smith* 836. Barranquilla, *Dugand* 37. Santa Rosa, near Barranquilla, *Dugand* 239 (Yale No. 22528). Santa Marta region, *Espina* 81 (Yale No. 20430), 28 (Yale No. 20477).

The vernacular names are reported as Amargo, Chivato, Macuíro (all according to Espina), Amargo or Carreto (Dugand).

The leaves vary considerably in shape, being usually oblong but sometimes oval or very narrowly oblong; the base varies from rounded to acute. Rusby states that *Smith* 836 is a mixture of two species, one of which is apparently *A. decipiens* Muell. Arg. The sheet of the type number in Field Museum bears two specimens apparently collected at different times, but I see no reason why both should not be referred to a single species, which is clearly distinct from *A. decipiens*.

Aspidosperma Dugandii, sp. nov.—Arbor 8–12-metralis, ramulis ochraceis saepe conspicue lenticellatis glabris; folia alterna mediocria petiolata subcoriacea, petiolo 1–2 cm. longo gracili glabro; lamina oblonga vel lanceolato-oblonga prope medium latissima 7–13 cm. longa 2.5–4 cm. lata acuta vel acutiuscula, apice ipso obtuso, basi acuta et plus minusve obliqua, glabra, supra in sicco viridis lucida, nervis nervulisque prominulis, subtus fere concolor, nervis numerosissimis parallelis fere rectis juxta marginem in nervum collectivum junctis, nervulis prominentibus arcte reticulatis; inflorescentiae terminales multiflorae breviter pedunculatae circa 2 cm. longae et 3 cm. latae densiusculae, ramis puberulo-tomentulosis, floribus breviter crasse pedicellatis; sepala ovato-rotundata 1.5 mm. longa apice rotundata vel obtusissima puberula erecta; corolla in alabastro 5 mm. longa extus praesertim ad lobos sericea, lobis angustis tubo brevioribus.—Colombia: Near Arroyo Caña, region of Barranquilla, February 18, 1932, *A. Dugand* 355; at the same locality, *Dugand* 208. Near Barranquilla, July 19, 1933, *Dugand* 428. Don Jaca, Santa Marta region, January 20, 1930, *Record* 66 (Yale No. 16465).

The vernacular name is Carreto. Concerning the tree, Mr. Dugand supplies the following notes: "The trees vary in size from 5–12 meters, the trunk generally straight, the bark greenish gray, peeling off in small patches, but sometimes reddish gray, smooth, and somewhat glossy on the branches. Scarcely any latex, the juice being rather watery and not milky. Trunk diameter 20 to 40 cm., but I understand some trees have trunks averaging over 80 cm., being, of course, taller—15 to 20 meters. The heartwood when cut is of a handsome pink color, the sapwood being dull grayish white."

TABEBUIA

Little has been known regarding the species of *Tabebuia* (Bignoniaceae) occurring in Colombia, for only lately has there become available any considerable quantity of material of these handsome trees. Even now the number of specimens is inadequate, but the excellent series obtained recently by Sr. Armando Dugand G. has made it possible to distinguish satisfactorily at least the more common species of the northern coast. Further exploration undoubtedly will add to the present list of eight Colombian species, for these are chiefly trees of the northwestern coast, and there are few specimens or records from the interior of the country, where additional species are to be expected.

The Tabebuias are important commercially throughout their range because of their valuable wood, useful for construction and cabinetwork. In addition, they merit general planting in tropical and subtropical regions for ornament, since few American trees are so showy and handsome. Their flowers, similar to those of the genus *Catalpa*, are either yellow or of varied tints of purple and pink. The trees of the latter group, as the writer has frequently remarked, exhibit almost exactly the same color effects as the celebrated Japanese cherries.

KEY TO THE SPECIES

Calyx and foliage lepidote with minute appressed scales. Corolla pink or rose-purple..... *T. pentaphylla*

Calyx stellate-pubescent or sometimes setose or pilose with long soft hairs.

Corolla sparsely or densely pubescent; flowers in small lax panicles or in elongate spikelike racemes.

Leaflets entire, glabrous; flowers purple, panicled..... *T. Dugandii*

Leaflets crenate, densely pubescent; flowers yellow, in spikelike racemes. *T. chrysea*

Corolla glabrous outside; flowers chiefly in dense heads, sometimes in umbels. Corolla yellow.

Calyx very densely pilose with long soft matted yellowish hairs. *T. chrysantha*

Calyx finely stellate-tomentose, or sometimes sparsely setose.

Leaflets with abundant pubescence of simple and stellate hairs. *T. rufescens*

Leaflets usually almost glabrous, the pubescence, if any, of minute stellate hairs.

Calyx almost 2 cm. long, short-setose..... *T. punctatissima*

Calyx about 1 cm. long, or often much shorter, stellate-tomentose.

Leaflets broadest above the middle, abruptly short-acuminate, or obtuse to rounded at the apex. Corolla about 4.5 cm. long..... *T. coralibe*

Leaflets broadest at or below the middle, gradually acute to long-acuminate.

Corolla usually 7–9 cm. long; leaflets at maturity coriaceous. *T. serratifolia*

Corolla 4–5 cm. long; leaflets thin..... *T. Billbergii*

Tabebuia pentaphylla (L.) Hemsl. One of the handsomest trees of tropical America, highly esteemed for its wood; ranging widely, from Colombia to Mexico and the West Indies, often abundant locally. Colombian specimens are at hand from Barranquilla (*Dugand* 330) and the Santa Marta region, at 1200 meters (*H. H. Smith* 1142). Called Roble Morado at Barranquilla.

Tabebuia Dugandii, sp. nov.—Arbor 6–10-metralis; folia magna, foliolis 5 longipetiolulatis ellipticis vel ovato-ellipticis 11–24 cm. longis 4.5–11 cm. latis sensim vel abrupte acuminatis basi rotundatis vel acutiusculis integris subcoriaceis glabris sed praesertim subtus minutissime albido-puncticulatis (lepidotis?), nervulis utrinque prominulis arcte reticulatis; flores laxiuscule paniculati, paniculis terminalibus parvis paucifloris circa 10 cm. latis, ramis gracilibus dense ochraceo-stellato-tomentosis, pedicellis brevibus vel elongatis; calyx anguste campanulatus 5 mm. longus supra dense minute stellato-tomentosus versus basin glabratus, lobis latis brevissimis; corolla purpurea c. 4.5 cm. longa extus ubique sat dense stellato-tomentosa, lobis brevibus latis subpatentibus.—COLOMBIA: Santa Rosa, near Barranquilla, in flower, February 3, 1933, *A. Dugand* 345; (Herb. Field Mus. No. 670392, type); November, 1932, *Dugand* 235 (Yale No. 22524). Puerto Colombia, January, 1933, *Brother Paul* 930.

Local names, Cañaguate, Cañaguate Rosado (Barranquilla); Roble Morado (Puerto Colombia). Well marked by the combination of glabrous leaves, purple flowers, and pubescent corolla.

Tabebuia chrysea Blake, Contr. Gray Herb. 53: 50. 1918. Described originally from Venezuela, where it is known as Araguán; known in Colombia only from the region of Barran-

quilla: Near Santo Tomás, in flower in December, *Dugand* 288. Santa Rosa, *Dugand* 237 (Yale No. 22526).

Vernacular names, Roble, Roble Amarillo. Mr. Dugand supplies the following notes regarding the local occurrence of this tree: A very common tree, 6–15 meters tall, the trunk sometimes 60 cm. in diameter, with gray rugose bark. At this time of the year (December), the Roble is almost bare of leaves, but it is a wonderful sight because of the profusion of beautiful golden blossoms, which make it very conspicuous in the landscape. The capsules are about 50 cm. long, and contain hundreds of white, flat, winged seeds.

Tabebuia chrysantha (Jacq.) Nichols. A widely distributed species, from the original locality, in Venezuela, to Mexico, although it is quite possible that more than a single species is treated currently under the name. The writer has seen Colombian specimens from the Barranquilla region (*Dugand* 369, 133), Santa Marta (*H. H. Smith* 1140), and Pandi (*André* 1572). The names reported are Cañaguate, Polvillo, and Guayacán Polvillo. Dugand's notes are as follows: A tree 12–14 meters tall, the trunk 40–60 cm. in diameter, with rimose whitish-grayish bark; crown rounded to depressed. Curious velvety puffs (the flower buds) grow at the end of the branchlets. The wood is reputed to be very hard, and gives off a yellow dust ("polvillo").

Tabebuia rufescens J. R. Johnston, Proc. Amer. Acad. 40: 696. 1905. Ranging from Colombia and Venezuela to Trinidad and the Lesser Antilles. Reported by Sprague and Sandwith (Kew Bull. 23. 1932) as having been collected in Colombia by Triana. One collection seen by the present writer is probably referable here: Santa Marta region, *H. H. Smith* 747.

Tabebuia punctatissima (Kränzl.), comb. nov. *Tecoma punctatissima* Kränzl. Repert. Sp. Nov. 17: 221. 1921. Type collected near Villata, Province of Bogotá, at 1400 m., by Karsten. Known to the writer only from the description.

Tabebuia coralibe, sp. nov.—Arbor 5–10-metralis, ramulis gracilibus ochraceis, novellis dense minute stellato-tomentosis serius glabratis; folia parva longipetiolata, foliolis 5 longipetiolulatis firme membranaceis integris plerisque obovato-ellipticis vel rotundato-obovatis supra medium latissimis 2–7 cm. longis 2–3.5 cm. latis abrupte breviter

acuminatis apice ipso obtuso vel apice interdum obtusis vel rotundatis, basin versus vulgo paullo angustatis et rotundatis vel obtusis, primo utrinque sparse minute stellato-puberulis mox glabratis vel fere glabris, sparse minutissime albido-punctatis, in sicco viridibus vel fusco-olivaceis, nervis subtus prominulis, nervulis reticulatis planis vel subimpressis; flores praecoces ad apices ramulorum subcapitato-congesti pauci sessiles vel breviter pedicellati; calyx campanulatus 6 mm. longus ubique dense fulvo-stellato-tomentosus 5-costatus, lobis brevibus ovato-triangularibus inaequalibus tubo triplo brevioribus; corolla lutea 4.5 cm. longa extus glabra, lobis patentibus ovalibus tubum semiaequantibus; capsula linearis c. 32 cm. longa primo stellato-tomentosa glabrescens fere laevis, valvis 1 cm. latis; semina numerosissima tenuia 1 cm. lata, utroque latere ala c. 7 mm. longa aucta.—COLOMBIA: El Paraíso, near Ponedera, March 26, 1933, *A. Dugand* 390 (Herb. Field Mus. No. 670391, type; specimen in flower, without leaves); same locality, February, 1932, *Dugand* 348. Barranca to Campeche, *Dugand* 71. Near Barranca, *Dugand* 145.

From all other species of the northwestern coast of South America this may be distinguished at once by its small, chiefly rounded-obovate, entire leaflets. The verbacular name is Coralibe. According to Mr. Dugand's notes, this is a tree of 5–10 meters, with a trunk diameter of 25–35 cm.; the bark is gray and rugose. While the flowers usually are produced on leafless trees, they sometimes accompany the foliage.

Tabebuia serratifolia (Vahl) Nichols. No Colombian specimens have come to the attention of the writer, but Sprague and Sandwith (Kew Bull. 26. 1932) report the species from Llanos de San Martín, *Triana* 4114, the material sterile, and therefore perhaps referable to one of the other species listed here. *T. serratifolia* ranges from Colombia to St. Vincent and the Guianas, and southward to São Paulo, Brazil, and Bolivia. Besides the vernacular names recorded by Sprague and Sandwith, there may be reported that of Tajibo Amarillo, current in Santa Cruz, Bolivia, according to Steinbach. It is of interest to note that in Venezuela *T. serratifolia* sometimes is called Coralibe, although it is quite unlike the Colombian trees here reported under that name.

Tabebuia Billbergii (Bur. & Schum.), comb. nov. *Tecoma Billbergii* Bur. & Schum. in Mart. Fl. Bras. 8, pt. 2: 319. 1897. Type collected at Cartagena, *Billberg* 114. The following specimens are in the herbarium of Field Museum: Santa Marta region, *H. H. Smith* 747. Santa Rosa, near Barranquilla, *Dugand* 260 (Yale No. 22549). Near Barranca, *Dugand* 144. Palmar-Ponedera Trail, *Dugand* 290. The leaflets vary in number from three to five, and they may be either entire or coarsely serrate. The flowers appear after the leaves. The Colombian tree has been confused with ***T. ipe*** (Mart.), comb. nov. (*Tecoma ipe* Mart.), which ranges from southern Brazil southward. It is, in fact, related to that species, and resembles it closely in foliage characters.

The vernacular name of *T. Billbergii* is reported as Coralibe. It is a common tree, 6–12 meters tall, with trunk diameter of 20–60 cm., the bark rugose and gray.

BEARING OF WOOD ANATOMY ON THE RELATIONSHIPS OF THE MYRISTICACEAE

By George A. Garratt

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The taxonomic history of the Myristicaceae, or Nutmeg family, is a record of successive changes. Some of the earlier confusion may be attributed to the fragmentary nature of the material available for study, but with the removal of this handicap botanists are still unable to agree on either the position or the composition of the family.

A previous paper, entitled "Systematic anatomy of the woods of the Myristicaceae" (*Tropical Woods* 35: 6–48), was concerned primarily with the internal organization of the family, whereas this one deals with the external relationships in the so-called natural system of plant classification. The investigation involved a comparison of the secondary woods of the Nutmeg family with those of the various other groups with which botanists at one time or another have considered it allied.

Taxonomy of the Family Myristicaceae

The genus *Myristica* was established for the Nutmeg tree by Linnaeus in 1742, being placed under a special appendix, constituting "fragmenta varia," apparently because Linnaeus could not determine, on the basis of the available material, whether the plant was dioecious or monoecious. In 1763 Adanson assigned *Myristica* to the "Pistacien" plants, on the basis of an inadequate description, while Lamarck[1] subsequently transferred it to the Lauraceae. Jussieu (1789) then added *Myristica*, together with *Hernandia* (now included in the family Hernandiaceae) and *Virola*,[2] externally to the Lauraceae. Later, however, Jussieu (1806) acknowledged that the genus *Myristica* belonged to a separate and distinct family, but did not attempt to name it. Finally Robert Brown (1810) proposed the name Myristicaceae for the family and placed it between the Proteaceae and the Lauraceae, although stating that it is not closely akin to either.

Chiefly because of its apetalous flowers, leaf type, and habit, the family Myristicaceae has frequently been placed in close proximity to the Lauraceae. Thus, it was adjoined to the Lauraceae by Link (1829), Dumortier (1829), Kunth (1831), and de Candolle (1856). F. v. Muller[3] placed it between the Monimiaceae and the Lauraceae, while Baillon (1870), Kurz (1877), Warming (1890), and Talbot (1902) all emphasized the affinity of the Nutmegs to the Lauraceae. Hutchinson (1926) also supports this view, placing both families in the order Laurales, together with the Monimiaceae, Gomortegaceae, and Hernandiaceae.

The affinity of the Myristicaceae to the Anonaceae has been emphasized by numerous systematic botanists, on account of a number of common structural features of the flowers and fruits. Bartling (1830) was the first to refer to this relation-

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[1] Mémoire sur le genre du muscadier. *Histoire de l'Acad. royale de sciences Act.*, Paris, 1788. Reported by Warburg (1897).

