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LAURACEAE*

A. J. G. H. KOSTERMANS **

SUMMARY

An attempt has been made at a classification of the Lauraceae, into taxa down to the rank of subgenus. The characters and their taxonomic value are discussed amply. A system of the family and keys are given. Two subfamilies, viz Lauroideae and Cassythoideae, are recognized; several new tribes, subtribes and subgenera have been described. The accepted genera, 31 in number, are surveyed, with synonyms, typification, description, and particulars.

Additional notes to "The genera of Lauraceae", which appeared in 1952, are given.

INTRODUCTION

In a former paper[1] I gave a historical survey of the genera of Lauraceae, together with their typification and synonymy. In the present paper I shall endeavour to elaborate a tentative classification of those genera which I consider to be acceptable.

I stressed in the first paper that the establishment of generic limits and the classification of genera should come after complete monographic revision. In as large a family as the Lauraceae this cannot be accomplished in a lifetime. Since I only have completely revised the subfamily Lauroideae[2] (American species), the subfamily Persoideae remains unsatisfactorily classified. All African and Madagascar Lauraceae have recently been revised, some (part of the genus *Beilschmiedia)* by Robyns and Wilczek, the remainder by myself. During the last ten years I have had the opportunity to obtain first hand field knowledge of the Malaysian Lauraceae.

* First published as Comm. of the Forest Research Institute, Indonesia No. 57, issued March 22, 1957.

NOTA BENE. The present reprint is verbatim, with the following restrictions: a) names in the original paper indicated as new and provided with a Latin description are here not indicated so and provided with an English description, in the index, however, they are printed in bold face type; b) in the genera 5, 19, and 28 the name of the type-including subgenus has been conformed to that of the genus, the original name being there given in syn.

The division of the text over the pages has remained the same from p. 206 onwards; the original page-number is found by subtracting 192 of the present number. There is not referred in the text to the above-mentioned publication. ED.

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[1] 'A historial survey of Lauraceae *in* J. sci. Research Indonesia 1: 83-95; 113-127; 141-159. 1952.,

[2] Sub-families as adopted by Pax.

The revisions have already yielded interesting results; genera formerly considered to be limited to certain continents proved to have a world wide distribution: *Hufelandia, Tylostemon* and *Beilschmiedia,* respectively from America, Africa and Asia, could be combined into one genus *Beilschmiedia; Potameia* from Madagascar and *Syndiclis* from Asia could be combined; American *Persea* proved to be congeneric with Asiatic *Machilus* and it is likely that American *Sassafras* is not different from Asiatic *Actinodaphne,* whereas *Ocotea* and *Cinnamomum* are very close to each other; American *Phoebe* is likely not different from Asiatic *Cinnamomum.*

Several views on the relationship between genera have been confirmed by anatomical research on the wood (cooperation in this field with W. F. Stern of the Yale School of Forestry, is much appreciated).

I am Well aware that the system outlined below will be far from conclusive and perhaps never can be made conclusive, but I hope that it will bring some clarification. I disagree with those who have expressed the belief that a classification of Lauraceae "in se" would be impossible.

A classification is especially necessary for workers in the field of palaeontology. In recent years fragments have been described as belonging to certain genera of Lauraceae; but it is — even in contemporary species — impossible to refer specimens to their proper genus without flowers or fruit at hand. Our insight in the relationships and development of Lauraceae will never be advanced by unreliable identification of fossil material.

I wish to express here my gratitude to Ir. Soesilo H. Prakoso, Head of the Forest Service of Indonesia, who with a broad view for pure and applied science in botany, has given his support and enabled me to carry on with taxonomic work in the Indonesian Forest Service. Furthermore I have to thank Prof. Dr. C. G. G. J. van Steenis, who kindly went through the manuscript and suggested many emendations and alterations, and Mr. M. Jacobs for proofreading.

I wish to thank Dr. A. C. Smith (National Science Foundation, New York), who pointed out to me that the names of a few type-including subgenera were not in accordance with Art. 22 of the International Code (which I could not consult). These names have been brought up to date in this reprint.

PRINCIPAL LITERATURE

A. L. de Jussieu, Genera PI. 89-90. 1789 (Lauri); Lamarck-Poiret, Encycl. meth. 1783-1817; Ventenat, Tabl. Regne veg. 2: 245. 1799 (Laurinae) ; Willdenow, Spec. PI. 2: 477. 1800; Lindley, Nat. Syst. 201. 1836 (Lauraceae); C. G. Nees von Esenbeck *in* Wallich, PL Asiat. rar. 2: 57-76. 1831; Plant. Laur. Expos., Breslau 1833; Systema Laurina'rum 1836; Endlicher, Gen. PI. 315-323. 1837; Enchir. 196-205. 1841; Meissner *in* DC, Prodr. 15 (1): 1-260. 1864; Baillon, Hist. PI. 2: 429-486. 1870; Bentham *in* Bentham & Hooker f., Gen. PI. 3: 146-164. 1880; Pax *in* Engler & Prantl, Nat. Pfl.Fam. 3 (2) : 106-126. 1889; Mez *in* Jahrb. kgl. bot. Gart. Berlin 5: 1-556. 1889; Hutchinson, Fam. fl. PL 1: 90. 1926; Kostermans *in* Rec. Trav. bot. neerl. 33: 719-757. 1936; 34: 500-575. 1937; 35: 56-129 et 831-931. 1938; *in* Rev. Univ. Chilena 24: 201-232. 1939; *in* Humbert, Not. syst. Paris 8: 67-128. 1939; *in* Bull. Jard. bot. Bruxelles 15: 73-108. 1938; *in* Humbert, Fl. Madagascar, 8le Famille Lauraceae: 1-90. 1950; *in* Bol. techn. Inst. Agron. Norte (Belem-Para, Brazil) 28: 49-76. 1955; Robyns & Wilczek *in* Bull. Jard. bot. Bruxelles 19: 459-506. 1949; Lawrence, Taxon. vase. PI. 512-513. 1951.

FAMILY CHARACTERS

GENERAL

Evergreen trees or shrubs (rarely parasitic climbers: *Cassytha)* with alternate (rarely opposite or subopposite: *Beilschmiedia, Endiandra, Cryptocarya,* etc. or whorled: *Actinodaphne;* occasionally in species of other genera) usually entire, rarely lobed *(Sassafras),* usually leathery leaves, without stipules, with usually numerous aromatic oil and slime cells (also in bark), pinnately or subpalmately veined (often triplinerved: *Aiouea, Litsea, Neolitsea, Lindera, Cryptocarya, Cinnamomum,* etc.) and usually densely reticulate; the reticulation as a rule not visible in the fresh leaves which often have a waxy appearance and often have a glaucous lower surface. Hairs — if present — simple, as a rule one-celled. Buds perulate, innovation flush-wise. Bark often aromatic. Timber usually not very durable, sometimes very durable *(Eusideroxylon, Ocotea. irodioei* Mez, *Dehaasia caesia* BL), finely grained, often yellow and with cigar-box wood smell.

Inflorescences definite, (rarely indefinite: *Cassytha)* paniculate, racemose or capitellate; before anthesis completely enveloped in large bracts *(Actinodaphne, Sassafras,* species of *Beilschmiedia, Cryptocarya,* etc.) or almost naked; ultimate flowers 3 or more together in axils of bracteoles or the end-flowers in pseudo-umbels, surrounded by persistent decussate bracts *(Lindera, Laurus, Litsea)* or irregular bracts *(Umbellularia).* Flowers usually small (the largest 2 cm in diameter; but usually less than 5 mm in diameter, the smallest: *Potameia,* often less than 1 mm in diameter), usually white or greenish white, sometimes yellow, sometimes reddish or turning red after anthesis *(Persea* subgen. *AIseodaphne),* usually aromatic; tepals either explanate or remaining almost closed *(Persea* subgen- *Alseodaphne, Licaria, Beilschmiedia).*

Flowers bisexual or by abortion monoecious, actinomorphic, usually trimerous (in the genera *Laurus, Neolitsea, Potameia* dimerous). Perianth gamosepalous, free, in bud valvate rotate, infundibuliform or urceolate with 6 or 4 tepals in two whorls, rarely 9 tepals in 3 whorls *(Phyllostemonodaphne* and *Dicypellium)* ; tepals equal or *(Persea,* species of *Persea* subgen. *Alseodaphne)* outer ones smaller, alternate, deciduous or persistent, sometimes indurate; tube either deciduous or altered into a cup which surrounds the basal part of the fruit, or the fruit completely included in the tube, or the ovary adnate to the tube (hypogynous: *Hypodaphnis).* Stamens alternate, attached to the throat of the tube, perigynous or epigynous, definite

in number (rarely sub-definite, in *Litsea)* in 4 whorls (or rarely more whorls in *Litsea),* usually the central whorl abortive and reduced to more or less conspicuous staminodes; more rarely the 2 outer whorls also abortive; the third whorl always present (very rarely sterile: species of *Cryptocarya,* one species of *Aniba* etc.), as a rule with two more or less stalked glands at either side of the filament or the stalks of the glands connate with the filaments; more rarely all stamens with basal glands *(Urbanodendron,* one species of *Endlicheria*; the subgenus *Pleurothyrium* in *Ocotea;* species of *Litsea)* ; filaments present or anthers sessile; outer 2 whorls of anthers as a rule introrse (some exceptions in *Licaria)* ; all extrorse in *Litsea;* the 3rd whorl of stamens as a rule extrorse, sometimes with (all or partly) apical or lateral cells. Anthers 4-, or 2-celled by abortion (very rarely 1-celled: *Potameia* species) ; the connective (of the 2-celled anthers) usually produced beyond the anthers (ablastic part) ; the cells placed in pairs above each other or in an arc; usually all species in one genus with the same number of anther-cells, rarely one or two whorls of anthers with different (half or double) number of cells. Cells opening by valves from base to apex, very rarely (in *Mezilaurus)* from outside to inside. Pollen simple, globose, poreless, granulate. Staminodes (if present) of the outer whorls tepal-like or ligulate, of the fourth whorl as a rule sagittate or cordate-sagittate, stalked, very rarely provided with glands, sometimes staminodes minute or none. If more than 4 whorls of stamens are present *(Litsea),* the 4th and inner whorls may have glands. The glands are either small or large (filling the entire space between the stamens) or altogether lacking. Carpels probably 3, forming a single, one-celled ovary, which is usually superior, rarely sub-inferior or (in *Hypodaphnis)* inferior; ovule single, pendulous, anatropous; style distinct, rarely inconspicuous; stigma discoid, often with one shallow lateral incision, often depressed, sometimes *(Beilschmiedia, Litsea)* inconspicuous, but decurrent at one side of the style as differently coloured tissue.

Fruit baccate, sometimes enveloped (adnate or free) by the accrescent flower tube which is often ligneous *{Cryptocarya, Ravensara, Eusideroxylon)* or completely inferior *(Hypodaphnis),* sometimes on a naked pedicel, sometimes with its base surrounded by the indurate perianth *{Phoebe, Apollonias)* ; sometimes with its base (or a larger part) embedded in a cup; sometimes *(Mezilaurus)* with a small, flat disc at base. Where a cup is present, the perianth may be either more or less persistent (unaltered), or the base of the perianth persists *(Cinnamomum)* or the base of the stamens persists, which makes the cup double-rimmed *(Licaria)* ; the margin is either entire or may be wavy (base of tepals) ; the cup is always fleshy, often provided with large, flat, round warts (lenticels) ; the fruit-pedicel is either cylindrical or may be fleshy and sometimes highly coloured *(Dehaasia;* species of *Persea* subgen. *Alseodaphne).* Exocarp fleshy, very thin or thick (edible in *Persea* species), usually bitter, aromatic and astringent. Fruit either small (5 mm diameter in *Litsea cubeba* Pers.) to large (15 cm and more long in *Persea americana* Mill, and *Eusideroxylon zivageri* T. & B.). Sometimes a kind of aril *(Potameia)* is present which envelopes the embryo, but for its apical part. Seed without albumen with

thin (rarely tough: *Cassytha)* testa; cotyledons large, flat-convex, pressed against each other (only in one species: *Beilschmiedia variabilis* Rob. & Wilcz., the embryo is transverse) ; corculum included, subpeltate; plumule well developed (2—8-leaved), often pilose. Rarely *(Ravensara)* ovary divided incompletely (in its lower half) into 6—12 compartments; the dividing dissepiments ruminate into the cotyledons.

BOLE, CROWN, BARK, ROOT

With the exception of *Cassytha,* which comprises parasitical, leafless twiners, all Lauraceae are woody plants. They range from small treelets or shrublike treelets of less than one metre height to trees of 40 and more metres, although they never become emergent trees in the tropical rain forest, but are confined to the second story, only some species belong to the first story. In some species the branches are weak and need the support of other trees. Originally pyramidal, the canopy becomes often irregular in mature trees, although some retain their regular appearance. The branching is either mono- or sympodial. In the latter case the tree remains pyramidal and has the typical whorls of leaves congested near the top of the branchlets, which is often thicker than the older part. *(Phoebe, Mezilaurus, Persea,* etc.).

The main branches are horizontal, more or less erect, or irregular. Sometimes they are dorsiventral (differently coloured on upper and lower j surface) ; the leaves are then often in one plane. Myrmecophily is found [exceptionally (South America, New Guinea) ; in that case the ants eat away the pith of the branchlets (usually swollen). Shedding of branches by means of an abscission joint has been described by Van der Pijl *(in* Indon. J. nat. Sci. 1, 2, 3: 20. 1953).

In some species *(Aiouea)* decurrent leaf spurs are present, which make the branches angular or ribbed.

Buttressing is common in many species, although large buttresses are an exception. Pneumatophores occur (rarely) in some species of marshy habitat. Stilt roots are, thus far, not known.

The bole is usually smooth (although thick, deeply fissured barks loccur too) and then often covered with numerous large, round, flat lenticeels. The dead bark is as a rule very thin and is shed in small fragments. In some Malaysian species *(Persea* subgen. *Alseodaphne)* the branchlets are pure white. In some South American species *(Mezilaurus, Ocotea verruculosa* Mez) the branchlets are covered with a corky layer, apparently an adaptation to habitat. The living bark is either thin or may be very thick; its colour varies between white, yellow, pink and dark red; it is usually brittle but for an inner fibrous layer; often it has a more or less

pronounced aromatic smell; in some species *(Cinnamomum iners* Bl.) where the bark is scentless and has only mucilage cells, the roots are fragrant.

The bark is almost always characterized by the presence of secretion cells containing essential oil or mucilage and of remarkable stone cells in the pericyclic region with onesided thickening; the secretion-cells are found in the cortex and especially in the bast. The stone cells usually contain starch grains and sometimes calcium oxalate crystals of different shapes. The number and length of the bast fibres is very variable. The medullary rays are from one to more cells wide. The oil and mucilage is formed in a resinogenous mass in the cells; according to Janssonius *(in* Blumea 6: 408-451. 1950) the mass is surrounded by a ligneous membrane (which is somewhat thicker in oil-cells), which shrinks together with the resinogenous mass, if soaked in alcohol. This does not fit with Tschirch's theory, according to which the resinogenous mass is formed in an resinogenous layer of the cell wall.

The mucilage is sometimes so abundant that it has economic value *(Litsea* species in Indochina and *Persea* species in Indonesia, for making hair-fixatives and glues). Sometimes *(Litsea* species in, Indonesia) the mucilage cells are more common in the sapwood. Shirasawa found, that in *Cinnamomum, camphora* Nees & Eberm. the oil-cells developed immediately below the vegetation point.

LEAF

The leaves are usually leathery and (on the upper surface) of a waxy, glossy dark green colour; the lower surface is often glaucous (layer of wax) ; in this character they strongly resemble the leaves of Myristicaceae and Monimiaceae. The dried leaves have a definite colour in different species.

The lower leaf-surface is often provided with domatia in the nerve-axils; they appear to represent a constant character for certain species and not to be caused by insects. Pinnately veined leaves are a rule, but in several genera *(Aiouea, Cinnamomum, Lindera,* several species of *Ocotea, Endlicheria, Cryptocarya, Ravensara,* American *Phoebe)* triplinerved leaves occur, (that this character is of no generic value is important for palaeontological identification). The venation, which becomes visible after drying, is either lax or very dense (areolate in *Endiandra* and in species of several other genera).

The leaves are spirally arranged (phyllotaxis $^{2}/_{5}$ and $^{3}/_{8}$), sometimes subopposite to opposite *(Beilschrfiiedia, Endiandra,, Cryptocarya,* etc.),

sometimes whorled *(Actinodaphne,* some species of *Endlicheria, Aniba,* etc.). Stipules are absent, but "Hochblaetter" are often present, the "Hochblaetter" are distinctive in *Actinodaphne* on the long internodes between the whorled leaves; they drop very soon, and hence are hard to study in herbarium specimens. Formerly it was supposed that only temperate representatives of the family had perulate leafbuds, but I found large numbers of this kind in species of the tropical rain forest where periodical leaf shedding is far from uncommon. Some species of *P&rsea* subgen. *Alseodaphne* in the wet rain forest e.g. are completely bare for a short period (a couple of days) ; in most species, however, the older leaves survive one or more flushes. The scales determine the shape of the leafbud, which may be a very useful vegetative character to recognize some genera *(Beilschmiedi-a,, Cryptocarya).*

The leaves are entire (perhaps slightly wavy in *Nectandra sinuata* Mez), the only exceptions are found in the lobed leaves of *Sassafras* and some aberrant leaves of the cultivated "avocado" *(Persea americana* Mill.) as described by Huber. The leaf surface is flat and smooth; rare exceptions are found where the leaves become boat-shaped and bullate *(Endlicheria bullata* Ducke, *Mezilaurus arassiramea* Taub., *Beilschmiedia bullata* Kosterm.). The leaf margin is always strengthened by sclerenchym. Even if the species is entirely glabrous, hairs are often present on leafbud scales. The hairs are simple, silky, woolly or strigose; as a rule the pilosity is denser on the lower, than on the upper surface, although the reverse is also represented *(Ocotea* subgenus *Nectandra)*; the hairs are usually silvery, but golden coloured hairs occur in several genera *(Actinodaphne, Endiandra, Licaria, Ocotea, Persea,* etc.). The hairs are mostly unicellular, frequently thick-walled, the lumen sometimes almost obliterated (Santos found differences in hair structure in Philippine *Cinnamomum* species). The leaf is generally dorsiventral, but palisade tissue is more strongly developed towards the abaxial than the adaxial surface of the leaf in species of *Nectandra, Phoebe, Mezilaurus.*

The leaf cuticle is delicately punctate in some species of *Ocotea* and varies in thickness in different species of a single genus from the same habitat. The epiderm of both surfaces in leaves of *Cinnamomum* consists of a single layer of rectangular, thick-walled and highly cutinized cells. In the surface view the cells are polygonal in outline with sinuate, thick walls. The hypoderm is one-layered, but shows a tendency to form two layers *(Cryptocarya, Endiandra).* The lower epidermis is commonly papillose; in the *Aniba* rosaeodora-group these papillae are highly developed. Pappilae-like cells are usually connected with a waxy lower leaf surface.

