W. M. Chattaway. MMC

Price 30 cents

Yale University School of Forestry

TROPICAL WOODS

NUMBER 73 MARCH 1, 1943

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

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

Subscription price One Dollar for four consecutive numbers. Remittances should be made payable to TROPICAL WOODS.

Address all communications to the editor, 205 Prospect Street, New Haven, Connecticut, U. S. A.

STUDIES IN THE SAPOTACEAE, II. THE SAPODILLA-NÍSPERO COMPLEX [1]

By CHARLES L. GILLY

New York Botanical Garden

Chicle, the coagulated latex used as a base in the manufacture of chewing gum, has long been known to be a product of a sapotaceous tree whose edible fruit is commonly called sapodilla (English) and níspero (Spanish). The names of the fruit have become transferred to the tree, which is usually listed in both economic and botanical literature under one of the following designations: *Achras zapota* (or *sapota*) L., *Sapota Achras* Mill., or *Sapota zapotilla* (Jacq.) Coville.

[1] The material comprising this paper is an abstract of an Essay submitted in partial fulfillment of the requirements for the degree of Master of Arts in the Faculty of Pure Science, Columbia University, 1942.

Vernacular names listed by Pittier (Contr. U. S. Nat. Herb. 18: 69–86. 1914) and Standley (Contr. U. S. Nat. Herb. 23: 1113–1124. 1924) include, among others, Zapote, Chicozapote, Zapotillo, and Naseberry.

The purpose of the present study, a part of the larger and more detailed investigation of the subfamily Mimusopoideae, was to determine whether all trees referred to as Sapodillas or Nísperos are of a single species or represent a complex of species (in addition to the previously described *Achras chicle* Pittier and *A. calcicola* Pittier). As shown in the taxonomic part of this paper, a species-complex is unquestionably present in certain regions of Mexico, Central America, northern South America, and the West Indies. This investigation of the Sapodilla-Níspero complex having been carried on in conjunction with a similar study of the chicle- and balata-producing trees in the genus *Manilkara* (commonly included in *Mimusops* by many authors), it became evident as work on both problems progressed that the two groups possessed so many items in common that they could scarcely be considered alone.

Owing to world conditions, material of some species of *Manilkara* could not be obtained for study; however, a sufficient representation of the members of this group has been examined to enable me to understand the range of variability within the genus. Moreover, because of circumstances which render it necessary for me to postpone further work on the Sapotaceae, it seems better to publish my results now rather than to wait until the remainder of the subfamily Mimusopoideae might be fully treated. Since much of the herbarium material available to me was incomplete, being either sterile or with only flowers *or* fruit present, and could not be used for complete correlations of flower, fruit, and vegetative characters, the present paper must be regarded as only a preliminary step toward the solution of the Sapodilla-Níspero complex. Only the salient facts upon which I have based my delimitatory and nomenclatural decisions are presented here. It is hoped that a complete discussion, accompanied by illustrations, can be published later.

Floral Morphology and Classification

The interpretation of the floral structure of members of the Sapodilla-Níspero and Balata complexes, as interpreted by workers from Linnaeus (Syst. Nat., ed. 10. 2: 988, 1381. 1759) to Hartog (Lond. Jour. Bot. 16: 65–72. 1878; 17: 356–359. 1879), Dubard (Ann. Mus. Col. Marseille III 3: 1–62. 1915), Lam (Bull. Jard. Bot. Buitenz. III 7: 1–289. 1925; Rec. Trav. Bot. Neerland. 36: 509–526. 1939), and Baehni (Candollea 7: 394–508. 1938) may be summed up as follows: Calyx composed of two series of members, three segments in each whorl. Corolla gamopetalous, the free segments six in number, each of these (in the Balata complex) exteriorly subtended by a pair of more or less petaloid "stipular appendages," or (in the Sapodilla-Níspero complex) these appendages lacking. Androecium of six stamens (one opposite each petal and inserted at approximately the top of the corolla tube) and six alternate staminodes. Gynoecium an ovary of 6–12 carpels, a single ovule in each.

Although a study of the vascularization is not yet fully completed, sufficient evidence has already been obtained to support the following revision of terminology for the parts of these flowers: Calyx (outer perianth cycle) composed of a single whorl of three valvate members, these sometimes slightly gamosepalous. Corolla (inner perianth cycle) polypetalous, composed of three imbricate members, these more or less narrowed or somewhat clawed at base. Androecium coroniform, composed of an outer series of more or less petaloid staminodes, and six stamens alternating with six interior staminodes, these all basally united into a tube. Gynoecium as above. The exterior staminodes (including both petals and stipular appendages of other authors) are arranged in groups of three, the median (and also the innermost) one of each group usually appearing more petal-like than the other two; and it is opposite these median exterior staminodes that the stamens are inserted. These triumvirates of exterior staminodes are either completely free from each other above the summit of the androecial tube, or are united in groups of

three above the tube. Thus the exterior cycle of staminodes is apparently composed either of 18 members, or of six trifid, trilobed, or tridentate members, or of six entire-margined members. Because of the trend of fusion [2] of the exterior staminodes, and because vegetative, fruit, seed, and perianth characters are fundamentally the same in both groups, I can see no real reason for maintaining the Sapodilla-Níspero (*Achras*) complex and the Balata (*Manilkara*) complex as separate genera.[3] Record's description (Trop. Woods **59**: 21–51. 1939) of the woods of these two "genera" as almost identical, in contrast to descriptions of the woods of other morphologically distinct genera in the family, would seem to corroborate my own conclusion.

To avoid possible confusion resulting from my revision of floral terminology in the group, I have not used the terms "sepals" and "petals" in the descriptive part of the paper. Instead I have employed the terms *outer perianth segments* (or *lobes*) and *inner perianth segments* (or *lobes*). The combined "petals" and "appendages" of other authors are herein called *exterior staminodes;* these when united or fused together will be termed *compound staminodes*. The "staminodes" of other authors are referred to here as *interior staminodes*. No changes of terminology were necessary as regards the stamens and gynoecium.

Brief Nomenclatural History of the Sapodilla

My decision that the members of the Balata complex and those of the Sapodilla-Níspero complex cannot be regarded as constituting separate genera has necessitated a search of the

[2] Whether, as an evolutionary trend, the exterior staminodes represent a fusion-series or a longitudinal-fission-series has not yet been determined, but for the purposes of the present paper, and because of the extent of distribution and the geographical occurrence of each of the types, it will be regarded as a fusion-series. That is, those species possessing 18 exterior staminodes will be regarded as more primitive (at least insofar as this one character is concerned) than those with six three-parted segments; these latter will, on the same basis, be regarded as more primitive than the species with six entire-margined segments.

[3] I am forced to this conclusion by the evidence of the plants before me, despite the fact that Lam (l.c., 1939) has only recently placed *Achras* and *Manilkara* in different subfamilies.

pertinent literature and a re-evaluation of the evidence therein to determine the proper name which should be applied to the aggregate genus containing both of these groups. The principal facts disclosed are briefly listed below. In determining validity and legitimacy of names and epithets, the dicta (principles and articles) of the International Rules of Botanical Nomenclature (ed. 3. pp. xii, 152. 1935) have been followed.

1. *Achras* L. (Sp. Pl. p. 1190. 1753; Gen. Pl. ed. 5. p. 497. 1754) and *Achras zapota* L. (l.c., 1754) should be typified by Plumier's plate, because the generic description is based entirely on the description and illustration published by Plumier (Nov. Pl. Am. Gen. p. 43. *t. 4.* 1703), and Linnaeus consistently associated the name *Achras* with Plumier's *Sapota* from 1737 (Gen. Pl. ed. 1. p. 365) to 1754. Since this plate depicts fruit and flowers that are perhaps not even of the same plant (and certainly do not represent the Sapodilla), the name and epithet must be rejected as *nomina confusa* under Art. 64. They cannot, therefore, be legitimately applied to the Sapodilla.

2. *Achras* L. (Iter Hisp. pp. 186–187. 1758; Syst. Nat. ed. 10. **2**: 988, 1381. 1759) and *Achras zapota* L. (l.c., 1759) are clearly referable to the Sapodilla, but they must be considered as later homonyms of *Achras* L. (1753; 1754) and *Achras zapota* L. (1753), respectively, since they are based on a different type. Therefore, they must be rejected as illegitimate under Art. 61. All subsequent usage of this name and epithet for the Sapodilla is equally homonymous.

3. *Sapota* Plumier ex Miller (Gard. Dict. ed. 7. 1759) is considered as a validly published generic name even though binary epithets were not applied to the two species included at the time of publication. However, since this genus has the same circumscription as *Achras* L. (1753; 1754), in being based on the Plumier description and plate which are the basis of the Linnaean generic name, and since *Achras* L. was cited as an equivalent synonym, this name must be rejected as a *nomen superfluum* under Art. 60.

4. *Achras mammosa* L. (Sp. Pl. ed. 2. p. 469. 1762) must be rejected as a *nomen superfluum* under Art. 60, because it is

merely a renaming of *Achras zapota* L. (1753), despite the addition of an unnamed β variety which, being based on a recognizable plate and description by Brown (Nat. Hist. Jam. p. 200. *t. 19., f. 3.* 1755), is referable to the Sapodilla.

5. *Achras sapota* L. (Sp. Pl. ed. 2. p. 469. 1762) must be regarded as an orthographic variant (Art. 70) of *Achras zapota* L. (1753) and, since it is based on a different type, is therefore considered as a later homonym of the latter name. Hence it must be rejected as illegitimate under Art. 61. All subsequent usage of this name is equally homonymous.

6. *Sapota Achras* Miller (Gard. Dict. ed. 8. 1768), the equivalent to Sapota 1 (Miller, l.c., 1759), must be considered as a substitute name for *Achras sapota* L. (1762); it must, therefore, be rejected as a *nomen superfluum* under Art. 60.

7. *Achras cosagüico* Llave (Reg. Trim. 1: 138. 1832) is based only on vague wood characters. Since no flowers or vegetative characters were given at the time the name was proposed, the application of the specific epithet is uncertain and must, therefore, be rejected as a *nomen dubium* under Art. 63.

8. *Achras zapotilla* (Jacq.) Nuttall (N. Am. Sylv. 3: 28. 1849), excluding the Catesby, Plumier, and Sloane references, is based on an earlier varietal name, proposed by Jacquin (Stirp. Amer. p. 57. *t. 41.* 1763), which was clearly applied to the Sapodilla at the time of its publication. *Zapotilla*, then, is the first available legitimate specific epithet clearly referable to the Sapodilla.

9. Although a specific epithet is available for the Sapodilla, no generic name clearly based upon, and therefore applicable to, the Sapodilla has been found. However, it has been demonstrated in the preceding section of this paper that the Sapodilla-Níspero complex of species cannot logically be separated from the species of the Balata complex on the basis of floral characters. Since all other characters of these two groups are of such nature that they should be considered congeneric, the earliest legitimate generic name applicable to a species of the Balata-complex should also be applied to the Sapodilla. This name is *Manilkara* Adanson (Fam. Pl. 2: 166. 1763), which must be considered as validly published despite the

fact that no species were assigned to it at time of publication.

10. The correct scientific name for the Sapodilla, then, consists of the combination of the generic name mentioned in paragraph 9 with the specific epithet mentioned in paragraph 8. For the legitimization of this combination, see a subsequent page in the taxonomic portion of this paper.

There are, perhaps, some who will contend that because the generic name *Achras* is so firmly entrenched in the literature it should be conserved for application to the Sapodilla-Níspero complex. I have carefully considered the advisability of such a procedure and have decided against it in the interest of a stabilized nomenclature. The transfer of the three presently accepted species of *Achras* to *Manilkara* certainly necessitates fewer changes of nomenclature than would the transfer of the 30 or more species of this latter genus to *Achras*. Moreover, as I have demonstrated above, *Achras* L. (1753) contained no element of the present Sapodilla-Níspero complex at the time of its publication; to conserve this name for the Sapodilla would scarcely seem to be in line with previous actions of nomenclatural conservation.

Taxonomic Treatment [4]

It has been demonstrated above (1) that the flowers of the Sapodilla-Níspero complex of species and of the Balata complex of species represent opposite ends of an evolutionary trend of androecial fusion between which are groups of intermediate or apparently intergradient forms, and (2) that the generic names *Achras* and *Sapota* are untenable for application to the Sapodilla and its relatives. As a result of these conclusions the species of the Sapodilla-Níspero complex are herein merged with *Manilkara*, the genus of which the species

[4] Specimens examined during the course of this study are deposited in the following herbaria: Arnold Arboretum (A), Field Museum (F), Gray Herbarium (G), University of Michigan (Mich), Missouri Botanical Garden (Mo), New York Botanical Garden (NY), National Herbarium (US), and Yale School of Forestry (Y). I wish to thank the curators of these herbaria for permission to examine their specimens. I am also grateful to Drs. H. A. Gleason, W. H. Camp, and H. W. Rickett, of the New York Botanical Garden, for counsel and nomenclatural advice, and to Mr. B. A. Krukoff for his invaluable assistance in securing material for study.

of the Balata complex are a part. I have previously presented (Trop. Woods **71**: 3–6. 1942) a key which will serve to distinguish *Manilkara* from the other western hemisphere members of the subfamily Mimusopoideae. Because of the inclusion of the Sapodilla-Níspero complex of species, as well as to correct the terminology of floral parts, this genus must be emended as follows:

MANILKARA Adanson (Fam. Pl. 2: 166. 1783), emend Gilly. Including *Achras* L., ex Loefling, Iter Hisp. 186. (*later homonym*) 1758; Syst. Nat., ed. 10. 2: 988. 1759; and of recent authors. Not *Achras* L. (*nomen ambiguum et confusum*) 1753; 1754.—Arbores lacticiferae. Folia alterna exstipulata, parallelinervia, indirectenervosa, costa supra impressa vel carinata, subtus prominente; nervis lateralibus tenuibus, obsoletis vel obscuris vel subprominentibus, reticulato-conjunctis. Inflorescentiae in axillis foliorum vel eorum cicatricum fasciculatae vel flores solitariis. Flores hermaphroditi, pedicellati, pedicello in fructu crasso. Perianthium biseriatum, lobis exterioribus (sepalis) 3, aestivatione valvatis; lobis interioribus (petalis) 3, aestivatione imbricatis. Androecium coroniforme, ad basim tubulatum; staminodia exteriora 18 libera vel in consortiis sex terna conjuncta, vel in staminodia-composita conjuncta ut videtur tantum 6; stamina 6, ad summitatem tubi coronae inserta; lobo medio staminodioram exteriorum opposita; antherae extrorsae, thecis 2, longitudinaliter dehiscentibus; staminodia interiora 6, staminibus alternata. Ovarium pubescens, 12–6-loculare, loculis 1-ovulatis; stylo glabro. Fructus baccatus, plurispermo vel ex abortus monospermo; semina compressa, testa crustacea vel chartacea, nitida; cicatrice laterali vel basilaterali, lineari, margine seminis longitudine aequante vel breviore. TYPE SPECIES: *Manilkara Kauki* (L.) Dubard (= *Mimusops Kauki* L.).

KEY TO THE WESTERN HEMISPHERE SUBGENERA OF MANILKARA

Petaloid or subpetaloid exterior staminodes 18, either not united above the summit of the corona tube or united in groups of three for not more than three-fifths of their length.

Exterior staminodes free or but slightly united above the summit of the corona tube; corona tube less than half the length of the exterior staminodes.....A. *Eumanilkara*.

Exterior staminodes united into groups of three for one-fifth to three-fifths of their length; corona tube more than half the length of the exterior staminodes.....B. *Manilkariopsis*.

Petaloid exterior staminodes fused in groups of three, thus appearing to be only 6 in number, these compound staminodes apically entire or tridentate for not more than one-fifth of their length.

Corona tube not more than half the length of the exterior staminodes; flowers fascicled in the leaf axils.....C. *Nisperoa*.

Corona tube essentially the same length as or longer than the exterior staminodes; flowers solitary in the leaf axils.....D. *Euachras*.

Together with the numerous instances of slight staminodial fusion in the subgenus *Eumanilkara*, the members of the subgenus *Manilkariopsis* form a transition between *Eumanilkara* and the subgenera *Nisperoa* and *Euachras*. *Nisperoa*, with its short corona tube and consequent rotate flower form, as contrasted to the long corona tube and the more or less urceolate flower form of *Euachras*, also appears to represent a sort of transitional stage between the latter subgenus and *Eumanilkara*.

A. MANILKARA, subgenus **Eumanilkara** (Dubard) Gilly, stat. nov. *Manilkara* sect. *Eumanilkara* Dubard, Ann. Mus. Col. Marseilles III **3**: 8. 1915.—Exterior staminodes not at all or but slightly united above the summit of the corona tube, which is less than half the length of the exterior staminodes; other characters as in the generic description. TYPE SPECIES: *Manilkara Kauki* (L.) Dubard (= *Mimusops Kauki* L.).

This subgenus is represented by 20–25 species in the western hemisphere (as well as numerous species in Africa and Malaysia), primarily distributed through northern South America and the West Indies. These species will be discussed in a subsequent paper.

B. MANILKARA, subgenus **Manilkariopsis** Gilly, subgen. nov.—Staminodia exteriora pro parte quarta vel usque ad tres partes quintas in consortiis sex terna conjuncta; coronae tubus quam staminodiis exterioribus duplo brevior vel aequans; characteres alii ut in subgenere *Eumanilkara*. TYPE SPECIES: *Manilkara tabogaensis* Gilly.

KEY TO THE SPECIES

Inner staminodes pubescent on the exterior surface.

Outer staminodes united into groups of three for half their length; inner staminodes petaloid and erect, entire or erose-margined but not bifid. 1. *M. tabogaensis.*

Outer staminodes united for only one-fifth to one-third of their length; inner staminodes not at all or scarcely petaloid, either reflexed or bifid.

Inner staminodes minute, truncate, reflexed; lateral pair of each group of outer staminodes longer than the median lobe.. 2. *M. staminodella.*

Inner staminodes erect, bifid at apices; lateral pair of each group of outer staminodes shorter than the median lobe..... 3. *M. striata.*

Inner staminodes (and the remainder of the androecium) glabrous.

Outer and inner series of staminodes united for a third of their length above the summit of the corona tube and level of stamen insertion..... 4. *M. Rojasii.*

Outer and inner series of staminodes not united above the summit of the corona tube and level of stamen insertion..... 5. *M. meridionalis.*

1. **Manilkara tabogaensis** Gilly, sp. nov.—Arbor, usque 10 m. alta; folia tenuia subtus pallidiora, lamina 9–13 cm. longa, 3.5–4.5 cm. lata, anguste elliptica vel obelliptica, ad basim rotunda vel subcuneata, ad apicem obtusa acuta vel subacuminata; petiolus gracile, 1.5–2.5 cm. longus; pedicellis petiolus subaequans; lobi perianthii exteriores ovati, 7 mm. longi, 5.4–5.7 mm. lati; lobi perianthii interiores obovato-cuneati, 8–9 mm. longi, 5 mm. lati; coronae tubus 5 mm. longus, staminodiis exterioribus breviores; staminodia exteriora 7–7.5 mm. longa, ad medium terna conjuncta, lobo medio spatulato, lobis laterales breviore; lobis lateralibus rotundato-spatulatis; staminodia interiora 6 mm. longa, ovato-cuneata vel orbiculari-cuneata, ad marginem erosa, extus villosa; stamina staminodiis interioribus breviora; antheris 1.25 mm. longis; ovarium 12-loculare; fructus maturus ignotus.

Specimens examined: PANAMA: Panama: Isla Taboga, Dec. 1923, *Standley 27099* (US); same locality, July 1938, *Woodson, Allen & Seibert 1455* (A, Mo, NY–type).

2. **Manilkara staminodella** Gilly, sp. nov.—Arbor, usque 30 m. alta; folia tenuia concolora, lamina 5–9 cm. longa, 2.5–3.5 cm. lata, elliptica vel lanceolato-elliptica, obtusa vel subacuta ad apicem, subcuneata ad basim; petiolus pedicellis aequans ad 2 cm. longus; lobi perianthii exteriores ovati acuti, 7–8 mm. longi, 5 mm. lati; lobi perianthii interiores obovato-rectangulares vel elliptici 8–9 mm. longi, 4.5–6 mm. lati; coronae tubus 3 mm. longus; staminodia exteriora tres partes quintas longitudine; staminodia exteriora 5 mm. longa ad quintam partem terna conjuncta, lobo medio lobis lateralibus breviore spatulato bel anguste spatulato, lobis lateralibus lanceolatis; staminodia interiora minuta (1–2 mm. longa) reflexa pubescentia, truncata ad apicem; stamina staminodiis exterioribus 2-plo brevioria; antheris 1.5–2 mm. longis; ovarium 8–9-loculare; stylus staminodia exterioria aequans; fructus ignotus.

Specimens examined: BRITISH HONDURAS: Cayo Dist.?: Chiquibul River, 1926, *Stevenson s. n.* (US, Y). Toledo Dist.?: Camp 33 [Br. Hond.-Guat. Bound. Survey], alt. 2850 ft., Apr. 29, 1934, *Schipp 1310* (A, F, G, Mich, Mo, NY–type).

3. **Manilkara striata** Gilly, sp. nov.—Arbor, usque 20 m. alta; folia tenui-coriacea, concolora, sub-nitida supra, lamina 8–14 cm. longa, 3.5–4.5 cm. lata, anguste elliptica vel lanceolato-elliptica, rotundo-cuneata ad basim, acuta vel subacuminata ad apicem; petiolus 2–2.5 cm. longus; pedicellis 1.5–2 cm. longis; lobi perianthii exteriores 7.5 mm. longi, 5.5 mm. lati; lobi perianthii interiores anguste ovati, subacuti, 8 mm. longi, 5 mm. lati; coronae tubus 4 mm. longus, staminodia exteriora subaequans, glabro lineis pubescentiae staminodia interiora infra exceptentibus; staminodia exteriora glabra, 4–5 mm. longa pro parte tertia vel quarta terna conjuncta, lobo medio lobis lateralibus longiore, oblanceolato vel spatulato, lobis lateralibus anguste ovatis subacutis; staminodia interiora ad 2 mm. longa, petaloidea ovato-rectangularia, extus sparse villosa, bifida ad apicem; stamina staminodiis exterioribus 2-plo breviora; antheris 2 mm. longis; ovarium 6-loculare; fructus maturus ignotus.

Specimen examined: GUATEMALA: Petén: Carmelita, Nov. 25, 1941, *Odell 12270/10* (NY–type).

4. **Manilkara Rojasii** Gilly, sp. nov.—Arbor; folia coriacea, concolora supra opaca, lamina 7–11 cm. longa, 3.5–5 cm.

lata, anguste elliptica, oblanceolata vel anguste obovata, subcuneata ad basim, subacuta vel obtusa et emarginata ad apicem; petiolus pedicellis aequans, 1–1.5 cm. longus; lobi perianthii exteriores anguste ovati acuti vel acuminato-cucullati, 7.5 mm. longi, 5 mm. lati; lobi perianthii interiores obovato-cuneati, obtusi, 8 mm. longi, 5 mm. lati; coronae tubus 5 mm. longus, glabrus, staminodia exteriora aequans; staminodia exteriora 5 mm. longa, ad medium usque ad tres partes quintas consortiis terna conjuncta, lobo medio lobis lateralibus breviore, obovato-cuneati, rotundo ad apicem, lobis lateralibus ellipticis vel obovatis; staminodia interiora 3 mm. longa, exterioribus breviora, linearitriangularia, bidentata; staminodia exteriora et staminodia interiora connata supra coronae tubus summitatem; stamina ut videtur infra coronae tubi summitatem inserta, ad 2 mm. longa; antheris 1–1.2 mm. longis; ovarium 12–10-loculare; fructus subglobosus vel ellipsoideus, ad 3 cm. diametro; semina compressa, subelliptica, nitida, cicatrice semini 2-plo breviore.

Specimen examined: Costa Rica: San José: Escasu, 1130 m. alt., Feb. 1937, *Rojas 524* (F–type, Mo, NY [photo & frag.]).

5. **Manilkara meridionalis** Gilly, sp. nov.—Staminodia exteriora pro parte in consortiis sex terna conjuncta; staminodia interiora glabra; staminodia exteriora et interiora nec connata supra coronae tubi summitatem, ceterum ut sub varietas *meridionalis* descripta.

This species seems best treated, at present, as composed of two more or less geographically separated varieties; when more material is available it may be necessary to accord specific rank to both of the varieties. The variety *meridionalis*, of course, contains the nomenclatural type of the species.

Key to the Varieties

Outer staminodes united in groups of three for one-fourth to one-third of their length, the free portion of the lateral lobes of each group lanceolate or oblong, subparallel with the median lobe; leaves obtuse or acute, 3.5 cm. or more in width ..... a. var. *meridionalis*.

Outer staminodes united in groups of three for at least half of their length, the free portion of the lateral pair of each group deltoid-triangular, divergent from the median lobe; leaves acuminate, 3.5 cm. or less in width
b. var. *caribbensis*.

5a. Manilkara meridionalis var. **meridionalis** Gilly, var. nov.—Arbor; folia tenui-coriacea vel coriacea, concolora, supra subnitida, lamina 8–13 cm. longa, 3.5–5 cm. lata, anguste elliptica vel ultra medium latiora, ad apicem obtusa, ad basim subacuta vel subacuminata, subrotundo-cuneata; petiolus 1–2 cm. longus; pedicellis petiolus aequans; lobi perianthii exteriores ovato-lanceolati vel ovati, acuti, 7–8 mm. longi, 4.5–6 mm. lati; lobi perianthii interiores lanceolato-elliptici vel ovato-rectangulares, 7.5–8 mm. longi, 5–6 mm. lati; coronae tubus 4.5–5.5 mm. longus, staminodia excedens; staminodia exteriora 4–4.5 mm. longa pro partem tertiam vel quatriam consortiis terna conjuncta, lobo medio lobis laterales subsequantis oblanceolato vel spatulato, lobis lateralibus ovato-lanceolatis vel oblongis; staminodia interiora exteriora in longitudine aequans, ex lineari-triangularia lanceolato-elliptica, bidentata erosa vel integra; stamina staminodiis 2-plo breviora; antheris 1.5–2 mm. longis; ovarium 10–9-loculare; fructus (specimini typici) ignotus.

Specimens examined: Mexico: without exact locality, *Liebmann 304* (S); Guerrero: Acapulco, *Palmer 71* (A, G, Mo). Costa Rica: Punta Arenas: Esparta, Feb. 1907, *Biolley 2023 H.P.* (US); same locality, Feb. 1909, *Biolley 17308* (NY [photo & frag.], US–type). Panama: without exact locality, Dec. 1859, *Hayes 167* (G) and *793* (NY).

5b. Manilkara meridionalis var. **caribbensis** Gilly, var. nov.—Arbor; folia tenui-coriacea, concolora, supra nitida, lamina 8–12 cm. longa, 3–3.5 cm. lata, lanceolata vel anguste elliptica, cuneata vel rotundo-cuneata ad basim, acuminata ad apicem; petiolus 1–1.5 cm. longus; pedicellis petiolus aequans vel longiore; lobi perianthii exteriores ovati, acuti vel acuminati, 7–7.5 mm. longi, 6 mm. lati; lobi perianthii interiores ovato-elliptici, acuti vel subacuti, 8–8.5 mm. longi, 6 mm. lati, ad basim constricti; coronae tubus 4–4.5 mm. longus; staminodia exteriora ad 4 mm. longa, ad medium consortiis terna conjuncta, lobo medio minuto, angusto-spatulato vel lineari-lanceolato, lobis lateralibus deltoideo-triangularibus, divergentibus; staminodia interiora exteriora longitudine aequantia, elliptico-lanceolata, integra, erosa vel bifida ad apicem; stamina staminodiis 2-plo breviora; antheris 2 mm. longis; ovarium 9-loculare; fructus non visus.

Specimens examined: COLOMBIA: Dept. Atlántico: Barranquilla, Feb. 19, 1932, *Dugand 368* (F, Y). VENEZUELA: Isla Margarita, El Valle, July 1901, *Miller & Johnston 103* (G-type, NY [photo]). ST. CROIX: Annas Hope, Nov. 2, 1925, *Thompson 960* (NY).

Britton & Cowell 9991, from coastal thickets near Cortes, Pinar del Río, Cuba (G, NY, US) has flowers in which the exterior staminodes are similar to this variety; however, the three segments of each group are united proportionately more than in the other specimens examined, and the leaves are much smaller (5–8 cm. long, 2–3.5 cm. wide) and subacute at the apices.

C. MANILKARA, subgenus **Nisperoa** [5] Gilly, subgen. nov.—Flores in axillis 2–5; staminodia exteriora terna connata, staminodia-composita ut videtur tantum sex, integra; coronae tubus staminodiis exterioribus duplo breviore vel minore; characteribus aliis ut in subgenere *Eumanilkara*. TYPE SPECIES: *Manilkara chicle* (Pittier) Gilly (= *Achras chicle* Pittier).

KEY TO THE SPECIES

Inner staminodes subpetaloid, merely erose or laciniate, not bifid at apices. 6. *M. chicle.*

Inner staminodes bifid at apices, the two lobes acute, more or less erose. 7. *M. calcicola.*

6. **Manilkara chicle** (Pittier) Gilly, comb. nov. *Achras chicle* Pittier, Jour. Wash. Acad. Sci. 9: 436. 1919.—Large tree, to at least 30 m. tall. Leaves coriaceous, dark green and dull but not glaucous above; lamina obovate-elliptic, oblong-elliptic or narrowly elliptic, rounded-cuneate or cuneate at the base, subacute and minutely emarginate at apices, 12–20 cm. long, 4–7 cm. broad; petioles about 2.5–3 mm. in diam., 2–3.5 cm. long, obscurely canaliculate above. Flowers several in each fascicle, the fascicles in leaf axils or above the scars of fallen leaves; flowering pedicels shorter than or equalling the petioles, lengthening somewhat in fruit. Outer perianth

[5] This subgeneric name is derived from the vernacular name most frequently applied to these species, "Níspero."

segments oblong-lanceolate or narrowly oblong-ovate, subacute at apices, 7.5 mm. long, 3–3.5 mm. wide; inner perianth segments similar to the outer or broadest above the middle, obtuse or subacute, 8 mm. long, 3–4 mm. wide. Corona tube 1.5–2 mm. long. Outer compound staminodes ovate-lanceolate, subacute or rounded at the apices, 5–6 mm. long; inner staminodes 4.5 mm. long, ovate-lanceolate, acuminate, the apex irregularly laciniate. Stamens approximating the outer staminodia in length; anthers 3 mm. long. Ovary 6–9 locular. Fruit globose-depressed to obovoid, 3.5–4 cm. in diameter. Seeds compressed, rhomboid-elliptic, brown, subglossy, 2–2.3 cm. long, 1.4–1.8 cm. broad, 5–7 mm. thick; hilum 6–7.5 mm. long, occupying one-third of the ventral margin.

Specimens examined: BRITISH HONDURAS: Toledo Dist.?, Camp 32 (Br. Hond.-Guat. bound. survey), 2700 ft. alt., *Schipp 1264* (A, G, Mich, Mo, NY). Stann Creek Dist., Stann Creek Valley, Baboon Ridge, *Gentle 3186* (A, Mich, NY). Orange Walk Dist.: without exact locality, *Lundell 689* (A, F, Mich); Xcanha, *Meyer 183* (F). Cayo Dist., Never Delay, *Walter s. n.* (G, US). GUATEMALA: Dept. Izabal: Vega Grande, May 1919, *Pittier 8537* (G, NY, US-type); between Escobas and Montana Escobas, *Steyermark 39336* (F); Izabal, *Whitford & Stadtmiller 75* (G, US, Y).

Gentle 3186, cited above, is perhaps an extreme form of the species, although it approaches *M. calcicola* in vegetative appearance. The following sterile specimens, with large oblanceolate leaves acuminate at the apices, are for the present referred here: MEXICO: Oaxaca: Ubero, *Williams 9432* (F, Mich, US, Y); Tolosita, *Williams 9574* (A, F). Chiapas: Sta. Margarita, Río Usumacinta, *Manzano 12240/4* (NY). Tabasco: Tenosique, Río Usumacinta, *Manzano 12247/10* (NY). BRITISH HONDURAS: without exact locality, *Duncan Stevenson 54* (US) and *Lundell 690* (F). Cayo Dist.: Roaring Creek, *Lundell 691* (F). EL SALVADOR: Dept. Sonsonate: San Julián, *Calderón 2215* (US). Dept. Libertad: Comasagua, *Calderón 1371* (US).

7. **Manilkara calcicola** (Pittier) Gilly, comb. nov. *Achras calcicola* Pittier, Jour. Wash. Acad. Sci. 9: 438. 1919.—On the basis of the specimens examined, it seems best to recog-

nize two varieties within this species. When more material is available for study it may become necessary to raise the large-leaved Colombian form to specific rank. The variety *calcicola*, of course, contains the nomenclatural type of the species.

KEY TO THE VARIETIES

Corona tube one-fourth the length of the outer compound staminodes; inner staminodes equalling the outer in length; leaves obelliptic to oblanceolate, 3–3.5 cm. wide..... a. var. *calcicola*.

Corona tube one-half the length of the outer compound staminodes; inner staminodes half the length of the outer; leaves obovate to rhomboid-elliptic, 6–9 cm. wide..... b. var. *colombiana*.

7a. MANILKARA CALCICOLA var. **calcicola** Gilly, var. nov.—Arbor; usque 25 m. alta; folia atroviridia, supra opaca vel subglauca, lamina 8–18 cm. longa, 3–3.5 cm. lata, obelliptica vel oblanceolata, ad basim cuneata, ad apicem acuta subacuminata vel obtusa; petiolus 1.5–3 cm. longus; flores in axillis 2–5; pedicellis 1–2.5 cm. longis; lobi perianthii exteriores ovati vel ovato-triangulares, 5.5–6.5 mm. longi, 4–5 mm. lati; lobi perianthii interiores obovato-elliptici, subacuti, 6–7 mm. longi, 3.5–4 mm. lati, ad basim constricti; coronae tubus ad 1 mm. longus, staminodia exterioribus 4-plo brevioribus; staminodia-composita exteriora 3.5–4 mm. longa, ovato-elliptica, subacuta; staminodia interiora bifida, subpetaloidea, exteriora subaequantes, laciniata vel erosa ad marginem et apicem; stamina staminodia subaequantes; antheris 3 mm. longis; ovarium 9-loculare; fructus globosus vel ovoideus; semina rhomboideo-elliptica, subacuta; cicatrice seminis margine 3-plo breviore.

Specimens examined: EL SALVADOR: La Paz: Zacatecoluca, March 1922, *Calderón 320* (G, NY, US). Dept. San Miguel: San Miguel Tepezontes, 1924, *Calderón 2052* (US). COSTA RICA: Guanacaste: Tilarán, alt. 500–650 m., Jan. 1926, *Standley & Valerio 45660* (US). PANAMA: Panama: near Alhajuela, May 1911, *Pittier 3457* (G, NY, US–type). Darién: Patino, Feb. 13, 1912, *Pittier 5698* (G, NY, US). COLOMBIA: Dept. Atlántico: Puerto Colombia, Jan. 1937, *Bro. Elias 1503* (F, US).

7b. MANILKARA CALCICOLA var. **colombiana** Gilly, var. nov.—Arbor; usque 20 m. alta; folia coriacea, glabra, atroviridia, supra opaca vel glauca, lamina 12–20 cm. longa, 6–9 cm. lata, elliptica, elliptico-rhomboidea vel obovato-elliptica; petiolus 2.5–3.5 cm. longus; flores in axillis 3–5; pedicellis ad 2 cm. longis; lobi perianthii exteriores ovato-lanceolati subacuti, 8–9 mm. longi, 4–5 mm. lati; lobi perianthii interiores oblongo-elliptici, rotundi vel subacuti, 8–9 mm. longi, 3 mm. lati; tubus coronae 2.5 mm. longus, staminodiis exterioribus 2-plo brevior; staminodia-composita exteriora 5 mm. longa, elliptica obtusa vel subacuta; staminodia interiora exteriora 2-plo breviora, bifida, ad apicem laciniata vel erosa, partibus basilibus rectangulari-ovatis; stamina staminodia subaequantes; antheris 3 mm. longis; ovarium 10-loculare; fructus (specimini typici) ignotus.

Specimens examined: COLOMBIA: Dept. Choco: "Darién country," *Dawe 868* (NY–type, US). Dept. Atlántico: El Pajar forest, March 29, 1934, *Dugand 535* (Y), *535b* (Y); Arroyo Cipauca, Sept. 16, 1934, *Dugand 717* (Y); "northern Colombia," Aug. 8, 1935, *Dugand 772* (F, Y); Casacoima, Sept. 6, 1936, *Dugand 1042* (F, Y).

D. MANILKARA, subgenus **Euachras**[6] Gilly, subgen. nov.—Flores in axillis foliorum solitariae; staminodia exteriora terna conjuncta, staminodia-composita ut videtur tantum 6, integra vel tridentata usque ad partem quintam longitudinis; coronae tubus staminodia exteriora longitudine aequans vel excedens; ceterum ut in subgenere *Eumanilkara*. TYPE SPECIES: *Manilkara zapotilla* (Jacq.) Gilly (= *Achras zapota* β *zapotilla* Jacq.).

KEY TO THE SPECIES

Exterior surface of both corona tube and inner staminodes pubescent, at least in part.

Corona tube completely pubescent on the exterior surface. *S. M. Calderonii.*

Corona tube glabrous except for vertical zones of pubescence on exterior surface below the inner staminodes.

[6] The subgeneric name has been given because *M. zapotilla*, the subgeneric type, is the true "*Achras*" of all recent authors.

Outer and inner series of staminodes not united above summit of corona tube and level of stamen insertion.

Flowers 9–12 mm. long; outer perianth segments 10 mm. long, 7–7.5 mm. broad..... 9. *M. Conzattii.*

Flowers 5–7 mm. long; outer perianth segments 6.5–7 mm. long, 3.5–4 mm. broad..... 10. *M. Gaumeri.*

Outer and inner series of staminodes united for half their length above the summit of corona tube and level of stamen insertion. 11. *M. breviloba.*

Exterior surface of corona tube and inner staminodes (as well as the remainder of the androecium) completely glabrous . . . *12. M. zapotilla.*

8. **Manilkara Calderonii** Gilly, sp. nov.—Arbor; folia tenui-coriacea, supra plumbeo-glauca, lamina 8–14 cm. longa, 3.5–5.5 cm. lata, anguste elliptica vel anguste obovata, rotunda vel subcuneata ad basim, acuta vel subacuminata ad apicem; petiolus 1.25–1.75 cm. longus; pedicellis ad 2 cm. longis; lobi perianthii exteriores ovati acuti, 6 mm. longi, 5–5.5 mm. lati; lobi perianthii interiores rotundi, abrupte constricti ad basim, subacuti ad apicem, 7.5 mm. longi, 5.5 mm. lati; coronae tubus 4.5 mm. longus, staminodia-composita excedens, extus dense-pubescens; staminodia-composita exteriora 3 mm. longa, petaloidea glabra, ovato-lanceolata, obtusa vel subacuta; staminodia interiora exterioribus similia, extus pubescentia; stamina ad duo partes tres staminodiorum exteriorum longitudine; antheris 1.5 mm. longis; ovarium 10-loculare; fructus ellipsoidalis ad 4.5 cm. longus et 3.5 cm. diametro; semina compressa, atrobrunnea, nitida, 2.2 cm. longa, 1–1.2 cm. lata, elliptica, cicatrice margines subaequantes, supra spiculata.

Specimen examined: El Salvador: Dept. San Miguel: San Miguel, May 11, 1923, *Calderón 1584* (G, NY [photo & frag.], US–type).

9. **Manilkara Conzattii** Gilly, sp. nov.—Arbor; folia subcoriacea, supra glauca, lamina 6–9 cm. longa, 2–3.5 cm. lata, anguste elliptica vel subrectangularia, attenuata ad basim et apicem, vel apice subrotunda; petiolus 1.5–3 cm. longus; pedicellis petiolus brevioribus; lobi perianthii exteriores ovati acuti, 10 mm. longi, 7–7.5 mm. lati; lobi perianthii interiores

ovato-rectangulares, 10.5–11 mm. longi, 7 mm. lati, subacuti ad apicem, ad basim constricti; coronae tubus 7 mm. longus, staminodia exteriora excedens; staminodia-composita petaloidea ovata, glabra, 6 mm. longa, ad apicem subacuta vel rotunda; staminodia interiora latolanceolato-ovata, staminodiis-compositis similis sed angustiore, extus strigillosa; stamina staminodia usque duplo breviora; antheris 3 mm. longis; ovarium 12-loculare; fructus ovoideus vel subglobosus, usque 3 cm. diametro; semina compressa, semi-elliptica, 2–2.2 cm. longa, 0.6–0.8 cm. lata, pallido-brunnea et nitida, cicatrice marginibus seminis 2-plo vel 3-plo breviore.

Specimen examined: Mexico: Oaxaca: Cuicatlán, 600 meter alt., March 7, 1919, *Conzatti 3432* (NY [photo & frag.], US–type).

10. **Manilkara Gaumeri** Gilly, sp. nov.—Arbor; folio subcoriacea, supra, opaca nec glauca, lamina 5–7 (–8.5) cm. longa, 2–2.9 (–3.5) cm. lata, anguste elliptica vel supra media latiora, obtusa vel subcuneata ad basim et apicem; petiolus 1.5–2 cm. longus; pedicellis 1–1.5 cm. longis; lobi perianthii exteriores anguste ovati acuti vel acuminati, 6.5–7 mm. longi, 3.5–4 mm. lati; lobis perianthii interiores ovato-lanceolati vel ovato-rectangulari, acuti, 7 mm. longi, 3.5–4.5 mm. lati; coronae tubus staminodia 4–5 mm. longus, staminodia excedens; staminodia-composita exteriore 3–3.5 mm. longa ovato-lanceolata vel latiora, subrotunda vel tridentata ad apicem, ad basim constricta; staminodia interiora exteriora aequantia, lineari-lanceolata bidentata; stamina staminodiis 2-plo breviora; antheris 1.5–2 mm. longis; ovarium 9-loculare; fructus ignotus.

Specimens examined: Mexico: Yucatán: without exact locality, *Gaumer 639* (G, Mich, Mo, NY, US). Quintana Roo: Chichankanab, *Gaumer 1898* (A–type, G, Mo, NY [photo & frag.], US).

11. **Manilkara breviloba** Gilly, sp. nov.—Arbor; folia tenuia, concolora, supra opaca nec glauca, lamina 8–12 cm. longa, 4.5–5.5 cm. lata, anguste elliptica, subrectangularia vel supra medium latiora, rotundo-constricta ad basim, subacuta vel subacuminata ad apicem; petiolus 2–3.5 cm. longus; pedicellis petiolus subaequans; lobi perianthii ex-

teriores lato-ovati acuti, 7 mm. longi, 6 mm. lati; lobi perianthii interiores ovato-elliptici, 8 mm. longi, 5 mm. lati, acuminato-cucullati ad apicem, constricti ad basim; coronae tubus 5.5–6 mm. longus, staminodia multo excedens; staminodia-composita exteriora usque 3.5 mm. longa, elliptica, integra vel subtridentata ad apicem; staminodia interiora exteriora aequantia, medio constricta, ultra medium elliptica, infra truncato-triangularia; staminodia exteriora et interiora supra coronae tubi summitatem connata; stamina infra coronae tubo summitatem ut videtur inserta, 2–2.5 mm. longa; antheris 1–1.25 mm. longis; ovarium 10–9-loculare; fructus ignotus.

Specimen examined: BRITISH HONDURAS: Belize Dist.: Maskall, April 26, 1934, *Gentle 1238* (A, G, Mich, Mo, NY–type, US).

12. **Manilkara zapotilla** (Jacq.) Gilly, comb. nov.