[2] *Virola*, recognized as a genus by Aublett (1775) for a Guiana species since then known as *sebifera*, was incorporated in the family Myristicaceae upon its establishment in 1810.

[3] *Census of the Australian plants*. Reported by Warburg (1897).

ship; he also assigned *Eupomatia* and *Hernandia* to the Myristicaceae, the latter with a question mark.[4] Lindley (1830) also pointed out the affinity to the Anonaceae, stating that, while the Myristicaceae have usually been placed in the vicinity of the Lauraceae on account of their apetalous flowers, they are perhaps more closely allied to the Anonaceae; he subsequently (1853: 301) enlarged upon this relationship, with the following comment: "They [the Nutmegs] may also be regarded as an apetalous form of Anonads, with which their trimerous flowers, arillate seed, ruminated albumen, minute embryo, and sensible properties closely ally them. *Bocagea*, which is usually considered as a connecting link between the latter [Anonaceae] and Berberids, must also be looked upon as one of the cases of transition from Anonads to *Virola* among the Nutmegs. Another and much more interesting instance is afforded by Wallich's genus *Hyalostemma* [placed in the Myristicaceae by Lindley but now absorbed in the genus *Miliusa* of the Anonaceae], which would be almost an involucrated *Myristica* if it had an aril. That plant, which has unisexual apetalous flowers, and a trifid calyx surrounded by an involucre of six subulate bracts, was regarded as a *Uvaria* by Roxburgh, and may be indifferently regarded as anonaceous if its numerous carpels are considered, or myristicaceous if its unisexual flowers and simple trifid calyx are allowed to have weight."

Lindley (1853), however, considered the relationship of the Myristicaceae to the Menispermales, or Menispermal Alliance,[5] as more significant, placing the family directly between the Schizandraceae and Menispermaceae. He states (p. 301): "While, however, all these relationships [cited above] may be allowed their due importance, it seems impossible to disjoin Nutmegs from the Menispermal Alliance, because of their strictly unisexual flowers. The diverging cotyledons of their embryo bring them up to the Monimiads, while the ruminated albumen finds its parallel in the genus *Anomospermum* in Menispermads."

[4] *Eupomatia* was subsequently assigned to the Anonaceae and is so treated by Bentham and Hooker (1862) and Engler and Prantl (1891), but Hutchinson (1926) considers it as constituting the monogeneric family Eupomatiaceae. *Hernandia* was placed among the Lauraceae by Bentham and Hooker (1880), but Engler and Prantl (1891) and Hutchinson (1926) assign it to the family Hernandiaceae.

[5] Lindley included the following families in the Menispermal Alliance: Monimiaceae, Atherospermaceae (later incorporated in the Monimiaceae), Myristicaceae, Lardizabalaceae, Schizandraceae, and Menispermaceae.

The conception of the affinity of the Myristicaceae to the Anonaceae and to the Menispermaceae was accepted by Endlicher (1836–1840), who placed the Nutmeg family between the Lardizabaleae (according to him a sub-order of the Menispermaceae) and the Anonaceae. Endlicher's views were shared by Hooker and Thomson (1855), who also pointed out the relationship to the Monimiaceae.

Engler (1886) [6] placed the Myristicaceae directly adjoining the Anonaceae, while Engler and Prantl (1891) gave it a like position. The latter authors state (p. 41) that the relationship between these two families appears so close that the genus *Myristica* might be embodied in the Anonaceae just as well as, or even sooner than, *Eupomatia*. Warburg (1897) emphasizes the affinity of the two families under consideration, although stating that the above contention of Engler and Prantl signifies too strong an emphasis on the real situation of the relationship. Löfgren (1917) also places the two families together.

A number of botanists have stressed the relationship of the Myristicaceae to the Monimiaceae. Chief among these have been Horaninow (1847), Lindley (1853), Hooker and Thomson (1855), Bentham and Hooker (1880), Hooker (1886), Thiselton-Dyer (1913), and Hutchinson (1926).

Other relationships of the Myristicaceae have been pointed out from time to time. Martius (1835) placed it directly before the Thymelaeaceae, under the cohort *Haplocarpae columniferae*. Meisner (1841) assigned it, with a query, to the order Daphnoidearum between Santalaceae and Phalerieae on the one hand and between Penaeaceae and Elaeagnaceae on the other. Reichenbach (1828) placed it in the order Aristolochiaeae; he also assigned the genus *Hernandia* to the Myristicaceae.

[6] *Führer durch den Breslauer botanischen Garten*. Reported by Warburg (1897).

In summing up this discussion of the various opinions held by systematic botanists, it may be pointed out that the main emphasis has been placed, at one time or another, on the relationship of the Myristicaceae with the following families: Lauraceae, Anonaceae, Monimiaceae, Lardizabalaceae, and Menispermaceae. The fact that the genera *Hernandia* and *Eupomatia* were at one time placed with the Myristicaceae, implies possible affinity between that family and the more recently established Hernandiaceae and Eupomatiaceae. Hutchinson, by placing the Myristicaceae in the order Laurales, also brought them close to the Hernandiaceae, as well as to the Gomortegaceae, while Lindley implied an affinity to the Schizandraceae. Further, because of the occurrence of oil (secretory) cells in the parenchymatous elements in the secondary xylem of a few species of the Myristicaceae, possible relationship is indicated with the Canellaceae (Winteranaceae) and the Magnoliaceae; in fact Warburg (1897) definitely states that the Nutmegs should not be placed too far from the former family.

Descriptions of the Woods of the Myristicaceae and Associated Families

The following descriptions of the secondary xylem of the families involved in this study are intended to bring out the important points of similarity and distinction between the woods of the Myristicaceae and those of the other plant groups. In these descriptions emphasis has been placed upon the basic anatomical characteristics that serve to indicate the possible affinities between the Nutmegs and the several other families. Except for the physical factors of color and density, the features considered are entirely microscopic.

Myristicaceae

The members of the Myristicaceae or Nutmeg family are trees, or rarely shrubs, widely distributed in the American, Asiatic, and African Tropics. The following description of the anatomy of their secondary xylem is a summary of that given by Garratt (1933), and is based upon a study of 165 specimens of wood, representing 82 species and 15 genera.

Woods very largely within the range of light and soft to medium hard and heavy, with specific gravity (based on room-dry weight and volume) of 0.35 to 0.77; in few cases hard and heavy (sp. gr. 0.87 to 1.01). Sapwood light brown in color, with often pronounced grayish, or pinkish, cast; heartwood usually not particularly distinct, but in some specimens deep red to chocolate brown. Growth rings at times absent; when present delimited either by concentric lines of wood parenchyma, or less often by rows of flattened wood fibers.

Pores chiefly solitary or in radial pairs, occasionally in multiples of 3 to 5; distribution fairly uniform, without definite pattern. Perforation plates variable from very predominantly simple to exclusively scalariform, sometimes reticulate or compound scalariform; scalariform plates generally with few (1 to 10) bars. Intervascular pit-pairs (face view) rather small to fairly large, numerous, somewhat crowded; arrangement usually alternate, occasionally rather definitely opposite; border outlines irregularly rounded to oval, or polygonal when crowded; apertures narrowly oval or lenticular to slit-like, mostly horizontal, and usually included. Pits to ray cells of two principal types: (*a*) large and radially elongated (occasionally somewhat oblique) and often extending almost width of cross-field in definite scalariform arrangement; borders complete, or sometimes covering only ends or apparently lacking; apertures generally conforming to shape of elongate-oval to broadly elliptical border outlines; (*b*) relatively small and similar to intervascular type; usually numerous, often crowded, arranged oppositely to irregularly; border outlines rounded to oval or more often irregularly angular; apertures fully included, slit-like or narrow-lenticular to broadly oval and horizontally inclined. The first type is the distinctive one and usually predominates, although both types, together with intermediates, sometimes occur in the same cell.

Wood fibers with small and more or less inconspicuously bordered pits (in a few cases possibly simple). Septate fibers localized in immediate vicinity of vessels (in rare cases also in terminal bands).

Wood parenchyma more or less abundantly developed and of three types: (*a*) metatracheal or terminal (absent in a rather large proportion of specimens), (*b*) paratracheal, and (*c*) diffuse. Metatracheal or terminal bands usually numerous and irregularly spaced, at times discontinuous or branched; 1 to 9, mostly 2 to 4, cells wide. Paratracheal parenchyma mostly in uniseriate vascular sheaths, although at times 2, or even 3, cells thick, especially at the tangential ends of pores and pore groups. Diffuse type usually very sparingly developed.

Rays predominantly uniseriate and biseriate or only locally triseriate; in some cases definitely wider (3 to 6 cells); usually distinctly heterogeneous, with one row (occasionally more) of squarish to decidedly upright cells on upper and lower margins; weakly heterogeneous, or even homogeneous in a few cases. Oil cells occasionally to commonly found in several species (in

Knema Alcarezii Merr. occasionally noted in wood parenchyma strands also). Tanniniferous tubes present in all specimens, although apparently very rare in a few cases; they occur in both uniseriate and wider portions of the rays and at times are apical; they provide a definite diagnostic feature, setting the Myristicaceae apart from all other woods.

Lauraceae

The Lauraceae are trees and shrubs, or very rarely twining parasitic herbs, and are mainly tropical and subtropical in their distribution. They are recognized as a distinct family by Bentham and Hooker (1880), Engler and Prantl (1891) and Hutchinson (1926), the last-named authority placing them close to the Myristicaceae in the order Laurales. The following description of the secondary xylem is based on various published accounts of individual woods and groups of woods, as well as on a personal study of a large proportion of the many lauraceous woods in the Yale collections. The parasitic genus *Cassytha* is not considered in this discussion.

Woods variable from medium light and soft (or rarely light and soft) to very hard and heavy; sp. gr. 0.40 to 1.15 or more. Heartwood often fragrant; its color ranges from all shades of yellow through various browns and reds to very dark brown or nearly black. Growth rings absent, very poorly defined, or distinct; usually demarcated by narrow layer of more or less perceptibly flattened and (or) thick-walled fibers, or in some cases by terminal parenchyma; *Sassafras* is ring-porous.

Pores diffuse (except in *Sassafras*); solitary or more or less often in multiples of 2 to 4, rarely more. Perforations usually exclusively simple; scalariform plates, chiefly with few (up to 8) bars, sometimes present. Intervascular pit-pairs mostly rather large, more or less crowded and alternate; border outlines rounded or oval to irregularly polygonal, not (or very rarely) scalariform; apertures slit-like to narrow lenticular or oval, horizontal or somewhat obliquely inclined, and mostly distinctly included, but at times slightly extended and tending to coalesce. Pits to ray cells variable from completely bordered to simple, at times bordered at ends only; sometimes small and more or less of the intervascular type, except for tendency to opposite arrangement, but more often relatively large and gash-like to irregular in outline; the larger pits, which are most abundant in upright marginal cells, are frequently horizontally (at times obliquely) elongated and in more or less distinct scalariform arrangement, and the outline of their apertures often of the same shape as that of the borders, as in Myristicaceae.

Wood fibers with simple pits, which are predominantly small and rather indistinct. Septate fibers present in many specimens, often predominating; distributed throughout ground mass and, unlike the Myristicaceae, not associated with vessels.

Wood parenchyma more or less abundantly developed; paratracheal and diffuse in all cases; tangential bands (terminal or metatracheal) present in certain specimens, but not as characteristic of this family as of the Myristicaceae. Paratracheal type usually in narrow sheaths (1 to 3 or 4 cells wide) about pores and pore groups,[7] but in some cases aliform and confluent. Terminal or metatracheal bands variable in width up to 5 to 14 cells. Diffuse type sparingly developed.

Rays very predominantly 1 to 4 cells wide, mostly biseriate or triseriate; occasionally definitely wider (up to 5 to 8 cells); variable from homogeneous to rather distinctly heterogeneous, usually rather weakly heterogeneous; marginal cells generally range from squarish to somewhat upright.

Oil cells occasional to frequent in great majority of specimens; principally in wood parenchyma strands, although in some cases more prevalent in rays.

Monimiaceae

The Monimiaceae are recognized as constituting a distinct family by Bentham and Hooker (1880: 137), Engler and Prantl (1891: 94), and Hutchinson (1926: 89), the last-named authority placing it, with the Myristicaceae, in the order Laurales. The representatives of the family are trees or shrubs, or rarely climbers, native to the tropics and subtropics. The following discussion of the anatomy of the secondary xylem is based upon an intensive study of the woods in the Yale collections (55 specimens, representative of 27 species of 11 genera), supplemented by the descriptions of Solereder (1908: 699) and Welch (1929).

Woods range in color from pale yellow or light brown to dark (chocolate) brown or almost black. Mostly medium light and soft to medium hard and heavy (sp. gr. 0.53 to 0.78), but occasionally light and soft (0.43 to 0.47) or, in available specimens of *Bracteanthus*, hard and heavy (0.83 to 0.95). Growth rings apparently lacking in a few cases, but usually more or less distinct, being delimited by narrow zones of generally denser wood, especially by one to several rows of somewhat flattened and often noticeably thicker-walled fibers; in *Bracteanthus* and some specimens of *Siparuna* flattened fibers are

[7] In the lauraceous woods examined, the chief development of the paratracheal parenchyma is usually found on the radial sides of the pores and pore groups, thus differing from the Myristicaceae, in which the parenchyma is largely massed at the tangential ends.

supplemented by more or less broken parenchyma lines or diffuse parenchyma strands.

Pores solitary or in multiples of 2 or 3, or at times 4 or 5; in *Siparuna* (pro parte) radial multiples may contain up to 8 to 12 or even more pores and are often disposed in long radial series, interrupted only by solitary wood fibers. Perforation plates generally exclusively scalariform, usually with 15 to many bars; in *Boldea* and *Bracteanthus* exclusively simple; in *Siparuna* variable from predominantly simple to almost exclusively scalariform (with less than 15 bars) and seldom to frequently net-like. Spiral thickenings distinct in vessels of *Peumus boldus* Molina. Intervascular pit-pairs of two types: (*a*) rather small to large, and transitional from opposite to scalariform, with distinctly scalariform arrangement usually predominating; apertures slit-like, extending horizontally almost to the slightly to decidedly elongated border outlines; (*b*) small to medium or rather large and distinctly alternate in arrangement; apertures slit-like, extending horizontally (at times obliquely) to, or almost to, rounded or slightly oval (sometimes polygonal due to crowding) border outlines. Scalariform type characteristic of genera having exclusively scalariform perforation plates, and consequently predominates. Pits to ray cells simple to completely bordered, often bordered only at ends; of two rather distinct types (as in Myristicaceae): (*a*) large and elliptical and usually in definite scalariform arrangement, with apertures in completely bordered pits generally conforming in shape to the border outlines; (*b*) relatively small and generally similar to intervascular pit-pairs, although having a more or less distinct tendency to opposite arrangement. The first type characterizes woods with scalariform perforation plates and scalariform intervascular pitting. In *Siparuna* (pro parte) pitting is predominantly unilaterally compound, two to six or more small vessel pits being subtended by a single elongated ray pit.

Wood fibers with simple, indistinctly bordered, or distinctly bordered pits. Occasionally to always septate, except in *Bracteanthus* and *Siparuna*, and distributed throughout ground mass (not definitely associated with vessels); septate fibers apparently simple-pitted even in those woods in which nonseptate fibers bear distinctly bordered pits.

Wood parenchyma sparingly developed and in the great majority of the genera diffuse only; a slight paratracheal tendency noted in *Tambourissa;* also in numerous, closely spaced and more or less definite, metatracheal lines or bands in *Bracteanthus* and *Siparuna*. No oil cells observed.

