WOOD-ANATOMY AND RELATIONSHIP

Taxonomic Notes in connection with the Key to the Javanese Woods

by

H. H. JANSSONIUS

(Amsterdam)

CONTENTS.

Introduction.

During the long years I was engaged in writing my "Mikrographie" (1), my main purpose was to give a survey of the wood-anatomy of as many representatives of the javanese wood flora as I could lay hands on, in connection with Koorders' and Valeton's "Bijdragen" (2). My attention being almost exclusively absorbed by the descriptive side of my task, little attention was paid to eventual conclusions regarding family relationships, though some were incidentally pointed out.

When this work of long years was completed, the need of a key for the identification of wood samples was felt. This I composed and completed just before the war. It was published in 1940 and written in German (3), as was the main work on which it was based. Immediately an English translation was prepared but though this was ready for the press as early as 1942, I was prevented from publishing it, at first because of the German occupation and later on for want of funds.

This key is, as a matter of course, entirely artificial, as all keys naturally must be to a certain extent. However, this one was particularly and purposely free from any taxonomical premeditation. No attempt whatever was made to build it up on the basis of one of the wellknown taxonomical systems. On the contrary, I consciously avoided to do so; I do not agree with the opinion of those authors like Pfeiffer (7) who assert that their keys grow more useful, as a closer connection with an existing system is strived at. My sole object and aim was to lead the user along the safest and shortest way to the information he is after, along the lines of anatomical evidence.

Of course, anatomical characters as well as any others, take their share in the complex of features characterising natural groups, as understood by modern typology (4, 5). Also in this field, however, it is true what has been repeatedly stated by various authors for other kinds of characters, that what is all to easily called '*relationship*' is oftentimes nothing but *similarity* or even *resemblance*. This is not yet generally understood, though. I fully agree with the introduction to Metcalfe's paper of 1946 (6), also in this respect.

It is true that the accurate reader — if he would be inclined to take the pains — could trace from the key various relationships on an anatomical basis. This would, however, be a tedious task, which nobody would care to tackle without some sort of guidance from the author. A key like this is deceptive in as far as taxa, supposedly related on morphological grounds, may be found far apart, and likewise taxa which are supposed to be not, or only distantly related, may be found close together. This, of course, is due to the different ways of sharing and participation

of characters in any large group as well as to the fact that the key is based upon o n e category of characters only. Many characters are so whimsically scattered all over a natural group that its internal relationships seem to be interwoven like the strings in a network. Moreover, a given character may be entirely constant in one taxon, more or less variable in another, entirely 'untrustworthy' in a third.

So as to disentangle for the reader what may be hidden in the mass of lines through the Key, so as to show as clearly as possible what obvious — or less obvious, as the case may be — conclusions lie concealed in its network, is one of the main purposes of this paper, conclusions, as I sometimes use to say to my friends, which in my 'Mikrographie des Holzes' found nothing but an honourable interment.

These conclusions will be found expressed and discussed in the 35 'Notes' underneath. Though they may claim a certain importance of their own, they should preferably be used in connection with the Key, to whose paragraphs I have repeatedly been referring. Here I have to mention a discrepancy between the German and the English edition, of which the numbers do not agree in the following cases: the numbers 238 to 272 inclusive of the English edition correspond to 236 to 270 inclusive of the German version.

If some of the 'Notes' seem to be of little consequence, it has to be remembered that negative results may be as important as positive ones. It is true, though, that some of the 'Notes' of this type are referring to more or less uncertain places in the Key and it should be borne in mind that this uncertainty may as well be due to our lack of knowledge as to a naturally vague gradation of characters.

As will appear, anatomy may reveal relationships which might otherwise easily escape our attention, and has, in fact, not rarely actually done so. In other cases anatomical evidence will throw a new light on supposed relationships based upon other particularly morphological data. Often earlier conclusions will be found confirmed, in other cases they will be weakened and this will necessitate and induce a more critical revision. The combination of anatomical and morphological characters — the latter mostly restricted to the sexual organs — is nothing but a, we hope felicitous and indispensable approach to the ultimate aim of taxonomy; to complete the typological picture by dealing with all evidence, from whatever quarter, impartially and critically. I think I have done so as far as Anatomy is concerned and I paid especial attention to those cases in which the results obtained through the anatomical method seem to disagree with those which are the outcome of morphological studies. Generally speaking, however, it will be found that the conclusions based upon wood-anatomy agree fairly well with those obtained through morphological methods, though it is my experience that when using wood-anatomical methods the families often seem to split up into more numerous parts than are distinguished on a purely morphological basis.

It will be found that, on account of the working method applied in my 'Mikrographie', the number of species representing a genus or even a family, is mostly restricted to a few. This inevitable feature necessitates special care in drawing conclusions. Attempts have been made to value

the various characters as accurately as possible in each individual case.

Of the 35 'Notes' given below, 29 are the direct outcome of a thorough going through the Key. The first 6 are concerning special cases and may be of some use to make the reader familiar with the nature of my subject. Note 1 deals with the apparent anatomical relationship of the *Meliaceae, Sapindaceae, Leguminosae* and *Combretaceae* and thus introduces the morphologically trained reader into a world of unexpected vistas. When I had written this first Note, more or less as an effort to marshal my facts and to draw concise conclusions from them, I was struck by the result, as it seemed stimulating and full of promise to me, and I decided to continue. The outcome is embodied in this and the remainder of these Notes. In Note 2 the *Euphorbiaceae* are circumstantially discussed. From a wood-anatomical point of view this family seems to be polyphyletic; the four parts, distinguished by this method, show so little mutual relation that they occur in most different places in the Key. Note 3 yields similar results regarding the *Melastomaceae*; 4 and 5 discuss the phenomenon that allegedly closely related species, when determined on the basis of an anatomical character which is variable within their genus may, in more than one case, be found far apart in the Key, which seems to suggest that they are less closely related than is generally supposed on morphological grounds. On the other hand, it is shown in 5 that a vague distinction between taxa from a morphological standpoint may well correlate with the same sort of conclusion according to wood-anatomy. In 6 a case is discussed of two closely related species which show a considerable difference in their wood anatomy; in 7 it is pointed out that I repeatedly used a combination of characters which is found in a number of families which are very much scattered in e. g. Bentham and Hooker's system, though they are particularly found in the *Calyciflorae*. On the basis of this combination several families are splitting up into two apparently little related parts.

Finally, it may be pointed out that I never went so far as to suggest the creation or delimitation of any taxon on a purely anatomical basis. My taxonomical starting point was the system of taxa of various ranks, created mainly with morphological methods. I merely restricted myself to putting before the reader to whatever corrections of the traditional system wood-anatomy may lead. It is up to the taxonomist to decide which of these he deems worthy of adoption into a system on a broader basis. Not being a systematist I trust that I, fully unbiased myself, have done my duty; and in full confidence I leave it to the taxonomist to take my suggestions for what they are worth and to use them or to leave them alone, as he thinks fit.

I will not conclude these introductory remarks without having tendered my hearty thanks to Dr H. C. D. de Wit, who sacrificed much of his valuable time in looking, with the eye of a modern taxonomist, through the typescript of a wood-anatomist of the old school. I owe him a great debt of gratitude for his kind help and his very able criticism by which I trust that my 'Notes' have considerably gained in clarity of thought and smooth readability.

Names of taxa used in the text have purposedly not been 'modernised' so as to maintain the link between the present publication and both my "Mikrographie" and my Keys. My main work has generally been referred to as 'Mikrogr.' or 'Mikrographie' for shortness' sake.

The "Taxonomical Works" referred to in the text are:
Bentham & Hooker, Genera Plantarum
Durand, Index Generum Phanerogamarum
Engler-Gilg, Syllabus der Pflanzenfamilien 7th, 9th and 10th Ed.
Hutchinson, The Families of Flowering Plants (Dicotyledons).

References.

1. MOLL, J. W. und H. H. JANSSONIUS, Mikrographie des Holzes der auf Java vorkommenden Baumarten, 6 Vols, 1906—1936.
2. KOORDERS, S. H. en TH. VALETON, Bijdragen tot de kennis der Javaansche boomsoorten. 13 Vols., 1894—1914.
3. JANSSONIUS, H. H., Anatomische Bestimmungstabelle für die Javanischen Hölzer. — E. J. Brill Ltd., Leiden 1940.
   It is hoped that an English translation will be published before long.
4. DANSER, B. H., Typologische en Phylogenetische Systematiek. — Vakblad voor Biologen 21, No. 8, 1940, 137—145.
5. ——, Typologische und Phylogenetische Systematik. — Physis 1, 1942, 52—63.
6. METCALFE, C. R., The systematic anatomy of the vegetative organs of the Angiosperms. — Biol. Reviews 21, 1946, 159—172.
7. PFEIFFER, J. PH., De Houtsoorten van Suriname (1926).

Note 1. On the similarity of the wood in some Leguminosae, Combretaceae, Sapindaceae, and Meliaceae.

Ths Nrs 289—299 of the Chief Key comprise 64 species (and varieties) belonging to 4 families. The advanced stage of the Key at which these families are reached, indicated by the high numbers, implies that in their wood-anatomy, they have many characters in common or, in other words, that their wood-anatomy is morphologically similar in many respects. These 4 families are *Meliaceae, Sapindaceae, Leguminosae,* and *Combretaceae.*

Hutchinson refers *Meliaceae* and *Sapindaceae* as succeeding families to 2 successive Orders, which belong to the same group of related Orders. Engler-Gilg place them in 2 succeeding "Reihen" — 23 and 24 — while Durand arranged *Leguminosae* and *Combretaceae* as families 65 and 74 in two successive cohorts of *Calyciflorae.*

It is evident that in the various systems, based on the usual (macroscopic) morphological characters, the 4 families are not considered to be closely related.

Nrs 289 and 290 of the Chief Key contain only *Meliaceae* (48 spp.).

Nr 299 consists of 2 paragraphs. The first comprises two *Pometia* species (*Sapind.*), *Pometia tomentosa* and *P. pinnata* var. *javanica.* The second paragraph contains *Terminalia teysmannii* (*Combr.*, cf. 592 and Note 35), *Peltophorum ferrugineum,* and *Pithecellobium moniliferum* (*Legum.*, cf. 595 and Note 35). Obviously, these three species, being placed in a single paragraph, resemble each other very closely as regards wood-structure. Their wood-anatomy resembles also greatly that of both the *Pometias* placed in the preceding paragraph of 299. This suggests close

alliance of the two *Leguminosae* and the *Combretacea* among each other and, in addition, to these Sapindaceous species. I failed to trace in Radlkofer's monograph on *Sapindaceae* (Pflanzenreich, Heft 98) in the descriptions of *Pometia tomentosa* and *P. pinnata*, any suggestion of some closer relationship towards *Leguminosae* or *Combretaceae* than was normally accepted in *Sapindaceae*.

In the Chief Key, Nrs 291 to 298 contain only species of *Sapindaceae* and *Leguminosae*. Nr 292 is again subdivided into 2 paragraphs, the first points to *Sapindus rarak* (*Sapind.*), and the second to *Albizzia lebekkoides* and *Albizzia lebbek* (Legum.). It is clear that, again, these three species belonging to *Sapindaceae* and *Leguminosae*, are very similar in their wood-anatomy.

These points of contact between *Sapindaceae* and *Leguminosae*, demonstrated in Nrs 299 and 292, are reflected in the Nrs 293 to 298 which contain nothing but sapindaceous and leguminous species in an irregular sequence. Summarizing, it seems that a number of species belonging to the two families, suggest close relationship by their wood-anatomy.

In assessing the amount and weight of the characters common to the 64 species and varieties found under the Nrs 289 to 299, it is necessary to consider the stages to be passed in the Chief Key leading to Nr 289. They are the following: 1b, 5b, 6b, 11b, 12c, 104b, 149b, 155b, 216a, 217b, 223b, 284b, 287b, 289. The accumulation of characters described under these numbers, is the total of characters common to the species entered from Nr 289 to 299.

It was mentioned that the major part of *Meliaceae* (Nrs 289 and 290; 46 spp.) was in this manner allied to the *Sapindaceae* and *Leguminosae* so far discussed, as was *Terminalia teysmannii* (*Combr.*).

Nr 518 has *Cedrela febrifuga* in two varieties (*glabrior* and *velutina*); *Cedrela* belongs to *Meliaceae*. In the second paragraph of 518, reference is made to Nr 519. The first paragraph of 519 and both the paragraphs of 520 have together two *Lumnitzeras* (*Combr.*), *L. coccinea* and *L. racemosa* and a variety, *L. racemosa* var. *pubescens*. This suggests again a possible relationship between *Meliaceae* and *Combretaceae*, now by way of other genera. In Note 30, I will again speak of this evidence. In the current botanical systems, *Meliaceae* and *Combretaceae* are not considered to be closely allied.

Nrs 615 to 623 of the Chief Key contain *Leguminosae* exclusively. *Albizzia lebekkoides* and *A. lebbek* (which we met in the second paragraph of Nr 292) occur again in the second paragraph of 623
3 other *Albizzia* species. Now the second paragraph of 614 leads to the numbers assigned to *Leguminosae* and the first paragraph of 614 has two species of *Terminalia*, viz. *T. bellerica* var. *laurinoides* and *T. bialata*. Again, Nr 614 is reached by way of the second paragraph of 613, and we find *Terminalia javanica* and *T. catappa* in the first paragraph of 613.

I studied the wood-anatomy of 5 *Terminalia* species in total. The fifth, *Terminalia teysmannii* was placed under Nr 299. From the beginning to Nr 614 is a long way which covers 22 Nrs. These are 1b, 5b, 6b, 11b, 12c, 104b, 149b, 155b, 216c, 320b, 345b, 497b, 498b, 516b, 548c,

580b, 581b, 596b, 598a, 607b, 612b, 613b, 614. From the foregoing, it is obvious that these *Leguminosae* and *Combretaceae* resemble each other closely in their wood-structure.

In addition, it is to be observed that *Terminalia bellerica* var. *laurinoides* and *T. bialata* occur again in the first paragraph of 593, and in the second paragraph of that same number *Leguminosae* are placed. The adjacent Nrs 594 and 595 comprise *Albizzia montana, Cassia javanica, C. fistula, C. siamea,* and the 7 *Pithecellobium* species which I examined.

Among the *Pithecellobiums* is to be noted in particular *P. moniliferum,* which had been also placed in 299. All three species of *Cassia* are found under Nr 296, *Cassia javanica* also under 621.

Nr 592 (which precedes Nr 593, viz. 2 *Terminalias* and the family of *Leguminosae*) has *Terminalia teysmannii* (cf. Nr 299) in the first paragraph and *Cassia timorensis* (cf. Nr 296) in the second. The section comprising the Nrs 592 to 595 is reached by way of 1b, 5b, 6b, 11b, 12b, 104b, 149b, 155b, 216c, 320b, 345b, 497b, 498b, 516b, 548c, 580b, 581a, 582b, 583b, 585b, 588b, 591a, 592.

In the taxonomic works consulted for the purpose of this study, no indications were found supporting a relationship among many *Leguminosae* and the greater part of *Terminalia* species as suggested by the similarities in their wood-anatomy. It is, of course, to be noted that the great distance in which Durand, Engler-Gilg, and Hutchinson place *Leguminosae* and *Combretaceae* may be seen as partly due to the inevitable linear arrangement in books treating the vegetable system. These authors, however, do not supply any, or at any rate very slender, evidence of a possible closer relationship than has been generally believed to exist.

Considering now the wood-anatomy of *Leguminosae* and *Sapindaceae,* it is to be observed that *Albizzia tomentella* is placed under Nr 623 in the company of 4 more *Albizzia* species. *A. tomentella* is the sole *Leguminosa* in the first paragraph of 313. Nr 313 is reached by way of the second paragraph of 309, while in the first paragraph of 309, the family of *Sapindaceae* has been placed. Many *Sapindaceae* are arranged under Nrs 310, 311, and 312. The wood-anatomy of *Albizzia tomentella,* therefore, is close to that of many *Sapindaceae.*

Xerospermum noronhianum (*Sapind.*) is placed under 298. Nrs 297 and 299 contain *Leguminosae.* Nr 311 contains again *Xerospermum noronhianum*; it is reached by way of the first paragraph of 309 while the second paragraph of 309 leads to the *Leguminosae* of Nr 313 (cf. Note 23).

Nr 563 has *Aphania montana* (*Sapind.*) in the first paragraph. In the second paragraph of this Number and in the two paragraphs of 564, *Bauhinia malabarica* and *Crudia bantamensis* (*Legum.*) occur. This suggests a possible relationship (cf. also Note 34).

Summarising the present Note it may be concluded that the anatomy of the wood of a number of species in *Sapindaceae, Combretaceae,* and *Leguminosae* suggests relationship among these families; to a certain extent this also applies to *Meliaceae*! This conclusion finds no support in the arrangement of families in current vegetable systems.

Note 2. Possible relationship of Euphorbiaceae with various other families.

When tracing the *Euphorbiaceae* through the Chief Key, it appears that Euphorbiaceous species are inserted 15 times. This high frequency is in agreement with many other general keys, so e. g. in Hutchinson's Key to the Families of Dicotyledons *Euphorbiaceae* occur in 17 places. This suggests a polyphyletic origin of the Family (cf. also Mikrogr. 5, p. 459).

Under Nr 47 of the Chief Key, the genus *Daphniphyllum* is found. Under Nr 49 occur *Daphniphyllum glaucescens* and *D. glaucescens* var. *blumeanum*. The characters mentioned in the Key refer these two species to a group in which all or nearly all division walls of the vessels are provided with scalariform perforations (cf. 1st paragraph of Nr 12), and in which fibre-tracheids are the ground tissue of the wood (1st paragraph of Nr 13). The woods belonging to this group have also two kinds of medullary rays, the first uni-seriate and consisting of upright cells and the second multi-seriate and consisting of simple or composed rays (cf. 1st paragraph of Nr 18).

The woods of *Daphniphyllum glaucescens* and its variety resemble each other very closely. They belong to the group distinguished by me as the fourth, which I found to occur in Javan *Euphorbiaceae* (Mikrogr. 5, pp. 460, 461, 462). I observed that this fourth group showed such wide deviations from the three other groups of the family that, judging by its wood-anatomy only, it had to be seen as of an essentially different nature. I concluded that the wood-structure in this group is the same as e. g. in *Hamamelidaceae* and *Ternstroemiaceae*, a result that was curiously illustrated by Hallier's earlier views (cf. Ueber die Gattung Daphniphyllum, ein Uebergangsglied von den Magnoliaceae und Hamamelidaceae zu den Kätzchenblütlern, in Bot. Mag. 18, 1904, 35).

The families or parts of families having the aberrant wood-anatomy just described, are scattered over the whole system (cf. Durand and Bentham & Hooker). They are most numerous among *Calyciflorae*. The wide-spread relationships suggested by the anatomy of their woods, deserve further investigation. The taxa characterized by these characters in the wood are found together in my Key from Nr 12 to 51 incl.