Stomata are on the lower surface, usually they are sunken, and overarched by subsidiary cells, which are usually arranged parallel to the pore and of the rubiaceous type, but the subsidiary cells of the depressed stomata are not easily recognizable. The guard cells are provided with ridge-like processes in most genera. The mesophyll consists of 1—3 layers of palisade cells, which may be constant in a genus or varying. Individual cells of the palisade layer in some species of *Actinodaphne, Ocotea,* and *Beilschmiedia* are transformed into stone cells, visible as dots on the surface of the leaf. Sclerified cells, immediately within the lower epidermis are present in *Ravensara;* spongy parenchyma containing large lacunae filled with stellate tissue occurs in *Aniba, Cryptocaryw, Licaria, Persea, Systemonodaphne* and *Urbanodendron,* The midrib is often surrounded by a mixed sclerenchymatous sheath, containing stone cells with U-shaped thickenings. Medium sized and small veins are frequently vertically transcurrent by sclerenchymatous elements; the sclerenchymatous sheaths in a few species of *Persea* are spread out beneath the upper epiderm. Oil cells in mesophyll and midrib are generally spherical with suberized walls and yellowish contents, frequently giving rise to transparent dots in the leaf; they are situated in the palisade or spongy tissue, rarely *(Umbellularia)* in the lower epidermis as well. Mucilage cells are found in almost all genera; they are similar in shape to oil cells and are confined to the palisade tissue or they occur also in other parts of the mesophyll. Crystals usually occur in the form of small needles or spindles.

The petiole, as a rule, has the same diameter over its entire length; in rare cases it is thickened towards its base *{Mezilaurus;* some species of *Persea* subgen. *Alseodaphne,* etc.).

The petiole in transverse section through the distal end exhibits a shallow crescentic vascular strand in species of several genera or a shallow arc of separate but closely placed bundles *{Beilschmiedia roxburghiana* Nees) ; there are no accessory bundles. Sometimes massive stone-cells are present in the petiolar ground tissue *{Cinnamomum zeylanicum* Bl.; *Ravensara)*.

WOOD ANATOMY[x]

Cork not formed until a relatively late stage; often arising in the epidermis or outer part of the cortex, but pericyclic cork said to occur in *Cinnamomum zeylanicum* Bl. Cork cells thin-walled in species of *Litsea, Persea, Sassafras* with inner tangential walls sclerosed in species of *Cinnamomum, Dehaasia, Dicypellium, Litsea, Ocotea.* A secondary ring of

Extracted more or less verbatim from Metcalfe and Chalk, Anat. of Dicotyl. 2: 1147-11521950; W. 1'.Stern*in* Trop. Woods **100.** 1954 and Record *in* Trop. woods 80: 15. **1944.**

stone cells reported to arise in the phelloderm in species of *Actinodaphne, Cryptocarya, Dehaasia, Litsea, Ocotea.* Primary cortex of relatively old branches sometimes containing stone cells.

Pericycle characterized by isolated strands of fibers interspersed with stone cells to form a continuous or locally interrupted ring. Some of the stone cells usually provided with thin outer tangential walls, but sclerosed on the inner tangential and radial walls. Pericyclic sclerenchyma rings of the above type, recorded in species of *Licaria, Beilschmiedia, Cinnamomum, Cryptocarya, Dicypellium, Endiandra, Endlicheria, Laurus, Lindera, Litsea, Ocotea, Persea, Phoebe, Sassafras.* Secondary phloem usually containing a few spindle-shaped fibers with narrow lumina, but fibers sometimes aggregated into bundles in *Licaria, Beilschmiedia, Ocotea.* Stone cells similar to those of the pericycle sometimes accompany the fibers in the secondary phloem, particularly in species of *Cryptocarya* and *Litsea.*

Xylem in the form of a continuous cylinder traversed by narrow rays (1—6 cells wide) ; relatively broad rays occur in certain genera; rays uniseriate (1—14 cells high) and multiseriate rays (3—6 cells high). Vessels usually with simple perforation; scalariform plates oecassional. Peripheral part of the pith in a few species consisting of amyliferous cells with thicker walls than those of the central part. Groups of stone cells sometimes present in the pith, e.g. in species of *Beilschmiedia* and *Ravensara.*

Secretory cells, containing oil or mucilage, present in the primary cortex, phloem, wood, and pith of the axis. Oil cells in the primary cortex and pith approximately isodiametric, but those in the phloem vertically elongated (barrel-shaped) ; recorded in the young stem of species of *Licaria, Aniba, Beilschmiedia, Cinnamomum, Cryptocarya, Dicypellium, Laurus, Litsea, Ocotea* subgen. *Nectandra, Persea, Sassafras, Umbellularia.*

Mucilage cells, usually vertically elongated, most frequent in the phloem (especially in *Cinnamomum* and other barks, but also recorded in the primary cortex and wood. Cells with unidentified but probably tanniniferous contents common and often abundant, particularly in the cortex and phloem, e.g. in species of *Beilschmiedia, Cinnamomum, Laurus, Persea.* Crystals common in the unlignif ied tissues, mostly acicular or spindle-shaped ; solitary prisms noted, e.g. in *Beilschmiedia.*

WOOD —Growth rings as a rule present, although sometimes in a single species *{Persea americana* Mill.) present or absent.

Vessels mostly medium-sized (100—200 μ mean tangential diameter; up to 650 μ„ according to Stern), but sometimes small (less than 100μ.), e.g. in species of *Laurus* and *Lindera;* sometimes very long (1224μ.), solitary and in numerous small multiples; multiples of 4 or more cells sometimes moderately common, e.g. in some species of *Persea* subgen. *Alseodaphne,*

Aniba, Cryptocarya, Eusideroxylon, and *Laurus,* and sometimes with a tendency to form loose oblique rows, e.g. in *Lindera* and *Persea;* 3—40, mostly 5—12, per sq. mm., fewer than 5 per sq. mm. in some species of *Beilsehmiedia, Cinnamomum, Cryptocarya, Hypodaphnis* and *Licaria;* ring porous in *Sassafras.* Perforations typically simple, but sporadic scaliform plates are of moderately common occurrence, particularly in the *Persoideae;* such plates usually with few bars but with many in *Persea;* according to Knoblauch, as quoted by Solereder, the perforation plates are entirely scalariform in *Beilsehmiedia pendula* Benth. (not confirmed). Intervascular pitting alternate, typically large, but occasionally small, e.g. in *Ocotea rodiaei* Mez and in *Lindera species* (not in material of *L. bifaria* Benth.) ; occasionally striated owing to coalescent apertures, e.g. in *Laurus* and *Umbellularia;* Solereder refers to spiral striation in *Cinnamomum eamphora* Nees & Eberm. and *Litsea,* pits to ray and wood parenchyma typically including many large, elongated and simple or only partially bordered pits, often almost scalariform, and sometimes unilaterally compound but with only small round pits similar to the intervascular pitting in *Hypodaphnis zenkeri* Stapf, *Laurus nobilis* L., *Lindera erythrocarpa* Mak., *Neolitsea acuta-trinerva* Kan. & Sas., and *Ocotea rodiaei* Mez. According to Bailey the sieve-like structures reported by Janssonius are not true vestured pits. Tyloses common, sclerotic in *Eusideroxylon zivageri* T. & B. and *Ocotea rodiaei* Mez and, according to Record and Hess and Stern, in some species of *Aniba* and *Licaria;* the walls of sclerotic tyloses are often laminated and they show ramiform pitting (Stern). Mean member length 0.35—0.8 mm. Parenchyma paratracheal, typically as an irregular and often incomplete sheath round each vessel (vasi-centric), sometimes tending to be aliform, e.g. in *Beilsehmiedia, Cryptoca,rya, Eusideroxylon, Hypodaphnis, Lindera,* and *Mezilaurus,* and occasionally locally confluent; sometimes very abundant in broad irregular bands in *Eusideroxylon zwageri* T. & B.; irregularly spaced bands; that appear to be terminal and bended apotracheal present in some species of *Beilsehmiedia, Cryptocarya, Endiandra, Hypodaphnis, Lindera, Ravensara* and *Mezilaurus.* Most authors refer also to diffuse parenchyma, but, though individual strands, separated from the irregular sheaths round the vessels and solitary oil cells, may appear to be scattered among the fibers, it appears to be somewhat misleading to classify these as diffuse. Strands usually of 2—4 cells. Tendency to be storeyed observed in *Mezilaurus lindaviana* Schw. & Mez and distinct storeys reported in 2 species of *Cryptocarya* from Madagascar. Oil cells present in more than half the species examined, often very abundant and sometimes very large, e.g. in *Beilsehmiedia mannii* Benth. Rays typically 2—3 cells wide and up to 4—8 cells wide in some species or specimens of *Beilsehmiedia, Cinnamomum, Cryptocarya, Endiandra, Eusideroxylon, Persea* and *Ravensara;* less than 1mm. high; uniseriates typically very few and low and composed of mixed upright and procumbent cells, but more numerous and composed entirely of upright cells in some species of *Beilsehmiedia* and *Cryptocarya;* occasional 'aggregate' rays noted by Dadswell and Eckersley in *Cryptocarya glaucescens* R. Br. and *C. corrugata* C. T. White, such rays, according to Francis,

associated with the deep indentations characteristic of the mature stem; 4—11, mostly 5—7, rays per mm.; typically rather weakly heterogeneous, with marginal row of square cells, sometimes homogeneous, e.g. in *Hypodaphnis zenkeri* Stapf and *Umbellularia californica* Nutt. Janssonius and Dadswell and Eckersley refer to occasional sheath cells in some species. Cells often with dark solid contents; crystals not observed. Occasionally with a distinct tendency to arrangement in echelon, particularly in some species of *Beilsehmiedia* and in *Mezilaurus lindaviana* Schw. & Mez. Commonly containing oil cells. Gonggrijp notes the presence of silica in *Endiandra* and *Litsea.* Fibers typical with simple pits that are more numerous in the radial than in the tangential walls, but the pits occasionally with small, rather indistinct borders in some of the species lacking septate fibres, e.g. some species of *Actinodaphne, Beilsehmiedia; Endiandra,* and *Ocotea rodiaei* Mez. Septate in *Licaria* p.p.; *Actinodaphne* p.p., *Aiouea, Persea* subgen. *Alseodaphne, Aniba, Cinnamomum* p.p., *Dehaasia, Dicypellium, Endlicheria, Licaria, Lindera* (one species only), *Litsea* p.p., *Ocotea* p.p., *Persea, Phoebe, Ocotea* subgen. *Pleurothyrium, Mezilaurus* and *Umbellularia;* occasional septate fibers may occur in some of the other genera (Kanehira, Stern). Septate fibers are not limited to the neighbourhood of the vessels, as in the Myristicaceae. Walls varying from very thin to very thick (the lumen is practically obliterated in certain species) sometimes gelatinous. Mean length 0.7—1.6. mostly 1.0—1.4 mm. Vasicentric tracheids recorded by Janssonius in *Phoebe dedinata* Bl., *Lindera subumbelliflora* Kosterm., and several species of *Litsea.*

Oil or mucilage cells are characteristic of most of the woods of this family, occurring usually in either the wood parenchyma or the rays and relatively rarely in both, e.g. in some species of *Licaria, Aiouea, Cinnamomum, Cryptocarya, Persea* and *Phoebe;* more commonly present in the wood parenchyma than in the rays and then occurring round the vessels and in the bands of parenchyma, if these are present. Isolated cells sometimes appear to be scattered among the fibers in transverse sections, but at least some of these are due to the presence on the margins of the rays of occasional high oil cells which may project into a transverse section that misses the rest of the ray. According to Janssonius (1934) oil and mucilage cells are indistinguishable except by their contents and are to some extent interchangeable; he found oil cells to be more numerous than mucilage cells, except in *Cinnamomum iners* Bl., *C. javanicum* BL, and *C. burmannii* Bl.; to these may be added *Persea thunbergii* Kosterm. Oil or mucilage cells not observed or very rare in some species or specimens of *Actinodaphne, Beilsehmiedia, Cryptocarya, Endiandra, Hypodaphnis, Lindera, Neolitsea* and *Ocotea rodiaei* Mez, and Kanehira notes the following genera of which individual specimens may or may not posses these cells: *Actinodaphne, Cryptocarya konishii* Hay., *Lindera, Litsea, Machilus* (=' *Persea), Phoebe,* and *Neolitsea.*

INFLORESCENCE

The inflorescences are always axillary (in some American *Persea* species terminal, according to Mez), even in species with sympodial ramification. With the exception of *Cassytha* the dichasial or racemose inflorescences are limited.

The inflorescences originate either from a mixed bud (but this is not very common) or from a flower bud. They are as a rule panicles, each ramification subtended by a bract; the ramifications repeat the phyllotaxis, but often the phyllotaxis becomes of a lower order (½ or even *Vi* in *Persea americana* Mill.) ; this is common in small (reduced) inflorescences. Sometimes the inflorescence is a raceme; its cymose nature may be deduced from the 2 bracts which subtend the flower (e.g. *Eusideroxylon melagangai* Sym.). A pseudo-spike occurs in some species *(Nectandra leucantha* Nees). When the ultimate ramifications are shortened, the flowers may be arranged in a head *{Endlicheria glomerata* Mez; *Litsea)* ; pleiochasia are sometimes present *{Licaria gvianensis* Aubl.) ; in *Licaria capitata* Kosterm. the entire inflorescence is reduced to a head on a long peduncle.

Sometimes the inflorescences occur on shortened branchlets *(Litsea, Lindera, Ocotea aniboides* Mez).

As a rule the inflorescences are erect (in *Endlicheria arunciflora* Mez they are perhaps pendulous) ; the infructescence, by the weight of the fruit, is often pendulous.

The inflorescence bracts usually drop at an early stage, although more or less persistent bracts occur in species of several genera.

Male inflorescences are as a rule more-flowered, more branched and bigger than female ones *{Endlicheria).*

In *Litsea* and *Lindera* the flowers, arranged in a pseudo-umbel, are surrounded by decussate, large, persistent bracts; usually this involucre drops after anthesis, but (especially in male flowers: *Litsea)* it persists and the inflorescence drops as a whole. The lower pair of the involucral bracts is usually transversal, the third one is just above the umbel-bearing bract. The pseudo-umbel is actually a shortened spiral; each flower is subtended by a small bract (sometimes, however, reduced). Rarely the number of involucral bracts is reduced to two. The perianth of the flower is often reduced, as its function is taken over by the involucrum.

The inflorescence of *Sassafras* should be (according to Mez) of the same type; the bracts at the base of the inflorescence are supposed to be the involucral bracts; the bud scales replace the involucral bracts to protect the flowers. The bracts, however, are not decussate and do not persist (they drop before anthesis) and hence are not exactly comparable

to those of *Litsea* and *Lindera,* although they have probably originated in the same way. In Asiatic species of *Beilschmiedia* and in *Actinodaphne* the same phenomenon occurs, and it is assumed that *Umbellularia* has the same kind of enveloping bracts, although in this genus the spirally arranged bracts occur at the top of the inflorescence.

In *Cassytha* the ramification of the inflorescence continues indefinitely; each branch is subtended by a reduced bract; the spiral follows the number ⅖.

FLOWER

The flowers are actinomorphic, usually bisexual, but dicliny is rather common.

In dioecious species the female flowers are usually bigger, the tube especially is larger. In *Endlicheria* all species are dioecious, in *Litsea* and *Lindera* several, in *Ocotea* (including the subgen. *Nectandra)* the greater part of the species.

In monosexual flowers remnants of the reproductive organs are as a rule present in the opposite sex, but in the male flower the reduced ovary may be completely suppressed, although style and stigma are always better preserved.

It is assumed that the "primitive" flower has two outer whorls of fertile, glandless stamens, a third whorl of gland-bearing fertile ones and a fourth whorl of staminodes. These staminodes are either relatively large and heart- or spear-shaped *(Persea, Beilschmiedia,* etc.) or minute *(Ocotea,* etc.); this character has been considered of importance to segregate genera.

The unilocular ovary has a single ovule, opposite the first leaf of the second perianth whorl; it is pendulous and anatropous and has 2 integuments.

According to anatomical investigation the two perianth whorls appear simultaneously and hence there is no reason to consider the inner whorl of corolla nature. In some genera *(Persea)* the outer tepals are smaller than the inner ones; the reverse is very rare *(Endlicheria paradoxa* Mez).

Sometimes the outer whorl of stamens is petaloid *(Phyllostemonodaphne* and *Dicypellium).* In *Potameia, Neolitsea,* and *Laurus* the perianth consists of two whorls of two decussate tepals each. In (abnormal) flowers of *Persea americana* Mill, it has often been observed that the perianth becomes dimerous, although the number of stamens in each whorl remains three. Abnormal numbers of tepals are often found in *Litsea.* Mez, who observed flowers with 5 tepals, concluded alliance with *Berberis. Octolitsea,* as established by Liou Ho, with 8 tepals, should be considered an

aberrancy. In *Litsea* sometimes the reverse happens and tepals are changed into stamens.

Mez stressed the apetalous nature of the flower by pointing at *Cassytha*, where the 1/3 -spiral is continuous through the (reduced) leaves, the inflorescence bracts and the perianth.

STAMENS. During its development the anther has usually already been completed before the basal part of the meristem develops into a filament. The anther consists of parenchymous tissue with numerous oil and slime ducts, the remnants of the not resorbed tapetum layer, the pollen cells, a layer of fibers that only partly covers the peripheral part, and an only slightly thickened epiderm.

The anthers are originally four-celled; this is clear from two-celled ones where the ablastic upper part often contains a single undeveloped or partly developed cell.

In *Potameia chinensis* Kosterm. and *P. velutina* Kosterm. the two remaining cells become confluent, although the flap is still two-lobed; some species of *Mezilaurus* show the same tendency.

Occasionally sterile stamens are present and as a rule they are reduced to foliar staminodes; in some cases, and often in the third staminal whorl, the anthers are normal in outline but lack cells *(Aniba kappleri* Mez, *Cryptocarya* species from Madagascar, etc.).

If 4 anther-cells are present, the "primitive" case is represented by 2 pairs above each other. In several genera the 4 cells are arranged in one arc-like row; this may be due to enlargement of the base of the anther; intermediate stages between superimposed anthers and those in one row are common.

The anthers are extrorse, introrse, lateral or apical; if there are two pairs of anther-cells, one pair (especially of the third whorl) may open in a direction different from that of the other pair.

Mez tried to correlate extrorsity or introrsity with the position of the floral glands. Although the theory is ingenious, it cannot explain all cases. In some species of *Persea* subgen. *Alseodaphne* and *Licaria* the anthers are very thick and fill the available space completely; they have small glands; the cells are apical, which perhaps may be explained by pointing out that it is only by this arrangement that pollinating insects can easily reach the pollen. When lateral cells are present, it also seems to me that this makes the pollen better accessible to insects. In flowers with spreading perianth the outer two whorls of stamens are as a rule also spreading and hence their introrse cells are well exposed; in these flowers the third whorl is erect and thus has its extrorse cells well exposed.

Extrorsity and introrsity have little generic value. In *Litsea* usually all anthers are extrorse, which also is easily understood for this kind of umbel-like inflorescence.

The velum of the anther cells contracts considerably after dehiscence; it is torn off at its base along a line where strengthening elements are lacking.

As I pointed out elsewhere, the valves in *Mezilaurus* seem to open from top to base; actually they open in the normal way from base to top, but the bases of the anthers are enlarged and have moved the bases of the cells outwards; the cells are apparently transverse.

The filaments are either long and slender *(Beilschmiedia* species, *Persea* species, *Litsea*, etc.) or as broad as, or broader than the anthers, or completely lacking.

