

CELASTRACEAE—I (Ding Hou, Leyden)

Trees, erect or scandent shrubs; stems sometimes producing rootlets (*Euonymus spp.*), rarely buttressed at the base (e.g. *Bhesa*) or with aerophores (*Lophopetalum multinervium*), sometimes thorny (*Maytenus spp.*); sometimes with elastic or resinous threads in the leaves, inflorescences, floral parts, fruits, or branchlets, showing on fractures. *Leaves* simple, alternate, spiral, decussate or opposite, sometimes fascicled on short branchlets, penninerved, sometimes black-dotted beneath, rarely so on both surfaces, often crenate, more rarely entire. *Stipules* small, simple or lacinate, caducous, or none. *Inflorescences* axillary and/or terminal, sometimes extra-axillary, or ramiferous, cymose, thyrsoid, paniculate, racemose, fasciculate, sometimes 1-flowered, usually bracteate. *Flowers* generally small, actinomorphic, bisexual or unisexual, in the latter case the plants usually dioecious or sometimes polygamous. *Calyx* 4- or 5-lobed, lobes imbricate, rarely valvate, usually persistent. *Petals* 4 or 5, imbricate, contorted, rarely valvate, caducous, sometimes persistent, rarely slightly connate at the base and sometimes also united with the staminal ring below the connate filament bases (i.e. the so-called 'disk' in *Microtropis*), upper surface usually smooth, sometimes partly covered with cristate, lamellate, fimbriate, or fleshy papilla-like appendages (e.g. *Lophopetalum*). *Stamens* (2-) 3, 4, or 5, rarely 8-10 (extra-Mal. gen. *Forsellesia*), alternate with the petals (except in *Forsellesia*), filaments inserted on or within the disk, on its margin or slightly below it, or on a basal ring (*Microtropis*), caducous or persistent; anthers mostly 2-celled, very rarely 1-celled (extra-Mal. *spp.*), usually ovoid, ellipsoid, or subglobose, rarely reniform, sometimes divergent, longitudinally, laterally, or very rarely apically (extra-Mal. *spp.*) dehiscent, introrse or extrorse, basifixed, dorsifixed, or dorso-basifixed. *Disk* various, often present and conspicuous, fleshy or membranous, patelliform or cupular, or flat, entire, dentate, angular, or lobed; extrastaminal to intrastaminal, sometimes adnate to the torus or partially free at the margin, usually annular and continuous, rarely discontinuous and lobed, or even forming staminiferous pockets (extra-Mal. genera *Cheiloclinium* and *Apodostigma*), rarely obscure (*Microtropis*), usually smooth, rarely covered with papilla-like or fleshy subulate processes). *Ovary* partly or entirely immersed in the disk, sometimes concealed within it or adnate to it, or free from it, usually glabrous, sometimes with a tuft of hairs at the top (*Bhesa*), rarely puberulous (extra-Mal. *spp.*), or covered with papilla-like or fleshy subulate processes at the base (*Euonymus spp.*), (1-)2-5-celled or rarely many-celled (*Siphonodon*), mostly completely, very rarely incompletely celled; usually ending in a style, or very rarely hollow at the top (*Siphonodon*); style distinct, short, or obscure, or lacking (*Brassiantha*, *Siphonodon* and extra-Mal. genus), simple, rarely almost divided to the base (*Bhesa*), terminal, rarely lateral in fruit (*Pleurostyliia*); stigma(s) simple, or lobed. *Ovules* mostly 2 in each cell, sometimes 1, or 3-18, anatropous, inserted at the inner angle, erect and inserted at the base or slightly higher, or pendulous, collateral, superposed or in 2 series. *Fruit* capsular, loculicidal or with 3 divergent separate or laterally connate 'follicles', or drupaceous, dehiscent, and sometimes leaving a columella, or indehiscent, smooth, sometimes echinate. *Seeds* erect or pendulous, sometimes winged; aril present or none, when present usually partly or entirely enveloping

the seed or cushion-like situated at the base of it; usually orange or orange-red, rarely white; albumen present or 0; embryo erect; cotyledons flat, foliaceous.

Distribution. The family *Celastraceae* (including *Hippocrateaceae*) comprises c. 90 genera and over 1000 *spp.*, distributed in both hemispheres except the arctic regions, predominantly occurring in the tropics and subtropics.

Ecology. The Malaysian *spp.* occur mostly in primary, occasionally in secondary rain-forests, some in peat or freshwater swamp forests. They are mostly shrubs or small trees of the substage, some species are climbers, but some may grow to large-sized trees, e.g. *spp.* of *Bhesa*, *Kokoona*, *Lophopetalum*, and *Siphonodon*. They commonly occur at low and medium altitudes, but some species grow above 1000 m up to 3200 m, e.g. species of *Euonymus*, *Microtropis*, and *Perrottetia*.

Almost all Malaysian species are adapted to everwet climatic conditions but a few, notably *Maytenus sp.* and *Cassine glauca* (ROTB.) O.K. prefer or are characteristic for seasonally dry climatic conditions and are consequently found in Central and East Java and the Lesser Sunda Islands.

Cassine viburnifolia (JUSS.) DING HOU is a typical mangrove plant.

Some species occur in peat swamps, notably *Lophopetalum multinervium* RIDL., *L. sessilifolium* RIDL., *L. rigidum* RIDL., *L. javanicum* (ZOLL.) TURCZ. (occasionally), and *Kokoona ovatolanceolata* RIDL. Under such conditions *L. multinervium* RIDL. possesses prominent buttresses and cylindrical aerophores (fig. 13).

The only spiny plants occur in the genus *Maytenus*.

Pollination. The flowers of most of the members of this family have nectariferous disks which sometimes show a marked contrast with the colour of the ovary or some other floral parts and are visited by various kinds of insects, e.g. ants, bees, beetles, and flies. Some species are dioecious, or polygamous and require presumably insect-pollination. Unfortunately we have no pertinent data on pollination of tropical *Celastraceae*.

Dispersal. The seeds of most of the members of this family are generally provided with a bright-coloured aril which contrasts to the colour of the pericarp and testa, if the latter is only partially covered by the aril. These arillate seeds are a great attraction to birds.

In *Celastrus* the ripe fruits are usually yellowish with seeds enclosed in a showy red or golden-yellowish aril; in the widely opening fruits the bright-coloured arillate seeds display a showy contrast. In *Glyptopetalum* and some *Euonymus spp.* the arillate seeds are hanging out from the capsules. The capsules of *Microtropis* and some species of *Bhesa* are splitting lengthwise on one side exposing the seeds covered with bright-coloured arils lying inside.

The winged seeds of *Lophopetalum* and *Kokoona* are wind-dispersed.

Some of the drupaceous fruits, e.g. in *Cassine* (syn. *Elaeodendron*), are also bird-dispersed. The fruits of some African *Cassine spp.* have been reported to be dispersed by elephants, which browse on the foliage swallowing the fruit with it; the seed germinates well after having passed the digestive tract.

In Malaysia *Elaeodendron subrotundum* = *Cassine viburnifolia* (JUSS.) DING HOU occurs along rivers and seashores. Its fruit has a thin exocarp and a not evenly thickened, corky mesocarp; according to RIDLEY it is well adapted for sea-dispersal (Disp. 1930, 120, 267, 357, 426).

It is remarkable that in some species of *Microtropis* full-grown fruits do not contain a single mature seed. The fruits I saw of *Pleurostylia* contain either no seed or this was damaged by insects. It could be that this deficiency of setting seed is correlated with the very restricted distribution or rarity of species of these genera.

Morphology. Elastic threads. In breaking young leaves, branchlets, inflorescences, floral parts, fruits, or seeds of some species, the two parts remain sometimes connected by a number of fine, elastic threads, e.g. in the leaves of the African *Maytenus acuminatus* and *spp.* of the American genus *Wimmeria*. They can be dissolved in benzene and are classified as gutta-percha.

The funicle of the S. American *Maytenus magnifolia* is also composed of fine threads but these are of an entirely different nature, namely spiral thickenings of vessels such as found under the seeds of *Talauma*, *Magnolia*, and other *Magnoliaceae*. The loosening of spiral thickenings from vessels is not uncommon in Monocotyledons, but according to Dr. METCALFE it is probably more rare in Dicotyledons.

Floral tube and disk. In the celastraceous flower there is generally a conspicuous cupular or plate-like structure which is commonly called the disk.

BERKELEY (J. Elisha Mitchell Sc. Soc. 69, 1953, 185–206, t. 3–4) has studied the floral morphology and anatomy of some representatives of *Euonymus*, *Celastrus* (2 *spp.*), and *Pachistima*. He interpreted the cup-shaped structure in *Celastrus* (i.e. *C. scandens* and *C. orbiculatus*), which surrounds the ovary but is free from it, as a 'floral tube' consisting of the fused basal portions of the floral whorls. The tissue between the stamens he called the 'disk' and considered it to represent the vestiges of reduced stamens. The broad flat structure surrounding the ovary, e.g. in *Euonymus*, to the edge of which are attached the floral whorls he also interpreted as being a 'floral tube' comparable to that of *Celastrus*; the 'disk' is considered to occupy the same position as in *Celastrus* and has been given the same interpretation.

The term disk used in this treatment, as I have done in my revision of *Celastrus* (cf. Ann. Mo. Bot. Gard. 42, 1955, 220) is equivalent to the 'floral tube' of BERKELEY while what I call disk lobes is equivalent to his 'disk'.

Arils and arillodes. According to PLANCHON (cf. Ann. Nat. Sc. III, 3, 1845, 281, 308, t. 11, f. 3-5, t. 12, f. 9) the so-called arils of the seeds of *Euonymus* and *Celastrus* are actually false arils or arillodes. They are formed by the dilatation and expansion of the edge of the 'exostome', the foramen of the outer integument which is often reflexed around the micropyle. He stated that one would find the same kind of arillodes in other genera of *Celastraceae*. A true aril is formed, after fertilization, as an expansion of the funicle, which is initially only adherent with the seed around the hilum, but it may eventually cover almost the entire surface of the seed, though often not covering the micropylar part. In the herbarium the origin of the arillate structure is difficult to trace and in this revision I have used the term 'aril' for the coloured body which is partly or completely enveloping the seed, sometimes cushion-like situated at the base of it, regardless of its origin.

Embryology. The embryology in *Microtropis* is not clear; see p. 273.

Indument. Hairs occur infrequently in this family. When present they are usually unicellular, e.g. in *Perrottetia* spp., sometimes multicellular-uniseriate, and occasionally associated with some tufted ones, e.g. in *Hexaspora pubescens* C.T. WHITE, or papilliform, e.g. in *Lophopetalum floribundum* WIGHT (cf. also METCALFE & CHALK, Anat. Dic. 1, 1950, 389).

BRIQUET (C.R. Soc. Phys. Hist. Nat. Genève 33, 1916, 65) reported that the margins of sepals of *Maytenus spinosa* (GRIS.) LOURT. & O'DONELL (syn. *Moya spinosa* GRIS.) are fringed by multiseriate trichomes which function as colleters exuding blastocola when young and persisting as ciliae in the adult stage. He found this kind of trichomes in *Maytenus* also on the margins of sepals, very rarely on petals. e.g. in *M. ilicifolia* MART.

I have examined the sepals of *M. ilicifolia*, which are short-fimbriate or -ciliate on the margin in agreement with BRIQUET's description. According to BRIQUET the margin of sepals or petals is in most of the cases reduced to two layers of epidermis without mesophyll between, so that these fringes or cilia are of epidermal origin and should be called trichomes. In my opinion, however, these fringes or cilia are marginal outgrowths of the sepals or petals, a sort of teeth, but not trichomes proper.

Galls. Leaf-galls caused by gall-midges have been found on the leaves of *Maytenus emarginata*, *Bhesa paniculata*, and *Siphonodon celastrineus*; the galls are \pm globose or ovoid, c. 4-5 mm long.

Flower galls occur in *Perrottetia alpestris*; they are caused by gall-midges. The ovary is swollen and resembles a fruit, sometimes hairy outside. Sometimes small lenticular or oval swellings, or small cavities situated close to the midrib or between the nerves and veins, have been frequently found in *Perrottetia* spp. (cf. DOCTERS VAN LEEUWEN, Zoocecidia N.I. 1926, 328-329).

Phytochemistry. Many highly characteristic compounds are known from this family, but most of them have thus far been found in a few species only.

Two exceptions may be made, however, with regard to this statement. All *Celastraceae* seem to accumulate the hexitol dulcitol in leaves and bark (V. PLOUVIER, C. R. Paris 227, 1948, 85; *ibid.* 228, 1949, 1886). This chemical compound may be looked upon as a highly characteristic biochemical feature of the family. Dulcitol has been isolated from many species of *Euonymus* and *Celastrus* and also from species of the genera *Catha*, *Gymnosporia*, *Lophopetalum*, *Maytenus*, *Siphonodon*, and *Tripterygium*. The second compound which seems to occur rather universally in the family is gutta. Gutta like rubber is a polymer of isoprene with the empirical formula $(C_5H_8)_n$; gutta has, however, trans-configuration while rubber has cis-configuration. Rubber is accumulated much more frequently by plants than gutta, which is known only from *Sapotaceae*, *Eucommiaceae*, *Hippocrateaceae*, and *Celastraceae*. Gutta was detected in *Celastraceae* in the bark of several species of *Euonymus* by COL in 1901 (C. R. Paris 132, 1901, 1354); he also noticed the anisotropy of the contents of the laticiferous tubes. Birefringency differentiates gutta deposits in plant tissues clearly from rubber deposits. According to METZ (Bot. Centr. Beih. 15, 1903, 309) rubber (in fact gutta!) occurs in many species of *Celastraceae*; in the leaves of species of *Wimmeria* and *Myrtocylon* it is deposited in special idioblasts but in many *Celastraceae* gutta accumulates in ordinary cells of the mesophyll. In the bark latex tubes are often present according to COL. A number of species of *Euonymus* was investigated, especially in Russia, for the possibility to produce gutta commercially in a temperate climate.

The seeds of *Celastraceae* contain a large amount of fatty oils. These oils are unusual in as far as they have a high saponification number and give rise to volatile acids on saponification. Among the latter formic, acetic and benzoic acids seem to be always present. It is probable, however, that these volatile acids are not esterified with glycerol but with polyhydric alcohols. The corresponding polyesters are soluble in the fatty oils and are therefore always extracted together with the seed fats. The fatty oil proper has a normal composition being composed predominantly of glycerides of palmitic, oleic, linoleic and linolenic acids. Therefore, the characteristic feature is not due to the composition of the fatty oils, but to the fact that the oils always contain appreciable amounts of polyesters of polyhydric alcohols in solution. This state of affairs has been proved in the case of the fatty oil of the seeds of *Celastrus paniculatus* WILLD. (B.G. GUNDL & T. P. HILDITCH, J. Chem. Soc. 1938, 1980).

It is interesting to note that the insecticidal alkaloids of the Chinese *Tripterygium wilfordii* HOOK. are also polyesters yielding acetic acid, benzoic acid, furan- β -carboxylic acid and a substituted nicotinic acid on saponification (M. BEROZA, J. Am. Chem. Soc. 75, 1953, 44). Insecticidal properties are also ascribed to other *Celastraceae*, e.g. *Euonymus europaeus* L. and the very rare furan- β -carboxylic acid first isolated from the bark of *Euonymus atropurpureus* JACQ. Furthermore the presence of alkaloids

has been noticed in seeds of different species of *Euonymus* and *Celastrus* and in the bark of *Lophopetalum toxicum* LOHER. Many features described in chemical literature indicate that in barks and seeds of *Celastraceae* polyesters of polyhydric alcohols are accumulated. If, as in the case of the insecticidal principles of *Tripterygium wilfordii*, derivatives of nicotinic acid are involved in esterification, the resulting polyesters contain heterocyclic nitrogen and are classified as alkaloids.

Bitter, cardiotoxic glycosides have been isolated from the seeds of *Euonymus europaeus* L. (glycosides of digitoxigenin; CH. TAMM & J. P. ROSSELET, *Helv. Chim. Acta* 36, 1953, 1309), the rootbark of *Euonymus atropurpureus* JACQ. (glycosides of digitoxigenin; TSCHESCHE R. *et al.* *Chem. Ber.* 88, 1955, 1619; C. A. BLISS & E. RAMSTAD, *J. Am. Pharm. Ass.* 46, 1957, 423). Digitaloid glycosides have further been detected in the bark of *Lophopetalum toxicum* LOHER (used as an arrow poison in the Philippines) and in the seeds of different species of *Euonymus*.

Triterpenoids are probably accumulated in large amounts in leaves and bark by many *Celastraceae*. Lupeol and betulin represent approximately 3% of the dry weight of the bark of *Lophopetalum toxicum* LOHER (H. DIETERLE *c.s.* *Arch. Pharm.* 271, 1933, 264). The leaves of *Celastrus scandens* L. contain lupeol and β -amyrin (E. J. COREY *c.s.*, *J. Am. Pharm. Ass.* 46, 1957, 183). From the leaves of *Euonymus alatus* SIEB. triterpenes of the friedelane series were isolated (T. MAZAKI & M. ARITOMI, *J. Pharm. Soc. Japan* 77, 1957, 1353) and the bark of *Siphonodon australe* BENTH. contains at least 12 triterpenes of the friedelane series (J. L. COURTNEY *c.s.*, *J. Chem. Soc.* 1956, 2115, 2119).

Taxonomically more important, however, are the red bark pigments celastrol (= tripterin) and pristimerin (= monomethylcelastrol), which according to GRANT *et al.* (*J. Chem. Soc.* 1960, 549) seem to be modified triterpenes. Celastrol was isolated from the rootbark of *Celastrus scandens* L. and *Tripterygium wilfordii* Hook. f. and pristimerin from the rootbark of *Celastrus* (= *Maytenus*) *dispermus* and *Denhamia pittosporoides*. The isolation of these pigments from species of different genera and different continents indicates that they are probably of frequent occurrence in the family.