Rays essentially different in width in the two tribes; narrow (1 to 3 or 4, infrequently 5 or 6, cells wide) in Atherospermeae, and predominantly broad (maximum widths variable from 7 to 16 cells) in Monimieae. Distinctly heterogeneous, with one to several rows of usually definitely upright marginal cells. Oil cells entirely lacking.

Gomortegaceae

Gomortega nitida R. & Pav., the single representative of this family, is a tree native to Chile. Hutchinson (1926: 91) incorporates the family in the order Laurales. The only known species appears to be very rare, as it is scarce in herbaria and hardly mentioned in the literature. There are no specimens in the Yale collections, and the brief description of the secondary xylem which follows is taken from Solereder (1908: 709).

Wood characterized by fiber-tracheids; narrow, heterogeneous rays; vessels having exclusively scalariform perforations (mostly with numerous bars), and relatively large, simple pits to ray cells; and limited parenchyma.

This family is omitted from further consideration in this paper because of insufficient data concerning the anatomy of its secondary xylem.

Hernandiaceae

This family, as now constituted, contains the four genera, *Gyrocarpus*, *Hernandia*, *Illigera*, and *Sparattanthelium*. These were included by Bentham and Hooker (1880: 164) in the Lauraceae, but Engler and Prantl (1891: 126) set them up in a separate family, Hernandiaceae, which was subsequently recognized by Hutchinson (1926: 92), who placed it in the order Laurales. The representatives are trees or shrubs, entirely tropical in their distribution. The following description of the anatomical structure of the secondary xylem is based in part on the work of Solereder (1908: 707), who investigated the wood of a single species of each genus, but more especially on a study of the material in the Yale collections (17 specimens, representing one species of *Gyrocarpus* and five species of *Hernandia*).

Woods very light and soft to light and soft; sp. gr. 0.21 to 0.43. Essentially light in color, varying from grayish white to pale brown. Growth rings apparently lacking in some specimens, but usually more or less distinct, being delimited by narrow bands of flattened fibers, at times supplemented by wood parenchyma, which is either diffuse or in rather broken lines or narrow bands.

Pores distributed uniformly throughout ground mass of wood; usually predominantly solitary, but occasionally to frequently in radial pairs and at times in radial (or irregular) groups of 3 to 6. Perforations exclusively simple.[8]

[8] Solereder (*loc. cit.*) states that in *Hernandia* (based on *H. sonora* L.) some of the perforation plates are scalariform with few bars, but none of this type was found in five species examined in this investigation (*H. cordigera* Vieill., *H. guianensis* Aubl., *H. ovigera* L., *H. peltata* Meissn., and *H. sonora* L.)

Intervascular pit-pairs relatively large, rather numerous and commonly crowded, and alternate; borders irregularly rounded to polygonal, or at times somewhat elongated horizontally; apertures slit-like to more or less lenticular, horizontal, and included. Pits to ray cells mostly entirely bordered, although at times only partially bordered or simple; predominantly large, the borders somewhat irregular (more or less rounded or oval to squarish) or seldom distinctly elongated radially; rather irregularly arranged (no scalariform tendency); apertures are (*a*) narrow to very broadly lenticular and extending entirely or nearly to the border, or (*b*) more often irregularly rounded to somewhat squarish, in conformity with border outline; pitting occasionally unilaterally compound.

Wood fibers with very small and rather indistinct simple pits. Septate fibers apparently entirely lacking.

Wood parenchyma primarily paratracheal; usually abundantly developed, aliform or confluent into irregular tangential bands; diffuse in some specimens, and in a few cases tending to form broken metatracheal lines, especially at growth-ring boundaries.

Rays 1 to 4 cells wide, chiefly biseriate and triseriate; predominantly distinctly homogeneous, although occasional rays show slight heterogeneous tendency, with one or two marginal rows of somewhat squarish cells.

Oil cells present in wood parenchyma strands (rare or lacking in rays) of *Hernandia cordigera* (rather common), *H. guianensis* pro parte (rare to occasional), *H. peltata* (common), and *H. sonora* (fairly common).

Magnoliaceae

In this investigation the accepted classification of the Magnoliaceae is that proposed by Hutchinson (1926: 81) and supported, at least in its essential phases, by McLaughlin (1933). The vesselless genera, *Drimys*, *Zygogynum*, *Trochodendron*, and *Tetracentron*, are excluded, along with certain other groups included in the family by Bentham and Hooker (1862: 16) and Engler and Prantl (1891: 12). The family is composed of trees and shrubs, widely distributed in North Temperate America, the West Indies, Brazil, and East Asia. The following description of the wood is based on the results of McLaughlin's investigation and on personal observation of many of the magnoliaceous woods in the Yale collections.

Woods light and soft to medium hard and heavy; sp. gr. 0.39 to 0.73. Sapwood primarily white in color; heartwood variable from yellowish to brown, or sometimes greenish yellow to purplish. Growth rings usually distinct; demarcated by definite bands of wood parenchyma, although in some specimens these bands do not appear to be definitely terminal.

Pores solitary or in multiples of 2 to 7, rather well distributed. Perforation plates predominantly scalariform (simple in some species of *Magnolia*), with few to fairly numerous bars (mostly less than 10, but in some specimens of *Magnolia* and *Talauma* up to 20 to 25, respectively). Spirals common in vessels of great majority of species (absent in *Liriodendron*). Intervascular pit-pairs commonly scalariform, or transitional to opposite (opposite in *Liriodendron*); apertures narrow lenticular or slit-like, horizontally inclined, and extending almost to the round to more often decidedly elongated border outlines. Pits to ray cells usually completely bordered, but at times only partially bordered or simple; often very large and greatly elongated, and frequently in distinct scalariform arrangement; unilaterally compound pit-pairs common in many species.

Wood fibers with small bordered pits. Septate fibers appear to be entirely lacking.

Wood parenchyma rather abundantly developed; disposed in definite concentric (terminal or metatracheal) bands, 1 to 10 (rarely more) cells wide; bands sometimes discontinuous or branching (anastomosing).

Rays mostly 1 to 3 cells wide, occasionally more (up to 7); heterogeneous, with 1 to several marginal rows of moderately upright cells. Oil cells rare to frequent in most genera (absent in *Manglietia* and *Liriodendron*); apparently confined to rays.

Schizandraceae

The two genera, *Schizandra* and *Kadsura*, were placed in a separate tribe (Schizandreae) of the family Magnoliaceae by both Bentham and Hooker (1862: 19) and Engler and Prantl (1891: 17). Hutchinson (1926: 83) subsequently elevated this tribe to family rank, keeping it close to the Magnoliaceae in the order Magnoliales. The representatives of the family, which have a climbing habit, are found in the North Tropical and Subtropical Zones. The following description of the secondary xylem is based upon McLaughlin's investigations, as well as on personal study of the wood specimens in the Yale collections.

Owing to the small size of the few available specimens of this family, no data are available concerning the density and color of the wood.

Pores solitary and diffuse. Perforation plates scalariform with 1 to 15 bars (*Schizandra*), or both simple and scalariform, the latter with 1 to 7 bars (*Kadsura*). Spirals present in vessels of both genera. Intervascular pitting opposite (*Kadsura*) to scalariform (*Schizandra*); similar to that in Magnoliaceae. Pits to ray cells relatively small and opposite, or very commonly distinctly elongated horizontally and in characteristic scalariform arrangement; pitting frequently unilaterally compound.

Wood fibers with bordered pits. Septate fibers lacking. Wood parenchyma in uniformly spaced, terminal bands, 1 to 3 cells wide. Rays uniseriate to triseriate; heterogeneous, with 1 to 7 marginal rows of upright cells. Oil cells found in all specimens; few in number; confined to rays.

Anonaceae

The family Anonaceae is a large group of trees, shrubs, or climbers, widely distributed in the tropics and subtropics. Its family ranking is recognized by Bentham and Hooker (1862: 20), Engler and Prantl (1891: 23), and Hutchinson (1926: 87). The following description of the secondary xylem is based chiefly on a personal study of 67 specimens, representative of 61 species of 44 genera, available in the Yale collections.

Wood light and soft to very hard and heavy; sp. gr. up to 1.00 or even more in some cases. Heartwood pale yellow or light brown to dark brownish or greenish, or nearly black. Growth rings usually present and more or less distinct; delimited by rather inconspicuously flattened or thicker-walled wood fibers, usually supplemented by more or less regular parenchyma lines (occasionally sufficiently definite to be classed as terminal); in *Asimina*, distinctly ring-porous condition gives rise to conspicuous growth rings.

Except for the ring-porous *Asimina*, pores are well distributed throughout wood; solitary or more or less often in multiples of 2 to 4, rarely up to 7 or 8. Perforations exclusively simple. Spirals absent, except in *Asimina*, there distinct in small vessels of late wood. Intervascular pit-pairs usually extremely small, very numerous and more or less crowded, and alternate; border outlines rounded or slightly oval to polygonal; apertures horizontally inclined or slightly oblique, and variable from slit-like or narrow lenticular (sometimes extended and coalescent) to rather broadly lenticular or oval. Pits to ray cells distinctly bordered and, in general, similar to the intervascular; small or less often of medium size, mostly alternate; apertures seldom extended; more or less distinctly unilaterally compound pitting, with 2 to 8 vessel pits included within limits of a single and usually vertically inclined ray pit, occasional to dominant in a number of specimens.

Wood fibers with small to minute bordered pits; in many instances the borders are rather indistinct. Septate fibers entirely lacking.

Wood parenchyma rather abundantly developed (except in *Asimina*); usually in fine but definite metatracheal lines or bands, 1 to 3 or rarely more (mostly 1 or 2) cells wide, that are numerous, closely and uniformly spaced, and distinctly interrupted by rays, giving ladder-like appearance under lens. Paratracheal parenchyma present in about half of specimens examined; in broken or continuous sheaths, 1 or 2 cells wide.

Rays 1 to 14 cells wide (maximum widths in individual specimens mostly within limits of 5 to 10 cells); predominantly broad (4 cells and wider); variable from homogeneous to distinctly heterogeneous; mostly very moderately heterogeneous, with squarish to slightly upright marginal cells.

Oil cells occur in occasional species, in this investigation being found in rays of *Aberemoa asterotricha* Diels, *Cleistopholis patens* Benth. (rather rare), *Duguetia* sp. (Yale No. 1613A), *D. panamensis* Standl., *D. vallicola* MacBride (also occasionally noted in wood parenchyma strands), *Monodora brevipes* Benth. (pro parte), and *Pachypodanthium Staudtii* Engl. & Diels; very distinctly enlarged and distributed throughout median portions of rays (not marginal).[9] In *Mezzettia parviflora* Becc., *Polyalthia fragrans* Benth. & Hook., and *P. oliveri* Engl. & Diels large isodiametric cells appear to be scattered in the rays, as seen in tangential section, but in radial view appear as rows of squarish cells interspersed between normal procumbent ones.

Eupomatiaceae

This is a family of shrubs, native to Australia. The single genus, *Eupomatia* R. Br., was included in the family Anonaceae by Bentham and Hooker (1862: 29); retained there by Engler and Prantl (1908: 115), but placed in a separate subfamily, Eupomatioideae; and finally recognized as belonging to a distinct family, Eupomatiaceae, of the order Anonales, by Hutchinson (1926: 88). The following description of the anatomy of the secondary xylem is based on a study of the single available specimen of *Eupomatia laurina* R. Br. in the Yale collections. It is worthy of note that the structure of the wood distinctly supports Hutchinson's contention that the group is better treated as a family separate from the Anonaceae.

Wood light brown to pale chocolate-brown in color and medium hard and heavy; sp. gr. 0.66. Growth rings indistinct; demarcated by zones of denser wood, rather poor in pores and limited by narrow rows of indistinctly flattened wood fibers.

Pores isolated or in multiples of 2 to 5; very often in long radial chains interrupted only by solitary wood fibers. Perforation plates conspicuously scalariform with many (approximately 20 to 100+) bars. Intervascular pit-pairs small, fairly numerous but not crowded, and definitely opposite in disposition; borders rounded to slightly oval (horizontally); apertures horizontal, slit-like to narrow lenticular, barely included. Pits to ray cells bordered, not distinctively elongated, small to medium-sized, never crowded;

[9] Moll and Janssonius (1906, I) report oil cells in the rays, especially on the margins, in *Canangium odoratum* Baill. and its variety *velutina*.

sometimes opposite, with tendency to scalariform arrangement; apertures broadly lenticular to oval, horizontal, barely included within the slightly to seldom decidedly horizontally elongated borders.

Wood fibers with simple or indistinctly bordered pits. Predominantly septate, with several fine but distinct septa per fiber.

Wood parenchyma sparingly paratracheal and diffuse; not in definite metatracheal bands. Oil cells absent.

Rays predominantly rather narrow, 1 to 6, mostly 3 to 5, cells wide; distinctly heterogeneous, the marginal cells being definitely upright. Oil cells absent.

Canellaceae

The Canellaceae (Winteranaceae) are aromatic trees, native to tropical America. The family is placed by Hutchinson (1926: 163) in the order Bixales. The following summary of the wood structure is based on a study of the specimens available in the Yale collections and published descriptions by Record and Mell (1924: 447), Record (1925: 9), and Solereder (1908: 87), covering the following species: *Canella alba* Murr., *C. Winterana* (L.) Gaertn., *Cinnamosma fragrans* Baill., *Cinnamodendron axillare* Endl., and *Warburgia ugandensis* Sprague.

Wood hard and heavy to very hard and heavy; sp. gr. 0.80 to 1.12. Sapwood white; heartwood light chocolate brown to olive brown or almost black. Growth rings poorly defined or absent.

Pores solitary or less often in multiples of 2, occasionally 3. Perforation plates scalariform, with relatively few to many bars (sometimes also foraminate in *Canella alba*, according to Solereder). Intervascular pit-pairs opposite, at times with tendency to scalariform arrangement; usually only slightly elongated horizontally, with narrow lenticular, barely included apertures. Pits to ray cells distinctly bordered, rather numerous, definitely opposite; border outlines rounded or oval to somewhat rectangular, mostly slightly elongated horizontally; apertures dot-like or broadly lenticular, included.

Wood fibers with large and conspicuously bordered pits. Septate fibers lacking. Wood parenchyma sparingly paratracheal and diffuse; sometimes with tendency to form short tangential lines, but not definitely metatracheal. Rays 1 to 4 cells wide, chiefly uniseriate and biseriate; homogeneous, or in some cases rather weakly heterogeneous. Large oil cells, with yellowish contents, occur in wood parenchyma strands and rays of *Cinnamosma fragrans*.

Menispermaceae

The Menispermaceae are twining or erect shrubs or small trees, confined largely to the tropics and subtropics. They are

recognized as constituting a distinct family by Bentham and Hooker (1862: 30), Engler and Prantl (1891: 78), and Hutchinson (1926: 101), the last named authority placing the group in the order Berberidales, together with the Lardizabalaceae and several other families. The following description of the anatomy of the stem is based on a study of 10 specimens of 3 genera and 6 species of wood in the Yale collections, as well as on the description given by Solereder (1908: 41).