The Javan *Viburnum* species (*Caprif.*) are met with under Nrs 46 and 47 of the Chief Key, in company of some *Eurya* and *Ternstroemia* spp. (*Ternstroem.*). Their places suggest affinity to *Daphniphyllum*.

I have stated concerning *Viburnum* (Mikrogr. 4, p. 9): (transl.) "*Viburnum* is the only genus of *Caprifoliaceae* I have studied. It is the first of the *Gamopetalae*. Its wood-anatomy is close, or even extraordinarily close, to that of several genera of *Polypetalae*, closest of all to *Altingia* and *Distylum* (*Hamamel.*). The wood-anatomy of these three genera is so similar that only slight taxonomic differences seem to be present."

I said later (Mikrogr. 5, p. 462): (transl.) "A new family, *Daphniphyllaceae* consisting of one genus, *Daphniphyllum*; has been accepted by some authors (e. g. Mueller-Arg. in DC. Prodr. 1, 1809, 1; K. Rosenthal, Diss. Breslau, 1916 and Das Pflzr. 68, IV, 147a; and Engler & Prantl, Die Nat. Pflz.fam. 19c, 1931). Miss Rosenthal suggests that the *Daphni-*

phyllaceae show close relationship to *Euphorbiaceae*. This is not confirmed by the wood-anatomy."

Putranjiva roxburghii, Cyclostemon subcubicus, Aporosa microcalyx, A. frutescens, A. campanulata, and *A. arborea* (*Euphorb.*) are placed under the Nrs 57 to 62. Their wood-anatomy is rather similar to *Claoxylon indicum, Cyclostemon longifolius, C. minahassae, Aporosa microcalyx* (!), *Baccaurea racemosa* and *B. javanica,* determined in the Nrs 90 to 95. In Nr 12, these two groups are separated. The first group has scalariform perforations in all, or nearly all, the division walls of the vessels, the second has those walls either with simple or with scalariform perforations and both kinds occur rather frequently. This difference is of slight taxonomical importance but the technique of the Key caused that these two related groups were placed far apart. Their close affinity is also demonstrated by the occurrence of the same genus in both groups (*Aporosa, Cyclostemon*). Together these two groups form my third group distinguished in the family of *Euphorbiaceae* (cf. Mikrogr. 5, p. 460). It is to be noted that *Claoxylon indicum* holds a different position, outside group III and is more suitably placed under Nr 483. The wood of *Aporosa microcalyx* is very close to the *Baccaureas* in the Chief Key (cf. Mikrogr. 5, p. 471) and in general the species belonging to the third group resemble each other greatly (cf. l. c., p. 471). I am unable to suggest a relationship to other taxa.

Twenty eight kinds of wood [Nrs 245 (243), 248 (246), 251 (249)—263 (261)] compose the first group of the four I found to exist in *Euphorbiaceae* (cf. l. c., p. 459). The first paragraph of 244 (242) refers to 245 (243), the second to 248 (246).

Nr 245 (243) contains *Cleistanthus sumatranus* (*Euphorb.*) and some *Bixineae.* Nrs 245 (243) and 244 (242) prove that the first group in *Euphorbiaceae* and many *Bixineae* have a related wood-anatomy.

The second paragraph of Nr 245 (243) refers also to Nr 246 (244). In Nr 246 (244) and 247 (245) are found *Bennettia horsfieldii, Flacourtia rukam, Fl. ramontchi, Fl. cataphracta,* and *Scolopia roxburghii.* These species are together the first group of four which I distinguished in *Bixaceae* (cf. l. c. 1, p. 200).

Nr 248 (246) has the first group of *Euphorbiaceae* (excepting *Cleistanthus sumatranus*), and the *Samydaceae.* Summarising these data, it appears that a close resemblance exists among the woods occurring in group I of *Euphorbiaceae* and in *Samydaceae.* The whole of *Samydaceae* (*Homalium tomentosum, H. javanicum, Casearia flavovirens, C. coriacea, C. tomentosa, C. grewiaefolia*) are met with under Nrs 249 (247) and 250 (248). The wood-anatomy of the *Bixaceae,* of many *Euphorbiaceae,* and of *Samydaceae* seems to suggest a closer relationship among these families than was hitherto suspected (cf. Durand and Bentham & Hooker). Engler-Gilg and Hutchinson refer *Bixaceae* (*Bixineae*) and *Samydaceae* to the same Order, but the *Euphorbiaceae* to another distant Order. One of the "Notes on Affinity" by Hutchinson, when discussing *Euphorbiaceae,* reads (cf. p. 19) "a composite family probably derived from several sources such as *Bixales* etc.". And he places *Bixaceae* and *Samydaceae* (with others) in the Order of the *Bixales.*

The characters of the wood in common to all 28 species can be summarised as follows. All (or nearly all) division walls of the vessels with simple perforations (third paragraph of 12), ground tissue consisting of libriform fibres, all or nearly all septate (first paragraph of 216), these fibres present in only one single kind (second paragraph of 217), the wood-parenchyma sparingly developed or absent (first paragraph of 223), and the vessels without scalariform pitting when in contact with each other (second paragraph of 224).

In this connection I wish to repeat my earlier observations on the subject. Concerning *Euphorbiaceae* I said (l. c. 5, p. 464): (transl.) "The wood-anatomy of the first group of *Euphorbiaceae* resembles very closely that of *Bixineae, Violarieae* (*Alsodeia*) and the *Samydaceae*. Concerning the *Samydaceae* I said (l. c. 3, p. 611): (transl.) "The microscopic wood-structure of these two genera — *Casearia* and *Homalium* — resemble the structures found in genera of *Bixineae* and *Violarieae* (*Alsodeia*) so closely that, judging by their characters alone, it would seem desirable to bring them to a single family. To this family should be added the first group distinguished in *Euphorbiaceae* or, alternatively, it should be placed in the closest proximity."

The second group of *Euphorbiaceae*, distinguished by me for reason of their wood-anatomy, remains to be considered.

Cyclostemon longifolius (cf. l. c. 5, p. 573) has the division walls of the vessels both with simple and with scalariform perforations. The latter are, however, very rare in this species but occur more frequently in the two other species in the genus. This aberrant character causes that *Cyclostemon longifolius* occurs twice in the Key. Its affinity is best expressed under Nr 93, where it stands in company with *Cyclostemon minahassae*; Nr 340, its other place, is less illustrative. *Cyclostemon longifolius* is best referred to the third group of *Euphorbiaceae* (cf. Note 24).

Claoxylon indicum (cf. l. c. 5, p. 679) occurs also twice, once under Nr 91 and the second time under 483. In the division walls of the vessels it has simple and scalariform perforations but the latter are much less often occurring. In *C. indicum* var. *gracilius* the scalariform perforations are entirely absent. For this reason, *Claoxylon indicum* is best placed in the second group of *Euphorbiaceae*.

The following is a summary of the characters of the wood-anatomy of this second group. Division walls of the vessels all, or nearly all with simple perforations (third paragraph of 12), ground tissue consisting of libriform fibres (second paragraph of 104), libriform fibres all, or nearly all, non-septate (third paragraph of 216). To these characters to be added that metatracheaal wood-parenchymatous layers are present, which are 1 cell thick, if 2 to 4 cells thick nearly always local; the layers at any rate the majority, forming tangential connections among medullary rays (at least 5 rays, usually more; first paragraph of 320).

The second group which I distinguished in *Euphorbiaceae* is probably related, on account of their wood-anatomy, to *Anonaceae, Sapotaceae, Ebenaceae,* and *Scrophularineae* (cf. foot note l. c. 5, p. 467).

I find no support for this view in current taxonomical systems.

Note 3. A subdivision of the Melastomaceae.

When considering the places of *Melastomaceae* in the Chief Key, in the manner adopted in Note 2 (*Euphorbiaceae*), it appears that the family is arranged in two groups which are wide apart (Nrs 7, 8 and 220—222).

Their wood-anatomy suggests that the *Melastomaceae* of Java, as a family, are biphyletic.

Nrs 7 and 8 have *Kibessia azurea, Memecylon paniculatum, M. floribundum, M. intermedium, M. laevigatum, M. oligoneurum,* and *M. excelsum.* Nrs 220, 221, and 222 have *Medinilla javanensis, Astronia spectabilis, A. macrophylla, Melastoma molkenboerii, M. setigerum, M. asperum,* and *M. lanuginosum.* The two groups correspond entirely to those I have proposed previously (Mikrogr. 3, p. 528, § 2). I then said: (transl.) "The two groups may be distinguished by the following characteristics. In group I, the ground mass of the wood consists of typical fibre tracheids. The wood parenchyma is often rather abundant and the three kinds of tissue are present viz. paratracheal, metatracheal, and diffuse (the diffuse tissue is distributed among the fibre tracheids). Two kinds of medullary rays are easily distinguished; numerous interxylar phloem strands are present.

In group II the ground mass are typical libriform fibres. These fibres show simple pits, are all or nearly all septate and differentiated in two kinds. The wood parenchyma occurs rarely, or very rarely, and usually only paratracheal. Medullary rays present in one single kind, resembling one of the kinds mentioned for group I. Interxylary phloem strands absent.

The following may further stress the differences between the two groups: the genera in each group show only small differences in their wood-anatomy, the species in a single genus very few, if any."

I reject the thought that the wood-anatomy of the two groups might prove less widely and consistently different than has been indicated above. A complex of characteristics of this size and importance never varies to such an extent that truly intermediate forms might be expected to occur. The difference in wood-anatomy between the two groups is so large that I cannot accept them as belonging to one family; they must be seen as belonging to different families.

My conclusion is partly supported by earlier taxonomic views, e. g. such as expressed by A. P. de Candolle, Lindley, Endlicher, Gardner, and Naudin (cf. van Tieghem, Ann. Sc. nat. Série 7, vol. 13, 1891, 23, 24). These authors (except Naudin) unite the genera *Memecylon* and *Mouriria* (not examined by me) into a separate family, placed between *Melastomaceae* and *Myrtaceae.* Naudin's classification (Ann. Sc. nat. Série 3, vol. 12, 1849, 196 and *ibid.* vol. 18, 1852, 85, 257) is followed by Miquel (Fl. Ind. Bat. 1, 1855, 498); they keep *Kibessia* and *Astronia* apart.

More recent taxonomists (e. g. Krasser in Engl. & Prantl III, 7, 1898, 143; Cogniaux in Durand, Index Generum, 1888, 130; and Bentham & Hooker, Gen. Pl. I, 1867, 725) hold an opinion entirely different from my own. They bring *Kibessia* and *Astronia* into the same section.

R. C. Bakhuizen van den Brink Jr wrote the most recent revision of Malaysian *Melastomaceae* (cf. Bijdr. Kenn. Melast. Mal. Arch. Ned. Ind., Diss. Utrecht, 1943, 31 pp., and Contr. Knowl. Melastom. Mal. Arch. Neth. Ind. in Rec. Trav. Bot. Néerl. 40, 1943—45, 1—391).

Bakhuizen, like many others before him, tried to separate the *Memecyloideae* from the rest of the family but failed; intermediate forms appeared to exist. He felt also obliged to refrain from a combination of *Memecyloideae* and *Tamoneae*. Bakhuizen concluded that the *Melastomaceae* are a natural group, belonging to *Myrtales*, and consisting of three distinct sub-families. His results, derived from the usual characteristics guiding taxonomical research, are different from mine, founded on the study of wood-anatomy.

Finally I wish to repeat my earlier conclusion (Mikrogr. 3, p. 530, 2): (transl.) "Authors who examined the anatomy of *Melastomaceae* like Van Tieghem and Solereder confirm by their results my observations. Van Tieghem (Ann. Sc. nat. Série 7, vol. 13, 1891, 23) divided the family into two "divisions". The first contains *Memecylon* and *Kibessia*, the second *Astronia*, *Melastoma*, and *Medinilla*. He has no wish to raise these "divisions" to family rank (cf. l. c., p. 90)."

Note 4. The consequences of the use of an unstable wood-anatomical character.

Sometimes species are closer related than might be expected when considering their places in the Chief Key. Notes 4 and 5 have been written in order to illustrate the point. Some Euphorbiaceous species are first of all to be considered.

Under Nr 12 the woods are separated into three groups according to the following wood-anatomical characters. Firstly: division walls of the vessels all, or nearly all, with scalariform perforations, secondly: division walls of the vessels all, or nearly all, with simple perforations, and thirdly: division walls of the vessels with simple or scalariform perforations and both kinds of perforations usually at least numerous.

It has appeared, during my wood-anatomical studies, that this distinction occasionally is of slight taxonomic value. It seems, now and again, that the distinction on this account, is not a very marked one. Some Euphorbiaceous species, of a single genus and closely related to each other, are placed far apart in the Chief Key solely because of their belonging to different groups whereas these groups are rather artificial.

Nr 483 has, in the first and second paragraphs, *Claoxylon indicum* and *Claoxylon indicum* forma *gracilius*. Nevertheless, *Claoxylon indicum* would be placed in the first paragraph of Nr 91, if it were referred to the third group just indicated above. I have indicated (Mikrogr. 5, p. 674—684) that *Claoxylon indicum* and *C. indicum* forma *gracilius* in their woods resemble each other closely. J. J. Smith (in Koorders & Valeton, Bijdr. Kenn. Booms. Java 12, 1910, 371, footnote) points to a wide variability in general (cf. bottom of p. 468, Mikrogr. 5).

There are three *Cyclostemon* species inserted in the Key. *C. longifolius* is placed in the first paragraph of 93 and in the first paragraph of 340,

C. minahassae in the second paragraph of 93 and *C. subcubicus* in the second paragraph of 59 (cf. Note 24). Their situation, so widely apart, is caused only by the division made under Nr 12. It is to be remembered that I have pointed to the close similarity of their woods (Mikrogr. 5, p. 470). In "Das Pflanzenreich" (no. 81, p. 234) we meet with these three species in the same section (Sectio *Sphragidia*). J. J. Smith (Bijdr. Kenn. Booms. Java 12, 1910, 200) remarked that the Javan species of *Cyclostemon* probably belong all to Sectio *Eucyclostemon* Muell.-Arg.

Similar cases may be traced in *Casuarina, Dehaasia, Litsea, Marlea* and *Vaccinium,* and further as regards different wood samples of *Itea-daphne confusa.*

Note 5. The aberrant wood-anatomy of Grewia microcos (Tiliac.).

Under Nr 153 of the Chief Key is found *Grewia microcos.* The other species of the genus *Grewia,* as represented in Java, are met with in 450 and 451. They are *G. celtidifolia, G. excelsa, G. eriocarpa, G. laevigata,* and *G. laevigata* var. *oblongifolia.* It might be assumed (cf. Note 4) that *Grewia microcos* is very different from the rest of the genus.

Tile cells occur in the medullary rays of *Grewia microcos* and are wanting in the other species of *Grewia* (and the variety). This is the only reason for the separation of *G. microcos* in the Key (cf. the remark on tile cells in Note 16 and also Note 28).

Tile cells (in the medullary rays) I found only in 7 species of trees occurring in Java. These 7 species belong to 3 families (*Malvaceae, Sterculiaceae,* and *Tiliaceae*) which are so closely related that several (particularly French) taxonomists considered them to as one single family, the other school keeps them in one Order. My results support the former view.

In the Chief Key, the 7 woods having tile cells are placed consecutively in 150—154. It might be believed, therefore, that the presence of these tile cells points to a close relationship. On the other hand, many species, the majority in fact, in these families have no tile cells in the medullary rays.

In *Grewia* I examined 5 species (and one variety in one of these). Of the other genera having species with tile cells, I only studied one species each. This makes comparison very nearly impossible.

The cells in the medullary rays of *Grewia microcos* are, moreover, no typical tile cells. In the medullary rays of *G. laevigata* cells are found which are different from the regular cells and resemble more or less tile cells. These aberrant cells are absent in its variety *oblongifolia.* It seems for these reasons that the isolated position of *Grewia microcos* is greatly overstressed and that its affinity to the rest of *Grewia* is closer than suggested in the Key (for further information cf. Mikrogr. 1, pp. 508, 510, 511).

The wood-anatomy of *Grewia microcos* provides no sufficient reasons to place it into another genus.

My conclusion after study of the wood-anatomy of *Tiliaceae* was (Mikrogr. 1, p. 481, § 2) that four groups ("divisions") might be disting-

uished. *Schoutenia buurmanni* and *Columbia javanica* were placed in "division b", together with *Grewia microcos*. The remainder of the genus *Grewia* was set apart as "divisions c and d". This might be used as an argument in favour of referring *G. microcos* to another genus. I wish to repeat that the wood-anatomy of *G. microcos* is no more different from the other species of *Grewia* than that of *G. laevigata* from *G. laevigata* var. *oblongifolia* ("division d"), and that existing among the *Grewia* species of "division c".

Miss M. Chattaway, on the strength of her study of the tile cells in the medullary rays of the *Malvales*, refers *Grewia microcos* to the genus *Microcos*, apart from *Grewia* (Trop. Woods 38, 1934, 9 and New Phytologist 32, 1933, 261—273). F. Kukachka and L. W. Rees arrive at the same conclusion for similar reasons (Agric. Exp. Sta. Univ. Minnesota Techn. Bull. 158, 1943 and Trop. Woods 84, 1943, 35).

Linnaeus established both the genera *Grewia* and *Microcos*; he later on united them (as *Grewia*). Nearly all taxonomists shared his final decision. M. Burret maintains *Microcos* and *Grewia* as separate genera (Notizbl. Bot. Gart. Mus. Berlin-Dahlem 88, vol. 9, 1926, 592—880). Burret found that *Grewia microcos* L. (Syst. ed. XII, 2, 1767, 602) is identical with *Microcos paniculata* L. (cf. l. c., p. 733) and that *Microcos paniculata* L. is the type species of *Microcos* (l. c., p. 757).

Schumann (in Engler & Prantl III, 6a) treats only *G. excelsa* and *G. microcos* and places each of them into a different subgenus. Burret places *G. laevigata* into another sectio of the genus *Grewia* than *G. celtidifolia, G. excelsa,* and *G. eriocarpa.*

It seems, that the opinions regarding the taxonomy of *Grewia* and allied groups are not settled. My study in their woor-anatomy has brought me to the decision that *Grewia microcos* holds no isolated position apart from the other species of *Grewia.*

Note 6. The wood-anatomy of Javan Schoutenia (Tiliac.).

Among the Javan species of *Schoutenia* (*Tiliac.*), I examined *S. ovata* and *S. buurmanni.*

Koorders & Valeton (Bijdr. Kenn. Booms. Java 1, p. 210) described *S. buurmanni* for the first time. No striking differences are mentioned between *S. ovata* and the new *S. buurmanni.* Heyne, discussing the economic properties of the species (Nutt. Pl. Ned. Ind., 1927, 1021, sub *Actinophora fragrans* R. Br. and *A. buurmanni* Kds) also mentions no wide difference nor does Burret, from a taxonomical point of view (Notizbl. Bot. Gart. Berlin-Dahlem 88, 9, 1926, 626, 627).

I found, however, a great difference in the wood-anatomy of these two species. It was even necessary to describe each wood in detail and separately instead of referring the second description to the first, as was usually possible when describing several species in one genus (cf. Mikrogr. 1, pp. 521, 523).