The shape of the anther is rarely constant in a genus (constant in *Aniba, Endlicheria).*

The third whorl of filaments is often connate *(Systemonodaphne)* or closely pressed together (Madagascar species of *Cryptocarya).*

Irregularities in the number of stamens were found in *Beilschmiedia roxburghiana* Nees *(LauromeirrilMa* was created on account of these irregularities).

The number of anther whorls is generally used for delimitation of genera. It is, however, a character to be handled with care. If it is not correlated with other characters, it has no generic value. In *Aiouea* 1, 2, or 3 whorls may be present; in *Beilschmiedia* 2 or 3 whorls; in *Endiandra* 1 or 2 whorls, etc.

FLOWER GLANDS are as a rule represented in all genera. Anatomical evidence (epiderm not cutinized; according to Mez cuticle occurring sometimes; small-celled parenchyma) shows that they are no staminodes, as suggested previously. Oil cells and a rudimentary vascular bundle are present. They may be minute or so large that they fill the space between the filaments completely. They are either sessile or stalked and the stalks may be partly grown together with the filaments. As a rule each filament is flanked by two glands.

Sometimes there is a considerable distance between the filaments and their glands.

In the regular type of flowers with 3 whorls of fertile stamens usually the third whorl only is provided with glands, but exceptions in a genus are not rare. Rarely all filaments are accompanied by glands *(Ocotea* subgen. *Pleurothyr'ium, Endlicheria* species, *Urbanodendron).* The number of glands, their presence or absence, has no generic value.

The glands are usually globular; exceptionally they may be flat or heart-shaped; in the latter case they strongly resemble staminodes.

STAMINODES. There are two trends of reduction of stamens; in *Lica/ria* the two outer staminal whorls are reduced to thin, foliate staminodes, without any difference between antherial part and filament. In *Phyllostemonodaphne* and *Dicypeilium* the outer whorl has become completely tepaloid (in *Eusideroxylon* the 4 minute cells are still present, but the stamens are tepaloid) ; in *Licuria* subgen. *Misantheca* the two outer staminal whorls are entirely lacking.

This mode of reduction, starting with the outer whorls, is also present in *Endiandra* and *Mezilaurus.* If, on the contrary, the two outer staminal whorls (or one) are fertile and the third whorl (and/or the second), the reduction of the stamens is usually less complete; they are not strap-like and show a distinct antherial part *(Aiouea).* The third whorl tends to become staminodial in some species of different genera *(Aniba kwppleri* Mez, *A. canelilla* Mez, *Endlichewia paradoxa* Mez, *Cryptocarya perrieri* Danguy, *Alseodaphne coriacea* Kosterm., etc.); in this case the reduction may be restricted to the anther being sterile only, or the stamens may be reduced to a stipe. The fourth staminal whorl in most genera is staminodial. The staminodes are either heart-shaped and stalked *(Beilschmiedia, Cryptocarya, Persea),* or minute and ligulate *(Ocotea, Cinnamomum).* In some genera not all species show the same degree of staminal reduction. Sometimes they still show the ablastic anther. According to Mez the staminodial tissue is similar to that of the floral glands and perhaps they may act as nectaries. I could not confirm this from living material, in which the slimy, glossy floral glands contrast with the dry staminodes.

In *Aiouea* (and also in African *Beilschmiedia* species) the staminodes of whorl 4 are inserted lower than the other stamens. The staminodes may be either sessile or stalked, pilose or glabrous (floral glands are never pilose); these characters have only specific value. In *Beilschmiedia roxburghiana* Nees flowers with 6 or 9 fertile stamens may be found on the same plant; sometimes the missing stamens are represented by an equal (sometimes unequal) number of staminodes.

GYNAECIUM. Although the ovary is one-celled and contains only one ovule, there is enough evidence that it is composed of 3 (or perhaps 6) carpels (pseudo-monomerous). This assumption is based on the following considerations: the stigma is sometimes 3-cleft (in the rudimentary ovary of the male flower) ; the fruit of *Ravensara* is divided (at the base) in 6 compartments; Mez found 6 primary vascular bundles in the ovary of *Cinnamomum sericeum* Sieb.

The style is either long, short, or absent; the stigma is variable in shape; it is either inconspicuous *(Beilschmiedia)* to relatively large and peltate *(Ocotea* species) ; in the latter case there is often one lateral indent, which would point to a single carpel. The ovary is epigynous, perigynous, or hypogynous *(Hypodaphnis).* The single ovule is pendulous and anatropous and gives rise to a one-celled fruit. The alleged exception in *Beilschmiedia roxburghiana* Nees is due to an error in the original description.

FRUIT

Meissner (1864) stressed the importance of the presence or absence of a fruit cup for generic delimitation.

Starting from the assumption that a superior ovary is more primitive than an inferior one we may arrange the genera according to this character, which is correlated with the character of the fruit. In flowers with a superior ovary the fruit is seated on a bare pedicel, with none or hardly a trace of the receptacle; in perigynous flowers the fruit is at the base partly covered by a cup, which represents the deep flower tube. In the most differentiated genera the ovary is included in the flower tube (adnate or not) ; the enlarged tube completely covers the fruit. Sometimes, however, the flower tube enlarges more quickly than the ovary, which results in a fruit at first completely enclosed in a cup *(Aniba, Ocotea, Litsea),* although at a later stage it may be much larger than the cup. During this transitional stage it is very difficult to differentiate the fruit from those whose ovary is at first completely included in the tube and whose fruit is completely enclosed in the accrescent tube *(Cryptocarya, Ravensara)* . In *Eusideroxylon* the flower tube is shallow, although it completely envelopes the mature fruit. Meissner combined genera showing transitional inclusion of fruit with genera like *Cryptoearya;* this is not advisable as the species showing transitional stages are not limited to definite genera.

In genera in which the perianth drops completely and in which no trace of a cup is to be found *(Beilschmiedia, Endiandra, Persea),* the abscission line is very sharp; the perianth generally drops as a closed ring consisting of a small basal collar and the tepals. In rare cases the abscission line is somewhat above the base of the flower tube. In that case a flat, small disc will be found below the fruit *(Mezilawrus).*

In *Phoebe* and *Apollonias* tube and tepals together enlarge slightly; the tepals harden and are pressed against the fruit. Although this is used as a generic character, the persistent, indurate perianth is also found in

some species of other genera *(Aiouea, Ocotea, Persea* subgen. *Alseodaphne),* although as a rule to a lesser degree.

In *Cinnamomum* (but also in *Phoebe amoena* Mez and other American species of *Phoebe)* only the basal half of the tepals with the tube persists under the fruit. The abscission line here goes half way through the tepals and results in a cup crowned with 6 truncate lobes.

In perigynous flowers the resulting cup varies considerably as to depth and size and in a single genus, like *Litsea,* an almost flat, inconspicuous cup may be found, or else a cup that covers the fruit completely (although in a different way than in *Cryptocarya)* ; as a rule, however, a normal hemispherical cup is present. The cup is generally more or less fleshy, although in a dried condition it may appear woody; it is either smooth, or *(Aniba)* covered with round, corky warts (lenticels). In a fresh condition it is usually green, yellowish green or red.

The cup is either sharply separated from the stalk, or gradually merges into it. In the latter case the fleshy stalk and the cup may be highly coloured *(Endlicheria).*

The rim of the cup is either simple, double or triple. Mez ascribed this phenomenon to a mechanical process by which the growing fruit carries the inner margin upwards. I cannot confirm this view. The second rim actually represent the grown-out tissue of the base of the fruit and second whorl of stamens together, and the third rim that of the third whorl of stamens. These double margins are constant in some genera: *Licaria, Systemonodaphne, Urbanodendron,* but occur also occasionally in species of other genera *{Ocotea).* Sometimes the rim is wavy, because the broadened bases of the perianth are persistent *(Ocotea).* The fruit pedicel is either cylindrical, or may (as in *Endlicheria)* be fleshy and conical, or (in *Dehaasia)* greatly swollen, club-shaped and highly coloured (also in *Ocotea clavigera* Mez), in *Litsea* species and in some species of *Persea* subgen. *AJtseodaphne).* The usually bright red stalks form a striking contrast with the black fruit.

The fruit is a one-seeded berry. The exocarp is ordinarily glossy and smooth, although in some cases it becomes woody *(Licaria camdra* Eosterm., *Alseodaphne paludosa* King, *Eusideroxylon, Cryptocarya).* As' a rule it is black in colour, sometimes red; yellow fruits are rare *(Actinbdaphne).* In an immature stage the fruit is generally white or greenish white, later red; some fruit are pure porcelain-white *(Litsea).*

The mejocarp is usually succulent; it is mostly thin, but may reach considerable thickness in the cultivated *Persea americana* Mill. According to Mez the mesocarp has its origin in the outer integument. The taste is

usually bitter, aromatic and astringent. In most cases the endocarp is thin and smooth. In some *Potameia* species a kind of aril is present, which covers the embryo completely but for a small apical area.

In fruits completely covered by the accrescent flower tube the latter assumes the function of the exocarp and mesocarp; the exocarp of the fruit becomes woody *(Ravensara, Cryptocarya, Eusideroxylon)* and is often ribbed *(Cryptocarya, Ravensara)* or furrowed *(Eusideroxylon).* In *Eusideroxylon, Cryptocarya,* and *Ravensara* the accrescent flower tube becomes entirely adnate to the fruit, although the ovary in the flower is still free from the tube. In the flowers of these genera the style is often constricted by pressure where it passes the narrow apical aperture of the flower tube; in *Eusideroxylon,* however, the tube has a very v/ide aperture and nothing indicates at this stage, that the receptacle will later enclose the ovary. In the monotypical genus *Hypodaphnis* the ovary is inferior from the beginning; here the exocarp —- contrary to that of *Cryptocarya, Ravensara,* and *Etisideroxylon* — remains thin.

The shape of the fruit it usually ellipsoid, sometimes globose, sometimes slightly oblique *(Persea* subgen. *Alseodaphne)* and often (in genera without cup) provided with a neck at the base. The ripe fruit has either no trace of a style and may even be a little depressed or it is mucronulate (base of style). All tissue usually contain plenty of oil and mucilage cells. In young fruit a clear, jelly-like substance is often present at one side between the cotyledons; this may be residuary endosperm.

The seed is composed of two large, flat-convex cotyledons that are easily separable (in *Ravensara* and *Cassytha* they are more or less fused) ; as a rule the cotyledons are white, rarely pink; they contain fatty oil *(Persea),* carbohydrates and proteins. The flattened apical (lateral in *Beilschmiedia variabilis* Robyns & Wilcz.) corculum is completely covered by the cotyledons, which are attached to it by a large area of tissue; the first leaves of the plumule, which are often pilose, are well developed, usually one is larger than the other and covers it slightly. The outside of the cotyledons is either smooth or irregularly sulcate. In *Ravensara* (in the basal part of the fruit) the endocarp penetrates the seed with 6 septa (rarely 12 septa).

The radicle is as a rule rather small, rarely swollen (species of *Beilschmiedia).* The testa is thin and smooth (in *Cassytha* it is tough, probably because the seeds are dispersed birds that swallow them).

DISPERSAL OF SEEDS. The fruit is dispersed mainly by birds, probably also by squirrels and monkeys. These are attracted by the glossy black,

red or yellow berries, often seated on a (swollen) red stalk. As there is no protecting coat except in *Cryptocarya, Ravensara* and *Cassytha,* the seeds only survive when they are not swallowed or too much damaged. The production of fruits is often enormous. The taste is as a rule bitter or pungent and I could observe that animals usually bite off a little of the tissue and then drop the fruit.

The heavy fruits of *Eusideroxylon* are carried around by porcupines on the ground and sometimes by monkeys.

Persea tonkinensis Kosterm. is dispersed by water. The species usually grows on alluvials along rivulets where periodical inundation occurs. They float by means of the air-filled space between seed coat and endocarp. Riverine species are apparently also dispersed by water.

POLLEN AND POLLINATION

According to Erdtman (Pollen Morphology and Plant Anat. 221. 1952) the pollen grains are non-aperturate, more or less sphaeroidal, 24—40(—70)µ in diameter, tenui-exinous, usually provided with spinules or spinuloid projections. The exine stratification is obscure. In general the pollen grains are similar to those in Gomortegaceae and Hernandiaceae. The flower glands point to insect-pollination; furthermore the flowers are often very fragrant. I never saw butterflies near the flowers and only occasionally found small beetles crawling around in them. Apparently self-pollination is frequent. The colour of the flowers is white or greenish, rarely yellow or red. In *Persea* subgen. *Nothaphoebe* they turn from yellow to red after anthesis.

In some genera *(Liearia, Persea* subgen. *Alseodaphne)* the flowers hardly open and the anthers are so near the stigma that self-pollination seems inevitable.

The existence of dioecious flowers points to the development of cross-pollination.

Pollination has been investigated in *Persea americana* Mill, by Stout *(in* J. New York Bot. Gard. 25: 1-7. 1924) ; he discovered dichogamy. The flowers of one specimen open and close in two separate periods; during the first the pistil becomes ready for pollination, and fertilisation takes place during the second phase when the pollen is shed. Abnormal weather conditions may intervene and even cause overlapping of periods. Stout discovered two groups of varieties, of which one opens its flowers for the first period in the forenoon, the other in the afternoon. The pollination is effected by insects.

Mez contents that the volatile oil prevents damage to the leaves by animals; in Indonesia, however, *Persea americana* Mill, is completely stripped of its leaves every year by caterpillars *(Cricula trifenestrata).*

MYRMECOPHILY

Mez gives examples of myrmecophily in American *Pleurothyrium* species. From New Guinea thus far two cases have become known *{Cryptocarya caloneitra* Kosterm. and *Beilschmiedia myrmecaphila* Kosterm.). The pith of the (secondary) terminal branches (usually swollen) is eaten away; there are oval or round entrance holes.

CHROMOSOME NUMBERS

The following figures are copied from Darlington — Janaki Ammal, Chromosome Atlas of cultivated plants (1945).

Laurus nobilis x = 7 42
Cinnamomum- x — 12
Cinnamomum camphora 24
C. japonicum (= *pedunculatum)* 24
C. linearifolium 24
C. obtusifolium . . . . . 24'
C. sieboldii {=burmannii) 24
C. zeylanicum 24
Lindera x = 12
L . glauca 24
L. benzoin (= *aestivale)* 24
Persea x = 12
P. americana 24
P. pubescens (= *caxolinensis)* 24
Sassafras x = 12 .
S. albidum (= *officinale)* 48

PALAEONTOLOGY

The oldest fossil Lauraceae are of Tertiary age (Palaeocene). The pretended Cretaceous species (Lesquerreux) from N. W. America is apparently not lauraceous.

Miocene and Pliocene fruit and flowers are known from Siberia, which makes it evident that Lauraceae occurred far North.

In the Pliocene period Lauraceae disappear from Europe, except for the genus *Laurus.*

A large number of fossil Lauraceae have been described. Species represented by fruit only (Reid & Chandler, London Clay Flora* 1933) may be referred to half a dozen genera. In contemporary species it is impossible, without flowers at hand, to identify most of the genera. Consequently generic identification of fossil material on the basis of fruits and/or leaves is usually dubious.

Species represented by leaves only can hardly be placed at all. Hollick *(in* Bull. New York Bot. Gard. 12: 298-300. 1924) distinguishes between *Nectandra* and *Ocotea,* genera which in contempory species are only differentiated by the position of anther cells and some minor (and not constant) characters of the flowers. The identifications in question should therefore be considered utterly unfounded guess work.

Triplinerved leaves are by palaeontologists consistently referred to *Cinnamomum,* although in contempory Lauraceae a dozen genera have species with such leaves. Triplinerved leaves are furthermore so common in other families that even the identifications as to family are doubtful.

Reid and Chandler, without sufficient knowledge of the variability of fruit in modern Lauraceae, often identify fossil material by the fruit. The results, if not completely wrong, are at any rate dubious (fruits of *Ocotea* species are apiculate, in *Beilschmiedia* usually not; the cup in *Cinnamomum,* only occasionally leaves a trace on the base of the fruit, but in numerous cases, where the cup is shallow it certainly does not, etc.).

Bandulska (Eocene of Bournemouth) approached the problem of identification of leaves by means of studying cuticles and stomata. This approach should also be handled with care, as is proved by *Aniba ridleyana* Mez, which has the *Aniba* type of stomata, but actually represents a species of *Ocotea.* She herself stresses, that in modern species of a single genus the variation in stomata and cuticle is astonishing.

Of *Trianthera* Conwentz a complete flower is preserved in amber, which makes it possible to relate it to *Eusideroxylon.*

Palaeontological results consequently have given us thus far only an incomplete idea of the distribution of Lauraceae in the Tertiary period, and have not yielded information on ancestral problems.

Described fossil genera (incomplete) :

Actinoda'phne
Aniba
Beilschmiedia
Benzoin
Cinnanwmoides
Cinnamomum
Crowella
Cylicodaphne
Daphnogene
Daphnophyllum
Endiandra
Laurinium
Laurinoxylon
LauriphyUum
Laurocalyx
Laurocarpum
Laurus
Lindera
Litsea
Mespilodaphne
' Neolitsea
Ocotea
Oreodaphne
Persea
Perseoxylon
Protoravensara
Sassafras
Tetranthera
Trianthera

RELATIONSHIPS

On account of the similarity of the dehiscence of the anther cells in Lauraceae and in some genera of Berberidaceae, Monimiaceae and Hamamelidaceae, relationship with these families has been suggested.

There are now two current views: 1) Lauraceae are related to Thymelaeaceae and 2) they belong in Ranales,

Of the two families Hernandiaceae and Gomortegaceae, nobody doubts that they are very close to Lauraceae.

Lindley (1853) already recognized that Lauraceae are far removed from Berberidaceae because of their polypetalous flowers, hypogynous stamens and endospermous seeds.

Still, Hallier f. (1912) derived the family (incorporated in the suborder Laurineae of the order Annonales) from hypothetical Proberberideae; he suggested relationship with Monimiaceae, Calycanthaceae and Chlorantaceae.

Alliance with Thymelaeaeeae was accepted by Lindley (1853), Baillon (1870), Bentham (1880), who placed the family in the Daphnales series, and Pax (1889), who considered Lauraceae to be a connecting link between Polycarpicae and Thymelaeaeeae.

Pax pointed to the significant differences between Lauraceae and Monimiaceae (acyclic flowers, several apocarp carpels, usual presence of/endosperm, different pollen, etc.).

Warming (1895), Bessey (1915), Johnson (1931), Engler & Diels (1936), Wettstein (1935), Gundersen (1943) and Pulle (1950), following Eichler (1886) adhere to relationship with Magnoliaceae (Magnoliales) of Ranales (Polycarpicae).

Hutchinson (1926) placed the family (with Monimiaceae, Hernandiaceae, Gomortegaceae and Myristicaceae) in a separate order Laurales (next to Annonales), which he considered as reduced perhaps from winteraceous ancestors of Magnoliales.

Apparently Myristicaceae are close to Lauraceae (apetalous flowers, ovary, etc.) ; Garret (1933) could find wood-anatomical support for this view.

USES

Persea americana Mill, produces the familiar alligator pear or avoeado with edible mesocarp. The seeds contain oil.

Well-known timbers are greenheart *(Ocotea rodioei* Mez) and ironwood *(Eusideroxyion zwageri* T. & B.). Many others are used locally and are highly esteemed for their durability and fine grain *(Ocotea bullata* E. Mey., *Persea lingue* Nees, *Dehaasia eaesia* Bl., etc.). Most timbers are liable to attack by borers and fungi; on account of the excellent grain it is worth while to apply preservation methods.