Finally two species have to be mentioned. The aril of *Maytenus* species is used in Brazil as a diuretic; according to FREISE (*Pharm. Zentralhalle* 76, 1935, 704) the drug contains 0.85% of caffeine. *Catha edulis* FORSK. yields the so-called khat or abyssinian tea; this drug contains an appreciable amount of the alkaloid norpseuodophrine (= cathine), a stimulant of the central nervous system (compare R. PARIS & Mme H. MOYSE, *Le thé des Abyssins*, *Bull. Stupéfiants* 10, n. 2, 1958, 10 and K. WINTERFELD & G. BERNAUER, *Arch. Pharm.* 293, 1960, 991).

Comparing the thus far known chemical characters of *Celastraceae* with those of other families we come to the conclusion that there are close biochemical affinities to one family only, *Hippocrateaceae*. These affinities are so striking (dulcitol, gutta, pristimerin) that from a phytochemical point of view the separation of these two families seems hardly justified. —R. HEGNAUER.

Wood-anatomy. DEN BERGER, *Determinatietabel houtsoorten van Malesië*, Veenman, Wageningen (1949) 30, 33, 34, 43, 46, 67; DESCH, *Mal. For. Rec.* 15¹ (1941) 77; *ibid.* 15² (1954) 430, 525 (hand lens); CHALK & CHATTAWAY, *Proc. Roy. Soc. B* (1933) 82; HEIMSCH, *Lilloa* 8 (1942) 182, 189; METCALFE & CHALK, *Anat. Dic.* 1 (1950) 393; MOLL & JANSSONIUS 2 (1908) 254.

The family is interesting because of the distribution of derived and primitive features among the genera: libriform fibres or septate libriform fibres and fibre tracheids; simple and scalariform perforation plates (with few or many bars); radial multiples and solitary pores; wood parenchyma absent or sparse, and multiseriate bands; multiseriate rays with short and such with very long wings. HEIMSCH, *l. c.*, suggested affinity of *Staphyleaceae* to *Celastraceae*, *cf.*, however, *Fl. Mal.* 6 (1960) 53.—C.A.R.-G.

Taxonomy. In PIERRE's opinion (*Fl. For. Coch.* 4, 1893, sub t. 296B) *Bhesa* (syn. *Kurrimia*), though closely related to *Celastraceae*, differs by its small embryo, distinct styles, and additional anatomical features and represents the type of a family of its own, 'Kurrimiacées' (*Kurrimiaceae*). This group, which is characterized by: spirally arranged leaves with crossbar veins, three vascular bundles in the petiole, two or three vascular bundles in the pith of the petiole, free styles, and an embryo which is much shorter than the albumen.

METCALFE & CHALK (*Anat. Dic.* 1, 1950, 395) have stated that from the wood-anatomical standpoint *Perrottetia* (syn. *Caryospermum*), *Bhesa* (syn. *Kurrimia*), and *Siphonodon* represent aberrant genera by the presence of paratracheal parenchyma and the absence of fibre tracheids. They quoted and followed the opinion of SPRAGUE, who said that *Tripterygium*, *Perrottetia*, and *Kurrimia* are not sufficiently distinct to exclude them from the *Celastraceae*.

METCALFE (*in litt.*) stated that the wood structure of *Siphonodon* differs to a certain extent from that of most of the *Celastraceae* represented in Jodrell Laboratory collection, 'but that the wood structure of the family as a whole is rather heterogeneous, and, if *Siphonodon* is to be excluded certain other genera such as *Microtropis*, *Bhesa*, and *Tripterygium* could with equal justice be excluded as well'. Mr H. K. AIRY SHAW (*in litt.*) feels that 'from evidence from external morphology *Siphonodon* should not be excluded from the family, although agreeing that the floral characters are somewhat aberrant.'

From external morphology, anatomical characters, pollen morphology and chemotaxonomical characters, *Hippocrateaceae* and *Celastraceae* are very closely related to one another. A.C. SMITH & BAILEY (*J. Arn. Arb.* 22, 1941, 389-394, t. 1) have, in a detailed discussion of the characters and relationships of the new Malaysian genus *Brassiantha*, pointed out that these two families 'exhibit parallel series of variations in characters pertaining to wood-anatomy and pollen-structure' and in their opinion their separa-

tion is quite artificial (*cf. l.c.* 394). On the basis of chemical characters HEGNAUER (see p. 230) has concluded that 'from a phytochemical point of view the separation of these two families seems hardly justified'. It is also my contention that *Celastraceae* and *Hippocrateaceae* cannot be upheld as two separate families and they will be treated in this revision as one.

Generic delimitation. In this revision the following new generic reductions have been made: *Quadripterium* TARDIEU has been reduced to *Euonymus* L., *Phanrangia* TARDIEU to *Mangifera* L., *Solenospermum* ZOLL. to *Lophopetalum* WIGHT, and *Monocelastrus* WANG & TANG to *Celastrus* L.

Although not occurring in Malaysia, there is another pair of genera which deserve attention, viz *Tripterium* Hook. f. in B. & H. Gen. Pl. 1 (1862) 368 from East Asia and *Wimmeria* SCHLECHT. Linnaea 6 (1831) 427 from Central America.

In the key by LOESNER (in E. & P. Pfl. Fam. ed. 2, 20b, 1942, 110) they are merely contrasted by the number of ovules, 2 basal and collateral in *Tripterium*, 6-8 (in his description 4-8) axile in two series in *Wimmeria*. This single character is feeble, as for example in *Euonymus* the number of ovules per cell varies from 2-12. If this would be the only differential character I would have reduced *Tripterium* to *Wimmeria*. There are, however, a number of other macroscopical differential characters observed on the available material, and besides anatomical differences, which I owe to Prof. HEGNAUER, worthwhile to put on record here:

Tripterium: Climbers. Bark of twigs lenticellate, often warted. Leaves herbaceous, broad-ovate; base of blade rounded; petiole and base of midrib sulcate on the upper surface. Inflorescences large, terminal thyrses leafy at the base. Ovules 2 per cell. In breaking the leaves no gutta-percha threads. Veins and nerves with well-developed tracheid sheath; Ca-oxalate crystals in the leaf parenchyma restricted to rows of cells of normal size adjacent to the tracheids of these sheaths.

Wimmeria: Shrubs or trees. Bark of the twigs not lenticellate or warted. Leaves chartaceous to coriaceous, narrower; base of blade cuneately attenuated into the petiole; base of midrib and petiole flat above, with prominent midrib. Inflorescences smaller, axillary, not forming large terminal thyrses. Ovules 4-8 per cell. Leaves with gutta-percha threads showing on the fractures. Veins and nerves without tracheid sheath; leaf parenchyma with large Ca-oxalate crystals in crystal-idioblasts.

Some of the leaf characters may be correlated with the more sclerophyllous texture of the leaves of *Wimmeria*. In each case these two genera are closely allied and one may quibble to unite them and give them subgeneric rank, but one cannot escape the definite impression that they are separate taxa. Their distribution coincides exactly with the North Pacific Asa Gray disjunction.

Uses. Some *Celastraceae* are used for timber, notably *Lophopetalum wightianum* ARN. and *L. multinervium* RIDL., *Kokoona littoralis* LAWS. and *K. reflexa* (LAWS.) DING HOU, *Bhesa paniculata* ARN., and *Siphonodon celastrineus* GRIFF. Timber of *Euonymus javanicus* BL. is said to be very resistant against weathering and insects, but little is known of it because timber of good size is extremely rare.

Bark of *Kokoona* and *Lophopetalum* species contains oil in a thin outer layer and is easily inflammable, even in a wet state; it is used as fire-lighter in the forest.

The fruits of *Salacia* and *Bhesa* have seeds with a rather large aril which is edible.

Leaves of *Celastrus paniculata* WILLD., *Cassine* spp., *Salacia* spp., and *Hippocratea* spp. are used for medicinal purpose. BURKILL discussed the use of a decoction of the bark of *Lophopetalum pallidum* LAWS. for dart poison, together with many other ingredients; it is not clear which role is played by *Lophopetalum*.

For further details see HEYNE, Nutt. Pl. (1927) 983-985 and BURKILL, Dict. (1935) 505, 904, 1288, 1365.

Note. For practical purposes the revision of this family will be published in two parts; the second part will contain the treatment of the genus *Siphonodon* and the genera formerly assigned to the *Hippocrateaceae*. In the second part I will discuss more fully the subdivision of the family, frame my final generic delimitation, and provide an emended key.

KEY TO THE GENERA

(based on flowering material)

1. Leaves spirally arranged or alternate.
2. Leaves with crossbar veins between the nerves; petiole thickened at the apex beneath. Petals contorted. Styles 2, free or slightly united at the base 1. *Bhesa*
2. Venation reticulate. Petals usually imbricate, rarely valvate (*Perrottetia*). Style simple.
3. Petals always larger than the calyx lobes and usually different in shape, imbricate. Ovary 3-4-celled (2-celled in *Maytenus diversifolia*).
4. Ovary (2-)-3-celled, each cell with two collateral ovules.
5. Ovary free from the disk. Ovules with a cup-shaped aril at the base. Scandent shrubs, always unarmed 2. *Celastrus*
5. Ovary usually partly immersed in the disk. Ovules without arillar cup at the base. Erect (sometimes scandent?) shrubs or small trees, sometimes spinous 3. *Maytenus*
4. Ovary 4-celled, each cell with c. 10 ovules arranged in two series 4. *Xylonymus*

3. Petals usually similar to calyx lobes both in size and shape, usually valvate. Ovary 2-celled. **5. Perrottetia**
1. Leaves decussate or opposite.
6. Petals slightly united at the base (very rarely free, in *Microtropis filiformis*). Disk proper absent, filaments united at the base in a ring or short tube, by some interpreted to represent a disk, usually united with the petals **10. Microtropis**
6. Petals free. Disk conspicuous, fleshy, cupular or flat (covering the ovary and coherent with it in *Glyptopetalum sp.*), free from the petals. **10. Microtropis**
7. Ovary 3-, or 4-5-celled. Ovules 1-18 in each cell.
8. Ovary 4-5-celled.
9. Ovules 2 in each cell **6. Euonymus**
9. Ovule 1 in each cell **7. Glyptopetalum**
8. Ovary 3-celled. Ovules (4-6)8-18 in each cell.
10. Petals contorted, without appendages **8. Kokoona**
10. Petals imbricate, usually with appendages on the inner side, very rarely naked **9. Lophopetalum**
7. Ovary 2-celled, or 1-celled by abortion (*Pleurostyliya*). Ovules 2 in each cell.
11. Disk more or less flat. Anthers subglobose and rounded at the apex, connective invisible on the dorsal side. **11. Cassine**
11. Disk cupular. Anthers ovoid and short-apiculate, connective distinct and broad on the dorsal side. **12. Pleurostyliya**

KEY TO THE GENERA

(based on fruiting material)

1. Leaves spirally arranged or alternate.
2. Fruit a loculicidally dehiscent capsule, sometimes splitting on one side only (*Bhesa*). Seeds smooth or sometimes areolate. Petals usually caducous after anthesis.
3. Fruit 2-3-celled, or 1-celled by abortion, 2-3-valved, or splitting on one side; valves usually leathery, less than 2 mm thick; each cell 1- or 2-seeded, in the latter case seeds collateral.
4. Leaves with crossbar veins between the nerves; petiole thickened at the apex beneath. Fruit usually not subglobose, sometimes 2-lobed, 2-valved or splitting on one side **1. Bhesa**
4. Venation reticulate; petiole not thickened at the apex beneath. Fruit usually subglobose, 3-valved (2-valved in *Maytenus diversifolia*).
5. Seeds completely enveloped by the aril. Scandent shrubs **2. Celastrus**
5. Seeds incompletely (at the lower half or at the base) enveloped by the aril. Erect (sometimes scandent?) shrubs or small trees **3. Maytenus**
3. Fruit large, 4-celled, 4-valved, valves woody, 7-9 mm thick, each cell c. 10-seeded; seeds arranged in two rows **4. Xylonymus**
2. Berry indehiscent. Seeds muricate-foveolate or tuberculate. Petals usually persistent. **5. Perrottetia**
1. Leaves decussate or opposite.
6. Fruit a dehiscent capsule.
7. Fruits 3-5-celled, loculicidally dehiscent, usually 3-5-valved, 3-∞-seeded.
8. Fruits usually 4-5-angular or -lobed, 4-5-celled, occasionally 1-3-celled by abortion, each cell 1- or 2-seeded. Seeds not winged, completely or incompletely enveloped by the aril.
9. Axis of the fruit splitting completely together with the valves when the fruit dehisces. Seeds usually 2 in each cell, attached to the top or base at the inner angle, raphe not branched. **6. Euonymus**
9. Axis splitting or not, free from the valves when the fruit dehisces (columella). Seeds only one in each cell, hanging from the top of the persistent axis, raphe branched usually at the morphological base of the seed, the bands ascending on the other side towards the hilum. **7. Glyptopetalum**
8. Fruits 3-angular, -lobed, or ± winged. Seeds winged. No aril. **8. Kokoona**
10. Seeds attached at their base, wing at the apical end **8. Kokoona**
10. Seeds attached at their ± centre on one side, the wing surrounding the entire seed. **9. Lophopetalum**
7. Fruits usually 1-celled, splitting on one side, usually 1-seeded. **10. Microtropis**
6. Fruit drupaceous, indehiscent.
11. Fruit with terminal persistent style or its scar **11. Cassine**
11. Fruit with lateral, persistent style. **12. Pleurostyliya**

1. CELASTRUS

LINNÉ, Gen. Pl. ed. 5 (1754) 91; Sp. Pl. (1753) 196; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 131; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 227.—*Celastrus* § *Eucelastrus* W. & A. Prod. (1834) 158.—*Monocelastrus* WANG & TANG, Acta Phytotax. Sin. 1 (1951) 36.—Fig. 1.



Fig. 1. *Celastrus novoguineensis* MERR. & PERRY. a. Habit, $\times \frac{2}{3}$, b. flower, $\times 6$, c. section of flower, pistil removed, $\times 6$, d. pistil, $\times 12$, e. petal, $\times 6$, f. dehiscent fruit, nat. size, g. seed, aril largely removed, $\times 2$.—*C. stylosus* WALL. h. Branch with fruit, $\times \frac{2}{3}$, i. stamen, $\times 6$, j. dehiscent fruit, seeds removed, nat. size, k. seeds, $\times 2$, l. remains of central axis and septa after valves and seeds have dropped (a-e BRASS 32222, f-g WOMERSLEY 6051, h, j, k (right), l BACKER 22483, i BAKHUIZEN 2534, j BACKER 22483, k (left) FORBES 3829).

Scandent deciduous, rarely evergreen shrubs, sometimes very large. Branchlets (in Mal.) terete, glabrous rarely pubescent, solid very rarely hollow, almost always lenticellate except sometimes on the flush. *Leaves* spirally arranged, petioled, elliptic to orbicular, dentate, crenate or subentire, rarely finely ciliate-serrulate (extra-Mal. *sp.*). *Stipules* small, usually laciniated and caducous. *Inflorescences* pyramidal or narrow raceme-like thyrses with cymosely arranged flowers, some-

times branched almost from the base, solitary, axillary, and/or terminal, peduncled or sessile, few- to many-flowered. *Flowers* 5-merous, small, usually light greenish, unisexual and the plants usually dioecious, or bisexual (extra-Mal. *spp.*), pedicelled and articulated. *Calyx* campanulate, persistent; lobes imbricate or valvate (extra-Mal. *sp.*). Disk usually membranous and cupular, or fleshy and flat, entire or 5-lobed, lobes alternate with the stamens. Fertile *stamens* inserted on the margin of the disk or immediately under the outer margin; filaments glabrous or papillose; anthers ovoid or oblong-ellipsoid, obtuse or apiculate, latrorse or introrse (not extrorse as stated by me, *l.c.* 228), dorsifixed, versatile, cells separated at the lower half or third; sterile stamens much smaller in size, their anthers usually ovate-oblong, acute or acuminate. *Ovary* free from the disk or its base slightly confluent with it, completely or incompletely 3-celled; style usually columnar, stigma usually 3-lobed, lobes obscure, or rarely each 2-fid; sterile pistil in ♂ fl. much smaller than the fertile one, sometimes columnar, its stigma usually not lobed. *Ovules* 2 or 1 (extra-Mal. *spp.*) in each cell, attached at the inner angle at the base, anatropous, sessile or on a short funicle; with a cupular aril at its base. *Capsule* usually subglobose, rarely subcylindric, tipped by the persistent style, loculicidally 3-valved, the central axis splitting close to the insertion of the seeds, both valves and axis ridged by the remains of the dissepiments. *Seeds* 1-6, enveloped by a fleshy crimson aril, sticking together, the valves spreading; testa with obscure or distinct areolae; albumen copious; embryo erect, cotyledons thin and broadly spatulate.

Distr. About 31 *spp.* largely in the tropical and subtropical zones, widely distributed chiefly in eastern Asia, Latin America (7 *spp.*), North America (1 *sp.*), New Caledonia and Australia (1 *sp.*), Fiji (1 *sp.*), and Madagascar (1 *sp.*).

Ecol. Chiefly in forests or thickets, from the lowland up to 3000 m.

Taxon. I have divided *Celastrus* into two subgenera, *l.c.* 216-217, pl. 31. All the Malaysian species belong to the *subg.* *Celastrus* which is characterized by: plants usually dioecious, flowers mostly unisexual, ovary 3-celled with 2 ovules in each cell.

This subgenus has been subdivided into two series, *viz ser. Paniculati* REHD. & WILS. characterized by species bearing terminal inflorescences only to which in Malaysia belong *C. paniculatus* and *C. novoguineensis*, and *ser. Axillares* REHD. & WILS. characterized by species with both terminal and axillary inflorescences, or axillary ones only to which in Malaysia belong *C. monospermoides*, *C. hindsii*, and *C. stylosus*.