Their greatly different wood-anatomy caused that the two *Schoutenias* occupy now in the Chief Key widely separate places. *S. ovata* is found under Nr 475 (second paragraph) and *S. buurmanni* under Nr 379 (second paragraph).

By way of 17 numbers, *S. buurmanni* is reached in the Key; *S. ovata* required 21 numbers. They have the first 12 numbers in common (cf. Note 26 for *S. buurmanni* and Note 28 for *S. ovata*).

This peculiar state of affairs is illustrated by a remark made previously (Mikrogr. 1, p. 483, end of § 2) when I discussed relationships among *Tiliaceae*: (transl.) "According to this classification, the species of *Grewia* and *Schoutenia* are distributed over two "divisions" and mingled with species of other genera; I find this here (end of volume 1) for the first time, till now, the species of one genus always showed a closer resemblance to each other than to any species of another genus."

Note 7. Fibre tracheids and scalariform perforations and their correlation with the medullary rays (Notes 7—12).

Nrs 14 to 52 of the Chief Key contain 75 kinds of wood referable to 12 different families. These are: *Celastrineae, Cornaceae, Olacineae, Styracaceae, Ternstroemiaceae, Dilleniaceae, Saxifragaceae, Staphyleaceae, Caprifoliaceae, Hamamelidaceae, Vacciniaceae,* and *Euphorbiaceae*. Five of these families are represented by one genus only, *viz. Elaeodendron* of the *Celastrineae* (*E. glaucum* and *E. glaucum* var. *macrocarpum*), *Turpinia* of the *Staphyleaceae* (*T. pomifera* and *T. parva*), *Viburnum* of the *Caprifoliaceae* (*V. sambucinum, V. sundaicum, V. sundaicum* var. *latifolia,* and *V. coriaceum*), *Vaccinium* of the *Vacciniaceae* (*Ericaceae*) (*V. lucidum*), and *Daphniphyllum* of the *Euphorbiaceae* (*D. glaucescens* and *D. glaucescens* var. *blumeanum*). As regards Miss K. Rosenthal's family of *Daphniphyllaceae,* see Note 2.

The 75 kinds of wood appear to have the following characters in common: the division walls of the vessels have all, or nearly all, scalariform perforations (Nr 12, first paragraph), and the ground mass is composed of fibre tracheids (Nr 13, first paragraph). These two characters occur in the majority of the 75 species in correspondence with some other characters. I have pointed out (Rec. Trav. Bot. Néerl. 28, 1931, 104) that: (transl.) "In families having the ground mass of the wood consisting of fibre tracheids, nearly all division walls of the vessels have scalariform perforations at the same time. In addition, the wood parenchyma is usually scattered among the fibre tracheids and the medullary rays occur in two kinds. The first kind is uni-seriate and the second consists for the greater part of typical compound medullary rays (cf. Mikrogr. 3, p. 304, sub *Hamamelidaceae*). The wood of these families is therefore distinctly different from that of all other families and they occur scattered at various places in the system of Bentham and Hooker, particularly among the *Calyciflorae.*" Many authors (in particular American) consider them to be primitive. A recent publication on this subject is by O. Tippo (Am. Midl. Nat. 36, 1946, 362—372, and Trop. Woods 89, 1947, 66).

I offer at present no explanation for the occurrence of this wood-structure in so many families, recurring at widely different places in the system. Further research may throw a new light on this problem.

When consulting the literature mentioned above, it becomes clear that a "storied" structure ("ripple-marks") is never met with in these families.

I have commented on this before (Mikrogr. 5, p. 461) and stated concerning the two species of *Daphniphyllum* (*Euphorb.*): (transl.) "Group IV of this family is formed by *Daphniphyllum glaucescens* and *D. glaucescens* var. *blumeanum*. This group is so significantly different from the three other groups in this family as regards its wood-anatomy, that it cannot possibly belong to the same family."

In group IV the ground mass of the wood consists of fibre tracheids, all the division walls of the vessels have scalariform perforations, bundles of vessels occur nearly always rarely, metatracheal wood parenchyma is entirely wanting and the members of the vessels are longer than in the three other groups. This group IV shows the same wood-structure as found in a considerable number of other families, e. g. in *Hamamelidaceae* (cf. Hallier, Bot. Mag. 18, 1904, 35) and in *Ternstroemiaceae*.

In this connexion a note on *Viburnum* (*Caprifol.*) is of importance, made on page 9 of the Mikrogr. 4 (cf. also Note 12).

For these reasons, the wood-anatomy of the species referred to above is strikingly similar in many respects. Is there a closer relationship among these families than was hitherto suspected? They have in the Chief Key in common Nrs 1b, 5b, 6b, 11b, 12a, 13a, and 14, i. e. only seven numbers and this might suggests only a limited, not a very close, resemblance.

In the current taxonomic works, only now and then some evidence points to a closer relationship among the species and families under discussion, but these facts and views are not all in agreement with my findings nor among each other. In Notes 8 to 12, I intend to discuss the problem more fully.

Note 8. Affinities among Olacineae, Styracaceae, and Symplocaceae.

Nr 20 in the Chief Key consists of two paragraphs. In the first paragraph are placed three species of *Platea* (*Olacin.*); *Platea latifolia*, *P. excelsa*, and *P. parvifolia*. They resemble each other closely in their wood-anatomy. The second paragraph contains the only species of *Bruinsmia* (*Styrac.*) I examined: *Bruinsmia styracoides*.

Being placed under one number and side by side, it is clear that the four species suggest to be allied. Nr 20 is still in the beginning of the Key and is reached by 1b, 5b, 6b, 11b, 12a, 13a, 14b, 15b, 16b, 17b, 18a, 19a; a way which does not stress in particular a close relationship among them.

In the current taxonomic works little or nothing points to a closer affinity, but Hutchinson, in the "Notes on Affinity" (p. 24), said that the *Styrales* (Order 63) are: "A small group probably most closely allied and finding its origin in the *Olacales*."

A possible relationship between these two families was suggested by me (Mikrogr. 2, p. 215 and 4, p. 471) when I remarked (foot-note vol. 4, p. 480): (transl.) "The structure of the wood in this family (*Styracaceae*), in particular as regards the genus *Symplocos*, resembles very closely that found in many other families such as *Ternstroemiaceae*, *Saxifragaceae*, *Hamamelidaceae*, and e. g. the genus *Platea* of *Olacineae*." I continued later on: (transl.) "Bentham & Hooker (Genera Pl. 2, p. 667) wrote:

— Ordo (*Styraceae*) inter Gamopetalos Sapotaceis et Ebenaceis prae aliis accedit, pluribus notis tamen ab utroque depellitur. A nonnullis cum Ternstroemiaceis, Meliaceis v. etiam Olacineis comparatur, sed affinitas, si adest, valde remota apparet. — Attention should be paid to the fact, that according to their wood-structures the *Meliaceae* and the *Styracaceae* are not related."

A. Brand (Das Pflzr. 6, 1901) treated *Symplocos* as a separate family. When discussing affinities (Verwandtschaftliche Beziehungen, p. 11) he said: (transl.) "The nearest relations of the *Symplocaceae* are the *Styraceae*, which follow in the system. They are still often united with the *Styraceae* to one family. They are different from the *Styraceae*, however, by characters of such importance that a splitting into two families seems warranted.".

Note 9. The genus Saurauja (Ternstroem.) and the Dilleniaceae.

The genus *Saurauja* (*Ternstroèm.*) is found in the Nrs 22, 23, and 24 of the Chief Key. The *Dilleniaceae* are placed under Nrs 22, 25, and 26; *Saurauja* and *Dilleniaceae* have Nr 22 in common.

This arrangement suggests close relationship. On the other hand, Nr 22 is only at the beginning of the Key and soon reached, which is not illustrative for a possible close affinity.

In the usual taxonomic works very different opinions are expressed as regards relationship between *Ternstroemiaceae* and *Dilleniaceae*. Durand assigned the *Ternstroemiaceae* to "cohors" 5 and the *Dilleniaceae* to "cohors" 1 of the *Thalamiflorae* (*Polypetalae*). Engler-Gilg (Syllabus, 9th and 10th ed.), while including *Saurauja* in *Actinidiaceae*, inserted the *Dilleniaceae* and the *Actinidiaceae* both in the first "Unterreihe" of the *Theineae*, which form part of the "Reihe" 27 in the *Parietales*. This is further confirmed in Engler & Prantl (Nat. Pfl.fam. 21, 1925).

Hutchinson refers the *Saurauiaceae* (fam. 113) to Order 32 (*Theales*) and the *Dilleniaceae* (fam. 85) to Order 24 (*Dilleniales*). In his "Notes on Affinity" (p. 17) he remarked, however, regarding the *Theales*: "Related to *Dilleniales* and *Bixales*", and a little earlier (p. 15), regarding the *Dilleniales*: "perhaps indicating the origin of the *Theales* and other families."

As a final quotation, I add (Mikrogr. 1, p. 287): (transl.) "It is worthy of note that Gilg in Engler & Prantl (1rst ed., III, 6, p. 126) places *Saurauja* with the *Dilleniaceae*. In general, the wood-anatomy of the *Dilleniaceae* and the *Ternstroemiaceae* show a more or less close resemblance. Moreover, all wood of *Saurauja* has raphide cells scattered among the parenchyma cells and in this concurs with *Dilleniaceae* which have, contrary to *Ternstroemiaceae*, raphide cells. On the other hand, the wood of *Saurauja* resembles more closely the wood of *Ternstroemiaceae*."

Note 10. Turpinia (Staphyl.), Symplocos (Styrac.), Ternstroemiaceae, Saxifragaceae, and Caprifoliaceae.

Nr 32 of the Chief Key has *Turpinia pomifera* and *T. parva* (*Staphyl.*). These two species resemble each other closely in their wood-anatomy. The

second paragraph of Nr 32 has a reference to Nr 33. In the first paragraph of 33, the genus *Symplocos* (*Styrac.*) and several *Ternstroemiaceae* (cf. 36 and 37) are placed, while in the second paragraph the genus *Eurya* (*Ternstroem.*) and several *Saxifragaceae* are met with. The *Saxifragaceae* are *Itea macrophylla, I. macrophylla* var. *minor, Polyosma mutabilis, P. integrifolia, P. integrifolia* forma *subdenticulata, P. ilicifolia*; in the same paragraph is also *Viburnum sambucinum* (*Caprifol.*).

It would seem that some relationship exists among these families and species, judging by their position in the Key.

In addition, in the first paragraph of Nr 30, *Styrax benzoin* (*Styrac.*) is placed, and in the second paragraph a reference is made to Nr 31 where, in the first paragraph, *Weinmannia blumei* (*Saxifr.*) is found and in the second paragraph reference is made to Nr 32.

On the other hand, all these numbers are still in the initial stages of the Key, and by way of only 18 preceding numbers our present group is reached. This allows no conclusion intimating a close resemblance.

In the usual taxonomic works, I hardly find any indication towards a closer relationship as is suggested by wood-anatomical characters.

Of *Staphyleaceae* I examined only 2 *Turpinia* species. These resembled each other very closely as regards their wood-anatomy and show no affinities to one of the other four families discussed here (cf. Mikrogr. 2, p. 416, foot-note)! I pointed out, however, that there was relationship with *Celastrineae*, and *Celastrineae* comprise *Elaeodendron*, a genus belonging to the related groups considered in these Notes (cf. Note 7, and Nr 14 of the Chief Key).

Of *Symplocos* I examined 10 kinds of wood. I concluded (l. c. 4, p. 480, foot-note): (transl.) "The wood-structures met with in this family (*Styraceae*), especially in *Symplocos*, resemble greatly those found in many other families, such as *Ternstroemiaceae, Saxifragaceae, Hamamelidaceae* and e. g. the genus *Platea* (*Olacineae*)."

My conclusion was cited in Note 8, where I added Bentham & Hooker's views on the relationships existing in this group and also A. Brand's opinions. To these I add what I have said in a foot-note in the "Mikrographie" (vol. 3, p. 307) that the species of *Hamamelideae* I examined (*Distylium stellare, Altingia excelsa, A. excelsa* var. *velutina*) seem to be closely related to the genera *Itea* and *Polyosma* (*Saxifr.*). When discussing the *Ternstroemiaceae* (l. c. 1, p. 282) and the *Saxifragaceae* (l. c. 3, p. 264) I suggested no affinities to any other families.

Of *Caprifoliaceae* I examined *Viburnum sundaicum, V. sundaicum* var. *latifolia, V. coriaceum,* and *V. sambucinum.* I concluded (l. c. 4, p. 9, foot-note): (transl.) "*Caprifoliaceae* are the first family of *Gamopetalae. Viburnum* is the only genus I studied. It is closely, one might say extremely closely, related to several families of *Polypetalae.* Closest is this relationship with *Altingia* and *Distylum* (*Hamamelideae*). The wood-anatomy of these three genera is so nearly identical, that only differences of very slight taxonomical value seem to be present."

Finally I note that *Nyssa* and *Mastixia* (*Cornaceae,* the final family of *Polypetalae*) are in their wood characters also closely related to *Viburnum. Mastixia* and *Nyssa* occur in Nrs 15 and 16 of the Key.

Note 11. Hamamelideae, Vacciniaceae, and Ternstroemiaceae.

Nr 42, first paragraph, has *Altingia excelsa* and *A. excelsa* var. *velutina* (*Hamamel.*). These two kinds of wood resemble each other very closely (cf. also Note 7). The second paragraph contains a reference to Nr 43.

Nr 43 (first par.) has *Vaccinium lucidum* (*Vaccin.*) and the second paragraph has *Distylium stellare* (*Hamamel.*) and several *Ternstroemiaceae.* The latter, which occupy also Nrs 44 and 45, are *Pyrenaria serrata, P. lasiocarpa, Haemocharis integerrima, Camella lanceolata,* and *Gordonia excelsa* var. *macrocarpa.*

I have pointed out before that the wood-anatomy of *Altingia* and that of *Distylium stellare* are closely alike (Mikrogr. 3, p. 307).

The manner in which these three families occur under the two Nrs 42 and 43 suggests a close resemblance of their woods and so a definite relationship. On the other hand, by way of 17 numbers only, this stage of the Key is reached and this is no strong evidence for a near affinity.

The current taxonomical works suggest little in support of affinity. I noted (Mikrogr. 5, p. 461) when dealing with *Daphniphyllum:* (transl.) "*Daphniphyllum* woods show the same structure as found in a large group of other families, including e. g. *Hamamelideae* and *Ternstroemiaceae.*" Further reference to the question is made in Notes 7 and 10.

Note 12. Viburnum (Caprif.) and Daphniphyllum (Euphorb.); their relationships to Hamamelideae and Ternstroemiaceae.

Nrs 46 (first paragraph) and 48 of the Chief Key contain the 5 species of *Viburnum* (*Caprif.*) I have examined.

The second paragraph of Nr 46 has a reference to Nr 47. In the first paragraph of Nr 47, *Daphniphyllum* (*Euphorb.*) is placed. The two species I studied are found under Nr 49.

The second paragraph of 47 comprises the genera *Eurya* and *Ternstroemia* (*Ternstroem.*); their species are placed in 50 and 51.

It appears that these groups are closely interwoven, at least when judging by their wood-anatomy. Nevertheless, by way of only 17 numbers the group is reached and this offers insufficient evidence for their relationship among each other. Nothing in current taxonomic works points to a closer affinity than was assumed to exist hitherto.

I have discussed before (Note 10) the resemblance of the wood of *Viburnum* (*Caprif.*) to *Altingia* and *Distylium* (*Hamamelid.*). The affinity of *Daphniphyllum* (*Euphorb.*) was remarked on in Notes 2 and 7; there appeared to be a link with *Hamamelideae* and *Ternstroemiaceae.*

It is finally to be noted that Nr 41 of the Chief Key refers to the species and families treated in Note 11, and that Nr 41 has also (in its second paragraph) a reference to the species and families treated in Note 12. I hold that the wood-anatomy of the groups dealt with in these present Notes 7—12 suggests that several phylogenetic affinities exist as yet unaccounted for by the commonly accepted systems.

Note 13. Scalariform perforations and a libriform fibrous ground mass.

The groups contained in the Nrs 52 to 81 in the Chief Key, have woods in which the division walls of the vessels show all, or nearly all, scalariform perforations (Nr 12, first paragraph), while libriform fibres compose the ground mass (Nr 13, third paragraph).

Nrs 52 to 81 house 45 kinds of wood, which belong to 14 families. These families are *Sabiaceae, Olacineae, Cornaceae, Euphorbiaceae, Magnoliaceae, Myristicaceae, Myrsineae, Saxifragaceae, Celastrineae, Bixineae, Monimiaceae, Rhizophoraceae, Araliaceae,* and *Violarieae.* Several of these families are represented by one genus only.

These are *Sabiaceae* (by *Meliosma,* 6 species), *Olacineae* (by *Strombosia membranacea*), *Cornaceae* (by *Marlea javanica*), *Myristicaceae* (by *Myristica,* 8 species), *Myrsineae* (by *Maesa forbesii*), and *Celastrineae* (by *Caryospermum serrulatum*).

Nrs 52 to 81 are reached by way of 1b, 5b, 6b, 11b, 12a, 13b, 52. This means that only the added characters of 7 Nrs mark their woods but are insufficient to illustrate their close affinity.

In the current taxonomic works here and there some data are found more or less in support of my findings. It is to be noted, however, that the various authors are not in agreement concerning certain points.

Strombosia membranacea (*Olacin.*) and *Marlea javanica* (*Cornac.*) occupy the first and second paragraph of Nr 56. I find nowhere any datum in support of a close relationship between the two. The only fact of possibly some significance is that *Marlea javanica* holds a somewhat isolated place in the genus having plates of scalariform perforations in the division walls of the vessels (cf. Note 28).

Seven species of *Magnoliaceae* are placed in Nr 63 (first paragraph). The same number (second paragraph) holds 8 species of *Myristicaceae.* There seems to exist a link between *Magnoliaceae* and *Myristicaceae.*

Durand indicated no closer relationship than was accepted so far. Engler-Gilg place the families in the same "Unterreihe" of "Reihe" 18 (*Ranales*). Hutchinson refers the *Magnoliaceae* as the first familiy to the *Magnoliales* (Order 1) while the *Myristicaceae* are the third family of the *Laurales* (Order 3); both Orders belong to a group of rather closely related ones.

The systems proposed by these authors have the *Monimiaceae* also close to both *Magnoliaceae* and *Myristicaceae,* or to *Myristicaceae* only. In *Monimiaceae* I only examined 2 species of *Kibara* (placed in Nr 79, first par.). I made no suggestion towards a possible relationship among these families in my "Mikrographie".

Nr 77 (first par.) has *Caryospermum serrulatum* (*Celastrin.*) and the second paragraph has *Bergsmia* (*Hydnocarpus*) *sumatrana* and *Taractogenos blumeana* (*Bixineae*). Their places, close together, again suggest relationship but I found nowhere any opinion expressed in support of this result of the study of their wood-anatomy. The same position exists regarding the four species of *Bruguiera* (*Rhizoph.*) and *Horsfieldia aculeata* (*Araliaceae*) placed side by side in Nr 80, the two species of

Rhizophora (*Rhizoph.*) and *Alsodeia cymulosa* (*Violac.*) placed under Nr 81.