Achras zapota L., Syst. Nat. ed. 10. 2: 988. *homonym.* 1759. Not *A. zapota* L., 1753.
Achras mammosa β L., Sp. Pl. ed. 2. 470. 1762.
Achras sapota L., Sp. Pl. ed. 2. 470. *homonym* (*orthographic variant*). 1762.
Achras zapota β *zapotilla* Jacq., Stirp. Amer. 57. *t. 41.* 1763.
Sapota Achras Miller, Gard. Dict., ed. 8, *nomen superfluum.* 1768.
Achras sapota α *globosa* Stokes, Bot. Nat. Med. 2: 292. 1812.
Achras sapota β *ovalis* Stokes, l. c.
Sapota Achras β *sphaerica* A. DC., Prodr. 8: 174. 1844.
? *Achras cosagüico* Llave, Regist. Trimestro 1: 138. *nomen dubium.* 1832.
Achras zapotilla (Jacq.) Nuttall, N. Am. Sylv. 3: 28. 1849.
? *Achras sapota* f. *asperrima* Gomez, Anal. Hist. Nat. Madrid 19: 253. 1890.
Achras sapota var. α *sphaerica* (A. DC.) Pierre, ex Pierre & Urban, in Urban Symb. Ant. 5: 97. 1904.
Achras sapota var. β *lobata* Pierre & Urban, l.c. Not *Sapota Achras* var. δ *lobata* A. DC. 1844.
Achras sapota var. γ *pedicellaris* Pierre, l.c.
Achras sapota var. δ *Candollei* Pierre, l.c.
Sapota zapotilla (Jacq.) Coville, in Safford, Contr. U. S. Nat. Herb. 9: 370. 1905.

Large tree, to 40 meters tall. Leaves concolorous, thin-coriaceous to coriaceous, dull, shining or subglaucus above; lamina from obelliptic or subrotund (5–8 cm. long, 3.5–5.5 cm. wide) to oblanceolate (8–12 cm. long, 3.5–5 cm. wide), oblong-elliptic or narrow-elliptic (8–14 cm. long, 3–4.5 cm. wide) or linear-lanceolate (9–12 cm. long, 1.75–2.5 cm. wide),

obtuse, emarginate, acute or acuminate at the apices, rounded, gradually narrowed or cuneate at base; petioles 1.5–3 cm. long. Flowers solitary in the leaf axils; flowering pedicels shorter than, equalling, or exceeding the petioles in length. Outer perianth segments broadly ovate, ovate-rectangular, oblong-elliptic, or ovate-lanceolate, 6–9 mm. long, 4–6 mm. broad; inner perianth segments extremely variable in shape, obelliptic, rectangular-ovate, ovate, subrotund, elliptic, or lanceolate, the base constricted, rounded, or acuminate, the apices subacute, acute, acuminate, or acuminate-cucullate, 6.5–10 mm. long, 3.5–6 mm. broad. Corona tube 3.5–7 (averaging 4.5–5) mm. long. Exterior compound staminodes petaloid, 3–6 (averaging 4–5) mm. long, ovate, lanceolate, or elliptic, gradually narrowed to abruptly constricted at base, entire, crenulate, or tridentate at the apices (the apical margin sometimes constant, sometimes variable from staminode to staminode in a single flower). Interior staminodes petaloid or subpetaloid, usually equalling the exterior staminodes in length, ovate-lanceolate, lanceolate-elliptic, or linear-lanceolate, gradually narrowed at the base, entire and subacute or rounded, or bidentate at apices (shape, apex, and size either constant or variable within a single flower). Stamens one-half to two-thirds the length of the staminodes; anthers 1.5–3 mm. long. Ovary 12–10 (–6)-loculare; style approximating or exceeding the staminodes in length. Fruit variable in shape and size; ellipsoid, ovoid, or subglobose, to at least 9 cm. in diameter; seeds variable in shape, compressed, elliptic, oblong, semicircular, or rhomboid in outline, 1.6–2.3 cm. long, 0.8–1.6 cm. broad; hilum 0.9–1.7 mm. long, occupying one-half to seven-eighths of the ventral margin.

Distribution: From the states of Vera Cruz and Oaxaca and the Yucatán Peninsula region of Mexico to Costa Rica; widely introduced and escaped from cultivation in other parts of Mexico, Central America, northern South America, the West Indies, Florida, and in the tropical and subtropical portions of the eastern hemisphere. Area with the greatest population concentration is the Yucatán Peninsula area of Mexico, northern British Honduras, and the state of Petén, Guatemala.

Representative flowering specimens: MEXICO: Oaxaca: *Reko 4189* (US). Vera Cruz: Barbacoa de Panoya, *Purpus 8429* (G, Mo, NY, US). Tabasco: Balancán, *Matuda 3254* (A, F, Mich, NY). Campeche: Tuxpena, *Lundell 1291* (F, G, Mich, Mo, NY, US). Yucatán: *Gaumer 23956* (A, G, Mo, US). BRITISH HONDURAS: Orange Walk Dist.: Honey Camp, *Meyer 198* (A, F, Mo, NY), *Lundell 500* (A, F, G, Mo, NY, US). GUATEMALA: Petén: Vaxactun, *Bartlett 12372* (F, NY, Mich). EL SALVADOR: Dept. Sonsonate: Izalco, *Standley 22226* (G, NY, US). COSTA RICA: Heredia: La Columbiana, *Pittier 13387* (US).

Many other specimens were examined in addition to those listed above. Numerous of these were either sterile or in fruiting condition and have been tentatively assigned to this species in the course of annotation of specimens; had flowers been present, at least a few of the Central American specimens among these might have been assigned to one of the other species treated in this paper. Twenty-two specimens, from plants cultivated in the eastern hemisphere, have also been examined; the flowers of these specimens were of such structure that all of them fall within the limits of *M. sapotilla*.

As herein delimited, *Manilkara zapotilla* is an extremely variable species; whether subspecific units of some sort may eventually be recognizable on the basis of flower or leaf form cannot be determined at present. Much more material, and that especially collected with the morphological and distributional problems of this species in mind, is necessary before a complete understanding of this species can be obtained.

The Yale Wood Collections

At the end of the year 1942 the total number of catalogued wood samples in the Yale collections was 40,642, representing 11,867 named species of 2794 genera of 232 families. There were 326 accessions during the year. To the slide collection were added sections of 107 specimens, making a total of 19,474 slides of 11,072 specimens of 6506 named species, 2616 genera, and 218 families.

KEYS TO AMERICAN WOODS (CONTINUED)

By SAMUEL J. RECORD

Herewith are two more keys in the series begun in *Tropical Woods* 72: 19–35. Each is intended to be complete in itself and to contain the name of every genus in which the key feature is known to occur, even if only rarely. This method frequently provides entirely different avenues of approach to the same wood.

I have detected an error in the first key (Ring-porous Woods) owing to my failure to note that *Fraxinus* does not belong in the small group of Oleaceae having vestured pits in the vessels. The statement should be deleted from 74a (top of page 27), and transferred from 95a to 96a (page 29).

IV. Vessels virtually all solitary. The usual expression for this condition is "pores all solitary," but a "pore" is a term of convenience for the cross section of a vessel member, hence a section through the overlapping ends of the members of a single vessel will show two (sometimes more) pores in contact tangentially. The equivalent expression for "vessels solitary" is "pores not in contact radially." When vessels are rarely in contact, a given tangential section may show no intervascular pitting, but its nature can be inferred from that of overlapping members as seen on radial section. Most woods with solitary vessels are tropical. It is interesting to note that *Liquidambar* specimens from Central America are in this category, while those from the United States are not, although the species is supposed to be the same.

V. Vessels with spiral thickenings. Nearly all of the woods in this group are from trees of temperate climates. Tropical species of *Ilex*, for example, are typically without spiral thickenings in their vessels and wood fibers, whereas these features are characteristic of material from the United States. Spirals are frequently limited to the smallest vessels in a specimen and sometimes occur only in the overlapping tips of members. When they are fine they can easily be overlooked and they are not always readily distinguished from striations.

IV. VESSELS VIRTUALLY ALL SOLITARY

(Pores rarely in contact radially)

1 a. Stems with included phloem 2
b. Stems without included phloem 6

2 a. Septate fibers in parenchyma-like arrangement ..... Hippocrateaceae.
b. Septate fibers absent 3

3 a. Phloem in strands (islands on cross section). *Mouriria* (Melastomaceae).
b. Phloem in concentric or anastomosing bands 4

4 a. Raphides present in conjunctive tissue. Small vessels with scalariform perforation plates ..... *Doliocarpus* (Dilleniaceae).
b. Raphides absent. Perforations exclusively simple 5

5 a. Pores very small. Normal rays uniseriate. Fiber pits small. *Simmondsia* (Buxaceae); *Diclidanthera* (Diclidantheraceae).
b. Pores large in part. Rays often biseriate. Fiber pits large. Polygalaceae.

6 a. Ripple marks present 7
b. Ripple marks absent 9

7 a. Ripple marks uniform and very fine (more than 200 per inch); all elements storied. Density very high ..... Zygophyllaceae.
b. Ripple marks irregular; larger rays not storied. Density low 8

8 a. Rays distinctly heterogeneous ..... *Dicraspidia* (Elaeocarpaceae).
b. Rays homogeneous or nearly so ..... *Muntingia* (Elaeocarpaceae).

9 a. Rays in part large (usually more than 7 cells wide) and conspicuous 10
b. Rays not conspicuous, though often distinct 24

10 a. Perforation plates with several circular openings. *Ephedra* (Ephedraceae).
b. Perforation plates not foraminate 11

11 a. Broad rays aggregates of small rays 12
b. Broad rays solid 13

12 a. Vasicentric tracheids abundant. Pores large in part. Small vessels with few-barred scalariform plates .. *Lithocarpus*, *Quercus* (Fagaceae).
b. Vasicentric tracheids absent. Pores all small. All vessels with many-barred scalariform plates ..... *Kalmia* (Ericaceae).

13 a. Rays mostly homogeneous. Frequently ring-porous. *Lithocarpus*, *Quercus* (Fagaceae).
b. Rays decidedly heterogeneous. Diffuse-porous 14

14 a. Fibers in part septate and in parenchyma-like reticulate arrangement ..... *Hemiangium*, *Hippocratea* (Hippocrateaceae).
b. Fibers not septate 15

15 a. Vessel perforations simple in part. Raphides common in rays. *Curatella*, *Davila* (Dilleniaceae).
b. Vessel perforations all multiple. Raphides absent 16

16 a. Vessels and fibers with spiral thickenings 17
b. Vessels and fibers without spiral thickenings 18

17 a. Perforation bars few. Rays less than 8 cells wide; pits to vessels all small. Heartwood light chocolate-brown .... *Garrya* (Garryaceae).
b. Perforation bars numerous. Rays often 8 or more cells wide; pits to vessels mostly small but in part large and elongated. Heartwood whitish ..... *Villaresia mucronata* (Icacinaceae).

18 a. Fibers with simple or indistinctly bordered pits. Vessel-ray pitting very coarse ..... *Hedyosmum* (Chloranthaceae).
b. Fibers with large bordered pits 19

19 a. Rays not over 8 cells wide 20
b. Rays often 8 to 15 (20) cells wide 21

20 a. Ray pits often narrowly elongated, tending to scalariform arrangement. Growth rings usually distinct .. *Cornus florida* (Cornaceae).
b. Ray pits round to oval, but not narrowly elongated. Growth rings absent or poorly defined ..... *Ternstroemia* (Theaceae).

21 a. Parenchyma reticulate. Heartwood yellowish 22
b. Parenchyma not reticulate. Heartwood brownish 23

22 a. Vessel-ray pitting fine, alternate ..... *Ottoschulzia* (Icacinaceae).
b. Vessel-ray pitting coarse, opposite to scalariform ..... *Metteniusa*, *Poraqueiba* (Icacinaceae).

23 a. Parenchyma diffuse. Vessel-ray pitting 2-sized. *Villaresia* (Icacinaceae).
b. Parenchyma unilaterally paratracheal and in narrow short to rather long wings. Vessel-ray pitting medium, not 2-sized. *Dendrobangia*, *Emmotum* (Icacinaceae).

24 a. Perforations exclusively or predominantly simple 25
b. Perforations exclusively or predominantly multiple 79

25 a. Vessel pits vestured; small 26
b. Vessel pits not vestured; very small to large 29

26 a. Rays homogeneous to weakly heterogeneous. *Aspidosperma*, *Geissospermum*, *Vallesia* (Apocynaceae).
b. Rays distinctly heterogeneous 27

27 a. Fibers with large bordered pits ..... Myrtaceae.
b. Fibers with small bordered pits 28

28 a. Rays 2-sized, the larger 4 or 5 (7) cells wide. *Elvasia*, *Ouratea* (Ochnaceae).
b. Rays 1 or 2 (3) cells wide ..... Rubiaceae.

29 a. Septate fibers present in parenchyma-like bands. Vessel pits small 30
b. Septate fibers absent, or, if present, not in bands. Vessel pits small to large 32

30 a. Vasicentric tracheids present ..... *Alvaradoa* (Simarubaceae).
b. Vasicentric tracheids absent 31

31 a. Rays all 1 or 2 cells wide. Vessels with fine spirals. *Austroplenckia* (Celastraceae).
b. Rays 1–5, mostly 2–4, cells wide. Vessels without spirals. *Maytenus* (Celastraceae).

32 a. Rays homogeneous or weakly heterogeneous 33
b. Rays distinctly heterogeneous (at least in part) 45

33 a. Vasicentric tracheids abundant ..... *Lithocarpus*, *Quercus* (Fagaceae).
b. Vasicentric tracheids apparently absent 34

34 a. Parenchyma in concentric bands 35
b. Parenchyma not definitely banded, mostly diffuse and reticulate. 37

35 a. Parenchyma bands about 1 pore-width apart. Rays 1–4 (7) cells wide; pits to vessels large in part. Pores in part medium-sized to large ..... *Symphonia* (Guttiferae).
b. Parenchyma bands several pore-widths apart, sometimes apparently terminal. Rays 1 or 2 (3) cells wide; pits to vessels very small. Pores small 36

36 a. Pores thin-walled. Wood yellowish ..... *Torralbasia* (Celastraceae).
b. Pores thick-walled. Wood reddish or purplish brown. *Wimmeria* (Celastraceae).

37 a. Vessels (at least in part) with spirals; fibers with or without spirals. More or less ring-porous in part 38
b. Vessels and fibers without spirals 41

38 a. Rays 1–5 (7) cells wide. Fibers with spirals. Heartwood resinous. *Koeberlinia* (Koeberliniaceae).
b. Rays 1 or 2 (3 or 4) cells wide. Heartwood not resinous 39

39 a. Fibers with small bordered pits; typically without spirals. Crystals abundant in rays. Parenchyma diffuse ..... *Canotia* (Celastraceae).
b. Fibers with large bordered pits. Crystals absent or few 40

40 a. Fibers without spirals. Parenchyma sparingly diffuse. Vessel spirals poorly developed ..... *Malus* (Rosaceae).
b. Fibers with spirals. Parenchyma reticulate. Vessel spirals fine but distinct ..... *Amelanchier*, *Cercocarpus*, *Heteromeles* (Rosaceae).

41 a. Fiber pits indistinctly bordered. Rays 1–4 (5) cells wide and up to 65 cells high. Heartwood bright yellow ..... *Schaefferia* (Celastraceae).
b. Fiber pits distinctly bordered. Rays 1 or 2 (3 or 4) cells wide and up to 15 (40) cells high 42

42 a. Vessel-ray pitting very fine 43
b. Vessel-ray pitting medium. Heartwood brown 44

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

44 a. Ring-porous. Parenchyma diffuse to sparingly reticulate. *Cowania* (Rosaceae).
b. Diffuse-porous. Parenchyma rather abundantly reticulate. *Crataegus* (Rosaceae).

45 a. Vessel-ray pitting fine to medium 46
b. Vessel-ray pitting coarse (at least in part) 63

46 a. Vessels with spirals, at least in tips of members 47
b. Vessels without spirals 52

47 a. Fibers with spirals. Parenchyma diffuse to reticulate 48
b. Fibers without spirals 49

48 a. Definitely ring-porous. Parenchyma diffuse ..... *Vauquelinia* (Rosaceae).
b. Diffuse-porous or with only a tendency to ring-porous. Parenchyma reticulate ..... *Lyonothamnus*, *Osteomeles* (Rosaceae).

49 a. Perforations exclusively simple. Parenchyma virtually absent ... 50
b. Perforations in part scalariform. Parenchyma sparse 51

50 a. Pores minute, uniform; scattered; diffuse-porous. *Monttea* (Scrophulariaceae).
b. Pores small to minute; numerous; with tendency to ring-porous. *Mortonia* (Celastraceae).

51 a. Rays 1 or 2, infrequently 3, cells wide. Pores gradually diminishing in size during season's growth. Spirals limited to tips of vessel members ..... *Elliottia* (Ericaceae).
b. Rays 1–4, frequently 3, cells wide. Pores fairly uniform in size. Spirals not limited to tips of vessel members. *Oxydendrum* (Ericaceae).

52 a. Vessel-ray pitting unilaterally compound (at least in part) 53
b. Vessel-ray pitting not unilaterally compound 55

53 a. Rays 1–3, mostly 2, cells wide and generally less than 25 cells high; most of the cells squarish. Parenchyma aliform, confluent, and diffuse. Heartwood brown ..... *Euphronia* (Trigoniaceae).
b. Rays 2-sized; the uniseriates numerous and composed wholly of upright and square cells; the others 3 or 4 cells wide with definite stratum of low procumbent cells. Parenchyma in apotracheal bands 54

54 a. Parenchyma bands very irregular in length, width, and spacing. Pores large in part. Heartwood yellow ..... *Trigonia* (Trigoniaceae).

b. Parenchyma bands concentric, fairly uniform in width, and spaced 4–7 pore-widths apart. Pores up to medium-sized. Heartwood brownish ..... *Zinowiewia* (Celastraceae).

55 a. Parenchyma reticulate 56
b. Parenchyma not reticulate 58

56 a. Fibers with thin to medium-thick walls; pits very numerous. Woods with tendency to ring-porous structure. *Eriodictyon*, *Nama* (Hydrophyllaceae).
b. Fibers with very thick walls. Woods diffuse-porous 57

57 a. Pores medium-sized in part. Rays 1–3 (6) cells wide, with many tall upright cells. Fiber pits very numerous. . *Lacunaria* (Quiinaceae).
b. Pores all small to very small. Rays 1 or 2 (3) cells wide, without tall upright cells. Fiber pits not very numerous. . *Ximenia* (Olacaceae).

58 a. Parenchyma in numerous broken concentric apotracheal bands 2–5 cells wide. Pores in diagonal rows ..... *Vismia* (Guttiferae).
b. Parenchyma not in apotracheal bands. Pores not in diagonal rows. 59

59 a. More or less distinctly ring-porous 60
b. Diffuse-porous 61

60 a. Pores large in part. Ground mass composed mostly of vessels. *Celastrus* (Celastraceae).
b. Pores small to minute. Ground mass composed of thick-walled fiber-tracheids and fibriform vessel members. *Crossosoma* (Crossosomataceae).

61 a. Pores medium-sized in part. Rays 2-sized, the larger 3–5 (6) cells wide and up to 100 cells high ..... *Quiina* (Quiinaceae).
b. Pores all small to minute. Rays 1 or 2 (3) cells wide and less than 30 cells high 62

62 a. Parenchyma abundantly paratracheal and often aliform to confluent ..... *Phlebotaenia* (Polygalaceae).
b. Parenchyma sparingly paratracheal. *Badiera*, *Polygala* (Polygalaceae).

63 a. Fibers with simple or indistinctly bordered pits 64
b. Fibers with distinctly bordered pits 69

64 a. Parenchyma absent or sparingly paratracheal. Rays 1–4 cells wide and up to 100 or more cells high. Pores few and scattered, without pattern 65
b. Parenchyma usually abundant 66

65 a. Vasicentric tracheids and fibriform vessel members present. Pits between vessel-members alternate. Parenchyma absent. *Anchietea* (Violaceae).
b. Vasicentric tracheids and fibriform vessel members absent. Pits between vessel members scalariform. Parenchyma sparingly paratracheal ..... *Oedematopus* (Guttiferae).

66 a. Parenchyma unilaterally paratracheal with short to long extensions and locally confluent. Rays 1 or 2 cells wide and 20 (30) cells high; pits to vessels 2-sized, small and very large. Pores fairly numerous; in irregular radial or diagonal arrangement. *Haploclathra* (Guttiferae).
b. Parenchyma in numerous concentric bands 67

67 a. Pores scattered without pattern. Vasicentric tracheids absent. Rays 1–3 (4–7) cells wide and 25 (40–70) cells high. Parenchyma bands wide and composing nearly half the ground mass. *Symphonia* (Guttiferae).
b. Pores in diagonal, radial, or long zigzag rows. Vasicentric tracheids present. Parenchyma bands narrow 68

68 a. Rays all uniseriate or in part biseriate and 15 (30) cells high. *Calophyllum* (Guttiferae).
b. Rays 1–3 (5) cells wide and 30 (50) cells high . . . *Vismia* (Guttiferae).

69 a. Rays distinctly 2-sized, the larger 3 or 4 (7) cells wide 70
b. Rays all 1 or 2 (3) cells wide 73

70 a. Rays up to 50 (100) cells high. Perforations multiple in part 71
b. Rays up to 25 (50) cells high 72

71 a. Multiseriate rays with many long procumbent cells. Vessels without spirals. Parenchyma reticulate; crystalliferous strands very numerous ..... *Hieronyma* (Euphorbiaceae).
b. Multiseriate rays with very few procumbent cells. Vessels with spirals in tips of members. Parenchyma unilaterally paratracheal; crystalliferous strands apparently absent ..... *Satyria* (Ericaceae).

72 a. Vessel-ray pitting simple; often coarse and irregular. Pores medium-sized in part. Parenchyma sparse; not reticulate. Perforations exclusively simple ..... *Bonnetia* (Theaceae).
b. Vessel-ray pitting half-bordered; not very coarse; opposite to scalariform. Parenchyma fairly abundant; diffuse to reticulate. Perforations multiple in part ..... *Schizocardia* (Clethraceae).

73 a. Parenchyma reticulate. Vessel-ray pitting distinctly 2-sized. *Liriosma* (Olacaceae).
b. Parenchyma not reticulate 74

74 a. Parenchyma rather sparse; unilaterally paratracheal, with occasional wing-like extensions. Vessel-ray pitting all coarse 75
b. Parenchyma in numerous concentric bands 1–4 cells wide 77

75 a. Pores large in part; arranged in diagonal rows. Rays mostly uniseriate. Heartwood grayish brown, sometimes with reddish hue; density medium ..... *Caraipa* (Guttiferae).
b. Pores small or rarely up to medium-sized; with local tendencies to diagonal arrangement. Rays frequently 2, sometimes 3, cells wide. Heartwood yellowish; density high 76

76 a. Heartwood horn-like; sclerotic tyloses and ray cells common. *Hebepetalum* (Linaceae).
b. Heartwood not horn-like; sclerotic cells apparently absent. *Roucheria* (Linaceae).

77 a. Vasicentric tracheids present. Vessel-ray pitting all coarse. *Cyrillopsis* (Cyrillaceae).
b. Vasicentric tracheids absent 78

78 a. Vasicentric parenchyma, 2–4 cells wide, present. Vessel-ray pitting distinctly 2-sized . . . . . Rosaceae-Chrysobalanoideae.
b. Vasicentric parenchyma absent or very sparse. Vessel-ray pitting all coarse . . . . . *Ochthocosmos* (Linaceae).

79 a. Vessel-ray pitting fine to medium 80
b. Vessel-ray pitting coarse, often scalariform 99

80 a. Rays homogeneous or with very few upright cells 81
b. Rays heterogeneous, typically with many upright cells 83

81 a. Rays narrow, but mostly more than 1 cell wide. Vessel-ray pitting fine. Perforation bars closely spaced. *Symplocos tinctoria* (Symplocaceae).
b. Rays all uniseriate or partially biseriate. Vessel-ray pitting medium, and opposite, the vascular complements with wide borders. Perforation bars widely spaced 82

82 a. Oil cells present in parenchyma strands. Parenchyma abundant; diffuse to reticulate . . . . . *Capsicodendron* (Canellaceae).
b. Oil cells absent. Parenchyma sparse; unilaterally paratracheal and occasionally diffuse . . . . . *Canella*, *Pleodendron* (Canellaceae).

83 a. Rays all uniseriate or partially biseriate 84
b. Rays not all uniseriate or partially biseriate 86

84 a. Pores in part medium-sized to large. Diffuse-porous. Perforation bars widely spaced . . . . . *Humiria*, *Sacoglottis* (Humiriaceae).
b. Pores all very small to minute 85

85 a. More or less ring-porous. Perforation bars thick, widely spaced. Fibers with spirals. Parenchyma diffuse . . *Fendlera* (Hydrangeaceae).
b. Diffuse-porous. Perforation bars narrow, closely spaced. Fibers without spirals. Parenchyma very sparingly paratracheal. *Columellia* (Columelliaceae).

86 a. Raphides present in the rays . . . . . *Saurauia* (Saurauiaceae).
b. Raphides absent 87

87 a. Septate fibers arranged in parenchyma-like bands. *Elaeodendron* (Celastraceae).
b. Septate fibers absent, or, if present, not in bands 88

88 a. Vessels with spirals (sometimes limited to tips of members) 89
b. Vessels without spirals 92

89 a. Rays up to 6 cells wide and 50 (170) cells high; uniseriate few. *Clethra* (Clethraceae).
b. Rays not over 4 cells wide and typically less than 30 cells high . . . 90

90 a. Semi-ring-porous. Perforations all multiple. Uniseriate rays very numerous. Parenchyma diffuse . . . . . *Rhododendron* (Ericaceae).
b. Diffuse-porous 91

91 a. Perforations simple in part. Parenchyma very sparse. Rays nearly all 2 or 3 cells wide; usually with single marginal rows of square or upright cells . . . . . *Oxydendrum* (Ericaceae).
b. Perforations exclusively multiple. Parenchyma abundant; diffuse to reticulate. Multiseriate and uniseriate rays about equal in number; upright cells very numerous . . . *Escallonia* (Escalloniaceae).

92 a. Pores mostly medium-sized to large . . . . . *Goupia* (Celastraceae).
b. Pores all small to minute 93

93 a. Fibers with fine spirals . . . . . *Philadelphus* (Hydrangeaceae).
b. Fibers without spirals 94

94 a. Vessel perforation plates short-oval, with rather few bars 95
b. Vessel perforation plates long, with many bars 96

95 a. Pores thick-walled. Parenchyma sparingly diffuse. Perforations all multiple . . . . . *Tricera* (Buxaceae).
b. Pores thin-walled. Parenchyma reticulate. Perforations simple in part . . . . . *Myrica* (Myricaceae).

96 a. Rays with definite strata of slender procumbent cells 97
b. Rays composed mostly of square and upright cells; procumbent cells mostly short, in poorly defined strata 98

97 a. Fiber pits small, exceedingly numerous. Perforations often no wider than the bars. Vessel-ray pitting very fine. Pores frequently crowded . . . . . *Cliftonia*, *Cyrilla* (Cyrillaceae).
b. Fiber pits large, moderately numerous. Perforations usually three times as wide as the bars. Vessel-ray pitting medium. Pores not crowded . . . . . *Cornus* (Cornaceae).

98 a. Rays very coarse-celled; 1–5 cells wide; sheath cells common. *Calatola* (Icacinaceae).
b. Rays rather fine-celled; 1 or 2 (3) cells wide; sheath cells absent. *Viburnum* (Caprifoliaceae).

99 a. Rays 1 or 2 (3) cells wide 100
b. Rays often 3 or more cells wide 108

100 a. Vessels with spirals in tips of members 101
b. Vessels without spirals 102

101 a. Rays all uniseriate or partially biseriate and less than 30 cells high; without distinctly upright cells. *Franklinia*, *Gordonia* (Theaceae).

b. Rays in part biseriate, sometimes triseriate, and up to 50 cells high; many of the cells upright. . . . . *Stewartia* (Theaceae).

102 a. Pores medium-sized to large in part 103
b. Pores all small to minute 104

103 a. Pores rather few, thick-walled. Parenchyma unilaterally paratracheal. Fibers with very thick walls and minute lumen. Vessel-ray pit-pairs often vertically or diagonally elongated. *Vantanea* (Humiriaceae).
b. Pores numerous, rather thin-walled. Parenchyma diffuse to reticulate. Fibers with medium walls and fairly large lumen. Vessel-ray pit-pairs elongated radially. . *Laplacea Brenesii* (Theaceae).

104 a. Rays with many palisade cells; long procumbent cells few; vessel-ray pitting finely scalariform. Perforation plates with 25–100 bars. Parenchyma very sparingly paratracheal. *Illicium* (Winteraceae).
b. Rays with few or no palisade cells; long procumbent cells numerous. Perforation plates usually with less than 25 bars. 105

105 a. Rays virtually all uniseriate; vessel-ray pitting oval to finely scalariform. Perforation plates usually with less than 15 bars. Parenchyma very sparingly diffuse. . *Hamamelis* (Hamamelidaceae).
b. Rays often biseriate. Perforation plates usually with more than 15 bars. 106

106 a. Vessel-ray pitting coarsely scalariform. Parenchyma fairly abundant; diffuse to reticulate. . . . . *Laplacea* (Theaceae).
b. Vessel-ray pitting opposite, with tendency to scalariform. Parenchyma sparingly diffuse. 107

107 a. Rays composed mostly of upright and square cells. Pores not crowded. Gum ducts absent. . . . . *Eurya* (Theaceae).
b. Rays composed mostly of procumbent cells. Pores crowded. Vertical traumatic gum ducts sometimes present. *Liquidambar* of Central America (Hamamelidaceae).

108 a. Parenchyma unilaterally paratracheal, sometimes locally confluent. Perforations simple in part. 109
b. Parenchyma not unilaterally paratracheal; mostly diffuse to reticulate. Perforations all multiple. Pores small to minute. 110

109 a. Pores all small. Vessels with spirals in tips of members. Rays 1–7 cells wide and up to 100 or more cells high; large crystals numerous; vessel-ray pitting scalariform. . . . . *Satyria* (Ericaceae).
b. Pores medium-sized in part. Vessels without spirals. Rays 1–4 cells wide and up to 50 (60) cells high; crystals apparently absent; vessel-ray pitting coarse and irregular, tending to scalariform. *Sterigmapetalum* (Rhizophoraceae).

110 a. Largest rays 3 (4) cells wide. 111
b. Largest rays 4–6 (8) cells wide. 112

111 a. Perforation bars fine and very numerous. Rays up to 25 (40) cells high. Pores thin-walled. Fiber lumen rather large. *Caldcluvia*, *Weinmannia* (Cunoniaceae).
b. Perforation bars rather coarse and not very numerous. Rays up to 50 (80) cells high. Pores thick-walled. Fiber lumen very small. *Heisteria* (Olacaceae).

112 a. Fibers with very small simple or indistinctly bordered pits. Uniseriate rays few; distinctly upright cells few or absent. Pores thick-walled. Perforation plates with 4–10 bars. *Rhizophora* (Rhizophoraceae).
b. Fibers with large bordered pits. Uniseriate rays numerous; distinctly upright cells numerous. Pores thin-walled. Perforation plates with many bars. 113

113 a. Multiseriate rays with sheath cells; without strata of slender procumbent cells. Parenchyma reticulate. 114
b. Multiseriate rays without sheath cells; with strata of slender procumbent cells. 115

114 a. Rays up to 30 (50) cells high; vessel-ray pitting oval and opposite to scalariform. . . . . *Viburnum* (Caprifoliaceae).
b. Rays up to 150 cells high; vessel-ray pitting coarsely scalariform. *Oecopetalum* (Icacinaceae).

115 a. Parenchyma very sparingly diffuse. Vessel-ray pitting opposite. *Staphylea* (Staphyleaceae).
b. Parenchyma rather abundantly diffuse to reticulate. Vessel-ray pitting scalariform. . . . . *Symplocos* (Symplocaceae).

V. VESSELS WITH SPIRAL THICKENINGS

1 a. Fibers with conspicuous bordered pits. 2
b. Fibers without conspicuous bordered pits. 35

2 a. Vessel perforations exclusively or predominantly simple. 3
b. Vessel perforations exclusively or predominantly multiple. 21

3 a. Pores (at least in late wood) rarely in contact radially. 4
b. Pores often in contact radially. 19

4 a. Fibers with spirals. 5
b. Fibers without spirals. 9

5 a. Rays up to 7 cells wide and 100 cells high. Pores medium-sized in part. . . . . *Koeberlinia* (Koeberliniaceae).
b. Rays 1 or 2, in some cases 3 or 4, cells wide and up to 25, rarely to 50, cells high. Pores small to minute. 6

6 a. Rays nearly homogeneous; sometimes with rather numerous small square cells. 7

b. Rays heterogeneous in part; often with upright or large square cells 8

7 a. Pores crowded, at least in early wood, becoming gradually smaller and less closely spaced in late wood.
Amelanchier, *Heteromeles* (Rosaceae).

b. Pores rather widely spaced, the larger ones irregularly scattered among the others ..... *Cercocarpus* (Rosaceae).

8 a. Rays mostly 3 or 4 cells wide; uniseriates few. Rather definitely ring-porous. Parenchyma diffuse ..... *Vauquelinia* (Rosaceae).

b. Rays mostly 1 or 2 (3) cells wide; uniseriates numerous. Parenchyma reticulate ..... *Lyonothamnus*, *Osteomeles* (Rosaceae).

9 a. Parenchyma-like bands of septate fibers present.
Austroplenckia (Celastraceae).

b. Septate fibers absent or, if present, not in bands 10

10 a. Definitely ring-porous 11

b. Not definitely ring-porous 12

11 a. Pores closely spaced in pore ring. Parenchyma sparse.
Elaeagnus, *Shepherdia* (Elaeagnaceae).

b. Pores wide spaced in pore ring. Parenchyma abundantly diffuse.
Canotia (Celastraceae).

12 a. Pores crowded in early wood, becoming gradually fewer and somewhat smaller in the late wood 13

b. Pores of fairly uniform size and distribution throughout growth ring 16

13 a. Parenchyma diffuse. Rays nearly homogeneous, or without definitely upright cells ..... *Sorbus* (Rosaceae).

b. Parenchyma absent or very sparse. Rays heterogeneous 14

14 a. Ground mass of wood composed mostly of vessels; fibers few.
Paebystima (Celastraceae).

b. Ground mass of wood composed mostly of fibers 15

15 a. Perforations exclusively simple. Fibriform vessel members abundant ..... *Monttea* (Scrophulariaceae).

b. Perforations multiple in part. Fibriform vessel members absent or few ..... *Elliottia* (Ericaceae).

16 a. Vessel-ray pitting very fine; not scalariform. Perforations exclusively simple. Rays 1–5 cells wide and up to 30 (40) cells high; definitely heterogeneous ..... *Maytenus boaria* (Celastraceae).

b. Vessel-ray pitting medium to coarse; more or less distinctly scalariform. Perforations multiple in part 17

17 a. Rays 1–8 cells wide and up to 100 or more cells high; decidedly heterogeneous ..... *Satyria* (Ericaceae).

b. Rays typically not over 3 cells wide and 25 cells high 18

18 a. Parenchyma very sparse. Multiseriate rays usually with single marginal row of square or upright cells .... *Oxydendrum* (Ericaceae).

b. Parenchyma abundant, reticulate. Multiseriate rays usually with several marginal rows of square and upright cells.
Myrceugenia (Myrtaceae).

19 a. Rays all broad and very high; rarely in contact with the pores.
Aristolochia (Aristolochiaceae).

b. Rays not all broad or high; often in contact with the pores 20

20 a. Rays uniseriate. Vascular pitting fine. Fibers with spirals.
Evonymus (Celastraceae).

b. Rays 1–5 (10) cells wide. Vascular pitting rather coarse. Fibers without spirals ..... *Prunus serotina* (Rosaceae).

21 a. Fibers with spirals 22

b. Fibers without spirals 26

22 a. Rays conspicuous in part 23

b. Rays not conspicuous 25

23 a. Pores solitary 24

b. Pores in radial multiples. Perforation plates with many bars. Wood chalky white throughout ..... *Ilex* (Aquifoliaceae).

24 a. Perforation plates with few bars. Heartwood brown.
Garrya (Garryaceae).

b. Perforation plates with many bars. Wood whitish throughout.
Villaresia mucronata (Icacinaceae).

25 a. Rays nearly homogeneous. Wood light-colored.
Symplocos tinctoria (Symplocaceae).

b. Rays decidedly heterogeneous. Wood reddish brown.
Escallonia (Escalloniaceae).

26 a. Pores often in contact radially 27

b. Pores rarely in contact radially 29

27 a. Rays large in part, often 5–7 cells wide and up to 50 (100) cells high. Intervascular pitting frequently scalariform ..... Vacciniaceae.

b. Rays 1 or 2 (rarely 4 or 5) cells wide and few to 50 cells high 28

28 a. Intervascular pitting scalariform in part. Parenchyma sparingly diffuse. Spirals common, in tips of vessel members. Vertical gum ducts sporadic ..... *Liquidambar* (Hamamelidaceae).

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32 a. Spirals limited to tips of vessel members. Parenchyma more or less reticulate 33
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33 a. Uniseriate rays few; multiseriates with stratum of slender procumbent cells; raphides absent ..... *Clethra* (Clethraceae).
b. Uniseriate rays numerous; multiseriates without stratum of slender procumbent cells; raphides present in some species. *Saurauia* (Saurauiaceae).

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39 a. Ripple marks apparently confined to parenchyma layers. *Zuccagnia* (Leguminosae).
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41 a. Radial gum ducts present ..... *Rhus*, *Schinus* (Anacardiaceae).
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42 a. Rays up to 20 or more cells wide and 150 (200) cells high, often interrupted by fiber layers. Parenchyma in narrow band on outer (concave) side of pore festoons. Diffuse-porous. *Guevina* (Proteaceae).

b. Rays not over 8 cells wide; often all narrow. Parenchyma and pores not as above. Definitely ring-porous or with more or less pronounced tendency 43

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CURRENT LITERATURE

Timbers of the New World. By SAMUEL J. RECORD and ROBERT W. HESS. Scheduled for publication about March 10, 1943. For sale by the Yale School of Forestry, 205 Prospect Street, New Haven, Conn. Price $10.

This large volume is an encyclopedia of the best information available concerning the trees and larger shrubs native to South America, Central America, Mexico, the West Indies, U.S.A., and Canada. It is the first attempt by anyone to describe all of the timbers of the entire Western Hemisphere (exclusive of the Pacific Islands). For purposes of comparison there are also references to most of the commercial timbers of the Old World.

Specifically, there are descriptions of the trees and woods of more than 1100 genera of 155 natural families. The arrangement is alphabetical by families and each family is concisely considered with reference to its size, distribution, and economic importance, first throughout the world and secondly in the Americas, with general descriptions of the American woods. Then each genus is treated in more or less detail according to its importance, including location, size, and accessibility of the trees and the properties and uses of their woods and other produce. Each generic account concludes with a list of the trade and vernacular names by countries.

The book contains about 650 pages, set two columns to

the page, and at the end is a bibliography of the principal publications arranged by countries. In addition to the general index there are special lists designed for convenience in locating trees and woods having special properties and uses or suitable for the same purposes as better-known kinds. There are eight original maps showing the geographical ranges of Latin-American timbers of commerce, 36 full-page reproductions of photographs of trees and forest scenes, and 22 plates with 75 photomicrographs prepared especially to show variety of anatomical details.

Campanulales: Campanulaceae (Lobelioideae). By ROGERS MCVAUGH. *North American Flora* (N. Y. Bot. Garden) 32A: 1: 1–134; Jan. 5, 1943.

Descriptions of all of the North American species of the 15 genera of the Lobelioideae, which are annual or perennial herbs, shrubs, or small trees, usually with a milky sap.

Una nueva Pinacea mexicana: *Pinus durangensis* sp. nov. By MAXIMINO MARTÍNEZ. *An. Inst. Biol.* (México, D. F.) 13: 1: 23–29; 4 text figs.; 1942.

Pinus durangensis Martínez is the name proposed for a medium-sized to large Pine tree first collected in 1906 by George Russell Shaw on Sandía Mesa in the State of Durango. Its leaves are 4–9 inches long and borne in fascicles of 5–8, mostly 6. The cones and seeds are small. The tree yields some turpentine and a light-colored moderately hard wood of good quality for structural purposes, but the occurrence of the stands at high elevations (8000 to 9000 feet above sea level) makes exploitation difficult.

Una nueva Pinacea mexicana: *Picea chihuahuana* sp. nov. By MAXIMINO MARTÍNEZ. *An. Inst. Biol.* 13: 1: 31–34; 4 text figs.; 1942.

This new species of Spruce is a tree 80–100 feet tall and 18–24 inches in diameter growing in humid and shady localities along arroyos at elevations of about 7500 feet above sea level in the State of Chihuahua, Mexico. The wood is white and slightly resinous.

Una Rubiacea nueva de México. By MAXIMINO MARTÍNEZ. *An. Inst. Biol.* 13: 1: 35–41; 4 text figs.; 1942.

An account in Spanish of *Balmea Stormae* Martínez first described in *Bull. Torrey Bot. Club* (New York) June 1942. (See *Tropical Woods* 71: 36.)

The response of *Achras zapota* in latex yield to wounding by the ibidem method of tapping. By JOHN S. KARLING. *Bull. Torrey Bot. Club* 69: 8: 553–560; 4 figs.; November 1942.

"Tapping experiments on *Achras zapota* in British Honduras involving application of the ibidem method commonly used on *Hevea brasiliensis* indicate a lack of response to the stimulus of wounding. The initial oblique incisions in the cortex drain the latex from an area approximately 10 to 14 inches above and below, and daily pairings of the lower margin of the incisions within such areas yield no additional latex. The results obtained show that *Achras zapota* cannot be tapped profitably by the ibidem method and that the successive incisions in the cortex must be spaced approximately 14 to 16 inches apart to secure the maximum yield per tapping." — *Author's summary.*

Plantae colombianae, II. Yoco, a stimulant of southern Colombia. By RICHARD EVANS SCHULTES. *Harvard Univ. Bot. Mus. Leaflets* 10: 10: 301–324; 3 plates, 1 map; Oct. 30, 1942.

Yoco has long been employed as a stimulant by the Indians of a small part of southern Colombia and the adjacent parts of Ecuador and Peru, but the botanical source has remained doubtful or unknown. "The flowering of the yoco plant, an extensively climbing liana, is apparently sporadic and capricious, and it was possible to collect fertile material only after months of search." These specimens were found to represent a new species of Sapindaceae which is described as *Paullinia yoco* Schultes & Killip. It appears to be the first plant whose bark is utilized for its caffeine content.

Nuevas especies colombianas del genero *Ficus*. By ARMANDO DUGAND. *Caldasia* (Bogotá) 4: 25–74; 17 figs.; April 1, 1942. **Dos adiciones.** *Idem* 5: 37–39; Aug. 1, 1942.

The two papers contain diagnoses of 48 species and two varieties of *Ficus*, bringing the known total for Colombia to 84.

De nuttige planten van Suriname. By GEROLD STAHEL. Bull. No. 57, Dept. Landbouwproefstation in Suriname, Paramaribo, August 1942. Pp. 197; 6 x 9.

An account of the useful plants in Surinam, both cultivated and growing wild. Part I is concerned with crop plants in a strict sense. Part II deals with 56 important trees, with check lists of the vernacular and scientific names, and classifications according to the principal properties and uses of the woods. Part III is a long annotated list of decorative plants.

A new *Dussia* and *Ormosia avilensis*. By JOHN H. PIERCE. *Bull. Torrey Bot. Club* 69: 8: 590–591; November 1942.

