M.M.C.

M. M. CHATTAWAY.

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

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RÔLE OF WOOD ANATOMY IN TAXONOMY[1]

By SAMUEL J. RECORD

The idea of employing the internal structure of plants as an aid to their systematic classification originated very early and has repeatedly been put forward. For example, stem structure figured conspicuously in the first distinctions of the groups of plants now termed Monocotyledons and Dicotyledons, and Martius included the nature of the wood in his diagnosis of the Coniferae. In 1810, Mirkel expressed the opinion that comparative anatomy would play an important part in perfecting the natural system of plant classification. In 1875, Radlkofer, after long preparatory work, published his monograph of the sapindaceous genus *Serjania* in which (in the words of Solere-

[1] Paper presented in a symposium on "New approaches to the taxonomy of vascular plants" before a session of the Systematic Section of the Botanical Society of America at Cambridge, Mass., Dec. 28, 1933.

der), "he undertook the investigation of the stem and of certain anatomical features of the leaf in species after species and showed in a convincing manner that the adoption of anatomical characters in classification was not merely a possibility, but a necessity; owing to his systematic and unprejudiced mode of procedure, he is to be regarded as the actual founder of the anatomical method." The results were so gratifying that in 1883, Radlkofer prophesied that the next hundred years of botany would be devoted to the anatomical method. At the botanical congress, held in Paris in 1889, the new method was submitted to discussion, with Vesque acting as its principal champion.

In 1898, Dr. Hans Solereder, who had been trained in Radlkofer's school of botany, published a monumental summary of the results secured in the anatomical field up to that time. His task was enormous and involved a critical study of hundreds of treatises, which, as he says, "sprang up like mushrooms." An English translation, made by Boodle and Fritsch and revised by Scott, was published at Oxford in 1908, under the title "Systematic anatomy of the Dicotyledons: A handbook for laboratories of pure and applied botany." Its two volumes, with a total of about 1200 pages, provide an inexhaustible mine of information for everyone interested in any phase of the subject.

From the data available, to what extent have the claims for the anatomical method been justified? Solereder says: "The answer is in every respect favorable and the results obtained will only disappoint those who imagined that an entirely new era had begun for systematic botany, with the introduction of the anatomical method, and who believed that the time had come at last for discarding the present classification, which, according to their views, was founded on a one-sided basis—that of the characters of the flower and fruit. No new system is created by the aid of the new method; it has rather become apparent that the classification based on external morphological characters, especially on floral features, and elaborated with great industry and skill, on the whole stands the test of the new method. The system created by the older taxonomic botanists is in its broad outlines a natural one, in so far, that

is, as one can speak of a natural system at all without having investigated the palaeontological history. There can be no question of actually substituting anatomical characters for external features; we are only concerned with the employment of endomorphic in conjunction with exomorphic characters. The anatomical method is only an auxiliary one, although it is of great importance. Properly employed, *i.e.*, when sufficient attention is also paid to external morphological features, it is of the greatest value both as a means of confirmation of results already obtained and for the further elaboration of the natural system. It provides a new series of distinctive features for the various groups of affinity, from the order down to the species; these features especially afford excellent and much needed diagnostic characters for species and are thus of the utmost value to systematists. There are very few good species which do not present some distinguishing anatomical feature. Anatomical characters sometimes lend support to the results obtained by the use of external morphology, *i.e.*, when they coincide with the external characters. Frequently, however, they disclose new points of view regarding affinities and thus serve to improve and complete the natural system. Anatomical characters are often preferable for the determination and delimitation of a systematic group, since they are more precise than external morphological characters and possess the further advantage, that they necessitate detailed observation and prevent a superficial treatment and too hurried decision."

In view of the foregoing, what has the student of wood to contribute that is new? My answer is that the wood anatomists are getting into a position where, for the first time, they will be able to make a comprehensive survey of the woods of the world. Solereder's vast compilation is weakest in its descriptions of woods, because the investigators were so largely limited in material to the small stems of herbarium specimens. Now in the Yale collections alone are over 24,000 wood samples representing about 8000 species and nearly 2200 genera of 212 families. The prime purpose of assembling this material is to promote systematic anatomy. To that end, pieces large enough for study are made available to competent research workers anywhere. The wood anatomists of 22 different countries have perfected an organization (the International Association of Wood Anatomists) for the exchange of ideas and materials and for the advancement in various ways of their branch of botanical science. In this community of interest, this world-wide coöperative effort, is a new and powerful stimulus to taxonomy.

The wood anatomist would much prefer to leave the naming and classification of his specimens to botanists who are specialists in that work. If he does, however, he sooner or later finds himself in trouble. If he is inexperienced he is likely to conclude that wood structure is inconsistent and not dependable for the separation of families, genera, and species, but if he is older and wiser he is likely to agree with Hutchinson of Kew (*Families of Flowering Plants*, p. 5) that "all this goes to prove that the delimitation of families, of genera, and of species is sometimes very much a matter of taste and personal idiosyncrasy."

If the study of woods is to proceed in an orderly manner it is obviously important that they be correctly determined. To protect himself the wood anatomist must scrutinize every identification and carefully check all that appear doubtful. I have been engaged in such work for several years and very frequently have occasion to ask the botanist to reëxamine certain specimens in the light of my conclusions from a study of the wood. All of the botanists with whom I have dealings seem to welcome such suggestions and give me their hearty coöperation. I think I have convinced some of them, at least, that a knowledge of wood structure can be helpful in determinations, particularly of incomplete or sterile specimens.

In most cases the anatomist is satisfied if the herbarium vouchers for his samples are accurately matched with named specimens. Not infrequently, however, he may have occasion to doubt the correctness of the original classification. He then realizes that no matter how confident he may be, for instance, that a species has been named in the wrong genus, or a genus placed out of its natural position, the evidence he may adduce from the wood will have little or no weight with orthodox taxonomists of the present day. Under such circumstances what is he to do?

The first step is to consult the literature and note how many aliases the plant has acquired. If the synonymy is extensive enough, all the anatomist has to do is to make a choice that best serves his purpose. As an example of what I mean, Bentham & Hooker include *Chloroxylon Swietenia*, or East Indian Satinwood, among the Meliaceae, and *Xanthoxylum flavum*, the West Indian Satinwood, among the Rutaceae. In the *Pflanzenfamilien*, however, they are both classified with the Rutaceae, and it is there that the wood anatomist thinks they belong.

I recently studied the wood of *Rhabdodendron*, a Brazilian genus that has been referred to the Rutaceae, the Rosaceae, and the Phytolaccaceae, and published this conclusion: "The woods of the Rosaceae-Chrysobalanoideae and of the Rutaceae comprise homogeneous groups with normal and distinctive anatomy. There is little in common between the two groups, while there are many fundamental differences. *Rhabdodendron* is as unlike either group as they are unlike each other. On the other hand, there is a marked affinity of that genus to certain genera of the Phytolaccaceae."

In my book, *Timbers of Tropical America*, published in 1924, I said that I could not understand why the Cuban "quiebrahacha" was named *Copaifera hymenaefolia*, since the wood is strikingly different from those of the other species of *Copaifera*, which are much alike. After three systematists had told me that the species was properly placed, I put the problem aside, but not out of mind. Some five years later, while visiting the New York Botanical Garden, I related my experience to Dr. N. L. Britton, who thereupon presented me with a manuscript he and Mr. Percy Wilson had prepared for publication in their North American Flora, and in it they had set up a new genus, *Pseudocopaiva*, for *Copaifera hymenaefolia*. I published that description in our magazine, *Tropical Woods* (20: 28, Dec. 1, 1929) and, so far as I am concerned, the status of that plant is permanently fixed.

If the original description was based on incomplete material, the proper procedure is for the anatomist to get the missing parts in the hope that they will prove his case. As an instance in point there appeared in *Tropical Woods* 14: 30, June 1, 1928, a short article on *Sickingia Maxonii* by Paul C. Standley, in which he says: "The type material of the new species consisted of fruiting branches only, but it did not occur to the writer, at the time of publication [1918], that there could be any doubt as to its generic position. . . . Professor Record, after examination of the wood, has suggested that it agreed rather with that of the genus *Sickingia*, a group unknown, until very recently, in Central America. In February of the present year Mr. G. Proctor Cooper collected in Panama excellent flowering and fruiting material of *Genipa Maxonii*, which is known there as 'guayatil colorado.' Examination of the flowers shows conclusively that the tree belongs to the genus *Sickingia*." I might add that Mr. Cooper's collection of the material was not by chance, but at my special request.

The instances I have cited from my personal experience are random examples of the bearing of wood anatomy on taxonomy in special and isolated cases. They are little more than practice for a major undertaking that involves the systematic classification of all woods. This calls for organized effort in the collection and distribution of specimens, in the fixing of international standards for terminology and descriptions, and the determination, so far as possible, of the relative diagnostic values of the various anatomical features.

Two years ago at the Science meeting in New Orleans I announced the organization of the International Association of Wood Anatomists and outlined its activities. Since that time substantial progress has been made. One of the projects, begun by the Organizing Committee a year before the Association was constituted, was the preparation of a glossary of terms used in describing woods. On December 1, 1933, the English edition of this glossary was published, and the choice and definition of 126 technical terms represent the activities of 25 scientists of thirteen different nationalities as harmonized by a committee of six American anatomists. The translation of the glossary into eight other languages is well under way. The results are bound to have a profound and far-reaching effect on the science of plant anatomy.

The systematic work now being done on woods is of two

principal types. One deals with certain structural features, and attempts to trace their origin and distribution and to evaluate their taxonomic significance. Hundreds of specimens have been supplied by members of the Association to assist such research. The work at the Imperial Forestry Institute at Oxford on the occurrence of included phloem in woods, and Professor I. W. Bailey's study at the Bussey Institution of the nature and distribution of vestured pits in Dicotyledons, are only two of a dozen projects I could mention that have received substantial aid from the Association.

The other type of work is concerned with the systematic anatomy of the woods of an entire family, order, or other logical group. Its major object is to formulate a classification that will be acceptable both to taxonomists and to those chiefly concerned with woods. All of the Gymnosperms are being intensively studied, and to my personal knowledge at least 20 of the more important families of Dicotyledons. During the past two years I have sent out from the Yale collections more than 3000 specimens for systematic study by trained anatomists and their students.

It is too early to say just what the outcome of this vast undertaking will be, but from present indications a classification will result that will retain the general form and substance of that now in use, but differ in a great many details. Heterogeneous families will probably be divided into more homogeneous units so that they can be keyed out and described without so many exceptions. As an example, I would cite McLaughlin's treatise on the Magnoliales (*Tropical Woods* 34: 3–39, June 1, 1933) in which he recommends, among other things, that Himantandraceae be transferred from that order to the Anonales and Lactoridaceae to the Piperales; that *Illicium*, *Euptelea*, and *Tetracentron* be each made the type of a separate family, etc. Since the work was of a preliminary nature, the changes were not actually made, but the data were presented in the hope that taxonomists would give them serious and sympathetic consideration.

The wood anatomists are at present principally concerned with the delimitation and position of the genera. Work on the separation of closely related species must, for the most part, be deferred until enough specimens are available to permit a decision as to the constancy of such anatomical differences as may be observed. Taxonomists describe new species on the basis of a single type specimen, a small fragment of a single tree, whereas the wood anatomists consider species in a broader sense and must search for characters that are inherent and constant throughout the range.

Wood anatomists look upon many of the so-called species proposed by taxonomists as nothing more than varieties and forms, and eventually they will set about to remedy the situation. Let me give an example of what can be done in this direction. One of my students, Edward C. Greene, Jr., made a study of the woods of the various species of *Calophyllum* represented in the Yale collections and was unable to find a basis for specific distinctions. At my suggestion, Paul C. Standley examined all the herbarium material he could obtain, with the result that four of our presumably distinct species were reduced to three varieties of a single species. (See *Tropical Woods* 30: 6–9, June 1, 1932.) In concluding his paper, Standley said: "It is possible that more ample material from Mexico and Central America will throw light on the relationships of all these variants and make it possible to separate some of them specifically or otherwise. It is suspected, however, that further material will merely complicate the matter and emphasize the futility of an attempt at their separation."

We anatomists know that we can revise existing classifications in a way that will much better serve our needs and those of the forester. To this end we are pooling our resources of information and materials, standardizing our terminology, testing our criteria, making systematic studies, and compiling and publishing the results. We do not intend to replace one classification, which we consider to be founded on an inadequate basis, with another founded on a different basis that is equally inadequate. On the contrary we shall, to the best of our ability, make use of all of the evidence available from every source and attempt to harmonize any conflicting opinions.

We welcome opportunities to coöperate with any or all

scientists who are striving toward a more logical, a more nearly natural scheme of plant classification. We contend that every problem in systematic botany that confronts the anatomist is a challenge to the taxonomists. In all my own experience I have found that if a wood was a misfit in the place to which it was assigned, there were always other grounds for placing it somewhere else. All we ask of the taxonomists is a sympathetic attitude, as evidenced by a willingness to seek in their own field for a different basis of classification, one that will take the whole plant into account. In solving our problems they will merely be solving their own.

BEARING OF UPRIGHT RAY CELLS IN THE WOOD OF *HIBISCUS MUTABILIS* L. ON USAGE OF THE TERM TILE CELL

By Irma E. Webber

The term tile cell has been commonly applied to a member of an indeterminate radial, usually interspersed, series of apparently empty, upright or square cells of approximately the same height as the accompanying procumbent ray cells. Moll and Janssonius (4) pointed out that cells of this type are known to occur only in certain genera of the Sterculiaceae, Bombacaceae, and Tiliaceae. Chattaway (1) as the result of a study of the whole group of Malvales found that cells of this (her *Durio*) type represent one end of a sequence of forms and accordingly has recently proposed extending the meaning of the term tile cell to include the whole sequence. This is represented at the other end by her *Pterospermum* type, characterized by upright cells approximately twice as high as the procumbent cells. Referring to tile cells as she defines them, Chattaway states that they occur only in the families in which the *Durio* type has long been known to occur and that there is a clear distinction between them and ordinary upright ray cells.

In my study of the woods of the Malvaceae I have found that the *Pterospermum* type of tile cell is frequently present in the xylem rays of a number of genera of this family.

Moreover the distribution of such cells in malvaceous woods is indicative of similarity rather than distinctness between them and other types of upright ray cells. Since the malvaceous woods possessing ray cells of the *Pterospermum* type show many features in common with some of the woods of the Bombacaceae described by Chattaway, it is not surprising that certain data she presents may also be interpreted as minimizing the distinctness between tile cells of her *Pterospermum* type and ordinary upright ray cells. These data will be considered before describing the additional evidence of similarity that may be found in malvaceous woods.

Chattaway states that tile cells differ from other erect ray cells in having extremely narrow radial diameters, in lacking contents, and in being central as well as marginal in the ray. However she cites examples of ordinary upright cells of multiseriate heterogeneous rays which resemble tile cells in shape and in the absence of contents and accordingly differ from them only in being restricted to the margins of the ray. When two rays of this type are connected vertically, the ordinary upright cells resemble tile cells in all respects on radial section, but, according to Chattaway, are essentially different from tile cells in that they form only a uniseriate waist between two multiseriate rays. In this connection it is interesting to note that in describing the *Pterospermum* type, Chattaway states that "true uniseriate rays do not occur, for the large cells alternate not with single procumbent cells but with small groups of them." Obviously this statement is suggestive of a certain resemblance between the tile cells in the narrow rays of the *Pterospermum* type and the upright cells forming uniseriate waists between narrow multiseriate rays.

Chattaway's data concerning uniseriate rays in woods possessing multiseriate heterogeneous rays are also noteworthy. She points out that cells of such uniseriate rays usually resemble the upright cells of the multiseriate rays, and in the case of woods in which multiseriate rays have sheath cells, the uniseriate rays are composed entirely of large upright cells. In her discussion of multiseriate rays having both sheath cells and tile cells she states that in most genera of the *Pterospermum* type the marginal and central cells are

identical and the marginal cells are therefore tile cells. Although Chattaway does not so state, from this evidence it seems logical to conclude that such uniseriate rays indicate that tile cells of the *Pterospermum* type are not necessarily central as well as marginal.

In malvaceous woods the distribution of various types of rays and of upright and procumbent cells within the individual rays are clearly indicative of similarity between the *Pterospermum* type of tile cell, sheath cells, and ordinary upright cells. In a single specimen of *Hibiscus mutabilis* L. (Yale No. 5228) are to be found uniseriate rays composed of upright cells, narrow rays with groups of procumbent cells alternating with upright cells, multiseriate rays with upright cells restricted to the margins, multiseriate rays with sheath cells, and multiseriate rays with tile cells of the *Pterospermum* type. As may be seen in Plate I, the various types of rays form a series that at once suggests either the derivation of small rays from large ones or of large rays from small ones. The first process seems the more probable in this case, since Forsaith (3) has pointed out the probability of the Malvales having come from ancestors with aggregate rays, and the general course of ray development indicated by Thompson's (5) study is that of primitive uniseriate rays followed successively by aggregate, large compound, small multiseriate, and occasionally uniseriate rays. Assuming dissection rather than compounding to have been operative in producing the various ray types in *Hibiscus mutabilis*, large rays with scattered central *Pterospermum*-type tile cells, such as shown in Plate I, 3, may be regarded as the source of the other forms. No. 4 depicts a transition from the compound to the aggregate condition represented in No. 5. Further dissection of relatively high rays similar to 6b, 6c, 6d, and 6f to form small multiseriate, biseriate, and uniseriate rays similar to 6a, 6e, 7a, 7b, 7c, and 8 is suggested not only by the forms of these rays but also by the distribution of rays in Nos. 6 and 7. Since the series of ray forms in *Hibiscus mutabilis* is suggestive of the derivation of rays with sheath cells from rays with central upright cells, and the further degeneration of rays with sheath cells to produce multiseriate rays with upright cells restricted to the margins and uniseriate rays composed entirely of upright cells, the available evidence indicates a fundamental similarity between all upright ray cells in such a wood; hence a distinction that is entirely dependent on their position in a ray must be regarded as arbitrary. It also follows that there is no adequate basis for distinguishing between marginal upright ray cells occurring in a specimen having upright cells in the center of some rays and morphologically similar cells in another specimen of the same species or genus that lacks rays with central upright cells.

As is clearly shown in Nos. 2–4, large upright cells of central location in a ray are at times filled with brown contents. Although the *Pterospermum* type of tile cell is supposedly empty and the association of brown cell contents with the development of procumbent cells is stressed by Chattaway, the similarity of form and position of such upright cells and those in the same ray which fulfill Chattaway's definition of *Pterospermum* type tile cells in all particulars, clearly indicates that a distinction should not be drawn between the cells with such contents and those lacking them. Moreover, it is well known that the contents of ray cells may be expected to vary from time to time, owing to the fact that conduction and storage are the principal functions of a ray.

From the foregoing it is evident that an extension of the meaning of the term tile cell such as proposed by Chattaway should logically be followed by still further amplification. However, since such a course would result only in decreasing the descriptive value of the term, the question of its proper limitation arises. Returning to Miss Chattaway's data we find a basis for a distinction between her *Durio* type and *Pterospermum* type of tile cells which might well be regarded as less arbitrary than a distinction between the *Pterospermum* type and ordinary upright cells. In her study of the development of the various cell types from the cambium she reports that in her *Durio* type there is little distinction in shape between initials of different cell rows and a change may take place from tile cell row to procumbent cell row and *vice versa*, while in the *Pterospermum* type cambial initials of upright and procumbent cells differ fundamentally in size and shape

and the two types cannot interchange as in *Durio*. Hence not only the established usage of the term tile cell, but also a fundamental morphological distinction between Chattaway's *Durio* and *Pterospermum* types argue against an extension of the meaning of the term which would be accompanied by a decrease in its descriptive value. It is accordingly suggested that the term tile cell should be used in the restricted sense defined in the glossary of the International Association of Wood Anatomists (2) rather than in that recently defined by Chattaway.

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Bishop Museum Transfers Wood Collections to Yale

In furtherance of a world-wide study of woods, the Bernice Pauahi Bishop Museum, Honolulu, T. H., after cutting off for reference a small sample of each of the 2500 wood specimens (other than exhibit material) in its collections, has sent the residue to the Yale School of Forestry. This is the largest single addition ever made to the Yale collections and brings the total number of catalogued samples to 26,576 on February 15, 1934.

The Bishop Museum woods are of exceptionally high scientific interest because nearly all of them were collected with herbarium vouchers in localities of which very little xylological information is available, for example, Fiji, Samoa, and Austral, Cook, Hawaii, Hoorn, Lauai, Line, Marquesas, Maui, Phoenix, Rapa, Raratea, Society, Tubuai, and Wake Islands.

THE WOOD OF *HIBISCUS TILIACEUS* L.

By Irma E. Webber

Hibiscus tiliaceus L. (*Paritium tiliaceum* St. Hil.) is a small tree along the seacoasts and tidal rivers throughout the tropics of the world. Although unimportant in world commerce, both its timber and its bark, which yields cordage, are valued in the regions in which the tree grows. The wood, aside from being widely employed by natives in the construction of canoes and floats for fish nets, is used principally for furniture, cabinet work, flooring, shingles, and railway crossties. As an indication of its local importance it should be pointed out that the wood is described in more or less detail in reports on timbers of tropical America (2, 9, 12, 13, 14), Samoa (3), Formosa (10), Indo-Malaya (7, 15), Indo-China (5, 11), India (8, 17), and Africa (6, 16, 18).

A survey of the existing descriptions of the wood shows lack of agreement on many points often used as key characteristics in the identification of woods. That these discrepancies are attributable not merely to differences in judgment on the part of the various investigators, but rather to the basing of specific descriptions on limited material is indicated by a study of 17 wood samples of *Hibiscus tiliaceus* in the Yale collections. These specimens include sapwood and heartwood from Cuba, Puerto Rico, British Honduras, Panama, Peru, New Caledonia, the Philippines, and Formosa, and constitute the basis for the present description.

General Properties of the Wood

In dry specimens the sapwood is of a cream or ecru color and readily distinguishable from heartwood, which frequently is streaked or variegated and ranges from light to medium reddish brown, or from light to dark yellowish or purplish brown, or from gray or light olive-green. A color range even greater than that observed is indicated by Kanehira's (10) report that the heartwood is bright reddish when fresh, turning dark blue or violet on exposure. The luster is rather dull in some specimens, but ordinarily is moderate to high. Usually the wood is soft, but some pieces are rather hard. Odor and taste are lacking or not distinctive. The texture is generally fine, occasionally medium. The grain is straight. The wood has been reported as from very light (1, 3, 7) to heavy (6, 16), and from moderately durable (6, 16) to durable (14, 18).

Gross Anatomy

Growth rings usually indistinct, rarely distinct. Pores generally barely visible without lens; scattered singly, in radial multiples of 2–6, and in roundish to irregular clusters of 2–9, the ratio of solitary to grouped pores varying greatly in different specimens (Plate II, Nos. 1, 2). Rays light-colored, visible on cross and radial sections, but usually indistinct without lens on the tangential; they are narrower than the pores and sometimes slightly curved about them; distance apart, 1–4, mostly 1 or 2, pore-widths. Ripple marks present; invisible to conspicuous without a lens; regular or occasionally irregular; number per cm. of length, 25–40.

Minute Anatomy[1]

Pores very few to very numerous (1–45 per sq. mm.); roundish to elliptic when solitary, more or less angular when grouped; extremely small to rather large (27–280μ), but mostly moderate-sized (138μ); commonly open, occasionally with yellowish, reddish, or brownish gum. Vessel members cylindrical to irregular in form; very short to short (59–456μ, mostly about 287μ); lateral walls 4–6μ thick, copiously pitted, without spirals. Intervascular pit-pairs with included slit-like to narrowly elliptic apertures and roundish, elliptic, or polygonal borders that generally are about 4–6μ in diameter, but occasionally attain a length of 38μ or more. Perforations simple, the plates oblique or horizontal.

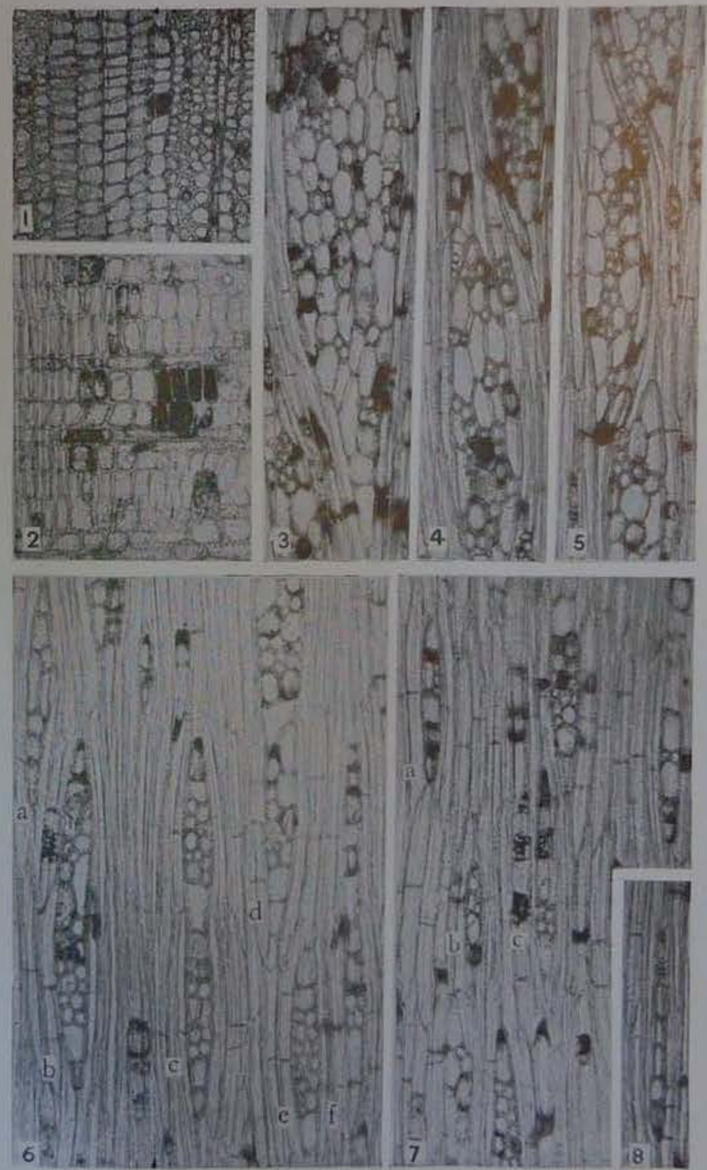
Rays heterogeneous (Plate II, Nos. 3, 5, 6); few to numerous, there being from 0–1 uniseriate rays and 4–9 multiseriate rays per mm. Uniseriate rays not storied; commonly from 11–27μ wide and from 1–8 cells (45–400μ) high, the cells mostly all upright, sometimes procumbent in part. Multiseriate rays

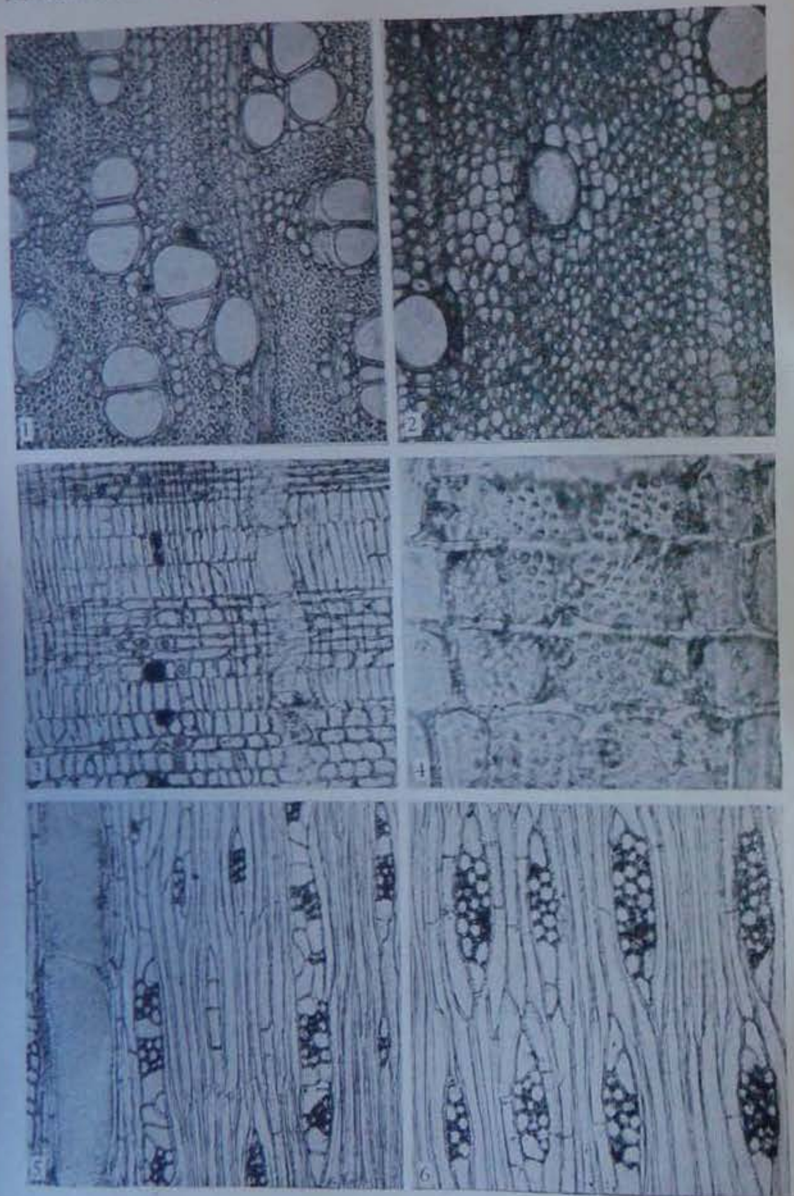
[1] Designations of abundance and size of individual wood elements are those proposed by Chattaway (4).

definitely to not at all storied; with or without wide uniseriate margins, and at times apparently vertically fused; size in normal wood, 2–6 cells (27–135μ) wide and 3–96 cells (80–3010μ) high; abnormally broad in zones of traumatic parenchyma; upright ray cells (which may be exclusively marginal, or diffuse, or occurring as sheath cells) widely variable in size and form from squarish to vertically elongated in radial section (Plate II, Nos. 5, 6). Starch grains, gum (reddish, brownish, yellowish, or greenish), druses, and large solitary crystals may or may not be present in the ray cells. Cell walls 2–5μ thick, copiously pitted, the pits between ray cells being roundish, 2–4μ in diameter; ray-vessel pit-pairs half-bordered, the simple ray pit commonly approximating the form of the border outline of the adjacent vessel pit and equalling or exceeding it in diameter (Plate II, No. 4); unilaterally compound ray-vessel pitting fairly common, a diagonally elongated ray pit subtending 2 or 3 vessel pits.

Libriform wood fibers (the chief element of the wood) spindle-shaped, tapering gradually or sometimes abruptly at first to smooth or occasionally saw-toothed or forked ends; definitely to not at all storied; very short to very long (970–2335μ, mostly about 1530μ); middle diameter 15–38μ, av. about 23μ; walls 5–9μ thick, and rather sparsely pitted.

Wood parenchyma normally moderately abundant; paratracheal and in narrow irregular metatracheal and occasionally terminal bands; gum and crystals sometimes present; walls commonly about 5μ thick, with numerous pits; parenchyma-vessel pit-pairs similar to ray-vessel pit-pairs. Paratracheal parenchyma chiefly vasicentric (Plate II, No. 2), the sheaths varying markedly in width in different specimens; strands commonly of 2–6 cells, the cells being 21–81μ wide and 27–216μ high. Metatracheal strands composed of 2–4 cells, the cells 16–38μ wide and 59–245μ high. Abnormally wide tangential bands of traumatic wood parenchyma containing vertical gum ducts occasionally present, the cells being of about the same size as those normally produced, but generally in longer strands, often up to 8 cells. The traumatic gum ducts are situated between the rays and frequently are bounded tangentially by them; their radial diameter com-





monly exceeds the tangential, and varies from 250–450μ in the specimens examined, but inasmuch as the ducts are at least partially lysigenous in development, considerably greater variation in size is to be expected.

Because of the wide distribution of *Hibiscus tiliaceus* the observed variations in general properties and structure of its wood may be somewhat greater than those occurring in localized species. The occurrence of such variation in any species should, however, emphasize the importance of basing keys for the identification of woods on representative collections rather than on individual specimens.

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EXPLANATION OF PLATES

Plate I. Wood of *Hibiscus mutabilis* L. (Yale No. 5228). × 100.

No. 1. Cross section showing radially elongated procumbent ray cells and upright ray cells with comparatively short radial diameters commonly equalled or exceeded by their tangential diameters.

No. 2. Radial section showing interspersed series of upright and procumbent ray cells.

Nos. 3 to 8. Tangential sections showing various ray forms indicative of similarity between upright cells at center, margins, and sides of multiseriate rays and those composing uniseriate rays.

Plate II. Wood of *Hibiscus tiliaceus* L.

No. 1. Cross section of Yale No. 4531 from Puerto Rico, showing pores mostly in multiples and clusters. × 74.

No. 2. Cross section of Yale No. 9082 from Cuba, showing solitary pores surrounded by relatively wide vasicentric parenchyma. × 74.

No. 3. Radial section of Yale No. 8826 from British Honduras, showing variation in form of upright ray cells. × 74.

No. 4. Radial section of the same, showing half-bordered ray-vessel pit-pairs. × 385.

No. 5. Tangential section of the same, showing variations in rays. × 74.

No. 6. Tangential section of Yale No. 14278 from New Caledonia, showing definitely storied rays. × 74.

REVISION OF THE SPECIES OF THE GENUS *ELIZABETHA* SCHOMB.

By Adolpho Ducke

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The genus *Elizabetha* is composed of trees, mostly of medium size, which grow in the upland forest or along the banks of small rivers with rapids, in a large zone that crosses the center of the hylaea obliquely from the Middle Japurá (Caquetá), Upper Rio Negro, and Upper Essequibo to the Lower Madeira and Middle Tapajoz. Although ten species have already been described, this genus may be considered as one of the least known of the Leguminosae of South America; therefore, as I have sufficient botanical material of most of the species at my disposal, I have prepared a revision of the genus, in coöperation with the Yale University School of Forestry. The plants are well worth the attention of botanists, not only because of their beauty but also on account of certain curious characters of some of them, such as the sweet secretion in the vegetative buds of *E. Duckei* and the extraordinary hardness and density of the wood of *E. durissima*.

The first two species, namely, *E. princeps* and *E. coccinae*, were discovered on the southern frontier of British Guiana by the brothers Schomburgk. These celebrated geographers and botanists described with enthusiasm the beauty of the trees, but it seems that they could not obtain enough material for study. Some 20 years later, Spruce discovered a third species, *E. macrostachya*, of which the existing material is also very scarce. For almost 60 years no collector referred to this genus, already famous for its rarity, till E. Ule, during one of his last voyages, found a fourth species, *E. oxyphylla*, which was distributed in flowering material to the principal botanical institutions. I discovered the remaining six species and collected sterile and flowering material of all and nearly adult fruits of five of them.

The type specimens of the new species described below are preserved in the Jardim Botanico of Rio de Janeiro; cotypes of two of them and duplicates of two other species I described have been sent to Yale University School of Forestry, accompanied by wood samples of mature stems. Cotypes or duplicates of all species I discovered have been (or will be) distributed to the botanical institutions at Berlin, Geneva, Kew, Paris, Stockholm, Utrecht, and Washington. *Elizabetha paraensis*, *E. leiogyne*, *E. Duckei*, and *E. speciosa* are cultivated in the Jardim Botanico of Rio de Janeiro; *E. paraensis* and *E. Duckei* in the garden of Museu Goeldi at Pará. All of them seem to be easily cultivable in any humid tropical country.

Synoptical Key to the Species

Inflorescence in a very long raceme (1 m.). Stamens and staminodia 10, of which 9 are connate at the base. Leaflets 4–6-jugate, oblong-elliptic, shortly acuminate. Flowers red (?) . . . . 1. *E. macrostachya* Benth.

Inflorescence short, not exceeding 1 dm. Stamens and staminodia not more than 9.

Leaflets 3–6-jugate, obovate-oblong, emarginate. Flowers scarlet.
2. *E. coccinea* Schomb. *ex* Benth.

Leaflets 6–8-jugate, narrower than in the preceding species and more or less acuminate or acute. Flowers white. . . . . 3. *E. oxyphylla* Harms.

Leaflets multijugate, oblong-linear. Stipules connate, elongate-cuneate, or nearly linear, measuring some centimeters in length, in some species deciduous before perfect evolution of the respective leaves, in others more or less persistent on the branchlets.

Flowers small (not over 16 mm. long), white, with flesh-colored glabrous pistil; inflorescences very numerous, pubescent in many parts. Leaflets 26–38-jugate, acute; very young branchlets and leaves pale greenish; stipules early deciduous . . . . 10. *E. durissima* Ducke.

Flowers not less than 20 mm. long; inflorescences not very numerous. Leaflets obtuse or emarginate, rarely subacute.

Flowers, as well as the whole inflorescence, glabrous.

Leaflets 40–50-jugate. Flowers whitish, with reddish pistil; bractlets scarcely shorter than the calyx tube. Buds greenish; stipules persistent on young plants . . . . 4. *E. leiogyne* Ducke.

Leaflets 20–30-jugate. Flowers dark red; bractlets much shorter than the very elongate calyx tube. Buds of an intense and magnificent pink color, secreting at margins of their scales droplets of a very sweet, colorless liquid greedily sought by little ants; stipules and bracts early deciduous . . . . 5. *E. Duckei* Huber.

At least the peduncles of the inflorescence and parts of the flowers tomentose.

Leaflets 30–50-jugate. Stipules persistent. Inflorescence globose-spicate, very dense; petals pinkish white, stamens flesh-colored. 9. *E. princeps* Schomb. *ex* Benth.

Leaflets 20–33-jugate. Bractlets nearly as long as the calyx tube.

Inflorescence and flowers glabrous, but peduncle and ovary tomentose. Buds, flowers, and pods red. Stipules and bracts rather persistent . . . . 6. *E. speciosa* Ducke.

At least the bracts, bractlets, and calyx tomentose. Buds greenish.

Inflorescence globose and very dense at first, with large subpersistent greenish bracts, afterwards more elongate-racemose; the very thick peduncles and rachis with extremely short internodes; calyx and petals white; pistil flesh-colored. Stipules rather persistent. Medium-sized to tall tree. 8. *E. paraensis* Ducke.

Inflorescence thinner and much more slender, with longer internodes of the much thinner rachis and smaller bracts and flowers. Stipules of the adult plant caduceous; flowers, bracts, and bractlets red, with whitish calyx tube and petals (in a variety, of a pale flesh color). Small to medium-sized tree. 7. *E. bicolor* Ducke.

1. *Elizabetha macrostachya* Benth.—Temporarily inundated forest of Rio Papory ("Paa-porés," according to R. Spruce), tributary of the Uaupés (Colombian frontier of Brazil), coll. R. Spruce. Not seen.

2. *Elizabetha coccinea* Schomb. ex Benth.—Upper Essequibo (British Guiana) and Upper Tacutú (frontier of Br. Guiana and Brazil), coll. R. Schomburgk. Not seen.

3. *Elizabetha oxyphylla* Harms.—Region of Surumú, tributary of Rio Branco (State of Amazonas, Brazil), coll. E. Ule. I saw a cotype consisting of one floriferous twig.

4. *Elizabetha leiogyne* Ducke, Bull. Muséum Paris (II) 4: 6: 727. 1932.—Not rare along "white water" streamlets in the upland forests of the cataract region of Rio Negro around São Gabriel and Camanáos and at the foot of Serra Curicuriary (State of Amazonas, Brazil). A medium-sized tree with a slender stem and little, irregularly developed, dark brown heartwood. The flowers, which are greenish white with very long erect stamens, are visited by humming birds.—Wood sample n. 157 (Yale n. 22617), S. Gabriel, Herb. Jard. Bot. Rio n. 23731.

5. *Elizabetha Duckei* Huber.—A magnificent tree of special interest because of the sweet secretion of the voluminous pink buds. The flowers, which are deep red with very long erect stamens, are visited by humming birds. This small tree has been found on the stony banks of streamlets around the two cataracts of Cupati, Rio Caquetá (Japurá), in the extreme southeast of Colombia near the Brazilian boundary.

6. **Elizabetha speciosa** Ducke, sp. nov.—Arbor vix ultra 12 m. alta ligno duro albido, interiore irregulari et tenui fusco, ramulis novellis petiolis foliorumque rhachidibus infra breviter brunneo-villosulis. Gemmae laete rubrae; stipulae ad 40 mm. et ultra longae obovato-lineari-cuneatae, membranaceae, glabrae opacae brunneae, praesertim in ramulis sterilibus diu persistentes. Foliola 20–33-juga, media 20–30 mm. longa et 4–6 mm. lata (in ramulis sterilibus nonnunquam maiora), basalia et praesertim apicalia gradatim minora, sessilia, oblongo-linearia vix minime subfalcata, obliqua, basi truncata, apice obtusa et saepe brevissime mucronulata, subcoriacea, vix nitidula, adulta utrinque viridia, praeter costam parum excentricam bene conspicuam supra avenia subtus sat obsolete lineato-nervia; folia novissima pendula

pulchre rubra. Racemi terminales et laterales, parum numerosi, compacti, breves, breviter pedunculati, pedunculo villosulo excepto glabri; bracteae sat persistentes fuscopurpureae nitidae late squamatae; pedicelli brevissimi; bracteolae rubrae coriaceae nitidae ultra medium connatae 10–12 mm. longae. Flores inodori sanguinei; calicis glabri tubus pallidior circa 12 mm. longus subcylindricus basi attenuatus, versus apicem 6–8 mm. latum sensim ampliatus, laciniae 4 petaloideae anthesi plus minus patulae post petala caducae, parum inaequales oblongae obtusae, maxima circa 12 mm. longa; petala 5 tenuia glabra obovato-oblonga obtusa parum inaequalia intimo breviore, anthesi erecta calicem vix excedentia caducissima; stamina et staminodia basi brevissime connata glabra, fertilia 3 filamentis (interdum pilis raris ciliatis) anthesi erectis petala duplo excedentibus antheris magnis, sterilia (staminodia) 6 filiformia parva numero nonnunquam incompleto; ovarium brevissime brunneo-sericeum stipite glabro, hujus parte inferiore calicis tubo adnata longa, parte superiore libera brevi; stylus filiformis stamina fertilia subsaquans glaber. Legumen ante maturitatem pulchre rubrum siccitate brunnescens, glabratum, ut specierum *leiogyne*, *paraensis*, *bicolor*, et *Duckei* magnum obliquum sutura superiore incrassata.

Habitat prope urbem Manáos silva non inundabili secus rivulos, leg. A. Ducke cum ligno n. 169 (Yale n. 23631) 2-10-1932 florifera, Herb. Jard. Bot. Rio n. 23730.

This beautiful new species grows in small formations among the lower and medium-sized trees of the virgin upland forest along small creeks of blackish water, near Manáos. I know two of these formations, one of them situated at the head of the Igarapé do Crespo, the other one on the margin of swampy ground, at the source of a little tributary of the Igarapé Mindú. The red flowers are probably ornithophilous; the wood resembles that of *E. leiogyne*.

7. **Elizabetha bicolor** Ducke, sp. nov.—Arbor parva ligno albido, ramulis novellis petiolis foliorumque rhachidibus infra breviter brunneo-villosulis. Gemmas non vidi, certe virides (folia novissima albido-viridia). Stipulae ut in affinibus, vulgo 30 mm. longae, cito caducae. Foliola 22–33-juga, estipellata, maiora (in ramis fertilibus) vulgo 9–14 mm. longa et 2–4 mm. lata, basi extrema subito at apicem versus gradatim magnitudine decrescentia, sessilia, oblongo-linearia, minime subfalcata, parum obliqua, basi truncata apice acutiuscula vel rarius subobtusa et saepissime distincte mucronulata, coriacea, parum nitidula, adulta utrinque viridia, costa vix excentrica utrinque bene conspicua, nervis lateralibus supra subtilibus subtus distincte elevatis subreticulato-lineatis. Racemi terminales et laterales, modice numerosi, compacti, breves (7 cm. non excedentes), brevissime pedunculati pedunculo et rhachide validis, dense rufo-ferrugineo-villosulis; bracteae saepe persistentes late ovatae roseo-purpureae demum fuscescentes, coriaceae, brunneo-tomentosae, opacae; pedicelli usque ad 5 mm. longi, validi; bracteolae coccineae coriaceae opacae tenuiter brunneo-tomentosae ultra medium connatae, 11–13 mm. longae. Flores inodori; calicis extus tenuiter tomentosi tubus roseus vel albidus, 10–15 mm. longus subcylindricus basi attenuatus versus apicem 6–8 mm. latum ampliatus, laciniae 4 petaloideae coccineae anthesi patulo-erectae post petala caducae, parum inaequales oblongae obtusae, maxima 12–15 mm. longa; petala 5 alba vel roseo-alba tenuia glabra obovato-oblonga obtusa parum inaequalia intimo breviore, anthesi erecta calycem vix excedentia caducissima; stamina et staminodia albida, ut in *E. speciosa* at filamentis basi dense pilosis; ovarium longius stipitatum, in specimine typico glabrum, caeterum ut in specie citata. Legumen ante maturitatem viride, magnitudine et forma ut in speciebus vicinis, breviter stipitatum, glabrum.

Habitat arbor typica in silva riparia non inundabili circa cataractam Cachoeira do Americano dictam fluminis Itapacurá fluvii Tapajoz affluentis (civitate Pará), 25-1-1933 leg. A. Ducke, Herb. J. B. Rio n. 23726; arbor altera ipso loco et die lecta typo omnino similis at ovario ferrugineo-sericeo, H. J. B. Rio n. 23727 (forsam abnormis, inflorescentiis a formicis abundanter habitatis).

Ad varietatem vel formam ovario tomentoso spectant arbores fructibus semiadultis floribus vetustis (alabastrissiccis in inflorescentia a formicis habitata sat bene conservatis) leg.

A. Ducke in declivibus collium Mangabal prope medium flumen Tapajoz, Herb. Amaz. Mus. Pará n. 16751 et Herb. Jard. Bot. Rio n. 10984 et 10985. Huic speciei pertinere videtur etiam arbor parva floribus (non bene conservatis) dilute carneis petalis albis ovario tomentoso, e silvis humidis prope Borba (Rio Madeira inferior), Herb. Jard. Bot. Rio n. 23287.

Specimina Herb. Amaz. Mus. Pará n. 16751 et Herb. Jard. Bot. Rio de Janeiro n. 10984, 10985, et 23287 errore olim cum specie *E. paraensis* confusa et sub hoc nomine distributa.

On account of an insufficiency of material, I at first confused this species with *E. paraensis*, from the same region. *E. bicolor*, however, is easily distinguished from the latter by, among other things, its smaller size, its deciduous stipules, the form of its inflorescence, and the color of its flowers. The color of the flowers appears to be decidedly variable if (as it seems to me) the Borba plant (n. 23287) really belongs to the present species. I have not been able to find any specific difference between plant n. 23726, with glabrous ovary, and the others with tomentose ovary; since the flowers from that plant are in better condition than those of the others (the inflorescences of which were infested with ants), I have considered it the type of the species.

8. **Elizabetha paraensis** Ducke, charact. emend., Archivos Jard. Bot. Rio de Janeiro III (1922), p. 102, pro parte. Arbor usque ad 20 rarius ad 30 m. alta ligno unicolore albido duro, ramulis novellis petiolis et latere inferiore rhachidum foliorum cano-ferrugineo-subvillosis. Gemmae brunneae demum virides; stipulae usque ad 60 mm. longae linerari-cuneatae membranaceae brunneae praesertim in individuis junioribus saepe diu persistentes, in ramulis fertilibus cito caducae. Foliola 22–33-juga, stipellis parvis munita, oblongo-linearia, inferiora in ramulis fertilibus vulgo 15–20 mm. longa et 2–3 mm. lata, in sterilibus saepe duplo maiora, foliola superiora valde decrescentia, omnia basi oblique sessilia apice obtusa vel retusa, glabra rarius basi et marginibus pilosula. Inflorescentiae paucae in ramulis terminales rarius laterales, primum subsessiles subglobosae densissimae, demum accrescentes

rhachi crassa basi nuda internodiis brevissimis transverse rimoso-annulata pedunculatae, ferrugineo-tomentellae, bracteis coriaceis sat persistentibus late squamatis diametro 10–25 mm., floribus anthesi breviter demum longius pedicellatis, bracteolis ad 15 mm. longis ad 2/3 connatis, bracteis et bracteolis tomentellis, in vivo viridibus. Flores albi petalorum basi extrema rubra, pistillo carneo; calicis extus tomentelli tubus anthesi 20–25 mm. longus ad 2/3 cylindricus tertio apicali turbinato-incrassatus, laciniae (4) anthesi 15–20 mm. longae oblongae erectae; petala (5) tenuia, 4 calycis laciniis aequilonga, quintum late subcordatum, caducissima; stamina fertilia 3 elongata filamentis parce ciliatis, staminodia 6 parva, omnia basi breviter connata; ovarium longe stipitatum dense fulvido-tomentosum stipite et stylo elongato glabris. Legumen forma ut in speciebus reliquis ubi notum, longius stipitatum, viride siccitate brunneum, glabrum; semina plurima planiuscula orbicularia diametro vulgo 20 mm. vel elliptica, exalbuminosa, testa tenui fusca rugosa et marginem versus radiatim sulcata.

Habitat civitate Pará in regione collina fluminis Tapajoz silva non inundabili locis humidis: prope cataractas Mangabal (Herb. Amaz. Mus. Pará 16449, sterile, speciei typus); ad Igarapé das Pedras prope cataractam Furnas (semina e quibus arbores in hortis botanicis Pará et Rio de Janeiro cultae); ad locos Francez et Montanha visa; prope fluminis Tapajoz affluentem Itapacurá loco Cachoeira do Americano, cum ligno n. 194 (Yale n. 23656), Herb. Jard. Bot. Rio. n. 23723, florifera et leguminibus novellis, et H. J. B. R. n. 23724 (sterilis); prope Bôa Vista fluminis Tapajoz inferioris (Cia. Ford Industrial do Brasil n. 374 [Yale n. 22052], florif.). Civitate Amazonas prope Parintins, inter lacum José-Assú et lacum Juruty Velho (H. J. B. R. n. 23725, sterilis).

Speciei *E. princeps* (non visae) evidenter affinis, a cujus descriptione differt foliis multum minoribus et floribus evidenter pedicellatis.

I at first confused the present species with *E. bicolor*, having found both in the same region, but only the latter with some old flowers. When the two species are both in bloom, they do not look very much alike.

9. *Elizabetha princeps* Schomb. ex Benth.—Environs of Roraima and meridional declivity of Humirida mountains, up to 4000 feet, and Upper Parima (Brazilian frontiers on British Guiana and Venezuela), coll. R. Schomburgk. Not seen.

10. **Elizabetha durissima** Ducke, sp. nov.—Arbor circa 25 m. alta ligno durissimo, interiore fusco valde denso, ramulis obscure brunneis pallido-lenticellosis, novellis ut foliorum petioli et rhachides subtus cano-tomentosis. Gemmas non vidi; folia novissima nondum bene evoluta cum ramulo pendula pallide virescentia; stipulae cito caducae, ut in speciebus aliis mihi notis cuneiformes at vix 25 mm. longitudine excedentes, membranaceae. Foliola vulgo 26–38-juga, in ramulis fertilibus usque ad 12–18 mm. longa et 2–3 mm. lata, folii basi extrema subito at folii apicem versus gradatim decrescentia, sessilia, subfalcato-linearia, basi oblique truncata, apice oblique angustata acutissima, tenuiter coriacea, glabra marginibus breviter ciliatulis, utrinque viridia et parum nitidula, praeter costam parum excentricam sat conspicue nervosa. Racemi e ramulis hornotinis plus minus defoliatis laterales et terminales numerosi subsecundi in ramulo aphyllo saepe inflorescentiam amplam et densam formantes, breves, brevissime pedunculati, rhachide tomentosa; bracteae caducissimae latae brunneae cano-puberulae; pedicelli breves vel ad 5 mm. longi albido-villosuli; bracteolae in vivis albidae, 5–8 mm. longae, membranaceae, extus parce sericeae, uno latere alte connatae, altero latere anthesi plus minus profunde solutae, post anthesin persistentes subspathaeformes. Flores suaveolentes, entomophili, pistillo excepto albi; calicis tubus 4–6 mm. longus subcampanulatus crasse coriaceus extus cano-pubescens, laciniae 4 petaloideae parum inaequales 8–10 mm. longae oblongae obtusae glabrae, cum petalis caducae; petala 5 tenuia calici aequilonga at angustiora, sublineari-oblonga acutiuscula, subaequalia interioribus minoribus acuminatis; stamina fertilia 3 circa 25 mm. longa et staminodia 6 parva subulato-filiformia basi breviter connata, glabra, fertilium filamenta longiuscule albo-ciliata; pistillum carneum glaberrimum, ovarii stipite longo (parte libera post anthesin elongata), stylo longo filiformi. Legumen ignotum.

Habitat in silva non inundabili ultra lacum José-Assú prope Parintins in civitatis Amazonas limine austro-orientali, 16–9–1932 leg. A. Ducke cum ligno n. 155 (Yale n. 22615), Herb. Jard. Bot. Rio n. 23729.

This species is remarkable in this genus on account of its well-developed, hard, heavy heartwood; also because of its very numerous racemes of relatively small flowers which are entomophilous, whereas all the other species I know seem to be ornithophilous. The densely floriferous branchlets have sometimes a *Macrolobium*-like aspect, but the plant is, by all its botanical characters, a real *Elizabetha*.

ADDITIONS TO THE TREES OF HONDURAS

By Paul C. Standley

Field Museum of Natural History

In *Tropical Woods* 21: 9–41, March 1, 1930, there appeared *A Second List of the Trees of Honduras*, including approximately 480 species. On the following pages there are enumerated 55 additional species, collected by Mr. J. B. Edwards during 1932 and 1933 in the mountains of central Honduras, chiefly in the departments of Comayagua and Tegucigalpa, for the Arnold Arboretum of Harvard University. The plants were submitted to the writer for determination through the courtesy of Professor Oakes Ames and Dr. Alfred Rehder.

Most of the material was obtained in the Pine forest region of the two departments named, but a considerable portion of it was gathered on the shore of Lake Yojoa, at Pito Solo, a settlement on the automobile road that extends from the end of the railroad, on the Atlantic slope, across Honduras to the capital, Tegucigalpa. Pito Solo lies in the wet tropical lowlands, and its vegetation is similar to that of the nearby Tela region, upon which in 1931 the writer published a report entitled *Flora of the Lancetilla Valley, Honduras* (Field Museum of Natural History, Botanical Series, Volume 10).

Mr. Edwards' collection is particularly valuable because of adequate notes accompanying the specimens, for most of which vernacular names are supplied. In the list here presented additions to previous tree lists are indicated by boldfaced type; names printed in italic have appeared in former lists, but Mr. Edwards has indicated for them vernacular names not recorded previously. Most of the new species are shrubs, rather than trees, and are described here primarily as a matter of convenience. Most important of the additions are the genera *Decazyx* and *Olmediella*, both known heretofore only from Guatemala, the former from a single locality.

Of even greater botanical interest, however, is the fact that Mr. Edwards has forwarded from Lake Yojoa excellent material of the American lotus, *Nelumbo pentapetala* (Walt.) Fernald. The writer was informed by Wilson Popenoe of the occurrence of this plant in Lake Yojoa, but he himself was unable to discover it on the two occasions when he crossed the lake, in 1928. Of notoriously erratic distribution in the United States—a distribution presumably to be explained by artificial introduction by the Indians, who used the plant as food—the lotus has been known previously from the vicinity of Tampico, Mexico, and it has been reported also from the delta of the Magdalena River in Colombia. It seems not improbable that the plant may have been introduced to Lake Yojoa long ago by Indian traders, who are known to have been great travelers in precolumbian times.

Amyris attenuata, sp. nov.—Arbor 11-metralis omnino glabra, ramulis gracilibus subflexuosis, internodiis elongatis; folia alterna unifoliolata, petiolo 6–8 mm. longo; lamina lanceolato-oblonga vel anguste elliptico-oblonga 6.5–10 cm. longa 2–3.5 cm. lata sensim anguste longiacuminata, acumine saepe falcato subobtuso, basi plus minusve oblique obtusa, integra, costa utrinque elevata; inflorescentiae terminales et axillares racemiformes vel racemoso-paniculatae foliis duplo breviores vel brevissimae pauciflorae, pedicellis gracilibus 1–3 mm. longis; calyx minutus brevissime lobatus, lobis rotundato-triangularibus; petala late oblonga vel obovata 2 mm. longa apice rotundata dense punctata alba; ovarium ovoideum glabrum, stylo brevissimo, stigmate capitato; stamina petalis aequilonga, filamentis gracilibus glabris.—HONDURAS: Open mountain forest, Concepción, Dept. Yoro, alt. 750 meters, Aug. 13, 1933, J. B. Edwards P-653 (Herb. Field Mus. No. 686992, type; duplicate in Herb. Arnold Arb.).

In its unifoliolate leaves suggestive of *Amyris monophylla* Brandeg. of Mexico, and *A. simplicifolia* Karst, of northern South America, both of which differ in having the leaflets rounded to merely obtusely short-acuminate at the apex.

Ardisia dichropetala, sp. nov.—Arbuscula 4.5 m. alta omnino glabra; folia majuscula subcoriacea, petiolo crassiusculo 10–14 mm. longo; lamina oblongo-obovata 12–16.5 cm. longa 4.5–7 cm. lata apice breviter obtuse acutata, basi acuta et breviter decurrens, integra, sublucida, supra sparse nigro-punctata; inflorescentia terminalis magna multiflora bipinnatim paniculata folia superans, ramis usque ad 14 cm. longis, pedicellis gracilibus 15–18 mm. longis, floribus racemosis, bracteis caducis; flores in alabastro late ovoidei 7 mm. longi obtusi; sepala rotundato-ovata 3 mm. longa apice rotundata prope apicem punctis paucis atro-rubris conspersa; petala coriacea breviter connata lobis ellipticis apice late rotundatis albis intus prope basin intense aurantiacis recurvis epunctatis vel punctis perpaucis conspersis; stamina petalis paullo breviora, filamentis 3 mm. longis et ultra, antheris 3.5 mm. longis ovoideis acutis epunctatis; ovarium ovoideum glabrum, stylo antheris bene longiore.—HONDURAS: Dense tropical forest, La Libertad, Dept. Comayagua, alt. 750 meters, June 25, 1933, J. B. Edwards P-621 (Herb. Field Mus. No. 686989, type; duplicate in Herb. Arnold Arb.).

Closely related to the Guatemalan *Ardisia paschalis* Donn. Smith, in which the flowers are densely punctate, and the filaments much shorter than the anthers.

Lisianthus auratus, sp. nov.—Herbacea vel suffruticosa scandens omnino glabra, ramis gracillimis teretibus viridibus, internodiis elongatis; folia parva membranacea, petiolo gracili 3–6 mm. longo; lamina oblongo-lanceolata vel anguste oblongo-elliptica 4.5–6 cm. longa 1.3–2 cm. lata abrupte sensimve longiacuminata, acumine angusto longiattenuato, basi acuta, subtus pallidior costa gracili elevata nervis lateralibus utroque latere 2 obscuris; pedunculi axillares 15–18 mm. longi triflori, pedicellis gracilibus 12–16 mm. longis; calyx viridis adpressus 8–9 mm. longus fere ad basin lobatus, laciniis lanceolato-linearibus longissime attenuatis; corolla aurea 3.5 cm. longa, tubo paullo supra basin 3 mm. lato, supra calycem abrupte contracto, superne sensim dilatato fauce 6 mm. lato, lobis oblongo-ovatis 1 cm. longis cuspidato-acutis extus viridi-tinctis; stamina corollae lobis paullo longiora, filamentis gracillimis; stylus corolla longior, stigmate parvo capitato; capsula elliptico-oblonga 12 mm. longa.—HONDURAS: Open mountain forest, Siguatepeque, Dept. Comayagua, alt. 1110 meters, Jan. 10, 1933, J. B. Edwards P-556 (Herb. Field Mus. No. 686990, type; duplicate in Herb. Arnold Arb.).

Clearly a relative of *Lisianthus axillaris* (Hemsl.) Kuntze, in which the flowers are solitary in the leaf axils, and the corollas, at least in the dried state, are conspicuously tinged with red.

Lippia lucens, sp. nov.—Frutex 2.5 m. altus ramosus, ramulis gracilibus subteretibus brunneis scabro-hirtellis et punctis elevatis dense conspersis, internodiis foliis duplo brevioribus; folia mediocria coriacea breviter petiolata, petiolo crasso 3–7 mm. longo; lamina elliptico-oblonga vel lanceolato-oblonga 7–9 cm. longa 2–3 cm. lata versus apicem acutum vel subobtusum angustata, basi cuneato-attenuata et decurrens, bullato-rugosa, crenata, lucida, supra asperrima hirtello-scabra venis profunde impressis, subtus paullo pallidior aspera praesertim ad venas hirtello-scabra ubique viscido-puberula, nervis venisque valde elevatis, margine plus minusve revoluto; flores lutei brevissime spicati, spicis capituliformibus 10–12 mm. longis et fere aequilatis in axillis foliorum geminatis, pedunculis gracilibus 2–2.5 cm. longis hirtello-scabris et glanduloso-puberulis, bracteis late ovatis vel rotundato-ovatis, infimis usque ad 8 mm. longis, superioribus gradatim brevioribus, acuminatis, extus sparse scabris vel fere glabris, scabro-ciliatis, post anthesin vix accrescentibus; calyx 2 mm. longus dense hirtellus, dentibus brevissimis triangularibus acutis; fructus late obovoideus 1.8 mm. longus bisulcatus laevis lucidus.—HONDURAS: Open mountain forest, Siguatepeque, Dept. Comayagua, alt. 1110 meters, Nov. 10, 1932, J. B. Edwards P-514 (Herb. Field Mus. No. 686991, type; duplicate in Herb. Arnold Arb.).

Of the alliance of *Lippia umbellata* Cav., a group badly in need of critical revision; apparently a form worthy of specific rank, and at least unlike any other Mexican or Central American material that has come to the writer's attention.

Solanum Edwardsii, sp. nov.—Frutex 3-metralis, ramis teretibus densissime stellato-tomentosis, pilis sessilibus vel brevissime stipitatis ochraceis multiradiatis, internodiis foliis multo brevioribus; folia mediocria breviter petiolata solitaria vel interdum altero valde reducto opposita, petiolo 3–6 mm. longo; lamina herbacea oblongo-ovata 5.5–9 cm. longa 1.5–4 cm. lata subabrupte interdum longissime acuminata, basi rotundata vel obtusa vulgo valde inaequalis, supra viridis mollis arcte minute stellato-pilosula ad nervos stellato-pilosa, subtus fere concolor ubique dense stellato-pilosa; flores umbellati albi, umbellis supra-axillaribus e medio internodii ortis sessilibus 2–4-floris, pedicellis gracilibus rectis 12–20 mm. longis; calyx fere ad basin lobatus densissime stellato-pilosus, lobis oblongis vel late oblongis 5–6 mm. longis post anthesin paullo accrescentibus obtusis vel acutiusculis erectis vel subpatentibus; corolla (perfecta non visa) profunde lobata extus sparse stellato-pilosa, lobis anguste triangulari-oblongis patentibus; antherae breves 1.2 mm. longae, poris magnis anterioribus terminalibus; bacca globosa glabra 7–8 mm. longa apice rotundata.—HONDURAS: Dense tropical forest, Temagua, Dept. Comayagua, alt. 600 meters, Aug. 6, 1933, J. B. Edwards P-639 (Herb. Field Mus. No. 686993, type; duplicate in Herb. Arnold Arb.).

In general appearance as well as in most characters this is very similar to *Solanum extensum* Bitter, of Panama, to which it is evidently closely related. The Panama plant differs conspicuously in its much more copious pubescence, consisting in part of long slender simple multicellular hairs.

Rondeletia Edwardsii, sp. nov.—Frutex 3-metralis fere omnino glaber, ramis gracilibus teretibus; stipulae rigidae triangulares acutae erectae c. 1 mm. longae; folia mediocria petiolata crasse membranacea, petiolo 4–6 mm. longo; lamina oblongo-ovata vel ovata 6–9 cm. longa 2.5–3.5 cm. lata longe attenuato-acuminata, basi obtusa vel subrotundata, costa subtus elevata, nervis lateralibus utroque latere c. 8

arcuatis; panicula corymbiformis terminalis laxe multiflora c. 5 cm. longa et 8 cm. lata 2.5 cm. longe pedunculata, bracteis lineari-subulatis usque ad 1 cm. longis, pedicellis crassis glabris 1–3 mm. longis; hypanthium subglobosum glabrum, calyce 5-denticulato, denticulis crassis late triangularibus acutiusculis vix 0.3 mm. longis; corolla alba extus glabra, tubo gracili leviter curvo 13–15 mm. longo supra vix dilatato, fauce dense aureo-barbato, lobis 5 patentibus obovatis 3–4 mm. longis.—HONDURAS: Pito Solo, Lake Yojoa, Dept. Comayagua, alt. 600 m., in dense forest, Aug. 29, 1932, J. B. Edwards P476 (Herb. Field Mus. No. 662645, type).

A relative of the Mexican *R. ligustroides* Hemsl., in which the corollas are approximately only half as large.