Several Lauraceae yield commercial volatile oils, such as rose wood *(Ardba rosaeodora.* Ducke and *Aniba duckei* Kosterm.).

Numerous barks have commercial value because of their oil content: Cinnamon *(Cinnamomum zeylanicum* Bl. and *C. cassia* Bl.), Massoy *(Ciryptocarya massoy* Kosterm.), *Litsea odorifera* Valet, (an extremely sweet-scented bark), *Licaria cinnamomoides* Kosterm. with the smell of nutmeg (the fruits are sold locally), *Aniba caneiilla* Mez, *Licaria puchury-major* Kosterm., *Dicypellium canjophyttatum* Nees and *Cryptocarya moschata* N. & M. smelling of nutmeg and/or clove (marketable fruit), *Rawensara aromatica* Sonn. (saleable fruit), *Endlicheria longifolia* Mez with the odour of aniseed, *Ocotea foeniculacea* Mez with the scent of *Foeniculum,* etc. — *Cinnamomum camphora* Nees & Eberm. yields the well-known Japan camphor. *Cinnamomum porrectum* Kosterm. has saffrol in its bark (for scenting soap). — Alcaloids could be extracted from several barks and seeds: *Aniba coto* Kosterm., *Ocotea veraguensis* Mez, *Ocotea rodioei* Mez, etc. (cf. Baillon for further particulars).

DISTRIBUTION

Lauraceae are typical for the tropical rain forest where they ascend to 4000 metres. Not only do they represent an integral part of the montane forest in this area; they are just as abundant in the lowland forests. They occur in marshy places and on well-drained soils. In forests under seasonal climatic conditions they become rare.

North and South of their main area they are found as far as California *(Umbellularia)* and other parts of the United States of America *(Sassafras)* up to 45—50° N. L. In Europe they do not reach farther than the Mediterranean area *(Laurus nobilis* L.) ; in India they are found in Nepal; in China they go as far as Korea *(Litsea)* ; they also occur in Japan *(Litsea, Lindera),* they reach Southern Chile (island of Chiloe: *Persea. lingue* Nees) and Argentine; in South Africa only a few species

are found *(Ocotea bullata* E. Mey.), but Madagascar has very many, including endemic genera. Lauraceae reach New Zealand "with two species *(Beilschmiedia tawa* Benth., *B. tarairi* Benth.).

Richest in species are perhaps South and Central America, followed by Malaysia. In Africa the family is represented rather poorly. This may be due to two factors: the scarcity of the pure tropical rain-forest and the desiccation of the African continent since the Tertiary period. In Australia its main centre is the rain forest area of Queensland and New South Wales.

Several genera have pantropical distribution *(Beilschmiedia, Cryptocarya, Persea, Phoebe, Litsea, Cassytha),* other are restricted to Asia and (or) Australia *(Actinodaphne, Persea* subgen. *Alseodaphne, Cinnamomum, Dehaasia, Endiandra, Eusideroxyion, Lindera, Hexapora, Neolitsea). — Cinnamomum, Actiodaphne* and *Litsea* are distributed over the whole area, with their main centre in Malaysia. *Eusideroxyion* is restricted to Borneo and parts of Sumatra; *Dehaasia* to Malaysia (very rare in New Guinea) and *Hexapora* to Malaya. *Lindera* and *Litsea* are (more so than the other genera) represented in China, Korea and Southern Japan. *Endiandra* has its centre in the Eastern part of Malaysia (and in Australia). Madagascar harbours the endemic genus *Ravensara. Potameia* has a disjunct area, the bulk of the species occuring in Madagascar, one in Nepal and one in Southern China. Africa has the remarkable endemic genus *Hypodaphnis.* The only genus rich in species in tropical Africa is *Beilschmiedia. Apollonias* has one species in India and one in Cape Verde. Typical American genera are *Ocotea,* including *Nectanclra* (with *Pleurothyrium), Aiouea, Aniba, Systemonodaphne, Urbanodendron, Licaria, Mezilaurus, Dicypellium* and *Phyllostemonodaphne. —* With other continents America shares *Beilschmiedia, Cryptocarya* and *Litsea* as well as North American *Lindera* and *Sassafras;* the latter genus has a disjunct area, one species occurring in America and two in China and Formosa.

Australia has the same genera as Malaysia, with a preponderance of *Endiandra.* This continent is the main centre for *Cassytha.*

SIZE OF THE GENERA

The figures after the generic names indicate the number of published binomials. From the number of species of revised genera it may be assumed that the actual number of species will be about10% - 40 % lower.

The accepted genera are printed in bold face type.

Acatsjavalli 0
Acrodiclidium 62
Actinodaphne 128
Adaphtos 0
Adenodaphne 1
Adenostemwm 1 (Gomorteg.)
Adenotraehelium 1
Afrodaphne 15
Agathophyllum 16
Agriodaphne 1
Aiouea 46
Alseodaphne 58
Ampelodaphne 4
Anaueria 1
Aniba 74
Apella 0
Aperiphracta 4
Aperula 18
Api'wa 0
Apollonias 12
Aydendron 45
Balanopsis 4
Beilsehmiedia 236
Bellota 5
Benzoin 89
Berniera 1
Berrija 1
Bihania 1
Brassiodendron 1
Bistama 0
BoWw 2
Boldus 3
Borbonia 19
Bryantkea 1
Calodium 1
Ccdosmon 3
Calycodaphne 3
Camphora 47
Camphorina 4
Camphor omoea 10
Canella 2
Cansiera 1
Caryodaphne 5
Caryodaphnopsis 3
Cassytha 50
Cecidodaphne 1
Cedrota 2
Ceramocarpium 10
Ceramophora 6
Chanekia 6
Chibaca 1 (non Laur.)
Christmannia 1 (= *Salacia)*
Cinnamomum 341
Clinostemon 1
Colomandra 0
Cryptocarya 318
Cubeba 1
Curondia, 1 (= *Salacia)*
Cussuta 1
Cyanodaphne 3
Cylicodaphne 59
Dambumeya 2
Daphnidium 20
Darwinia 1
Decapenta 1
Dehaasia 33
Dendrodaphne 1
Dictyodaphne 7
Dicypellium 1
Dipliathus 1
Dodecadenia 4
Douglassia 2
Dovera, 0 (Salvador.)
Drimophylltom 0
Ehrhardia 0
Endiandra 95
Endlicheria 55
Endocarpa 1
Euodia 0
Euosmus 6
Euphoebe 7
Eusideroxylon 2
Evelyna 2
Evodia 2
Evonymodaphne 1
Evosmus 1
Farnesia 0
Fwtfa. **11**
Glabraria 7
Goeppertia 16
Gymnobalanus 10
Haasia 23
Heckaria 1
Hexanthiis 1
Hexapora 1
Huberodaphne 1
Hufelandia 16
Plypodaphnis 1
Icosandra 1
Iteadaphne 2
Jozosmene 0
Jozoste 52
Lauromerrillia 1
Laurus 334
Lepidadenia 30
Leptodaphne 3
Lethedon 1 (?)
Licaria 52
Lindera 135
Linharea 2
Litsea 474
Machilus 100
Malapoenna 168
Mespilodaphne 65
Menestrata 1
Mezia 6
Mezilaurus 10
Micropora 2

Misanteca 20
Nectandra 248
Nemodaphne 1
Neocinnamomum 8
Neolitsea 93
Neosilvia 0
Nesodaphne 3
Nobeliodendron 1
Nothaphoebe 41
Nyctandra 0
Nyrophyllum 0
Ocotea 697
Oreodaphne 178
Ozanthes 1
Ozarthris 4 (?wm Laur.)
Parabenzoin 2
Parthenoxylon 3
Persea 240
Petalanthera 1
Peumus 5 (3)
Phoebe 174
Phyllostemonodaphne 1
Pipalia 1
Pleurothyriwm 18
Polydenia 18
Pomatium 1
Porostema 2
Potameia 22
Pseudocryptocarya 1
Pseudolitsea 1
Psewdosassafras 2
Purkayasthea 1
Quinquedula 0
Ravensara 27
Rombut 1
Rumputris 1
Salgada **1**
Sassafras 16
Sassafridium 2
Sckauera 0
Sciadiodaphne 0
Sebifera 3
Senneberia 0
Septina 0
Silvia 12
Spironema 1
Stemmatodaphne 1
Strychnodaphne 6
Symphysodaphne 1
Synandrodaphne 3
Syndiclis 2
Systemonodaphne 3
Tamala 8
Teleiandra 1
Tetradenia 45
Tetranthara 220
Thouvenotia 1
Tomex 12
Triplomeia 1
Tylostemon 45
Umbellularia 2
Urbanodendron 1
Volutella 1
Wimmeria 1
Yiishunia 1

The total number of published binomials is 5462 (1956). The accepted genera are listed below, arranged according to their size.

Ocotea 697
Litsea 474
Persea 339
Cinnamomum 341
Cryptocarya 318
Beilsehmiedia 236
Phoebe 174
Lindera 135
Actinodaphne 128
Endiandra 95
Neolitsea 93
Aniba 74
Endlicheria 55
Licaria 52
Cassytha 50
Aiouea 46
Dehaasia 33
Ravensara 27
Potameia 22
Sassafras 16
Mezilaurus 10
Systemonodaphne 3
Eusideroxylon 2
Apollonias 2
Laurus 2
Umbellularia 2
Dicypellium 1
Hexapora 1
Hypodaphnis 1
Urbanodendron 1
Phyllostemonodaphne 1

The total number of binomials of accepted genera is 3435; we may assume that Lauraceae comprise between **2000** and **2500** species.

CLASSIFICATION

Linnaeus recognized only two genera *(Laurus* and *Cassytha).* •— A. L. de Jussieu (1789), under his Order *Lauri* enumerated the genera *Laurus, Ocotea* and *Aiouea* and as allied genera *Myristica* and *Virola,* and *Hernandia.* Several lauraceous genera *(Ravensara, Cassytha, Lindera, Tomex* and *Liearia)* were relegated to the genera incertae sedis. The first general monograph appeared in 1836 (C.'G. Nees von Esenbeck, Systema Laurinarum), who divided the family into 13 tribes. Nees created a considerable number of small genera and moreover reinstated older genera, which had formerly been incorporated in *Laurus.* Altogether he recognized 34 genera.

The second monograph appeared in 1864 (Meissner *in* DC, Prodr. 15 (1): 1-265). Although Meissner already combined several of Nees' genera, he still accepted 46 genera, which he divided into 4 tribes. Actually Lauraceae were divided into 3 suborders, of which the second *(Gyroearpeae)* is now included in the family Hernandiaceae; suborder 1 is *Laurineae;* suborder 3 *Cassytheae.* In our classification these two are considered subfamilies (according to modern rules). The suborder *Laurineae* was divided into 2 groups (without names) according to presence or absence of an involucrum of bracts under the subumbellate flowers. The group without involucrum comprised 3 tribes, mainly differentiated by the development of the flower tube in the fruit. The tribes were subdivided again, according to the number of anther cells and the number of flower parts. These subdivisions are not named. The group with involucrate flowers comprises only one tribus *(Litsaeaceae)* which was again subdivided according .to the number of anther cells. Here the subtribus received names *(Tetranthereae* and *Daphnidieae).* Baillon (1870) recognized 8 tribus, of which 6-8 are now incorporated in Hernandiaceae. The 5 tribus of Lauraceae proper correspond more or less to those of Meissner *(Oreodaphneae* Meissner are called here *Ocoteae* Baill.). Some genera of Meissner's tribus *Cryptocaryeae* are moved to Baillon's tribus *Cinnamomeae,* which more or less covers Meissner's *Perseaceae.*

Bentham (1880) divided the family into 4 tribus: *Perseaceae* without involucre, *Litseaceae* with involucre, *Cassytheae* and *Hernandieae.* He observed, that the fruit characters, as stressed by Meissner, were not sufficiently known. The subdivision of *Perseaceae* was made according to the number of anther cells and the development of the flower tube in the fruit, these subdivisions remained unnamed. Bentham recognized only 33 genera of the Lauraceae proper.

Pax (1889) composed a very artificial classification based on the number of anther cells. In his system the aberrant genus *Cassytha,* often considered to belong to a separate family, was classified into the tribe *Lauroideae,* merely by its 2-celled anthers, and genera like *Eusideroxylon* and *Gryptocarya,* which are closely related, were referred to widely separated tribes. Curiously enough wood-anatomical data (Dadswell & Eckersley 1940; Desch 1941) concur with regard to this artificial subdivision in *Lauroideae* and *Persoideae.*

After Pax no general monograph has appeared. Mez' system of American Lauraceae (1889) is worth to be mentioned here. He divided the family into two suborders: *Laureae* and *Cassytheae.* The *Laureae* were subdivided into two tribus: *Perseae* and *Litseeae,* differing by the absence or presence of an involucrum; the next subdivision (unnamed) was made according to the number of anther cells.

In the classification outlined below, I have adopted the following sequence of characters (according to their importance) :

1. The development of the flower tube in the fruit, which runs more or less parallel with inferior, intermediate and superior ovary.
2. The presence or absence of an involucrum of decussate persistent bracts surrounding and enveloping the pseudo-umbels.
3. The number of fertile stamens.
4. The number of anther cells.
5. The development of the 4th staminodial whorl.

It should be stressed here that several genera are linked by one or a few intermediate species.

Apparently the combination of characters is more or less indefinite and almost all combinations are represented. We may assume either that missing combinations are extinct or that the potentiality, that they will develope is still present. With such an assumption and without any indication of the palaeontological succession I have refrained from trying to make a chronological family tree and have simply grouped related genera together. Even the position of the groups (tribus) has no proper phylogenetical base; nobody can tell whether *Hypodaphnis* with an inferior ovary has developed from *Ocoteae,* from *Litseeae,* or *Perseeae,* etc., although in our diagram it is placed at the end (top).

The course of the phylogenesis is not clear; the only thing we know is, that the family must be rather old (ubiquist).

SYSTEM OP THE FAMILY

1 a. Arborescent. Leaves normal . . . . . subfam. A. Lauroideae
2 a. Inflorescences paniculate. Flower-umbels without involucre. Fruit without a cupula . . . . . tribus I Perseeae
3 a. Anthers 4-celled . . . . . subtrib. a. Perseineae
1. Persea
2. Phoebe
3 b. Anthers 2-celled . . . . . subtrib. b. Beilschmiediineae
3. Apollonias
4. Dehaasia
5. Beilsehmiedia
6. Endiandra
7. Mesilaurus
8. Hexapora
9. Potameia
2 b. Inflorescences paniculate. Flower-umbels without involucre. Fruit-base embedded in a cupula . . . . . tribus II Cinnamomeae
4 a. Anthers 4-celled . . . . . subtrib. a. Cinnamomineae
10. Ocotea
.11. Cinnamomum
12. Actinodaphne
13. Sassafras
H. Umbellularia
15. Dicypellium
i b. Anthers 2-celled . ." . . . . . subtrib. b. Anibineae
16. Aiouea
17. Aniba
18. Endlieheria
19. Licaria
20. Urbanodendron
21. Systemonodaphne
22. Phyllostemonodaphne
2 c. Flower-umbels surrounded by an involucre of decussate, large, persistent bracts. Fruit more or less embedded in a cupula . . . . . tribus III Litseeae
. . 5 a. Anthers 4-celled . . . . . subtrib. a. Litseineae
23. Litsea
2J,.. Neolitsea
5 b. Anthers 2-celled . . . . ". . . . subtrib. b. Lauriineae
25. Lindera
26. Laurus
2 d. Inflorescence paniculate. Flower-umbels without involucre. Ovary superior. Fruit completely included in the accrescent flower tube.
tribus IV Cryptocaryeae
'6 a. Anthers 4-celled . . . . . subtrib. a. Eusideroxylineae
27. Eusideroxylon,

6 b. Anthers 2-celled . . . . . subtrib. b. Cryptocaryineae
28. Cryptocarya
29. Ravensara
2 e. Inflorescences paniculate. Flower-umbels without involucre. Ovary inferior.
tribus V Hypodaphneae
30. Hypodaphnis
1 b. Parasitical climbers without proper leaves . . . . subfam. B. Cassythoideae
31. Cassytha

KEIST TO THE GENERA

1a. Arborescent; leaves normal 2
b. Parasitical twiners with reduced leaves . . . . . *31. Cassytha*
2a. Flowers in pseudo-umbels (rarely single), surrounded by large, decussate, persistent bracts, forming an involucre, the bracts as a rule decussate 3
b. Flowers not surrounded by a persistent involucre 6
3a. Flowers dimerous 4
b. Flowers trimerous 5
4a. Flowers dioecious or bisexual; male ones with 3 whorls of 4 stamens, all bearing glands; anthers introrse, 2-celled. Female flowers with 4 large staminodes, all provided with glands . . . . . *26. Laurus*
b. Flowers dioecious; male ones with 3 whorls of 2 stamens; inner whorl with glands; anthers 4-celled, introrse. Staminodes in female flowers as many as stamens in male ones . . . . . *2U- Neolitsea*
5a. Anthers 4-celled . . . . . *23. Litsea*
b. Anthers 2-celled . . . . . *25. Lindera*
6a. Ovary inferior . . . . . *30. Hypodaphnis*
b. Ovary superior or — if embedded in the flower tube — not adnate to the tube. 7
7a. Fruit completely included by the adnate, enlarged flower tube; usually only a small orifice at apex 8
b. Fruit seated on and partly covered by a shallow or deep cup developed from the flower tube 10
c. Fruit on a naked pedicel; or the perianth persistent, but no cup 22
8a. Anthers 4-celled . . . . . *27. Eusideroxylon*
b. Anthers 2-celled 9
9a. Basal part of fruit septate; cotyledons ruminate . . . . . *29. Ravensara*
b. Fruit 1-celled . . . . . *28. Cryptocarya*
10a. Anthers 4-celled 11
b. Anthers 2-celled 16
11a. Inflorescence before anthesis covered by long-persistent, large, non-decussate bracts (pseudo-involucrum) 12
b. Bracts of inflorescence small, soon deciduous 14
12a. Bracts at the end of a long peduncle . . . . . *lit. Umbellularia*
b. Bracts at the base of the inflorescence 13
13a. Leaves alternate, incised . . . . . *13. Sassafras*
b. Leaves verticillate, rarely alternate, entire . . . . . *12. Actinodaphne*

14a. Tepals 9; fruit cup flat . . . . . *15. Dicypellium*
b. Tepals 6; fruit cup flat or deep 15
15a. Staminodes of innermost whorl minute or none . . . . . *10. Ocotea*
b. Staminodes of innermost whorl conspicuous, stipitate, heart- or arrow-shaped. *11. Cinuamomum*
16a. Tepals 9 . . . . . *22. Phyllostemonodaphne*
b. Tepals 6 17
17a. Fertile stamens 9 18
b. Fertile stamens 3, 6, rarely 9 21
18a. All stamens provided with large glands. Fruit-cup with double rim. Flowers bisexual . . . . . *20. Urbanodendron*
b. Only third whorl of stamens with glands, (in one *Endlicheria* species all stamens with glands, but the flowers dioecious) 19
19a. Flowers dioecious. Fruit cup fleshy, merging into the fleshy, slightly club-shaped pedicel . . . . . *18. Endlicheria*
b. Flowers bisexual. Fruit-cup not fleshy, sharply demarcated from the not or hardly thickened pedicel 20
20a. The 3 inner stamens triangular, fleshy, connate; fruit cup with double rim, with persistent, not enlarged perianth . . . . . *21. Systemonodaphne*
b. Inner stamens not connate, not fleshy; rim simple . . . . . *17. Aniba*
21a. The 2 outer whorls of stamens staminodial or none. Fruit cup double- or triple-rimmed, distinct from the pedicel . . . . . *19. Licaria*
b. All anthers fertile, or those of the 2 outer whorls fertile, the inner whorl sterile, or the first whorl fertile, the inner two sterile. Fruit cup shallow, thickened, merging into the fleshy pedicel . . . . . *16. Aiouea*
22a. Perianth in the fruit indurate, clasping the base of the fruit 23
b. Perianth in the fruit deciduous, or, if persistent, not indurate and not clasping the fruit 24
23a. Anthers 4-celled . . . . . *2. Phoebe*
b. Anthers 2-celled . . . . . *3. Apollonias*
24a. Fruit pedicel strongly thickened, fleshy, often highly coloured. Anthers 2-celled. *U. Dehaasia*
b. Fruit pedicel hardly or not thickened (if thickened, anthers 4-celled) 25
25a. Anthers 4-celled . . . . . *1. Persea*
b. Anthers 2~celled 26
26a. Flowers dimerous . . . . . *9. Potameia*
b. Flowers trimerous 27
27a. Leaves subverticillate; top of fruit-pedicel with a small disc. Anther-flaps opening from inside to outside . . . . . *7. Mezilaunis*
b. Leaves alternate or subopposite; fruit-pedicel without disc. Anthers opening from base to top 28
28a. Fertiles stamens 3 (in one species 6). Leaves areolate . . . . 6'. *Endiandra*
b. Fertile stamens 6 or 9. Leave;? reticulate (in one species areolate). Outer 2 staminal whorls introrse; inner one extrorse . . . . . *5. Beilschmiedia*
c.' Fertile stamens 9. Leaves reticulate. All anthers introrse. Fruit unknown. *8. Hexapora*

LAUEACEAE

Lauraceae Lindl., Nat. Syst. 200. 1838.
SYNONYMS. — *Lauri* Juss., 1790. — *Laurinas* Vent., 1799. — *Laurineae* St. Hil., 1805. — *Laureae* Reichenb., 1828. — *Laureacsae* Lindl., 1833. *

A. Subfamily Lauroideae Kosterm., 1957.

SYNON. — *Laurineae verae* Zoll. *in* Nat. en Geneesk. Arch. 1: 603. 1845; Miquel, Fl. Ind. Bat. 1 (1) : 891. 1855. — *Laureae* Mez, 1889.