"The original description of *Ormosia avilensis* Pittier is bigeneric and in need of clarification. The foliage and fruit described are clearly those of *Ormosia*, while the flower is that of *Dussia*. The material collected or identified by Pittier is also bigeneric and there is further some question as to the number cited for the type specimen. . . . It seems probable that when Pittier described *O. avilensis* he had before him two or more of the specimens listed above and that he based the floral part of the description on *Delgado 47*, the rest on *Delgado 35*. This confusion can perhaps best be clarified by selecting *Delgado 35* as the lectotype of *O. avilensis*. The floral portion of the original description is excluded from *Ormosia* and refers to *Delgado 47*, which then becomes the type of *Dussia coriacea* Pierce. . . . This species is known only from the type locality [Selvas del Avila, Venezuela] and is readily distinguished from the other species of the genus by the small number of leaflets, the coriaceous texture and uniform pubescence of the leaflet, and the smaller fruit."

Rubiaceae. *Dialypetalanthus* Kuhlmann. By J. G. KUHLMANN. *Rodriguésia* (Rio de Janeiro) 6: 15: 25–27; 2 plates, June 1942.

The genus *Dialypetalanthus*, with one species, *D. fuscescens* Kuhlm., is made the sole representative of a new tribe of the

Rubiaceae, namely, Dialypetalantheae, closely related to the Cinchoneae.

The genus *Batocarpus* Karst. (Moraceae). By F. R. Fosberg. *Proc. Biol. Soc. Washington* 55: 99–102; Aug. 13, 1942.

Anonocarpus amazonicus Ducke is considered to be a second species of *Batocarpus*, becoming *B. amazonicus* (Ducke) Fosberg. The other species, *B. orinocensis* Karst., is a tall tree in Colombia and Peru, being known in the latter country as Leche-caspi. "The latex is used locally to mix with *Hevea* latex in making rubber. A gum has been offered for sale recently in Peru under the name 'leche de caspi' or 'leche caspi,' which may possibly come from this tree, though its origin and uses are still doubtful."

A doença dos *Citrus* no vale do Paraíba. By R. Drummond-Gonçalves and J. Aranha Pereira. *O Bibliógico* (São Paulo, Brazil) 8: 8: 199–207; 4 plates; August 1942.

Serious injury to Citrus trees in the Paraíba valley in Brazil proves to be the result of attacks by cambium miners, the larvae of one or more species of *Agromyza*, which produce the well-known pith flecks in many fine-textured woods.

Apuntes botanicos. Sobre el belloto chileno de frutos comestibles (*Beilschmiedia Berteroana* [Gay] Kosterm.). By Marcial R. Espinosa B. *Bol. Mus. Nac. Hist. Nat.* (Santiago de Chile) 19: 9–18; 2 text figs., 9 plates; 1941.

A detailed account of one of the two Bellotos of Chile, a rather large aromatic tree well suited for planting for decorative purposes and for its fruit. The young bark contains large quantities of mucilage. The cream-colored wood is used for general carpentry and for fuel. The author believes that the species is well worthy of protection and propagation.

Acalypheae Argentinae (Euphorbiaceae). By A. Lourteig and C. A. O'Donell. *Lilloa* (Tucumán) 8: 1: 273–333; 19 text figs., 1 range map, 9 plates; July 25, 1942.

A systematic account of the Argentine species of the euphorbiaceous genera *Acalypha*, *Adelia*, *Alchornea*, *Bernardia*, *Dysopsis*, and *Mercurialis*. There is a description of one new species, *Acalypha Schreiteri* Lillo, a shrub or little tree growing in Jujuy and Tucumán.

Jardim Botanico do Rio de Janeiro. Guia dos vistantes. Rio de Janeiro, 1942. Pp. 71. 5½ x 8; 29 plates; 1 map.

This attractively illustrated guide to the Botanical Garden of Rio de Janeiro, though intended primarily for visitors, is serviceable to others as it shows well the appearance of the trees and other interesting plants, provides a good check list of their common and scientific names, gives the times of flowering, and supplies much other information.

Revision of the Hawaiian members of the genus *Pittosporum* Banks. By Earl Edward Sherff. *Bot. Ser. Field Mus.* (Chicago) 22: 10: 467–566; Nov. 16, 1942.

"As an outgrowth of my own examination and revisional study of all available Hawaiian specimens of *Pittosporum*, a considerable number of additional species, varieties, and forms have come to light. These have been published in two recent papers (*Am. Journ. Bot.* 28: 18–31. 1941; *Field Mus. Bot. Ser.* 22: 407–441. 1941). The present paper represents an attempt to consolidate the information contained in these other two papers with the main body of factual material in Hillebrand's *Flora* and elsewhere, and thus to afford as nearly serviceable a revisional or monographic treatment of the native and naturalized *Pittospora* of Hawaiian Islands as the present state of our knowledge will permit."

A note on *Xylosma hawaiiense* Seem. By Earl Edward Sherff. *Bot. Ser. Field Mus.* 22: 10: 572–573; Nov. 16, 1942.

The type of *Drypetes Forbesii* Sherff proves upon closer study to have been placed in the wrong family (Euphorbiaceae) and is now identified with *Xylosma hawaiiense* Seem. (Flacourtiaceae).

Fijian plant studies, II. By A. C. Smith (and collaborators). *Sargentia* (Jamaica Plain, Mass.) 1: 1–148; 5 figs. July 20, 1942.

"The greater part of the material which forms the basis

for this treatment was collected in Fiji in 1940–41 by Mr. Otto Degener, a member of the Pacific cruise of the 'Cheng Ho', sponsored by Mrs. Anne Archbold. . . . The area covered by members of the expedition centered on the largest island, Viti Levu, where numerous regions near the coast were visited. Mr. Degener also spent several weeks in the mountains of Tholo North Province, and additional work was done in the Savu Savu Bay region of Vanua Levu."

"In this treatment only new and unusual plants are discussed, in the hope that further study of the Fijian flora will permit redescription of all the plants known from the archipelago. Ninety-one species, eight varieties, and two forms are described as new; 63 of these entities are based on the collections of Mr. Degener and his assistants (at least as regards the type specimen), while the remaining 38 are based on earlier collections. In addition it has been found necessary to propose 43 new combinations and six new names. An additional 53 species or varieties are reported from Fiji for the first time (at least in strictly botanical literature); of these, 17 are apparently indigenous while 36 are weeds or otherwise introduced plants."

Sargentia is the new title given to a new series of technical papers "too extensive for publication in ordinary serial literature" and is a continuation of "Contributions from the Arnold Arboretum of Harvard University." It is named in honor of Dr. Charles Sprague Sargent (1841–1927), who organized the Arnold Arboretum and served as its first Director from 1872 until his death in 1927.

Names in *Amaranthus, Artocarpus,* and *Inocarpus*. By F. R. Fosberg. *Journ. Wash. Acad. Science* 31: 3: 93–96; March 15, 1941.

According to the author, the correct name for the Breadfruit tree is *Artocarpus altilis* (Parkinson) Fosberg instead of *A. communis* Forst. or *A. incisus* (Thunb.) L.f. Likewise that of the Tahitian Chestnut should be *Inocarpus fagiferus* (Parkinson) Fosberg and not *I. edulis* Forst.

M. M. Chattaway.

Price 30 cents

Yale University

School of Forestry

TROPICAL WOODS

NUMBER 74

JUNE 1, 1943

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 74 June 1, 1943

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

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

Subscription price One Dollar for four consecutive numbers. Remittances should be made payable to TROPICAL WOODS.

Address all communications to the editor, 205 Prospect Street, New Haven, Connecticut, U. S. A.

THE MOST IMPORTANT WOODS OF THE AMAZON VALLEY

By ADOLPHO DUCKE

The hylaea of equatorial South America occupies first place among the tropical forests of the world because of its enormous geographical area and the great diversity of the tree species growing there. Forest products are the economic base for human existence in nearly all parts of this immense region which comprises parts of nine countries, namely, Brazil, the three Guianas, Venezuela, Colombia, Ecuador, Peru, and Bolivia. Many products are exported, with rubber occupying first place. The timber industry is still insufficiently developed even to meet local requirements and export trade is practically nonexistent except in restricted parts of the Brazilian and Peruvian Amazon and the Guianas. We may presume, however, that after the end of the present war the timber exports from the Amazon will be greatly increased, since it is

here that the largest wood reserves will be available for rebuilding.

The species enumerated in this report are some of the best known in the Brazilian Amazon. Many others, now neglected or ignored, will perhaps in the future become equally useful. The references to international trade are based on exportations made prior to December 1941. Some of the technical data on the woods were taken from publications of Professor Record and of Dr. Paul Le Cointe, former Director of the Museu Comercial do Pará.

1. Acapú, *Vouacapoua americana* Aubl., family Leguminosae-Caesalpinioideae.—A rather tall but slender tree whose bole seldom attains a diameter of 0.5 meter. It is said to occur scatteringly in British Guiana and to be fairly common in parts of French Guiana and Surinam, but it reaches its best development in the eastern third of Brazilian Amazonia, State of Pará, where it extends, so far as actually known, from the basins of the Curuá do Sul and the Trombetas in the west to the middle of the Bragança railroad in the east. The trees grow only in upland rain forest. Most of the Acapú of commerce comes from the Guamá, Acará, and Mojú Rivers, affluents of the Rio Pará. The port of Pará exports it to other parts of Brazilian Amazonia and to northeastern Brazil, and also in small quantities to southern Brazil and the United States.

The heartwood is dark chocolate-brown with prominent pencil-striping of lighter brown; hard and heavy (sp. gr. 0.87–1.00), very strong, incorruptible, and not attacked by insects. It is highly esteemed at Pará where it is the most important of the timbers of local commerce, particularly for flooring in conjunction with some light-colored wood, such as Pau Amarello (*Euxylophora*), and for posts.

In the Brazilian State of Amazonas, where the true Acapú does not grow, that name is sometimes applied to other timbers of merely local or very restricted use. Thus Acapú in the Rio Negro basin is the lighter-colored *Vouacapoua pallidior* Ducke, which seldom yields good pieces, while on the Solimões it is *Cassia scleroxylon* Ducke (Leg.-Caes.) and *Minquartia punctata* (Radlk.) Sleum. (Olacaceae).

2. Águano, *Swietenia macrophylla* King, of which the more recently described *S. Candollei* Pittier (from Venezuela), *S. Tessmannii* Harms (from Peru), and *S. Krukovii* Gleason & Panshin (from Brazil's Acre Territory) seem to be mere individual forms (see *Tropical Woods* 16: 50 and 66: 21); family Meliaceae.—The wood is true Mahogany of the best quality and does not show any essential differences from the well-known Mahogany of the North and Central American markets.

Águano is a giant tree, being sometimes 50 or even 60 meters in height, with a straight cylindrical trunk often two meters or more in diameter above the heavy buttresses. It occurs on fertile soil in the upland rain forest in the western and southwestern parts of Amazonia, divided among Peru, Bolivia, and Brazil. In Peru it is north and south of the Amazon River, Department Loreto; in Brazil it has been found hitherto in the Acre Territory, in the basin of the Rio Juruá (State of Amazonas), and in some localities of northern Matto Grosso, where it appears to be frequent.

Águano lumber is exported chiefly from Iquitos, Peru, where two companies (Astoria and Loretana) have sawmills working exclusively with that timber. The Brazilian Águano proceeds from the upper basins of the Purús and the Juruá down to Manáos in rafts mixed with logs of Cedar (*Cedrela*). The Águano of Matto Grosso has so far not been exported, as its growing places are not readily accessible.

3. Andiroba, *Carapa guianensis* Aubl., family Meliaceae.—A large tree with a straight and robust bole, occurring throughout the whole hylaea from the foot of the Andes to the vicinity of the Atlantic coast at Pará and the Guianas, reaching at the northeast the delta of the Orinoco. It is very common in the State of Pará and frequent also in the State of Amazonas, always in marshy or periodically overflowed forests.

The wood is rather hard and compact; sp. gr. 0.60–0.75. The heartwood is a uniform reddish brown and suggests red Cedro (*Cedrela*), but is heavier and more compact. It is sometimes sold as a substitute for Águano (Mahogany), to which it is, however, inferior in luster. It is good for joinery and is resistant to insects, but is of relatively restricted use, espe-

cially at Pará where the exportation of Andiroba timber is forbidden because of the usefulness of the oil-yielding seeds of the trees; it is more frequent in the timber trade of Manáos. To frustrate the restrictions at Pará, the timber is sometimes exported under the name of Aboridan, an anagram of Andiroba.

4. Angelim. This name is applied in Brazilian Amazonia to various leguminous trees, but seldom to species of the genus *Andira*, the Angelim of southern Brazil. Only two kinds of Angelim are of present commercial importance in Amazonas.

The common Angelim or Angelim Pedra, *Hymenolobium excelsum* Ducke and *H. petraeum* Ducke (Leg.-Papil.), are giant trees of the upland forest of the State of Pará and the eastern part of the State of Amazonas. The hard wood, which is yellow-brown with darker fiber layers and lighter bands and stripes, is excellent for turnery. Owing to the limited quantity available it is exported only in small amounts and not to the exterior.

Angelim Rajado, *Pithecolobium racemosum* Ducke (Leg.-Mim.), is a rather small to medium-sized tree, always with a slender stem, of infrequent occurrence in drier places of the upland rain forest in the State of Pará, the eastern half of the State of Amazonas, and in the Guianas. The wood is pale yellow-brown with irregular black or purplish brown stripes that are very conspicuous and characteristic; there is also a fine pencil-striping of light-colored lines. It is hard and heavy (sp. gr. 1.0–1.15), resistant, and durable, and makes beautiful joinery and cabinetwork. It is sawed in Pará mills and either consumed in local industry or exported to southern Brazil.

A third sort of Angelim, *Dinizia excelsa* Ducke (Leg.-Mim.), does not have a special commercial name because it has never been exploited. The trees, which seem to be the tallest in all Amazonia, are frequent in many places from the Breves islands at the mouth of the Amazon to the Rio Negro and the Rio Madeira. The wood, though unknown to the trade, is highly durable and could be produced in large quantities.

5. Balsamo, *Myroxylon peruiferum* L.f., family Leguminosae-Papilionatae.—This species is widely distributed in tropical America and is everywhere esteemed for its excellent

wood, which is red-brown, often with darker areas, moderately hard and heavy, and used for furniture and durable construction. In Brazilian Amazonia it is a tall tree of the upland forest, mostly in Acre Territory, where it is rather frequent. The timber is known only in local commerce because of the poor accessibility of the trees.

6. Cedro, *Cedrela odorata* L., family Meliaceae.—This species has an extensive range in tropical America from the Amazonian hylaea northward. Two other species are known to occur in the higher parts of the State of Pará, but they have no commercial importance. The Cedro of extra-Amazonian Brazil as well as that of Argentina is of still different species.

Amazonian Cedro occurs chiefly in the forest of the overflowed lowlands (varzea) along rivers with "white" (troubled) waters, less frequently on swampy loam of the uplands. One important center of exploitation is on and around the islands of the great Amazonian estuary, but most of the logs come from the southern tributaries of the upper Amazon and from the Rio Madeira, where they are rafted to the sawmills at Manáos, Itacoatiara, etc. A considerable quantity of lumber is obtained all along the river from floating trunks of trees undermined by the flood waters of the large southern tributaries. Cedro is the most important of all the timbers of the local trade and it is also exported to Europe and the United States where it is known as Spanish Cedar, along with kinds from the West Indies and other parts of tropical America.

Amazonian Cedro of good quality, regardless of species, is called Cedro Vermelho (red Cedar). The name Cedro Blanco (white Cedar) is applied to inferior and lighter-colored kinds of *Cedrela* and also to less useful timbers bearing some resemblance to true Cedro. Cedro-rana (false Cedar) usually refers to certain species of *Vochysia* (Vochysiaceae), more commonly known as Quaruba, and to *Cedrelinga catenaeformis* Ducke, a big leguminous tree with a Cedro-like bark and yielding rather a good timber of local utility.

7. Cumarú, chiefly *Coumarouna odorata* Aubl. (= *Dipteryx odorata* [Aubl.] Willd.), family Leguminosae.—This is a rather large tree in the drier parts of the upland forest of the

eastern half of Brazilian Amazonia and French Guiana, often of frequent occurrence. Its yellow-brown wood is one of the hardest of the region, very heavy (sp. gr. 1.10–1.20), difficult to work, and little used despite its resistance and durability. The tree is better esteemed for its fragrant seeds (tonka beans) which provide at present one of the most important forest products exported from Pará and Amazonas. Two other, though less frequent, species of the same genus, namely, *C. punctata* Blake and *C. trifoliolata* Ducke, also yield tonka beans and are characterized by a cumarin-scented sapwood.

Cumarú de Cheiro or Imburana de Cheiro, *Torresea acreana* Ducke (Leg.-Pap.), is a moderately large tree of the Acre Territory and the extreme southwestern part of the State of Amazonas. It supplies one of the best timbers of that region, but the available quantity is limited.

Cumarú Ferro (iron Cumarú), *Coumarouna ferrea* Ducke, is one of the largest trees of the southern part of the State of Amazonas and of Acre Territory. Its extremely hard wood is seldom used.

Cumarú-rana (false Cumarú) is a local trade name for various very hard and strong woods showing some resemblance to the true Cumarú. It is most commonly applied to *Taralea oppositifolia* Aubl. and species of *Coumarouna* with unscented seeds.

8. Cupiuba, *Goupia glabra* Aubl., family Celastraceae.—This is a good-sized to very large upland forest tree of the whole hylaea. Its lumber is cut in all the eastern parts of the State of Pará and is the most popular of the secondary timbers. The tree is less common in Amazonas and its timber is almost unknown there. The reddish brown wood is of medium weight and hardness, easy to work, but ill-scented when fresh. It is good for cheap construction and joinery, but when old and dry is often attacked by termites.

9. Freijó, *Cordia Goeldiana* Huber, family Boraginaceae.—This tree, which sometimes attains large dimensions, grows in the upland forest of the eastern part of the Atlantic zone of Pará and of the Tocantins and Xingú basins. Its yellowish brown, moderately heavy, rather strong wood was formerly exported in considerable quantities, chiefly to Portugal, for

making barrels and pails. It is no longer on the market, but the timber is of good quality and may regain its place when more abundant supplies are found.

10. Itaúba, *Silvia itauba* (Meissn.) Pax (=*Mezilaurus itauba* [Meissn.] Taub. =*Oreodaphne Hookeriana* Meissn.), family Lauraceae.—This upland forest tree of larger or smaller size is disseminated from French Guiana through western Pará and eastern Amazonas to northwestern Matto Grosso. It is very frequent in some localities of the Tapajoz and Trombetas valleys, including the neighborhoods of Santarem and Obidos. The wood is typically yellow-brown when freshly cut, but soon becomes much darker. Material lighter in weight and color is known as Itaúba Amarella, that with darker and heavier wood, Itaúba Preta. Though often heavy (sp. gr. up to 0.93), it is of medium hardness and easy to work. It is very resistant to decay and insects and is a first class timber for naval construction and for all sorts of carpentry work, but its use seems to be local.

Itaúba-rana (false Itaúba) is the name for some leguminous tree and has nothing to do with Itaúba.

11. Jacarandá or Jacarandá do Pará, *Dalbergia Spruceana* Benth., family Leguminosae-Papilionatae.—A small to medium-sized tree of the upland forest in such parts of the lower and middle Amazon as have a well-defined dry season. It is the source of true Rosewood similar to the more famous Jacarandá from southern Brazil. The wood is dark brown with fine stripes of violet or nearly black color and is very hard and heavy (sp. gr. 1.10). It is exported from Pará to Europe and the United States for use by cabinetmakers.

12. Jaraná, *Holopyxidium jarana* (Huber) Ducke, family Lecythidaceae.—A tree of variable size growing on fertile soil in upland forest throughout the State of Pará, being fairly common along the Bragança railroad and abundant along the lower Tapajoz. The timber, which is reddish brown, hard, rather heavy (sp. gr. 0.85–0.96), and durable, is considered excellent for carpentry, railway crossties, etc. It is worked in the sawmills along the Bragança railroad and in the region of Santarem; though highly esteemed in local trade it is not exported.

The generic status of this tree is still uncertain, as indicated in the following synonymy:

Holopyxidium jarana (Huber) Ducke, Arch. Jard. Bot. Rio 4: 152 (1925).
Chytroma jarana Huber, Bol. Mus. Goeldi 6: 209 (1910), nomen.
Eschweilera (*Chytroma*) *jarana* Ducke, Arch. Jard. Bot. Rio 5: 177 (1930).
Lecythis jarana A. C. Smith, Bull. Torrey Bot. Club 60: 381 (1933).
Holopyxidium retusum Ducke, Arch. Jard. Bot. Rio 4: 152 and pl. 15 (1925), not *Lecythis retusa* Berg = *Chytroma retusa* Miers = *Eschweilera retusa* Nied.

A. C. Smith placed this species in the genus *Lecythis*, but Knuth (letters of March 25 and June 8, 1938) resurrected *Holopyxidium*, apparently with reason. The tree resembles *Lecythis* in many characters of the bark, wood, leaves, and flowers, but the fruit and seeds are entirely different. Smith, reproducing a field note by Krukoff, says: "The general aspect of the plant is that of *Lecythis*. . . . Study of the flowers makes necessary the above new combination (*Lecythis jarana*). . . . Fruits such as those described and figured by Ducke are certainly of *Lecythis* rather than *Eschweilera*." Smith, however, had seen only the drawing of one fruit, and not the fruit itself nor the seeds. This fruit resembles in shape, and often also in size, the well-known fruits of the genus *Lecythis*, but its shell is chartaceous and fragile, not thick, hard, and woody as in *Lecythis*. It is indehiscent, and when, after ripening, it falls from the tree, its operculum is only detached from the pyxidium by decay of the suture, a rather long time after contact with the moisture of the forest soil. The funicles of the seeds are small and insignificant, just as they are in *Eschweilera*, and not thick, fleshy, and of sweet taste as in *Lecythis*. The seeds differ only by their large size from those of the common species of *Eschweilera*, section *Chytroma;* they do not resemble those of *Lecythis*. They often germinate in the decaying pyxidium.

13. Louro is the name given in Brazilian Amazonia to nearly all members of the great family Lauraceae, subdivided by taxonomists into several more or less artificial genera. It corresponds to Canella in southern Brazil, where Louro denotes species of the genus *Cordia* (Boraginaceae). The Lauraceae have in the Amazonian hylaea one of the principal centers of their geographical distribution round the world and

supply many timbers of local importance, but are not yet classifiable into commercial sorts for the export trade. The best of these Louros are Louro Abacate, L. Amarello, L. Aritú, L. Chumbo, L. Pimenta, L. Preto, and L. Vermelho. Each one of these vernacular names may be applied to more than one botanical species, as local usage varies. Louro Inamuhy (often corrupted to Mamory) can be classified with certainty as *Ocotea barcellensis* (Meissn.) Mez (=*Nectandra elaiophora* Barb. Rodr.); it is abundant in the lowland forest along the Rio Negro and could be exploited industrially, but it is more popular at present for the inflammable liquid obtained from its stem than for its excellent timber. All of the Louros mentioned and many others yield very good lumber for carpentry.

When a Louro timber acquires commercial importance for other purposes than carpentry a new popular name is given to it. For example, the Pau Rosa of the Amazon was a simple Louro twenty years ago before it was known as the source of the same "linaloe" essence produced by the Bois de Rose of French Guiana.

14. Macacahuba, *Platymiscium trinitatis* Benth. (=*P. Duckei* Huber) in the uplands, and *P. Ulei* Harms (=*P. paraense* Huber) in the lowlands; family Leguminosae-Papilionatae.—The range of the first species reaches the Guianas and Trinidad. The trees sometimes attain large dimensions, but more often do not exceed medium size. The wood, which is a rather pale red-brown with lighter and darker veining, or sometimes dark brown (Macacahuba Preta), is hard and heavy (sp. gr. 1.00 or more), highly durable, and easy to work. It commands a high price for cabinetwork, chiefly in local industry, though there are some exports of it from Pará to southern Brazil. *P. Ulei* is limited to the overflowed Amazonian varzea and its wood is always more or less inferior to that of the other species.

15. Marupá, *Simaruba opaca* (Engl.) Radlk. (possibly a mere variety of *S. amara* Aubl. of French Guiana), family Simarubaceae.—This tree varies in size, the largest individuals occurring on silicious soil in moist places; it is common in Amazonia and also in the State of Maranhão, where it is

known as Papariuba. Besides its use in domestic remedies, it supplies the only soft timber of commercial value in the Pará region, being highly esteemed because its bitterness makes it resistant to insect attacks. It is yellowish white, light in weight (sp. gr. 0.40–0.50), but firm, and makes a good substitute for Pine. Some of the lumber is exported to southern Brazil.

At Pará, the Marupá is sometimes confused with one of the Parapará or Caraúba trees, *Jacaranda copaia* (Aubl.) D. Don (family Bignoniaceae), whose wood is quickly destroyed by insects.

16. Massaranduba, all Brazilian species of *Mimusops* (=*Manilkara*), but in Amazonia chiefly *Mimusops Huberi* Ducke (=*Manilkara Huberi* [Ducke] A. Chev.); family Sapotaceae.—This species is the only one supplying the true Massaranduba of the timber trade of Pará. The tree is readily recognized by the yellow lower surfaces of the leaves. Its edible fruits are sold in the Pará market and its latex yields a very inferior grade of balata, the American gutta-percha. It attains very large size and grows in the upland rain forest of the eastern half of the hylaea, from Pará and the Guianas to the basins of the Madeira (reaching Matto Grosso) and the Rio Negro, being frequent in many places such as Almeirim, Rio Tapajoz, Rio Trombetas, Rio Nhamundá, and Parintins. The wood is deep red-brown, homogeneous, very hard and heavy (sp. gr. over 1.00), very strong, and highly durable. It is good for carpentry, but its principal use is for railway crossties and bridge timbers. It has been exported, chiefly to Europe.

The other Amazonian species of this genus are called Maparajuba more commonly than Massaranduba. *M. bidentata*, however, is known as Balata, since it is the source of the balata of best quality. The woods of all of these species are good, but they are less highly esteemed than that of *M. Huberi*.

17. Matamatá, *Eschweilera odora* (Poepp.) Miers (=*E. matamata* Huber) and other, less well known, species of the same genus; family Lecythidaceae.—A rather large tree in upland rain forest of the hylaea, including the Guianas. The red-brown wood is hard and heavy (sp. gr. 1.15) and highly resistant to insects and decay. It is good for posts, railway crossties, and carpentry and is in general use throughout the whole region, but is not exported.

18. Muiragiboia, *Swartzia cinerea* Ducke, family Leguminosae-Caesalpinioideae.—This is a small tree of the upland rain forest of the Solimões River (Fontebôa, Tocantins). Its irregularly dilated and narrowed dark heartwood is often interlaced with yellowish sapwood. Such figured pieces, always of small size, are in demand at Manáos, chiefly by canemakers.

19. Pau Amarello or Pau Setim, *Euxylophora paraensis* Huber, family Rutaceae.—This large and beautiful tree occurs in upland rain forest on humo-silicious soil in a region which apparently extends from the vicinity of the eastern coast of Pará southwestward to the Anapú basin, including the southwestern part of the island of Marajó northward to Aramá. It has nearly disappeared from along the Bragança railroad where it was formerly common, but it is fairly abundant in less accessible localities of the Tocantins valley, according to reports from that country.

The wood is a uniform bright yellow, of medium hardness and density (sp. gr. 0.81), and homogeneous. It is obtainable in very large planks and is well adapted for furniture and cabinetwork, though its principal use is for the beautiful floors made of alternate boards of Pau Amarello and Acapú which are so characteristic of the houses of Pará. Exports are chiefly to the interior of Pará and to the neighboring states, Amazonas and Maranhão, as well as to the northeastern states and to some extent to southern Brazil. In extra-Amazonian trade Pau Amarello is known as Pau Setim, but this name is also applied to timber of other kinds.

20. Pau Mulato or Pau Marfim, *Calycophyllum Spruceanum* Benth., family Rubiaceae.—This beautiful tree, which sometimes attains large dimensions, is one of the most conspicuous elements of the loamy banks and periodically inundated varzea forests along the whole course of the Amazon River and its white-water tributaries. The region of greatest abundance is in the southwestern part of Amazonia, where it grows in nearly pure stands, unlike all other large-sized dicotyledonous trees of the hylaea. In Peru, such stands are called capi-

ronales (from Capirona, the Peruvian name for the tree). In Brazil, similar formations occur chiefly in Acre Territory.

The light-brown wood is rather hard and heavy (sp. gr. 0.85) and of fine and uniform texture. It is considered one of the best fuel woods in Amazonia and is also used in construction and joinery, though in the equatorial climate it soon acquires a dingy color and is attacked by insects. Considerable quantities of the timber are exported to southern Brazil under the trade designation of Pau Marfim, a name also applied to very different woods in the Amazonian interior as well as in other parts of Brazil.

Pau Mulato trees are remarkable for their smooth and lustrous dark brown bark, and for this reason their vernacular names are sometimes given not only to other species of the same genus and of allied genera (all of them rare) but also to representatives of other families having bark of more or less the same aspect. These woods, however, are useless at present.

21. Pau Roxo or Violete, *Peltogyne* spp., family Leguminosae-Caesalpinioideae.—The species most frequent and of widest distribution is *P. densiflora* Spruce ex Benth., which grows on marshy or frequently overflowed banks of rivers whose waters contain little sediment. It is small or medium-sized and, like many of the trees growing in igapó (swamp forest), is seldom of good form for timber. The genus *Peltogyne*, however, includes some large trees of the terra firme (upland) forest having tall cylindrical boles suitable for lumber, but such specimens are too scattered to be of much economic importance. They are often known as Pau Roxo da Terra Firme and the principal species are *Peltogyne LeCointei* Ducke (Obidos and Tapajoz), *P. excelsa* Ducke (upper Rio Negro), and *P. gracilipes* Ducke (upper Rio Branco); their woods seem to preserve their beautiful color longer than that of the common *P. densiflora*.

Pau Roxo (Purpleheart of the English and United States timber trade) is brown when first cut but soon acquires a magnificent purple color when exposed. It is hard and heavy (sp. gr. around 1.00), but easy to work, and is used in Amazonia (chiefly Pará) for joinery, cabinetwork, and sometimes also for carpentry. Lumber is cut in the sawmills of Pará,

mostly for local consumption though some is exported, particularly to southern Brazil, under the trade name of Violete, which is more frequently applied to timber of the genus *Dalbergia*.

22. Pau Santo, *Zollernia paraensis* Huber, family Leguminosae-Caesalpinioideae.—A medium-sized to large tree of rare occurrence in upland forest of the eastern and southeastern parts of the State of Pará (Bragança railroad, Tocantins, and lower Tapajoz). The wood is more or less dark greenish black and extremely hard and heavy (sp. gr. 1.30–1.33). It is considered excellent for turnery, but the quantity available is very limited. The name Pau Santo is applied in the Rio Negro region to a yellow timber produced by *Peridiscus lucidus* Benth. (family Flacourtiaceae).

23. Pracuúba, *Mora paraensis* Ducke, family Leguminosae-Caesalpinioideae.—The name is also given to two other kinds of timber, namely *LeCointea amazonica* Ducke (family Leg.-Caesalp.), in varzea along the whole Amazon, and *Trichilia LeCointei* Ducke (family Meliaceae), in the Amazon estuary (rare in the State of Amazonas); but only the *Mora* is likely to become important in the trade.

Mora paraensis is the most common of the very large trees of the varzea forest along many of the rivers of the great estuary of the Amazon, from the city of Pará (Rio Guamá) to Macapá and westward to the mouths of the Xingú and Parú. It is closely related to the famous Mora of British Guiana, but its timber has so far been neglected in commerce and even in local industry, owing perhaps to the difficulty of cutting such large trees. The wood is light or dark reddish brown (Pracuúba Branca and Pracuúba Vermelha, respectively), rather hard and heavy (sp. gr. 0.83–0.96), and is suitable for carpentry and strong and durable construction.

24. Piquiá, *Caryocar villosum* (Aubl.) Pers., family Caryocaraceae.—One of the largest-boled trees of Amazonia, widely but sparsely distributed in upland forest throughout the Amazon region and the State of Marinhão and the Guianas, and sometimes cultivated for its edible fruits. The wood is yellowish when fresh, but becomes grayish brown when dry and old. It is of medium hardness and weight (sp. gr. about

0.81), very strong and resistant, and excellent for naval construction and carpentry. It is exported in small quantities from Pará, but it is not abundant enough to become important in the timber trade.

Piquiá-rana is the name for other Amazonian species of *Caryocar*, one of which yields good timber and is of more frequent occurrence than the true Piquiá. Piquiá Marfim (ivory Piquiá) applies at Manáos to an apocynaceous tree, *Aspidosperma centrale* Mgf., whose wood is a sort of Peroba.

25. Saboarána, *Swartzia laevicarpa* Amsh. (probably the same as *S. Benthamiana* Miq. of Guiana), family Leguminosae-Caesalpinioideae.—A low to medium-sized tree of frequent occurrence in the central and western parts of Brazilian Amazonia, chiefly in lowland forest along the banks of the lower Rio Negro. The wood is very hard and heavy. Only the largest trees contain heartwood, which is one of the most beautiful cabinet woods of the region, being brown or reddish brown with purplish brown stripes. Because of the difficulty of obtaining good pieces the wood is costly and is not exported.

26. Sapupira or Sucupira, *Bowdichia* spp. and *Diplotropis* spp., family Leguminosae-Papilionatae.—The name Sucupira has been introduced from northeastern Brazil and applies to several leguminous woods. The two genera mentioned might perhaps better be united into one genus, *Bowdichia*.

The most frequent species in the upland forest are *Bowdichia nitida* Spruce ex Benth. and *D. purpurea* (Rich.) Amshoff. *D. Martiusii* Benth. occurs in the igapó or varzea forest along rivers having little sediment in their water. They are medium-sized, or occasionally large, trees with a hard and heavy, deep chocolate-brown heartwood which resembles Acapú but is coarser-textured and much more difficult to work. It is used extensively in local industries for civil and naval construction and railway crossties, and is cut into lumber in the sawmills at Pará, but only insignificant quantities are exported.

In the Madeira region (Porto Velho), the name Sucupira is also applied to *Recordoxylon amazonicum* Ducke which belongs to the Leguminosae-Caesalpinioideae but has a wood like the preceding. This timber has been little exploited, but

the tree is one of the largest in the virgin forest and its enormous bole yields pieces of great dimensions.

27. Tauary is a name for species of the genera *Couratari*, *Allantoma*, and *Cariniana* of the family Lecythidaceae and also (on the upper Amazon) for Pau d'Arco (Ipé of southern Brazil), a species of *Tabebuia* (or *Tecoma*), family Bignoniaceae. Of all of these, the only one of interest to the trade is *Cariniana*, the genus supplying the well-known Jequitibá timber of southern Brazil.

Cariniana micrantha Ducke is often of giant size and of rather frequent occurrence in upland rain forest throughout Brazilian Amazonia except eastward of the basins of the Tapajoz and the Trombetas. It is closely allied to *C. pyriformis* Miers of Colombia and Venezuela and its little-known timber may prove to be equally good. The light brown wood bears some resemblance to Spanish Cedar, is easy to work, and offers good opportunities for commerce in the future. On the upper Juruá the vernacular name for this tree seems to be Cedro Macho (literally Male Cedar, but meaning False Cedar).

STUDIES IN THE SAPOTACEAE, III. A NEW SPECIES OF *MANILKARA* FROM CUBA

By CHARLES L. GILLY

New York Botanical Garden

Among specimens recently received for identification were two sheets of a sapotaceous plant which on first examination seemed to be a species of *Mimusops*. Further study of this material, and of specimens previously collected from the same locality, shows conclusively that in spite of the presence of some four-parted flowers the several collections in question should be referred to the genus *Manilkara*. This proposed new species, related to both *M. emarginata* (L.) Britton & Wilson and *M. Wrightiana* (Pierre) Dubard, may be characterized as follows:

Manilkara Howardii Gilly, sp. nov.—Arbor minor, ad 5 m. alta, trunco ad 13 cm. diametro, cortice griseo, levi; foliis ad

apicem ramorum aggregatis; laminae coriaceae ellipticae vel anguste oblongo-ellipticae, 4–6.5 cm. longae, 2–3.5 cm. latae, ad basim rotundato-obtusae, ad apicem rotundatae et emarginatulae, margine tenuiter revoluta, supra opacae vel subglaucae et glabrae, subtus opacae et rufotomentellae ad venulas, usque glabrescentes; costa supra impressa, subtus prominens; nervis lateralibus 8–15; venulis supra obsoletis subtus reticulatis et prominentibus; petiolus 1–1.5 cm. longus, sparse rufotomentellus; flores in axillis solitarii, pedicellis 2.5–3 cm. longis, glabris vel sparse strigulosis; perianthium biseriatum, segmenta extus dense rufotomentella, intus sparse albido-tomentella; lobis exterioribus valvatis (sepalis) 3 vel 4, anguste ovato-triangularis, ad apicem acutis, 7 mm. longis et 4 mm. latis; lobis interioribus imbricatis (petalis) 3 vel 4, ovatis, 7.5 mm. longis et 4.5–5 mm. latis, ad apicem acutis vel mucronulatis, ad basim rotundato-constrictis et 1 mm. lati; androecium coroniforme tubulatum glabrum, tubus coronae cylindricus, ad 1.5 mm. altus; staminodia exteriora 18 vel 24, in consortiis 6 vel 8 terna conjuncta, lobo medio lobis lateralibus majora, anguste spatulato-elliptico, 6.5 mm. longo, ad apicem obtuso vel subacuto; lobis lateralibus divergentibus, ad 4 mm. longis, lanceolatis, margine laciniato-erosa; stamina 6 vel 8, lobo medio staminodiorum exteriorum opposita; filamenta anguste lineari-triangularia, 4.5 mm. longa; antherae sagittato-ovatae, 3 mm. longae, extrorsae, thecis longitudinaliter dehiscentibus; staminodia interiora cum staminibus alternantia 6 vel 8, brevia, quadrangularia vel triangularia, ad apicem acuta, truncata vel crenato-dentata, 0.5 mm. longa minusve, ad 2 mm. lata ad basim; ovarium globosum strigosum, ad 5 mm. altum et crassum, 10–12 loculare, loculis 1-ovulatis; ovula ad lateralim vel ad basim affixa; stylus crassus glaber, ad 10 mm. longus, stigmatibus obscuris; fructus (in specimini typico) non visus.

Specimens examined: CUBA: Las Villas (=Santa Clara): near Milpa, common on coralline outcrops along Cienfuegos Bay, June 29, 1941, *R. A. Howard 5423* (G, NY—type); same locality, Mch. 21, 1910, *Britton & Wilson 5748* (NY). A sterile specimen from Punta Diablo, Cienfuegos Bay, March 19, 1910, *Britton & Wilson 5662* (NY), is apparently referable here.

All of the very few flowers on the specimens collected by Howard are 4-parted. Some of the flowers of the Britton and Wilson specimen from the same locality are 3-parted and others 4-parted; this specimen is merely in bud but, although their size cannot be accurately determined, the structure of the flower parts matches that of the flowers from the Howard specimen. Fruits on a second sheet of the Britton and Wilson material from Milpa are 4 cm. in diameter (perhaps larger before drying?) apparently nearly globose, granular-crustaceous on the outer surface and 10–12-locular. The seeds, insofar as can be determined from the material at hand, are elliptic in outline, compressed, about 1.8 cm. long, 1.2 cm. wide and 5 mm. in thickness; the hilar scar is basi-lateral, linear, and about one-third the length of the seed.

Manilkara Howardii differs from both *M. emarginata* and *M. Wrightiana* in the prominently reticulate under-surface of the leaves and the minute staminodes.

KEYS TO AMERICAN WOODS (CONTINUED)

By SAMUEL J. RECORD

The keys given below are the sixth and seventh, respectively, in the series begun in *Tropical Woods* No. 72, December 1, 1942, and continued in No. 73, March 1, 1943. Those preceding are: I. Ring-porous woods. II. Pores in ulmiform or wavy tangential arrangement. III. Pores in flame-like or dendritic arrangement. IV. Vessels virtually all solitary. V. Vessels with spiral thickenings.

VI. Vessels with scalariform perforation plates. In this key there are 146 named genera of 68 different families. In only a few more than half of the genera mentioned are the plates exclusively scalariform. In contrast, there are about 135 families with a total of several hundred American genera in which the vessel perforations are exclusively simple.

VII. Vessels with very fine pitting. Good examples of pits in this size class are provided by *Swietenia* and *Betula*. In most instances all of the pits are very small, but occasionally they are associated with larger ones. In woods with solitary

vessels the pitting may be confined to the walls of contact between members of the same vessel or between vessels and parenchyma cells, particularly ray cells. In the latter case the ray pits may be large and the vascular pits very small (unilaterally compound pitting) or the pit-pairs may be of two distinct sizes. Very small pits are typically alternate and the vessel perforations are predominantly simple.

VI. VESSELS WITH SCALARIFORM PERFORATION PLATES

1 a. Rays in part conspicuous (7 or more cells wide or over 150 cells high, or both) 2
b. Rays not conspicuous, though often distinct 46

2 a. Woods with included phloem; large rays composed of conjunctive tissue ..... *Doliocarpus* (Dilleniaceae).
b. Woods without included phloem; large rays not conjunctive tissue. 3

3 a. Apparently broad rays really aggregates of fine rays 4
b. Broad rays solid or aggregates of coarse rays 6

4 a. Vessels with spirals ..... *Corylus* (Corylaceae)
b. Vessels without spirals 5

5 a. Rays all uniseriate or partially biseriate; aggregates common. Intervascular pitting mostly opposite ..... *Alnus* (Betulaceae).
b. Rays 1–4 (5) cells wide; aggregates uncommon. Intervascular pitting alternate ..... *Betula* (Betulaceae).

6 a. Fibers with distinct to conspicuous bordered pits, at least in part. 7
b. Fibers with simple or inconspicuous bordered pits 34

7 a. Vessels virtually all solitary 8
b. Vessels not all solitary 29

8 a. Vasicentric tracheids abundant ..... *Lithocarpus*, *Quercus* (Fagaceae).
b. Vasicentric tracheids absent 9

9 a. Pores few and large ..... *Curatella*, *Davilla* (Dilleniaceae).
b. Pores numerous and small 10

10 a. Vessels with spirals 11
b. Vessels without spirals 14

11 a. Perforation plates with few bars. Fibers with spirals. *Garrya* (Garryaceae).
b. Perforation plates with many bars 12

12 a. Rays often over 8 cells wide and up to 150 (200) cells high. Fibers with spirals. Parenchyma diffuse to reticulate. *Villaresia mucronata* (Icacinaceae)

b. Rays infrequently up to 8 cells wide and 50 cells high. Fibers without spirals 13

13 a. Parenchyma fairly abundant, diffuse to reticulate. Uniseriate rays mostly low; pits to vessels very small, round and opposite or narrowly elongated and parallel ..... *Vaccinium* (Vacciniaceae).
b. Parenchyma very sparse. Uniseriate rays mostly high; pits to vessels rather small, round to oval ..... *Staphylea* (Staphyleaceae).

14 a. Conspicuous rays few and consisting of aggregates of rays 3–5 cells wide; other rays 1–3 cells wide ..... *Kalmia* (Ericaceae).
b. Conspicuous rays numerous and typically solid 15

15 a. Rays often more than 100 cells high 16
b. Rays typically less than 50, occasionally up to 100, cells high.. 25

16 a. Larger rays 4–6 (8) cells wide 17
b. Larger rays 7–15 (20) cells wide 21

17 a. Parenchyma very sparse or apparently absent. Perforations often simple in part 18
b. Parenchyma fairly abundant; diffuse to reticulate. Perforations exclusively multiple 20

18 a. Vessels with spirals, at least in tips of members. Fiber pits large. *Gaylussacia* (Vacciniaceae).
b. Vessels without spirals. Fiber pits rather small 19

19 a. Growth rings present. Pores small ..... *Psammisia* (Vacciniaceae).
b. Growth rings apparently absent. Pores very small. *Cavendishia* (Vacciniaceae).