Rondeletia nebulosa, sp. nov.—Frutex 2.5–3 m. altus, ramulis albido-tomentosis atque dense breviter hirsutis; stipulae angustissime triangulares 7 mm. longae longe attenuatae suberectae; folia mediocria crasse membranacea anguste elliptico-oblonga 7–13 cm. longa et ultra 2.5–5 cm. lata acuminata basi obtusa vel subacuta, supra fere glabra rugosa nervis valde impressis, subtus tomento denso adpresso albo obtecta atque ubique dense hirsuta, nervis venisque valde elevatis; panicula terminalis spiciformis 13–14 cm. longa 3.5 cm. lata, floribus in cymulas capituliformes densas multifloras aggregatis, sessilibus vel brevissime pedicellatis, bracteis parvis inconspicuis; hypanthium subglobosum dense arachnoideo-tomentosum, calyce 4-lobato, lobis 4 anguste triangularibus 1–2 mm. longis acutis erectis vel subrecurvis; corolla purpurea extus dense arachnoideo-tomentosa et hispidula, tubo gracili 15–18 mm. longo fauce paullo dilatato, lobis 4 oblongis vel ovalibus patentibus 3 mm. longis intus fere glabris.—HONDURAS: La Aurora Trail, Rosario, San Juancito, Dept. Tegucigalpa, alt. 1620 m., in cloud forest, Apr. 2, 1932, J. B. Edwards P10 (Herb. Field Mus. No. 662646, type).

A member of the group *Laniflorae*.

ACTINIDIACEAE

Saurauia villosa DC. PACÓN.

ANONACEAE

Desmopsis Schippii Standl. Pito Solo, dense forest, *Edwards* 443. A tree 18

meters high, with yellow flowers. The species was described recently from British Honduras.

APOCYNACEAE

Tonduzia parvifolia Pittier. Pito Solo, dense forest, *Edwards* 448. A tree 18 meters high with small white flowers.

AQUIFOLIACEAE

Ilex tolucana Hemsl. (?). Siguatepeque, open mountain forest, *Edwards* 489. A tree 15 meters high. The material is sterile, and the determination therefore doubtful, but the species represented is different from any of those known heretofore from Central America.

ARALIACEAE

Gilibertia Smithiana I. M. Johnston. MANO DE LEÓN. A tree 19 meters high.

BIGNONIACEAE

Crescentia alata H. B. K. JÍCARO, MORRO.

BURSERACEAE

Bursera graveolens (H. B. K.) Triana, var. **pubescens** Engler. Las Limas. A tree 9 meters high.

Bursera Simaruba (L.) Sarg. JINICUITE.

CAPRIFOLIACEAE

Viburnum discolor Benth. Meambar, Dept. Comayagua. A tree 9 meters high, with white flowers. The genus has not been recorded previously from Honduras.

Viburnum glabratum H. B. K. TOTASCÁN. Siguatepeque and Minas de Oro. A large shrub or a tree, 5–12 meters high, with small white flowers.

COCHLOSPERMACEAE

Cochlospermum vitifolium (Willd.) Spreng. BOMBÓN.

COMPOSITAE

Vernonia Deppeana Less. MULULE.

Vernonia leiocarpa DC. ACERILLO. Minas de Oro. A tree 7.5 meters in height.

EUPHORBIACEAE

Acalypha villosa Jacq. Río Lindo, Dept. Cortés. A tree 6 meters high, but more often only a shrub.

FAGACEAE

Quercus conspersa Benth. ENCINO. Coyocutena. A tree of 15 meters.

Quercus oleoides Cham. & Schlecht. ENCINO. A tree as much as 21 meters tall.

FLACOURTIACEAE

Olmediella Betschleriana (Goepp.) Loes. Siguatepeque, open mountain forest, altitude 1100 meters, *Edwards* 492. A tree 15 meters high. In a recent number of *Tropical Woods* (32: 17. 1932) the writer noted the discovery of this tree in Guatemala, where it is believed to be native. This new collection from Honduras leaves no question as to its being native in Central America, and indicates that it may have a rather wide distribution. The Honduran specimens are sterile, but there is no doubt that they are referable to this genus and species.

Zuelania Guidonia (Sw.) Britt. & Millsp. *Z. Roussoviae* Pittier. RESINA. Careful examination of West Indian and Central American material of this tree reveals no character by which *Z. Roussoviae*, ranging from southern Mexico to Panama, may be separated from the West Indian type.

HYPERICACEAE

Vismia ferruginea H. B. K. Pito Solo. A tree 13 meters high.

LEGUMINOSAE

Acacia acatlensis Benth. QUEBRACHO. Las Limas, alt. 900 meters. A tree 15 meters high, with spikes of yellow flowers.

Acacia Hindsii Benth. CORNEZUELO, CARNIZUELO. The latter name is a frequent Central American corruption of the former.

Acacia Milleriana Standl. ESPINO. Las Limas. A tree 10–12 meters high, with small heads of yellow flowers. More often, probably, this species is merely a shrub.

Caesalpinia Conzattii (Rose) Standl., comb. nov. *Poinciana Conzattii* Rose, Contr. U. S. Nat. Herb. 13: 303. 1911. Comayagua. A tree of 12 meters, the flowers orange and lemon-yellow.

Calliandra centralis (Britt. & Rose) Standl. Jacaieto, Dept. Comayagua. Flowers red and white; reported as a tree 7.5 meters high, but more often only a shrub.

Cassia emarginata L. Comayagua. Reported as a tree 15 meters high, a size that must be greatly exaggerated, since this species is usually much smaller.

Dalbergia cubilquitzensis (Donn. Smith) Pittier. CHAMPERNO. Las Limas, at 900 meters. A tree 20 meters high. The vernacular name reported for the Honduras Rosewood is probably only an incorrect recording of the word "chaperno," a term usually applied to species of *Lonchocarpus*.

Dialium guianense (Aubl.) Steud. *D. divaricatum* Vahl. CANILLO.

Inga edulis Mart. GUAJINIQUIL (at Las Limas). A tree 12–15 meters tall.

Inga leptoloba Schlecht. Pito Solo, in dense forest; a tree of 12 meters.

Lonchocarpus hondurensis Benth. CHAPERNO. A tree 12 meters high.

Lonchocarpus rugosus Benth. MASICARÁN. Las Limas and Pito Solo. A tree 12–24 meters high, with maroon flowers. The vernacular name may be an erroneous one, for the term is applied commonly to certain Moraceae.

Machaerium biovulatum Micheli. Santa Cruz de Yojoa, Dept. Cortés. Reported as a tree 15 meters tall, with light blue flowers. I am inclined to doubt that the species attains so great a size.

Mimosa tenuiflora (Willd.) Poir. CARBÓN. Las Limas. A tree 7–15 meters high, with small spikes of white flowers. The wood is burned for charcoal.

MELASTOMACEAE

Conostegia subhirsuta DC. Río Lindo, Dept. Cortés. A shrub, or sometimes a tree of 4.5 meters, with white flowers.

Conostegia xalapensis (Bonpl.) Don. SARCIL.

Miconia borealis Gleason. Pito Solo. A tree 10 meters in height.

Miconia calvescens DC. (?) SIRÍN. Pito Solo. A tree of 12 meters. The material is sterile, but probably referable to this widely distributed species.

Miconia dodecandra Cogn. Siguatepeque. A shrub or tree 4.5 meters high, with pink flowers.

Miconia guatemalensis Cogn. SARCIL. San Juancito, at 1500 meters. A tree 6 meters high, with small pink flowers. The species has been known from Honduras, but only as a shrub.

MELIACEAE

Trichilia hirta L. CEDRILLO. Las Limas. A tree 19 meters tall, with small white flowers.

MONIMIACEAE

Siparuna nicaraguensis Hemsl. Minas de Oro, alt. 1260 meters. Reported as a tree 7.5 meters high, but more frequently only a straggling shrub.

MORACEAE

Ficus inamoena Standl. HIGUERO.

MYRSINACEAE

Ardisia revoluta H. B. K. UVA. Las Limas, in river valley forest. A tree of 9 meters.

Rapanea guianensis Aubl. (?) UVA. Rancho Grande, San Luis, in mountain forest. A tree 10 meters high. The specific determination is rather uncertain.

MYRTACEAE

Eugenia axillaris (Sw.) DC. GUAYABILLO.

Eugenia fragrans (Swartz) Willd. Río de las Jollas, Dept. Comayagua. A tree of 7.5 meters, with white flowers.

Eugenia vincentina Krug & Urban. UVA. Minas de Oro. A tree 7 meters high with small white flowers and edible fruit.

NYCTAGINACEAE

Pisonia aculeata L. UÑA DE GATO.

PIPERACEAE

Piper calvescens Trel. CORDONCILLO. Las Limas. Reported as a tree of 10 meters, a most unusual size for members of this genus.

QUIINACEAE

Quiina Schippii Standl. Pito Solo, dense forest, *Edwards* 461. A tree of 18 meters. The specimens are sterile, but probably referable to this British Honduras species. The family was unknown in Central America until only a few years ago. Another species is known from Panama.

RHAMNACEAE

Krugiodendron ferreum (Vahl) Urban. Pito Solo, dense forest, alt. 600 meters, *Edwards* 393. A tree of 10 meters. On the continent this West Indian tree has been known only from Yucatan and British Honduras. The Honduras specimens at first glance appear quite unlike those from Yucatan, especially in their rather large and thin leaves, but I have been unable to discover any essential differences between them.

RUBIACEAE

Anisomeris protracta (Bartl.) Standl. Minas de Oro and Coyocutena. A tree 10–14 meters high, with small white flowers. Reported previously from Honduras, but only as a shrub.

Calycophyllum candidissimum (Vahl) DC. Colorado.

Cephalanthus occidentalis L. Pito Solo, "aquatic," alt. 600 meters, *Edwards* 463. A shrub 5 meters high, with globose heads of small white flowers. The common buttonbush of the United States has long been known to grow in Mexico, but it has not been discovered heretofore in Central America. Another species of the genus grows in the interior of Honduras.

Randia aculeata L. El Portillo, Dept. Comayagua. Usually a shrub, but the collector reports the plant as a tree of 7.5 meters.

Randia malacocarpa Standl. Crucita, Las cruces. Las Limas, river valley forest, alt. 900 meters, *Edwards* 379, 160. A tree 6–9 meters high with small white flowers. Previously this species has been known only from northwestern Mexico, and an extension of its range to central Honduras seems rather improbable, yet I find no character for separating the Central American material.

RUTACEAE

Decazyx macrophyllus Pittier & Blake. Pito Solo, dense forest, *Edwards* 449. A tree 13 meters in height. Described from nearby Guatemala, this tree, the only member of its genus, has been known heretofore only from the type specimen. The Honduras material is sterile, but clearly referable here.

Zanthoxylum microcarpum Griseb. Chinchillo. Las Limas and Pito Solo. A tree 12 meters high, with small white flowers.

SAPINDACEAE

Allophylus Cominia (L.) Sw. Las Limas. A tree of 15 meters. The specimens are sterile, but apparently referable to this species, known on the continent only from Yucatan and British Honduras.

Cupania glabra Sw. Pava.

SAPOTACEAE

Bumelia conglobata Standl. Comayagua. A tree 14 meters high. The species has been known previously only from the original collection, obtained in Guatemala.

Sideroxylon tempisque Pittier. Tempisque. Las Limas and Pito Solo. A tree 13–18 meters high.

Mr. Edwards has collected imperfect material of two other Sapotaceae that probably represent undescribed trees, of doubtful generic position.

SIMARUBACEAE

Picramnia antidesma Sw. Quinina. Pito Solo, a shrub of 4.5 meters, but in Central America often becoming a tree. The material is sterile, and the specific name perhaps questionable. A tea made from the bitter bark is a local remedy for malaria.

STYRACACEAE

Styrax argenteus Presl. Coyocutena, in mountain forest. A tree of 18 meters.

SYMPLOCACEAE

Symplocos martinicensis Jacq. San Juancito, in cloud forest. A tree of 15 meters, with spreading branches.

THEOPHRASTACEAE

Deherainia smaragdina (Planch.) Dcne. Pito Solo, in dense forest. A shrub of 3.5 meters, but probably becoming a tree. The species was known previously from southern Mexico, Guatemala, and British Honduras.

TILIACEAE

Heliocarpus Donnell-Smithii Rose. Damajao.

ULMACEAE

Celtis monoica Hemsl. Yalla. Pito Solo, in dense forest, alt. 600 meters. A tree 24 meters high. Apparently a rare species, seldom collected.

URTICACEAE

Boehmeria caudata Sw. Minas de Oro, open forest, at 1260 meters. A tree 9 meters high.

Myriocarpa yzabalensis (Donn. Smith) Killip. Tapón.

VERBENACEAE

Citharexylum hexangulare Greenm. Santa Cruz de Yojoa. A tree 12 meters high, with small white flowers.

Citharexylum trinerve Blake. Las Limas. A tree of 18 meters.

Vitex longeracemosa Pittier. Flor azul. Las Limas. A tree 13–15 meters high, with panicles of "lovely blue" flowers.

VOCHYSIACEAE

Vochysia guatemalensis Donn. Smith. Coyocutena, alt. 1200 meters, dense mountain forest. A tree 12 meters high, with yellow flowers. It is rather doubtful whether *V. hondurensis* Sprague can be separated from this earlier species.

ZYGOPHYLLACEAE

Guaiacum guatemalense Planch. Comayagua. Reported as a tree of 24 meters, a very exceptional size for trees of this genus in Central America. The genus has been reported previously from Honduras, but without a specific name.

Check List of the Common Names

Acerillo	*Vernonia leiocarpa* DC.	Compositae
Bombón	*Cochlospermum vitifolium* (Willd.) Spreng.	Cochlospermaceae
Canillo	*Dialium guianense* (Aubl.) Steud.	Leguminosae
Carbón	*Mimosa tenuifolia* (Willd.) Poir.	Leguminosae
Carnizuelo	*Acacia Hindsii* Benth.	Leguminosae
Champerno (?)	*Dalbergia cubilquitzensis* (Donn. Smith) Pittier	Leguminosae
Chaperno	*Lonchocarpus hondurensis* Benth.	Leguminosae
Chinchillo	*Zanthoxylum microcarpum* Griseb.	Rutaceae
Colorado	*Calycophyllum candidissimum* (Vahl) DC.	Rubiaceae
Cordoncillo	*Piper calvescens* Trel.	Piperaceae
Cornezuelo	*Acacia Hindsii* Benth.	Leguminosae
Crucita	*Randia malacocarpa* Standl.	Rubiaceae
Damajao	*Heliocarpus Donnell-Smithii* Rose	Tiliaceae
Encino	*Quercus conspersa* Benth.	Fagaceae
Flor azul	*Vitex longeracemosa* Pittier	Verbenaceae
Guajiniquil	*Inga edulis* Mart.	Leguminosae
Guayabillo	*Eugenia axillaris* (Sw.) DC.	Myrtaceae
Higuero	*Ficus inamoena* Standl.	Moraceae
Jícaro	*Crescentia alata* H. B. K.	Bignoniaceae
Jinicuite	*Bursera Simaruba* (L.) Sarg.	Burseraceae
Las cruces	*Randia malacocarpa* Standl.	Rubiaceae
Mano de león	*Gilibertia Smithiana* I. M. Johnston	Araliaceae
Masicarán (?)	*Lonchocarpus rugosus* Benth.	Leguminosae
Morro	*Crescentia alata* H. B. K.	Bignoniaceae
Mulule	*Vernonia Deppeana* Less.	Compositae
Pacón	*Saurauia villosa* DC.	Actinidiaceae
Pava	*Cupania glabra* Sw.	Sapindaceae
Quebracho	*Acacia acatlensis* Benth.	Leguminosae
Quinina	*Picramnia antidesma* Sw.	Simarubaceae
Resina	*Zuelania Guidonia* (Sw.) Britt. & Millsp.	Flacourtiaceae
Sarcil	*Conostegia xalapensis* (Bonpl.) Don	Melastomaceae
Sarcil	*Miconia guatemalensis* Cogn.	Melastomaceae
Sirín	*Miconia calvescens* DC. (?)	Melastomaceae
Tapón	*Myriocarpa yzabalensis* (Donn. Smith) Killip	Urticaceae
Tempisque	*Sideroxylon tempisque* Pittier	Sapotaceae
Totascán	*Viburnum glabratum* H. B. K.	Caprifoliaceae
Uña de gato	*Pisonia aculeata* L.	Nyctaginaceae
Uva	*Ardisia revoluta* H. B. K.	Myrsinaceae
Uva	*Eugenia vincentina* Krug & Urb.	Myrtaceae
Uva	*Rapanea guianensis* Aubl. (?)	Myrsinaceae
Yalla	*Celtis monoica* Hemsl.	Ulmaceae

THE YALE WOOD COLLECTIONS

Contributors

On December 31, 1933, the total number of catalogued samples in the Yale wood collections was 24,079, representing 2202 genera of 212 families. The accessions during the year were 1623 and were from the following sources:

Africa: Mr. C. Vigne (*Gold Coast*); Comité National du Bois Coloniaux, and Service des Eaux et Forêts (*Madagascar*); Mr. Jas. D. Kennedy (*Nigeria*); Mr. Nils B. Eckbo (*So. Afr.*); Forest Products Institute (*Pretoria*); Dr. Mildbraed, Berlin (*Tanganyika*).

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

Australia: Mr. H. E. Dadswell, East Melbourne.

Brazil: Companhia Ford Industrial do Brasil, Bôa Vista (Through Field Museum of Natural History, Chicago); Dr. A. Ducke (Manáos); Dr. F. C. Hoehne, São Paulo; Dr. Paul Le Cointe, Museu Commercial, Pará; Sr. J. A. Pereira, São Paulo; Prof. J. Rafalski, Poznań, Poland.

British Honduras: Mr. R. S. Pelly, Asst. Conservator of Forests, Belize.

Canada: Mr. F. Malcolm Knapp, Vancouver.

China: Fan Memorial Institute of Biology, Peiping.

Colombia: Sr. A. Dugand G., Barranquilla.

Costa Rica: Museo Nacional, San José.

Cuba: Dr. Roig, Santiago de las Vegas.

DOMINICAN REPUBLIC: Mr. J. C. Scarff, San Pedro de Macoris.

ECUADOR: Dr. A. Rimbach, Riobamba.

FEDERATED MALAY STATES: Forest Research Institute, Kepong, Selangor.

FORMOSA: Prof. M. Fujioka, Komaba, Japan; Dr. R. Kanehira, Taihoku, Japan.

HAWAII: Bernice P. Bishop Museum, Honolulu.

INDIA: Forest Research Institute, Dehra Dun; Royal Botanic Gardens, Kew, England.

JAVA: Dr. H. H. Janssonius, Amsterdam, Netherlands; Mr. C. Van de Koppel, Buitenzorg; Experiment Station, Hawaiian Sugar Planters' Association, Honolulu.

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

NEW ZEALAND: Dr. Irma Webber, Berkeley, California.

PANAMA: Mr. G. P. Cooper (Cooper Third Caribbean Expedition).

PERU: Field Museum of Natural History, Chicago.

PHILIPPINE ISLANDS: Bureau of Forestry, Manila.

POLAND: Prof. J. Rafalski, Poznań.

PORTO RICO: New York Botanical Garden.

RUSSIA: Scientific Institute of Forestry, Moscow.

U. S. A.: Prof. H. de Forest, Dr. Irma Webber (*Calif.*); Field Museum of Natural History (*Illinois*).

MISCELLANEOUS: Peabody Museum of Natural History (New Haven, Conn.); U. S. Dept. of Agriculture (Washington, D. C.)

Genera Added February 1, 1933–January 1, 1934

AMYGDALACEAE
Amygdalus
ANACARDIACEAE
Lithraea
Thyrsodium
ANONACEAE
Diclinanona
APOCYNACEAE
Nerium
Rejoua
ARALIACEAE
Fatsia
Strobilopanax
Tieghemopanax
BERBERIDACEAE
Nandina
BORRAGINACEAE
Echium
Heliotropium
BRETSCHNEIDERACEAE
Bretschneidera
BUXACEAE
Tricera
CANELLACEAE
Capsicodendron
CAPPARIDACEAE
Buchholzia
CAPRIFOLIACEAE
Abelia
CARICACEAE
Carica
CELASTRACEAE
Cassine
Catha
Mystroxylon

CHENOPODIACEAE
Chenopodium
Eurotia
Grayia
Haloxylon
CISTACEAE
Cistus
COMPOSITAE
Centaurea
Eriophyllum
Moquinia
Piptocarpha
Tetradymia
CRASSULACEAE
Sempervivum
CRUCIFERAE
Lepidum
ERICACEAE
Azalea
Calluna
Cavendishia
Ficalhoa
Psammisia
EUPHORBIACEAE
Lingelsheimia
Neowawraea
Pycnocoma
Richeria
FLAGELLARIACEAE
Flagellaria
FLACOURTIACEAE
Dasylepis
Kiggelaria
Peridiscus
GERANIACEAE
Pelargonium
HYDROPHYLLACEAE
Nama
ICACINACEAE
Alsodeiopsis
LACISTEMACEAE
Lozania
LAURACEAE
Dicypellium
LEGUMINOSAE
Alexa
Ammodendron
Bandeiraea
Caragana
Chorizema
Colutea
Coronilla
Etaballia
Genista
Mucuna
Ononis
Pseudosamanea
Sarothamnus
Taralea
Trachylobium
MALVACEAE
Althaea
MELASTOMACEAE
Centronia
Huberia
MELIANTHACEAE
Melianthus
MENISPERMACEAE
Disciphania
Tiliacora
MENTHACEAE
Lavandula
Leonotis
Rosmarinus
Salazaria
Teucrium
MORACEAE
Helianthostylis
Plecospermum
Pseudostreblus
MYRISTICACEAE
Brochoneura
MYRTACEAE
Mooria
OLEACEAE
Forsythia
PALMACEAE
Rhapis
Washingtonia
PAPAVERACEAE
Romneya
PLUMBAGINACEAE
Plumbago
POLYGONACEAE
Calligonum
Eriogonum
PORTULACACEAE
Portulacaria
PROTEACEAE
Leucadendron
RANUNCULACEAE
Clematis
RHIZOPHORACEAE
Blepharistemma
Kandelia
Macarisia
ROSACEAE
Coleogyne
Crataegomespilus
Mespilus
Nuttallia
Osmaronia
Potentilla
Purshia
Pyracantha
Quillaja
Sorbaria
RUBIACEAE
Bathysa
Cuviera
Dialypetalanthus
Dictyandra
Euclinia
Galium
RUTACEAE
Cneoridium
Diosma
Oricia
SAPINDACEAE
Diatenopteryx
Glossolepis
Podonephelium
SCROPHULARIACEAE
Calceolaria
Castilleia
Veronica
SIMARUBACEAE
Brucea
Castelaria
Kirkia
SOLANACEAE
Brachistus
Iochroma
Streptosolen

SYMPLOCACEAE	Schoenobiblos	Turnera
Bobua	TILIACEAE	URTICACEAE
TAMARICACEAE	Desplatzia	Touchardia
Myricaria	Glyphaea	VACCINIACEAE
THYMELAEACEAE	TURNERACEAE	Englerodoxa

Sections for Microscopic Study

The number of specimens of which sections were made and catalogued during the year 1933 was 547, representing 289 species of 117 genera and 26 families.

Specimens Distributed

The total number of specimens distributed during 1933 was 1936. With the exception of 58 in general exchange, all were for use in connection with definite scientific projects. The following report is to supplement those published in *Tropical Woods* 22: 2, 25: 26, 30: 39, and 33: 24.

Alangiaceae, Cornaceae, and **Nyssaceae.** To Dr. E. Schönfeld, Borna bei Leipzig, Germany, 4 samples of *Alangium*, 15 samples of 8 genera of Cornaceae, and 14 of 3 genera of Nyssaceae.

Anacardiaceae and **Apocynaceae.** To Dr. R. Kanehira, Kyushu Imperial University, Fukuoka, Japan, 29 samples of 14 genera of Anacardiaceae (see *Tropical Woods* 22: 3), and 1 sample of *Alstonia*.

Bombacaceae. To Dr. L. Chalk, Imperial Forestry Institute, Oxford, England, 30 samples of 9 genera.

Caryocaraceae. To Prof. R. H. Wetmore, Biological Laboratories, Harvard University, Cambridge, Mass., 10 samples of 2 genera. To Mr. L. Williams, Field Museum of Natural History, Chicago, Illinois, 5 samples of 2 genera.

Chenopodiaceae. To Dr. L. Chalk, 3 samples of 3 genera.

Coniferae. To Prof. R. H. Wetmore, 29 samples of 2 genera of Araucariaceae; 3 samples of *Cephalotaxus;* 123 samples of 13 genera of Cupressaceae; 3 samples of *Ephedra;* 1 of *Ginkgo;* 1 of *Gnetum;* 66 samples of 4 genera of Podocarpaceae; 28 samples of 2 genera of Taxaceae; 19 samples of 8 genera of Taxodiaceae; and 1 sample of *Welwitschia*.

Dilleniaceae and **Dipterocarpaceae.** To Prof. R. H. Wetmore (see Caryocaraceae and Coniferae), 21 samples of 4 genera of Dilleniaceae, and 166 samples of 15 genera of Dipterocarpaceae.

Euphorbiaceae. To Dr. R. Kanehira (see Anacardiaceae), 65 samples of 32 genera.

Guttiferae. To Prof. R. H. Wetmore (see Dilleniaceae), 17 samples of 5 genera.

Malvaceae. To Dr. L. Chalk (see Bombacaceae), 83 samples of 11 genera. To Dr. Irma Webber, Riverside, California, 1 sample of *Tetrasida*.

Marcgraviaceae. To Prof. R. H. Wetmore (see previous families), 4 samples of 2 genera.

Meliaceae. To Dr. A. J. Panshin, New York State College of Forestry, Syracuse, 64 samples of 10 genera.

Menispermaceae. To Dr. L. Chalk (see Bombacaceae, Malvaceae), 1 sample each of *Abuta* and *Tiliacora*.

Moraceae. To Prof. R. H. Woodworth, Biological Laboratories, Harvard, 524 samples of 46 genera.

Quiinaceae. To Prof. R. H. Wetmore (see previous families), 5 samples of 2 genera.

Sterculiaceae and **Tiliaceae.** To Dr. L. Chalk (see Bombacaceae, Malvaceae, and Menispermaceae), 32 samples of 10 genera of Sterculiaceae, and 36 samples of 12 genera of Tiliaceae.

Ulmaceae. To Mr. Frank W. Jane, University College, London, England, 11 samples of 4 genera.

Urticaceae and **Vochysiaceae.** To Dr. L. Chalk (see Sterculiaceae), 2 samples of 2 genera.

Miscellaneous. To Prof. I. W. Bailey, Bussey Institution, Forest Hills, Boston, Mass. (see *Tropical Woods* 33: 27), 298 samples of 22 families.

To Prof. A. Chevalier, Paris, France, 100 samples of 26 families of Liberian woods.

To Mr. R. A. Cockrell, School of Forestry and Conservation, University of Michigan, Ann Arbor, 42 samples of 26 families.

To Mr. C. F. Metcalfe, Royal Botanic Gardens, England, 27 samples of 8 families.

Reports on Yale-aided Studies of Woods

The following reports summarize the information received regarding the status of various projects for which the Yale School of Forestry has supplied some of the materials. All of the investigations listed are by, or under the direction of, members of the International Association of Wood Anatomists. Special attention is called to the need of additional specimens of the Malvaceae and Moraceae.

Betulaceae and **Corylaceae.** The dissertation of Mr. Ernst C. Abbe, candidate for the Ph.D. degree at Harvard University, was based on a study of the plants of these groups. (See *Tropical Woods* 30: 39.)

Caryocaraceae. Mr. L. Williams, of the Field Museum of Natural History, is studying the systematic anatomy of the woods of this family through cooperation with the University of Chicago. Mr. Paul C. Standley is assisting on the taxonomic problems involved.

Flacourtiaceae. Professor Walter W. Tupper, of the University of Michigan, presented a paper before the general session of the Botanical Society of America at Cambridge, Mass., Dec. 30, 1933, on "The wood structure of the Flacourtiaceae." (See *Tropical Woods* 30: 39.)

Guttiferae and **Hypericaceae.** Mr. P. A. Vestal, graduate student at Harvard University, is studying the comparative morphology and anatomy of the Hypericoideae in relation to the Guttiferae, under the direction of Professor Wetmore. (See *Tropical Woods* 33: 27.)

Lacistemaceae. Dr. L. Chalk and Miss M. M. Chattaway published a paper on perforated ray cells in the *Proceedings of the Royal Society* B: 113: 82–92. "Large ray cells which appeared to have scalariform perforations were first observed by the authors in the wood of *Lacistema aggregatum* (Berg.) Rusby" from the Yale collections. Other specimens also were supplied for this investigation. (See *Tropical Woods* 33: 27.)

Leguminosae. Dr. Eloise Gerry, of the U. S. Forest Products Laboratory, Madison, Wisc., presented a paper before the general session of the Botanical Society of America at Cambridge, Mass., Dec. 30, 1933, on "The wood structure of *Monopteryx uaucu* Spruce, a South American legume with broad rays." (See *Tropical Woods* 30: 39.)

Magnoliales. A report by Dr. Robert P. McLaughlin on the woods of this order was published in *Tropical Woods* 34: 3–39.

Malvaceae. Dr. Irma E. Webber, Rubidoux Laboratory, Riverside, California, is continuing the study of this group. (See *Tropical Woods* 25: 26.) She is in need of material of the following genera: *Bastardia, Cienfuegosia, Decaschistia, Dicellostyles, Gaya, Goethea, Hoberia, Howittia, Julostyles, Kosteletzkya, Palava, Plagianthus, Senra, Sidalcea, Urena,* and *Wissadula.* Two short papers by Dr. Webber appear in this issue of *Tropical Woods.*

Moraceae. Mr. Tippo, graduate student at Harvard University, is studying the anatomy of both woody and herbaceous plants of this family, under the direction of Professor R. H. Woodworth. In addition to the 524 samples of 46 genera supplied by Yale, there is need for woods or, in the case of herbs, pickled stems of the following unrepresented genera: *Ampalis, Balanostreblus, Batocarpus, Bleekrodia, Cardiogyne, Conocephalus, Dorstenia, Fatoua, Lanessania, Maillardia, Olmediophaena, Pachytrophe, Plecospermum, Sabagunia,* and *Scyphosyce.* The following genera are each represented by a single specimen of only one species: *Anonocarpus, Brosimopsis, Helianthostylis, Malaisia, Noyera, Olmedioperebea, Paratrophis, Phyllochlamys, Sparathosyce, Taxotrophis,* and *Treculia.*

Myristicaceae. Reports by Professor George A. Garratt on the woods of this and closely related families were published in *Tropical Woods* 35: 6–48 and 36: 20–44.

Podocarpaceae. Mr. Ernest C. Crocker, of Arthur D. Little, Inc., Cambridge, Mass., published a paper entitled "Mäule lignin test on *Podocarpus* wood" in *Botanical Gazette* 95: 1: 168–171, September 1933. (See *Tropical Woods* 30: 40 and 36: 76.)

Rhizophoraceae. Mr. Herbert F. Marco, graduate student at Yale University, is writing a dissertation on the systematic anatomy of the woods of this family.

Sterculiaceae. Miss M. M. Chattaway, according to the 9th annual report of the Imperial Forestry Institute at Oxford, is continuing her study of the woods of this family. (See *Tropical Woods* 30: 40 and 31: 60.)

Ulmaceae. Mr. Frank W. Jane, Lecturer in Botany at

University College, London University, reports substantial progress in the study of this group. (See *Tropical Woods* 30: 40.)

Anomalous woods. Dr. L. Chalk, according to the 9th annual report of the Imperial Forestry Institute at Oxford, is making good progress in the study of this interesting but difficult group of woods with included phloem. (See *Tropical Woods* 25: 26.)

Incense woods. Mr. C. R. Metcalfe, of the Jodrell Laboratory at Kew, England, is continuing his studies of this intriguing and elusive subject with good results. A wood sample of *Cinnamosma fragrans* obtained for Yale by the Governor General of Madagascar proved particularly helpful. (See *Kew Bulletin*, 1933, pp. 3–15.)

Vestured pits. Professor I. W. Bailey published his report on this subject in the *Journal of the Arnold Arboretum* 14: 259–273. Eight hundred samples of 55 genera were supplied especially for this investigation. (See *Tropical Woods* 33: 27 and 36: 75.)

INTERNATIONAL ASSOCIATION OF WOOD ANATOMISTS

The Council of the Association has approved all of the terms and definitions recommended by the Committee on Nomenclature in the English edition of a "Glossary of terms used in describing woods" as published in *Tropical Woods* 36: 1–12. Of the 2000 reprints made, about 1300 have already been sold; the price is 10 cents apiece for single copies or 13 for one dollar, postpaid.

Dr. Laurence Chalk of the Imperial Forestry Institute, Oxford, is in charge of the preparation of a report on the standardization of numerical values for dimensions of elements. For the basis for the proposals, see Miss Chattaway's paper in *Tropical Woods* 29: 20–28, March 1, 1932.

Mr. J. D. Hale, of the Forest Products Laboratories of Canada, Ottawa, is in charge of a similar study with respect to the terms used to designate weight and density of wood.

The Association will meet in Amsterdam at the time of the Sixth International Botanical Congress, the dates being September 2–7, 1935, instead of September 9–14 as originally announced.

CURRENT LITERATURE

***Schippia*, eine neue Palmengattung aus British Honduras.** By M. Burret. *Notizblatt Bot. Gart. Berlin* 11: 867–869, Aug. 1, 1933.

Schippia concolor of the Stann Creek Valley, British Honduras, is the type of a new genus related to *Tessmanniophoenix*. It is a palm 10 meters high, known as the Silver Pimento or Mountain Pimento.

Chicle exploitation in the sapodilla forest of the Yucatan Peninsula. By Cyrus Longworth Lundell. *Field & Laboratory* 2: 1: 15–21, Nov. 1933.

The dominant forest tree of the virgin bush areas of the Yucatan Peninsula is the Sapodilla, *Achras Zapota* L., important commercially as the source of chicle, the basis of chewing gum. From Cape Catoche to Lake Petén it is one of the most frequent species, characterizing this limestone region, which is a phytogeographic unit with a typical flora. It is estimated that in the whole area of the Sapodilla forest there is a minimum of one hundred million trees. It has been suggested as possible that when the ancient Mayas, who valued the tree highly, made agricultural clearings, they spared Sapodilla trees, which thus obtained an advantage over other vegetation when the areas were abandoned to the jungle.

Three varieties of the tree, based upon bark characters and sap color, are distinguished by the native chicleros. The lumber was used extensively in ancient times for construction purposes. For its latex the tree is tapped during the wet season, from June to February, the average production of gum per tree being less than one pound, a maximum yield at present being less than five pounds. Many of the trees are killed by damage from careless tapping, a large part of the Sapodilla forest of the Maya area already having been killed. To obtain the 12,000,000 pound production of 1927, 1928, and 1929, a minimum of 12,000,000 trees would have to be tapped annually, and as a general rule not more than two trees on each acre could be tapped each year. Since 1929 the demand for chicle has decreased annually until the 1933 production is only a small fraction of its former volume. The Sapodilla tree is not suited for plantation culture because of its slow growth and because a healing period of about five years is necessary between successive tappings.—P. C. STANDLEY.

New plants mainly from western South America. IV. By ELLSWORTH P. KILLIP. *Journ. Wash. Acad. Sci.* 24: 42–52. Washington, D. C., Jan. 15, 1934.

Among the woody plants described as new are *Gaiadendron macranthum*, Peru; *Hesperomeles nitida*, Colombia; *Acaciella curassavica* Britt. & Killip, Curaçao; *Mabea acutissima*, Colombia; *Abatia macrostachya*, Peru. The new name *Derris amazonica* is proposed for *Lonchocarpus negrensis* Benth. of the Amazon region.

Studies on the flora of northern South America. XVIII. Plantae Lawranceanae Colombianae. By H. A. GLEASON. *Phytologia*[1] 1: 25–38. 1933.

Among new species collected in the Department of Boyacá, Colombia, by A. E. Lawrance are the following trees: *Hortia colombiana*, a tree of 22–30 meters; *Matisia longiflora; Godoya magnifica*, vernacular name Azuceno, the wood used for making gears of sugar mills; *Anthodiscus montanus; Dendrostigma hystricina*, a small tree, representing a new genus of Flacourtiaceae; *Miconia megalantha*, reported to reach a height of 30 meters.

Estudos sobre madeiras. By FREDERICO A. BROTERO. Bul. No. 10, Lab. de Ensaio de Materiaes, Escola Polytechnica de São Paulo, Brazil, July, 1933. Pp. 31; 6¾ x 10; 3 half-tones.

A discussion of endwise compressive tests on long columns and short posts, with consideration of the principles involved and some of the influencing factors.

[1] *Phytologia* is a new magazine, printed by the offset process and published at New York Botanical Garden under the editorship of H. A. Gleason and H. N. Moldenke.

Noticia sobre la distribución de las palmeras en la flora de Entre Ríos. By JUAN R. BÁEZ. *Memorias del Museo de Paraná* (Argentina), No. 5, 11 pp., 2 pp. of bibliography; 7 figs.; map. 1933.

In the Province of Entre Ríos there are found the following three palms:

Cocos yatay, Palma Yatay. Widely dispersed, but usually in small groves of little importance, extending southward to latitude 32°, usually in sandy soil. Of particular importance is the forest of this species called the Palmar Grande, between Berduc and Ubajay, which it is suggested should be set aside as a national reservation. Although the fruits of this palm are used for preparing sweetmeats and liquors, its chief value is as an ornamental tree.

Trithrinax campestris, Caranday or Carandá. Widely distributed in the western part of the northern half of the province, sometimes attaining a height of six meters; the most widely distributed of Argentine palms. The leaves are sometimes exploited commercially as a source of fiber. The fruits are eaten by cattle.

Cocos Romanzoffiana, Pindó or Palma Dátil, the handsomest of the palms planted in the parks of the coast cities. It grows chiefly along the Uruguay River, and in the delta region, extending into the Province of Buenos Aires. In some regions this palm is utilized for forage and thatching, but in Entre Ríos, where it is scarce, it is employed only for ornament, although the sweet fruits sometimes are eaten.—P. C. STANDLEY.

Flora do Rio Cuminá (Estado do Pará, Brasil). Cyperaceas, Malpighiaceas e Leguminosas. By A. J. DE SAMPAIO. *Archivos do Museu Nacional* (Rio de Janeiro) 34: 49–109. 1932.

An annotated list of plants collected by the Rondon Expedition to the Serra Tumuc-Humac in 1928. Among the Malpighiaceae listed are: *Byrsonima coccolobifolia* Kunth, local name Mirichi; *B. coriacea* (Sw.) Kunth, Muricí de Folhas Pequenas; *B. crassifolia* (L.) Kunth, Murici; *B. verbascifolia*

Rich., Mirichi (or Mirici) Rasteiro; *Hiraea faginea* (Sw.) Ndz., Sarabátupú, used as a fish poison; *Tetrapterys squarrosa* Griseb., Sarabatucú. Among the numerous Leguminosae mentioned are: *Mimosa paniculata* Benth., Rabo de Cameleão; *Piptadenia peregrina* (L.) Benth., Angico; *Campsiandra laurifolia* Benth., Manaiára; *Cassia quinquangulata* Rich., Feijão Bravo; *Macrolobium acaciaefolium* Benth., Arapari; *Sclerolobium tinctorium* Benth., Ritangueira; *Centrosema Plumieri* Benth., Feijão Bravo; *Coumarouna odorata* Aubl., Cumarú; *Dioclea lasiocarpa* Mart., Feijão Bravo; *Machaerium Bangii* Rusby, Aturiá. The author has listed, besides the species collected by himself, many others reported from the State of Pará, with the vernacular names recorded for them by other collectors.—P. C. STANDLEY.

New or noteworthy trees from Micronesia. IV. By RYÔZÔ KANEHIRA. *Botanical Magazine* (Tokyo) 47: 669–680, Oct. 1933.

There are listed 22 species of trees from the islands of Rota and Palau, among these described as new being the following: *Horsfieldia amklaal*, a tall tree with whitish, light and soft wood, known by the name Amklaal; *Northiopsis Hoshinoi* (*Northia Hoshinoi* Kanehira, 1932), a new genus; *Manilkara udoido*, a fairly large tree, with very hard, reddish wood esteemed for building material and for bridge construction.

Flora Micronesica. (In Japanese.) By RYÔZÔ KANEHIRA. Pub. by the South Seas Bureau, Japanese Mandate Territory, 1933. Pp. 468; 7¼ x 10; pls. 21; figs. 211; 1 map.

This handsome volume was written for Japanese foresters, and the whole text, except for botanical names and the citation of literature, is in Japanese. Western readers, however, can at least understand the numerous half-tone plates, illustrating scenery and individual plants, and the line drawings used as text figures to illustrate 211 species of the woody plants.

The book is a report of the author's botanical expeditions to Micronesia during 1929–1932. Chapter 1 deals with the history of the expedition, and gives a general account of the geography, phytogeography, vegetation, and useful plants of the islands. Chapter 2 occupies the main part of the book and contains descriptions of the principal trees and shrubs, a total of 347 species referable to 211 genera and 72 families. Chapter 3 lists all of the plants known from Micronesia, amounting to 1085 species of 594 genera and 137 families. The author discovered one new genus and 62 new species of trees and determined the existence of 36 species of 33 genera that were not previously known to occur in Micronesia. (These new records and the descriptions of the new species are appearing in various numbers of the Japanese *Botanical Magazine*.)

Endemism in the flora of Micronesia is only 39.1 per cent, whereas that of the Philippines is 76.5, Formosa 42.9, and Hawaii 81 per cent. There are, however, five endemic genera, namely, *Glubiopsis*, *Bentinckiopsis*, and *Ponapea* of the Palmaceae, *Guamea* of the Anonaceae, and *Northiopsis* of the Sapotaceae, the last being the author's new genus. It is highly significant that no genus is confined to the region embracing both Micronesia and the Philippines, whereas, Micronesia and New Guinea together have seven endemic genera, namely, *Clitandropsis* (Apocynaceae), *Myrtella* (Myrtaceae), *Pentaphalangium* (Guttiferae), *Pseudera* and *Ryncophreatia* (Orchidaceae), *Soulamea* (Simarubaceae), and *Salacicratea* (Hippocrateaceae). Dr. Kanehira accordingly proposes a line between Micronesia and the Philippines (see his map, p. 18) which connects with Weber's Line, thus fixing the eastern boundary of *Wallacea* as Merrill and Jackson's adjustment of Wallace's Line did the western. (For further information on this subject and the phytogeography of Micronesia see the author's paper in *Tropical Woods* 29: 1–6, March 1, 1932.)

On a light-weight wood, drifted on the shores of the Caroline Islands. (In Japanese.) By R. KANEHIRA. *Journal of the Society of Forestry of Japan* 15: 10: 113–116. 1933. Illustrated.

This exceedingly light driftwood is identified as the root or the foot of the stem of *Alstonia spathulata* Bl. (See *Tropical Woods* 32: 2–4.) The structural and physical properties of the wood are described and there is an account of its utilization.

On light-weight woods. (In Japanese.) By R. Kanehira. *Journal of the Society of Forestry of Japan* 15: 601–615; figs. 24. 1933.

As a result of finding some driftwood of exceptionally light weight on the shores of the Caroline Islands and its subsequent identification as *Alstonia spathulata* Blume (see *Tropical Woods* 32: 2–4, Dec. 1, 1932), the author made a study of it and other light-weight woods. The samples investigated, most of which were supplied from the Yale collections, are classified on a basis of their absolute specific gravities as follows:

Aeschynomene hispida Willd. (Cuba)	0.044
Alstonia spathulata Bl. (Driftwood)	0.058
Herminiera elaphroxylon Guill. & Perr. (Afr. Nile)	0.065
Cavanillesia platanifolia H. B. K. (Panama)	0.103
Cavanillesia arborea K. Schum. (Brazil)	0.106
Anona palustris L. (root wood; Cuba)	0.116
Ochroma boliviana Rowlee (Peru)	0.116
Ochroma sp. (Central America)	0.120
Nyssa sp. (buttress; so. U. S. A.)	0.124
Erythrina variegata L. (Phil. Is.)	0.162
?*Chorisia* sp. (Bahia, Brazil)	0.245
Paulownia tomentosa Steud. (Japan)	0.260
Pisonia grandis R. Br. (Marianne Is.)	0.290
Alstonia scholaris R. Br. (Java)	0.303
Samadera indica Gaertn. (Palau)	0.322
Bombax malabaricum DC. (Formosa)	0.340
Ochroma sp. (Central America)	0.377
Calpidia Nishimurae Rehd. & Wils. (Bonin Is.)	0.378
Pisonia umbellifera (Forst.) Seem. (Saipan)	0.409

The author also classifies the woods on a basis of their gross anatomy as follows: (1) Heterogeneous or laminate type. In this group are *Pisonia* and *Culpidia*, with anomalous structure (*i.e.*, included phloem), and *Erythrina*, with its somewhat tangentially arranged bands of libriform fibers in a ground mass of soft tissue. (2) Homogeneous type. In the woods of this group the fibrous and the parenchymatous elements are either (a) of fairly uniform size and appearance, or (b) one or the other is scarce quantitatively, or (c) both are evenly distributed. Of this type are *Aeschynomene*, *Anona*, *Alstonia*, *Herminiera*, *Nyssa*, *Ochroma*, *Paulownia*, and *Samadera*. (3) Intermediate type. Here belong *Bombax*, *Cavanillesia*, and *Chorisia*, in which the contrast between the hard and the soft tissue is not so pronounced as in the first type.

The low density of the woods is attributable to the very thin walls and large lumina of the fibers and parenchyma, the vessels and rays not being involved.

It is an interesting fact, as observed by Rowlee (*Journ. N. Y. Bot. Garden* 256: 75–78. 1921), that the trees with exceptionally light-wooded stems occur in the tropics where high temperature and humidity are conducive to rapid growth, that they usually have tough, fibrous bark and large leaves, and that their wood is light-colored and perishable.

The air-seasoning of Malayan timbers. By W. F. Chipp. Reprinted from *Quarterly Journal of the Engineering Association of Malaya*. Pp. 7; 7¼ x 9¾. 1933.

"In the climatic conditions of Malaya, the air-seasoning of timber is a much simpler matter than in temperate countries, just because there is such a relatively small variation in temperature and humidity; and, once the technique of seasoning a particular timber has been worked out, its application can be reduced, more or less, to 'rule-of-thumb.' It seems unlikely that artificial seasoning or kiln-drying, with all its complications and expense, will have to be resorted to in Malaya to any great extent. At all events the Forest Department does not propose to embark upon research on kiln-drying until the possibilities of air-seasoning have been thoroughly studied."

Timber tests: Damar laut daun besar (*Shorea glauca* King). By A. V. Thomas. *The Malayan Forester* (Kuala Lumpur) 2: 3: 137–140, Sept. 1933.

"The heartwood . . . is more durable than that of most species of timber in Malaya. The sapwood, though mechanically very little inferior to the heartwood, is, like that of all species of timber, susceptible to fungous attack if used in exposed positions, and if a large proportion of it is used in such sites it should be protected by some form of preservative. The mechanical properties and natural durability of *Shorea glauca* recommend it for use for all heavy constructional work such as bridge timbers, building posts, wharves, etc., and it should make good telegraph posts, power line standards, masts, and sleepers. Unfortunately it shrinks quite a lot and has a tendency to split badly when drying. This may detract from its usefulness in certain circumstances unless care is taken in seasoning."

The resistance of tropical timbers against the attack of shipworms. By A. T. J. Bianchi. Comptes Rendus, Congrès de Nancy, 1932. Nancy, 1933, pp. 493–498.

A summary of the results of tests at Buitenzorg, Java, on the resistance of certain silica-containing timbers to the attacks of marine borers. Woods of 814 species were examined and about 180 of them, representing 28 different families, contained silica excretions.

"Although only a small part of the silica-containing timbers will be of real importance, many being too soft, having an insufficient silica content, or being not durable enough in other respects, the enumeration given may serve as a guide in the search for hitherto unknown woods, which may prove to be resistant against teredo.

"The shape in which the amorphous silicic acid occurs in wood is mostly in that of globular or more or less oblong bodies in the cavity of special cells (mostly ray cells), or fibers. Besides, certain timbers were found to contain silicified tyloses (*Artocarpus*, *Gironniera*, *Hydnocarpus*, *Stereospermum*, *Talauma*, *Taraktogenos*, *Tectona*), or a silicified membrane attached to the interior wall of tracheal elements (*Artocarpus*, *Dillenia*, *Manglietia*, *Parasponia*, *Pellacalyx*, *Peronema*, *Stereospermum*, *Tectona*, *Teysmanniodendron*, *Ulmus*). Sometimes the interior wall of some of the fibers and (or) parenchymatic cells shows a similar silicified coating (*Artocarpus*, *Combretocarpus*, *Manglietia*, *Michelia*, *Parasponia*, *Peronema*,

Tectona, *Teysmanniodendron*), while in some cases the whole cavity of these elements is filled with a vitrous mass of silica (*Artocarpus*, *Combretocarpus*, *Dillenia*, *Gironniera*, *Michelia*, *Pellacalyx*, *Sloetia*, *Teysmanniodendron*). In one case (*Gynotroches*) a similar filling of isolated ray cells was encountered." (See *Tropical Woods* 33: 51.)

The chemistry of Australian timbers. Part 3. The chemical composition of four pale-coloured woods of the genus *Eucalyptus: E. gigantea, E. obliqua, E. regnans, E. sieberiana.* By W. E. Cohen, A. G. Charles, and A. B. Jamieson. Technical paper No. 9, Div. of For. Products, Council for Sci. & Ind. Research, Melbourne, 1932. Pp. 22; 6 x 9½.

Summary

"An investigation of the chemical composition of four woods of a group of Australian Eucalypts, commonly referred to as the 'Ash' group, is recorded.

"The samples examined were obtained from four species, the woods of which may generally be described as light-colored, and which are the most suitable of the Eucalypt woods for pulping purposes. The species occur in the eastern portion of the Australian continent and in Tasmania. The woods are sufficiently alike to render identification from appearance, density, and other physical characteristics difficult in many cases.

"Forty-nine authentic samples were examined. These were collected from districts as widely distributed as collection facilities would permit, and consisted of sound truewood [heartwood], mainly from butt logs of mature trees. . . .

"The study showed that these Eucalypts differ generally in chemical composition from the hardwoods of North America and, to a lesser degree, from the Eucalypts of the Ironbark group which have been described in an earlier paper.

"Some regular differences in certain chemical factors such as total pentosans, percentages of 'solubles' in various solvents, and 'solubles' ratios, were found, and the possibility of employing these as an aid to identification is indicated.

"Variation of chemical composition within a species was

studied, and its possible influence on wood pulp yields is discussed."

The genus *Trichocladus* Pers. (Hamamelidaceae). By J. HUTCHINSON. *Bulletin of Miscellaneous Information*, Royal Botanic Gardens, Kew, 1933, pp. 427–430. Illustrated.

With the exception of *Trichocladus*, two small genera in the Mascarene Islands, and a little-known genus in northeastern Queensland, the family Hamamelidaceae is confined to the northern hemisphere. *Trichocladus* consists of six species of shrubs or trees, ranging from Abyssinia to Transvaal and Natal. *T. dentatus* is described as new from Tanganyika Territory.

The properties and uses of silver beech (*Nothofagus Menziesii*). By W. C. WARD. Circ. No. 34, N. Z. State Forest Series, Wellington, 1932. Pp. 22; 6 x 9½; 9 text figs.

An account of the tree and the properties and uses of the timber.

The vegetation of Schoemanskloof, eastern Transvaal. By J. C. SMUTS. *Bulletin of Miscellaneous Information*, Royal Botanic Gardens, Kew, 1933, pp. 417–427.

A report upon the vegetation as observed in June 1932. Characteristic trees and shrubs of lower and middle elevations are Acacias (particularly *Acacia caffra*, *A. pennata*, and *A. giraffae*), *Ficus*, *Pyrenacantha*, *Royena lucida*, *Euclea*, *Myrsine africana*, *Ximenia americana*, *Rhamnus prinoides* and *R. Zeyheri*, *Chrysophyllum magalismontanum*, *Bauhinia punctata*, *Eugenia*, *Pterocarpus*, *Pittosporum viridiflorum*, *Maesa rufescens* (the dominant tree in some places), *Euphorbia ingens*, *Clerodendron glabrum*, *Gardenia*, *Celtis*, *Rhus*, etc. On one mountain, at an elevation of 5000 feet, there were noted *Rapanea melanophloeos*, *Curtisia faginea*, *Cephalanthus natalensis*, *Burchellia capensis*, *Lachnopylis*, and others, while on the top of the mountain was a pure *Tricbopteryx* association, and two species of *Protea*. On Mt. Anderson (7300 feet) *Erica arborea* is plentiful. The paper is accompanied by a long list, prepared by J. Hutchinson, of the plants collected. *Erythrina lysistemon* Hutch., a small tree, is described as new.

Forest trees and timbers of the British Empire. II. Twenty West African timber trees. By L. CHALK, J. BURTT DAVY, H. E. DESCH, and A. C. HOYLE. Oxford, Clarendon Press, 1933. Pp. 108; 6 x 9¼; 20 text figs.; 20 plates. Price 7s. 6d.

The twenty species described are *Holarrhena Wulfsbergii* Stapf (Apocynaceae); *Afzelia africana* Smith, *A. bipindensis* Harms, and *Hymenostegia Afzelii* Harms (Caesalpiniaceae); *Terminalia superba* Engl. & Diels, *T. ivorensis* A. Chev., *T. glaucescens* Planch., and *T. sokodensis* Engl. (Combretaceae); *Ricinodendron africanum* Muell. Arg. (Euphorbiaceae); *Garcinia Mannii* Oliv. and *Ochrocarpus africanus* Oliv. (Guttiferae); *Lovoa Klaineana* Pierre and *Pseudocedrela Kotschyi* Harms (*Meliaceae*); *Piptadenia africana* Hook. f. (Mimosaceae); *Lophira alata* Banks and *L. alata*, var. *procera* Burtt Davy (Ochnaceae); *Mitragyna stipulosa* (DC.) O. Kuntze (Rubiaceae); *Irvingia gabonensis* Baill. (Simarubaceae); *Cistanthera papaverifera* A. Chev. (Tiliaceae); *Holoptelea grandis* Mildbr. (Ulmaceae).

"The selection of species for description has been based primarily on the commercial importance of their timbers. It has been thought advisable to include, also, some less well-known trees whose timbers seem likely to be more widely used in the future or to be confused with other species which have been described. A few of the most important species, such as Iroko and the Mahoganies, have been omitted, however, from this number, as they are still under investigation by the Forest Products Research Laboratory, Princes Risborough, and it is obviously advisable to await the completion of this work before publishing descriptions of these particular woods.

"In the preparation of this number . . . a few alterations in form have been made. A brief discussion of each genus, with an indication of those characters by which it is distinguished from allied genera, is given before the discussion of the species concerned. As the generic description is necessarily brief, references to the full descriptions in the *Genera Plan-*

tarum, *Die Pflanzenfamilien*, and the *Flora of Tropical Africa* are given. The large amount of fresh botanical material which has been received from the Forest Services in West Africa has cleared up many previously obscure points, and has given a much better idea of the range of variation within the species; for this reason it has been felt desirable to redescribe each species in the light of the additional material. . . . Some changes of terminology have been made in the wood descriptions, in accordance with suggestions put forward by the Committee of the International Association of Wood Anatomists, which is considering terminology, *e.g.*, vessel 'segments' become 'elements,' and pits 'with cribriform membranes' become 'vestured.'"

The work of which this is a part (see *Tropical Woods* 30: 56) is an especially valuable contribution to the knowledge of important forest trees as it combines the efforts of the taxonomist, the wood anatomist and technologist, and the forester.

Ein Hektar Regenwald auf Fernando Poo aufgenommen von H. Burchardt. By J. MILDBRAED. *Notizblatt Bot. Gart. Berlin* 11: 946–950. Aug. 1, 1933.

A tabular census of the trees on a hectare of rain forest in Fernando Po. The most abundant of the large trees were *Chrysophyllum africanum* (27 individuals) and *Pycnanthus kombo* (46); of the middle-sized and small trees, *Strombosia grandifolia* (105), *Monodora myristica* (19), and *Musanga Smithii* (9). The total number of trees, of 23 species, was 238, of which 38 were 60 cm. or more in diameter, 82 were 30–59 cm., and 118 were 1–29 cm. There were present also 16 species of shrubs, 8 species of vines, and 12 species of herbs.

Stone in *Chlorophora excelsa* B. & H., iroko. By C. M. HARRIS. *Empire Forestry Journal* 12: 2: 229–238, Dec. 1933.

The appearance of stone (concretions of calcium carbonate) in Iroko wood is described and three types are distinguished. The concretions are associated with abnormal tissues and perhaps have their source in sap-exudation streams maintained over a long period by insect activity. (See *Tropical Woods* 36: 69.)

Bulletin des bois du Congo Belge. By PAUL LEDOUX. *Revue Internationale du Bois* (Paris) 1: 1: 89–96, Jan. 1934.

The timber of various species of *Millettia* in the Sungu region of the Belgian Congo is being marketed in Belgium under the name of Wenge. It is used for paneling, marquetry, veneers, furniture, and staircases. Among the woods from Kasai are Tskimay (an undetermined Meliaceae) and Musasae (*Piptadenia africana*). A timber of the type of *Macrolobium Dewevrei* and known to the trade as Limbali or Jarrah du Congo is being utilized for construction. It is also being experimented with for use in fresh and in brackish water.

Note on the ayo and the opepe of Nigeria. By A. C. HOYLE. *Empire Forestry Journal* 12: 2: 267–268, Dec. 1933.

"Thanks to the persistent efforts of Mr. J. D. Kennedy and Mr. W. D. MacGregor, of the Nigerian Forest Service, adequate material has been received which has enabled us to identify the Ayo with *Holoptelea grandis* Mildbr. (family Ulmaceae). Its occurrence in Nigeria is an extension of range beyond that recorded in the *Flora of West Tropical Africa*, in which it is mentioned only from Togo and N. E. Congo. The identity of the species has for some years been a mystery. In the absence of flowering material it was for long thought to be a *Terminalia*, and was known as the Orange-barked *Terminalia*, but it differed from any known species of that genus. The Ayo is described as a large tree 80 to 160 ft. high.

"The problem of the correct name for the high-forest timber *Sarcocephalus* of the west coast of tropical Africa has at last been solved. The Opepe proves to be *Sarcocephalus Diderrichii* De Wild. Previously the species has been referred to *S. esculentus* Afzel., which is definitely an edible-fruited shrub or struggling tree of the savannah, with which *S. Russegeri* Kotschy is synonymous.

"Specimens of the timber tree represented in the herbaria at Kew, the British Museum, and the Imperial Forestry Institute have been compared with De Wildeman's type material of *S. Diderrichii*, kindly loaned by Professor Robyns, of the Jardin Botanique de l'État, Brussels, and there is now no doubt that they are conspecific. This species has small flowering and fruiting heads and comparatively small leaves. The older species forming sizeable trees, which are distinguishable as having larger flower heads and larger leaves, are *S. Gilletii* De Wild., *S. Vanderguchtii* De Wild., *S. Pobeguinii* Hua, and *S. nervosus* Hutch. & Dalz."

Les copaliers de l'Afrique occidentale française. By André Aubréville. Reprint from *Bulletin de l'Agence Générale des Colonies* No. 292. Melun, 1933. Pp. 8; 6 x 9½. Illustrated.

An account of the principal species of *Copaifera* producing copal gum in tropical West Africa, with drawings of the leaves, flowers, and fruits of *C. Salikounda* Heck., the type of the group characterized by pinnate leaves with 5–7 pairs of opposite leaflets, and *C. ebie* A. Chev. and *C. Guibourtiana* Benth., with a single pair of opposite leaflets.

Le forêt de la Côte d'Ivoire. By André Aubréville. Reprint from *Bulletin du Comité d'Etudes Historiques et Scientifiques de l'Afrique Occidentale Française* (Paris) 15: 2, 3, Apr., Sept. 1932. Pp. 45; 6½ x 10; 4 plates, 1 map. Paris, 1933.

The author has called his study an "Essai de géobotanique forestière" and such a title describes it fairly. The descriptive portions are well written and it is not difficult to visualize the different parts of the Ivory Coast which are portrayed. The treatment, however, is not merely descriptive. The essay contains some valuable attempts to correlate the forest vegetation with the environment even if it only goes to show once again how difficult a thing it is to arrive at a satisfactory correlation.

The effect of climate is actually the principal consideration, but it is interesting to find the influences of shifting cultivation and the result of fire given so much importance in the ecological interpretation of the forest vegetation.

Five "types climatiques" are recognizable, namely "forêts des dunes littorales," "rain forests," "deciduous forests," "forêts des hauts sommets du pays de Man," and "savanes boisées." It is rather surprising to find a French forester using English terms, such as rain forests and deciduous forests, but

the author explains that this is done because they are familiar to French colonial foresters and difficult to replace with simple French equivalents. At the same time he points out that the terms are not altogether satisfactory, an opinion with which the reviewer agrees.

The author arrives at rather different conclusions from those of J. R. Ainslie, in his *Physiography of Southern Nigeria and its effects on the forest flora of the country*. A good and sensible distinction is drawn between the total annual rainfall (pluviosité annuelle) and the distribution of the rainfall expressed in terms of the length of dry seasons (durée des saisons sèches). In addition to an attempt at an ecological explanation of the various types of vegetation in the Ivory Coast, there are numerous notes regarding the different species found in these types. These notes have been made from personal observations and are valuable. The more ecological descriptions of this nature we can get the better, and the sooner will it be possible to explain vegetation in its relation to the environment.—William N. McNeill, *Commonwealth Fund Fellow, Yale University*.

Tile cells in the rays of the Malvales. By Margaret M. Chattaway. *The New Phytologist* 32: 4: 261–273, Nov. 6, 1933. Illustrated.

The author defines tile cells as a "special type of erect cells, without visible contents, occurring in radial series, much narrower radially than the procumbent cells of the ray, and interspersed among them." "The original German term 'ziegelsteinförmig,' from which our term 'tile-shaped' is derived, was given to cells which look like Roman bricks on the radial section of the wood, because they are extremely narrow radially. In some cases, for example in *Neesia synandra* Mast., the tangential walls are so numerous that, although they are very thin, they become the most conspicuous feature of the radial sections." Tile cells are known to occur only in certain genera of three families, namely, *Bombacaceae*, *Sterculiaceae*, and *Tiliaceae*.

Tile cells are confined to xylem rays, and the initials of the procumbent cells have dark contents while those of the tile cells contain only protoplasm and nuclei. It is suggested that the presence or absence of certain cell contents may determine whether or not the mother cell elongates radially. (For further discussion see Dr. Webber's paper on pp. 9–13 of this issue of *Tropical Woods*.)

Comparative anatomy of the woods of the Meliaceae, sub-family Swietenioideae. By A. J. Panshin. *American Journal of Botany* 20: 10: 663–668, Dec. 1933; 12 plates.

The work is based on a large and varied collection of authentic wood specimens of the Swietenioideae covering seven genera and some 22 species and varieties, chiefly from west and central tropical Africa. No material was available of the American genus *Elutheria*, the authenticity of which is questioned.

The objective of the study was to determine from detailed information whether it is possible to separate the genera on a basis of the comparative anatomy of the woods and to ascertain how grouping by anatomical relationships compares with accepted natural classifications. The woods described are as follows:

American Swietenioideae: *Swietenia* Jacq. including *S. mahogani* Jacq., *S. macrophylla* King, and *S. humilis* Zucc. It is stated that in general the woods of *Swietenia* spp. cannot be separated anatomically with any degree of certainty, although as Record has noted, commercially experienced handlers appear to be able to recognize typical material from specific regions.

Indo-Malayan Swietenioideae: *Chukrasia* A. Juss., including: *C. tabularis* A. Juss., also var. *velutina* Roem.; *Soymida febrifuga* A. Juss.

African Swietenioideae: *Entandrophragma* C. DC. Subgenus 1. Choriandra: *Entandrophragma Candollei* Harms; 2. Eu-entandrophragma: *E. angolense* C. DC., including a number of varieties, considered by some as distinct species, which show distinct minor but constant variations in their wood anatomy; 3. Pseudo-entandrophragma: *E. cylindricum* Spr., which is sometimes confused with the wood of *Guarea cedrata* (Chev.) Pell, but can be distinguished by color and structure (key summary given); 4. Neo-entandrophragma: *E. utile* Spr.; *Lovoa* Harms, with nine species, only one well known, namely *L. Klaineana* Pierre; *Khaya* A. Juss. with 15 described species, of which seven are included; and *Pseudocedrela Kotschyi* Harms.

A summary of the physical and anatomical features of the woods studied covers color, luster, odor, hardness, weight, texture, grain, and figure, together with comparisons of histological features, and presents a detailed key, based upon minute anatomy, for the separation of the genera. It is pointed out that the genera *Swietenia*, *Pseudocedrela*, *Khaya*, and *Entandrophragma* are difficult to distinguish, but the author gives a summary comparison of *Khaya* and *Swietenia* characteristics by which, he states, these genera "can be separated without question." "Apparently the only character of diagnostic value in separating *Pseudocedrela* from *Swietenia* is found in the rays, which are 1–7 (mostly 3–6) seriate in *Pseudocedrela* and 1–6 (mostly 3–4) seriate in *Swietenia*," but it should be noted that the author studied only one specimen of *Pseudocedrela*.

From the data presented it appears that *Lovoa* departs consistently from the other genera of the Swietenioideae on the basis of wood characters. The analysis of the wood of the species of *Entandrophragma* is found to bear out the contention that they fall naturally into four distinct groups, corresponding with the four sub-genera established by Harms on the basis of morphological differences.—Eloise Gerry, *U. S. Forest Products Laboratory, Madison, Wisconsin.*

A manual of the timbers of the world; their characteristics and uses. (Revised edition.) By Alexander L. Howard. London, Macmillan & Co., Ltd., 1934. Pp. 672; 5¾ x 8½; 91 text figs.

"The second edition of *Timbers of the World* has been undertaken for the same reason as the first [1920], namely, to supply a clearly arranged handbook which will give information regarding those timbers which have been, or are expected to be, used in works of art or utility."