For the distinction of the genera *Celastrus*, *Maytenus*, and *Gymnosporia* see under *Maytenus*.

Notes. WANG & TANG (*l.c.*) have described a new genus *Monocelastrus* from Yunnan (China), comprising *M. virens* WANG & TANG (Type: C. W. WANG 79015) and *M. monosperma* (ROXB.) WANG & TANG (based on *Celastrus monospermus* ROXB.). They stated that the new genus has the scandent habit of *Celastrus* but differs from it by the stamens inserted under the disk and by the ovary which is not immersed in the disk but only confluent with it at its base. As the latter character holds, however, for the entire genus *Celastrus* and the insertion of the stamens is variable, sometimes even in one species for the two sexes, there is no reason for segregation.

Except one sheet (TAI 52465) I have seen all specimens cited to belong to '*Monocelastrus*' and in my opinion they all belong to one species, *C. monospermus* ROXB., except one (C.W. WANG 76880) which is a doubtful specimen in fruit which I believe belongs to *C. hindsii* BENTH. (*cf.* Ann. Mo. Bot. Gard. 42, 1955, 245, 255, 297-298).

On a few field labels it was noted that the plant would be a tree; I believe this to be due to erroneous observation.

The synonyms cited under the species are those which are based on Malaysian collections, extra-Malaysian ones which are important for nomenclature or discussion, and a few which I missed in my revision of the genus.

KEY TO THE SPECIES

1. Inflorescences terminal only.
2. Branches of the inflorescence \pm obliquely erect. Pedicel distinct usually $1\frac{1}{8}$ - $3\frac{1}{2}$ mm (3-6 mm on fruits). Stamens in the ♂ flowers distinctly filamentous; filaments sometimes longer than the anthers in an open flower; anthers usually truncate or obtuse at the apex 1. *C. paniculatus*

2. Branches of the inflorescence usually at \pm right angles with the rachis. Pedicel obscure or very short, c. $\frac{1}{2}$ mm (c. 1 mm on fruits). Stamens in the δ flowers usually subsessile; anthers apiculate.
2. *C. novoguineensis*
1. Inflorescences both terminal and axillary, or axillary or laterally only.
3. Inflorescences usually without accompanying bud. Stamens with glabrous filaments. Fruits usually 1-seeded. Seeds broad-ovoid or -ellipsoid, 5–12 by 5–10 mm, obtuse at both ends.
4. Inflorescences few-flowered, in simple lax cymes or 1-flowered; disk membranous, cupular, 5-lobed; stamens inserted usually between the lobes of the disk. Leaves densely reticulate. Young branchlet (in the herbarium) light green, smooth and lacking lenticels. 3. *C. hindsii*
4. Inflorescences usually many-flowered, in dense umbelliform cymes; disk \pm fleshy, flat, rounded; stamens inserted just beneath the margin of disk. Leaves loosely reticulate. Young branchlets (in the herbarium) usually light brown, densely covered with slightly elevated lenticels
4. *C. monospermoides*
3. Inflorescences usually each accompanying a bud. Stamens with papillose filaments. Fruits 3–6 seeded. Seeds \pm plano-convex to slightly lunar, 4–6 by 1–2 mm, attenuate at both ends. . 5. *C. stylosus*

1. *Celastrus paniculatus* WILLD. Sp. Pl. 1 (1797) 1125; ROXB. Fl. Ind. ed. Wall. 2 (1824) 388; DC. Prod. (1825) 6; ROXB. Fl. Ind. ed. Carey 1 (1832) 621; WIGHT, Ill. (1840) 176, t. 72; Ic. 1 (1840) t. 158; THWAITES, En. Pl. Zeyl. (1864) 72; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 617; TRIM. Fl. Ceyl. 1 (1893) 272; BAKER in Andrews, Monogr. Christmas Isl. (1900) 175; LOES. Bot. Jahrb. 30 (1902) 470; PRAIN, J. As. Soc. Beng. 73, ii (1904) 195; LOES. Bot. Jahrb. 39 (1906) 160, *pro var. balansae* LOES.; MERR. Philip. J. Sc. i (1906) Suppl. 85; BACKER, Schoolfl. (1911) 234; PITARD, Fl. Gén. I.–C. 1 (1912) 890; KOORD. Exk. Fl. Java 2 (1912) 524; RHED. & WILS. in Sargent, Pl. Wilson. 2 (1915) 355; GAMBLE, Fl. Madras (1918) 208; RIDL. Fl. Mal. Pen. 1 (1922) 451; CRAIB, Fl. Siam. En. 1 (1926) 284; MERR. Lingn. Sc. J. 5 (1927) 116; KANJILAL & DAS. Fl. Assam 1, 2 (1937) 268, *pro var. venulosoides* KANJ. & DAS; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 132, f. 31, K & L; TARDIEU, Suppl. Fl. Gén. I.–C. (1948) 803, f. 98, 4–6, *incl. var. poilanei* TARD.; Not. Syst. 14 (1950) 45; MERR. J. Arn. Arb. 35 (1954) 141; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 229, t. 32 & 34, f. 3 map 1, *incl. ssp. paniculatus, serratus et multiflorus*.—*C. multiflorus* ROXB. [Hort. Beng. (1814) 18, *nomen*] Fl. Ind. 2 (1824) 389, *non* LAMK, 1785; ed. Carey 1 (1832) 622; PRAIN, J. As. Soc. Beng. 73, ii (1904) 196.—*C. nutans* ROXB. [Hort. Beng. (1814) 18, *nomen*] Fl. Ind. ed. Carey 1 (1832) 623.—*Diosma serrata* BLANCO, Fl. Filip. (1837) 168; ed. 2 (1845) 119; ed. 3, 1 (1877) 213.—*C. subspicatus* HOOK. Ic. Pl. 5 (1842) t. 482; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 236, map 1.—*Alsodeia glabra* BURGERSD. in Miq. Pl. Jungh. (1852) 122; MIQ. Fl. Ind. Bat. 1, 2 (1859) 116; OUDEM. Arch. Néerl. Sc. Exact. & Nat. 2 (1867) 199, t. 9.—*C. australis* HARV. & F. v. M. Trans. Phil. Soc. Vict. 1 (1855) 41; BENTH. Fl. Austr. 1 (1863) 398; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 236, t. 32.—*C. polybotrys* TURCZ. Bull. Soc. Nat. Mosc. 31, 1 (1858) 449.—*C. racemosa* TURCZ. *ibid.* 36, 1 (1863) 599, *ex descr.*, photogr. of type seen.—*Rinorea glabra* O.K. Rev. Gen. Pl. 1 (1891) 42.—*C. papuana* WARB. Bot. Jahrb. 13 (1891) 366. Up to 10 m. Innovations usually pubescent. Leaves glabrous, sometimes pubescent beneath

especially on the venation, elliptic to elliptic-oblong, broad-obovate, or suborbicular, ovate or ovate-oblong, 5–15 by $2\frac{1}{2}$ –6 cm; base cuneate, obtuse or rounded; apex acute, acuminate, obtuse, rarely emarginate; midrib elevated on both surfaces; nerves 5–8 pairs; petiole $\frac{1}{2}$ – $1\frac{1}{2}$ cm. Panicles usually thrice to multi-compound, rarely once compound, spreading, (2–)5–10 cm long, sometimes up to 20 cm long, usually puberulous when young; peduncle 6–10 mm. Pedicels $1\frac{1}{2}$ – $3\frac{1}{2}$ mm (3–6 mm on fruits), the articulation at the base.— δ : calyx lobes semi-orbicular, short-ciliate, $\frac{2}{3}$ –1 by $1\frac{1}{2}$ mm. Petals oblong or obovate-oblong, obtuse, entire, $2\frac{1}{2}$ –3 by 1– $1\frac{1}{2}$ mm. Disk cupular, the lobes obscure or slightly triangular. Stamens c. 3 mm long; filaments subulate; anthers ovoid, obtuse. Sterile pistil columnar, c. $1\frac{1}{3}$ mm long.— σ : calyx lobes, petals, and disk as in the male. Sterile stamens $1\frac{1}{3}$ mm long. Pistil 2– $2\frac{1}{2}$ mm long; ovary globose; style columnar; stigmas 3-lobed and each sometimes bifid, slender. Fruits subglobose; valves broad-elliptic, 5–10 by 5–8 mm, 3–6-seeded. Seeds ellipsoid, $3\frac{1}{2}$ –5 by 2–3 mm, yellowish to reddish brown, smooth, or with obscure areoles.

Distr. Widely distributed in India, Burma, Siam, Indo-China, southern China, throughout Malaysia (except Borneo), to Australia and New Caledonia.

Ecol. Chiefly in thickets, 200 to 1800 m.

Notes. The type specimen of *C. polybotrys* TURCZ. from the Philippines is CUMING 1324, not 1321 as cited in the original description.

In my former revision I have distinguished three subspecies within *C. paniculatus* but the distinctions given, mainly based on dimensions of leaves and geographical distribution, have broken down through the study of abundant material from Bogor. There are local forms but all are connected by intermediate forms and cannot be keyed out; consequently I have withdrawn them.

C. paniculatus is very closely allied to *C. novoguineensis*.

2. *Celastrus novoguineensis* MERR. & PERRY, J. Arn. Arb. 22 (1941) 260; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 234, t. 32 in part, map 1.—Fig. 1a–g.

Shrub up to 10 m tall. Innovations glabrous.

Leaves oblong, elliptic-oblong, or broad-ovate; base obtuse or rounded, sometimes acute; apex acute or obtuse; nerves 5–7 pairs; petiole 1–2½ cm. *Panicles* terminal, up to 20 cm, divaricately branching, usually thrice compound. Pedicels c. ½ mm (c. 1 mm on fruits), distinctly articulated. —♂: *calyx* lobes subreniform, slightly erose, c. 1 mm long. *Petals* oblong, obtuse, subentire, scarious-marginate, 2½ by 1½ mm, subcarinose, sometimes brownish-punctate. Disk cup-shaped, membranous, lobes obscure, truncate or mucronate. *Stamens* subsessile or with very short flat filaments; anthers narrow-ovoid, obtuse, apiculate, brownish-dotted; sterile pistil 1 mm long. —♀: *calyx* lobes, *petals*, and disk as in the male. Sterile *stamens* 1 mm long. Pistil c. 1½ mm long; *ovary* subglobose; style obsolete; stigmas 3-lobed, each bifid. *Fruits* subglobose, the valves broadly ovate, 9–12 by 7–10 mm, 3–6-seeded. *Seeds* ellipsoid, 5–8 mm by 2½–3½ mm, reddish-brown, smooth.

Distr. *Malaysia*: New Guinea, throughout the island.

Ecol. In thickets or forests, usually at 1220–1830 m, sometimes found in the forest at 2400–2900 m, rarely occurring along river-banks at 100 m.

Vern. *Rau'wihj*, *remohnremohn*, Enga language.

3. *Celastrus hindsii* BENTH. in Hook. J. Bot. Kew Misc. 3 (1851) 334; MAXIM. Bull. Ac. Imp. Sc. Pétersb. 27 (1881) 455; FORB. & HEMSL. J. Linn. Soc. Bot. 23 (1886) 455; HALL. f. Med. Rijksherb. 1 (1910) 8; PITARD, Fl. Gén. I.–C. 1 (1912) 892; DUNN & TUTCHER, Kew Bull. add. ser. 10 (1912) 61; REHD. & WILS. in Sargent, Pl. Wilson. 2 (1915) 357; MERR. Lingn. Sc. J. 5 (1927) 116; KANEHIRA, Formos. Trees. ed 2 (1936) 384, t. 341; WANG, Chin. J. Bot. 1 (1936) 63; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 134; TARDIEU, Suppl. Fl. Gén. I.–C. (1948) 802; DING HOU, Taiwania 1 (1950) 175; Ann. Mo. Bot. Gard. 42 (1955) 249, f. 7, map 2, 10.—*C. racemulosus* HASSK. Hort. Bogor. Descr. 1 (1858) 155, non FRANCH. 1886; MIQ. Fl. Ind. Bat. 1, 2 (1859) 590; BACKER, Schoolfl. (1911) 234; KOORD. Exk. Fl. Java 2 (1912) 524; Fl. Tjib. (1923) 145.—*Flieggæ serrata* MIQ. Fl. Ind. Bat. 1, 2 (1859) 356, cf. HALLIER f. Med. Rijksherb. 1 (1910) 7.—*C. racemulosa* FRANCH. Bull. Soc. Bot. Fr. 33 (1886) 455, non HASSK. 1858; Pl. Delav. pt 2 (1889) 132.—*C. franchetiana* LOES. Bot. Jahrb. 30 (1902) 470, new name for *C. racemulosa* FRANCH.; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 133.—*C. tonkinensis* PITARD, Fl. Gén. I.–C. 1 (1912) 892, f. 112, 1–2.—*C. marianensis* KOIDZ. Bot. Mag. Tokyo 30 (1916) 400, ex descr.—*C. axillaris* RIDL. J. Mal. Br. R. As. Soc. 1 (1923) 56.

Evergreen, up to 30 m. Young branchlets usually without lenticels. *Leaves* usually coriaceous, glabrous, elliptic- or obovate-oblong, sometimes elliptic or broadly elliptic, 4–14½ by 1½–6 cm; base cuneate, obtuse or rounded; apex abruptly acute or acute; nerves 6–9 pairs; veins and veinlets almost always distinctly elevated and densely

reticulate on both surfaces; petiole ½–1 cm. *Flowers* usually in axillary as well as terminal 3–5-flowered cymes, these not unfrequently combined in axillary narrow racemes of cymes which may exceed the subtending leaf; peduncle very short sometimes up to 2½ cm. Pedicels obsolete, or very short (½–1½ mm), rarely up to 4 mm.—♂: *calyx* lobes semi-orbicular, imbricate, obtuse, short-ciliate, sometimes erose, c. 1½ mm long. *Petals* oblong or obovate, obtuse, glandular-ciliate, 2–5 by 1⅓–2½ mm. Disk cup-shaped, lobes usually deltoid, rarely slightly oblong, shortly acute, rounded, or slightly dentate. *Stamens* c. 2⅓ mm; filaments subulate, glabrous; anthers ovoid, obtuse, cordate. Sterile pistil ovoid, c. 1½ mm long.—♀: *calyx* lobes, *petals*, and disk as in the males, but the petals smaller. Sterile *stamens* c. 1½ mm. Pistil flask-like, c. 2 mm long; *ovary* subglobose; style columnar; stigma 3-lobed. *Fruits* ovoid to subglobose; valves broadly-ovate or -elliptic, or suborbicular, 8–11 by 7–9 mm, usually 1-seeded. *Seeds* broad-ellipsoid, 5–8 by 5 mm, reddish-brown, smooth.

Distr. India, Burma, Siam, Indo-China, Central to S. China (also Hainan), Bonin Is., Marianas, and *Malaysia*: Sumatra (East Coast Res.), Borneo (Kinabalu), and Java (in West, once in Central Java).

Ecol. Chiefly in thickets, rarely in mossy forest, 1000–1800 m, only once at 550 m.

Vern. *Areuj ki sorot*, *reunghas areuj*, S.

4. *Celastrus monospermoides* LOES. Nova Guinea 8 (1910) 280; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 134; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 247, f. 6, map 2, 9.—*C. championii* (non BENTH.) KING, J. As. Soc. Beng. 65, ii (1896) 639; RIDL. J. Fed. Mal. St. Mus. 4 (1901) 11.—*C. malayensis* RIDL. J. Str. Br. R. As. Soc. n. 75 (1917) 18; Fl. Mal. Pen. 1 (1922) 451; CRAIB, Fl. Siam. En. 1 (1926) 283.—*C. apoensis* ELMER, Leaf. Philip. Bot. 7 (1915) 2579; MERR. En. Philip. 2 (1923) 482.

Up to 17 m tall. *Leaves* elliptic to elliptic-oblong, ovate, rarely broad-ovate or subrotundate, 5–16 by 2½–7½ cm; base cuneate, obtuse or rounded; apex acute to acuminate; nerves 4–7 pairs, obliquely spreading and curving upwards; veins distinct and slightly raised below, obsolete above; petiole 6–13 mm. *Inflorescences* axillary or also terminal, 1–3 together, frequently forming narrow raceme-like thyrses up to 10 cm long, once to thrice compound. Bracts deltoid, irregularly erose. Peduncle up to 1½–3½ cm, sometimes very short or obscure. Pedicels 3½–5 mm, the articulation at the base.—♂: *calyx* lobes sub-orbicular, c. ⅔ mm long, entire, short-ciliate, sometimes erose. *Petals* oblong or oblong-elliptic, (1–)1½–2½ mm long, obtuse or rounded, entire, usually pink-punctate. Disk fleshy, flat, obscurely lobed, the lobes transverse-oblong. *Stamens* 1½–2½ mm, attached slightly under the margin of the disk; filaments filiform; anthers ovoid, obtuse; sterile pistil conoid, c. ½ mm long.—♀: *calyx* lobes, *petals*, and disk as in the males.

Sterile *stamens* c. $\frac{2}{3}$ mm long. Pistil flask-shaped, c. $1\frac{1}{4}$ mm long. Ovary globose; style slender, distinct; stigma discoid or slightly 3-lobed. *Fruits* angular-ovoid, obovoid, or sometimes subglobose; valves ovate or obovate, or broadly elliptic, 12–17 by 7–11 mm, once noted to be rich-yellow. *Seeds* broad-ovoid, 7–12 by 5–10 mm, blackish brown, smooth; aril bright red.

Distr. *Malaysia*: Sumatra (N. half), Malay Peninsula (also Penang), Borneo (N. half), Philippines (Mindanao), Moluccas (Ceram, Ambon), and New Guinea.

Ecol. Forests, from the hills up to 3000 m. Vern. *Mangauat*, Bag., *djirak*, Sum. W.C.