Note 14. Simple and scalariform perforations in the division walls of the vessels in connection with fibre tracheids and libriform fibres.

Nrs 82 to 103 in the Chief Key comprise a number of groups which have both simple and scalariform perforations in the division walls of the vessels, and both to a considerable amount (Nr 12, second par.). Nrs 83 to 88 have the wood characterized by a ground mass consisting of fibre tracheids (Nr 82, first par.) and Nrs 89 to 103 have a ground mass of libriform fibres (Nr 82, second par.).

Nine kinds of wood are contained in 82 to 88, belonging to *Rubiaceae, Vacciniaceae, Myricaceae,* and *Casuarinaceae.* Twenty one kinds of wood are contained in 89 to 103, belonging to *Laurineae, Euphorbiaceae, Bixineae, Myrsineae,* and *Araliaceae.* The families are often represented by a single genus.

The group 82—103 is reached by way of 6 numbers only, which is not an adequate stress on the similarity of the wood-anatomy in these species.

The current taxonomic works, again, contain but few data in support of any closer relationship among the groups under discussion; opinions also vary. During my previous study in wood-anatomy I myself have made no remark on the subject.

Nr 84 (first par.) has *Lasianthus purpurea* and *Lasianthus spec.* (*Rub.*). The second paragraph has four species of *Vaccinium* (Vacc.). For this contact between *Rubiaceae* and *Vacciniaceae* I have no suggestion to offer, neither from literature nor from my own earlier work. It is to be noted that the species of *Lasianthus,* on account of their wood-anatomy, hold a somewhat isolated position from the rest of *Rubiaceae* (cf. Mikrogr. 4, p. 35).

Nr 87 (first paragraph) has *Myrica javanica* (*Myric.*). The second paragraph contains two species of *Casuarina* (*Casuar.*). Is there in reality a close relationship as is suggested by their adjacent position in the Chief Key?

Durand places *Myricaceae* and *Casuarinaceae* immediately together, and in the same Series. Engler-Gilg keep them not far apart but assign them to different "Reihen". Hutchinson keeps them relatively close together but refers them, nevertheless, to different Orders (*Myricales,* 46, and *Casuarinales,* 49) though still belonging to one related group. I myself mentioned no supporting data towards a relationship before. A perusal of the Chief Key further shows that the groups placed in 83—88 are closely interwoven if judged only by the evidence supplied by their wood-anatomy.

I examined the wood of 65 kinds of *Laurineae.* A general character is the presence of oil and mucilage cells. The following 9 kinds are without them: *Iteadaphne confusa, Cryptocarya densiflora, Lindera bibracteata, Litsea chinensis, L. chinensis* var. *littoralis, L. citrata, L. diversifolia, L. tomentosa,* and *Actinodaphne macrophylla* var. *angustifolia.* Of these exceptional woods are placed in Nr 100, first paragraph *Iteadaphne con-*

fusa, Litsea diversifolia and some other *Laurineae*. In the second paragraph are found the two *Macropanax* species I studied and the seven *Heptapleurums*, all *Araliaceae*. This point of contact between the two families cannot be explained in the light of any opinion expressed in the current taxonomic works; I myself have no further evidence in favour of a close relationship to offer.

Note 15. Simple perforations in the division walls of the vessels in correlation with fibre tracheids.

Nrs 104 to 148 have a group of woods distinguished by simple perforations in all, or nearly all, division walls of the vessels (Nr 12, third par.) while fibre tracheids compose the ground mass of the wood (Nr 104, first par.).

The group is composed of 78 kinds of wood, belonging to 10 families *viz. Celastrineae, Vacciniaceae, Casuarinaceae, Rhizophoreae, Olacineae, Myrtaceae, Rubiaceae, Rosaceae, Polygaleae,* and *Apocynaceae.*

Only 6 numbers form the way by which this group in the Chief Key is reached. This is too little stress on the similarities in reality existing among these species.

The usual taxonomic works present but few data pointing to a closer relationship among the species and families than was believed to exist hitherto; opinions also are not quite in agreement.

In the first paragraphs of 6 numbers between 104 and 149 one or more species of one family occur whereas all second paragraphs of these numbers contain one or more species of another family. In each case, this may indicate some relationship between such families. Only in one of these six cases, I am able to throw some more light on the problem; the other five remain without further comment at present as there are no supplementary data available from literature.

Nr 125 (first par.) has *Ochrosia salubris* and *O. ackeringae* (*Apocyn.*); the second paragraph contains many *Rubiaceae.*

This might point to a relationship between *Apocynaceae* and *Rubiaceae.* Durand and Engler-Gilg offer very little, if anything, in support of this. Hutchinson takes *Apocynaceae* as family 230 to belong to the 65th Order (*Apocynales*) and *Rubiaceae* as family 232 to the 66th Order (*Rubiales*); these Orders belong to different groups.

Now under Nr 119, *Hymenodiction excelsum* (*Rubiac.*) is separated from *Rauwolfia sumatrana* and *R. reflexa* (*Apocyn.*). I noted (Mikrogr. 4, p. 572) that *Rauwolfia* and *Ochrosia,* both genera of *Apocynaceae,* may be seen as a small group separate from the remainder of *Apocynaceae.* I made no suggestion, however, that this small group would be closely related to *Rubiaceae.*

In three non-consecutive numbers in the present group (104—148), a genus of *Celastrineae* is met with, being 106, 108, and 112. This is better understood when considering what was said earlier (Mikrogr. 2, p. 262: (transl.) "I found that the woods of the 6 genera of *Celastrineae* which I studied, differ from each other more than is anywhere found in the preceding families."

Rubiaceae are placed in 4 numbers: *Mussaenda frondosa* in 115, *Hymenodiction excelsum* in 119, two genera and several species in 122, and in 125 a large number of species.

I wish to leave it at this. For the moment it must suffice to have pointed to the possibilities arising from the arrangement in the Chief Key.

Note 16. Relationship of Malvaceae, Sterculiaceae, and Tiliaceae; their tile cells.

The section of the Chief Key comprising Nrs 149 to 154 has seven kinds of wood belonging to three families, *viz. Malvaceae, Sterculiaceae,* and *Tiliaceae.* They have tile cells in the medullary rays (Nr 149, first paragraph).

Seven numbers lead to this section of the Chief Key, and this does not accentuate the very close resemblance existing in the anatomy of these woods. The wood-anatomy actually strongly points to a near affinity.

This conclusion is supported by the current taxonomic systems. Durand joins them as "Cohors" 6 of the *Malvales* (*Thalamiflorae*). Engler-Gilg bring the 7 kinds of wood to the same "Unterreihe", the *Malvineae,* of "Reihe" 26 (of the *Malvales*). Hutchinson unites them in one Order (*Tiliales,* Order 35).

In support of the close relationship I found to exist on account of the wood-anatomy, I cited (Mikrogr. 1, p. 374): (transl.) "Schumann (in Engler & Prantl, III, 6, p. 83) stated that the *Malvaceae* and the two following families (*Sterculiaceae* and *Tiliaceae*) had been united by French botanists; he had hardly any objection against this combination. It appears from my descriptions of the wood-anatomy occurring in the three families that it supports combination."

I finally note that tile cells are present only in the minority of the genera in each of the three families. This is confirmed by Miss M. M. Chattaway (New Phytologist 32, 1933, 261); see also Miss I. E. Webber (Trop. Woods 37, 1934, pp. 9—13).

In the genus *Grewia* (*Tiliac.*) tile cells are present only in part of the species (cf. Mikrogr. 1, p. 497, and Note 5).

Note 17. Rubiaceae, Sonneratiaceae, Melastomaceae, and Connaraceae.

The section of the Chief Key comprised by the Nrs 217 to 222, contains 11 kinds of wood, belonging to four families, *viz. Rubiaceae, Lythrarieae* (or *Sonneratiaceae*), *Melastomaceae,* and *Connaraceae.* Their wood is characterised by simple perforations occurring in all, or nearly all, division walls of the vessels (Nr 12, third par.), while libriform fibres, all or nearly all septate, form the ground mass of the wood (Nr 216, first par.) and are present in two kinds (Nr 217, first par.).

In the various taxonomic works very different opinions are expressed concerning their affinities; Durand's opinion comes closest to mine.

The wood-anatomy of the four families is so similar in many respects that I suggest that a close relationship exists among these species. On the other hand, this section of the Key is reached by only 10 numbers, which is too little stress on their actually great resemblance.

Of *Melastomaceae* I examined *Medinilla javensis, Astronia spectabilis, A. macrophylla, Melastoma molkenboerii, M. setigerum, M. asperum,* and *M. lanuginosum*; these are placed in Nr 222 (see also Note 3).

Now under Nrs 219 (second par.) and 220 (first par.) are found *Lythrariceae* and *Melastomaceae.* Durand assigned them as successive families to "Cohors" 12, the *Myrtales,* of the *Calyciflorae* (*Polypetalae*).

The *Connaraceae* appear in the Chief Key under Nr 220 (second par.) and the *Rubiaceae* are placed in Nr 218 (second par.). Durand accepts the *Connaraceae* as the 1st family of "Cohors" 11, the *Rosales,* of the *Calyciflorae* and the *Rubiaceae* to "Cohors" 1, the *Rubiales,* of the *Gamopetalae.* Here, the results obtained by the study of the wood-anatomy and the view of Durand are not in agreement. It is to be noted that the only species of *Rubiaceae,* placed in the Chief Key in this section, is *Guettarda speciosa.* This holds an isolated place (cf. Mikrogr. 4, p. 35, § 2). In addition, Bentham & Hooker classed the *Guettardeae* as a Tribus among the *Formae abnormales* and Valeton remarked (Bull. Dép. Agric. Ind. Néerl. 26, 1909, p. 7) that: (transl.) "*Guettarda* is generally a genus very much different from the other *Guettardeae* by the structure of its seed", and (l. c., p. 20): (transl.) "the *Guettardeae* form a very homogeneous group belonging neither to the *Coffeae* nor to the *Cinchoneae* according to our present concept of them."

Note 18. Ampelideae and Araliaceae.

The genus *Leea* (*Ampelid.*) is found in Nr 225 of the Chief Key. The species of *Leea* which I examined occur under 226 and 227; they are *L. sundaica, L. javanica, L. angulata,* and *L. sambucina.*

In Nr 225 (second par.), *Arthrophyllum diversifolium* (*Aral.*) is placed. I studied some other species of *Araliaceae* but these are found in other places of the Key.

The five species discussed at present have some pecularities in their wood-anatomy in common. All, or nearly all, division walls of the vessels have simple perforations (Nr 12, third par.), all, or nearly all, libriform fibres, which form the ground mass of the wood, are septate (Nr 216, first par.) and they occur only in one single kind (Nr 217, second par.). The wood parenchyma is sparingly developed to absent (Nr 223, first par.), the vessels are with scalariform pits where in contact (Nr 224, first par.). Only these 5 species among all I investigated have this wood-structure in common.

On the other hand, the short way by which they are reached in the Chief Key (13 numbers) lays insufficient accent on their possibly close relationship.

In current taxonomic works, the *Ampelideae* and *Araliaceae* are not considered to be related. In my previous work, I made no suggestion towards a relationship either, but remarked (Mikrogr. 3, p. 645, § 2): (transl.) "Harms (in Engler & Prantl, III, 8, p. 22) stated that Seemann advocates the exclusion of *Arthrophyllum* from the *Araliaceae,* merely because the genus is characterized by a one-celled ovary whereas in all other characters it is typically Araliaceous. Harms believed that Seemann

attaches too much importance to the number of the members of the flower whorl."

The aberrant wood-anatomy of *Arthrophyllum* lends support to Seemann's view. There is also a remark of Hutchinson's worthy of note in this connection (cf. Notes on Affinity, p. 22) when he states when discussing the *Rhamnales*, to which the *Ampelideae* belong: "Closely allied to the *Celastrales*" and (l. c. p. 23), when discussing the Order of the *Umbelliferae*, to which the *Araliaceae* belong: "Probably partly derived from the *Calastrales* and *Rhamnales*."

Note 19. Sapindáceae, Burseraceae, Euphorbiaceae, Loganiaceae, and several other families.

The section of the Chief Key comprising the Nrs 228 to 284, is devoted to kinds of wood which are distinguished by the same characters as were mentioned in Note 18. There is, however, this difference, that the vessels, when in contact with each other do not show scalariform pits. This distinction is mentioned under Nr 224 (second par.).

The section is composed of 18 families, *viz. Geraniaceae, Myrsineae, Sapindaceae, Burseraceae, Oleaceae, Urticaceae, Euphorbiaceae, Bixineae, Samydaceae, Apocynaceae, Rubiaceae, Loganiaceae, Celastrineae, Anacardiaceae, Araliaceae, Compositae, Verbenaceae,* and the *Laurineae*. They are represented by 110 kinds of wood.

The section is reached by way of only 13 numbers which seems insufficient stress on possible relationships among some of these families.

The current taxonomic works, now and then, contain data indicating a relationship between two of the families mentioned here, rarely three of them are considered to be related.

Nr 233 contains the family of *Sapindaceae* (first par.), represented by a number of species and some genera. The second paragraph has *Canarium* (*Burser.*) represented by 6 species. This arrangement seems natural in the light of Hutchinson's classification, where *Sapindaceae* (family 198) are referred to the *Sapindales* (Order 57) and the *Burseraceae* (family 196) to the *Rutales* (Order 55) and the two Orders are taken with the *Meliales* (Order 56) as composing a group of related Orders. I have pointed out before (Mikrogr. 2, p. 325, foot-note) that *Ganophyllum falcatum*, which is at present referred to *Sapindaceae*, was put among *Burseraceae* by Bentham & Hooker and by Blume. Owing to the fruit, studied by Baillon and Radlkofer and to the anatomy, studied by Jadin, *Ganophyllum* is now regarded as Sapindaceous.

I support this latter view. On account of wood-anatomical characters I distinguished in the *Sapindaceae* six groups. *Ganophyllum falcatum* belongs to the second group, and the species of *Sapindaceae* considered here are all members of the sixth group. The groups were distinguished by me on the basis of the quantity and distribution of the wood parenchyma. Otherwise the *Sapindaceae* are very uniform in their wood-structure (cf. also Mikrogr. 2, p. 324, § 2).

Nr 245 (243) (first paragraph) has *Cleistanthus sumatranus* (*Euphorb.*) and the second paragraph has the *Bixineae*; the latter family is further

represented under 246 (244) and 247 (245) by a number of species and genera.

Nr 248 (246) (first par.) has several species of *Homalium* and *Casearia* (*Samyd.*); the second paragraph has many species and genera of *Euphorbiaceae.*

So three families are placed in two groups. The groups were set apart in Nr 244 (242) on account of a character that proved to be of small taxonomical value generally. It would seem that the three families are closely related, judging from their wood-anatomy.

Durand's classification holds nothing in favour of this conclusion. Engler-Gilg refer *Bixineae* and *Samydaceae* to the same "Reihe" and, similarly, Hutchinson refers them to the same Order; both authors keep the *Euphorbiaceae* in a non-related Order. Hutchinson (cf. Notes on Affinity, p. 19) thinks that the *Euphorbiaceae* are derived from several sources such as *Bixales.* To the latter Order belong the *Bixaceae, Flacourtiaceae, Samydaceae,* etc.

In the *Euphorbiaceae* I have distinguished, on account of wood-anatomical characters, four groups (cf. Note 2 and Mikrogr. 5, p. 459, § 2 for their delimitation). The 28 kinds of Euphorbiaceous woods contained in the section now under discussion belong all to the first group.

In *Bixineae* I distinguished for similar reasons three groups. (Mikrogr. 1, p. 200, § 2). Group I is present here.

The Samydaceous woods I examined are all included here. On the whole, this arrangement fully agrees with the extensive foot-notes (l. c. 3, p. 611, § 2 and 5, p. 464, § 2). I point in particular to: (transl.) "The wood-structure of this group (I of the *Euphorbiaceae*) resembles very closely that of the *Bixineae, Violarieae* (*Alsodeia*) and *Samydaceae.*" (cf. also Note 2 and the citations there).

Nr 265 (263) (first par.) contains *Geniostoma haemospermum, G. miquelianum,* and *G. oblongifolium* (*Logan.*) and *Siphonodon celastrineus* (*Celastr.*). The second paragraph of 265 (263) has *Orchipeda* (*Voacanga*) *grandifolia* and *Tabernaemontana sphaerocarpa* (*Apocyn.*); the third paragraph comprises *Psychotria robusta, P. aurantiaca,* and *P. viridiflora* var. *macrocarpa* (*Rubiac.*). As these families have been placed into one number, though separated on account of a character of usually slight taxonomical value, I think that there is a closer relationship among them than was suspected so far.

Durand classed the *Apocynaceae* and the *Loganiaceae* among the *Gentiales* ("Cohors" 7) in the *Gamopetalae,* the *Rubiaceae* in "Cohors" 1 (*Rubiales*) in the *Gamopetalae* and the *Celastrineae* in "Cohors" 9 (*Celastrales*) in the *Polypetalae.*

Engler-Gilg placed *Apocynaceae* and *Loganiaceae* in the "Unterreihe", *Gentianineae* which form part of the *Contortae* ("Reihe" 5) of the *Sympetalae,* the *Rubiaceae* in the *Rubiales* ("Reihe" 8) of the *Sympetalae* and the *Celastraceae* in *Sapindales* ("Reihe" 24) of the *Choripetalae.* Hutchinson placed the *Apocynaceae* in Order 65 (*Apocynales*), the *Loganiacae* in Order 64 (*Loganiales*), and the *Rubiaceae* in Order 66 (*Rubiales*). Order 64 and Order 65 belong to a group of more closely related Orders. He refers the *Celastrinae* to Order 51 (*Celastrales*). In the "Notes on

Affinity" (p. 24), Hutchinson remarked when discussing the *Loganiales*: "A very mixed group either mimicking or having direct affinity with several other families such as *Rubiaceae* (*Psychotria*), *Appcynaceae* etc.". In the same chapter (p. 25) he continued, when dealing with the *Apocynales*: "advanced fixed types from the preceding group (*Loganiales*)" and he said about the *Rubiales*: "A very natural group, but probably derived from more than one source, i. e. *Loganiales*". This, I believe, is rather in support of my conclusions.

In my "Mikrographie" I have not commented on possible relationships among these families but pointed to the special place occupied by several of the species discussed here (ll. cc. § § 2). In particular *Tabernaemontana sphaerocarpa, Orchipeda grandifolia, Psychotria* spp., *Siphonodon celastrineus* deviate markedly from the rest of their families.