"Throughout this book the common name, if it is well known, has been made use of in the alphabetical headings, and the alternative vernaculars, as well as the botanical term, have been added in all cases where it has been possible. It is hoped that the inclusion of these names will be of considerable service. For the Indian timbers, the vernacular names have been taken from Mr. J. S. Gamble's well-known *Manual of Indian Timbers* and from Sir Alexander Rodger's *Trees and Shrubs in Burma*, by the kind permission of the Government of India and Sir Alexander Rodger. In the case of the South American woods, the common names have been taken from Professor Samuel J. Record's *Timbers of Tropical America*, and those of Malaya and the Philippines from Dr. Foxworthy's *Philippine Journal of Science* and *Malayan Forest Records*, No. 3, by the kind permission of the respective authors. The publication of *Commercial Timbers of India*, by Pearson and Brown, has occurred at almost the last moment. From the timbers named in these volumes, although they have not been seen in ordinary commercial usage, a selection of some forty species has been made, as they would seem to be of sufficient importance to be included in this work. The weights given are in all cases the weight per cubic foot when dry of my own specimens, but when this has been impossible, from the accepted authorities as stated. An index of vernacular names is added to facilitate reference."

As stated in the preface of the first edition, this book "is not intended to supercede any of the works on timber hitherto published, but to supplement them. . . . The aim has been to treat the subject from its commercial, technical, and industrial aspects." The result is a valuable compendium written as no one else could have written it, for Mr. Howard has been a life-long student of woods and has had the unique privilege of learning of their sources, peculiarities, and uses through nearly 55 years of practical experience in the timber trade.

Buch der Holznamen. II. Cé—Ise bubaki. By Hans Meyer. Hannover, Germany, 1933. Pp. 109–232; 7 x 10. Price (parts I–IV) about RM. 25.

This is the second part of a comprehensive and exceedingly useful work which, when completed, will contain the common and vernacular names of timbers and woody plants of the world and their equivalent scientific designations so far as known. (See *Tropical Woods* 35: 72.)

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M. M. CHATTAWAY. Price 35 cents

Yale University School of Forestry

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THE PROBLEM OF VARIATION IN THE STRUCTURE OF WOOD

By B. J. RENDLE *and* S. H. CLARKE

Forest Products Research Laboratory, Princes Risborough

One of the major difficulties underlying the study of wood is the fact that the structure of any one species is subject to an indefinite range of variation. Although a brief acquaintance with timber is sufficient to demonstrate that one or two random samples may give an erroneous impression of a species as a whole, not enough attention has been given to assessing the significance of results obtained from a study of limited material. As a consequence the published results of many investigations are of less value than they might have been, and this applies with special force to records of anatomical measurements included in descriptions of woods, and keys to their identification. Unless the reader is informed of the methods that have been used in making the measurements and the means of expressing the results, he is badly handicapped in his efforts to interpret the figures before him.

Standardization of methods is indicated as the obvious solution to this difficulty, and a special committee of the International Association of Wood Anatomists has recently been set up to examine the question. Since, however, the successful development of standard methods of measurement depends on a proper comprehension of the variables concerned, it will not be amiss to inquire into some of the fundamental considerations affecting variation in wood structure. The object of this paper is not to put forward definite proposals, but rather to discuss the nature of the variations, which calls for careful consideration as a preliminary to formulating any standard methods of procedure.

With a view to elucidating the principles that govern variation within the species and within the individual tree, statistical methods of analysis have been applied to large numbers of measurements of the elements of wood, which have been accumulated over a period of years in the course of investigations on temperate and tropical timbers in the Forest Products Research Laboratory. Their usefulness for this purpose lies in the fact that they cover a wide range of material, the measurements for each of the species investigated having been made on samples specially selected from several different trees, in some cases from different localities. In examining these figures, the first point that demands attention is that variation is due to the combined action of several factors.

Taking vessel diameter as an example, the types of variations in this feature may be conveniently classified under four heads: (1) *Local variations in a small sample*, say 1 cm. cube, attributable to the different conditions surrounding the development of individual vessels from the cambial initials. (2) *Variations from pith to periphery*. At any given height in a tree the elements of successive annual rings are progressively larger during what may be called the *youthful* period, after which the mean size of the elements becomes relatively

constant, with small fluctuations due to variations in the external conditions, and the wood is said to be *adult*. (3) *Variations from the base of the stem upwards*. In any one annual ring there is an increase in the mean size of the elements to a certain height in the stem, above which the average size of the elements decreases towards the crown. (4) *Variations resulting from changes in external conditions* and superimposed on the first three types.

The significance of each type of variation must be considered before a satisfactory system of sampling can be devised. For example, it is obvious that, no matter how many vessels are measured in one small section (covering, perhaps, two growth rings), the figures tell us nothing of the other three types of variation and must be interpreted with due regard to the limitations imposed by the small size of the specimen. A few measurements on many samples are therefore preferable to many measurements on a few samples.

When a comparatively wide range of material is available for examination, the procedure will depend on the degree of accuracy desired. Owing to practical considerations of the time and labor involved in making measurements, the investigator generally wishes to limit the number to the minimum necessary to give a significant result. If, for instance, the problem is to find an approximate figure for the mean vessel diameter of a timber, together with some indication of the range of variation on either side of the mean, it is tentatively suggested that a value lying within ± 10 per cent of the actual mean 99 times in 100 is probably sufficient to reveal any real differences of diagnostic significance between two species.

According to the range of material available for the examination of a timber, two problems present themselves: (1) Given a wide range, how should samples be selected, how many are necessary, and how many observations should be made on each? (2) Given a limited range, how is the significance of observations to be estimated? Inasmuch as the solution of these problems is the key to the whole question of describing timbers, they will be discussed in some detail below.

SELECTION OF SAMPLES FROM A WIDE RANGE OF MATERIAL

Since the four types of variation described above are, to a large extent, independent of each other, the effect of each should be considered in the selection of samples. It generally is possible to eliminate variations of the second type (effect of distance from the pith) by selecting adult material from a mature tree. A complete description of a wood should always include the approximate age or distance from the pith at which the adult stage begins. If a description is based on youthful wood this fact should be explicitly stated so that proper allowance may be made in interpreting the results. It can usually be decided by inspection whether an isolated specimen consists of youthful or adult wood. The third type of variation (accompanying changes of height in the tree) is generally small compared with the others and may be disregarded as a rule. This is fortunate, because it rarely is possible to form an opinion as to the height in the tree from which the sample was taken. The effect of the first and fourth types of variation can not be eliminated by judicious selection of one or two samples from suitable positions in the tree; it can only be covered by taking *a relatively large number of samples, selected at random.* It remains to determine the number of samples and the number of measurements on each sample necessary to give a mean value of a known degree of accuracy. For convenience, the second phase of the problem will be dealt with first.

It is necessary, at this point, to introduce a few statistical terms. In recent years considerable progress has been made in applying statistical methods to problems of variation. The technique developed in connection with the study of natural products, such as agricultural crops, affords a means of assessing the accuracy of results obtained from samples, and can be applied with advantage to the study of wood anatomy, for example, when it is required to compare the average diameter of the vessels in two samples of wood. It must be mentioned that the variations in vessel diameter are approximately of the type known as *normal,* and it follows that the best figures to describe this feature are the (arithmetic) *mean* and the *standard deviation.*

The mean is obtained by dividing the sum of the individual values by the number of observations (in this instance the sum of the diameters by the number of vessels measured). The difference between an individual value and the mean is known as the *deviation.* The standard deviation (*SD*) is found by dividing the sum of the squares of the deviations (d) by the number (n) of the deviations or (esp. if n is small) by $n-1$, and extracting the square root of the quotient, the formula being $SD=\sqrt{\frac{\Sigma d^2}{n}}$ or $\sqrt{\frac{\Sigma d^2}{n-1}}$. It should be noted that the standard deviation itself is not an expression of the amount by which extreme sizes may differ from the mean; for practical purposes it may be assumed that extremes will not usually differ from the mean by more than about three times the standard deviation.

TABLE I

Coefficient of var. not greater than—	Number of observations required	Coefficient of var. not greater than—	Number of observations required
0.067	3	0.17	20
0.077	4	0.19	25
0.086	5	0.21	30
0.12	10	0.24	40
0.15	15	0.27	50

Dividing the standard deviation by the mean gives the *coefficient of variation.* This figure is useful in determining the number of observations necessary to give a specified degree of accuracy, since the larger the coefficient of variation the greater the number of samples that must be examined. If the coefficient of variation is calculated from 100 measurements on one sample, the number of observations that must be made on each subsequent sample to keep the estimated mean within ±10 per cent of the actual mean 99 times in 100 can be read off from Table I, which is applicable to any series of measurements that are *normally* distributed.

In the forty or more species in which vessel diameter has been studied, the coefficient of variation was found to be between 0.14 and 0.19 in the majority of cases, although there were a few exceptional samples; that is to say, 14 to 25 observations on each sample would be sufficient to give a figure for the mean within the requisite limits of accuracy.

Just as the number of measurements required depends on the variation shown by the elements of a sample, so does the requisite number of samples depend on the variation shown by the means of the samples. This latter variation can be treated in exactly the same way as the variation within the sample, and the number of samples necessary can be found by referring to Table I. The writers' observations indicate that the desired accuracy should be reached in most cases if not less than five samples from each of four trees are examined.

Significance of Observations on Limited Material

As it is not always practicable to base timber descriptions on the examination of a large number of samples specially selected from several different trees, it is useful to have some idea of the value of observations based on only a few specimens. It has been shown that a single small sample can not throw much light on the variation likely to occur between different samples, and it follows that any estimate of the value of a description based on a single specimen must depend on previous experience with other species. Thus it may be shown that if we obtain from one specimen a mean tangential vessel diameter of 250μ and a standard deviation of $\pm 50\mu$, then, quite apart from variations due to the influences of environment, we may expect to find other samples of 25 vessels with a mean tangential diameter between 210μ and 290μ. In general terms, the mean of a second sample of 25 observations may differ from the first by more than

$$\pm 4\left(\frac{SD}{\sqrt{25}}\right).$$

The foregoing remarks are sufficient to show that if detailed anatomical descriptions of woods are to be used to the best

advantage, the reader must be informed regarding the methods used in preparing a description. It is not sufficient to state the number of specimens examined; records of measurements, which at best are approximations, should be accompanied by an indication of the degree of accuracy they represent. To anyone who is not mathematically minded, the statistical methods suggested for the treatment of anatomical measurements may appear at first sight a somewhat formidable proposition, and it is fully realized that if they are made too complicated they will not prove generally acceptable and will thus defeat their own ends. The present paper is an attempt to show that if the problem of variation is approached in the right way, good results can be obtained with a relatively small expenditure of time and effort. By the use of such methods wood anatomists, working independently in different parts of the world, can express their results in a way that will be universally understood and readily correlated.

Suggestions for Improving Descriptions

Before leaving this discussion, it is desired to raise the question of the actual value of detailed measurements in wood descriptions. In the writers' experience, the inclusion of measurements in published descriptions is of little value unless they are shown to be of significance in distinguishing two or more similar woods. Too frequently timbers are studied and described as isolated species, without regard to their affinities, and in this kind of description specific characteristics are likely to be obscured by a mass of irrelevant detail, or even entirely overlooked. Anyone who has tried to identify a timber from another's published description will agree that this is often a matter of considerable difficulty, while to distinguish two closely related species from a scrutiny of separate descriptions prepared by different investigators is harder still. It is only by the comparative examination of related species that the diagnostic significance of anatomical features can be assessed, and it is suggested that, whenever possible, woods should be studied in this way, and descriptions should state clearly the characters which distinguish the wood from its congeners.

The value of a description ultimately depends on the extent to which it can be used by other workers. At the present time the science of wood anatomy has not reached the stage where the significance of different structural features as family, generic, or specific characters, is properly understood; in consequence the tendency has been to overload descriptions with detail on the chance that some of it may be significant. It is believed that a useful purpose will be served by examining the significance of anatomical features in the light of our present knowledge, and in a subsequent paper it is proposed to deal with certain characters from this point of view. Suggestions will be welcomed, and if any worker in this field is in a position to supply unpublished data that can be made use of in this connection, the assistance will be gratefully acknowledged.

SUMMARY

In the foregoing paper the problem of variation in the structure of wood is discussed with special reference to vessel diameter as an example.

The selection of samples for microscopic examination and the number of observations necessary to achieve a definite degree of accuracy are considered. It is shown that an estimate of the mean vessel diameter, accurate within ±10 per cent of the actual mean, will generally be obtained by measuring 25 vessels selected at random from each of five samples taken from each of four trees.

A record of the mean vessel diameter should be accompanied by the standard deviation. This quantity can be used as a measure of the significance of observations based on a limited range of material and is essential if it is desired to make use of anatomical measurements for diagnostic purposes.

Material Wanted

Wood samples with herbarium vouchers are needed for a systematic study of the Avicenniaceae and Verbenaceae by Dr. A. J. Panshin and Mr. Harold N. Moldenke, in coöperation with the Yale School of Forestry.

ANATOMICAL EVIDENCE THAT *GREWIA* AND *MICROCOS* ARE DISTINCT GENERA

By M. M. CHATTAWAY

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In a paper published in the *New Phytologist* in 1933 (*2*) the author discussed special kinds of erect cells in the rays of certain genera in the Malvales. Two types were described, the main difference between them being in their relative heights with respect to the procumbent cells. Those in *Durio*, for example, are little if any taller than the procumbent cells, but are much narrower radially, 10–14 of them corresponding to one procumbent cell. In *Pterospermum*, on the other hand, the upright cells are about twice as tall as the procumbent ones, and 4–6 correspond radially to one procumbent cell. In the opinion of the author both of these forms should be included under the term "tile cell," though the *Pterospermum* type does not conform to the definition given in the "Glossary of Terms Used in Describing Woods" (*3*) issued by the International Association of Wood Anatomists.

Although the two types appear to be quite distinct, some doubt was felt about their systematic significance because both were found in different species of *Grewia*. Mr. H. L. Edlin, who is studying the taxonomy of the Malvales and Tiliales at the Imperial Forestry Institute, Oxford, recently called the author's attention to a paper by Burret (*1*) in which the restoration of the Linnean genus *Microcos* is suggested. Linnaeus (*Spec. Pl.* 1 [1753]) at first considered the two genera *Microcos* and *Grewia* distinct, but later (*Syst. ed.* 12, 1767) united them, a change that has been accepted by nearly all botanical authorities since.

Burret bases his classification largely on differences in the stigma, which is simple and apical in *Microcos*, but dilated or lobed in *Grewia*, and on the fruit, which is elobate in *Microcos* but nearly always more or less lobed in *Grewia*. These distinctions are claimed to be quite clear cut and obvious.

Investigation of the wood indicates close relation between Burret's rearrangement of the genus and one based upon the structure of the wood. Of the material of *Grewia* in the Imperial Forestry Institute, all specimens with the *Durio* type of upright cells are of species that Burret refers to *Microcos*, while those of the *Pterospermum* type of erect cells are of species he considers true *Grewias*. Thus, in *Grewia elastica* Royle, *G. multiflora* Juss., *G. oppositifolia* Buch. ex DC., *G. Rolfei* Merr., *G. Rothii* DC., *G. tenax* (Forsk.) Asch. & Schwf., *G. tiliifolia* Vahl, and *G. vestita* L. the xylem ray cells are of the *Pterospermum* type, while the *Durio* type characterizes *Microcos globulifera* (Mast.) Burret, *M. lanceolata* (Miq.) Burret (*Grewia Miqueliana* Kurz), *M. latifolia* (Mast.) Burret, *M. laurifolia* (Hook.) Burret, *M. paniculata* L. (*G. Microcos* L.), *M. stylocarpa* (Warb.) Burret, and *M. tomentosa* Sm.

Some of the other anatomical differences noted in the two groups are as follows:

Microcos	*Grewia*
Parenchyma predominately in short metatracheal lines one cell wide; paratracheal parenchyma occasionally present.	Parenchyma predominately paratracheal; metatracheal parenchyma occasionally present as scattered cells or short lines one cell wide.
Solitary pores usually oval; occasionally round.	Solitary pores usually round, rarely oval. Pores and pore groups more numerous than in *Microcos*.
Intervascular pit-pairs extremely small and numerous.	Intervascular pit-pairs larger and less numerous than in *Microcos*.
Uniseriate rays extremely numerous and often very high.	Uniseriate rays usually very few, or, if numerous, rather low.

Among the species examined the distinction based on the type of erect ray cells holds without exception, but these species represent a comparatively small proportion of this very large genus. The author would be grateful for wood samples of other species of *Grewia* or *Microcos*, especially for samples correlated with herbarium material.

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PRELIMINARY REPORT ON THE WOOD STRUCTURE OF THE FLACOURTIACEAE

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The Flacourtiaceae, according to Ernst Gilg in the latest edition of Engler & Prantl's *Die Natürlichen Pflanzenfamilien*, consist of 84 genera and several hundred species of plants, mostly shrubs or small trees, widely distributed throughout the tropics. This family includes the Samydaceae and a part of the Bixaceae of earlier classifications, and is divided into 11 tribes.

In his account of the relationships of this family, Gilg notes that the Flacourtiaceae are closely related to, and in some instances can hardly be separated with precision from, several other families, namely, the Passifloraceae, Violaceae, Turneraceae, Caricaceae, Bixaceae, Cistaceae, Datiscaceae, and Stachyuraceae of the same order (Parietales), the Tiliaceae (Malvales), the Capparidaceae (Rhoeadales), and the Berberidaceae (Ranales). He continues his discussion of these relationships with descriptions of the detailed differences between the Flacourtiaceae and each one of these other closely related, or strikingly similar, families on the basis of their flower, fruit, and seed characteristics. He believes that the Flacourtiaceae are of ancient lineage, with much possibility of variation in the flowers through the different development of the crown and disc appendages, of which only vestiges remain in the present, and concludes that however much the individual genera may differ from one another, they are capable of being grouped into tribes that obviously are related, in part closely. He adds that to break up this family into a series of others would therefore be a profitless undertaking and would on the one hand obscure the view of the whole and on the other lead to fluctuating regroupings as a result of each new study, and thereby an unnecessary uncertainty in respect to the delimitation of the family. The interpretation of the limits of the Flacourtiaceae by Gilg is more conservative and more restricted than is that of Baillon (*Hist. des Pl.* 4: 265. 1873), and yet wider and more inclusive than that of Bentham & Hooker (*Gen. Plant.* 1: 122, 794. 1862).

As considerable difficulty has arisen in the determination of the exact limits of this family, and particularly with regard to the systematic position of several of its genera, the writer has undertaken a study of the wood structure of the group with the hope that it might prove to be of value in establishing the relationships of its members, and of excluding from the family any plants which might not rightly belong to it. He also hopes to determine and to describe any important and general characteristics of flacourtiaceous woods that may be helpful in their identification. The present paper is a preliminary report on this investigation.

Woods from over 50 species of 32 genera, representing six different tribes, were received from the Yale collections. These woods came from the far corners of the world—Japan, Puerto Rico, Colombia, Philippine Islands, Haiti, Formosa, British Guiana, Burma, Liberia, Java, Madagascar, and many other places. At the University of Michigan were additional samples which had been collected, together with herbarium specimens, by Professor Bartlett in Sumatra and elsewhere. And lastly, still more woods of this family were examined under the microscope in the laboratories of Professor Irving W. Bailey at Bussey Institution, Harvard. All together, a pretty good representation of these woods has been obtained.

The anatomy of all of these flacourtiaceous woods, with only two exceptions, has been found to be remarkably and strikingly constant and similar. The most noticeable and most characteristic feature is in the rays, which are narrow and inconspicuous, but are strongly heterogeneous. The median

part of the ray is multiseriate and the ray cells are radially elongated, while the marginal parts are uniseriate and the compound cells are vertically elongated or square. Frequently these heterogeneous rays are vertically confluent, thus forming exceedingly high, thin sheets of ray tissue. In many of the woods, such as *Scolopia*, *Laetia*, and *Prockia*, the rays are of two distinct kinds, uniseriate and biseriate, but here again, either one or both types are heterogeneous and they tend to be confluent vertically. Seen in the radial section, these woods are very striking and characteristic, with their long rows or tiers of vertically elongated, rectangular cells in regular, straight lines, and connecting with the rays above and below. In many genera the ray cells contain large, many-sided crystals. The rays are so numerous and so close together in several of the flacourtiaceous woods that they constitute as much as 50 per cent of the wood.

Growth rings are not evident in most of the flacourtiaceous woods, but in a few of them, such as *Samyda rosea* Sims. and *Casearia guianensis* (Aubl.) Urb., rings are faintly marked by bands of fibers. The woods are all diffuse-porous, and the individual pores are small and evenly distributed. The vessel members have characteristically simple perforations, but *Taraktogenos*, *Hydnocarpus*, *Scottellia*, and *Hasseltia* have exclusively scalariform perforation plates, or at least predominantly this type, while other genera, such as *Osmelia*, have occasional scalariform perforations, with the simple type predominant. Wood parenchyma is generally lacking in flacourtiaceous woods. When it does occur, as in *Laetia* and *Pangium*, it is very scanty and paratracheal, although a single genus, *Paropsia*, has been described by Den Berger (*Bul. Jard. Bot. Buitenzorg*, [ser. 3] 9: 227. 1928) as having abundant and diffuse wood parenchyma. The wood fibers have thick lateral walls and simple pits, and generally are septate.

The only two exceptions to the characteristic wood structure of the Flacourtiaceae which were found in the more than a hundred woods examined both came from the island of Mauritius, and lack herbarium vouchers. One of these woods, labeled *Aphloia mauritiana* Bak., common name Fandamane, has enormously broad rays, some of which are aggregate, in addition to uniseriate ones. These rays are heterogeneous, however, and the other characteristics of the wood are similar to those of the other Flacourtiaceae, except that the vessel members have scalariform perforation plates, which is the less common type in this family. In view of the fact that Professor Lecomte (*Les bois de la forêt d'Analamazaotra*, pp. 94–95) describes the wood of a Madagascar variety of the same species as having very coarse rays and scalariform perforation plates, there seems to be no reason to question the identification of the specimen. *Aphloia* (=*Neumannia*) may then be either considered as an exception to the typical structure of the Flacourtiaceae, or, as suggested on other grounds by Van Tieghem (*Journ. de Bot.* 13: 361. 1899), segregated into a separate family, the Neumanniaceae.

The other exceptional wood is labeled *Erythrospermum amplifolium* Thou. It has homogeneous rays, and otherwise is distinct in its anatomy from any of the others. Should it prove to have been correctly identified, it may furnish considerable evidence that *Erythrospermum* does not belong in the Flacourtiaceae, as indeed Baillon (*Hist. des Pl.* 4: 265. 1873) has placed it in the Berberidaceae. Den Berger (*Bul. Jard. Bot. Buitenzorg*, [ser. 3] 9: 227. 1928), however, has described another species of this genus having much more nearly the characteristic wood structure of the family.

Several, at least, of the closely related families seem to be readily distinguishable from the Flacourtiaceae on a basis of their wood anatomy. While the Stachyuraceae, the Passifloraceae, and the Violaceae have about the same kind of rays as the Flacourtiaceae, all three of these families have abundant, diffuse wood parenchyma. Additional work must be done on some of the allied groups, but it seems probable that the Flacourtiaceae will prove to be a remarkably distinctive and easily recognizable family on the basis of their wood structure.

SYSTEMATIC ANATOMY OF THE WOODS OF THE MALVACEAE

By IRMA E. WEBBER

The composition of the Malvaceae, or Mallow family, has undergone many changes since the original designation of the group by Adanson (*1*) in 1763. An account of the earlier attempts at revision was prepared by Baillon (*2*) in 1875. The matter continues to be a subject of discussion among taxonomists and there is still considerable confusion regarding the delimitation of malvaceous genera, the family Malvaceae, and the order Malvales. The more important systematic treatments that have appeared during the past 70 years are outlined below.

System of Bentham & Hooker (*4*).—MALVALES: MALVACEAE: Tribes Malveae (sub-tribes Malopeae, Eumalveae, Sideae, Abutileae), Ureneae, Hibisceae, and Bombaceae; STERCULIACEAE, and TILIACEAE.

System of Baillon (*2*).—MALVACEAE: Series Sterculieae, Helictereae, Dombeyeae, Chiranthodendreae, Hermannieae, Buttnerieae, Lasiopetaleae, Malveae, Malopeae, Ureneae, Hibisceae, and Bombaceae.

System of Hallier (*30*).—MALVALES: PAPAYACEAE, EUPHORBIACEAE, BOMBACACEAE, MALVACEAE, ELAEOCARPACEAE, TILIACEAE, RHAMNACEAE, URTICACEAE (including Ulmaceae, Moraceae, and Cannabineae), and DIPTEROCARPACEAE.

System of Engler & Gilg (*17*).—MALVALES: (1) Elaeocarpineae: ELEAOCARPACEAE; (2) Chlaenineae: CHLAENACEAE; (3) Malvineae: GONYSTYLACEAE, TILIACEAE, MALVACEAE, BOMBACACEAE, and STERCULIACEAE; (4) Scyptopetalineae: SCYPTOPETALACEAE.

System of Bessey (*5*).—MALVALES: STERCULIACEAE, MALVACEAE, BOMBACACEAE, SCYPTOPETALACEAE, CHLAENACEAE, GONYSTYLACEAE, TILIACEAE, ELAEOCARPACEAE, BALANOPSIDACEAE, ULMACEAE, MORACEAE, and URTICACEAE.

System of Hutchinson (*39*).—TILIALES: SCYPTOPETALACEAE, TILIACEAE, GONYSTYLACEAE, STERCULIACEAE, and BOMBACACEAE. MALVALES: MALVACEAE.

The order, as defined by taxonomists other than Hutchinson, is also known as Columniferae (*73*, *77*). Schumann in Engler & Prantl (*18*) states that the Malvaceae, Bombacaceae, Sterculiaceae, and Tiliaceae are so closely related that no serious objection can be advanced against combining the four families. Hochreutiner (*37*) indicates that the discovery of the genus *Humbertiella* Hochr., which he regards as intermediate between Malvaceae, Bombacaceae, and Sterculiaceae, lends support to Baillon's system.

The morphological characteristics of the Malvaceae in the narrowest sense may be summarized as follows: Herbs, shrubs or rarely trees with mucilaginous juice, often fibrous, usually stellate pubescent. Leaves alternate, entire or lobed, mostly palmately veined, stipulate. Flowers perfect or rarely polygamous or dioecious, regular. Sepals 3–5, often gamosepalous, valvate in bud, subtended by an epicalyx. Petals 5, free from each other, inserted on the base of the staminal column, contorted or imbricated in the bud. Stamens indefinite, hypogenous, monodelphous in a column enclosing the pistil and divided at the apex; anthers one celled, opening lengthwise; pollen muricate. Ovary superior, commonly 2 or more, often 5 celled, rarely of 1 carpel, or rarely the carpels in vertical rows; style branched above or rarely clavate; ovules 1 to several from the inner angle of each cell. Fruit a loculicidal capsule, baccate, or a schizocarp. Seed with copious or scanty endosperm; the embryo straight or curved with the cotyledons often plicate or contortuplicate. The family as here described is commonly divided into four tribes based on differences in arrangement of carpels and characteristics of the fruit. Many of the genera are poorly separated. Lewton (*49*) points out that none of the characters that have been most frequently used in separating the genera of the Hibisceae tribe are constant or exclusive for any of the genera. An annotated list of commonly recognized genera is given below.

Tribe Malopeae

Carpels arranged in a spherical head in five groups opposite to the petals, fruitlets separating from each other.

1. **Malope** L. (Syst. ed. I. 1735), 8 spp., Mediterranean region, annuals.

2. **Kitaibelia** Willd. (Ges. Naturf. Fr. Neue Schr. 2: 107. 1799), 2 spp., central Europe and Sicily, perennial herbs.

3. **Palaua** Cav. (Diss. 40. 1785), 3 spp., Chile and Peru, glabrous or tomentose perennial herbs.

Tribe Malveae

Number of stylar branches equal to that of carpels, fruit a schizocarp, fruitlets indehiscent.

4. **Bakeridisia** Hochr. (Ann. Cons. et Jard. bot. Genève 15: 298. 1913), 4 spp., Mexico and Brazil, segregated from *Abutilon*.

5. **Horsfordia** A. Gray (Proc. Amer. Acad. 22: 296. 1887), 4 spp., Mexico and southwestern U. S. A.

6. **Neobrittonia** Hochr. (Ann. Cons. et Jard. bot. Genève 9: 184. 1905), 1 sp., Mexico, 2–3 m. high.

7. **Abutilon** Adans. (Fam. 2: 398. 1763), 105 spp., tropical and subtropical herbs, shrubs, or trees.

8. **Wissadula** Medic. (Malv. 24. 1878), 37 spp., tropical America, Asia, and Africa, shrubs, usually tomentose.

9. **Pseudabutilon** Fries (Svenska Vetenskapsaked. Handl. 43: 4: 96. 1908), 9 spp., Mexico and South America, shrubs, segregated from *Wissadula*.

10. **Modiola** Moench. (Meth. 619. 1794) including *Modiolastrum* K. Schum. (Mart. Fl. Bras. 12: 3: 276. 1891), 2 spp., South America, annuals. *Modiolastrum* is recognized as a distinct genus of 3 spp. by some taxonomists, but Hochreutiner (*36*) presents evidence that it should be included in *Modiola* as here indicated.

11. **Howittia** F. Muell. (Trans. Vict. Inst. 1: 116. 1855), 1 sp., Australia, tomentose shrub.

12. **Kydia** Roxb. (Hort. Beng. 50: 97. 1814), 2 spp., India and East Indies, trees yielding timber used locally for inferior buildings, plows, and matches.

13. **Lavatera** L. (Gen. ed. I: 205. 1737), 28 spp., southern Europe, southern U. S. A., central Asia, and Australia, herbs or shrubs, several of horticultural value.

14. **Althaea** L. (Syst. ed. I. 1735), 15 spp., temperate regions of old world or rarely subtropical, annual or perennial herbs. *A. officinalis* L. roots are medicinal. *A. rosea*, var. *nigra* is cultivated in Europe for the coloring matter of the flowers which is used in coloring wines. *A. cannabina* L. yields cordage.

15. **Malva** L. (Syst. ed. I. 1735), 65 spp., temperate Europe, Asia, Africa, and America, herbs. Leaves and flowers of *M. sylvestris* L. and *M. borealis* Wallm. are medicinal.

16. **Callirhoe** Nutt. (Jr. Acad. Nat. Sci. Phil. 2: 181. 1821), 7 spp., North America, herbs. By some taxonomists combined with *Malva*.

17. **Sidalcea** A. Gray (Benth. Pl. Hartw. 300. 1848), 12 spp., western North America, herbs. Recently monographed by Roush (*59*).

18. **Napaea** L. (Syst. ed. VI. add. 1748), 1 sp., eastern U. S. A., tall, stout, perennial, dioecious herb.

19. **Sphaeralcea** A. St. Hil. (Fl. Bras. Mer. 1: 209. 1825), 34 spp., tropical and subtropical America and South Africa, herbs, half-shrubs, or shrubs of the habit of *Malva* and *Malvastrum*.

20. **Malvastrum** A. Gray (Mem. Am. Acad. n. s. 4. 1849), 75 spp., South Africa, North and South America, herbs or shrubs. *M. capense* Garcke and *M. Thurberi* A. Gray are cultivated for their showy flowers.

21. **Nototriche** Turcz. (Bull. Soc. Nat. Mosc. 36: 1: 567. 1863), 70 spp., South America, segregated from *Malvastrum*.

22. **Abutilothamnus** Ulbr. (Notizblatt Konigl. Bot. Gart. u. Mus. Berlin-Dahlem 6: 316. 1915), 1 sp., Brazil, shrub or tree 3–10 m. high.

23. **Plagianthus** Forst. (Char. Gen. 85. 1776), 14 spp., Australia and New Zealand, small trees, shrubs or rarely herbs. *P. betulinus* A. Cunn. yields a timber of minor importance.

24. **Sidastrum** Baker (Jour. Bot. 30: 137. 1892), 1 sp., tropical America, coarse herb.

25. **Sida** L. (Syst. ed. I. 1735), 131 spp., chiefly American but well represented in Australia, herbs or half-shrubs. *S. rhombifolia* L. is a source of cordage. Gandoger (*28*) gives a key to the species.

26. **Tetrasida** Ulbr. (Engl. Jahrb. liv. Beibl. 117: 66. 1916), 1 sp., Peru, woody.

27. **Bastardiopsis** Hassler (Rep. Nov. Spec. 8: 40. 1910), 1 sp., Brazil and Paraguay, tree.

28. **Tarasa** Phil. (Anal. Mus. Nac. Chile 10. 1891), 2 spp., Chile.

29. **Robinsonella** Rose & Baker (Garden & Forest 10: 244. 1897), 7 spp., Central America and Mexico, shrubs or trees. A synopsis of the genus is given by Roush (*60*).

30. **Gaya** H. B. K. (Nov. Gen. et Sp. 5: 266. 1821), 10 spp., tropical America, herbs or half-shrubs.

31. **Pseudobastardia** Hassler (Bull. Soc. Bot. Genève 2: 209. 1909), 3 spp., Brazil, Paraguay and Argentina, annual or perennial herbs.

32. **Bastardia** H. B. K. (Nov. Gen. et Sp. 5: 254. 1821), 2 spp., West Indies and South America, herbs or half-shrubs of the habit of *Sida*.

33. **Anoda** Cav. (Diss. 1: 38. 1785), 14 spp., tropical and subtropical America, annuals. For a monograph of the genus see Hochreutiner (*35*).

34. **Sidanoda** (Robinson) Woot. & Standl. (Cont. U. S. Nat. Herb. 19: 427. 1915), segregated from *Anoda*.

35. **Hoheria** A. Cunn. (Ann. Nat. Hist. ser. 1, 3: 319. 1839), 3 spp., New Zealand, small trees. *H. populnea* A. Cunn. yields a timber of minor commercial importance.

36. **Briquetia** Hochr. (Ann. Cons. et Jard. bot. Genève 6: 11. 1902), 1 sp., Paraguay, perennial herb. For a discussion of the genus see Hassler (*32*).

37. **Lecanophora** Speg. (Rev. Argentina Bot. 1: 4a: 211. 1926), 6 spp., Patagonia, herbs.

38. **Cristaria** Heist. (Syst. 12. 1748), 25 spp., Chile and Peru, annual or perennial, usually prostrate herbs.

Tribe Ureneae or Malvavisceae

Carpels 5 in 1 whorl, the fruit a schizocarp, generally with nut-like fruitlets but in some dehiscent by two valves, or baccate; style branches twice as many as carpels.

39. **Malvaviscus** Cav. (Monad. Diss. 131. 1780), 11 spp., tropical and subtropical America, shrubs or trees with berry-like fruit. Several species of horticultural value.

40. **Malachra** L. (Mant. 1: 13. 1767), 9 spp., tropical America, East Indies, and Africa, mostly annuals.

41. **Urena** L. (Syst. ed. I. 1735), 6 spp., tropical regions, annuals, perennials, or rarely shrubs. For taxonomy of the genus see Hochreutiner (*34*).

42. **Codonochlamys** Ulbr. (Notizblatt. Konigl. Bot. Gart. u. Mus. Berlin-Dahlem 6: 329. 1915), 2 spp., Brazil, shrubs or half-shrubs.

43. **Triplochlamys** Ulbr. (Notizblatt. Konigl. Bot. Gart. u. Mus. Berlin-Dahlem 6: 333. 1915), 5 spp., Brazil, shrubs.

44. **Pavonia** Cav. (Diss. 2 app. 11. 1786), 102 spp., tropical and subtropical herbs or shrubs. The sections *Lebretonia* Schranck (Pl. Rar. Hort. Monac. 90. 1819) and *Typhalea* Neck (Elem. 2: 412. 1790), are given generic rank by some taxonomists. Ulbrich (*69*) gives a monograph of the African species and a discussion of the genus. *P. hastata* Cav. is cultivated as an ornamental. The root of *P. odorata* Willd. is aromatic and a febrifuge.

45. **Pseudopavonia** Hassler (Rep. Nov. Sp. 7: 74. 1909), 2 spp., Paraguay, perennial herbs.

46. **Lopimia** Mart. (Nov. Act. Acad. Caes. Leop. Carol. 11: 96. 1823), 2 spp., Cuba, Mexico, and South America, shrubs. Often included in the genus *Pavonia*.

47. **Peltaea** (Presl) Standl. (Contr. U. S. Nat. Herb. 18: 3: 113. 1916), 4–6 spp., Panama and South America, low shrubs or herbs woody at the base.

48. **Peltobractea** Rusby (Mem. N. Y. Bot. Gard. 7: 298. 1927), 1 sp., Brazil, herb.

49. **Goethea** Nees (Flora 4: 304. 1821), 5 spp., Brazil, shrubs.

50. **Blanchetiastrum** Hassler (Rep. Nov. Sp. 8: 28. 1910), 1 sp., Brazil, woody at the base.

Tribe Hibisceae or Gossypieae

Fruit a capsule.

51. **Decaschistia** Wight & Arn. (Prod. 52. 1834), 6 spp., tropical Asia, small shrubs or half-shrubs.

52. **Senra** Cav. (Diss. 2: 83. 1786), 1 sp., Socotora and Arabia, small shrub.

53. **Lagunaria** G. Don (Gen. Syst. 1: 485. 1831), 1 sp., Norfolk and Howe Islands, Australia, tree. Wood not used except for fuel. Cultivated as an ornamental in California.

54. **Wilhelminia** Hochr. (DeBeaufort, Pulle & Rutten: Nova Guinea, Botanique 14: 160. 1924), 1 sp., New Guinea, small tree.

55. **Wercklea** Pitt. & Standl. (Bul. U. S. Nat. Mus. 18: 111–112. 1916), 1 sp., Costa Rica, tree.

56. **Hibiscus** L. (Gen. ed. I: 207. 1737), about 200 spp., mostly tropical, herbs, shrubs, or trees. The most recent revision of the genus is by Hochreutiner (*33*). For a discussion of the African species see Ulbrich (*69*). In Gandoger's (*27*) enumeration of malvaceous genera, *Gossypium*, *Cienfuegosia*, *Thurberia*, and *Thespesia* are included in this genus. *H. cannabinus* L. and *H. verrucosus* L. are cultivated in India for textile fiber. *H. elatus* Sw. bark

yields cordage known as Cuban bast. Timbers of minor commercial importance are produced by *H. tiliaceus* L. throughout the tropics, *H. elatus* Sw. in tropical America, *H. praeclarus* Gagnep. in Indo-China, *H. mutabilis* L. in Asia, *H. macrophyllus* Roxb. in India, and *H. D'Albertisii* F. v. M. in Papua and New Guinea. The flowers of *H. rosa-sinensis* L. contain coloring matter used by the Chinese to blacken their shoes and eyebrows.

57. **Abelmoschus** Medic. (Malv. 45. 1787), often included as a section of *Hibiscus*. *A. esculentus* Guillem & Perr., the okra, is cultivated for its edible fruits.

58. **Hibiscadelphus** Rock (Hawaii Agric. & For. Bot. Bul. 1: 8. 1911), 4 spp., dry sections of Hawaii and Maui, small trees.

59. **Bombycidendron** Hassk. (Flora 30: 660. 1847), 2 spp., Philippine Islands, trees. *B. campylosiphon* Warb. and *B. vidalianum* Merr. & Rolfe yield timbers of local importance.

60. **Brockmania** W. V. Fitzg. (Jr. & Proc. Roy. Soc. W. Austral. 3: 174. 1918), 1 sp., west Australia, annual.

61. **Jumelleanthus** Hochr. (Candollea 2: 79. 1924), 1 sp., Madagascar, woody.

62. **Megistostegium** Hochr. (Ann. Cons. et Jard. bot. Genève 18: 221. 1915), 4 spp., Madagascar, woody plants.

63. **Perrieranthus** Hochr. (Ann. Cons. et Jard. bot. Genève 18: 235. 1915), 1 sp., Madagascar, woody.

64. **Perrierophytum** Hochr. (Ann. Cons. et Jard. bot. Genève 18: 229. 1915), 2 spp., Madagascar, woody plants.

65. **Humbertiella** Hochr. (Candollea 3: 3. 1926), 1 sp., Madagascar, woody.

66. **Kosteletskya** Presl. (Rel. Haenk. 2: 130. 1831), 10 spp., America, Abyssinia, Mediterranean region, herbs or shrubs.

67. **Dicellostyles** Benth. (Journ. Linn. Soc. 6: 122. 1862), 2 spp., Ceylon, Himalaya, trees.

68. **Julostylis** Thw. (Enum. Pl. Zeyl. 30. 1858), 1 sp., Ceylon, tree.

69. **Symphyochlamys** Gürke (Engl. Bot. Jahrb. 33: 379. 1904), 1 sp., Africa, shrub.

70. **Montezuma** Moc. & Sesse (DC. Prod. 1: 477. 1824), 2 spp., West Indies, trees. Wood of *M. speciosissima* is valued in Puerto Rico for furniture, musical instruments, and construction purposes where strength and durability are essential. Taxonomic history of the genus is given by Urban (*72*).

71. **Ulbrichia** Urb. (Dansk Bot. Archiv. 4: 7. 1924), 1 sp., West Indies, shrub.

72. **Thespesia** Corr. (Ann. Mus. Par. 9: 290. 1807), tropical Asia, Africa, and America, trees or shrubs. *T. populnea* Corr. yields cordage from the bark and a timber of some commercial importance.

73. **Armouria** Lewton (Jr. Wash. Acad. Sci. 23: 63–64. 1933), 1 sp., Haiti, tree.

74. **Shantzia** Lewton (Jr. Wash. Acad. Sci. 18: 10–16. 1928), 1 sp., Africa, shrub.

75. **Sideria** Ewart & Petrie (Proc. Roy. Soc. Victoria 38: 164–182. 1926), 1 sp., Australia, shrub 4–5 feet high.

76. **Cienfuegosia** Cav. (Diss. 174. 1787), including *Alyogyne* Alef. (Oestr. Bot. Zeitschr. 13: 12. 1863), 20 spp., America, Australia, and Africa, half-shrubs or shrubs.

77. **Kokia** Lewton (Smithson. Misc. Coll. 5: 2. 1912), 3 spp., Hawaii, small trees. Notes on the species are given by Rock (*58*). The wood of *K. drynarioides* (Seem.) Lewton is described by Brown (*7*).

78. **Selera** Ulbr. (Verhandl. Bot. Ver. Brandenburg 55: 168. 1913), 1 sp., Mexico. Resembles *Gossypium* except for involucre of entire bracts and slightly hairy seeds.

79. **Gossypium** L. (Syst. ed. I. 1735), 42 spp., tropical and subtropical Asia, America, Australia, and Africa, herbs, shrubs or trees. Commercially the most important genus of the family because it is the source of cotton. For a discussion of the history, taxonomy, and genetics of the genus see Kearney (*45*), Watt (*74*), and Zaitzev (*78*).

80. **Thurberia** A. Gray (Mem. Am. Acad. n. s. 5: 308. 1854), 1 or 2 spp., Mexico and southern United States, herbaceous or fruticose. Hybridizes with *Gossypium* and by some taxonomists regarded as not distinct from that genus (*31*).

81. **Erioxylum** Rose & Standl. (Contrib. U. S. Nat. Herb. 13: 307–308. 1911), 2 spp., west coast of Mexico, shrubs or small trees. *E. aridum* Rose & Standl. timber is used for fencing.

82. **Arcynospermum** Turcz. (Bull. Soc. Nat. Mosc. 1: 191. 1858), *gen. dub.*, Mexico.

The position of the family in the phylogenetic system is not agreed upon by taxonomists. The presence of an epicalyx and the tendency toward free carpels lead some to regard the group as rather primitive, while others regard these characters as reversionary. In Hallier's (*30*) scheme the Malvales are derived from the hypothetical group Drimytomagnolieae. He attributes the difficulties of arrangement and limitation of the Malvales to most of the families of the order representing parallel lines having the same point of departure in the Sterculiaceae, but regards Malvaceae as having originated from Bombacaceae which he derives from Sterculiaceae. In the systems of Bessey (*5*) and Clements & Clements (*14*) the Malvales are derived directly from the Ranales, and in the latter system, Geraniales are derived from the Malvales. Hutchinson (*39*) regards the family as representing a fixed type of the fairly advanced group Tiliales derived from arborescent Magnoliales through the Dilleniales.

The present study was undertaken to ascertain the extent to which a knowledge of the anatomy of the secondary xylem might be of use in settling questions concerning the internal organization of the family and its position in the natural system.

Description of the Woods

Material

The wood specimens upon which this report is based are in the collections of the Yale University School of Forestry. Material was contributed expressly for this investigation by Dr. J. M. Webber, U. S. Department of Agriculture; Mr. B. J. Rendle, Forest Products Research Laboratory, Princes Risborough, England; Dr. W. Youngman, Department of Agriculture, Ceylon; and the State Forest Service, New Zealand, to all of whom I wish to acknowledge my indebtedness. The number of specimens of the various species examined is as follows:

Tribe Malveae: *Abutilon Chittendeni* Standl. (1), *A. megapotamicum* St. Hil. (1), *A. pauciflorum* St. Hil. (1), *A. striatum* Dicks. (1); *Althaea rosea* Cav. (1); *Bastardiopsis densiflora* (H. & A.) Hassler (2); *Hoberia populnea* A. Cunn. (2); *Kydia calycina* Roxb. (2); *Lavatera arborea* L. (1), *L. assurgentiflora* Kellog (1); *Malvastrum fasciculatum* Nutt. (1), *M. Thurberi* A. Gray (1); *Plagianthus betulinus* A. Cunn. (1); *Sida pyramidata* Desp. (1), *S. rhombifolia* L. (1); *Sphaeralcea ambigua* A. Gray (1); *Tetrasida polyantha* Ulbr. (1); *Wissadula zeylanica* Medic. (1).

Tribe Ureneae: *Malvaviscus arboreus* Cav. (1), *M. mollis* DC. (1); *Pavonia rosea* Schl. (1), *P.* sp. (1); *Urena lobata* L. (1).

Tribe Hibisceae: *Bombycidendron* sp. (2); *Cienfuegosia bakaefolia* (Giord.) Hochr. (1); *Dicellostyles axillaris* Benth. (1); *Erioxylum aridum* Rose & Standl. (1); *Gossypium arboreum* L. (1), *G. hirsutum* L. (1), *G. intermedium* Tod. (1), *G. jamaicense* Macfad. (1), *G. mexicanum* Tod. (1), *G. Morrilli* Cook (1), *G. nanking* Meyen (1), *G. obtusifolium* Roxb. (1), *G. peruvianum* Cav. (1), *G. punctatum* Thon. & Schum. (1), *G. Schottii* Watt (1), *G. Sturtii* F. Muell. (1); *Hibiscus Breckenridgei* A. Gray (1), *H. cryptocarpus* A. Rich. (2), *H. Arnottianus* A. Gray (1), *H. elatus* Sw. (4), *H. lasiococcus* H. Bu. (1), *H. macrophyllus* Roxb. (1), *H. moscheutos* L. (1), *H. mutabilis* L. (2), *H. rosa-sinensis* L. (2), *H. schizopetalus* Hook. (1), *H. tiliaceus* L. (17); *Julostylis angustifolia* Thw. (1); *Kokia drynarioides* Lewton (1); *Lagunaria Patersonii* G. Don (1); *Montezuma cubensis* Urb. (2); *Shantzia Garckeana* Lewton (2); *Thespesia populnea* Corr. (8); *Thurberia thespesioides* A. Gray (1); *Wercklea insignis* Pitt. & Standl. (1).

General Properties

In dry woods the color of sapwood is commonly cream, ecru, yellow or reddish, while the heartwood is occasionally

whitish, cream-colored or yellow (*Wercklea*, *Hibiscus*) but more commonly brownish, frequently with a reddish to purplish tinge, or grayish and then often with a greenish cast, frequently streaked or variegated. A distinct line of demarcation may or may not be present between heartwood and sapwood. The range of color within the genus *Hibiscus* is nearly as great as that within the family, and most of the observed colors have been reported as occurring in the woods of *H. tiliaceus* (*76*). According to Kanehira (*44*) and Schneider (*61*) the fresh woods may differ markedly from dry woods in color. Luster is moderate in most specimens but ranges from rather dull to high in *Abutilon*, *Sida*, *Malvaviscus*, *Hibiscus*, *Gossypium*, and *Thespesia*. In the case of *Hibiscus tiliaceus* and *Thespesia populnea*, considerable variation in luster occurs within specimens representing a species. Odor and taste are commonly lacking or not distinctive. Some specimens are slightly astringent. *Thespesia populnea* is sometimes called Rosewood because it possesses a faint odor of roses when rubbed. According to Stone (*64*) the wood of *Hibiscus elatus* is faintly aromatic and peppery when worked.

Most of the woods are light to moderately heavy, but reported weights per cubic foot range from 15 lbs. for *Wercklea insignis* (*40*) to 53 lbs. for *Thespesia populnea* (*6*). The woods vary from very soft in *Hibiscus lasiococcus* and *Wercklea insignis* to hard in *Abutilon Chittendeni* and *Bombycidendron*, but are chiefly soft or moderately hard. Durability is apparently exceedingly variable; *Kydia calycina* being reported as not durable (*67*) while *Montezuma speciosissima* Moc. & Sesse is said to be very durable in contact with soil (*8*). *Plagianthus betulinus* appears to be immune to attack by Anobium while *Hoberia populnea* is not (*41*). Color, hardness, and durability are among the general properties of the woods which seem to be influenced by conditions of growth (*57*). This fact may partially account for wide differences in these characteristics reported as occurring within different specimens of *Hibiscus elatus* (*57*), *Hibiscus tiliaceus* (*76*), and *Thespesia populnea* (*3, 9, 13, 19, 22, 26, 29, 47, 50, 71*). The grain usually is straight, although roe grain is not uncommon in *Thespesia populnea*. The texture generally is very fine or fine, occasionally medium.

Gross Anatomy

Woods diffuse-porous or very rarely (in *Thurberia*) tending to be ring-porous. Growth rings indistinct to readily distinct, frequently less than 1 mm. wide in some species of *Abutilon*, *Sida*, *Hibiscus*, *Gossypium*, *Shantzia*, *Thurberia*, *Kokia*, *Montezuma*, and *Thespesia*, but up to 8 mm. wide in *Hibiscus macrophyllus;* the widths often variable within a single specimen, a range of 0.5–7 mm. being noted in *Plagianthus betulinus*, and 2–7.5 mm. in *Hibiscus tiliaceus*.

Pores often indistinct without a lens; in most genera some solitary, some in radial multiples of 2–5 (or rarely as many as 9 in *Malvastrum* and *Althaea*), and some in roundish, radially elongated or irregular clusters of 3–8 (or as many as 24 in *Althaea*), the ratio of solitary to grouped pores often highly variable in different specimens of the same species; in some genera (*Plagianthus* and *Hoberia*) restricted to conspicuous tangential bands of parenchyma alternating with bands of fibers.

Rays commonly light colored, but reddish to dark brown in some specimens. In most genera visible on cross and radial sections, but indistinct on the tangential, without a lens; rarely indistinct on cross section (in *Pavonia*); visible on all sections without a lens in some specimens of *Lavatera*, *Althaea*, *Malvastrum*, *Plagianthus*, *Hoberia*, *Shantzia*, *Erioxylum*, *Kokia*, *Cienfuegosia*, *Lagunaria*, and *Hibiscus*. Chiefly narrower than pores in *Kydia*, *Hibiscus*, *Montezuma*, *Wercklea*, and *Bombycidendron;* mostly broader than pores in *Sphaeralcea*, *Lavatera*, *Althaea*, *Malvastrum*, *Plagianthus*, *Hoberia*, *Erioxylum*, *Cienfuegosia*, and *Lagunaria;* generally straight or slightly curved about pores; in *Hoberia* and *Plagianthus* sometimes noticeably broader in bands of parenchyma and pores than in bands of fibers. Distance apart in most genera 1–10, commonly 1–3 pore-widths; in *Hoberia* and *Plagianthus*, 4–25 pore-widths.

Ripple marks frequently visible; often conspicuous without a lens in *Abutilon* (*56*), *Kydia*, *Hoberia*, *Sida* (*55*), *Tetrasida*,

Bastardiopsis, *Hibiscus* (*55*), *Gossypium* (*55*), *Shantzia*, *Montezuma*, *Thespesia* (*55*), *Wercklea* (*40*), *Bombycidendron* (*21*), *Dicellostyles*, and *Julostylis;* regular or occasionally irregular. Number per cm. of length, 21 (*Kydia*) to 49 (*Abutilon*), varying considerably in different specimens of the same species.

Minute Anatomy [1]

Pores (Plates I, II) very few in *Kydia*, *Hibiscus*, *Kokia*, *Montezuma*, *Thespesia*, and *Wercklea* to very numerous in *Abutilon*, *Sphaeralcea*, *Wissadula*, *Lavatera*, *Althaea*, *Malvastrum*, *Hoberia*, *Sida*, *Pavonia*, *Malvaviscus*, *Hibiscus*, *Gossypium*, *Shantzia*, *Thurberia*, *Cienfuegosia*, *Montezuma*, *Thespesia*, and *Plagianthus;* 0–250 per sq. mm. Roundish to elliptic when solitary, more or less angular when grouped. Extremely small to rather large (12μ in *Sphaeralcea* to 270μ in *Kydia*), but mostly very small in *Sphaeralcea*, *Wissadula*, *Lavatera*, *Althaea*, *Malvastrum*, *Pavonia*, *Shantzia*, *Erioxylum*, and *Cienfuegosia*, small in *Abutilon*, *Hoberia*, *Sida*, *Gossypium*, and *Lagunaria*, and moderate-sized in *Kydia*, *Kokia*, *Thespesia*, *Wercklea*, and *Bombycidendron*. Chiefly open, but in most genera occasionally with yellowish, brownish, reddish, or rarely greenish gum.

Vessel members (Plates III–V) cylindrical to irregular in form; very short to long (45μ in *Sphaeralcea* to 707μ in *Malvaviscus*) but mostly short (330–450μ) in *Kydia*, *Hoberia*, *Malvaviscus*, *Wercklea*, and *Bombycidendron*, and very short (115–280μ) in the other genera examined. Lateral walls 3–11, mostly 5–6μ thick, copiously pitted. Spiral thickenings observed in *Abutilon megapotamicum*, *Wissadula zeylanica*, *Sphaeralcea ambigua*, *Malvastrum fasciculatum*, *M. Thurberi*, *Hoberia populnea*, *Plagianthus betulinus* and reported by others in *Plagianthus pulchellus* (*50*) and *Plagianthus sidioides* (*62*). Intervascular pitting (Plate V, 1–3) alternate, opposite, or occasionally scalariform in part, the pits with included or extended slit-like to narrowly elliptic apertures and roundish, elliptic or polygonal borders than generally are about 4–10μ in

[1] Designations of abundance and size of individual wood elements are those proposed by Chattaway (*10*).

diameter, but occasionally are much elongated in *Althaea* (*15*, *46*), *Hibiscus*, *Gossypium*, *Thurberia*, *Montezuma*, *Thespesia*, and *Wercklea*. Perforations (Plate V, 6, 14) simple, the plates oblique or horizontal.

Vascular tracheids occur in limited numbers in *Wissadula*, *Malvastrum*, and *Plagianthus*.

Rays (Plates I-V) heterogeneous; few in *Hibiscus*, *Gossypium*, *Lagunaria*, and *Wercklea*, to very numerous in *Kydia*, *Pavonia*, *Hibiscus*, and *Gossypium*, but commonly moderately numerous to numerous in most genera, there being from 0-10 uniseriate and 1-10 multiseriate rays per mm. Uniseriate rays not storied; width from 8μ in *Abutilon* to 38μ in Hibiscus; height from 1 cell in all genera to 35 cells in *Althaea*, or from 16μ in *Abutilon* and *Althaea* to 1428μ in *Pavonia*. Cells mostly all upright, sometimes procumbent in part. Multiseriate rays (*a*) all definitely storied, as in some specimens of *Abutilon*, *Hibiscus* (Plate III, 1), *Montezuma*, *Thespesia*, and *Bombycidendron*, or (*b*) of two size classes, both tending to be storied (*Tetrasida*, Plate III, 2), or (*c*) the smaller storied, the larger not storied, as in some specimens of *Bastardiopsis* (Plate III, 3), *Hibiscus* (*48*), *Julostylis*, and *Dicellostyles*, or (*d*) not at all storied; with or without wide uniseriate margins, occasionally aggregative, and at times apparently vertically fused (Plate III, 2); width[1] very fine (biseriate, 16-27μ) to broad (6-16 cells, 113-200μ) in most of the genera studied, but some very broad (9-26 cells, 216-342μ) in *Sphaeralcea*, *Lavatera*, *Malvastrum*, *Hoberia*, *Plagianthus*, and *Lagunaria*, and some extremely broad (16 cells, 2450μ) in *Hibiscus Breckenridgei* and *Cienfuegosia*; in *Plagianthus* and *Hoberia* sometimes broader in bands of vessels and wood parenchyma than in bands of fibers, and in *Hibiscus* abnormally broad in bands of traumatic parenchyma; height extremely low (3-6 cells, 59-254μ) to rather low (43-258 cells, 2029-4900μ) or rarely moderately high (in *Pavonia*). Upright cells (*a*) exclusively marginal (Plate III, 1), or (*b*) diffuse (Plate III, 6), or (*c*) occurring as sheath cells (Plate IV, 1); widely variable in

[1] Maximum ray width reported by Solereder (*62*) is 9-seriate in *Hoberia*. Tupper (*68*) reports conspicuously large rays in *Hibiscus* and *Plagianthus*, but does not indicate their width in cells or μ.

size and in form from squarish to vertically elongated and rarely approximating tile cells in form in radial section (Plate V, 11), and from radially to tangentially elongated in cross section (Plates I, II). Cell walls 2-5.5μ thick, copiously pitted; ray-vessel pit-pairs half-bordered (Plate V, 5), the simple ray pit commonly approximating the form of the border outline of the adjacent vessel pit and equalling or exceeding it in diameter; unilaterally compound ray-vessel pitting fairly common in *Pavonia*, *Malvaviscus*, *Hibiscus* (Plate V, 4), *Gossypium*, *Thurberia*, and *Wercklea*, a single diagonally elongated ray pit commonly subtending 2 or 3 vessel pits. Starch grains (Plate V, 13); reddish, brownish, yellowish, or greenish gum (Plate V, 11); druses (Plate V, 7), and large solitary crystals (Plate V, 10) may or may not be present in the ray cells.

Gossypol cavities (Plate II, 4; IV, 5) similar to those noted by Stanford & Viehover (*63*) in the phloem rays of *Gossypium*, *Thespesia*, *Cienfuegosia*, *Erioxylum*, and *Thurberia* were observed in the multiseriate xylem rays of *Gossypium mexicanum*, *G. Morrilli*, *G. peruvianum*, and *G. Schottii*. The cavities are filled with a yellowish or brownish substance and surrounded by a layer of more or less flattened cells. In the xylem they are most conspicuous in tangential sections where one or two roundish or vertically elongated cavities, 32-155μ in vertical diameter and 27-108μ in tangential diameter, may occur near the center or toward the ends of a single ray. In transverse and radial sections they are commonly slightly radially elongated elliptic.

Libriform wood fibers (usually the chief element of the wood) cylindrical or somewhat angular in the central part, tapering gradually or sometimes abruptly at first to smooth or occasionally saw-toothed or forked ends; definitely to not at all storied. They range from very short (365μ in *Abutilon*) to very long (2335μ in *Hibiscus*), but are chiefly very short in *Abutilon*, *Sphaeralcea*, *Wissadula*, *Lavatera*, *Althaea*, *Sida*, *Malvastrum*, *Gossypium*, *Erioxylum*, *Kokia*, *Cienfuegosia*, *Montezuma*, *Lagunaria*, and *Wercklea*, mostly short in *Kydia*, *Shantzia*, *Thurberia*, and *Thespesia*, and mostly long in *Hoberia* and *Bombycidendron*; middle diameter from 11μ in

Sida, *Erioxylum*, *Thurberia*, and *Cienfuegosia* to 38μ in *Kydia* and *Althaea*, commonly 16–25μ in most genera examined. Walls commonly 4–8μ, rarely as much as 13μ, thick. Pits few to moderately numerous, simple or very indistinctly bordered, and commonly restricted to the median part of the fiber.

Fiber-tracheids are lacking or distinctly subordinate in most genera, but form a considerable portion of the wood in *Pavonia* and *Wercklea*. They resemble libriform wood fibers, and are very short (515–970μ, mostly about 740μ, long), with a middle diameter of 13.5–95μ. Walls 3.5–5μ thick, with fairly numerous, small, often distinctly bordered pits in the central portion.

Wood parenchyma rather scanty to abundant, the amount varying greatly in different species of a genus (*Abutilon*, *Hibiscus*) and considerably in different specimens of the same species (*Hibiscus tiliaceus*); paratracheal in all genera, metatracheal (Plate II, 5, 6) in many, and occasionally diffuse or terminal. Paratracheal wood parenchyma vasicentric (Plate I, 6), aliform, or confluent (Plate I, 2). Metatracheal parenchyma bands uniseriate or partially biseriate and very numerous in some specimens of *Abutilon*, *Hibiscus*, *Gossypium*, *Shantzia*, *Erioxylum*, *Thurberia*, *Montezuma*, *Thespesia*, *Dicellostyles*, and *Julostylis*; wider (3–6 cells) and less numerous in *Kokia* and *Lagunaria*. Wood parenchyma cells often fusiform (Plate IV, 3) in *Lavatera* and *Althaea*, but commonly in strands (Plate IV, 4) of 2–4 or up to 8 cells (*Kydia*) in the other genera studied. Fusiform wood parenchyma cells and wood parenchyma strands usually definitely or at least somewhat storied; frequently with crystals in *Althaea*, *Hibiscus*, *Kokia*, *Thespesia*, and *Bombycidendron*; with yellow, reddish or brown gum in *Kydia*, *Althaea*, *Malvaviscus*, *Hibiscus*, *Gossypium*, *Kokia*, and *Thespesia*; and with starch in *Althaea*, *Hibiscus*, *Erioxylum*, *Kokia*, *Lagunaria*, *Dicellostyles*, and *Julostylis*. Wood parenchyma cells adjoining vessels vary in width from 11μ in *Thurberia* to 81μ in *Wercklea* and *Hibiscus*, and in height from 18μ in *Shantzia* to 243μ in *Pavonia*; width of other parenchyma cells from 11μ in *Thurberia* to 54μ in *Hibiscus*, height from 43μ in *Thespesia* to 286μ in *Gossypium*, and in a given specimen are commonly

narrower and higher than those adjoining vessels. Thickness of walls from 1.5μ in *Sida* to 8μ in *Hibiscus*. Pits abundant, 1.5–4μ in diameter, except in facets of wall in contact with vessels; parenchyma-vessel pitting similar to ray-vessel pitting.

Vertical gum ducts (Plate IV, 6, V, 14) of traumatic origin (*54*) were observed in *Hibiscus tiliaceus*, *H. elatus*, and *Urena lobata*. Secretory cavities reported by Höhnel (*38*) as occurring in the wood of *Thespesia populnea* may be of this nature (*51*) or, possibly, gossypol cavities, since these are known to occur in the phloem rays of this species (*63*).

Wood Anatomy in Relation to the Taxonomic Divisions of the Malvaceae

Dumont (*15*), in summarizing the characteristics of malvaceous woods, indicates that those of the Hibisceae tribe resemble the Bombacaceae in being very parenchymatous and having few but very large vessels, whereas those of the tribes Malveae and Ureneae are characterized by the presence of alternating fibrous and parenchymatous layers. The present study has shown that this distinction between woods of the Hibisceae and those of the other tribes of the family is not valid. In specimens of the Hibisceae examined, parenchyma is but moderately abundant in the majority of species, no very large pores were observed (the range in pore size being from extremely small to rather large) and bands of metatracheal parenchyma are common.

Within certain of the genera as they are now delimited, differences in structure of the woods of different species are greater than those occurring in available specimens of woods representing different closely related genera. Some species show considerable variation in wood structure; for example, different specimens of *Hibiscus tiliaceus* and *Thespesia populnea*, exhibit greater anatomical differences than those existing between some specimens of *Thespesia* and *Montezuma*. Owing to the variation within species and genera and to a lack or insufficiency of material of some of them, no attempt is made at this time to construct a key for use in the identification of malvaceous woods.

Wood Anatomy in Relation to the Phylogeny of the Malvaceae

The secondary xylem of the Malvaceae shows considerable evidence of specialization, thereby indicating that the family is a fairly advanced group. Vessel members are commonly very short or short, no very long or extremely long vessel members occurring in the material studied; according to Frost (*23*), short vessel members are an evidence of specialization. Vessel perforations in malvaceous woods are exclusively simple, the perforation plates being either oblique or horizontal; simple perforations and horizontal perforation plates are highly specialized (*24*). The lateral walls of the vessels usually possess alternately or oppositely arranged bordered pits; occasionally transitional scalariform pitting. Since Frost's (*25*) study indicates that lateral pitting of vessels commonly specializes more rapidly than the perforation, the latter type of pitting may be developed by fusion of smaller pits (*20*). Spiral thickenings on the lateral walls of vessels are an additional evidence of specialization (*25*) found in some of the genera.

Libriform wood fibers are commonly the dominant element of the wood, more primitive fiber-tracheids (*53*) occurring in but a few of the genera studied.

Wood parenchyma, which generally is believed to have arisen through specialization of tracheids (*43, 53, 66*), is usually moderately abundant and of a fairly specialized type; wood parenchyma strands being far commoner than fusiform wood parenchyma cells. Since the distribution of parenchyma throughout the growth ring is regarded as the primitive type of arrangement (*43, 16*), the common occurrence of metatracheal and, to some extent, confluent bands of parenchyma in the woods of the Malvaceae is indicative of moderate advancement. It is noteworthy that, as in the case of the Sterculiaceae (*11*), some species are characterized by very narrow bands of metatracheal parenchyma, while broader bands of metatracheal parenchyma and rather wide bands of confluent parenchyma occur in other species.