20 a. Vessel-ray pitting mostly rather fine to medium. Perforation plates with numerous fine and closely spaced bars.. *Calatola* (Icacinaceae).
b. Vessel-ray pitting coarsely scalariform. Perforation plates with rather coarse and widely spaced bars ..... *Oecopetalum* (Icacinaceae).

21 a. Parenchyma diffuse and unilaterally aliform. Pores in part medium-sized to rather large. Vessel-ray pitting medium 22
b. Parenchyma abundantly reticulate. Pores small to minute (exc. *Poraqueiba*) 23

22 a. Procumbent ray cells mostly sclerotic. Pores medium-sized. Density high ..... *Emmotum* (Icacinaceae).
b. Ray cells not sclerotic. Pores large. Density medium. *Dendrobangia* (Icacinaceae).

23 a. Vessel-ray pitting all very fine ..... *Ottoschulzia* (Icacinaceae).
b. Vessel-ray pitting coarsely scalariform, at least in part 24

24 a. Pores medium-sized in part; not very numerous. *Poraqueiba* (Icacinaceae).
b. Pores all small; very numerous ..... *Metteniusa* (Icacinaceae).

25 a. Parenchyma very sparse 26
b. Parenchyma diffuse and in short tangential lines 27

26 a. Multiseriate rays with strata of long procumbent cells; vessel-ray pitting opposite, rather fine . . . . . *Staphylea* (Staphyleaceae).
b. Procumbent cells absent or short; vessel-ray pitting coarsely scalariform . . . . . *Macleania* (Vacciniaceae).

27 a. Rays up to 25 (30) cells high. Vessel-ray pitting fine and opposite to narrowly elongated and scalariform. Heartwood light to dark reddish brown, often more or less oily . . . . . *Cyrilla* (Cyrillaceae).
b. Rays up to 50 (100) cells high 28

28 a. Growth rings distinct. Vessel-ray pitting with tendency to scalariform. Heartwood brown to reddish brown, sometimes with greenish hue; sharply demarcated from the sapwood . . *Cornus florida* (Cornaceae).
b. Growth rings absent or poorly defined. Vessel-ray pitting fine, without tendency to scalariform. Heartwood brownish, merging gradually into the sapwood . . . . . *Ternstroemia* (Theaceae).

29 a. Multiseriate rays homogeneous or nearly so 30
b. Multiseriate rays distinctly heterogeneous 32

30 a. Pores few, medium-sized to large. Parenchyma in numerous fine concentric bands throughout growth ring. Scalariform plates infrequent. *Panopsis* (Proteaceae).
b. Pores numerous, small 31

31 a. Many rays 1–3 cells wide. Parenchyma in wavy or broken uniseriate bands, more numerous in outer late wood. Perforation plates infrequently scalariform . . . . . *Fagus* (Fagaceae).
b. Few rays 1–3 cells wide. Parenchyma sparse; occasionally in short tangential lines and diffuse. Perforation plates mostly scalariform. *Platanus* (Platanaceae).

32 a. Multiseriate rays with sheaths of square or upright cells surrounding one or more cores of slender procumbent cells. Fibers septate in part. *Ribes* (Grossulariaceae).
b. Rays without sheaths. Fibers not septate 33

33 a. Parenchyma in short tangential lines and diffuse. Pores radially arranged. Vessels and fibers often with distinct spirals. Heartwood chalky white . . . . . *Ilex* (Aquifoliaceae).
b. Parenchyma absent or very sparse. Pores not in definite radial arrangement. Vessels and fibers without spirals. Heartwood reddish or brownish . . . . . *Turpinia* (Staphyleaceae).

34 a. Rays all broad and extending full length of the internodes; rarely in contact with the pores . . . . . *Piper* (Piperaceae).
b. Rays not all broad; heights variable; often in contact with the pores 35

35 a. Gum ducts present in some of the rays. *Dendropanax*, *Oreopanax* (Araliaceae).
b. Gum ducts absent from the rays 36

36 a. Pores (and parenchyma) in numerous scallops or festoons between the large rays 37
b. Pores not so arranged 38

37 a. Pores rather small; in a continuous tangential row in each parenchyma band. Narrow rays few. Vessels without spirals. *Embothrium* (Proteaceae).
b. Pores minute; composing bands of variable width and spacing, the parenchyma obscure. Narrow rays fairly numerous. Vessels with spirals . . . . . *Guevina* (Proteaceae).

38 a. Vessels virtually all solitary. Perforation plates often appearing to extend the full length of a vessel member. *Hedyosmum* (Chloranthaceae).
b. Vessels not all solitary. Perforation plates not exceptionally long. 39

39 a. Fibers abundantly septate, at least in part. Parenchyma absent or very sparse 40
b. Fibers not septate. Parenchyma abundant 44

40 a. Perforations predominantly simple. *Mayna*, *Ryania* (Flacourtiaceae).
b. Perforations exclusively multiple 41

41 a. Parenchyma diffuse, the strands often with several large cells. *Mollinedia* (Monimiaceae).
b. Parenchyma apparently absent 42

42 a. Pores often in long multiples, appearing in distinct radial arrangement because of the close spacing of the rays. *Carpotroche* (Flacourtiaceae).
b. Pores in short multiples and not appearing in distinct radial arrangement, the rays being less closely spaced 43

43 a. Intervascular pitting fine to very fine; irregular. *Rinorea* (Violaceae).
b. Intervascular pitting medium to rather coarse; opposite to locally scalariform . . . . . *Amphirrox* (Violaceae).

44 a. Parenchyma in numerous narrow concentric bands 1–4 cells wide, forming a spider-web pattern with the rays. Pores few. *Panopsis* (Proteaceae).
b. Parenchyma reticulate. Pores rather numerous 45

45 a. Rays frequently more than 8, sometimes up to 15, cells wide; cells rounded and fairly uniform (tang. sect.) . . . . . *Grias* (Lecythidaceae).
b. Rays infrequently up to 8 cells wide; cells very irregular in size and shape (tang. sect.) . . . . . *Discophora* (Icacinaceae).

46 a. Vessels virtually all solitary (at least in late wood) 47
b. Vessels not all solitary 97

47 a. Perforations frequently to predominantly simple 48
b. Perforations exclusively or predominantly multiple 56

48 a. Pores in late wood in flame-like or dendritic arrangement. Vasicentric tracheids abundant. Rays uniseriate; homogeneous or nearly so. *Castanopsis* (Fagaceae).

b. Pores not in flame-like or dendritic arrangement. Vasicentric tracheids apparently absent. Rays not all uniseriate; heterogeneous..... 49

49 a. Rays typically all less than 4 cells wide..... 50

b. Rays frequently 4–6 cells wide..... 54

50 a. Vessel-ray pitting fine; not scalariform..... 51

b. Vessel-ray pitting medium to very coarse; scalariform in part.... 52

51 a. Vessels with spirals. Parenchyma very sparingly paratracheal. Fibers with conspicuous bordered pits. More or less ring-porous. *Elliottia* (Ericaceae).

b. Vessels without spirals. Parenchyma diffuse to finely reticulate. Fibers with inconspicuous bordered pits. Diffuse-porous. *Remijia* (Rubiaceae).

52 a. Parenchyma very sparse; not reticulate. Vessels with spirals. *Oxydendrum* (Ericaceae).

b. Parenchyma fairly abundant; more or less reticulate..... 53

53 a. Vessels with spirals. Fiber pits large.....*Myrceugenia* (Myrtaceae).

b. Vessels without spirals. Fiber pits small. *Cassipourea* (Rhizophoraceae).

54 a. Pores rather large, variable in abundance. Multiseriate rays up to 50 (100) cells high; procumbent cells long. Vessels without spirals. Parenchyma reticulate.....*Hieronyma* (Euphorbiaceae).

b. Pores small, numerous. Rays with few or no long procumbent cells. 55

55 a. Multiseriate rays up to 25 (50) cells high. Vessels without spirals. Parenchyma diffuse to reticulate.....*Schizocardia* (Clethraceae).

b. Multiseriate rays up to 100 or more cells high. Vessels with spirals in tips of members. Parenchyma unilaterally paratracheal. *Satyria* (Ericaceae).

56 a. Vessel-ray pitting fine to medium..... 57

b. Vessel-ray pitting coarse, often scalariform..... 78

57 a. Rays homogeneous or with very few upright cells..... 58

b. Rays heterogeneous, typically with many upright cells..... 60

58 a. Rays mostly 2 or 3 cells wide...*Symplocos tinctoria* (Symplocaceae).

b. Rays all uniseriate or partially biseriate..... 59

59 a. Oil cells present in parenchyma strands. *Capsicodendron* (Canellaceae).

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

60 a. Rays all uniseriate or partially biseriate..... 61

b. Rays wider..... 63

61 a. Pores in part medium-sized to large. Perforation bars widely spaced. *Humiria, Sacoglottis* (Humiriaceae).

b. Pores all very small to minute..... 62

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

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

63 a. Septate fibers arranged in parenchyma-like bands. *Elaeodendron* (Celastraceae).

b. Septate fibers absent or, if present, not in bands..... 64

64 a. Vessels with spirals (sometimes limited to tips of members).... 65

b. Vessels without spirals..... 69

65 a. Rays up to 6 cells wide and to 50 or more cells high..... 66

b. Rays not over 4 cells wide and typically less than 30 cells high.. 67

66 a. Multiseriate rays with stratum of long and narrow procumbent cells uniseriate rays few.....*Clethra* (Clethraceae).

b. Multiseriate rays with few or no long and narrow procumbent cells; uniseriate rays numerous.....*Saurauia* (Saurauiaceae).

67 a. Semi-ring-porous (under compound microscope). Perforations exclusively multiple. Uniseriate rays very numerous. Parenchyma diffuse.....*Rhododendron* (Ericaceae).

b. Diffuse-porous..... 68

68 a. Perforations simple in part. Parenchyma very sparse. Rays nearly all 2 or 3 cells wide; usually with single marginal rows of square or upright cells.....*Oxydendrum* (Ericaceae).

b. Perforations exclusively multiple. Parenchyma abundant; diffuse to reticulate. Multiseriate and uniseriate rays about equal in number; upright cells very numerous.....*Escallonia* (Escalloniaceae).

69 a. Pores medium-sized in part..... 70

b. Pores all small to minute..... 71

70 a. Semi-ring-porous. Perforation plates with many bars. Parenchyma very sparse. Texture fine.....*Lyonia* (Ericaceae).

b. Diffuse-porous. Perforation plates with few bars. Parenchyma abundant. Texture coarse.....*Goupia* (Celastraceae).

71 a. Fibers with fine spirals.....*Philadelphus* (Hydrangeaceae).

b. Fibers without spirals..... 72

72 a. Perforation plates short oval, with rather few bars..... 73

b. Perforation plates long, with many bars..... 74

73 a. Pores thin-walled. Perforations simple in part. Parenchyma reticulate. *Myrica* (Myricaceae).

b. Pores thick-walled. Perforations exclusively multiple. Parenchyma sparingly diffuse.....*Tricera* (Buxaceae).

74 a. Rays with definite strata of slender procumbent cells..... 75

b. Rays composed mostly of square and upright cells; procumbent cells short..... 76

75 a. Fiber pits small, exceedingly numerous. Pores frequently crowded. Perforations often no wider than the bars. Vessel-ray pitting very fine. *Cliftonia*, *Cyrilla* (Cyrillaceae).

b. Fiber pits large, moderately numerous. Pores not crowded. Perforations usually three times as wide as the bars. Vessel-ray pitting medium. *Cornus* (Cornaceae).

76 a. Rays typically uniseriate and biseriate; rather fine-celled; sheath cells absent. *Viburnum* (Caprifoliaceae).

b. Rays frequently 3 or 4 cells wide; coarse-celled; sheath cells common. 77

77 a. Perforation bars thin. Interior cells of multiseriate rays fairly uniform in size (tang. sect.). Heartwood gray to purplish blue. *Calatola* (Icacinaceae).

b. Perforation bars coarse. Interior cells of multiseriate rays very irregular in size and shape (tang. sect.). Heartwood pale reddish brown. *Saurauia* (Saurauiaceae).

78 a. Rays 1 or 2 (3) cells wide. 79

b. Rays often 3 or more cells wide. 89

79 a. Vessels with spirals in tips of members. 80

b. Vessels without spirals. 81

80 a. Rays all uniseriate or partially biseriate and less than 30 cells high; without definitely upright cells. *Franklinia*, *Gordonia* (Theaceae).

b. Rays often 2, sometimes 3, cells wide and up to 50 cells high; with many upright cells. *Stewartia* (Theaceae).

81 a. Pores in part medium-sized to large. 82

b. Pores all small to minute. 83

82 a. Pores rather few, large, thick-walled. Fiber lumen minute. *Vantanea* (Humiriaceae).

b. Pores numerous, medium-sized, rather thin-walled. Fiber lumen fairly large. *Laplacea Brenesii* (Theaceae).

83 a. Rays with few or no long procumbent cells. 84

b. Rays with many long procumbent cells. 86

84 a. Perforations simple in part. Fiber pits small. *Englerodoxa* (Vacciniaceae).

b. Perforations exclusively multiple. Fiber pits large. 85

85 a. Perforation plates few-barred in part. Crystals numerous in vertical series of 2–4 cubical cells in tiers of upright ray cells. *Distylium* (Hamamelidaceae).

b. Perforation plates all many-barred. Crystals not in vertical series of ray cells. *Illicium* (Winteraceae).

86 a. Rays virtually all uniseriate. Perforation plates usually with less than 15 bars. *Hamamelis* (Hamamelidaceae).

b. Rays often biseriate. Perforation plates generally with more than 15 bars. 87

87 a. Vessel-ray pitting coarsely scalariform. Parenchyma more or less reticulate. *Laplacea* (Theaceae).

b. Vessel-ray pitting opposite, with tendency to scalariform. Parenchyma sparingly diffuse. 88

88 a. Rays composed mainly of square and upright cells. Pores not crowded. *Eurya* (Theaceae).

b. Rays composed mainly of procumbent cells. Pores crowded. *Liquidambar* of Central America (Hamamelidaceae).

89 a. Perforations simple in part. Parenchyma unilaterally paratracheal, sometimes locally confluent. 90

b. Perforations exclusively scalariform. Parenchyma not unilaterally paratracheal; mostly diffuse to reticulate. 91

90 a. Rays 1–7 cells wide and up to 100 or more cells high. Pores all small. Vessels with spirals in tips of members. *Satyria* (Ericaceae).

b. Rays 1–4 cells wide and up to 50 (60) cells high. Pores medium-sized in part. Vessels without spirals. *Sterigmapetalum* (Rhizophoraceae).

91 a. Largest rays 3 (4) cells wide. 92

b. Largest rays 4–6 (8) cells wide. 93

92 a. Fiber lumen very small. Pores thick-walled. Perforation bars rather coarse; not very numerous. Rays up to 60 (80) cells high. *Heisteria* (Olacaceae).

b. Fiber lumen rather large. Pores thin-walled. Perforation bars fine; very numerous. Rays up to 25 (40) cells high. *Caldcluvia*, *Weinmannia* (Cunoniaceae).

93 a. Fiber pits simple or indistinctly bordered. Uniseriate rays few; definitely upright cells few or absent. Pores thick-walled. *Rhizophora* (Rhizophoraceae).

b. Fiber pits distinctly bordered. Uniseriate rays numerous; definitely upright cells numerous. Pores thin-walled. 94

94 a. Multiseriate rays with strata of long procumbent cells; sheath cells absent. 95

b. Multiseriate rays without strata of long procumbent cells; sheath cells present. 96

95 a. Vessel-ray pitting opposite. Parenchyma very sparingly diffuse. *Staphylea* (Staphyleaceae).

b. Vessel-ray pitting scalariform. Parenchyma abundantly diffuse to reticulate. *Symplocos* (Symplocaceae).

96 a. Rays up to 30 (50) cells high; vessel-ray pitting opposite to scalariform. *Viburnum* (Caprifoliaceae).

b. Rays up to 150 cells high; vessel-ray pitting coarsely scalariform. *Oecopetalum* (Icacinaceae).

97 a. Fibers with distinct to conspicuous bordered pits..... 98
b. Fibers with simple or inconspicuous bordered pits..... 112

98 a. Ring-porous, with multiseriate band of large pores in early wood. *Castanea* (Fagaceae).
b. Diffuse-porous..... 99

99 a. Radial gum ducts present.....*Mammea* (Guttiferae).
b. Radial gum ducts absent..... 100

100 a. Parenchyma reticulate..... 101
b. Parenchyma not reticulate..... 109

101 a. Rays uniseriate..... 102
b. Rays 2-sized, the larger at least 3 cells wide..... 103

102 a. Rays very high and closely spaced; vessel-ray pitting very coarse. *Peridiscus* (Flacourtiaceae).
b. Rays usually less than 30 cells high; vessel-ray pitting very fine. *Pamphilia* (Styracaceae).

103 a. Fiber pits large. Intervascular pitting more or less scalariform... 104
b. Fiber pits not large. Intervascular pitting very fine, not scalariform..... 106

104 a. Perforation plates mostly short. Fiber pits rather small. Multiseriate rays with stratum of slender procumbent cells. *Myrceugenia apiculata* (Myrtaceae).
b. Perforation plates typically long. Fiber pits large..... 105

105 a. Multiseriate rays with stratum of slender procumbent cells sharply demarcated from the marginal cells; enlarged crystalliferous cells common; vessel-ray pitting finely scalariform. *Aextoxicon* (Aextoxicaceae).
b. Multiseriate ray cells variable in form; enlarged crystalliferous cells absent; vessel-ray pitting not scalariform.....*Styloceras* (Buxaceae).

106 a. Perforations predominantly simple..... 107
b. Perforations predominantly multiple..... 108

107 a. Pores all very small to minute. Vessel pits vestured. Parenchyma finely reticulate. Fibers with thin walls and large pits. *Rauwolfia Duckei* (Apocynaceae).
b. Pores medium-sized in part. Vessel pits not vestured. Parenchyma coarsely reticulate in part. Fibers with thick walls and rather small pits.....*Dichapetalum* (Dichapetalaceae).

108 a. Pores all small to very small. Perforation bars closely spaced. Fiber pits medium-sized.....*Halesia* (Styracaceae).
b. Pores medium-sized in part. Perforation bars widely spaced. Fiber pits small.....*Styrax* (Styracaceae).

109 a. Rays distinctly 2-sized, the larger often 3–5 cells wide..... 110
b. Rays not distinctly 2-sized, being mostly 1 or 2, infrequently 3 or 4, cells wide..... 111

110 a. Pores medium-sized; numerous but not crowded laterally; mostly in radial multiples of 2–5. Intervascular pitting opposite. Rays 1–5 (8) cells wide; uniseriates tall.....*Turpinia* (Staphyleaceae).
b. Pores small to minute; very numerous, often crowded; mostly not in multiples. Intervascular pitting scalariform. Rays 1–4 (6) cells wide; uniseriates usually only a few cells high. *Eucryphia* (Eucryphiaceae).

111 a. Spirals common in tips of vessel members. Intervascular and vessel-ray pitting scalariform in part. Parenchyma sparingly diffuse. Vertical gum ducts sporadic.....*Liquidambar* (Hamamelidaceae).
b. Spirals absent or of very rare occurrence in tips of vessel members. Intervascular and vessel-ray pitting typically opposite. Parenchyma diffuse or in short tangential lines. Gum ducts absent. *Nyssa* (Nyssaceae).

112 a. Parenchyma in apparently terminal bands 2–5 cells wide. Pores rather few.....*Rhabdodendron macrophyllum* (Phytolaccaceae).
b. Parenchyma not in concentric bands. Pores numerous..... 113

113 a. Parenchyma reticulate..... 114
b. Parenchyma not reticulate..... 121

114 a. Perforations all multiple.....*Minquartia* (Olacaceae).
b. Perforations mostly simple..... 115

115 a. Rays 1 or 2 (3) cells wide..... 116
b. Rays 1–4 (6) cells wide..... 120

116 a. Vessel-ray pitting unilaterally compound. Vessel pits vestured. *Anacampta* (Apocynaceae).
b. Vessel-ray pitting not unilaterally compound. Vessel pits not vestured. 117

117 a. Vessel-ray pitting very fine.....*Drypetes* (Euphorbiaceae).
b. Vessel-ray pitting rather to very coarse, often scalariform..... 118

118 a. Pores large in part.....*Caryocar* (Caryocaraceae).
b. Pores all small to minute..... 119

119 a. Growth rings distinct. Vessels sometimes with spirals; tyloses common to abundant. Parenchyma lines coarse.....*Nothofagus* (Fagaceae).
b. Growth rings absent or indistinct. Vessels without spirals; tyloses apparently absent. Parenchyma lines fine..*Belangera* (Cunoniaceae).

120 a. Multiseriate rays with strata of long procumbent cells; typically rounded (tang. sect.). Pores often in long multiples. Vessel-ray pitting 2-sized.....*Asteranthos* (Lecythidaceae).
b. Rays not stratified; cells nearly all upright or square; typically flattened hexagonal (tang. sect.). Pores usually in short multiples. Vessel-ray pitting coarse.....*Siparuna* (Monimiaceae).

121 a. Radial gum ducts present 122
b. Radial gum ducts absent 123

122 a. Rays enlarged about ducts; uniseriates numerous. Perforation bars numerous, closely spaced . . . . . *Campnosperma* (Anacardiaceae).
b. Rays not distinctly enlarged about ducts; uniseriates few. Perforation bars rather few, widely spaced.
Dendropanax, *Didymopanax*, *Oreopanax* (Araliaceae).

123 a. Tanniniferous tubes common in rays 124
b. Tanniniferous tubes absent 128

124 a. Parenchyma sparingly paratracheal and diffuse 125
b. Parenchyma in closely to widely spaced narrow concentric bands. 126

125 a. Perforations exclusively multiple. Growth rings normally absent. Rays not over 2 cells wide . . . . . *Dialyanthera* (Myristicaceae).
b. Perforations simple in part. Growth rings frequently demarcated by flattened fibers. Rays at times 3–5 cells wide . . *Virola* (Myristicaceae).

126 a. Perforations predominantly simple . . . *Osteophloeum* (Myristicaceae).
b. Perforations predominantly to exclusively multiple 127

127 a. Rays all 1 or 2 cells wide . . . . . *Iryanthera* (Myristicaceae).
b. Rays sometimes 3–5 cells wide . . . . . *Compsoneura* (Myristicaceae).

128 a. Oil cells present in either rays or parenchyma strands or both . . 129
b. Oil cells absent 130

129 a. Vessels with predominantly simple perforations; intervascular pitting alternate. Parenchyma not exclusively terminal. Fibers often septate.
Lauraceae.
b. Vessels with exclusively multiple perforations; intervascular pitting scalariform. Parenchyma all in terminal bands, sometimes doubled. Fibers not septate . . . . . *Talauma* (Magnoliaceae).

130 a. Rays homogeneous or nearly so 131
b. Rays definitely heterogeneous, at least in part 134

131 a. Vessels with spirals. Perforation plates with few bars 132
b. Vessels without spirals. Perforation plates with many bars 133

132 a. All vessels with scalariform perforation plates. Rays frequently aggregated . . . . . *Corylus* (Corylaceae).
b. Only smallest vessels with scalariform perforation plates. Rays not aggregated . . . . . *Ostyra* (Corylaceae).

133 a. Intervascular pitting mostly opposite. Rays often aggregated.
Alnus (Betulaceae).
b. Intervascular pitting alternate. Rays rarely aggregated.
Betula (Betulaceae).

134 a. Fibers septate, at least in part. Parenchyma sparse or apparently absent 135
b. Fibers not septate. Parenchyma various 148

135 a. Fibers of two distinct types: thick-walled non-septate and thin-walled septate resembling diffuse parenchyma. Parenchyma limited to diffuse crystalliferous strands . . . . . *Marila* (Guttiferae).
b. Fibers not of two distinct types. Parenchyma sparingly paratracheal or absent 136

136 a. Vessels with spirals. More or less ring-porous 137
b. Vessels without spirals. Diffuse-porous 139

137 a. Vessel spirals fine and indistinct. Small pores in late wood mostly not in multiples. Scalariform plates few . . . . . *Arctostaphylos* (Ericaceae).
b. Vessel spirals rather coarse and very distinct. Pores in late wood mostly in multiples. Scalariform plates few to many 138

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

139 a. Rays 1 or 2 (3) cells wide 140
b. Rays often 3 or 4 (5) cells wide 141

140 a. Pores very numerous and evenly distributed; composing ground mass of the wood. Intervascular pitting medium, mostly opposite. Rays mostly biseriate, with strata of procumbent cells.
Oreopanax meiocephalum (Araliaceae).
b. Pores not very numerous; mostly in radial multiples; ground mass of wood composed of fibers. Intervascular pitting coarse, mostly scalariform. Rays mostly uniseriate, without strata of procumbent cells.
Brunellia (Brunelliaceae).

141 a. Pores medium-sized in part; infrequently in contact radially. Upright ray cells few or absent . . . . . *Vitex spongiocarpa* (Verbenaceae).
b. Pores small to minute; frequently in contact. Upright ray cells common to abundant 142

142 a. Intervascular pitting definitely opposite to scalariform . . . Violaceae.
b. Intervascular pitting alternate or indefinitely opposite 143

143 a. Pore multiples mostly long, with many of the pores much flattened. Procumbent cells short 144
b. Pore multiples mostly short; the pores of long multiples, when present, not much flattened 145

144 a. Uniseriate rays many cells high; multiseriate rays stratified, the body cells fairly uniform in size and shape (tang. sect.); crystals numerous, not confined to vertical series of cubical cells. Perforations frequently simple . . . . . *Arechavaletaia*, *Azara* (Flacourtiaceae).
b. Uniseriate rays few cells high; multiseriate rays not definitely stratified, the cells irregular in size and shape (tang. sect.); crystals apparently absent. Perforations predominantly simple.
Aristotelia (Elaeocarpaceae).

145 a. Multiseriate rays typically not stratified; crystals absent or few. Fibers septate in part, mostly in outer late wood. Long pore multiples absent or rare. Perforations exclusively multiple..... *Meliosma* (Sabiaceae).
b. Multiseriate rays stratified; crystals abundant. Fibers apparently all septate. Long pore multiples frequent..... 146

146 a. Rays with rather few definitely upright cells; vessel-ray pitting fine; crystals abundant, of general occurrence.. *Zuelania* (Flacourtiaceae).
b. Rays with many definitely upright cells; vessel-ray pitting coarse, often scalariform..... 147

147 a. Ray crystals mostly in vertical pairs of cubical cells. Perforations predominantly simple..... *Hasseltia* (Flacourtiaceae).
b. Ray crystals of general occurrence. Perforations predominantly multiple..... *Hasseltiopsis*, *Tetrathylacium* (Flacourtiaceae).

148 a. Parenchyma exclusively terminal (the bands sometimes in pairs in *Talauma*)..... 149
b. Parenchyma not exclusively terminal..... 151

149 a. Intervascular pitting typically opposite. Vessels without spirals. *Liriodendron* (Magnoliaceae).
b. Intervascular pitting typically scalariform..... 150

150 a. Rays all heterogeneous. Vessel-ray pitting coarse, often scalariform. Pores few to numerous. Vessels without spirals. *Talauma* (Magnoliaceae).
b. Rays homogeneous in part. Vessel-ray pitting fine, unilaterally compound. Pores very numerous. Vessels often with spirals. *Magnolia* (Magnoliaceae).

151 a. Intervascular pitting opposite or scalariform. Perforations exclusively multiple..... 152
b. Intervascular pitting mostly alternate. Simple perforations present, sometimes predominant..... 153

152 a. Intervascular pitting typically opposite. Rays often 100 or more cells high; very numerous, crowding the pores. *Lacistema*, *Lozania* (Lacistemaceae).
b. Intervascular pitting typically scalariform. Rays up to 30 cells high; not crowding the pores..... *Laurelia* (Monimiaceae).

153 a. Parenchyma in bands..... 154
b. Parenchyma not in bands..... 156

154 a. Perforation bars numerous, closely spaced. Pores numerous. Vessel-ray pitting fine. Parenchyma in coarse-celled bands 1–3 cells wide, spaced about a pore-width apart, suggesting Anonaceae. *Lissocarpa* (Lissocarpaceae).
b. Perforation bars few to several, widely spaced. Pores rather few. Vessel-ray pitting coarse..... 155

155 a. Pores medium-sized in part; diagonally arranged. Parenchyma bands very fine, inconspicuous. Rays 1 or 2 (3) cells wide and up to 25 (50) cells high..... *Alfaroa*, *Engelhardtia* (Juglandaceae).
b. Pores all small; not diagonally arranged. Parenchyma bands 1–5 cells wide, sometimes conspicuous. Rays 1–4 cells wide and up to 75 cells high..... *Bracteanthus* (Monimiaceae).

156 a. Intervascular pitting rather coarse. Pores clustered, tending to form tangential bands in late wood. Rays 1–5 cells wide and up to 40 cells high. Parenchyma sparingly paratracheal. *Sambucus* (Caprifoliaceae).
b. Intervascular pitting very fine. Pores often in radial chains or multiples, but not clustered or in bands..... 157

157 a. Vessels with fine spirals. Rays 1–4 cells wide and up to 100 cells high. Parenchyma diffuse..... *Turnera* (Turneraceae).
b. Vessels without spirals. Rays 1 or 2 cells wide and less than 30 cells high. Parenchyma sparingly paratracheal... *Adiscanthus* (Rutaceae).

VII. VESSELS WITH VERY FINE PITTING

(Pits typically not over 4μ in diameter)

1 a. Included phloem present..... 2
b. Included phloem absent..... 8

2 a. Phloem in bands..... 3
b. Phloem in strands (islands on cross section)..... 4

3 a. Pores small to minute; often in contact radially. Septate fibers, when present, not arranged in parenchyma-like bands. *Avicennia* (Avicenniaceae).
b. Pores large; rarely in contact radially. Septate fibers in numerous narrow parenchyma-like bands. *Cheiloclinium Gleasonianum* (Hippocrateaceae).

4 a. Septate wood fibers arranged in numerous narrow parenchyma-like bands..... *Cheiloclinium cognatum* (Hippocrateaceae).
b. Septate wood fibers absent..... 5

5 a. Rays in part with included phloem strands..... 6
b. Rays without included phloem strands..... 7

6 a. Parenchyma sparse. Fiber pits simple or indistinctly bordered. *Antonia* (Loganiaceae).
b. Parenchyma in bands. Fiber pits small but distinctly bordered. *Bonyunia* (Loganiaceae).

7 a. Pores often in contact radially. Rays 1–3 cells wide. Color yellow. *Mouriria pseudo-geminata* and *M. Marshallii* (Melastomaceae).
b. Pores infrequently in contact radially. Rays uniseriate. Color brown. *Mouriria* spp. (Melastomaceae).

8 a. Rays in part large and conspicuous..... 9
b. Rays not conspicuous, though often distinct..... 28

9 a. Apparently broad rays really aggregates of small rays; solid broad rays absent. Perforations multiple 10
b. Broad rays solid. Perforations simple (exc. in *Ottoschulzia*) 11

10 a. Vessels solitary. Rays heterogeneous ..... *Kalmia* (Ericaceae).
b. Vessels not solitary. Rays homogeneous ..... *Betula* (Betulaceae).

11 a. Rays with aggregates of thin-walled resinous cells ..... Myrsinaceae.
b. Rays without such aggregates 12

12 a. Pores (and parenchyma) in scallops or festoons between the large rays. *Roupala* (Proteaceae).
b. Pores not so arranged 13

13 a. Vessels virtually all solitary 14
b. Vessels frequently in contact 15

14 a. Perforations simple. Rays homogeneous; infrequently 8 cells wide. Ripple marks present, but indistinct ... *Muntingia* (Elaeocarpaceae).
b. Perforations multiple. Rays heterogeneous; often 15–20 cells wide. Ripple marks absent ..... *Ottoschulzia* (Icacinaceae).

15 a. Parenchyma reticulate 16
b. Parenchyma not reticulate 20

16 a. Rays with tile cells 17
b. Rays without tile cells 18

17 a. Ripple marks present ..... *Guazuma* (Sterculiaceae).
b. Ripple marks absent ..... *Mortoniodendron* (Tiliaceae).

18 a. Ripple marks present ..... *Goethalsia* (Tiliaceae).
b. Ripple marks absent 19

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

20 a. Parenchyma in uniform concentric bands 1 or 2 cells wide and 1 or 2 pore-widths apart, forming spider-web pattern with the rays. *Sapranthus*, *Stenanona* (Anonaceae).
b. Parenchyma otherwise (or apparently absent) 21

21 a. Rays virtually all multiseriate 22
b. Rays not all multiseriate 25

22 a. Rays heterogeneous; cells mostly square or upright, being flattened hexagonal on tangential section. Fibers septate ..... Myrsinaceae.
b. Rays homogeneous or nearly so; cells rounded on tangential section 23

23 a. Fibers septate. Ray cells slender procumbent. Vessel pits vestured. Heartwood red-brown ..... *Symmeria* (Polygonaceae).
b. Fibers not septate. Ray cells large, short procumbent. Vessel pits not vestured. Heartwood yellow 24

24 a. Pores of two sizes; often in contact with the rays. *Jacquinia* (Theophrastaceae).
b. Pores all very small to minute; rarely in contact with the rays. *Clavija*, *Theophrasta* (Theophrastaceae).

25 a. Parenchyma finely terminal; also narrowly vasicentric to vasicentric confluent. Fibers not septate. Pores tending to diagonal or concentric arrangement ..... *Petrea* (Verbenaceae).
b. Parenchyma absent or very sparse. Fibers septate. Pores not in diagonal or concentric arrangement 26

26 a. Pores in distinct radial arrangement because of the close spacing of the rays. Crystals common to abundant in the rays. *Casearia* (in part), *Hecatostemon*, *Ryania* (Flacourtiaceae).
b. Pores not in distinct radial arrangement. Rays less numerous. Crystals few or absent 27

27 a. Multiseriate rays with many procumbent cells rounded on tangential section. Vessel pits vestured ..... *Elaeagia* (Rubiaceae).
b. All rays coarse-celled, without definitely procumbent cells; in part flattened hexagonal on tangential section. *Eupatorium* (Compositae).

28 a. Ripple marks present 29
b. Ripple marks absent 43

29 a. Vessel pits vestured 30
b. Vessel pits not vestured 33

30 a. Rays mostly homogeneous; usually not over 5 cells high. Heartwood purplish brown. Ripple marks 115–140 per inch. *Holocalyx* (Leguminosae).
b. Rays heterogeneous; up to 15 cells high 31

31 a. Ray cells irregular in size and shape throughout; crystals not limited to marginal cells. Heartwood yellowish brown; not scented. Ripple marks about 125 per inch ..... *Harpalyce* (Leguminosae).
b. Interior ray cells procumbent, with single marginal rows of larger crystalliferous cells. Heartwood fragrantly scented 32

32 a. Heartwood rich brown, with waxy appearance. Ripple marks 100–120 per inch ..... *Myrocarpus* (Leguminosae).
b. Heartwood reddish brown, becoming deep red or purplish. Ripple marks 90–100 per inch ..... *Myroxylon* (Leguminosae).

33 a. Vessel-ray pitting distinctly 2-sized 34
b. Vessel-ray pitting all very fine 35

34 a. Ripple marks local; mostly only fusiform parenchyma cells storied. *Schoepfia* (Olacaceae).
b. Ripple marks characteristic; all elements storied. *Christiania*, *Carpodiptera* (Tiliaceae).

35 a. Rays with tile cells ..... *Mollia* (Tiliaceae).
b. Rays without tile cells 36

36 a. Ripple marks more than 200 per inch. Vessels solitary. *Guaiacum*, *Porlieria* (Zygophyllaceae).
b. Ripple marks less than 150 per inch. Vessels not all solitary.... 37

37 a. Parenchyma in closely spaced uniseriate lines. *Diospyros virginiana* (Ebenaceae).
b. Parenchyma otherwise.... 38

38 a. Parenchyma sparse; narrowly vasicentric and diffuse.... 39
b. Parenchyma abundant.... 40

39 a. Rays uniseriate or partially biseriate and typically very low. Ripple marks fairly regular.... *Suriana* (Surianaceae).
b. Rays 1–3 cells wide and up to 30 or more cells high. Ripple marks irregular.... *Helicteres* (Sterculiaceae).

40 a. Parenchyma rather coarsely terminal; not aliform or confluent. Fibers septate.... *Swietenia* (Meliaceae).
b. Parenchyma aliform and confluent; sometimes terminal also. Fibers not septate.... 41

41 a. Rays 1 or 2 cells wide and 6 (8) cells high. Heartwood brownish. *Cneorum* (Cneoraceae).
b. Rays 1–4 cells wide and 10–25 (50) cells high. Heartwood yellow. 42

42 a. Pores fairly numerous. Fibers rather thin-walled. Ripple marks 60–90 per inch. Taste very bitter.... *Aeschrion* (Simarubaceae).
b. Pores rather few. Fibers thick-walled. Ripple marks 100–120 per inch. Taste not bitter.... *Tetrasida* (Malvaceae).

43 a. Vessels virtually all solitary, at least in late wood.... 44
b. Vessels not all solitary.... 78

44 a. Perforations exclusively or predominantly multiple.... 45
b. Perforations exclusively or predominantly simple.... 48

45 a. Septate fibers arranged in parenchyma-like bands. *Elaeodendron* (Celastraceae).
b. Septate fibers absent.... 46

46 a. Perforation plates long, with many closely spaced bars. *Cliftonia*, *Cyrilla* (Cyrillaceae).
b. Perforation plates short oval, with rather few bars.... 47

47 a. Pores medium-sized to large. Heartwood reddish brown. *Goupia* (Celastraceae).
b. Pores minute. Heartwood yellow.... *Tricera* (Buxaceae).

48 a. Septate fibers arranged in parenchyma-like bands.... 49
b. Septate fibers absent.... 51

49 a. Vasicentric tracheids present.... *Alvaradoa* (Simarubaceae).
b. Vasicentric tracheids absent.... 50

50 a. Rays all 1 or 2 cells wide. Vessels with fine spirals. *Austroplenckia* (Celastraceae).
b. Rays 1–5, mostly 2–4, cells wide. Vessels without spirals. *Maytenus* (Celastraceae).

51 a. Vessels with spirals, at least in tips of members.... 52
b. Vessels without spirals.... 55

52 a. Fibers with spirals. Pores medium-sized in part. Rays homogeneous or nearly so.... *Koeberlinia* (Koeberliniaceae).
b. Fibers without spirals. Pores small to minute. Rays heterogeneous. 53

53 a. Rays 1–5 cells wide and up to 30 (40) cells high. *Maytenus boaria* (Celastraceae).
b. Rays 1 or 2 cells wide.... 54

54 a. Rays mostly biseriate. Pores angular. Perforations all simple. *Mortonia* (Celastraceae).
b. Rays mostly uniseriate. Pores rounded. Some perforations multiple. *Elliottia* (Ericaceae).

55 a. Rays homogeneous or weakly heterogeneous.... 56
b. Rays distinctly heterogeneous, at least in part.... 68

56 a. Vessel pits vestured.... 57
b. Vessel pits not vestured.... 65

57 a. Pores medium-sized in part.... 58
b. Pores all small to minute.... 61

58 a. Rays 1 or 2 cells wide. Enlarged parenchyma cells often present. 59
b. Rays 1–4 cells wide. Enlarged parenchyma cells absent.... 60

59 a. Parenchyma reticulate.... *Geissospermum sericeum* (Apocynaceae).
b. Parenchyma in irregular narrow bands 1–3 pore-widths apart. *Geissospermum excelsum* (Apocynaceae).

60 a. Parenchyma forming caps on outer face of pores; also diffuse. *Aspidosperma desmanthum*, *A. megalocarpon* (Apocynaceae).
b. Parenchyma reticulate. *Aspidosperma quebracho-blanco* (Apocynaceae).

61 a. Rays 1–4 cells wide. Parenchyma reticulate. *Vallesia* (Apocynaceae).
b. Rays not over 2 cells wide.... 62

62 a. Parenchyma narrowly terminal and diffuse. Wood yellow, not roseate. Taste not distinctive. *Aspidosperma eburneum*, *A. Vargasii* (Apocynaceae).
b. Parenchyma reticulate. Wood brown, roseate, or variegated. Taste bitter.... 63

63 a. Rays nearly all biseriate and up to 20 (25) cells high. *Aspidosperma peroba* (Apocynaceae).
b. Rays often uniseriate; height up to 40 cells.... 64

64 a. Stems more or less cylindrical. *Aspidosperma Curranii*, *A. dominguensis* (Apocynaceae).
b. Stems deeply sulcate. . . . . *Aspidosperma excelsum* (Apocynaceae).

65 a. Parenchyma in concentric bands several pore-widths apart. 66
b. Parenchyma reticulate. 67

66 a. Pores thin-walled. Heartwood yellowish. . *Torralbasia* (Celastraceae).
b. Pores thick-walled. Heartwood reddish or purplish brown. *Wimmeria* (Celastraceae).

67 a. Fiber pits small. Pores small; rather numerous. Density very high. *Rochefortia* (Boraginaceae).
b. Fiber pits large. Pores minute; very numerous. Density medium. *Crataegus* (Rosaceae).

68 a. Parenchyma in apotracheal bands. 69
b. Parenchyma otherwise. 71

69 a. Parenchyma bands concentric, fairly uniform in width and spacing. Rays 1–4 cells wide and up to 60 cells high. Pores up to medium-sized. Density medium. Heartwood brownish. . . *Zinowiewia* (Celastraceae).
b. Parenchyma bands irregular in width, length, and spacing. Density high. 70

70 a. Rays uniseriate or partially biseriate and up to 70 cells high. Pores small. Heartwood olive. . . . . *Kotchubaea* (Rubiaceae).
b. Rays 1–3 (4) cells wide and up to 50 cells high. Pores large in part. Heartwood yellow. . . . . *Trigonia* (Trigoniaceae).

71 a. Parenchyma irregularly paratracheal, more or less aliform and confluent. 72
b. Parenchyma reticulate. 74

72 a. Rays 1–3 (6) cells wide and 100 or more cells high. Heartwood dark olive to reddish brown, sometimes streaked. Density very high. *Quiina* (Quiinaceae).
b. Rays infrequently more than 2 cells wide and 25 cells high. Density high. 73

73 a. Vessel-ray pits distinctly 2-sized. Parenchyma unilaterally paratracheal. Heartwood orange-red. . . . . *Haploclathra* (Guttiferae).
b. Vessel-ray pitting not distinctly 2-sized, though often unilaterally compound. Parenchyma not unilaterally paratracheal. Heartwood brown. . . . . *Euphronia* (Trigoniaceae).

74 a. Vasicentric tracheids present. Pores medium-sized in part. Fibers with large bordered pits. Heartwood purplish. Density high. *Amomis*, *Calyptranthes* (Myrtaceae).
b. Vasicentric tracheids absent. Pores small to minute. Fibers with small to medium-sized pits. 75

75 a. Rays typically not more than 2 cells wide and 20 (25) cells high. . 76
b. Rays 1–4 (6) cells wide. 77

76 a. Vessel pits vestured. Vessel-ray pitting often unilaterally compound. Density medium. Heartwood not scented. . . . . Rubiaceae.
b. Vessel pits not vestured. Vessel-ray pitting not unilaterally compound. Density high. Heartwood fragrantly scented. . . *Ximenia* (Olacaceae).

77 a. Rays infrequently up to 65 cells high; procumbent cells common in all rays; crystals small. Texture very fine. Heartwood yellow. *Schaefferia* (Celastraceae).
b. Rays frequently up to 100, sometimes over 200, cells high; procumbent cells common only in widest rays; crystals large. Texture medium. Heartwood reddish or grayish brown. . *Elvasia*, *Ouratea* (Ochnaceae).