5. *Celastrus stylosus* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 401; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 618, *pro parte*; PRAIN, J. As. Soc. Beng. 73, ii (1904) 196; AMSHOFF, Blumea 5 (1945) 517.—Fig. 1h–l.

ssp. stylosus.—DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 272, f. 12, map 3, 22A.—*Gymnosporia neglecta* WALL. ex LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 619; PRAIN, J. As. Soc. Beng. 73, ii (1904) 198; Nov. Ind. (1905) 419.

Shrub 3–4 m tall. Innovations puberulous or pubescent. *Leaves* glabrous, or pubescent on the nerves and veins beneath, glabrescent, elliptic or obovate-oblong, rarely subrotundate, 5–8 by 3–5 cm; base acute, or obtuse; apex acute; nerves 5–7 pairs, obliquely spreading and slightly curving upward, as the veins raised beneath, not so above; veins loosely reticulate; petiole 1–2 cm, pubescent, glabrescent. Peduncle 5–11 mm, puberulous. Pedicels 2–5 mm, puberulous, articulated usually at the middle. *Inflorescences* axillary, as well as cauline at the basal part of the new shoot, rarely also terminal, cymose, short.—♂: *calyx* lobes ovate, or oblong, $1\frac{1}{2}$ mm long, obtuse, slightly erose to entire. *Petals* obovate, obtuse, slightly erose, 2–4 by 1– $1\frac{1}{2}$ mm, usually papillose on both surfaces, white. Disk membranous, cup-shaped; lobes distinctly arcuate or depressed-quadrate. *Stamens* inserted between the disk lobes, $2\frac{1}{2}$ mm long; filaments filiform, fleshy, usually densely rarely sparsely papillose; anthers ovoid, obtuse. Sterile pistil c. $1\frac{1}{2}$ mm.—♀: *calyx* lobes, *petals* and disk same as in the male. Sterile *stamens* c. 1 mm. Pistil flask-shaped, c. 3 mm; *ovary* subglobose; style distinctly columnar; stigmas 3-lobed, each lobe bifid, flat, reflexed. *Fruits* subglobose, 7–12 by 5–10 mm, 3- to 6-seeded, valves broadly elliptic. *Seeds* more or less plano-convex to slightly lunar, attenuate at both ends, reddish to blackish-brown, 4–6 by 1–2 mm, with distinct areoles.

Distr. India (Assam, Bengal, and Sikkim) and *Malaysia*: W. Java (Preanger) and Lesser Sunda Is. (Lombok and Timor).

Ecol. In thickets, or forests, 1000–2750 m.

Note. The specimens of *Malaysia* match very well those of India.

A slightly different *ssp. glaber* DING HOU with usually glabrous filaments and elliptic-oblong

leaves occurs commonly in S. China and N. Indo-China.

Excluded or doubtful

Celastrus lucida WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 400, *non C. lucidus* L. Mantissa 1 (1767) 49.—*C. wallichii* G. DON, Gen. Syst. 2 (1832) 8, *nom. nov.*—*C. jackianus* STEUD. Nomencl. (1841) 314, *nom. nov.*, *illegit.*

Based on a collection by JACK, in Penang.

According to Mr AIRY SHAW (*in litt.*) there is an empty sheet in the Wallich Herbarium which evidently never bore a specimen. The description is very brief; I agree with AIRY SHAW that if the plant is Celastraceae, there is every likelihood of the plant being *C. monospermoides* which is the only *Celastrus* species occurring in Penang.

Celastrus micrantha ROXB. [Hort. Beng. (1814) 86, *nomen*] Fl. Ind. ed. Wall. 2 (1824) 393; *ibid.* ed. Carey 2 (1832) 625.

Based on a specimen from the Moluccas.

According to the isotype in the Martius Herbarium at Brussels, kindly sent on loan by Prof. ROBINSON, it is an *Aglaia*. Although the isotype bears no flowers, distinctly conspecific fertile material is collected in the Moluccas and New Guinea; it appears to be distributed from the Moluccas to Queensland. It is reduced here to *Aglaia sapindina* (F. v. M.) HARMS in E. & P. Pfl. Fam. 3, 4 (1896) 298.—*Celastrus micrantha* ROXB. *l.c. non A. micrantha* MERR. 1905.—*Aglaiaopis glaucescens* MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 58, *non A. glaucescens* KING, 1895.—*A. miquelii* MERR. Philip. J. Sc. 11 (1916) Bot. 280 (*Meliaceae*).—Ed.

Celastrus pauciflora WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 400.

Based on a specimen from JACK, in Penang. WALLICH noted that he had not seen a specimen, but had received the description from JACK.

By the 1-celled ovary and hairy pistil impossible to refer to any known Malaysian *Celastraceae*. Mr. AIRY SHAW (*in litt.*) found the description clearly indicating a *Rinorea*, and very probably *R. lanceolata* (ROXB. 1832) O.K., which is common in Penang. As the epithet *pauciflora* is already occupied no name change is necessary (*Violaceae*).

Celastrus repandus BL. Bijdr. (1827) 1145 is according to HALLIER *f. Med. Rijksherb.* 1 (1910) 8 = *Maesa membranifolia* MEZ, but according to MEZ's and BACKER's identifications of the type in the Rijksherb. = *Maesa ramentacea* (ROXB. 1824) A. DC. (*Myrsinaceae*).

Celastrus trigyna ROXB. Fl. Ind. ed. Wall. 2 (1824) 391; *ibid.* ed. Carey 1 (1832) 624, *non* LAMK. Provenance: Moluccas.

WALLICH noted already the homonymy and wrote in a footnote that this species should be renamed; he made a cross-reference to *C. obtusifolia* ROTH on page 394 of Fl. Ind.; it is not clear why, because the latter is from Mauritius.

BAKER, in Hook. f. Fl. Br. Ind. 1, p. 618, erroneously equalized ROXBURGH's and LA-

MARCK's *C. trigyna*, treated by BAKER (Fl. Maur. Seych.) as *Gymnosporia trigyna*.

According to the very inadequate description

ROXBURGH's plant could be Celastraceae. Mr AIRY SHAW wonders whether it could not be a *Dichapetalum* (*Dichapetalaceae*).

2. MAYTENUS

MOLINA, Saggio Chile (1782) 177, *em.* BOSC, Nouv. Dict. Hist. Nat. 14 (1803) 211; *cf.* BLAKELOCK, Taxon 3 (1954) 196; *ibid.* 9 (1960) 15; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 134; LOURTEIG & O'DONELL, De Natura 1 (1955) 184.—*Celastrus* § *Gymnosporia* W. & A. Prod. 1 (1834) 159.—*Gymnosporia* HOOK. *f.* in Benth. & Hook. *f.* Gen. Pl. (1862) 356; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 147.—Fig. 2.

Shrubs or small trees; rarely scandent? Branchlets glabrous; young parts sometimes pubescent. *Stipules* small, lanceolate, sparsely lacinate, caducous, or exstipulate (in some extra-Mal. *spp.*). Spines terminating a short-shoot, and/or in a leaf axil, or none. *Leaves* spiral, alternate, rarely opposite (extra-Mal.), or in fascicles especially on short-shoots, variable both in shape and texture even in one species. *Cymes* axillary, one to several in a leaf axil, sometimes crowded at the uppermost part of a short-shoot, or flowers sometimes in axillary fascicles. Pedicels articulated. *Flowers* bisexual, sometimes unisexual. *Calyx* 5(–4)-lobed. *Petals* 5(–4), patent sometimes reflexed after anthesis. Disk fleshy, flat or rarely cupular, rounded, or slightly angular. *Stamens* inserted on the margin of the disk or slightly just beneath its outer margin, in ♀ fl. abortive; anthers ± introrse. *Ovary* partly or rarely entirely immersed in the disk, the emerging part subglobose or slightly 3-angular; completely or incompletely 3- (or 2-)celled, each cell with 2 ovules; stigmas 3 (or 2), slender, lobed or obscure. *Ovules* attached on the inner side of the septum near the base. *Capsule* subglobose, sometimes slightly 3(–2)-angular, loculicidal, 2–6-seeded. *Seeds* ellipsoid, at least at the base enveloped by the aril, after dehiscence remaining and exposed in the spreading valves, or erect and sticking together (in extra-Mal. *spp.*).

Distr. The genus is distributed in the tropics and subtropics of both the Old and New Worlds. It is very difficult to estimate the total number of species; 5 occur in *Malaysia*.

Ecol. Lowland rain-forest, dry thickets at low altitudes, and on the beaches or at the inner mangrove. As far as noted on labels the impression is gained that the seed is red and the aril white.

Taxon. In my revision of the genus *Celastrus* (Ann. Mo. Bot. Gard. 42, 1955, 216, p. 31) I have compared the characters of the genera *Celastrus*, *Gymnosporia*, and *Maytenus* in tabular form. Keeping to these provisional definitions there are, in America, especially Latin America, few species of *Celastrus* and many of *Maytenus*. Three of the latter have spiny branchlets similar to those in *Gymnosporia*; for that reason they have been transferred to *Gymnosporia*, and later to the genus *Moya* (*cf.* LOESENER in E. & P. Pfl. Fam. ed. 2, 20b, 1942, 109, 146–147). The genus *Moya* has recently been reduced to *Maytenus* by LOURTEIG & O'DONELL (De Natura 1, 1955, 188).

In Asia the generic name *Maytenus* has never been used; there are two distinct groups of species, referred to *Celastrus* and *Gymnosporia*.

In Africa the situation is again different: the species formerly described under *Celastrus* have been transferred to either *Gymnosporia* or *Maytenus*, or first to *Gymnosporia* and then to *Maytenus*. EXELL has pointed out (Bol. Soc. Brot. II, 26, 1952, 222 and Kew Bull. 1953, 103) that the separation of *Gymnosporia* and *Maytenus* as defined by LOESENER (*l.c.* 109) appears artificial and there seems little point in keeping the two genera distinct. His view is generally accepted and followed by botanists in treating that group of plants in the African floras or revisions, *e.g.* EXELL & MENDONÇA (Consp. Fl. Angol. 2, 1954, 1–10), HUTCHINSON & DALZIEL (Fl. W. Trop. Afr. ed. 2, 1 (2), 1958, 623–624), C. WILCZEK (Fl. Cong. Belg. 9, 1960, 114–125), and W. MARAIS (Bothalia 7, 1960, 381–386). It seems also agreed that there is no *Celastrus* in the Africa proper.

The differences between *Gymnosporia* and *Maytenus* listed in the table of my revision of *Celastrus* as mentioned above can not be maintained, specially not in the African flora as expressed by MARAIS (*l.c.*).

After a discussion with Mr EXELL, Mr BLAKELOCK, and Mr MARAIS I agree with the latter (*l.c.*) that



Fig. 2. *Maytenus curtisii* (KING) DING HOU. *a.* Habit, with fruits, $\times \frac{2}{3}$, *b.* flower in section, $\times 8$, *c.* one fruit valve with 2 seeds, nat. size, *d.* seed, with raphe and aril, $\times 2$.—*M. emarginata* (WILLD.) DING HOU. *e.* Seed, with raphe and aril, $\times 2$.—*M. cupularis* DING HOU. *f.* Flower in section, $\times 8$, *g.* sections of ovary, $\times 12$ (*a* SF. 15137, *b.* SF. 7529, *c-d* SF. 21368, *e* C.H.B. xv. J-B-iii-7a, *f-g* BRASS 22124).

'there seems no character or combination of characters constant enough to justify the retention of *Gymnosporia*'.

Pending the decision by a competent world monographer of the whole assemblage I retain *Celastrus* and *Maytenus* which can be distinguished by a combination of three characters: habit, degree of adnation of ovary and disk, and fruit structure.

So far known *Celastrus* spp. are scandent, *Maytenus* spp. are erect shrubs or trees. In a few sheets the data of field labels were probably erroneous.

The ovary in *Celastrus* is free from the disk and only confluent with it at the base; in *Maytenus* it is partly or, rarely, entirely immersed in the disk. There are two exceptions in the latter genus, however, e.g. *M. senegalensis* (LAMK) EXELL (cf. HUTCH. & DALZ. Fl. W. Trop. Afr. ed. 2, 1 (2), 1958, 623-624, f. 117 B & C) and *M. cupularis* DING HOU.

After dehiscence of the fruit in *Celastrus* the central axis splits close to the insertion of the seeds and after the seeds and valves have dropped the thickened placenta can still be observed on the pedicel. In *Maytenus*, however, the central axis splits to the very base and after the seeds and valves have fallen almost nothing can be discerned on the top of the pedicel.

Whether this combination of differences will hold for the numerous species described in *Maytenus* and *Gymnosporia* is not yet established.

The Australian genus *Denhamia* MEISN. 1837 is also probably not distinct from *Maytenus*, the differential characters being normally a 1-celled ovary with 3 parietal placentas with 6-8 ovules per placenta in *Denhamia*, against a completely or incompletely 2-3-celled ovary with 2 ovules at or near the base of each cell in *Maytenus*. Of the four species of *Denhamia*, however, two (*D. parvifolia* L. S. SMITH and *D. pittosporoides* F. v. M.) possess normally 2 ovules per placenta or cell, with occasionally a third or fourth ovule. Besides, in *D. pittosporoides* F. v. M. the capsule is 3-celled before dehiscence, the dissepiments touching axially, and the seeds are attached at or near their base. From this it appears that the distinction between *Maytenus* and *Denhamia* is very meagre indeed, essentially remaining limited to the occurrence of 3-4 seeds per placenta which in two *Denhamias* is only occasional. L. S. SMITH, in his revision (Proc. R. Soc. Queensl. 67, 1956, 30-31), pointed to the anomalous characters in *D. pittosporoides*, but he restricted his observations in *Maytenus* to the few Australian representatives. Really, *D. pittosporoides* and *D. parvifolia* form a transition between *Maytenus* and *Denhamia*, in that order.

In North Queensland there is another genus, *Hexaspora* C. T. WHITE (Contr. Arn. Arb. 4, 1933, 58, t. 6). In habit, especially the 2-ranked leaves with zigzag twigs, it reminds of *Perrottetia*, but it has a distinct differentiation of petals and sepals, apically dehiscent depressed-oblong anthers, and a 3-celled ovary with 2-4 ovules per cell. Besides, it has a well-developed indument consisting of multicellular uniseriate hairs. C. T. WHITE recorded the ovules to be pendulous, but I found them attached clearly horizontally or slightly obliquely at the inner angle at the base or sometimes slightly above it. The fruit of *Hexaspora* is unfortunately unknown.

The delimitation and naming of the species of *Maytenus* given here is rather tentative. A thorough treatment can only result from a large study including the African and continental Asian material; the impression is that there are in Asia few but variable species.

Note. The type species of the genus is *M. boaria* MOLINA, hence in accordance with the 1956 Code Rec. 75A the generic name *Maytenus* should be treated as feminine.

KEY TO THE SPECIES

1. Ovary or fruits 3-celled, occasionally some 2-celled. Disk flat. Fruits subglobose, obovoid, or ellipsoid, 10-15 mm long, not compressed.
2. Fruits subglobose or slightly depressed-globose. Pericarp thin (c. $\frac{1}{4}$ mm).
3. Fruits c. 15 mm long. Seeds (excluding the aril) c. 7 mm long; aril flat or shallow disk-like, laterally attached at the base of the seed. Leaves usually elliptic, sometimes broad-elliptic; apex usually acute to short-acuminate 1. *M. curtisii*
3. Fruits 9-12 mm long. Seeds (excluding the aril) $2\frac{1}{2}$ - $3\frac{1}{4}$ mm long; aril fleshy, attached at the base of the seed. Leaves usually obovate; apex obtuse or rounded 2. *M. emarginata*
2. Fruits obovoid or ellipsoid. Pericarp rather thick (c. $1\frac{1}{2}$ mm). Leaves usually elliptic or elliptic-oblong 3. *M. crassa*
1. Ovary or fruits 2-celled, occasionally some flowers with 3-celled ovary. Disk cupular. Fruits broad-obcordate, smaller, 5-6 mm long, \pm compressed (not known in *M. cupularis*).
4. Plant with axillary and/or terminal spines. Leaves obovate-oblong, oblanceolate, or broad-obovate, $1\frac{1}{2}$ - $4\frac{1}{2}$ by $\frac{1}{2}$ -2 cm; apex obtuse, sometimes slightly emarginate 4. *M. diversifolia*
4. Plant unarmed. Leaves elliptic, $7\frac{1}{2}$ -11 by 4-5 cm; apex acuminate 5. *M. cupularis*

1. *Maytenus curtisii* (KING) DING HOU, *comb. nov.*—*Gymnosporia curtisii* KING, J. As. Soc. Beng. 65, ii (1896) 353; PRAIN, J. As. Soc. Beng. 73, ii (1904) 198; RIDL, Fl. Mal. Pen. 1 (1922) 451; CRAIB, Fl. Siam. En. 1 (1926) 284.—Fig.

2a-d.

An erect (or scandent?) shrub, or small tree. Short-shoots very rarely terminating into a spine. Leaves chartaceous to subcoriaceous, elliptic, sometimes broadly elliptic, suborbicular, rarely

obovate or ovate, 7-16 by 4-9 cm; base cuneate, narrowed to the petiole; apex acute or short-acuminate, rarely obtuse; margin shallow-crenate; nerves 7-9(-15), obliquely spreading towards the margin and then curved upwards; veins elevated and reticulated beneath, visible above; petiole c. 10 mm. *Cymes* usually crowded towards the apex of the short-shoots, axillary, sometimes puberulous when young, c. 1½ cm. Peduncle 5-10 mm. Bracts lanceolate, short-fimbriate. Pedicels 2-5 mm. *Calyx* lobes deltoid or semi-orbicular, ½-¾ mm ø, the margins sparsely short-ciliate. *Petals* ovate, ovate- or obovate-oblong, 2½-3 by 1½ mm, obtuse, ± entire. *Stamens* inserted just beneath the outer margin of the disk, usually c. 2¼ mm, in the ♀ or functionally ♀ sometimes very short (c. 2/3 mm) or abortive; anthers broad-ovoid, c. ½ mm long, slightly apiculate. Disk fleshy, rounded, 1½-2 mm ø. *Ovary* semi-inferior, narrowed towards the apex into a short style; stigma obscure sometimes 3-lobed. *Fruits* depressed-globose, ± flat or slightly concave at the tip, 3-furrowed, c. 1½ by 1¼ cm, 3-celled, each cell 1- or 2-seeded. *Seeds* ellipsoid, slightly, irregularly rugose, 7½-8 by 4-5 mm; aril ± flat or shallow disk-like and attached laterally at the base.