Arborescent. Leaves normal. Inflorescence definite.
TYPE GENUS. — *Lmirus* L.

I. Tribu3 Perseeae Mez, 1889.

Tribus ***Perseeae*** Mez *in* Jahrb. bot. Gart. Barlin 5: 3. 1889.
SYNON. — *Perssae* Nees, 1836, *p.p.* — *Perseacsae* Maissn., 1834. *p.p.* — *Persoideae* Pax, 1889, *p.p.*

Inflorescence paniculate, without involucrum, flower tube deciduous.

a. Subtribus Perseineae Kosterm., 1957.

Anthers with 4 cells.

1. PERSEA[1] [Plumier] Boehmer, 1760.

Perssa [Plum.] Boshmer *in* Ludwig, Defin. 38. 1760.
SYNON. — *Famesia* Heist, *ex* Fabric. 1763. — *Nyrophyllum* Necker 1790 (?). — *Menestrate* Vello^o 1825. — *Alseodaphne* Nees 1831. — *Machilus* Nees 1831. — *Tamala* Rafin. 1838. — *Nothaphosbe* Bl. 1851. — *Euphosbe* El. *ex* Meissn. 1864. — *Stemmatodaphne* Gamble 1910. — *Caryodaphnopsis* Airy-Shaw 1940.
PRINCIPAL LITERATUEO). — Nees, Syst. 123. 1836; Endlieher, Gen. 317. 1836-40; Msissner *in* DC. Prodr. 15 (1): 43. 1834; Baillon, Hist. PL 2: 469. 1870; Bsntham *in* B. & H., Gen. PL 3: 153, 157. 1880; Mez *in* Jahrb. bot. Gart. Berlin 5: 134—179. 1889; Pax *in* Engl. & Prantl, Pfl. Fam. 3 (2): 114. 18S9; Blake *in* J. Wash. Acad. Sci. 10: 9—21. 1920; Kostsrmans *in* J. sci. Ees. Indon. 1: 86 & 116. 1952.

Trees or shrubs. Leaves alternate, chartaceous to rigidly coriaceous. Panicles axillary or sub-terminal- Flowers bisexual; tepals 6, the outer whorl as a rule smaHer than the inner one, deciduous or persistent (but not indurate and not clasping the fruit) ; tube very shallow. Fertile stamens 9 or 6 (two or three outer whorls) with, as a rule, long and slender filaments and introrse cells (in subgenera *Nothaphoebe* and *Clavi-persea*, stamens sessile); anthers of whorl three extrorse or lateral and

[1] Antique Greek name of an Egyptian cauliflorous .tree, which has nothing in common with the modern *Persea*.

filaments flanked by glands. Fourth whorl consisting of conspicuous usually stipitate staminodes (small in subg-enera *Nothaphoebe* and *Clavi-persea).* Anthers as a rule 4-celled, rarely those of the third whorl 2-celled; cells usually large. Fruit on a naked pedicel, or the perianth (not enlarged) more or less persistent. Pedicel cylindrical or enlarged and fleshy. Pantropic.

TYPE SPECIES. — *Persea americana* Miller.

Number of binomials 239. It is not possible to estimate the exact number of "good" species. If we accept Mez' circumscription, most species are found in tropical America, Mez differentiated the genus from its nearest relative *Phoebe* by the position of the anther cells (in 2 pairs above each other in *Phoebe* and showing tendency to be placed in an arc in *Persea)* and the not enlarged perianth under the fruit. The way of separating the two genera is not satisfactory. The position of the anther cells has certainly no generic value.

In Asiatic species of *Phoebe* the persistent, indurate and enlarged perianth is appressed to the fruit; the flower tube does not enlarge, and the pedicel of the fruit is not thickened. The genus *Machilus* has already been included by me in *Persea,* as the persistent, not enlarged, spreading or recurved perianth is also found in American *Persea* and the leaf- reticulation strongly resembles *Persea.*

If the character of the indurate, appressed perianth can be maintained in American species of *Phoebe,* it seems to be advisable to restrict only these species to *Phoebe* and to incorporate all other in *Persea,* and perhaps partly in *Cinnamomum.*

Equally unsatisfactory is the delimitation versus *Nothaphoebe* and *Alseodaphne. Nothaphoebe,* as typified by *N. umbelliflora* BL, is characterized by sessile, thick anthers, minute staminodes and a more or less permanently semi-closed perianth with smaller outer tepals. The fruit is seated on a naked, not or hardly thickened pedicel. *Alseodaphne,* as typified by *A. semecarpifolia Nees,* is more like *Persea* in its flower characters than *Nothaphoebe* by its more spreading perianth.

Revision of all species is necessary to make certain whether *Nothaphoebe* and *Alseodaphne* may be kept separate from *Persea* or whether Bentham's view should be adopted to incorporate them, together with *Phoebe,* into *Persea* (as I have done here).

Pax' system is unacceptable; it is partly based on wrong assumptions of floral and fruit characters of the genera concerned.

Anatomical characters of leaves and wood yield no definite conclusion although at any rate they do not support separation of the genera mentioned above.

I agree with Airy-Shaw, that the character of 2- or 4-celled anthers is less important than stressed formerly in Pax' and Mez[5] classification.

In this paper I have incorporated *Alseodaphne* and *Nothaphoebe* in *Persea,* with the status of subgenera; moreover a new subgenus *Clavi-persea* is added, comprising species characterized by flowers as in *Notha-phoebe,* but with thickened, fleshy fruit pedicel with persistent tepals,

Persea americana Miller yields the well-known avocado; *P. lingue* Nees from Chile is a well-known timber, like *P. thunbergii* (Sieb. & Zucc.) Kosterm., (basonym: *Machilus thunbergii* Sieb. & Zucc. *in* Münch. Abh, II Cl. Akad. Wiss. IV, 3. Abth. 202. 1943) from Japan.

Subgenera five. — 1. *Persea,* syn. *Eupersea* Benth.: tepals deciduous. 2. *Machilus* (Nees) Kosterm.: tepals persistent, patent. 3. *Notha-pkoebe* (Bl.) Benth.: tepals incurved, stamens sessile, staminodes small. 4. *A[7]seodaphne* (Nees) Benth.: tepals patent, deciduous, stamens with conspicuous filaments, staminodes large, fruit pedicel thickened. 5. *Clavi-persea* Kosterm.,: flowers as in *Nothaphoebe,* fruit peduncle swollen, fleshy, crowned by the persistent perianth.

2, PHOEBE[2] Nees, 1836.

Phoebe Nees, Syst. 93. 1836.

SYNON. — *Persea* **Boehm.** 1760. *p.p.*

PKIHCIPAL **LITERATURE.** — Nees, Syst. 98. 1836; Baillon, Hist. PL 2: 468. 1870; Bentham *in* B. & H., Gen. PL 3: 157. 1880; Mez *in* Jahrb. bot. Gart. Berlin 5: 180. 1889; Pax *in* Engl. & Prantl., Pfl. Fam. 3 (2): 115. 1889 *p.p.;* Kostermans *in* J. scl. Res. **Indon. 1:** 122. **1952.'**

Floral characters as in *Persea.* Perianth persistent, indurate, enlarged, clasping the basal part of the fruit.

TYPE SPECIES. — *Ph. lanceolata* Nees.

Number of binomials 174. The actual number of species depends on the delimitation of the genus. As characterized above, the genus is restricted to Asia. The American species with cylindrical fruit-pedicel with or without persistent, not enlarged perianth, should be incorporated into *I'ersea;* the American species with thickened fruit-pedicel and disc-like cup, are perhaps better incorporated in *Cinnamomum.*

Pax recognized two sections, of which *Eupersea* comprises the species of *Phoebe* proper. The section *Gnesiopersea* of Bentham, incorporated by Pax with *Phoebe,* definitely belongs to *Persea.*

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[2] **From the Greek *cpoifios,* phoibos = shining; the name of Apollon as sun god.**

b. Subtribus Beilschmiediineae Kosterm., 1957.

Anthers with two cells.

3. APoLLoNIAS[3] Nees, 1833.

Apollonias Nees, Frogr. grat. 10. 1833.

PRINCIPAL LITERATURE[1]. — Nees, Progr. grat., Annexa pi. laur. expos. 10. 1833; Baillon, Hist. PL 2: 470. 1870; Bentham *in* B. & H., Gen. PI. 3: 152. 1880; Kostermans *in* Humbert, Fl. Madag., 81e Fam.: 2—10. 1950; *in* J. sci. Res. Indon. 1: 118. 1952.

Flowers and fruit characters as in *Phoebe*, but anthers 2-ceiled-

TYPE SPECIES. — *A. barbusana* (Cav.) A. Braun.

Number of binomials 12; number of species 2. The Madagascar species, of which the fruit has become known better, were relegated to *Beilschniiedia*. The genus has a disjunct area; one species in the Canary Islands, one in India.

4. DEHAASU[4] Bluma, 1835.

Dehaasia Blume. Rumphia 1: 161. 1835.

SYNOS. •— *Haasia* Nees 1833. — *Cyanodaphne* Blume 1851.

PRINCIPAL LITERATURE. — Bentham *in* B. & H., Gen. PL 3: 152. 1880; Kostermans *in* J. sci. Ees. Indon. 1: 120. 1952.

Floral characters as in *Persea* subgen. *Nothaphoebe*, but anthers 2-celled. The fruit-pedicel is strongly enlarged, fleshy, and often highly coloured.

TYPE SPECIES. •— *D. incrassata* (Jack) Kosterm.

Number of binomials 33; the actual number of species will prove to be far smaller.

The genu3 is closely related to *Persea* subgen. *Nothaphoebe*, but differs in the number of anther-cells and the swollen fruit-pedicel, which also occurs in *Persea* subgen. *Clavipersea*. Airy-Shaw advocates fusion of *Alseodaphne* and *Dehaasia*, which are very similar generally; because of the different pedicel and number of anther-cells, however, I think that *Dehaasia* merits generic status. The genus is restricted to Malaysia-

[3] After the Greek god Apollon.

[4] Named in honour of Dirk ds Haas, Head of the Dutch East India Company's establishment in Japan in 1677—1679, later (1687) governor of Amboina.

5. BEILSCHMIEDIA[5] Nees, 1831.

Beilschmiedia Nees *in* Wall. PL Asiat. rar. 2: 61, C9. 1831.

SYNON. — *Boldu (non* Feuillée) Nees 1833. — *Hufelandia* Nees 1833. — *Bailschmidtia* Reichenbach 1841. — *Belloia* Gay 1819. — *Nesodaphne* Hooker f. 1855. — *Wimmer'a* Nees *ex* Maissner 1834. — *Bsrniera* Baillon 1870. — *Boldus* O.K. *(non* Adans.) 1891. — *Tylostemon* Englsr 1898. — *Afrodaphne* Stapf 1905. — *Thouvenotia* Danguy 1920. — *Ananeria* Kostsrmans 1938. — *Purkayasthaea* Purkayastha 1938. — *. jEsauromerrillia* Allen 1942.

PRINCIPAL LITERATURE. — Bentham *in* B. & H., Gen. PL 3: 152. 1880; Kostermans *An* Rec. Trav. bot. Neerl. 35: 837—868. 1938; Robijns & Wilczek *in* Bull. Jard. bot. jBruxelles 19: 459—506 1951.

Flowers bisexual. Tepals equal or subequal. Fertile stamens 9 or 6, 2-celled; two outer whorls introrse, glandless; third whorl extrorse, flankled by glands; fourth whorl consisting of conspicuous, usually stipitate staminodes. Stigma inconspicuous, consisting of differently coloured tissue [1] decurrent at one side from the apex of the style. Fruit on a not (or hardly) swollen, bare pedicel. Leaves often suboppsite; reticulation lax, usually conspicuous.

TYPE SPECIES. — *B. roxburgkiana* Nees.

Number of binomials 238, the actual number of species will not be fles3 than 200. This pantropical genu.3 is well represented in Africa.

The subdivision of the genus, as proposed by Robijns and Wilczek for the African species, is not applicable to Beilschmiedia in other con-'tinents.

Subgenera two. — 1. *Beilschmiedia*, syn. *Ennearrhena*, Stapf, ,1905; fertile stamens 9. 2. *Hexaa^rhena* Stapf, 1905: fertile stamens 6.

6. ENDIANDRA[6] E. Brown, 1810.

Endiandra R. Br., Prodr. Nov. Holl. 402. 1810.

SYNON. — *Dictyodaphne* Blume 1850. — *Brassiodcndron* Allan 1942.

PRINCIPAL, LITERATURE. — Baillon, Hist. PL 2: 474. 1870; Bentham *in* B. & H., Gen. PL 2: 154. 1880.

Floral characters as in *Beilschmiedia*, but (third whorl) only three often sessile stamens (one exception: *E. fragrans* Kosterm. with 6 fertile stamens). Staminodes minute or none. Leaves alternate or opposite with areolate reticulation.

TYPE SPECIES. — *E. glauca* R. Brown.

[5] Named in honour of K. T. Beilschmied, pharmacist and author of soms plant-gaographical works, born 1793 in Silesia, died 1843 in Herrnstadt near Breslau (Vratislava).

[6] From the Greek *ἐvdeia*, endeia = lack, and *ἀvijg, ἀvdgog*, aner, andros = man. A plant lacking stamens.

Number of binomials 95; number of species perhaps 80. The genus is restricted to Malaysia, the Pacific region and Australia. It is closely related to *Beilschmiedia,* with which it is linked by *E. fragrans* Kosterm. with 6 fertile stamens, whereas *B. endiandraefolia* Kosterm. (ined.) has the areolate reticulation of *Endiandra.*

It is also very similar to South American *Mezilaurm,* which has a small disc-shaped remnant of the flowertube at the top of the fruit pedicel. This occurs also in some Australian *Endiandra* species, but the anthers in *Mezillaurus* are different and the leaves are fascicled, near the apex of the branches.

7. MEZILAUSUS[7] Taubert, 1892,

Mezilaurus Taub. *in* Bot. Zentralbl. 50: 21. 1892.

SYNON. — *Silvia* Allemao 1854. — *Silvaea* Meissner 1834. — *Endiandra* Bentham 1880, *p.p.* — *Mezia* (nee Sehwacke) 0. Kuntze 1891. — *Neosilvia* Pax 1897.

PRINCIPAL LITERATURE. — Kostermans *in* Rec. Trav. bot. neerl. 35: 109—12S. 1938.

Floral characters as in *Endiandra,* but anthers often dehiscing laterally. Leaves fascicled.

TYPE SPECIES. — *M. na-valium* (All.) Taub.

Number of binomials 10; number of species 9. The genus is restricted to South America, It is closely related to *Endiandra. Mezilaurus navalium* Mez and *M. itauha* Mez furnish well-known commercial timbers,

8. HExAPoRA[8] Hooker f., 1886.

Hexapora Hook, f., Fl. Brit. Ind. 5: 189. 1886.

SYNON. — *Micropora* Hooker f. 1883.

PRINCIPAL LITERATURE. — Hooker f. *in* Hook. Icon. *t. 15k-7.* 1886; Fl. Brit. Ind. 5: 862. 1886; Ridley, Fl. Mai. Pen. 3: 90. 1924; Kostermans *in* J. sci. Kes. Indon. 1: 144. 1952.

Flowers bisexual; perianth of 6 equal, rotundate tepals. Fertile stamens 6, without glands, 2-celled, extrorse. Staminodes 3, thick. Stigma as in *Beilschmiedia.* Leaves alternate. Fruit unknown.

TYPE SPECIES. — *H- curtisii* Hook. f.

This monotypic genus is allied to *Beilschmiedia* and *Endiandra.* It is endemic in the Malay Peninsula.

7 Named in honour of C. Mez, born in 1836 at Freiburg; in 1900, professor in Halle, in 1910 in Konigsberg, a well-known botanist, author of monographs on Lauraceae, Myrsinaceae, and Bromeliaceae.

8 Named for the 6 pores of the stamens. Actually there are 6 x 2 pores, and Hooker, when discovering his mistake, changed the name into *Micropora.*

9. POTAMEIA[9] Th0U., 1808.

Potameia Dupetit-Thouars, *Nov.* Gen. madag. 5: 16. 1803.

SYNON. — *Cansiera (non* Juss.) Sprengal 1825. — *Potwmica* Poiret 1826. — *Syndiclis* Hooker f. 1836.

PRINCIPAL LITERATURE. — Kostermans *in* Humbert, FL Madag., 81e Fam.: 10—18. 1950; *in* J. sci. Res. Indon. 1: 144. 1952; Communic. 55 Forest Research Instit. Bogor 3—35. 1957.

Flowers bisexual; tepals 4, equal, in two opposite whorls. Fertile stamens 4, in two whorls, 2-celled (rarely one-celled). Staminodas 2, small, flanked with glands, or none; stigma inconspicuous. Fruit-pedicel with disc-like small remnant of tube with subpersistent perianth, or naked.