78 a. Latex tubes present in some of the rays. 79
b. Latex tubes absent. 81

79 a. Fibers septate. Parenchyma apparently absent. Distended ray cells common. . . . . *Peschiera*, *Stemmadenia* (Apocynaceae).
b. Fibers not septate. Parenchyma abundant. Distended ray cells absent. 80

80 a. Parenchyma reticulate. . . . . *Ambelania* sp. (Apocynaceae).
b. Parenchyma in concentric lines about 1 pore-width apart. *Couma*, *Hancornia* (Apocynaceae).

81 a. Parenchyma reticulate. 82
b. Parenchyma not reticulate; sometimes absent. 96

82 a. Perforations multiple (plates scalariform). . *Pamphilia* (Styracaceae).
b. Perforations exclusively or predominantly simple. 83

83 a. Fibers with large bordered pits. Radial channels common. 84
b. Fibers without large bordered pits. Radial channels absent. 85

84 a. Rays 1–5 cells wide and 20 (40) cells high; marginal cells inflated in part. . . . . *Rauwolfia* (Apocynaceae).
b. Rays 1–3 cells wide and up to 80 cells high; marginal cells not inflated. *Malouetia* (Apocynaceae).

85 a. Vessel-ray pitting very coarse in part. 86
b. Vessel-ray pitting not coarse in part, though sometimes unilaterally compound. 87

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

87 a. Fiber pits rather small, but distinctly bordered. 88
b. Fiber pits very small, simple or indistinctly bordered. 91

88 a. Pores all very small to minute. . . . . Rubiaceae.
b. Pores medium-sized in part. 89

89 a. Fibers with very thick walls and small lumen. Parenchyma banded in part. Heartwood very dark brown..... *Cameraria* (Apocynaceae).
b. Fibers with thin to medium walls and rather large lumen. Parenchyma not banded. Heartwood light brown..... 90

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

91 a. Uniseriate rays few..... 92
b. Uniseriate rays numerous..... 93

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

93 a. Parenchyma coarsely reticulate and irregularly confluent. Rays in part 5 or more cells wide; vessel-ray pitting unilaterally compound.
Tapura (Dichapetalaceae).
b. Parenchyma finely reticulate. Rays infrequently up to 4 cells wide; vessel-ray pitting not unilaterally compound..... 94

94 a. Ray cells nearly all square or upright. Pores very small and very numerous; mostly in long radial rows..... *Savia* (Euphorbiaceae).
b. Procumbent cells numerous in multiseriate rays..... 95

95 a. Pores medium-sized in part. Vessel perforations multiple in part. Rays up to 50 (100) cells high; crystals abundant.
Drypetes (Euphorbiaceae).
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CURRENT LITERATURE

Trees of Puerto Rico. Volume II. By L. R. Holdridge. Occ. Paper No. 2, Tropical Forest Experiment Station, Río Piedras. Pp. 105; 8 x 10½; 50 multilithed plates; September 1942.

This is the second volume of the highly useful series proposed to cover all of the species of trees found in Puerto Rico (see *Tropical Woods* 72: 36). Like the first, it contains descriptions and line drawings of 50 species. Twenty-five families are represented.

The Caribbean Forester. Pub. quarterly by the Trop. For. Exp. Sta., U. S. Forest Service, Río Piedras, Puerto Rico. Vol. IV: 1: 1–48; 2: 49–98; October 1942 and January 1943, resp.

Contents of No. 1

CONTENTS OF No. 2

New vascular plants from Texas, Mexico, and Central America. By CYRUS LONGWORTH LUNDELL. *American Midland Naturalist* (Notre Dame, Ind.) 29: 2: 469–492; March 1943.

"One new genus, *Malea* of the Ericaceae, 32 new species, and three transfers are included along with critical notes on various other plants. Among the new species are four from Texas in the genera *Eleocharis*, *Linum*, *Forestiera*, and *Tetraclea*. The new species from Mexico and Central America belong to *Merostachys*, a grass genus not recorded previously from North America, *Scleria*, *Roupala*, *Phoebe*, *Crotalaria*, *Erythroxylon*, *Amanoa*, *Euphorbia*, *Sapium*, *Hypericum*, *Calyptranthes*, *Eugenia*, *Myrcia*, *Psidium*, *Tibouchina*, *Malea*, *Ardisia*, *Cordia*, *Solanum*, *Russelia*, and *Chiococca*. Transfers are made in the genera *Neea*, *Thamnosma*, and *Sapium*."

Studies of Central American plants. III. By PAUL C. STANDLEY and JULIAN A. STEYERMARK. *Field Museum Botanical Series* 23: 1: 1–28; Jan. 14, 1943.

Contains descriptions of one new genus (*Pachecoa*, a leguminous shrub) and 35 new species (eight of them trees) of 19 families. The material was collected by the authors in Guatemala.

Notas a la flora de Colombia. V. By JOSÉ CUATRECASAS. *Rev. Acad. Col. Cienc. Exactas, Físicas & Naturales* (Bogotá) 5: 17: 16–39; 3 plates, 22 text figs.; January–June, 1942.

Descriptions of new species, varieties, etc., in the genera *Espeletia*, *Culcitium*, *Senecio*, *Mutisia*, *Weinmannia*, *Polylepis*, *Brunellia*, *Trichilia*, *Picramnia*, *Halenia*, *Hypericum*, and *Cavendishia*.

Vocabulario de terminos vulgares en historia natural colombiana. By HERMANO APOLINAR MARÍA. *Rev. Acad. Col.* 5: 17: 40–60; January–June, 1942.

The current installment of this valuable dictionary contains entries 927–1114, Batatilla–Bocachico del Magdalena.

***Ceroxylon ferrugineum* André, the Salento waxpalm.** By MIRIAM L. BOMHARD. *Journ. Wash. Acad. Sci.* 33: 1: 1–8; Jan. 15, 1943.

"Recognition of André's publication establishes the botanical identity of the distinct species of waxpalm that occurs on the western slope of the Quindío [Colombia], in the region of the town of Salento and of the rivers Boquío and Quindío. The full extent of its range is unknown. The elevations at which it grows may be placed, from available data, at 1600 to 2800 meters. The material thus far collected in the Salento area is quite uniform in character. André's brief description, substantiated by his own and later collections, appears to be sufficiently adequate to validate the name *Ceroxylon ferrugineum* André."

Notes on American Euphorbiaceae, with descriptions of eleven new species. By LEON CROIZAT. *Journ. Wash. Acad. Sci.* 33: 1: 11–20; Jan. 15, 1943.

The new arborescent species are in the genera *Phyllanthus*, *Croton*, *Senefeldera*, and *Pedilanthus;* they are all tropical American. *Gymnanthus texana* Standl. is shown to be *Forestiera reticulata* Torr. (Oleaceae).

Exploraciones botánicas en la Guyana venezolana. I. El medio y bajo Caura. By LLEWELYN WILLIAMS. Pub. by Servicio Botanico, Min. Agr. & Cria, Caracas, 1942. Pp. 468; 6¼ x 9; 53 plates, 2 maps.

This is a valuable contribution to the knowledge of the region of the middle and lower Caura River, a southern affluent of the Orinoco. Part I consists of an introduction (pp. 7–12), a descriptive account of the author's explorations (13–100), notes on agriculture, transportation facilities, and climate (100–119), and a summary (121–141) of the principal

forest and agricultural products. Part II is chiefly an annotated list of the genera and species of the Caura (145–400), followed by a check list of the vernacular and scientific names (401–426), and 40 pages of index. Mr. Williams has an excellent background of tropical experience, not only in Venezuela but also in the Peruvian Amazon and southern Mexico.

The taxonomy of the monogeneric tribe Elvasieae (Ochnaceae). By JOHN D. DWYER. *Bull. Torrey Bot. Club* 70: 1: 42–49; January 1943.

Elvasia, with seven described species of shrubs and medium-sized trees, is limited to British Guiana, Surinam, Venezuela, and Brazil. "While intragenerically the author maintains the two subdivisions *Euelvasia* and *Hostmannia*, which are based on differences in the number of carpels, further study indicates that a break in *Euelvasia* is necessary on the basis of stigmatic differentiation coupled with variations in the number of stamens. A third division, *Euessequibensa*, is proposed in this paper." The two species in the new section are *Elvasia brevipedicellata* Ule and *E. essequibensis* Engl.

***Kaieteurea*, a new genus of the Ochnaceae.** By JOHN D. DWYER. *Bull. Torrey Bot. Club* 70: 1: 50–52; January 1943.

Kaieteurea, with one known species, *K. Gillyana* Dwyer, is a tree or shrub known only from Kaieteur savanna in British Guiana. Though similar to *Ouratea* in vegetative habits and structure, it shows marked differences in its flowers and fruit. The torus becomes lignose in fruit, scarcely expands, and bears a single drupe encased in the erect persistent sepals, which are frequently reduced to two. The seeds are without endosperm.

As regiões naturais de Pernambuco. By VASCONCELOS SOBRINHO. *Arquivos do Inst. Pesquisas Agronômicas* (Pernambuco, Brazil) 3: 25–33; 11 plates; 2 maps; 1941.

The various vegetative zones are delimited, described, and illustrated. There are notes on the principal species, particularly the trees, but for many of these only the common names are given.

Penão, *Cnidoscolus Marcgravii* Pohl, novo recurso oleifero da Bahia. By GREGORIO BONDAR, Bol. No. 12, Inst. Central de Fomento Economico da Bahia, 1942. Pp. 16; 6¼ x 8¾; 4 text figs.

An account of a botanically neglected arboreous Jatropha, a species of *Cnidoscolus*, a tree of eastern Brazil, with an illustrated discussion of its botanical characters and taxonomic identity. In respect to the latter the last word has probably not been said. The tree was first described by Soares in 1587 under the name Pino and is commonly known as Penão in the cacao zone of southern Bahia where it is abundant. A distinct peculiarity of the tree is the presence of projecting cushions of urticant hairs on the branches and patches of spiny and severely urticant reduced branches scattered on the trunk. It is well known to local woodsmen that contact with these outgrowths produces inflammation that lasts for several days. The wood of the Penão is in demand for refrigerator insulation; the edible seeds yield a semi-drying oil.—B. E. DAHLGREN, *Field Museum*.

Estudo do lenho de algumas espécies florestais de Timor. By José PACHECO DE TÔRRES. *Revista Agronómica* (Lisbon, Portugal) 29: 1: 56–86; 5 plates showing 39 photomicrographs; 1941.

Contains detailed description of the macroscopic and microscopic features of thirteen woods, as follows: (1) *Parinarium corymbosum* Miq., (2) *Intsia amboinensis* Thouars, (3) *Pterocarpus Blancoi* Merr., (4) *Canarium moluccanum* Bl. (?), (5) *Garuga floribunda* Dcne., (6) *Dysoxylum caulostachyum* Miq., (7) *Melia dubia* Cav., (8) *Dictyoneura* aff. *philippinensis* Radlk., (9) *Pometia pinnata* Forst., (10) *Sterculia foetida* L., (11) *Calophyllum Inophyllum* L., (12) *Terminalia catappa* L. (?), and (13) *Memecylon* sp. (?).

The vernacular names given are: (1) Ai Béssi Mutim, Pau Ferro, Pau de Manufai; (2) Ai Béssi, Pau Ferro; (3) Ai Na, Pau Rosa; (4) Ai Quiar; (5) Ai Feu; (6) Ai Seria; (7) Ai Mara; (8) Ai Cnia; (9) Ai Mara; (10) Ai Nita; (11) Ai Sampalo; (12) Ai Calesse Catapo; (13) Ai Siba.

Each anatomical description is illustrated with photomicrographs of the cross, radial, and tangential sections at

30 × or 55 ×. There are also notes on the technical properties and uses of the woods.

A list showing the location of the principal collections of Verbenaceae and Avicenniaceae. By H. N. MOLDENKE. N. Y. Botanical Garden, Feb. 20, 1942. Pp. 46; 8½ x 10¾; photo-offset printing. Price 85¢ net.

"A preliminary record, alphabetically arranged, of the location, as to institutions and herbaria, of the material of 5311 collectors and combination of collectors as found by the writer during the course of his monographic studies of these two plant families during the past twelve years."

The known geographic distribution of the members of the Verbenaceae and Avicenniaceae. By H. N. MOLDENKE. N. Y. Botanical Garden, March 12, 1942. Pp. 104; 8½ x 10¾; photo-offset printing. Price $1.00 net.

"Users of this list must clearly bear in mind that it is as yet only a preliminary one. While naturally every effort has been made to make it accurate and complete, it must be remembered that it represents merely the present state of our knowledge of the geographic distribution of the recognized valid species, varieties, hybrids, and named forms of the two plant families, Verbenaceae and Avicenniaceae. Some names herein included may later prove to be invalid or to be synonymous with others here included. Many additional species and varieties still remain to be studied and will be included in a later edition, since it seems very probable that these two families contain fully 80 distinct genera and over 3000 species, varieties, and forms. The known ranges of many of these will doubtless be considerably amplified as more herbarium material is collected and more records become available to the writer."

An alphabetic list of invalid and incorrect scientific names proposed in the Verbenaceae and Avicenniaceae. By H. N. MOLDENKE. N. Y. Botanical Garden, March 14, 1942. Pp. 59; 8½ x 10¾; photo-offset printing. Price 85¢ net.

A new and revised edition of a previous paper (1940) and its supplement (1941). The present work contains about 4700 names.

M. M. Chattaway.

Price 25 cents

Yale University School of Forestry

TROPICAL WOODS

NUMBER 75 SEPTEMBER 1, 1943

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 75 September 1, 1943

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

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

Subscription price One Dollar for four consecutive numbers. Remittances should be made payable to TROPICAL WOODS.

Address all communications to the editor, 205 Prospect Street, New Haven, Connecticut, U. S. A.

THE OAK FORESTS OF COSTA RICA

By WILLIAM R. BARBOUR

U. S. Forest Service

Oak in Costa Rica is typically a tree of the cloud forests. Most of the fifteen species of *Quercus* described to date were collected on the slopes of the Volcanos Poás, Barba, Irazú, and Turrialba, where they are found, often in pure stands, in the *tierra fría* at elevations from 6000 to 10,000 feet above the sea. It is, however, along the summit of the Cordillera de Talamanca, which forms the Continental Divide south from Cartago, that these Oak forests reach their optimum development. Until the opening of the right-of-way of the Inter-American Highway which follows the crest of the Cordillera, this part of Costa Rica was practically *tierra incognita*, its forests so trackless and impenetrable that few botanists and no foresters had ever visited them.

During the past six months the members of the Costa Rican party of the Latin American Forest Resources Project explored portions of these cloud forests from Cartago as far south as the treeless *páramos* that lie atop the Cerro de la Muerte. How much further south the Oak forests extend along the Cordillera cannot be stated definitely, but it is probable (and this supposition is supported by distant views from the air) that they continue south—perhaps interrupted by treeless areas on the summit of Cerro Chirripó, to or beyond the Panama border.

There is no well-defined lower altitudinal limit to these Oak forests. *Quercus* descends the ridges to at least as low as 3000 feet on the Atlantic side and 5000 feet on the Pacific side, gradually merging into the mixed evergreen rain forests of the *tierra templada*. At 6000–7000 feet Oaks begin to predominate, and from 8000 up to over 10,000 feet, where woods abruptly terminate in páramos, the forests are nearly pure Oak. They reach their optimum development on the rounded crest of the Cordillera at elevations from 7500 to 8500 feet, where they grow in a luxuriance probably not equalled by Oaks in any other part of the world.

The principal Oak of the forests along the crestline of the Cordillera de Talamanca is *Quercus copeyensis* Muller, whose leaves are entire, ovate, 3–4 inches long, and whose acorns are very large and round. The bark varies from a type suggestive of Post Oak to extremely scaly, like Shagbark Hickory. The wood resembles White Oak in its texture and prominent rays, but is somewhat harder and denser. It is locally called Encino or Roble. Other Oak species present in limited quantities include *Quercus borucasana* Trelease, *Q. aaata* Muller, and *Q. eugeniaefolia* Liebm.

In the region of its optimum development, *Quercus copeyensis* reaches tremendous sizes. The largest tree actually measured by the party was 96 inches d.b.h. and about 120 feet high. Many trees reach or exceed these dimensions, and clear lengths of 80 feet or more are common. The largest trees, which presumably are very old, have buttressed bases and often are hollow-butted.

Typical of the excellent timber form of the medium-sized

oaks are the following measurements of a tree felled to obtain wood samples: No. 6002. Not buttressed. Stump height 4 ft. D.b.h. 31 in. Top 1st 16-ft. log, d.o.b. 26 in. Top 2nd 16-ft. log, d.o.b. 24 in. Top 24-ft. log, d.o.b. 22 in. Top 22-ft. log, d.o.b. 20 in. Total clear length 82 ft. Crown length 35 ft., width 40 ft. Total height 117 ft. No visible defects. Log scale (Doyle Rule) 1535 board feet.

In the absence of applicable volume tables, figures on stands per acre can be little more than estimates. Sample plots, however, indicate that there are individual acres that will contain at least 60,000 board feet, and extensive areas that will run 20,000 feet per acre. An average stand per acre of 10,000 feet for the entire type is believed to be very conservative.

The Oak forests are distinctly two-storied, with the Oaks dominant or "emergent." The second story, which seldom constitutes more than 5 per cent of the merchantable volume of the stand, includes Arrayán (*Weinmannia pinnata*), Lorito or Ciprecillo (*Podocarpus montanus* and *P. oleifolius*), Quiebra Muelas (*Drimys Winteri*), Magnolia (*Magnolia poasana*), and several Lauraceae known locally as Ira and Quizarrá.

There is a dense understory of dwarf palms, tree ferns, bamboo, and small trees largely of the Melastomaceae. The ground cover is composed of an infinite variety of herbaceous plants and ferns. Mosses, lichens, and liverworts are abundant. The limbs of the Oaks are laden with masses of bromeliads and other epiphytes, and great vines often climb to the treetops. One accustomed to the forests of the temperate zone would find it hard to believe that he was actually in an Oak forest. Much of the time these high mountain Oak woods are shrouded by clouds and bathed in misty rain. Save for the soughing of the wind through the treetops, an unearthly silence prevails.

Until recently, these unique mountain Oak forests were so utterly inaccessible as to be in no danger of destruction. Now, with the development of the Inter-American Highway, whose route traverses the heart of the Oak forest for many miles, the situation has changed. Unless steps are taken soon there is a real danger of destructive exploitation. At the very

least, a strip along both sides of the highway should be set aside as a Costa Rican national forest or national park, and so preserved for the delectation of the thousands of tourists who, once the war is over, will drive over the Inter-American Highway.

REDUCTION OF *CASTELARIA BRITTONII* SMALL

By JOSEPH MONACHINO

Merck Research Laboratory, Rahway, New Jersey

Information that experiments with *Castelaria Brittonii* Small in the laboratories of Merck & Co., Inc., Rahway, N. J., did not show the evidence of the biological-chemical effects observed in all the other members of *Castela* (= *Castelaria*) hitherto tested suggested a careful examination of this species and resulted in the discovery that it does not belong in the family Simarubaceae. The floral characters did not conform regularly to any of the known families of living plants—they did recall, however, the anomalous genus *Coeloneurum* in the Solanaceae. Engler and Prantl's Planzenfamilien classifies *Henoonia* next to this genus, and *Henoonia angustifolia* Urban (Fedde Report. 18: 120. 1922) was found an exact match for the type specimen of *Castelaria Brittonii* Small (N. Am. Fl. 25: 232. 1911). *Henoonia* Griseb. (Cat. Pl. Cub. 166. 1866) is the correct genus in which *Castelaria Brittonii* belongs. In compliance, then, with the International Rules of Nomenclature governing priority the proper binomial is *Henoonia Brittonii*.

Henoonia is placed in Sapotaceae by Grisebach (who claims that it connects Sapotaceae with Myrsinaceae) and Urban, and it appears in this family with question in Bentham & Hooker's Genera Plantarum. Professor Record places *H. angustifolia*, on basis of its wood structure, definitely in Sapotaceae. The flowers are gamosepalous and gamopetalous, the epipetalous stamens alternate with the corolla-lobes, and the ovary one-celled with a single basal ovule. The exact family position of the genus cannot be suggested by the contributor of this note, but in his judgment it has been properly associated with *Espadaea* Rich., *Goetzea* Wydl., and *Coeloneurum* Radlk. in the West Indian section *Cestreae-Goetzeinae* in Planzenfamilien. The examination of a single leaf, of the midrib characteristically swollen near the base of the blade, in each of these genera is sufficient to prove their affinity; and Professor Record, in a personal response to the contributor's query, agrees that the wood structure of *Coeloneurum* and *Espadaea* is in harmony with that of *Henoonia*. *Henoonia* is generically closely allied to *Coeloneurum*, and it will be difficult to disassociate these genera from their relatives in *Cestreae-Goetzeinae*, including even the markedly zygomorphic flowered *Espadaea* (placed doubtfully in Verbenaceae by Bentham). Notwithstanding that *Henoonia* by itself seems better taxonomically in Sapotaceae, the section *Cestreae-Goetzeinae*, considered as a whole and from the advisability of maintaining it as an integral group, had perhaps best remain tentatively in Solanaceae.

A COSTA RICAN SPECIES OF *VANTANEA*, OF THE FAMILY HUMIRIACEAE, A GROUP NEW TO CENTRAL AMERICA

By PAUL C. STANDLEY

Field Museum of Natural History

In a small collection representing important timber trees of Costa Rica, made by the Latin American Forest Resources Project of the U. S. Forest Service, there has been found a species of *Vantanea*, the generic determination having been made first by Mr. W. A. Dayton. During the past 30 years there have been collected in Central America many genera unknown previously on the North American continent, but it is rarely indeed that a family new to North America has been found, or can be expected. The Humiriaceae are essentially a South American group, the genus *Humiria* extending as far northward as Colombia.

Vantanea Barbourii Standl., sp. nov.—Arbor elata usque at 30 m. alta, trunco 30 cm. diam. et ultra, praeter inflores-

centiam omnino glabra, ramulis rigidis crassiusculis fusco-brunneis subteretibus; folia breviter petiolata coriacea sublucida, petiolo crasso ca. 8 mm. longo plus minusve marginato; lamina oblongo-elliptica 8–12 cm. longa 4–5.5 cm. lata, apice rotundata vel obtusa et emarginata, basi acuta, integra, supra in sicco lutescenti-viridis, nervis non elevatis, subtus in sicco brunnescens, nervis lateralibus utroque latere 7–8 gracillimis arcuatis prominulis, venis vix elevatis laxe reticulatis; inflorescentiae terminales et axillis superioribus axillares multiflorae corymbosae dense pilis minutis patentibus pilosulae, floribus brevissime crasseque pedicellatis, alabastris oblongo-ovoideis; calyx profunde divisus, 2.5–3 mm. latus, lobis orbicularibus ciliatis fere glabris; petala 8 mm. longa oblongo-lanceolata attenuata extus retrorso-hispidula; stamina numerosa, filamentis crassiusculis sursum attenuatis, antheris minutis, loculis bilocellatis; ovarium densissime albido-villosum.—Costa Rica: Prov. San José, 1 mile north of San Isidro del General, one-half mile south of the Pan American Highway right-of-way, alt. 750 meters, rain forest, clayey loam soil, June 11, 1943, W. A. Dayton & W. R. Barbour 3129 (type in Herb. Field Museum).

Local name Ira Chiricana. Bark brownish gray with longitudinal fissures. Here is referable also a specimen (No. 16822) in the herbarium of the Yale School of Forestry received 13 years ago from H. J. Marks of Golfo Dulce, Costa Rica, and believed to have come from the nearby mountains.

Of *Vantanea* there are known about a dozen species, ranging from the Guianas through tropical Brazil to Peru. The Costa Rican tree appears most like *V. obovata* (Nees & Mart.) Benth. of Brazil, but differs from it in several respects. All the species are much alike in general appearance but separated by minor characters that are apparently constant and important. With none of the known species does the Costa Rican tree agree, and its geographical isolation is so great that the genus could scarcely have been expected to occur in Costa Rica.

Note. I have not seen the wood of the type of *Vantanea Barbourii*, but the Marks' sample is of that genus. I have identified other woods from Costa Rica, including the one obtained at a sawmill by Scholten and Barbour, as *Humiria*.—S. J. R.

NOTE ON *VANTANEA BARBOURII* STANDLEY

By William F. Barbour

Ira Chiricana (*Vantanea Barbourii* Standl.) was first discovered as a sawmill sample by John A. Scholten of the Forest Products Laboratory and the writer, at San Isidro del General, Costa Rica. The sample was sent to Professor Record, who reported that the wood structure agreed with the Humiriaceae, though that family was not known to occur in North America.

Subsequently the writer and W. A. Dayton of the U. S. Forest Service made a special trip by plane from San José to San Isidro to collect Ira Chiricana and several other species whose identities were in doubt. We were fortunate enough to obtain botanical material with flowers and immature fruit, and also took wood samples from the same tree.

The valley of the Río General, which flows south between the Cordillera de Talamanca and the Pacific coastal range of hills, is a particularly rich collecting ground that has not been thoroughly covered by botanists and had never been visited by foresters until the arrival of the members of the Latin American Forest Resources Project. With the exception of a few clearings and some natural savannas, this great valley is covered with heavy first-growth forests of the Evergreen Rain Forest type.

The range of Ira Chiricana, so far as is now known, is confined to a relatively small area on the rolling hills near San Isidro, at elevations from 700 to 800 meters above sea level. It is found in patches, associated with Campana (*Laplacea semiserrata*), Comenegro (*Hieronyma oblonga*), Chancho Blanco (probably *Goethalsia meiantha*), Colorado (*Nectandra concinna*), Volador (*Persea Austin-Smithii*), Alasán (probably *Ormosia toledoana*), Laurel (*Cordia alliodora*), María (*Calophyllum brasiliense*), Mayo (*Vochysia ferruginea*), Gallinazo (*Jacaranda* sp.), and various trees of the Lauraceae and Leguminosae.

Ira Chiricana has a thin brownish gray bark with longitudinal fissures. It is usually buttressed at the base, above which it has a good timber form. Specimens 36 inches or

more in diameter, with 40 feet or more of clear length, are not uncommon. Its fairly hard and heavy reddish brown wood has a good local reputation for strength and durability and is being used for bridge timbers on the Inter-American Highway, which traverses its range.

KEYS TO AMERICAN WOODS (CONTINUED)

By SAMUEL J. RECORD

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

VIII. Vessels with opposite or scalariform pitting. This key applies to 100 named genera of 52 families. For woods with vessels in contact the feature shows to best advantage on tangential sections. When the vessels are virtually all solitary the characteristic pitting can usually be seen in the walls of contact of overlapping members of the same vessel (radial section); also in the cross fields of ray cells and adjacent vessels.

IX. Woods with conspicuous rays. Preparation of this key has followed the general plan outlined in Dadswell and Record's "Identification of woods with conspicuous rays" (*Tropical Woods* 48: 1–30). That study was world-wide in scope and applied to 50 families, each of which was briefly described. The present key is more detailed and includes 136 named American genera of 62 families. Woods with broad rays of conjuntive tissue associated with included phloem are omitted.

VIII. VESSELS WITH OPPOSITE OR SCALARIFORM PITTING

1 a. Vessels virtually all solitary (pores rarely in contact radially)... 2
b. Vessels not all solitary... 33

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

3 a. Rays in part large (usually more than 7 cells wide) and conspicuous... 4
b. Rays not conspicuous, though often distinct... 9

4 a. Rays mostly homogeneous. Frequently ring-porous. *Quercus* (Fagaceae).
b. Rays decidedly heterogeneous. Diffuse-porous... 5

5 a. Fibers with simple or indistinctly bordered pits. *Hedyosmum* (Chloranthaceae).
b. Fibers with large bordered pits... 6

6 a. Vessel perforations simple in part; scalariform plates few-barred.. 7
b. Vessel perforations all multiple; scalariform plates mostly many-barred... 8

7 a. Pores large. Largest rays 12–20 cells wide; pits to vessels medium-sized; raphides common. Parenchyma abundant in fine lines. *Curatella*, *Davilla* (Dilleniaceae).
b. Pores small to minute. Largest rays up to 8 cells wide; pits to vessels large; raphides absent. Parenchyma sparse. *Macleania*, *Thibaudia* (Vacciniaceae).

8 a. Rays often 8–15 (20) cells wide. Vessel-ray pitting coarse. *Metteniusa*, *Poraqueiba* (Icacinaceae).
b. Rays infrequently up to 8 cells wide. Vessel-ray pitting not coarse. *Cornus florida* (Cornaceae).

9 a. Vessel perforations exclusively or predominantly simple... 10
b. Vessel perforations exclusively or predominantly multiple... 13

10 a. Rays rarely over 2 cells wide... 11
b. Rays 1–4 (6) cells wide... 12

11 a. Ring-porous. Rays virtually all uniseriate; homogeneous or nearly so... *Castanopsis* (Fagaceae).
b. Diffuse-porous. Rays frequently biseriate; decidedly heterogeneous... *Cassipourea* (Rhizophoraceae).

12 a. Fibers with simple or indistinctly bordered pits. Parenchyma sparingly paratracheal... *Oedematopus* (Guttiferae).
b. Fibers with distinctly bordered pits. Parenchyma reticulate. *Hieronyma* (Euphorbiaceae).

13 a. Vessel-ray pitting very fine to medium... 14
b. Vessel-ray pitting coarse... 26

14 a. Rays homogeneous or with very few upright cells... 15
b. Rays heterogeneous, typically with many upright cells... 16

15 a. Rays mostly biseriate. Vessel perforation bars very closely spaced. Oil cells absent. ..... *Symplocos tinctoria* (Symplocaceae).
b. Rays all uniseriate or partially biseriate. Vessel perforation bars widely spaced. Oil cells present in parenchyma strands. *Capsicodendron* (Canellaceae).

16 a. Perforation plates short, rather few-barred. 17
b. Perforation plates long, many-barred. 22

17 a. Rays typically not over 2 cells wide. ..... *Fendlera* (Hydrangeaceae).
b. Rays frequently 3 or more cells wide. 18

18 a. Multiseriate rays with strata of slender procumbent cells; uniseriates few and low. Vessels without spirals. 19
b. Multiseriate rays without strata of slender procumbent cells; uniseriates numerous, often tall. Vessels with fine spirals, at least in tips of members. 21

19 a. Perforations simple in part. ..... *Myrica* (Myricaceae).
b. Perforations all multiple. 20

20 a. Fiber pits small, exceeding numerous. Perforations often no wider than the bars. Vessel-ray pitting very fine. Pores frequently crowded. ..... *Cliftonia, Cyrilla* (Cyrillaceae).
b. Fiber pits large, fairly numerous. Perforations usually three times as wide as the bars. Vessel-ray pitting medium. Pores not crowded. *Cornus* (Cornaceae).

21 a. Parenchyma abundant. Vessel-ray pitting not scalariform. Fibers often with spirals. ..... *Escallonia* (Escalloniaceae).
b. Parenchyma very sparse. Vessel-ray pitting often finely scalariform. Fibers without spirals. . *Gaylussacia, Vaccinium* (Vacciniaceae).

22 a. Rays typically uniseriate and biseriate. . . *Viburnum* (Caprifoliaceae).
b. Rays frequently 3 or 4 cells wide. 23

23 a. Parenchyma very sparse; vasicentric and diffuse. Rays less than 25 cells high. More or less ring-porous; largest pores medium-sized. *Lyonia* (Ericaceae).
b. Parenchyma reticulate. Rays often over 25, sometimes 100 or more, cells high. Pores all small to minute. 24

24 a. Uniseriate rays few; multiseriates with many slender procumbent cells. ..... *Clethra* (Clethraceae).
b. Uniseriate rays numerous; multiseriates with few or no slender procumbent cells. 25

25 a. Perforation plates with widely spaced bars. Raphides sometimes present in ray cells. ..... *Saurauia* (Saurauiaceae).
b. Plates with very closely spaced bars. Raphides absent. *Styloceras* (Buxaceae).

26 a. Rays normally not over 2 cells wide. 27
b. Rays often 4 or more cells wide. 29

27 a. Vessels with spirals in tips of members. *Franklinia, Gordonia* (Theaceae).

b. Vessels without spirals. 28

28 a. Rays virtually all uniseriate. Perforation plates usually with less than 15 bars. ..... *Hamamelis* (Hamamelidaceae).
b. Rays often 2 cells wide. Perforation plates typically with more than 15 bars. . . . *Liquidambar* of Central America (Hamamelidaceae).

29 a. Fibers with very small simple or indistinctly bordered pits. Uniseriate rays few; distinctly upright cells few or absent. Pores thick-walled. ..... *Rhizophora* (Rhizophoraceae).
b. Fibers with large distinctly bordered pits. Uniseriate rays numerous. Pores thin-walled. 30

30 a. Multiseriate rays with strata of slender procumbent cells; sheath cells absent. 31
b. Multiseriate rays without strata of slender procumbent cells; sheath cells present. 32

31 a. Parenchyma very sparingly diffuse. Vessel-ray pitting opposite. *Staphylea* (Staphyleaceae).
b. Parenchyma rather abundantly diffuse to reticulate. Vessel-ray pitting scalariform. ..... *Symplocos* (Symplocaceae).

32 a. Perforations simple in part; scalariform plates short, rather few-barred. ..... *Cavendishia, Psammisia* (Vacciniaceae).
b. Perforations all multiple; plates long, many-barred. *Viburnum* (Caprifoliaceae).

33 a. Scalariform perforation plates present, at least in part, and not confined to smallest vessels. 34
b. Scalariform perforation plates absent or confined to smallest vessels. 73

34 a. Rays in part conspicuous. 35
b. Rays not conspicuous though often distinct. 43

35 a. Wide rays with multiseriate sheaths of square or upright cells surrounding one or more cores of slender procumbent cells. Late-wood pores tending to ulmiform arrangement. *Ribes* (Grossulariaceae).
b. Rays without multiseriate sheaths. Pore arrangement not ulmiform. 36

36 a. Fibers with distinct to conspicuous bordered pits; not septate. . . . 37
b. Fibers with simple or inconspicuous bordered pits; abundantly septate, at least in part. 40

37 a. Multiseriate rays homogeneous or nearly so. 38
b. Multiseriate rays distinctly heterogeneous. 39

38 a. Many rays 1–3 cells wide. Perforations mostly simple. *Fagus* (Fagaceae).
b. Few rays 1–3 cells wide. Perforations mostly scalariform. *Platanus* (Platanaceae).

39 a. Pores radially arranged. Vessels and fibers often with distinct spirals. Parenchyma rather abundant. Heartwood chalky white. *Ilex* (Aquifoliaceae).

b. Pores not in definite radial arrangement. Vessels and fibers without spirals. Parenchyma absent or very sparse. Heartwood reddish or brownish. ..... *Turpinia* (Staphyleaceae).

40 a. Rays in part with gum ducts. . *Dendropanax*, *Oreopanax* (Araliaceae).
b. Rays without gum ducts. 41

41 a. Pores often in long multiples, appearing in distinct radial arrangement because of the close spacing of the rays.
Carpotroche (Flacourtiaceae).
b. Pores solitary and in small multiples not in distinct radial arrangement, the rays being less closely spaced. 42

42 a. Perforation plates with rather few, widely spaced bars. Parenchyma sparingly diffuse, the strands often with several large cells.
Mollinedia (Monimiaceae).
b. Perforation plates with many closely spaced bars. Parenchyma apparently absent. ..... *Amphirrox* (Violaceae).

43 a. Fibers with distinct to conspicuous bordered pits. 44
b. Fibers with simple or indistinctly bordered pits. 51

44 a. Ring-porous. Late-wood pores in dendritic arrangement.
Castanea (Fagaceae).
b. Diffuse-porous. Pores not in dendritic arrangement. 45

45 a. Parenchyma reticulate. 46
b. Parenchyma not reticulate. 48

46 a. Rays all 1 or 2 cells wide and very high; without strata of definitely procumbent cells. Intervascular pitting coarse, opposite.
Peridiscus (Flacourtiaceae).
b. Rays 1–4 cells wide and not very high; multiseriates with strata of definitely procumbent cells. 47

47 a. Vessels with scalariform pitting. ..... *Aextoxicon* (Aextoxicaceae).
b. Vessels with fine, more or less opposite pitting.
Halesia (Styracaceae).

48 a. Rays distinctly 2-sized, the larger often 3 or 4 (6) cells wide. 49
b. Rays not distinctly 2-sized, being mostly 1 or 2, infrequently 3 or 4, cells wide. 50

49 a. Pores medium-sized in part; mostly in radial multiples of 2–5. Intervascular pitting opposite. Uniseriate rays tall.
Turpinia (Staphyleaceae).
b. Pores small to minute; mostly not in multiples. Intervascular pitting scalariform. Uniseriate rays low. . *Eucryphia* (Eucryphiaceae).

50 a. Spirals common in tips of vessel members. Intervascular and vessel-ray pitting scalariform in part. Vertical gum ducts sporadic.
Liquidambar (Hamamelidaceae).
b. Spirals absent, or of very rare occurrence in tips of vessel members. Intervascular and vessel-ray pitting typically opposite. Gum ducts absent. ..... *Nyssa* (Nyssaceae).

51 a. Parenchyma more or less reticulate. 52

b. Parenchyma not reticulate. 53

52 a. Growth rings distinct. Vessels sometimes with spirals; tyloses common to abundant. Parenchyma cells large. *Nothofagus* (Fagaceae).
b. Growth rings absent or indistinct. Vessels without spirals; tyloses apparently absent. Parenchyma cells small. *Belangera* (Cunoniaceae).

53 a. Radial gum ducts present. 54
b. Radial gum ducts absent. 55

54 a. Rays enlarged about ducts; uniseriates numerous. Perforation bars numerous, closely spaced. ..... *Campnosperma* (Anacardiaceae).
b. Rays not distinctly enlarged about ducts; uniseriates few. Perforation bars rather few, widely spaced.
Dendropanax, *Didymopanax*, *Oreopanax* (Araliaceae).

55 a. Rays commonly with tanniniferous tubes. (See Key VI, 125–127.)
Myristicaceae.
b. Rays without tanniniferous tubes. 56

56 a. Oil cells present in rays. ..... *Talauma* (Magnoliaceae).
b. Oil cells absent. 57

57 a. Fibers septate, at least in part. Parenchyma sparse or apparently absent. 58
b. Fibers not septate. Parenchyma various. 68

58 a. Vessels with spirals. More or less ring-porous. 59
b. Vessels without spirals. Diffuse-porous. 61

59 a. Vessel spirals fine and indistinct. Small late-wood pores mostly not in multiples. Scalariform plates few. . *Arctostaphylos* (Ericaceae).
b. Vessel spirals rather coarse and very distinct. Late-wood pores mostly in multiples. Scalariform plates few to many. 60

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

61 a. Rays 1 or 2 (3) cells wide. 62
b. Rays often 3 or 4 (5) cells wide. 63

62 a. Rays mostly biseriate, with strata of procumbent cells. Pores very numerous. Intervascular pitting mostly opposite.
Oreopanax meiocephalum (Araliaceae).
b. Rays mostly uniseriate, without strata of procumbent cells. Pores not very numerous. Intervascular pitting mostly scalariform.
Brunellia (Brunelliaceae).

63 a. Pores rarely or not at all in long multiples. 64
b. Pores frequently in long multiples. 65

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

65 a. Pores in long multiples much flattened radially. *Arechavaletaia* (Flacourtiaceae).
b. Pores in long multiples not much flattened 66

66 a. Ray crystals mostly in vertical pairs of cubical cells. Vessel perforations predominantly simple ..... *Hasseltia* (Flacourtiaceae).
b. Ray crystals of general occurrence. Vessel perforations predominantly multiple 67

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

68 a. Parenchyma exclusively terminal (the bands sometimes in pairs in *Talauma*) 69
b. Parenchyma otherwise 71

69 a. Intervascular pitting typically opposite. Vessels without spirals. *Liriodendron* (Magnoliaceae).
b. Intervascular pitting typically scalariform 70

70 a. Rays all heterogeneous. Vessel-ray pitting coarse, often scalariform. Pores few to numerous. Vessels without spirals. *Talauma* (Magnoliaceae).
b. Rays homogeneous in part. Vessel-ray pitting fine, unilaterally compound. Pores very numerous. Vessels often with spirals. *Magnolia* (Magnoliaceae).

71 a. Intervascular pitting typically scalariform. Rays up to 30 cells high. Parenchyma very sparse ..... *Laurelia* (Monimiaceae).
b. Intervascular pitting not scalariform. Rays up to 100 or more cells high. Parenchyma not sparse 72

72 a. Pores medium-sized in part. Vessel perforations simple in part; pitting alternate to opposite. Parenchyma in numerous uniform narrow concentric bands suggesting Anonaceae. *Lissocarpa* (Lissocarpaceae).
b. Pores all small. Vessel perforations exclusively multiple; pitting typically opposite. Parenchyma in irregular metatracheal rows and diffuse ..... *Lacistema* (Lacistemaceae).

73 a. Rays large and conspicuous, at least in part 74
b. Rays not conspicuous, though often distinct 82

74 a. Fibers with conspicuous bordered pits 75
b. Fibers with simple or inconspicuous bordered pits 76

75 a. Rays virtually all multiseriate and not in contact with the pores. Intervascular pitting tending to scalariform. *Aristolochia* (Aristolochiaceae).
b. Rays not all multiseriate; frequently in contact with the pores. Intervascular pitting opposite ..... *Ancistrothyrsus* (Flacourtiaceae).

76 a. Parenchyma in narrow closely spaced concentric bands. *Anona*, *Unonopsis* (Anonaceae).
b. Parenchyma not in bands 77

77 a. Radial channels present ..... Cactaceae.
b. Radial channels absent 78

78 a. Rays sometimes 10 or more cells wide. Pitting opposite to scalariform 79
b. Rays infrequently 7 cells wide; decidedly heterogeneous. Pitting uniformly long scalariform 81

79 a. Rays nearly homogeneous. Small pores mostly flattened in long multiples ..... *Vitis* (Vitaceae).
b. Rays definitely heterogeneous. Pores solitary and in small multiples 80

80 a. Rays with definite strata of slender procumbent cells. Fibers with very thick walls ..... *Sloanea* (Elaeocarpaceae).
b. Rays without slender procumbent cells. Fibers with thin walls. *Mentzelia* (Loasaceae).

81 a. Uniseriate rays rather few. Long crystalliferous strands with dilated cells common. Fibers septate ..... *Clusia* (Guttiferae).
b. Uniseriate rays numerous. Crystalliferous strands apparently absent. Fibers not septate ..... *Tovomita* (Guttiferae).

82 a. Parenchyma reticulate 83
b. Parenchyma not reticulate 85

83 a. Intervascular pitting scalariform. Rays uniseriate or partially biseriate; pits to vessels much elongated. Density low. *Euphorbia* (Euphorbiaceae).
b. Intervascular pitting more or less opposite; not scalariform. Rays often more than 2 cells wide; pits to vessels small. Density medium to high 84

84 a. Rays up to 15 (30) cells high. Heartwood yellow. *Malpighia* (Malpighiaceae).
b. Rays up to 100 or more cells high. Heartwood pinkish brown. *Fouquieria* (Fouquieriaceae).

85 a. Ring-porous or nearly so 86
b. Diffuse-porous, though with pores sometimes gradually decreasing in size during a season's growth 89

86 a. Pores in late wood in flame-like or zigzag arrangement. Fibers not septate 87
b. Pores not so arranged. Fibers septate 88

87 a. Early-wood pores in short uniseriate arcs; smaller vessels with spirals. Rays all uniseriate. Terminal parenchyma present. Fibers with very thin walls and minute pits ..... *Leitneria* (Leitneriaceae).
b. Early-wood pores in an indefinite band; vessels without spirals. Rays 1–3 cells wide. Terminal parenchyma absent. Fibers with rather thick walls and distinctly bordered pits. *Myoschilos* (Santalaceae).