Thompson's (*65*) study of the phylogenetic sequence of ray forms indicates that multiseriate rays such as occur in

the Malvaceae are an advanced type. As has been pointed out in the case of *Hibiscus mutabilis* (*75*), the distribution of accompanying uniseriate rays, together with the morphology of uniseriate ray cells, suggests that the uniseriate rays in malvaceous woods represent a further advance. Chattaway's (*12*) study of serial tangential sections has shown that dissection of multiseriate rays may result in formation of similar uniseriate rays in woods of the related Sterculiaceae.

The tendency toward storied structure of the wood (*52*) is another evidence of specialization in the Malvaceae, for Janssonius (*42*) has found a high correlation between such structure, which he terms Stockwerkmerkmale, and specialized structure of individual wood elements.

Summary

The more important systems of classification of the Malvaceae are summarized and an annotated list of genera of the Malvaceae is given.

The woods of the Malvaceae as a whole are described on a basis of specimens in the Yale collections.

Structural features of the woods hitherto unreported for the family or at variance with previous reports include (*a*) the occurrence of vertical gum ducts of traumatic origin in *Urena lobata*, (*b*) gossypol cavities of sporadic occurrence in the xylem rays of *Gossypium mexicanum*, *G. Morrilli*, *G. peruvianum*, and *G. Schottii*, (*c*) broader rays than previously reported for the family, and (*d*) macroscopic ripple marks in *Kydia*, *Tetrasida*, *Hoberia*, *Shantzia*, *Montezuma*, *Dicellostyles*, and *Julostylis*.

There is considerable variation between individual wood specimens of some of the species. Differences between woods of certain genera are less marked than between species of some of the others.

The woods show evidences of specialization which indicate that the Malvaceae are fairly advanced in the phylogenetic scale.

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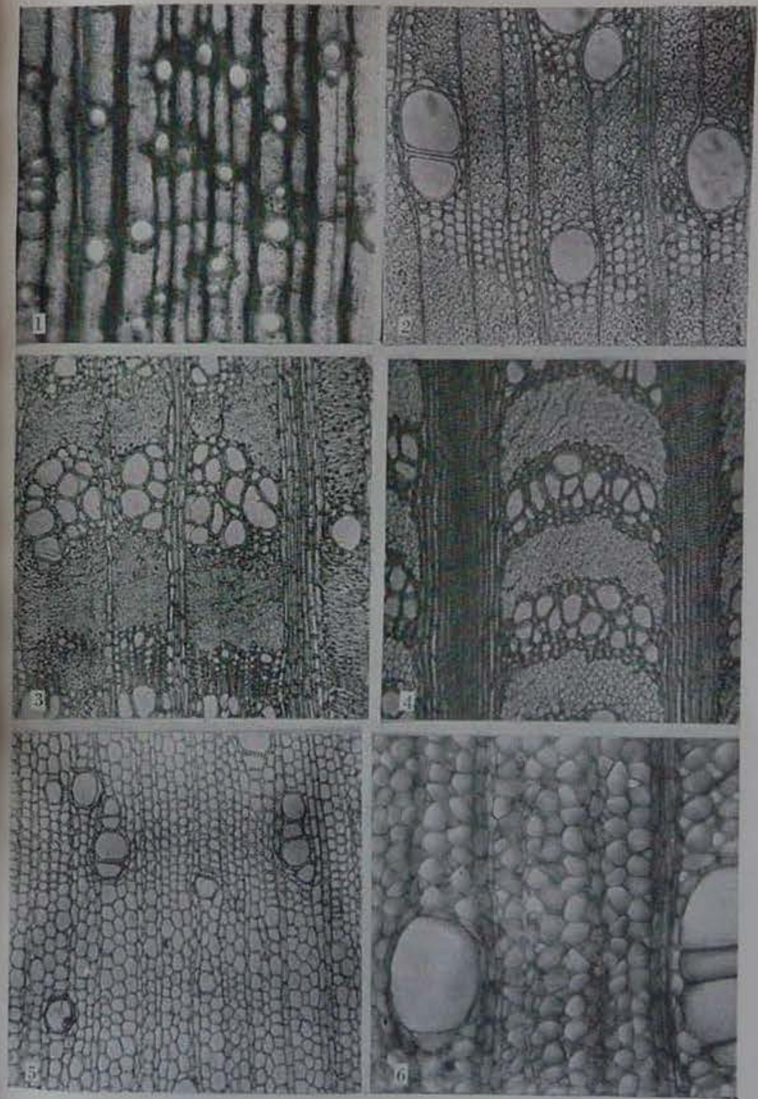

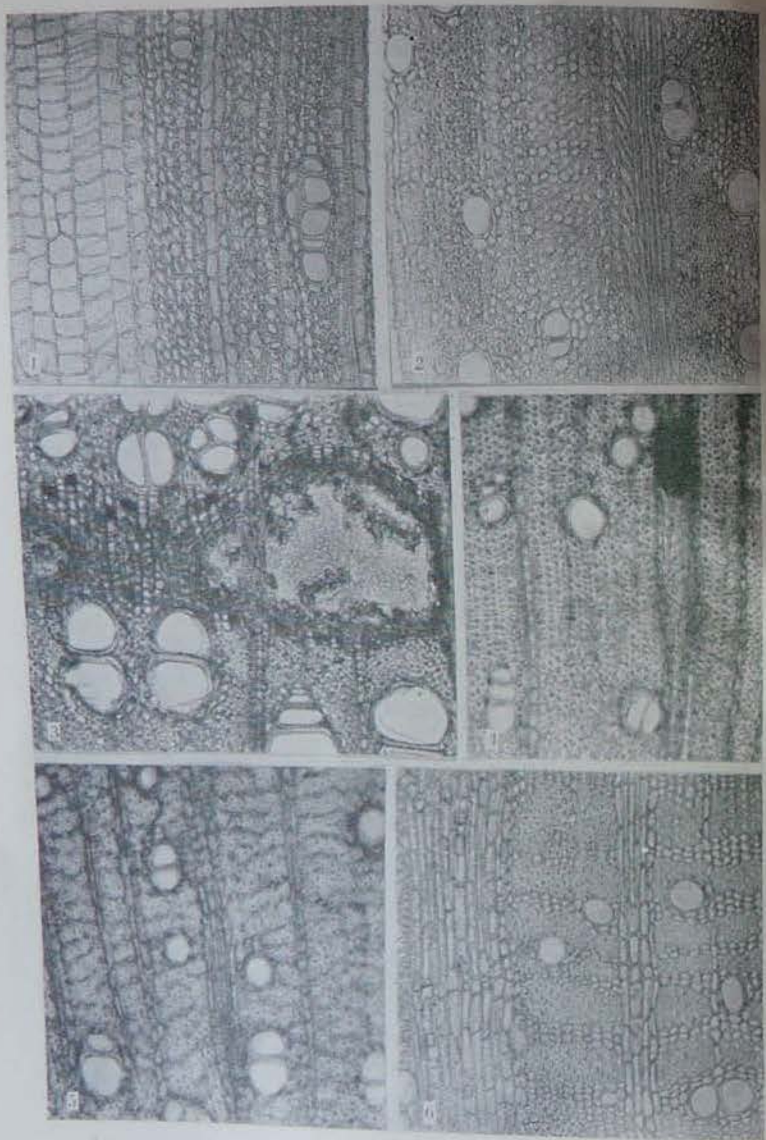
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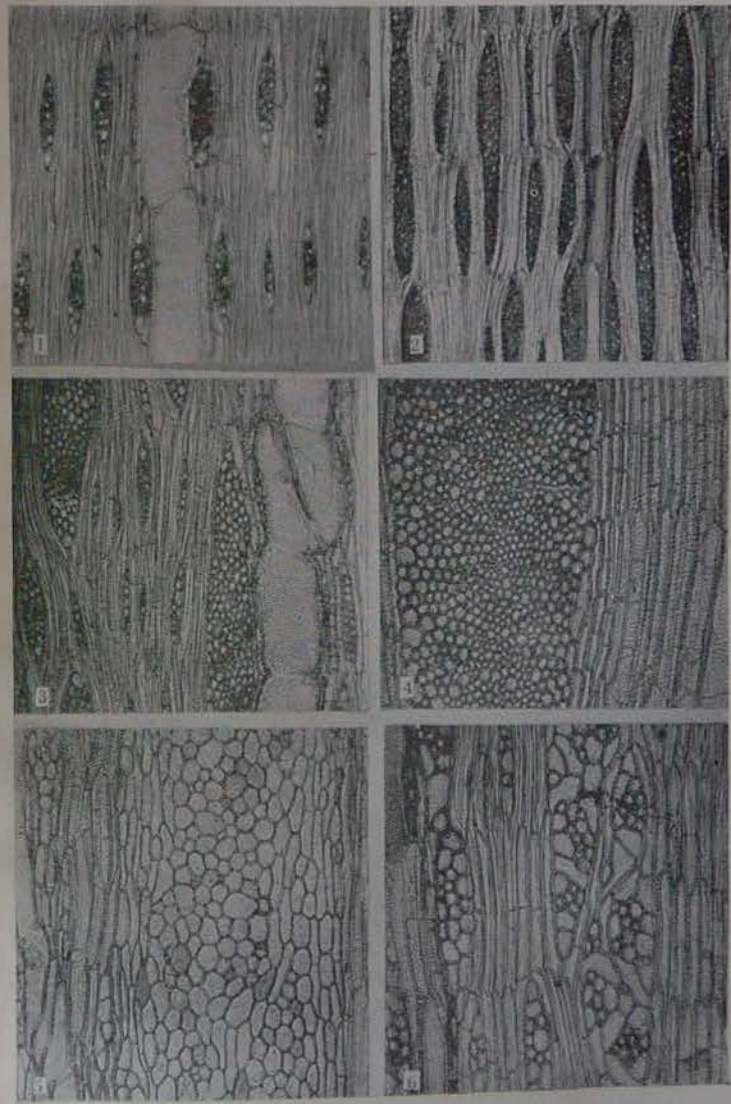
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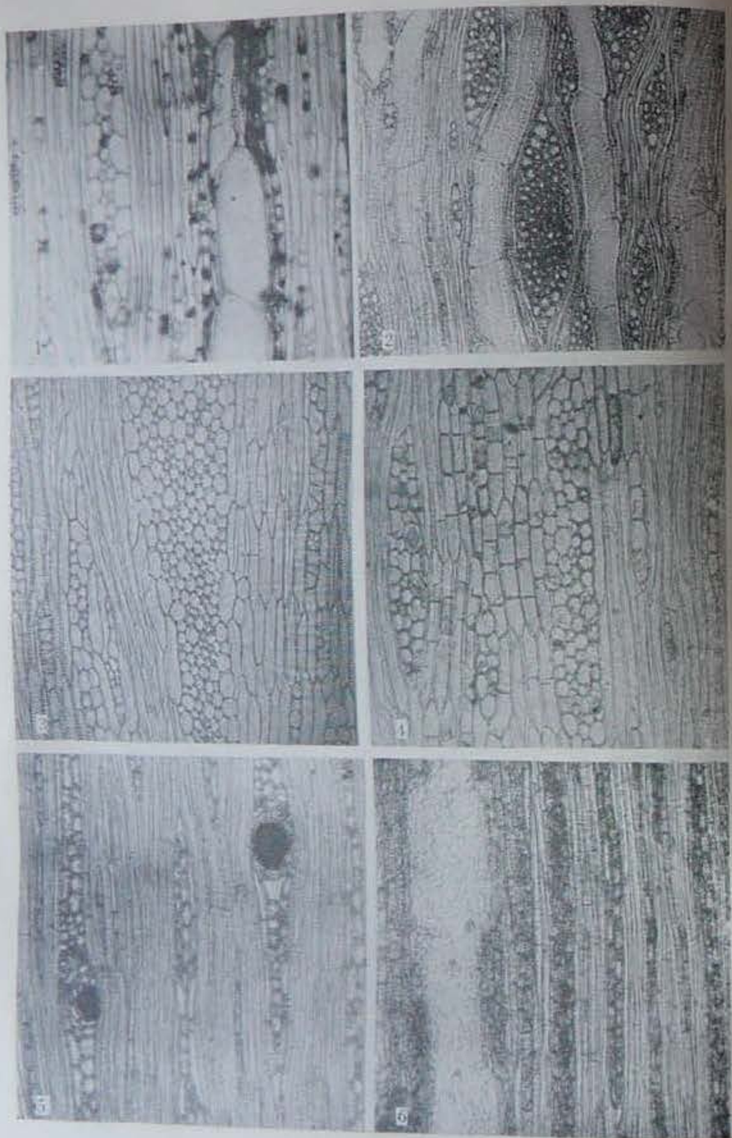

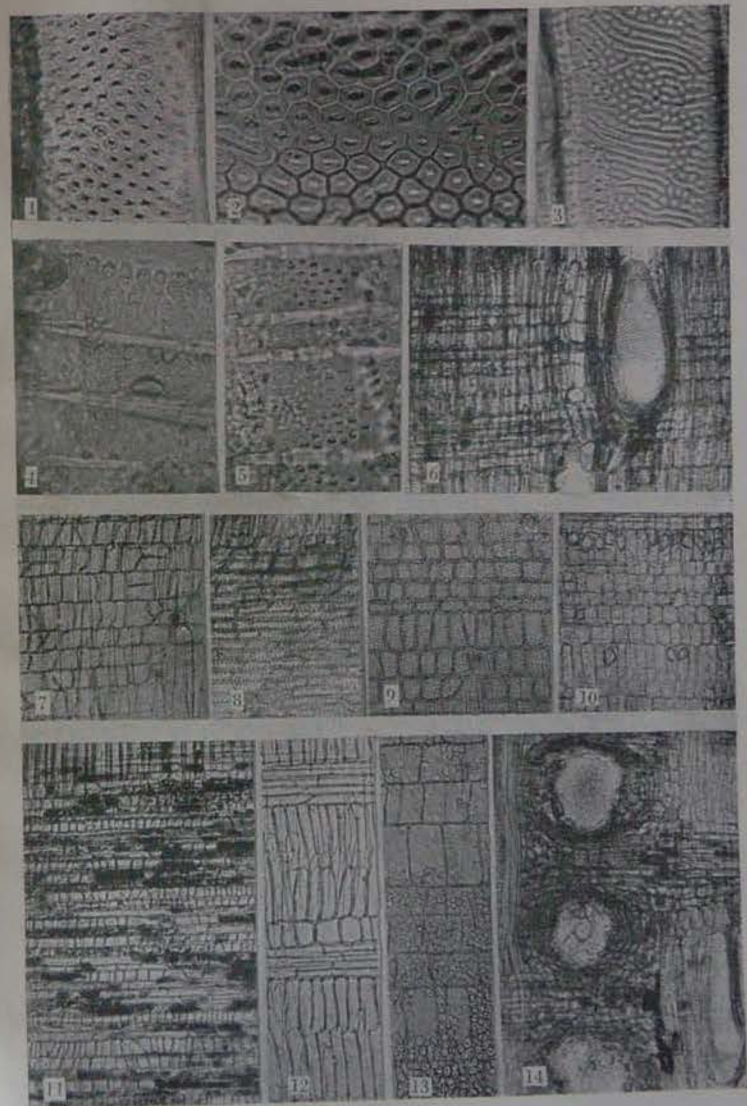

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EXPLANATION OF PLATES

Plate I. CROSS SECTIONS OF MALVACEOUS WOODS. × 72.

No. 1. *Abutilon Chittendeni* Standl. (Yale 10009) from Honduras.
No. 2. *Bastardiopsis densiflora* (H. & A.) Hassler (Yale 3161) from S. Paulo, Brazil.
No. 3. *Malvastrum Thurberi* A. Gray. (Yale 6713) from California.
No. 4. *Plagianthus betulinus* A. Cunn. (Yale 26655) from New Zealand.
No. 5. *Pavonia rosea* Schl. (Yale 3358) from Pará, Brazil.
No. 6. *Wercklea insignis* Pitt. & Standl. (Yale 4370) from Costa Rica.

Plate II. CROSS SECTIONS OF MALVACEOUS WOODS. × 72, except No. 3.

No. 1. *Hibiscus moscheutos* L. (Yale 19839) from Berkeley, California, showing ray cells with tangential diameter exceeding the radial.
No. 2. *Hibiscus schizopetalus* Hook. (Yale 17924) from Peru, showing irregularly shaped ray cells.
No. 3. *Hibiscus elatus* Sw. (Yale 5008) from Cuba, showing traumatic gum ducts. × 52.
No. 4. *Gossypium Morrilli* Cook (Yale 21690) from Palm Springs, California, showing gossypol cavity.
No. 5. *Shantzia Garckeana* Lewton (Yale 13947) from Washington, D. C., showing narrow bands of metatracheal parenchyma.
No. 6. *Lagunaria Patersonii* G. Don (Yale 20116) from Riverside, California, showing wider bands of metatracheal parenchyma.

Plate III. TANGENTIAL SECTIONS OF MALVACEOUS WOODS. × 72.

No. 1. *Hibiscus elatus* Sw. (Yale 739) from Cuba, showing definitely storied rays.

No. 2. *Tetrasida polyantha* Ulbr. (Yale 19033) from Peru, showing apparently vertically fused, storied rays.

No. 3. *Bastardiopsis densiflora* (H. & A.) Hassler (Yale 1704) from Argentina, showing small storied rays and large non-storied rays.

No. 4. *Hoberia populnea* A. Cunn. (Yale 23737) from New Zealand, showing portion of very broad ray composed of small, thick-walled ray cells.

No. 5. *Cienfuegosia bakeafolia* Hochr. (Yale 21688) from California, showing portion of very large ray composed of relatively large ray cells.

No. 6. *Thespesia populnea* Corr. (Yale 11066) from Venezuela, showing irregularly shaped, scattered upright ray cells.

Plate IV. TANGENTIAL SECTIONS OF MALVACEOUS WOODS. × 72.

No. 1. *Hibiscus mutabilis* L. (Yale 5228) from Florida, showing ray with sheath cells.

No. 2. *Hibiscus schizopetalus* Hook. (Yale 17924) from Peru.

No. 3. *Lavatera arborea* L. (Yale 19840) from Berkeley, California, showing fusiform wood parenchyma cells.

No. 4. *Kokia drynarioides* (Seem.) Lewton (Yale 1866) from Hawaii, showing storied wood parenchyma strands.

No. 5. *Gossypium Morrilli* Cook (Yale 21690) from Palm Springs, California, showing gossypol cavities in the rays.

No. 6. *Urena lobata* L. (Yale 26654) from Ceylon, showing high, narrow rays and axial traumatic gum duct.

Plate V. STRUCTURAL DETAILS OF MALVACEOUS WOODS.

Nos. 1–3. Tangential sections showing types of intervascular pitting. × 375. (1) *Julostylis angustifolia* Thw. (Yale 26652), from Ceylon. (2) *Wercklea insignis* Pitt. & Standl. (Yale 4370) from Costa Rica. (3) *Hibiscus schizopetalus* Hook. (Yale 17924) from Peru.

No. 4. *Hibiscus tiliaceus* L. (Yale 14278) from New Caledonia; radial section showing unilaterally compound ray-vessel pitting. × 325.

No. 5. *Dicellostyles axillaris* Benth. (Yale 26651) from Ceylon; radial section showing half-bordered ray-vessel pit-pairs. × 325.

Nos. 6–13. Radial sections of malvaceous woods, showing differences in form, size, contents, and arrangement of procumbent and upright ray cells. × 72. (6) *Thespesia populnea* Corr. (Yale 11066) from Venezuela. (7) *Althaea rosea* Cav. (Yale 23707) from California. (8) *Plagianthus betulinus* A. Cunn. (Yale 26655) from New Zealand. (9) *Malvaviscus mollis* DC. (Yale 19842) from California. (10) *Erioxylum aridum* Rose & Standl. (Yale 20107) from California. (11) *Kydia calycina* Roxb. (Yale 12549) from Burma. (12) *Hibiscus lasiococcus* H. Bu. (Yale 12873) from Madagascar. (13) *Hibiscus Breckenridgei* A. Gray (Yale 23281) from Hawaii.

No. 14. *Hibiscus elatus* Sw. (Yale 5008) from Cuba; radial section showing axial traumatic gum duct. × 52.

CURRENT LITERATURE

Identification of the timbers of temperate North America. By SAMUEL J. RECORD. John Wiley & Sons, Inc., 440 Fourth Avenue, New York. May 1934. Pp. ix+200; 5¾ x 9; 47 text figs.; 8 plates. Price $3.00.

This book was written to replace the author's *Identification of the economic woods of the United States* (1912 and 1918), which now is out of print. It is more than a revision, as Part I, "Anatomy and certain physical properties of wood," has been completely rewritten, while much new material has been added to Part II, "Timbers of temperate North America."

The first part, except for a few of the 16 tables, applies to woods of both temperate and tropical climates. In it the author has attempted to elaborate and illustrate the anatomical terms and definitions adopted by the International Association of Wood Anatomists. All but four of the 47 text figures are from photographs, and many of them were made especially for this book.

The second part includes (1) a revised descriptive key to more than 80 commercial woods of the United States and Canada, (2) a new section containing accounts of the distribution, size, importance, common names, relationships, and utilization of the trees, and (3) 300 references.

Continuous and discontinuous growth of cambium. By D. T. MACDOUGAL. *Year Book of the Carnegie Institution of Washington* No. 32 from 1932–33, pp. 189–190.

"The capacity of the cambium layer of trees to carry on growth without cessation or rest and without rhythm, as exemplified by the Monterey Pine, has been previously described. A similar condition exists in the Monterey Cypress. A dendrograph attached to a tree 12 cm. in diameter late in 1931 revealed the fact that the trunk was in a state of active enlargement at that time. The record shows continuous growth activity through the 20 months since the observations were begun.

"The behavior of the green smooth stems of the desert Palo Verde (*Parkinsonia microphylla*) is in striking contrast. An instrument attached to the trunk of such a tree in 1920 showed no enlargement. The instrument was taken to be faulty and the observations discontinued, to be resumed in February 1929 with an improved apparatus. The record now extending into the fifth season shows that there was a net decrease in the diameter of the trunk in the seasons of 1929, 1930, and 1931. In the fourth year a net increase of 0.44 mm. was measured. The trunk, which is sound, healthy, with a green smooth bark, has at this date (July 1933) a diameter 4 mm. less than at the beginning of 1929. These observations indicate that areas of cambium may remain inactive for long periods despite the fact that the majority of the thin branches elongate and bear leaves every season.

"To what extent the activity of the cambium extends downward from such active growing points can not be conjectured. Marked concentric zonation of the wood occurs. X-ray images of cross-sections show that this is not due to annually formed or seasonal layers of wood. Inhibition of the activity of the cambium as a traumatic effect of pruning, topping, or defoliation is well known in many trees. It seems to be a normal procedure in *Parkinsonia*. The implied inactivity may be due to growth-inhibiting substances which may also be responsible for the long life in a dormant condition of cells in *Parkinsonia* trunks. Some of the living elements have an estimated age of between three and four hundred years. Many incompletely differentiated wood fibres, tracheids, and other elements are found several inches inward from the surface of the trunk."

Revision der Oleaceengattung *Haenianthus*. By E. Knoblauch. *Repertorium Specierum Novarum Regni Vegetabilis* (Berlin-Dahlem) 34: 139–142; 1933.

The genus *Haenianthus* of the family Oleaceae, endemic in the Greater Antilles, consists of six species of trees and shrubs. After careful study of the group, the author decides that only two of the species are clearly valid, *H. incrassata* (Sw.) Griseb., of Jamaica, and *H. salicifolia* Griseb., of Cuba, Hispaniola, and Puerto Rico, the latter divisible into three varieties, *H. variifolia* Urb. and *H. grandifolia* Urb., of Cuba, still are insufficiently known.

Las plantas medicinales de México. By Maximino Martínez. Mexico City, *Ediciones Botas*, 1933. Pp. 644; 5½ x 7½; fully illustrated.

This volume contains accounts of many hundreds of Mexican plants; although listed by their vernacular names, an index to them and their Latin equivalents makes the information contained immediately available. The work is divided into four parts: (1) Plants whose Latin names are known, and whose properties have been studied more or less completely from a medical standpoint; (2) those whose Latin names are known, but the plants have not been studied thoroughly, or often not at all; (3) those known only by their vernacular names, but reputed to have medicinal properties; (4) information taken from the Libro del Judío, published in Yucatan in 1834, and from other similar publications relating to Yucatan plants.

While the book is devoted primarily to medicinal plants, it contains much information regarding trees and shrubs. The very numerous and chiefly original illustrations of Mexican plants, many of which never have been figured before, make the work a useful one for any one interested in the study of the flora of the region.—P. C. Standley.

Dendrograph studies on *Achras zapota* in relation to the optimum conditions for tapping. By John S. Karling. *American Journal of Botany* 21: 4: 161–193, April 1934. Illustrated.

Summary

"The trunk of *Achras zapota* in British Honduras undergoes more or less rhythmic diurnal expansion and contraction under fairly constant weather conditions. It reaches the maximum diameter between 6:00 and 7:00 a.m. and then gradually decreases to a minimum at approximately 5:00 p.m.

"Such rhythmic diurnal changes, however, obtain only under fairly constant weather and environmental conditions. Rain, increased humidity, changes in temperature, and wind velocity may alter the rhythm considerably, particularly during the day. The season of the year and the position of the tree in the jungle, whether exposed or sheltered, likewise alter the mode and magnitude of the reversible variations.

"Since the Sapodilla stem reaches its maximum diameter and doubtless its greatest turgidity at approximately 6:00 a.m., this is probably the most favorable time for tapping as far as internal conditions are concerned. However, before tapping and drainage of the latex are completed, external factors such as increased temperature, wind, sun, and decreased relative humidity become effective and doubtless influence the yield. For these reasons tapping at night seems most conducive to a maximum yield.

"The effect of tapping on the diametral variations of the trunk, as shown in the dendrograph records, is less marked than that of hot, dry, windy weather.

"The Sapodilla stem undergoes marked seasonal variations in diameter which correspond closely with the wet and dry seasons in British Honduras. The trunk gradually reaches its maximum diameter in December at the end of the rainy period, and declines to the minimum in April at the conclusion of the dry season. As the rains start again, the stem begins to increase in diameter. Thus the daily reversible and seasonal variations are both closely correlated with weather conditions.

"The chicle bleeding season in British Honduras runs usually from June to January and is thus concurrent with the rainy season and the period of maximum trunk diameter.

"Rehydration, auxesis, and meresis[1] appear to be the dominant factors in the gradual increment of the Sapodilla stem during the rainy season.

"The condition of the stem relative to turgidity and available water supply and the external environmental conditions are the determining factors in the time of the tapping seasons."

[1] "Rehydration [increase in turgor] . . . consists primarily of the swelling up or increase in volume of more or less flaccid xylem, phloem, and other tissue cells by the imbibition of water. . . . Mass growth, or auxesis, involves the increase in size or enlargement and volume of immature and perhaps recently divided cells. . . . [It] may be divided into two classes: (1) increase in size and volume with dry weight increase, and (2) without dry weight increase. . . . There is need for a more concise name for census growth [or growth with cell multiplication], and I am hereby proposing the term *meresis* for this process. Meresis independently does not necessarily involve increase in size or dry weight, except perhaps the kinoplastic material which forms the cell plates and subsequent cell boundaries, but it provides the units in which mass growth operates."

Ensayo sobre las formaciones ecológicas vegetales en el Departamento del Atlántico. By ARMANDO DUGAND G. In Colegio de Barranquilla's *Apuntes sobre la historia natural del Departamento del Atlántico*, Barranquilla, Colombia, October 1933, pp. 21–29.

The Departamento del Atlántico of Colombia, occupying the extreme northern part of the Magdalena Valley, has a temperature that varies from 19° to 36° C., with a mean of 27°, and an average rainfall of 100 cm. The dry season covers the months of December to April, the wet season the rest of the year, with an interruption in July and a marked increase in intensity in September and October. The region consists chiefly of almost level plains, separated by hills of slight elevation and lowlands flooded during the high waters of the Magdalena.

The ecologic divisions of the region are indicated as follows:

Xerophilous zone. (1) THORN FOREST. A dry region alternating with the strand formation and also occurring as islands in the interior. Characteristic plants are Cactaceae, species of *Acacia*, *Pithecolobium*, *Piptadenia*, *Capparis*, *Jacquinia*, and *Bumelia*, and a palm, *Copernicia sanctae-marthae*. The only important trees are *Hura*, *Bombacopsis Fendleri*, and *Caesalpinia granadillo*. (2) DRY OR XEROPHILOUS FOREST. Covering the low coastal hills and the region about Barranquilla. Among the common trees are *Gliricidia*, *Pereskia colombiana*, *Bursera Simaruba*, *Platymiscium polystachyum*, *Crescentia cujete*, *Sapindus*, *Gyrocarpus*, *Torrubia Olfersiana*, *Tabebuia* spp., and *Hura*.

Tropophilous zone. (1) DRY SAVANNA OR "TIERRA FIRME." Characterized by herbaceous plants, especially grasses, with isolated patches of forest. Among the trees are species of *Hura*, *Tabebuia*, *Bombax*, *Acacia*, *Sterculia*, *Vitex*, *Melicoccus*, *Talisia*, *Cordia*, *Lonchocarpus*, *Machaerium*, *Ceiba*, *Lecythis*, *Astronium*, *Ficus*, *Enterolobium*, *Cecropia*, *Ochroma*, and *Swartzia*. (2) INUNDATED LOWLANDS. Overflowed at times by flood waters of the river, the water draining away but slowly, many of the plants being aquatic. Among the trees are *Bactris*, *Guadua*, *Anacardium excelsum*, *Samanea saman*, *Tabebuia pentaphylla*, *Lecythis minor*, *Ficus* spp., *Bravaisia*, *Triplaris*, *Pterocarpus podocarpus*, *Chlorophora*, *Coccoloba*, *Crataeva*, and *Salix chilensis*. (3) TRANSITION FOREST. Undoubtedly the most interesting formation, and the one with most numerous species, but insufficiently known at present; occupying at least a third the area of the department, and all the subcentral and west-central portions of it. The trees mentioned are *Cavanillesia*, *Copaifera*, *Toluifera*, *Sciadodendron*, and *Aspidosperma Dugandii*.

Halophilous zone. (1) MANGROVE SWAMPS, with the usual species of *Rhizophora*, *Laguncularia*, *Avicennia*, and *Conocarpus*. (2) THE STRAND, characterized by *Hippomane*, *Guaiacum*, *Caesalpinia crista*, *Bursera graveolens*, and *Cocos nucifera*.—PAUL C. STANDLEY.

Observaciones sobre la denominación de dos plantas. By ARMANDO DUGAND G. In Colegio de Barranquilla's *Apuntes sobre la historia natural del Departamento del Atlántico*, Barranquilla, Colombia, October 1933, pp. 30–32.

The following trees are described in detail: *Samanea pistaciaefolia* (Willd.) Dugand, comb. nov. (*Mimosa pistaciaefolia* Willd., *Samanea guajacifolia* Pittier), vernacular name, Guayacán Chaparro; *Cathormium mangense* (Jacq.) Dugand, comb. nov. (*Mimosa mangensis* Jacq., *Pithecolobium mangense* Macbride), vernacular names, Olla de Zorro, Hoyo de Zorro, Vainillo, and Vivaseca.

The vegetation of Moraballi Creek, British Guiana: An ecological study of a limited area of tropical rain forest. Parts I and II. By T. A. W. DAVIS and P. W. RICHARDS. *Journal of Ecology* 21: 2: 350–384, Aug. 1933; 22: 1: 106–133, Feb. 1934. Illustrated.

"The aim of the ecological work undertaken by the Oxford University Expedition to British Guiana was to be intensive rather than extensive. After only 15 weeks of field work the most we could hope to do was to give an accurate and, as far as possible, quantitative description of the vegetation of our chosen area. It was clear that we could only raise problems and not solve them. Though one of us [Mr. Davis] had some years previous experience of the Guiana forest, which was valuable in suggesting lines of work, it must be emphasized that our results and conclusions apply only to the limited area we studied and not necessarily to the whole Guiana forest, still less to rain forests in general."

SUMMARY OF PART I

"The district whose vegetation is described is only a few miles in extent and lies in the rain forest region of British Guiana in lat. 6° 11′ N.

"The chief characteristics of the climate are high and even temperature (mean annual 25.9° C.) and constantly high humidity. Mean annual rainfall 270 cm. There are two dry seasons in the year, but no month has an average rainfall of less than 10.7 cm. In relation to these conditions the vegetation shows little periodicity, though there is some indication of two flowering seasons in the year.

"Human interference has been one of the most important biotic factors. It has chiefly taken the form of shifting cultivation and timber (Greenheart) exploitation. The latter is much the more important at the present time. Its effects can be mostly allowed for in ecological work.

"The structure of the forest is described in some detail. The trees form only two distinct strata, an irregular canopy of about 24 m. average height and undergrowth trees up to about 14 m. high. Above the former many trees of up to 42 m. stand out incompletely, while here and there are exceptionally tall trees which have their whole crown clear of their neighbors. The stratification of the trees was shown by felling and measuring all the trees on sample plots. Two strata of herbs and shrubs are recognized and the former are grouped into a number of synusiae. The stratification of the climbers and the distribution of the epiphytes is mainly a response to the internal climate of the forest determined by the vegetation itself. This internal climate differs from the general climate of the region in its even more extreme uniformity, which increases from the canopy downwards.

"The height at which the epiphytes grow is shown to depend mainly on light intensity and to be hardly at all related to differences in the humidity of the air."

SUMMARY OF PART II

"The primary forest of the district is not homogeneous, but consists of five distinct communities, the Mora (dominant, *Mora excelsa* Benth.), Morabukea (dominant, *Mora Gonggrijpii* Kleinhoonte), Mixed (no clear dominant), Greenheart (dominant, *Ocotea Rodioei* Schomb.), and Wallaba (dominant, *Eperua falcata* Aubl.) types. The floristic composition of each was analyzed by counts of trees on sample plots.

"Each type of forest is more or less clearly limited to a definite type of soil. If the types are arranged in order from the type on the wettest (Mora) to the one on the driest soil (Wallaba) some striking regularities are disclosed. Dominance of a single species of tree is marked at each end of the series

(67 per cent of all over 41 cm. diameter) and decreases regularly to a minimum at the middle. The number of trees on unit area increases steadily from Mora to Wallaba. The number of species of trees on the sample plots is greatest in the Mixed and Greenheart forest and considerably smaller in the other types. The proportion of Leguminosae is high at each end of the series and diminishes towards the middle.

"The buttressing of the trees is greatest in the Mora type and diminishes with great regularity to the Wallaba. This fact supports the views of Petch and is quite contrary to any teleological interpretation of their significance. Other facts are given which point in the same direction.

"All five types of forest are climax communities, but the Mixed type probably occupies the optimum habitat and should be regarded as the climatic climax of the district."

Flora of the Kartabo region, British Guiana. By Edward H. Graham. *Annals of the Carnegie Museum* 22: 1: 17–292; pls. 3–18; figs. 1–2; Feb. 1, 1934.

The flora is based upon material collected within a radius of 60 miles from Kartabo, at the junction of the Cuyuni, Mazaruni, and Essequibo Rivers, near the coast of British Guiana. The introduction contains information regarding the general features of the colony, its geology and botanical exploration, and the plants of Georgetown. The Kartabo region is treated in detail, the vegetation being classified as follows: Fluvio-littoral association; forest association, with six societies, namely, high-forest, mid-forest, low-forest, forest-floor, epiphyte, and forest-margin; forest-clearing associes.

The systematic treatment, which comprises the larger part of the paper, includes a key to the families, keys to the genera and species of pteridophytes and spermatophytes, brief descriptions of the species collected by the author and others and references to many other plants cultivated in the region or reported from it, and vernacular names of many of the species, with notes regarding the economic applications of the plants. There are listed formally 119 families and 624 species, the families represented by the greatest number of species being Leguminosae (69), Rubiaceae (34), and Melastomaceae (31).

While evidently quite incomplete for the region that it is intended to cover, as the author himself states, this flora will prove highly useful to all persons interested in the plant life of the Guianas, or even of lowland tropical regions more distant. Certain inaccuracies in nomenclature, mostly of a minor nature, will not detract seriously from the practical usefulness of the publication.—P. C. Standley.

Studies in the decomposition of timber under industrial conditions. I. Greenheart. By Ernest A. Rudge. *Journal of the Society of Chemical Industry* (London) 52: 36: 283–285T, Sept. 8, 1933. Illustrated.

This is the first of a series of investigations undertaken to determine the factors underlying "the decay of woody tissue under circumstances where the biochemical action due to fungi, bacteria, or animal life may be regarded as of secondary character, negligible, or absent entirely." The subject of the present study was a section of Greenheart (*Ocotea Rodioei*) taken from approximately the middle of a pile embedded for 40 years in a permanently wet condition, in a matrix of clinker, sand, mud, and calcareous matter. Under such conditions the pile showed limited external decomposition, the decay being greatest in the middle and least at the ends. The decayed part, in section, was lighter in color than the sound center and separated from it by a distinct, undulating, dark-colored line, independent of that distinguishing the sapwood from the heartwood. "Across this line exist very marked differences in mechanical strength, ash content, and inorganic decomposition." The outer decomposed layer, spongy in texture, was found to be perforated with worm holes, sometimes up to six or seven, but at no time penetrating the sound wood. The decomposition of the wood was accompanied by the infiltration of calcium and aluminum compounds. Inorganic examination of the pile section showed no appreciable difference in moisture content between the decayed and sound wood. Whereas the values for acid content of the sound wood were almost normal, the decayed wood had a high degree of acidity, probably as a result of decomposition of the woody tissue. The author suggests that the sapwood is not selectively decomposed under these circumstances. Tests for crushing strength of the timber indicated that the sound inner wood had suffered little or no loss of strength, and this factor is maintained up to the line of demarcation.—L. WILLIAMS, *Field Museum of Natural History.*

Notes on Guiana Euphorbiaceae. By J. LANJOUW. *Recueil des Travaux Botaniques Néerlandais* 31: 451–465; 1934.

Among the woody plants of Guiana enumerated are the following: *Phyllanthus acuminatus* Vahl, vernacular name Conaparoo, a shrub used as a fish poison; *Drypetes variabilis* Uitt., a tree 15–27 meters high, Shibadan (Arowak name); *Croton potaroensis* and *C. Bartlettii*, new species.

Flora of Surinam (Dutch Guyana). Edited by A. PULLE. Koninklijke Vereeniging Koloniaal Instituut te Amsterdam, Med. No. XXX, Afd. Handelsmuseum No. 11, March 1934. 6¼ x 9¾. Prices: Vol. I, pp. 49–160, f 4.55; II, pp. 113–144, f 1.30; III, pp. 65–160, f 3.90; IV, pp. 113–304, f 7.80.

The first instalments of this valuable *Flora* were issued in April-May 1932. (See *Tropical Woods* 33: 35, March 1, 1933.) The families covered in the current parts are as follows: I, Polygonaceae, Cyperaceae, Caryophyllaceae, Proteaceae, and Aizoaceae (in part). II, Myristicaceae, Menispermaceae, and Anacardiaceae (in part). III, Guttiferae, Lecythidaceae, Punicaceae, Bixaceae, and Araliaceae (in part). IV, Rubiaceae, Ericaceae, and Campanulaceae (in part).

***Bactris* und verwandte Palmengattungen.** By M. BURRET. *Repertorium Specierum Novarum Regni Vegetabilis* (Berlin-Dahlem), 34: 167–253; 1933–34.

The Palm genera considered are *Bactris*, *Martinezia*, *Guilielma*, and *Pyrengoglyphis*. Of *Bactris*, 150 valid species are listed, many of which are described as new, and there are extensive notes regarding distribution, vernacular names, etc. Seven species of *Guilielma* are recognized. *Pyrenoglyphis* has usually been merged with *Bactris*, but it is here treated as a valid group, with 28 species.

Among the new species described are the following (all but one Brazilian): *Bactris Luetzelburgii*, var. *anacantha* (Rio Tarumâ), called Ubim; *B. simplex* (Amazonas), Ubim; *B. amoena* (Rio Içá), Ubim; *B. Huebneri* (Manáos), Ubim Rana; *B. erostrata* (Rio Yapurá), Maraja; *B. leptospadix* (Rio Yapurá), Maraja; *B. tucum* (Bahia), Tucum; *B. polyclada* (Rio de Janeiro), Tucum; *B. dianeura* (Nicaragua), Coyolito.

Notas sôbre o genero *Duckeodendron*. By J. G. KUHLMANN. *Arquivos do Instituto de Biologia Vegetal* (Rio de Janeiro) 1: 1: 35–37, Jan. 1934.

Nine years ago Kuhlmann described this Brazilian tree and placed it in the family Solanaceae. Four years ago he decided that it belonged to the Boraginaceae. Last year Record looked at the wood and found that it fitted most comfortably in the Apocynaceae. Called upon to choose from three families, I agreed with Record. (See *Tropical Woods* 33: 7–10, March 1, 1933.)

Now Kuhlmann has obtained still better material and returns *Duckeodendron* to the Solanaceae. His objection to the Apocynaceae is based on the quincuncial aestivation, the free anthers, the nature of the stigmas, the syncarpous ovary, and the structure of the embryo. In its drupaceous fruit it differs so strongly from the rest of the Solanaceae that he sets up for it a new tribe, the Duckeodendrinae, which he places next to the Mandragorinae. This is really quite an extension of the Solanaceae-concept, but Kuhlmann believes the only alternative is the creation of a new independent family, the Duckeodendraceae.—H. A. GLEASON, *New York Botanical Garden.*

O gênero *Eichleria* sinonimo de *Rourea*. By J. G. KUHLMANN. *Arquivos do Instituto de Biologia Vegetal* (Rio de Janeiro) 1: 39–40; figs. 1–4; Jan. 1934.

Study of material of the genus *Eichleria* from Brazil shows that it is synonymous with the older genus *Rourea*. The two species described under *Eichleria*, therefore, become *Rourea Blanchetiana* (Prog.) Kuhlmann and *R. Progeliana* Kuhlmann (*Eichleria lucida* Prog.).

Estrutura do lenho do *Mimusops Huberi*. By F. R. Milanez. *Arquivos do Instituto de Biologia Vegetal* 1: 1: 49–62; 9 plates, 4 text figs.; Jan. 1934.

The very dense, durable, and fine-textured wood of the true Massaranduba, *Mimusops Huberi* Ducke, is described at length and illustrated with photomicrographs. There is also a discussion of various structural features of wood and an appendix elaborating some previous observations on crystalliferous parenchyma cells.

Plantae Krukovianae, II. By H. A. Gleason and A. C. Smith. *Bulletin of the Torrey Botanical Club* (Menasha, Wisconsin) 61: 191–196; April 1934.

The following trees, new species unless otherwise indicated, are recorded from the Maracassumé River, State of Maranhão, Brazil: *Aniba opaca* Smith, vernacular name Louro Abacate; *Ocotea Froesii* Smith, Louro do Igapó; *Moquilea riparia* Gleason, Camacary; *Cupania olivacea* Gleas. & Smith, Páo de Arapuce; *Sloanea reticulata* Smith, Guabiraba Branca; *Couratari coriacea* Mart., Tauary Branco.

El cedro peruano, *Cedrela Herrerae* Harms. By Fortunato L. Herrera. *Revista Sudamericana de Botánica* (Montevideo) 1: 21–27; Feb. 1934.

There are known from Peru at least two species of *Cedrela*, *C. fissilis* Vell. and the recently described *C. Herrerae* Harms. The latter forms extensive forests in the Department of Cuzco, in the Urubamba Valley, and it is also cultivated commonly at elevations of 2800 to 3400 meters. The tree is of slow growth, flowering at fifteen years or more. There are recognized locally two forms of the tree, Atoc-cedro, 15–20 meters high, with fibrous white wood, porous and with but slight odor, growing in the bottoms of quebradas, along streams; and Cedro Virgen, 25–30 meters high, with reddish, compact, very resinous wood, having a pungent odor, growing on hillsides. From the former are obtained planks 4–5 meters long, and from the latter, which is more highly valued, planks 7–8 meters in length. It is probable that both these forms represent a single species. The wood, incorruptible, light in weight, and easily worked, is employed for making fine furniture.—P. C. Standley.

Interim report on work under project No. 2, strength tests of timbers in structural sizes, with test results up to 1932. By L. N. Seaman. *Indian Forest Records* (Econ. ser.) 17: 7: 1–39. Delhi, 1933. Illustrated. Price 1 s. 9 d.

This report is concerned with the establishment of correct ratios between the strength functions of small clear specimens of Indian timbers and the allowable working stresses in structural members. As it is intended for use by practical engineers, architects, and timber users in general, special attempt has been made to present the subject in simple language, and the amount of tabulated data is reduced to a minimum.

Report of a botanical trip to the Ranau Region, South Sumatra. By C. G. G. van Steenis. *Bull. Jard. Bot.* (Batavia) 3: 13: 1–56; 11 figs.; Dec. 1933.

The contents include articles upon topography and geology, earlier collections, author's route and collections, sketches of the vegetation, plant-geographical remarks, and occurrence of mountain plants at low altitudes. Much information concerning the forest vegetation is contained in paragraphs upon secondary growth, the primary forest between 500 and 1000 m. altitude, the gorge of Air Telanai, the mountain forest of Bt Pakiwang, the mountain forest of G. Raja, and trip to G. Pesagi. The paper ends with the following "Conclusion": "Java and Sumatra do not show a fundamental difference in altitudinal range for plants and most of the examples of former authors have not held. Descent of mountain plants into the lowland country is found throughout Malaysia as well as ascent of lowland plants. The favored localities for the former are characterized by open vegetation (either originally or secondary) and unfertile, mostly acid-reacting soil and give the opportunity for fixed establishment in the lowland. Temporary establishment may be due to local dispersal by water. Descent in altitude in the tropics is only possible in eurytherm genera; true stenotherm mountain plants have never been observed below the 1000 m. contour whatever favoring factor was offered them."—P. C. Standley.

Contributions towards a flora of British North Borneo. III. *Bulletin of Miscellaneous Information* (Royal Botanic Gardens, Kew), 1933, pp. 487–495.

Among the trees listed are: *Xanthophyllum ellipticum* Korth., Keramundoi (Dusun); *Sterculia megistophylla* Ridley, Biris Merah (Kadayan); *Grewia antidesmifolia* King, var. *hirsuta* King, Damak-Damak (Kadayan); *Erioglossum rubiginosum* Bl., Berbogon (Dusun); *Kandelia candel* Merr., Lingg-jong; *Eugenia incarnata* Elmer, Jambu Keresek (Brunei); *Memecylon caloneuron* Miq., Merbinga (Dusun); *M. paniculatum* Miq., Lumbai Andu (Bisaya); *Actinodaphne Maingayi* Hook. f., var. *macrocarpa* Gamble, Pengalaban Gala (Kadayan); *Phoebe opaca* Bl., Medang Lada (Kadayan); *Ostodes macrophylla* Benth., Putat Rimba (Brunei).

Some remarks on the Kinabalu collection of Chaplain and Mrs. Clemens, 1931–32. By C. G. G. van Steenis. *Journ. Bot. Brit. & For.* (London) 72: 1–12; 1934.

During 1931–32 Chaplain and Mrs. Clemens collected 3500 numbers of plants on Mt. Kinabalu, British Borneo, at elevations of 3000 to 13,500 feet. The author publishes several new species and names based upon the collections: *Weinmannia Clemensiae; Radermachera ramiflora; Rhamnus borneensis; Paratrophis glabra* (Merr.), comb. nov. (*Gironniera glabra* Merr.), a tree called Laudji in Celebes and having a whitish sapwood and a dark red-brown heartwood so hard as to turn the edge of a knife.

Die Phanerogamenflora der Kleinen Sunda-Inseln und ihre Beziehungen. Ein Beitrag zur Renschschen Sunda-Expedition. By Jacob von Malm. *Repertorium Specierum Novarum Regni Vegetabilis* (Berlin–Dahlem) 34: 255–307; 1934.

There is a brief account of the geography of the islands treated, which extend for a length of more than 1000 km. between the eighth and ninth degrees of southern latitude. Briefly treated, also, are the climate and the principal plant formations; and, in greater detail, the relationship and origin of the flora. Two pages are devoted to bibliography of the

islands. There is also an annotated systematic list of the more characteristically Malaysian plants represented in the flora.

Methods for the identification of the light-coloured woods of the genus *Eucalyptus*. By H. E. Dadswell, Maisie Burnell, and Audrey M. Eckersley. Bull. No. 78, Council for Sci. & Ind. Research; Tech. Paper No. 12, Div. of Forest Products. Melbourne, 1934. Pp. 60; 6 x 9½; 76 photomicrographs.

"The development of methods for the identification of the more important timbers belonging to the botanical genus *Eucalyptus* has been divided into two main parts. Part 1 consisted of the study of the macroscopic and microscopic features of some 37 colored woods of the genus, and as a result of the investigations a tentative key for the separation of these timbers was developed. [See *Tropical Woods* 33: 54, March 1, 1933.] The present investigation forms the second part of this project, and in it the macroscopic and microscopic features of 41 pale or lightly colored woods of the same genus have been investigated. While the microscopic examination of the various colored woods is by no means complete, it has been considered of greater importance to proceed with the examination of the pale colored woods.

"As previously discussed, the timbers of the various species of the genus *Eucalyptus* were divided into two main groups on the basis of color, namely, (1) the definitely colored woods (including dark red, red, dark brown, chocolate, and pink woods); (2) the pale or lightly colored woods (including those light brown, brown, yellow, white, or faintly colored).

"The results of the examination of the second group, *i.e.*, the pale-colored woods, are included in this publication. In the great majority of cases, classification into these two groups according to the color of the wood has proved satisfactory. In some cases, however, as would be expected, samples of several species which were considered in the second group indicated above showed a definite color. As a result, these species will also have to be considered with the woods of the colored group.

"As an aid to identification, two possible keys have been developed. One of these is intended more for the use of the practical man who has not the facilities for examining microscopic sections. The other has been developed for the use of wood anatomists, particularly those overseas to whom Australian timbers are not familiar."

Properties of Australian timbers. Part I. Eight timbers of the genus *Eucalyptus* (ash group). By H. E. DADSWELL. Pamphlet No. 47, Council for Sci. & Ind. Research; Tech. Paper No. 13, Div. of Forest Products. Melbourne, 1933. Pp. 28; 6 x 9½; 15 photomicrographs.

"This publication is the first of a series in which it is proposed to record the available information regarding the properties and uses of the principal commercial timbers of Australia. The data it contains have been collected from various publications, a list of which is included, and from unpublished reports of the various sections of the Division of Forest Products. Officers of the Division have personally visited the principal milling centers in all the states and a very large number of the main wood-using industries, in order to study the uses of timbers. In addition, use has been made of the results of five years' work in the Division, covering numerous phases of utilization, seasoning, preservation, mechanical properties, structure, and chemistry. It is realized that in some respects the information is incomplete, as additional data are constantly being collected. However, it has been deemed essential to begin this series in order to supply a source from which reliable information concerning Australian timbers can be obtained.

"A number of Eucalypts of low density and pale color have been called Ash timbers because of a superficial resemblance to the Ashes of the northern hemisphere (*Fraxinus* spp.). These timbers are of definite commercial importance since they have found favor both in the local trade and in the overseas markets. They have been described at various times, but the publications are not of recent date. Therefore, because of their commercial importance and because additional information of practical value to users is available, some repetition is justifiable.

"Of the Eucalypts, the timbers of the species listed below have, to a varying degree, the general appearance mentioned above. These species are listed in order of commercial importance: *E. regnans* F. v. M., *E. gigantea* Hook. (syn. *E. delegatensis* R. T. B.), *E. obliqua* L'Her., *E. Sieberiana* F. v. M., *E. fastigata* Deane & Maiden. In addition, the species *E. oreades*, *E. fraxinoides*, and *E. consideniana* are also considered. *E. regnans*, *E. gigantea*, and *E. obliqua* are of more or less equal importance, and are commonly sold in Australian and overseas markets as Tasmanian or Australian Oak.

"All the timbers of the above species are pale colored, light or moderate in weight, of open texture, and generally straight-grained. In cell structure they are very much alike, and definite identification is not always possible."

Révision des espèces congolaises du genre *Cynometra* Linn. By J. LEBRUN. *Bulletin du Jardin Botanique de l'État Bruxelles* 9: 281–302; Dec. 1933.

From the Congo there are reported 11 species of *Cynometra*, for each of which there are provided descriptions, citation of specimens examined, and miscellaneous notes, besides a key for separation of the species. Vernacular names are reported, as follows: *C. leptantha* Harms, N'koko; *C. Mildbraedii* Harms, Hoabe, Disagua; *C. kisantuensis* Vermoesen, Kiala Moka; *C. Alexandri* C. H. Wright, Wenzele, Angu, Liera, Bapa, Tembwe, Tembu, Aro; *C. Schlechteri* Harms, Etuna; *C. Hankei* Harms, Botuna, Bongile, Bohili, Baraka, Kassassesase, Boseke. *C. Dacremontii* is described as a new species, from Lower Congo.

C. Alexandri is remarkable in having a wide distribution, and is especially abundant along the eastern border of the equatorial Congo forest, at the base of the Massif du Ruwenzori and toward Mambassa, where it constitutes 50–70 per cent of the arborescent flora and 30–80 per cent of the exploitable trees. The grayish to deep pink sapwood is as much as 30 cm. thick, the heartwood is violet-yellow to maroon-brown at first, reddening conspicuously on exposure to the air, and exhibiting dark violet striping on radial surfaces; it is very hard, has a sp. gr. of about 0.80, and is difficult to work.—P. C. STANDLEY.

Les *Pachylobus* (Burséracées) de la Côte d'Ivoire. By François Pellegrin. *Bull. Soc. Bot. France* (Paris) 80: 712–715; 1 fig.; 1933.

Recently collected material shows that the genus *Pachylobus* is represented in Ivory Coast by at least three species.

De quelques Légumineuses de l'Afrique occidentale. By François Pellegrin. *Bull Soc. Bot. France* (Paris) 80: 463–467, Dec. 23, 1933.

The following new trees of the Leguminosae are described from Ivory Coast: *Dialium Aubrevillei*, vernacular name Croupio or Kroupio; *Hymenostegia Aubrevillei; Kaoue Stapfiana* (A. Chev.) Pellegrin (*Oxystigma Stapfiana* A. Chev.), a new genus, Kaoué, Kahu; *Piptadenia Aubrevillei*, Atembré; *Aubrevillea Kerstingii* (Harms) Pellegrin (*Piptadenia Kerstingii* Harms), a new genus, Pipigbalé, also *A. platicarpa*, called Kléklé; *Calpocalyx Aubrevillei*, Guepizou, Bois Salé.

Révision du genre *Enantia* Oliv. (Anonacées). By W. Robyns and J. Ghèsquière. *Bulletin du Jardin Botanique de l'État Bruxelles* 9: 4: 303–316; Dec. 1933.

The genus *Enantia* consists of 10 species of large or small trees, confined to the Guinea forest province of tropical Africa, except for *E. Kummeriae*, which occurs in Tanganyika Territory. Numerous vernacular names are reported for the species. *E. chlorantha* Oliv. is known in commerce as African Yellow Wood, West-afrikanisches Gelbholz, and Moambe Jaune. New species described are *E. Lebrunii* (Belgian Congo); *E. atrocyanescens* (Belgian Congo), vernacular name Lunginu; *E. olivacea* (Belgian Congo), M'Bila; and *E. kwiluensis* (French Equatorial Africa), Muamba-benki.

Note sur les bois d'*Enantia* (Anonacées). By D. Normand. *Bulletin du Jardin Botanique de l'État Bruxelles* 9: 4: 317–322, Dec. 1933. 2 photomicrographs.

Study was made of the mature wood from the following African species of *Enantia: E. polycarpa* Engl. & Diels, the M'baoué of the Ivory coast; *E. chlorantha* Oliv. from Gaboon, where it is known as Mfôl (Pahouin), though exported as Moambe Jaune; and *E. affinis* Exell from Cameroun, also exported as Moambe Jaune.

The general structure, based on the examination of some 20 African species, is described as follows: *Rays* of varying size, the larger ones frequently cut obliquely across by fibers (tang. sec.). Large oil cells of scattered occurrence. *Pores* few, solitary or in small multiples, rather regularly distributed; abundant deposits of calcium carbonate sometimes present. Diameters 80–125μ, possibly indicating freedom from attack by insects (*Lyctus*). *Parenchyma* in numerous parallel metatracheal lines, exceptionally narrow-vasicentric; distinct under lens and often to the unaided eye on cross section because of the brown color imparted by the contents of the secretory cells. *Wood fibers* compose the ground mass. Their walls vary greatly in thickness in different species, the thickest containing very numerous small pits. *Color* is more distinctive than structure in separating these woods from the others in this family, being brilliant sulphur-yellow with a grayish tinge, becoming reddish on exposure. There is no sharp difference between sapwood and heartwood.

An attempt to prepare a key for the three species on a basis of the macroscopic and microscopic characteristics of the material available was not successful because differences within a species were found to be as great as the differences between species. Indicative data as obtained are presented in a table which shows much overlapping. A detailed description of the structure of the wood of *E. chlorantha* Oliv. is given. The woods discussed are soft and light and not well suited to general uses.—Eloise Gerry, *U.S. Forest Products Laboratory*.

Dermatitis due to woods. By Francis Eugene Senear. Reprinted, with additions, from *The Journ. of the American Medical Association* (Chicago) 101: 1527–1532, November 11, 1933.

Dermatitis resulting from contact with woods or their dusts is relatively common, and while those of tropical origin are most frequently responsible, the author believes that woods of temperate climates may give rise to such reactions more often than generally is supposed. "That this subject is not new is shown by the fact that . . . one of the earliest known cutaneous diseases in the Orient was dermatitis due to contact with the milky white juice of *Rhus vernicifera*," the Japanese Lacquer Tree. Because of the industrial aspect, greatest attention has been given in modern times to those cases in which dermatitis has resulted from contact with dusts produced in working with woods themselves, but eruptions may occur from contacts of other types. For example, there are recorded instances of dermatitis caused by smoke from burning branches of the Mango Tree (*Mangifera indica*); by contact with water contaminated with latex exuded by the fruit of the Rengas (*Gluta* spp. and *Melanorrhea* spp.) of the Malay Peninsula, and by the use of furniture made from that timber, especially when it has become worn; and by contact with various barks, particularly in stripping.

Wood is as a rule more toxic when freshly cut, but in a few instances the toxicity increases on seasoning. The length of the period of contact before dermatitis develops varies from a few days to several years, but generally the eruptions appear after a short period. The possibility of infection is increased by perspiration and seborrhea. Although tolerance may be established in the case of some woods, more often sensitivity once developed is persistent. The toxic agents most commonly responsible are nonsaturated resinous acids in a free state or alkaloids.

There is included a list of 143 woods causing dermatitis, with their botanical classification, common names, source, and uses. Of this number approximately 74 per cent are of tropical or semi-tropical origin, and among them are such useful timbers as Gonçalo Alves (*Astronium fraxinifolium*), Peroba Amarella (*Aspidosperma tomentosum*), Macassar Ebony (*Diospyros ebenum*), Greenheart (*Nectandra Rodioei*), Embuia (*Nectandra* sp.), Cuban Mahogany (*Swietenia Mahagoni*), African Mahogany (*Khaya senegalensis*), Andiroba (*Carapa guianensis*), Fustic (*Chlorophora tinctoria*), and Teak (*Tectona grandis*).—L. WILLIAMS, *Field Museum of Natural History*.

M M Chattaway.

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Yale University School of Forestry

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WOOD ANATOMY AND ANGIOSPERM ORIGIN

By G. R. WIELAND

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Discussion of the systematic value of wood anatomy having been accorded a place on the program of the Sixth International Botanical Congress at Amsterdam next year, the following five recent contributions bearing on Angiosperm origin and on the significance of the so-called "homoxylous Angiosperms" may deserve note here.

1. **Zur Organogenie und Phyllogenie der Koniferen-Zapfen.** By O. HAGERUP in *Kgl. Dansk. Vidensk. Selsk, Biolog. Med.* X, 7, Copenhagen, 1933; pp. 82, with 146 figs. in text.

2. **Zur Abstammung einiger Angiospermen durch Gnetales und Coniferae.** By O. HAGERUP in *Kgl. Dansk. Vidensk. Selsk, Biolog. Med.* XI, 4, Copenhagen, 1934; pp. 83, with 116 figs. in text.

3. **De l'ancienneté des caracteres anatomiques des Magnoliacées.** By R. LEMESLE, in *Rev. Générale de Botanique*, Tome 45, Paris 1933; pp. 12, pls. XIV–XVII.

4. **On the wood anatomy and theoretical significance of homoxylous Angiosperms.** By K. M. Gupta in *Jour. Indian Botanical Soc.*, Vol. XIII, No. 1, Madras, 1934, pp. 71–101, with various figs. in text and six plates.

5. **The cambium and its derivative tissues, No. IX. Structural variability in the redwood, *Sequoia sempervirens*, and its significance in the identification of fossil woods.** By I. W. Bailey and Anna F. Faull in *Journ. Arnold Arboretum, Harvard University*, July 1934, Vol. XV, No. 3, pp. 233–254, plates 99–106.

Just as botanical science has been slow to admit the fact that wood anatomy cannot be ignored if taxonomy is to be placed on a sound basis, so it is an odd paragraph in the history of ultimate study of floral and strobilar features that not until the past year has anyone even attempted to examine cone and, to a certain extent, flower development in the light of serial sections cut on an adequate scale and tracing the entire earlier growth stages for the main groups of the Conifers and the Gnetaleans, as comparable with certain of the Angiosperms. Such a study has now been carried out by Hagerup, and while not all of the views and conclusions he reaches may by any means find full assent, the question argued for just a hundred years as to whether the cone of a Pine or an Araucarian, etc., is a flower or an inflorescence is nearing a most unequivocal answer.

Evidently the Conifers are a homogeneous group in their more remote origins, and their cones inflorescent, although the lower limit of the inflorescence in a single seed is reached in several and widely differing genera; while in *Juniperus*, inflorescent reduction may end anomalously in a whorl of stamens subtending the reduced apical whorl of megasporophylls, that is, in a flower, according to the severest definition. The sterile short shoot of the Pines becomes a simple, easily understood specialization appearing relatively late in time, while *Araucaria* and *Cryptomeria* remain vegetatively old in feature, though in their cones nearly as specialized as Pines. Whence the inflorescent condition is both old and normal to the Conifers, going back to the Cordaites, from which by fairly common consent they sprang.

Having reached this point, Hagerup infers that from the Psilotales were derived the Selaginellas, and from them the Lepidophytes, which gave rise to the Cordaites, from which descended the Conifers ending in the Gnetaleans and finally in certain of the Angiosperms. Another botanist who regards *Selaginella* as in any case a most important type in the older evolutionary sequence is Clements, while Hirmer is in near agreement with the view of Lepidophytes (or Sphenophylls) as precedent to the Cordaites, as is also Seward.

On reaching the Angiosperms by way of the Gnetales it is the Piperaceae and Juglandales that first come into view, and then the belief is emphasized that the Angiosperms are polyphyletic with a second group arising by way of the ferns and Pteridosperms, perhaps by way of the Caytoniales. But Hagerup, like H. H. Thomas, does not believe in a line coming up from *Cycas*, and he seems even to avoid all mention of the Cycadeoids. It is here, therefore, that a point is reached where some attention must be given to stem structure, if our views of descent and taxonomy are to rise above the level of a closed argument.

Now, M. Lemesle in further consideration of the *Magnolia* stem anatomy gives a brief account of the species *Michelia Cumingii*, *Talauma pubescens*, and *Schizandra chinensis*, with note of the genus *Kadsura*. The wood of *Michelia Cumingii* is without growth rings and has large vessels of distinctly scalariform pitting. *Talauma pubescens*, as in all the species of this genus, is marked by vessels mainly scalariformly pitted and perforated. In *Schizandra chinensis* the vessels are in part alternately pitted, but the perforation plates are always scalariform. The ray cells are thick walled in *Kadsura*, the vessel pitting and perforating are scalariform, and the ground mass is composed of fiber-tracheids, as also seen in various species of *Magnolia* and in *Liriodendron*. Without adding in further detail the features distinguishing species, our greater interest here concerns the phylogenetic conclusions reached by M. Lemesle. He believes the greater *Magnolia* group to present clear transitions from scalariform tracheids to vessels, and to be very ancient as compared with other Angiosperms, on the score of both structure and geologic history. Like Hutchinson he views the group as complex and, like Bailey and Thompson, concludes that the "cycadeoid theory" of Angiosperm origin must be reckoned with because of the obvious resemblances between the cycadeoid and magnolian woods.

There is no indication in M. Lemesle's notes that he has seen the sections of the important *Cycadeoidea micromyela* of Lignier from the Liassic of Normandy. Nor has he had the advantage of seeing the bettered illustrations of the cycadeoid woods as prepared for my present publication in *Paleontographica*. But had he had the advantage of studying, first hand, sections of important types as done by both Bailey and Thompson, the views reached would not have been less determinative. For it is indeed a very important fact that not only is the cycadeoid wood like that of the Magnolias, especially when transitions are considered and when the radial section next the pith is brought into the comparison, but in those differences which are in some sense outstanding it is seen that feature by feature it is always the Magnolias which are the more advanced. This is particularly true of the ray cells as well as the vessels and fiber-tracheids. In one word the cycadeoid wood is in close to all features just such a wood as might be hypothesized for the early period of Angiosperm evolution. Were the foliage and the flowers unknown, were the vegetative similarity to the Cycads wholly unseen, even the most competent anatomist would seem to see a far closer relationship to the Angiosperms than has yet been proven to exist. Knowing the Cycadeoids as we do, we look on them as an old stock, one that had persisted a long time before we see it in defined form in the early Jurassic. We therefore should merely consider this much as proven, namely, that somewhere and in some manner the Cycadeoids bore a relation to the primitive Angiosperm stock and that, being a flowering group, their wood resemblances to the Magnolias cannot be set aside as of less significance than floral features in our attempts to reach a bettered taxonomy as based on a more and more clearly seen phylogenetic history.