The wood is very distinctive, because of its anomalous structure.[10] The cross section of the woody cylinder shows a very characteristic pattern, the radially disposed and somewhat wedge-shaped bundles of xylem and phloem being surrounded by prominent bands of conjunctive tissue. The conjunctive tissue is in concentric, occasionally anastomosing, laminations connected by rays, which are not necessarily continuous through the successive laminations. The wood is medium hard and heavy to hard and heavy (sp. gr. 0.63 to 0.93) and relatively light in color, being variable from grayish to greenish brown.

Pores are well distributed throughout the xylem mass, solitary or occasionally in groups of 2 to 4; in *Tiliacora glycosmantha* Diels they are generally in tangential rows, interrupted by wide rays of conjunctive tissue, but in other specimens there is no evident pore pattern. Perforations exclusively simple. Intervascular pit-pairs of medium size, alternate; rather numerous but not crowded; borders rounded to somewhat horizontally elongated; apertures slit-like and barely included.

Wood fibers with rather indistinctly bordered pits. Wood parenchyma chiefly metatracheal, forming fine, closely spaced, more or less broken and wavy uniseriate lines between the rays of conjunctive tissue; occasionally diffuse.

Lardizabalaceae

The Lardizabalaceae are twining or rarely erect shrubs, found in temperate South America and East Asia. Bentham and Hooker (1862: 40) recognized the group as a tribe (Lardizabaleae) of the family Berberidaceae, but Engler and

[10] Solereder (1908: 42) states that the anomalous stem structure occurs in certain, but not all, members of the family. All of the specimens available in the Yale collections show the anomaly of included phloem.

Prantl (1891: 67) established it as a distinct family, placing it before the Berberidaceae. Hutchinson (1926: 99) maintains the family ranking and places the group, together with the Menispermaceae and several other families, in the order Berberidales. The following discussion of the wood is taken from Solereder (1908: 45),[11] since there are no specimens in the Yale collections.

Wood of anomalous structure (included phloem) and broad rays (presumably heavy rays of conjunctive tissue such as characterize the woody cylinder of the Menispermaceae). Vessel perforations are simple as a rule, although in *Holboellia* the plates are scalariform with few bars. Spirals occur in the smaller vessels of *Holboellia;* only slightly indicated in *Lardizabala biternata* Ruiz & Pav. Wood fibers with either simple or bordered pits in *Holboellia*, but bordered pits only in *Lardizabala*. Wood parenchyma sparse or wanting; not metatracheal.

The Myristicaceae as a Natural Group

That the Nutmegs constitute a characteristic and well-defined group is attested by the fact that but three genera have been incorrectly assigned to it since its establishment as a family in 1810. *Hernandia* was placed in the Myristicaceae by Reichenbach (1828) and Bartling (1830), *Eupomatia* by Bartling (1830), and *Hyalostemma* (now absorbed in the genus *Miliusa* of the family Anonaceae) by Lindley (1853). However, the addition of these genera to the Nutmeg family was apparently never seriously considered by other systematic botanists.

The close affinity among the Myristicaceae is also affirmed by the secondary xylem of the various representatives, which is found to present an unusually unified structure throughout the family. In fact the anatomy of the wood indicates a much more natural group than such well-recognized families as the Euphorbiaceae, Leguminosae, and Monimiaceae, and about as distinct and characteristic a plant aggregation as the Lauraceae and Magnoliaceae, to cite but a few examples.

Probably the outstanding anatomical feature of the Myristicaceae is the occurrence of tanniniferous tubes in the rays.

[11] Solereder followed Bentham and Hooker in dealing with *Lardizabala*, *Holboellia*, and *Akebia* (the genera he investigated) under the Berberidaceae.

So far as known, they do not occur in the woods of any other group and hence serve as a unique diagnostic character.

Among the members of the Nutmeg family, distinctive anatomical variability is found only in the type of vessel perforation plates, the nature of the growth rings, and the very minor size (width) differences in the rays. The predominance of scalariform perforation plates in the vessel members of some genera and of simple perforations in others, as well as a like variation even within certain genera, is duplicated among other well established families, of which the Monimiaceae may be cited as a conspicuous example. The distinctions in the character of the growth rings, which are demarcated in part by definite bands of wood parenchyma, but may be delimited by flattened wood fibers or even entirely lacking, is clearly duplicated in the Lauraceae. And finally, the minor diversity in the width of the rays of the Myristicaceae is no greater than in many other families, such as the Lauraceae, Magnoliaceae, and even the tribe Atherospermeae of the Monimiaceae; it is worthy of consideration that the variations in the width of the rays in all of these enumerated groups is not nearly so decided as in the Anonaceae, the secondary xylem of which (except for *Asimina*) otherwise presents a remarkably unified structure.

Systematic Position of the Myristicaceae

In comparing the secondary xylem of the Myristicaceae and those families with which they have been considered to have more or less affinity, it is found that certain of these groups show marked resemblance to the Nutmeg family, while others are distinctly different. The following paragraphs are devoted to a discussion of the comparative anatomy of the Myristicaceae and each of the other families under consideration.

The greatest similarity to the Myristicaceae is unquestionably found in the wood of the Lauraceae, thus corroborating the opinion of those systematic botanists who have placed the two families close together. Features common to the secondary xylem of both families include the character of the intervascular and vessel-ray pitting, the type and size (width) of ray, and the general distribution and arrangement of wood

parenchyma, although certain individual distinctions are noted in this last-named feature. Septate wood fibers are also of more or less common occurrence in both families, although differing in distribution in each. Considerable agreement is evident, even in the variability which marks certain features; thus, both groups are similar in the density range of their woods, and in the lack of consistency in growth-ring characteristics. Further, oil cells occur in both the Myristicaceae and Lauraceae, although they are so much more numerous in the latter group that this might almost be considered as a point of distinction. One major difference, the type of pitting in the wood fibers, is to be noted in the two families, although an added distinction of more or less significance is the predominance of exclusively simple perforations in the vessel members of the Lauraceae; aside from these points, however, the structural differences between the two families are of a minor nature.

Of the families considered in this investigation the most conspicuous variation in wood structure is shown among the Monimiaceae. In consequence, certain representatives exhibit more marked similarity to the Myristicaceae than others. If the diversity in the anatomy of *Boldea*, *Bracteanthus*, and *Siparuna* (the three genera responsible for the major variations found in the family) is disregarded, the points of similarity and difference between the Monimiaceae and the Myristicaceae are much more definite. Thus, the two families are then found to be alike in the general density range of their wood, in the nature of the vessel-ray pitting, in the presence (but not the distribution) of septate fibers, and in the type (in the tribe Atherospermeae also the width) of ray; there is also some similarity, at least among individual representatives, in the type of the fiber pits and in the growth ring characteristics. On the other hand, distinct differences are noted in the type of perforation plates, intervascular pitting, abundance and arrangement of wood parenchyma, and ray width (tribe Monimieae), as well as in the complete lack of oil cells in the Monimiaceae.

Of the three genera cited above for their variability from the prevailing structure of the Monimiaceae, *Siparuna* is outstanding in that it possesses several major features that tend to ally it rather closely to the Myristicaceae. Thus it is similar to the Nutmegs in its intervascular pitting and also shows the same variation in type of vessel perforation plates that characterizes some of the myristicaceous genera. Tending to offset these added points of similarity, however, are the predominance of unilaterally compound vessel-ray pitting in certain species and the complete lack of septate fibers. *Boldea* and *Bracteanthus* also resemble the Myristicaceae in intervascular pitting; on the other hand, the occurrence of exclusively simple perforations in the vessel members of these two genera is not duplicated in the Nutmegs; further the presence of spiral thickenings in the vessel members of *Boldea* and the absence of septate fibers in *Bracteanthus* are added points of difference from the Myristicaceae.

Despite the fact that Hutchinson (1926) includes the Hernandiaceae with the Myristicaceae in the order Laurales, and that both Reichenbach (1828) and Bartling (1830) incorporated the genus *Hernandia* in the Nutmeg family, the woods of the Hernandiaceae and Myristicaceae have little in common. Conspicuous points of difference are found in the density of the woods of the two families and in such anatomical features as type of perforation plates, vessel-ray pitting,[12] arrangement and distribution of wood parenchyma, fiber pitting, and type of ray; the Hernandiaceae also lack septate wood fibers. Only in intervascular pitting and ray width, and to some extent in growth ring characteristics and the presence of oil cells, is there any noticeable similarity between the woods of the two families.

The Hernandiaceae do, however, bear somewhat greater resemblance to the Lauraceae. These two families exhibit distinctive similarity in intervascular pitting, fiber pitting, and prevailing ray width, and to some extent in type of perforation plates, growth-ring characteristics, and presence of oil cells. In addition, the pronounced low density of the Hernandiaceae is approximated by some of the representatives of the

[12] The main distinction between the vessel-ray pitting in the two families lies in the fact that the pit-pairs in Hernandiaceae are seldom distinctly elongated and are not in the scalariform arrangement that typifies the Myristicaceae.

Laurel family, and such anatomical features as the occurrence of aliform to confluent paratracheal parenchyma and of homogeneous rays, and the absence of septate wood fibers are duplicated in part by certain of the Lauraceae, although these features cannot be considered typical of the majority of the representatives of the Laurel family.

The woods of the two families of the order Magnoliales under consideration, namely Magnoliaceae and Schizandraceae, show a remarkable similarity to each other. They also possess a number of distinctive anatomical features in common with the Myristicaceae, such as the presence of elongated and frequently scalariform vessel-ray pit-pairs, bordered fiber pits, and narrow heterogeneous rays. In addition, the density range of the magnoliaceous woods is generally similar to that of the Nutmegs. The points of difference from the Myristicaceae are also definitely marked, at least in so far as they concern the predominance of exclusively scalariform perforation plates, the occurrence of scalariform intervascular pitting, frequent unilaterally compound vessel-ray pitting, and vessel spirals, and the absence of septate fibers and definite paratracheal parenchyma; the representatives of the Magnoliales all exhibit distinct bands of wood parenchyma which are almost always uniformly spaced and definitely terminal, in contrast to the irregular bands that characterize many of the Myristicaceae. Oil cells are so much more common in the Magnoliales that their presence may almost be considered as a point of distinction rather than of similarity with the Nutmeg family.

Despite the frequency with which the Myristicaceae have been assigned to a position close to the Anonaceae by systematic botanists, there is comparatively little evidence in the anatomy of the secondary xylem of the two families to support such an inferred affinity. Outstanding points of distinction between the woods of the two families are found in the nature of the vessel-ray pitting, type of perforation plates, size of rays, and arrangement of wood parenchyma, and in the absence of septate wood fibers in the Anonaceae. As opposed to these differences, such general similarities as occur in the density range of the woods, the intervascular and fiber

pitting, the type of ray, and the occasional occurrence of oil cells are considered to be less significant. There is also some basis for comparison in the growth ring characteristics, but this may also serve in part as a point of distinction.

The genus *Eupomatia* has been variously treated. It was assigned to the Myristicaceae by Bartling, but Bentham and Hooker subsequently placed it in the Anonaceae, as did Engler and Prantl; Hutchinson considers it as constituting the monogeneric family, Eupomatiaceae. The anatomy of the secondary xylem clearly supports the last-named treatment, for the structure of the available specimen of *Eupomatia* is quite distinct from that of the myristicaceous and the anonaceous woods. As compared with the Nutmegs, *Eupomatia* exhibits distinct differences in distribution of pores, type of perforation plates, character of vessel-ray pitting, and predominance and distribution of septate wood fibers. The two families are in complete agreement only in type of ray, but, owing to the anatomical variation within the Nutmeg family, some of the other individual features which typify *Eupomatia* are duplicated here and there in certain genera of the Myristicaceae; these characteristics include distribution of wood parenchyma, character of growth-ring boundaries, intervascular and fiber pitting, ray width, and absence of oil cells. However, the distinctions are so pronounced as to indicate little relationship between the two plant groups.

The Canellaceae are likewise distinct from the Myristicaceae in the anatomy of their wood. Aside from the size of the rays and the infrequent occurrence of oil cells, there is little consistent similarity between the two groups, although the type of perforation plates, intervascular pitting, and rays, the arrangement of wood parenchyma, and the apparent absence of growth rings which characterize the Canellaceae may be duplicated in individual genera and species of the Myristicaceae. Major distinctions in density and in such structural features as vessel-ray and fiber pitting and presence or absence of septate wood fibers are sufficient to separate the woods of the two families.

The wood of the Menispermaceae and Lardizabalaceae,

both of which are essentially families of shrubs, is quite distinct from that of the Myristicaceae and all the other families under consideration, because of its conspicuous anomalous structure. Consequently it implies little or nothing in the way of possible affinity between the Nutmegs and the two families in question.

Summary

In summary, it may be said that a comparison of the anatomy of the secondary xylem of the several families under consideration lends definite support to the action of those systematic botanists who have placed the Myristicaceae close to the Lauraceae, since the general similarity between the woods of these two families is outstanding.

With the other investigated families which Hutchinson has placed in the order Laurales, namely the Monimiaceae and Hernandiaceae, the affinities of the Myristicaceae are not nearly so clear.

While there is some similarity to the woods of the Monimiaceae, the resemblance of the Nutmegs to the Hernandiaceae is far from striking; however, the Hernandiaceae do bear somewhat greater resemblance to the Lauraceae.

Some affinity is indicated between the Myristicaceae and the families Magnoliaceae and Schizandraceae, of the order Magnoliales, but the relationship is not nearly so marked as with the Lauraceae.

The structure of the wood of the Anonaceae is so strikingly different from that of the Myristicaceae that it indicates little or no relationship between the two groups.

The same may be said with regard to the Eupomatiaceae, which are considered by systematic botanists to be more or less definitely allied with the Anonaceae, despite the fact that the available woods of the two families bear little resemblance to each other.

The Canellaceae, likewise, seem rather far removed from the Myristicaceae, despite certain points of similarity.

Finally, the families Menispermaceae and Lardizabalaceae are both so decidedly different from the Myristicaceae in the character of their woods, that practically no affinity can be assumed.

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Material of Monimiaceae Wanted

Professor Garratt is making a detailed study of the systematic anatomy of the woods of the Monimiaceae. In the Yale collections are samples of 27 species of 11 genera as follows: *Atherosperma* (1), *Bracteanthus* (1), *Daphnandra* (1), *Doryphora* (1), *Hedycarya* (1), *Kibara* (2), *Laurelia* (2), *Mollinedia* (4), *Peumus* (1), *Siparuna* (11), *Tambourissa* (2). Additional wood specimens of all of the genera could be used to advantage.

CURRENT LITERATURE

Die von E. L. Ekman in Westindien gesammelten Koniferen. By RUDOLF FLORIN. *Arkiv för Botanik* 25A: 5: 1–22; pls. 1–3; figs. 1–2. Stockholm, 1932.

A list of three species of *Podocarpus*, four of *Pinus*, and five of *Juniperus* that are native in Cuba and Hispaniola, besides certain cultivated representatives of other genera.

Podocarpus Ekmanii Urban is restricted to the mountains of the Province of Oriente, Cuba; *P. angustifolius* Griseb. is reported from Pinar del Río, Cuba, and its variety *Wrightii* Pilger from Oriente; *P. Buchii* Urban is reported from both Haiti and the Dominican Republic, and its variety *latifolius* Florin from the mountains of Haiti. The pines reported for Cuba are *Pinus tropicalis* Morelet, *P. caribaea* Morelet, and *P. cubensis* Griseb.; for Haiti and the Dominican Republic, *P. occidentalis*. Of the *Juniperus* species, *J. saxicola* Britt. & Wilson, and *J. lucayana* Britton, are recorded from Cuba; *J. lucayana*, *J. gracilior* Pilger, *J. Ekmanii* Florin, a new species, and *J. Urbaniana* Pilg. & Ekm. from Hispaniola.