Distr. Siam (Surat, Lower Siam, and Bangtaphan) and *Malaysia*: Malay Peninsula (Langkawi Is., once in Perlis).

Ecol. On limestone at sea-level, or in lowland forests.

Vern. *Simah bater*, M.

Note. KING described the type as 'scandent' but no habit is recorded on the label. Two other specimens from Langkawi Is. collected by HANIFF & NUR (SF 7085, 7529) are marked to be scandent, but all others are defined as shrubs. The first-mentioned may have been 'sprawling' shrubs.

2. *Maytenus emarginata* (WILLD.) DING HOU, *comb. nov.*—*Celastrus emarginatus* WILLD. Sp. Pl. 1, 2 (1798) 1128, *ex descr.*, non R. & P. 1802; R. & S. Syst. Veg. 5 (1819) 424; ROTH, Nov. Pl. Sp. (1821) 155; ROXB. Fl. Ind. ed. Wall. 2 (1824) 387; ed. Carey 1 (1832) 620.—*Celastrus montanus* ROTH in R. & S. Syst. Veg. 5 (1819) 427; Nov. Pl. Sp. (1821) 154; ROXB. Fl. Ind. ed. Wall. 2 (1824) 387 (*montana*); ed. Carey 1 (1832) 620; W. & A. Prod. (1834) 159.—*Catha montana* G. DON, Gen. Syst. 2 (1832) 9; HASSK. Tijds. Nat. Gesch. Phys. 10 (1843) 140; MIQ. Fl. Ind. Bat. 1, 2 (1859) 589.—*Cupania spinosa* BLANCO, Fl. Filip. (1837) 184; ed. 2 (1845) 204; ed. 3, 2 (1878) 17.—*Celastrus semiarillata* TURCZ. Bull. Soc. Nat. Mosc. 36, 1 (1863) 599.—*Elaeodendron horizontale* TURCZ. l.c. 603, *ex descr.*—*Gymnosporia montana* BENTH. Fl. Austr. 1 (1863) 400, *pro comb.*, *pro specim.?*; VIDAL, Sinopsis Atl. (1883) 20, t. 31, f. A; Rev. Pl. Vasc. Filip. (1886) 88; MERR. Bull. Bur. For. Philip. 1 (1903) 34; BACKER, Voorl. Fl. Java (1908) 55, *pro var. littoralis* BACKER; Schooffl. (1911) 235; KOORD. Exk. Fl. Java 2 (1912) 524.—*Gymnosporia emarginata* THW. En. Pl. Zeyl. (1864) 409; TRIM. Fl. Ceyl. 1 (1893)

273; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 150.—*Gymnosporia ambigua* VIDAL, Sinopsis Atl. (1883) 20, t. 31, f. B.—*Gymnosporia spinosa* (BLANCO) MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 109, *incl. var. parva* MERR. & ROLFE, non (FORSK.) C. CHRISTENS. 1922; MERR. Fl. Manila (1912) 302; Sp. Bl. (1918) 235; En. Philip. 2 (1923) 483; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 151.—*Gymnosporia inermis* MERR. & PERRY, J. Arn. Arb. 20 (1939) 335.—Fig. 2e.

Shrub 2-4 m. Innovations sometimes puberulous. Spines terminating short-shoots, and/or axillary, or unarmed. *Leaves* chartaceous to coriaceous, usually obovate to subspathulate, sometimes elliptic to elliptic-oblong, very rarely subrotundate, (2½-3½-14½ by (1¼-2-9 cm; base attenuate; apex obtuse or rounded, sometimes emarginate; margin distinctly shallowly crenate to entire; nerves (4-5-7 pairs; petiole 2-15 mm. *Cymes* axillary, simple or fascicled at the leaf axil, sometimes crowded at the apex of the brachyblast, very short, rarely up to 3½ cm. Peduncle very short sometimes up to 2 cm. Bracts deltoid, short-fimbriate. Pedicels 3½-10 mm. *Flowers* white. *Calyx* lobes deltoid, acute rarely obtuse, slightly erose or sparsely short-laciniate, c. ½ mm long. *Petals* obovate-oblong or oblong, sometimes ovate-oblong, 2-3½ by 1-1½ mm, obtuse, entire. Disk fleshy, rounded. *Stamens* inserted slightly beneath the outer disk margin, 2-3 mm, sometimes small or even abortive; anthers broadly ovoid, ½-2/3 mm long, in functionally ♀ fl. smaller or abortive, obtuse or slightly apiculate. Pistil 1-1½ mm above the disk; *ovary* semi-immersed, 3-celled, narrowed into a distinct or very short cylindrical style; stigmas 3, distinct, slender, reflexed, lobed, or obscure. *Fruits* broadly obovoid or subglobose, 10-12 by 8-9 mm. *Seeds* ellipsoid, red, 3-3½ by 2-2¾ mm, aril fleshy, white, attached at the base, 2-2½ mm long.

Distr. Ceylon and SE. Asia to N. Queensland (Cape York); in *Malaysia*: Malay Peninsula (Johore), Java (throughout), Philippines (Luzon, Lubang I., and Mindanao), Celebes (SE. Peninsula: Kendari; Bonerate I., and Lembeh Strait), Moluccas (Sulu Sanana, Taliabu, Kai Is., and Tenimber Is.), and New Guinea (Western Div., Hisiu, Daru I., Pt Moresby, and Merauke).

Ecol. In dry thickets at low altitudes, behind the beach or at the inner mangrove.

Notes. In his key to the species of *Gymnosporia*, LOESENER (1942, p. 147) divided the species into two groups, one with a normally 3-celled ovary and fruit and one with a 2-celled ovary and fruit. In the latter group he recorded the African *G. senegalensis* (LAMK) LOES. (= *Maytenus senegalensis* (LAMK) EXELL) as distributed from tropical Africa through India and Malaysia to Australia. He may have confused this African species with the Asian-Malaysian *G. diversifolia* MAXIM. (= *Maytenus diversifolia* (MAXIM.) DING HOU) which has also 2-celled ovaries, but which differs by few-flowered cymes, smaller leaves, flowers, and fruit, and a short aril situated at the base of the seed. This error may have been

induced by BENTHAM's remark (Fl. Austr. 1, 1863, 400) that *Celastrus montanus* ROXB. 'is apparently the same as the tropical African *Celastrus senegalensis* Lam.' However, the latter species has always 2-celled ovaries. As a matter of fact the present species occurs in Australia; I have seen a specimen from Cape York Peninsula which exactly matches Malaysian material.

Technically *Celastrus montanus* ROTH and *Celastrus montanus* ROXB. are different names, the latter being a later homonym; however, WALLICH already correlated ROXBURGH's name in the original publication with that of ROTH; later authors (W. & A., BENTH., etc.) have not always realized that ROTH's publication preceded that of ROXBURGH.

ROXBURGH distinguished *C. montanus* from *C. emarginatus* by minor characters, viz larger, not emarginate leaves which were not fascicled and had a slightly serrate margin, its flowers in more lush, dichotomous panicles, flowers white (instead of yellow), three styles (instead of a style halfway split into three branches), and a not inflated capsule. The species is, however, very variable in vegetative characters and the other characters vary in degree, and I cannot attach much value to them. The variability seems, at least in part, due to variable environmental conditions.

In the present wide circumscription of this common plant more names in use for Asiatic specimens may fall into its synonymy, but this requires an extensive study and falls outside the scope of the present revision.

The species is distinctly variable but cannot be subdivided. Specimens from the beach in Java and Johore have usually both prominent short-shoots terminating into a stout spine and axillary spines, while those from other areas are bearing either only distinct sometimes small axillary spines, or are unarmed. Most specimens from the Philippines, and some from Celebes and the Moluccas have flowers with long stamens, a normal ovary with a short, 3-lobed but not spreading style, and obscure stigmas, while those from New Guinea, Java, and a few from Celebes and Philippines, have flowers which have small or even abortive stamens, a normal ovary with a distinct style, and 3 slender, reflexed stigmas. ELMER 12573 collected in Luzon has both forms of flowers mentioned above, i.e. the flowers on the duplicates at Bogor and Leyden are the same as those commonly on the specimens from the Philippines, while those on the duplicates at Geneva and Florence are similar to those on the specimens from New Guinea or Java; the duplicates are very homogeneous, but I do not know whether they stem from the same plant.

As to the leaf margin, there is a tendency to become entire, which is distinctly so in the type of *Maytenus emarginata*.

The closely allied Polynesian *Maytenus vi-tiensis* (A. GRAY) DING HOU, *comb. nov.* (*Catha vitiensis* A. GRAY, Bot. Wilkes Exp. Phan. (1854) 287, t. 23) differs by ciliate calyx lobes.

According to the detailed original description,

M. rapakir LOES. (Notizbl. Berl.-Dahl. 13, 1936, 217) from the Bismarcks would be distinct by the broadly ovate-oblong to ovate leaves and elliptic petals.

For the reduction of *Cupania spinosa* BLANCO and *Gymnosporia ambigua* VIDAL I have followed MERRILL.

3. *Maytenus crassa* DING HOU, *nom. nov.*—*Gymnosporia nitida* MERR. Philip. J. Sc. 9 (1914) Bot. 311; En. Philip. 2 (1923) 483, *non Maytenus nitida* MART. 1841.

Shrub or small tree, glabrous, unarmed or with a small, short axillary spine. *Leaves* coriaceous, strongly shining above, rather dull beneath, ovate-oblong to obovate-oblong, 4–7 by 2–4 cm; base acute or cuneate; apex obtuse or rounded; margin crenulate; nerves c. 8 pairs, slender, obliquely ascending towards near the margin and anastomosing; veins and veinlets reticulate; petiole 5–10 mm. *Flowers* unknown. *Infructescences* up to 3 cm long (*ex descr.*). *Capsule* obovoid or ellipsoid, c. 15 mm by 8–10 mm; rounded at apex; pericarp thick (c. 1½ mm).

Distr. *Malaysia*: Philippines (Luzon: Prov. Pangasinan), once found.

Ecol. Forests at low and medium altitude.

Note. The isotype in US consists of a sterile branch with some detached, dehisced, empty fruits. The fruits are obovoid or ellipsoid and the pericarp is much thicker than in any of the other species I know. The species was described as unarmed, but there is a very small spine in the leaf axil.

4. *Maytenus diversifolia* (MAXIM.) DING HOU, *comb. nov.*—*Gymnosporia diversifolia* MAXIM. Bull. Ac. Imp. Sc. St. Pétersb. 27 (1882) 459; MERR. En. Philip. 2 (1923) 483; Lingn. Sc. J. 5 (1927) 116; KANEHIRA, Formos. Trees, rev. ed. (1936) 393, f. 350; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 149; TARDIEU, Suppl. Fl. Gén. I.–C. (1948) 799; Not. Syst. 14 (1950) 44; DING HOU, Taiwania 1 (1950) 177; HARA, En. Sperm. Jap. 3 (1954) 93.—*Celastrus diversifolius* HEMSL. in Forb. & Hemsl. J. Linn. Soc. Bot. 23 (1886) 123; HAYATA, Ic. Formos. Pl. 1 (1911) 139.—*Gymnosporia montana* var. *parvifolia* PITARD, Fl. Gén. I.–C. 1 (1912) 884.

Erect, sometimes scandent (?) shrub. Spines terminating a short-shoot, and/or a small axillary spine. *Leaves* obovate-oblong, oblanceolate, or broad-obovate, 1½–4½ by ½–2 cm; base attenuate narrowed into the petiole; apex obtuse, sometimes slightly emarginate; margin sparsely denticulate or crenulate, sometimes subentire; nerves 3–4; petiole very short or obscure. *Cymes* fasciculate or solitary, sometimes 1-flowered, axillary or crowded at the upper part of a short-shoot. Peduncle 2–6 mm. Bracts elliptic, short-fimbriate, c. ½ mm long. Pedicels 1–4 mm. *Calyx* lobes deltoid or suborbicular, ½–⅔ mm ø, short-fimbriate. *Petals* oblong or elliptic, obtuse, 1–2 mm long. Disk cupular. *Stamens* c. 1¼ mm long, sometimes small or abortive. Pistil flask-like, c.

1 mm long. *Ovary* subglobose, narrowed into a distinct style, 2-celled; stigmas 2, each 2-lobed; sometimes the style very short and stigmas obscure. *Fruits* compressed-obcordate, 5-6 by 5-8 mm. *Seeds* ellipsoid, c. 3 by 1½ mm (excluding the aril), smooth and shining; aril at the base of the seed, 1-2 mm long.

Distr. Siam (Soematjaj), Indo-China (Tonkin and Annam), Ryu-Kyu, China (Fukien, Hainan, and Formosa), and *Malaysia*: Philippines (Luzon) and Lesser Sunda Is. (Bali).

Ecol. In dry thickets at low altitude.

Vern. *Kum*, Bali.

5. *Maytenus cupularis* DING HOU, *nov. sp.*

Arbor 12-15 m *alta*. *Folia chartacea, elliptica, 7½-11 cm longa, 4-5 cm lata, basi cuneata, apice acuminata, margine serrulata, nervis utrinque 7-10. Inflorescentiae racemiformes, vel paniculatae, axillares, 1⅓-2½ cm longae. Pedicellus c. 1½ mm longus. Flores albi. Calyx 5(-4)-lobatis, lobis late ovatis, c. 1 mm longis. Petala 5(-4), ovata, 2½ mm longa, 1½ mm lata, acuminata. Discus crassus, cupularis. Stamina 5(-4), ad disci marginem inserta. Ovarium basi discum late adnatum, imperfecte 2(-3)-loculare. Ovula in loculis 2, basalia.*
Typus BRASS 22124, K.—Fig. 2 f-g.

Tree 12-15 m. Branchlets terete, or slightly angular. *Leaves* chartaceous, pale brown above, greyish beneath, elliptic, 7½-11 by 4-5 cm; base cuneate; apex acuminate; margin crenulate; midrib elevated on both surfaces; nerves 7-10 pairs, slightly elevated on both surfaces, ± obliquely ascending and anastomosing towards the margins; veins and veinlets fine, loosely reticulate on both surfaces; petiole 8-10 mm. *Stipules* very small, filiform ¼-¾ mm. *Inflorescences* racemose or with a few short branches at the base, axillary, solitary or 3 together, 1⅓-2½ cm long,

few-flowered. Peduncles very short or none. Bracts triangular, c. ¾ mm. Pedicels c. 1½ mm. *Flowers* white. *Calyx* lobes 5(-4)-lobed, lobes broad-ovate, c. 1 mm long, slightly erose or denticulate. *Petals* 5(-4), ovate, 2½ by 1½ mm, acuminate. Disk rather fleshy, cupular. *Stamens* 5(-4), inserted ± on the margin of the disk; filaments filiform; anthers ovoid, c. 1⅓ mm long, introrse. Pistil flask-shaped, c. 1 mm above the disk, the base confluent with the thick, cupular disk. *Ovary* incompletely 2(-3)-celled; style short; stigma slightly 2-lobed. *Ovules* 2 in each cell, attached at the base, erect. *Fruits* unknown.

Distr. *Malaysia*: New Guinea (Milne Bay District: BRASS 22124, type, K), once collected. Ecol. Rain-forest, 30 m.

Note. The type number has been distributed as *Celastrus monospermoides* LOES.; I have examined the duplicate in the Kew Herbarium. It is an interesting species of which the inflorescence resembles that of certain *Denhamias*, but it is also allied to some of the Australian species of *Maytenus*. From *Denhamia* it differs by the incompletely, usually 2-celled ovary with 2 basally attached ovules in each cell. From *M. bilocularis* (F. v. M.) LOES. it can be separated by the sparsely crenulate leaf margin, the short pedicel (c. 1½ mm, not 3-5 mm), by the cupular (not flat) disk, and by the ovary of which the base is confluent with the disk but not immersed in it. Though a cupular disk is rare in *Maytenus*, its other floral characters agree with that genus.

Excluded

Catha fasciculata TUL. Ann. Sc. Nat. IV, 8 (1857) 98 has by Ind. Kew. erroneously been credited to hail from Malaya; it was described from Madagascar.

3. XYLONYMUS

KALKMAN, *nov. gen.*—Fig. 3.

Glabrous shrub. *Leaves* alternate (distichous). *Inflorescences* cymose, solitary, axillary, few-flowered. *Flowers* 4-merous. Disk flat, fleshy. *Stamens* 4, inserted on the disk towards the margin. *Ovary* 4-celled, partly immersed in the disk. *Ovules* c. 10 in each cell, arranged in 2 axial rows. *Fruit* a 4-angular loculicidally dehiscent capsule, leaving a columella in the lower half; valves 4, thick and woody, composed of strong radial bundles of fibres. *Seeds* distinctly arillate; albuminous; embryo rather large, axile, cotyledons foliaceous.

Distr. Monotypic, in *Malaysia*: New Guinea.

Ecol. Primary rain-forest, at low altitude.

Notes. The generic name is a contamination of 'euonymus' and 'xylos' referring to its close affinity with the genus *Euonymus* as well as indicating its characteristic woody fruit.

The floral characters of this new genus agree entirely with those of *Euonymus*, although the multi-ovulate ovary-cells are not common in that genus. However, the strictly distichous leaves and the characteristic woody fruit-valves have induced us to keep it as a genus separate from but closely allied to *Euonymus*.