Vernonia arborea var. *javanica* (*Compos.*) occurs in Nr 272 (270) (also under Nr 354, with *Vernonia* in general; cf. Note 25). In the second paragraph of Nr 272 (270) are found *Garuga pinnata* and *Protium javanicum* (*Burser.*). I found no support for an opinion towards a close relationship in any of the taxonomic works, but I have previously noted (Mikrogr. 4, p. 256) that the wood-structure of *Vernonia arborea* var. *javanica* is very variable; this is in agreement with the morphological variation reported by Koorders and Valeton.

Nr 282 has *Geunsia farinosa* (*Verbenac.*) in the first paragraph. In the second are found *Litsea tomentosa, L. chinensis, L. chinensis* var. *littoralis* (*Laur.*). It is a long way through the Chief Key before these species are reached (24 numbers) which suggests also a close affinity. Not in my own, nor in the current taxonomic works is any indication to be found towards this relationship.

Geunsia farinosa appears to be separated from some *Verbenaceae* in Nr 273. These species, placed in Nrs 275 to 282, are *Gmelina villosa, Premna tomentosa, P. foetida, P. cyclophylla, P. leucostoma, P. rotundifolia*, and 5 species of *Vitex*. I have pointed out (Mikrogr. 4, p. 764, § 2) that *Geunsia farinosa* is intimately related in wood-structure to the rest of the *Verbenaceae*.

The wood-structure in *Litsea* is very similar in the various species (Mikrogr. 5, p. 103, § 2). The three *Litseas* in Nr 283 are placed there in complete isolation from the remainder of *Laurineae*, caused by the absence of oil and mucilage cells (cf. Note 14). The septate libriform fibres and the fibres of the wood parenchyma resemble each other more closely here than in most other cases (cf. Nr 283, first par.).

Note 20. Lythrarieae and Verbenaceae.

Nrs 285 and 286 have kinds of wood in which the wood parenchyma is abundant or very abundant (second par. of 223) and the inner part of the growth layers is a wood parenchyma lamella, 4 to 7 cells thick (first par. of 284) while in this lamella the vessels are usually, or always, strikingly wider than elsewhere; the wood is thus ringporous.

Nr 285 has *Lagerstroemia speciosa* and *L. ovalifolia* (*Lythrac.*) (first par.), and in the second paragraph the *Verbenaceae*.

Nr 286 (first par.) contains *Tectona grandis* and the second paragraph has *Gmelina villosa.*

Only 13 numbers form the way through the Key leading to 285 and 286. This is but a weak accent on a possible relationship between *Lythrarieae* and *Verbenaceae.*

In the current taxonomic works I found no support for an opinion of this nature. I have stated previously (Mikrogr. 3, p. 575) that the four genera of *Lythrarieae* (*Crypteronia, Lagerstroemia, Duabanga,* and *Sonneratia*) are so different in their wood-anatomy that they should be preferably seen as belonging to four different families (cf. also Notes 25, 28, and 32). *Gmelina villosa* is among all Verbenaceous species I examined closest to *Tectona grandis* (l. c. 4, p. 764).

Note 21. Classification of Avicennia (Verben.).

When reviewing the Javan *Verbenaceae* as a whole, having discussed some parts of the family in advance (Notes 19 and 20), it appears that they are widely spread through the Chief Key.

Nr 9 has *Avicennia alba* and *A. officinalis*; *Tectona grandis* and *Gmelina villosa* (closely related, cf. Mikrogr. 4, 763, § 2) only occur under Nrs 285 and 286, and the remainder is found in the section 275 to 283 (cf. Note 19).

Both species of *Avicennia* are markedly distinct from the rest of the *Verbenaceae* by their wood-anatomy. Phloem strands are present in their wood (Nr 6, first par.) and only occurring in a peculiar parenchymatous layer (Nr 9, first par.). These characteristics are highly significant and ensure the species of *Avicennia* a position which is distinctly isolated.

The current taxonomical works offer small support for this conclusion.

I split the *Verbenaceae* into two groups (Mikrogr. 4, p. 763) and stated: (transl.) "In group II (*Avicennia alba* and *A. officinalis*) the wood consists of tangential layers of two kinds which alternate regularly. One layer has the common wood-structure but the other is very different, resembling secondary phloem. In group I the wood has no such tangential layers but shows the commonly found structure throughout. The wood of group I, and the structure of the "common" layers of group II are not greatly different and lend only slight support, I believe, to Van Tieghem's opinion that the species of *Avicennia* should be placed in a family different from the *Verbenaceae* (Journ. de Botanique 12, 1898, 356)."

At present, I have come to the view that "slight support" was too weak an expression, and I think that Van Tiehem was right. This is in accordance with the views of the monographer H. N. Moldenke, who considers Avicennia the representative of a monotypic family.

I further said (l. c. p. 764): "My findings agree with Bentham & Hooker's classification (Gen. Pl. II, 2, p. 112) and with Briquet (in Engler & Prantl, IV, 3a, p. 143). These authors separate *Avicennia* as a different division from that formed by the other genera."

Note 22. Anacardiaceae, Sapindaceae, Araliaceae, &c.

Twenty-three kinds of wood are contained in Nrs 300 to 309. Their

wood-anatomy is characterised by a ground mass consisting of libriform fibres, septate or non-septate and both rather numerous (second par. of 216) and the wood parenchyma is sparingly developed or absent (first par. of 300).

Six families are represented: *Anacardiaceae, Araliaceae, Tiliaceae, Sapindaceae, Pittosporaceae,* and *Laurineae.*

The way through the Chief Key leading to this section consists of 10 numbers (1b, 5b, 6b, 11b, 12c, 104b, 149b, 155b, 216b, 300). This is small evidence in support of a close relationship among the members of this section.

In the usual taxonomic works only *Anacardiaceae* and *Sapindaceae* are considered to be more or less related (both belonging to the *Sapindales*). Hutchinson thinks that *Araliaceae* are also somewhat related to these families. The latter belong to the Order *Umbelliferae* and this Order forms a related group with soms others, among which the *Sapindales.* In this section of the Chief Key *Araliaceae* occur twice; firstly under Nr 302 (*Trevesia sundaica*) and secondly under Nr 306 (*Aralia dasyphylla* var. *strigosa*), while *Buchanania florida* (*Anacardiaceae*) occurs in the first paragraph of 301 and *Schleichera trijuga* (*Sapindaceae*) in the first paragraph of Nr 305, each being connected with the numbers following.

Nr 307 has four species of *Pittosporum* (*Pittosp.*); the second paragraph has *Iteadaphne confusa* and *Lindera bibracteata* (*Laur.*). These latter occur also in Nr 308 and in the preceding Nrs 100 and 171.

I found nothing in support of a relationship between *Laurineae* and *Pittosporaceae,* as was suggested here by their wood-anatomy. Oil and mucilage cells are absent in *Lindera bibracteata* but present in the four other species of *Lindera* I examined (cf. also Notes 14 and 29).

Note 23. Sapindaceae, Leguminosae, and Urticaceae.

The section of the Chief Key comprised between Nrs 309 to 320 contains 49 kinds of wood, belonging to three families: *Sapindaceae, Leguminosae,* and *Urticaceae.*

Their wood-anatomy is characterized by a ground mass of libriform fibres (septate or not, and both kinds rather numerous; second par. of 216) while the wood parenchyma is abundant (Nr 300, second par.).

The section is reached by way of 11 numbers which is inadequate to demonstrate the actually close resemblance of these woods.

The first paragraph of 309 has the *Sapindaceae* and the second paragraph refers to 313. The first paragraph of Nr 313 has *Albizzia tomentella* (*Legum.*) and the second the *Urticaceae. Albizzia tomentella* occurs also in Nr 623 (cf. Note 35). The position of these groups suggests a closer relationship between *Leguminosae* and *Sapindaceae* than was believed hitherto, a view supported by the position discussed in Note 1.

In the current taxonomic works I found no data in favour of my conclusion. In group III of *Urticaceae* (cf. Mikrogr. 6, p. 20) *Streblus asper* follows immediately the species of *Ficus.*

Note 24. Polygalcae, Anonaceae, Sapotaceae, Scrophularineae, and Euphorbiaceae.

The section in the Chief Key extending from 320 to 345 contains woods characterised by a ground mass of libriform fibres (all or nearly all non-septate; Nr 216, third par.) and in which metatracheal wood parenchymatous lamellae are always present. The lamellae are nearly always 1 cell thick, if 2 to 4 cells thick they are nearly always only locally present, connecting tangentially (at least for the greater part) at least c. 5, usually more medullary rays (Nr 320, first par.).

The section has 43 kinds of wood, belonging to 5 families: *Polygaleae, Anonaceae, Sapotaceae, Scrophularineae,* and *Euphorbiaceae.*

Only 10 numbers lead to this section. This suggests little affinity. The usual taxonomic works offer little in support of a close relationship.

Engler-Gilg refer the *Polygalaceae* and *Euphorbiaceae* to "Reihe" 23 (*Geraniales*) but the first to "Unterreihe" 3 (*Polygalineae*) and the second to "Unterreihe" 5 (*Tricoccae*).

Hutchinson (Notes on Affinity, p. 23) discussing the Order of *Ebenales* (which contains the *Sapotaceae*) remarked: "Perhaps some affinity here with some *Anonaceae*".

I myself noted (Mikrogr. 5, p. 467, § 2): (transl.) "The wood-structure of this group II of *Euphorbiaceae* resembles those of *Ebenaceae, Sapotaceae,* and *Anonaceae*". It was also stated (l. c. 4, p. 421, § 2): (transl.) "Judging by their wood-structure the *Ebenaceae* are very closely related to the preceding family of *Sapotaceae.*" All *Euphorbiaceae* placed in this section belong to "Group II" except *Cyclostemon longifolius* (cf. Notes 2 and 4).

Note 25. Urticaceae, Araliaceae, Lythrarieae, Rosaceae, &c.

The woods contained in the section of the Chief Key comprising the Nrs 352 to 364 are characterised by the following.

Ground mass consisting of libriform fibres which are all, or nearly all, septate (Nr 216, third par.). Metatracheal wood parenchyma lamellae very often absent; if present more than one cell thick, if only one cell thick short to very short in a tangential direction and connecting usually not more than 2 or 3, at the utmost usually only locally a larger number of medullary rays (Nr 320, second par.). The medullary rays are firstly usually uni-seriate and usually consisting of upright cells and, secondly, of a wider type and nearly always partly consisting of compound rays. In the latter case the simple rays and the multiseriate stories of the compound rays about identical (Nr 345, first par.). No vertical schizolysigenous gum ducts, surrounded by wood parenchyma are present (Nr 346, second par.) and wood parenchyma is rare to very rare (Nr 351, first par.).

This wood-structure typifies 27 kinds of wood, belonging to 9 families, *viz. Urticaceae, Araliaceae, Laurineae, Compositae, Loganiaceae, Sterculiaceae, Tiliaceae, Lythrarieae,* and *Rosaceae.*

Only 14 numbers lead through the Key to this section and yet the resemblance of these woods to each other is remarkably close.

Some numbers in this section contain 2 or 3 families.

Nr 354 (first par.) contains *Polyscias nodosa* (*Aral.*). The second paragraph has *Litsea citrata* (*Laur.*) which occurs also in Nr 174. The third paragraph has the *Vernonia spp.* (*Comp.*) which I examined.

Nr 357 has *Melochia indica* (*Stercul.*); the second paragraph has several species of *Urticaceae,* which occur also in 358, 359, 360, and 361.

Nr 363 has *Crypteronia paniculata* and *C. paniculata* var. *leptostachya* (cf. Notes 20 and 28) in the first paragraph; the second has 9 kinds of *Pygeum* (*Rosac.*).

In the second paragraph of 362 reference is made to 363; the first paragraph has *Trichospermum javanicum* (*Tiliac.*). This arrangement again suggests relationships existing among the families determined here.

In the current taxonomical works some data are found in support of a closer relationship among these families than is usually believed to exist. They agree in referring *Sterculiaceae* and *Tiliaceae* to the same Order.

Durand (cf. Nr 363) placed *Lythrarieae* and *Rosaceae* into two consecutive "cohortes" (11 and 12) of the *Calyciflorae.* In "cohors" 15 (*Calyciflorae*) the *Araliaceae* are found (Nr 354). Engler-Gilg bring the *Araliaceae* and *Lythrarieae* to "Reihe" 30 of *Umbelliflorae* and "Reihe" 29 of *Myrtiflorae.*

In conclusion I wish to refer to the "Mikrographie" where I placed *Maoutia diversifolia* (vol. 6, p. 18, § 2) into Group I, § 2 of *Urticaceae*; this species occurs under Nr 352 in the Chief Key. The *Urticaceae* found in 358, 359, 360, and 361 form one intimately related section "α" in Group II.

I examined only two genera of *Compositae* (*Vernonia* and *Anaphalis*); their wood-anatomy is widely different (cf. l. c. vol. 4, p. 252, also footnote p. 256, Note 19; *Vernonia arborea* var. *javanica* was also comprised in Nr 272).

Melochia indica (Nr 357) is group II of *Sterculiaceae* and *Trichospermum javanicum* (cf. Nr 362) is section "e" in Group I of *Tiliaceae* (cf. l. c., vol. 1, pp. 418 and 481).

Among *Lythrarieae* the wood-anatomy is very variable (cf. l. c., vol. 3, p. 575, § 2; Notes 20 and 28, passim).

Note 26. Sapotaceae, Euphorbiaceae, Myrtaceae, Sterculiaceae, &c.

The section in the Chief Key represented by Nrs 365 to 385 contains 35 kinds of wood belonging to 9 families, viz. *Sapotaceae, Euphorbiaceae, Myrtaceae, Sterculiaceae, Scrophularineae, Tiliaceae, Olacineae, Rubiaceae,* and *Boragineae.*

These woods show generally the same characteristics as those discussed in the previous paragraph. In contrast, however, the wood parenchyma is abundant or very abundant (Nr 351, second par.). The metatracheal wood parenchyma lamellae only short in a tangential direction, on transverse section often interrupted or merging. In a radial direction as a rule one, more rarely 2 or 3 cells thick, often passing gradually

into the parenchyma among the libriform fibres (diffuse parenchyma) (Nr 364, first par.).

Nr 376 (first par.) has the *Sterculiaceae* represented by several species; the second paragraph contains *Wightia gigantea* (*Scrophul.*) (see also Note 24, and Nr 334).

Nr 375 (second par.) leads to 376; the first paragraph has *Barringtonia spicata, B. insignis,* and *B. gigantostachya* (*Myrtac.*); the latter occurs also in Nr 380.

Nr 383 (first par.) contains *Sterculia foetida* (*Stercul.*) and the second paragraph has *Ehretia javanica, E. dichotoma,* and *E. acuminata* (*Boragin.*). Between Nrs 375 and 383 *Schoutenia buurmanni* (*Tiliac.*) occurs in Nr 379, and in Nr 380 *Barringtonia gigantostachya* (*Myrtac.*). This suggests affinity among these families.

The current taxonomical works indicate some relation among these families, but opinions do not agree.

Unanimously, *Sterculiaceae* and *Tiliaceae* are referred to the same Order. Hutchinson placed *Euphorbiaceae* in the same group of related Orders.

Durand refers *Scrophularineae* and *Boragineae* to "cohortes" 9 and 8 of Series III in the *Bicarpellatae* (*Gamopetalae*).

Engler-Gilg arrange them in different "Unterreihen" in "Reihe" 6 of the *Tubiflorae*; Hutchinson refers the first to *Personales* (Order 75) and the second to *Boraginales* (Order 73) but these two Orders are not considered to be related. Nevertheless, Hutchinson suggests some affinity for the *Ebenaceae* and *Sapotaceae* with *Anonaceae* (Notes on Affinity, p. 23) and thinks that the *Euphorbiaceae* ("a composite family") may be "derived from several sources such as *Tiliales, Malvales* etc." (l. c. p. 19). The *Myrtales* (p. 17) are "probably epigenous representatives of the *Theales* and some *Tiliales*". The *Tiliales* (p. 18) are: "a fairly advanced group whence considerable evolution is evident, i. e. to *Celastrales, Rhamnales,* and the bulk of *Euphorbiaceae* (apetalous types)". The *Olacales* (p. 21) are: "more advanced types of the preceding group of the *Celastrales*" and "perhaps discoid types descended from the *Tiliales* and *Theales* etc.".

On account of the wood-anatomy I suggested a very close relationship between *Ebenaceae* and *Sapotaceae* (Mikrogr. 4, p. 421, § 2). Group II in the *Euphorbiaceae* (all kinds found under 372 and 373) I found, as regards their wood-anatomy, much relation to *Ebenaceae, Sapotaceae,* and *Anonaceae* (l. c., vol. 5, p. 467).

Nrs 377 and 378 contain *Pterospermum javanicum, Pt. javanicum* var. *montanum,* and *Pt. diversifolium, Tarrietia sumatrana* and *Heritiera littoralis,* all belonging to Group II, which I distinguished in *Sterculiaceae. Sterculia foetida,* placed in Nr 383, belong to Group I of *Sterculiaceae. Schoutenia buurmanni* is found in Nr 379 and so succeeds immediately the species of Group II of *Sterculiaceae* (cf. also Note 6). I find no support in the current taxonomic work for a closer relationship among these or other groups arranged in this section of the Chief Key.

Note 27. Sterculiaceae, Guttiferae, Urticaceae, Myrtaceae, and Oleaceae.

The sections of the Chief Key from Nr 385 to Nr 414 comprises 106 kinds of wood, belonging to 5 families, viz. *Sterculiaceae, Guttiferae, Urticaceae, Myrtaceae,* and *Oleaceae.*

These woods are distinguished from those discussed in the previous Note by the metatracheal wood parenchyma lamellae which are distinctly longer, though varying in length, in a tangential direction, in transverse section much less often interrupted or merging, and considerably thicker radially; they do not change into diffuse parenchyma among the libriform fibres (Nr 364, second par.).

Only 15 numbers lead through the Key to this section which is inadequate stress on their close resemblance.

Twice occur three families in company. Nr 386 has *Firmiana colorata* (*Stercul.*) in the first paragraph; in the second occur *Garcinia celebica, G. balica, G. dulcia, G. salakensis* (*Guttif.*), *Streblus asper,* several spp. of *Ficus* and three *spp.* of *Celtis* (*Urtic.*), (cf. also Note 31 and 34).

Nr 401 has *Fraxinus eedenii* (*Oleac.*) in the first paragraph; in the second two *Garcinia* species occur (*Guttif.*), and numerous *Myrtaceae* spp. The first paragraph of Nr 400 refers to Nr 401 and the second contains the *Myrtaceae.* Many *Eugenia* spp. (*Myrt.*) are placed in 411, 412, and 413, in relation with many other *Eugenias* in the preceding numbers.

Relationship between two of the five families is now and then suggested in the usual taxonomical works, but the suggestions are of a different nature.

Durand placed *Sterculiaceae* and *Guttiferae* in resp. "cohors" 6 of the *Malvales* and "cohors" 5 of the *Guttiferales* (in Series I of the *Thalamiflorae*). The *Myrtaceae* are referred to "cohors" 12 of the *Myrtales* (Series III of the *Calyciflorae, Polypetalae*).