The paper includes extensive systematic notes upon some of the species, a chapter regarding their geographic distribution and relationships, and a bibliography.—P. C. STANDLEY.

Notes on the Trinidad and Tobago species of Lauraceae. By R. L. BROOKS. *Kew. Bull. Misc. Inf.* 209–228. Kew, England, 1933.

The family, known as the "Lauriers" in Trinidad, is of considerable interest in forestry on account of its economic value as providing useful soft woods and of its general prevalence. Considerable confusion prevails locally with regard to the native names, several species being given the same name, and more than one name being given to a single species.

There are provided keys to the 8 genera and 21 species (3 of them introduced), descriptions of the species, and lists of the specimens studied. Among the local members of the family are *Aiouea densiflora*, Laurier Canelle; *A. Schomburgkii*, Laurier Pulcherro; *Aniba trinitatis*, Laurier Canelle;

A. megacarpa, Laurier Pulcherro; *A. panurensis*, Laurier Canelle; *Ocotea leucoxylon*, Duckwood, Black Cedar, a tree yielding good timber, much used in Tobago; *O. arenaensis*, sp. nov., Laurier Mattack, Laurier Siparia Fine Leaf, a good timber, much used in interior construction; *O. Eggersiana*, Laurier Mattack; *O. canaliculata*, Laurier Petite-feuille; *O. glomerata*, Laurier Zaboca, Laurier Cypre; *O. oblonga*, Fine-leaf Laurier; *Nectandra surinamensis*, Laurier Mattack, Laurier Zaboca; *N. martinicensis*, Laurier Cypre; *Persea americana*, Avocado Pear, Zaboca; *Phoebe elongata*, var. *lanceolata*, var. nov., Laurier Cypre, Laurier Mama z'Enfant. —P. C. STANDLEY.

Risultati della spedizione biologica Austriaca in Costa-rica nel 1930. Raccolte botaniche. Seconda parte. By GIORGIO CUFODONTIS. *Archivio Botanico* 9: 179–204. Forli, 1933.

The Austrian Biological Expedition to Costa Rica was undertaken in 1930 chiefly under the auspices of the Notgemeinschaft der Deutschen Wissenschaft, and the direction of Dr. Otto Porsch of Vienna. The present paper is a report upon certain families of plants collected, and contains descriptions of numerous new species, chiefly of herbaceous plants. Among the woody plants reported are the following: *Baubinia Beguinotii*, sp. nov.; *Havenia rosea* Standl., known previously only from Nicaragua; *Billia Hippocastanum* Peyr.; *Meliosma irazuensis* Standl., sp. nov.; *Marcgravia rectiflora* Tr. & Pl.; *Eugenia rigidissima*, sp. nov.; *Oreopanax latissimum*, sp. nov.; *Symplocos irazuensis*, sp. nov.

Ergebnisse der Osterreichischen Biologischen Costa-Rica Expedition 1930. II. Teil. By G. CUFODONTIS, with the assistance of various specialists. *Annalen des Naturhistorischen Museums in Wien* 46: 225–241. Vienna, July 1933.

A list of the species of certain families of plants collected by the expedition, chiefly Gramineae, Orchidaceae, and Lobeliaceae. The only woody plants treated are palms: *Reinhardtia rostrata* Burret, sp. nov., *Pholidostachys pulchra* H. Wendl., *Geonoma longevaginata* H. Wendl., and *Bactris Porschiana* Burret, sp. nov.

Distinctive tropical trees. A pocket guide to sixty distinctive tropical trees cultivated in the open in the United States. By NELLIE IRENE STEVENSON. Pp. 66; 4¾ x 6½; 4 halftones. Fayette, Iowa, March 1933. Price $1.00 postpaid.

The pamphlet describes in non-technical language many of the common and some of the rarer tropical trees cultivated in the southeastern and southwestern parts of the United States, particularly Florida and southern California. There are many notes regarding economic applications of the trees in their native lands, and usually some account of the nature of their wood. The publication is designed primarily for winter visitors to the regions in which these trees are planted.

The flora of Barro Colorado Island, Panama. By PAUL C. STANDLEY. *Contributions from the Arnold Arboretum*, No. 5, pp. 1–178; pls. 1–21; map. Jamaica Plain, Mass., Oct. 1, 1933.

Barro Colorado Island in Gatun Lake in the Panama Canal is the seat of the laboratory for tropical research maintained by the Institute for Tropical Research, under the National Research Council. It has an area of six square miles, and a shore line of 25 miles; its surface is broken and hilly, with a maximum elevation of 537 feet.

The present flora is based in part upon three earlier lists by the same author, but contains new data obtained from extensive collections made recently upon the island. There are enumerated 1259 species of flowering plants and cryptogams, many of them unknown elsewhere in the Canal Zone. Vernacular names and brief descriptive notes are given for many of the species, which include a high percentage of trees and shrubs, several of which are described as new. Of special interest is the report of *Lacmellea edulis* Karst., unknown previously from North America, a tree of the family Apocynaceae with edible fruit, known in Colombia by the name Leche y Miel.

The plates illustrate details of the vegetation and some of the plants described as new.

Life zones in the Andes of Venezuela. By CARLOS E. CHARDÓN. *Bull. Pan American Union* 67: 8: 620–633; illustrated. Washington, D. C., August 1933.

The life zones recognized in the Andes of Venezuela, upon the basis of the author's exploration and the publications (cited in a special bibliography) of other investigators, are the following:

Tropical zone (*tierra caliente*), between sea level and an elevation of 800 meters. This covers by far the greater part of Venezuela, and is most important agriculturally. The forest vegetation varies from the rain forests of the upper Maracaibo basin to the intermediate or deciduous forests of the Yaracuy Valley and Upper Llano (region of Parapara and Ortiz). It may be also a xerophytic growth of spiny Mimosaceae and Cacti, as in the La Guayra-Macuto seaboard, or purely desert, as in the states of Lara and Falcón.

Subtropical zone (*tierra templada*), at 800 to 2000 meters. The zone ends at the lower limit of wheat cultivation. It is abundantly covered by luxuriant rain forests, especially in the Cordillera de la Costa, along the high point of the Maracay-Ocumare road and the upper Aguada River, but the exposed mountain sides of that range have lost their primitive forest and are now barren and sometimes deeply eroded. The subtropical forests in the Andes of Mérida are similar to those of the Cordillera de la Costa. At the base of the Sierra Nevada there is an abundant and rich forest growth. Approaching the dry climatic conditions of the Táchira River, on the Colombian border, the forests are deciduous, dry, and sparse.

Temperate zone (*tierra fría*), at 2000 to 3000 meters. The climate is cold (48°–54° F.), with appreciably less precipitation than in the subtropical zone. The area is small, restricted to the Andean states of Mérida, Táchira, and Trujillo. Staple crops are wheat and potatoes. The region has rather poor, shrubby vegetation and abundant natural pastures.

Paramo zone, from 3000 meters to the snow line (4600 to 4800 meters); a small area, in the states just mentioned. There is a superb display of bright-colored flowers, and

numerous colonies of low shrubs that gradually disappear with the altitude. The characteristic plant of the paramo is the Frailejón, various species of *Espeletia* (Compositae). —P. C. STANDLEY.

Timbers of British Guiana. Notes on four timbers recently tested at the Forest Products Research Laboratory, Princes Risborough. Compiled by the Forest Department of British Guiana. Pp. 10; 8½ x 13. Georgetown, 1933.

"The object of this report is to make available to the general public the results of preliminary tests of four of the Colony's timbers, *viz.*, Greenheart [*Ocotea Rodioei*], Wallaba [*Eperua falcata*], Purpleheart [*Peltogyne pubescens*], and Crabwood [*Carapa guianensis*]. These were selected for test by the Forest Products Research Laboratory, Princes Risborough, in preference to a number of woods from other colonies largely because the systematic forest valuation surveys carried out by the Forest Department enabled the Conservator of Forests to prove to the satisfaction of the authorities of that institution that the timbers are available in commercial quantities and they were therefore worth the trouble and expense of carrying out the preliminary test. They have all proved sufficiently promising to be recommended for further tests on a large scale.

"The results of these tests and the uses for which the timbers have been recommended have been briefly summarized in these notes. A description of the uses to which they are put locally and of local experience of their properties has been included. A brief account of the forests in which they grow, the methods by which they are usually extracted, and the habit of the trees is also given, along with the quantities, as disclosed by the valuation surveys carried out by the Forest Department, that are available."

Contributions to the flora of tropical America: XVI. New species and first records from British Guiana, mainly collected by Mr. T. A. W. Davis. By N. Y. SANDWITH. *Kew Bull. Misc. Inf.* 323–339. Kew, England, 1933.

Most of the species listed were obtained by T. A. W. Davis,

Assistant Conservator of Forests, in the interior of British Guiana, in the savanna and forest country of the Rupununi and Takutu rivers and their tributaries, about the base and slopes of the Kanaku Mountains, and on Mount Kusad. Among the new and old species of woody plants enumerated are the following: *Vochysia crassifolia* Warm., known by the Arawak name Iteballi; *Guazuma ulmifolia* Lam., Wonam (Arawak); *Protium Sagotianum* March., Kurokai (Arawak); *P. crenatum*, sp. nov., Kurokai; *Tetragastris panamensis* (Engl.) Kuntze, Haiowaballi (Arawak); *Trichilia leucastera*, sp. nov., Ulu (Arawak); *Guarea Davisii*, sp. nov., Kufiballi (Arawak); *Cedrela odorata* L., Red Cedar; *Loxopterygium Sagoti* Hook. f., Hububalli (Arawak); *Parkia Ulei* (Harms) Kuhlm., Uya; *Guettarda acreana* Krause, Yakki (Arekuna), the bark used by the Makusi Indians in the preparation of the arrow poison curare; *Cordia trichotoma* (Vell.) Arrab., Taparai (Wapisiana), Brown Silverballi (Arawak); *Ocotea canaliculata* (Rich.) Mez, White Silverballi (Arawak); *Psittacanthus plagiophyllus* Eichl., Werokarotika (Arawak).

Les bois de la Guayane française. By R. Benoist. *Archives de Botanique* 5: 1: 1–292; 10 figs.; 58 plates. Meslin, Caen, 1931.

The total area of French Guiana is 80,000 sq. kilometers, of which 70,000 sq. kilometers is forest land. The purpose of this memoir, as the author points out in his introductory remarks, is twofold: (1) to present an enumeration of the forest products thus far encountered in French Guiana; (2) to give a description of the microscopic structure of some woods occurring in the Colony.

For the systematic work, the author referred to material in the herbarium of the Museum de Paris. Study of wood structure was based upon specimens collected by the author while stationed in the Colony during 1913 and 1914. A brief discussion is given of other important explorations and publications upon the woods of French Guiana, including those of Barrère (1749), de Préfontaine (1752), Noyer (1827), Dumonteil (1820), de Lapparent (1863), Sagot (1869), Martin-Lavigne (1909), H. Stone, etc. There is also included

a concise account of the forest composition and of the macroscopic features of the woods.

The main portion of the publication is devoted to the dicotyledonous woods. There is a brief account of each family, a key to the genera, and for each species, a description of the herbarium material and the cross and tangential sections of the wood, followed by notes on the present potential uses of the timber. There is a key to the species on the basis of the minute anatomy of the wood. Other features are a bibliography, figures and plates, an alphabetical index to families, genera and species, and a check list of vernacular names.—L. Williams, *Field Museum of Natural History*.

Descriptions d'espèces nouvelles de phanérogames sud-américaines. By R. Benoist. *Bull. Société Botanique de France* 80: 333–336. Paris, Sept. 10, 1933.

The plants described as new are the following, all except the last being from Ecuador: *Tovomita aequatoriensis; Saurauia mojandensis* and *S. hypomalla; Matisia coloradorum*, a tree of 20 meters, with soft yellowish wood; *Salacia Colasi*, from the Iquitos region of eastern Peru.

Les caractères essentiels de la famille des Sebestenaceae et revision du genre Varronia. By Frhr. C. v. Friesen. Pp. 1–91; pl. 1; figs. 1–9. Geneva, 1933.

The author finds that the group of plants sometimes termed the Cordieae and referred to the family Boraginaceae constitute a distinct family, the Sebestenaceae, to which are referable the groups typified by the genera *Cordia*, *Heliotropium*, and *Tournefortia*. The generic name *Cordia* he discards, distributing the species commonly referred to that genus among the genera *Myxa* Friesen, *Collococcus* P. Br., *Sebestena* Gaertn., *Calyptracordia* Britt. & Wils., *Varronia* P. Br., *Varroniopsis* Friesen (typified by *Cordia villicaulis* Fresen), *Montjolya* Friesen (based on *Lantana bullata* L., i.e. *Varronia curassavica* Jacq.), *Ulmarronia* Friesen (type, *Lantana corymbosa* L.), *Gerascanthus* P. Br., and *Cordiopsis* Desv. These genera are described briefly, and a key is supplied for their separation.

Varronia alone is treated in detail, 20 species being referred to it. For each of these there is supplied a description, usually the original one, sometimes emended, synonymy, and lists of specimens examined. One Bolivian species, *V. Bridgesii*, is described as new. The paper concludes with a bibliography of the works consulted.—P. C. STANDLEY.

Esquisse phytogéographique de l'Argentine subtropicale et de ses relations avec la géobotanique sud-américaine. By LUCIEN HAUMAN. *Bull. Soc. Roy. de Bot. de Belgique* 64: 1: 20–64; pl. 1–16 (including map). Brussels, 1931.

Subtropical forest of the Territory of Misiones. In northeastern Argentina, between the Alto Paraná and Uruguay rivers, and between Paraguay and Brazil, lies Misiones, whose hills do not exceed 500 meters in elevation. The climate is moist, with almost 100 days of rain, and a precipitation of 160–180 cm. The upper two-thirds of the region is covered with a superb continuous forest, almost tropical in character, which extends into eastern Paraguay and the Brazilian states of Santa Catharina, Paraná, and Rio Grande do Sul. Here are found all the ordinary features of rain forest, only to a lesser degree than nearer the equator—various levels of dense vegetation representing a great number of families, palms, arborescent ferns, bamboos, lianas, and epiphytes. There are, however, only two palms, two or three tree ferns and large-leaved Marantaceae, four or five bamboos, and some dozens of lianas and epiphytes, and the total number of species of trees and shrubs probably will not exceed 250. Among the larger trees of these wet forests are species of *Araucaria*, *Ficus*, *Phytolacca*, *Ocotea*, *Phoebe*, *Nectandra*, *Prunus*, *Inga*, many Leguminosae, Rutaceae, *Cedrela*, *Alchornea*, *Diatenopteryx*, *Ilex*, *Luehea*, *Chorisia*, *Casearia*, *Aspidosperma*, *Tecoma*, *Jacaranda*, and numerous other groups. Although the forests usually are of very mixed composition, certain species are especially abundant, and others dominate locally. The giants of the forest are *Peltophorum dubium* and *Tecoma ipe*. Other important trees are *Cedrela fissilis* var., *Apuleia praecox*, *Piptadenia rigida*, *Enterolobium contortisiliquum*, *Bastardiopsis densiflora*, and species of *Holocalyx*, *Cabralea*, *Cordia*, *Patagonula*, and *Fagara*.