TYPE SPECIES. — *P. thouarsii* R. & Sch.

Number of binomials 22; number of species 21. The genus has a disjunct area; 19 species occurring in Madagascar, one in Bhutan, one in Hainan. The latter two, formerly described under *Syndiclis,* show fusion of the 2 anther cells, although the valves are still bilobed, this is also the case in one Madagascar species (P. *argentea* Kosterm.).

II. Tribus Cinnamomeae Baill., 1870, *emend.* Kosterm., 1957.

Cinnamomeae Baillon, Hist. PI. 2: 468. 1870, *p.p.*

SYNON. — *Oreodaphnsae* Meissn. 1864.

Inflorescences without involucrum, paniculate. Fruit-base embedded in a cupula.

a. Subtribus Cinnamomineae Kosterm., 1957.

Anthers with 4 cells.

10. OCOTEA[10] AubL, 1775.

Ocotea Aublet, Hist. PL Guyane fr. 2: 780. 1775.

SYNON. — *Borbonia* [Plumier] Boehmer 1760. — *Nectrandra* Eolander ex Eottbosll 1778. — *Porostema* Sehreber 1789. — *Senneberia* Necker 1790. — *Perostema* Raeuschel 1797. — *Linharea* Arr. de Camara ex Kostsr 1810. — *Gymnobalanus* Nees & Martius 1833. — *Lsptodaphne* Nees & Mart. 1833. — *Mespilodaphne* Nees & Mart. 1833. — *Oreodaphne* Nees & Mart. 1833. — *Petalanthera* Nees & Mart. 1833. — *Strychnodaphne* Nees & Mart. 1833. — *Teleiandra* Nees & Mart. 1833. — *Pleurothyrium* Nees *ex* Lindley 1836. — *Pomatium* Nees & Mart, *ex* Lindley 1836. — *Calycodaphne* Bojer 1837. — *Balanopsis* Rafin. 1838, *p.p.* — *Damburneya* Rafin. 1838. — *Agathophyllum (non* Willd., *nee* Jussieu) Blume 1851, *p.p.* — *Dendrodaphne* Beurling 1854. — *Adenotrachelium* Nees *ex* Meissner 1834. — *Agriodaphne* Nees *ex* Meissner 1834. — *Aperiphracta* Nees *ex* Meissner 1884. — *Camphoromoea* Nees *ex* Meissner 1834. — *Cannella* Schott *ex* Meissner 1864. — *Ceramocarpium* Nees *ex* Meissner 1834.

9 From the Greek *nora/AO?,* potamos = river, and *fieiov,* meiou = smaller.

10 Local name Ocote in French Guiana.

— *Ceramophora* Nees *ex* Meissnsr 1864. — *Nemodaphne* Meissner 1834. — *Sassafridium* Meissner 1864. — *Synandrodaphne* Meissnsr 1834. — *Adenotrachelima* Baillon 1870. — *Nyctandra* Prior 1883—86. — *Sennebiera* O. Kuntze 1904.

PRINCIPAL LITEUATUEE. — Nees, Systema 277—340; 346—331; 380—470; 471—484. 1833; Meissner in DC, Prodr. 15 (1): 93—170. 1834; Baillon, Hist. Fl. 2: 473, 477. 1870; Bentham *in* B. & H., Gen. PI. 3: 157—158. 1880; Mez *in* Jahrb. bot. Gart. Berlin 5: 219—174. 1889; Kostermans *in* Bull. Jard. bot. Bruxelks 15: 73—88. 1938; *in* Humbert, Fl. Madagasc, 81e Fam.: 18—43. 1950; *in* J. sci. Res. Indon. 1: 1952; Communic. Forest Kessarch Inst., Bogor, 60: 1—44. June 1957; Allan *in* Ann. Missouri bot. Gard. 35: 16—62. 1948.

Flowers in panicles, without involucre, bisexual or dioecious; flower tube small or conspicuous- Tepals equal, deciduous or persistent. Fertile stamens 9 in 3 whorls, the fourth whorl staminodial; staminodes minute or altogether lacking. Third whorl (only in one case all stamens) with glands. Anthers 4-celled, cells in pairs above each other or arranged in an ar"c. Cells of outer 2 whorls as a rule introrse, those of the third whorl generally extrorse. Stigma peltate. Fruit on a more or less developed cup with simple or double rim; perianth sometimes persistent.

TYPE SPECIES. •— O. *guianensis* Aublet,

Number of binomials *(Ocotea)* 449, *(Nectandra)* 248. The actual number of species will prove to be far smaller. This large genus is restricted to tropical America.

As Mez already indicated *Ocotea* and *Neeiandra* (and even *Phoebe)* are very difficult to separate.

The position of the anther cells, the main and perhaps the sole difference between the two genera, is certainly not of generic value, as intermediate cases are not uncommon.

The other characteristics (thin contra fleshy tepals, reflexed contra expanded tepals) are of even lsss generic value.

Ocotea veraguensis Mez has the same number of glands as *Pleurothyrium* and as the number of glands is not stable in other genera, I have already incorporated *Pleurothyrlum* with *Ocotea.*

Against *Phoebe, Cinnamomum,* and *Persea,* the genus *Ocotea* is merely differentiated by the minute staminodes of whorl four.

Ocotea and *Nectandra* are better combined and considered two subgenera.

Ocotea rodiaei Mez is the well-known greenheart of Guiana; *O. bullata* E. Mey. is a good timber from South Africa-

Subgenera three. — 1. *Ocotea:* anther-cells in pairs above each other. 2. *Nectandra* (Rol.) Kosterm.: anther-cells in one row. 3. *Pleurothyrium* (Nees) Kosterm.: all anthers with glands.

11. CINNAMOMUM[11] Boehmer, 1760.

Cinnamomum Boshmer *in* Ludwig, Defin. 63. 1760.

E^NON. — *Camphora* [Bauh.] Boshmer 1760. — *Septina* Noronha 1790 (?). — *Camphorina* Noronha 1790 (?). — *Cecidodaphne* Nees 1833. — *Parthenoxylon* Blume 1831. — *Cynamonum* Deniker 1883. — *Neocinnamomum* Liou-Ho 1932.

PKINCINAL LITERATURE. — Nees, De Cinnamomo Disput. 1823; Syst. 1836; Meissner *in* DC, Prodr. 15 (1); 10. 1834; Baillon, Hist. PL 2: 468. 1870; Bentham *in* B. & H., Gen. PL 3: 155. 1880; Perrot & Ebsrhardt, Les Canelliers de l'Indochine 1903; Cammtrloher *in* Bull. Jard. bot. Buitsnzorg 3, 7: 446—498. 1925; Lukmanoff, Nomencl. et Iconogr. Canell. et Camphr. 1—2: 1—28, *pi. 1—16* (n.v.).

Flowers bisexual, rarely polygamous; fertile stamens 9 (or 6) in 3 whorls; outer two whorls introrse, ^landless; inner whorl extrorse, flanked by glands. Anthers 4-c3lled, very rarely 2-celled. Fourth whorl consisting of conspicuous, stipitate, glandlezs staminodes. Stigma discoid or peltate. Flower tube accrescent, growing out into a cup which surrounds the basal part of the friut; often the basal part of (or the entire) perianth persistent on the rim of the cup. Leaves usually opposite and triplinerved.

TYP3 SPECIES. — *C. zeylaiucum* Bl.

Number of binomials 341; a revision will reduce the actual number of species considerably. The genus occurs from the Asiatic mainland to Formosa, the Pacific islands and Australia.

The flower characters are similar to those of *Persea* and *Phoebe,* but the tube is usually deeper and grows out into a cup; sometimes this cup is very fleshy and shallow, merging into the pedicel. In the latter case the genus is very close to *Aiouea,* which also has triplinerved species and persistent tepals; in *Aiouea* the anthers are always 2-celled. In the few cases where in *Cinnamomum* the anthers are two-celled, the upper ablastic tissue is usually distinct. As in the genus *Phoebe* in the sense of Mez), there are species in *Cinnamomum* whose anther cells are arranged in an arc, these were considered to belong to a different genus *(Neoc'nnamomum)* by Liou-Ho. The arrangement of the anther cells, however, has no generic value.

The alliance and delimitation between *Cinnamomum* and *Aiouea* remains to be cleared. *Ocotea* is apparently also related to *Cinnamomum,* but has smaller staminodes. Some American species of *Phoebe* should perhaps be included in *Cinnamomum.*

[11] Latin transcription of the Greek: *xivva/xcofiov,* kinnamomon = cinnamon.

12. ACTINODAPHNE[12] Nees, 1831.

Actinodaphne Nees *in* Wall., Fl. asiat. rar. 2: 61, 68. 1831.

SYNON. — *lozoste* Nees 1831, *p.p.* — *Jozoste* Nees ex O. Kuntze 1891.

PRINCIPAL LITERATURE. — Bentham *in* B. & H., Gen. PL 3: 160. 1880; Hooker £., Fl. Brit. Ind. 5: 147—154. 1886; Koorders & Valet, *in* Meded. Lands PI. tuin 68: 110—123. 1904; Teschner *in* Engl. bot. Jahrb. 58: 385. 1923; Ridley, Fl. Mai. Pen: 3: 107—112. 1924; Liou Ho, Laur. Chine et Indoch. 155—162. 1932; Allen *in* Ann. Missouri Bot. Gard. 25: 440—414. 1938; Kostermans *in* J. sci. Res. Indon. 1: 115. 1952.

Leaves usually verticillate. Flowers dioecious; tepals 6, subequal. Fertile stamens in male flower as a rule 9; the inner whorl biglandular. Anthers 4-celled, all introrse. Staminodes in female flower usually 9; the inner whorl biglandular. Stigma peltate. Fruit on a shallow or deep cup.

TYPE SPECIES. — *A. pruinosa* Nees.

Number of binomials 128; the number of species will be about 60—70.

The genus is usually placed near *Litsea,* because of the introrse anther cells. It differs, however, by the lack of an involucre of decussate, persistent bracts, as found in *Litsea* and I therefore prefer to leave it near *Ocotea* and *Cinnamomum.* It is very close to *Sassafras,* with which it might be combined ultimately. The genus is restricted to the Asiatic mainland and Malaysia.

13. SASSAFRAS[13] [Kramer] Boehmer, 1780.

Sassafras [Kramer] Boehmer *in* Ludwig, Defin. 36. 17S0.

SYNON. — *Euosmus* Nuttall 1818, *p.p.* — *Evosmus* Rafin. 1838, *p.p.* •— *Pseudosassafras* Lecomte 1911. — *Yushunia* Kamikoti 1933.

PRINCIPAL LITERATURE. — Nees, Syst. 487. 1838; Nees & Ebsrm., *in* Handb. Med.-Pharm. Bot. 1: 448. 1830; Baillon, Hist. PI. 2: 439, 479. 1870; Bentham *in* B. & H., Gen. PI. 3: 160. 1880; Bantley & Trimen, Madic. PI. 3: 220. 1880; Mez *in* Jahrb. bot. Gart. Berlin 5: 484. 1889; Berg & Schm., Atl. off. PfL, ed. 2, 4: 79. 1899; Blake *in* Rhodora 20: 98. 1918; Render *in* J. Am. Arb. 1: 242—44. 1920; Record & Hess *in* Trop. Woods 69: 31—32. 1942; Kosterm. *in* J. sci. Res. Indon. 1: 88, 95, 147. 1952.

Flowers dioecious. Tepals subequal. Stamens in male flowers and staminodes in female ones 9, all introrse, 4-celled; the inner whorl with glands. Flower tube enlarging into a fruit-cup. Flowers in shortened racemes (pseudo-umbals), surrounded by deciduous, alternate bracts- Leaves alternate.

TYPE SPECIES. — *S. albidum* (Nees) Nutt.

12 From the Greek: *Aung, dmivoQ,* aktis, aktinos — ray, and *dacpvrj,* daphne = laurel. The leaves are arranged in star-shaped whorls.

'i* French, Italian and Spanish name, perhaps derived from latin: saxifraga.

Number of binomials 4; number of species 2.

The genus has a disjunct area, one species occurs in North* America, one in Formosa. The Formosan one is not constant in its number of anther cells and differs moreover by the presence of staminodes and bisexual flowers.

I provisionally accept Render's view to consider *Pseudosassafras* as congeneric.

The genus has always been put near *Litsea,* because all anthers are introrse. As I am not convinced that the in- or extrorsity of the anthers is more important than the involucre of decussate, persistent bracts, as found in *Litsea,* I prefer to place the genus near *Actinodaphne.* The genus is the only one that has lobed leaves.

14. UMBELLULAEIA[11] Nuttall, 1842.

Dmbellularia Nuttall, N. Amer. Sylva 1: 103. 1842.

SYNONYMS. — *Drimophyllum* Nuttall 1842. — *Sciadiodaphne* Reichenbach 1841.

PRINCIPAL LITERATURE. — Bentham *in* B. & H., Gen. PI. 3: 162. 1880; Mez *in* Jahrb. bot. Gart. Berlin 5: 482. 1889; Busss *in* Bsr. deut. pharm. Ges. 6 (2): 56—61. 1896; Jepson, The Silva of Calif. 2: 243. 1910; Bambacioni *in* Annali Bot. 22 (2): 99. 1941; Guenther, Ess. Oils 4: 207. 1950.

Flowers bisexual; tepals 6, equal. Fertile stamens 9; the inner whorl with glands. Anthers 4-celled, first and second whorl introrse; third whorl extrorse. Fourth whorl staminodial. Flowers in a shortened raceme, surrounded by alternate, deciduous bracts. Fruit on a flat cup. Leaves alternate.

TYPE SPECIES. — *U. californica* (Nees) Nuttall.

Number of binomials 2; number of species 1.

This monotypic genus occurs in California. It is usually considered to be related to *Litsea,* but in my opinion it is close to *Actinodaphne.*

It differs more from *Litsea* than does *Sassafras* (in the position of the anther cells and the not decussate, non-persistent involucral bracts). It is possibly advantageous to incorporate it with *Actinodaphne.*

15. DICYPELLIUM[15] Nees & Mart, 1833.

Dicypellium Ness & Martins, Progr. grat. 14. 1833.

PRINCIPAL LITERATURE. — Nees, Syst. 343. 1836 (excl. *Licaria);* Mez *in* Jahrb. bot. Gart. Berlin 5: 472—473. 1889; Kostermans *in* J. sci. Res. Indon. 1: 119. 1952.

14 Flowers in stalked umbels.

is From Greek *xvnelkov* kupellon = cup; the cup is double-rimmed.

Flower and fruit characters as in *Ocotea;* tepals 9. Second and third whorl of -anthers foliaceous, ovate, 4-celled. Staminodes of the fourth whorl none. Tepals persistent, enlarged under the fruit.

TYPE SPECIES. — *D. caryophyllatum* Nees.

This monotypic genus from Brazil has a marketable fruit with clove fragrance. It is related to *Ocotea,* but also to *Phyllostemonodaphne.*

b. Subtribu.3 A n i b i n e a e Kosterm., 1957.

Anthers with two cells.

16. A.I o u E A[16] Aublet, 1775.

Aiouea Aublet, Hist. Guyane franc. 1: 310. 1775.

SYNON. — *Ehrhard'.a* Seopoli 1777. — *Douglassia* Schreber 1783. — *Colomandra* Necker 1730. — *Apivea* Steudsl 1821. — *Endocarpa,* Eafinesqua 1838.

PRINCIPAL LITERATURE. — Kostsrm. *in* REC. Trav. bot. neerl. 35: 57—104. 1938; *in* J. sci. Res. Indon. 1: 88. 1952; *in* Bol. tacn., Inst. Agron. Norts Brasil 28: 51—52. 1955.

Flowers bisexual flower-tube not very deep. Tepals equal. Fertile stamens 9, 8 or 3; anthers 2-celied; those of the two outer whorls (with 3 exceptions) introrse. Sterile stamens represented by staminodes, which are often strap-like. Staminodes of the innermost whorl well developed. Stigma peltate. Fruit usually seated on a swollen obconical body with a slight concavity at top; sometimes perianth persistent and accrescent.

TYPE SPECIES. — *A. guianensis* Aublet.

Number of binomials 46, number of species 30. The genus is restricted to tropical America. The species are often difficult to distinguish from those of genera like *Aniba* and *Endlicheria.'* They frequently have a characteristic yellowish leaf colour and a thickened leaf margin.

S u b g e n e r a three. 1. *Aiouea:* stamens of the outer two whorls fertile; of the inner two whorls sterile. 2. *Endocarpa* (Rafin.) Kosterm.: stamens of outer 3 whorls fertile; of fourth whorl sterile. 3. *Trianthem* Mez: stamens of first outer whorl fertile; of the other whorls sterile.

17. ANIBA[17] Aublet, 1775.

Aniba Aublet, Hist. Guyane franc. 1: 327. 1775.

SYNON. — *Cedrola* Schrebsr 1789. — *Aydendron* Nees & Mart. 1833.

PRINCIPAL LITERATURE. — Kostsrm. *in* Rec. Trav. bot. neerl. 35: 866—1938; *in* J. sci. Res. Indon. 1: 83. 1952; *in* Bol. teen. Inst. Agron. Norta Brasil 28: 52—57. 1955.

16 Local name Ajoue in French Guiana.

[17] Local name in French Guinea.

Flowers bisexual with conspicuous tube which increases in size after anthesis, becoming urceolate and temporarily enclosing the developing fruit; in the mature fruit appearing as a rather woody, mottled cup, surrounding the basal half of the fruit. Fertile anthers 9 (in one case the third whorl sterile), 2-cslled; outer two whorls introrse; third whorl extrorse and flanked by glands. Staminodes minute or none. Stigma as a rule inconspicuous, obtuse or truncate. The stamens in almost all species have the same characteristic shape.

TYPE SPECIES. — *A. guianensis* Aublet.

Number of binomials 74; number of species about 40. The genus is close to *Endlicheria,* from which it differs by its bisexual flowers, the different fruit cup and the differently shaped anthers. *Aniba rosaeodora* Ducke and *A. duckei* Kosterm. yield the well-known rose oil of commerce. The genus is restricted to tropical South and Central America.

S u b g e n e r a two. 1. *Aniba*: stamens of the third whorl fertile, cells normal, extrorse. 2. *Aioueopsis* Mez: stamens of the third whorl sterile or with minute lateral cells.

18. ENDLICHERIA[18] Nees, 1833 *(nom. eons.).*

Endlicheria Nees *in* Linnaea 8: 37. 1833.

SYNOX. — *Goeppsrtia* Ness 1836. — *Schaucra* Nees 1838. — *Sehaueria* Nees *ex* Msissnsr 1834. — *Ampelodaphne* Meissnsr 1834. — *Huberodaphne* Ducke 1925.

PRINCIPAL LITERATURE!. — Kostermans *in* Rec. Trav. bot. neerl. 34: 500—557. 1937; *in* J. sci. Res. Indon. 1: 17. 1952; *in* Bol. *tzen.* Inst. Agron. Norfce Brasil 28: 62—65. 1955; Allen *in* J. Arn. Arb. 26: 421. 1945.