Engler-Gilg placed *Sterculiaceae, Guttiferae,* and *Myrtaceae* resp. in "Reihe" 26 (*Malvales*), "Reihe" 27 (*Parietales*), and "Reihe" 29 (*Myrtiflorae*). Hutchinson referred *Sterculiaceae* to *Tiliales* (Order 35), *Guttiferae* to *Guttiferales* (Order 34) and *Myrtaceae* to *Myrtales* (Order 33); Orders 33 and 34 belong to a group of related Orders.

Hutchinson stated concerning *Guttiferales* (Notes on Affinity, p. 18): "showing the same tendency as in the *Malvales,* i. e. stamens gathered into bundles" and the *Malvales* (Order 36) succeed the *Tiliales* in one group of more intimately related Orders. On *Myrtales* Hutchinson (l. c. p. 17) remarked: "probably epigenous representatives of the *Theales* and some *Tiliales* with leaves becoming opposite".

I examined only two genera of *Guttiferae* and found their wood-structure widely different (Mikrogr. 1, p. 254, § 2). In *Garcinia* I studied 6 species, all included in this section but not a single species of *Calophyllum* (the second genus of *Guttiferae* studied) is present (cf. also Note 31).

Firmiana colorata (*Stercul.*) is met with in Nr 386 (first paragraph) and somewhat related to *Guttiferae* but not to *Urticaceae,* judging by the data contained in the current taxonomical works. Nevertheless, the second paragraph of 386 has both the latter families. Nrs 387 to 397 have species

belonging to the two families and 397 and succeeding numbers contain 7 species of *Sterculia* (*Stercul.*).

The first paragraph of 401 has *Fraxinus cedenii* (*Oleac.*) and the second *Guttiferae* and *Myrtaceae*. I find no data sustaining a view towards a closer relationship in the usual taxonomical works.

Note 28. Euphorbiales, Ebenales, Malvales, and Sapindales, and their relationships.

The section in the Chief Key extending from 431 to 497 has 112 kinds of wood which have many characters in common and, moreover, are characterized by (cf. Nr 427, second par.) the following.

The medullary rays form a minor part of the wood, the second type of rays is less wide and less high, more rarely or never 2 or 3 of these wider medullary rays occur vertically above each other. In transverse sections the metatracheal wood parenchyma lamellae show either blind endings or are interrupted; they do not connect the wider medullary rays. The vessels do not border on the inner side of the metatracheal wood parenchyma lamellae and the vessel groups do not consist as a rule of 2—5 vessels adjacent in a tangential direction. The libriform fibres are shorter than 2300 μ.

Fifteen families are represented: *Apocynaceae, Urticaceae, Anacardiaceae, Euphorbiaceae, Sterculiaceae, Oleaceae, Myrtaceae, Tiliaceae, Datiscaceae, Laurineae, Ebenaceae, Lythrarieae, Rosaceae, Cornaceae,* and *Juglandeae.*

The section as a whole may be subdivided but only for reasons of small taxonomical value. It is better discussed as a single unit.

Several families occur more than once e.g. *Apocynaceae* 4 times, *Anacardiaceae* twice, *Euphorbiaceae* 5, *Sterculiaceae* 3, *Oleaceae* 2, *Myrtaceae* 3, and *Tiliaceae* 2 times. This stresses the similarities in wood-structure existing among these families (cf. also Note 35), a resemblance which is inadequately indicated by the short way through the key leading to this section (16 numbers).

In the current taxonomical works some relationship between two (sometimes more) of the families are indicated but, again, opinions vary.

Durand arranged *Apocynaceae* and *Oleaceae* both into "cohors" 7 (*Gentianales*) in Series III of *Bicarpellatae* (*Gamopetalae*).

Engler-Gilg referred these two families to "Reihe" 5 of *Contortae* but to a different "Unterreihe". Hutchinson placed them successively in Order 65 (*Apocynales*) and 64 (*Loganiales*), these Orders belong to a larger group of related Orders.

Durand placed *Ebenaceae* into "cohors" 6 (*Ebenales*) of Series II (*Heteromerae*) in *Gamopetalae*; a weak link with both the previously mentioned families. Engler-Gilg put *Ebenaceae* into "Reihe" 4 (*Ebenales*) and Hutchinson into Order 61 (*Ebenales*) which belong to the same group as *Apocynales* and *Loganiales.*

Hutchinson remarked (Notes on Affinity, p. 25) concerning *Apocynaceae*: "Advanced fixed types from the preceding group and perhaps from *Sapotaceae.*" Now the Order 61 (*Ebenales*) is composed of *Ebenaceae* and *Sapotaceae.*

Concerning *Oleaceae* Hutchinson said (l. c., p. 24), considering the Order 64 (*Loganiales*): "a very mixed group either mimicking or having direct affinity with several other families, such as *Rubiaceae, Melastomaceae, Apocynaceae,* etc."

Sterculiaceae and *Tiliaceae* belong both, according to Durand to "cohors" 6 (*Malvales*) of Series I (*Thalamiflorae*) of the *Polypetalae*. Engler-Gilg refer them to "Reihe" 26 (*Malvales*) but to different "unterreihen". Hutchinson placed them into Order 35 (*Tiliales*).

In his "Notes on Affinity" (p. 18) Hutchinson considered the *Tiliales* to be: "A fairly advanced group whence considerable evolution is evident, i. e. to *Calastrales, Rhamnales* and the bulk of *Euphorbiaceae* (apetalous types)."

Euphorbiaceae and *Tiliales* are placed in the same group of related Orders; they occur also repeatedly in the present section of the Chief Key.

Durand placed into Series VII (*Unisexuales*) of the *Monochlamydeae*, the *Euphorbiaceae, Urticaceae,* and *Juglandeae*. The *Euphorbiaceae* are put by Engler-Gilg into the 23rd "Reihe" (*Geraniales*), the *Urticaceae* to the 12th "Reihe" (*Urticales*) and the *Juglandeae* into the 8th "Reihe" (*Juglandales*). Hutchinson referred the three families resp. to Order 38 (*Euphorbiales*), Order 50 (*Urticales*), and Order 58 (*Juglandales*). The degree of relationship is, it will be admitted, valued very differently.

Hutchinson stated on *Euphorbiales* (l. c., p. 19), represented only by the *Euphorbiaceae*: "a composite family probably derived from several sources such as *Bixales, Tiliales, Malvales, Celastrales,* and perhaps *Sapindales.*" A perusal through the section of the Chief Key now under discussion, will show that the arrangement of families agrees fairly well with Hutchinson's views.

The *Anacardiaceae* are kept apart by Durand from the families occurring in this section of the Key. Engler-Gilg refer them to "Reihe" 24 (*Sapindales*); Hutchinson to Order 57 (*Sapindales*). Order 57 is placed with Order 58 (*Juglandales*) and Order 59 (*Umbelliflorae*) which includes the *Cornaceae,* into one group of related Orders. Hutchinson (l. c., p. 22) further thinks: "*Sapindaceae* and *Anacardiaceae* especially related to some *Euphorbiaceae,* from some of which part of the latter may have arisen."

In the light of what has been said so far, it seems that the amount of relationship among *Anacardiaceae, Juglandeae,* and *Euphorbiaceae* is judged very differently. In this section of the Chief Key the two first families do not occur close together.

Durand placed the *Myrtaceae* and *Lythrarieae* into "cohors" 12 (*Myrtales*) of Series III in the *Calyciflorae* (*Polypetalae*). The following families occur in the section of the Chief Key belonging to Series III: *Rosaceae* (*Rosales* or "cohors" 11), *Datisceae* (*Passiflorales* or "cohors" 13), *Cornaceae* (*Umbellales* or "cohors" 15). Durand thus brings these five families to the same Series and believes them to be more or less related. Engler-Gilg placed *Myrtaceae* and *Lythrarieae* into the same "Unterreihe" (*Myrtineae*) of "Reihe" 29 (*Myrtiflorae*), *Rosaceae* into "Reihe" 21 (*Rosales*), *Datiscaceae* into "Reihe" 27 (*Parietales*), and *Cornaceae* into "Reihe" 30 (*Umbelliflorae*).

Hutchinson referred *Myrtaceae* to Order 33 (*Myrtales*), *Lythrarieae* to

Order 21 (*Lythrales*), *Rosaceae* to Order 40 (*Rosales*), *Datiscaceae* to Order 30 (*Cucurbitales*), and *Cornaceae* to Order 59 (*Umbelliflorae*). Again, relationships are judged very differently. Engler-Gilg brought *Tiliaceae* and *Sterculiaceae* to *Malvales* ("Reihe" 26) and to the next "Reihe" (27, *Parietales*) the *Datiscaceae*. Now, *Datiscaceae* and *Tiliaceae* occur both under Nr 451 (see also below).

Hutchinson (p. 17) said about the *Myrtales:* "probably epigenous representatives of the *Theales* and some *Tiliales* with leaves becoming opposite."

In the now discussed section of the Chief Key, *Myrtaceae* are found e. g. under Nrs 470 and 478. Between those numbers, *Lythrarieae* are inserted in 473 and *Rosaceae* in 476; *Cornaceae* occur in 481, 485, 486, and 487. *Datiscaceae* were placed in Nr 451, and several *Myrtaceae* in 446, 447, 448, and 449.

The current taxonomical works have no indications towards a closer relationship between *Laurineae* and the remaining 14 families occurring in this section. *Cryptocarya densiflora* is the only representative; its wood has neither oil nor mucilage cells (cf. Note 19).

In the "Mikrographie" four species of *Alstonia* are described; three resemble each other closely (*A. scholaris, A. angustiloba,* and *A. spatulata*) and the fourth (*A. villosa*) is rather different (cf. l. c., vol. 4, p. 573, § 2). *Alstonia villosa* is placed in 480 whereas the three other *Alstonias* are placed in 488, 489, and 490. The position is well supported in Engler & Prantl IV, 2 (1895) by K. Schumann and also by Bentham & Hooker (vol. 2, p. 705).

Bouea macrophylla (*Anacardiac.*) belongs to group I distinguished by me in *Anacardiaceae* (l. c. vol. 2, p. 447, § 2), and *Semecarpus* to the second group. In the Key this is reflected by their position in Nrs 436 and 445.

The woods of group II of *Euphorbiaceae* (l. c., vol. 5, p. 467) resemble those of *Ebenaceae, Sapotaceae,* and the whole of *Anonaceae.* The family of *Ebenaceae* is found in the present section of the Key close to the representatives of group II (*Euphorb.*; l. c., vol. 5, p. 459).

Two widely different groups compose the family of *Oleaceae* (l. c., vol. 4, p. 518). All members of the first group are placed into this section; *Ligustrum glomeratum* represents the second group and is found in a widely different place.

The first sub-group "a" of group II in *Myrtaceae* (l. c., vol. 3, p. 393) is entirely contained in Nrs 447, 448, and 449. Of the sub-group "b" (cf. 412) is present *Eugenia densepunctata* (in 448) which is to be explained from its position nearest to "a" in sub-group "b" (l. c., p. 393).

Sub-group "c" of group I in *Tiliaceae* (l. c., vol. 1, p. 482, § 2) is composed of *Grewia celtidifolia, G. excelsa,* and *G. eriocarpa* and sub-group "d", composed of *G. laevigata* and *G. laevigata* var. *oblongifolia,* is found in 450 and 451 (cf. also Notes 5 and 6).

The position of the two genera of *Ebenaceae* is to be understood from my earlier work (l. c., vol. 4, p. 421).

Lythrarieae occur only in 473 within the section, i. c. *Crypteronia paniculata* and its variety *leptostachya*; they are also found in 363. The

genera of this family are very different (cf. l. c., vol. 3, p. 575, and Note 25).

Of *Cornaceae*, for similar reasons, species of *Marlea* only are found in 485, 486, and 487. *Marlea javanica*, however, was inserted as early as Nr 56 (cf. Note 13, and l. c., vol. 3, p. 705, § 2).

In the section now under discussion, some numbers contain two families; this close proximity, again, may point to a closer relationship than was thought to exist.

Nr 436 has (first par.) a species of *Anacardiaceae* and (second par.) a species of *Euphorbiaceae*. The characters mentioned in the preceding 20 numbers leading to Nr 436 are shared by these two species. Regarding the accepted relationship between *Anacardiaceae* and *Euphorbiaceae*, I refer to what was said in Notes 2, 4, and 19. The first paragraph of 435 refers to 436 and the second has several *Urticaceae*. This suggests links between the latter family to both the previously mentioned but there is no support in the current taxonomical works.

Nr 445 has two species of *Semecarpus* (*Anacardiac.*) in the first paragraph; in the second *Fraxinus eedenii* (*Oleac.*).

Nr 446 (first par.) contains *Chionanthus macrocarpa* (*Oleac.*) and (second par.) many *Eugenia* spp. (*Myrtac.*). Considering the position as present in Nrs 436, 445, and 446 it seems that the wood-anatomy suggests a much closer relationship among *Anacardiaceae, Euphorbiaceae, Oleaceae* and *Myrtaceae* than was hitherto suspected.

Nr 451 (first par.) has *Tiliaceae*, represented by *Grewia laevigata* and its variety *oblongifolia*; the second paragraph contains *Datiscaceae* (*Tetrameles nudiflora*). The long way by which they are reached in the Key points to a great similarity in their wood-anatomy.

Durand and Hutchinson do not suggest any relationship between these two families. Engler-Gilg refer them to 2 successive "Reihen". Referring to what has been said earlier in this Note, I quote (Engler & Prantl, 1st ed., III, 6a): (transl.) "the affinities of *Datiscaceae* have often been discussed but no agreement was reached."

Nr 454 has *Sterculiaceae*, i. e. *Pterospermum javanicum*, its variety *montanum*, and *Pt. diversifolium* (first par.); the second paragraph has several species of different genera in *Euphorbiaceae*. Durand and Engler-Gilg do not suggest any closer relationship but Hutchinson thinks they are related (cf. above and Hutchinson l. c., p. 18, 19).

No support is found, apart from what has been cited previously, towards a conception of closer relationship in the following cases of families in juxtaposition: Nr 473 (*Lythrarieae* and *Euphorbiaceae*), Nr 475 (*Apocynaceae* and *Tiliaceae*; cf. also Note 6), Nr 478 (*Sterculiaceae* and *Myrtaceae*; cf. also Hutchinson, l. c. p. 17), Nr 481 (*Euphorbiaceae* and *Cornaceae*) and the complex Nrs 491 and 488 (*Juglandeae, Oleaceae,* and *Apocynaceae*; cf. also Hutchinson l. c. p. 24 and 25).

Note 29. Myrsineae, Moringeae, Malvaceae, Capparidaceae, Boragineae, and Leguminosae.

The section of the Chief Key extending from Nr 499 to Nr 515, contains 23 kinds of wood. In addition to the characters mentioned in the

numbers leading to this section (13 in total) they have the following characteristics in common. All or nearly all medullary ray cells are procumbent; the cells of the upper and lower radial row (c. q. rows) usually only rarely upright or more or less resembling upright cells (Nr 497, second par.). The wood parenchyma without crystals, or not immediately adjacent to vessels, is composed of substitute parenchyma fibres and of wood parenchyma strands which have always, or nearly always, only one partition wall (Nr 498, first par.). Five families are represented in this section, viz. *Myrsineae, Moringae, Malvaceae, Capparidaceae, Borragineae,* and *Leguminosae* (*Papilionaceae*).

The comparatively short way by which the section is reached, is insufficient accent on their similarity while the peculiar characteristics of the wood parenchyma suggest rather strongly that a definite relationship may axist among them.

Nr 505 has in the first paragraph all *Papilionaceae* examined by me, and in the second paragraph *Cordia suaveolens* (*Borragineae*).

In the first paragraph of Nr 504 reference is made to Nr 505, and in the second paragraph *Crataeva nurvala* (*Capp.*) is met with. This arrangement of the three families suggests relationship.

Durand referred *Malvaceae* and *Capparideae* resp. to "cohors" 6 (*Malvales*) and "cohors" 2 (*Parietales*), both part of Series I (*Thalamiflorae*) in *Polypetalae*. The *Myrsineae* and *Borragineae* are resp. placed into "cohors" 5 (*Primulales*) and "cohors" 8 (*Polemoniales*) both belonging to *Gamopetalae* in the *Polypetalae*.

Engler-Gilg referred *Moringeae* and *Capparideae* both to "Reihe" 19 (*Rhoeadales*) and resp. to "Unterreihe" 4 (*Moringineae*) and "Unterreihe" 2 (*Capparideae*). To some degree, this corresponds with the placing of *Leguminosae* into "Reihe" 21, the *Rosales*.

Hutchinson arranged *Moringeae* and *Capparideae* as succesive families (37 and 36) in Order 10 (*Capparidales*).

The *Leguminosae* examined by me (Mikrogr. 3) were separated into 3 groups (l. c., p. 24, § 2) and the first group, *Papilionaceae*, is found in this section of the Key. This is supported by Hutchinson's remark (Notes on Affinity, p. 19) when he stated that the *Papilionaceae* are a very natural family.

Similarly, I divided *Malvaceae* also into 3 groups (Mikrogr. 1, p. 378, § 2). The first group is distinctly different from the remaining two, which explains that only this first group is contained in the section of the Key under discussion now.

Aegiceras corniculatum occupies an isolated place in *Myrsineae* (l. c., vol. 4, p. 298, § 2). It is the only representative of the family in this section.

For similar reasons, *Cordia suaveolens* (cf. l. c., vol. 4, p. 689) is in the present section the only representative of *Borragineae*.

I note finally that all kinds of wood in the section, except *Crataeva nurvala*, have the storied wood structure.

Note 30. Meliaceae, Combretaceae, and Rutaceae.

The woods contained in the section extending from 517 to 547 in the

Chief Key are characterized by the following: wood parenchyma without crystals or not immediately adjacent to vessels, consisting of substitute parenchyma fibres and wood parenchyma strands, or only of wood parenchyma strands, all or for the greater part with more than 3 partition walls (Nr 516, first par.). The characters typifying section 499—515, are also present here. The present section falls apart into three smaller groups (cf. Nr 517). The first extends 518 to 523 and is distinguishable on account of the wood parenchyma being rare to very rare. This first part has 13 kinds of wood belonging to *Meliaceae, Combretaceae,* and *Rutaceae.*

Being placed higher in the Key the resemblance to each other of these woods is still greater than among the woods discussed in the previous Note.

Nr 519 contains *Lumnitzera* (*Combret.*) as the genus; the species are placed in Nr 520 and their wood-anatomy is very similar. The three kinds recur in Nrs 549 and 550 (cf. Note 33). In 519 (second par.) *Rutaceae,* as a family, are found; seven kinds occur in 521, 522, and 523 and closely resemble each other (cf. Mikrogr. 2, p. 19, 20, § 2). The arrangement of these woods in the Nrs 522 and 523 is entirely in keeping with my previous results. These 7 Rutaceous woods recur in 556 and 557, while *Murraya exotica* var. *sumatrana* is also met with in Nr 539 (cf. Notes 32 and 33).