In *Euonymus* some species are credited with alternate leaves; in *E. nana* M.B. (E. Europe to China) the leaves are very variable in phyllotaxis, on one specimen they may be strictly opposite, verticillate, or spiral probably in 4 rows but not strictly alternate. This is probably similar in *E. platyclinis* OHWI from

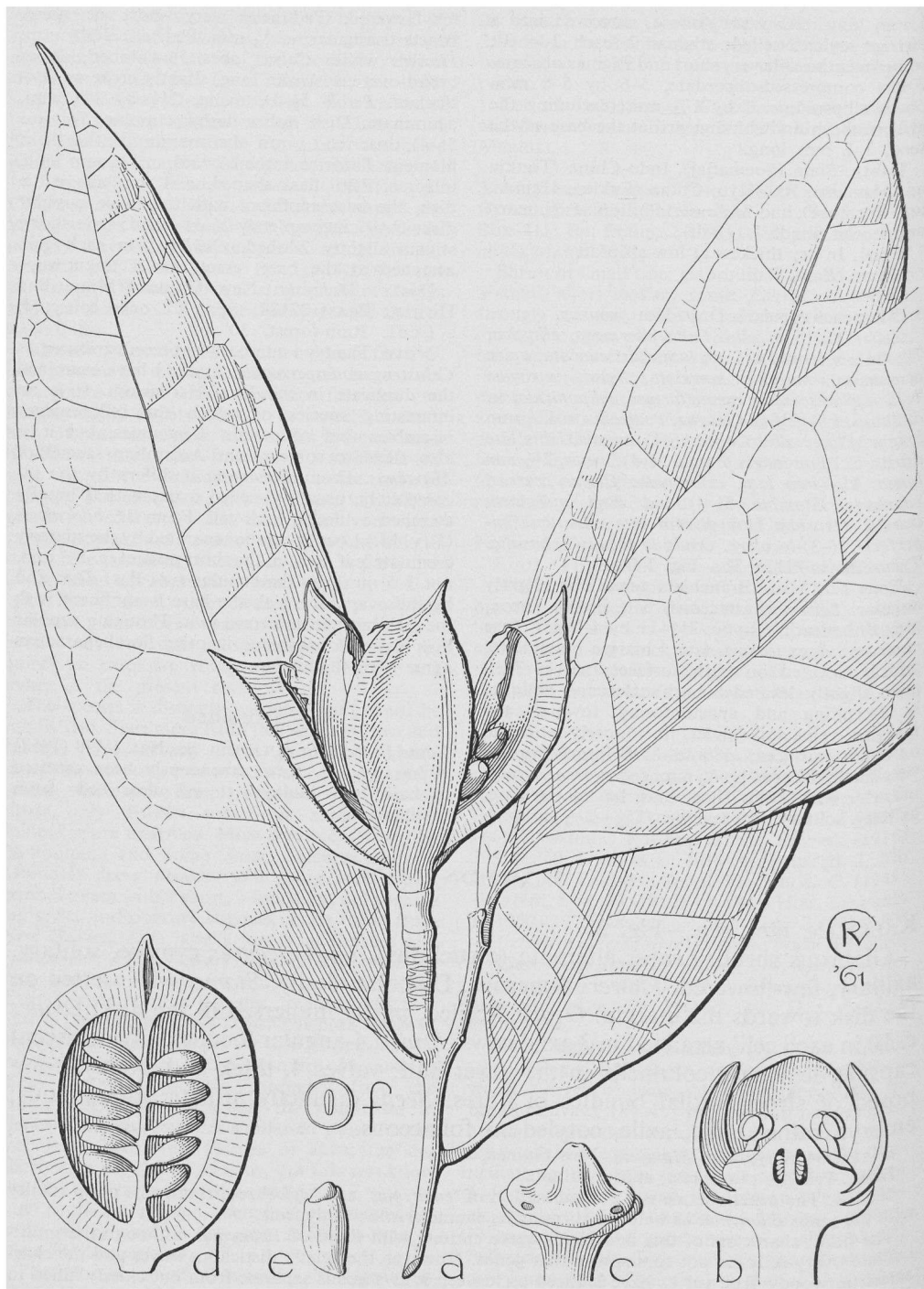


Fig. 3. *Xylonymus versteeghii* KALKMAN in DING HOU. a. Twig with fruit, $\times \frac{2}{3}$, b. bud in section, $\times 8$, c. pistil and disk, $\times 8$, d. fruit in section, $\times \frac{2}{3}$, e. seed enveloped by aril, f. ditto, in section, both nat. size (VERSTEEGH BW 4686).

Formosa, *E. yunnanensis* FRANCH., *E. decora* W. W. SM., and *E. linearifolia* FRANCH. from China (the latter closely allied to *E. lichiangensis* W. W. SM. with opposite leaves). Another Chinese species from Szechuan, *E. omeiensis* FANG, has tomentose leaves which are said to be alternate but would appear opposite from the photograph; this may be not *Euonymus*.

In *Xylonymus*, however, the phyllotaxis is strictly alternate, *i.e.* distichous.

In a European species of *Euonymus* there is also a columella left after dehiscence, *viz* in *E. latifolia* (L.) MILL.

1. *Xylonymus versteeghii* KALKMAN, *nov. sp.*—Fig. 3.

Frutex glaber; folia alterna; cymae axillares pauciflorae pedunculatae; flores hermaphroditii, tetrameri; ovarium disco semimmersum, ovulis in loculis circiter 10, biserialis. Capsula 4-loculicida, dehiscens, valvis crassis lignosis, columellata; semina albuminosa, arillata. Typus VERSTEEGH 4686, L, isotypes K, MAN.

Shrub up to 7 m tall. Branchlets angular, \pm laterally flattened under the nodes. *Stipules* present, caducous (only scars seen). *Leaves* chartaceous, greyish green above, pale brownish beneath, elliptic-lanceolate, 20–23 by 6–7½ cm; base cuneate; apex acuminate; margin entire; midrib elevated on both surfaces; nerves 10–14 pairs, elevated on both surfaces, divaricate, or slightly obliquely spreading towards near the margin, archingly connected, to c. 3–5 mm from the edge; veins loosely reticulate, slightly elevated on both surfaces. *Cymes* (very young) probably few-flowered; peduncle 10–12 mm. Rather young flower. *Sepals* triangular, pale green. *Petals* broad-ovate or subrotundate, 2½–3 by 2½ mm, yellow, in the dry state dark-brown or with dark-brown pigments especially at the upper ⅔. Disk fleshy, cushion-shaped, rounded-quadrangular, c. 2½ mm across, the angles alternate with the petals. *Stamens*

c. 1 mm long, inserted on the disk towards the margin at the angles; filaments filiform; anthers suborbicular, c. ⅔ mm long, cells spreading at the lower part but not free from the consequently triangular connective, latrorse. Pistil partly immersed, the free part above the disk resembling a \pm 4-pointed pyramidal star; style and stigma obscure. *Ovules* c. 10 in each cell, arranged in 2 rows, ascending, apotropous-anatropous. *Fruits* dark red when ripe, oblong, 6½ by 3 cm, tetragonal on cross-section, opening with 4 woody valves 7–9 mm thick, the septa rupturing in dehiscence, leaving a free central column; pedicel in fruit c. 1 cm. *Seeds* ellipsoid, 11 by 6 mm, enveloped by a fleshy aril except the uppermost part on one side; testa horny; endosperm copious.

Distr. Malaysia: New Guinea (W. extremity of the Vogelkop Peninsula, near Kalagilik between Sorong and Klamono).

Ecol. Primary rain-forest, flat country, clay soil, temporarily inundated, scarce, 10 m.

Note. The epithet of this new species is chosen in honour of the collector, Mr CHR. VERSTEEGH, at present assistant-botanist at Manokwari, who in the course of his years in New Guinea has collected so many new or otherwise interesting plants.

4. EUONYMUS

TOURNEF. *ex* LINNÉ, Gen. Pl. ed. 5 (1754) 91; Sp. Pl. (1753) 197; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 115; BLAKELOCK, Kew Bull. (1951) 232.—‘*Evonymus*’ Auct.—*Pragmotessara* PIERRE, Fl. For. Coch. (1894) sub t. 309.—*Pragmatropa* PIERRE, *l.c.*—*Sphaerodiscus* NAKAI, J. Jap. Bot. 17 (1941) 686.—*Quadripterygium* GARDIEU, Bull. Soc. Bot. Fr. 95 (1948) 179; Fl. Gén. I.—C. Suppl. (1948) 809.—**Fig. 4.**

Usually shrubs or small trees, rarely of moderate size (25 m), erect, rarely scandent, glabrous, evergreen or deciduous. *Leaves* opposite, usually decussate, very rarely spiral, alternate or verticillate (extra-Mal. *spp.*), sometimes with dark dots underneath. *Stipules* lanceolate, caducous. *Inflorescences* axillary, cymose, rarely flowers in fascicles (*E. javanicus*); pedicels articulated. *Flowers* bisexual, 5- or 4-merous. *Calyx* deeply lobed, imbricate, entire, erose, or minute-denticulate. *Petals* imbricate, spreading or reflexed, entire, erose, short-ciliate, or long-fimbriate, smooth or finely areolate (strong lens!) on the inner surface. Disk distinct, fleshy or thin, flat, 5- or 4-angular, or 5- or 4-lobed, or rounded, very rarely membranous cupular (in the African *E. congolensis* WILCZEK), smooth, or covered with fleshy papilla-like or subulate processes. *Stamens* inserted on the disk, at the margin or halfway; anthers deltoid, \pm depressed-oblong, or broad-ovoid, obtuse or short-apiculate, slightly free at the base, dehiscent on the top,

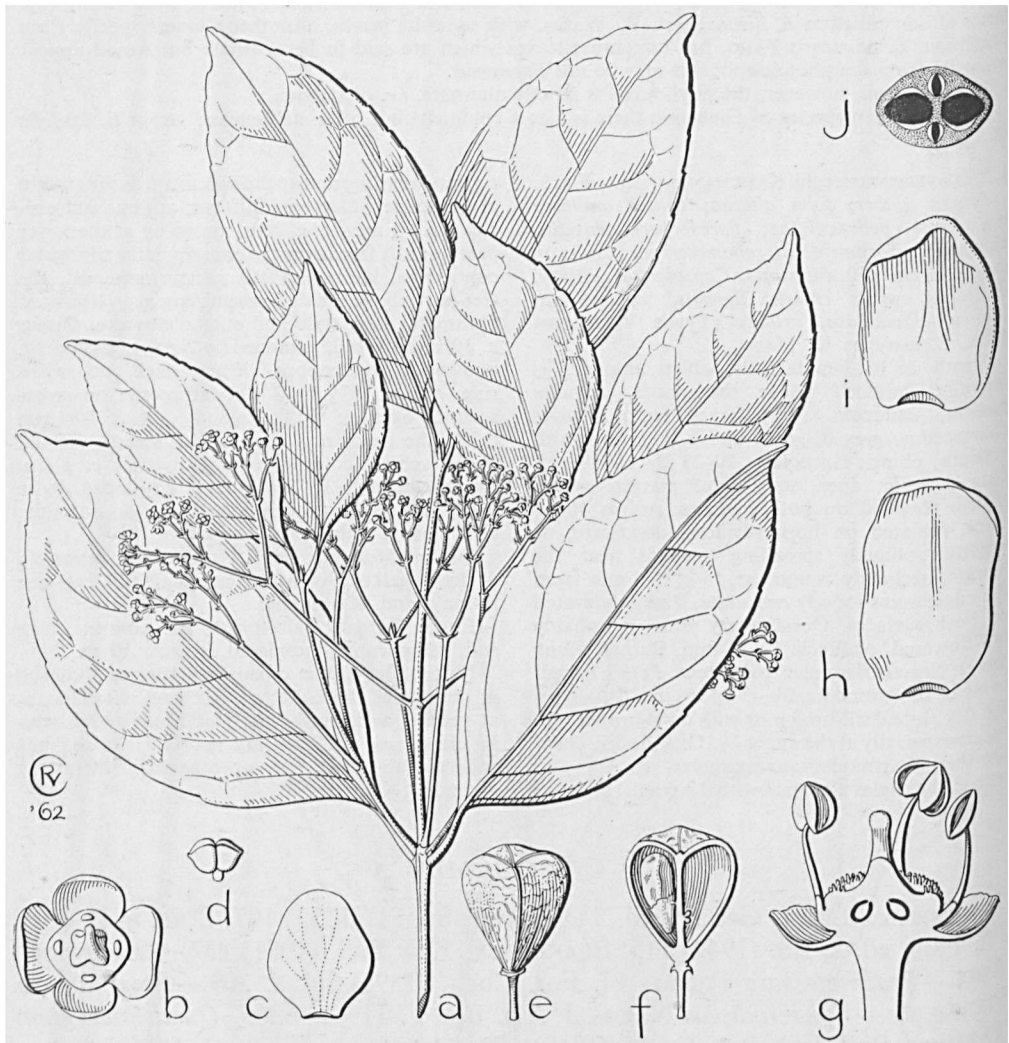


Fig. 4. *Euonymus castaneifolius* RIDL. a. Twig with flowers, $\times \frac{2}{3}$, b. flower, petals and stamens removed, $\times 6$, c. petal, $\times 6$, d. young stamen, $\times 12$, e. fruit, f. one valve, both nat. size. — *E. japonicus* THUNB. 5; Flower, in section, $\times 6$, h-i. petals, $\times 6$, j. fruit, in section, seeds removed, $\times 2$ (a-d KOSTERMANS 74 e-f ENDERT 3159, g-i VAN STEENIS 18264, j ditto 4954).

lateral, or introrse, either 2-celled or 1-celled (extra-Mal.); filaments obscure or distinct. Free part of the pistil terete, or slightly 4-5-angular towards the base, gradually narrowed to the apex; the basal part sometimes covered with papillose or subulate processes. Stigma obscure, obtuse, or discoid; ovary partly or \pm wholly immersed in the disk; if the disk is angular the angles are episepalous. Ovules mostly 2 in each cell (rarely 3-12 in each cell in a few extra-Mal. spp.), attached to the inner angle near the base, or pendulous. Fruit a loculicidal capsule, often coloured, when dehiscent the valves splitting and leaving no central axis (except in the extra-Mal. sp. *E. latifolia* (L.) MILL.), usually (3-)-4-5-angular or -lobed, sometimes globose, rarely fusiform, smooth or echinate; apex obtuse,

acute, \pm truncate, or concave. *Seeds* (usually black) with (mostly orange) aril at the base, or enveloped by it.

Distr. In the latest synopsis 176 specific names have been enumerated by BLAKELOCK (Kew Bull. 1951, 210-290). The genus is distributed chiefly in tropical and subtropical Asia (especially in the Himalaya, China, and Japan), 4 *spp.* in Europe, 1 *sp.* in Africa (Congo), 2 *spp.* in Madagascar, 1 *sp.* in NE. Queensland, and 9 *spp.* in North and Central America, but none in the Pacific; in *Malaysia* 12 *spp.*

Ecol. In Malaysia in primary and secondary forests from the lowland up to 3200 m.
Taxon. BLAKELOCK (*l.c.* 211-219, 232-238) followed BECK (Fl. Nied.-Oesterr. 2, Abt. 1, 1892, 588) in distinguishing two subgenera, *viz* *subg. Kalonymus* BECK characterized by 1-celled anthers dehiscing with one continuous slit, winter buds usually conic, very acute, large, and capsules obovate-globose, winged, and *subg. Euonymus* characterized by anthers with two cells each dehiscing with one slit, winter buds usually ovoid, acute, and small, and capsules of various shape but if obovate-globose then not winged. All Malaysian *spp.* belong to the *subg. Euonymus*.

This has been further subdivided into six sections comprising twelve series. I have not gone very deeply in scrutinizing the characters on which they are based (fruit-shape, evergreen or deciduous, *etc.*) but the differences between them are found 'difficult'.

I have reduced the monotypic Indo-Chinese genus *Quadriptygium poilanei* TARDIEU to *Euonymus*, after a study of the description, plate, and an isotype specimen. It was proposed because it was assumed that though fruits were not available they would be 'very probably winged and indehiscent'. However, the free part of the ovary is slightly 4-angled as occurs in several species of *Euonymus*. *Quadriptygium poilanei* TARDIEU is closely related to *E. tonkinensis* LOES. and may be conspecific with it.

Note. Sterile material of this genus cannot be identified.