India is a land of Cycads and Cycadeoids set on a grand scale. What botanist of the occidental world has not wished to see the most superb of all flowering plants, *Magnolia Campbelli*, in full bloom, on the high Sikkim Himalayas as belted round by *Michelia excelsa* flowering so freely over the yet

leafless forest as to present the appearance of a snow-fall in the distance? And what fossil botanist can fail to note the great parallel development of cycadeous vegetation in India and Mexico in Liassic times? Indeed it is from all that foreground that K. M. Gupta of the University of Lucknow approaches the subject of the homoxylous Angiosperms, giving a comparative account of all four of the homoxylous genera, namely, *Tetracentron*, of montane central and western China; *Trochodendron*, central to southern Japan and Formosa; *Zygogynum*, the New Caledonian endemic; and *Drimys*, with its remarkable distribution represented by many species extending from the United States to the Straits of Magellan, and occurring also in east Australia, Tasmania, New Guinea, Borneo, New Caledonia, and New Zealand, as well as probably in other islands of the Pacific, F. B. H. Brown having written me that he found in Tahiti the form with flowers as small as those of a "chickweed."

In addition note is given of the structure of *Pataloxylon*, a Queensland Tertiary wood without true vessels described first by Sahni as having the appearance of some simpler *Magnolia* in which vessels were in course of being evolved from tracheids; also of *Trochodendromagnolia* Zander, a German Tertiary lignite wood with tracheids suggestive of *Trochodendron*. The *Homoxylon rajmahalense* Sahni, which is "probably" Jurassic and much like *Tetracentron*, and the very similar *Tetracentronites* as described by Mathiesen from the early Tertiary of East Greenland, so closely resembling *Trochodendron*, are both featured with some illustration.

After reviewing the foregoing wood types, the next great fact recorded is again their remarkable resemblance to the woods of Cycadeoids of Cretaceous and Jurassic time, including such so-called Williamsonians as the Lower Jurassic *Bucklandia indica*. But before going on to note the conclusions reached after this outline of the two groups of homoxylous Angiosperms, that is the pitwood or *Drimys* group and the scalariform or *Trochodendron* group, it is necessary to recall that extremely clever find of Thomas in the Gristhorpe beds of the Yorkshire coast, of Bajocian or mid-Jurassic age. For in this strange plant the stamens have four loculi with grooves between the ridges, and the ovules are borne inside closed carpels "with a distinct and physiologically specialized stigma, with the ovules orthotropous and sometimes arranged in two rows each probably having two integuments and other features in common with the angiospermous ovule." To be sure, T. M. Harris holds that the actual condition may have been gymnospermous since the ovary seems to have been sufficiently open at the time of pollination to admit pollen grains, though quite closed in the ripe fruit. But on the other hand Harris finds that the *Sagenopteris* leaf types have an epidermis, cuticle, and stomata which appear angiospermous rather than gymnospermous. While it is not absolutely sure these leaves are those of the *Caytonia*, when I first encountered them in the Mexican Liassic they seemed too well developed for foliage of cryptogams; and when I next collected them in the Gristhorpe beds in company with Dr. Thomas I could see that the leaf form was ternately trifoliate with a very distinct petiole, in short a leaf as distinct as that of a Cycad or even an Angiosperm. Hence for my part I have all along believed that *Caytonia* is an Angiosperm of some kind; and it is only when others neglect the longer and better known stem and floral record for this little-known type that I begin to find objection, the more especially as I regard the greater trends of evidence as nearly always suggesting great antiquity and often polyphyly.

The Gupta resumé of the homoxylous woods is valuable and clear. A particularly good bibliography of the subject goes back to their first recognition by Goeppert in 1842, and their first appearance in classification when Van Tieghem in 1900 separated the group from the Magnoliaceae, as the Homoxyleae including the Drimytaceae, Trochodendraceae, and Tetracentraceae. But it is very difficult to assent to the view that much depends on whether *Homoxylon*, that is that general type of wood, is of Jurassic or Cretaceous age. It is of course useful and necessary to keep the age record of all fossils as nearly accurate as possible, but in the case of such a generalized type of wood of unknown foliage and fructification it would be singular indeed if a single Mesozoic find were to settle the time of origin. Moreover, if found in the Cretaceous, because of the near analogy to Jurassic woods supposedly cycadeoid, some persistence in time would be the first inference.

Is it possible to put the case as Gupta does? He insists that the age of *Homoxylon*, if proved to be definitely Jurassic, "would manifest" a parallel development of the Magnolias and Cycadeoids, the latter reaching a total extinction because a real angiospermy was unattainable by them! And next the suggestion is offered that the Magnolias might have arisen from contemporaries of *Caytonia*, if not directly from the Paleozoic seed ferns. Either view is but a far cry into the dim past.

Now first it is not yet certain that *Homoxylon* is nearer to the actual *Magnolia* line than to the Cycadeoids. And second we merely know that the Cycadeoids within our purview did not reach angiospermy. There is of course no known type within the great group from which the Angiosperms could in the fully defined sense have sprung. But botanists, I may especially mention Professor Mez, find in small-flowered, free-branched Cycadeoids an arresting group. I once called these, with reference to their possible angiospermous affinity, the Microflorae, and Scott wrote me he thought that "a pretty group." But neither of these great botanists ever for a moment failed to recall that while the cones, the flowers, were absolutely generalized, the megasporophylls were as simple as those of the Cordaites. The point which Mez scored was that those flowers just because old and simple of type might indicate a certain nearness to the normal course of evolution; for we did not need to be lost in a maze of uncertain relationships, giantism, and floral asymmetry, and we could patiently await the course of future discovery.

And similarly, too, that which Scott stressed was not the disappearance of the Cycadeoids, no more strange than that of other ancient groups, but their number—the indication of a group that as it had spread over the globe all the way down from the Permian had surely numbered its thousands of species, with all their possibilities of variation which might never be seen. And, in lighter mood, he made this criticism of Seward, that "he (Seward) thought the evidence for the origin of the Angiosperms must come from within the Angiosperms themselves." I am sure that in a solemn hour it may well be wished that the memory of the real point of that remark be kept, that in the course of our efforts actually to see the remoter course of group evolution we might sometimes be compelled to and could, if cautious, even safely rely on collateral evidence where we might forever fail to trace the direct course of change.

Indeed in all our discussion of the origin of the Angiosperms it is the collateral evidence to which we turn continually. In the case of the Gnetaleans it is probably a moot question whether we are dealing with direct or collateral evidence, and may long so remain despite the findings of Hagerup, as yet so new that we may not claim that we have in some measure fairly evaluated them. And similarly it would be a great mistake, however we may regard the Conifers, to see nothing at all in the floral emplacement in *Juniperus* suggestive at least of the more general course of evolutionary change within the angiospermous stock. Nor can the point be put more succinctly than by citing *Caytonia* once more. No Cycadophyte as we see is in any proven or final sense actually angiospermous. Yet the group in the collateral sense has not only "brought the origin of the Angiosperms within the range of scientific discussion," as Scott fairly said, but has probably shed far more light on early angiospermous history than *Caytonia* and all other fossil types, which may in any fair sense be considered as actually falling within the greater Angiosperm complex, put together.

Turning again to the topic more directly within our present purview, that is, stem structure, of direct interest is the remark of Gupta that it is "unfortunate that the well preserved *Cycadeoidea Painei* is not yet fully investigated." Well! To say the last word on any fossil is most difficult. As A. G. Nathorst said: "In a fossil there is always missing that which you most wish to see." Now, the original type of Ward was a picked specimen from amongst a considerable number of specimens from the south mesa front of the Fossil Cycad National Monument, where the best preservation occurred. Next the specimen became one, as it were, again culled

from amongst other types for its fine preservation, its small fruits and leaf bases, the presence of a branched habitus that could be proven, and a general all round fine preservation. In Part VIII of my shorter studies of the Cycads (*Am. Journ. Sci.*, Vol. XLVI, 1918, pp. 645–650) there is given a good figure of a young seed cone with its enveloping disk. But at that time our descriptions suffered somewhat from a failure to insist on disk structure in its simplest terms. Later, another flower of the type was found to bear few but large synangia, so that while the exact number of eight or ten stamens could not be counted it became certain that the flowers were small with the disks much reduced as compared with various other species. And now, while it is certain there are amongst the Yale series various specimens of this species, that which is most wished is the needed development at the Monument which will surely bring into view the unweathered specimens from their horizon as so precisely known.

Meanwhile with respect to the wood it is explained that the lower half of the trunk as first studied did not show nearly the very remarkable preservation later found at about the base of the upper third portion. The sections have great beauty, but I found them difficult to figure, and have been loath to give indifferent drawings. So far as photomicrographs go, such now appear in the current *Palaeontographica*. My own view of the wood as being, because of its rays, more advanced than that of the Cycads and as presenting a certain sharp parallel to the wood of the *Magnolia* group remains unchanged. The closest resemblance, so far as I have comparative material in hand just at present, is to be seen in either *Trochodendron* or *Zygogynum*, remembering that the latter wood shows a broad band of scalariform tracheids next the pith before transition into the pitted drymatoid condition, just as we see the transition in *Dioon*. It has only been more recently that the extreme importance of the ray cell structure has come into fuller view, and these features are in the fossils generally difficult to give. But they can be given if enough care and patience are exercised in the sectioning.

When I visited Lignier at Caen in 1907 there were many points to go over so that I did not see his sections of the noteworthy *Cycadeoidea micromyela.* At that time it was the scalariform-pit transition that was held to be the feature of premier interest or importance, and no confrontation of *Magnolia* wood sections had been made by anyone. But Lignier both describes and figures the ray cells of his fine type as simple, thin walled and muriform, or as just one more item in the likeness to wood rays in Cycads. Probably his description is correct, as he was one of the cleverest and most resourceful sectioners and delineators of petrified structures in all the records of the subject from Witham down. Now as we see, however, it will be, for some time to come, the ray cells that will require the closest examination and illustration, seeing that change in them has been as significant in the course of angiosperm wood and foliar development as tracheidal change.

In closing these notes on wood anatomy and its bearing on and possible use in attaining bettered ideas of descent, and even in reaching a more severely exact taxonomy, the important contribution of Bailey and Faull must be given mention, if but briefly. For several years students of fossil woods have shown considerable reluctance in establishing new species on the basis of indifferently preserved material as seen from a few sections cut from some chance portion of a fossil stem. Here is shown the reason why yet more caution must be used to get beyond mere "trial and error." The "trial and error method" must indeed have some value where large numbers of fossil specimens are seen in their simpler features, as in the case of leaf imprints, but the method should not be allowed to interfere with solution of the greater conifer problems. It is found that the range of structure-variation in the Redwood extending broadly to the supposedly conservative characters, is even greater in a single tree than in homologous parts from different trees, so that withal there is a something left over in the nature of fixity of type. The preliminary study shows, however, that, "while it is possible to differentiate the wood of *Sequoia* from that of the Taxaceae, Araucariaceae, Abietoideae, and Pinoideae, it is difficult to distinguish it in all cases from that of the Podocarpaceae, Cupressaceae, and Taxodiaceae." Nor are there any convincing arguments for regarding various *Paracupressinoxyla* and Brachyphylleae as transitional or ancestral Araucarians rather than relatives of the Taxodiaceae, Cupressaceae, or the Podocarpaceae.

Indeed these more severe studies of the potential range of structural variability in conifer woods seem even to agree with the floral studies of Hagerup in indicating the Conifers to be in all their later or more visible history a completely homogeneous group. Would not such a great fact, then, later analysis and discovery sustaining it, go far to show that the Hagerup view of the Angiosperms as Cretaceous-Tertiary continuants of the Conifers is quite inadmissible? Would not the outstanding truth be that stem anatomy shows any such view of Angiosperm derivation to depend on mere contrasts between end results of specialization and reduction rather than on citable forms which can be proven consecutively primitive and simple? In any case we are sure that while a better balanced understanding of wood structure present and past may never be found as directly usable in classification as floral features, any appeal to the one set of evidence without the other is no longer thinkable.

NOTES ON VERNACULAR NAMES OF TREES FROM THE TAPAJOZ RIVER, BRAZIL

By Adolpho Ducke

Jardim Botanico do Rio de Janeiro

While on a botanical excursion through the Tapajoz Valley, in January of 1933, I had the opportunity of visiting Bôa Vista, the headquarters of the plantations of the Companhia Ford Industrial do Brasil. In the two days I spent in this locality I could appreciate the extraordinary development of a region that was virgin forest a few years before, and I had opportunity to examine the duplicates of the herbarium and wood samples sent by the Company to the Field Museum of Natural History. I am very grateful to Mr. Roy Carr, the organizer of the above collection, who not only allowed me to inspect the material, but also gave me duplicates of some species of particular interest, which I brought to the Jardim Botanico do Rio de Janeiro.

Two papers dealing with the above mentioned collection were published in *Tropical Woods* (Nos. 29 and 33). They consisted of descriptions of some new species and of long lists of vernacular names. Some of these names came from a collection made by Sr. R. Monteiro da Costa, who is an expert on matters pertaining to the Amazon forest. The greater part of the material, however, was collected during the extensive clearing for the plantations, and the popular names of the felled trees were supplied by the laborers, most of whom were immigrants from the northeastern part of Brazil, especially from Ceará. As a consequence, many of the species limited to the Amazonian hylaea appear in those lists baptized with vernacular names which, in the northeastern states, are used with respect to trees similar in appearance, but botanically very different. It must be mentioned that, whereas in the northeastern states there is a fairly stable vernacular plant nomenclature, such is not the case in Amazonia, since its fluctuating and heterogeneous population, with a high percentage of northeastern elements, has resulted in a very confused and mixed nomenclature. (I have touched upon this question in *Archivos do Jardim Botanico do Rio de Janeiro* III, p. 17–18.) As a striking instance I will mention the name Páo Santo: In Belem and in the Tocantins and Tapajoz regions it is applied to *Zollernia paraensis* Hub., well known because of its very valuable dark wood; in the Rio Negro region to *Peridiscus lucidus* Bth., with beautiful yellow wood; in Gurupá to *Trichanthera gigantea* H.B.K., the wood of which is valueless. In the places where there is a predominance of immigrants from Ceará, however, *Zollernia paraensis* is known as Coração de Negro, the Ceará designation for another species, *Zollernia Ulei* Harms. The Amazonian natives give the name Coração de Negro to some species of *Swartzia* and, less frequently, to certain species of *Cassia*.

APOCYNACEAE

The name Marfim certainly corresponds to *Rauwolfia pentaphylla* Ducke (=*Couma pentaphylla* Hub. ms.). I have often found the species in the

Tapajoz. *Couma rigida* M. Arg. has been, by mistake, mentioned as occurring in Pará.

BIGNONIACEAE

Tarumá Tuira is the name given in Pará to *Vitex flavens* H.B.K. (Verbenaceae), and is never used with relation to any Bignoniaceae. No. 216, labeled with the above name and as *Tabebuia serratifolia*, however, is *Couralia toxophora* (Spruce) B. & H. It is known by the natives as Capitary or Páo d'Arco do Igapó. Complete material of *Couralia toxophora*, collected in Manáos (*Ducke* lign. n. 153), is found in the Yale collections (No. 22613).

CAPPARIDACEAE

Crataeva tapia L., the Tapiá or (most frequently) Trapiá from the dry Brazilian Northeast, with edible fruits, does not occur in Amazonia. *Crataeva Benthami* Eichl., on the contrary, is very abundant on the Tapajoz and the whole Amazon, where it is called Catauary. Its fruits, with a very repulsive taste, are eaten only by fish.

CARYOCARACEAE

Caryocar glabrum (Aubl.) Pers. is the Piquiarana of the upland forest; *Caryocar microcarpum* Ducke is the Piquiarana da Varzea of the marshy lowland and of swampy banks of streamlets in the upland.

EUPHORBIACEAE

The Seringuera Itaúba of the Tapajoz is, no doubt, *Hevea guianensis* Aubl. (*H. collina* Hub. is merely a form of the latter). I have complete material from numerous trees of this species. The true *H. lutea* is limited to the upper Rio Negro, Solimões, and intermediate region.

LECYTHIDACEAE

The vernacular name of *Eschweilera Carrii* is probably Matamatá and never Geniparana, for in Pará and the Amazon all species of *Eschweilera* are called Matamatá. Geniparana is the general popular name for the species of the genus *Gustavia*.

LEGUMINOSAE

The occurrence of the true *Acacia glomerosa* in the State of Pará has not yet been confirmed. I ignore the vernacular name Cujuba. A closely allied species, *Acacia polyphylla* DC., is quite frequent in the Tapajoz, where it is known as Paricarana.

Bauhinia stenocardia Standley, Mororozinho (the Ceará name of the lesser species of *Bauhinia*, subgenus *Pauletia*), is synonymous with *Bauhinia holophylla* (Bong.) Steud., var. *paraensis* Ducke in Archivos do Jardim Botanico do Rio de Janeiro IV, p. 52. But it is, possibly, a good species, and in such case Standley's name should be kept.

Dinizia excelsa Ducke is frequently called Angelim, but this name is most used for the genus *Hymenolobium*. The name Angelim Pedra, however, is never applied to *Dinizia*, but only to *Hymenolobium petraeum* Ducke (in Amazonia, and not in southern Brazil).

Drepanocarpus inundatus Mart. is a climbing shrub and not a 60-foot high tree. The name Andirá-uchy is indeed given to leguminous trees (*Andira retusa* and *A. inermis*), but these have violet flowers, and not yellow. There evidently has been some confusion here.

Tucunaré-envira is *Dalbergia inundata* Benth., of which *Drepanocarpus paludicola* Standley is a synonym. The fructiferous and flowerless herbarium samples of this plant look like a *Drepanocarpus*. I have examined a cotype (*Monteiro da Costa* 250).

Inga Capucboi Standley is synonymous with *Inga capitata* Desv. I have compared a cotype. The species is frequent throughout the Amazonian hylaea and is represented in southern Brazil by a geographical variety.

The name Jatobahy do Igapó is wrongly applied to *Ormosia excelsa* Spruce. All the *Ormosia* species are called Tento. The present species (*O. excelsa*) is called Tento Amarello on account of its yellow seeds. The name Jatobá is used in the Brazilian Northeast for the genus *Hymenaea* (corresponding to Jutahy in Brazilian Amazonia and Jatahy in southern Brazil). The ending "hy" means small, hence Jatobahy would be a Jatobá with small fruits.

Sclerolobium chrysophyllum Poepp. & Endl. has, so far, been found only in the upper Amazon. The Tapajoz samples I have seen do not belong to this species.

Swartzia leptopetala Benth. occurs in the Tapajoz, but the name Muirapixuna is applied to species of *Swartzia* and *Cassia* with dark brown heartwood, which is not the case with *S. leptopetala*.

Swartzia polycarpa Ducke is frequent in the Tapajoz and has the vernacular name of Cumbeira. Goncalare is probably an alteration of Gonçalo Alves, the northeastern and central Brazilian term for species of *Astronium*.

Sweetia nitens Benth. The popular name given everywhere in Brazilian Amazonia to this plant is Itaubarana. I ignore the name Arapichuna. Piranheira, however, corresponds, in the Amazon, to the euphorbiaceous *Piranhea trifoliolata* Baill.

MELASTOMATACEAE

Miconia prasina (Swartz) DC. The name Capitihu (Caapitiú) corresponds exclusively to the ill-flavored species of Monimiaceae, especially of the genus *Siparuna*.

POLYGALACEAE

Securidaca volubilis L. The name Cumandahy or Comandahy does not belong to this species or to any other of this family. It is applied to various Leguminosae-Phaseoleae, the flower but not the fruits of which look like those of *Securidaca*.

RUBIACEAE

Duroia macrophylla Hub.=*Coupoui brasiliensis* Wernham=*Amaioua Monteiroi* Standley. This is the Puruhy Grande da Matta which is frequent all over the lower Amazon and its affluents, from Santarem as far as Manáos. I have compared one of the cotypes (*Monteiro da Costa* 290).

SAPOTACEAE

Lucuma pariry Ducke. The material in the Bôa Vista collection (No. 431) corresponds perfectly to the type of the species. But the vernacular name is Pariry (not Piriry).

VERBENACEAE

Vitex cymosa Bert. The Amazonian name for this species as well as for all other indigenous species of this genus is Tarumá. Jaramataia is the name given to the species of *Vitex* in the northeastern states of Brazil. This name is entirely unknown to the natives of the Amazon.

VIOLACEAE

Leonia glycycarpa R. & Pav. The name Trapiarana (false Trapiá) is not used in the Amazon.

Rinorea guianensis Aubl. is frequently called Inambuquiçaua, but never Ajará, a name which is used exclusively for the Sapotaceae.

VOCHYSIACEAE

The Coataquiçaua of the Tapajoz is *Peltogyne paniculata* Benth. (Leguminosae), the bark of which looks much like that of *Qualea Dinizii* Ducke (Vochysiaceae). The latter has flowers and leaves similar to those of *Qualea parviflora* Mart., a little tree of the campos of central and northeastern Brazil but entirely absent from the Amazon. The leaves and flowers of the herbarium material labeled as Coataquiçaua, which I examined in the Bôa Vista collection (No. 224), belong to *Qualea Dinizii*.

Check List of the Common Names

Ajará	(Divers spp.)	Sapotaceae
Andirá-uchy	*Andira* spp.	Leguminosae
Angelim	*Hymenolobium* spp. and *Dinizia excelsa* Ducke	Leguminosae
Angelim pedra	*Hymenolobium petraeum* Ducke	Leguminosae
Caapitiú or Capitihu	*Siparuna* spp.	Monimiaceae
Capitary	*Couralia toxophora* (Spruce) B. & H.	Bignoniaceae
Catauary	*Crataeva Benthami* Eichl.	Capparidaceae
Coataquiçaua	*Peltogyne paniculata* Benth.	Leguminosae
Comandahy or Cumandahy	(Phaseoleae divers)	Leguminosae
Cumbeira	*Swartzia polycarpa* Ducke	Leguminosae
Geniparana	*Gustavia* spp.	Lecythidaceae
Inabuquiçaua	*Rinorea guianensis* Aubl.	Violaceae
Itaubarana	*Sweetia nitens* Benth.	Leguminosae
Jutahy	*Hymenaea* spp.	Leguminosae
Marfim	*Rauwolfia pentaphylla* Ducke	Apocynaceae
Matamatá	*Eschweilera* spp.	Lecythidaceae

Muirapixuna	*Swartzia* spp. and *Cassia* spp.	Leguminosae
Pão d'arco do igapó	*Couralia toxophora* (Spruce) B. & H.	Bignoniaceae
Paricarana	*Acacia polyphylla* DC.	Leguminosae
Pariry	*Lucuma pariry* Ducke	Sapotaceae
Piquiarana	*Caryocar glabrum* (Aubl.) Pers.	Caryocaraceae
P. da varzea	*Caryocar microcarpum* Ducke	Caryocaraceae
Piranheira	*Piranhea trifoliolata* Baill.	Euphorbiaceae
Puruhy grande da matta	*Duroia macrophylla* Hub.	Rubiaceae
Seringueira itaúba	*Hevea guianensis* Aubl.	Euphorbiaceae
Tarumá	*Vitex* spp.	Verbenaceae
Tarumá tuira	*Vitex flavens* B.H.K.	Verbenaceae
Tento	*Ormosia* spp.	Leguminosae
Tento amarello	*Ormosia excelsa* Spruce	Leguminosae
Tucunaré-envira	*Dalbergia inundata* Benth.	Leguminosae

RECORDOXYLON: A NEW GENUS OF LEGUMINOSAE-CAESALPINIOIDEAE

By ADOLPHO DUCKE

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RECORDOXYLON Ducke, gen. nov.—A genere *Melanoxylon* Schott, foliorum florumque characteribus affini, differt ligno more generis *Bowdichia*, legumine parvo lineari-oblongo valvis tenuiter coriaceis fragilibus tardius et non elastice dehiscentibus intus inter semina non farctis, et seminibus testa simplici uno latere subcarinato-marginata, exalbuminosis.

Arbor magna partibus vegetativis glaberrimis, foliis sat amplis saepissime 7-foliolatis, panicula terminali magna rufo-tomentella, calice dense rufo-sericeo, petalis sat magnis aureis, staminibus glabris, ovario sericeo, legumine adulto glabro.

Species unica bene nota hylaeae amazonicae partis borealis mediae (Rio Negro) incola [1]:

[1] Whether *Melanoxylon speciosum* R. Benoist is a second species of *Melanoxylon* or of *Recordoxylon* cannot be decided without a study of the fruit and wood, both of which are unknown.

Recordoxylon amazonicum Ducke, comb. nov. = *Melanoxylon amazonicum* Ducke, Tropical Woods 31 (1932), p. 15 (description of the wood by Professor Record, p. 25), and Archivos do Jardim Botanico do Rio de Janeiro VI, p. 27 (1933). See the description of this species, *l.c.*—TYPE: Herb. Jar. Bot. Rio de Janeiro n. 23323; wood, Ducke n. 58, Yale n. 21002. Cotypes of herbarium material have been distributed to the botanical institutions at Berlin-Dahlem, Geneva, Kew, Paris, Stockholm, Utrecht, Washington, and to Yale University School of Forestry.

This tree, in the flowering stage, looks like *Melanoxylon*, but the pods are entirely different; they recall those of some species of *Cassia*, *Acacia*, and *Piptadenia;* the wood, however, is similar to those of *Bowdichia.*

I discovered this tree in December 1929; it was in flower and had some young fruits, the seeds of which were not yet fully developed. I placed the new species in the genus *Melanoxylon* and prepared a description of it for publication in Vol. VI of the *Archivos do Jardim Botanico do Rio de Janeiro*, but a series of circumstances delayed the appearance of that volume until 1933. Meanwhile, in December 1931, I visited the Rio Negro again, and finding the same tree with ripe fruits I had it felled and thus acquired fructiferous herbarium material as well as wood samples (*Ducke* 58). On returning to Manáos in 1932 and not knowing that the printing of Volume VI of the "Archivos" had begun, I decided to publish the diagnoses of my new species elsewhere in order that their priority should not be lost. The description of *Melanoxylon amazonicum* was published in *Tropical Woods* after I added to it the description of the ripe fruit, which I wrote while in Manáos where I could not consult the botanical literature or make comparison with the fruit of *Melanoxylon brauna.*

On reading Professor Record's "Notes on new species of Brazilian woods," which follows the description of my new species, I noticed he said that the structure of *M. amazonicum* is different from *Melanoxylon brauna* Schott, if specimens of that name in the Yale collections are correctly determined. Dr. Fernando Milanez, of the Instituto de Biologia Vegetal at

Rio de Janeiro, compared the wood of the new species with authentic samples of *Melanoxylon brauna* Schott and found them markedly different. At the same time, a comparison of the fruits and the seeds of these two species reveals fundamental differences, on account of which it is impossible to place both in the same genus. I decided, therefore, to create a new genus, and I have named it *Recordoxylon* in honor to Professor Record, since it was his observation regarding the wood structure that led to the revision of my original classification.

SYSTEMATIC ANATOMY OF THE WOODS OF THE MONIMIACEAE

By George A. Garratt
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The Monimiaceae are mostly aromatic shrubs or trees, rarely climbers, largely confined to the tropical and subtropical regions of the southern hemisphere. As now generally accepted, the family is composed of 32 genera and about 350 species, few of which are of any commercial importance. While there has not been any particular disagreement among taxonomists as to the internal division and arrangement of the family, various opinions have been expressed concerning its position in the natural system. The object of this investigation has been primarily to determine the bearing of the anatomy of the secondary xylem both on the generally accepted internal classification of the group and on its systematic position.

The morphological characteristics of the Monimiaceae have been summarized by Rendle (1925), from whose description the following is taken:

Leaves evergreen, leathery, generally opposite, and exstipulate; contain oil cells. Flowers solitary or cymose, usually unisexual and characterized by more or less cup-shaped, sometimes very deeply hollowed receptacle, on inside of which stamens and carpels are borne. Perianth leaves usually present, small and four to many in number; in latter case the inner are petaloid. Stamens generally numerous, sometimes few; dehiscence of anthers longitudinal, transverse, or sometimes valvular; short filaments sometimes

provided with a pair of lateral appendages. Carpels vary similarly in number, but generally are numerous; free; each contains a single ovule, variable in position. Fruits one-seeded, indehiscent, and generally enclosed in an enlarged floral axis. Embryo small and enclosed in copious, not ruminate, endosperm.

Economic Importance

Except for some of the Australian species, the woods of the Monimiaceae find but little commercial use. Two of the Australian timbers, namely *Doryphora Sassafras* Endl. and *Daphnandra micrantha* Benth., are reported by Swain (1928) as grouped under the official trade designation of Canary Sassafras, a name derived from the color of the wood and the aromatic nature of the bark.[1] Both work well and are not fissile; are without distinctive figure, stain readily and hold paint well; though not particularly durable, are said to resist the attacks of borers and white ants. Their uses include turned articles, broom handles, brush stocks, cheap furniture, toys, flooring, lining, and case material. *Doryphora* has also been used for clothes pegs and tallow-cask staves. *Daphnandra repandula* F. Muell. and *D. aromatica* Bailey, lesser North Queensland species, have similar uses. Welch (1929) says that the Tasmanian Sassafras, *Atherosperma moschatum* Labill., is an excellent wood for turnery and probably the best native material for clothes pegs; it also has been used to some extent for purposes similar to those mentioned above.

The single New Zealand member of the family, *Laurelia novae-zelandiae* Cunn., is employed occasionally for boat building, weather boards, furniture, and posts in sandy land. Of the American representatives, the only one supplying commercial timber is the Chilean Laurel, or Huahuan, *Laurelia aromatica* Juss., although *Mollinedia Schottiana* (Spreng.) Perk., the Capixim of eastern Brazil, is reported by Record and Mell (1924) as supplying a tough and elastic wood used for barrel hoops and sieve rims.

Owing to the presence of abundant quantities of a volatile

[1] Welch (1929) gives the local names of *Doryphora Sassafras* as Sassafras, Grey or Black Sassafras, and of *Daphnandra micrantha* as Yellow Wood, Satinwood, Yellow or Grey Sassafras, Yellow Box, Socket Wood, and Butter Wood.

oil, most of the Monimiaceae are distinguished by an aromatic, often very agreeable odor, and some of them have a certain reputed medicinal value. Perkins and Gilg (1901) state that for this reason the bark or leaves of such species as *Atherosperma moschatum* and *Doryphora Sassafras* in Australia and *Laurelia aromatica* and *Peumus boldus* Mol. in Chile are often used locally in preparing a tea. The leaves of *Peumus* yield a product known under such names as "Folia Boldo" and "Boldo Leaf Oil," from which a stomachic is derived; this was formerly an article of commerce, but by 1900 had apparently become obsolete. None of the species of *Siparuna* are considered of any importance, except for medicinal value of their leaves; *S. guianensis* Aubl. is said to yield a remedy for colic, as well as a vermin exterminator for fowls. The bark of *Peumus* has been used for tanning purposes, while the drupes of *Ambora* (*Tambourissa*) have been reported by Le Maout and Decaisne (1873) to yield a red juice analogous to annotto.

Geographical Distribution

The Monimiaceae are distributed over the tropical and subtropical regions of the world, especially in the southern hemisphere. There are eight genera in Central and South America. *Mollinedia* (with more than 70 spp.) and *Siparuna* (over 100 spp.) are widely distributed, occurring from Mexico, through British Honduras and the other Central American countries, to Peru and southern Brazil. Both are especially well represented in Brazil. *Laurelia*, with two species, is found in Chile (one species extending into Peru), as is the monotypic genus, *Peumus*. Four other monotypic genera have been found in Brazil, *Hennecartia*, *Macropeplus*, *Macrotorus*, and *Bracteanthus*; the first-named has also been reported from Paraguay.

Some twenty genera are found in Malaysia and Oceania, a fact that leads Perkins and Gilg (1901) to consider the Indo-Malayan region as the original habitat, or starting point, of the family. They extend from the Philippines, Borneo, and the Sunda Islands, through New Guinea and Australia, to Samoa, the Fiji Islands, and New Zealand. Of these, *Kibara* (30 spp.), *Steganthera* (15 spp.), and *Hedycarya* (15 spp.) are

best represented. The other genera occurring in this general region are *Amborella*, *Levieria*, *Trimenia*, *Piptocalyx*, *Mollinedia*, *Matthaea*, *Anthobembix*, *Tetrasynandra*, *Wilkiea*, *Lauterbachia*, *Carnegieodoxa*, *Palmeria*, *Nemuaron*, *Daphnandra*, *Laurelia*, *Atherosperma*, and *Doryphora*.

Two genera, *Xymalos* and *Glossocalyx*, are indigenous to tropical Africa; three, *Ephippiandra*, *Monimia*, and *Tambourissa*, occur in Madagascar and the neighboring islands of Mauritius and Reunion; and a single genus, *Hortonia*, is found in Ceylon.

Perkins and Gilg (1901) point out that the family is a very old one, which fact has been responsible for the distribution of the proportionally few species over almost the entire tropical and subtropical southern hemisphere, despite rather unfavorable means of distribution. It will be noted that but two genera are represented in both the Old World and the New. *Laurelia* is considered to occupy a typical old-antarctic region of distribution, with *L. aromatica* (=*L. sempervirens* Tul.) confined to Chile and *L. novae-zelandiae* growing only in New Zealand. *Mollinedia*, widely distributed from Mexico to southern Brazil, is also represented in Australia by *M. Huegeliana* Tul. and possibly other species.

Taxonomic Divisions of the Monimiaceae

It was not until 1775 that the first monimiaceous genus, *Siparuna*, was established by Aublett. Before the close of the century, four additional genera were recognized, namely, *Hedycarya* Forst. in 1776, *Peumus* Mol. and *Tambourissa* Sonn. in 1782, and *Mollinedia* Ruiz & Pav. in 1794.

Jussieu (1789), apparently the first to attempt a classification of any of these genera, placed *Hedycarya* and *Ambora* Juss. (=*Tambourissa*) in the Urticeae; *Siparuna* was listed as of uncertain position, while *Peumus* was evidently unknown to him. In 1809, Jussieu combined *Ambora* with *Atherosperma* Labill., *Citrosma* Ruiz & Pav. (=*Siparuna*), *Monimia* Thou., *Pavonia* Ruiz & Pav. (=*Laurelia* Juss.), and *Ruizia* (=*Peumus*) to form the family Monimieae, which he divided into two tribes, according to the drupaceous or nut-like character of the fruit. Robert Brown (1814) considered *Pavonia* and

Atherosperma as distinct from the genera *Ambora*, *Monimia*, and *Ruizia*, which Jussieu had included in the Monimieae and placed them in a separate family, the Atherospermeae.

Bartling (1830) and Endlicher (1836–1840) both placed under the Monimieae the genera that Brown had included in the Atherospermeae, while Lindley (1853) again set them up in a distinct family, basing the separation on differences in the position of the ovule and the structure of the anthers. In the Monimiaceae Lindley included eight genera, *Ambora*, *Monimia*, *Kibara* Endl., *Citrosma*, *Tetratome* Poepp. & Endl. (=*Mollinedia*), *Hedycarya*, *Boldoa* Juss. (=*Peumus*), and *Mollinedia*; in the Atherospermaceae he placed three genera, *Atherosperma*, *Laurelia*, and *Doryphora* Endl. Tulasne (1855) once more combined the genera in the single family, Monimiaceae, which arrangement has since been universally accepted. De Candolle (1868) and Baillon (1867–1869) followed Tulasne's treatment in general, although the latter proposed that Calycanthaceae and also the genus *Gomortega* Mol. be added to the Monimiaceae as secondary groups or series.

Bentham and Hooker (1880), working with more abundant material than the previous investigators, segregated the 22 recognized genera into two tribes and seven groups, as follows:

Tribe I. Monimieae:
1. *Monimia, Tambourissa, Palmeria.*
2. *Mollinedia, Kibara, Ephippiandra.*
3. *Matthaea, Hedycarya, Peumus.*
4. *Hortonia, Levieria, Amborella, Piptocalyx, Trimenia.*

Tribe II. Atherospermeae:
1. *Conuleum, Siparuna, Glossocalyx.*
2. *Atherosperma, Doryphora.*
3. *Nemuaron, Laurelia, Daphnandra.*

Pax (1891) accepted Bentham and Hooker's classification with only minor changes, arranging the 23 genera under the tribes Hortonieae, Hedycarieae, and Monimieae of the subfamily Monimioideae, and the tribes Laurelieae, Atherospermeae, and Siparuneae of the subfamily Atherospermoideae.

The most detailed work on the family has been done by Perkins and Gilg (1901), and subsequently revised by Perkins (1911), with the result that the classifications of Bentham and Hooker and of Pax have been altered to the following:

Subfamily I. Monimioideae

Tribe I. Hortonieae
1. *Hortonia* Wight—in Mag. Zool. and Bot. II (1838).
2. *Peumus* Mol.—Saggio Chile (1782).
3. *Amborella* Baill.—Hist. pl. I (1869).
4. *Hedycarya* Forst.—Char. gen. (1776).
5. *Levieria* Becc.—Malesia I (1877).

Tribe II. Trimenieae
6. *Trimenia* Seem.—Fl. vitiens (1865–1873).
7. *Piptocalyx* Oliv.—in Benth. Fl. austral. V (1870).
8. *Xymalos* Baill.—in Bull. Soc. Linn. Paris I (1887).

Tribe III. Mollinedieae
9. *Macropeplus* Perk.—in Engler's Bot. Jahrb. XXV (1898).
10. *Mollinedia* Ruiz & Pav.—Fl. peruv. et chil. prodr. (1794).
11. *Macrotorus* Perk.—in Engler's Bot. Jahrb. XXV (1898).
12. *Ephippiandra* Decne.—in Ann. sc. nat. 4. ser. IX (1858).
13. *Matthaea* Blume—Mus. bot. Lugd. bat. II (1852–1856).
14. *Steganthera* Perk.—in Engler's Bot. Jahrb. XXV (1898).
15. *Anthobembix* Perk.—in Engler's Bot. Jahrb. XXV (1898).
16. *Tetrasynandra* Perk.—in Engler's Bot. Jahrb. XXV (1898).
17. *Wilkiea* F. Muell.—in Trans. Phil. Inst. Victoria II (1858).
18. *Kibara* Endl.—Gen. (1837).
19. *Lauterbachia* Perk.—in K. Schumann u. Lauterbach, Flora d. Deutsch. Schutzgeb. in d. Südsee (1900).
20. *Carnegieodoxa* (*Carnegiea*) Perk.—in Pflanzenfamilien, Nachtr. IV, 94 (1915).

Tribe IV. Monimieae
21. *Palmeria* F. Muell.—Fragm. IV (1864).
22. *Monimia* Thou.—Hist. veg. Isles de France, La Reunion et Madagascar (1804).
23. *Tambourissa* Sonn.—Voy. Ind. orient. II (1782).
24. *Hennecartia* Poisson—Bull. Soc. bot. France XXXII (1885).

Subfamily II. Atherospermoideae

Tribe V Laurelieae
25. *Nemuaron* Baill.—in Adansonia X (1871–1873).
26. *Daphnandra* Benth.—Fl. austral. V (1870).
27. *Laurelia* Juss.—in Ann. Mus. Paris XIV (1809).
28. *Atherosperma* Labill.—Nov. Holl. pl. spec. II (1806).
29. *Doryphora* Endl.—Gen. (1836–1840).

Tribe VI. Siparuneae
30. *Siparuna* Aubl.—Hist. pl. Guian. franç. II (1775).
31. *Glossocalyx* Benth.—in Hook. Icon. pl. (1880).

The above classification of Perkins was subsequently accepted by Engler and Prantl (1908 and 1915). Recently Ducke (1930) has established the new genus *Bracteanthus* Ducke, which he states shows a definite affinity to *Siparuna*.

Affinities of the Monimiaceae

The first to indicate the relationship of the Monimiaceae was Jussieu who in 1789 assigned the genera *Hedycarya* and *Ambora*, on the basis of their apetalous flowers and disunited sexes, to the Urticeae. Later (1809), when he established the Monimieae, he still placed the group near the Urticeae, although also noting its affinity with the Calycanthaceae. Brown (1814), upon separating Monimieae from Atherospermeae, maintained the position of the former near the Urticeae and brought Atherospermeae near the Laurineae, on account of their aromatic properties and especially the structure of their anthers. Endlicher (1836–1840) combined the Atherospermeae with the Monimieae and placed them before the Laurineae.

Lindley (1853), who again separated the recognized genera into two distinct families, the Monimiaceae and the Atherospermaceae, placed them in the Menispermal Alliance (Menispermales), together with the Myristicaceae, Lardizabalaceae, Schizandraceae, and Menispermaceae. Concerning the affinities of the Monimiaceae, he says: "The true station is evidently among unisexual orders, with a very large quantity of albumen, where they may be very naturally associated with Nutmegs (Myristicaceae) and their allies. . . . The extremely aromatic quality of these Monimiads is a strong confirmation of the propriety of this view. Their numerous carpels bring them also into contact with Kadsurads (Schizandraceae), another aromatic order. The structure of the calyx of *Boldoa* (=*Peumus*), the gradual transition of its segments into petaloid leaves, and the disunited carpels, indicate some analogy to Calycanths, but the minute embryo and disunited sexes forbid us to regard the connection between these plants and Monimiads as being of an intimate kind."

Tulasne (1855) stressed the affinity of the Monimiaceae (including Lindley's Atherospermaceae) to the Rosaceae, through the Calycanthaceae, notwithstanding the alternate leaves, stipules, and absence of albumen. In most Rosaceae the leaves are simple, as in the Monimiaceae, and the two

families are alike in their inflorescence, the numerical type of the floral envelopes, and the perigynous stamens; Tulasne also noted other points of similarity between individual genera in the two families, and contended that the relationship is much closer than that between the Monimiaceae and either the Laurineae or the Urticeae. Perkins and Gilg (1901) also emphasized this relationship, stating that the Monimiaceae must be brought under the order Ranales and placed close to the Lauraceae and the Calycanthaceae.

Hooker and Thomson (1855) placed the Monimiaceae in the vicinity of the Myristicaceae and of the second tribe of the Magnoliaceae (*Illicium*). Le Maout and Decaisne (1873) also recognized this affinity, founded on such features as the aromatic properties, pellucid-punctate leaves, diclinism, number of stamens, solitary anatropous ovule, albuminous seed, and divaricate cotyledons. Engler and Prantl (1903) further supported this point of view and included the family in the order Ranales, close to the Myristicaceae, Gomortegaceae, and Lauraceae. Other investigators who have stressed the relationship between the Monimiaceae and the Myristicaceae include Horaninow (1847), Bentham and Hooker (1880), Hooker (1886), and Thiselton-Dyer (1913).

Even among the recent writers there is little or no agreement as to the systematic position of the Monimiaceae. Hutchinson (1926) placed the family in the order Laurales, together with the Lauraceae, Gomortegaceae, Hernandiaceae, and Myristicaceae, thus supporting the treatment of Engler and Prantl. Rendle (1925) pointed to its relation to the Magnoliaceae on the one hand and the Lauraceae on the other, while Johnson (1931) emphasized its similarity to the Rosaceae and the Calycanthaceae, as well as to the Berberidaceae and the Lauraceae. Concerning the affinity of the Monimiaceae to the Magnoliaceae, Rendle says: "The structure of the flowers suggests Magnoliaceae with a concave floral axis, in which the numerous stamens and free carpels are depressed. The small embryo embedded in a copious endosperm also recalls Magnoliaceae, but the biological character of the flowers —inconspicuous and generally asexual—is very different."

Description of the Woods of the Monimiaceae

Material

The wood specimens studied in this investigation are part of the collections of the Yale School of Forestry. There are 65 specimens of mature secondary xylem, representing 30 species and 12 genera, distributed as follows:

Atherosperma Labill.—5 specimens of 1 species.
Bracteanthus Ducke (monotypic)—2 specimens.
Daphnandra Benth.—2 specimens of 1 species.
Doryphora Endl. (monotypic)—2 specimens.
Hedycarya Forst.—1 specimen of 1 species.
Kibara Endl.—5 specimens of 4 species; 2 unassigned.
Laurelia Juss.—7 specimens of 2 species; 2 unassigned.
Matthaea Blume—1 specimen of 1 species.
Mollinedia Ruiz & Pav.—5 specimens of 3 species.
Peumus Mol. (monotypic)—1 specimen.
Siparuna Aubl.—26 specimens of 12 species; 1 unassigned.
Tambourissa Sonn.—3 specimens of 2 species.

Macroscopic Features

General Properties. *Density* variable; woods mostly medium light and soft to medium hard and heavy (sp. gr. 0.53 to 0.78, based on room-dry weight and volume); occasional specimens light and soft (sp. gr. 0.43 to 0.47); available samples of *Bracteanthus* hard and heavy (sp. gr. 0.83 to 0.95); greatest range noted in *Siparuna* (sp. gr. 0.49 to 0.76). *Texture* fine to rather coarse, depending on size of rays and abundance of parenchyma. *Grain* mostly straight, sometimes decidedly irregular. *Color* range from pale yellow or light brown to dark (chocolate) brown or almost black, but mostly rather light brown, with a grayish to yellowish or greenish hue. *Odor* not distinctive, except in *Peumus boldus*, which is strongly aromatic; according to Welch (1929), freshly cut wood of *Doryphora Sassafras* has a pleasant safrol-like scent, soon lost on exposure.

Growth rings apparently absent in some species, or in some specimens of a given species, but usually more or less distinct to unaided eye, although often indefinite; delimited by narrow zones of generally denser wood, and especially by one to several rows of somewhat to decidedly flattened and often

noticeably thicker-walled fibers; in *Bracteanthus* and *Siparuna* (in part) the flattened fibers are supplemented by more or less broken parenchyma lines or diffuse parenchyma strands.

Wood parenchyma indiscernible in all genera studied, except *Bracteanthus*, with definite, closely spaced, more or less regular, metatracheal bands, readily visible to unaided eye, and *Siparuna* (in part) with broken closely spaced lines, invisible without hand lens.

Pores invisible without lens and sometimes indistinct with it; mostly open; rather few to very numerous, mostly moderately abundant, rather regularly distributed; solitary or in multiples of 2 or 3, or at times more, except in *Siparuna* (in part) where they commonly occur in radial multiples up to 8 to 12 or more and are often disposed in long radial series with other pores and pore groups.

Rays. In Monimioideae (*Hedycarya*, *Kibara*, *Matthaea*, *Mollinedia*, *Peumus*, and *Tambourissa*) mostly relatively wide and high; on cross section, the larger ones usually considerably lighter than ground mass, few to moderately numerous, mostly somewhat more than a pore's width apart, and generally straight and uniform; not especially prominent on tangential surface, because of lack of color contrast with ground mass. Heterogeneous character of rays readily visible on split radial surface under a 10×lens; in *Kibara*, and to lesser degree in *Tambourissa*, prevailing squarish cells also visible on cross section.

In Atherospermoideae (*Daphnandra*, *Laurelia*, *Atherosperma*, *Doryphora*, *Siparuna*, and *Bracteanthus*) rays narrow and very low to low (frequently high in *Siparuna*), with little or no color contrast with background; numerous, uniformly distributed, straight, variable from indistinct to distinct to unaided eye on cross section, fairly distinct on radial; scarcely visible even with lens on tangential surface of most specimens.

Minute Anatomy

Vessels, as seen on cross section (pores), irregularly rounded or oval to more often definitely angular (irregularly polygonal) in outline when solitary; decidedly compressed, with common walls of contact very definitely flattened, in the multiples. Solitary pores very small to small, or occasionally moderate-sized (based on tangential measurements).[2] Distribution fairly uniform, without definite pattern, except for distinct radial disposition of solitary pores and pore groups in certain species of *Siparuna;* in some specimens somewhat smaller and less abundant at outside of growth rings. Abundantly developed in great majority of specimens investigated, ranging from numerous to very numerous (20 to 100+ pores and pore groups per sq. mm.); in *Kibara* (in part) and *Tambourissa* moderately numerous (10 to 20 per sq. mm.), in *Bracteanthus* relatively few (2 to 10 per sq. mm.). Walls very thin to rather thin, usually appreciably narrower than fiber walls. (Plates I and II.)

Vessel members short to extremely long, but mostly within range of long to very long; occasionally to commonly with short tips, at times up to 0.3 to 0.5 mm. No spiral thickenings observed except in *Peumus boldus*, where they are fine but distinct. Inclination of perforation plates slightly to very oblique, mostly the latter; those with smaller angle of inclination usually associated with simple perforations. Perforations variable from exclusively simple to exclusively multiple.

Scalariform plates, with 10 to many bars, characterize *Atherosperma, Daphnandra, Hedycarya, Kibara, Laurelia* (rarely simple), *Matthaea, Mollinedia,* and *Tambourissa;* bars thin and occasionally anastomosed or branched. In *Doryphora* predominantly scalariform plates are occasionally to frequently replaced at both ends of vessel members by pitted areas, in which the small but distinctly bordered pits are mostly opposite and horizontally elongated, with tendency to scalariform arrangement; similarly pitted areas of rare occurrence in a few of other investigated genera. Simple perforations occur in *Peumus* (exclusively) and *Bracteanthus* (rarely multiple, with 2 to 4 rather coarse bars). No single type consistently outstanding in *Siparuna,* varying from predominantly simple (*S. bifida* [P. & E.] DC., *S. cervicornis* Perk., *S. guianensis* Aubl.) to predominantly or almost exclusively scalariform with relatively few (mostly 10 or less), coarse and regular bars (*S. Gilgiana* Perk., *S. magnifica* Perk., *S. nicaraguensis* Hemsl., *S. pauciflora* [Beurl.] DC., *S. Poeppigii* [Tul.] DC., *S. Rimbachii* Standl., *S. thecaphora* [P. & E.] DC., *S. Tonduziana* Perk., *S. Williamsii* Macbr.); more or less reticulate or netlike (malformed) plates also observed in all specimens examined, varying from frequent (*S. bifida, S. cervicornis, S. nicaraguensis*) to rare in occurrence.

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

Intervascular pit-pairs of two types: (*a*) Rather small to large, and transitional from opposite to scalariform, with distinctly scalariform arrangement usually predominating (*Atherosperma, Daphnandra, Doryphora, Hedycarya, Kibara, Laurelia, Matthaea, Mollinedia, Tambourissa*). Apertures slit-like, extending horizontally to, or almost to, the slightly to decidedly elongated border outlines; pits not crowded axially in most species. (*b*) Small to medium or rather large and distinctly alternate in arrangement, numerous and somewhat crowded in most cases (*Peumus, Bracteanthus, Siparuna*). Apertures slit-like or narrow lenticular, extending horizontally (at times obliquely) to, or almost to, the rounded or slightly oval (sometimes polygonal, due to crowding) border outlines; in some specimens of *Siparuna* apertures at times oblique, definitely included, and crossed. (It will be noted that alternate intervascular pitting is characteristic of the genera with simple perforations.)

Pits to ray cells simple or partially to completely bordered; of two rather distinct types: (*a*) Large and radially elongated (elliptical) and usually in definite scalariform arrangement, with apertures in completely bordered pits generally conforming in shape to border outlines (Plate III); (*b*) relatively small and generally similar to the small intervascular pit-pairs noted in *Peumus, Bracteanthus,* and *Siparuna,* although having a more or less distinct tendency to opposite arrangement; pits of intermediate and variable size and outline are of common occurrence in the genera characterized by simple perforations.

The two distinctive types of pitting usually occur in the same wood, at times in the same cell, but the scalariform type is characteristic of the genera having scalariform perforation plates. In *Doryphora Sassafras,* distinctly scalariform pitting is associated, for the most part, with vessels having scalariform perforation plates, and small, irregular pits with members having perforations replaced by pitted areas. In some specimens of *Siparuna* (*S. bifida, S. cervicornis, S. guianensis, S. Poeppigii*), vessel-ray pitting is predominantly and more or less distinctly unilaterally compound, two to six or more small and distinctly bordered vessel pits being subtended by a single elongated ray pit; occasional unilaterally compound pitting was noted in some of the other genera.

Vessels without contents in most of the woods examined, but these were principally small specimens in which heartwood development had not yet begun. In *Atherosperma moschatum* (in part), *Peumus boldus*, *Bracteanthus glycycarpus* Ducke, *Daphnandra micrantha*, *Kibara macrophylla* Benth., and *Tambourissa Thouvenotii* P. Dang. some vessels contain tyloses, mostly thin-walled, regular, and moderately pitted.

Wood fibers (cross section) usually compose only half or less of the ground mass of wood, but are somewhat more abundant in the denser woods (*e.g.*, *Bracteanthus* and *Siparuna* spp.); mostly irregularly polygonal in outline and variable in arrangement; in some woods disposed in fairly definite radial rows, where not too crowded by numerous pores and pore groups; in others (*Peumus*, *Bracteanthus*, *Doryphora*, *Siparuna* spp.) with little or no tendency to radial arrangement, even between closely spaced rays, except toward periphery of growth ring. Walls usually medium, but ranging from very thin to extremely thick; in *Bracteanthus* and some species of *Siparuna* (*S. bifida*, *S. cervicornis*, *S. guianensis*, *S. pauciflora*, *S. Poeppigii*, and *S. Williamsii*) generally so thick that cavities are nearly eliminated. Mucilaginous fibers occur in some of thicker-walled specimens, being especially abundant in denser representatives of *Siparuna*.

Pits more or less abundant in all investigated genera, except *Bracteanthus* and *Siparuna*; in some instances numerous in both radial and tangential walls, in others largely confined to the radial. Apparently entirely simple in *Peumus*, *Bracteanthus*, and *Hedycarya*; simple or very indistinctly bordered in *Daphnandra*, *Kibara*, *Matthaea*, *Siparuna*, and *Tambourissa*; distinctly bordered, at least in part, in *Atherosperma*, *Doryphora*, *Laurelia* (Plate III, 2) and *Mollinedia*.

Septate fibers present in all genera, except *Bracteanthus* and *Siparuna*, often predominant to exclusive; distributed throughout ground mass of wood; with one to several fine cross walls, sometimes lined with brownish gum suggesting horizontal resin plates (Plate IV, 2).

Except in *Mollinedia*, septate fibers are apparently simple-pitted, even in those woods in which non-septate fibers bear distinctly bordered pits; in *Mollinedia* predominant septate fibers appear to bear bordered pits, although bordered condition is usually more or less indistinct. In general, the results of

this investigation support the findings of Solereder (1908), as regards the pitting and septation of the fibers.

Isolated fibers (macerated material) variable in length, even in same wood (maximum range from very short to very long), but mostly within range of short to long, predominantly long; fairly regular in outline, tapering gradually from indefinite and somewhat enlarged median portions to fairly sharp ends.

Wood parenchyma usually sparingly developed and predominantly of diffuse type, occurring as isolated strands among the wood fibers; sometimes, especially in *Peumus*, *Hedycarya*, *Kibara*, *Matthaea*, *Mollinedia*, and *Tambourissa*, with a slight paratracheal tendency; in *Bracteanthus* and *Siparuna* also definitely metatracheal.

In *Bracteanthus*, parenchyma is abundantly developed in well-defined, rather regularly and closely spaced bands, 1 to 6, mostly 2 to 4, cells wide; these bands are fairly continuous and frequently contact the pores, although rarely definitely embracing them (Plate II, 2). In *Siparuna*, it is rather well developed, often forming numerous, short, broken, irregular, uniseriate lines (Plate II, 1).

Rays, on cross section, rather regularly distributed (spaced 1 to 14, mostly not over 6, fiber rows, or from slightly less to decidedly more than a pore's width apart), and usually exhibiting little or no deformation in contact with pores and pore groups; on tangential section, 1 to 15, mostly 4 to 10, per mm., and generally different in width in the two subfamilies.

In the Atherospermoideae the rays range from very fine to usually not more than moderately broad (up to about 0.09 mm.), and 1 to 3 or 4, infrequently locally 5 or 6, cells wide (Plate IV, 1). In a few cases they measure somewhat wider, *e.g.*, in *Bracteanthus* (up to 0.13 mm.) and some specimens of *Siparuna* (0.11 mm.), but the width in cells does not exceed 6 and is dominantly 2 to 4. In one of the two available specimens of *Doryphora Sassafras* (Yale No. 16126) the rays are up to 7, occasionally locally 8, cells wide, with the wider ones predominating. Rays in this tribe show a vertical range from extremely low to low, or in *Siparuna* to high or very high. Uniseriate rays do not exceed 8 to 15 cells high, except in some specimens of *Siparuna*, in which the maximum height noted was about 25 cells; wider rays attain maximum heights ranging from 30 to 75 cells.

In the Monimioideae, with exception of *Peumus*, the rays are predominantly broad and high to extremely high; in *Peumus* they are mostly moderately broad and low. Maximum widths range from 0.14 mm. in *Peumus* to 0.50+ in *Kibara;* maximum cell widths vary from 7 or 8 (*Peumus, Matthaea*, and *Kibara* in part) to 16 (*Tambourissa quadrifida* Sonn., Plate IV, 2). Uniseriate rays usually are sparsely developed and inconspicuous, up to 5 to 13 cells in height in genera under consideration; multiseriate rays many cells in height.

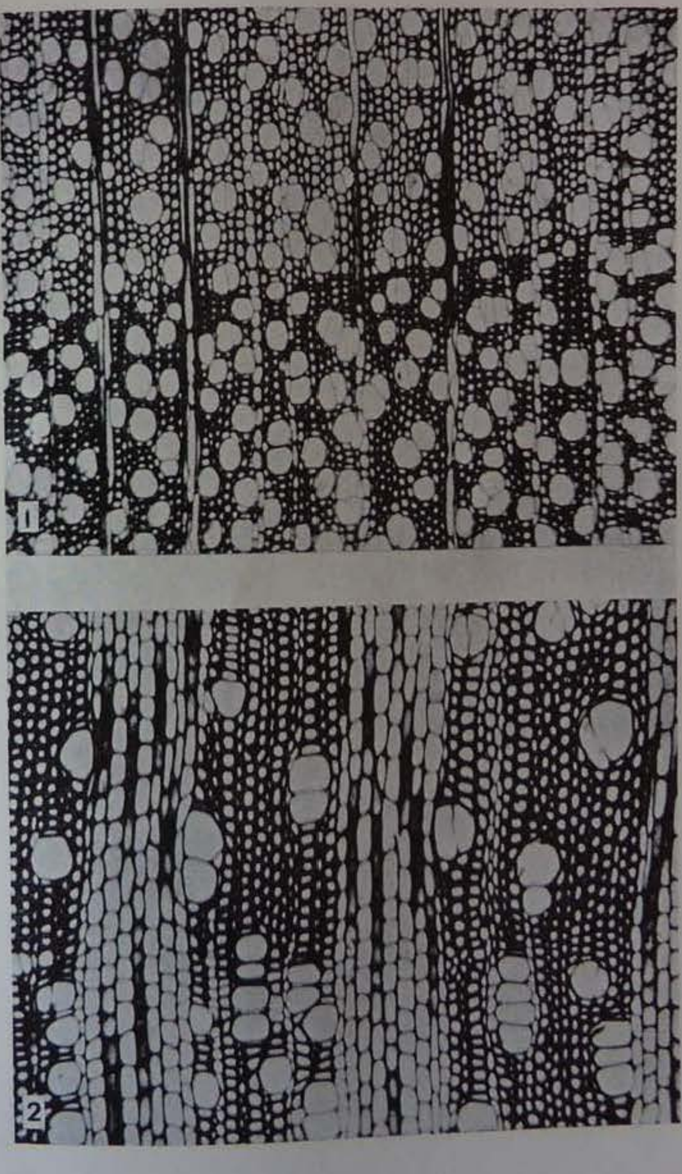
Wider rays in both groups seldom to commonly bear uniseriate margins, which are mostly low, ranging up to 4 to 10 cells (up to 18 cells in *Siparuna*). Sometimes two or three rays are fused vertically. The wide rays in *Hedycarya angustifolia* R. Cunn. are of distinctive appearance in tangential section, the interior part consisting of small cells, irregularly rounded or slightly elongated axially, entirely surrounded by one to several layers of larger cells, which are usually distinctly elongated vertically.

As seen on radial section, rays rather weakly heterogeneous (*Peumus*) to much more often distinctly or even conspicuously so (Plate III). Uniseriate rays and uniseriate margins (one to several rows of cells) of wider rays composed of squarish to decidedly upright cells. Interior cells of wider rays vary from distinctly procumbent (*Atherosperma, Doryphora, Laurelia*) to consistently squarish and at times even upright (*Matthaea* and *Siparuna*). In *Atherosperma, Daphnandra, Hedycarya*, and *Siparuna pauciflora* some of the cells are lined, or more or less filled, with brownish gum. In *Matthaea* small crystals are of very common occurrence in ray cells.

Oil cells sporadic among the marginal (upright) cells in *Daphnandra micrantha* (Plate III, 1) and *Doryphora Sassafras* (in part); they are slightly (*Daphnandra*) to decidedly (*Doryphora*) more distended than normal ray cells.

Artificial Key to the Genera

The following key has been proposed as an aid to the identification of those Monimiaceae which can be readily distinguished, and also to emphasize the structural similarity and unity of the others. It will be noted that but three genera, *Peumus, Bracteanthus*, and *Siparuna*, are outstanding anatomically, although the separation of the remaining genera of the subfamily Monimioideae from those of the Atherospermoideae is not difficult because of the size distinctions in the rays. *Daphnandra* and *Doryphora* are also somewhat

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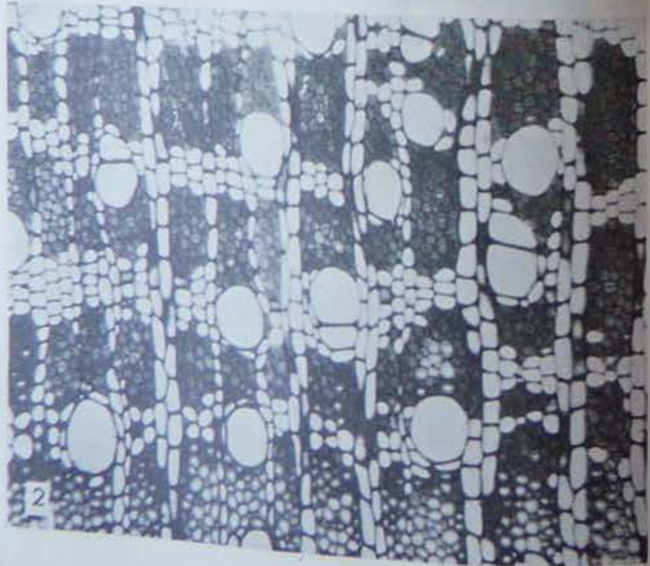
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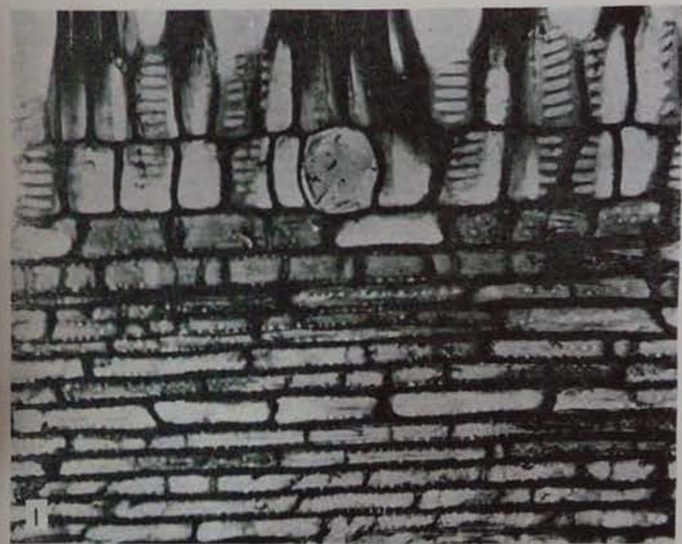
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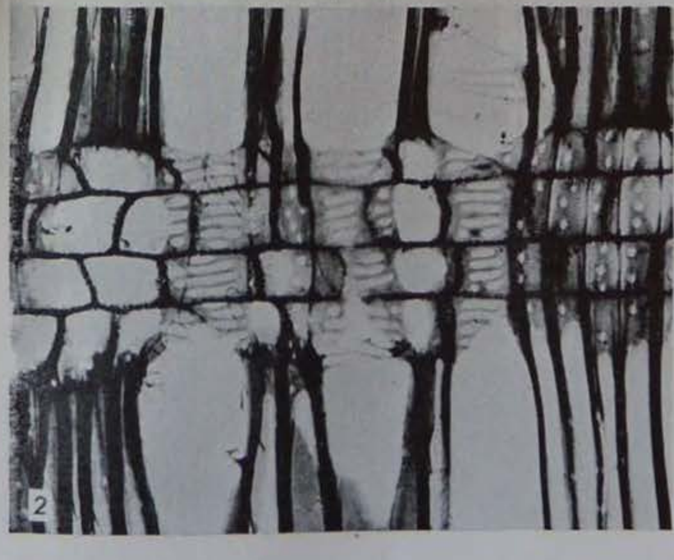
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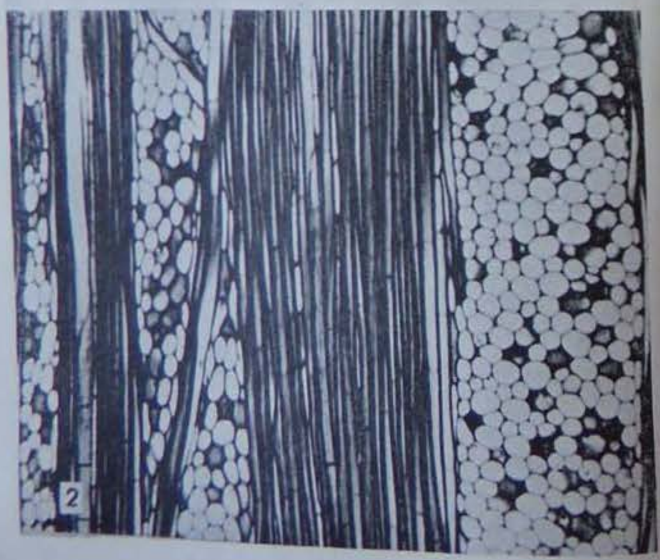

distinct from the other woods, owing to the presence of oil cells in their rays.