Nr 518 has in its second paragraph a reference to 519 and in its first *Meliaceae,* as a family represented by three kinds of *Cedrela.* The arrangement in these numbers suggests a close relationship among the three families; most closely related are, I believe, *Combretaceae* and *Rutaceae.* Some information concerning a relationship between *Meliaceae* and *Rutaceae* may be derived from Notes 31 and 33. The relationship between *Meliaceae* and *Combretaceae* was also suggested in Note 1 and as affinity was suspected there for other reasons, the evidence offered in this present Note supports my earlier statements.

The usual taxonomical works have some data which support my conclusions to some extent.

Durand referred *Meliaceae* and *Rutaceae* to "cohors" 7 (*Geraniales*) of Series II (*Disciflorae*) in the *Polypetalae.* Engler-Gilg placed them into the "Unterreihe" *Geraniineae* in the *Geraniales.* Hutchinson arranged them in Order 56 (*Meliales*) and Order 55 (*Rutales*) and refers these Orders to a group of related ones. *Combretaceae* are, however, kept quite apart by all authors.

In the "Mikrographie" I distinguished four groups in *Meliaceae* (l. c., vol. 2, p. 116, § 2); the second group comprises *Cedrela* and is rather isolated. This explains why only *Cedrela* occurs in this section and no other *Meliaceae.*

Note 31. Rutaceae, Guttiferae, Hypericineae, Meliaceae, and Urticaceae.

The second sub-section of the three indicated in the preceding Note comprises Nrs 524 to 531. It is distinguished by abundant or very abundant wood parenchyma, especially the metatracheal parenchyma (cf. Nr 517, second par.).

Twenty two kinds of wood were referred to it, belonging to *Rutaceae,*

Guttiferae, Hypericineae, Meliaceae, and *Urticaceae.* The similarity of these kinds of wood is generally the same as that found in the first subsection, the places in the Key being the same.

Nr 524 (first par.) has 5 *Evodia spp.* (*Rutac.*), closely allied as regards their wood anatomy. *Rutaceae* are also found in 520, 521, 522, and 523.

Nr 527 (first par.) has *Cratoxylon* (*Hyper.*) as a genus; the species are placed in 528 and resemble each other closely (cf. also Mikrogr. 1, p. 242, § 2). Under Nr 527 *Walsura pinnata* is met with (*Meliac.*). The second paragraph of 526 has a reference to 527 while in the first paragraph of 526 are found 5 *spp.* of *Calophyllum* (*Guttif.*). The *Calophyllums* are very similar (cf. also Notes 32, 34, and 35).

The arrangement of the three families discussed so far, suggests a close relationship, closest perhaps between *Hypericineae* and *Meliaceae.*

Nr 531 (first par.) has *Gironniera cuspidata* (*Urtic.*) and *Garcinia celebica* (*Guttif.*) in the second paragraph. Nr 530 (first par.) refers to 531, and the second paragraph of 530 has four out of six *Garcinia* species examined by me.

In Nr 529 (first par.) Guttiferous *Garcinia dioica* occurs and the second paragraph refers to 530. Nr 529 has been split into two paragraphs on account of a character of slight taxonomical value. All *Garcinias* recur in the Key (cf. Note 34).

The position of *Gironniera cuspidata* and the 6 *Garcinia spp.* suggests a possible relationship between *Urticaceae* and *Guttiferae.* It seems to be, however, a somewhat isolated point of contact, as *Gironniera cuspidata* is aberrant in its wood-anatomy from *Urticaceae* as a whole (cf. l. c., vol. 6, p. 21, 22, § 2). It is to be noted, on the other hand, that in Nr 386 are combined four *spp.* of *Garcinia* and several *Urticaceae* (cf. Note 27).

The genera *Calophyllum* and *Garcinia,* both belonging to *Guttiferae,* differ in their wood-anatomy wider than is usually found in the genera of a single family (cf. l. c., vol. 1, p. 254, § 2). For this reason they were placed under different, quite separate, numbers in this section of the Key.

Some data in support of an affinity among the families now being considered may be derived from the current taxonomical works.

Durand placed *Hypericineae* and *Guttiferae* as consecutive families into "cohors" 5 (*Guttiferales*) of Series I (*Thalamiflorae*) in *Polypetalae.* Hutchinson accepted them as families 123 and 126 resp. in Order 34 (*Guttiferales*). Engler-Gilg referred to sub-family *Hypericoideae* (in the family *Guttiferae*), *Cratoxylon, Calophyllum* and *Garcinia.*

Durand arranged *Rutaceae* and *Meliaceae* into "cohors" 7 (*Geraniales*) of Series II (*Disciflorae*) of *Polypetalae*; Engler-Gilg placed them into the same "Unterreihe" (*Geraniineae*) of "Reihe" 23 (*Geraniales*). Hutchinson considered *Rutaceae* to belong to Order 55 (*Rutales*) and *Meliaceae* to Order 56 (*Meliales*) and the Orders to a group of related Orders. All authors keep *Urticaceae* quite apart.

I refer further to Notes 30, and 32 and wish to attract attention to the fact that the relationships suggested in this present Note are again stressed in Notes 30 and 32, on different counts which strengthens my conclusions.

Note 32. Rutales, Meliales, Sapindales, Guttiferales, and Tiliales.

The third of the three sub-sections distinguished in Note 30, is comprised by Nrs 532 to 547. This third sub-section is distinguished by the presence of neither rare nor abundant wood parenchyma (Nr 517, third par.).

Twenty-five kinds of wood are represented, belonging to *Euphorbiaceae, Guttiferae, Cupuliferae, Lythrarieae, Rutaceae, Sapindaceae, Meliaceae, Simarubaceae,* and *Tiliaceae.*

It may be deduced from the position of this sub-section in the Key that the similarity among these woods is approximately the same as existing in the preceding two sub-sections.

Among these 9 families, three occur more than once.

Euphorbiaceae (*Homalanthus populneus* and *H. giganteus*) are found in Nr 533 (second par.) and in Nr 534 (first and second par.), *Excoecaria virgata* is met with in Nr 536 (first par.) and *Gelonium glomeratum* in Nr 540 (first par.).

I found (Mikrogr. 5, p. 460 and 467, § 2) that both the species of *Homalanthus* and *Excoecaria* resemble each other very closely whereas *Gelonium glomeratum* is a transition between *Homalanthus* and the rest of the second group in *Euphorbiaceae,* which I distinguished on account of wood-anatomical characters (cf. l. c.; and also Note 35). The kinds of wood occurring between 533 and 540 (Euphorb.) closely resemble the species just mentioned and each other.

Of *Rutaceae* occurs *Murraya exotica* var. *sumatrana* in Nr 539 (second par.); the same variety is found under Nrs 523 (cf. Note 30) and 557 (Note 33). *Aegle marmelos, Micromelum pubescens,* and *M. pubescens* var. *denticulata* were referred to 545 and 547, the first recurring in 605, and Aegle and both the *Micromelums* in 604 (cf. Note 35).

This arrangement is in accordance with my findings (l. c., vol. 2, p. 19, § 2).

Meliaceae are represented in Nr 541 (first par.) by *Melia azedarach, M. azedarach* var. *javanica, M. bogoriensis,* and *M. composita.* They recur in 597 and resemble each other closely. The same applies to *Sandoricum indicum* and *S. nervosum* (occurring in 544, first paragraph, and recurring in 611; cf. also Note 35).

It is to be noted, however, that the woods of *Melia* and *Sandoricum* are so widely different (cf. l. c., vol. 2, p. 116, § 2) that on account of their wood-anatomy they suggest to be separate families.

Duabanga moluccana (*Lythrar.*) was placed into Nr 536 (second par.) side by side with *Excoeraria* (see above and Note 20). When discussing *Lythrarieae* I stated (l. c., vol. 3, p. 575, § 2): (transl.) "The 4 genera examined cannot be divided into groups according to their wood-structures; the differences among them are too wide. At best it would seem possible to bring *Lagerstroemia* and *Duabanga* to one group." It was further said (l. c., p. 576): (transl.) "It appears that the differences among *Sonneratia, Lagerstroemia,* and *Duabanga* are so wide that they seem to belong to different families."

The first paragraph of Nr 535 refers to 536; the second paragraph

contains 5 *Calophyllum species* (*Guttif.*), all I examined, and the third paragraph has the genus *Castanea* (*Cupulif.*). I examined 3 species of *Castanea*, all closely alike, and found under 537 and 538. The five *Calophyllums* were already referred to 526 (cf. Note 31) and recur twice again (cf. Notes 34 and 35). This arrangement supports the views towards a closer relationship among these four families suggested in previous Notes on different grounds.

Nr 540 (first par.) has *Euphorbiaceae* (*Gelonium glomeratum*) and the second paragraph has *Sapindaceae* (*Harpullia imbricata* and *H. cupanioides*). Both species recur in 590 (cf. Note 35), they are closely alike and the latter is mentioned in the foot-note to 532.

Nr 539 (first par.) refers to 540 and the second paragraph contains *Murraya exotica* var. *sumatrana* (*Rutac.*) which was also placed into 523 (cf. Note 30) and recurs in 557 (Note 33). It is again apparent that the arrangement of these three families is in accordance with affinities suggested in previous Notes.

Nr 545 contains *Berria ammonilla, B. quinqueloculari*s and *Pentace polyantha* (*Tiliac.*), which are also found in Nr 546. In the second paragraph of 545 occur *Aegle marmelos, Micromelum pubescens*, and *M. pubescens* var. *denticulata* also occurring in 547. All this is in accordance with my earlier results (l. c., vol. 2, p. 19, § 2). *Pentace polyantha* recurs in 602 (cf. Note 35). *Aegle marmelos* recurs in 605 (cf. Note 35). Both *Micromelums* are found again in 604 (cf. Note 35). In Nr 544 (second paragraph) occurs a reference to 545, and in the first paragraph are found two species of *Sandoricum* (*Meliac.*), all I examined and closely alike. They occur both in 611 (cf. Note 35).

Earlier in this Note, it was pointed out why the species of *Melia* are absent in 541.

Some data on the affinities existing among the nine families discussed in this present Note, are found in the current taxonomic works. They are of a various character.

Durand placed *Rutaceae, Meliaceae*, and *Simarubeae* into "cohors" 7 (*Geraniales*) of Series II (*Disciflorae*) in *Polypetalae*, and the *Tiliaceae* into "cohors" 6 (*Malvales*) of Series I (*Thalamiflorae*) in *Polypetalae*, while he referred to "cohors" 5 (*Guttiferales*) the *Guttiferae*, in the same series I. *Sapindaceae* he arranged in "cohors" 10, *Sapindales* of the Series II (*Disciflorae*), and *Lythrarieae* to "cohors" 12 (*Myrtales*) in Series III (*Calyciflorae*) in *Polypetalae*. The *Euphorbiaceae* and *Cupuliferae* went into Series VII of the *Unisexuales* of the *Monochlamydeae*; the *Euphorbiaceae* forming the first and *Cupuliferae* the final family of the Series.

Engler-Gilg assigned *Rutaceae, Meliaceae* and *Simarubeae* to the first "Unterreihe" (*Geraniineae*) of "Reihe" 23 (*Geraniales*). *Euphorbiaceae* were placed into "Unterreihe" 5 (*Tricoccae*) of "Reihe" 23. *Sapindaceae* were brought to "Reihe" 24 (*Sapindales*), *Tiliaceae* to "Reihe" 26 (*Malvales*), *Guttiferae* to "Reihe" 27 (*Parietales*), *Lythrarieae* to "Reihe" 29 (*Myrtiflorae*), and the *Fagaceae* to "Reihe" 11 (*Fagales*).

Hutchinson referred *Rutaceae* (family 194) and *Simarubaceae* (family 195) to the *Rutales* (Order 55), *Meliaceae* to Order 56 (*Meliales*),

and *Sapindaceae* (family 198) to Order 57 (*Sapindales*). *Guttiferae* (family 126) belong to Order 34 (*Guttiferales*) and *Tiliaceae* to *Tiliales* (family 128, Order 35). Both the latter Orders belong to another group of related Orders.

His views on the affinity of *Tiliales* and *Euphorbiaceae* were cited before (cf. Notes 2, 16, and 19).

Lythraceae are referred by Hutchinson as family 72 to Order 21 (*Lythrales*), *Fagaceae* (family 163) to Order 48 (*Fagales*). Concerning *Sapindales* Hutchinson stated (Notes on Affinity, p. 22): "*Sapindaceae* and *Anacardiaceae* especially related to some *Euphorbiaceae*, from some of which part of the latter may have arisen."

Finally I wish to stress that *Rutaceae* and *Meliaceae* represented in this section of the Key, seem to be related (cf. Notes 30 and 31). The present Note contains some good examples of a repeated occurrence in company of some families which stresses very effectively any opinion of a closer relationship than was suspected for the usual taxonomical reasons.

Note 33. Combretaceae, Gesneraceae, Capparidaceae, Aceraceae, and Rutaceae.

The section of the Key from 548 to 623 contains woods distinguished by the same characters as found in the section 499 to 515. It is different, however, in having the wood parenchyma (when without crystals or not adjacent to vessels) composed of strands only or together with substitute parenchyma fibres; the strands have all, or in majority, at the utmost 2 or 3 partition walls (Nr 516, second par.). This section is subdivided into 3 smaller sub-sections; the first extends from 549 to 557 and is distinguished by the presence of rare or very rare wood parenchyma.

Fourteen kinds of wood are represented in this first sub-section, belonging to *Combretaceae, Gesneraceae, Capparidaceae, Aceraceae,* and *Rutaceae.*

The similarities in wood-structure are, as may be derived from the position of the sub-section in the Key, of the same nature as discussed in Notes 30—32; the characters mentioned in Nrs 516 (second par.) and 548 (first par.) point in particular to an affinity as was discussed in Note 30.

Nr 552 (first par.) has *Cyrtandra cuneata* (*Gesneraceae*) and in the second paragraph two species of *Capparis* (I examined three), belonging to *Capparidaceae.*

These species of *Capparis* (*C. micracantha* and *C. subacuta*) are closely alike as regards their wood-anatomy and occur in Nr 553. The first paragraph of 551 refers to 552 and in the second paragraph of 551 is a reference to 554. Now Nr 554 (first par.) has *Acer niveum* (*Aceraceae*) and in the second paragraph *Rutaceae.* Nrs 556 and 557 have seven kinds of Rutaceous woods (*Lunasia costulata, Zanthoxylum budrunga, Z. budrunga* var. *paucijuga, Z. budrunga* f. *puberula, Murraya exotica* var. *sumatrana, Glycosmis simplicifolia,* and *G. pentaphylla*).

These seven Rutaceous kinds were already found in Nrs 522 and 523

in the Key, and *Murraya exotica* var. *sumatrana* is also met with in 539 (cf. also Notes 30 and 32). The coupling of the seven species is in accordance with my earlier findings (Mikrogr. 2, p. 18, § 2).

Nr 549 (second par.) refers to 551 and in the first paragraph occurs the genus *Lumnitzera* (*Combret.*). Nr 550 has the three kinds I examined (*L. coccinea, L. racemosa,* and *L. racemosa* var. *pubescens*); they resemble each other closely.

The three *Lumnitzeras* were also placed into Nr 520 a position which laid still greater stress on a relationship between *Combretaceae* and *Rutaceae* than is the case here (cf. Note 30).

So far, the relationships between *Gesneraceae* and *Capparidaceae*, and between *Aceraceae* and *Rutaceae* seem very close.

On consulting the current taxonomical works it appeared that Durand referred *Gesneraceae* to "cohors" 9 (*Personales*) in Series III (*Bicarpellatae*) in *Gamopetalae*, and *Capparideae* to "cohors" 2 (*Parietales*) of Series I (*Thalamiflorae*) of *Polypetalae*. *Aceraceae* were placed into "cohors" 10 (*Sapindales*) and *Rutaceae* into "cohors" 7 (*Geraniales*); both "cohortes" belong to Series II (*Disciflorae*) in *Polypetalae*. *Combretaceae* are arranged by Durand in "cohors" 12 (*Myrtales*) of Series III (*Calyciflorae*) in *Polypetalae*. Durand, therefore, suspects the *Aceraceae* and *Rutaceae* to be most nearly related among these five families.

Engler-Gilg referred *Aceraceae* and *Rutaceae* to successive "Reihen", resp. 24 (*Sapindales*) and 23 (*Geraniales*). The other families are kept further apart.

Hutchinson thinks that *Aceraceae* and *Rutaceae* are most closely related and assigns them to Orders 57 (Sapindales) and 55 (Rutales); both Orders form part of a group of related Orders.

In my previous work (l. c., vol. 2, p. 407) when discussing the only species of *Aceraceae* I examined (*Acer niveum*) I stated: (transl.) "The wood is very closely resembling that of *Sapindaceae* but there are some differences."

Note 34. Rhamnales, Leguminosae, Guttiferales, and Bignoniaceae.

The second sub-section (cf. Note 33) extends from 558 to 579. It is distinguished because the wood parenchyma is abundant (or very abundant) in particular the metatracheal parenchyma (Nr 548, second par.).

The sub-section contains 35 kinds of wood. The following families are represented: *Guttiferae, Anacardiaceae, Loganiaceae, Sapindaceae, Leguminosae, Rhamnaceae, Capparidaceae, Urticaceae, Malvaceae, Rutaceae,* and *Bignoniaceae.*

The position in the Chief Key, occupied by this sub-section is nearly identical to the sections discussed in the four preceding Notes and the affinities of its woods are therefore of a similar nature, best comparable, perhaps, to Note 31.

Anacardiaceae, represented by *Gluta renghas,* occur in Nr 561 (first par.) and *Loganiaceae,* represented by *Fagraea morindaefolia, F. obovata,* and *F. javana* are found in the second paragraph. These woods closely resemble each other. The similarity between *Gluta renghas* and *Aphania montana* are discussed in Note 35.

Nr 563 has *Sapindaceae* (*Aphania montana*) and, in the second paragraph, *Leguminosae* (*Bauhinia malabarica* and *Crudia bantamensis*, also found in Nr 564). These woods are very similar and here a link seems to exist between *Sapindaceae* and *Leguminosae* (cf. Note 1).

Nr 565 (first par.) has again *Leguminosae* (*Adenanthera microsperma* and *A. pavonina*). In the second paragraph of the same number, *Ziziphus jujuba* (*Rhamneae*) is met with. *Ziziphus jujuba* occurs also under Nr 586 and there in company of quite different groups (cf. Note 35). The wood-anatomy as found in *Aphania montana, Ziziphus jujuba* and several species of *Leguminosae* suggests that certain affinities exist among *Leguminosae, Rhamneae,* and *Sapindaceae.*

Nr 568 (first par.) contains *Gymnartocarpus venenosa* (*Urtic.*). *Malvaceae* occur in the second paragraph, represented by *Eriodendron anfractuosum, Bombax malabaricum,* and *Bombax* sp. (aff. *B. insignis* ?). They form the second group distinguished by me in *Malvaceae* (Mikrogr. 1, p. 378, § 2).