KEY TO THE SPECIES

1. Flowers (and fruit) 5-merous.
 2. Petals usually long-fimbriate (short-fimbriate or denticulate in some specimens of *E. cochinchinensis* from Celebes). Bud-scales or bracts crowded at the base of inflorescence and with reddish-brown, long-fimbriate margins.
 3. Inflorescences distinctly dichotomously (up to 5 times) lax-branched. Peduncles always distinct, $1\frac{1}{4}$ -8 cm. Pedicels $\frac{1}{3}$ - $\frac{1}{2}$ cm. Fruits broadly-obovoid, rather small, *c.* 1 cm long, apex concave.
 1. *E. cochinchinensis*
 3. Flowers in almost sessile or short-peduncled, simple, axillary, 1-3-flowered cymes, sometimes crowded or fasciated on minute knoblike brachyblasts. Peduncles usually obscure or very short, very rarely up to 2 cm; pedicels ($\frac{1}{2}$ -)1-2 cm. Fruits larger, usually clavate, or broad-obovoid, rarely globose, $1\frac{1}{2}$ - $2\frac{3}{4}$ cm long, the upper end conical, obtuse, or truncate, sometimes concave.
 2. *E. javanicus*
 2. Petals entire, erose, or obscurely denticulate. Bud-scales or bracts at the base of inflorescence lax, usually entire, sometimes short-ciliate or fimbriate.
 4. Leaves chartaceous to subcoriaceous; apex short-acuminate, or acuminate. Stigma obtuse or rarely truncate.
 5. Petals (when boiled) transparent with distinct, longitudinal nerves. Disk rather thin, obscurely 5-angular or suborbicular. Filaments obscure or very short. Pistil 5-angular towards the base.
 6. Branchlets 4-angular. Nerves usually impressed above. Flowers 12-15 mm \varnothing at anthesis. Fruits (immature) obovoid, slightly lobed, \pm truncate at the top 3. *E. impressus*
 6. Branchlets terete. Nerves slightly elevated above. Flowers smaller, 6-7 $\frac{1}{2}$ mm \varnothing at anthesis. Fruits broad-obovoid, or slightly depressed-globose, deeply lobed, concave at the top.
 7. Flowers rose or dull-red. Leaf margins usually entire, sometimes obscurely, remotely serrulate. Pedicels (5-)8-14 mm. Fruit longer than wide, 18-25 by 13-17 mm 4. *E. wrayi*
 7. Flowers cream-coloured. Leaf margins serrulate usually towards the upper half. Pedicels 2-4 mm. Fruit wider than long, 8-12 by 12-17 mm 5. *E. glaber*
 5. Longitudinal nerves on petals invisible. Calyx lobes unequal, reflexed in anthesis. Disk orbicular, fleshy. Filaments distinctly as long as or longer than the anthers. Pistil terete, slightly enlarged towards the base, smooth. Fruits suboblongeolate or subfusiform 6. *E. recurvans*
 4. Leaves usually membranous, sometimes chartaceous especially those from high altitudes; margin dentate or crenate; apex usually long-acuminate. Stigma discoid, 5-angular.
 7. *E. acuminifolius*
1. Flowers (and fruit) 4-merous (very rarely and only occasionally a few flowers 5-merous).
 8. Fruits broad-obovoid or subglobose, 4-angular, 4-lobed, smooth, or echinate, the apex round, truncate, or concave.
 9. Disk rather thin, *c.* $1\frac{1}{4}$ mm \varnothing , smooth. Stamens inserted between the pistil and the edge of the disk, *c.* $\frac{1}{2}$ mm long; anthers depressed oblong or deltoid, dehiscent on the top. Ovules basally attached. Fruits broad-obovoid. Seeds with a short cup-shaped aril at the base.
 10. Leaves slightly bullate by the distinctly sulcate nerves and major veins; nerves distinct. Fruits 4-angular, slightly irregularly wrinkled outside, \pm truncate at the top. 8. *E. castaneifolius*

10. Leaves not bullate by the distinctly sulcate nerves and major veins; nerves obscure above. Fruits 4-lobed, smooth outside, concave at the top 9. *E. glandulosus*
9. Disk fleshy, 2-2½ mm ø, covered with sparse papillae, sometimes fleshy processes, or smooth. Stamens inserted on the margin or each in an obscure marginal notch of the disk, 2-3 mm long; anthers broad-ovoid, introrse. Ovules pendulous. Fruits ± globose. Seeds completely covered by the aril.
11. Pedicels 3-5 mm. Calyx lobes, at least the inner two, usually entire and the margin light yellowish brown (in the herbarium); the base of the free part of pistil usually glabrous. Fruits smooth. Erect or climbing with rootlets 10. *E. japonicus*
11. Pedicels 7-9 mm. Calyx lobes slightly denticulate and the margin always reddish brown (in the herbarium); the base of the free part of pistil covered with fleshy, subulate processes. Fruits echinate. Obviously decumbent or climbing shrub 11. *E. benguetensis*
8. Fruits clavate, slightly 4-ridged and short-apiculate, smooth. Inflorescence a simple cyme. Leaves elliptic to elliptic-oblong, usually ash-coloured on both surfaces 12. *E. moluccensis*

1. *Euonymus cochinchinensis* PIERRE, Fl. For. Coch. 4 (1894) t. 309A; PITARD, Fl. Gén. I.-C. 1 (1912) 873, f. 108, 6; MERR. Philip. J. Sc. 16 (1920) 450; En. Philip. 2 (1923) 480; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 119; TARDIEU, Suppl. Fl. Gén. I.-C. (1948) 781; BLAKELOCK, Kew Bull. (1951) 255.—*E. timorensis* (non ZIPP. ex SPAN.) TURCZ. Bull. Soc. (Imp.) Nat. Mosc. 31, i (1858) 447; F.-VILL. Nov. App. (1880) 46; VIDAL, Phan. Cuming. (1885) 103.—*Glyptopetalum scor-techinii* KING, J. As. Soc. Beng. 65, ii (1896) 345; RIDL. Fl. Mal. Pen. 1 (1922) 447.—*E. philippinensis* MERR. Philip. J. Sc. 3 (1908) Bot. 238.—*E. viburnifolius* (non *Aegiphila viburnifolia* JUSS.) MERR. *ibid.* 9 (1941) Bot. 312, *pro specim.*—*E. oliganthus* MERR. *ibid.* 10 (1915) Bot. 320; En. Philip. 2 (1923) 480.—*E. pahangensis* RIDL. Fl. Mal. Pen. 5 (1925) 299.—*Sphaerodiscus cochinchinensis* NAKAI J. Jap. Bot. 17 (1941) 686.

Small tree, up to 12 m by 14 cm ø. Branchlets terete, rarely angular, greenish, or reddish brown. Leaves chartaceous to subcoriaceous, elliptic to elliptic-oblong, sometimes obovate-oblong, 4½-16 (-25) by 2½-7(-10) cm; base cuneate, rarely obtuse or rounded; apex acute, acuminate; margin entire, sometimes remotely serrate; nerves and veins obscure or slightly elevated on both surfaces; petiole 3-8(-15) mm. Inflorescences axillary, extra-axillary, and sometimes on internodes, usually at the basal part of the new twig, 3-10½ cm long, loosely, dichotomously (up to 5 times) branched; peduncle 1¼-8 cm; bracts lanceolate, c. 2 mm long, fimbriate. Pedicel 3-5 mm. Flowers light yellowish or greenish yellow. Calyx lobes subreniform, 1½-2½ by 2-4 mm, short-fimbriate. Petals broad-obovate, 4½ by 4 mm, fimbriate, or rarely denticulate, areolate on the inner surface. Disk fleshy, suborbicular or obscurely 5-angular, c. 3 mm ø. Stamens inserted between the pistil and disk margin; filaments c. 2 mm, flat, subulate; anthers ± deltoid, c. 4/5 mm long, obtuse or slightly apiculate. Pistil c. 2 mm above the disk, gradually narrowed upwards. Stigma obscure. Fruits broad-obovoid or subglobose, c. 1 cm long, concave at the apex, deeply 5-lobed. Seeds ellipsoid, obtuse at both ends, 5-6 by 3-4 mm.

Distr. Siam (Kaw-koh-suwan, Koh-si-kah), Indo-China (Cambodia), China (Hainan), and Malaysia: N. Sumatra (Atjeh), Malay Peninsula, N. Borneo, Philippines (Batan Is., Luzon, Min-

doro, Polillo, Sulu Is., Palawan, Masbate, Mindanao), SW. Celebes, Lesser Sunda Is. (Sumbawa), Moluccas (Sula Is. and Kai Is.), and W. New Guinea (also Waigeo and Aru Is.).

Ecol. Forests, from the lowland up to 1300 m. Vern. *Ampah loloh*, *bunga sanggara*, Celebes; Philip.: *alumangug*, P. Bis., *baras-báras*, ILC., *burubatuán*, Tag., *káyum-bakiu*, Luzon.

Notes. The fruits of MERRILL 9644 (type of *E. oligantha*) is broad-obovoid and not sulcate, which is obviously due to insects. Another Philippine specimen (BS 76829, SING), in which the rather young fruits are also not sulcate, is also damaged by insects. Normally young fruits are always sulcate or lobed.

2. *Euonymus javanicus* BL. Bijdr. (1827) 1140; BENN. & R. BR. Pl. Jav. Rar. (1840) 130, t. 28; HASSK. Tijd. Nat. Gesch. & Phys. 10 (1843) 140; Cat. Hort. Bog. (1844) 229; Pl. Jav. Rar. (1848) 230, *incl. var. sphaerocarpus* HASSK.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 588, *incl. var. sphaerocarpus*; SCHEFFER, Nat. Tijd. Ned. Ind. 34 (1870) 98; KURZ, J. As. Soc. Beng. 39, ii (1870) 73; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 607; KURZ, J. As. Soc. Beng. 45, ii (1876) 123; For. Fl. Burma 1 (1877) 249; F.-VILL. Nov. App. (1880) 46; VIDAL, Sinopsis (1883) 20, t. 31, f. C; Rev. Pl. Vasc. Filip. (1886) 87; PIERRE, Fl. For. Coch. 4 (1894) t. 308C, *pro var. talungensis* PIERRE; KING, J. As. Soc. Beng. 65, ii (1896) 339; KOORD. Minah. (1898) 396; K. & V. Bijdr. 7 (1900) 89-90, *incl. var. genuina et sphaerocarpus*; MERR. Philip. J. Sc. 2 (1907) Bot. 278; BACK. Schoolfl. (1911) 233, *incl. var. sphaerocarpus et horsfieldii, et f. genuinus*; KOORD. Exk. Fl. Java 2 (1912) 523; KOORD.-SCHUM. Syst. Verz. 1, Fam. 158 (1912) 1; PITARD, Fl. Gén. I.-C. 1 (1912) 869; K. & V. Atlas 1 (1913) t. 139; GIBBS, Arfak (1917) 214; RIDL. Fl. Mal. Pen. 1 (1922) 445; MERR. En. Philip. 2 (1923) 480; CRAIB, Fl. Siam. En. 1 (1926) 279, *incl. var. talungensis*; TARDIEU, Suppl. Fl. Gén. I.-C. (1948) 788, f. 95, 4-5, *pro var. talungensis*; BLAKELOCK, Kew Bull. (1951) 257, *incl. var. genuinus, sphaerocarpus, timorensis, elmeri et coriaceus*.—*E. timorensis* ZIPP. ex SPANOGHE, Linnæa 15 (1841) 186; KOORD. Minah. (1898) 396. —*E. sumatranus* MIQ. Fl. Ind. Bat. 1, 2 (1859) 589; Sum. (1861) 512; BLAKELOCK, Kew Bull. (1951) 257.—*E.*

bancanus MIO. Sum. (1861) 513; KURZ, Nat. Tijd. Ned. Ind. 27 (1864) 194.—*E. horsfieldii* TURCZ. Bull. Soc. (Imp.) Nat. Mosc. 36, 1 (1863) 598, *ex descr.*, photogr. of type seen!; K. & V. Bijdr. 7 (1900) 90.—*E. alatus* ELM. Leaf. Philip. Bot. 4 (1912) 1484, *non* (THUNB.) SIEBOLD 1830.—*E. elmeri* MERR. Philip. J. Sc. 12 (1917) 281, new name for *E. alatus* ELM.; En. Philip. 2 (1923) 480.—*E. coriaceus* RIDL. Fl. Mal. Pen. 5 (1925) 299.—*E. micropetalus* RIDL. *l.c.*; BLAKELOCK, Kew Bull. (1951) 258.

Tree up to 23 m by 53 cm \varnothing , sometimes shrub. Branchlets terete. *Leaves* chartaceous to subcoriaceous, elliptic to elliptic-lanceolate, sometimes broad-elliptic, obovate, or obovate-oblong, 5–20 by 2–9 cm; apex acute to acuminate; base cuneate, rounded, or attenuate; margins entire rarely crenate in the upper half; nerves 4–7 pairs, obliquely arcuate, ascending and loosely anastomosing near the margin; petiole 5–8 mm, furrowed above. *Flowers* 1– ∞ on a condensed, short, tubercular axillary and extra-axillary glomerule, very rarely in a simple cyme with a peduncle ($\frac{2}{3}$ –2 cm). Bracts lanceolate, fimbriate, c. 1 mm long. Pedicels ($\frac{1}{2}$ –)1–2 cm, articulated at the base. *Flowers* 5-merous. *Calyx* brown to reddish, lobes unequal in size, suborbicular, reniform, or ovate, 1–3½(–5) by 1½–4(–6) mm, slightly concave, minutely denticulate. *Petals* light green or yellowish, broadly obovate or suborbicular, 4½–5 by 3½–6½ mm, areolate, fimbriate. Disk fleshy, 2½–3 mm \varnothing , 5-angular, flat or slightly concave, sometimes slightly swollen at the base of the filaments. *Stamens* inserted on the margin of the disk or quite near to it, c. 2½ mm; anthers triangular, divaricate, 4/5–1 mm long and wide, obtuse or short-apiculate, the base reddish to darkish brown (in herbarium). Pistil conical, emerging 1½–2 mm from the disk, smooth or obscurely 5-angular towards the base, gradually narrowed into a short style; stigma obtuse. *Ovules* inserted near the base. *Fruits* red, usually clavate or broadly obovoid, rarely globose, the upper end conical, obtuse, truncate, or concave, bearing an apiculate apex, 5(–4)-celled, one or two seeds in each cell.

Distr. India (Andamans; Nicobars, *sec.* KURZ, 1876), Burma (Tenasserim), Siam (Tassan Champhon and Huey Mut), Indo-China (Cochinchina), and *Malaysia*: Sumatra (also Simalur, Batu, and Banka Is.), Malay Peninsula (also Penang I.), SE. Borneo (Téwe R.) and Natuna Is., Java (common), Lesser Sunda Is. (Bali, Sumba, Timor, and Wetar), Celebes (also Salajar I.), Philippines, Moluccas (Talaud and Halmahera), and New Guinea (Manokwari; also in Misool, Sorong, and Radjah Ampat Is.). Fig. 5.

Ecol. Primary dryland rain-forests, from the lowland up to 1500 m.

Vern. Sumatra: *awa kudang kudang*, *bientol pajo*, *bintol eiafai*, *kudang kudang balah*, *lamelul*, *simani dotan*, *tutun bintol lantja*, Simalur, *kaju kumbang ketjil*, *kumbang*, Palembang, *kienjiens*, Banka; Mal. Pen.: *bélimbing hutan*, *kémuuing*

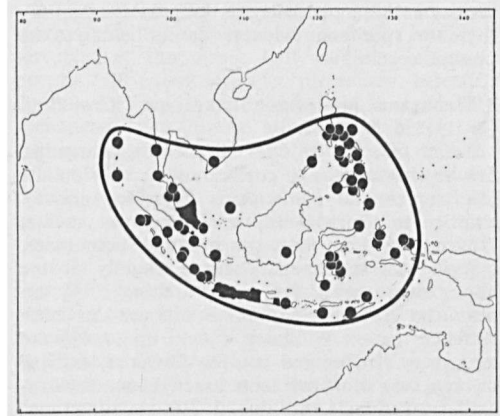


Fig. 5. Distribution of *Euonymus javanicus* BL.

ayer, *k. gading*, *logan*, Temuan, *bélungkas*, Perak, *gading*, Pahang; Java: *atiati*, *E. Java*, *djambon*, *djirak*, *pajangan*, *ragen*, *sapèn*, Central Java, *képitng*, M., *kakatjangan*, *ki keujeup*, *kihapit lalaki*, *ki-katjang*, S; Lesser Sunda Is.: *aadakurang*, *aitada kuru*, Sumba; Natuna Is.: *gunu*; Philip.: *kalimótas*, *malasangka*, *surag*, *tubatubhán*, Tag., *tabáan*, Mbo., *talangutiñgon*, C. Bis.; Celebes: *sandu molaba*, *tadugheho*, Tobela; Moluccas: *ligisata'a*, Talaud I., *radja*, Weda.

Notes. The fruits of this species are rather variable in shape and size. They are commonly clavate or broad-obovoid, sometimes being globose; intermediate forms also occur. Several varieties have been described based chiefly on the shapes and sizes of fruits. From the many fruiting specimens examined it is very difficult to distinguish well defined varieties.

Under *E. javanicus*, HASSKARL (Tijd. Nat. Gesch. Phys. 10, 1843, 140; Cat. Hort. Bog. 1844, 229) named two varieties, *viz* *var. conocarpus* and *var. sphaerocarpus*, but he provided no descriptions. In 1848 (Pl. Jav. Rar. 229–230) he gave a rather detailed description of *E. javanicus* and of its *var. sphaerocarpus*, but did not mention *var. conocarpus*; evidently he treated the latter as the type variety. The fruit of *E. javanicus* he defined as 'ob-pyramidal, prominently angular, with conical, acute apex'. In *var. sphaerocarpus* the fruit is 'obconical-subglobose when young and prominently 5-angular at the base and rounded or mucronate-acute at the apex at maturity'. Unfortunately I could not locate the type specimens of these varieties.

KOORDERS & VALETON (1900) interpreted *var. conocarpus* HASSK. in the sense of the type variety and named it *var. genuinus*. They also accepted *var. sphaerocarpus* HASSK. and amplified its description by including specimens with obcordate fruits, which was also accepted by BACKER (1911) and BLAKELOCK (1951).

LAWSON (*l.c.* 610) identified two specimens, collected by HELFER in Tenasserim or the Andaman Is. and by KURZ in Pegu respectively, as '*E. timorensis* ZIPP.'. In the description he stated:

'cymes as long or nearly as long as the leaves'; these two specimens evidently do not belong to the present species.

3. *Euonymus impressus* BLAKELOCK, Kew Bull. (1951) 256, f. 5, left.

Small tree up to 6 m. Branchlets 4-angular. *Leaves* chartaceous to coriaceous, usually bullate (i.e. nerves and some veins depressed above), elliptic to narrow-elliptic, sometimes ovate, 7–12 by 2½–4 cm; base cuneate; apex acuminate; margin remotely crenate-serrate usually at the upper half; nerves 5–6 pairs, arching c. ½ cm near the leaf margin; veins obscure on both surfaces; petiole 3–5 mm. *Cymes* up to 4½ cm long, very slender and lax, few-flowered, axillary or on a very short bracteate brachyblast, or extra-axillary. Peduncle very fine, 2–2½ cm, sometimes very short. Bracts lanceolate, c. 1 mm long, sparsely short ciliate. Pedicels 8–12 mm, very fine. *Flowers* 5-merous. *Calyx* lobes semi-orbicular or reniform, ¾–1 by 1½–3 mm, slightly concave, transparent, irregularly denticulate. *Petals* sub-orbicular or broad-obovate, unequal in size, 3–6 mm ø, slightly contracted at the base, irregularly denticulate, distinctly veined, areolate on the inner surface. Disk suborbicular, rather thin, c. 3 mm ø. *Stamens* inserted ± halfway on the disk; filaments very short; anthers c. ½ mm long. Pistil conical, c. 1 mm above the disk, slightly 5-angular; stigma obscure. *Fruits* (immature) obovoid, slightly lobed, ± truncate at the top.