Flowers dioecious; tuba distinct. Male flowers with 9 fertile stamens; anthers as a rule 2-celled; the two outer whorls introrse; the inner whorl extrorse and usually flanked by glands. Staminodes none or minute. Ovary sterile, stipitiform. Female flowers as a rule slightly smaller and with broader tube; stamens smaller, sterila, but with same shape; stigma discoid or peltate, conspicuous. Fruit cup usually rather shallow, fleshy, merging into the usually fleshy, thick pedicel.

TYPE SPECIES. — *E. sericea* Nees.

Number of binomials 55; number of species about 40. The genus, which is restricted to tropical South and Central America, is related to *Aniba* by its floral characters and to *Aiouea* by its enlarged fruit pedicel.

[18] Named in honour of H. L. Endlicher, born 1804, Prssburg, died 1849, Vienna, Professor in Vienna and a well-known botanist.

19. LICARIA[19] Aublet, 1775.

Licaria Aublet, Hist. Guyane franc.. 1: 313. 1775.

SYNONYMS. — *Acrodiclidium* Nees 1833. — *Evonymodaphne* Nees *ex* Lindley 1838. — *Dipliathus* Rafin 1838. — *Triplomeia* Rafin. 1838. — *Misanteca* Cham. & Schdl. 1831. — *Symphysodaphne* A. Richard 1850. — *Nobeliodendron* 0. C. Schmidt 1930. — *Chanekia* Lundell 1937. — *Clinostemon* Kuhlm. & Sampaio 1928.

PRINCIPAL LITERATURE. — Kostermans *in* Rec. Trav. bot. neerl. 34: 575—604. 1937; 35: 123—125. 1938; *in* J. sci. Res. Indon. 1: 89. 1952; *in* Bol. tacn. Inst. Agron. Norte Brasil 28: 65—71. 1955.

Flowers bisexual; flower tube usually distinct. Stamens of the two outer whorls changed into small staminodes or wanting; stamens of the third whorl fertile, free or partly connate, basal glands present or none; cells two, introrse, extrorse or sub-apical. Fourth whorl of staminodes minute, usually absent. Stigma inconspicuous. Fruit cup large, with a double, rarely triple margin.

TYPE SPECIES. — *L. guianensis* Aublet.

Number of binomials 58; number of species about 45, The genus is restricted to tropical South and Central America. It is related to *Ardba*, and Macbride suggested merging the two genera.

Several species yield merchantable fruit with nutmeg or clove aroma,

Subgenera two. 1. *Licaria*, syn. *Acrodiclidium* (Nees) Kosterm. 1957: staminodes of the two outer whorls present. 2. *Misanteca* (Cham. & Schdl.) Kosterm.; staminodes of the two outer whorls lacking.

20. URBANODENDRON[20] 'Mez, 1889.

Urbanodendron Mez *in* Jahrb. bot. Gart. Berlin 5: 80. 1889.

SYNON. — *Aydendron* Nees & Mart. 1833, *p.p.*

PRINCIPAL LITERATURE. — Kostermans *in* Rec. Trav. bot. neerl. 35: 106—109. 1938; *in* J. sci. Ees. Indon. 1: 146. 1952.

Flower characters as in *Licaria*, but stamens 9; anthers 2-celled, those of the two outer whorls introrse; of the inner extrorse. All filaments flanked by large glands. Stigma inconspicuous. Fruit cup large, double-rimmed.

TYPE SPECIES. — *U. verrucosum* (Nees) Mez.

This monotypic genus from Brazil is related to *Licaria*, but differs by the number of fertile stamens, which puts it near *Aniba*. The double-rimmed cup is similar to that of *Licaria*.

*[9] Local name Licari in French Guinea.

20 Named in honour of Ignatz Urban, a well-known German botanist, Director of the Botanic Garden and Museum at Berlin-Dahlem.

• 21. SYSTEMONODAPHNE[21] Mez, 1889.

Systemonodaphne Mez *in* Jahrb. bot. Gart. Berlin 5: 78. 1889.

PRINCIPAL LITERATURE. — Kostsrmans *in* Rec. Trav. bot. neerl. 35: 104—108. 1938; *in 3.* sci. Res. Indon. 1: 145, 1952; *in* Bolet. teen. Inst. Ag-ron. Norte Brasil 28: 73—75. 1955.

Flowers bisexual; tube short. Fertile stamens 9; anthers 2-celled. Fourth whorl of staminodes lacking. Outer two whorls with introrse cells and distinct, free filaments; third whorl connate, with small glands. Stigma small, discoid. Fruit cup disc-shaped-, double-rimmed with persistent perianth.

TYPE SPECIES. — *S. mezii* Kosterm.

Number of binomials 3; number of species 2. A small genus from Brazil; related to *Licaria*, but different by the number of fertile stamens and the fruit cup.

22. PHYLLOSTEMONODAPHNE[22] Kosterm., 1936.

Phyllostemonodaphne Kostsrmans *in* Rec. Trav. bot. n,eerl. 33: 754. 1938.

PRINCIPAL LITERATURE. — Kostermans *in* Eec. Trav. bot. neerl. 33: 754. 1936; *in* J. sci. Res. Indon. 1: 149. 1952.

Flower characters as in *Licaria*, but the outer whorl of stamens is completely tepaloid; the second and third whorl are fertile and provided with glands. Anthers of the second whorl introrse, of the third whorl extrorse, 2-celled. Staminodes of the fourth whorl small of none. Stigma inconspicuous. Fruit cup flat, double-rimmed.

TYPE SPECIES. — *Ph. geminiflora* (Meissn.)' Kosterm,

This monotypic genus from Brazil is closely related to *Licaria*, but differs by the number of fertile stamens and tepals and by the shape of the fruit cup. It is also close to *Dicypellium*, which, however, has 4-celled anthers.

III. Tribus Litseeae Mez, 1889.

Tribus *Litseeae* Msz *in* Jahrb. bot. Gart. Berl. 5: 6. 1889.

Flowers in pseudo-umbels, surrounded by persistent, decussate, large bracts, forming an involucre. As a rule all stamens introrse. Tepals often more or less reduced. Tubs persistent and enlarged as a more or less developed fruit cup on a usually not enlarged pedicel.

a. Subtribus Litseineae Kosterm., 1957.

Anthers with 4 cells.

[21] From Greek *aw*, sun = together; *orrj/xcov*, stemon = stamen, and *dawvri*, daphne = laurel; the stamens are grown together.

[22] From Greek *yvllov*, phullon = leaf; *ort]/Ltcov*, stemon = stamen, and *dawvn*, daphne = laurel; the outer stamens are leaf-like.

23. LITSEA[23] Lamk. 1791 *(nom. cons.).*

Litsea Lamarck, Encycl. meth. bot. 3: 574. 1791.

SYNOX. — *Malapoenna* Adanson 1763. — *Tomex* Thunbsrg 1783. — *Hexanthus* Loureiro 1790. — *Quinquedula* Noronha 1790. — *Fiwa* Gmelin 1791. — *Tetranthera* Jacquin 1797. — *Berrija (non* Roxb.) Klein *ex* Willdenow 1800. — *Litsaea* Jussieu 1805. — *Pipalia* Stokes 1812. — *Darwinia* Dennstsdt 1818. — *Dodecadenia* Nees 1831. — *Cylicodaphns* Nees 1831. — *Iozoste* Nees 1831, p.p. ^- *Jozosmene* Nees *ex* Lindley 1836. — *Lepidadenia* Walker Arnott *ex* Nees 1833. — *Cubeba* Rafinesqus 1838. — *Dccapenta* Rafinesqus 1838. — *Evslyna* Rafinesque 1838, *p.p.* — *Heckcria* Rafinesque 1838. — *Evosmus* Rafinesque 1838, *p.p.* — *Fiva* Stsudel 1840. — *Sebifera* Blanco 1845. — *Darwiniana* "Dsnnstadt" *ex* Lindlay 1846. — *Glabraria* (non L.) Blume 1851. — *Adenodaphne* S. Is Moore 1921. — *Pssudolitsea* Yang 1945.

PRINCIPAL LITERATURE. — Baillon, Hist. PI. 2: 440, 480. 1870; Bentham *in* B. & H., Gen. PI. 3: 181. 1880; Eooker f., Fl. Brit. Ind. 5: 154—182. 1883; Mez *in* Jahrb. bot. Gart. Bsrlln 5: 474—482. 1889; Koorders & Val. *in* Medsd. Lands Pl.tuin Buitansorg 68: 123—192. 1904; Bartlett *in* Proc. Am:r. Ac. 44: 597—001. 1909; Lecomt3, Fl. gin. Indochine 5: 130—142. 1914; Ridlsy, Fl. Mai. Pen. 3: 112—131. 1924; Liou-Ho, Laur. Chine et Indochine 1—207. 1932; Allen *in* Ann. Missouri Bot. Gard. 25: 331—400. 1938; *in* J. Arnold Arb. 26: 106. 1945; Nakai, Fl. sylv. Koreana 22: 49—61. 1939; Kostsrmans *in* J. sci. Res. Indon. 1: 93. 1952.

Flowers dioecious in pseudo-umbels, surrounded by an involucre of persistent or subpersistent, large, decussate bracts. Tepals 6 or 0. Fertile stamens In male flower 9 or 12, sometimes more than 12 (subgenus *Dodecadenia/.* Outer 2 whorls usually glandless; third and inner whorls flanked by glands. Filaments usually slender; anthers 4-celled, all introrse, or the basal pair of the third staminal whorl lateral. Ovary in the male flower stipitiform or 0. In the female flower an equal number of staminodes as stamens in the male flower; stigma peltate, conspicuous. Fruit seated in a more or less developed cup or disc; ths perianth usually caducous.

TYPE SPECIES. — *L. chinensis* Lamk.

Number of binomials 474; number of species approximately 400. This large and widely distributed genus, only lacking in Africa and Europe, extends north to Japan, Korea and North America; south to New Zealand and subtropical South America. The diversity in such a large genus is appreciable, but does not warrant splitting it up into smaller entities, as has often been advocated in local floras. The flowers and umbels are remarkably uniform. The fruit cup is either shallow and disc-like or semiglobose, or may even completely ennvelop the fruit (in that case it differs from the fruit of *Cryptocarya* by the large apical aperture) ; sometimes it is very swollen and fleshy, sometimes thinly walled. The number of

[22] From the Chinese litse.

stamens is the largest in sub-genus *Dodecadenia,* a small group, which is here, more or less arbitrarily, included in *Litsea;* the sub-genus *Dodecadenia* has bisexual flowers.

Subgenera three. 1. *Litsea:* flowers monoecious. 2. *Dodecadenia* (Nees) Kosterm.: flowers bisexual. 3. *Octolitsea* Liou-Ho: flowers dioecious, with 8 tepals.

24. NEOLITSBA-'[4] Merr., 1906.

Neolitsea Merrill *in* Philip. J. Sci., Bot., Suppl. 1 (1) : 56. 1906.

SYNON. — *Tetradenia* (non Benth.) Nees 1831. — *Balanopsis* Rafinesque 1838, *p.p.* — *Bryantea* Rafinesque 1838. — *Litsea* sect. *Neolitsea* Bentham 1880.

PRINCIPAL LITERATURE. — Lecomte, Fl. gen. Indoch. 5: 142:—144. 1914; Ridley, Fl. Mai. Pen. 3: 131—133. 1924; Liou-Ho, Laur. Chine & Indoch. 139—155. 1932; Allen *in* Ann. Missouri Bot. Gard. 25: 415—431. 1938; Kostermans *in* J. sci. Res. Indon. 1: 147. 1952.

Flowers dioecious, involucrate, involucral bracts large, persistent, decussate. Flowers dimerous; fertile stamens in male flowers and staminodes in female flowers 6 in 3 whorls; the inner whorl with glands. Anthers 4-celled, introrse. Stigma in female flower conspicuous, peltate. Fruit on a disc-like cup; pedicel often slightly thickened.

TYPE SPECIES. — *N. cassia* (L.) Kosterm.

Number of binomials 93; the number of species will be about 80. The genus is restricted to the Asiatic mainland and Malaysia. It is related to *Litsea.*

b. Subtribus Lauriineae Kosterm., 1957.

Anthers with two cells.

25. LINDEEA[25] *(non* Adans.) Thunb., 1783 *(non. cons.).*

Lindera Thunberg, Nov. Gen. PL 3: 64. 1783.

SYNON. — *Benzoin* Boehmer 1760. — *Bistania* Noronha 1790 (?). — *Euosmus* Nuttall 1818, *p.p.* — *Calosmon* Bercht. & Presl. 1823. — *Sassafras* Bercht. & Presl. 1823. — *Daphnidium* Nees 1831. — *Polyadenia* Nees 1831. — *Evelyna* Rafinesque 1838, *p.p.* — *Ozanthes* Rafinesque 1838. — *Evosmus* Rafinesque 1838, *p.p.* — *Aperula* Blume 1851. — *Iteadaphne* Blume 1851. —• *Parabenzoin* Nakai 1924.

PRINCIPAL LITERATURE. — Hooker f., Fl. Brit. Ind. 5: 182—189. 1886; Mez *in* Jahrb. bot. Gart. Berlin 5: 486—489. 1889; Koorders & Valet, *in* Meded. Lands Pl.tuin

24 p,om Greek *ve.og,* neos = new, and Litsea.

25 Named after Johann Linder (1678, Karlstad, Sweden; f 172,3, Stockholm) who was elevated to nobility under the name of Lindestolpe; author of a botanical pamphlet.

Buitenzorg 58: 229—246. 1904; Lecomte, Fl. gen. Indochine 5: 152—158. 1914; Ridley, Fl. Mai. Pen. 3: 133—137. 1924; Liou-Ho, Laur. Chine & Indoch. 117—139. 1932; Kostermans *in* J. sci. Res. Indon. 1: 90. 1952.

Flowers and fruit characters as in *Litsea*, but anthers 2-celled (very rarely partly 4-celled) ; usually the fruit cup very shallow; perianth sometimes persistent.

TYPE SPECIES. — *L. umbellata* Thunb.

Number of binomials 135; the number of species will be about 100. Like *Litsea*, to which this genus is closely related, it is widely distributed, also outside the tropical area; like *Litsea* it is not represented in Africa.

Subgenera two. 1. *Lindera:* umbels many-flowered. 2. *Iteadaphne* (Bl.) Kosterm.: involucre with one flower.

26. LAURUS[26] L., 1753.

Laurus Linnaeus, Spec. pi. 369. 1753.

SYNON. — *Apella* Adanson 1763. — *Adaphus* Necker 1780 (?).

PEINCIPAL LITERATURE, — Webb & Berth., Phytogr. Canar. 3 (3) : 229. 1836—40; Gandoger, Fl. Europae 20: 44. 1890; Thome, Fl. Deutschl. 1: 157. 1&03; Coste, Fl. France 3: 215. 1906; Bonnier, Fl. France, etc. 9: *t. 536.* 1927; Hegi, Fl. Europa ed. 2, 4 (1) : 11. 1935; Kostermans *in* Rev. Univ. Chilena 24: 204—206. 1939.

Flowers dioecious or bisexual, involucrate. Flowers dimerous. Male flowers with 12 stamens in 3 whorls; those of the outer whorl glandless; anthers 2-celled, introrse; ovary abortive. Female flowers with 4 large staminodes, alternating with the tepals, all with glands. Stigma discoid. Fruit on a fleshy, thickened pedicel, disc-like at the apex.

TYPE SPECIES. — *L. nobilis* L.

Number of binomials 334; number of species 2.

The genus is restricted to the Mediterranean region and the Canary islands. Because of its involucre of decussate bracts it belongs near *Litsea*. The reduced number of staminodes in the female flower is an uncommon feature in Lauraceae.

IV. Tribus Cryptocaryeae Meissn. 1864, *p.p.*

Tribus *Cryptocaryeae* Meissner *in* DC, Prodr. 15 (1) : 5. 1864, *p.p.*

Fruit completely included in the accrescent flower tube.

a. Subtribus Eusideroxylineae Kosterm., 1957.

Anthers with 4 cells.

[26] Old latin plant name.

27. EusiDEROXYLON-[7] Teijsm. & Binn., 1863.

Eusideroxylon Teijsmann & Binnendijk *in* Natuurk. Tijdschr. Ned. Ind. 25: 292. 1863.

SYNON. — *Bihania* Meissner 1864.

PRINCIPAL LITERATURE. — Teijsm. & Binn. *in* Natuurk. Tijdschr. Nederl. Ind. 25: 292. 1863; de Wit *in* Bull. Bot. Gard. Buitenzorg 3, 18: 200—207. 1949; Kostermans *in* J. sci. Res Indon. 1: 141. 1952; *in* Penggemar Alam 35: 57. 1955.

Flowers bisexual. Tepals 6, equal; flowers tube shallow. Fertile stamens 3 (third whorl), 4-celled, extrorse; outer 2 whorls petaloid; all glandless; stigma discoid. Fruit completely enclosed in and adnate to the accrescent flower tube; seedcoat horny, furrowed.

TYPE SPECIES. — *E. zwageri* T. & B.

Number of species and binomials 2. *E. zwageri* T. & B. occurs in East Sumatra, Bangka, Biliton, and Borneo. *E. melagangai* Sym. is restricted to North, West, and Central Borneo.

In its fruit characters the genus resembles *Cryptocarya*, but the number and shape of the stamens is different. The timber (ironwood) is one of the heaviest and most durable in Malaysia and resembles in this quality *Ocotea rodioei* Mez from Guiana,

b. Subtribus Cryptocaryineae Kosterm., 1957.

Anthers with two cells.

28. CRYPTOCAEYA[2S] R. Brown, 1810.

Cryptocarya R. Brown, Prodr. FL Nov. Holland. 402. 1810.

SYNON. — *Peumus* Molina 1782, *p.p.* — *Cryptocaria* Gay 1849. — *Caryodaphne* Blume *ex* Nees 1836. — *Salgada* Blanco 1845. — *Icosandra* R. A. Philippi 1857. — *Pseudocryptocarya* Teschner 1923.

PRINCIPAL LITERATURE. — Baillon, Hist. PL 2: 472. 1870; Bentham *in* B. & H., Gen. 3: 150. 1880; Hooker f., FL Brit. Ind. 5: 117—121. 1890; Bailey, Queensl. Fl. 1297. 1901; Lecomte, Fl. gen. Indoch. 5: 144—148. 1914; Liou-Ho, Laur. Chine et Indochine 95—102, 1932; Kostermans *in* Rec. Trav. bot. neerl. 34: 557—575. 1937; *in* Bull. Jard. bot. Bruxelles 15: 91—108. 1938; *in* Humbert, Fl. Madagascar, 81e famille: 74—84. 1950; *in 3.* sci. Res. Indon. 1: 94. 1952.

Leaves alternate or opposite. Flowers bisexual; tube slender, conspicuous; tepals 6, equal. Fertile stamens 9, 6, or 3, anthers 2-celled; anthers of two outer whorls introrse, of third whirl extrorse and filaments flanked by glands. Fourth whorl consisting of conspicuous, stipitate staminodes. Stigma small or inconspicuous, rarely peltate. Fruit entirely

[27] From Greek *sv*, eu = good, *ocdtjQog*, sideros = iron, and *£vlov*, xulon = wood.

[28] From Greek *y.Qvnzoi*, kruptos = hidden, and *y.ngvov*, karyon = nut; the fruit is covered by the accrescent flower tube.

included in the enlarged flower tube, leaving only a minute orifice at apex. Endocarp and exocarp often bony and ribbed.

TYPE SPECIES. — *C. glaucescens* R. Brown.