I. Rays predominantly wide and high (low in *Peumus*); maximum width ranging from 7 to 16 cells; many cells in height. Oil cells entirely lacking. Wood parenchyma diffuse and weakly paratracheal. Wood fibers predominantly to entirely septate. Pores solitary or in multiples of 2 to 4, or at times 5 or 6. . . . . MONIMIOIDEAE.
   A. Vessel perforations exclusively simple. Vessel walls with fine but distinct spiral thickenings. Intervascular pitting alternate. Vessel-ray pit-pairs somewhat variable in size and shape, and more or less opposite; pitting rarely scalariform. Pores and pore groups numerous (18 to 45 per sq. mm.). Fiber pits simple. Rays rather weakly heterogeneous; width up to 7 or 8 cells (0.14 mm.), chiefly 4 to 6 cells. . . . . *Peumus boldus*.
   B. Vessel perforation plates exclusively scalariform, chiefly with 10 to many bars. Walls not spirally thickened. Intervascular pitting scalariform, or transitional to opposite. Vessel-ray pitting typically distinctly scalariform. Pores moderately to very numerous (10 to 83 per sq. mm.). Fiber pits simple (*Hedycarya*) to bordered (*Mollinedia*). Rays distinctly heterogeneous; up to 7 or 8 to 16 cells wide in individual genera. . . . . *Hedycarya angustifolia*, *Mollinedia*, *Matthaea sancta*, *Kibara*, *Tambourissa*.

II. Rays predominantly narrow, usually not more than 1 to 3 or 4 cells, infrequently locally 5 or 6 cells (0.09 mm.), wide (up to 7 or 8 cells in one specimen of *Doryphora*); low, except in *Siparuna*; distinctly heterogeneous. . . . . ATHEROSPERMOIDEAE.
   A. Wood parenchyma metatracheal. Septate fibers absent. Intervascular pitting alternate. Oil cells entirely lacking.
      1. Metatracheal parenchyma in definite bands, 1 to 6, mostly 2 to 4, cells wide. Pores solitary or about as often in radial groups of 2 to 4, rarely 5 or 6; few to moderately few (2 to 8 per sq. mm.). Perforations exclusively simple, or practically so. Vessel-ray pitting variable in size, outline, and distribution, but at times rather distinctly scalariform; occasionally unilaterally compound. Wood fibers extremely thick-walled; pits simple. Rays 1 to 4, mostly 3 or 4, cells wide (up to 0.13 mm., but mostly less than 0.08 mm.); uniseriate, 1 to 9 cells high. . . . . *Bracteanthus glycycarpus*.
      2. Metatracheal parenchyma in short, broken, irregular, uniseriate lines. Pore multiples seldom of more than 2 or 3 cells in some species, in others radial groups of 8 to 12 are common; moderately to very numerous (15 to 58 per sq. mm.), mostly numerous (20 to 40). Perforations variable from predominantly simple to almost exclusively multiple, the latter mostly with less than 10 bars; reticulate plates frequent to rare in all specimens. Vessel-ray pitting usually distinctly scalariform in

some specimens; predominantly unilaterally compound in others. Wood fibers variable from extremely thick-walled to thin-walled; pits simple or at times indistinctly bordered. Rays 1 to 4, at times locally 5 or 6, cells (up to 0.11 mm.) wide; uniseriate rays up to 13 to 25 cells high in the investigated species. . . . . *Siparuna*.

B. Wood parenchyma diffuse only. Fibers occasionally to apparently exclusively septate; walls thin. Pores very numerous (40 to 80+ per sq. mm.; up to 120 in *Atherosperma moschatum*); solitary or in multiples of 2 to 4, or at times 5. Perforation plates exclusively scalariform with 10 to many bars. Intervascular and vessel-ray pitting mostly distinctly scalariform. Fiber pits simple or indistinctly bordered (*Daphnandra*) to distinctly bordered. Oil cells occasional in rays of *Daphnandra* and *Doryphora*. . . . *Daphnandra micrantha*, *Doryphora Sassafras*, *Atherosperma moschatum*, *Laurelia*.

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

From the foregoing description of the minute anatomy of the woods of the Monimiaceae, and the artificial key to the genera, it is obvious that the great majority of the investigated genera afford a striking similarity in the structure of their secondary xylem, a condition which indicates a very unified group.[3] If *Peumus*, *Siparuna*, and *Bracteanthus* are excluded, the only essential difference in the structure of the wood of the remaining genera lies in the size of the rays, and this feature is not always absolutely clear-cut. These groups are in more or less complete agreement in such significant features as type of vessel perforation plate; size, number, and arrangement of pores; character of intervascular and vessel-ray pitting; occurrence of septate wood fibers; type of wood parenchyma; and type of ray.

Peumus, although included by Perkins and Gilg in the tribe Hortonieae, together with *Hedycarya* and other genera, differs decidedly from the prevailing structure of the family. Its simple perforations, spiral thickenings on the vessel walls, alternate intervascular pitting, and variable (seldom scalariform) vessel-ray pitting are features not duplicated in *Hedycarya* or the other investigated members of the subfamily Monimioideae. The structure of the wood would indicate that, if it is correctly included in the Monimioideae, *Peumus* should at least be placed in a tribe separate from those established by Perkins and Gilg.

Likewise *Siparuna* and *Bracteanthus* are anatomically distinct from the other Monimiaceae of both tribes, although they possess certain features in common with *Peumus*. The presence of metatracheal parenchyma, although it differs in the two genera under consideration, the absence of septate fibers, the alternate intervascular pitting, and the exclusive (*Bracteanthus*) or partial (*Siparuna*) occurrence of simple perforations are all departures from the prevailing structure in the family. The opinion of Ducke (1930) as to the close relationship between *Bracteanthus* and *Siparuna* is definitely borne out in the wood structure. Since no specimens of *Glossocalyx* are available, it has not been possible to determine whether or not the structure of the two investigated genera is typical of the entire tribe Siparuneae.

In some respects *Siparuna* seems transitional between the two extremes of structure of the family, represented by *Bracteanthus* on the one hand and the other members of the subfamily Atherospermoideae on the other. Its wood parenchyma is disposed in short, broken lines, which may be considered intermediate between the definite bands of *Bracteanthus* and the typical diffuse parenchyma of the other genera; its vessel perforations are variable from predominantly simple (*Bracteanthus* type) to almost exclusively multiple (scalariform); the vessel-ray pitting is variable, being unilaterally compound in certain species and definitely scalariform in others; and, finally, the wood fibers range from extremely thick-walled (as in *Bracteanthus*) to thin-walled.

Hobein (1889) first noted the anatomical distinction between the members of the subfamily Monimioideae and those of the Atherospermoideae, based on the width of the primary rays. He determined that the rays were broad in the Moni-

[3] Perkins and Gilg (1901) state that if the tribe Trimenieae (*Trimenia*, *Piptocalyx*, *Xymalos*, and *Chloropatane*) is excluded, the family is an unusually natural and closed one. They mentioned that the four genera which they placed in this tribe were not any too well known and at least some of them might later be shown to belong to some other family; *Chloropatane* was later recognized as a synonym for *Erythrococca* Benth. of the Euphorbiaceae. No wood specimens of these genera were available for comparison with the representatives of the other tribes.

mioideae, being readily distinguished with the unaided eye or a low-powered hand lens, while in the Atherospermoideae they could not be distinguished with the naked eye. Perkins (1898 and 1901) also found this to be the case, the primary rays of the Monimioideae being mostly 3- to 6-seriate, and very seldom biseriate; those in the Atherospermoideae are 1-, 2-, or seldom 3-seriate.

In the specimens of mature secondary xylem available for this study, the distinctions between the widths of the rays in the two subfamilies are in general decidedly more marked. Among the Monimioideae the rays are mostly 4-seriate and wider, the maximum widths ranging from 7 or 8 cells in *Peumus* and *Matthaea* to as many as 12 to 16 cells in *Hedycarya*, certain species of *Mollinedia* and *Kibara*, and in *Tambourissa*. In the representatives of the Atherospermoideae, on the other hand, they are generally not more than 1 to 3 or 4 cells wide, or infrequently 5 or 6 cells at localized points; only in one specimen of *Doryphora Sassafras* were they mostly broad, attaining a maximum width of 7, or occasionally locally 8, cells.[4]

Bearing of Wood Anatomy on the Systematic Position of the Monimiaceae

Various positions have been assigned to the Monimiaceae in the different systems of plant classification, but the relationship of this family to the Myristicaceae and the Lauraceae has been most often stressed. From time to time, botanists have also pointed to affinities with the Calycanthaceae, Urticaceae, Magnoliaceae, Schizandraceae, Hernandiaceae, and Gomortegaceae. Further, the occurrence of oil (secretory) cells in a few representatives of the Monimiaceae points to possible relationship with the Anonaceae and Canellaceae. In the following paragraphs, the structural affinities of these families with the Monimiaceae are indicated, but no attempt

[4] There is a possibility that the determination of this specimen may have been incorrect, since Welch (1929), basing his findings upon the examination of material in the collection of the Technological Museum, Sydney, Australia, and trade samples, states that the rays of *Doryphora Sassafras* are uniseriate or usually biseriate or triseriate.

has been made to enumerate the points of similarity and distinction.[5]

Myristicaceae

While the woods of Monimiaceae can be definitely separated from those of the Myristicaceae, on the basis of the tanniniferous tubes and definite paratracheal parenchyma which characterize the latter, they have important anatomical characteristics in common. The myristicaceous woods are like *Hedycarya*, *Kibara*, *Mollinedia*, *Matthaea* and *Tambourissa* in a number of significant features, and their resemblance to *Atherosperma*, *Daphnandra*, *Doryphora*, and *Laurelia* is even more marked, because of the greater similarity in ray widths and occurrence of oil cells in *Daphnandra* and *Doryphora*. The closest resemblance appears in some of the investigated species of *Siparuna*. *Bracteanthus* and *Peumus* show perhaps the least anatomical similarity to the Myristicaceae, but even in these genera there are points of likeness which cannot be entirely disregarded.

Lauraceae

Although the Monimiaceae, in general, bear less resemblance to the Lauraceae than to the Myristicaceae, the woods of the two families under consideration have a number of features in common. Of the monimiaceous genera, *Peumus* shows the most striking similarity to the Laurels; except for the type of wood parenchyma and the presence or absence of oil cells and spiral markings on the vessel walls, there do not appear to be any major differences between them. The structure of *Bracteanthus* also parallels that of the Lauraceae to a noticeable degree, while the similarity to *Siparuna* is less marked. As was the case with the Nutmegs, *Atherosperma*, *Daphnandra*, *Doryphora*, and *Laurelia*, of the subfamily Atherospermoideae are more nearly like the Laurels than are *Hedycarya*, *Kibara*, *Matthaea*, *Mollinedia* and *Tambourissa*

[5] A discussion of the structure of all of these families, except the Calycanthaceae and Urticaceae, has been incorporated in a previous paper, Garratt (1933), and the reader is referred to this for data concerning the anatomical characteristics.

of the Monimioideae, owing to their prevailing narrow rays and the occurrence of oil cells in certain genera.

Hernandiaceae

Some anatomical similarity is found between the Hernandiaceae and the genera *Bracteanthus*, *Peumus*, and *Siparuna*, especially the first two. The woods of the other monimiaceous genera have little in common with the Hernandiaceae; in fact they are so unlike those of this family as to imply little or no relationship. Among the outstanding features of the Hernandiaceae that are not duplicated in any of the Monimiaceae are the extremely low density of the wood, the very characteristic paratracheal wood parenchyma, and the distinctly homogeneous rays.

Gomortegaceae[6]

Owing to the very limited information concerning the anatomy of the secondary xylem of the Gomortegaceae, serious consideration cannot be given to the suggested relationship between this family and the Monimiaceae. However, the available data indicate some similarity with the narrow-rayed *Atherosperma*, *Daphnandra*, *Doryphora*, and *Laurelia;* the resemblance of *Hedycarya*, *Kibara*, *Matthaea*, *Mollinedia*, and *Tambourissa* to the Gomortegaceae is somewhat less marked.

Anonaceae

Certain significant anatomical features of the Anonaceae are definitely duplicated in wood of *Bracteanthus*, *Peumus*, and *Siparuna*, but the points of distinction are equally outstanding and little relationship appears to be indicated. The remaining investigated genera are very definitely structurally distinct from the Anonaceae.

Magnoliaceae

The woods of the two families are in many ways distinct.

[6] This is a monotypic family, the only known species of which, *Gomortega nitida* Ruiz & Pav., appears to be very rare. There are no specimens in the Yale collections and the only available data on the structure of the wood is that given by Solereder (1908).

The greatest anatomical similarity is found between the Magnoliaceae and the genera *Atherosperma*, *Daphnandra*, *Doryphora*, and *Laurelia*, all of which agree fairly well with the Magnolias in the majority of important features; however, there are also a number of significant structural characteristics in common with *Bracteanthus*, *Siparuna*, and the wide-rayed *Hedycarya*, *Kibara*, *Matthaea*, *Mollinedia*, and *Tambourissa*. Except for a few features, such as the presence of spirals on the vessel walls and the type of ray, *Peumus* has little in common with the Magnoliaceae.

Schizandraceae

The woods of the Schizandraceae and the Magnoliaceae bear a remarkable similarity to each other. Consequently the preceding comparisons between the Monimiaceae and the Magnolias may be considered to apply to the Monimiaceae and the Schizandraceae.

Canellaceae

The Canellaceae are distinct from the Monimiaceae in so many significant features, including density of wood, character of vessel-ray and fiber pitting, and type of ray, that little or no relationship can be inferred.

Calycanthaceae[7]

The only available wood specimens of this family (*Calycanthus* spp.) are too small to yield reliable data as to density, which appears to be intermediate. Growth rings demarcated by definitely flattened wood fibers.

Pores diffuse; solitary or more often in usually radial multiples of 2 to 10, rarely more. Perforations exclusively simple. Intervascular pit-pairs definitely alternate. Pits to ray cells alternate. Vessel walls marked by fine but distinct spirals. Wood fibers with distinctly to indistinctly bordered pits; not septate. Wood parenchyma poorly developed; diffuse and rather weakly paratracheal, tending to form broken sheaths, 1 cell wide, about pores and pore groups. Rays 1 to 2, occasionally 3, cells wide; rather distinctly heterogeneous.

[7] The characteristic features of the secondary xylem of the Calycanthaceae and the Urticaceae are summarized here, since the description of the anatomy of the woods of these families was not included in the previous paper, Garratt (1933).

The Calycanthaceae have very few anatomical features in common with the great majority of monimiaceous genera and the points of distinction are so outstanding as to indicate that their relationship, if any exists, is remote. Only with *Bracteanthus*, *Peumus*, and *Siparuna* is there sufficient similarity to the Calycanthaceae to indicate possible, although somewhat indefinite, affinity.

URTICACEAE [7]

Woods light and soft to moderately hard and heavy. Some genera with anomalous structure. Growth rings apparently lacking or very indistinct in some specimens, definite in others; being formed by flattened or at times relatively large and thin-walled wood fibers.

Pores solitary, or more or less often in radial multiples of 2 or 3, or rarely to occasionally 4 or 5. Vessel perforations exclusively simple. Intervascular pit-pairs alternate. Pits to rays of irregular distribution, but mostly alternate, in some instances; more or less definitely scalariform in others. Wood fibers with simple pits; predominantly to exclusively septate in most cases. Wood parenchyma definitely paratracheal, in more or less broken sheaths, 1 to 3 cells wide, about the pores and pore groups. Rays uniseriate, or much more often rather broad (3 to 7 cells wide, rarely more); rather weakly to more often distinctly heterogeneous.

The structure of the secondary xylem of the Urticaceae is quite closely paralleled by that of *Peumus*, the two groups having so many significant features in common that a definite relationship might be implied. The resemblance of *Bracteanthus* and *Siparuna* to the Urticaceae is decidedly less marked, while the other monimiaceous genera are very distinct in most respects.

Summary

A study of 65 specimens, representative of 30 species and 12 genera of the Monimiaceae, revealed a marked similarity in the structure of the secondary xylem of the great majority of the investigated genera and a decided diversity in the anatomy of the others. *Hedycarya*, *Kibara*, *Mollinedia*, *Mathaea*, and *Tambourissa*, of the subfamily Monimioideae, and *Atherosperma*, *Daphnandra*, *Doryphora*, and *Laurelia*, of the subfamily Atherospermoideae, have a unified wood structure. On the other hand, *Peumus*, of the Monimioideae, and *Bracteanthus* and *Siparuna*, of the Atherospermoideae, are readily separable from the other investigated genera and, to a more or less marked degree, from one another. In fact the structure of the wood indicates that *Peumus*, if it is correctly assigned to the subfamily Monimioideae, should be placed in a tribe separate from those established by Perkins and Gilg. *Siparuna* and *Bracteanthus* are equally distinct from the other examined representatives of the subfamily Atherospermoideae. Significant differences also occur in the other plant parts of these two genera, which have been segregated in the tribe Siparuneae by Perkins and Gilg. No specimens of *Glossocalyx*, the third genus included in this tribe, were available for study.

As first pointed out by Hobein (1889), the woods of the two established subfamilies can be rather definitely distinguished on the basis of ray size. The woods of the Monimioideae are characterized by rays which are essentially broad, those of the Atherospermoideae by definitely narrow rays.

Oil (secretory) cells are of sporadic occurrence in the rays of *Daphnandra micrantha* and *Doryphora Sassafras*. This brings to eight the number of families in which such cells have been reported in either the wood parenchyma or the rays, or both, the other families being the Lauraceae, Myristicaceae, Hernandiaceae, Magnoliaceae, Schizandraceae, Anonaceae, and Canellaceae.

Rather unusual features were noted in the vessels in *Siparuna* and *Doryphora Sassafras*. In the former more or less reticulate or net-like (malformed) perforation plates were found in all the specimens examined, varying from frequent to rare in occurrence. In *Doryphora* the normal scalariform perforation plates are occasionally to frequently replaced by special pitted areas.

There is considerable diversity of opinion among taxonomists as to affinities of the family. That there is no clear-cut relationship with any other family is indicated in the structure of the wood. Of the families to which the Monimiaceae have been considered as related, the greatest affinity appears

to be with the Myristicaceae, especially through the genus *Siparuna*. There is also more or less marked similarity with the Lauraceae, particularly on the part of *Peumus*. This tends to corroborate Hutchinson's inclusion of the Monimiaceae in the order Laurales, although the relationship of this family to the Hernandiaceae does not appear very definite. Some similarity was also noted between the woods of the Monimiaceae and those of the Magnoliaceae, Schizandraceae, Urticaceae, and Calycanthaceae.

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EXPLANATION OF PLATES

PLATE I

No. 1. *Atherosperma moschatum* Labill. (Yale No. 19451). Cross section showing arrangement and distribution of pores, narrow rays, and growth ring demarcated by flattened wood fibers. × 56.

No. 2. *Tambourissa quadrifida* Sonn. (Yale No. 15518). Cross section showing arrangement of pores and wide rays, the latter with characteristic short cells. × 56.

PLATE II

No. 1. *Siparuna guianensis* Aubl. (Yale No. 19041). Cross section showing arrangement and distribution of pores and characteristic wood parenchyma pattern. × 56.

No. 2. *Bracteanthus glycycarpus* Ducke (Yale No. 20700). Cross section showing pore arrangement, parenchyma pattern, and thick-walled wood fibers. × 56.

PLATE III

No. 1. *Daphnandra micrantha* Benth. (Yale No. 19345). Radial section showing oil cell, heterogeneous character of ray, and scalariform vessel-ray pitting. × 164.

No. 2. *Laurelia aromatica* Juss. (Yale No. 5546). Radial section showing heterogeneous ray (composed entirely of squarish to upright cells), scalariform vessel-ray pitting, and definitely bordered fiber and fiber-ray pitting. × 164.

PLATE IV

No. 1. *Daphnandra micrantha* Benth. (Yale No. 19345). Tangential section showing narrow rays. Scalariform intervascular pitting is visible in vessel wall shown on extreme left. × 56.

No. 2. *Kibara macrophylla* Benth. (Yale No. 20060). Tangential section showing typical wide rays. A number of septate wood fibers are visible in the lower center of the illustration. × 56.

CURRENT LITERATURE

Ebano, arellano o palo colorado, amapas, tecomate ayele o guaje cirial, guayacán, haba. By JESÚS GONZÁLEZ ORTEGA. *Boletín de Pro-Cultura Regional* (Mazatlán, Mexico) 1: 33: 3–12; 2 pls.; March 1934.

There are published descriptions of the following species of Sinaloa trees, with notes regarding their distribution, rate of growth, and other details: *Caesalpinia sclerocarpa* Standl., vernacular name Ebano; *C. platyloba* Wats., Arellano, Palo Colorado; *Tabebuia Palmeri* Rose, *T. chrysantha* (Jacq.) Nichols., and *T. pentaphylla* Hemsl., all known by the name Amapa; *Crescentia alata* H.B.K., Tecomate Ayele, Guaje Cirial; *Guaiacum Coulteri* Gray and *G. Palmeri* Vail, Guayacán; *Hura polyandra* Baill., Haba.

British Honduras. Report of the Forest Trust for the biennial period ending March 31st, 1933. By J. B. KINLOCH. Belize, 1934. Pp. 22; 8 x 13.

"The increasing depression in the trade of the Colony made

economy imperative during the period under review. The Forest Trust early decided that further silvicultural work, with its long lock-up of capital, was to be discontinued and all reserves were placed on a care-and-maintenance basis. The energies of the department were then applied to the furtherance of the research work into the exploitation and marketing of the secondary timbers with the view to taking prompt advantage of the recovery of world trade when the present depression lifts. This research has been made possible by a Colonial Development Fund Grant and is devoted to the investigation of the forest resources of the Colony with particular reference to a group of the lesser known hardwoods under test or promise of test at Princes Risborough. It continues the methodical working out of the accepted forest policy and provides a profitable channel for activity of the whole of the trained staff during the present period of financial stringency.

"Until the Colonial Development Fund Grant was finally approved, preliminary reconnaissances were made to decide the area in which resources survey should first be started. Demarcation work on the Indian reserves was completed and later tied into the recently completed trigonometrical survey of the southern half of the Colony. Perhaps the greatest achievement during this period was the compilation of a vegetation map in May 1932, in which the main forest divisions are shown over 85 per cent of the area of the mainland, the greater part of the remaining 15 per cent being in the unexplored, and at present inaccessible, Maya Mountains, where the forest is without doubt chiefly the advanced type of high rain forest with mountain forest on the siliceous rock formations and on the ridges above the limit of Cohune, which with its associates forms the climatic climax of the Colony."

Risultati della Spedizione Biologica Austriaca in Costa-rica nel 1930 (Raccolte botaniche—Terza parte). By GIORGIO CUFODONTIS. *Archivio Botanico* 10: 25–51; pls. 1, 2; Forlì, Italy, 1934.

Among the woody plants described as new from Costa Rica are the following: *Piper Cufodontii* Trel., *P. negritosense* Trel.; *Erythrina gibbosa* Cuf., *E. globosa* Porsch & Cuf.;

Cufodontia stegomeris Woodson, a new genus of Apocynaceae, a second species of the genus being described from Petén, Guatemala; *Cordia Johnstoni* Cuf.; *Tournefortia poasana* Cuf.; also new species in *Brachistus* and *Streblacanthus*.

A monograph of the genus *Aegiphila*. By HAROLD NORMAN MOLDENKE. *Brittonia* (Lankester, Pa.) 1: 245–477; April 1934.

Aegiphila, of the Verbenaceae, consists of shrubs and trees, ranging from Mexico and the West Indies southward through tropical South America. There are listed 125 species, for which are provided keys, descriptions, synonymy, citation of specimens, and miscellaneous notes.

Die Gattung *Astronium*. By FR. MATTICK. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 991–1012, Berlin-Dahlem, Jan. 20, 1934.

The genus *Astronium*, of the Anacardiaceae, consists of trees, some of which attain a large size and are an important source of lumber. They range from southern Mexico and the West Indies to Bolivia and Argentina. The author recognizes 12 species, with various varieties, and provides a key for their separation. Vernacular names are reported for some of the species, as follows: *A. obliquum* Griseb., Yoke (Trinidad); *A. gracile* Engl., Ubatão (Brazil), Urundeý-itá, Urundeý-pytá, Urundeý-pará (Paraguay); *A. graveolens* Jacq., Gateado, Diomate, Yomate, Gusanero, Tibigaro (Venezuela), Gusanero (Colombia), Zorro (Panama), Ronrón (Salvador), Palo Obero (Honduras), Copaiva (Oaxaca), Palo de Cera, Palo de Culebra (Guerrero); *A. graveolens*, var. *Planchonianum* Engl., Gonçalo Alves, Gonçalo, Gonzales (Brazil), Quebrahacha, Diomate, Quebracho (Colombia); *A. fraxinifolium* Schott, Gonçalo, Aratanha, Aroeira, Gonçaleiro Branco (Brazil), Almendro Macho, Cuchi Blanco (Bolivia), Quebrahacha (Colombia); *A. Le Cointei* Ducke, Muiracoatiara, Muiraquatiara (Brazil); *A. macrocalyx* Engl., Aroeira do Mucury (Brazil); *A. urundeuva* (Allem.) Engl., Aroeira, Ubatan, Chibatan (Brazil), Cuchi, Sotocolo (Bolivia), Urundeý-mí (Paraguay), Urundel (Argentina); *A. urundeuva*, var. *Candollei* (Engl.) Hassl., Aroeiro (Brazil), Urundai-mi (Paraguay); *A. Balansae* Engl., Urunday, Urunday Pardo. Urundeý-pichai (Argentina). *A. Gardneri* and *A. Glaziovii* are described as new, from Brazil.—P. C. STANDLEY.

Palmae neogeae. V. By M. BURRET. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 1037–1050, Berlin-Dahlem, Jan. 20, 1934.

Among the new (unless otherwise indicated) Palms listed are: *Brahea psilocalyx*, British Honduras; *Chamaedorea Schippii*, British Honduras; *Oenocarpus Hoppii*, islands of the mouth of the Amazon, vernacular name Patauá; *O. macrocalyx*, Matto Grosso, Brazil, Bacabinha; *Attalea ferruginea*, upper Rio Negro, Venezuela-Brazil boundary, Curuá; *Scheelea insignis* (Mart.) Karst., Inajá-rana, Curua-y (Brazil); *S. Wallisii* (Huber) Burret, Jacy (Brazil); *S. Dryanderae*, Colombia, Marano.

Beiträge zur Kenntnis der Flacourtiaceen Südamerikas. I. By HERMANN SLEUMER. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 951–960, Berlin-Dahlem, Jan. 20, 1934.

New South American species are described in the genera *Abatia*, *Banara*, and *Casearia*. New combinations are published in various genera, and a number of names are reduced for the first time to synonymy. The new section *Endoglossum* is established for *Casearia tremula* (Griseb.) Wright, of which *C. spiralis* Johnst. and *C. bonairensis* Boldingh are synonyms.

The great savannah district of British Guiana, with brief notes on the vertebrate fauna. By DESMOND VESEY-FITZGERALD. *Tropical Agriculture* 11: 5: 111–116; figs. 1–6; May 1934.

"Apart from a comparatively small coastal strip the greater part of British Guiana is covered by a continuation of the great Amazon rain forest. At the head of the Rupununi River, however, there is a considerable area of savannah country, which is a continuation of the great savannahs of Northern South America. The writer visited this country during the dry season of 1932–33 (August–January) . . . The object of the present article is simply to convey a few impressions of the conditions encountered in this little visited part of the Colony.

"Any good map will show the main details of the district under consideration, but the exact course of the boundary between British Guiana and Brazil was only decided by the international boundary commissions at work during last year. The territories to be allotted to each of the three great countries of British Guiana, Venezuela, and Brazil are decided largely by watersheds of the Essequibo, Orinoco, and Amazon. The former British boundary with Brazil in this area followed the river Cotinga, but the present boundary is considerably further east, on the Ireng. Mount Roraima, well named by the Indians 'Father of the Waters,' since it sends water to each of these great river systems, becomes divided between British Guiana, Venezuela, and Brazil, though formerly it was entirely British. . . .

"The great savannah district of British Guiana is drained by the Rupununi River, flowing north into the Essequibo, and by the Ireng and Takutu Rivers, flowing south into the Rio Branco, an important tributary of the Rio Negro-Amazon system. The watershed between the Amazon and Essequibo is only 11 feet high in this district. The main savannah is only about 300 feet above sea level, but it is divided into a northern and southern portion by the Kanuku Mountains. These mountains reach their highest point in Iramikipang which is about 3000 feet. They are largely covered by tropical rain forest vegetation.

"To the northwest, the foothills of the Pakaraima Mountains meet the savannah, and the country rises in a series of plateaus, reaching its highest point at Mt. Roraima, which is 9000 feet high. The Pakaraima foothills are characterized by rounded, savannah covered hills. A deciduous forest resembling monsoon forest covers some of these hills, and rain forest fills the larger valleys. The Pakaraima Mountains are typically flat-topped sandstone blocks, completely surrounded by sheer precipices.

"The climate is comparatively pleasant owing to the prevalence during the dry season of an almost continual wind on the open savannah. The rainfall is not heavy, being about 40

inches. September to May is regarded as the dry season, the remaining months being wet. In the dry season, the grass dries up and there are extensive fires.

"The grass *Trachypogon plumosus* and the shrub *Curatella americana*, locally known as the Sandpaper Tree, are the most characteristic members of the savannah vegetation. *Byrsonima crassifolia* and *B. verbascifolia* and a small *Paepalanthus* are constant associates of the above. Certain 'islands' of raised land are dominated by Cashew orchard. Lower areas, which are liable to flooding during the wet season, are covered by a mixed sedge vegetation. Definite hollows remain as lagoons or swamps throughout the year. The flowers of the water hyacinth are conspicuous on the lagoons. In the swampy areas, the stately Aete Palms, *Mauritia* sp., are seen forming either islands of considerable size, or drawn-out belts following the course of some creek. . . . The river fringes are largely and typically composed of *Inga* spp."

Observations on a journey from the mouth of the Amazon to Mt. Roraima and down the cattle trail to Georgetown. By J. G. MYERS. *Agricultural Journal of British Guiana* (Georgetown) 5: 2: 86–100; June 1934.

An interesting and instructive report embodying the "miscellaneous impressions of a travelling agricultural ecologist." The journey included a visit to Bôa Vista or Fordlandia, the settlement on the Ford Rubber concession of approximately 4000 square miles on the Rio Tapajoz.

"At the time of our first visit (1932) the company was buying all the timber from these contractors, delivered at rail head by caterpillar tractors lent by the company. The logs were carried to the settlement by the company's railways and used for fuel and for timber. They were handled by the largest and most up-to-date saw mill in South America. Great logs, four feet in diameter, were rolled off a railside pile, grappled into a conveyor, subjected to a furious stream of water to remove grit which might injure the saws, raised to the second floor of the mill, and thrown bodily but with careful adjustment into the shrieking path of a great bandsaw, which cut them, with astonishing speed, into large thick planks. These passed through a succession of other saws, all operated by previously untrained Brazilians, which finally reduced them to usable and standard sizes. The capacity of the mill was 25,000 board feet (1 sq. ft., 1 in. thick) per 8-hour day. There was provision, if necessary, for two shifts, to run 16 hours.

"The kind of timber received at the mill varied with the area from which forest was being cleared. For the first six months of 1932 the chief timbers handled were as follows:

Andiroba (*Carapa guianensis*)	12.44 per cent
Para-para (*Jacaranda copaia*)	11.08 " "
Castanheira (*Bertholletia excelsa*)	10.52 " "
Muiracoatiara (*Astronium Lecointei*)	8.29 " "
Cedro (*Cedrela* sp.)	7.42 " "
Marupa (*Simaruba amara*)	7.35 " "
Massaranduba (*Mimusops Huberi*)	7.06 " "
Cumarú (*Dipteryx odorata*)	2.63 " "
Guariuba [*Clarisia nitida*]	2.53 " "

There were many others in small quantities, making a total of 86 distinct species of timber trees received at the mill. In addition, all those which had proved susceptible to borer of any kind were left in the forest to be burned or used as fuel in the settlement (the power house burns only wood).

"Some of the timbers were seasoned in the open or under tarpaulins. Others went to the great kilns, the only ones in South America, where individual treatment, arrived at by considerable experimental work, was given to each. These kilns had a capacity of 100,000 to 125,000 board feet. Heat and humidity were very rigidly controlled and recorded by elaborate instruments with dials arranged along a tunnel corridor beneath the whole series of kilns. One hundred sixty-five thousand board feet of timber, cut to standard sizes, had up to that time been exported (in one experimental cargo) to find a market for the newer and less familiar kinds in the north. The bulk of the output was, however, so far used in the building of the model settlement. On my second visit in 1933—a year later—I found lumbering operations had ceased, and the great mill closed down. The trial shipment had not travelled well, the timber had arrived in poor condition, and this combined with another factor, namely, the increasing distance of the clearings from headquarters, rendering the railway more and more expensive, had led to the abandonment of the whole timber enterprise."

Notes on the Rubiaceae of Surinam. By C. E. B. Bremekamp. *Recueil des Travaux Botaniques Néerlandais* 31: 248–308; 1934.

The paper consists of critical notes and descriptions of new species of Rubiaceae, preparatory to the treatment of this family which appeared in a recent issue of Pulle's *Flora of Surinam*. The genera *Pagamea* and *Perama*, placed by most recent authors in the Rubiaceae, are treated in the *Flora* in an appendix to the family, it being the author's belief that *Pagamea* is more properly referable to the Loganiaceae, where it was placed formerly.

Numerous new species are described, the woody plants including species of *Chimarrhis*, *Capirona*, *Gonzalagunia*, *Chomelia*, *Ixora*, *Bellynkxia*, *Faramea*, *Coussarea*, *Mapouria*, *Cephaelis*, *Psychotria*, and *Rudgea*. The genus *Psychotria*, as treated by most recent writers, is divided, *Mapouria* Aubl., *Ronabea* Aubl., *Nonatelia* Aubl., and *Strempelia* A. Rich. being restored, and several segregates from the genus being established: *Naletonia*, *Notopleura*, *Chytropsia*, *Gamotopea*, and *Petagamoa*. These segregates probably merit generic status, but it is doubtful whether the species of *Psychotria*, in the broad sense, are sufficiently well known at present to make such a division of the genus practical, and it is probable that other generic segregates must be made if the genus is divided consistently.

This paper, like other recent Dutch publications upon the flora of Surinam, is of exceptionally high quality. It is particularly admirable because of the careful consideration of recent work by American botanists, work which has been practically neglected by some European botanists who have published recently upon tropical American plants.—P. C. Standley.

A Amazonia Brasileira. III. Arvores e plantas uteis (indigenas e acclimadas). By Paul Le Cointe. Livraria Classica, Belem-Pará, 1934. Pp. 487; 6½ x 9½; 12 plates.

The distinguished director of Museo Commercial do Pará, author of the well-known *L'Amazonie Brésilienne* (Paris, 1922), the most important single work extant on the physiographic conditions, economics, and natural resources of Amazonia, has just added a third volume to this work. Appropriately, *Arvores e Plantas Uteis* is published in Pará and in Portuguese. It is a substantial, well printed volume, listing alphabetically under their vernacular names the most important of the thousands of plants described from the Amazon region. Scientific names are, of course, given, but without botanical descriptions except for brief indications of special characteristics, occurrence, properties, and uses, whether as food or for forage, for wood or other industrial raw material, as a source of drugs, or as ornamentals. The scientific nomenclature in large part has been checked and brought up to date by Dr. Adolpho Ducke. Scientific synonymy has been largely eliminated except where especially indicated by reason of long current or recent usage, *e.g.*, in the case of the balata tree *Manilkara bidentata* (DC.) Chev. (*Mimusops bidentata* DC.). Only the scientific nomenclature of the palms has escaped revision as a whole, but this detracts little from the usefulness of the list, *Oreodoxa*, *Elaeis*, *Bactris*, and *Geonoma* still being more familiar than the names *Roystonea*, *Corozo*, *Pyrenoglyphis*, and *Taenianthera*, by which they must be supplanted in whole or in part. An index to the botanical genera cited facilitates reference to the work.

No one at all acquainted with the Amazon region will be astonished at the large number of vernacular names of Tupí origin, often in their nheêngatú form, as this may be set down in an orthography about which there is no agreement, *e.g.*, Caá-uassú, Muira-piranga, Abati-mirim, etc., at times more or less adapted or hybridized with Portuguese, *e.g.*, Gramaassú, Malva-y, Jatobazinho, etc. What is, perhaps, surprising, is the very large number of plainly Portuguese plant names in current use in this vast, sparsely settled region where the Indian language and tradition has so long been such a large factor.

More than 1850 species are included and probably more than twice as many vernacular names and their synonyms, regional or otherwise. Well over a hundred of the species

listed are the introduced plants usual in the American tropics, fruit trees, food plants, and ornamentals of Old World origin or from other regions of the American continent or islands.

Of the 1700-odd native species more than 1000 are woody plants, including some 200 shrubs and almost 100 palms and perhaps half as many woody climbers. The remaining woody species, more than 700, are trees that the author classifies as small, medium, and large. Including with the latter the 60 designated as very large, the three groups are represented in about equal numbers. The wood of almost 450 of them appears to be sufficiently well known to receive at least a very brief characterization.

Sixty Amazonian species are classed as *very large* trees. The following list of these (and six others classed as large or very large), compiled from M. Le Cointe's work, should be of interest to the readers of *Tropical Woods*.

Check List of the Common Names of Large Trees

Aiúba	*Aydendron permolle* Nees	Lauraceae
Amanoa	*Amanoa guianensis* Aubl.	Euphorbiaceae
Amapá-rana	*Brosimum parinarioides* Ducke	Moraceae
Angelica do Pará	*Dicorynia paraensis* Benth.	Leguminosae
Angelim	*Hymenolobium pulcherrimum* Ducke	Leguminosae
Angelim commum	*Hymenolobium excelsum* Ducke	Leguminosae
Angelim falso	*Dinizia excelsa* Ducke	Leguminosae
Angelim grande	*Hymenolobium elatum* Ducke	Leguminosae
Angelim pedra	*Hymenolobium petraeum* Ducke	Leguminosae
Balata rosada	*Sideroxylon cyrtobotryum* Miq. and *S. resiniferum* Ducke	Sapotaceae
Balata verdadeira	*Manilkara bidentata* DC.	Sapotaceae
Boloteiro	*Bombax* sp.	Bombacaceae
Breu jauaricica	*Protium icicariba* DC.	Burseraceae
Caá-xió	*Cryptocarya guianensis* Meissn.	Lauraceae
Cachaceiro	*Hortia excelsa* Ducke	Rutaceae
Cajú-assú	*Anacardium giganteum* Engl. and *A. Spruceanum* Engl.	Anacardiaceae
Capote	*Sterculia speciosa* Schum.	Sterculiaceae
Castanha	*Bertholletia excelsa* H.B.K.	Lecythidaceae
Caucho macho	*Brosimum amplicoma* Ducke	Moraceae
Cedro-rana	*Cedrelinga catenaeformis* Ducke	Leguminosae
Cedro vermelho	*Cedrela fissilis* Vell.?	Meliaceae
Copahyba cuiarana	*Copaifera glycycarpa* Ducke	Leguminosae
Cumarú	*Coumarouna ferrea* Ducke and *C. polyphylla* (Hub.) Ducke	Leguminosae

Cunury	*Cunuria Spruceana* Baill.	Euphorbiaceae
Faveira de rosca	*Enterolobium Schomburgkii* Benth.	Leguminosae
Freijó	*Cordia Goeldiana* Hub.	Boraginaceae
Jutahy-assú	*Hymenaea Courbaril* L.	Leguminosae
Jutahy pororóca	*Hymenaea parvifolia* Hub.	Leguminosae
Macucú	*Couepia divaricata* Hub.	Amygdalaceae
Mandioqueira	*Qualea albiflora* Warm.	Vochysiaceae
Maparajuba	*Manilkara amazonica* Hub.	Sapotaceae
Massaranduba	*Manilkara excelsa* (Ducke) A. Chev. and *M. Huberi* (Ducke) A. Chev.	Sapotaceae
Mirindiba	*Buchenavia grandis* Ducke	Combretaceae
Muirá-juba	*Apuleia molaris* Benth.	Leguminosae
Muirá-tinga da varzea	*Olmedia maxima* Ducke	Moraceae
Panacocó	*Swartzia tomentosa* (Willd.) DC.	Leguminosae
Páo amarello	*Euxylophora paraensis* Hub.	Rutaceae
Páo d'arco de flores roxas	*Tecoma violacea* Hub.	Bignoniaceae
Páo doce	*Glycoxylon praealtum* Ducke	Sapotaceae
Paracuhuba branca	*Mora paraensis* Ducke	Leguminosae
Paricá grande da terra firme	*Piptadenia suaveolens* Miq.	Leguminosae
Paricá grande da varzea	*Pithecolobium niopoides* Benth.	Leguminosae
Parinari	*Parinarium Rodolphi* Hub.	Amygdalaceae
Piquiá	*Caryocar villosum* (Aubl.) Pers.	Caryocaraceae
Quaruba	*Vochysia maxima* Ducke	Vochysiaceae
Quaruba azul	*Qualea caerulea* Aubl. and *Q. ingens* Warm.	Vochysiaceae
Sumahuma da varzea	*Ceiba pentandra* Gaertn.	Bombacaceae
Tacacazeira da varzea	*Sterculia elata* Ducke	Sterculiaceae
Tachy branco	*Sclerolobium paraense* Hub.	Leguminosae
Tachy preto da matta	*Tachigalia myrmecophila* Ducke	Leguminosae
Tamboril	*Enterolobium maximum* Ducke	Leguminosae
Tapaiuna	*Dicorynia ingens* Ducke	Leguminosae
Taperibá	*Spondias lutea* L.	Anacardiaceae
Tatuary	*Couratari Krukovii* Smith, *C. macrosperma* Smith, and *C. tauary* Berg	Lecythidaceae
Tauary	*Cariniana excelsa* Casar., *C. micrantha* Ducke, and *C. rubra* Miers	Lecythidaceae
Visgueiro	*Parkia gigantocarpa* Ducke and *P. pendula* Benth.	Leguminosae

The author's well-known scientific qualifications, his long residence in the region of which he writes and his exceptional familiarity with its products, has enabled him to produce a reference work of great merit. His *Arvores e Plantas Uteis* will be appreciated for its usefulness not only in the Amazon region and in Brazil, but also more widely by all who have an interest in the botany of the American tropics.—B. E. DAHLGREN, *Field Museum of Natural History.*

Beobachtungen aus brasilianischen Küstenurwäldern. (With summary in English.) By FRIEDR. W. FREISE. *Zeitschrift für Weltforstwirtschaft* (Neudamm & Berlin) 1: 7: 417–438; April 1934.

"As a result of personal observations, the author distinguishes between two regions of the virgin forest of Brazil, *viz.*, one in the extreme S.W. of the State of Rio de Janeiro and secondly the eastern slopes of the Serra dos Aymorés in the State of Espirito Santo. . . .

"In the State of Rio de Janeiro the southern slopes, with a strong insolation and a heavy rainfall, exhibit a very energetic decomposition of the litter. Erosion is strong. On the other hand only slow decomposition was observed on the northern slopes. Here hardly any erosion takes place. The decomposition of the litter—which is about 15,000 kg. per year and hectare—is incomplete, the result being a humus layer of a depth of several feet. The result of the weathering processes is a moderately compact, fairly porous, well aerated soil with a high capacity for holding moisture.

"The investigated region of virgin forest in the State of Espirito Santo is situated far from the traffic routes. The influence of human beings is here very negligible; 0.2 sq. km. or 0.2 per cent of the total area is cleared yearly. Up till 1888 the virgin forest in the State of Rio de Janeiro was regularly subject to human influences. At the present time 28 sq. km. of a total area of 448 sq. km. are leased to charcoal manufacturers, 306 sq. km. are still undisturbed virgin forest, 66 sq. km. are worked under principle of open-stand system, and 48 sq. km. are being reforested.

"The determination of the stand quality, done by methods which are very primitive according to European ideas, shows approximately 300 timber-producing species, of which 60 appear abundantly, and 20 very abundantly. In the S.W. region 9 families, and in the Espirito Santo region 7 families form 95 per cent of the composition of the stands. In both regions the Leguminosae and Apocynaceae are dominant. [Details about the individual species and genera are given in Table I.]

"With regard to the climatic factors and their influence on plant growth, moisture plays the leading rôle, then comes light, and lastly heat. The author also gives more detailed particulars about the claims of the individual species on moisture and soil.

"In order to determine the volume of the standing timber, 15 sample plots, each of the size of 1 ha., were laid out. The results are represented by Table II.

"Careful investigation was made about the processes of regeneration, namely after natural retrogression and landslides, which investigations proved to the author that in the course of the centuries a change of mixture of the trees resulted in wholesale suppression of families and species. With regard to the natural retrogression, Table III gives more detailed information about the behavior of the most important species. Table IV shows observations about the influence on seed quantity and quality by the age of the tree. Table V shows diameter, height, and volume increment of some species for an afforestation period of 24 years under medium site conditions and with careful tending of the cultures, therefore no evidence about the growth relations in the virgin forest. . . .

"The above article represents the first endeavor to investigate the natural relationships in two regions of virgin forest and therefore makes no claim at perfection, this being the duty of future generations."

Os generos *Cordia* e *Tournefortia* (familia das Borraginaceas). By A. C. Brade. *Boletim Mus. Nacional* 8: 13–47; pls. 1, 2; Rio de Janeiro, 1932 (rec'd in 1934).

Keys are provided for separation of the 50 species of *Cordia* and 17 of *Tournefortia* known to exist in Brazil. Under each species are listed the specimens by which it is represented in

the herbarium of the section of botany of the Museu Nacional of Rio de Janeiro.

Über die Gattung *Asteranthos*. By R. Knuth. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 1034–1036, Berlin-Dahlem, Jan. 20, 1934.

In the *Natürlichen Pflanzenfamilien* Niedenzu referred to the Lecythidaceae three heterogeneous plant groups. The Old World plants should be treated as a separate family, Barringtoniaceae, while most of the American ones constitute the true Lecythidaceae. The genus *Asteranthos*, of the Rio Negro region of Brazil, has sufficient characters to constitute another separate family, the Asteranthaceae.

A usina de creosotagem da Estrada de Ferro Central do Brasil. By Paulo Ferreira de Souza. Rio de Janeiro, 1934. Pp. 25; 6¼ x 9¼; 6 plates.

An account of the operation of a creosoting plant located near the town of Juiz de Fóra in the State of Minas Geraes where crossties are given preservative treatment, mostly by the Rueping process, for use on the Central Railway of Brazil. The author, a trained forester, lists and briefly describes the several kinds of suitable timbers and discusses the various problems encountered in their utilization.

A zoologist in the pantanal of the upper Paraguay. By James A. G. Rehn. *The Scientific Monthly* (New York) 39: 20–39; July 1934.

"The Brazilian state of Matto Grosso . . . has an area about twice that of Texas or, to be exact, 532,683 square miles. Few elevations within its borders reach as much as 3000 feet above the sea, but what is lacking in contour diversity is made up in other physiographic contrasts. To the northward we have Amazonian forests, particularly along the stream courses, passing into the 'chapadão' and open forest country of the plateau divide, succeeded southward by the vast, nearly level, low river plain, elevated but slightly above the river, and during the rainy season, which extends from October to April, and for several months thereafter, is almost entirely flooded to a depth of from a few inches to as much as six feet. This country is the 'pantanal' of the Brazilian, in general consisting when dry of open grassy campo-like plains dotted with usually circular islands of tangled forest, known as capões (pronounced capōns), and with riverine screens of similar jungle forest. Many shallow channels, called 'corixas' (coriches), filled with tall sedge and papyrus, wind through the pantanal or spread out in broad sloughs. During the dry season rain may not fall for as much as three and a half months, the campo grassland bakes dry, the grass sun-cures, the corixas largely dry up, being merely water pockets and not flowing stream courses, and many of the caapões trees become leafless. The native Borero Indian cattlemen then burn off the dry grass, and the smoke of grass fires is much in evidence. While the temperature may at times be high, the dry season is 'winter' in the pantanal, and cold south winds, the backwash of Argentine 'pamperos,' blow for days at a stretch; the writer has seen the temperature drop from 97° to 40° F. in ten hours.

"The Rio Paraguay at Descalvados . . . is a stream about two to three hundred yards wide, swift and powerful in spite of its low elevation (approximately 600 feet) there, about 2000 miles from the sea. The river has many holes, some being over 40 feet deep at low stages of the water, although toward the end of the dry season shoals often give trouble to the shallow draught river steamer, which operates between Corumbá and the town of São Luiz de Caçeres, some 70 miles upstream from Descalvados. Caçeres is an old settlement and has figured conspicuously in the past history, and the natural history, of Matto Grosso. In the past it was also called Villa Maria, and is so quoted in some of the older scientific literature.

"Some 50 miles or so down stream from Descalvados the Paraguay breaks up into several channels which squirm and twist through forest-bordered pantanal. . . .

"A hundred or more miles above Corumbá the various channels merge into a deep powerful stream, which flows among the eastern ridges of a rugged mountainous area. This uplift, rising out of the pantanal and the ghostly lakes of

Uberaba, Guiba, and Mandioré, stretches far off westward into Bolivia. . . . The dry slopes show many candelabra cacti (*Cereus peruvianus*), which are locally called Urumbeba in Brazil, and are sometimes as tall as 45 feet, while the hill slopes are also dotted with the pink and yellow flowers of the Peúvas. We know little of these mountains or their animal life. They have never been accurately surveyed and are chartered on the best Brazilian maps as just surpassing 300 meters in elevation. With our plane we cleared the summit of one of the higher peaks by about 200 feet and found its height was approximately 4000 feet above the level of the Rio Paraguay.

"To return to the Paraguay at Descalvados, the surface of the river generally bears floating islands or marginal fringes of 'camalotes' (*Eichhornia* and *Pontederia*), larger cousins of the water-hyacinth of our southern states. These mats of vegetation often solidly choke the channels of ox-bow cut-offs which lead back from the main stream. Quiet shallow pools or small lagoons with little or no current will shelter the glorious 'rainha dos lagos' or queen of the lakes, a species closely related to the *Victoria regia* of more northern South America.

"The dense fringe of jungly forest which borders the river and for long distances forms a screen cutting off the hinterland, is made up of a large number of species of trees. This forest, being more generally inundated during high water than the drier caapões, has a different fascies. It is what might be called more truly tropical in the more frequent palms, of which the Carandá Palm (*Copernicia cerifera*) is the most abundant, while others are the Auassú (*Orbignya speciosa*), the Burity Palm (*Mauritia*) and the great-leaved Acury (*Attalea*), a near relative of the Central American Corozo or Manaca Palm. Among the many other riverine forest components may be mentioned great wild Figs or Figueiras (*Ficus*), species of *Cercopia*, locally called Umbaubeira, which is the Guarumo or Trumpet Tree of much of Spanish America, the False Dragon's Blood (*Heliocarpus americanus*), and the Páo Santo (*Bulnesia Sarmienti*). The fringe forest is often almost solidly mantled with a blanket of vines, tying all into mounds or domes of green, as seen from the stream. When the water is high all the land bearing the riverine forest is inundated or at least but a few inches above the flood.

"The open pantanal of campo character is generally treeless, short-grassed, level, sometimes with an open grove-like tree cover of species of relatively low stature, most of which become completely leafless by the end of the dry season. The dense caapões are scattered like islands over the campo and wetter pantanal, usually elevated a few feet above the general level and thus generally dry most of the year, serving as refuges for many mammals during the flood time. They are generally circular in outline, which is particularly pronounced when the pantanal is seen from a plane, and rise quite sharply from the campo, with no definite transition area. The densely matted tree growth is made up of many kinds, most conspicuous of which are the great-leaved Lixeira (*Curatella americana*), species of wild Fig (*Ficus*), several palms, the giant Jatobá (*Hymenaea*), species of *Inga*, called Ingasinho, and lianes of varied and strange type, of which the Cipó de Escada (probably a *Bauhinia*), with it ladder-like convolutions, draws prompt attention. On the few low, rocky hills near Descalvados—apparently isolated remnants of the mountains to the south already mentioned—one finds a more xerophytic vegetation, with candelabra cactus, low spiny agave-like types and the yellow and red flowered Peúva trees, locally Peúva Amarella (*Tecoma ochracea*) and Peúva Roxa (*T. ipe*). These beautiful trees in the dry season are mantled with great clusters of golden yellow and purplish pink trumpet-like blooms, although then quite leafless. The wet swales of the pantanal, with their standing water, are densely grown up in a tall coarse sedge, which has much the same cutting propensities as Florida saw-grass. Often these areas occupy many acres, filling every slight depression in the land. In the deepest wet spots are dense eight-foot stands of papyrus. Many shallow lagoons are scattered over the pantanal, bearing great mats of 'camalotes' and the 'rainha dos lagos' much as embayments of the more truly riverine sections. Until the middle of the dry season the recurrent splashing of water, when crossing the corixas or shallow pools, is the regular accompaniment of pantanal travel in the saddle. This brief picture of the major features of pantanal landscape will give a background for comments on its more evident animal life."

La estructura histológica del leño de "guayaibí," *Patagonula americana* L. (Boraginaceae). By Augusto C. Scala. *Revista Sudamericana de Botanica* (Montevideo) 1: 1: 1–7; February 1934; 5 figs.

Contains a description of the wood of the Guayaibí, long known in Argentina as a valuable source of timber, but which has been cut down so indiscriminately that it now faces extermination. Sometimes confused with Guayabil of Salta (*Saccellium lanceolatum* Humb. & Bonpl.), the species is also known locally as Guayabí, Guayaibí morotí, Guayaibí blanco, Guayaibirá (Misiones), Guayubirá (Corrientes), and Guayabil (Salta, Jujuy). Owing to its toughness and flexibility the wood is employed by the Indians of Misiones for their bows. Two other species of *Patagonula* are recognized, namely *P. bahiensis* Moric. and *P. Tweediana* Miers.

Anatomy of the xylem of *Pseudolarix*. By Alan S. Peirce. *Botanical Gazette* (Chicago) 95: 4: 667–677; text figs. 1–16; June 1934.

A detailed description of the wood of *Pseudolarix Kaempferi* (Lindl.) Gordon, a tree of eastern China, is followed by a discussion of the affinities of the plant. "The anatomical characters reveal that *Pseudolarix* occupies a relatively high position in the Abietineae. The anatomy, moreover, merges with that of the Taxodineae in a number of features, indicating a general transition in this direction."

Philippine experience in reforestation with ipil-ipil (*Leucaena glauca*) and its application to conditions in Kwangtung Province, China. By Robert L. Pendleton. *Lingnan Science Journal* 13: 2: 211–224; plates 20–28; April 18, 1934.

"Comparing the conditions in general in the Philippines and Kwangtung, and after having seen the vigorous growth of Ipil-ipil in Mau-ming, Tungshan, and on the Lingnan University Campus, Canton, it can be definitely stated that at least for the lowland and lower hill-slope cogonals of coastal Kwangtung this tree is well adapted, both for the production of firewood, of which there is such a great consumption in the coastal regions and of which there is at present not an adequate supply, and for the primary control of the cogon and other grasses as a first step in the permanent afforestation of the grassy hills. Although in certain parts of Kwangtung reforestation is carried on by planting the small pine seedlings out directly in the closely pastured cogonals, yet it is certain that the use of Ipil-ipil as a nurse crop would be very advantageous in the establishment of most sorts of forest trees."

"With the decreasing world supply of tannin materials, and the much greater distance that tan-barks as compared with fuel wood can profitably be transported to central concentration plants, one naturally thinks of the possibility of utilizing some other small leguminous tree which might approximate Ipil-ipil in ability to control cogon, and at the same time produce a good quality bark for tannin production. Ipil-ipil bark is relatively valueless for tannin materials as the extracts are reported to be very dark colored, producing a leather of unsatisfactory appearance for most purposes. Camanchile (*Pithecolobium dulce*), known locally in the Philippines also as Damortis in Ilocos, and as Camantiris in Abra, has been recently considered a very promising tree for this purpose, as the tree grows rapidly under ordinary conditions, and produces large quantities of a most excellent tan-bark. Some recent tests have shown as much as 25 per cent of tanning substance in the bark of eight-year-old trees. A particular advantage of the Camanchile is that, like Ipil-ipil, it coppices freely. Hence after cutting for harvesting the bark, replanting is not necessary to maintain the stand."

New or noteworthy trees from Micronesia. V. By Ryôzô Kanehira. *Botanical Magazine* 48: 116–130; figs. 1–8; Tokyo, Febr. 1934.

The paper is devoted to an account of the Pandanaceae of the Caroline and Marianne Islands, by U. Martelli. Ten species of *Pandanus* and *Freycinetia* are enumerated, of which

nine are described as new. *P. ponapensis* Martelli is known by the local names Taip and Kipal in Ponape; *P. patina* Martelli as Peat in the same island.

Progress report on forest administration in the Jammu & Kashmir State for the Fasli year 1988–89, ending 31st Assuj 1989 (16th October 1932). By P. H. Clutterbuck. Kashmir, Srinagar, 1933. Pp. 43; 7 x 9¾; 5 plates.

In the chapter on "commercial development and research" is the following interesting note concerning Pohu, *Parrotia Jaquemontania* Dcne., a large gregarious shrub or small tree of common occurrence in many of the Deodar forests and a serious enemy to their regeneration.

"Fifty green Pohu billets were sent to Dehra Dun to find out the best method of seasoning them. The Forest Research Institute experimented on these billets for six months and the Forest Economist in his final report states that the effect of the water-soaking is undoubtedly to reduce the amount of degrade due to surface cracking and also to shorten the period of drying. On the other hand this favorable influence is offset by the loss in toughness due to soaking. In impact bending the elastic limit in foot-pounds was found to be 25.9 for the unsoaked, and from 16.9 to 20.9 for the soaked specimens. The Forest Economist, therefore, recommends that air-seasoning should be resorted to without removal of the bark and with the ends of the billets coated with rosin composite. He estimates six months time for proper seasoning when the final moisture contents will be from 10 to 12 per cent. Interesting comparisons have also been made between Pohu timber on the one hand and Hickory and foreign Ash on the other, and they show that the strength of Pohu, though in some instances intermediate between Ash and Hickory, has the tendency to approach the latter to which it is in some respects superior. The strength and elasticity of Pohu fit it admirably for use as hammer handles. Acting on this advice about 13,000 fresh billets have been cut for air seasoning.

"Besides tool handles, Pohu is now being used in the boot and shoe industry. Sports and drum manufacturers at Sialkot are also trying to use it as substitute for Hickory which is imported from America. Further experiments are going on and it is hoped that in the near future a big market will be established for this timber which up to this time was used as firewood only."

A comparative study of Indian species of *Avicennia*. By K. Biswas. *Notes Bot. Gard. Edinburgh* 18: 159–166; pl. 243–246; April 1934.

Of 22 species of *Avicennia* listed in Index Kewensis all except nine have been reduced. Treatment of Indian species has been diverse among different authors, but cumulative evidence shows that at least three occur in the region. The morphology of their capsules and their germination are discussed in detail, and a key is provided for the three, which are described and illustrated. *A. officinalis* L., *A. tomentosa* Jacq., and *A. alba* Bl. are common constituents of the littoral forest. Economically they are of little importance. The very brittle wood is used chiefly for fuel and sometimes for house building; the bark is employed for tanning.—P. C. Standley.

Das leichteste Holz. By Edmund Graefe. *Umschau* 38: 9: 170–171; 1934; illustrated.

Alstonia spathulata growing in the Malay Peninsula and neighboring regions of the Far East is known as Akar Anggal, Light Root, and Kajoe Gaboeh (pronounced Caju Babu). The light wood is found under ground in the tree's roots, which often extend for a distance of 30 feet and usually are very much branched. The tree grows in swampy land or standing water and has a height of about 25 feet and a stem diameter of 6 to 10 inches. Where the stem joins the root there is a marked swelling so that the diameter of a 6-inch stem may increase to 24 inches near the ground. The wood of the swelling is about midway in composition between the rather hard stem wood and the light, almost pithy root. Root wood is yellowish white, somewhat like ivory in color on fresh fractures, and feels like velvet. It is so soft that it can easily be dented with a finger nail, yet it is used in plywood, tropical helmets (weight of wood used, 70 gms.), life preservers, insulation, and similar uses. If a block is compressed to a

tenth of its normal size it will, upon release of pressure, expand to about a fourth of its original volume and, if soaked, may regain its full size. The specific gravity is from 0.06–0.08, thus making it one of the lightest woods known. [According to Kanehira it ranks second to *Aeschynomene hispida* of Cuba, sp. gr. 0.044. See *Tropical Woods* 37: 52.] Since volume is a factor in shipping costs it is of interest that 100 English pounds of the wood take about the space of a ship ton. Various sizes are sold; the largest are limited in amount, but pieces 3–5 inches in diameter and about a foot long are common and those 1–1.5 inches in diameter and 18–30 inches long are plentiful.—Eloise Gerry, *U. S. Forest Products Laboratory.*

Notes on Malayan timbers. By H. E. Desch. *The Malayan Forester* 3: 2: 90–102; 2 plates; April 1934.

"The accompanying notes and lens descriptions of the timbers of four of our common jungle trees constitute the first of a series of articles which it is hoped will be continued in succeeding numbers of the *Malayan Forester.*

"The botanical notes, vernacular names, distribution, and habit are the work of Mr. Symington, and Dr. Buckley is collaborating by supplying the chemical data. The section dealing with importance and uses is of necessity in the nature of a compilation but the writer is responsible for the tentative suggestions as to possible new uses of the timbers described. . . .

"The scope of the work in hand is the preparation of a book, in the nature of a 'Forest Record,' which will bring together all the available data concerning the timbers of the commoner jungle trees of the Malay Peninsula. The difficulties to be overcome are partly financial, partly lack of material, and partly the question of deciding just how detailed the information to be given should be. The object, which it is felt should always be kept in view, is to present all useful data of practical importance, collected on strictly scientific lines, without swamping it with irrelevant detail. It is felt that much more ground must be covered before deciding what is to be regarded as relevant and what is not. The unavoidable delay before such a project can be completed is thought to be sufficient justification for publishing this series even though in certain cases the data are incomplete."

The four timbers described are Merbau (*Afzelia Bakeri* Prain, *A. retusa* Kurz, and *A. bijuga* A. Gray), Kempas (*Koompassia malaccensis* Maing.), Tualang (*K. excelsa* Taub. = *K. parvifolia* Prain), and Karanji (*Dialium* spp.).

Timber tests: Meranti rambai daun (*Shorea acuminata* Dyer) and Melantai (*Shorea macroptera* Dyer). *The Malayan Forester* 3: 2: 82–87; April 1934.

Results of tests made at the Timber Research Laboratories, Sentul, on small clear specimens in a green condition of two species of *Shorea* which, together with *S. leprosula*, *S. parvifolia*, *S. platyclados*, *S. Curtisii*, and certain less common species, comprise a group producing timber generally known throughout Malaya as Red Meranti. "Actually the color of each of these species varies from a light pink to moderately dark red depending on the tree and the location of the timber in the tree. Meranti Bukit and Seraya are usually darker than the other species, which are indistinguishable by color, whereas Melantai is sometimes distinctly yellowish. There would, therefore, be more justification for grouping these species according to similarity of strength values rather than by color.

"*Shorea Curtisii* (Seraya) and *Shorea platyclados* (Meranti Bukit) are essentially hill forms, the former being a distinctive feature of ridge forests at altitudes between 1000 ft. to 3000 ft. above sea level, whereas the latter is not so generally confined to ridges and occurs between 2500 ft. and 4000 ft. *Shorea leprosula* (Meranti Tembaga) and *Shorea parvifolia* (Meranti Sarang Punai) are usually found in lowland forest but may ascend to 1500 feet or more. *Shorea acuminata* (Meranti Rambai Daun) is commonest on low hills and ridges, and *Shorea macroptera* (Melantai) may be met between sea level and 2500 ft. Meranti Tembaga and Melantai are the most common and widely distributed species and are found in Borneo and Sumatra, as also is Meranti Bukit. The other three species have not yet been recorded outside the Malay Peninsula.

"All the species can be worked easily either by machine or hand. They are all susceptible to attack by wood boring beetles and almost invariably occur with a certain amount of heart rot or spongy wood surrounding the pith."

Changkol handles. By B. S. Mee. *The Malayan Forester* 3: 2: 75–80; April 1934.

An account of some practical tests of various species of Malayan timbers for hoe handles.

Matériaux pour la flora de la Nouvelle-Calédonie. XXXIV. Revision des Myrtacées à fruit sec suivie de quelques notes sur les Myrtacées à fruit charnu. By A. Guillaumin. *Bull. Soc. Bot. France* (Paris) 81: 3–17; 1934.

The dry-fruited Myrtaceae of New Caledonia belong to the genera *Tristania*, *Melaleuca*, *Spermolepis*, *Baeckea*, *Moorea*, *Metrosideros*, *Callistemon*, *Xanthostemon*, and *Pleurocalyptus*. Keys are provided for separating the species of each genus, and new species of trees and shrubs are described in the genera *Tristania*, *Metrosideros*, *Xanthostemon*, and *Syzygium*.

A note on the wood structure of *Acradenia Frankliniae* Kipp. By H. E. Dadswell and Audrey M. Eckersley. Div. of For. Prod. Reprint No. 15 from *Journ. Council for Sci. & Ind. Research* (Melbourne) 7: 1: 39–42; figs. 1–3; Febr. 1934.