88 a. Pore ring multiseriate; late-wood pores in clusters with tendency to diagonal or tangential arrangement. Parenchyma rather abun-

dant in early wood ..... *Aralia spinosa* (Araliaceae).
b. Pore ring uniseriate; late-wood pores in small scattered multiples. Parenchyma very sparsely paratracheal . . *Pseudopanax* (Araliaceae).

89 a. Parenchyma abundant and in concentric bands 90
b. Parenchyma sparse to absent; not in bands 91

90 a. Parenchyma in uniform closely spaced biseriate bands; oil cells common. Pores small ..... *Cymbopetalum* (Anonaceae).
b. Parenchyma in wavy multiseriate bands; oil cells absent. Pores large ..... *Moronobea* (Guttiferae).

91 a. Intervascular pitting uniformly long-scalariform 92
b. Intervascular pitting not uniformly long-scalariform 97

92 a. Fibers septate, at least in part. Palisade ray cells abundant 93
b. Fibers apparently not septate. Palisade ray cells few, except in *Tovomita* 95

93 a. Long crystalliferous parenchyma strands present. Rays sometimes up to 7 cells wide; uniseriates few to rather numerous. *Clusia* (Guttiferae).
b. Long crystalliferous parenchyma strands absent. Rays not over 4 cells wide; uniseriates numerous 94

94 a. Rays up to 40 cells high ..... *Havetiopsis* (Guttiferae).
b. Rays up to 100 or more cells high. *Chrysochlamys*, *Tovomitopsis* (Guttiferae).

95 a. Procumbent ray cells virtually absent. Parenchyma sparingly paratracheal; not aliform ..... *Oedematopus* (Guttiferae).
b. Procumbent ray cells common, though often rather short. Parenchyma more or less short-aliform 96

96 a. Uniseriate rays numerous; palisade cells common; multiseriate rays sometimes up to 7 cells wide ..... *Tovomita* (Guttiferae).
b. Uniseriate rays few; palisade cells uncommon; multiseriate rays not over 3 or 4 cells wide ..... *Tovomitidium* (Guttiferae).

97 a. Intervascular pitting typically very fine and alternate, but with local tendencies to irregularly scalariform; pits vestured; vessel members frequently with plural (2–4) simple perforations near either or both ends ..... *Cephaelis* (Rubiaceae).
b. Intervascular pitting medium to coarse; opposite in part; pits not vestured; perforations single 98

98 a. Vessels with spirals ..... *Olmediella* (Flacourtiaceae).
b. Vessels without spirals 99

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b. Rays frequently 3 or 4 (5) cells wide and more than 50 cells high; distinctly 2-sized 101

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

101 a. Pores often in long multiples. Procumbent ray cells few; not definitely stratified 102
b. Pores not in long multiples. Procumbent ray cells numerous in definite strata in multiseriate rays 103

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

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

IX. WOODS WITH CONSPICUOUS RAYS

1 a. Vessels absent ..... *Drimys* (Winteraceae).
b. Vessels present 2

2 a. Apparently broad rays actually aggregates of fine rays 3
b. Broad rays solid or aggregates of coarse rays 7

3 a. Pores large in part, rarely in contact radially. Vasicentric tracheids abundant ..... *Lithocarpus*, *Quercus* (Fagaceae).
b. Pores small to minute; often in contact radially. Vasicentric tracheids absent 4

4 a. Vessels with simple perforations; fine spirals present. Ray aggregates mostly confined to depressions in the stem. *Carpinus* (Corylaceae).
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b. Vessels without spirals 6

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b. Intervascular pitting alternate. Rays 1–4 (5) cells wide; aggregates rare ..... *Betula* (Betulaceae).

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b. Fibers with simple or inconspicuous bordered pits 47

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CURRENT LITERATURE

Economic plants of St. John, U. S. Virgin Islands. By ROBERT H. WOODWORTH. *Harvard Univ. Bot. Mus. Leaflets* 11: 2: 29–54; Apr. 22, 1943.

An annotated list of the plants of the island under the following classifications: Food plants; plants used for fish bait; poisonous plants; medicinal plants; plants which produce essential oils; dye plant; plants used as soap; plants used for their wood; fiber plants; ornamental plants; noxious plants and weeds; and miscellaneous. Both common and scientific names are given.

Nouveautés dans les palmiers royaux de Cuba oriental. By FRÈRE LEÓN. *Memorias de la Sociedad Cubana de Historia Natural Felipe Poey* 17: 1; 1943.

As a result of studies of the specialized flora of the region of Maisi, three new species are described: *Roystonea lenis*

León, Palma de Seda, *R. violacea* León, Palma Criolla Azul or Palma Roxa, and *R. stellata* León, Palma Blanca. The ordinary, popular distinction made in Cuba between Palma Real with ventricose, tapering trunk, and Palma Criolla with cylindrical stem, refers only to two age-phases of *R. regia*.—B. E. DAHLGREN, *Field Museum*.

The Caribbean Forester. Pub. quarterly by Tropical Forest Exp. Sta., U.S.F.S., Río Piedras, Puerto Rico. Vol. IV: 3: 99–144; April 1943.

CONTENTS

Una nueva especie de *Pinus* mexicano. By MAXIMINO MARTÍNEZ. *Madroño* 7: 1: 4–8; 1 text fig., 1 plate; January 1943.

The new species, *Pinus Douglasiana* Martínez, is a tree about 65 feet high and 12–20 inches in diameter growing in Sinaloa, Nayarit, Jalisco, Michoacán, México, Oaxaca, and probably also in Guerrero. It is a 5-needle Pine, perhaps included by Shaw under *P. pseudostrobus*, var. *tenuifolia* (Benth.) Shaw. Its principal associates are *P. Lumholtzii*, *P. leiophylla*, and *P. oocarpa*, but it sometimes occurs in pure stands. Its soft, white wood is used locally in house construction and furniture-making.

Tres especies nuevas mexicanas del genero *Abies*. By MAXIMINO MARTÍNEZ. *An. Inst. Biol.* (México, D.F.) 13: 2: 621–634; 10 text figs.; 1943.

Three species of *Abies* are described, bringing the total number of Mexican Firs to eight. The new ones are named *Abies durangensis*, *A. mexicana*, and *A. Vejari;* all of them attain large size on good sites at elevations of 2200–3000 meters above sea level.

Nuevas fanerogamas del S. O. del Estado de Puebla. By F. MIRANDA. *An. Inst. Biol.* 13: 2: 451–462; 5 figs.; 1943.

The proposed new species of Mexican trees are *Bursera Vejar-Vazquezii*, *Cedrela poblensis* (vern. name Cuachichile), *Jatropha Riojae*, and *Fouquieria Ochoterenae* (Rabo de Iguana).

Botanica general colombiana. By JESÚS M. DUQUE JARAMILLO. Manizales, 1943. Pp. 400; 7 x 9½; illustrated.

A text book of general botany published by the Government for official use in the schools of Colombia. Of special interest to wood technologists are the classifications of native commercial timbers according to their properties and uses (pp. 174–176), tables of mechanical properties of 100 woods (pp. 340–341), and the "Diccionario taxonómico de la flora industrial de Colombia" (pp. 349–381).

O palmito e o coco nos usos culinàrios no Brasil. By GREGORIO BONDAR. *Boletim do Ministerio de Agricultura*, Rio de Janeiro, (1941) 1942. Pp. 23.

On the use of palm cabbage (*palmito*) of the Coconut and other palms, and of coconut "milk" (*leite de coco*) expressed from the grated fresh albumen. Since the cabbage includes the terminal bud and its removal is fatal to the palm, the planting of Coconut and other palms for palm-cabbage is recommended, either as special plantings (*e.g.* of *Euterpe* and *Attalea*) or, in case of *Cocos*, halfway between the 8-meter rows of new Coconut plantations. Of the 625 plants thus grown per hectare, 469 may be cut for their cabbage in four or five years, leaving the usual 156 to develop.—B. E. DAHLGREN, *Field Museum.*

As cêras no Brasil e o Licurí, *Cocos coronata* Mart., na Bahia. By GREGORIO BONDAR. Boletim No. 11, Instituto Central de Fomento Economico da Bahia, 1942. Pp. 86; 6¼ x 9; 18 plates.

After an introductory account of waxes in general and vegetable waxes in particular, the most important of which for forty years has been Carnaúba palm wax, the body of this bulletin treats of the Licurí palm, *Cocos (Syagrus) coronata*, which until a few years ago was almost completely unknown as a source of wax. There is a discussion of its various common names, its taxonomy, physiological characteristics, distribution, abundance (estimated number five billions) in the State of Bahia, and its utility (principally yield of oil as well as wax), which is followed by an account of the history and development of licurí-wax production from a few pounds in 1935 to 1000 tons in 1940 and 2300 tons in 1941. The rationale of gathering and recent improvements in the rudimentary mechanics of the industry are explained and illustrated and the physical and chemical characteristics of the wax are compared with those of Carnaúba. Other matters considered are Licurí oil and by-products, the economics of the destruction of the palm by requirements of agriculture versus its protection and planting, and finally insect enemies.

A preliminary paper on the subject by the same author was noticed in *Tropical Woods* 69: 38 a few years ago, and include reference to an article from an English source referring to the same product as "Ouricury" wax, a confusing name now definitely abandoned by the industry, since it belongs preeminently to a well-known Amazonian palm of very different relationships.

The Cauassú wax of Pará, tentatively referred by the author to a palm, Babassú, *Orbignya*, is from the large leaf (caa-assú) of a Marantaceous plant, *Calathea*, a source of leaves for lining the open-mesh baskets and hampers used on the Amazon in place of bags.—B. E. DAHLGREN, *Field Museum.*

Wood structure of *Ryania*. By M. W. Bannan. *Am. Journ. Bot.* 30: 5: 351–355; 1 pl. with 8 photomicrographs, 1 text fig. with 29 drawings; May 1943.

Results of the study of 80 wood samples of roots, stems, and twigs representing six species of *Ryania* (*Patrisia*), a small flacourtiaceous genus of shrubs and small trees of tropical America. The wood is of interest to pharmacologists because of its poisonous content. The anatomical details have been carefully studied and described, but "the range of variability in one species extends deep into that of the most similar species. Slight specific differences are indicated, but as a rule the differences are too small and the variability too great for any of these characters, taken alone, to have diagnostic value in distinguishing species."

The Araliaceae of China. By Hui-Lin Li. *Sargentia* (Jamaica Plain, Mass.) 2: 1–134; 14 text figs.; Oct. 26, 1942.

A systematic study of the Chinese Araliaceae in which attempt is made to account for every published binomial as recorded from China in botanical literature since 1753. A total of 17 genera, 121 species, 32 varieties, and three forms are recognized.

The family Araliaceae consists of about 60 genera and more than 800 species, mostly woody plants, occurring in the tropical and, less frequently, in the temperate regions of both hemispheres. "The ginseng, *Panax schin-seng* Nees, is a very famous Chinese tonic. The root bark of *Acanthopanax gracilistylus* W. W. Smith, its varieties, and possibly some of the related species, known as 'wu-chia-pi,' is used in making a well known medicinal wine. The root of *Aralia cordata* Thunb., and the stems, leaves, and fruits of *Hedera nepalensis* var. *chinensis* Rehder are also used in Chinese medicine. The pith of *Tetrapanax papyriferus* Koch produces the rice paper, 'tung-tsao,' which is used in medicine and is very extensively employed in making artificial flowers and for other purposes of decoration. . . . *Kalopanax pictus* (Thunb.) Nakai is an important timber tree in China. It is widely scattered and common throughout most parts of China. A few species, such as *Schefflera octophylla* Harms, produce lumber that is used for making furniture and for other purposes. Many shrubs, particularly those of the genera *Acanthopanax*, *Nothopanax*, and *Aralia*, are valued as ornamentals."

A revision of the genus *Sabia* Colebrooke. By Luetta Chen. *Sargentia* 3: 1–75; 9 text figs.; Jan. 30, 1943.

The representatives of the genus *Sabia* are mostly evergreen shrubs, scandent or suberect, rarely erect, and, except for a single species, unarmed. The genus "is characteristic of certain tropical and subtropical regions of the Old World, having no representatives in Africa and Madagascar, Australia, Polynesia, and the New World. The greatest development in species occurs in China, from which country 36 species and nine varieties are recognized in this revision; within China the largest number of forms is found in the extreme southwest in Yunnan Province, where 21 species are now known."

The Chinese and Indo-Chinese species of *Ormosia*. By E. D. Merrill and Luetta Chen. *Sargentia* 3: 78–120; Jan. 30, 1943.

"The objective in this attempt to revise the eastern Asiatic species of *Ormosia* is to enumerate all of the known Chinese and Formosan species, as well as those of Indo-China, to give the more important literature references, to adjust the synonymy, to cite all specimens available to us for study purposes, and to indicate the known range for each species. For the convenience of those who may have occasion to study the genus later an artificial key to the 34 recognized species has been prepared. The net result has been to increase the known Chinese species of *Ormosia* from 10 to 27, the additions all being in the form of previously undescribed species."

The origin and certain trends of specialization of the vessel in the Monocotyledoneae. By Vernon I. Cheadle. *Am. Journ. Bot.* 30: 1: 11–17; 9 figs.; January 1943.

"The evidence indicates that vessels have originated from tracheids. Those vessel members nearest to the tracheid have scalariform perforation plates with over 50 bars on very oblique end walls. These vessels are, therefore, primitive. On the contrary, those vessel members which are least like

tracheids have simple perforation plates on transversely placed end walls. The evidence in general indicates that tracheids are the most primitive upright conducting cells in the xylem and that vessel members with short length, simple plates on transverse end walls, oval to circular outlines in cross section, and constant width of cell walls at all degrees of thickness are the most specialized. Vessel members with scalariform plates are intermediate in specialization. Those with the largest number of bars are the most primitive, while those with the smallest number are the most highly specialized among such vessel members.

"Size and wall thickness should be used with great caution as indicators of specialization. No conclusion can be made at this time concerning the significance of various types of pitting on tracheids or vessels. In essential features, both the origin and the lines of specialization of the vessel in the primary xylem of the Monocotyledoneae parallel those of the vessel in the secondary xylem of the Dicotyledoneae. It seems clear that vessels have originated independently in these two groups of the Angiospermae."—*From Author's summary.*

On your own. By SAMUEL A. GRAHAM and EARL C. O'ROKE. Univ. of Minn. Press, Minneapolis, 1943. Pp. 150; 5¼ x 7¾; 52 text figs. Price $2.

This is a handy manual for field and service men on how to take care of oneself in wild country. It tells in a concise manner what a person can do to guard against discomfort and perhaps danger. The book has 14 sections, with the following titles: 1. How to meet physical extremes. 2. Preventing and treating minor injuries and infections. 3. Quicksand, quagmire, and water hazards. 4. Your food in the field. 5. Wild plants you can eat. 6. Wild animals you can catch for food. 7. How to protect yourself from poisonous plants. 8. What to do about annoying or dangerous animals. 9. What to do about insects and other irritating pests. 10. How to avoid animals' diseases. 11. Disease carriers. 12. Parasites that attack man. 13. Equipment you will need in the field. 14. General advice.

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 76 DECEMBER 1, 1943

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Yale University School of Forestry

TROPICAL WOODS

NUMBER 76 December 1, 1943

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

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

Subscription price One Dollar for four consecutive numbers. Remittances should be made payable to TROPICAL WOODS.

Address all communications to the editor, 205 Prospect Street, New Haven, Connecticut, U. S. A.

THE WOOD INDUSTRY BEGINS TO WAKEN

By ROBERT W. HESS

The wood industry, despite its antiquity, has shown the fewest advances in fundamental technology of all the major industries. From the primitive 2-man pit-saw in the recesses of a tropical forest to the mammoth sawmill in the western United States is a great stride in mechanical development, but the purpose of each is to convert logs into lumber. The progress has been in the method of manufacture, the product has remained the same.

Now, at long last, the industry begins to waken. Discoveries are being made and new processes are being perfected that stir the imagination. They promise the first opportunity for the general application of the principle of sustained yield to millions of acres of mishandled and ruthlessly exploited forests. Owners of woodlots and timberlands will practice forestry, not

because of threats of forced regulation or promises of financial subsidies or appeals to patriotism, but because the growing of wood crops will become a profitable enterprise. The real incentive to the business of forest utilization will come with the successful development of the many newly created types of forest products.

The most notable recent developments in the field of wood utilization have taken place in the plywood industry. Highly stressed three-ply 1/32-inch-thick skins of a 400-mile-per-hour airplane and continuous 80-foot plywood panels forming the hulls of powerful torpedo boats are striking examples of hundreds of plywood uses made possible by new fabrication methods, adhesives, finishing, design data, and numerous other associated developments. Bonds fully as durable as the wood, even imparting some measure of resistance to moisture movement through the panel, have made a host of new uses available. Greatly improved slicing, drying, pressing, and conditioning methods under close technical supervision and control have standardized the product and built a substantial reputation for the industry. Species heretofore not used for plywood are now being sliced, in production or experimentally; many other species could be cut for high-grade plywoods with only a minimum of study of techniques. The cutting of small logs for veneers awaits only the development of new types of equipment. High-speed equipment is now commonly used to join the edges of narrow veneers into wide sheets. Virtually continuous sheets of plywood are not only possible but might, in certain circumstances, prove the most economical method of manufacture. Defects in the plywood panels would be clipped out as complete panels to serve as the cores for thicker panel stock.

Plywood manufacture in utilitarian grades should prove to be one of the most feasible methods of utilizing tropical forests. The great variety of species would have much less effect in this than in a lumber industry. Undoubtedly several kinds of core and face stock could be considered interchangeable. Chemical treatment of logs, rapid moving to the mill, and submergence until use would prevent stain and decay. The green slicing and rapid drying of veneers eliminates the tropical seasoning problem of lumber. It would probably be feasible to treat the veneer for decay-resistance prior to drying.

The manufacture of formed shapes from plywood, the so-called "molded plywood," is one of the most dramatic phases of the expanding industry. Beginning with a few simple shapes, such as chair backs and drawer fronts, this industry, made possible by simultaneous development of artificial resin adhesives and new processes, cannot yet visualize its bounds. Furniture, boats, canoes, engine parts, and dozens of intricate aircraft parts have been made on a production basis. Some structural shapes, such as angles, channels, and "hat sections" have been manufactured literally by the mile. Even "I" beams have been constructed of molded plywood complete in one operation. Plywood tubing with inside diameters of from one-half inch to 24 inches are being made in any length ordered. These tubes, which are highly efficient structural members, have been used in aircraft, as collapsible tent poles, collapsible antenna poles 90 feet tall, and for other military purposes. With or without waterproof artificial resin impregnation or plastic inner layers, they conduct liquids efficiently and are not subject to the internal corrosion, calcification, or other obstruction characteristics of metal pipes. Tubing in round and modified forms should have considerable application in furniture of the near future. Cylinders for efficient barrels are being made in large quantities, special cylinders and tanks have been constructed in sizes up to 11 feet in diameter. Standard molded plywood shapes for house construction are a definite possibility. Extensive use of molded plywood for light-weight, sturdy, and artistic furniture is assured. The limitations of the process are not known; the range of items being considered include all manner of articles from luxurious cabin cruisers to violins and clarinets. Even bathtubs have been successfully constructed of molded plywood; the low thermal conductivity of this material is said to have sensory advantages for this use.

Recent constructions of laminated timber buildings have developed enormously, culminating in fire-proofed wood structures a thousand feet long, seventeen stories high, with a clear span width of 250 feet. The prefabricated laminated arches,

beams, and columns are built up of pieces held together by adhesives or metal timber connectors. Intricate and huge as many present-day wood structures are, they represent only the initial step into a field of infinite possibilities. The efficient beams constructed from laminated wood cap-strips with plywood webs (the wood counterpart of the metal "I" beam) has long been used in aircraft, but only recently in industrial buildings and dwellings. Laminated structural panels, often carrying their own internal insulation, are being made in standard unit sizes. The extensive use of laminated structural materials will greatly reduce the lumber size requirements for large timbers. Even single-thickness boards are being joined at the ends to form long clear lumber. Such combinations offer promising outlets for the abundant low-quality second-growth timber. The extent of the possibilities of this field can be visualized in the methods of *continuous* manufacture of laminated timbers being seriously considered at this time.

Along with the general improvement of standard wood-seasoning equipment and processes have come new methods of overcoming this age-old difficulty. Salt treatments have been accepted for commercial seasoning of large timbers, refractory woods, and some specialty products, but a number of problems must be solved before this method can be considered completely satisfactory. The fire-proofing and seasoning-aid properties of some salts offer the possibility of developing a combined process of considerable value. High-frequency electrostatic heating for drying wood has many proponents, but with present equipment it cannot be considered commercially practicable for anything but high-grade specialty products. Radical methods of heating in liquids and gases are being developed. Considerable promise of very rapid drying of high-grade products is held in a process of replacing the water with hydrocarbon gases of a high boiling point.

Elimination of defects from boards and plywood panels has reached the stage where plastic compounds containing wood flour are injected under pressure into the spaces left when parts are cut out and form strong, inconspicuous patches. For structural materials, however, the use of smaller, sound pieces bonded with high-strength adhesives appears more feasible.

Many of the recent developments in wood utilization have been made possible by the new types of synthetic-resin adhesives which have appeared in the last two years. The major features of these new adhesives are bond strengths greater than that of the wood, complete waterproofing, prevention of decay, and the ability to "set" under various conditions and extremely rapidly at elevated temperatures. Structural bonds of wood to plastics and wood to metal are now possible, opening another field of importance to wood utilization. One of the great weaknesses of wood structures of all kinds has been its low joint-strength. Now that it is possible to bond metal plates or fittings to wood this problem is reduced to one of design.

Pursuit of methods of controlling shrinkage and swelling in wood has unexpectedly disclosed an entire new field of wood uses. It was discovered that the close affinity of wood substance to some of the synthetic resins permitted fundamental changes in the physical properties of the wood itself. Parallel research in plastics helped to supply additional information. All indications at present are that wood is not merely an inert material that may resist centuries of exposure to the elements, but is essentially a complex chemical compound which can most nearly be likened to a combined thermoplastic-thermosetting resin with its own filler material in the form of fibers perfectly aligned to produce structurally laminated plastics whose properties exceed those of any similar material so far constructed by man. The properties of wood can, however, be improved in an increasing number of ways. Artificial resins can be added which virtually eliminate shrinkage and swelling and increase compressive strength. Controlled resin-impregnation and compression produce materials of controllable high density, very high strength values, and other unique properties. By this process the strength properties of a poor wood become as good as those of the strongest! Similar material with somewhat different properties can be made of very thin veneers and interleaved resin films without previous resin impregnation. Removal of the lignin and replacement with a synthetic resin improves the properties of wood and exposes an entirely new field for future developments. Perhaps of even

greater import is the newest discovery of all in which the addition of synthetic resin plastics is eliminated and the lignin itself (also a resin plastic) is used to change the properties of wood.

The place of the resin-impregnated or otherwise modified woods in future products can be anticipated to some extent. At present the densified material finds important use as aircraft propellers, bearings, gears, rollers, bearing plates, ski parts, and similar items. Wide acceptance can be expected for floors, counter tops, table tops, sporting goods, decorative pieces, and for many uses requiring great strength, wear resistance, or mar-proof beauty. Resin-impregnated woods, not necessarily densified, will find a host of applications where lack of shrinkage and swelling or maximum durability is of importance; aircraft parts, plywood house-siding, boats, exterior doors, vehicle parts, electrical cabinets, and precision instruments are but a few of the examples. Stabilizing and protecting fancy veneers without noticeably altering their appearance is a possibility; the densification of light-weight woods will make available many species never before considered suitable for decorative furniture or panelling.

In some stages and with certain resins the preceding materials can be molded to shape with the same precision as any other compression-molded plastic. Entire aircraft propeller blades are pressed to shape in the operation; they frequently have a previously selected varying density through their length and leave the mold with a durable polished plastic finish. There are many possibilities for such a product although not all of the problems of manufacture have been eliminated. The shaping of wood following impregnation with urea should find a number of applications, particularly now that a method has been developed for converting the salt to a strong plastic within the wood. Other methods of molding "wood" are being rapidly developed. Perhaps the most promising consists of a partial pulping process which yields a fibrous mass to which an artificial resin is added to augment the lignin, and the whole molded to shape. The dividing line between an impregnated pulp-like material chemically or mechanically manufactured from wood and a chemically impregnated solid-

wood member becomes intangible when heat and pressure mold them into plastic articles.

The chemistry of wood and its derived products now occupies a position similar to that of the petroleum industry some years ago. A great number of products can be synthesized, many of them new and with unknown properties and applications. It is probable that at least as many chemical products can be derived from wood as can be made from crude oils, once the chemical research reaches the magnitude of that in the oil industry. The crude destructive distillation of wood, a waning industry, cannot be considered exemplary, as it is only an extremely inefficient, virtually uncontrolled example of one of at least six major processes now used in chemically treating wood. Production of sugar or alcohol from hemi-celluloses is practicable and will probably continue so after the war. Bakers' yeast is being produced commercially from wood. Tanning materials, battery-plate depolarizers, rubber fillers, deflocculating or emulsifying agents, and other compounds are derived from lignin. Over 300,000 pounds of vanillin were produced last year. Lignin can easily supply all the D-ribose vitamin needed. From the host of products produced experimentally or predicted, those most promising for early commercial production include new types of solvents, anti-freeze, wood preservatives, lactic acid, humic acid, photographic developers, gum inhibitors for gasoline, plastic and rubber plasticizers, and special lubricants and plastics. The manufacture of paper and cellulosic products such as rayon are well-established industries, but it is not impossible that the chemical products obtainable from the enormous quantities of waste lignin will become of even greater importance. The significance of these complementary industries and their relation to wood-waste utilization cannot be overestimated.

The manufacture of plastics or adhesives from wood is rightfully a chemical phase of wood products, but it is considered separately because of both the magnitude and the complexity of the problem. Fundamentally the manufacture of a plastic from wood consists of breaking down a complicated thermo-set-thermoplastic resin (lignin) plastic, removing part or all of its laminated filler (celluloses), re-plasticizing the converted

"lignin" to a new plastic resin, adding a filler, and "setting" by the application of heat. Present processes tend to carry the lignin reduction so far that the molecules must be rebuilt to form suitable plastic molecular structures, but to reduce the cost the extraction processes are being modified to avoid excessive alteration of the composite lignin molecular structures. Results are becoming increasingly promising. These plastics, with the addition of small amounts of phenol formaldehyde compounds, are now being produced in quantity for comparatively low-grade plastic products. Improved methods and products are rapidly raising this low-cost plastic source to a prominent place in the industry. A huge potential source of superior plastic compounds awaits only the alchemy of the chemist to release it for reuse.

New kinds of equipment have made their appearance as new processes have been devised. Large pressure cylinders up to 12 feet in diameter and 50 feet in length, with doors in one end, take plywood shapes fastened to intricate molds and covered with a rubber bag. Simultaneous heat and pressure applied to the air-evacuated bags force the veneer layers to the mold and bond them into permanent shapes. Steam and air-filled rubber bags replace one or both platens of hydraulic presses to mold simple curved shapes in amazingly short cycles. Semi-cylindrical tanks with rubber faces perform similar functions on larger articles. Intricate or simple jigs, made specifically for one part, operate with the hydraulic pressure directly applied by the expansion of a fire hose. Heat for adhesive polymerization may be supplied by ingenious strip-heaters, steam coils, resistance foil, infra-red lamps, induction heating, or high frequency electrostatic means. One type of glue film with a fine, resistant metal-screen base can be interleaved between the wood layers and quickly bonded by connecting an electric current of suitable voltage. Most spectacular and promising for bonding any but the thinner plywoods is the high frequency electrical equipment. The ability of the electrostatic field to heat internally permits bonding of resinous adhesive layers without raising the wood to correspondingly high temperatures. This apparently is the answer to the problem of bonding thick laminates quickly. The internal

heating of the wood without materially affecting the surface temperature has brought about a marked change in a process that cannot be revealed at this time. High-frequency heating offers many advantages in the manufacture of resin-impregnated compressed products and should be investigated for use in the development of other plasticized lignin and resin products of wood.

With the high stressing of laminated parts and the reliance placed upon adhesive joints, the inspection of parts and completed structures becomes increasingly important, especially for detecting poor glue bonds and internal wood defects. To meet this problem mechanical aids are being devised. Fluoroscopic inspection of glue bonds and of thick material for hidden defects appears feasible. The electrical resistance of glue layers may offer a clue to the thickness of adhesive between two points. Sonic devices appear most promising for determining the quality of an adhesive bond after it has been formed.

Improvements in fabrication methods and new wood materials introduce a new field for the designer. Structural plywood panels for houses, with rounded interior and exterior corners, and wood floors in sheets (or rolls!) permit new and more efficient structural shapes. New designs can be expected in strong, light-weight furniture with legs an integral part of the structure and having cigarette-, alcohol-, and waterproof surfaces which can be refinished with light sanding and buffing. Molded plywood shells for boats have already given rise to designs feasible only with this material. Monocoque structures will be common in plywood aircraft. Laminated timber structures are rapidly changing the conventional wood industrial building construction.

Scientific progress is too rapid and the changes too numerous to permit a clear picture of the future of wood utilization, but several important developments indicated by present trends may be stated as follows:

1. Improvement of wood properties by processes involving heat and gases or solutions.
2. Use of many so-called inferior species for applications formerly reserved for high-grade woods through the use of impregnating materials.

3. Extensive manufacture of plywood from tropical timbers.
4. Development of economical methods of cutting veneer from small logs.
5. Production manufacture of high-grade boards and structural laminates from relatively small pieces.
6. General acceptance of the fireproofing of wood.
7. Enormously expanded use of molded plywood shells for such items as canoes, small boats, truck cabs, special piping, aircraft, housing specialties, and furniture.
8. Striking changes in the methods of furniture manufacture, producing lighter-weight items with greatly improved surfaces.
9. Development of more than one promising method of reducing shrinkage and swelling, including widespread use of resin impregnation for this purpose.
10. Great expansion of methods and manufacture of finely divided wood reformed into flat sheets or shapes.
11. Discovery of new compounds obtainable from wood; with industrial exploitation of many of them.
12. Initial extensive investigations of chemical, fibrous, and cork products obtainable from tree barks.
13. Development of methods of plasticizing, compressing, and molding wood in one complete operation.
14. Use of delignification and density-reduction processes in the formation of specific products.
15. Enormous expansion of the chemical industry based upon the products obtainable from lignin and celluloses from wood.
16. Combination of processes to utilize all lignin and cellulose products, thus eliminating the present waste from pulp mills and similar operations.
17. Great improvement of the various plastics obtainable from wood.
18. Rapid improvement and use of new adhesive types for wood and wood-metal bonding.
19. Great changes in design of wood structures, which, while using less wood, will be stronger and have a more pleasing appearance.

Unfortunately the rapid development of the new processes, together with the backwardness of the wood industry, has resulted in a grave shortage of basic data and criteria for efficient design and use. Even more serious is the present rate at which these data are being assembled for the coming period in which the great competition will be between steel, light metals (particularly aluminum), plastics, and wood. Of these, the wood industry and associated agencies are doing the least in preparation. Proper use of our forest resources can only be obtained when all the products therefrom are in sufficient demand to make complete use feasible. Attempts to establish universal sustained-yield production through scientific forestry practices will never be successful in the present industrial and chemical period as long as it is handicapped by the gross inefficiencies of raw wood as a fuel or the waste of 75 per cent of the material at the sawmill. Only the income from new products and the increased efficiency of use brought about by new methods can support full forest-crop production to supply the needs of society and meet the competition of other materials. Only systematic and comprehensive research can discover and utilize for man's well-being the many secrets which still exist in wood. And wood, unlike metals, coal, oil, and other exhaustible natural resources, can be supplied in perpetuity from lands unneeded for other purposes.

NEW OR CRITICAL EUPHORBIACEAE OF BRAZIL

By Leon Croizat

Arnold Arboretum, Harvard University

Material of Brazilian origin, kindly sent by Dr. G. Bondar, through Dr. B. E. Dahlgren, and by Mr. B. A. Krukoff, has suggested the notes and new publications in this paper.

Jatropha Linnaeus

Attempts have been made for over a century to break up *Jatropha* L. into several genera. One of these segregates, *Cnidoscolus* Pohl, has won wide recognition, this generic name being applied to forms with a stimulose or otherwise pungent indumentum, and flowers said to be lacking a "corolla." In my

opinion, *Cnidoscolus* may lack a calyx (represented oftentimes by minute scales or bracteoles at the base of the perianth), but hardly a true corolla. In a very definite sense *Cnidoscolus* connects *Jatropha*, *sensu strictu*, with *Manihot* Miller, which is quite shorn of calyx.

The carpic characters of *Cnidoscolus*, understanding under this name the stimulose or prevailingly stimulose forms of *Jatropha* with a much reduced or suppressed calyx, are exceedingly variable. In some species (*e.g.*, *J. urens* L.), the fruit is a weak and rather small capsule; in others (*e.g.*, *J. olygantha* Muell. Arg.), a large, very hard, woody, drupaceous structure. I believe we have not yet reached a stage in the study of this aggregate when we can appreciate critically the significance of characters such as the presence of more or less abundant stimulose hairs, more or less reduced calyx lobes, and more or less large and woody fruits. In consideration of these factors, I retain *Jatropha* in its broad traditional sense, granting *Cnidoscolus* only subgeneric recognition at present.

Jatropha oligandra Muell. Arg. in Fl. Bras. 11 (2): 502. 1874; Pax in Pflanzenr. IV. 147: 109. 1910. *Cnidoscolus Marcgravii* Bondar in Inst. Centr. Fom. Econ. Bahia, Bol. 12: 1–16. 1942. Non Pohl, 1827.—The type specimen is *Peckolt 173*, collected at Cantagallo in the State of Rio de Janeiro, and the original description mentions "Planta alte fruticosa . . . tota estimulosa. . . . Fructus ignoti." Pax cites *Peckolt 173* and *16328*, characterizing the fruit as "Capsula magna, stimulosa, drupiformis."

The material of *Bondar s.n.* (Bahia), on which is based the interpretation of *Cnidoscolus Marcgravii* cited above, agrees very well indeed with the descriptions by Mueller and Pax, and a photograph of *Glaziou 16328* (Cantagallo; not *Peckolt 16328*!) in the herbarium of Copenhagen, bearing the identification slip of Pax: "*Jatropha oligandra* Müll. Arg." The evidence suggests that the reference to *Peckolt 16328* was actually meant by Pax for *Glaziou 16328*.

The plants in this vicinity are stimulose to a very variable degree; they are described, accordingly, as stimulose or estimulose by authors who have relied exclusively upon herbarium material.

Bondar emphasizes and figures the peculiar caulocarpic growth of this species, which Mueller and Pax do not mention. Growth of the kind, however, may not be present upon young specimens, such, for instance, as Peckolt appears to have seen ("Planta alte fruticosa"), or be more or less well developed in different individuals. The range (Rio de Janeiro, Espirito Santo, and Bahia) is fairly consistent as one floristic domain.

Cnidoscolus Marcgravii has been carefully described and figured by Bondar in the paper cited (reviewed in *Tropical Woods* 74: 47, June 1, 1943).

Jatropha Froesii, nom. nov. *Jatropha pubescens* Pax in Pflanzenr. IV. 147: 110. 1910. Non Steud., 1840.—Like *J. oligandra*, this species is placed by Pax in subg. *Cnidoscolus* (Pohl) Muell. Arg., sect. *Oligandrae* Pax, characterized by small flowers and comparatively few stamens and staminodes. The type specimen is *Glaziou 14254* (Minas Geraës, according to the original label of an isotype in our herbarium; Rio de Janeiro, according to Pax, *loc. cit.*).

Glaziou's collection (seemingly taken from a short lateral shoot, therefore bearing small and possibly not quite typical leaves) is certainly very close to, if not identical with, *Froes 1036* (Bahia, Basin of the Rio Pardo, near Sapucaia). Froes describes the plant: "Tree 60 ft. high, 18 in. in diameter, 40 ft. to the first fork. Growing in the highlands in hilly country."

The material I have now at hand is not suitable for a stringent study which should be made to ascertain the characters of the pistillate flower and the fruit. The staminate flower and the somatic notes are sufficient for identifying the section, but hardly useful in working out the units below it.

Jatropha Froesii might prove to be a trinomial, if not a synonym of *J. oligandra*. The binomial of Pax cannot be maintained, however, and it seems strange that Froes, a trained collector, should have failed to notice caulocarpic growth if any had been present on the *mature* tree he saw. Under the circumstances, a new name must be presented pending further study.

Jatropha paucistaminea, the third species placed by Pax in this affinity (*op. cit.*, 110) is based upon material from Corumbá, Matto Grosso, which is said to have denticulate leaves

and a glabrous staminal column. The base of the staminate column is definitely pubescent in *J. oligandra* and *J. Froesii*, but the glandular disc in the former is continuous, whereas that of the latter is of discrete, if closely set, glands. This character may or may not be important.

ALGERNONIA Baillon

Algernonia pardina Croizat, sp. nov.—Arbor ad 20 m. alta, glaberrima. Foliis ellipticis vel ovato-ellipticis, utrinque rotundatis, apice mucronulatis vel brevissime acuminatis ad 9 cm. longis, 4.5 cm. latis, firme subcoriaceis, margine integerrimis, ad petioli radicem glandulis 2 late cicatricosis in limbo ipso impositis ornatis, nervis ca. 9–12 jugis patentibus gracilibus at obviis, petiolo 1.25–3 cm. longo, stipulis scariosis latis citissime deciduis innovationes cicatrice annulari more *Fici* generis notantibus. Perianthio ♀ (sub fructu tantum viso): lobis rotundatis 5 ca. 2 mm. longis latisque, carnosulis, margine integris; capsula obvie trigona depressa ca. 2 cm. lata, 1.5 cm. longa, epicarpio leviter ruguloso sublaevi; pedicello cicatricoso, crasso, ca. 0.5 cm. longo. Caeterae desunt.

Brazil, Bahia, Municipio do Itambé, Agua Bela, basin of the Rio Pardo, *12654/20 Froes*, Nov. 1942 (in herb. Krukoff).

I am much indebted to Dr. Charlotte G. Nast of the Biological Laboratories of Harvard University for a study of the wood anatomy of this plant. Her report bears out the conclusion, reached from a consideration of the meager material available, that a species of *Algernonia* Baill. is involved. The genus consists so far of two species, namely, *A. brasiliensis* Baill. and *A. obovata* Muell. Arg. I have seen authentic material of both and believe they are quite unlike my new species in their foliage.

Algernonia pardina is locally known as Pau de Leite, a name given to all arborescent plants yielding a milky sap. Nothing is known of the possible economic value of this tree.

NEW FOREST TREES AND CLIMBERS OF THE BRAZILIAN AMAZON

By ADOLPHO DUCKE

The forest trees and climbers here described or mentioned represent a fourth series (see *Tropical Woods* 31: 10–29, September 1, 1932; 43: 19–23, September 1, 1935; and 50: 33–40, June 1, 1937) of botanical novelties I have collected in the Brazilian State of Amazonas. The type of specimens are preserved in the Jardim Botanico of Rio de Janeiro. Cotypes are in the Instituto Agronomico do Norte and the Museu Paraense Emilio Goeldi, both of Pará; others will be distributed after the war to botanical institutions of the United States. Wood samples have been collected for the Yale School of Forestry.

LILIACEAE

Smilax papyracea Poir.—This species is the only one in Brazilian Amazonia yielding "salsaparrilha," which is exported chiefly from Pará. (See *Arquivos do Jardim Botanico do Rio de Janeiro* 5: 101 and plate 1. 1930.) One plant from the Rio Madeira flowered and fruited in the garden of Mr. A. Pinto, perfumist in Manáos. The staminate inflorescences were borne on the upper branches of the vine and the pistillate ones on the lower branches of the same plant, simultaneously. The ripe fruits are globose, with a diameter of 15–18 mm., and are of a pretty scarlet color. The plant flowered for the first time in January 1941, but the fruits did not begin to ripen until April 1943, the longest interval I ever observed between flowering and fruiting of any plant. For *Bertholletia*, the Brazil-nut tree, which previously held the record of time for the evolution of the fruit, that period is, under normal conditions, only 15 months.

ULMACEAE

Ampelocera latifolia Ducke, sp. nov.—Speciei *A. edentula* Kuhlm. arcte affinis et forsan ejus varietas; foliis fructibusque multo maioribus divergit (flores ignoti). Arbor sat magna. Folia quam in specie citata vulgo duplo vel triplo latiora (100–210 mm. longa, 50–150 mm. lata), suboblongo-elliptica

opinion, *Cnidoscolus* may lack a calyx (represented oftentimes by minute scales or bracteoles at the base of the perianth), but hardly a true corolla. In a very definite sense *Cnidoscolus* connects *Jatropha, sensu strictu*, with *Manihot* Miller, which is quite shorn of calyx.

The carpic characters of *Cnidoscolus*, understanding under this name the stimulose or prevailingly stimulose forms of *Jatropha* with a much reduced or suppressed calyx, are exceedingly variable. In some species (*e.g.*, *J. urens* L.), the fruit is a weak and rather small capsule; in others (*e.g.*, *J. olygantha* Muell. Arg.), a large, very hard, woody, drupaceous structure. I believe we have not yet reached a stage in the study of this aggregate when we can appreciate critically the significance of characters such as the presence of more or less abundant stimulose hairs, more or less reduced calyx lobes, and more or less large and woody fruits. In consideration of these factors, I retain *Jatropha* in its broad traditional sense, granting *Cnidoscolus* only subgeneric recognition at present.

Jatropha oligandra Muell. Arg. in Fl. Bras. 11 (2): 502. 1874; Pax in Pflanzenr. IV. 147: 109. 1910. *Cnidoscolus Marcgravii* Bondar in Inst. Centr. Fom. Econ. Bahia, Bol. 12: 1–16. 1942. Non Pohl, 1827.—The type specimen is *Peckolt 173*, collected at Cantagallo in the State of Rio de Janeiro, and the original description mentions "Planta alte fruticosa . . . tota estimulosa. . . . Fructus ignoti." Pax cites *Peckolt 173* and *16328*, characterizing the fruit as "Capsula magna, stimulosa, drupiformis."

The material of *Bondar s.n.* (Bahia), on which is based the interpretation of *Cnidoscolus Marcgravii* cited above, agrees very well indeed with the descriptions by Mueller and Pax, and a photograph of *Glaziou 16328* (Cantagallo; not *Peckolt 16328*!) in the herbarium of Copenhagen, bearing the identification slip of Pax: "*Jatropha oligandra* Müll. Arg." The evidence suggests that the reference to *Peckolt 16328* was actually meant by Pax for *Glaziou 16328*.

The plants in this vicinity are stimulose to a very variable degree; they are described, accordingly, as stimulose or estimulose by authors who have relied exclusively upon herbarium material.

Bondar emphasizes and figures the peculiar caulocarpic growth of this species, which Mueller and Pax do not mention. Growth of the kind, however, may not be present upon young specimens, such, for instance, as Peckolt appears to have seen ("Planta alte fruticosa"), or be more or less well developed in different individuals. The range (Rio de Janeiro, Espirito Santo, and Bahia) is fairly consistent as one floristic domain.

Cnidoscolus Marcgravii has been carefully described and figured by Bondar in the paper cited (reviewed in *Tropical Woods* 74: 47, June 1, 1943).

Jatropha Froesii, nom. nov. *Jatropha pubescens* Pax in Pflanzenr. IV. 147: 110. 1910. Non Steud., 1840.—Like *J. oligandra*, this species is placed by Pax in subg. *Cnidoscolus* (Pohl) Muell. Arg., sect. *Oligandrae* Pax, characterized by small flowers and comparatively few stamens and staminodes. The type specimen is *Glaziou 14254* (Minas Geraës, according to the original label of an isotype in our herbarium; Rio de Janeiro, according to Pax, *loc. cit.*).