Number of binomials 303; number of species perhaps between 200 and 250. This pantropic genus, (only lacking in Central Africa) has its centre in Malaysia. Species occur as far as Chile and Australia. *C. moschata* Mez yields saleable fruit (nox moschado) with nutmeg smell and taste.

Subgenera three. 1. *Cryptocarya,* syn. *Enneanthera,* Kosterm., 1957: fertile anthers 9. 2. *Hexanthera* Kosterm.: fertile anthers 6. 3. *Tnandra* Kosterm.: fertile anthers 3.

29. RAVENSARA[29] Sonn., 1782.

Bavensara Sonnerat, Voy. Indes et Chine 3: 248. 1782.

SYNON. — *Euodia* Gaertner 1791. — *Agathophyllum* (non Blume) Jussieu 1789.

PRINCIPAL LITERATURE. — Kostermans *in* Humbert, Notul. system. Paris 8: 96—112. 1939; *in* Humbert, PI. Madag., 81e Fam.: 46—74. 1950.

Floral characters as in *Cryptocarya.* Fruit included in the accrescent flower tube; the basal part of the fruit divided into 6 (rarely 12) compartments by 6 (rarely 12) false dissepiments, growing out from the inner wall of the flower tube; the dissepiments ruminating the seed.

TYPE SPECIES. — *R. aromatica* Sonn.

Number of binomials 27; number of species 18. The genus is endemic in Madagascar. It differs from *Cryptocarya* only by its ruminate seed and basal fruit septa.

V. Tribus Hypodaphneae Kosterm., 1957.

Ovary inferior.

30. HYPODAPHNIS[30] Stapf, 1909.

Hypodaphnis Stapf *in* Dyer, PI. trop. Africa 6 (1) : 185. 1909.

PRINCIPAL LITERATURE. — Kostermans *in* Bull. Jard. bot. Bruxelles 15: 88—91. 1938; *in* J. sci. Res. Indon. 1: 1952.

Leaves alternate. Flowers bisexual. Fertile stamens 9 in three whorls; anthers 4-celled, those of the two outer whorls introrse, of the third whorl extrorse and extrorse — lateral, third whorl with glands. The fourth whorl lacking. Ovary inferior; stigma small, discoid.

TYPE SPECIES. — *H. zenkeri* (Engl.) Stapf.

This monotypic genus is endemic in Cameroon, Gaboon, and Nigeria.

29 From the local Madagascar name: ravin-tsara.

so$_{pr}$om the Greek *vno,* hypo = under, and *dayns,* daphms = laurel. The name alludes to the inferior ovary.

B. Subfamily Cassythoideae Kosterm., 1957.

SYNON. — *Cassytheae* Nees 1831; *Cassythaceae* Dumortier *ex* Lindley (Nat. Syst., ed. 2: 202. 1836).

Parasitical or partly autotrophic monotypical twiners with small haustoria. Stems filiform, containing chlorophyll. Leaves reduced to minute scales, arranged spirally (1/3). Inflorescence indefinite, spicate or racemose, or reduced to heads. Flowers sessile or pedicellate within a minute bract with 2 similar bracteoles close under the perianth, bisexual or semi-dioecious (?). Tepals 6 (the outer 3 smaller and resembling the bracts), persistent; tube shallow, enlarged, and enveloping the fruit. Fertile stamens 9, two-celled; the outer two whorls without glands and with introrse anthers (rarely the second whorl staminodial) ; the third whorl flanked by glands and with extrorse anthers; the fourth whorl of distinct, sessile or stipitate staminodes; stigma small, obtuse or capitellate. Fruit completely included in the enlarged and succulent flower tube, with small orifice at apex, usually surrounded by the persistent, erect perianth. Testa membranous or coriaceous; cotyledons thick, flehy, often unequal, distinct at an early stage, but later more or less consolidated.

TYPE GENUS. — *Cassytha* L.

31. CASSYTHA[31] L., 1753.

Cassytha [Osbeck] Linnaeus, Sp. PI. 1: 35. 1753.

SYNON. — *Cussuta* Rumphius 1747. — *Rombut* [Rumph.] Adanson 1763. — *Aeatsjavalli* [Rheede] Adanson 1763. — *Cassyta* L. 1764. — *Cassita* Hill 1765. — *Volutella* Forskal 1775. — *Calodium* Loureiro 1790. — *Rumputris* Rafinesque 1836.

PRINCIPAL LITERATURE. — Meissner *in* DC, Prodr. 15 (1) : 252. 1864; Bentham, PL Austral. 5: 308. 1870; Baillon, Hist. PI. 2: 444, 483. 1870; Bentham *in* B. & H., Gen. PL 3: 164. 1880; Hackeberg- *in* Verh. Natur. Ver. Rheinl. und Westfalen 46: 98—138. 1889; Pax *in* Engl. & Prantl, Pfl.Pam. 3 (2) : 124. 1889; Boewig *in* Bot. Confer. Univ. Pennsylv. 2: 399—416. 1904; Black, Fl. S. Austr. 338. 1922—29; Kienholz *in* Proc. Ann. Phil. Soc. 65, Suppl. 58—100. 1926; Metcalfe and Chalk, Anat. Dicot. 2: 1152. 1950.

TYPE SPECIES. — *Cassytha filiformis* L.

Number of binomials 50, of which perhaps not more than one third will stand after critical revision. The genus is mainly Australian; one species *(C. filiformis* L.) is pantropical; Africa has a few species. By its aberrant habit and ecology, it has often been treated as a separate family, but in floral characters it is not different from Lauraceae and approaches *Cryptocarya.*

The plants contain superabundant (even in the cotyledons) mucilaginous material.

31 Greek name *(xadviag,* kasytas or *Hadvxas* kadytas) for *Cuscuta.* (dodder).

The epidermis is composed of heavily cutinized, square cells. Stomata in rows; pores at right angles to the axis, rubiaceous, deeply sunken, with heavy cuticular ridge, forming an outer vestibule to the narrow stomatal pore. Outer part of cortex of 1—6 layers of small rounded cells. Endodermis not differentiated. Phloem in the form of strands situated in furrows in the outer periphery of the xylem. Xylem in the form of a continuous cylinder, bounded internally by protoxylem groups extending into the pith. Vessels in the inner part of the secondary wood 120 μ or more in diameter, and much larger than those in the denser peripherpal part; lateral pits large, circular, bordered; perforations simple. A ring of separate vascular bundles, sometimes consisting wholly of phloem, recorded by Solereder in the hypocotyl and young axis. Acicular crystals in the cortex.

Fruit enclosed by a hard, horny layer of the endocarp and/or exocarp. The cotyledons remain quite distinct morphologically, but they seem to be adherent by means of some cementing substance.

The seeds germinate best in almost pure sand. After germination the food substance is rapidly passed from the cotyledons into the hypocotyl, causing it to become very turgid; the food remains dissolved in the cell sap as sugar. Side roots develop, which soon outstrip the main root. Above, the hypocotyl attenuates rapidly into a thin, almost filamentous, bright green stem; it carries up with it the empty seed, which, because of its firm, elastic shell, is difficult to strip off.

The seedling show's active circumnutating movements in clockwise direction; the sweep is fairly rapid. The roots have no root cap.

ADDITIONS TO: A HISTORICAL SURVEY OF LAURACEAE

p. 85. *Laurus cassia* L. is based on no. 146 in his Flora zeylanica, which in turn is based on Hermann's specimens. In Hermann's Herbarium (British Museum) these represent a mixture of *Litsea zeylanica* Nees and the wild *Cinnamomum zeylanicum* (Trimen *in* J. Linn. Soc, Bot. 24: 140. 1887).

p. 89. *Nyctandra* Prior *(in* Proc. Linn. Soc. (1883—86) : 5) is a synonym of *Nectandra* Rol. *ex* Rottb.

p. 91. Almost simultaneously with my recombination *Dehaasia incrassata* (Jack) Kosterm. (April 1952), Merrill published the same new combination *in* J. Arnold Arb. 33: 230. June 1952.

* *In* vol. 1 of J. sci. Res. Indon. (1952).

p. 94. Through the courtesy of Dra. Ida de Vattimo of the Botanical Garden in Rio de Janeiro, I obtained exhaustive information on the genus *Linharea* Arruda de Camara.

Camara's paper: "Ensaio sobre a utilidade de estabelecer jardins nas principals provincias do Brasil" was never published. This paper was translated in part in Henri Koster's: "Travels in Brazil" (1810). Koster's book was later translated into French (1818) and into Portuguese. On page 584 of the Portuguese edition, corresponding to page 493 of the English and page 491 of the French edition, we find the following (translation by de Vatimo) :

Plants of Pernambuco

.....

.....

Canela do mato, *Linharea aromatica,* Arrud. Cent. Plant. Pern.

Catinga Branca, *Linharea tinctoria,* Arrud. Cent. Plant. Pernam.

In the first plant the leaves and cortex have a pleasant perfume, resembling the scent of pinkies (clove smell). The plant is not employed by man. I obtained a tasteful extract from the leaves and cortex by distillation. I learned by experience that the liquid extracted from the leaves is not only agreeable to smell and taste but also is very good (therapeutic) for the stomach. It is very abundant in the "taboleiros" of the States of Paraiba and Ceara, in the margins of the Pinhanco; I saw them also in Piani (17).

The second plant is a shrub that grows very abundant in the slopes of mountains and water courses margins in the interior of Brazilian states of Pernambuco, Paraiba and Ceara. When boiled the plant yields a yellow colour, long lasting over skins. May be it to be possible to find a way of fixation of this colour in cotton cloth, the same way we do with the tatajuba *(Motrus tinctorea).* It is also used in the treatment of itch, an eruptive disease. As I could not include these plants in none of the known genera I put them in a new genus and gave it the name *Linharea* in honour to D. Rodrigo de Souza Coutinho, Count of Linhares, culta and protector of Arts".

The footnote 17 refers to a note of Koster and of Camara, which runs as follows:

"17. Labat speaks about a species of "canelle batarde" and adds: "On se sert beaucoup, en Italie, d'une canelle semblable a celle que je viens de décrire. Les Portugais l'apportent du Brésil dans des paniers de roseaux refendus et à jour; on l'apelle canelle giroffle

(canella garofanata). On la met en poudre avec un peu de girofle, de veritable canelle, de Poivre, et de graines tout-a-fait resemblables à celles de nos bois d'Inde des Isles, et on en fait un débit assez considérable" — Nouveau Voyage, Tome III, p. 92 (K).

Pinhanco is the same as Pianco (C).

From the description and from the fact that *Linharea aromatica* is a common plant, it is possible that it represents *Ocotea pretiosa* Benth. Nothing can be said of *Linharea tinctoria* and it may be even not Lauraceous.

In Roster's book and the French translation the generic name is wrongly spelt *Linharia.*

p. 95. 1812 Stokes, Jonathan.

Through the courtesy of Dr C. V. Morton (Smithsonian Institution, Washington), I obtained a transcript of the original description of *Pipalia* Stokes in "A botanical materia medica consisting of the generic and specific characters of the plants used in medicine and diet" (vol. 4, page 456. 1812).

"884. Pipalia.

Calyx of the male flowers none, of the female polyphyllous, corolla none. Style curved at the base. Stigma capitate. Berry monospermous. From Jones.

1. *Pipalia solitaria.*

Gajapippali. Jones in as. res. IV. 313"

The genus and the single species are validly published (combined generic and specific description of a monotypic genus. Stokes probably did not know this plant at all; he copied the data from a paper on Indian plants by Sir William Jones, which was published in the Transactions of the Royal Asiatic Society of Bengal (vol. 4: 227. 1801). Of Jones' paper I also obtained a transcript from Dr. Morton. The paper does not bear Jones' name, but merely states that it is by "the late President" (this was definitely Sir William Jones). Jones' paper bears as title: A catalogue of Indian plants, comprehending their Sanscrit and as many of their Linnaean generic names as could with any degree of precision be ascertained" (p. 225).

On page 227 we find

169 "Gajapippali, a new genus"

On page 295 and 296

"ON SELECT INDIAN PLANTS. 295

66. *Gajapippali:*

Syn. Carippali, Capiballi, Colaballi, Srevasi, Vasira.

Some add, *Chavica,* or *Chavya;* but that is named in the *Amaracosh* as a distinct plant, vulgarly *Chava,* or *Chavi.*

Vulg. Pippal-fhanca, Maidah.

MALE FLOWERS.

Cal. Common Perianth four-leaved; *leaflets* roundish, concave; the two exterior, opposite, smaller, containing from *eight* to four*teen* florets. *Partial calyx* none.

Cor. None. *Nectary,* many yellow glands on the pedicel of the filaments.

Stam. Filaments from eight to eighteen in each floret, connected by a short villous pedicel, thread-form, very hairy. *Anthers* large, netted, irregular, inflated, containing the pollen.

Pist. Rudiments of a germ and *style* withering.

FEMALE FLOWERS.

Cal. *Common Perianth* as in the male, but smaller; containing from ten to twelve florets.

Partial calyx none, unless you assume the corol.

Cor. many-petaled, umbelled, *Petals* erect, lance-linear, fleshy, covered within and externally with white hairs. *Nectary,* yellow glands sprinkling the receptacle.

BOTANICAL OBSERVATIONS

Pist, Germ oval. Style cylindric, curved at the base, *Stigma* headed,

Per. Berry globular, one-seeded.

Seed spherical, smooth.

Flowers umbelled, yellow from their anthers.

Leaves mostly oblong-lanced, but remarkably varying in shape, alternate. Both flowers and fruit have an agreeable scent of lemonpeel; and the berries, as a native gardener informs me, are used as a spice or condiment. It was from him that I learned the Sanscrit name of the plant; but as balli means a creeper, and as the Pippal-jhanca is a tree perfectly able to stand without

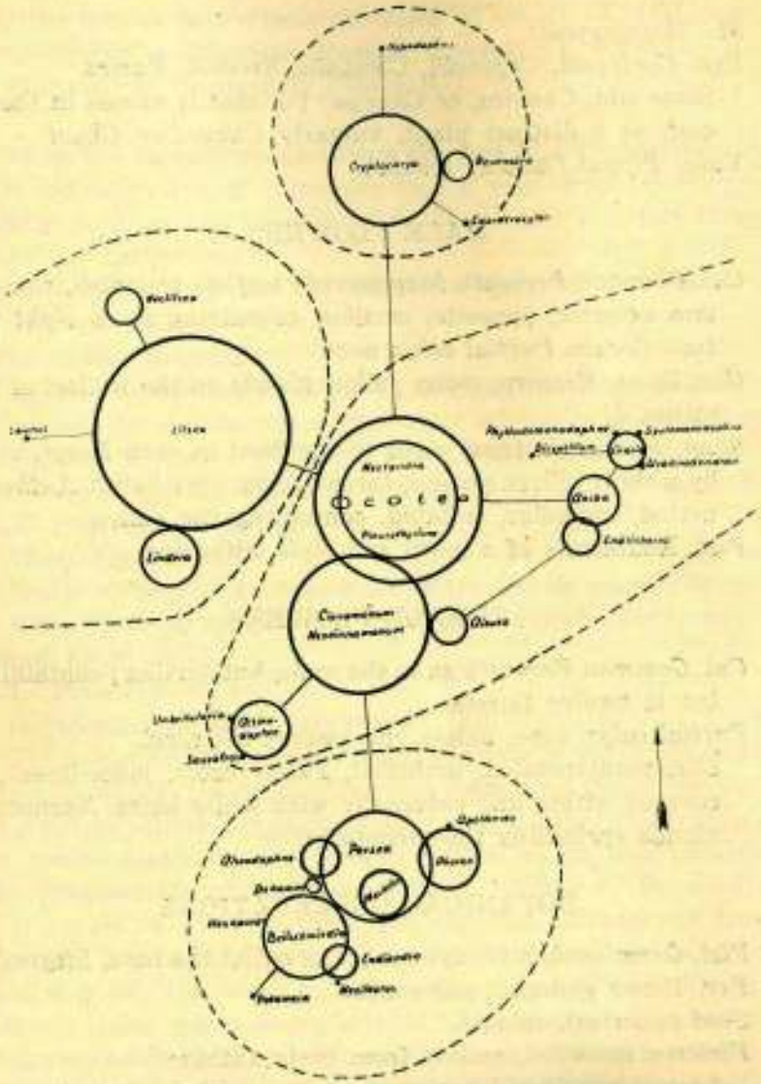

FIG. 1. Relationships within the Lauraceae.

support, I suspect in some degree the accuracy of his information; though I cannot account for his using a Sanscrit word without being led to it, unless he had acquired at least traditional knowledge. It might be referred, from the imperfect mixed flowers, to the twenty-third class."

From this description it is evident, that *Pipalia* represents either *Litsea* or *Lindera* (the number of anther cells is not indicated) . The shape of the leaf and their scent points to *Litsea cubeba* Pers.

p. 113. 1823 C. G. Nees and Th. Fr. L. Nees von Esenbeck, de Cinnamomomo disputatio (a supplement: "Berichtigung zur Disputatio de Cinnamomo" appeared in Allg. Bot. Zeit. 34: 1—30. 1831). In this paper the authors described new *Cinnamomum* species under the generic name *Laurus* and an exhaustive historical survey is given of *Cinnamomum zeylwnicwm* Bl.

INDEX TO LAURACEAE

Names published as new in the original publication, Comm. For. Res. Inst. Indon. no. 57, March 22, 1957, of which this article is a reprint, are in this index still given in bold face type. The page number in the original publication is found by subtracting 192 from the. present number. Synonyms are given in *italics.* The names on pages 218 and 219 are not listed in this index.

REINWARDTIA
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FLORAE MALESIANAE PRAECURSORES XVI

ON THE TAXONOMIC SUBDIVISION OF THE GLEICHENIACEAE, WITH DESCRIPTIONS OF NEW MALAYSIAN SPECIES AND VARIETIES

by

R. E. HOLTTUM *

SUMMARY

A new subdivision is given of the fern family Gleicheniaceae. The genus *Platyzoma* R. Br is excluded from the family. The genus *Stromatopteris* from New Caledonia is arranged in a distinct subfamily. In the remainder of the family, subfamily Gleichenioideae, two genera are recognized, *Gleichenia* (with subgenera *Diplopterygium, Gleichenia,* and *Mertensia)* and *Dicranopteris* (with subgenera *Acropterygium* and *Dicranopteris)*. The problem of subdividing the family is discussed with reference to former treatments and to new data, and a conspectus of the new system, with synonymy and key to the genera and subgenera, is given. A number of new species, new varieties, and new combinations is made both in *Gleichenia* and *Dicranopteris.*

In preparing a taxonomic revision of the family Gleicheniaceae for Flora Malesiana, I have reviewed the status of the genera proposed within the family by previous authors, and as a result have been led to take a position midway between the arrangement of Christensen *(Index Filicum* 1905) and of Copeland *(Genera Filieum* 1947). The present paper gives a summary of the facts on which this decision was reached; a fuller comparative treatment of the subject, with a discussion on morphology and growth-habit in this and other families of primitive ferns, will be published elsewhere.

The genus *Platyzoma* R. Br., which has usually be included in Gleicheniaceae (even in the genus *Gleichenia),* appears to me so different that it should be excluded. A statement on this subject has been published separately (Kew Bulletin 1956; 551) ; the genus will not be further mentioned in the present paper.

The genus *Stromatoptetis,* confined to New Caledonia, is peculiar in various ways, but has superficial sori of sporangia which agree with

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