The single recorded species of the rutaceous genus *Acradenia* is a small tree or a shrub, known as Wirewood or Whiteywood, inhabiting gullies on the west coast of Tasmania. "Average-sized trees grow to a diameter of 5 to 6 inches breast high, while large trees are 10 inches in diameter, with occasional ones up to 15 inches. The total height of the tree varies from 25 to 40 feet, with usually 10 feet of bole free from large branches, but often covered with twig-like branches. The crown is dense and compact. Small trees, up to 2 inches in diameter, occur in dense thickets. The stems of the large trees are usually fluted, but those of the average sized trees are more or less round. No definite information as to supplies of this timber is available, since it is located in very rough forest country not completely assessed. However, it has been estimated that, in one area, approximately 500,000 super. feet in the round are available. It is at present being milled, and it is possible to obtain supplies for special purposes in Melbourne."

Eine neue Oleaceen-Gattung der Comoren. By E. KNOBLAUCH. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 1032–1033, Berlin-Dahlem, Jan. 20, 1934.

Comoranthus obconica is the type of a new genus of the Oleaceae, related to *Chionanthus*, *Linociera*, and *Haenianthus*.

Lista das Leguminosas africanas, colhidas em Angola por Carrisso e Mendonça (Iter Angolanum 1927), e Mario de Castro, e em Moçambique por Gomes e Sousa e Pomba Guerra. By E. G. BAKER. *Bol. Sociedade Broteriana* (Coimbra, Portugal) Sér. II: 8: 102–115; 1933.

An annotated list of Leguminosae occurring in Angola and Mozambique, with descriptions of seven new species and a new genus (*Carrissoa*, related to *Eriosema* and *Rhynchosia*). Most of the plants listed are herbs. Among the woody ones is *Millettia acuticarinata*, sp. nov., Angola, vernacular names Mufufa and Mariapembe.

Remarques à propos de la forêt équatoriale congolaise. By E. DE WILDEMAN. Brussels, 1934. Pp. 120; 6½ x 10; 2 maps 12 x 12.

A comprehensive, carefully prepared, documented account of the forestry problems in the Belgian Congo, with suggestions for the protection and conservation of the natural resources of that territory. Much of the report is applicable to other tropical countries and should be widely read.

Sur la présence de deux espèces de *Chlorophora* (iroko) en Afrique Occidentale Française. By A. AUBRÉVILLE. *Rev. Botanique Appliqué & d'Agr. Tropicale* (Paris) 14: 152: 245–250; 1 plate; April 1934.

In addition to *Chlorophora excelsa* B. & H.f., the better known and more widely distributed species, there is another, *C. regia* A. Chev., endemic to French Guinea and Ivory Coast. The differences in the flowers, fruits, and leaves are described and figured. It appears that there are also differences in the woods, and the yellow Iroko is believed to be the product of *C. regia*, the brown of *C. excelsa*, though the matter needs further investigation.

Le difou (*Morus mesozygia* Stapf). By A. AUBRÉVILLE. *Rev. Botanique Appliqué & d'Agr. Tropicale* 14: 152: 251–253; 1 plate; April 1934.

A short, illustrated description of a West African tree whose hard canary-yellow wood is similar to Iroko (*Chlorophora*) and considered suitable for the same purposes. The vernacular names are as follows: Difou (Abé), Atchoumapou (Attié), Sand (Ouolof), Ndongosan (None), Boab (Casamance), Apia (Baoulé), Dabadoué (Ouobé), and Broué (Yacoba).

Note sur le bois de difou. By D. NORMAND. *Rev. Botanique Appliqué & d'Agr. Tropicale* 14: 152: 253–256; 2 figs.; April 1934.

A description of the gross and minute anatomy of the wood of *Morus mesozygia* and a comparison of the tree and timber with other species of *Morus* and with *Chlorophora excelsa*.

Ray development in the Sterculiaceae. By M. M. CHATTAWAY. *Forestry* (The Journal of the Society of Foresters of Great Britain) 7: 2: 93–108; 7 text figs. Oxford, 1933.

Two phases of ray development in the Sterculiaceae are considered: (1) The increase in number of rays, to maintain the distribution of ray tissue as the stem increases in girth, and (2) the increase in size of individual rays.

The formation of new rays is accomplished either by the subdivision of fusiform initials to form ray initials, or by the breaking up of large rays into smaller ones. The latter method is the reverse of the former, involving the conversion of ray initials to fusiform ones.

The usual procedure throughout the family is for one fusiform initial, or at times two or three superposed initials, to undergo a process of subdivision and thus give rise to a new uniseriate ray. Since the initials are storied, the resulting short rays are disposed in regular horizontal rows. These rays are very numerous in many genera and often so distinctive from the multiseriate ones as to give the impression of two separate size classes. This is especially the case in very young stems, where the rays are either (so-called) primary and multiseriate, or (so-called) secondary and uniseriate. In older stems, however, the multiseriate rays do not all begin at the pith, and represent all gradations in width from biseriate to many-celled. An exception is noted in *Mansonia*, for here the first-formed rays are small and the new rays do not increase much in size, with the result that the storied arrangement of all the elements gives rise to distinct ripple marks in the wood.

In some woods uniseriate rays are only sparingly developed and the increase in number of rays is accomplished mainly by the breaking up of the large rays into smaller ones, which in turn grow and subdivide. Certain of the initials which had been producing ray cells are converted to fusiform initials, in such a way as to cut across the ray. These then begin producing wood fibers and wood parenchyma cells, thus splitting the original ray into two smaller ones. It is through the continued growth and subsequent splitting of these large rays that at least part of the increase in ray tissue, necessitated by the expanding perimeter of the stem, is provided in species of *Cola*, *Sterculia*, *Eribroma*, *Pterygota*, and *Theobroma*.

Growth in size of individual rays is usually accomplished by the swelling and division of the ray initials. This type of ray growth adds to the width of the ray by the production of new cells; the peripheral initials are larger and divide more actively than those in the center. Increase in height is attained by the activity of the cells at the apex, which push up between the adjacent fusiform initials as they swell and then divide.

In some genera the ray widths are limited to 3–5 cells, but in others, including many of the subfamily Sterculieae, they become very much wider. In *Fremontia* each new ray increases to about 12–14 cells, after which growth slows down and finally ceases; in many species of *Theobroma*, on the other hand, there appears to be no cessation of growth, the width of the rays being limited by the subdivision of the larger elements.

A second method of growth is that of converting adjacent fusiform initials to ray initials and adding them to the existing ray. In many of the woods of the family, height increase is attained by the transformation of a fusiform initial immediately above or below a ray into a series of ray initials. The newly

added initial usually remains attached to the ray and grows with it. Occasionally, however, it may become detached, while still in the uniseriate condition, and develop as an independent ray. In the subfamily Sterculieae, increased width results from the addition of new initials to the sides of the ray, giving rise to sheath cells which partially or completely surround the rays of all of the members of the subfamily, except *Heritiera*. In the cases in which these enlarged marginal cells form only a partial sheath around the rays, growth in width takes place chiefly by the division of existing initials, supplemented by the occasional addition and conversion of fusiform initials.

In considering the distribution of ray types within the family, the author found that the development of the rays is not in accord with the systematic classification. The Sterculieae comprise the only really homogeneous subfamily, although both *Tarrietia* and *Heritiera* are somewhat different from the other members of the group. In an earlier investigation Miss Chattaway pointed out that this subfamily also stands apart from the other Sterculiaceae as regards the distribution of the wood parenchyma; further, that it is possible to arrange the genera in a progressive sequence on the basis of the wood parenchyma and vessel characteristics. "This sequence corresponds closely with the relative abundance of sheath cells, and it appears that abundance of sheath cells and the method of enlarging the rays at the expense of the fusiform initials is a primitive feature, and that the small-rayed species are on the whole more advanced than the large-rayed ones. It is, therefore, possible that the history of the rays is one of reduction from the unwieldy rays of the Sterculieae to the small rays of *Mansonia*, and that the occasional retention of the power to add a fusiform initial is a reversion to a lost character rather than a stage in the acquisition of a new one."

In conclusion an attempt is made to indicate possible affinities between the different genera, by grouping them according to the method of growth and size of the rays. It is to be noted that tile cells, "resulting from numerous extra-cambial subdivisions of the ray initials," are present in the rays of a number of genera, although entirely lacking in the Sterculieae.—GEORGE A. GARRATT.

Bestimmungstabelle für rezente und fossile Coniferenhölzer nach mikroskopischen merkmalen. *Med. van het Bot. Museum en Herbarium van de Rijks Univ. te Utrecht* 10: 482–513; text figs. 1–19, Amsterdam, 1934.

An illustrated artificial key, based upon the minute anatomy, to the woods of 40 genera of living and 20 of fossil Gymnosperms.

An improved method of softening hard woody tissues in hydrofluoric acid under pressure. By K. A. CHOWDHURY. *Annals of Botany* 48: 189: 309–310, January 1934. Illustrated.

A report of investigations carried out on various timbers at the Forest Research Institute, Dehra Dun, to discover a method of hastening the softening of woody material for sectioning. Using a cylinder similar to one employed in a previous experiment ("A shorter celloidin method," *Science* 2: 60; 67–8, 1924), but modified by lining the inside with lead sheeting to prevent the corroding effect of hydrofluoric acid and attaching a gauge to indicate pressure and to detect leakage, the author found that "Timbers which formerly used to take six weeks to soften have been softened under pressure in a week's time, and those taking eight weeks or more have been softened in ten to fifteen days."

To ensure uniform action of the acid and to eliminate air as much as possible, the wood blocks were first boiled in water for a few hours, then transferred to unsealed gutta-percha bottles, containing acid, placed in the cylinder and pressure applied with an ordinary foot pump. More than 200 blocks of some 125 species were softened in this way and best results were obtained by applying a pressure of 80 lbs. per sq. in., but beyond this the blocks showed a tendency to become brittle. Moderately soft to moderately hard timbers can be softened either by diluting the acid and keeping the blocks under pressure for a week, or by treating them with undiluted acid under pressure for two to four days. "The former method is always better, but the latter method has been used for urgent cases with fairly satisfactory results. Hard to very hard timbers usually give no trouble when treated with undiluted acid."—L. WILLIAMS, *Field Museum of Natural History.*

Yale University School of Forestry

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THE TRANSITION FORESTS OF ATLÁNTICO, COLOMBIA

By ARMANDO DUGAND G.

Barranquilla, Colombia, South America

Atlántico is the smallest of the 14 Departments constituting the Republic of Colombia, South America. It is situated at the outlet of the Magdalena valley, near the Caribbean seacoast, lying roughly between the 10th and 11th degrees of north latitude, and has an area of 3070 square kilometers with a population of nearly 260,000. In a broad sense, the generic and even the specific composition of the forests of Atlántico is related or similar to that of all the dry and semi-dry forests that cover irregular stretches of land on the northern coast of South America, from the Gulf of Maracaibo, in Venezuela, to the Gulf of Darien, between Colombia and Panama. Atlántico itself is divisible into three main ecological zones, namely, dry, wet, and transitional. These in turn are composed of characteristic formations and types of vegetation that vary according to many local factors, especially nature of the soil, exposure, moisture, and altitude. The following description is confined to the types of forests of the transition zone, which are the most important and the ones with most abundant species.

The forests cover well over a third of the total area of Atlántico, particularly in the south-central and southwestern parts of the Department. They are generally well timbered, although the stand has been gradually cleared by fires for agricultural purposes and a great portion of it is second growth, especially in the lowlands. The forested region is somewhat sheltered from the strong offland winds that prevail during the dry season in the northern districts. The climate is distinctly tropical, the average annual temperature being about 27° C. Rainfall is more abundant than in the littoral region, averaging some 150 cm. annually, but most of this precipitation occurs during a few torrential downpours in September and October. The dry season (*verano*) covers the months of January to April; there is also a dry period (*veranillo*) in July.

The transition (tropophilous) forest resembles the rain (hygrophilous) forest during the wet season, but appears somewhat like the dry (xerophilous) forest during the period of drought. It differs from the former, however, in the absence of dense fern or scitamineous undergrowth and in the predominance of deciduous trees, and from the latter in the scarcity of thorny shrubs and cacti and in the prevalence of large-sized trees having long and straight boles.

The transition forest is of two types, the lowland and the upland, which are usually well defined according to topography. The density of the stand is practically the same in both, and the forest canopy is generally two-storied, the underwood being 8–10 m., the overwood 15–25 and often up to 30 m. high. The specific composition of each type, however, shows decided variations.

Lowland Type of Forest

This forest covers level, poorly drained bottomlands usually inundated during the wet season. The soil generally is clayey and underlaid with an impervious hardpan, but in the vicinity of the seasonal streams it is sandy. Over two-thirds of the species are deciduous and the underwood is composed mostly of large shrubs, small deciduous trees, and vines. In many places, where the soil is sandy and not too dry, a bamboo-like grass called Cañabrava excludes all other forms of vegetation; in others, large stretches of clayey ground are covered with colonies of sword-leaved Bromeliads called Piñuelas; some open stands are chiefly composed of Palmiche, and a large number of rough-barked trees are hosts to epiphytic Bromeliads (*Tillandsia* spp.) and Orchids (*Oncidium* spp.). At the height of the dry season, the majority of the trees and shrubs are bare of leaves, but, in striking contrast to this dull background, stand such evergreen species as Mamón Real, Mamón de Mico, Mamón Cutuplis, Yayo, Angolito, Sarnisclo or Barbasco, and a crowd of Capparidaceae, of which Olivo, Calabazuelo, and Limpiadiente are the most common. The bulk of the stand is composed of Guayacán de Bola, Ceiba de Leche, Coralibe, Cañaguate Polvillo, Ceiba Colorada, Canalete Prieto, and Granadillo; a second group of trees occurring less frequently is composed of Palo de Agua, Arepo, Guayabo Colorado, and Jobo. The underwood consists chiefly of Vivaseca, Purgación, Peronío, Silbadero, Tiracó, Volador, Dividivi, Chivato, Jagua, and Algodón de Monte, while here and there grows the queer-looking Cornizuelo or Bullhorn Acacia, whose huge horn-shaped stipules are hollow and harbor legions of ferocious ants.

Where the lowland forest meets the wet savanna, the soil becomes loamy and retains considerable moisture during the dry months. The characteristic trees here are Olla de Mono, Sangregao, Brasilete, Guayacán Chaparro, Buche, Uvero, Roble Morado, Cañandonga, Mora, Sabanero, Suán, and Hipato.

The forest is little exploited commercially except for some Coralibe for heavy exterior construction, Ceiba Colorada for match boxes, Canalete Prieto for vehicles and tool handles, and Guayacán de Bola whose olive-yellow, very hard wood is used for making pulleys and other implements which must stand friction or wear. The woods of Sangregao and Grao Blanco have been found suitable, although not very satisfactory, for toothpicks. The stems of Cañabrava are used for making ladders and adobe-wall frames; those of Palmiche are employed for house posts, being noted for the hardness of the wood and its resistance to decay and termites; the fan-shaped leaves of the same palm are used for thatching, the roofs being known to last for as long as 40 years. Charcoal manufacturing constitutes one of the chief occupations of the natives besides agriculture; a great variety of woods are used for this purpose, especially Coralibe.

Upland Type of Forest

Where the land begins to ascend gradually towards the hilly region, a sort of intermediate type occurs between the lowland and the upland forests. The boundaries of this subformation are not well defined, but the stand usually is open and the trees are rather short-boled, growing in coarse sand or deep gravelly soil. Though many of the species of the lowland and upland forests mingle here, the region may be readily recognized by the presence of three groups of trees which are quite characteristic of this special region.

The first group is found in the low hills extending from Arroyo de Piedras to Luruaco, and is composed of Macondo, Carreto, Bálsamo, Guáimaro, and Palo de Agua. The largest tree of this group is the Macondo, which grows generally to 35 m. but often reaches 45 m. with an enormous cylindrical bole 2 m. and even 3 m. through and clear of limbs for nearly four-fifths of the length; its wood is lighter than Balsa, but is very soft and brittle, weak, coarse-grained, and decays rapidly. Bálsamo, whose handsome, deep reddish brown, sometimes purplish, timber is too well known to need further description, is used for beams and rafters, but its consumption has declined since the advent of ferro-concrete building, at least in the Barranquilla market. Carreto occurs abundantly in the foothills and lower ridges where it attains a height of 20–25 m., and a trunk diameter of 60–80 cm.; its heartwood,

when freshly cut, is of a handsome rose-pink color, turning gradually to deep rose-yellow with time, and its odor is slightly spicy and characteristic. Carreto wood is handsome, close-grained, hard and heavy, although liable to splinter and difficult to work; it is reputed to be durable and is used for railway crossties, bridge building, and other heavy exterior construction; it takes a high polish and is becoming popular for cabinet making.

The second group seems to prefer the moist level lands and foothills bordering Guájaro Lagoon; it is composed of Palma de Vino, Copé, Tabaca, Cajón, Membrillo, Majomo, and Culo de Indio. Palma de Vino grows in almost pure stands; its sugary sap is fermented by the natives into a champagne-flavored "wine" and the nuts are used by a Barranquilla concern for manufacturing a fine vegetable lard. Copé is a common Fig tree of the "strangler" kind and is usually found entirely enveloping the stipes of Palma de Vino. The trunks of Culo de Indio are generally hollow in the heartwood section and full of a dark brown, ill-scented liquid matter, a product of decay.

The third group is characteristic of the open stands occupying rolling lands near Guájaro, Sabanalarga, and Manatí. It is composed for the most part of leguminous trees, such as Campano, Carito, Guacamayo, Papo de Zamba, and Cascarillo; common associates are Camajorú, Aceituno, and Ají de Monte. Algarrobo is often found in this group, but this large, handsome tree is rather independent; its dark brown, very hard wood is used for making primitive sugar-mill "teeth." Carito is preferred by the natives for boat making.

The real upland forest begins at an elevation of some 150–200 m. above sea level and covers a region characterized by flat-topped ridges with steep slopes and deep gullies (*quebradas* and *cañadas*); the ridges vary in height, but the highest point in Atlántico (Sierra de Caballo) is not over 600 m. above sea level. The soil is heterogeneous, although sand predominates in different forms, from fine to coarse sand and deep gravelly soil, the latter often being mixed with red or yellow clay. The beds of the streams are decidedly rocky or gravelly. The topsoil is almost everywhere underlaid with sedimentary limestone, bluish-gray sandstone, and other similar rocks which sometimes emerge as cliffs (*peñas*) or as large boulders erratically disposed in fields.

Spiny shrubs are scarce. The trees grow large, their boles usually long and straight, often buttressed at the base. At least half of the species are deciduous, but in the deep moist ravines the vegetation often assumes the appearance of the true rain forests with the majority of the trees evergreen. This forest has suffered but little from fire damage or cutting and apparently is in primeval condition. The crown of the trees is covered with abundant epiphytic shrubs of the Loranthaceae or with climbing vines and hanging rope-like lianas, of which the most common are Bejuco de Cadena or Escalera de Mico (monkey ladder), Abrazapalo, Habilla, Pintabollo, and *Banisteria jasminellum*.

Many of the trees are lactiferous, such as Níspero de Monte, Mamón de Tigre, Caimito, Doncello, Guáimaro, Piñique, Pivijay, and Higuerón, or somewhat resinous as Quebracho, Caraña, Almácigo, Caracolí, and Canime. Another group of timber trees common in this forest is composed of Olleto, Tamarindo de Monte, Guayabo León, Madura Plátano, Ají de Monte, Carreto, Cañaguate Polvillo, Yayo, Muñeco, and Estribo. The underwood is a dense growth of small or slender, rod-like trees, the most common being Vara de Piedra, Guayabo Prieto, Guayabo Icotea, Grao Blanco, Caimancillo, Corona, Saúco, Arate, Canalete de Humo, Trébol, Cañafístolo, Arrayán, Mano de Pilón, Ramoncillo, Guáimaro Lechoso, Pinito, Peronilla, Camarón, Níspero de Saíno, Venenito, Sietecueros, and Pasita.

The higher ridges extending over Sierra de Gallinazo and Sierra de Caballo have not been satisfactorily explored as yet, but the author has learned, from fairly reliable sources, that Cedro (Spanish Cedar) is to be found, although growing so scatteringly as to be considered rare. Other trees growing at higher elevations are Canelo and Balaustre and probably also Tananeo.

The soil of the lower ridges extending northward is well drained and almost exclusively sandy near the dry savanna or the sand is found more or less mixed with clay and lime in the

vicinity of the xerophilous forest. The vegetation is influenced by that of the adjacent types and often merges into them. The dominant forms are shrubby and subarboreous; the stand is sometimes fairly open and then covered with gregarious subfruticose species, especially Escoba Morada, Cruceto, Plateado, and Añil, or it forms low impenetrable thickets of interwoven vines. The trees are mostly short-boled and deciduous. Near the xerophilous forest the most common ones are Almácigo, Banco, Jaboncillo, Meoparado, Caballito, Sillo, Uvito or Caujaro, Guácimo, Guamacho, Papayote, Amargo, Cañaguate Morado, Vara Blanca, Camarón, Florón, and Matijón. Near the dry savanna there are open stands of Roble Amarillo, Matarratón, Ceiba de Leche, Guacamayo, Baranoa, Bocachico, Cojón de Verraco, Bollo Limpio, Mantequillo, Calabacito, Bonga, Majagua, Palo de Piedra, Balso, Guarumo, Coralibe, and Limoncillo. The fibrous bark of Majagua and the stems of many bignoniaceous and sapindaceous vines are used for making tough cordages, and the silky wool produced by the ripe pods of Bonga (the kapok of commerce) finds a suitable use in stuffing pillows and mattresses. Trees commonly planted for live fence posts are Matarratón, Uvito, Guamacho, Jobo, Almácigo, Papayote, Ciruelo, and Cardón.

The foothills extending westward, towards the sea, are more or less clayey. Here occur, among many of the species mentioned above, a few scattered forerunners of the arid coastal "thorn" formation. The stand is generally open, with abundant subfruticose plants and a large proportion of thorny shrubs. The common species are Trupillo, Dividivi, Aromo Real, Jayo, Coca, Bija, and Platanito, and many Capparidaceae, especially Medialuna.

Check List of the Common Names

The following list is based upon a series of collections made by the author during the past two years, in collaboration with Professor Record. It contains all the local names mentioned in the preceding article and several others of common trees and shrubs of Atlántico. Care has been taken to verify the local names so far as possible, a task involving a great amount of checking from different sources as the natives are wont to name a tree arbitrarily if they do not know its real name. The total collections number 720 herbarium specimens (over 400 species) and 330 wood samples; field notes were taken regarding the occurrence and average size of the trees. With but very few exceptions, the species were determined by Paul C. Standley, Field Museum of Natural History, Chicago.

Abrazapalo	*Anthurium* sp.	Araceae
Aceituno	*Vitex cymosa* Bert.	Verbenaceae
Ají de monte	*Nectandra concinna* Nees and *N. pichurim* (H. B. K.) Mez	Lauraceae
Algarrobo	*Hymenaea courbaril* L.	Leguminosae
Algodón de monte	*Luehea candida* (DC.) Mart.	Tiliaceae
Algodón de seda	*Calotropis procera* (Willd.) Ait.	Asclepiadaceae
Almácigo	*Bursera Simaruba* (L.) Sarg.	Burseraceae
Amargo	*Aspidosperma ellipticum* Rusby	Apocynaceae
Angolito	*Zizyphus angolito* Standl.	Rhamnaceae
Anón de cerdo	*Anona glabra* L.	Anonaceae
Anón de verruga	*Anona squamosa* L.	Anonaceae
Añil	*Indigofera suffruticosa* Mill.	Leguminosae
Arepo	*Piscidia carthaginensis* Jacq.	Leguminosae
Arizá; Arizal	*Brownea ariza* Benth.	Leguminosae
Aromo de olor	*Acacia Farnesiana* Willd.	Leguminosae
Aromo real	*Acacia macracantha* H. & B.	Leguminosae
Aromo trupí	*Acacia tortuosa* Willd.	Leguminosae
Arrayán	*Eugenia* sp.	Myrtaceae
Aruñagato	*Pisonia aculeata* L.	Nyctaginaceae
Bajagua	*Cassia reticulata* Willd.	Leguminosae
Balaustre	*Ocotea* sp. (?)	Lauraceae
Balsamito	*Myrospermum fruticosum* Jacq.	Leguminosae
Bálsamo	*Myroxylon balsamum* (L.) Harms	Leguminosae
Balso	*Ochroma obtusa* Rowlee	Bombacaceae
Banco	*Gyrocarpus americanus* Jacq.	Hernandiaceae
Baranoa	*Acacia glomerosa* Benth.	Leguminosae
Barbasco	*Jacquinia aurantiaca* Ait.	Theophrastaceae
Barbero	*Seguieria americana* L.	Phytolaccaceae
Bejuco de cadena	*Bauhinia heterophylla* Kunth.	Leguminosae
Bencenuco	*Hamelia pedicellata* Wernham	Rubiaceae
Bija	*Bursera glabra* Tr. & Planch.	Burseraceae
Bocachico	*Piptadenia robusta* Pittier	Leguminosae
Bolita de perro	*Bunchosia mollis* Benth.	Malpighiaceae
Bollo limpio	*Lonchocarpus* sp.	Leguminosae
Bombito	*Cassia biflora* L.	Leguminosae
Bonga	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae
Brasilete	*Sickingia Klugei* Standl.	Rubiaceae
Buche; B. blanco	*Pithecolobium spinulosum* Pittier	Leguminosae
Buche colorado	*Pithecolobium dulce* (Roxb.) Benth.	Leguminosae
Caballito	*Tecoma stans* (L.) Juss.	Bignoniaceae
Cachitos	*Acacia costaricensis* Schenck	Leguminosae
Caimancillo	*Agonandra brasiliensis* Miers	Opiliaceae
Caimito	*Chrysophyllum cainito* L.	Sapotaceae

Cajón	*Platypodium Maxonianum* Pittier	Leguminosae
Calabacito	*Capparis macrophylla* H. B. K.	Capparidaceae
Calabasuero	*Stuebelia nitida* Pax	Capparidaceae
Calabazo	*Crescentia cujete* L.	Bignoniaceae
Calabazuelo	*Stuebelia nitida* Pax	Capparidaceae
Calenturo (?)	*Coccoloba leptostachya* Benth.	Polygonaceae
Camajorú	*Sterculia apetala* (Jacq.) Karst.	Sterculiaceae
Camarón	*Maytenus longipes* Briquet	Celastraceae
Campano	*Samanea saman* (Jacq.) Merr.	Leguminosae
Canalete de humo	*Cordia alliodora* (Ruiz & Pav.) Cham.	Boraginaceae
Canalete de río	*Cordia toqueve* Aublet	Boraginaceae
Canalete prieto	*Cordia gerascanthoides* H. B. K.	Boraginaceae
Canelo	*Ocotea* sp.	Lauraceae
Canime	*Copaifera* sp.	Leguminosae
Cantagallo blanco	*Sesbania grandiflora* (L.) Pers.	Leguminosae
Cantagallo colorado	*Erythrina glauca* Willd.	Leguminosae
Cañabrava	*Gynerium* sp. (?)	Gramineae
Cañafístolo	*Caesalpinia acutifolia* Johnston	Leguminosae
Cañaguate morado	*Tabebuia Dugandii* Standl.	Bignoniaceae
Cañaguate polvillo	*Tabebuia chrysantha* (Jacq.) Nichols.	Bignoniaceae
Cañandonga	*Cassia grandis* L.	Leguminosae
Cara	*Enterolobium cyclocarpum* Griseb.	Leguminosae
Caracolí or Caricolí	*Anacardium excelsum* (Bert. & Balb.) Skeels	Anacardiaceae
Caraña	*Bursera graveolens* Tr. & Planch.	Burseraceae
Carate	*Diphysa carthaginensis* Jacq.	Leguminosae
Cardón	*Cephalocereus* sp. or *Cereus griseus* Haw.	Cactaceae
Carito	*Enterolobium cyclocarpum* Griseb.	Leguminosae
Carreto	*Aspidosperma Dugandii* Standl.	Apocynaceae
Cascarillo	*Swartzia* sp. (?)	Leguminosae
Caujaro	*Cordia alba* Roem. & Schult.	Boraginaceae
Cedro	*Cedrela* sp.	Meliaceae
Ceiba blanca	*Hura crepitans* L.	Euphorbiaceae
Ceiba bonga	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae
Ceiba colorada	*Bombacopsis Fendleri* (Seem.) Pittier	Bombacaceae
Ceiba de lana	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae
Ceiba de leche	*Hura crepitans* L.	Euphorbiaceae
Cerezo	*Malpighia glabra* L.	Malpighiaceae
Chivato	*Cassia emarginata* L.	Leguminosae
Chocolatillo	*Chomelia spinosa* Jacq.	Rubiaceae
Chupa chupa	*Combretum farinosum* H. B. K.	Combretaceae
Ciruelo	*Spondias purpurea* L.	Anacardiaceae
Coca	*Erythroxylon rigidulum* DC.	Erythroxylaceae
Cojón de verraco	*Tabernaemontana psychotriifolia* H. B. K.	Apocynaceae

Copé	*Ficus nymphaeifolia* L.	Moraceae
Coralibe; C. arco	*Tabebuia coralibe* Standl.	Bignoniaceae
Coralibe; C. lumbre	*Tabebuia Billbergii* (Bur. & Schum.) Standl.	Bignoniaceae
Cornizuelo	*Acacia costaricensis* Schenck	Leguminosae
Corona	*Xylosma prunifolia* Griseb.	Flacourtiaceae
Coroncoro	*Mimosa* sp.	Leguminosae
Cotoprís	*Talisia oliviformis* (H. B. K.) Radlk.	Sapindaceae
Cruceta	*Rauwolfia heterophylla* R. & S.	Apocynaceae
Cruceto	*Rauwolfia heterophylla* R. & S. and *R. littoralis* Rusby	Apocynaceae
Cruceto	*Randia Gaumeri* Greenm. & Thomps.	Rubiaceae
Culo de indio	*Cupania glabra* Swartz	Sapindaceae
Culo de indio	*Matayba scrobiculata* Radlk.	Sapindaceae
Dividivi	*Caesalpinia coriaria* (Jacq.) Willd.	Leguminosae
Doncello	*Bumelia panamensis* Standl.	Sapotaceae
Escalera de mico	*Bauhinia heterophylla* Kunth	Leguminosae
Escoba babosa	*Sida acuta* Burm.	Malvaceae
Escoba blanca	*Melochia fasciculata* Benth.	Sterculiaceae
Escoba morada	*Melochia tomentosa* L.	Sterculiaceae
Espino de brujo	*Bumelia panamensis* Standl.	Sapotaceae
Estribo	*Torrubia fragrans* (Dum. Cours.) Standl.	Nyctaginaceae
Florón	*Plumeria acutifolia* Poir.	Apocynaceae
Garbancito	*Phyllanthus acidus* (L.) Skeels	Euphorbiaceae
Granadillo	*Caesalpinia granadillo* Pittier	Leguminosae
Grao blanco	*Pterocarpus floribundus* Pittier	Leguminosae
Guacamayo	*Acacia riparia* H. B. K. and *A. sarmentosa* Dcne.	Leguminosae
Guácimo	*Guazuma ulmifolia* Lam.	Sterculiaceae
Guadua	*Guadua latifolia* Kunth. (?)	Gramineae
Guáimaro; G. comestible	*Brosimum terrabanum* Pittier (?)	Moraceae
Guáimaro lechoso	*Trophis racemosa* (L.) Urban	Moraceae
Guamacho	*Pereskia colombiana* Britt. & Rose	Cactaceae
Guamo	*Inga edulis* Mart.	Leguminosae
Guamo de arroyo	*Inga spuria* Humb. & Bonpl.	Leguminosae
Guanábano pún	*Anona purpurea* Mociño & Sessé	Anonaceae
Guarumo	*Cecropia arachnoidea* Pittier	Moraceae
Guayabo colorado	*Calycophyllum candidissimum* (Vahl) DC.	Rubiaceae
Guayabo icotea	*Eugenia* sp.	Myrtaceae
Guayabo león	*Terminalia* sp.	Combretaceae
Guayabo murciélago	*Eugenia roraimana* Berg. (?)	Myrtaceae
Guayacán chaparro	*Samanea pistaciaefolia* (Willd.) Dugand	Leguminosae
Guayacán de bola	*Bulnesia arborea* (Jacq.) Engler	Zygophyllaceae

Guayacán de playa	*Guaiacum officinale* L.	Zygophyllaceae
Habilla	*Fevillea cordifolia* L.	Cucurbitaceae
Higuerón	*Ficus Dugandii* Standl., *F. panamensis* Standl., and *F. radula* Willd.	Moraceae
Higuerón copé	*Ficus velutina* Willd. (?)	Moraceae
Hipato	*Helietta Pleana* Tulasne	Rutaceae
Hoyo de zorro	*Cathormium mangensis* (Jacq.) Dugand	Leguminosae
Iguanero	*Acacia polyphylla* DC.	Leguminosae
Jaboncillo	*Sapindus saponaria* L.	Sapindaceae
Jago; Jagua	*Genipa caruto* H. B. K.	Rubiaceae
Jayo; J. de montaña	*Erythroxylon carthaginensis* Jacq.	Erythroxylaceae
Jobo	*Spondias Mombin* L.	Anacardiaceae
Juán garrote	*Coccoloba novogranatensis* Lindau	Polygonaceae
Lata; L. de corozo	*Bactris major* Jacq.	Palmaceae
Limoncillo	*Ximenia americana* L.	Olacaceae
Limoncillo blanco	*Schaefferia frutescens* Jacq.	Celastraceae
Limoncillo moján (?); L. prieto	*Achatocarpus nigricans* Triana	Phytolaccaceae
Limpiadiente	*Capparis flexuosa* L.	Capparidaceae
Lumbre	*Tabebuia Billbergii* (Bur. & Schum.) Standl.	Bignoniaceae
Macondo	*Cavanillesia platanifolia* H. B. K.	Bombacaceae
Madura plátano	*Sciadodendron excelsum* Griseb.	Araliaceae
Maíz tostado	*Celtis iguanaea* (Jacq.) Sargent	Ulmaceae
Majagua	*Bombax barrigon* (Seem.) Dcne.	Bombacaceae
Majomo	*Lonchocarpus* sp.	Leguminosae
Malambo	*Croton malambo* Karst.	Euphorbiaceae
Mamón casero	*Melicoccus bijugatus* Jacq.	Sapindaceae
Mamón cutuplis	*Talisia oliviformis* (H. B. K.) Radlk.	Sapindaceae
Mamón de mico	*Talisia* aff. *oliviformis* (H. B. K.) Radlk.	Sapindaceae
Mamón de tigre	*Sideroxylon colombianum* Standl.	Sapotaceae
Mamón real	*Melicoccus bijugatus* Jacq.	Sapindaceae
Mangle amarillo; M. blanco	*Laguncularia racemosa* (L.) Gaertn.	Combretaceae
Mangle colorado	*Rhizophora mangle* L.	Rhizophoraceae
Mangle salado	*Avicennia nitida* Jacq.	Verbenaceae
Mangle zaragoza	*Conocarpus erecta* L.	Combretaceae
Mano de pilón	*Myrospermum fruticosum* Jacq.	Leguminosae
Manolo	*Jatropha aconitifolia* Mill.	Euphorbiaceae
Mantequillo	*Trichilia hirta* L.	Meliaceae
Manzanillo	*Hippomane mancinella* L.	Euphorbiaceae
Mariangola	*Coutarea hexandra* (Jacq.) Schum.	Rubiaceae
Mariangola	*Randia armata* (Sw.) DC.	Rubiaceae
Matamaiz	?	Capparidaceae (?)
Matarratón	*Gliricidia sepium* (Jacq.) Steud.	Leguminosae

Matijón	*Zanthoxylum* sp.	Rutaceae
Medialuna	*Capparis linearis* Jacq.	Capparidaceae
Membrillo	*Gustavia superba* (H. B. K.) Berg.	Lecythidaceae
Meoparado	*Lonchocarpus punctatus* H. B. K.	Leguminosae
Mimbre	*Tessaria mucronata* DC.	Compositae
Mondonguito	*Zizyphus angolito* Standl.	Rhamnaceae
Mora	*Chlorophora tinctoria* (L.) Gaud.	Moraceae
Muela	*Zanthoxylum monophyllum* (Lam.) P. Wils.	Rutaceae
Muñeco	*Cordia glabra* L.	Boraginaceae
Murta	*Coccoloba ramosissima* Lind.	Polygonaceae
Naranjito	*Crataeva tapia* L.	Capparidaceae
Níspero de monte	*Achras calcicola* Pittier (?)	Sapotaceae
Níspero de saíno	*Morisonia americana* L.	Capparidaceae
Olivo	*Capparis Breynia* Jacq., *C. indica* (L.) Fawc. & Rendle, and *C. odoratissima* Jacq.	Capparidaceae
Olla de mono	*Lecythis dubia* H. B. K. and *L. elliptica* H. B. K.	Lecythidaceae
Olleto	*Lecythis elliptica* H. B. K.	Lecythidaceae
Palma amarga	*Sabal mauritiaeformis* (Karst.) Griseb. & Wendl.	Palmaceae
Palma de vino	*Scheelea butyracea* (Mart.) Karst.	Palmaceae
Palmiche	*Copernicia sanctae-marthae* Becc.	Palmaceae
Palo de agua	*Bravaisia integerrima* (Spreng.) Standl.	Acanthaceae
Palo de piedra	*Crudia obliqua* Griseb.	Leguminosae
Palo de sangre	*Machaerium glabratum* Pittier	Leguminosae
Papayote	*Cochlospermum vitifolium* (Willd.) Spreng.	Cochlospermaceae
Papo de zamba	*Lonchocarpus sanctae-marthae* Pittier	Leguminosae
Paraiso	*Melia Azedarach* L.	Meliaceae
Pasita	*Bumelia obovata* (Lam.) A. DC.	Sapotaceae
Pata de gallina	*Cordia macrostachya* (Jacq.) Roem. & Schult.	Boraginaceae
Pata de vaca	*Bauhinia mollifolia* Pittier and *B. ungula* Jacq.	Leguminosae
Peronilla	*Erythrina rubrinervia* H. B. K.	Leguminosae
Peronío	*Pithecolobium unguis-cati* (L.) Mart.	Leguminosae
Pinito (?)	*Colubrina heteroneura* (Griseb.) Standl.	Rhamnaceae
Pintabollo	*Arrabidaea sanctae-marthae* Sprague	Bignoniaceae
Piñique	*Sapium aucuparium* Jacq. and *S. Hippomane* Mey.	Euphorbiaceae
Piñuela	*Bromelia Karatas* L. (?)	Bromeliaceae
Pisigallo	*Aphelandra tetragona* (Vahl) Nees	Acanthaceae

Pitamo; P. real	*Pedilanthus Fendleri* Boiss.	Euphorbiaceae
Pivijay	*Ficus prinoides* H. & B.	Moraceae
Platanito	*Cassia bicapsularis* L.	Leguminosae
Plateado	*Croton niveus* Jacq.	Euphorbiaceae
Polvillo	*Tabebuia chrysantha* (Jacq.) Nicholson	Bignoniaceae
Purgación	*Machaerium arboreum* (Jacq.) Vogel	Leguminosae
Quebracho	*Astronium fraxinifolium* Schott.	Anacardiaceae
Ramoncillo	*Coursetia arborea* Griseb.	Leguminosae
Resbalamono	*Bursera Simaruba* (L.) Sarg.	Burseraceae
Roble; R. amarillo	*Tabebuia chrysea* Blake	Bignoniaceae
Roble de río; R. morado	*Tabebuia pentaphylla* (L.) Hemsl.	Bignoniaceae
Sabanero	*Phyllostylon brasiliensis* Cap.	Ulmaceae
Sanaguare	*Samanea saman* (Jacq.) Merr.	Leguminosae
Sangregao	*Pterocarpus podocarpus* Blake	Leguminosae
Sapo	*Torrubia pacurero* (H. B. K.) Standl.	Nyctaginaceae
Sarnisclo	*Jacquinia aurantiaca* Ait.	Theophrastaceae
Sauce	*Parkinsonia aculeata* L.	Leguminosae
Saúco	*Stemmadenia grandiflora* (Jacq.) Miers	Apocynaceae
Serencere	*Salix chilensis* Mol.	Salicaceae
Sietecueros	*Machaerium Moritzianum* Benth.	Leguminosae
Silbadero	*Geoffroya striata* (Willd.) Macbride	Leguminosae
Sillo	*Torrubia Olfersiana* (L., K. & O.) Standl.	Nyctaginaceae
Suán	*Ficus dendrocida* H. B. K.	Moraceae
Tabaca; T. de monte	*Samanea samanigua* Pittier	Leguminosae
Tabaco de monte	*Solanum bicolor* Willd.	Solanaceae
Tamarindo de monte	*Dialium divaricatum* Vahl	Leguminosae
Tananeo	*Peltogyne* sp.	Leguminosae
Tapabotija	*Ipomoea carnea* Jacq.	Leguminosae
Tiracó	*Pithecolobium lanceolatum* (H. & B.) Willd., *P. ligustrinum* Klotzsch, and *P. oblongum* Benth.	Leguminosae
Totumo	*Crescentia cujete* L.	Bignoniaceae
Trébol	*Platymiscium polystachyum* Benth.	Leguminosae
Trupillo	*Prosopis chilensis* (Mol.) Stuntz	Leguminosae
Uvero; U. macho	*Coccoloba caracasana* Meissn.	Polygonaceae
Uvito; U. de murciélago	*Cordia alba* Roem. & Schult.	Boraginaceae
Vara blanca	*Casearia nitida* (L.) Jacq.	Flacourtiaceae
Vara de piedra	*Casearia tremula* Griseb.	Flacourtiaceae
Vara santa	*Triplaris americana* L.	Polygonaceae
Velita	*Lippia hemisphaerica* Cham.	Verbenaceae

Venenito	*Rauwolfia canescens* L.	Apocynaceae
Vijaguillo	*Muntingia Calabura* L.	Elaeocarpaceae
Vivaseca	*Cathormium mangense* (Jacq.) Dugand	Leguminosae
Volador	*Ruprechtia ramiflora* (Jacq.) Mey.	Polygonaceae
Yaya, Yayo	?	Sapotaceae
Yuca antigua	*Manihot Pittieri* Pax & Hoffm.	Euphorbiaceae
Zarza colorada	*Piptadenia communis* Benth.	Leguminosae

Additional Species without Known Common Names

Thevetia nitida H. B. K.	Apocynaceae
Maba inconstans (Jacq.) Griseb.	Ebenaceae
Laetia apetala Jacq.	Flacourtiaceae
Andira inermis H. B. K.	Leguminosae
Crudia obliqua Griseb.	Leguminosae
Machaerium capote Triana	Leguminosae
Piptadenia peregrina Benth.	Leguminosae
Zygia latifolia (L.) Browne	Leguminosae
Ouratea lucens (H. B. K.) Engler	Ochnaceae
Heisteria sp.	Olacaceae
Coccoloba filipes Standl.	Polygonaceae
Pittoniotis trichantha Griseb.	Rubiaceae
Psychotria microdon (DC.) Urban	Rubiaceae
Esenbeckia alata (Karst. & Tr.) Tr. & Pl.	Rutaceae
Cestrum alternifolium (Jacq.) Schulz	Solanaceae
Ayenia magna L.	Sterculiaceae
Helicteres carthaginensis L.	Sterculiaceae
Celtis Hottlei Standl.	Ulmaceae

A NEW *COCCOLOBA* FROM COLOMBIA

By Paul C. Standley

Field Museum of Natural History

Coccoloba filipes, sp. nov.—Frutex 3–4-metralis, ramis gracilibus teretibus ochraceis rimosis glabris; ochreae oblique truncatae adpressae 8–11 mm. longae; folia (unum tantum visum) membranacea, petiolo gracili 12 mm. longo, lamina oblonga 12.5 cm. longa 4.5 cm. lata medio latissima abrupte breviter caudato-acuminata, acumine 6 mm. longo, basi anguste rotundata, glabra, in sicco fusca, costa gracili subtus prominente, nervis lateralibus utroque latere circa 6 adscendentibus inconspicuis vix prominulis; racemi terminales solitarii vel fasciculati gracillimi simplices 10–25 cm. longi nodis unifloris, rhachi gracili flexuosa glabra, pedicellis gracilibus 3–4 mm. longis divaricatis vel subreflexis basi paullo dilatatis; bracteae ut ochreolae 0.5 mm. longae inconspicuae; perianthium basi abrupte contractum et substipitatum, tubo lato brevissimo, segmentis late ellipticis vel subrotundatis 3 mm. longis apice late rotundatis glabris; filamenta filiformia perianthio paullo longiora.—Colombia: Santa Rosa, west of Barranquilla, March 15, 1933, *A. Dugand* 380 (Herb. Field Mus. No. 670393, type).

The distinctive characters of the species are the greatly elongate, many-flowered, lax racemes, with flowers on conspicuously long and slender pedicels.

THE CAOBANILLA TREE OF THE DOMINICAN REPUBLIC

By Paul C. Standley

Field Museum of Natural History

During the past two years I have received material of a tree of the Dominican Republic known there by the name Caobanilla, a diminutive of Caoba, the Spanish term for Mahogany (*Swietenia*). The specimens were collected for the Yale School of Forestry by Mr. James C. Scarff, of San Pedro de Macoris. The first samples were incomplete and their determination was uncertain, but careful examination of complete specimens now available shows that the tree is referable to the monotypic genus *Stahlia* of the Leguminosae, subfamily Caesalpinieae. *Stahlia monosperma* (Tul.) Urban has been known heretofore only from a few localities along the coast of Puerto Rico and on the neighboring island of Vieques.

The specimens from the Dominican Republic differ from the Puerto Rican ones only in having a glabrous rather than sparsely pilose inflorescence and eciliate rather than ciliate sepals, differences that perhaps are sufficient to justify the former's designation as a variety. The fruits are somewhat larger than those described for *S. monosperma*, but it is suspected that the description of those of the Puerto Rican tree were drawn from immature pods. The Caobanilla tree of the Dominican Republic may be designated as:

Stahlia monosperma (Tul.) Urban, var. ***domingensis***, var. nov.—A forma typica non nisi racemis glabris et sepalis eciliatis differt; legumen indehiscens ovale vel late ellipticum circa 5 cm. longum, 3–3.5 cm. latum et 1–2 cm. crassum.—Dominican Republic, delta of Soco River, in 1934, *J. C. Scarff* (Herb. Field Mus. No. 714180, type; Yale No. 27244).

The lower surface of the leaflets in all the available specimens of *Stahlia* bears numerous small black organs that have been described as glands. They have every outward appearance of being insect galls, but since they appear in abundance upon the leaflets of a plant just emerging from the seed, it is probable that they really are glands.

According to Mr. Scarff, the Caobanilla is of limited occurrence in the Republic, being confined to ridges 6–30 feet high in or near coastal swamps and marshy deltas. The tree has a short bole, rarely over 10–12 feet, and it is covered with sprouts which the inhabitants of the region chop down when about wrist size to use for rafters and other building purposes. The cuttings can be repeated at intervals without any seeming loss of vigor in the parent tree. The heartwood is very hard and heavy (weight about 80 pounds per cubic foot, unseasoned), but is not very difficult to work and takes a lustrous finish resembling Mahogany (*Swietenia mahagoni*). It is noted for its resistance to decay and, according to José Schiffino (*Riqueza forestal Dominicana*, Santo Domingo, 1927, p. 49), many of the larger trees in the Provinces of Seybo and San Pedro de Macoris have been cut for railway crossties and exported. An objection to the use of Caobanilla for lumber is that the wood cracks when sawed, even after the logs have been seasoning for several years.

The following description of the wood is furnished by Professor Record: Color of heartwood variable, being brown or brick-red, with intermingling of shades when fresh, later becoming purplish brown and, upon long exposure, nearly black. Odor and taste absent or not distinctive. Grain irregular, usually finely cross-banded or roey; texture rather fine. Growth rings absent or poorly defined. Parenchyma abundant, paratracheal confluent into numerous, irregular, wavy bands frequently wider than the horn-like fiber layers; fairly distinct on cross section and producing fine pattern on tangential surface. Pores barely visible without lens, imbedded in parenchyma, few, scattered, solitary or, less commonly, in multiples of 2 or 3; dark, amberlike deposits common. Vessel lines indistinct. Rays numerous, very fine and uniform, not visible without lens on cross and tangential sections; low and inconspicuous on radial surface, appearing lighter than background; arranged in horizontal seriation. Ripple marks present, fine, fairly regular, not distinct without lens, all elements storied; no. of markings per inch of length, about 100. No gum ducts observed. Material: Yale Nos. 23689, 23690, 27244 (Dominican Republic); 8008, 11207 (Puerto Rico).

ARE TEAK PLANTATIONS PROFITABLE?

It had for many years been considered probable that attack by the beehole borer (*Xyleutes ceramica*) was much heavier in the case of Teak trees grown in plantations than in natural forest. Investigations by Mr. C. W. Scott and Mr. D. J. Atkinson, Deputy Conservators of Forests, the results of which were published in Burma Forest Bulletin No. 29, published in 1932, led them to the conclusion that plantation Teak was much more heavily attacked by the borer than natural forest Teak in any given locality. Further, as Teak plantations are made mainly as a commercial proposition, with the object of growing Teak timber for export, Government must be certain that making such plantations will be a financial success. My predecessor, Sir Hugh Watson, issued for the guidance of the Department a circular in which he ordered that "Plantations should only be formed when their formation can be justified either by a combination of suitability of soil and prospects of an assured market at a remunerative price or by a combination of accessibility and an assured remunerative demand." This question of a remunerative price, which means that plantations must prove profitable when made to produce timber for export, has never received sufficient attention, but is becoming of great importance owing to the increasing use of substitutes for timber. It is therefore necessary to consider the question of the advisability of discontinuing making any further Teak plantations on the ground that such plantations do not produce timber of the same quality as that produced in natural forest and also on the ground that it is very doubtful whether such plantations will prove a financial success. Unless when the plantations are mature the price of Teak is very much higher than it is to-day, the present-day policy of making some 3500 acres of Teak plantations annually will involve Government in very heavy loss. The enquiry is proceeding and the result may be expected in next year's report.—S. F. Hopwood, *Chief Conservator of Forests*, in "Report on forest administration in Burma for the year ending 31st March 1933," p. 15.

NOTE ON THE CLASSIFICATION OF *GOETHALSIA*

In *Phytologia* 1: 2: 112, July 1934, Gleason presents an emended description of *Goethalsia* Pittier and proposes to transfer the genus from Tiliaceae to Flacourtiaceae. Following are some reasons for deferring any change in classification until the fruit is known.

The resemblance of the leaves and flowers to certain other Tiliaceae is so marked that Pittier, Donnell Smith, Burret, and Standley apparently did not question the reference of the Central American type specimens to Tiliaceae; in fact Smith described the plant as *Luehea meiantha*. Cooper and Slater remarked a general resemblance of the tree, except in size, to *Luehea Seemannii*. Williams, in his account of the wood, notes a similarity to *Tilia*. (See *Tropical Woods* 15: 15, Sept. 1, 1928.)

I have examined the twig and mature wood of the Yale sample of *Goethalsia* (*Cooper & Slater* 219) and the stem of Gleason's specimen (*Lawrance* 494), and have compared them with similar material of many other genera of the two families involved. I find that the pith, bark, and wood of *Goethalsia* all suggest Tiliaceae and not Flacourtiaceae.—S. J. R.

MEASURING THE LENGTH OF VESSEL MEMBERS

By L. Chalk *and* M. M. Chattaway

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Descriptions of dicotyledonous woods commonly include an indication of the length of the vessel members. Though it is doubtful whether this feature is likely to prove of diagnostic value for distinguishing closely allied woods, it has been shown by Frost (*1*) to have a definite phylogenetic significance, and this probably justifies its inclusion in the full description of a timber.

Three Methods of Measurement

There are three different ways of measuring the length of a vessel member, and each gives an entirely different value for the same material and has its own advocates. Consequently, even if an author indicates the method adopted, his figures cannot be compared with those of another worker who has made his measurements in a different way.

The three methods are indicated in Fig. 1. The figure on the left illustrates a common way of obtaining vessel-member length on a tangential section. Four members of a vessel are visible, and their combined length, as measured from the *middle* of the perforation plates at the top and bottom of the series, is divided by the number of members. In this particular instance the length is 940μ and the number of members is four, so that the average length of the member is 235μ. The figure 235μ therefore represents the average length of member, measured from the middle of the perforation plates at either end, and the same results would be obtained by measuring each individual member as in *B*, and taking the average. This measure takes no account of the "tails" or narrow portions of the vessels which occur beyond the perforations, and may for convenience be called the "mean body length."

Another method is illustrated in *C*. In this the measurement, made on individual members, is from the *top* of the upper perforation plate to the *bottom* of the lower, and may be termed "extreme body length." This method is only suitable for use with macerated material, and gives a value that is higher than B, particularly where the perforation plates are scalariform.

In D the length has been measured from the tips of the tails and, for convenience, the members are shown slightly separated. This will be referred to as the "total length." It can only be carried out on macerated material, and usually gives a much higher figure than body length. In the illustration the average lengths for the three types of measurement are as follows: mean body length (A and B), 235μ; extreme body length (C), 280μ; total length (D), 470μ.

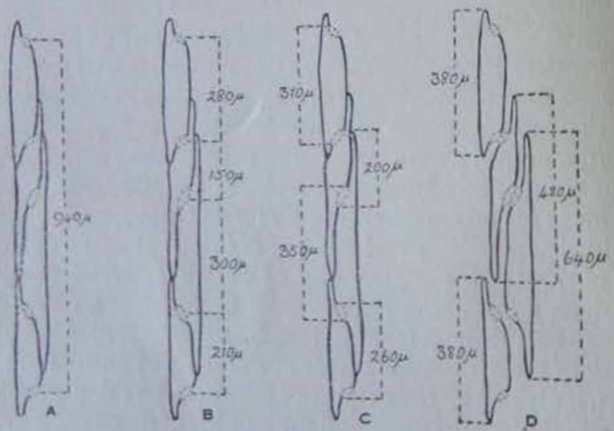

Fig. 1. Diagram illustrating the different methods of measuring the length of vessel members. A and B, mean body length; C, extreme body length; D, total member length.

There is no general agreement as to which of these methods is best, and the object of the present paper is to discuss their relative merits with a view to recommending the adoption of one of the methods as standard for descriptive purposes. Data collected for this purpose have brought to light several interesting points about the factors governing the range of variation in member length, and the relation between the different parts of the member, but only such facts as have a direct bearing on the present problem are included here. It is hoped to publish the rest later in a separate paper.

Relation to the Cambial Initial

The phylogenetic significance of vessel-member length is probably due to its relation to the length of the cambial initial, and it is therefore important to determine which of these measurements gives the closest approximation to it. This depends primarily on the interpretation of the tails; either the internal pressure which produces the lateral expansion of the vessels also causes the ends of the members to extend longitudinally between the fibres or the lateral expansion is limited to the central part of the cell, the ends remaining narrow.

TABLE I

Species of wood	Vessel members		Parenchyma strands:	Differences of the means, and their standard errors *	
	Total length in μ (a)	Body length in μ (b)	Total length in μ (c)	(a) and (c)	(b) and (c)
Cassine crocea	1006	828	1016	10 ± 36.9	188 ± 36.5
Cocculus laurifolius	333	294	328	5 ± 8.3	34 ± 8.5
Faurea Macnaughtonii	499	390	473	26 ± 17.7	83 ± 19.3
Platylophus trifoliatus	974	798	934	40 ± 33.1	136 ± 31.6
Pterocelastrus tricuspidatus	605	475	595	10 ± 16.6	120 ± 16.0

* To be significant the difference should be at least three times the standard error; thus, 188 ± 36.5 denotes a significant difference, but 10 ± 36.9 indicates that the difference is only accidental.

If the former explanation is correct, one would expect the tails to be most pronounced where the pressure is greatest, in other words where the diameter of the vessels is largest, but actually it has been found that tails are generally more pronounced in woods with narrow vessels. If the second explanation is the true one, the length of a vessel member (including the tails) should be equivalent to that of the cambial initial from which it is derived. It is hard to obtain direct evidence of this, owing to the difficulty of measuring cambial initials in sufficient numbers and from a sufficiently wide range of woods, but it seems reasonable to suppose that the cambiform strands of parenchyma do not elongate, and that they therefore afford a good standard for comparison. Investigation of various diffuse-porous woods show, for a given specimen, that the parenchyma strands are of approximately the same length as the vessel members, provided the tails of the latter are included in the measurements, but that there is a significant difference in length if only the bodies of the vessel members are measured, as will be seen in Table I.

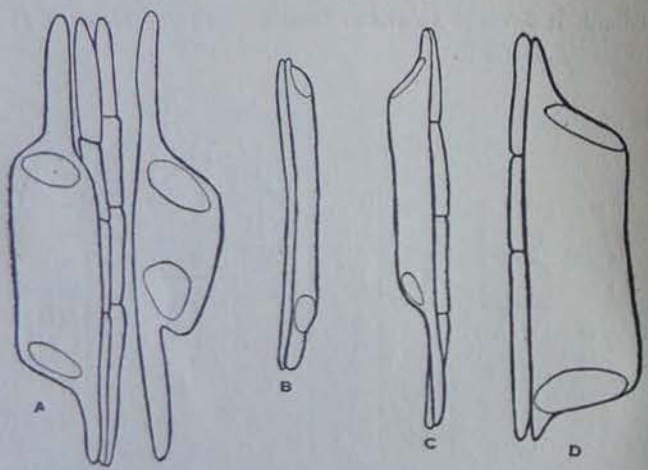

Fig. 2. Drawings from macerated material showing vessel members and parenchyma strands from the same cambial initial. *A*, *Faurea Macnaughtonii* Phill.; *B*, *Cocculus laurifolius* DC.; *C*, *Ochna arborea* Burch.; *D*, *Beilschmiedia assamica* Meissn. × 100.

Figure 2 shows how, in individual members, the total length (*i.e.*, including the tail) corresponds to the length of the adjacent cambiform strands, which, as can be seen from the position of the perforations in the vessel members, are radially placed and probably therefore have been derived from the same cambial initial.

Further confirmation can be obtained from the fact that in any sample the longest tails are associated with the shortest

bodies, and *vice versa*. This is quite natural if we regard the tail as already existing in the undifferentiated cell as a region that will not expand laterally with the rest of the vessel member. Consequently a long tail would then only be formed at the expense of body length. But it is difficult to find any explanation of this relation between tail and body length if the tails are regarded as extensions.

Finally if the tails were pushed up between the next vessel member and the surrounding cells the plasmodesma would

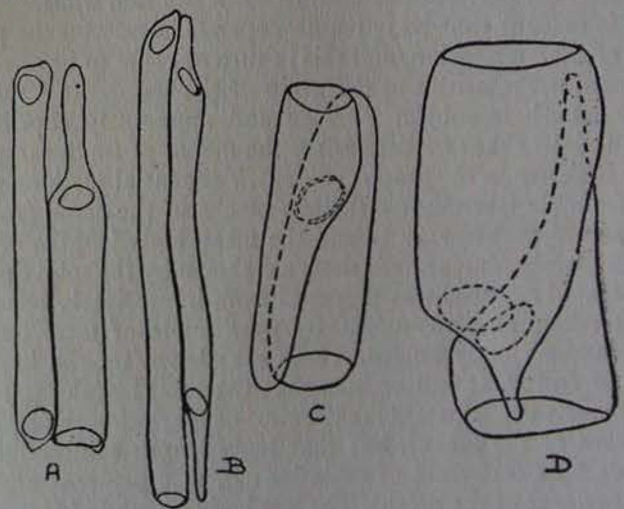

Fig. 3. Drawings from macerated material showing different body lengths in vessel members from the same cambial initial. *A* and *B*, *Ochna arborea* Burch.; *C*, *Mansonia altissima* A. Chev.; *D*, *Entandrophragma cylindricum* Sprague. × 100.

in all probability be ruptured, and there should be no pits, or the pits should not correspond (Priestley *2*); actually the tails are heavily pitted where they touch the next vessel member, and these pits are not displaced.

The authors therefore conclude that the tails are not extensions of a vessel member, and that the total length of a vessel member corresponds closely with that of the cambial initial from which it was derived.

Comparison of Body Length and Total Length

In Figure 3, *A* and *B* illustrate two radial pairs of vessel members from *Ochna arborea* Burch., and show how the same cambial initial can give rise to two vessel members of the same total length, but of very different body lengths, according to the position of the perforations. In the same figure, *C* and *D* represent vessel members from woods in which tails are infrequent, and limited to members such as those illustrated, in which the perforations tend to be in the side walls.

It is evident that body length depends largely on the position of the perforation, and this in turn appears to be affected by local irregularities in the grain of the wood. As a result, body length is subject to wide and apparently capricious fluctuations that seriously affect the means of small samples. This is shown in the graphs (Fig. 4). Tangential sections were cut from six laterally contiguous blocks in the same growth layer in *Acer campestre* L. and the mean body lengths of the vessel members measured; these are shown by the solid line *C*. Macerated material was prepared from immediately beneath the sections and measurements were made of total length and extreme body length. These are shown by the broken lines *A* and *B*. It will be seen that the total lengths (*A*) are comparatively constant (extremes of variation being 4.6 per cent of the mean), but that body length exhibits great fluctuations (extremes of variation: *B*, 11.8 per cent and *C*, 19.4 per cent of the mean). The low body length in blocks III and IV could be traced to a type of development in which the members composing the vessels lie almost side by side and not one above the other. An extreme form of this type of development is illustrated by Record (*3*, Fig. 19, 2).

This greater variation in body length was checked by comparing the coefficients of variation of 43 different specimens. It was found that the coefficient was invariably higher for body length. This signifies that, to attain any given standard of accuracy, body length would require a greater number of measurements than total length (Rendle and Clarke *4*). As previously stated, measurement on a section (method *A*) is a measure of body length; therefore it is subject to this inaccuracy. Its attraction as a method lies in the

apparent simplicity and ease with which it can be used. In actual practice, however, many sections are found to be unsuited to this type of measurement, and where tyloses are abundant it is often impossible to obtain anything approaching an accurate measure of body length. The fact that the method is not applicable to all woods should rule it out completely from adoption as a standard method.

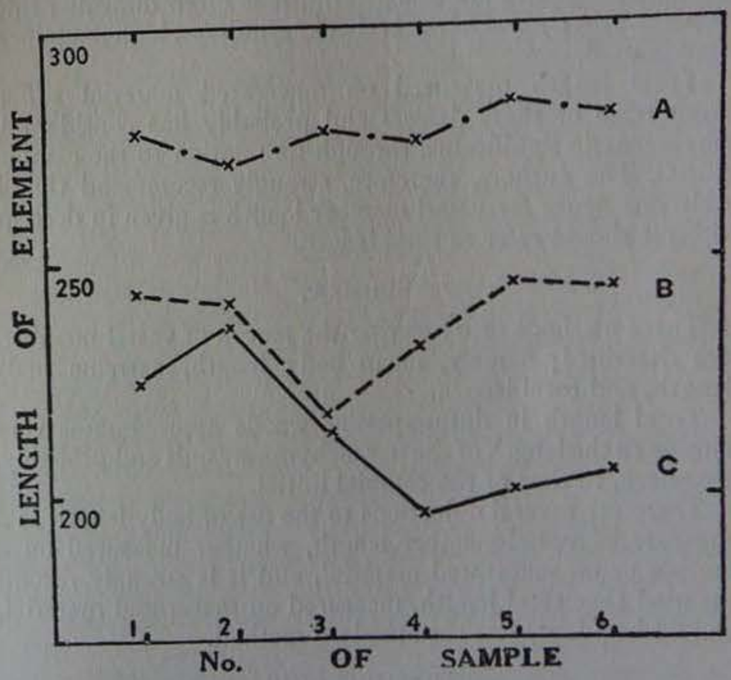

Fig. 4. Graphs showing length of vessel members from six laterally contiguous samples from the same growth layer of *Acer campestre* L. *A*, total member length; *B*, extreme body length; *C*, mean body length.

Two further disadvantages may be pointed out: (*1*) Often it is impossible to avoid a biased selection, as the longest elements are the most likely to run out of the section; (*2*) it gives no indication of the range of variation of individual members and therefore does not admit of statistical treatment.

By using extreme body length, which is measured on macerated material, most of these objections can be eliminated. The method is applicable to all woods, permits of a random selection, and gives the range of individual members, but suffers from the defect inherent to all body-length measurements in that it is relatively more variable and, accordingly, less accurate than total length. Where both pitting and perforation plates are scalariform, it is often difficult to determine exactly where the body ends, unless a high magnification is used.

Total length measured on macerated material suffers from none of these defects and probably has considerable phylogenetic significance through its relation to the cambial initial. The authors, therefore, strongly recommend that if only one figure for vessel-member length is given in descriptions it should refer to total length.

Summary

Three methods of measuring the length of vessel members are described; namely, mean body length, extreme body length, and total length.

Total length in diffuse-porous woods approximates very closely to the length of the parenchyma strands and probably, therefore, to that of the cambial initial.

There are several objections to the use of body length as a measure of vessel-member length, whether measured on a section or on macerated material, and it is strongly recommended that total length, measured on macerated material, should be adopted as the standard method.

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THE DIAGNOSTIC VALUE OF MEASUREMENTS IN WOOD ANATOMY

By B. J. Rendle *and* S. H. Clarke[1]

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The diagnostic value of any feature depends on the extent to which it may vary in different samples of the same species; this was considered in a previous paper (5) in which, taking vessel diameter as an example, a method was outlined for selecting samples to yield information conforming to a predetermined standard of accuracy. It was shown that there is a limit to the number of measurements that can usefully be made in determining the mean vessel diameter of a single small sample of wood for diagnostic purposes; this limit is determined by the variation between the means of different samples and depends on the influence of growth conditions. It was further suggested that differences of diagnostic value between two species would usually be revealed by a mean figure which could be expected to lie within ±10 per cent of the actual mean 99 times in 100.