The savanna of southern Misiones and Corrientes. The savanna occupies the regions of less rainfall—120–150 cm., and seems dependent also upon the nature of the soil. To a botanist it is fascinating because of its great profusion throughout the year of showy-flowered plants, although its flora is less well known, as yet, than that of the forest. The southern limit of the subtropical savanna is difficult to indicate, because southward the tropical species gradually are replaced by those of temperate genera. Although the rainfall is abundant and evenly distributed, the vegetation is of a xeromorphous character, perhaps as a result of the high mean temperature. The vegetation is chiefly herbaceous, grasses being especially abundant, but there are some shrubs —three palms, *Cocos yatay* Mart., *C. poni* Haum., *Diplothemium campestre* Mart.; and representatives of such groups as *Schinus*, Anonaceae, Compositae, Leguminosae, Euphorbiaceae, and Malvaceae. There are extensive tracts of swampy or marshy land. In places there are also small areas of forest, composed of immigrants from the eastern forests: *Patagonula*, *Luehea*, *Lonchocarpus*, *Ficus*, *Tabernaemontana*, *Ocotea*, *Sebastiania*, *Inga*, and members of other genera.

Forests and savannas of the Chaco. This province, often called the Gran Chaco, is limited on the east by the Paraguay and Paraná rivers, on the west by the foothills of the Andes; on the south it merges towards 28° latitude with the prairies of the pampas. The climate is characterized by a rapid and regular diminution of rainfall from east to west, of 130 to 60 cm., while there is a corresponding increase in temperature, in spite of the lower minimum temperatures of winter. The region has the appearance of a perfectly level plain, whose elevation does not exceed 200 meters; its soil is very fertile, although still only in small part under cultivation. The two types of vegetation are xerophilous forest and savannas.

The dry forest. Its aspect and composition vary somewhat, although progressively and almost imperceptibly, from east to west, the forest being dense eastward but open

in the west. The dominating trees and shrubs are species of *Schinopsis*, *Prosopis*, *Ruprechtia*, *Capparis*, and *Coccoloba*, and *Aspidosperma quebracho-blanco*. *Schinopsis Balansae*, Quebracho colorado, is exploited for tanning, the wood or its extract being exported. The other Quebracho colorado, *S. Lorentzii*, less rich in tannin, is even more exploited for its extremely hard and resistant wood, used exclusively in Argentina for railroad ties. *Prosopis alba* and *P. nigra* are so abundant and so useful to the inhabitants that they are sometimes called merely *árbol*, the tree *par excellence*. Besides the trees there are many shrubs, of such genera as *Acacia*, *Coccoloba*, *Porlieria*, and *Bulnesia*. Most of the woody plants shed their leaves in winter.

The savanna. This is rich in species, especially grasses, in the east, but apparently poorer in elements westward. The most important feature is the enormous abundance of a tall palm, the Caranday, *Copernicia australis*, that often forms true forests of great extent. There are also isolated trees of *Acacia Farnesiana*, *Prosopis nandubay*, *Gourliaea*, *Chorisia*, *Schinus dependens*, etc.

Wet forests. Limited to the banks of streams or lagoons, these are of small extent, but rich in species, and interesting floristically. Their elements are derived in large part from the South-Brazilian forest, in part from the forests of the west.

Halophilous vegetation. In places where the soil is impregnated with alkaline salts there is a distinct type of vegetation, chiefly herbaceous, but including such shrubs as *Maytenus paraguariensis* and *Prosopis ruscifolia*.

Tucumán-Bolivian forest. Lying between the xerophilous forest of the Chaco and the still more xerophilous vegetation of the central Andes above 3000 meters, this forest is the result of local climatic conditions; the humid winds from the east, after crossing the Chaco plains, suddenly give up here the rest of their moisture. At the foot of the mountains the rainfall doubtless is more than 150 cm. The region has been settled for three centuries, and the vegetation greatly modified. There are local and often complicated zones of vegetation, dependent upon rainfall and elevation. The

humid subtropical forest is less tropical than that of Misiones; the trees are lower and less diversified; palms, bamboos, and tree ferns are absent. For the greater part of this association the dominating trees are *Phoebe porphyrea*, *Tipuana tipa*, *Juglans australis*, *Cedrela Lilloi*, *Tecoma Avellanedae*, and, locally, *Myroxylon peruiferum*, *Calycophyllum multiflorum*, *Enterolobium timbouva*, and *Piptadenia macrocarpa*. On the mountain slopes above 1200 meters, where the climate is still humid but cold, there are elements that characterize the upper limit of the forests. Typical trees are *Alnus jorullensis* var. *Spachii*, *Polylepis australis*, *Podocarpus Parlatorei*, *Prunus tucumanensis*, and *Eugenia mato*, besides many shrubs of the Compositae.

The paper concludes with a resumé of the geobotany of extra-tropical South America and a tabular scheme for its classification.—P. C. Standley.

Contribuição a identificação micrographica das nossas madeiras. By José Aranha Pereira. Bul. No. 9, Escola Polytechnica de São Paulo. Pp. 165; 7 x 10; 130 photomicrographs. São Paulo, Brazil, June 1933.

In his introductory notes the author gives a historical summary of the growth of knowledge of woods in Europe and the United States and the development of its experimental values; determination of physical and mechanical properties based upon uniform tests; microscopic identification as a means of determining physical and mechanical properties in the application of timbers; and the question of and modern tendencies in the production of timber in the various countries. The author proceeds to emphasize the need of improving the knowledge of woods occurring in the State of São Paulo and the initiative taken at the Laboratorio de Ensaio de Materiaes to study their physical and mechanical properties, also the importance of replacing vernacular names by a scientific nomenclature. There follows an outline of the basic principles of microscopic identification and a brief history of the systematic work on wood structure begun at the laboratory in 1931.

Part I is devoted to definitions, aided by a number of descriptive photomicrographs, of the principal elements in the anatomy of wood. This includes notes on the macroscopic examination of a transverse section, bark, sap, heartwood, pith, growth rings and the chemical composition; also the macroscopic structure in reference to vessels, fibers, rays, parenchyma, vessel contents, growth layers, etc.

Part II deals with the technical aspects of the work, with particular reference to the treatment of wood for cutting sections and the preparation of microscopic slides; and the technique of photomicrography. A list of references is also included.

The first section of Part III is a page index to the species studied. The second section is devoted to notes on the microscopic examination of 52 species of woods, of which 50 are dicotyledonous. The Gymnosperms described are *Araucaria brasiliensis* Rich.-Lamb. and *Podocarpus* sp., preceded by a brief account of the essential differences between the Gymnosperms and Angiosperms. In each instance there is shown a photomicrograph of the transverse and longitudinal sections of the species, the local name is given, and a description of the microscopic structure based on cross, tangential, and radial sections.—L. Williams, *Field Museum of Natural History*.

Estudo dos caractéres physicos e mecanicos das madeiras.

By Frederico A. Brotero. Boletim No. 8, Escola Polytechnica de São Paulo, Laboratorio de Ensaio de Materiaes. Pp. 50; 7 x 10; 17 figs.; 1 folded table. São Paulo, Brazil, March 1932.

The first part of the bulletin describes the methods employed in testing the physical and mechanical characters of woods. The second part gives the results of tests made upon Brazilian woods, chiefly of the State of São Paulo, those considered being Peroba Rosa, *Aspidosperma* sp.; Pinho do Paraná, *Araucaria brasiliana;* Canjarana, *Cabralea cangerana;* Cambará, *Moquinia polymorpha;* Eucalypto, *Eucalyptus longifolia* and *E. rostrata;* Jacaré, *Piptadenia communis;* Macacahuba, *Platymiscium* sp.; Massaranduba, *Mimusops* sp.; Pau Roxo, *Peltogyne* sp.; Sucupira, *Bowdichia* sp.; Pau Marfim, *Balfourodendron Riedelianum.*

The third part treats of the micrographic identification of the woods of Pinho do Paraná, Cambará, Canjarana, and Pau Marfim, all of which are illustrated by photomicrographs of transverse and longitudinal sections of the wood.

Plantes nouvelles ou peu connues de la région amazonienne.

By A. Ducke. *Archivos Jard. Bot. Rio de Janeiro* 6: 1–107; pls. 1–11. Rio de Janeiro, Jan. 1933.

The paper consists wholly of descriptions of numerous new species of the Amazon Valley, or of notes upon old ones, and it contains a large amount of new information regarding the Amazonian flora. Among new or noteworthy woody plants are the following: *Ogcodeia venosa*, n. sp., vernacular name Quina; *O. amara* Ducke, Balsamo, Quina; *Brosimopsis obovata*, n. sp., Mururé; *Iryanthera tricornis*, n. sp., Punan; *Couepia longipendula* Pilger, Castanha de Gallinha, Castanha Pendula; *Cedrelinga catenaeformis* Ducke, Yacayacá; *Eperua purpurea* Benth., Jébaro, Yébaro; *E. leucantha* Benth., Yauácano, Jauácano; *E. oleifera*, n. sp., Jacaré-copahiba, whose balsam is exported for varnish making; *Clathrotropis macrocarpa*, n. sp., Cabory, Timbó Páo; *Vochysia maxima*, n. sp., Quaruba, Cedro-rana; *Hevea guianensis* var. *cuneata* (Hub.), n. comb., Seringueira da Terra Firme, S. Itaúba (Brazil), Shiringa Amarilla, S. del Cerro (Peru); *S. lutea* var. *pilosula*, n. var., Seringueira Itaúba; *H. Benthamiana* Muell. Arg., Seringueira Chicote; *H. membranacea* Muell. Arg., Seringueira da Catinga, S. itaúbarana; *Platonia insignis* Mart., Bacury, Bacury-assú; *Lucuma dissepala* (Krause) Ducke, Abiurana Grande, Cutitiribá-rana, Guajará; *Sideroxylon cyrtobotryum* Mart., said to produce the Balata Rosada, as does also *S. resiniferum* Ducke; *Chrysopyllum eximium*, n. sp., Massaranduba-rana; *Ecclinusa balata* Ducke, Abiurana, Coquirana, Ucuquirana, Balata, whose latex yields the resin called Balata Inferior; *E. spuria*, n. sp., Ucuquirana Bravo.

There are extensive notes regarding the genera *Parkia*

(in which the new sections *Platyparkia* and *Sphaeroparkia* are proposed), *Hevea*, and *Dicranostyles*. Several new genera are described: *Vataireopsis* (Leguminosae), *Nycticalanthus* (Rutaceae), *Dodecastigma* (Euphorbiaceae), *Anomalocalyx* (Euphorbiaceae), *Polygonanthus* (Euphorbiaceae), and *Botryarrhena* (Rubiaceae).—P. C. STANDLEY.

Novo genero de Celastraceas da flora amazonica. By J. GERALDO KUHLMANN. *Archivos Jard. Bot. Rio de Janeiro* 6: 109–111; pl. 12. Rio de Janeiro, Jan. 1933.

Contains a description of the new genus *Goniodiscus*, of the Celastraceae, with a single species, *G. elaeospermus*, a medium-sized tree of the State of Amazonas, Brazil. Its seeds contain a high percentage of oil, which is the basis of a small local industry. The vernacular names are Cabeça de Cutia, Andirobinha, and Mapiá.

Contribuição para a flora do Itatiaia. By J. GERALDO KUHLMANN and P. CAMPOS PORTO. *Archivos Jard. Bot. Rio de Janeiro* 6: 113–117; pls. 13, 14. Rio de Janeiro, Jan. 1933.

A small tree of Mount Itatiaia is described as new, under the name *Ormosia Getuliana*.

Sur la question forestière et l'importance biogéographique des reserves forestières au Brésil intertropical. By PAUL LEDOUX. *Bull. Soc. Royale Belge de Géographia*, fasc. 2, pp. 121–132. Brussels, 1932.

Certain new technical terms are proposed or mentioned by the author, namely, forestobotaniste, forestobotanique (German Forstbotaniker, Forstbotanik); forestologie, the science of forest formations; forestobiologie, forest biology; forestotechnologie; forestodendrologie.

The forestry question, so important in Brazil because of the vast forests of that country, has attracted much attention there during the past few years. Brazil has long possessed a certain number of excellent forest botanists and various institutions qualified in forestry work, and there has been organized a national institution, the Serviço Florestal Brasil,

which publishes the interesting Boletim do Serviço Florestal (Rio de Janeiro). Brazil has a future of rich potentiality, and it is difficult to overestimate the importance of conserving her forests for the future.

There is much needed at the present time a forest bibliography of Brazil, to include all works pertaining to its woody plants. Mention is made of the more important sources of such material.

In August 1931, there was organized in Rio de Janeiro the Sociedade dos Amigos das Arvores, whose purpose is the protection of the Brazilian flora. Dr. A. J. de Sampaio of this society was invited by the Prefect of the Federal District to participate in the operations of the Conselho Technico Florestal, and through his intervention the society obtained a decree establishing the forest reserve of Itapeba. Another reserve established through the efforts of Dr. Sampaio is the Biologic Reserve of Itapuca, in the State of Rio de Janeiro. The State of Minas Geraes, which has suffered heavily by the destruction of its forests, has decreed the establishment of a botanical garden, and forest reserves in typical vegetation zones of the public lands.

There are brief descriptions of the reserves already established in Brazil: Alto da Serra, in São Paulo, at an average elevation of 850–950 meters, where there is a research laboratory; Itatiaya, on the borders of Rio de Janeiro, São Paulo, and Minas Geraes, probably with the highest mountains of Brazil, where there is a Biologic Station; Macacu, south of Novo Friburgo, which protects the water supply of Rio; Itumirim, a section of the caatinga or dry forest of the State of Bahia; and Catu-Utinga, which protects the water supply of Belem, State of Pará.—P. C. STANDLEY.

Timber studies of Chinese trees. IV. Anatomical studies and identification of Chinese softwoods. I. By Y. TANG. *Bulletin of the Fan Memorial Institute of Biology* 4: 7: 209–268; pls. 9. Peiping, China, March 16, 1933.

The report covers 41 species of 24 genera of Gymnosperms. There are notes on the size and distribution of the trees, the appearance of the bark, general properties of the woods, and

descriptions of the gross and minute anatomy of the woods. There is a key to the woods by genera; also two large tables summarizing all of the distinctive features of the species. Comprising the first two plates are 36 small, natural-size photographs of cross sections; the other seven plates consist of 12 photomicrographs each.

A revision of the genus *Rhodoleia*. By A. W. Exell. *Sunyatsenia* 1: 95–102; pl. 25–28. Hongkong, July 1933.

The genus *Rhodoleia* of the Hamamelidaceae consists of seven species, all of which are comparatively limited in range. Four of the species occur in China, two being endemic there, in Hongkong and Yunnan, the other two ranging just outside Chinese territory. The three other species occur in Sumatra and the Malay Peninsula. They are shrubs or trees, attaining a height of at least fifty feet. *R. Forrestii* Chun is described as new from Yunnan and Upper Burma, and *R. subcordata* Exell from Pahang. For *R. Teysmannii* Miq. of Sumatra there are reported the vernacular names Kajoe Barana, Santoe, and Katji Barana.

The Combretaceae of China. By A. W. Exell. *Sunyatsenia* 1: 85–94; pl. 21–23. Hongkong, July 1933.

The Combretaceae, being a family mainly confined to the tropics, are poorly represented in China. In the present enumeration there are reported six species of *Combretum*, *Quisqualis indica*, four species of *Terminalia*, and *Lumnitzera racemosa*. Keys are supplied for separating the genera and species, and there is citation of synonymy and of specimens studied. *Combretum yunnanense*, described as new, extends to Burma and the Malay Peninsula.