Nr 574 (first par.) has *Bignoniaceae,* represented by *Oroxylum indicum* (cf. also Note 35, as it occurs again in 597 and 612). In the second paragraph is found *Garcinia* (*Guttif.*) as a genus. The six species I examined are keyed out in 575 and 576 (cf. also Notes 27 and 31).

Nr 573 (first par.) refers to 574, and the second paragraph of 573 contains a reference to the familie of *Leguminosae* as it leads to 577, 578, and 579 where *Dialium indum, Cynometra ramiflora, Acrocarpus fraxinifolius, Acacia leucophloea,* and *A. tomentosa* are found.

The arrangement of these *Bignoniaceae, Leguminosae* and *Guttiferae* (Nrs 573 and 574) leads to the acceptance of a close affinity among them. It has been pointed out that a close relationship might be assumed among *Sapindaceae, Leguminosae,* and *Rhamneae* and so, as a whole, the arrangement of the five families in this sub-section of the Chief Key, suggests a near relationship.

It will be observed that a group of *Guttiferae* (five species of *Calophyllum*) holds a somewhat isolated position from the other *Guttiferae,* as it is placed in Nr 559. These *Calophyllums* occur also under Nrs 526, 535, and 582 (cf. Notes 31, 32, and 35). An explanation for the distance between *Garcinia* and *Calophyllum* is found in "Mikrographie" (vol. 1, p. 254, § 2) where the wood-anatomy of *Garcinia* and *Calophyllum* was found to be more different from each other than was usual between two genera belonging to the same family (cf. also Note 31).

The usual taxonomic works present some data in support of the affinities I suggested, though of a various character.

Durand placed *Anacardiaceae* and *Sapindaceae* into "cohors" 10 (*Sapindales*) of Series II (*Disciflorae*) in the *Polypetalae.*

Engler-Gilg arranged them in "Reihe" 24 (*Sapindales*) and Hutchinson in Order 57 (*Sapindales*). This, then, fully supports the outcome of my study into the wood-anatomy of *Sapindaceae* and *Anacardiaceae.*

Durand placed *Rhamneae* and *Leguminosae* at some distance from the preceding families. The *Rhamneae* he referred to "cohors" 9 (*Celastrales*) and the *Leguminosae* to "cohors" 11 (*Rosales*) of the Series III (*Calyciflorae*) of *Polypetalae.*

Engler-Gilg referred *Rhamnacede* to "Reihe" 25 (*Rhamnales*) and the *Leguminosae* to "Reihe" 21 (*Rosales*).

Hutchinson placed the *Rhamneae* into Order 54 (*Rhamnales*) and *Leguminosae* represented Order 41. Concerning *Guttiferales* Hutchinson stated ('Notes on Affinity', p. 18): "showing the same tendency as in the *Malvales*, i. e. stamens gathered into bundles."

Note 35. Combretaceae and Leguminosae. Relationships of Euphorbiaceae, Tiliales, Rutales, Sapindales, &c.

Nrs 580 to 623 comprise the third sub-section of the section 548—623 (cf. Notes 33 and 34). It is distinguished by the presence of neither rare nor abundant wood-parenchyma (Nr 548, third par.).

Seventy six woods represent in this sub-section thirteen families, viz. *Sapindaceae, Guttiferae, Anacardiaceae, Rhamneae, Simarubaceae, Thymelaeaceae, Euphorbiaceae, Bignoniaceae, Combretaceae, Leguminosae, Meliaceae, Tiliaceae,* and *Rutaceae.* The degree of similarity is of the same order as in both the preceding Notes.

In this sub-section, seven of the thirteen families occur more than once; three families recur four times. This frequency is larger than was generally the case and it is due to the fact that the woods comprised in this sub-section are often similar to a very high degree. This implies that they are distinguished by characters which have, very often, only a slight taxonomical value.

Nr 580, (first par.) has *Dodonaea viscosa* (*Sapind.*) and Nr 590 first par.) contains *Harpullia imbricata* and *H. cupanoides*, also of *Sapindaceae.* Both the latter species were also found in Nr 540 (cf. Note 32) and *H. cupanoides* occurred also in Nr 532.

Anacardiaceae occur in 583 or are placed between the Nrs 580 and 590, which stresses again the relationship between *Anacardiaceae* and *Sapindaceae* (cf. Note 34).

Melanochyla tomentosa var. *glabrescens* (*Anac.*) is found in Nr 584 (first par.) and five species of *Mangifera* (*Anac.*) in the second paragraph of Nr 584; this is in accordance with my earlier findings (Mikrogr. 2, p. 447, § 2). In the previous Note, it was demonstrated that *Sapindaceae* and *Anacardiaceae* appeared to be related, and this on account of the similarity in the woods of quite different species. The outcome of the present Note, therefore, supports strongly what has been found before.

In Nr 582, i. e. between Nrs 580 (*Sapindaceae*) and 583 (*Anacard.*), five *Calophyllums* are met with (*Guttif.*). These five species of *Calophyllum* were also placed into Nrs 526, 535, and 559 (cf. Notes 31, 32, and 34). Their position indicates the relations existing among *Guttiferae* (*Calophyllum*), *Anacardiaceae* and *Sapindaceae.*

The affinity between *Gluta renghas* (*Anacard.*) and *Aphania montana* (*Sapind.*) has been discussed before (Note 34). Now the first paragraph of 560 refers to 561 (first paragraph: *Gluta renghas*). The second paragraph of 560 refers to 563 which has *Aphania montana* (first paragraph). So, for different reasons, affinity between *Anacardiaceae* and *Sapindaceae*

is suggested by their wood-anatomy, and further relationship to *Guttiferae* (*Calophyllum*) appears when Nr 559 is taken into account.

Nr 592 (first par.) has *Terminalia teysmannii* (*Combret.*), which was also placed under 229 (cf. Note 1). Nr 593 (first par.) again has *Combretaceae*, represented by *Terminalia bellerica* var. *laurinoides* and *T. bialata*. These *Terminalias* are distinguished by a larger or smaller number of vessels pro mm² in transverse section, which is generally a character of small value (cf. Nr 593).

Combretaceae occur again in Nr 613 (first par.), represented by *Terminalia javanica* and *T. catappa*, and in 614 (first par.) by *T. bellerica* var. *laurinoides* and *T. bialata* (cf. 593). Nrs 613 and 614 are different through the presence or absence of very large clusters of crystals in the wood parenchyma cells, another character of slight value.

Both *Leguminosae* and *Combretaceae* occur in 4 places of this subsection. In three out of four times, *Leguminosae* were placed in the second paragraph of a number, whereas the *Combretaceae* occurred in the first paragraph (cf. Nrs 592, 593, and 614). A close resemblance in the wood-anatomy of these families appears to be present (cf. also Note 1).

Nr 592 (second par.) has *Cassia timorensis* (also found under 296; cf. Note 1). The second paragraph of 593 has *Albizzia montana, Cassia javanica, C. fistula, C. siamea*, and seven species of *Pithecellobium*, including *P. moniliferum*. *Cassia javanica* recurs in 296 (cf. Note 1), and in 621. *C. fistula* and *C. siamea* also occur in 296 (cf. Note 1). *Pithecellobium moniliferum* was placed into 299 (cf. Note 1). Nrs 594 and 595 contain the several species. The arrangement is here not in accordance with my views on the taxonomical relationships as explained previously (Mikrogr. 3, p. 24, § 2).

Leguminosae are also found under Nr 601 (*Dichrostachys cinerea*) and in the second paragraph of 614, where a reference is made to the numerous species keyed out in Nrs 615 to 623. Again, this is in contradiction with my previously expressed views (l. c.).

Durand, among the taxonomists referred to in this paper, is the only author who supported to some extent a relationship between *Leguminosae* and *Combretaceae*.

In the second paragraph of Nrs 590, 597, and 601, and in the first paragraph of 612, *Bignoniaceae* are met with. In 590 occurs *Dolichandrone rheedii*, in 597 *Oroxylum indicum* (cf. also Nr 574 and Note 34; and Nr 612). In 601 occur *Stereospermum hypostictum* and *St. glandulosum*. When considering the various places of *Oroxylum indicum*, it appears that it is found in close proximity to *Leguminosae* (Nr 574), to *Meliaceae* (with the 4 species of *Melia* in 597), to *Thymelaeaceae* with *Phaleria capitata* (Nr 612) and to *Meliaceae*, also in Nr 612 with 2 *Sandoricum* species.

Now *Thymelaeaceae* occur in the second paragraph of 587, the first of 599, and the second of 611 (resp. *Gonystylus miquelianus, Wikstroemia junghuhniana*, and *Phaleria capitata*).

The wood-anatomy found in the *Bignoniaceae* and the *Thymelaeaceae*, discussed in this Note, is very similar in the various genera and species and suggests affinity. This is in accordance with my previous conclusions

(cf. l. c. vol. 4, p. 728, § 2, and vol. 5, p. 420). The arrangement of *Leguminosae, Meliaceae, Combretaceae, Tiliaceae, Rutaceae,* and *Simarubeae* suggests further affinities existing among these families and *Bignoniaceae* and *Thymelaeceae.*

Nrs 587 and 608 have, in the first paragraphs, *Picrasma javanica* (*Simarub.*). Nr 609 (first par.) has the genus *Ailanthus.* Nr 610 contains the species of *Ailanthus* (*Ai. moluccana* var. *javanica, Ai. malabarica* var. *mollis* and *Ai. malabarica*) which is in accordance with my views expressed previously (l. c. vol. 2, p. 76, § 2). I pointed out there, also, that the differences in wood-anatomy of *Picrasma* and *Ailanthus* were very small. Actually, the species keyed out between 587 and 610 resemble each other closely.

In Nr 597 are found four kinds of *Melia,* viz. *M. azedarach, M. azedarach* var. *javanica, M. bogoriensis,* and *M. composita*; they are closely alike. In Nr 611 are found the two species of *Sandoricum* I examined, *S. indicum* and *S. nervosum,* also resembling each other closely. The four *Melias* were also placed into 541 (first par.), and both the *Sandoricums* into 544 (cf. Note 32).

Nr 587 (first par.) has *Picrásma* (*Simarub.*); in the second paragraph is found *Gonystylus miquelianus* (*Thymel.*). In the first paragraph of 586 is a reference to 587, and in the second paragraph is found *Ziziphus jujuba,* the sole representative of *Rhamneae* I examined (cf. also 565 and Note 34). It has been advised by several taxonomists that *Gonystylus* should not be assigned to *Thymelaeaceae* or, at least, be seen as an aberrant genus. In its wood-anatomy, however, it is closely related to both the other genera of *Thymelaeaceae* which I examined (cf. l. c. vol. 5, p. 420, § 2).

Ziziphus jujuba is also found under 565 (cf. Note 34). This earlier place in the Key is surrounded by quite different families (esp. *Leguminosae*) than are found near 586.

Earlier in this Note, the position of *Harpullia* in Nrs 590, 540, and 532 was indicated. A reference was also made to *Dolichandrone rheedii* as found in 590. The second paragraph of 589 leads to 590, and the first paragraph of 589 contains *Excoecaria agallocha* (*Euphorbiac.*). This arrangement points to a closer relationship among *Sapindaceae, Bignoniaceae,* and *Euphorbiaceae.* The affinities of *Euphorbiaceae* are further stressed by their position in 540 where they occur side by side again with *Sapindaceae,* this time represented by *Gelonium glomerulatum* and *Excoecaria agallocha.* Both the latter species have proved to be very nearly related (cf. l. c. 5, pp. 460 and 467, § 2, and also Note 32).

In this Note I have pointed out that *Leguminosae* occurred in Nrs 592, 593, 594, and 595. Now *Combretaceae* occur in Nr 592 (*Terminalia teysmannii*; cf. also 299 and Note 1) and in Nr 593 (*T. bellerica* var. *laurinoides,* and *T. bialata*; cf. also 614). In the first paragraph of 591 a reference is made to 592 and in the second paragraph of 591 to 593. The differentiation in 591 rests on a character of small taxonomical value. Generally speaking, the position of the *Combretaceae* and *Leguminosae* in this sub-section fully supports the affinity which I suggested in Note 1.

I have also indicated, earlier in this Note, the several numbers in which *Meliaceae, Bignoniaceae,* and *Guttiferae* are found (574, 597, and

612). To these families are linked the *Leguminosae,* which becomes clear when it is realized that the first paragraph of 573 leads to 574, and the second paragraph of 573 has part of *Leguminosae.* These *Leguminosae* are keyed out in 577, 578, and 579. This means that the wood-anatomy as present in these four families suggests affinity among them and so it appears that *Meliaceae* and *Leguminosae* are related, this time for entirely different reasons than were presented in Note 1. I pointed out before, in addition, that in Nr 601 the families of *Leguminosae* and *Bignoniaceae* were combined. This is new stress on the affinity existing between the two families.

Nr 602 (first par.) has *Tiliaceae* (*Pentace polyantha*; cf. also 546 and Note 32). The second paragraph of 602 has *Rutaceae, viz. Micromelum pubescens, M. pubescens* var. *denticulatum* (both occurring in 547, cf. Note 32), *Citrus hystrix, Aegle marmelos* (also found in 547), and *Feronia lucida.* It will be noticed that *Pentace polyantha* and various *Rutaceae* (*Micromelum* and *Aegle*) occur in immediate vicinity in Nrs 545, 546 and 547 and also in 602, 603, 604, and 605. The conclusion is justified that the woods of these species are closely resembling each other and that a relationship between *Tiliaceae* and *Rutaceae* exists.

The first paragraph of 600 refers to 601 where *Leguminosae* and *Bignoniaceae* are found. The second paragraph of 600 refers to 602, or, to *Tiliaceae* and *Rutaceae.*

The second paragraph of 599 is a reference to 600, and the first paragraph of 599 has *Wikstroemia junghuhniana* of *Thymelaeaceae.* These 5 families appear to be closely linked.

Nr 544 (second par.) refers to 545 where *Tiliaceae* and *Rutaceae* are met with. The first paragraph of 544 has *Meliaceae* (*Sandoricum indicum* and *S. nervosum*). The three families suggest in this manner to be related (cf. Note 32). Moreover, the 5 families just discussed seem to be related to *Meliaceae* also.

The *Sandoricums* recur in 611 (first par.). On considering the position of *Thymelaeaceae* and *Simarubeae* as found in 609, 610, and 611 (cf. also earlier in this Note) it appears that relationships exist among *Simarubeae, Thymelaeaceae,* and *Meliaceae.*

The striking resemblance between *Leguminosae* and *Combretaceae* is still further stressed in the final part of this sub-section of the Key.

In 614 (first par.) occurs *Terminalia bellerica* var. *laurinoides* (*Combretac.*), and *T. bialata* (also found in 593, cf. above in this Note). In 593 these *Terminalias* are in proximity of nearly the same species as in 614. In the second paragraph of 614 *Leguminosae* are referred to as a family. The species are keyed out from 615 to 623. *Cassia javanica,* found in 621, also occurs in Nr 296 (cf. Note 1) and in 595 (cf. above). *Albizzia lebekkoides* and *A. lebbek* are found in 623 (also in 292, cf. Note 1), *A. tomentella* in 623 (also in 313, in proximity of other families, cf. Note 23).

Combretaceae and *Leguminosae* are distinguished here on account of characters of small taxonomical value and the woods resemble each other closely. The position, as it is found in this part of the Key, is new evidence for their affinity.

The second paragraph of 612 refers to 613, and the first paragraph contains *Bignoniaceae,* represented by *Oroxylum indicum* (cf. Nrs 574 and 597, Note 34 and what has been said earlier in the present Note). Here the position is comparable to my earlier findings and again stress is laid on the affinities existing among the families now discussed.

Data of a varying character, partly in support of the affinities among these thirteen families, may be derived from the current taxonomical works.

Durand, as we have seen, admitted a close relationship between *Anacardiaceae* and *Sapindaceae* ("cohors" 10). This is agreed to by Engler-Gilg ("Reihe" 24, though to different "Unterreihen") and Hutchinson (Order 57). At a short distance of *Sapindaceae* and *Anacardiaceae,* appear *Rhamneae* ("cohors" 9, *Celastrales,* of the *Disciflorae*) and the *Leguminosae* ("cohors" 11, *Rosales,* of Series III (*Calyciflorae*) of the *Polypetalae*).

Engler-Gilg refer *Rhamneae* to "Reihe" 25 but *Simarubeae, Euphorbiaceae, Meliaceae,* and *Rutaceae* all to "Reihe" 23 (*Geraniales*) and even to the same "Unterreihe" (*Geraniineae*) with the exception of *Euphorbiaceae* which belong to a different "Unterreihe".

Hutchinson placed *Simarubaceae* and *Rutaceae* into Order 55 (*Rutales*), *Meliaceae* into Order 56 (*Meliales*), and *Sapindaceae* and *Anacardiaceae* to Order 57 (*Sapindales*). These three Orders are combined into a group of related Orders. The *Rhamnaceae,* however, belonging to Order 54 (*Rhamnales*) are not included in this group of related Orders.

Durand assigned *Simarubeae, Meliaceae,* and *Rutaceae* to "cohors" 7 (*Geraniales*) of Series II in *Disciflorae* of the *Polypetalae.*

Engler-Gilg refer these families to the same "Unterreihe" (*Geraniineae*) of "Reihe" 23. Hutchinson placed them into Orders 55 and 56.

Durand placed *Tiliaceae* into "cohors" 6 (*Malvales*) in Series I (*Thalamiflorae*) of the *Polypetalae,* which is not far from the preceding three families. Engler-Gilg referred *Euphorbiaceae* also to "Reihe" 23, though to "Unterreihe" 5 (*Tricoccae*), which seems still closer. Hutchinson's views have been indicated above.

Among the remaining families, *Leguminosae* and *Combretaceae* are considered to be most related by Durand, as was referred to before. The other taxonomical works offer different opinions. Engler-Gilg bring *Combretaceae* to "Reihe" 29 (*Myrtiflorae*) and *Leguminosae* to "Reihe" 21 (*Rosales*). Hutchinson referred them resp. to Orders 33 (*Myrtales*) and 41 (*Leguminosae*).

Of Hutchinson's "Notes on Affinity" I cite (p. 22): "*Sapindaceae* and *Anacardiaceae* especially related to some *Euphorbiaceae* from some of which part of the latter may have arisen.". On *Tiliales,* Hutchinson commented (l. c., p. 18): "A fairly advanced group whence considerable evolution is evident, i. e. to *Celastrales, Rhamnales* (petaliferous, disciform types) and the bulk of *Euphorbiaceae* (apetalous types)". On *Euphorbiales* (l. c., p. 19) Hutchinson stated: "A composite family probably derived from several sources such as *Bixales, Tiliales, Malvales, Celastrales,* and perhaps *Sapindales.*" (cf. also Note 2). On *Myrtales,* Hutchinson (l. c., p. 17) remarked: "Probably epigenous representatives of the *Theales* and some *Tiliales* with leaves becoming opposite." The *Leguminosae,* Hutchinson

believed to be (l. c., p. 19): "Prolific and highly successful group derived from the *Rosales* through the *Mimosaceae* and *Caesalpiniaceae* and ending in the very natural family of *Papilionaceae*."

Index.