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basi obtusa, vel saepius late ovali-elliptica basi oblique subcordata, costis lateralibus valde arcuatis, pilis microscopicis subscabridula. Drupa maior quam in specie citata (oblongo-ovata, 15–20 mm. longa, 8–12 mm. lata), canopilosula subscabrida, matura flava mesocarpio pulposo dulci. Stamina sub drupae basi hinc illinc persistentia, filamentis dilatatis iis *A. edentulae* similibus.

Prope Esperança (ad ostium fluminis Javary) in silva non inundabili, 29–X–1942, *Ducke 1039*.

A new species, or possibly an upper-Amazonian geographical form of *A. edentula* of the lower Amazon.

Meliaceae

Guarea carinata Ducke, sp. nov.—Arbor sat magna. Ramuli dense cano-pilosi tardius glabrati. Folia (cum petiolo) maiora 300–500 mm. longa, minoribus saepissime praesentibus, petiolo et rhachide robustis angulosis dorso applanatis, canovillosis, rhachide in gemmulam terminata, foliolis in foliis maioribus vulgo 4-rarius 5-jugis, oppositis. Foliola e petiolulo brevi (2–6 mm.) crasso ferrugineo- vel cano-villoso, vulgo 100–200 mm. longa et 50–90 mm. lata, obovato- vel elliptico-oblonga basalibus saepe brevius ellipticis, basi obtusa vel rarius acuta vel rotundata saepe complicata, apice vulgo brevissime apiculata, margine revoluto, adulta coriacea, concoloria, punctis pellucidis non conspicuis, supra sat nitida pilis punctiformibus minutis sparsis asperula, subtus dense et longe molliter canopilosa, pilis e papillis minutis oriundis, costis et venulis supra impressiusculis subtus prominentibus, costis lateralibus utrinque 10–15 subrectis vel (in brevioribus) arcuatis. Inflorescentiae fructiferae solae visae, in ramulis hornotinis axillares solitariae vel rarius binae. Capsulae 1 ad 4 per inflorescentiam, crasse pedunculatae, subglobosae apice saepius magis plane quam basi, stipite nullo, adultae usque ad 50 mm. diametri metientes, maturitate ab apice in valvas 6 (rarissime 7) dehiscentes; valvae carinis 3 longitudinalibus fortiter elevatis (saepe subalaeformibus) percursae, mediana e basi usque ad apicem, laterales e basi usque ad capsulae medium vel parum altius. Capsulae juniores

rubrae, canotomentosae, maturae glabratae, juniores calicis relicto breviter 3–5-lobato longe denseque canopiloso fultae.

Esperança (ad ostium fluminis Javary), silva loco alto, 31-I-1942 fructibus novellis et semiadultis in arbore, vetustibus sub arbore, *Ducke 1060*. Arbor unica visa.

Species haec nova foliolis coriaceis, horum pilis e papillo oriundis, et praesertim capsulis magnis sub-alato-carinatis eximia et inconfundibilis.

The present new species cannot be confounded with any one of the many Guareas growing in the same country, because of the large size and the very conspicuous keels or wings of its capsule.

Vochysiaceae

Vochysia urubuensis Ducke, sp. nov.—Ad seriem II, *Calophylloideae*. Arbor parva. Ramuli subteretes, supra parum angulosi, decorticantes, glabri, vetustiores pallide cinnamomei, novelli fusci. Stipulae parvae. Folia opposita glaberrima, petiolo 6–10 mm. longo tenui supra canaliculato; lamina vulgo 30–80 mm. longa et 20–40 mm. lata, obovata, basi sat breviter in petiolum angustata, apice rotundato-obtusa et in medio retusa, margine subtus tenuissime revoluto, coriacea, supra nitida in sicco lutescens, subtus subopaca et pallidior, costis lateralibus (sat approximatis) et venulis (crebre reticulatis) in utraque pagina tenuibus at distinctissime prominulis, nervo praemarginali sat obsoleto. Inflorescentiae terminales saepius 100–200 mm. rarius ad 250 mm. longae, 20–30 mm. latae, cylindricae apicem versus angustatae, floribus modice densis in rhachide valida subglabra fuscescente; cicinni saepissime uniflori, sat longe et tenuiter pedunculati; bracteae magnae obovato-lanceolatae caudato-acuminatae, in inflorescentiae parte novella subimbricatae, ad 12 mm. longae. Alabastra sub-falcato-cylindrica subobtusa subglabra. Flores lutei; calix glaber laciniis 4 anterioribus parvis, lacinia postica post anthesin expansa et reflexa, ad 10 mm. longa et ad 5 mm. lata, calcare ad 10 mm. longo fortiter uncinato-inflexo tenui apice obtuso; petala tenuia glabra, maiore obovato-oblongo ad 9 mm. longo. Stamen glabrum. Ovarium tenuiter flavidosericeum. Capsula ut in vulgari *V. obscura*.

Speciebus *V. expansa* Ducke, *V. obscura* Warm., et *V. obidensis* Ducke affinis, recedit praesertim foliotum venulis crebre prominulo-reticulatis, calcare longo, bracteis latis ovato-lanceolatis. Frequens secus ripas inundabiles fluminis Urubú inter cataractas Lindoya et Iracema, 5-VI-1941, *Ducke 815*.

This new species, next to *Dimorphandra urubuensis* Ducke (Leguminosae), is the most characteristic element of the flora of the flooded banks of the middle Rio Urubú. The trees grow in analogous conditions and have the same aspect as *V. angustifolia* Ducke of the Curicuriary, tributary of the upper Rio Negro.

Qualea gracilior Pilger = *Qu. lancifolia* Ducke.—The specimens I collected in the western part of the Brazilian Amazon (São Paulo de Olivença and, more recently, Esperança) correspond exactly to the description of the plant named by Pilger, collected by Tessmann in Amazonian Peru (mouth of the Río Santiago). Pilger's name has priority.

Euphorbiaceae

Caryodendron amazonicum Ducke, sp. nov.—Speciei *C. orinocense* Karst. affine, recedit foliorum forma et nervatione, et spicis elongatis. Arbor dioica 30–40 mm. alta, trunco cylindrico, cortice laevi pallide brunneo vel cinerascente, ligno flavescenti-albido duro et denso, partibus vegetativis omnibus glabris. Stipulae sat magnae ramuli gemmam terminalem cingentes, striatae, vulgo longe acuminatae, caducae. Foliorum petiolus 20–60 mm. longus; lamina vulgo 120–200 mm. longa et 40–100 mm. lata, obovato-oblonga vel elliptica, basi acuta obtusa vel rotundata, complicata, biglandulosa, apice breviter obtuse acuminata vel retusiuscula, coriacea, subconcolor, nitidula, costis lateralibus utrinque 5–8, ut venulae laxe reticulatae in utraque pagina magis vel minus prominentibus. Spicae masculae terminales et subterminales saepissime 5–7, erectae, strictae, simplices vel raro una vel altera parum super basin ramosa, 120–200 mm. longae, multiflorae, rhachi sat valida, angulosa, canopilosa. Flores virides, in glomerulis secus spicae rhachin sat dissitis, inter bracteas et bracteolas parvas dense sericeopilosas, glabri

praeter discum superne sericeum, sepalis tribus vix ultra 1 mm. longis, ovatis, acutis, staminibus 4. Spicae femineae terminales solitariae vel raro binae, 80–120 mm. longae solum in dimidio vel duobus tertiis superioribus fertiles, pedunculo et rhachi crassis subglabris. Flores 8–12 per spicam, inter bracteas et bracteolas breves et latas sessiles, virides, glabri praeter margines dense sericeos, anthesi circiter 10–12 mm. longi; calix e basi campanulata demum in torum evoluente, sepalis 5 vel 6 imbricatis latis obtusis apice ciliatis. Ovarium glabrum ovoideum supra in collum anthesi e calice emersum attenuatum, stigmatibus tribus revolutis in sicco flavis, subvillosulo-papillosis. Capsula inter sepala persistentia toro cylindrico 5–8 mm. alto, 4–6 mm. crasso insidens, adulta circiter 40 mm. longa et parum minus crassa, pericarpio rigide chartaceo ruguloso maturitate in valvas tres soluto et caduco, endocarpio durissime lignoso valvis tribus in medio longitudinaliter carinatis, hac carina ante apicem subito in forum terminata; semen circiter 30 mm. longum, brunneum, latere externo convexum, interno subplanum at in medio longitudinaliter subcarinatum, edule. Caruncula in speciminibus nostris non adest.

Habitat sat frequens in silva primaria terris altis circa Esperança (ad ostium fluminis Javary), ubi "castanha de porco" appellatur. Arbor mascula florifera 28-IX-1942, *Ducke 1070;* arbor feminea florifera 24-IX-1942, *Ducke 1071;* arbor fructibus maturis 11-II-1942, *Ducke 1072*.

The present is the fourth species of the little known genus *Caryodendron*, the three other species growing in Panama (*C. angustifolium* Standl.), on the eastern side of the Andes of Colombia and Venezuela (*C. orinocense* Karst.), and on the mountains of Rio de Janeiro (*C. grandifolium*). The seeds of *C. orinocense* are edible like those of the Amazon species.

Icacinaceae

Dendrobangia multinervia Ducke, sp. nov.—Ab unica hujus generis specie hucusque nota (*D. boliviana*) differt foliis maioribus, breviter petiolatis, multinerviis, floribus in spicas breves vel glomerulos dense congestis. Arbor circiter 20 m. alta trunco cylindrico, ramulis junioribus canotomentosis.

Foliorum petiolus 2–3 mm. longus, canaliculatus; lamina vulgo 100–180 mm. longa et 30–55 mm. lata, lanceolato-oblonga, basi saepius obtusa, apice longe acuminata, papyracea fragilis, siccitate fusca, supra sat nitidula vix rugulosa, subtus subopaca et asperula, in utraque pagina lepidiis pallidis dissite conspersa, costis lateralibus e centrali utrinque 20–25, supra tenuissimis subtus sat prominentibus, venulis subtus sat evidenter transverse reticulatis. Flores in paniculae ramorum parte apicali subspicati et secus rhachides in capitula dense glomerati, virides petalis albidis, magnitudine structura et indumento ut in *D. boliviana*. Drupam non vidi.

Esperança (ad ostium fluminis Javary), silva non inundabili versus Igarapé Jurará, 10-X-1942, *Ducke 1084*. Arbores duae visae.

This new species is a tree of the very moist upland rain forest of Esperança, on the Brazilian side of the mouth of the Javary. It is easy to distinguish from the other species by the above mentioned characters of leaves and inflorescences. The other species of the present genus, which until now has been considered monotypical, is widely spread from the Atlantic zone of the hylaea (Pará, Surinam) to the Madeira River and Amazonian Bolivia; it was found in three different countries and three times described, with the names of *Dendrobangia boliviana* Rusby, *Clavapetalum surinamense* Pulle, and *Asterolepidium elatum* Ducke.

Bombacaceae

Quararibea spatulata Ducke, sp. nov.—Speciei *Qu. guianensis* Aubl. partibus vegetativis similis, solum foliis (in speciminibus nostris) aliquanto rigidioribus, horum pilis lepidoto-stellatis magis conspicuis, florum characteribus plurioribus diversa; specimina sicca odore characteristico in altris speciebus (*Qu. guianensis* Aubl. et *Qu. Duckei* Huber) observato destituta. Arbor mediocris, floribus suaveolentibus, calice in vivo viridi, petalis albis. Ramuli, stipulae, folia et bracteae *Qu. guianensis;* pedunculi autem brevissimi, vix usque ad 3 mm. longi; alabastra breviora et crassiora, magis obovata. Calix anthesi 20–25 mm. longus, apice (in exsiccatis) 8–10 mm. latus parum profunde fissus dentibus subaequalibus

vulgo subtriangularibus, basi sat obtusus, extus dense ochraceo-tomentellus (pilis stellato-lepidotis magis conspicuis quam in specie citata), intus albidosericeus. Petala 45–50 mm. longa, ante apicem usque ad 10 mm. lata, oblique oblongo-spatulata tenuiter albosericea, sub anthesi erecta demum irregulariter contorta et recurva. Tubus stamineus anthesi petalis brevior, demum usque ad 60 mm. elongatus, albolanatus; antherae in tubi apice et loborum basi sessiles. Stylus tubo stamineo aequilongus, tomentosus; stigmatis lobi breves, supra glabri. Fructus ignotus.

Habitat prope Esperança (ad ostium fluminis Javary), non rara in silva non inundabili leviter paludosa prope rivulos, 22-X-1942, *Ducke 963*.

This pretty tree, with scented flowers of pure white, cannot be confounded with any other species of the genus. Its differential characters in relation with *Qu. guianensis* (a rather common tree of swamp forests of the Amazon estuary and the Guianas) are enumerated in the above diagnosis. *Qu. amazonica* Ulbr. ex Schum., from the Rio Juruá-Miry, Acre Territory, has glabrous leaves, longer peduncles, subbilabiate calyx with prominent angles and nerves, and much longer lobes of the style. *Qu. Wittii* Ulbr., of the Lower Juruá, State of Amazonas, has long-pedunculate flowers, a very different shape of calyx, and shorter petals. The other Amazon species of the present genus have much smaller flowers.

Matisia paraensis Huber.—This species, hitherto known only from the Amazon estuary, was recently found near Esperança, mouth of the Rio Javary.

Elaeocarpaceae

Sloanea longipes Ducke.—Adult capsule 30–50 mm. long, short ovoid (laterly 4-valvate), apiculate, inermous, covered with a thin stratum of microscopic, reddish brown tomentum; pericarp woody, thick and very hard; seeds one or more, seldom two, involved with a white arillus, pale rosy above. Manáos, December 29, 1942, *Ducke 1154*.

Sloanea macrantha Ducke.—This species, remarkable because of the large flowers and the strong cyanhydric smell of the bark, has hitherto been known only from Esperança, at

the mouth of the Javary river. I there observed recently a tree in the fructifying stage. The fruits, evidently very young, were already 33 mm. long; they are inserted on a large torus, oblong-obovoid, inermous, covered with microscopic grayish tomentum, and had four longitudinal furrows indicating the future valves; the peduncle was very thick. When adult, these capsules would certainly attain an unusually large size for this genus.

Sloanea brachytepala Ducke, sp. nov.—Arbor altissima (ultra 40 m.) adspectu elegante, trunco cylindrico basi radicibus tabularibus valde elevatis fulto. Ramuli mediocriter crassi, nodosi, juniores cinnamomei, lenticellosi, canotomentelli. Stipulae vix ultra 5 mm. longae, lanceolatae, canosericeae, caducissimae. Folia alterna, ad apices ramulorum congesta, nonnula sparsa, magnitudine in eodem ramulo valde diversa; petiolus 15–45 mm. longus, strictus, canotomentellus, basi et apice incrassatus et fuscescens, apice canaliculatus; lamina vulgo 60–120 mm. longa et 35–65 mm. lata, non raro autem dimidio maior vel minor, elliptico- vel oblongo-obovata, basi breviter acuta vel subacuta, basi et apice oblique plicata, apice brevissime abrupte acuminata vel obtusa rarius rotundata et retusa, margine integro, sat rigide coriacea modice crassa, supra nitida in sicco glaucescens, subtus nitidula pallidius olivaceo-viridis, ubique glaberrima solum in costa subtus parce puberula, hac costa supra immersa subtus crasse prominente, costis lateralibus utrinque 10–18 supra immersiusculis subtus valide prominentibus, marginem versus curvatis et ante marginem arcuato-anastomosantibus, venulis reticulatis transversis supra obsoletis subtus tenuissime prominulis. Inflorescentiae in ramulorum parte foliata axillares, erecto-patentes, 25–55 mm. longae, racemiformes, nonnunquam e basi triramosae, saepius breviter pedunculatae pedunculo et rhachi tenuibus canotomentellis, pedicellis gracilibus substrictis secus rhachin distanter binis vel trinis, canotomentellis, basi bracteis lanceolatis parvis tomentosis fultis, inferioribus vulgo 10–15 mm. longis, superioribus gradatim brevioribus, ultimis vix usque ad 5 mm. longis. Flores virides, in alabastro subglobosi; tepala 4 subaequalia anthesi deflexo-revoluta, maiora vix usque ad 3 mm. longa et parum minus lata, plus minus ovata apice acuta vel obtusa, subcoriacea, anthesi brunnescentia subglabra marginibus tenuiter albidosericeis. Stamina numerosa longitudine sat inaequalia, filamentis filiformibus, albidopilosulis anthera conspicue longioribus, maiora tepalis aequilonga, antheris oblongis vel ovato-oblongis minime ciliatulis breviter at bene conspicue apiculatis. Ovarium 4-loculare densissime albido-sericeo-hirtum, stylo glabro apice breviter 4-fido. Capsula in pedicello sat valido, 25–40 mm. longa, 18–25 mm. lata, obovato-oblonga, 4-(rarissime 5-) valvis, pericarpio crasse lignoso, extus tomento cano minuto at denso coperta, solum vetusta visa, semine ignoto.

Manáos, in silva primaria terris altis argillosis ultra Coloniam João Alfredo, arbores duae visae quarum una junior sterilis; arbor adulta florebat 20-X-1941, fructibus vetustis sub arbore numerosis. Specimina *Ducke 862*. Nomen vulgare ut omnium hujus generis specierum "urucú-rana."

This species is one of the highest trees of the upland rain forest near Manáos. It is certainly rare, for I have so far seen only two specimens. The tree has an elegant aspect. Its strictly cylindrical stem exceeds, in height, the neighboring forest trees, but all of large size; the base of the bole is sustained by three high buttresses. The flowers, however, are insignificant. It may be interesting to know that this tree has an exceedingly short flowering period: October 11, 1941, very young inflorescences were observed, with the flower buds still involved in the bracts; October 20, all flowers were open and many of them already decaying; October 27, no flower in the stage of anthesis was present.

I am not yet able to indicate the relationship of *Sloanea brachytepala* with its congeneries, rather numerous in the Amazon forests. There may be some affinity with *S. excelsa* Ducke, of equal size and rather similar aspect, but leaves, inflorescences, flowers, and fruits of both species diverge in many characters. The inflorescences and the flowers of *S. brachytepala* are very small, smaller even than those of *S. excelsa*. Incomplete herbarium specimens of *S. brachytepala* might be confused with *S. sinemariensis* Aubl., but the latter belongs to a very different species-group, characterized by open prefloration and echinated fruits.

GUTTIFERAE

Lorostemon bombaciflorum Ducke.—This exceedingly interesting tree was till now observed only on a small area of upland forest on sandy soil, not very distant from the kilometer 8 of the Aleixo road, northeast of Manáos. Though a representative of a monotypic genus and subfamily of the Guttiferae, it bears a well-marked resemblance in flowers and fruits to certain Bombacaceae. The fruit described in *Arq. Inst. Biol. Veget.* 1: 210 (1935) was not ripe, and that description must be corrected in some details. A fully ripe fruit recently obtained was 18 cm. long and 7 cm. wide at its upper tierce, elongate-obovoid, with 15 longitudinal ribs, narrowed at its base to the 8 cm. long stipes, obtuse at the summit. It had a green, thin hide, a thick, nearly tasteless, white, fleshy exocarp, and 4 seeds covered with some brownish, spongy pulp. The fruit, after maturing, falls by rupture of the softened and decaying stipes; it is eaten by animals of the forest.

COMBRETACEAE

Thiloa inundata Ducke, sp. nov.—Inter sectiones I et II intermedia: antheris carunculatis at staminodiis nullis. Frutex alte scandens, ramulis novellis parum dense albido-lepidotis, vetustioribus glabratis. Foliorum petioli sat graciles, 10–15 mm. longi, profunde canaliculati; laminae 60–100 mm. longae et 40–70 mm. latae, plus minus oblongo-ellipticae basi rotundatae, hic in centro anguste plicatae et subito in petiolum angustatae, apice vulgo rotundatae et in hujus medio in acumen 5–8 mm. longum saepe retusiusculum abrupte protractae, membranaceae, utrinque nitidulae, subtus lepidibus pallidis (demum evanescentibus) et granulis fuscis (persistentibus) conspersae, punctis pellucidis non visis, costis centrali et lateralibus supra immersiusculis subtus prominentibus, venis transversalibus et reticulatis utrinque prominulis. Spicae axillares patulo-pendulae graciles, folio subaequales vel longiores, simplices vel e pedunculo communi ternatae, cinnamomeo-lepidotae, pedunculis et rhachidibus tenuibus, bracteis subulatis ovario brevioribus caducis, hoc sub anthesi circiter 2 mm. longo. Flores in vivo brunnei, odorati. Calix

diametro circiter 2 mm., extus parce lepidotus, intus disco piloso excepto glaber. Staminodia deficientia. Antherae carunculatae. Fructus ignotus.

Haud infrequens ad ripas inundatas fluminis Tonantins et rivi Santo Antonio (infra Esperança), fluvii Solimões affluentum, *Ducke 644* et *1109;* October et November florebat.

Thiloa inundata seems to be allied with *Th. gracilis* Eichl. which I have not seen. This South Brazilian species has, however, according to the description, pellucid-punctate leaves of oblong form with acute base, a larger calyx, and well developed staminodia. As to the other characters inclusive of the shape of the inflorescences, both species seem to be similar. The fruits of both are, however, unknown. *Th. inundata* grows on flooded shores in the Amazon hylaea and *Th. gracilis* on the Serra do Mar in southern Brazil, in mountains with subtropical climate.

There is another Amazonian species, *Th. stigmaria* Eichl., described from fruiting specimens only. I have not seen it. According to the description, its leaves are oblong or oblong-lanceolate, not shining, but with pellucid points and with acute base and apex. The inflorescences are much shorter than those of my new species.

MELASTOMACEAE

Mouriria densifoliata Ducke, sp. nov.—Arbor parva vel rarius mediae altitudinis, partibus vegetativis glabris, ramulis novellis angulosis. Folia suberecta subimbricata internodiis saepius triplo longiora, petiolo crasso vix ultra 1 mm. longo, vulgo 40–60 mm. longa et 20–25 mm. lata, ovato-elliptica basi anguste rotundata vel obtusa et subcordata, apice obtusa, rotundata rarius brevissime subapiculata, in apicis medio leviter retusa, margine subtus prominulo et saepe revoluto, rigide coriacea, subtus pallidiora, praeter costam supra immersam subtus crasse prominentem avenia. Pedunculi axillares erecto-patuli stricti superne in pedicellum unicum articulati vel saepius trifidi, 20–40 mm. longi, glabri, bracteis ad articulationes circiter 4 mm. longis subulatis caducis, bracteolis in pedicelli quarto superiore duabus patentibus persistentibus circiter 3 mm. longis lanceolato-ovatis acumin-

atis, rigidis. Flores 5-meri calice et ovario interdum 6-meris, in alabastro longe et abrupte acuminati. Calix subglaber, tubo in alabastro campanulato basi acuto, anthesi cum lobis patentibus circiter 8 mm. latus; lobi 5 nonnunquam 6, triangulares basi profunde soluti, apice acuti. Petala alba, membranacea, intus tenuiter furfuracea, anthesi patentia 12–14 mm. longa et 6–7 mm. lata, oblonga basi subunguiculata apice longe acuminata, marginibus irregulariter sinuosis et saepe denticulatis. Stamina violacea, filamentis praefloratione inflexis anthesi longe exsertis circiter 15 mm. longis, antheris loculis hippocrepiformibus birimosis connectivo modice recurvo postice calcarato dorso glandula munito. Ovarium 5-vel rarius 6-loculare supra depressum et alulis membranaceis 10 (vel 12) e styli basi radiantibus coronatum. Fructus ignotus. Speciei guianensi (mihi solum e descriptione et iccone in Martii Flora Brasiliensi nota) *M. dumetosa* Cogn. evidenter affinis; folia autem dure coriacea subimbricata apice retusa, bracteolae persistentes et a flore sat remotae, calix in lobos apice acutos profunde partitus, petala longe acuminata.

Frequens secus fluminis Urubú cursum medium inter cataractas Lindoya et Iracema, in silva humiliore ripae arenosae 26-IX-1941, *Ducke 801*. Arbor unica ad ripas altas lacus Uaicurapá ad meridiem oppidi Parintins, mense September 1932, A. Ducke Herb. Jard. Bot. Rio *25518*.

This pretty species, like *Dimorphandra urubuensis*, *Jacqueshuberia purpurea*, and *Vochysia urubuensis*, is a characteristic element of the flora of the sandy shores of the middle Rio Urubú, tributary of the Amazon east of the lower Rio Negro. A single tree was found also on the shores of Lake Uaicurapá south of the Paraná de Ramos, an arm of the Amazon near the town of Parintins. I formerly distributed specimens from this locality under the name of *M. dumetosa* Cogn., a Guiana species which certainly has affinity with our plant, according to the description and the drawing in Martius' *Flora Brasiliensis*. Some important characters, however, are discordant. I do not know if *M. dumetosa* has the winged rays of the top of the ovary observed in this new species, for I have not seen specimens of the Guiana plant.

SAPOTACEAE

Calocarpum odoratum Ducke, sp. nov.—Arbor ut videtur 35–40 m. alta, cortice interiore acidum cyanhydricum redolente. Ramuli cicatricibus verrucosis florum fasciculorum notati, grisei, in sicco striato-rugosi, parte juniore canotomentella. Folia alterna, apice ramulorum congesta; petiolus 20–40 mm. longus tenuis strictus parum canaliculatus, canotomentellus; lamina 100–200 (rarius 270 mm.) longa et 50–80 (rarius 105) mm. lata, obovato-oblonga, basi anguste rotundata vel obtusa, apice brevissime abrupte acuminata acumine ipso saepius obtuso, membranacea, utrinque glabra et in sicco viridis, supra parum nitidula, subtus nitida, costa centrali supra vix, subtus fortiter prominente, costis lateralibus e costa centrali utrique 15–18, sat distantibus, tenuibus, subtus distincte prominentibus, subrectis parum ante marginem arcuatis et anastomosantibus, venulis in utraque pagina tenuiter prominulis, maioribus laxis costas laterales connectentibus, minoribus crebre reticulatis. Flores odore gratissimo, in fasciculis paucifloris e ramulorum parte inferiore defoliata ad cicatrices foliorum delapsorum, pedicellis 2–3 mm. longis validis griseosericeis. Calix in vivo viridis, anthesi 7–9 mm. longus, 3–4 mm. crassus; sepala 11, spiraliter imbricata, dorso tenuiter sericea, ab extimo (infimo) vix ad 2 mm. longo usque ad intimum (supremum) 7–9 mm. longum magnitudine gradatim crescentia, exteriora dorso carinata apice breviter acuminata, intermedia rotundata, interiora valde convoluta oblonga. Corolla in vivo alba, sicca 15–18 mm. longa, 5–7 mm. lata, tubo 14–15 mm. longo cylindrico glabro, lobis 5 utrinque sericeis margine glabro, praefloratione imbricatis, oblongis, obtusis. Stamina 5 et staminodia 5 versus tubi apicem inserta, stamina sub lobis, staminodia sub sinibus, omnia subglabra; filamenta circiter 3 mm. longa recta, antherae 1.5 mm. longae oblongo-ovatae, staminodia filamenta parum excedentia, subulata. Ovarium 5-loculare, apice longe pilosum; stylus circiter 15 mm. longus, glaber. Fructus in arbore inventus, onus solus vetustus siccus, ut videtur nondum adultus, globosus diametro 35 mm., pedunculo 6 mm. alto 15 mm. lato, pericarpio crasso, seminibus tribus maxima ex parte putredine destructis, circiter 20–25

mm. longis 14–17 mm. latis 8–12 mm. crassis, testa fragili nitida, cicatrice umbilicali (sat lata) et embryone destructis.

Circa Esperança ad ostium fluminis Javary, in silva non inundabili, 12-X-1942, *Ducke 1161*, arbor unica visa.

This is the first species of this small genus that I have seen in the Amazonian hylaea. I do not know the others, but, according to their descriptions, the present new species should be easily recognized. The bark of the stem and branches has a strong cyanhydric smell, but the flowers have a very agreeable scent, uncommon for a Sapotacea.

Apocynaceae

Condylocarpon amazonicum (Mgf.) Ducke, comb. nov. = *Rhipidia amazonica* Mgf.—The discovery of a new species closely allied with the present one, but differing by multi-ovulate carpels and multiseminate, articulate fruits, compels me to suppress the genus *Rhipidia*, transferring its sole species to *Condylocarpon*.

Condylocarpon hirtellum Ducke, sp. nov.—Speciei *C. amazonicum* habitu generali, partibus vegetativis, inflorescentiis et floribus (ovario excepto) simile, differt indumento, disco nullo, ovulis numerosis, et fructibus multiarticulatis et multiseminatis. Frutex alte scandens floribus albidis. Folia basi saepius obtusa nec rotundata, in utraque pagina pilis sat longis non multum densis hirtula; inflorescentia minus dense at longius pilosa, bracteis validioribus post anthesin persistentibus, in ramulis ultimis saepe subimbricatis; corolla in alabastro apice latior quam in specie citata, crassius clavata, limbo anthesi expanso usque ad 8 mm. diametri metiente, demum caducissima, hujus structura et staminum ut in specie citata; discus nullus; ovula per loculum usque 16 observata, in series 4 vel 5 disposita. Mericarpia (nondum matura) saepe ad 300 mm. longa, ad semina et in articulationibus circiter 3 mm. lata, inter semina et articulationes solum 2 mm. lata, usque ad 18-articulata articulis ultimis sterilibus, articulis seminiferis usque ad 12 observatis, pilis ut in specie citata fulvis et microscopice verruculosis at vix ultra 1 mm. longis, subcrispulis, adscendentibus. Semen (immaturum) speciei citatae simile essere videtur.

Sat frequens circa Esperança ad ostium fluminis Javary in silvae non inundabilis locis humidis, 28-IX-1942 floriferum et cum fructibus immaturis, *Ducke 1171*.

This new species is evidently intermediary between the untenable genus *Rhipidia* and the true *Condylocarpon*. Many of its botanical characters are those of *Rhipidia*, but the most important part, the articulate and multi-seminate fruit, is more typical of true *Condylocarpon*.

Condylocarpon reticulatum Ducke, sp. nov.—Ab affini specie *C. amazonicum* primo adspectu differt ramulis glabris, foliis solum sparsim pilosis, nitidis, conspicue reticulatis, inflorescentiis subglabris. Frutes scandens. Foliorum petiolus praesertim ad latera longe fulvovillosus; lamina basi saepius acuta, in adultis utrinque nitida, margine et saepe costa centrali subtus magis minusve disperse setosis, nervo praemarginali valde conspicuo et a margine ipso sat remoto, costis lateralibus et venulis pulchre reticulatis utrinque prominentibus subtus saepe pallidis. Inflorescentiae pedunculi primarii et secundarii glabri, superiores subglabri. Flores subglabri, virides, magnitudine et structura iis speciei citatae similes (discus adest, ovula per loculum 4, superposita). Fructus ignoti.

Habitat prope Esperança ad ostium Igarapé Santo Antonio, in silva riparia a fluvio Solimões inundabili, 9-II-1942, *Ducke 1172*.

This new species is closely allied with *C. amazonicum*, but diverges by its much less abundant pubescence and by the beautiful reticulate-veined leaves.

Examination of the dried ovary of these plants is very difficult. I obtained the data given in the above descriptions through the kindness of Dr. Kuhlmann who carefully studied the material.

Bignoniaceae

Schlegelia roseiflora Ducke, sp. nov.—Frutex robustissimus in arboribus altis epiphyticus et scandens. Ramuli non radicantes, dure lignei, glaberrimi, nitidi, grisei, lenticellis sparsis, juniores angulosi. Pseudostipulae in axillis geminatae, lanceolatae, acuminatae, concavae, durae, vulgo 4–6 mm.

longae, diu persistentes. Foliorum petiolus 10–20 mm. longus, validus, supra profunde canaliculatus, parte basali intus glandulis squamiformibus pallidis transverse oblongis obtectus; lamina 70–110 mm. longa et 25–50 mm. lata, elongato-elliptico-oblonga vel obovato-oblonga, basi et apice obtusa vel anguste rotundata, margine fortiter revoluto, rigide coriacea nonnunquam subbullata, subconcolor, supra magis quam subtus nitida, costis lateralibus in utroque latere 5–7 supra immersis subtus tenuiter prominentibus, arcuatis, ante marginem evanidis, venulis nullis vel vix conspicuis. Paniculae laterales in ramuli parte inferiore ad axillas folioram delapsorum, subracemiformes, 20–40 mm. longae; pedunculi, rhachides, bracteae, pedicelli et bracteolae pilosuli; rahchides primariae tetragonae; bracteae parvae, subulatae; pedicelli tenues, basi bibracteolati. Calix viridis, 4–6 mm. longus, apice 3–4 mm. latus, glaber, tenuiter subcoriaceus, tubuloso-campanulatus, basi abrupte in stipitem brevem (1.5 mm.) contractus, in alabastro clausus poro apicali foratus, sub anthesi subaequaliter bilabiatim in lobos duo rotundatos membranaceos fissus, basi extus subreticulato-rugosus. Corolla pallide rosea, glabra, tubo circiter 8 mm. longo cylindrico, laciniis circiter 5 mm. longis oblongis intus papillosis, anthesi reflexis. Stamina glabra, parum inaequalis. Pistillum glabrum. Fructus ignotus.

Esperança (ad ostium fluminis Javary), in silva non inundabili, 2-II-1942 florifera, *Ducke 1142*. Individuum unicum visum.

This species can be easily recognized by its small flowers which are borne in lateral panicles and have a corolla of a pale roseate color and a calyx that is bilabiate. Unlike the previously known species of *Schlegelia*, this one apparently has no rootlets on its small branches.

Key to the Species of *Schlegelia* of the Hylaea of Amazonia and the Guianas

Panicles rather large, multiflorous, and terminal, or both terminal and at the axillae of leaves on the superior part of the twigs. Tube of the corolla cylindrical. Branches with rootlets. Robust climbers.

Panicles up to 200 mm. long. Leaves without glands. Calyx toothed. Corolla (according to the authors) pinkish mauve; tube 12–18 mm. long..... *Sch. violacea* (Aubl.) Griseb. (Guiana) and *Sch. scandens* (Briquet et Spr.) Sandw. (Rio Uaupés).

Panicles up to 130 mm. long. Leaf blades with thick glands beneath on the sides of the petiole. Calyx truncate. Corolla white; tube about 12 mm. long. São Gabriel, Rio Negro..... *Sch. albiflora* Kuhlm.

Inflorescences lateral, at axillae of fallen leaves on the interior part of the branchlets, not over 40 mm. long.

Flowers in fascicles or in very short and poor racemes. Calyx truncate and irregularly denticulate. Corolla whitish with purple limb, 35 mm. long or longer; tube narrowed at the base. Branches with rootlets. A robust climber. Breves, Amazon estuary..... *Sch. paraensis* Ducke.

Flowers in short but rather multiflorous panicles. Calyx bilabiate. Corolla pale rosy; tube about 8 mm. long, cylindrical. Branches without rootlets. A very robust climber. Esperança, mouth of Rio Javary.
Sch. roseiflora Ducke, sp. nov.

Flowers in short, decussate racemes. Corolla apex constricted and very shortly lobate. Branches with rootlets. Thin, not very woody, climbers.

Calyx very conspicuously toothed. Calyx and corolla golden yellow; up to 15 mm. long. Rio Curicuriary, tributary of the upper Rio Negro.
Sch. aurea Ducke.

Calyx truncate or often shortly and irregularly split on the apex. Corolla red; about 22 mm. long. Upper Rio Negro basin and British Guiana.
Sch. Spruceana Schum.

Rubiaceae

Retiniphyllum chloranthum Ducke, sp. nov.—Ad sectionem *Euretiniphyllum* M. Arg. Arbuscula vel frutex 3–4 m. altus, ramulis subglabris, novellis ut inflorescentiae resinam exsudantibus. Stipulae breves truncatae connatae. Foliorum petiolus 20–30 mm. longus, late canaliculatus, glaber; lamina saepius 150–250 mm. longa et 65–100 mm. lata, obovata vel oblongo-obovata, basi sat longe in petiolum attenuata, apice late obtusa et in medio breviter abrupte acuminata, herbacea, utrinque nitida et concolor, glabra subtus minute scabrida, nervis validioribus utrinque 13–16 cum tenuibus intermixtis, venulis tenuissime reticulatis. Racemi terminales solitarii 80–100 mm. longi parte basali sterili (pedunculo) circiter 20 mm. longa, glabri. Flores virides, praeter corollam et stamina glabri; caliculus (involucellum) anthesi ad 1 mm. demum ad 2 mm. pedicellatus, 1–2 mm. altus, lobis 5 ovatis acutis distinctissimis; ovarium breviter stipitatum; calix 1 mm. vix altior et circiter 1.5 mm. latus, apice truncatus et minute

denticulatus; corolla tubo tenui cylindrico circiter 15 mm. longo, intus parum infra medium annuligero, lobis reflexis linearibus circiter 10 mm. longis, tenuiter canosericea, extus vulgo valde resinosa. Stamina filamentis albidopilosis. Discus altus, angustus. Stilus glaber. Fructus ruber, globosus, 10-costatus, pyrenis dorso carnis tribus valde elevatis.

Habitat in silva humiliore circa campinam arenosam prope flumen Tarumá-miry urbi Manáos vicinum, 4-VII-1941, *Ducke 1143*. Affine speciei *R. concolor* (Spr. ex Bth.) M. Arg. e silvulis "catinga" Rio Negro superioris, differt praesertim caliculo evidentissime quinquelobo, corollae tubo parum infra medium annuligero, pyrenis fortissime carinatis, et forma foliorum.

This species was hitherto found only at one place near the upper course of the Rio Tarumá-miry, a small tributary of the Rio Negro northwest of Manáos. There are "campinas" of white sand with a superficial layer of black humus around which is a forest of scarcely medium-sized dicotyledonous trees and numerous palms of *Mauritia carana*, like certain "catinga" of the upper Rio Negro basin. *R. chloranthum* is one of the characteristic shrubs of the undergrowth of that forest; more frequent and more showy here is the red-flowered *R. rhabdocalyx* M. Arg., which previously was known only from the type specimen collected by Martius on the upper Japurá (Caquetá), now belonging to Colombia.

KEYS TO AMERICAN WOODS (CONTINUED)

By Samuel J. Record

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

In Key III, 7a and b, the statements "pores all solitary" and "pores not all solitary" should be deleted. *Bulnesia retama* is the only one of the three species with pores rarely in contact radially. Key VI contains two instances of faulty construction: 9 and 18 are out of place and should be deleted. In Key VII, 30a, the statement that the rays of *Holocalyx* are usually not over five cells high is incorrect, as they are frequently 10–12 (15) cells high.

X. Woods with storied structure. This key includes 149 genera of 29 families, mostly tropical. The largest groups belong to the Leguminosae (77 genera: 2 Mim., 24 Caes., 51 Papil.) and the Malvales (Bombacaceae 11, Elaeocarpaceae 2, Malvaceae 6, Sterculiaceae 6, Tiliaceae 10). The storied arrangement of some or all of the elements gives rise to the horizontal markings known as "ripple marks." The number of these markings per inch is measured axially on the tangential surface. The number is not constant even for the same specimen, hence small differences are without diagnostic value. In woods with considerable variation in the height of the rays, the markings are likely to be indistinct except in the parenchyma layers. If the parenchyma cells are regularly two per strand a secondary seriation results and the number of tiers is twice that produced by the vessel members and other elements. Occasionally the cells of 4-celled strands are similarly storied. Some of the types of storied structure are shown in Plates LI and LIII in *Timbers of the New World.*

Storied structure represents a high degree of specialization. In woods so characterized the vessel members are typically short and have exclusively simple perforations. The fiber pits are simple or provided with only small borders. If the ripple marks are uniform the rays are usually only 1–3 cells wide, less than 15 cells high, and homogeneous or nearly so. Parenchyma is generally abundant; some of the distinctive patterns (and other features) are illustrated in *Timbers of the New World.*

The Leguminosae (excepting *Bauhinia* and *Cercis*) com-

prise the second half of the key. To bring them together it was necessary to employ a feature (vestured pits) which, though constant and reliable, is often difficult to use when the pits are very small. Usually, though, the pits are large enough to show the structure distinctly. The only other woods in the key with vestured pits are *Isomeris* (Capparidaceae) and *Daphnopsis* and *Schoenobiblos* (Thymelaeaceae).

X. WOODS WITH STORIED STRUCTURE

1 a. Ripple marks 220–280 per inch 2
b. Ripple marks 50–150 (200) per inch 8

2 a. Rays up to 100 (200) cells high; mostly not storied. *Isomeris* (Capparidaceae).
b. Rays mostly less than 8, sometimes up to 30, cells high; typically storied 3

3 a. Pores often in contact radially 4
b. Pores rarely in contact radially 5

4 a. Pores fairly uniform in size; arranged in radial chains. Parenchyma sparingly vasicentric ..... *Bulnesia arborea* (Zygophyllaceae).
b. Pores small to minute; arranged in clusters surrounded by vasicentric tracheids and parenchyma, producing more or less dendritic pattern ..... *Bulnesia Sarmienti* (Zygophyllaceae).

5 a. Parenchyma inequilaterally paratracheal and aliform; also in diffuse aggregates. Rays uniseriate and one-storied. *Guaiacum*, *Porlieria augustifolia* (Zygophyllaceae).
b. Parenchyma finely reticulate 6

6 a. Rays uniseriate and one-storied. Pores in flame-like or dendritic arrangement ..... *Porlieria Lorentzii* (Zygophyllaceae).
b. Rays frequently or mostly biseriate and more than one-storied. 7

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

8 a. Vessel pits not vestured 9
b. Vessel pits vestured 71

9 a. Pores rarely in contact with the rays, which are all wide and very high 10
b. Pores regularly in contact with the rays, which are not all wide and high 11

10 a. Rays all extending full length of internodes; oil cells sometimes present ..... *Piper* (Piperaceae).
b. Rays of various heights; oil cells absent ..... *Coriaria* (Coriariaceae).

11 a. Pores in zig-zag, ulmiform, or dendritic pattern, at least in late wood 12
b. Pores not so arranged 16

12 a. Diffuse-porous. Vessels without spirals. Rays 1 or 2 (3) cells wide. (See *Tropical Woods* 63: 37–38.) ..... Bignoniaceae.
b. More or less ring-porous. Vessels with spirals. Rays wider 13

13 a. Interxylary corky laminations present. *Artemesia tridentata* (Compositae).
b. Such laminations absent 14

14 a. Parenchyma rather abundantly paratracheal. *Baccharis* (Compositae).
b. Parenchyma sparingly paratracheal or absent 15

15 a. Rays 1–4 cells wide. Early-wood pores medium-sized, in rather wide band ..... *Cercis* (Leguminosae).
b. Rays mostly coarse, nearly all over 4 cells wide. Early-wood pores small, the pore-band narrow ..... *Berberis* (Berberidaceae).

16 a. Woods with slender strands (islands on cross section) of included phloem or unlignified parenchyma 17
b. Woods without such strands 18

17 a. Islands (containing sieve tubes) at outer end of short rows of pores. Rays very fine ..... *Pisonia* (Nyctaginaceae).
b. Islands (without sieve tubes) independent of pores. Rays mostly coarse ..... *Urera* (Urticaceae).

18 a. Woods with narrow to wide bands of unlignified (cottony) parenchyma 19
b. Woods without such bands 20

19 a. Parenchyma cells in the bands all elongated radially. *Apeiba* (Tiliaceae).
b. Parenchyma cells in the bands mostly cubical. *Heliocarpus* (Tiliaceae).

20 a. Rays with small tile cells 21
b. Rays without small tile cells 25

21 a. Parenchyma reticulate 22
b. Parenchyma typically not reticulate, though sometimes with local tendencies 23

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

23 a. Parenchyma sparingly paratracheal ..... *Buettneria* (Sterculiaceae).
b. Parenchyma otherwise 24

24 a. Parenchyma finely aliform, sometimes confluent into irregular bands. Vascular pits minute ..... *Mollia* (Tiliaceae).
b. Parenchyma is narrow bands about 1 pore-width apart, some times uniform, sometimes broken and irregular. Vascular pits small ..... *Lueheopsis* (Tiliaceae).