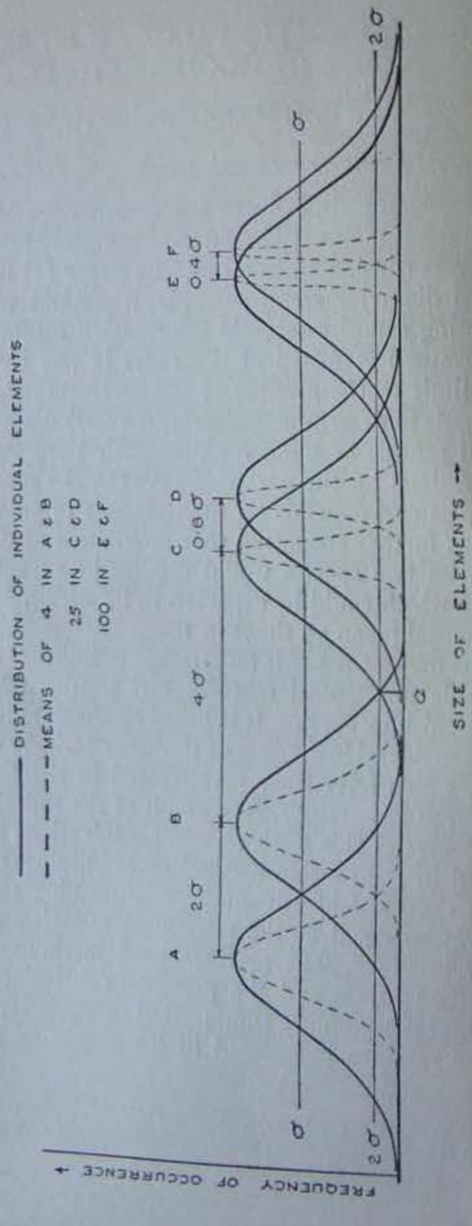
The present paper is an attempt to indicate how far certain variable anatomical features can legitimately be used for distinguishing species. It is based on the detailed examination of a considerable number of timbers of widely different structure, which have been investigated in the Forest Products Research Laboratory. As a result of the experience gained in the course of this work certain modifications have been suggested in the routine method of examining timbers, which have the twofold advantage of increasing the accuracy of descriptions and at the same time reducing the amount of labor involved. The mathematical methods employed are described below and the practical conclusions drawn from this investigation are summarized in Table II.

The features considered in the course of this paper fall

[1] The authors desire to acknowledge their indebtedness to Mr. E. D. van Rest, of the Forest Products Research Laboratory, for his valuable assistance with the statistical treatment of their data.

FIGURE 1

DIAGNOSTIC SIGNIFICANCE OF ELEMENT SIZE



into two categories which it is important to keep distinct: (1) the dimensions of individual *cells*, which show a *normal* type of variation; (2) the measurable characteristics of *tissues*, which are subject to more complex variations than those shown by individual cells. In each case the purpose of measurement should be borne in mind and the results expressed in such a way as to bring out differences likely to be of importance in comparative studies of related species.

Dimensions of Individual Cells

In the authors' previous paper (*5*) reference was made to the fact that within a small piece of wood the variations in cell dimensions, such as vessel diameter and fibre length, are approximately of the type known as *normal*. When the measurements of such dimensions are grouped into size classes of uniform range, the curve showing the number of elements in each size class approximates to the form shown in Figure 1. In order to obtain a measure of the significance of the differences between the mean element sizes of species it is simplest to consider first a hypothetical case in which variation is normal and in which it may be assumed that the elements of a single small sample form a random sample of those of the species. In Figure 1 the curves *A*, *B*, *C*, *D*, *E*, and *F* represent the size distribution of the elements of six species. The distributions have the same standard deviation; and the horizontal lines σ and 2σ intersect the curves at the points where they would be cut by ordinates erected at distances from the mean equal to once and twice the standard deviation, respectively. Clearly the measurement of a single element in each case would be sufficient to distinguish *A* from *C*, *D*, *E*, or *F*; moreover, the overlapping of the distributions of *A* and *C* is so small that individual elements of each species would rarely be confused. The ranges of *B* and *C*, *A* and *B*, *C* and *D*, *E* and *F*, however, overlap to greater extents, so that identification is progressively more difficult. The curves *B* and *C* cut each other at the ordinate *a* at a distance of twice the standard deviation from their respective means. This ordinate marks a size that will be exceeded approximately 195 times in 200 by the elements of *C*, but only 5 times in 200[2] by the

[2] This relation is explained in Fisher's manual (*4*, p. 44).

elements of B, and if we decide to neglect the 2.5 per cent of larger vessels in B, and smaller vessels in C, it is clear that a diagnosis based on the observation of a single vessel will be correct 195 times in 200 (*i.e.*, an accuracy of 97.5 per cent).

It is obvious that, for any particular feature under consideration, the means of a number of samples will show less variation than the individuals themselves. Further, the larger the size of the samples the smaller will be the variation of their means. The variation of the means of samples is definitely related to the variation of the individuals, and if s represents the standard deviation of individuals about the mean of the sample and n the number of observations in each sample, the standard deviation of means of samples of n individuals may be estimated by calculating $\frac{s}{\sqrt{n}}$. Where the distributions of individuals of two species overlap to a considerable extent, therefore, an advantage is gained by obtaining the mean of a representative sample; if we have full particulars of the species (as in the ideal circumstances illustrated in Figure 1), it is possible to decide how many individuals must be observed to provide a sample large enough to establish the identity of a particular group by fulfilling the conditions: $\frac{d}{2} \geq \frac{a\,s}{\sqrt{n}}$ where d represents the difference between mean values of two species, and a is a factor depending on degree of accuracy required[3] (*5*).

In Figure 1 the dotted curves show the distribution of means of samples of various sizes (calculated on the basis that the standard deviation of the mean of a sample $= \frac{s}{\sqrt{n}}$). From the points at which the dotted curves cut each other it may be seen that 97½ times in 100 differences between A and B, C and D, and E and F would be revealed by taking samples of not less than 4, 25, and 100 measurements, respectively.

In these theoretical considerations the influence of environment has been neglected purposely, and diagnostic value is clearly a function of sample size, the lower limit to differences detectable between related species being set by the number of observations that it is practicable to make on any one sample. In practice, however, although for most purposes it may be assumed that the elements of a single small sample are formed under approximately uniform conditions of growth, the same assumption cannot be made with regard to the conditions which operate during the formation of different

[3] The numerical value of a is determined from tables such as Fisher's table of x (*4*, pp. 44 and 74).

TABLE I

(*1*) Species	(*2*) Feature	(*3*) No. of samples and no. of individuals in each	(*4*) S.D. within sample (s)	(*5*) $\frac{s}{\sqrt{n}}$	(*6*) S.D. of means (s_m)	(*7*) $\frac{s_m\sqrt{n}}{s}$
Fraxinus excelsior	*Vessels:* Rad. diam.	20 of 100	44.5	4.5	17.6	3.9
	Tang. diam.	20 of 100	36.0	3.6	17.0	4.7
	Fibres: Length	13 of 100	0.12	0.012	0.06	5.0
Khaya anthotheca	*Vessels:* Rad. diam.	23 of 100	40.0	4.0	32.0	8.0
	Tang. diam.	23 of 100	28.0	2.8	24.0	8.6
	Fibres: Length	14 of 100	0.20	0.02	0.09	4.5
Mora excelsa	*Vessels:* Rad. diam.	12 of 25	34.0	6.8	25.0	3.7
	Tang. diam.	12 of 25	26.0	5.2	23.0	4.4
	Fibres: Length	12 of 25	0.14	0.028	0.055	5.1
Virola merendonis	*Vessels:* Rad. diam.	8 of 50	30.0	4.2	4.3	1.0
	Tang. diam.	8 of 50	24.5	3.5	6.8	1.9

samples, and it is found that the diagnostic value of differences is controlled less by sample size than by the extent of the influence of the external factors.

In order to obtain information concerning the relative importance of these factors, an analysis of variance was carried out on data available for a number of species. Typical results are given in Table I, in which column *4* shows the standard deviation of individuals about the mean of a single sample. Assuming individual samples to be formed under growth conditions of limited variation, the figures in column *4* may be regarded as a measure of the variation due to the influence of internal factors. The means of successive groups of observations from the same sample of wood will themselves vary and the extent of this type of variation may be estimated from observations on a single sample by calculating $\frac{s}{\sqrt{n}}$ (see column *5*). The different samples indicated in column *3* were not formed under identical growth conditions and the means will, therefore, be subject to an additional source of variation; the actual standard deviation of these means is given in column *6*. The disagreement of columns *5* and *6* is attributed to the influence of the "external factors" and it is evident that this is of considerable importance. Columns *5* and *6* are compared by division, and the quotients are given in column *7*. In this table only 11 items from four species are considered; in all, 45 features from 16 species were actually examined, but the complete range observed is covered by the examples in Table I. In only three instances did the figure in column *7* exceed 6.

There is no obvious reason to expect a relation between the variations due to internal and external influences, and none was discovered. It may be shown, however, that, in extreme cases, for cell size to be of diagnostic value the species means must differ by not less than 3.5 *s*, where *s* is the standard deviation of individuals about the mean of either species. To do this it is necessary to make the reasonable assumptions that (*a*) in the majority of cases the variance due to growth will be such that the actual standard deviations of the means (column *6*) will not be more than about 6 times the standard error of the means ($\frac{s}{\sqrt{n}}$ as in column *5*); (*b*) 64 measurements are made on each sample[4]; and (*c*) an accuracy of 99 per cent is sufficient, so that $a = 2.33$.

[4] The number 64 is chosen purely for convenience of size and because $\sqrt{64} = 8$.

Making the necessary substitutions in the formula $\frac{d}{2} \geq \frac{a\,s}{\sqrt{n}}$, $d \geq \frac{2 \times 6 \times 2.33s}{8} \geq 3.5\,s$. These figures demonstrate the extent of the influence of external conditions on cell size, and indicate the need for caution in using such features as a means of distinguishing between species. Although differences smaller than 3.5 *s* are frequently of diagnostic significance, this should be tested carefully in each case.

Measurable Characteristics of Tissues

Variations in woody tissues are more complex than those occurring in cells, since the former are concerned with the numerical distribution of cells as well as with their dimensions. Their characteristic features appear to be more deeply affected by conditions of growth and are consequently less reliable for diagnostic purposes.

Just as with individual cells, the diagnostic features of tissues should be studied from a comparative viewpoint, and the value of descriptive work cannot fail to be enhanced if this principle is adhered to and attention is concentrated on anatomical features that are likely to be specific in character.

The diagnostic value of certain features commonly used in identification is discussed below.

Number of vessels per unit area. The number of vessels in a given area of cross section is a useful indication of the texture and general character of a wood and is usually included in systematic descriptions. For classifying timbers into a convenient number of broad divisions the general method is to record the number of vessels in an area of one square millimetre, but there are several reasons against regarding this figure as an essential part of every description.

In the first place, the method is applicable only to timbers with a fairly even distribution of vessels. It is obviously inappropriate in attempts to compare ring-porous woods with diffuse-porous woods showing little or no variation throughout the seasonal growth ring. Again when the normal condition is for the vessels to be solitary or in small groups of two or three, it is advisable to regard the group as the unit, but in the case of woods like *Carpinus Betulus* or certain genera of the family Sapotaceae, in which the vessels occur in long radial rows or chains, nothing is gained by trying to record vessel numbers by a method ill adapted to such an arrangement.

In the second place, the extreme variation between different timbers in respect to vessel number is so wide that it is impracticable to fix any one unit of area as the standard for descriptive purposes. As an instance of the range of variation there may be cited *Ricinodendron Rautanenii*, with about 35 vessels to the square centimetre, and *Buxus sempervirens*, which may contain over 20,000 vessels in the same area. As a practical proposition, the method suggested is to choose an area appropriate to the particular timber or group of timbers under investigation, for example 1, 2, 4, or 5 square millimetres, such that it contains about 50 to 100 vessels.

A convenient and rapid method of counting vessel number is to project an image at a magnification of about 30 times on to white paper on a horizontal table; over the white paper place a sheet of black paper with a hole (square or circular) representing the chosen area at the required magnification. The vessels may then be crossed out on the white paper with a dark-colored crayon, and the number counted rapidly without fear of including the same vessel twice. It is better to express the results in terms of the area on which the vessels were counted, than in terms of one square millimetre, because the expected variation depends to a large extent on the size of the area observed. The importance of sample size in determining variation has already been discussed (*supra*), and Chattaway (*1*, p. 22) has drawn attention to this type of discrepancy, in recording her observations on a slide of *Copaifera mopane;* the number of vessels occurring in individual square millimetres was found to vary between 1 and 8, while the average number per square millimetre based on an area of 25 square millimetres was 2.3.

In recording vessel number in certain diffuse-porous temperate woods, it is necessary to take into account the seasonal variation that often occurs within each growth ring. In order to obtain a fair estimate of the vessel number the cross sec-

tional area examined should take the form of a radial strip including an integral number of growth rings.

Vessel groups. Where vessels are grouped, it is advisable to record the frequency with which the different group sizes occur. No rule has been discovered governing group size and the simplest way of describing it is to give the most frequent and the maximum sizes, as in Table II.

Rays. Similar remarks apply to the rays, which do not vary normally in size. The position is further complicated in some woods by fusions and divisions (*2*) which are not always recognizable as such. The frequency with which different sizes occur in any sample usually gives an asymmetric curve, and the simplest way of dealing with the situation is to quote the most frequent sizes and the maximum size encountered (Table II). It is convenient to express the height of a ray in terms of cells where the average height is not more than about 15 cells, but where this size is exceeded it is usually better to record the height in microns. The proposed limit is entirely a matter of convenience, but uniformity of practice is desirable.

Suggestions for Preparing Descriptions

In the authors' previous paper (*5*) it was concluded that as a general rule five samples from each of four trees are sufficient to prepare a reasonably accurate description of a timber. In the nature of things it is frequently impracticable to examine so many samples, and it then becomes necessary to modify the procedure accordingly. Table II contains suggestions for the routine examination of a timber according to the amount of material available. The maximum requirements will demand but little time if a projection method is adopted (*3*).

Summary

The significance of certain types of structural variation is discussed in relation to the description of woods.

Evidence is adduced to show that in extreme cases, unless the mean sizes of an element in two species differ by at least 3.5 times the standard deviation of the individual elements in any sample of either species, it is unsound to use the feature diagnostically.

TABLE II

SUGGESTIONS FOR TREATMENT OF DATA IN PREPARING DESCRIPTIONS

Feature	Treatment of each sample when there is available—	
	Only one sample	Abundant material (The number of samples should be stated.)
Vessels: Size	Measure 100 vessels; give mean and standard deviation (S.D.) of radial & tang. diams., *e.g.*— Mean radial diam... 212μ S.D.............. ± 32μ	Measure 25 vessels; give mean, S.D., and S.D. of means of rad. & tang. diams., *e.g.*— Mean radial diam.. 212μ S.D.............. ± 32μ S.D. of means...... ± 12μ
Number	Where evenly distributed, select a typical region by inspection; observe number in convenient area, which need not be standard, but should include an integral number of growth rings and contain 50–100 vessels; give most frequent range and maximum *in area examined; e.g.,* "vessels evenly distributed; usually 80–90 (110) pores or groups per 3 sq. mm."	
Grouping	Regard small radial groups as units and give frequency with which groups of given size occur, as "solitary or in groups of 2–4; about 40 per cent of vessels in pairs."	
Fibres: Length	Measure 100 fibres; give mean fibre length (m.f.l.) and S.D., *e.g.*— M.f.l......... 1.49 mm. S.D.......... ±0.15 mm.	Measure 25 fibres; give m.f.l., S.D., and S.D. of means, *e.g.*— M.f.l......... 1.49 mm. S.D.......... ±0.15 mm. S.D. of means. ±0.06 mm.
Rays: Height	Where average height is not more than about 15 cells, count cells; above this height it is usually more convenient to measure height in μ.	
Height and Width	Measure 100 rays. Count cells in 100 rays.	Measure 50 rays. Count cells in 50 rays.
Width	Give most frequent range and maximum, as "1–3 (4) cells wide; about 50 per cent biseriate."	

NOTE: The most frequent range must generally be decided in an arbitrary manner. It frequently happens that a wood has some characteristic proportion of elements of a definite size; where this is not the case the upper and lower limits containing about 50 per cent of the observations should be given.

It is pointed out that tissue variations demand a different treatment from that which is suitable for variations in cell size.

Suggestions are made (Table II) for use in describing element size and tissue variations so that all information of diagnostic value may be included.

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ACTION OF HYDROFLUORIC ACID IN SOFTENING WOOD

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In the preparation of sections of wood for microscopical work, the use of a preliminary softening agent is frequently necessary. Immersion in hydrofluoric acid is one of the most common methods employed; yet, in spite of its wide use, its softening action is little understood among wood technologists. The lessened resistance to cutting after the use of hydrofluoric acid has been ascribed to the removal of silica (Plowman, *3*), and more recently to a change in the lignin (Harlow, *2*). Both of these factors may play a part, for the action of hydrofluoric acid on a chemically heterogeneous substance, such as wood, must be exceedingly complex. Nevertheless, the chief cause of the softening can be explained by a partial degradation of the cellulose and not by a change in the lignin or the inorganic constituents.

Silica is dissolved by hydrofluoric acid, but desilicification alone does not account for the softening action on wood. This has been emphasized by Harlow (*2*), who points out the low percentages of silica normally present in the ash of wood, the lack of correlation between silica content and the ease of sectioning, and the obvious physical change in the wood after the acid treatment. Harlow shows that there is a definite correlation between the specific gravity of wood and the resistance to sectioning; the higher the specific gravity, the more difficult the material is to cut.

The conception that hydrofluoric acid produces a physical change in the lignin has undoubtedly arisen from the fact that lignified material requires softening, whereas unlignified tissues may be cut without preliminary treatment. At the same time, it must be remembered that wood also contains large masses of secondary wall fibers, while soft tissues usually possess thin walls.

There is no severe chemical change in the lignin after a short immersion in hydrofluoric acid. Lignin is known to be resistant to the action of cold mineral acids, and this resistance is used in the separation of lignin from other cell components. Thus, two of the standard procedures used in the preparation of lignin consist in (1) the use of 70–72 per cent sulphuric acid, followed by boiling in 3 per cent sulphuric acid and (2) the use of 40–43 per cent hydrochloric acid. Lignin prepared by these methods consists always of a residue of the compound middle lamella and, at times, of a structural residue of the secondary walls. Such residues may be imbedded in paraffine and sectioned without difficulty.

Lignin residues, prepared by the action of 72 per cent sulphuric acid upon sections, have been studied by Ritter (*4*), Harlow (*2*), and others. Sections cut from blocks which have been immersed in hydrofluoric acid for a relatively short period give the same type of lignin residues in 72 per cent sulphuric acid as sections cut from fresh material. However, if the blocks are left for a longer period in the acid, so that the wood becomes too soft to cut with ease, sections prepared from these blocks show an increased resistance to 72 per cent sulphuric acid. Thus, sections of *Robinia Pseudoacacia*, cut

from a block which had been immersed in the acid for 10 days, left a secondary wall lignin residue in 72 per cent sulphuric acid, although fresh preparations, similarly treated, show only the remains of the compound middle lamella.

A study has also been made on the delignification of acid-treated wood. When sections are treated with chlorine water and hot sodium sulphite or chlorine water and 10 per cent ammonium hydroxide, which removes the lignin, there is no essential difference in the time and type of delignification between acid-treated and fresh material. There is, however, a marked change in the properties of the delignified fibers.

Changes in the lignin reactions have been noted after immersion in hydrofluoric acid. Harlow (*2*) showed that the color of the phloroglucin and the Mäule reactions is diminished after the use of hydrofluoric acid and, with prolonged treatment, may even be destroyed. It is quite apparent that the brown discoloration of the wood, produced by the acid, interferes with the red tint of these color tests. Furthermore, there is no correlation between the diminished intensity in the phloroglucin and Mäule reactions and the process of softening, since most of the color loss takes place with prolonged acid immersion and after the wood already cuts with ease. It is unfortunate that we know so little concerning the chemistry of these useful lignin color tests.

In contrast to the slight effect on lignin, the action of hydrofluoric acid upon cellulose is quite striking and agrees with general effects noted for other mineral acids. It has been known for a long time that many acids under various conditions attack cellulose and give a degraded product known as hydrocellulose. This change is accompanied by a loss of tensile strength of the fibers, so that they become brittle and tend to break up into segments. Hydrocellulose may be produced in cotton by the following methods: (1) boiling in dilute acids, such as 1–3 per cent sulphuric or hydrochloric acids, for several hours; (2) drying dilute acids (*e.g.*, 1 per cent HCl) into the fiber at 60–70° C. for 3–4 hours; (3) immersion in 55 per cent sulphuric acid for 24 hours. The preparation and properties of hydrocellulose are described by

Schorger (*5*), Dorée (*1*), and others. The different methods for the preparation of hydrocellulose are not comparable, for after treatment the fibers still consist of a large and varying proportion of unattacked cellulose, together with a degraded product which is somewhat soluble in dilute sodium hydroxide.

The action of 48 per cent hydrofluoric acid on cotton is similar to that of other mineral acids, but it is not so rapid as the methods given above. In the length of time necessary to soften blocks of wood in hydrofluoric acid, cotton fibers show the general property of hydrocellulose in the loss of their tensile strength.

Hydrofluoric acid also produces a similar loss of tensile strength in wood cellulose. Longitudinal sections of various woods, cut from blocks which have been immersed in hydrofluoric acid, may be delignified by the use of chlorine water and 10 per cent ammonium hydroxide. Such delignified fibers show the same properties as cotton hydrocellulose, breaking up in dilute caustic soda. This is particularly striking when blocks of wood have been given a prolonged treatment in the acid so that the wood is too soft to section easily. It seems reasonable, therefore, to associate the softening of wood after immersion in hydrofluoric acid with physical changes due to the formation of hydrocellulose.

If the softening of wood is due to hydrocellulose, it should be possible to demonstrate this by the use of other acids. Blocks of *Fraxinus americana* and *Robinia Pseudoacacia* were treated by the methods given for the production of hydrocellulose in cotton. In all cases the woods were softened and cut with ease. Drying dilute acids into blocks of wood softens the material, but the action is never uniform. Immersion in 55 per cent sulphuric acid produces swelling of the fibers at the same time that softening occurs. Wood blocks were boiled in sulphuric acid of various concentrations from 0.5 to 5 per cent for two hours and longer periods, and these all sectioned without difficulty. It is interesting to note that boiling for four hours in 3 per cent sulphuric acid is part of the standard treatment for the preparation of lignin. Boiling of wood blocks in dilute sulphuric acid softened some of the

hardest tropical forms, and this may prove useful in the study of lignin residues in woods which are too hard to section without a preliminary treatment.

Good sections were rarely obtained by these methods, since they are too rapid to give uniform results, and frequently are accompanied by morphological distortion. This is not surprising, since the chemistry of hydrocellulose is little known and, even with the use of cotton, the different methods are not comparable. With wood there are additional complexities in the reactions of hemicellulose and lignin. By a detailed study of the actions of many acids on woods at varying times, concentrations, and temperatures, it may be possible to develop a better method for softening woody tissues than the use of hydrofluoric acid. This is desirable on account of the disagreeable properties of the reagent and the lack of uniformity in different samples of acid.

In the softening of wood, a severe degradation of the cellulose is both unnecessary and undesirable. The slow action of hydrofluoric acid is advantageous, since hydrocellulose is produced gradually, and there remains in the fibers a large ratio of unattacked cellulose. In the early stages of hydrocellulose formation, there is only a slight loss in tensile strength, so that the wood cuts with ease but does not crumble. After a prolonged treatment in the hydrofluoric acid, the loss of tensile strength has so increased that the wood tends to crumble rather than cut. At this stage the delignified fibers dissolve in cellulose solvents with a small amount of swelling. This may account for the fact that wood sections from such blocks show an increased resistance to 72 per cent sulphuric acid, since the cellulose does not swell to the stage where it disrupts the structural lignin residue.

Conclusion

The softening of woody tissues by the use of hydrofluoric acid is associated with a partial degradation of cellulose and the formation of hydrocellulose. This causes a change in the physical properties of the fibers. The lessened resistance of wood to sectioning after immersion in hydrofluoric acid may be correlated with loss of tensile strength of the cellulose.

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CURRENT LITERATURE

Contributions to the flora of tropical America. XIX. *Eugenia aeruginea* DC., a misidentified type specimen. By N. Y. SANDWITH. *Bull. Misc. Inf. Kew* 124–126; 1934.

Eugenia aeruginea, whose habitat was unknown when the species was described, has been misinterpreted by recent authors. Examination of the type specimens shows that it is the species described from Cuba and Jamaica as *E. Fadyenii* Krug & Urb., that name therefore falling into synonymy. The plant of Puerto Rico and Hispaniola listed wrongly as *E. aeruginosa* in recent publications should be known as *E. domingensis* Berg.

The pulping of cajeput, white mangrove, Australian pine, and Cunningham pine by the sulphate process. By C. E. CURRAN, SIDNEY L. SCHWARTZ, and MARK W. BRAY. *Paper Trade Journal* (New York) 98: 23: 44–47; June 7, 1934.

This report deals with pulping experiments at the U. S. Forest Products Laboratory on Cajeput (*Melaleuca leucadendron*), White Mangrove (*Laguncularia racemosa*), Australian Pine (*Casuarina equisitifolia*), and Cunningham Pine (*Casuarina Cunninghamiana*). Only the second is native to Florida, the others having been introduced, probably from Australia, but they are all found in considerable quantity in the southern part of the State. "Because they grow rapidly, are now of little commercial value, and occur in an area in need of industrial development, the question has been raised many times as to the possibility of their use in paper pulp.

The work reported here was undertaken to answer this question."

"All four species are short-fibered and the pulps resulting from them were inferior to pulps of the same type from the common pulpwood species. The available means of pulping do not appear to be adapted to the conversion of these species into products which can successfully compete with pulps and papers from commonly used pulpwoods. The best chance of utilizing these species for paper appears to be in admixture with stronger and more suitable fibers, or in some specialty product (the nature of which is not now apparent) for which they may subsequently be found adapted."

The physiography and vegetation of Trinidad and Tobago. A study in plant ecology. By R. C. MARSHALL. Oxford Forestry Memoirs, No. 17. Mr. Milford, Oxford University Press, 1934. Pp. 56; 7½ x 10¾; 32 figs; price 6 s. net.

After a number of cyclopedic statements on the history of Trinidad and Tobago and a good topographical description, notes on the geology and soils follow; the author, who is Conservator of Forests in the Colony, confines himself to general remarks on the quality of the soils. More weight is laid on a description of the climate, particularly such factors as temperature and, especially, humidity and rainfall. Numerous good maps and graphs allow the reader to get quickly acquainted with the various local climatic conditions to which the main climatic vegetation types correspond.

The forests have been examined and mapped after a method largely tested out in Sweden, but perhaps also in other countries, the "strip surveying"; with this as with other methods the results depend on the type concept used. Whether or not this is the best under the circumstances is difficult to tell without personal experience in the same field, but Mr. Marshall's types seem to have been well chosen. Two main association groups are distinguished, one wetter and one drier, the limit drawn at a yearly rainfall of 50–60 in., a minimum amount for the formation of tropical rain forest, the climatic climax. Such forest, along with its edaphic varieties, formerly covered about 90 per cent of the area, but now only between 40 and 50 per cent.

Four types, with the rank of associations, are distinguished in Trinidad and one in Tobago and designated by vernacular names; the principal type is the Crappo-Guatecare (*Carapa-Eschweilera*) association which, in its turn, has four edaphic (mainly) subdivisions which seem to correspond to sociations. A reader who objects to the use of local names like Crappo and Guatecare will in most cases find that he is just as much or as little familiar with a majority of the Latin names; a "temperate" botanist often finds it impossible to take his bearings among this multitude of tropical binomials of which so many mean nothing to him. He misses very much references to families, not to speak of indications of growth forms and suitable illustrations. The use of Raunkiaer's leaf-size classes should be considered. The photographs, good as they are, can only give a general idea of what the different vegetation types look like.

The second type is the Mora association, and this is, according to the author, the real rain forest *climax*. *Mora excelsa* is an invasive species and supposed gradually to take possession of more soil; thus, in considerable areas the climatic climax has not yet been attained. This sounds strange and one might easily believe that human action, in some way or other, is responsible for the advance of Mora. That in places Crappo-Guatecare forest is slowly invaded by *Mora* is, however, a fact.

The third association is, to judge from the map, a function of altitude and so is certainly the fourth, "mountain forest." From a botanical viewpoint it is to be regretted that the survey has not been carried above 2000 ft.; there are fully 1000 ft. above this line not yet examined.

The edaphic units of the rain forest comprise Mangrove-herbaceous swamp (occasionally with "palm stands")—freshwater swamp forest, arranged in a successional series. A special chapter is devoted to the important second growth which eventually results in a "deflected climax" when, caused by repeated human action, a certain stabilization is attained. Such is the "orchard" type, the bracken patches, palm stands of *Maximiliana caribaea*, etc.

Under "Succession" very interesting remarks on second-

growth development are made (p. 48) dealing with the conditions under which a destroyed primeval forest has a chance—always small it seems—to reconstruct itself on the basis of second growth.

Under "Beach forests" various colonies on sand and rock are briefly mentioned. The statement that the Coconut might to some extent be indigenous in these islands may well be disputed, since the genus *Cocos* has become monotypical and entirely non-American.

The drier main group is called "semi-deciduous forest." Three "associations" are described, each apparently including more than one sociation.

The most important associations, such as the Crappo-Guatecare and Mora, are illustrated by complete lists of the trees, with indication of the number of individuals, distributed among ten girth size classes. These tables, probably important to the forester, do not quite satisfy the phytosociologist. The species are divided into three groups—"dominants," "sub-dominants," and "lower story"—an unusual terminology, for "dominance" here has nothing to do with abundance or physiognomic importance, but refers solely to the height of the trees. The relative part taken by different species within the strata is illustrated by the figures giving numbers of individuals; it is a pity that the author has not gone a little further and applied some method for grouping the species according to abundance-importance, the more as a scale of 6 degrees has been used, occasionally at least, during the course of field work (see Appendix).

In the last chapter, "Forestry, agriculture, and land allocation," the author touches a number of important practical problems, and he is undoubtedly right when he says that "a proper understanding of the various types of forest . . . should form the basis of schemes for the allocation of land and would be of value to the agriculturist as well as to the forester."

There is indeed no abundance of papers accurately describing tropical vegetation, and Mr. Marshall's little monograph is a welcome addition to the list. He does not pretend to enter on a detailed description of the structure of his plant communities—the undergrowth, with epiphytes, lianas, cryptogams, etc., has been left out entirely—but he has laid a good foundation by his survey; the forester has cleared the road for the phytosociologist who should follow in his wake.—CARL SKOTTSBERG, *Bishop Museum Visiting Professor of Botany, Yale University*.

Studies of new and noteworthy tropical American plants. II. By HAROLD N. MOLDENKE. *Phytologia* (New York) 1: 95–105; figs. 13; July 1934.

Among the woody plants described as new are: *Alseis Mutisii*, Colombia; *Avicennia nitida*, var. *trinitensis*, Trinidad; *Vitex Klugii*, Peru; *V. lucida*, Dominican Republic (its local names Palo Perrito and Matta Becerro); and *V. Rusbyi*, Colombia. *Recordia boliviana*, representing a new genus of Verbenaceae from Bolivia, is named in honor of Samuel J. Record.

Palmae neogeae. VI. By M. BURRET. *Notizblatt Bot. Gart. Berlin-Dahlem* 12: 42–44; June 25, 1934.

Chamaedorea columbica, described from Colombia, is the first representative of subgenus *Stephanostachys* reported from South America. *Geonoma Heinrichsiae* is described from Ambato, Ecuador, where it is called Caña Brava.

Note on the genus *Goethalsia* Pittier. By H. A. GLEASON. *Phytologia* (New York) 1: 112; July 1934.

Study of material of *Goethalsia isthmica* collected recently in Colombia convinces the author that the tree should be referred to the Flacourtiaceae, rather than to the Tiliaceae, in which it was originally placed, when described as new, from Panama.

The dental plant of the Citará Indians in Colombia. By W. ANDREW ARCHER. *Journ. Washington Academy of Science* (Menasha, Wisconsin) 24: 402–404; Sept. 15, 1934.

A scandent shrub of the family Rubiaceae, *Schradera marginalis* Standley, a new species, is chewed by certain Indians of northwestern Colombia in order to color their teeth black. The plant is known by the vernacular names Querá and Quedá. It is reported, also, that in the Caquetá region of Colombia and Peru, *Neea parviflora* Poepp. & Endl., known as Yana Muco, is employed for the same purpose.—P. C. STANDLEY.

Addimenta cognitionis Lecythidacearum. I. By R. KNUTH. *Repert. Spec. Nov.* (Berlin-Dahlem) 35: 338–342; July 15, 1934.

The following new trees are described: *Gustavia gracilipes*, Colombia; *G. iquitosensis* and *G. Tessmannii*, Peru; *Grias loretensis*, *G. maranonensis*, and *G. Tessmannii*, Peru; *Cariniana ianeirensis*, Brazil; *Couroupita amazonica* and *C. Froesii*, Brazil; *C. St. Croixiana*, St. Croix, cultivated; *C. venezuelensis*, Venezuela.

Für Venezuela neue Pflanzen der Sammlung Vogl. By K. SUESSENGUTH. *Revista Sudamer. de Bot.* (Montevideo) 1: 81–86; June 1934.

There are listed numerous additions to Kunth's *Initia Florae Venezuelensis*. Most of the additions are herbaceous plants, but among the woody ones are *Anacardium pumilum*, *Sambucus peruviana*, various Malpighiaceae, *Clidemia strigillosa*, *Pimenta acris*, and *Achatocarpus nigricans*, var. *inermis* Suesseng.

Decades kewenses plantarum novarum in herbario Horti Regii conservatarum. Decas CXXX. *Bull. Misc. Inf. Kew* 99–107; 1934.

Shrubs and trees described as new are *Gochnatia arequipensis* Sandwith, Peru; *Martinella insculpta* Sprague & Sandw., British Guiana and Venezuela; *Pleonotoma echitidea* Sprague & Sandw., British Guiana; *P. pavettiflora* Sandw., Brazil; *Protea stipitata* Phillips, Transvaal.

Description d'espèces nouvelles de Phanérogames de l'Equateur. By R. BENOIST. *Bull. Soc. Bot. France* (Paris) 81: 324–326; 1934.

The new species described from Ecuador, collected by the author, are: *Protium ecuadorense*, a tall tree; *Rubus lloensis*;

Polylepis subintegra, a medium-sized tree; and *Axinaea quitensis*.

New species of plants of the Ladew expedition to Bolivia. By H. H. Rusby. *Phytologia* (New York) 1: 49–80; July 1934.

Among the woody plants described as new are: *Guatteria setosa*, *Alchornea megalostylis*, *Paullinia Tatei*, *Serjania lyrata*, *Caopia parvifolia*, and *Duranta recurvistachys*.

Beiträge zur Kenntnis der Flacourtiaceen Südamerikas. II. By Herman Sleumer. *Notizblatt Bot. Gart. Berlin-Dahlem*. 12: 50–56; June 25, 1934.

New species described are: *Banara amazonica*, Peru and Bolivia; *Eichlerodendron mexicanum*. Among the new names are *Eichlerodendron intermedium* (Seem.) Sleumer (*Xylosma intermedium* Tr. & Planch.); *Hasseltia dioica* (Benth.) Sleumer (*Banara dioica* Benth.; *Hasseltia mexicana* Standl.); *Hecatostemon guazumaefolius* (H. B. K.) Sleumer (*H. dasygynus* Blake, *Laetia guazumaefolia* H. B. K.). There are also numerous new reductions to synonymy in *Casearia* and other genera.—P. C. Standley.

Legislação florestal. Primeira parte: Legislaçoã historica, 1789–1889. By Paulo Ferreira de Souza. Pub. by D. N. P. V., Ministerio da Agricultura, Rio de Janeiro, 1934. Pp. 184 + xiii; 6½ x 9.

A collection of laws, edicts, and decrees pertaining to forestry in Brazil during the century preceding the establishment of the republic. Those dating prior to 1805 emanated from Lebôa, and refer in part to the management and exploitation of the forest belonging to the crown in Portugal, in part to those of Brazil, where all woods and forests bordering on the sea, on rivers that empty directly on the sea as far as rafts may be floated, were declared the property of the crown, and to be restored if possible to the crown if already granted to private individuals who might be compensated by corresponding territory in the interior.

The governors are ordered to prepare maps and information concerning these forests, accompanied by samples of the

woods, with recommendations as to form of administration most suitable to the conservation of the forests and the economy of their exploitation, also to devise an accounting system that would show the actual cost of each piece delivered. The object of the royal interest in woods was in the first place construction timbers for the royal navy and merchant marine, in the second place also profit to the royal treasury.

The principal construction timbers, the so-called "madeiras de lei," were not to be cut without a license and not to be sold except to the royal arsenals. These were enumerated in regulations issued as early as 1623-33 and hence not contained in the present publication, but it may be gathered that they included Perobas of all kinds, Tapinhoãn, and Páo Brazil—as well as various others such as Canellas, Vinhaticos, and Tecas (Acapú), Potumujú, Buranhem of the variety known as female, Páo Marfim, Páo Roxo, Páo d'Arco, Amoreira, Oiticica, Páo Rainha, etc.

Some replanting was ordered in the royal Pine forests of Portugal at an early date and recommended in one or two instances in Brazil (1800). With the arrival of Dom João of Portugal in Bahia in 1808, the ports of Brazil were opened by royal decree to foreign commerce, and direct importation and exportation of all kinds of merchandise was permitted, except trade in Páo Brazil and Páo Rainha which remained a prerogative of the crown until 1834 and 1859 when with scarcity of buyers and with great accumulation of stocks on hand the price had declined, from as much as £40 per ton for the best grades, to a level at which it was no longer worth while to maintain the monopoly.

During the stay of the Portuguese king in Brazil, which lasted till 1821, his interest in "the natural resources with which providence has enriched this fertile part of my domains" appears to have been considerable. He arranged premiums for the introduction and acclimatization of spices of India and for the cultivation of other plants, native and foreign, useful in pharmacy and in the arts. He ordered Mulberry trees planted in Bahia with a view to the importation of "seed of the silkworm," the establishment of a botanic garden in Rio to promote the cultivation of nutmegs, camphor, cloves, cinnamon, pepper, and cochineal cactus, to experiment with the best method of producing plantations of timber trees, etc.; the establishment of a school of Agriculture in Bahia to serve as a model for the many others that he planned to create in all parts of the country and founded a chair of botany and agriculture in Rio as a part of the faculty of philosophy.

After his departure for Portugal, the regents acting during the minority of his son, afterwards D. Pedro I, who was left in Brazil, ordered the garden in the capital to furnish seed and plants free to all who might apply for them, and to furnish plants for botanic gardens in Bahia, Pará, Pernambuco, Cuyabá, Sergipe, São Luiz de Maranhão, and Minas Geraes, some of which gardens either failed to materialize as such or were perhaps later given up. The publication of Velloso's *Flora Fluminense* was ordered in 1825.

From this time to the end of the period covered by the first part of the *Legislação Florestal*, the regulations deal chiefly with the removal of some former restrictions and with permits and charters for individuals and companies that desired to introduce processes of manufacture, such as paper pulp from banana fiber (1843), from wood (1867), from bagasse (1878), for exportation of rubber in liquid form (1853), for exploitation of Paraná Pine (1872), of herva mate (1858 and 1882). Provisions were made as early as 1861 for the protection of the watershed which still supplies the capital and incidentally for some reforestation there in that connection. An annual subsidy of two contos to the publication of Martius' *Flora Brasiliensis* was ordered in 1862.

One of the last items of general importance is a review of former laws and a decision to the effect that the government lacks authority to concede to private interests, permission or rights to exploit forests on public lands. Aside from this general statement of principle and always with the reservation of valuable timbers for the purposes of the realm, the intention is evident to protect the forest from the reckless exploitation and the devastation which throughout the period was the order of the day in Brazil as elsewhere on the American continent. The legislation up to the time of adoption of

a republican form of government in 1889 bears, however, no evidence of an attempt to formulate a comprehensive policy based on a realization of the importance of the forest even to a country where nature is as prodigal as in Brazil.—B. E. Dahlgren, *Field Museum of Natural History*.

Revision der Arten einiger Anonaceen-Gattungen. III. By Rob. E. Fries. *Acta Horti Bergiani* (Upsala) 12: 1–220; pls. 1–20; figs. 1–14; 1934.

The paper continues Dr. Fries' admirable monographs of the Anonaceae, which present in so lucid a manner a detailed and orderly account of genera that have long been in almost hopeless confusion. His method of treatment is one that all botanists might take as a model, but one that few of them will be able to equal. The genera monographed in the present paper are: *Diclinanona*, with two species, one of them new; *Anaxagorea*, with 17 species, eight of which are new; *A. multiflora* of Pará, Brazil, is called Invireira. *Duguetia* (including *Aberemoa* of recent authors, not of Aublet; *Geanthemum*, and *Alcmene*), with 13 sections and 60 species, many of them new; *D. echinophora* of Amazonian Brazil is called Ameipi, its wood used for frame buildings; *D. calycina*, subsp. *Versteegii*, of Surinam, is called Soort Zuurzak. *Duckeanthus grandiflorus*, a new genus of Amazonian Brazil. *Guatteriopsis*, a new genus, with three species in Amazonian Brazil and Peru. *Rollinia*, with eight sections and 54 species; *R. sericea* of Brazil is called Pisame; *R. Glaziovii* of Minas Geraes, Banana de Macaco. *Rolliniopsis*, with four species. In addition to the generic monographs, new species are published in the following genera: *Hornschuchia; Oxandra* (*O. Krukoffii* of Pará, Brazil being known as Envira Preta), *Ephedranthus*, *Malmea*, *Crematosperma*, *Fusaea*, *Xylopia*, and *Anona*.—P. C. Standley.

Plantae Krukovianae. III. By H. A. Gleason. *Phytologia* (New York) 1: 106–111; July 1934.

Woody plants described as new from Brazilian Amazonia are: *Ryania sauricida*, whose bark is used by the Indians for poisoning alligators; *Trichilia Krukovii; Bixa excelsa* Gleason

& Krukoff, a tree of 30 meters; *Henriettella sylvestris; Bernoullia sweitenioides;* and *Diclidanthera octandra.*

New or noteworthy trees from Micronesia. VI. By RYÔZÔ KANEHIRA. *Botanical Magazine* (Tokyo) 48: 400–405; 2 figs.; 1934.

The following six trees and shrubs are described as new from the Marianne and Palau Islands: *Drypetes nitida* and *D. dolichocarpa; Calophyllum Wakamatsui,* whose wood is used for canoes and construction; *Boerlagiodendron pachyphyllum* and *B. truncatum; Maba palauensis.*

Properties and uses of common Philippine woods. By LUIS J. REYES and LUIS AGUILAR. *The Makiling Echo* (Manila) 13: 3: 139–174; July 1934.

"There are many species of timber in the Philippine Islands suitable for construction and cabinet making. Some 50 or 60 species of these are ordinarily found in the local timber markets. The most important timber species belong to the Dipterocarpaceae, or Lauan family, which furnishes about 80 per cent of the total amount of timber cut in the Islands. The woods vary from moderately soft to extremely hard, and in color they range from pale yellow to very dark brown; reddish colors, however, predominate and even the so-called 'White Lauans' have a reddish tint. The members of the family described in this pamphlet are Almon, Apitong, Bagtikan, Guijo, Manggachapui, Mayapis, Narig, Palosapis, Red Lauan, Tangile, Tiaong, White Lauan, and Yakal. Second to the Dipterocarpaceae comes the Leguminosae, or Narra family, which furnishes most of our beautiful furniture woods. Among these are Akle, Akleng-parang, Batete, Ipil, Narra, Supa, and Tindalo, all of which are described in this paper. Other cabinet timbers of the Islands belonging to several families have also been included."

Study of the natural defects of Benguet pine logs. By JUAN S. VERSOZA. *The Makiling Echo* (Manila) 13: 3: 175–180; July 1934.

"In our study of all defects covering 284 logs, none was found to be free of interior defect. Benguet Pine logs contain natural defects in the interior portion caused by either heart checks or brash center. The cores, however, are usually boxed into squares within which the defects are included, hence these interior defects are sometimes utilized. In addition to brash center and heart checks the other most common defects found in Benguet Pine are butt rot, rotten knot, and cat face. When found existing in the log the last three are always in combination with either one of the first two which are always found in the interior portion of the log."

***Firmiana* and *Erythropsis*.** By H. N. RIDLEY. *Bull. Misc. Inf. Kew* 214–217; 1934.

The genera *Firmiana* and *Erythropsis* were united with *Sterculia* by Bentham and Hooker, but now are generally recognized as distinct, although the two former are much confused. To *Firmiana* belong *F. platanifolia* (L. f.) Mars., *F. maior* Hand.-Mazz. of Yunnan, *F. diversifolia* A. Gray of Fiji, *F. papuana* Mildbr. of Papua, and probably *F. Merrittii* Merrill of the Philippines. *F. borneensis* Merrill is *Scaphium affine* (Masters) Pierre. To *Erythropsis* belong *E. colorata* (Roxb.) Burkill, *E. fulgens* (Mast.) Ridley; *E. pallens* Ridley, a new species of India; *E. Barteri* (Mast.) Ridley, comb. nov., *E. Midgeodii* (Exell) Ridley, comb. nov., and *E. erythrosiphon* (Baill.) Ridley, comb. nov.—P. C. STANDLEY.

Identification of the commercial timbers of the Punjab. By K. AHMAD CHOWDHURY. Bul. 84, Forest Research Institute, Dehra Dun, 1934. Pp. 68; 5½ x 8¼; 28 plates; price 5 s. 3 d.

"The aim of this bulletin primarily is to show the differences of the antomical structure of some of the more common commercial timbers of the Punjab and the way to identify them on the spot with the help of a pocket knife and a hand lens. Secondly, it was thought that short notes on the strength, durability, seasoning properties, and working qualities of these timbers would be helpful in addition to the anatomical descriptions, and these have been added.

"To start with, the publication contains some elementary notes on wood structure. Although these notes were published in a former publication on the identification of timbers, they are again included in this bulletin in order to make it as complete as possible. A key for the identification of the timbers has also been added. This is meant as a guide and includes only those anatomical characteristics which are of distinguishing value. A detailed description of the wood structures visible with a hand lens follows. This is based on an examination of numerous specimens in the collection of the Forest Research Institute at Dehra Dun, and gives the range of variation that is likely to be found in a species. In order to help in identification, low power (× 10) photomicrographs [negative prints] have also been included."

Die Gattung *Astronidium* A. Gray. By Fr. Markgraf. *Notizblatt Bot. Gart. Berlin-Dahlem* 12: 47–50; June 25, 1934.

Astronidium of the Melastomaceae, described in 1854, was united with *Astronia* by Triana, but should be recognized as a valid genus. It consists of 11 (perhaps more) species, of the Malayan and Polynesian regions.

Contributions towards a flora of British North Borneo. IV. *Bull. Misc. Inf. Kew* 119–124; 1934.

New species are described by Ridley in the following genera of woody plants: *Ixora*, *Psychotria*, *Lasianthus*, *Ardisia*, *Madhuca*, *Jasminum*, *Linociera*, *Melodinus*, *Kopsia*, and *Gaertnera*.

Matériaux pour la flore de la Nouvelle-Calédonie. XXXV. Révision des Méliacées. By A. Guillaumin. *Bull. Soc. Bot. France* (Paris) 81: 242–246; 1934.

All the Meliaceae of New Caledonia, except *Dysoxylum bijugum*, are endemic. They belong to the genera *Dysoxylum* (26 species), *Aglaia*, *Amoora*, *Carapa*, and *Flindersia*. A key to the species of *Dysoxylum* is published, and three species are described as new.

Matériaux pour la flore de la Nouvelle-Calédonie. XXXVI. A propos des Ternstroemiacées. By A. Guillaumin. *Bull. Soc. Bot. France* (Paris) 81: 283–285; 1934.

The Ternstroemiaceae are poorly represented in New Caledonia, if, indeed, they are represented at all. The genus

Strasburgeria, formerly referred to the family, has been made the type of a separate family. *Microsemma* Labill., originally placed in the Ternstroemiaceae, has been referred also to the Flacourtiaceae and Thymelaeaceae by later authors. It is represented in New Caledonia by ten species, for which a key is provided, four of the species being described as new.

The moisture equilibrium of timber in different parts of New South Wales. By M. B. Welch. Reprinted from *Journ. & Proc. Roy. Soc. New South Wales* (Sydney) 67: 364–375; 1 text fig.; Feb. 23, 1934.

"In order to obtain information relative to the equilibrium moisture content of woods in various parts of New South Wales, small samples of ten different timbers were despatched to ten country towns. With certain exceptions these, together with a similar set of timbers in Sydney, were weighed weekly from October 1930 to December 1932, and the moisture contents calculated."

"The results of the experiment clearly indicate the necessity for thoroughly protecting woodwork to be used in inland districts with moisture resistant coatings in order to minimize as far as possible the excessive normal variation between winter and summer conditions."

Some mechanical properties of alpine ash (*Eucalyptus delegatensis* R. T. B.). Part I. By M. B. Welch. Reprinted from *Journ. & Proc. Roy. Soc. New South Wales* (Sydney) 67: 385–402; plate IV, 4 text figs.; Feb. 23, 1934.

"A series of static bending tests were made on nine logs of Alpine Ash, *Eucalyptus delegatensis*, from three trees of varying girths. The results did not show any uniform increase in strength towards the top of the tree, and in some instances the wood was decidedly weaker in the uppermost log than in the lowest.

"The weight per cubic foot varied from 32 to 46 lbs., with a mean of 40.1 lbs., and except for wood of low density, the results proved that Alpine Ash possesses considerable strength with a high modulus of elasticity, whilst the toughness, as indicated by the work to the maximum load, and also the elastic resilience, is very satisfactory. The fiber stress at the proportional limit, modulus of rupture, and modulus of elasticity increased comparatively regularly with the density, but the effect of density was more irregular on the work to the proportional limit and to the maximum load.

"The rate of growth varied from 2 to 10 growth rings per inch, the maximum density and strength (modulus of rupture) being obtained at 6 r.p.i., although the maximum values for fiber stress at the proportional limit and modulus of elasticity were found in the wood of slowest growth. The greatest shock-absorbing ability was found in wood of somewhat slower growth. Although there were numerous exceptions, wood showing less than three growth rings per inch, especially if cut near the heart and of low density, was unsatisfactory with regard to strength."

Steganthus und _Leuranthus_, zwei neue Gattungen der Oleaceen. By E. KNOBLAUCH. *Notizblatt Bot. Gart. Berlin-Dahlem* 12: 115–117; June 25, 1934.

The new genus *Steganthus* consists of three species of eastern Africa and Mauritius: *S. Welwitschii* (Knobl.) (*Mayepea Welwitschii* Knobl., *Linociera Welwitschii* Baker); *S. urophylla* (Gilg) (*Linociera urophylla* Gilg); *S. lancea* (Lam.) (*Olea lancea Lam.*). *Leuranthus* consists only of *L. Woodiana* (*Olea Woodiana* Knobl., *O. Mackenii* Harv.), of Natal.—P. C. STANDLEY.

Neue und seltene Arten aus Ostafrika (Tanganyika-Territ. Mandat) leg. H. J. Schlieben. V. By J. MILDBRAED. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 1058–1092; Jan. 20, 1934.

Most of the numerous new species described are herbs or low shrubs, but among the trees are the following: *Craibia Schliebenii* Harms, *Trichilia Schliebenii* Harms, *Trichoscypha uluguruensis* Mildbr., *Rawsonia uluguruensis* Sleumer, *Scolopia riparia* Mildbr. & Sleumer.

Neue und seltene Arten aus Ostafrika (Tanganyika-Territ. Mandat) leg. H. J. Schlieben. VI. By J. MILDBRAED. *Notizblatt Bot. Gart. Berlin-Dahlem* 12: 79–108; June 25, 1934.

Among the woody plants described are *Podocarpus uluguruensis* Pilger; *Cynometra Schliebenii* Harms, Kiluguru name Mlihati; *Sorindeia calantha* Mildbr., Kiluguru name Mseugue; *Rapanea Schliebenii* Mildbr., Kiluguru name Mkuwika; *R. gracilior* Mildbr., Kiluguru names Kilemelamondo and Mjelemamondo; *Premna Schliebenii* Werd., Kipogoro name Mtutiopala; *Solanum hirsuticaule* Werd., Mudulofa; *S. Schliebenii* Werd., Kiluguru name Ndugut; *S. lignosum* Werd., Kiluguru name Lussongolagola; *Chlamydostachya spectabilis* Mildbr., a new genus of Acanthaceae, Kiluguru name Mbabala. The Kiluguru name of Kongoë is reported for *Pterocarpus polyanthus* Harms.—P. C. STANDLEY.

Die Theaceen des tropischen Afrikas. By H. MELCHIOR. *Notizblatt Bot. Gart. Berlin-Dahlem* 11: 110: 1093–1100; Jan. 20, 1934.

The African Theaceae are represented by *Ternstroemia*, with two species; *Adinandra*, with two; and *Asteropeia*, endemic in Madagascar, with seven species. There are described as new *Ternstroemia polypetala*, from the Uluguru Mountains, the Kiluguru name being Mbojamboja; and *Adinandra Schliebenii*, from the same range, its local name Msungu.

Rehabilitation du _Cordia senegalensis_ de Jussieu. By FRANÇOIS PELLEGRIN. *Bull. Soc. Bot. France* (Paris) 81: 270–272; 1 fig.; 1934.

Cordia senegalensis DC. is different from *C. senegalensis* Juss., the former being a synonym of *C. Gharaf* (Forsk.) Ehrenb. *C. senegalensis* Juss. is a valid species, having as a synonym *C. Heudelotii* Baker.

New trees and shrubs from tropical Africa. III. By A. C. HOYLE and H. DUNKLEY. *Bull. Misc. Inf. Kew* 182–190; 2 figs.; 1934.

New species described are: *Homalium rhodesicum*, Northern Rhodesia, its vernacular names Mulunga and Mwendamalonga; *Dombeya praetermissa*, Tanganyika and Kenya, called Mbwale and Mukeu; *Berlinia confusa*, Nigeria and Cameroons, Ekpagoi; *Millettia Kennedyi*, Southern Nigeria;

Hippocratea hirtiuscula, Northern Rhodesia, Naminda; *Salacia owabiensis*, Gold Coast; *Fagara trijuga*, Northern Rhodesia and Tanganyika, Chongwemaura; *Pachylobus paniculatus*, Gold Coast; *Canthium Martinii*, Northern Rhodesia, Sikanganteme; *Bonamia Vignei*, Gold Coast; *Crossandra spinescens*, Northern Rhodesia, Kanyangomaluba.—P. C. STANDLEY.

A botanical reconnaissance in the Virunga volcanoes of Kigezi Ruanda, Kivu. By R. D. BURTT. *Bull. Misc. Inf. Kew* 145–165; pls. 7; 1934.

The Virunga volcanoes consist of eight principal peaks, the highest with an elevation of 14,780 ft., in Belgian Congo and Belgian Mandate, about 120 miles south of the Ruwenzori ice cap. The vegetation discussed is chiefly that of the alpine zone, which is dominated by *Senecio Erici-Rosenii*. The subalpine and subtropical evergreen forests greatly resemble in composition the forests seen on East African mountains, and many species are common to the two regions. The trees include species of *Dracaena*, *Euphorbia*, *Lobelia*, *Erica*, *Erythrina*, *Trichilia*, *Hagenia*, *Hypericum*, *Senecio*, *Philippia*, *Croton*, *Albizzia*, *Mimusops*, *Bersama*, *Podocarpus*, *Cornus*, *Antiaris*, *Schefflera*, *Conopharyngia*, *Neoboutonia*, and *Cussonia*.—P. C. STANDLEY.

Note sur quelques bois du Gabon. By D. NORMAND. *Revue de Bot. Appliquée & d'Agr. Tropicale* (Paris) 14: 154: 414–421; June 1934. Illustrated.

Of the many woods which have long been exported from the French colonies several of them still remain to be identified botanically. From this the author infers that the scientific names are not important from a commercial standpoint, although a definite relationship is often indicated between the vernacular or commercial names and the scientific determinations.

The wood of Izombé, exported from Gaboon, has a fine grain with numerous vessels, is moderately hard and rather heavy, yellowish orange-brown with a light grayish cast, and has an offensive odor when fresh. Determined as *Testulea gabonensis* Pellegr., it belongs to a small family Luxembourgiaceae, near the Ochnaceae. It grows in the West African forests from Mayombe to the French Cameroon. Herbarium material suggests Sapotaceae and upon superficial examination it could be confused with *Omphalocarpum Trillesianum* Pierre. In appearance, the wood is analogous with *Corynanthe* (Rubiaceae) and in particular with the Aqué (*Pausinystalia brachythyrsa* De Wild.) of the Cameroon. The wood known as Roné from the Cameroon is slightly denser, otherwise it presents the same anatomical structure as Izombé and is undoubtedly the same species.

Not all the Copal trees (Copaliers) of Gaboon belong to the genus *Copaifera*. This is demonstrated in the case of *Sindora Klaineana* Pierre (subfamily Caesalpinioideae, tribe Amherstieae), known locally as Ebana, N'Gome, or Ovèng'kol. In the Pahuin dialect the term "Ebana" is given to this Copal tree and its resin. Also called Banda Rouge in Mayombe, which is probably the same as Ibandâ of the Bayaka dialect, the tree grows up to 95 feet in height, usually along the border of forests, parallel with the coast and alternating with the savanna belts. The wood has a roseate cast, is light in weight, not strong, and is inferior to the Gu (*Sindora* sp.) of Indo-China, so extensively employed in the construction of pagodas.

Kevazingo, a commercial wood exported from Gaboon, does not belong to *Didelotia africana* Baill. Herbarium material shows affinity to *Copaifera Demeusii* Harms, and closely related to this is *C. Tessmannii* Harms. Both Kevazingo and Bubinga, also from Gaboon, belong to one or the other of these species.—L. WILLIAMS, *Field Museum of Natural History*.

Gold Coast Colony. Annual report on the Forestry Department for the year 1933–34. By H. W. MOOR. Accra, 1934. Pp. 10; 8½ x 13. Price 1 s.

"The exploitation of timbers other than Mahogany is receiving attention. A beginning has been made with Mansonia (*Mansonia altissima* A. Chev.), and the first year's shipments have amounted to 1500 cubic feet at least, and probably more, as a further 1800 cubic feet were included in the category of 'Walnut logs,' a part or all of which is likely to have been Mansonia. An interesting feature of the development of this timber is that the forests of a part of the country outside the Mahogany-producing zone now become exploitable, and the landowners are enabled to utilize trees which would otherwise have been felled and burnt in the course of farming operations. The possibilities of establishing an export trade in other timbers are being investigated."

L'origine botanique du bois d'ébène du Gabon. By François Pellegrin. *Bull. Soc. Bot. France* (Paris) 81: 327–328; 1934.

Gaboon Ebony, called Evila or Ivila by the inhabitants, is obtained from *Diospyros crassiflora* Hiern, of which *D. incarnata* Gürke and *D. evila* (Pierre) A. Chev. are synonyms

***Olea Mildbraedii*, ein Beispiel für die Variabilität der Oleaceen.** By E. Knoblauch. *Repert. Spec. Nov.* (Berlin-Dahlem) 35: 343–349; July 15, 1934.

Olea Mildbraedii ranges from Cameroons to East Africa. There are described as new three varieties, *typica*, *cuspidata*, and *lanceolata*.

The cambium and its derivative tissues. No. IX. Structural variability in the redwood, *Sequoia sempervirens*, and its significance in the identification of fossil woods. By I. W. Bailey and Anna F. Faull. *Journal of the Arnold Arboretum, Harvard University* 15: 3: 233–254; July 1934.

"1. A detailed investigation of the secondary xylem of the Redwood demonstrates that most anatomical characters fluctuate considerably not only in trees grown under markedly different environmental conditions but also within different parts of a single tree. This is as true of such supposedly conservative qualitative characters as form and orientation of pits, or of pit apertures, as of such quantitative characters as width of annual rings, dimensions of cells, or number of rays per unit area.

"2. In general, the range of variability tends to be greater in different parts of a single, large mature tree than in

homologous parts of different trees. There are significant differences not only in comparable parts of stems, roots, and branches, but also in growth layers formed at successive intervals during the development of each of these organs.

"3. In the Redwood, as in other conifers, the cambial initials and their derivatives increase in size for a varying period of years, after which they tend to remain constant except where deviations are induced by various modifying factors. The cells of roots and of the outer parts of the clear lengths of huge old stems tend to be larger than those of young stems, of physiologically dwarfed stems, or of branches.

"4. Many of the salient variations in the size, form, number, and orientation of pits and of primary pit-fields are correlated with such fluctuations in the size of cells and in the thickness and physical structure of their walls. Thus, different combinations of anatomical characters tend to prevail in different parts of a tree and in tissues formed under varying growth conditions.

"5. A preliminary study of the ranges of structural variability in various representatives of the Coniferae indicates that although it is possible to differentiate the wood of *Sequoia* from that of the Taxaceae, Araucariaceae, Abietoideae, and Pinoideae, it is difficult to distinguish it in all cases from that of the Podocarpaceae, Cupressaceae, and other genera of the Taxodiaceae.

"6. Characters which have been interpreted as indications of araucarian affinities, *i.e.*, contiguity and alternation of tracheary pitting, absence of crassulae and of wood parenchyma, occurrence of 'resinous' tracheids and of clusters of medullary stone cells, etc., are of not uncommon occurrence in the Redwood and other representatives of the Podocarpaceae, Taxodiaceae, and Cupressaceae.

"7. There are no convincing arguments for assuming that the various Paracupressinoxyla and Brachyphylleae are transitional or ancestral types of Araucariaceae, rather than forms related to the Podocarpaceae, Taxodiaceae, or Cupressaceae. A number of them exhibit combinations of anatomical characters which fall within the potential range of structural variability of the genus *Sequoia*.

"8. Systems of classifying and identifying the woods of Gymnosperms and Angiosperms have developed largely through trial and error. Available anatomical data—tabulated from miscellaneous collections of more or less fragmentary specimens and without due regard to significant developmental, physiological, and ecological factors—do not provide a reliable basis for distinguishing the woods of most closely related species and of many remotely related ones.

"9. If the problem of classifying and identifying the woods of Gymnosperms and Angiosperms is to be attacked from a thoroughly scientific point of view, collections of authentic specimens must be assembled, not only from different genera, species, and varieties, but also from different parts of mature trees and from trees growing under different environmental conditions."

Of special interest to wood anatomists is the nature of the pitting between the tracheids and the ray cells, since the latter do not develop a secondary wall and hence are without true pits.

"The ray cells of the Redwood, as of the Taxodiaceae, Araucariaceae, Taxaceae, Podocarpaceae, Cupressaceae, and Cephalotaxaceae are provided with a more or less thickened primary wall, but do not form a true secondary wall such as is a characteristic feature of tracheary cells and of the rays of the Abietoideae and most arborescent Dicotyledons. This primary wall is derived directly from the ray initials of the cambium and is, in fact, a more or less modified cambial wall. As in the case of the ray initials, it is provided with more or less conspicuous primary pit-fields and plasmodesmata, *i.e.*, sieve-pitting, and tends to be conspicuously thickened at the angles of the cells where in contact with intercellular spaces. Simple pits and pits to intercellular spaces, which are characteristic features of the ray walls of the Abietoideae, are entirely absent.

"The presence of a true secondary wall in the rays of the Abietoideae and its absence in the rays of the Taxodiaceae, Cupressaceae, etc., are of fundamental significance in any discussion of ray pitting. For example, there is at times a certain superficial resemblance between the end walls of the ray cells of *Juniperus* and those of *Cedrus*, *Abies*, or *Tsuga*. In *Juniperus* the investigator is concerned with deeply depressed primary pit-fields in primary walls, whereas in *Cedrus*, *Abies*, or *Tsuga* he is concerned with simple pits in secondary walls, *i.e.*, entirely distinct morphological structures. In the case of pits in the 'crossing field' or 'tracheid field' of the rays of *Abies* or *Cedrus*, the investigator is dealing with half bordered pit-pairs; whereas in the rays of *Juniperus* or *Sequoia*, he is dealing with bordered pits which have no complementary simple pits on the ray side. The pit membranes are double structures formed by the wall of the ray and the adjacent primary wall of the tracheid, just as the tori and pit membranes of paired bordered pits are formed by the two adjacent primary walls of the tracheids."

Structure of the cell wall of wood fibers. By GEORGE J. RITTER. *The Paper Industry* (Chicago) 16: 3: 178–183; June 1934; 19 photomicrographs.

"The major portion of the lignin is located in the middle lamella; the remaining portion is in the cell wall. Cellulose and hemicellulose form the major part of the cell wall, which is composed of several thin layers arranged as concentric sleeves that can be loosened chemically and separated mechanically by slipping them off from one another endwise.

"Layers of the cell wall can be separated into fibrils by chemical and mechanical means. The fibrils of the outer layer are oriented at approximately 90 deg. to the fiber's long axis, whereas those in the remaining layers are oriented anywhere from zero to 30 deg. to the fiber's axis.

"Fibrils can be separated into fusiform bodies that are uniformly spindle-shaped.

"Fusiform bodies can be separated into smaller subdivisions, which are spherical in shape when separated and have accordingly been named spherical units.

"A cementing material of hemicellulosic nature is believed to exist between the layers and the fibrils of the cell wall of delignified fibers. When the material is removed by means of hemicellulosic solvents, the layers and the fibrils of the cell wall can be separated by mechanical means."

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