Tutcher's enumeration of Kwantung plants in the reports on the botanical and forestry department of Hongkong. By Woon-Young Chun. *Sunyatsenia* 1: 157–187. Hongkong July 1933.

In the annual reports of the Botanical and Forestry Department of Hongkong, 1913 to 1918, Superintendent William

James Tutcher published lists of plants not previously known to occur in Hongkong, the Hongkong New Territories, and Kwantung. These lists include five new species and one new variety, and 190 additional species. Since the reports had a limited distribution, and are not available to many students of Chinese botany, the "supplements" in which these lists appeared are here reprinted.

The strength and composition of some tropical woods of Siam. (In Japanese, with summary in English.) By Ihachiro Miura and Teisuke Yoshida. Bul. No. 17, Tokyo Imperial University Forests. Pp. 39; 7½ x 10¾; 10 plates; 9 text figs. Tokyo, 1933.

This bulletin deals with the physical, mechanical, and chemical properties of five timbers, namely, *Dalbergia cochinchinensis* and *Dalbergia* sp. (Rosewood), *Diospyros mollis* (Ebony), *Cassia siamea* (Ironwood), and *Pterocarpus indicus* (Pradu). Among the illustrations are photomicrographs of the cross, radial, and tangential sections of the woods.

Espèces et variétés nouvelles du genre *Quercus*. By Aimée Camus. *Bull. Société Botanique de France* 80: 353–355. Paris, Sept. 10, 1933.

Among the new Oaks described are *Quercus brevistyla*, from Malacca, and *Q. daichangensis*, from Dai-chang, Siam.

Philippine Rutaceae-Aurantioideae (Revisio Aurantiacearum VII). By Tyôzaburô Tanaka. *Trans. Nat. Hist. Soc. Formosa* 22: 418–433; Dec. 1932.

Study of the Citrus group of the family Rutaceae has made slow progress in the Philippines since 1923, when 31 species and 7 varieties were listed in Merrill's *Enumeration of Philippine Flowering Plants*, but the present author's recent investigations necessitate some changes in nomenclature and classification. In the list here presented there are recognized 50 species and 16 varieties from the islands. Notes are given regarding their general distribution, and several new varietal names are proposed.

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General remarks on the genus *Fortunella*. By Tyôzaburô Tanaka. *Studia Citrologica, Tanaka Citrus Experiment Station* 5: 2: 141–154, Nov. 1932; and 6: 1: 19–40, July 1933.

Japanese, with English summary. *Fortunella* Swingle is a valid genus of the Rutaceae, consisting of six species of kumquats. *F. obovata* Hort. ex Tanaka is described as new, and the new name *F. polyandra* (Ridley) Tanaka is published. Original descriptions of all the species are reprinted, with redescriptions of the type and other authentic specimens. Measurements are given of the fruits of five of the species, and notes regarding their Japanese and Chinese vernacular names.

Contributions to the flora of Burma: XI. By C. E. C. Fischer. *Kew Bull. Misc. Inf.* 364–366. Kew, England, 1933.

Palaquium Sukoei is described as new, a tree of the family Sapotaceae. Vernacular name, Pyinlebyin. "Blaze purple or brick-red, exuding milky juice; heartwood dark red."

***Taiwania* in Burma—a new record.** By M. Y. Orr. *Notes from the Royal Botanic Garden, Edinburgh* 18: 86: 6. Edinburgh, April 1933.

The peculiar monotypic genius of conifers, *Taiwania*, was found originally on Mount Morrison, Formosa, in 1904, and was discovered in northwestern Yunnan in 1916. It has been reported only from these two regions, and has been cited as a remarkable example of discontinuous distribution. There has been discovered recently in the Edinburgh Herbarium a specimen of this tree, collected in 1912 in the Myitkyina district of Upper Burma, the vernacular name being reported as Shoak.

Additions to the flora of the Malay Peninsula. By M. R. Henderson. *Gardens' Bulletin, Straits Settlements* 7: 87–128; pl. 15–32. Singapore, May 10, 1933.

Forty-five species of flowering plants are recorded as additions to the flora of the Malay Peninsula, 29 being described as new. Nine genera are reported for the first time from the area—*Acanthopanax*, *Ainsliaea*, *Cipadessa*, *Keenania*, *Myriophyllum*, *Pistacia*, *Richeriella*, *Sumbaviopsis*, and *Sycopsis*. Among the new species of woody plants are *Goniothalamus tortilipetalum*, Malaya name Kenerak; *Dysoxylum undulatum*, Sakai name Sirai (Seral), the sapwood yellow, the heartwood reddish orange; *D. Corneri*, Malay names Chengkuang, Gapis, and Bekak, sapwood white, heartwood dark reddish brown, the wood hard but easily split and rather brittle; *Acanthopanax malayana*, Sakai name Berlaki; *Richeriella malayana*, Malay name Pokok Surangkeng, the wood used for rafters and firewood.

Notes on Malayan Dipterocarpaceae—I. By C. F. Symington. *Gardens' Bulletin, Straits Settlements* 7: 129–159; pl. 33–47. Singapore, May 10, 1933.

Study of the collections at Kew "reveals the necessity for readjustment of our conception of the botanical status of some of our trees and considerable reduction to synonymy with the consequent alteration of some of the accepted names." The paper is devoted mainly to notes regarding species of *Shorea*, but also treats *Balanocarpus multiflorus*. There are extensive notes regarding synonymy, distinguishing characters of the species, distribution, and vernacular names.

Enumeration of Malayan Ebenaceae (with brief descriptions of new and noteworthy species). By R. C. Bakhuizen van den Brink. *Gardens' Bulletin, Straits Settlements* 7: 161–189; pl. 48–50. Singapore, May 10, 1933.

The present list of 166 species of *Diospyros* is a preliminary survey of the group as it is represented in the Malay Archipelago and Peninsula. Since there are no well-defined differences between *Diospyros* and *Maba*, the latter is merged with the former as a subgenus. Many new combinations are made in specific names, and very numerous new species are diagnosed. Three additional subgenera are recognized: *Hierneo-*

dendron Bakh., *Cargillia* (R. Br.) Bakh., and *Eu-Diospyros* (L.) Bakh. Vernacular names are indicated for a few of the species: *D. baloen-idjoek* Bakh., Baloen idjoek, in Sumatra; *D. malam* Bakh., Malam, Kajoe malam, in Borneo; *D. paraoesi* Bakh., Paraoesi, in Borneo.

Fourth report on plantation rubber in the Middle East, 1932. By H. N. WHITFORD. Pub. by Rubber Manufacturers Association, Inc., 250 West 57th Street, New York, 1932.

"This report is based on investigations made in the Middle East from July 15, 1931 to June 15, 1932. . . . It describes in some detail the human elements which go to make up the organizations of the European Estates and their response to the changing economic conditions. The standard methods of cultivation of *Hevea* by Europeans, built up by thirty years of experience, calls for an expensive outlay both in planting and production. The economic conditions have forced some changes in these methods. It is of vital interest to know how the rubber tree itself will respond to these changes in cultivation and treatment. Hence the necessity of a knowledge of the behavior of the *Hevea* under a new set of environmental conditions. The studies of the biological response of *Hevea* under various environmental situations made during the past year, reinforce conclusions formed as a result of studies of the previous years. These conclusions are that many of the fundamental principles which form the basis for the standard methods of Europeans need, to say the least, a careful re-examination as to their soundness both from a biological and economic standpoint. The fact that *Hevea* has responded to the treatment accorded it by the standard, and at the same time expensive, methods of cultivation may have been due to the fact that it is a hardy tree. Some believe, however, that a radical change in cultivation methods, which are at the same time less expensive, is necessary for the best response of *Hevea*. Therefore it is deemed advisable to discuss fully in this report the claims of those who believe that forestry methods may eventually replace the present standard methods."

Ergebnisse der Reise von Dr. A. U. Däniker nach Neu-Caledonien und den Loyalty-Inseln (1924/6). Katalog der Pteridophyta und Embryophyta siphonogama. III. Teil. By A. U. DÄNIKER. *Vierteljahrsschrift der Naturforschende Gesellschaft in Zürich* 78, Beiblatt Nr. 19: 237–338. Zürich, June 30, 1933.

The present instalment covers the families Anacardiaceae to Umbelliferae, inclusive, of the Engler and Prantl sequence. It is a list of the species collected, many of which are trees and shrubs, with notes as to their occurrence, size, and vernacular names. New species of trees and shrubs are described in several families.

Pandanaceae of Tahiti. By UGLINO MARTELLI. *Univ. Calif. Publ. Bot.* 17: 149–170; pl. 16–21. Berkeley, Sept. 8, 1933.

From Tahiti there are reported two species of *Freycinetia*, one of which has not been determined, and nine of *Pandanus*, of which four are described as new.

Pandanaceae of Rarotonga. By UGLINO MARTELLI. *Univ. Calif. Publ. Bot.* 17: 171–186; pl. 22–25. Berkeley, 1933.

From Rarotonga, an island about 30 miles in circumference, there are known one species of *Freycinetia* and three species and one variety of *Pandanus*, all of which are described as new. *P. ala-kai* is so named because it is known locally as Ala-kai, "edible pandanus."

***Myoporum* in Rarotonga.** By C. SKOTTSBERG. *Meddel. Göteborgs Bot. Trädgard* 8: 147–167; figs. 1–48. Göteborg, Sweden, June 20, 1933.

The *Myoporum* of Rarotonga has been referred to *M. laetum* R. Br. and *M. sandwicense* (A. DC.) Gray, but incorrectly so. It is here described as *M. Wilderi*, sp. nov.

A simple chemical test for separating the woods of hoop pine (*Araucaria Cunninghamii*) and bunya pine (*Araucaria Bidwilli*). By W. E. COHEN. *Journ. Council Sci. & Ind. Research*, May 1933, pp. 126–127.

"The test is applied to the aqueous extracts which are prepared as follows: Rasped samples of the woods are prepared and the material which passes through a 20-mesh sieve is used. Five grams of this material (if air dry) is placed in a flask fitted with a reflux condenser, and extracted for two or three hours, at the temperature of a boiling water bath, with 50 cc. of water. After filtering and pressing the residual wood, the latter is washed with 50 cc. of boiling water, the wash being added to the original extract. When cool, the volume of the extract is adjusted to 100 cc. To 2 cc. of the aqueous extract, contained in a roomy test tube, 1 cc. of concentrated sulphuric acid is added to form a layer. The layers are mixed by gently shaking the test tube.

"In the case of Bunya Pine, a pink color will develop immediately, and an orange (harvest) colored precipitate will form (sometimes slowly). With Hoop Pine, there will be no immediate color change, but later a white gelatinous precipitate will form.

"The observation of the pink color has been found to be more reliable than that of the subsequent precipitate. In many cases the aqueous extracts of Bunya Pine are more deeply colored (light orange) than those of Hoop Pine. Although this cannot be claimed to constitute another test, it can generally be used to give a fairly reliable indication. Naturally, in such cases, the pink color mentioned above will then be orange pink. The test has been found to give the above differences when applied to 21 out of 22 samples of Bunya Pine and to 26 samples of Hoop Pine, all from individual trees. The defaulting Bunya Pine sample resembled Hoop Pine in many ways, and its origin is being further investigated."

Ecological studies in Victoria.—The Cheltenham flora. By R. T. PATTON. *Proc. Roy. Soc. Victoria* 45: 2: 205–218; figs. 1–3. Aug. 1, 1933.

"The term Cheltenham Flora has been given temporarily to this very well-defined association as I have hesitated to use the type of nomenclature at present finding favor in the ecological world. The addition of the suffix '*etum*' to the stem of the generic name of one of the dominants to designate an association implies that the ultimate classification of associations must be based on taxonomic principles, a view to which I cannot give any adherence. Associations owe their particular or peculiar physiognomy to the environment, physical and biotic, and not to the taxonomic relationships of the constituent members of the association. In the classification of plants we are concerned particularly with their floral parts, but in ecology we are only to a minor degree affected by such considerations, but we do concern ourselves with the vegetative appearance of the plants in the association. In this particular association one must be struck by the very great vegetative similarity of the dominants and subdominants. Yet they belong to the most diverse families."

This association is of great interest because of its similarity ecologically and taxonomically to areas in Europe and South Africa, one of the important families being Epacridaceae, closely related to Ericaceae. It consists of scrub species, three to five feet high, with small, narrow, usually coriaceous leaves. The stems are never robust but always thin, and spines often are present. Because of the uniformity of leaf size, gray-green color, and completeness of ground cover, no one species is especially conspicuous. The dominant species are *Casuarina distyla*, *Banksia marginata*, *Acacia Oxycedrus*, *Ricinocarpus pinifolius*, *Leptospermum myrsinoides* and *L. scoparium*, and *Olearia ramulosa*. The evergreen members of the association are decidedly xeromorphic. The chief problem of the plants is the availability of water during the hot summer and autumn months. Although during this period the rainfall (12.91 inches) is actually greater than in the six winter months, April to September (12.60 inches), evaporation is much more rapid during the former period. The nature of the soil is such that it is unable to retain much water.—P. C. STANDLEY.

Les Brexiées de Madagascar. By H. PERRIER DE LA BATHIE. *Bull. Soc. Bot. France* 80: 198–214. Paris, 1933.

Six species of *Brexia* are reported from Madagascar, four of which are described as new. They are shrubs or trees, which

sometimes attain a height of 10 meters. The closely related genus *Brexiella* is proposed, with 5 species, all new. They likewise are shrubs or trees, as much as 20 meters in height. The genus *Brexiella* emphasizes the affinities already indicated between *Brexia* and Celastraceae, and it is suggested that it may be necessary to refer the plants to that family rather than to the Escalloniaceae, where they are placed at present. The paper concludes with a detailed account of the distribution and biology of the two genera.

A contribution to the geological history of the Dipterocarpaceae. By HELEN BANCROFT. *Geologiska Föreningens i Stockholm Förhandlingar* 55: 1: 59–100; figs. 19. Jan.–Feb. 1933.

"Five specimens of fossilized woody stems from Mount Elgon in East Africa are described; on account of definite structural characteristics, they are referred to Dipterocarpaceous affinities, the new species, *Dipterocarpoxylon africanum*, being proposed.

"The present distribution of the Dipterocarpaceae in Asia, and the extension of the family into Africa are discussed; the atypical nature of the wood structure of the African representatives, the Monotoideae, is noted.

"Fossil records of the Dipterocarpaceae are reviewed; and the importance of the Elgon specimens is emphasized as indicating that typical Dipterocarps were, in pre-Pleistocene times, much more widely distributed than at the present day."

Le fruit du *Dioncophyllum* Baillon, Flacourtiacées. By FRANÇOIS PELLEGRIN. *Bull. Soc. Bot. France* 80: 233–236. Paris, 1933.

The genus *Dioncophyllum* was based by Baillon in 1890 on material of a curious vine collected in Congo, which he named *D. Tholloni*. The leaves of the plant are distinguished by having the midnerve terminated by two peculiar hooks. Two other species have been described from Sierra Leone, *D. Dawei* Hutch. & Dalz. and *D. peltatum* Hutch. & Dalz., the latter known by the vernacular name Tomai. The capsule of the

genus has never been described, but that of *D. Tholloni*, recently collected, is now illustrated, and its development and form described. The capsule is a most remarkable one, opening at an early stage by 5 linear valves, which bear seeds on greatly elongate funicles. The seeds increase in size after dehiscence of the capsule, becoming very large, disk-shaped, and broadly winged.—P. C. STANDLEY.