25 a. Fiber pits with large borders; few. Parenchyma reticulate. *Gaiadendron* (Loranthaceae).
b. Fiber pits with small borders or simple; often numerous. Parenchyma various 26

26 a. Vessels with spirals 27
b. Vessels without spirals 29

27 a. Rays typically uniseriate and less than 20 cells high. Parenchyma finely terminal . . . . . *Aesculus* (Hippocastanaceae).
b. Rays 1–5 (6) cells wide and up to 50 (100) cells high 28

28 a. Parenchyma paratracheal and more or less confluent, sometimes forming concentric bands few to 15 cells wide. Very small vessels associated with larger ones. Density medium to high. *Castela*, *Holacantha* (Simarubaceae).
b. Parenchyma in numerous fine lines or reticulate and finely terminal. Vessels fairly uniform in size. Density low . . . . . *Tilia* (Tiliaceae).

29 a. Vessel-ray pitting distinctly 2-sized: very fine and coarse 30
b. Vessel-ray pitting not distinctly 2-sized 31

30 a. Ripple marks characteristic; all elements storied. Large vessel-ray pit-pairs fairly numerous, elongated. *Carpodiptera*, *Christiania* (Tiliaceae).
b. Ripple marks local; mostly only fusiform parenchyma cells storied. Large vessel-ray pit-pairs few, round to broadly oval. *Schoepfia* (Olacaceae).

31 a. Vessel-ray pitting coarse to very coarse 32
b. Vessel-ray pitting not very coarse; sometimes very fine 39

32 a. Parenchyma reticulate, at least in part. Density low 33
b. Parenchyma banded; not reticulate 37

33 a. Septate fibers abundant 34
b. Septate fibers absent or few 35

34 a. Heartwood rich reddish brown; sharply defined. *Bombacopsis* (Bombacaceae).
b. Heartwood dull brown; not sharply defined. *Bombax*, *Pachira* (Bombacaceae).

35 a. Parenchyma cells flattened radially; in irregular uniseriate rows in a ground mass of rather large thin-walled fibers. Rays all multiseriate; cells not distinctly 2-sized (tang. sect.). *Bernoullia* (Bombacaceae).
b. Parenchyma cells not flattened; fibers small, often thick-walled, and arranged in narrow bands or diffuse aggregates separated by much coarser bands of parenchyma. Ray cells distinctly 2-sized . . 36

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

37 a. Density very low. Open radial channels sometimes present. Vertical gum ducts absent . . . . . *Cochlospermum* (Cochlospermaceae).
b. Density medium to high. Radial channels absent. Vertical traumatic gum ducts sometimes present 38

38 a. Heartwood rich reddish brown; density high. *Aguiaria* (Bombacaceae).
b. Heartwood yellow-brown; density medium. *Catostemma*, *Scleronema* (Bombacaceae).

39 a. Parenchyma reticulate or in closely spaced uniseriate lines 40
b. Parenchyma otherwise 48

40 a. Pores only occasionally in contact radially 41
b. Pores frequently in contact radially 43

41 a. Rays homogeneous or nearly so. Vasicentric tracheids present. *Muntingia* (Elaeocarpaceae).
b. Rays definitely heterogeneous. Vasicentric tracheids absent 42

42 a. Rays with many procumbent cells; uniseriates numerous. Parenchyma strands with 4–8 cells . . . . . *Goethalsia* (Tiliaceae).
b. Rays without definitely procumbent cells; uniseriates few. Parenchyma strands mostly 2-celled . . . . . *Dicraspidia* (Elaeocarpaceae).

43 a. Pores small. Rays often more than 8 cells wide; pits to vessels medium-sized . . . . . *Theobroma* (Sterculiaceae).
b. Pores medium-sized. Rays less than 8, sometimes only 1 or 2, cells wide; pits to vessels small 44

44 a. Rays with numerous sheath cells (tang. sect.) and rows of upright cells resembling large tile cells (rad. sect.) 45
b. Rays without such cells 47

45 a. Fibers very thin-walled. Rays sometimes 100–200 cells high. Wood light and soft. Heartwood yellowish brown or pinkish. *Hampea* (Bombacaceae).
b. Fibers thick-walled. Rays mostly 10–25, sometimes up to 70, cells high. Wood moderately heavy and hard. Heartwood deeply colored 46

46 a. Ripple marks 100–120 per inch. Heartwood uniform reddish brown . . . . . *Montezuma* (Malvaceae).
b. Ripple marks 80–100 per inch. Heartwood reddish brown or chocolate, more or less variegated and striped . . . *Thespesia* (Malvaceae).

47 a. Pores numerous, fairly uniform in size; walls rather thin. Rays frequently more than one-storied. Density low . . . . *Bixa* (Bixaceae).
b. Pores rather few, variable in size with tendency to ring-porous; walls very thick, particularly where two vessels are in contact. Rays typically one-storied. Density rather high. *Diospyros virginiana* (Ebenaceae).

48 a. Vessels in part normally filled with calcium carbonate 49
b. Vessels without calcium carbonate (except possibly near wounds). 50

49 a. Pores very numerous. Heartwood lemon-yellow. *Phyllostylon* (Ulmaceae).

b. Pores not very numerous. Heartwood purplish brown. *Ampelocera* (Ulmaceae).

50 a. Parenchyma rather sparse, often not distinct with lens 51
b. Parnechyma fairly to very abundant, often distinct without lens. 59

51 a. Rays homogeneous or nearly so 52
b. Rays heterogeneous 56

52 a. Rays mostly 4–6 cells wide. *Cybistax Donnell-Smithii* (Bignoniaceae).
b. Rays infrequently over 3 cells wide, mostly narrower 53

53 a. Ripple marks regular. Heartwood very dense; lapachol abundant. *Tabebuia* (Bignoniaceae).
b. Ripple marks irregular. Heartwood moderately dense; lapachol absent or sparse 54

54 a. Rays mostly biseriate and up to 25 (35) cells high. Ripple marks 90–95 per inch. Heartwood olive . . . . . *Paratecoma* (Bignoniaceae).
b. Rays 1–3 (4) cells wide. Ripple marks 110–125 per inch 55

55 a. Rays less than 15 cells high; uniseriates few; pits to vessels small, uniform. Heartwood yellowish . . . . . *Cybistax chrysea* (Bignoniaceae).
b. Rays up to 30 (50) cells high; uniseriates numerous; pits to vessels variable in size and form. Heartwood brown or reddish brown. *Bauhinia* (Leguminosae).

56 a. Rays uniseriate or partially biseriate; one-storied. Ripple marks general and fairly regular . . . . . *Suriana* (Surianaceae).
b. Rays wider; often more than one-storied. Ripple marks irregular 57

57 a. Rays 1–7 cells wide; with numerous sheath cells (tang. sect.) and rows of upright cells resembling large tile cells (rad. sect.); pits to vessels medium-sized, oval to elongated. Density very low. *Belotia* (Tiliaceae).
b. Rays 1 or 2 (3) cells wide; without sheath or tile cells; pits to vessels small. Density high 58

58 a. Rays with definite strata of procumbent cells. Parenchyma in part diffuse and sometimes finely terminal. *Helicteres* (Sterculiaceae).
b. Rays without definite strata of procumbent cells. Parenchyma not diffuse or terminal . . . . . *Bontia* (Myoporaceae).

59 a. Definitely ring-porous . . . . . *Fraxinus* (Oleaceae).
b. Diffuse-porous 60

60 a. Parenchyma in multiseriate, apparently terminal, bands; not aliform or confluent. Fibers septate . . . . . *Swietenia* (Meliaceae).
b. Parenchyma aliform and confluent; sometimes terminal also. Fibers rarely, if at all, septate 61

61 a. Pores large; few. Rays mostly large; up to 9 (20) cells wide and 200 (300) cells high. Texture very coarse; feel harsh. *Basiloxylon, Sterculia* (Sterculiaceae).
b. Pores small to medium-sized; usually numerous. Rays variable in width, but usually less than 50, rarely up to 100, cells high. Texture fine to medium 62

62 a. Rays homogeneous or nearly so 63
b. Rays heterogeneous, at least in part 67

63 a. Lapachol abundant in vessels of heartwood. *Cotema, Tabebuia* (Bignoniaceae).
b. Lapachol absent or sparse 64

64 a. Parenchyma locally aliform and confluent. Rays mostly 4–6 cells wide . . . . . *Cybistax Donnell-Smithii* (Bignoniaceae).
b. Parenchyma generally confluent into distinct bands 65

65 a. Rays mostly uniseriate; one-storied . . . . . *Crescentia* (Bignoniaceae).
b. Rays mostly 2 or 3 cells wide 66

66 a. Rays typically one-storied. Ripple marks regular. *Tabebuia pentaphylla* (Bignoniaceae).
b. Rays often more than one-storied. Ripple marks usually irregular. *Godmania* (Bignoniaceae).

67 a. Rays 1 or 2 cells wide and commonly less than 8 cells high. *Cneorum* (Cneoraceae).
b. Rays wider and taller 68

68 a. Largest pores fairly distinct without lens. Vertical gum ducts sometimes present 69
b. Largest pores not distinct without lens. Gum ducts absent 70

69 a. Heartwood olive to purplish; distinct from sapwood. Rays up to 100 cells high; sheath cells present. Gum ducts rare. Ripple marks 70–100 per inch . . . . . *Hibiscus* (Malvaceae).
b. Heartwood yellowish; not distinct from sapwood. Rays generally less than 30 cells high; sheath cells absent. Gum ducts common. Ripple marks 50–80 per inch . . . . . *Simaruba* (Simarubaceae).

70 a. Ripple marks 60–90 per inch. Wood with very bitter taste. *Aeschrion* (Simarubaceae).
b. Ripple marks 100–120 per inch. Woods without bitter taste. *Abutilon, Bastardiopsis, Tetrasida* (Malvaceae).

71 a. Open radial channels present. *Daphnopsis, Schoenobiblos* (Thymelaeaceae).
b. Radial channels absent 72

LEGUMINOSAE

72 a. Included phloem present in concentric bands . . . . . *Machaerium.*
b. Included phloem absent . . . . . *Poincianella.*

73 a. Gum cysts common in parenchyma 74
b. Gum cysts absent 75

74 a. Fibers apparently all septate 77
b. Fibers rarely or not at all septate 76

75 a. Septate fibers in part short, thin-walled, and arranged in parenchyma-like patches or bands. Ripple marks 80–90 per inch. Heartwood brown . . . . . *Poeppigia.*
b. Septate fibers not of two types and not in parenchyma-like arrangement 76

76 a. Parenchyma very abundant and conspicuous about pores. Rays heterogeneous. Ripple marks about 80 per inch. Heartwood dull yellow-brown; taste very bitter ..... *Vatairea.*
b. Parenchyma sparingly vasicentric and diffuse; inconspicuous. Ripple marks 50–60 per inch. Heartwood lustrous yellow to brown, more or less striped; without bitter taste ..... *Plathymenia.*

77 a. Vessels with spiral thickenings 78
b. Vessels without spiral thickenings 79

78 a. Rays 1–4 cells wide. Pores in dendritic pattern. Ripple marks about 140 per inch. Heartwood waxy orange-brown ..... *Zuccagnia.*
b. Rays 1–8, mostly 4–6, cells wide. Pores in ulmiform pattern. Ripple marks about 140 per inch. Heartwood laminated light and and dark brown ..... *Edwardsia.*

79 a. Vessel pits all very small (not over 4μ) 80
b. Vessel pits larger 84

80 a. Rays typically homogeneous 81
b. Rays typically heterogeneous 82

81 a. Parenchyma distinct without lens; mostly in wavy bands including the pores; cells storied. Ripple marks 115–140 per inch. Heartwood purplish brown, streaked ..... *Holocalyx.*
b. Parenchyma indistinct without lens; in numerous narrow bands touching but not always including the pores; cells not storied. Ripple marks 75–90 per inch. Heartwood brown, reddish-brown, or blackish ..... *Swartzia.*

82 a. Ray cells irregular in size and form throughout; crystals not limited to marginal cells. Ripple marks about 125 per inch. Heartwood yellowish brown; unscented ..... *Harpalyce.*
b. Interior ray cells procumbent; crystals confined to single marginal rows of larger cells. Heartwood fragrantly scented 83

83 a. Heartwood rich brown. Ripple marks 100–120 per inch ..... *Myrocarpus.*
b. Heartwood reddish brown to deep red or purplish. Ripple marks 90–100 per inch ..... *Myroxylon.*

84 a. Vessels filled with tyloses in heartwood 85
b. Vessels without tyloses 88

85 a. Rays mostly uniseriate 86
b. Rays mostly 3–5 cells wide, the uniseriates few 87

86 a. Rays fairly uniform in height; usually not over 10 cells. Ripple marks about 130 per inch. Heartwood olive-brown ..... *Gliricidia.*
b. Rays variable in height up to 50 cells. Ripple marks about 100 per inch. Heartwood said to be orange or brown ..... *Hebestigma.*

87 a. Pores mostly in short multiples or solitary; usually not completely surrounded by parenchyma. Vessel pits 7–8μ. Ripple marks about 140 per inch. Heartwood probably purplish brown ..... *Lennea.*

b. Pores mostly in long multiples or clustered; completely surrounded by parenchyma. Vessel pits 9–11μ. Ripple marks 140–160 per inch. Heartwood dark brown, somewhat variegated. *Olneya.*

88 a. Parenchyma reticulate in part ..... *Dalbergia.*
b. Parenchyma not reticulate 89

89 a. Rays typically homogeneous 90
b. Rays more or less distinctly heterogeneous, at least in part 127

90 a. Rays all uniseriate or only partially biseriate 91
b. Rays frequently biseriate or wider 104

91 a. Pores in ulmiform or wavy tangential arrangement. Ripple marks 160–190 per inch. Heartwood probably brown ..... *Gourliea.*
b. Pores not so arranged 92

92 a. Pores in part large and distinct without lens 93
b. Pores not large, though in some instances up to medium-sized and barely visible without lens 94

93 a. Parenchyma distinct without lens; short to long aliform, becoming confluent into irregular bands in late wood. Ripple marks 120–135 per inch. Heartwood yellowish ..... *Tipuana.*
b. Parenchyma indistinct without lens; narrowly vasicentric and abundantly diffuse (crystalliferous strands). Ripple marks about 60 per inch. Heartwood brownish, with dark red vessel lines. *Cedrelinga.*

94 a. Parenchyma vasicentric to aliform and more or less confluent, but not in regular concentric bands within growth ring 95
b. Parenchyma in concentric bands, at least in late wood 99

95 a. More or less ring-porous; multiples of 2-sized pores common. Ripple marks about 150 per inch. Heartwood probably brown. *Cascaronia.*
b. Diffuse-porous; pores not 2-sized in multiples 96

96 a. Parenchyma abundantly paratracheal; readily visible; sometimes confluent into very irregular bands 97
b. Parenchyma not abundant; usually indistinct without lens 98

97 a. Parenchyma usually surrounding the pores; apotracheal patches common. Ripple marks 90–110 per inch; regular to very irregular. Heartwood red to purplish, often striped; unscented ..... *Platymiscium.*
b. Parenchyma usually not completely surrounding the pores; apotracheal patches absent or rare. Ripple marks 75–85 per inch; regular. Heartwood light to dark brown; sometimes with faint scent of vanilla ..... *Coumarouna.*

98 a. Pores rather small; frequently surrounded by narrow sheath of parenchyma. Vessel lines distinct. Ripple marks 110–130 per inch. Heartwood variegated orange, becoming red ..... *Centrolobium.*
b. Pores very small; rarely with complete sheath of parenchyma. Vessel lines indistinct. Ripple marks about 115 per inch. Heartwood probably yellowish ..... *Paramachaerium.*

99 a. Parenchyma rather to very abundantly paratracheal and confluent into irregular bands 2–8 cells wide; crystalliferous cells cubical. . . . 100
b. Parenchyma not abundant about pores and usually not surrounding them; bands typically narrow and fairly concentric; crystalliferous cells globose. . . . 101

100 a. Pores all small; numerous. Parenchyma bands narrow and frequently anastomosed, occasionally concentric; non-crystalliferous strands mostly 4-celled. Ripple marks 140–150 per inch. Heartwood probably purplish brown. . . . *Geoffraea.*
b. Pores medium-sized in part; not numerous. Parenchyma bands variable in width and not distinctly anastomosed; non-crystalliferous strands mostly 2-celled. Ripple marks 120–130 per inch. Heartwood brown. . . . *Fissicalyx.*

101 a. Pores usually with complete parenchyma sheath. Fibers thin-walled. Ripple marks about 120 per inch. Heartwood normally absent; traumatic heartwood dark brown or purplish. . . . *Pterocarpus.*
b. Pores infrequently with complete parenchyma sheath. Fibers not thin-walled. . . . 102

102 a. Pores rather few; scattered irregularly. Parenchyma bands unevenly spaced; prominent on tangential surface. Fibers thick-walled. Ripple marks 120–150 per inch. Heartwood variegated red and brown. . . . *Etaballia.*
b. Pores rather numerous; fairly evenly distributed. Parenchyma bands fairly evenly spaced, particularly in late wood; not very distinct without lens. . . . 103

103 a. Fibers with thick walls. Ripple marks 75–90 per inch. Heartwood brown, reddish brown, or blackish; sharply demarcated from the sapwood. . . . *Swartzia.*
b. Fibers with medium walls. Ripple marks 105–125 per inch. Heartwood brownish; merging gradually into the yellow sapwood. *Platypodium.*

104 a. Parenchyma in numerous concentric bands within the growth rings; regular to wavy or irregular. . . . 105
b. Parenchyma not in numerous concentric bands within the growth rings; sometimes confluent in diagonal or anastomosing bands. . . . 118

105 a. Parenchyma bands coarse; readily visible to conspicuous. . . . 106
b. Parenchyma bands not coarse; mostly indistinct without lens. . . . 114

106 a. Ripple marks not over 70 per inch; sometimes very irregular. . . . 107
b. Ripple marks 100 or more per inch; fairly regular. . . . 108

107 a. Parenchyma cells mostly short and plump. Fibers with rather large lumen. Pores large to very large; very few. Ripple marks about 50 per inch. Heartwood yellow. . . . *Dussia.*
b. Parenchyma cells mostly long and slender. Fibers with minute lumen. Pores medium-sized; few. Ripple marks 60–70 per inch. Heartwood orange-brown, deepening to reddish brown. *Martiodendron.*

108 a. Non-crystalliferous parenchyma strands mostly 4-celled. . . . 109
b. Non-crystalliferous parenchyma strands not mostly 4-celled. . . . 110

109 a. Vessel pits small (less than 6μ). Pores small; few. Rays 1–3 cells wide and up to 20 (40) cells high. Ripple marks about 100 per inch. Heartwood probably yellowish. . . . *Fairchildia.*
b. Vessel pits medium-sized (7–8μ). Pores medium-sized in part; fairly numerous. Rays 1 or 2 (3) cells wide and up to 15 (30) cells high. Ripple marks 100–140 per inch. Heartwood dark red to chocolate or blackish. . . . *Libidibia.*

110 a. Rays mostly 3 or 4 cells wide and frequently up to 50 cells high; many rays more than one-storied. Pores rather large in part; not numerous, sometimes few and scattered. . . . 111
b. Rays 1 or 2, in some genera 2–4, cells wide and infrequently more than 15 cells high; few rays more than one-storied. . . . 112

111 a. Vessel pits small (5–7μ). Parenchyma bands fairly uniform. Ripple marks 110–130 per inch. Heartwood probably light-colored. . . . *Clitoria.*
b. Vessel pits medium-sized (8–9μ). Parenchyma bands irregular and more or less anastomosed. Ripple marks 120–150 per inch. Heartwood yellowish to dark brown. . . . *Piscidia.*

112 a. Rays 1 or 2 cells wide, the uniseriates numerous; ray-height usually considerably less than tier-height. Four-celled parenchyma strands common; fusiform cells few. Pores medium-sized in part; very few. Ripple marks about 100 per inch. Heartwood dull brown to brick-red, becoming chocolate, purplish, or nearly black. . . . *Stahlia.*
b. Rays mostly 2 or 3 cells wide, the uniseriates few; ray-height often approximately full tier-height. Four-celled parenchyma strands few. . . . 113

113 a. Fusiform parenchyma cells numerous. Pores large to small; few to rather numerous. Ripple marks 100–140 per inch. Heartwood yellowish brown to dark red. . . . *Lonchocarpus.*
b. Fusiform parenchyma cells few. Pores rather large; few. Ripple marks about 140 per inch. Heartwood said to be orange. . . . *Bergeronia.*

114 a. Ripple marks 180–190 per inch. Fusiform parenchyma cells numerous. Rays 1 or 2 cells wide and 5 (10) cells high. Heartwood rich brown, variegated or finely striped. . . . *Brya.*
b. Ripple marks 90–120 (150) per inch. Fusiform parenchyma cells absent or few. . . . 115

115 a. Uniseriate rays numerous. Heartwood dark violet-brown, more or less streaked; some specimens walnut-scented. . . . *Machaerium.*
b. Uniseriate rays few. Heartwood unscented. . . . 116

116 a. Parenchyma bands including the pores; cells storied. Heartwood deep reddish brown (*Z. tango*), dark olive, or blackish. . . . *Zollernia.*
b. Parenchyma bands touching, but usually not including, the pores; cells not storied. . . . 117

117 a. Pores small. Vessel pits medium-sized (8–10μ). Rays sometimes up to 40 (60) cells high. Heartwood uniform brown or reddish brown. ..... *Dialium.*
b. Pores medium-sized. Vessel pits small (not over 6μ). Rays up to 15 (25) cells high. Heartwood brown, reddish brown, or blackish, in solid color or variegated. ..... *Swartzia.*

118 a. Parenchyma very abundant and conspicuous in coarse-textured paratracheal masses, more or less confluent 119
b. Parenchyma not very abundant; inconspicuous. 123

119 a. Pitting between parenchyma cells coarse. Rays not over 2 cells wide. Pores large; very few. Ripple marks about 70 per inch. Heartwood pale olive ..... *Aldina.*
b. Pitting between parenchyma cells fine. Rays frequently 3 cells wide. Pores medium-sized to small. Ripple marks more than 70 per inch. 120

120 a. Parenchyma cells storied. 121
b. Parenchyma cells not definitely storied 122

121 a. Rays 1–3, mostly 2, cells wide. Ripple marks 110–115 per inch. Heartwood brownish yellow; taste bitter ..... *Ferreirea.*
b. Rays 1–4, mostly 2 or 3, cells wide. Ripple marks 80–100 per inch. Heartwood pale brown; taste not bitter. ..... *Pterodon.*

122 a. Pores small; rather few. Vessel pits medium-sized (7μ). Rays rarely triseriate. Ripple marks about 75 per inch. Heartwood sulphur-yellow when fresh, but turning rich purplish red. *Goniorrhachis.*
b. Pores medium-sized; few. Vessel pits large (10–11μ). Rays frequently triseriate. Ripple marks about 100 per inch. Heartwood rather waxy yellowish brown. ..... *Luetzelbergia.*

123 a. Pores very small 124
b. Pores medium-sized 126

124 a. Rays 1–5, mostly 2 or 3, cells wide and of various heights up to 200 cells. Parenchyma barely visible; vasicentric to vasicentric-confluent. Ripple marks about 140 per inch. Heartwood orange-brown, streaked with red. ..... *Sophora secundiflora.*
b. Rays mostly biseriate and less than 50 cells high. 125

125 a. Rays 1–3 cells wide and 10 (20) cells high. Parenchyma narrowly aliform and confluent; visible without lens. Ripple marks about 125 per inch. Heartwood brown or orange-brown. ..... *Behaimia.*
b. Rays 1 or 2 cells wide and 15 (45) cells high. Parenchyma narrowly vasicentric and short aliform; not distinct without lens. Ripple marks about 90 per inch. Heartwood orange to deep red. *Guilandina.*

126 a. Rays less than 15 cells high. Ripple marks 95–125 per inch; fairly regular. Heartwood flesh-colored to mahogany. ..... *Pterogyne.*
b. Rays up to 30 (40) cells high. Ripple marks 60–80 per inch; irregular. Heartwood dark brown, more or less striped. ..... *Melanoxylon.*

127 a. Parenchyma in concentric bands within the growth ring 128
b. Parenchyma not in definitely concentric bands (other than terminal); vasicentric, vasicentric-confluent, or more or less aliform and locally confluent into diagonal or anastomosing bands 138

128 a. Parenchyma bands coarse 129
b. Parenchyma bands fine 133

129 a. Pores large, at least in part. Ripple marks 100–140 per inch. Heartwood scarcely distinguishable from the sapwood 130
b. Pores all small to medium-sized. Rays 1–3 cells wide and not over 40 cells high. Heartwood distinct. Density medium to very high. 131

130 a. Pores distinctly 2-sized: large and small. Rays 1–3 cells wide and less than 50 cells high. Density medium. ..... *Clitoria brachycalyx.*
b. Pores not distinctly 2-sized. Rays coarse; sometimes up to 20 cells wide and more than 100 cells high ..... *Erythrina.*

131 a. Pores small; fairly numerous. Vessel pits medium-sized (7–8μ). Ripple marks about 100 per inch. Uniseriate rays numerous. Heartwood reddish brown. ..... *Ateleia.*
b. Pores medium-sized; few. Vessel pits small (not over 6μ). Ripple marks about 70 per inch. 132

132 a. Uniseriate rays numerous. Heartwood brownish ..... *Crudia.*
b. Uniseriate rays few. Heartwood orange-yellow ..... *Poecilanthe.*

133 a. Pores small to very small. Ripple marks 150 or more per inch. Fusiform parenchyma cells numerous. Rays typically less than 8 cells high 134
b. Pores medium-sized. Ripple marks fewer than 125 per inch. Fusiform parenchyma cells absent or few. Rays frequently more than 10 cells high 136

134 a. Fibers thin-walled. Rays nearly all uniseriate or only partially biseriate. Parenchyma cells mostly fusiform. Ripple marks about 150 per inch. Heartwood probably red. ..... *Drepanocarpus.*
b. Fibers very thick-walled. Rays often biseriate. Parenchyma mostly in 2-celled strands. 135

135 a. Rays 1 or 2 cells wide. Heartwood chocolate-brown; sapwood yellowish. ..... *Pictetia.*
b. Rays 1–3 (4) cells wide. Heartwood olive, more or less streaked with black; sapwood white ..... *Belairia.*

136 a. Vessel pits large (up to 12μ). Uniseriate rays few. Ripple marks 85–110 per inch. Heartwood yellow ..... *Apuleia.*
b. Vessel pits small (not over 7μ). Heartwood brown or purplish brown. 137

137 a. Uniseriate rays numerous. Ripple marks 100–120 per inch. Heartwood reddish brown, with orange hue. ..... *LeCointea.*
b. Uniseriate rays few. Ripple marks 50–60 per inch. Heartwood dark brown or purplish brown, uniform or streaked ..... *Dicorynia.*

138 a. Parenchyma sparse to moderately abundant; usually not distinct without lens. Pores small to medium-sized; fairly numerous.... 139
b. Parenchyma very abundant and conspicuous. Pores large; few... 145

139 a. Ripple marks 140–160 per inch..... 140
b. Ripple marks fewer than 125 per inch..... 142

140 a. Pores clustered and in irregular diagonal or ulmiform arrangement. Rays 1–6 cells wide and up to 50 cells high. Density medium. Heartwood brownish gray, more or less variegated or striped with dark brown.....*Dalea.*
b. Pores not so arranged. Density high..... 141

141 a. Diffuse-porous. Rays 1–6, mostly 3 or 4, cells wide and sometimes up to 30 (60) cells high; not definitely storied. Parenchyma diffuse in part. Heartwood greenish yellow, changing to olive and eventually to russet-brown.....*Diphysa.*
b. With tendencies to ring-porous. Rays 1–3 cells wide and 10 (20) cells high; definitely storied. Parenchyma not diffuse. Heartwood brown or reddish brown, often streaked.....*Eysenhardtia.*

142 a. Ray margins with crystalliferous cells. Pores small..... 143
b. Ray margins apparently without crystalliferous cells..... 144

143 a. Crystals in vertical series of cubical cells, each series resembling a single upright cell, frequently tapering to a point. Uniseriate rays few. Parenchyma sometimes short aliform to locally confluent. Ripple marks regular; 100–110 per inch. Heartwood brown, with greenish or purplish tinge; more or less striped.....*Myrospermum.*
b. Crystals mostly solitary in cubical cells. Uniseriate rays rather numerous. Parenchyma sparingly vasicentric; not aliform or confluent. Ripple marks irregular; 100–110 per inch. Heartwood dark brown, with blackish striping.....*Apoplanesia.*

144 a. Pores small. Uniseriate rays numerous. Ripple marks 90–105 per inch. Heartwood purplish red.....*Pseudocopaiva.*
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b. Parenchyma in large lozenge-shaped masses about the pores and only locally confluent. Wood fibers with rather large lumen. Ripple marks about 100 per inch. Heartwood yellowish, with slight orange hue; vanilla-scented.....*Amburana cearensis.*

148 a. Fusiform parenchyma cells common. Ripple marks 80–100 per inch. Heartwood rose-red, more or less variegated.....*Platycyamus.*
b. Fusiform parenchyma cells apparently absent. Ripple marks about 100 per inch. Heartwood yellowish, reddish, or brown, sometimes very dark.....*Andira.*

149 a. Parenchyma very irregularly arranged; usually not completely surrounding the pores; also more or less diffuse. Ripple marks 85–95 per inch. Heartwood chocolate to reddish brown...*Bowdichia.*
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150 a. Rays nearly all biseriate. Parenchyma sometimes long aliform. Ripple marks about 65 per inch. Heartwood without distinctive odor or taste.....*Ormosiopsis.*
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CURRENT LITERATURE

Algumas plantas medicinales de Izúcar de Matamoros y Pueblos anexos. By IRENE RIVERA M. *Anales del Instituto de Biologia* (México, D. F.) 14: 1: 37–67; 4 figs.; 1943.

This annotated list of Mexican medicinal plants includes 113 species of herbs, shrubs, and trees of 96 genera and 49 families. The information pertains mostly to the distribution of the plants, their vernacular names, and the uses which various parts of the plants have in local medicine.

Contribution to the morphology and anatomy of guayule (*Parthenium argentatum*). By ERNST ARTSCHWAGER. Tech. Bull. No. 842, U. S. Dept. Agr., Washington, D. C., April 1943. Pp. 33; 6 x 9¼; 23 plates, 18 text figs. Price 15¢.

"Ross and Lloyd, through their studies, have given us a general insight into the anatomy of the plant, the ontogeny of the tissues, and the place and time for rubber synthesis, but they tell us very little about the detailed structure of the secondary xylem and phloem, so important in the development of the plant from the standpoint of performance. This bulletin aims to consider critically and briefly the plant in

its entirety, laying emphasis on structural features that have been previously neglected or omitted and that, in the author's opinion, have a direct bearing on breeding to serve the present need."

Plantas huliferas: el guayule y la *Cryptostegia grandiflora*. By MAXIMINO MARTÍNEZ. México, D. F., 1943. Pp. 111; 4¾ x 7¼; 12 text figs.

The first part of this little book pertains to Guayule, *Parthenium argentatum* Gray, a low Mexican shrub cultivated as an industrial source of rubber latex. The second part describes an East Indian liana, *Cryptostegia grandiflora*, which has been planted in Mexico for ornamental purposes and in some localities has become naturalized. The author suggests that this asclepiadaceous plant, known in India as Palay, has excellent potentialities in industry, as the latex is rich in rubber.

The Caribbean Forester. Pub. quarterly by the Trop. For. Exp. Sta., U. S. Forest Service, Rio Piedras, Puerto Rico. Vol. IV: 4: 145–199; July 1943.

CONTENTS

Studies in palms. 4. *Brahea* and one *Erythea*. 5. New palms of Panama, and others. By L. H. BAILEY. *Gentes Herbarum* (Ithaca, N. Y.) 6: 4: 175–264, figs. 87–139.

The author reviews and illustrates the genus *Brahea* Mart., hitherto with four species, describing and figuring two new species, *B. prominens*, a stout erect tree, and *B. bella*, not so large, respectively of Guatemala and Mexico; then redefines

Erythea Watson, renaming the uncertain *E. Roezlii*, *Erythea clara* Bailey. His recent studies of Panama palms have yielded descriptions of no less than 28 new species distributed among the following genera: *Sabal*, *Euterpe*, *Prestoea*, and *Aiphanes* with one new species each, *Desmoncus* two, *Geonoma* three, *Bactris* six, and *Chamaedorea* twelve. A small distinct Geonoma-like palm becomes the type of a new genus, *Woodsonia* Bailey.

Bactris major and *B. minor* are reviewed on the basis of new material collected by the author at Carthagena. The long existing *Malortiea-Reinhardtia* confusion is discussed and clarified and *R. rostrata* Burret is transferred to *Malortiea*.—B. E. DAHLGREN, *Field Museum*.

Flora of Panama: Palmaceae. By L. H. BAILEY. *Ann. Missouri Bot. Garden* 30: 327–396; figs. 44–69; September 1943.

A clear and competent, well-illustrated account of the palms of Panama, including the new species lately described more extensively in *Gentes Herbarum*. "Even with the 70 . . . species in 26 native genera I now include in the Panama inventory, I conclude that the country is yet only fragmentarily covered for palms. We are beginning to understand that for the most part the species of palms do not naturally inhabit great expanse of territory, and many of them are strictly local."—B. E. DAHLGREN, *Field Museum*.

Giant oaks of Costa Rica. By ARTHUR BEVAN. *American Forests* (Washington, D. C.) 49: 10: 486–487, 509; 3 half-tones; October 1943.

A popular account, with illustrations, of the Costa Rican Oak forest described by William R. Barbour in *Tropical Woods* 75: 1–4, Sept. 1, 1943.

Estudio sobre los principales barbascos colombianos. By GABRIEL GUTIERREZ V. *Supl. Agricultura y Ganaderia* (Bogotá) 8: 1–42; 10 text figs.; 1943.

Plants containing rotenone, an important insecticide harmless to warm-blooded animals, have long been used by natives

of tropical countries as fish poisons. In Colombia and some other parts of Latin America such plants are called Barbascos. The present work is divided into two parts, the first giving an annotated list of all of the plants known to be employed by the natives of Colombia in fishing, the second a summary of the information available regarding the genera and species which are now or are likely to become important commercial sources of insecticides.

Notas a la flora de Colombia, IV. By José Cuatrecasas. *Rev. Acad. Col. Cienc. Ex., Fís. & Nat.* (Bogotá) 4: 15/16; 337–348; 22 text figs.; Aug.–Dec. 1941.

Contains descriptions of 17 new species in the following genera: *Espeletia* (3), *Brunellia* (4), *Polylepis* (2), *Valeriana* (1), *Paullinia* (6), *Sida* (1), and *Biophytum* (1). The species of *Brunellia* and *Polylepis* are small to medium-sized trees growing at elevations of 7000–11000 feet above sea level.

Palmas de Colombia, II. Localización tipica de algunas especies coleccionadas por Martius en el Caquetá colombiano. By Armando Dugand. *Rev. Acad. Col. Cienc. Ex., Fís. & Nat.* 5: 18: 212–216; July–Dec. 1942.

Gives data obtained mostly in the libraries of Arnold Arboretum and Gray Herbarium of Harvard University regarding the localities in Colombia where the types of 20 species of palms were collected by Karl Friederick von Martius in 1819–1820.

Notas sobre el genero de palmas *Cuatrecasea*. By Armando Dugand. *Caldasia* (Bogotá, Col.) 2: 6: 69–73; March 1943.

Cuatrecasea vaupesiana Dugand (1940) of the Colombian Amazon region proves to be identical with the Brazilian palm described in 1875 as *Iriartea Spruceana* Barb.-Rodr. and in 1903 as *Iriartella setigera* var. *pruriens* Barb.-Rodr. (figured on Plate 6 of "Sertum palmarum brasiliensium" as *Iriartella Spruceana*). Dugand accordingly proposes to rename this type of his genus *Cuatrecasea Spruceana* (Barb.-Rodr.) Dugand.—B. E. Dahlgren, *Field Museum.*

Una palma nueva del genero *Desmoncus*. By Armando Dugand. *Caldasia* 2: 6: 75–76; March 1943.

The proposed new species, *Desmoncus myriacanthos* Dugand, is a palm of the lower Magdalena and Carib coast of Colombia, where it is known as Matamba.

Notes on *Cereus* and *Acanthocereus*. By Leon Croizat. *Caldasia* 2: 7: 117–122; June 30, 1943.

The author concludes his discussion of the various taxonomic problems involved by "accepting *Cereus* as the equivalent of *Piptanthocereus*, and *Acanthocereus* as a valid, distinct genus."

Euphorbiaceae Cactaceaeque novae vel criticae colombianae, I. By Leon Croizat. *Caldasia* 2: 7: 123–139; 1 plate; June 30, 1943.

"The botanical investigations now so vigorously conducted in the Republic of Colombia bring forth a continuous stream of novelties or critical forms in the Euphorbiaceae and the Cactaceae, which it is the purpose of these and following notes to describe and discuss as they become known."

A new genus with a single species, *Phyllanoa colombiana* Croizat, is a euphorbiaceous tree about 25 feet tall growing at elevations of 6000–7500 feet in El Valle near the summit of the Cordillera Occidental. "For the present, *Phyllanoa* may rest near *Savia*. The generic name is derived by anagram from *Phyllanthus* and *Amanoa*." New species are described in *Croton* (3), *Alchornea* (1), *Euphorbia* (1), and *Sapium* (1). There are also accounts of species of *Sapium*, *Pedilanthus*, *Opuntia*, *Acanthocereus*, and *Farilea*.

Notas criticas sobre *Ficus pallida* Vahl y *Ficus prinoides* H. & B. ex Willd. By Armando Dugand. *Caldasia* 2: 7: 149–152; June 30, 1943.

These two closely related species of *Ficus* are described and differentiated and the various collections cited.

El genero monotipico *Stuebelia* en Colombia y Venezuela.

By ARMANDO DUGAND. *Caldasia* 2: 7: 153–157; 2 plates; June 30, 1943.

A detailed and illustrated account of *Stuebelia nemorosa* (Jacq.) Dugand, a small capparidaceous tree of northern Colombia and Venezuela. (See *Tropical Woods* 43: 15–16; Sept. 1, 1935.) The vernacular names in Atlántico and Bolivar, Colombia, are Calabacito, Calabasuero, Calabazuelo, and Cojón de Burro.

***Machaerium capote* Triana.** By ARMANDO DUGAND. *Caldasia* 2: 7: 159–164; 1 plate; June 30, 1943.

This is a small to rather large Colombian tree known as Capote (Cundinamarca, Tolima, and Huila), Sietecueros (Atlántica and northern Bolivar), and Sietecascas (other parts of Bolivar). Its scientific name has been used repeatedly in the literature, but apparently there was never any Latin diagnosis, an omission that the present author corrects, along with an account of the occurrence of the species.

La Mesa de Guanipa: ensayo de fitogeografia. By H. PITTIER. Caracas, Venezuela, 1942. Pp. 57; 6 x 9¼.

The results of ecological studies of the vegetation of a part of the Llanos of Venezuela. The data were collected by the author during various visits to the Mesa de Guanipa and adjacent regions. The report concludes with a checklist of the vernacular and scientific names of the plants observed and notes on their uses.

Hippomaneae argentinae (Euphorbiaceae). By C. A. O'DONELL and A. LOURTEIG. *Lilloa* (Tucumán) 8: 2: 545–591; 14 text figs., 2 maps, 6 plates; May 27, 1943.

A systematic study of all of the Argentine species of *Actinostemon*, *Colliguaya*, *Sapium*, *Sebastiania*, and *Stillingia*. *Sapium haematospermum* Muell. Arg., var. *saltensis* is described as new. The occurrence of four species is recorded for the first time for Argentina.

Indice de la flora leñosa Argentina. By FRANCO E. DEVOTO and MAX ROTHKUGEL. Misc. Pub. No. 140, Dir. Prop. y Pub., Ministerio de Agricultura, Buenos Aires, (1942) April 1943. Pp. 182; 6 x 9.

This important work contains the following sections: Index to the common names (pp. 7–23). Index to the families and genera (25–33). Annotated list of the trees, shrubs, and lianas, arranged by official common names under families, for three zones (35–142). List of exotic trees introduced into Argentina (143–148). Glossary of aboriginal names: Guarani (151–167), Quichua, Araucanos, and others (168–172). Bibliography (173–182).

Studies on Pacific island plants, III. New and noteworthy flowering plants from Fiji. By A. C. SMITH, *Bull. Torrey Botanical Club* 70: 5: 533–549; September 1943.

"The species discussed . . . are either novelties, or represent range extensions into Fiji, or are sufficiently unusual to merit notes. The greater part of the herbarium material which is the basis for this study was forwarded from Bishop Museum in 1941." Ten species are described as new, namely, *Celtis vitiensis*, *Polyaltha angustifolia*, *Xylopia pacifica*, *Aglaia Parksii*, *Allophylus umbrinus*, *Xylosma Bryanii*, *Discocalyx sylvestris*, *Rapanea crassiramea*, *Linociera Gillespiei*, and *L. vitiensis*.

Timber and forests. South Africa's needs and resources. By ERNEST J. NEETHLING. Pub. by South African Interests Group, Inc., Cape Town, 1943. Pp. 42; 5½ x 8½.

"In this work I have tried to stimulate a better appreciation of South Africa's timber problem by presenting the facts in a handy form. These facts and figures speak clearly to those who have time and application to study them. They point a moral for the future and may, I hope, be of value to all concerned in the industry at present. The bulk of the first half of this work gives a detailed analysis of the available figures. The second half surveys the post-war problem both in relation to the timber resources of the world and more particularly in relation to South Africa's needs. Here, too, an outline of a suggested timber policy is given."—*From Author's preface.*

Contributions to the life history, morphology, and phylogeny of *Widdringtonia cupressoides*. By MAYNARD F. MOSELEY, JR. *Lloydia* (Cincinnati, Ohio) 6: 2: 109–132; 3 plates; June 1943.

"The Callitroideae, containing the genera *Actinostrobus*, *Callitris*, and *Widdringtonia*, are regarded as a natural group which should be established as a distinct subfamily of the Cupressaceae. . . . The Callitroideae are thought to be the highest evolved subfamily of the Cupressaceae. . . . The Cupressoideae and the Juniperoideae are considered the least evolved subfamilies of the Cupressaceae. The Thujoideae stand between these groups, and *Thuja* is the highest evolved member of this subfamily. The Callitroideae were probably derived from an ancestral '*Fitzroya-Tetraclinis* complex' . . ."—*From Author's summary.*

Studies of the Icacinaceae. VII. A revision of the genus *Medusanthera* Seeman. VIII. Brief notes on some Old World genera. By RICHARD A. HOWARD. *Lloydia* 6: 2: 133-143; 1 plate; 144–154; 3 plates; June 1943.

"Seeman described *Medusanthera* in 1864 but later reduced it to synonomy with *Stemonurus*. It is distinct from *Stemonurus* but is identical with *Tylecarpus* of Engler and, being older, must replace Engler's name. I transferred six species to *Medusanthera* in 1940. Two new combinations and one new species are added here. In addition, *Medusanthera australis* and *Stemonurus* (*Tylecarpus*) *Merrittii* have been segregated as the type species of two new genera. Thus ten species are now recognized in this genus."

Paper VIII "contains further notes on the application of the name *Stemonurus* Blume, descriptions of two new species of *Urandra* Thwaites, and also two of *Platea* Blume, as well as the first description of the fruits of the genus *Pittosporopsis* Craib."

Journal of the Arnold Arboretum (Jamaica Plain, Mass.) 24: 1–518; January, April, July, October 1943.

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