Un *Entandrophragma* C. DC. (Meliaceae) nouveau de l'Ituri (Congo Belge): *Entandrophragma Thomasii* Ledoux, n. sp. By PAUL LEDOUX. *Communications du laboratoire des produits végétaux et de l'herbier du Service Forestier du Kivu*, No. 2; 2 unnumbered pages, Brussels, June 20, 1932.

The new species is described as a tree 45 meters high, with a trunk diameter of three meters, growing at an elevation of 950 meters, and reported as rare. The vernacular name is said to be Mugutisi.

Côte d'Ivoire. L'arbre à lepre des guérés. By A. AUBRÉVILLE. *Actes & Comptes Rendus de l'Association Colonies-Sciences* 9: 97: 151–153; illustrated. Paris, July 1933.

This tree, previously identified as *Cynometra Vogelii*, is shown to be *Loesenera kalantha* Harms.

The composition and origin of "stone" in iroko wood (*Chlorophora excelsa* Benth. & Hook. f.). By W. G. CAMPBELL and R. C. FISHER. *Empire Forestry Journal* (London) 11: 2: 244–245; 1 plate; 1932.

"The frequent occurrence of large stone-like deposits in the wood of *Chlorophora excelsa* has been recognized for some considerable time, but doubt still appears to exist concerning the true composition and origin of the material. . . .

"A specimen of 'stone' was submitted to the Forest Products Research Laboratory for examination in 1929, and since that time various pieces of information have come to hand from Forest Officers and others which seem to render it advisable to record the following observation. . . .

"As to the steps in the formation of the deposit there would appear to be little doubt that the initial cause is a wound. According to information supplied to the Laboratory in 1931 by an Assistant Conservator of Forests, Uganda, 'stone' is found in logs cut from both sexes of *C. excelsa*, particularly if the trees have been injured by grass fires or if a branch has been broken off. Wounding appears to be followed by a flow of a latex-like exudation which, on exposure to the air, sets hard like stone. The peculiar nodular, in fact, almost stalactitic form of the specimen illustrated here, however, suggests that it has been formed in a cavity as a result of the gradual loss of carbon dioxide and water, according to the views quoted by Schorger (1926) and Record (1927). The presence of insect remains, and pulverized wood suggests that sap has penetrated into a cavity in which wood-borers have been at work and to which other insects had access from the outside. Before solidification began to take place, insects, wood powder (which may be frass) and chips must have become incorporated with the sap. That decay must in many cases play a part in the formation of the cavity is suggested by the fact that 'stone' is frequently found in logs which are hollow for the greater part of their length. This is further borne out by the presence of remains of insects which, although not true wood borers, may frequently be found in decaying timber. The obvious inferences to be drawn here are that wounds of growing trees should be guarded against or suitably treated, and that, during conversion, logs from old trees showing any signs of wounds or decay should be closely scrutinized."

La Guinea española y su riqueza forestal. Conferencia dada en el Instituto de Ingenieros Civiles el Día 14 de Diciembre de 1929. By FERNANDO NÁJERA. Pp. 119; 6½ x 9½; 5 maps; 47 full-page halftones; Madrid, 1930.

Spanish Guinea has an area of approximately 2,500,000 hectares, or about one-twentieth that of Spain. It is drained by three principal rivers, with numerous smaller tributaries. The coast is low, but at a distance of 15 to 20 km. from it rise hills, and farther inland mountain ranges, the highest of which reach an elevation of 1000 to 1100 meters.

The region is, for the most part, densely forested, from coast to mountain tops, the trees being of huge size and of great variety, and reaching their best development along the rivers. The forests are of two types, virgin forest and secondary, the latter composed of trees of rapid growth and soft wood on cut-over or abandoned land. Such forests prevail everywhere, except in Mangrove (*Rizophora mangle* and *R. racemosa*) swamps that extend along the coast and up the rivers as far as the tides reach.

In the secondary forest the most important trees are: Asen or Palomero, *Musanga Smithii*, which invades every foot of abandoned land, its soft wood having a specific gravity of 0.26; Ekok, *Ricinodendron africanum;* Ebap, *Pachylobus balsamifera*, a tree with adventitious roots; Asonná, *Anthostema Aubryanum;* Okume or Angumá, *Aucoumea Klaineana*, basis of the present timber industry in the Colony, whose wood is used for veneer.

Of the virgin forest, the handsomest tree is Palo Rojo or Envé, *Pterocarpus Soyansii*, of tall and majestic growth, whose sap is much used by the native people for painting the body; but the most characteristic species is Akoga, *Lophira procera*, called Palo de Hierro or Ironwood in Europe, whose wood when dry has a specific gravity of 1.100. Conspicuous because of its giant size is the Ukola, *Dumoria africana*, with a trunk sometimes 28 meters high to the first branches and a diameter of 4.15 meters, capable of furnishing 120 cubic meters of wood.

The writer classified 170 kinds of native woods, and brought to Spain 60 tons of them for study in the Instituto Forestal de Experiencias. It is estimated that there are in the Colony, assuming that 20 per cent of the area is devoted to cultivation and habitation, 1,010,000,000 cubic meters of timber from which it is theoretically possible to draw annually 5,000,000 cubic meters, five times as much as was imported into Spain in 1928. The chief obstacle to their export is the fact that they are unknown in European markets. It was believed until recently that the west African forests consisted chiefly of heavy or "precious" woods, of only limited application in cabinetwork. However, it is estimated that 37 per cent of the

local trees yield very hard woods, 20 per cent hard, 19 per cent semi-hard, 12 per cent soft, and 12 per cent very soft; consequently 51 per cent of Guinea timbers have the same density range as the well-known woods of Europe. It is estimated that there are in the Colony approximately 15,000,000 tons of Okume lumber.

The publication contains, also, much additional information regarding the Colony, particularly its climate, sanitary conditions, fauna, and inhabitants; the importance of Guinea as a source of lumber for Spain, and the desirability of a permanent exhibit of its woods; the possibility of utilizing some of the species for cellulose and charcoal; and the necessity of a fixed forest policy. The numerous illustrations include several maps and excellent views of the forests.—P. C. STANDLEY.

Le vrai bois de rose de l'antiquité. By AUG. CHEVALIER. *Revue de Botanique Appliquée et d'Agriculture Tropicale* (Paris) 13: 141: 347–348; May 1933.

There are many species of wood known as Bois de Rose. One type, much sought after for cabinet-making, is so called because of the coloring of the wood, while a second type derives its name from a perfume obtained by distillation. The former is represented by *Dalbergia nigra* F. Allem of Brazil, *Dalbergia latifolia* Roxb. of India, *Dalbergia* spp. of Indo-China, and *Thespesia populnea* L. of the Pacific; the latter by *Aniba roseodora* Ducke of Guiana, *Aniba terminalis* Ducke of the Amazon estuary, and *Bursera* spp. of Mexico.

The ancient Mediterranean people used a wood they called Bois de Rose or Bois de Rhodes for incense, cutting it up into small pieces and burning it. Modern botanists now identify it as the root-wood of *Rhodorhiza scoparia* Webb & Berth. (=*Convolvulus scoparius* L. f.), a species endemic to the Canary Islands and known as the Bois de Rose de Ténériffe. According to Victor Loret this wood was one of the ingredients of "kyphi" (analogous to the Chinese joss sticks) used in the ceremonies of an ancient Egyptian cult. There is some question as to how they procured the wood unless it formerly was cultivated outside the Canary Islands or the roots were

transported long distances by sea or by caravans across the Sahara. It is not now exploited, nor are *Rhodorhiza virgata* Webb & Berth. and *R. florida* (L. f.) Webb & Berth., which also are sources of Bois de Rose.

Professor Chevalier thinks an attempt to cultivate these species would be successful in Morocco, although it would be several years before the roots would be lignified enough for exploitation.—MARY E. RECORD.

The flora of Mount Elgon. General introduction by E. J. LUGARD. **Enumeration of plants** by A. A. BULLOCK. *Bulletin of Miscellaneous Information* (Royal Botanic Gardens, Kew) 2: 49–106; 1933.

Mount Elgon, on the boundary between Uganda and Kenya, is one of the highest mountains of Africa, with an elevation of 14,178 feet. It is an extinct volcano, with a crater eight miles in diameter and 1500 to 2000 feet in depth. On the eastern slopes at 6500 to 7000 feet the annual rainfall is 45 to 50 inches, the conditions being suitable for growing coffee, maize, and wheat.

In the present list are enumerated 649 species of ferns and flowering plants, which are said to be not more than two-thirds of the total number of plants known from the mountain. Many of the species listed are trees and shrubs, for some of which local vernacular names are reported. The three vegetation zones of the mountain are the following:

Sub-montane zone. At 6000–7500 feet, the country open and park-like, with scattered trees and grasslands, much of it now under cultivation. The most common trees are Acacias, especially *A. abyssinica*; Nandi coffee, *Coffea eugenioides*, grows in subtropical forest along streams; *Erythrina tomentosa* is conspicuous because of brilliant scarlet flowers. Genera represented among the shrubs are *Clerodendron*, *Acanthus*, *Hypericum*, and *Loranthus*.

Mountain forest zone. Roughly between 7500 and 10,300 feet, including the bamboo belt and the grass glades. The most valuable timber is Podo (*Podocarpus milanjianus* and *P. gracilior*), used throughout the country by Europeans as a substitute for Deal, and the Pencil Cedar (*Juniperus procera*). The last is sometimes 20 feet in girth and more than 100 feet high; the Podo as much as 80 feet in height, with girth of 25 feet. The bamboo forming extensive belts between 8000 and 9000 feet is *Arundinaria alpina*, the only bamboo of the equatorial mountains of Africa.

Alpine zone. At 10,300 to 14,000 feet, known as the "mountain meadows." There are many giant forms of the genera *Lobelia*, *Senecio*, and *Hypericum*,

some of the Lobelias attaining a height of 30 feet, and the Senecios becoming as large as apple trees. The only trees of the zone are *Hagenia abyssinica* and the tree heath, *Erica arborea*.—P. C. STANDLEY.

The cambium and its derivative tissues. VII. Problems in identifying the wood of mesozoic Coniferae. By I. W. BAILEY. *Annals of Botany* 47: 185: 145–157; pls. III, IV. London, January 1933.

"The tracheary pitting of the genus *Cedrus* is plastic and variable, and of fully as intermediate or transitional a character as any that occurs in the so-called Protopinaceae or Araucariopityeae.

"The distribution of the resin canals in the adult wood of *Keteleeria Davidiana* is of the same type as occurs in *Protopiceoxylon* and *Pinoxylon dacotense*.

"Such hypothetical transitional genera as *Protocedroxylon*, *Protopiceoxylon*, *Planoxylon*, *Thylloxylon*, etc., fall within the range of structural variability of *Cedrus*, *Keteleeria*, and other genera of the Pinaceae. If they are to be classified as Protopinaceae or Araucariopityeae, then so must fragments of the wood of *Cedrus*, *Keteleeria*, and other genera of the Pinaceae.

"This paradoxical situation, and many others, have arisen owing to a dearth of extensive and reliable information concerning the limits of structural variability in living representatives of the Coniferae. They cannot be fully clarified until large collections of authentic specimens are assembled, not only from different genera, species, and geographical races, but also from different parts of the tree and from trees grown under different environmental conditions."

The cambium and its derivative tissues. No. VIII. Structure, distribution, and diagnostic significance of vestured pits in Dicotyledons. By I. W. BAILEY, *Journal of the Arnold Arboretum* 14: 259–273; 4 text figs.; 3 plates with 18 photomicrographs. Jamaica Plain, Mass, 1933.

Vestured pits "appear to be restricted to tracheary elements; in half-bordered pit-pairs they are present in the bordered pits of the tracheary elements, but are absent in the simple pits of the adjoining parenchymatous cells. . . .

"In the Dicotyledons (2660 species and 979 genera) examined by me, vestured pits are either present throughout the secondary xylem of a species or genus or are entirely absent. A similar constancy in the presence or absence of these structures appears to prevail in most subfamilies and families.

"Vestured pits, therefore, are of considerable value both in the systematic study of woods and in discussions concerning the relationships and classification of specific groups of Dicotyledons." (See *Tropical Woods* 31: 46.)

Perforated ray cells. By L. CHALK and M. M. CHATTAWAY. *Proceedings of the Royal Society* B: 113: 82–92. London, 1933.

"In certain woods, whose rays have extensive uniseriate margins, an individual marginal cell may sometimes be modified, by the perforation of its side walls, to connect two vessel segments on opposite sides of the ray." This unusual, although not uncommon, type of ray cell was first observed in *Lacistema aggregatum* (Berg.) Rusby (Lacistemaceae). The description of these cells is based mainly upon two woods in which they are numerous, namely, *Lacistema aggregatum*, in which the perforation plates are scalariform, and *Ptychopetalum anceps* Oliv. (Olacaceae), in which the perforations are simple. The anatomy of these woods is discussed in relation to the occurrence of this type of cell. Perforated ray cells were observed in 74 species from 17 families, a list of which is given. There are also included 7 figures.—L. WILLIAMS, *Field Museum of Natural History*.

Multiperforate plates in vessels, with special reference to the Bignoniaceae. By L. CHALK. *Forestry* (The Journal of the Society of Foresters of Great Britain) 7: 1: 16–25; illustrated. Oxford, 1933.

In this paper the term "multiperforate plate" is used to indicate a vessel membrane that includes more than one perforation, for example a scalariform perforation plate, while for the plate with only one perforation, "simple perforation" is retained in preference to "uniperforate plate."

"In the less primitive of the woods with scalariform perforation plates, and in the transitional stages, it is not unusual to find an occasional more complex plate in which the perforations are small and more numerous." Multiperforate plates occur also, though rarely, among woods with very short vessel elements, horizontal end walls, and normally simple perforations. Such perforations are particularly common among woods of the family Bignoniaceae.

The type of perforation plate originally observed in the Nyctaginaceae and Boraginaceae, generally known as the *Cordia* form, is also found in several species of the Bignoniaceae. "It consists of a thin membrane . . . pierced by a large number of closely spaced angular perforations so that the membrane or perforation plate has the appearance of a fine net." Another form of multiperforate plate described is that found in *Oroxylon indicum* Vent. in which the perforations are much larger and the plate has the appearance of having been irregularly pierced. Other variations were found in *Dolichandrone* and in *Millingtonia hortensis* L.f.

There is given a list of the species of Dicotyledons, compiled from the observations of the author and from literature, in which these perforation plates occur, followed by a discussion of the *Cordia* and *Oroxylon* forms. The author notes that the distinction between the forms of perforation plate in the Bignoniaceae and those associated with scalariform plates is not clearly defined and their separation for purposes of classification is regarded as impracticable. An alternative classification is suggested, based upon the reticulate and foraminate character of the perforation plates. The article also includes 3 figures, 8 photomicrographs, and a list of references. — L. Williams, *Field Museum of Natural History*.

Mäule lignin test on *Podocarpus* wood. By E. C. Crocker. Botanical Gazette 95: 1: 168–171. Chicago, Sept. 1933.

"The Mäule lignin test is apparently a reliable practical test for distinguishing the woods of the conifers from those of the Angiosperms and the Gnetales. The only exception found was the single coniferous species *Podocarpus amarus*.

"Xylem from the three types of Gnetales, *Welwitschia*, *Gnetum*, and *Ephedra*, all give positive Mäule tests."