Distr. *Malaysia*: Celebes (SW. Peninsula), once collected.

Ecol. Rain-forest, along stream, 1100 m.

4. *Euonymus wrayi* KING, J. As. Soc. Beng. 65, ii (1896) 344, excl. RIDLEY 2652; PRAIN, *ibid.* 73, ii (1904) 194; RIDL. J. Fed. Mal. St. Mus. 4 (1909) 11; Fl. Mal. Pen. 1 (1922) 446; BLAKELOCK, Kew Bull. (1951) 254.—*E. rufulus* RIDL. J. Str. Br. R. As. Soc. n. 75 (1917) 19; Fl. Mal. Pen. 1 (1922) 446; BLAKELOCK, Kew Bull. (1951) 255.

Shrub or small tree, up to 5 m. Branchlets terete. *Leaves* chartaceous to subcoriaceous, rarely coriaceous, ovate-oblong, elliptic to elliptic-oblong, sometimes obovate to obovate-oblong, 7½–15 by 2½–7 cm; base cuneate to narrow-cuneate; apex acuminate; margins entire, sometimes obscurely, remotely serrulate; nerves 7–9 pairs, towards the margin loosely arching-anastomosing; petiole 5–8 mm. *Inflorescences* cymose, axillary, at the base of the new twigs, or crowded on the undeveloped shoot in the leaf-axil, 1–7½ cm long, sometimes very short. Peduncle very short, sometimes up to c. 5 cm. Bracts lanceolate, ½–2½ mm long, fimbriate. Pedicels (5–)8–14 mm. *Flowers* pink or dull red, 5-merous. *Calyx* lobes unequal in size, subreniform or suborbicular, 1–2 by 1–2½ mm, slightly erose. *Petals* broad-obovate, broad-elliptic or suborbicular, 3–4 by 2½–3 mm, irregularly minutely denticulate, areolate. Disk 1½–2 mm ø, ± round, or

obscurely 5-lobed. *Stamens* inserted on the disk between its margin and pistil; anthers ± deltoid; filament short. Pistil very short, sometimes emerging c. ½ mm from the disk, 5-angular at base. *Fruits* broadly obovoid, 17–25 by 13–17 mm, concave at the apex, distinctly 5-lobed, gradually narrowed towards the base. *Seeds* ellipsoid, 13 by 6 mm, reddish- or dark-brown.

Distr. *Malaysia*: Sumatra (Atjeh and Gajolands) and Malay Peninsula (Perak, Kedah, Trengganu, Pahang, and Selangor).

Ecol. In forests, usually between 1300–2500 m, rarely in the lowland.

Vern. *Ségading bukit*, M.

Note. Very close to *E. javanicus* from which it can only be distinguished by laxer, more branched and longer peduncled cymes and minutely, irregularly denticulate petals. Leaves and fruits are exactly matching those of *E. javanicus*. Bracts of axillary buds are usually rusty fimbriate.

5. *Euonymus glaber* ROXB. [Hort. Beng. (1814) 86, *nomen*] Fl. Ind. ed. Wall. 2 (1824) 403; *ibid.* ed. Carey 1 (1832) 628; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 609; BLAKELOCK, Kew Bull. (1951) 254.—*Lophopetalum pedunculatum* RIDL. J. Str. Br. R. As. Soc. n. 59 (1911) 85; Fl. Mal. Pen. 1 (1922) 449.

Small tree up to 5 m. Branchlets terete. *Leaves* chartaceous, elliptic, sometimes elliptic-oblong, 7–8 by 3–4½ cm; base narrow-cuneate; apex acute to short-acuminate; margins usually dentate-crenate in the upper half; nerves 5–6 pairs, rather fine; petiole 5–7 mm. *Cymes* axillary or slightly extra-axillary, usually at the base of a new shoot, up to 4¼ cm long, sometimes on a leafy axillary brachyblast. Peduncles up to 2½ cm. Bracts ovate, short-ciliate. Pedicels 2–3½ mm. *Flowers* cream-coloured, 5-merous, some flowers occasionally 4-merous. *Calyx* lobes unequal, usually the outer two smaller, suborbicular or broadly-obovate, rarely subreniform, slightly erose, sometimes short-ciliate. *Petals* suborbicular, sometimes broad-obovate, 2–2½ by 2–2½ mm, sometimes slightly contracted at the base, the margin usually minutely denticulate. Disk ± orbicular, c. 1½ mm ø. *Stamens* very short, inserted near the margin of the disk; anthers ± triangular. Pistil c. ¾ mm emerging from the disk, 5(–4)-angular at the base, narrowed into a short, cylindrical style. *Fruits* slightly depressed-globose, 8–12 by 12–17 mm, deeply 5(–4)-lobed, usually concave at the apex, narrowed towards the base. *Seeds* usually only 1 in each cell.

Distr. E. Pakistan (Chittagong), Siam, and *Malaysia*: Malay Peninsula (Perlis), twice collected.

Ecol. On hill slope.

6. *Euonymus recurvans* MIQ. Sum. (1861) 513; BLAKELOCK, Kew Bull. (1951) 262.

Branchlets terete. *Leaves* chartaceous, light brown to brown beneath, elliptic, 7–8 by 3½–4 cm; base cuneate rarely obtuse; apex short-acuminate; margin usually crenate at the upper

half, slightly recurved; nerves 4-7 pairs, obliquely ascending towards near the margin and curving upwards; petiole 5-8 mm. *Cymes* axillary or extra-axillary near the base of a new twig, simple or once forked. Peduncle very short, sometimes up to 18 mm. Bracts deltoid, fimbriate. Pedicels 4-5 mm. *Flowers* 5-merous. *Calyx* lobes unequal, the inner two much larger, semi-orbicular to reniform, $\frac{1}{2}$ -2 by 1-2 $\frac{1}{2}$ mm, slightly erose, reflexed at anthesis. *Petals* (from floral bud) suborbicular, 2 mm \varnothing , short-ciliate. Disk fleshy, orbicular, c. 2 $\frac{1}{2}$ mm \varnothing . *Stamens* inserted on the disk about halfway the edge and pistil; anthers \pm triangular, free at lower half, slightly apiculate; filaments c. $\frac{3}{4}$ mm. Pistil c. 2 mm emerging from the disk. *Ovules* attached at the base. *Fruits* (young) suboblongate or subfusiform, 1 $\frac{1}{2}$ by $\frac{1}{2}$ cm.

Distr. *Malaysia*: Sumatra (Padang: Mt Singalang; Priaman).

7. *Euonymus acuminifolius* BLAKELOCK, Kew Bull. (1951) 753, f. 5, right, incl. var. *borneensis* BLAKELOCK.

Shrub up to c. 3 $\frac{1}{2}$ m. Branchlets 4-angular or subterete. *Leaves* membranous, sometimes chartaceous (especially at high altitude), ovate-oblong to lanceolate, or elliptic to elliptic-oblong, 7 $\frac{1}{2}$ -10 $\frac{1}{2}$ by 2-4 cm; base cuneate sometimes obtuse; apex usually long-acuminate (acumen up to 2 cm); margin crenate-serrulate or serrulate; nerves 4-6 pairs, spreading towards 3-5 mm from the edge and then arching; petiole 2-6 mm. *Cymes* 1-3 times branched, axillary or extra-axillary, or crowded on axillary brachyblasts, very short to sometimes up to 8 cm long, few-flowered. Peduncle short, sometimes up to 4 cm. Bracts triangular, 1-2 mm long, entire or sometimes short-ciliate. *Flowers* purplish-red, 5-merous. *Calyx* lobes semi-orbicular or subreniform, $\frac{1}{2}$ -1 $\frac{1}{2}$ mm long, the inner two usually larger, irregularly minute-denticulate. *Petals* suborbicular, 2 $\frac{1}{2}$ -3 by 2 $\frac{1}{2}$ mm, minute-denticulate, slightly contracted at the base. Disk obscurely 5-angular, c. 2 mm \varnothing . *Stamens* small; filaments very short; anthers c. $\frac{1}{2}$ mm long. Pistil short, emerging c. 3 mm from the disk, slightly 5-angular; stigma discoid, obscurely 5-angular. *Fruits* obcordate, distinctly 5-lobed, 1 $\frac{1}{2}$ -2 by 1 $\frac{1}{4}$ -1 $\frac{3}{4}$ cm. *Seeds* (very young) with aril at the base.

Distr. *Malaysia*: Central West Sumatra (Ophir Distr.), N. Borneo (Mt Kinabalu) and SW. Celebes (Enrekang).

Ecol. Forests, from 700-3200 m.

8. *Euonymus castaneifolius* RIDL, Kew Bull. (1931) 36; BLAKELOCK, *ibid.* (1951) 255.—*E. moultoni* RIDL, *ibid.* (1931) 36; BLAKELOCK, *ibid.* (1951) 256.—Fig. 4a-f.

Tree, 5 up to 15 m by 20 cm \varnothing . Branchlets terete. *Leaves* chartaceous to subcoriaceous, elliptic to elliptic-oblong, sometimes ovate-oblong, rarely broad-elliptic, 5 $\frac{1}{2}$ -13 $\frac{1}{2}$ by 2 $\frac{1}{2}$ -7 $\frac{1}{2}$ cm, sometimes with scattered, black dots beneath; base acute to cuneate, sometimes attenuate; apex

short-acuminate to acuminate, rarely obtuse; margin slightly cartilaginous, usually remotely serrulate at the upper half, slightly recurved; nerves 5-9 pairs, strongly prominent beneath, depressed above, sometimes flat above (especially specimens from higher altitude), obliquely ascending near the margin and then curving upward; veins obscure sometimes visible on both surfaces; petiole 12-15 mm. *Cymes* 1-4 times branched, axillary, extra-axillary, solitary or sometimes fasciculate crowded on an axillary brachyblast, 1-3(-7) cm long, usually with several small, fimbriate bracts at the base, sometimes with subulate ones up to 6 mm. Peduncle very short, sometimes 1 $\frac{1}{2}$ -5 cm. Pedicels 3-6 mm, articulated at the base. *Flowers* white, 4-merous. *Calyx* lobes suborbicular, 1-1 $\frac{1}{2}$ mm \varnothing , the inner pair largest. *Petals* elliptic, or broad-elliptic, 2-2 $\frac{1}{4}$ by 1 $\frac{1}{2}$ -2 mm, obtuse and erose, with a few longitudinal veins. Disk slightly 4-angular. *Stamens* inserted on the disk between its edge and the pistil; anthers slightly depressed-oblong and contracted at the base, sometimes deltoid, dehiscing at the top. Pistil emerging c. $\frac{3}{4}$ mm from the disk, 4-angular towards the base. *Fruits* subobovoid, obscurely 4-angular, red when mature, 10-18 by 7-11 mm, flat or slightly concave sometimes slightly obtuse at the top, slightly irregularly wrinkled when dry. *Seeds* ellipsoid, 12 by 10 mm, irregularly wrinkled, with a cup-shaped aril at the base.

Distr. *Malaysia*: Central Sumatra (Pajakumbuh) and Borneo (Mt Kinabalu, Balikpapan, Kutai and Sarawak).

Ecol. Primary forests, sandy ridges, mossy forest, from low ridges up to 1500 m.

Note. The dark dots on the underside of the leaves are not caused by a fungus; they appear to be resinous (?), but the coloured substance is not soluble in alcohol. The only other species in which they also occur is the following one.

9. *Euonymus glandulosus* (MERR.) DING HOU, *nov. comb.*—*Glyptopetalum glandulosum* MERR. Philip. J. Sc. 12 (1917) Bot. 279; En. Philip. 2 (1923) 481.

Shrub or small tree 3 to 5 m. Branchlets terete, sometimes sulcate or slightly 4-angular. *Leaves* chartaceous to subcoriaceous, always with scattered black dots beneath, elliptic to elliptic-lanceolate, rarely ovate, or obovate-oblong, 4 $\frac{1}{2}$ -12 $\frac{1}{2}$ (-14 $\frac{1}{2}$) by 2-4 $\frac{1}{2}$ (-5 $\frac{1}{2}$) cm; base cuneate; apex acuminate; margin slightly recurved, serrulate at the upper half; nerves 4-5 pairs, slightly elevated below, visible or obscure, sometimes depressed above, sometimes obscure on both surfaces, spreading towards near the margin, arching; veins usually obscure on both surfaces; petiole 5-8 mm. *Cymes* 2-4 times branched, sometimes a triad or even a solitary flower, axillary, or towards the base of the new twigs, short, sometimes up to 3 $\frac{1}{2}$ cm, few-flowered. Peduncle short, sometimes up to 2 $\frac{1}{2}$ cm. Pedicels 4-6(-8) mm. *Flowers* dark purple, 4-merous. *Calyx* lobes subreniform or suborbicular, $\frac{3}{4}$ -1 by 1-1 $\frac{1}{2}$ mm, slightly erose, inner lobes slightly larger, thinner, and

transparent. *Petals* suborbicular or broad-obovate, 2¼–3 by 2–3 mm, slightly erose, with a few, longitudinal veins. Disk obscurely 4-angular, c. 1¼ mm ø. *Stamens* small; anthers slightly depressed-oblong, ½ by 4/5 mm, dehiscing at the top; filaments very short, inserted between the pistil and the edge of the disk. Pistil c. ½ mm emerging from the disk, slightly 4-angular towards the base. *Fruits* broad-obovoid, 18 by 15 mm, 4-lobed, concave at the apex, cuneate at the base, smooth, ochre-yellow suffused with rose-red, finally red. *Seeds* ellipsoid, smooth, 8 by 5 mm, aril at the base disk-like.

Distr. *Malaysia*: Borneo (Mt Kinabalu) and Philippines (Mindanao and Palawan).

Ecol. In forests, 900–2700 m.

Note. This species has been described under *Glyptopetalum* because MERRILL found only one ovule in each cell of the ovary; in the duplicates of the type (MERRILL 9547, Bo, K, L), however, the ovary distinctly bears two ovules in each cell. The black dots on the leaves are similar to those in the foregoing species.

10. *Euonymus japonicus* THUNB. Nov. Act. R. Soc. Sc. Upsal. 3 (1780) 198 & 208; Fl. Jap. (1784) 100; BANKS, Ic. Kaempf. (1791) t. 8; BLUME, Bijdr. (1827) 1147; LINDL. Bot. Reg. n.s. 17 (1844) t. 6; MIQ. Ann. Mus. Bot. Lugd. Bat. 2 (1865) 86, incl. var. *radicans* MIQ.; FRANCH. & SAVAT. En. Pl. Jap. 1 (1875) 79; MAXIM. Bull. Ac. Imp. Sc. St. Pétersb. 27 (1882) 441; FORB. & HEMSL. J. Linn. Soc. Bot. 23 (1886) 120; KOORD. Minah. (1898) 395; LOES. Bot. Jahrb. 29 (1900) 441; K. & V. Bijdr. 7 (1900) 85; LOES. Bot. Jahrb. 30 (1902) 453; BACK. Schoolfl. (1911) 234; KOORD. Exk. Fl. Java 2 (1912) 523; LOES. & REHD. in Sargent, Pl. Wilson. 1 (1913) 485; STEEN. Trop. Natuur 22 (1933) 175, fig.; MERR. Sunyatsenia 1 (1934) 197; WANG, Chinese J. Bot. 1 (1936) 50; ROEPKE, Trop. Natuur 25, Jub. no (1936) 20, f. 2–3; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 118; STEEN. Bull. Jard. Bot. Btzg III, 17 (1948) 400; BLAKELOCK, Kew Bull. (1951) 268; HARA, En. Sperm. Jap. 3 (1954) 86. —*E. japonicus* L. f. Suppl. (1781) 154; JUEL, Pl. Thunberg. (1918) 176. —*Elaeodendron fortunei* TURCZ. Bull. Soc. Nat. Mosc. 36, i (1863) 603; WALP. Ann. 7 (1868) 582; MAXIM. Bull. Ac. Imp. Sc. St. Pétersb. 27 (1882) 460; FORB. & HEMSL. J. Linn. Soc. Bot. 23 (1886) 124. —*Elaeodendron javanicum* TURCZ. Bull. Soc. Nat. Mosc. 36, 1 (1863) 602. —*E. radicans* (MIQ.) SIEB. ex MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 202; HAND.-MAZZ. Symb. Sin. 7 (1933) 660. —*Cassine fortunei* O.K. Rev. Gen. Pl. 1 (1891) 114. —*E. fortunei* HAND.-MAZZ. Symb. Sin. 7 (1933) 660; REHD. J. Arn. Arb. 19 (1938) 75, t. 218, incl. var. *radicans* (MIQ.) REHD.; Man. Cult. Trees & Shrubs ed. 2 (1940) 559; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 118; BLAKELOCK, Kew Bull. (1951) 268; HARA, En. Sperm. Jap. 3 (1954) 84. —*Pragmatessara japonica* PIERRE, Fl. For. Coch. (1894) sub t. 309. —*E. fungosus* OHWI, Acta Phytotax. Geobot. 5 (1936) 186, ex descr.—Fig. 4g–j.

Erect, procumbent, or scandent shrub, or small tree, up to 8 m. Branchlets terete, if procumbent or scandent bearing rootlets. *Leaves* chartaceous, thin-coriaceous to coriaceous, ovate or broad-ovate, obovate or obovate-oblong, elliptic to elliptic-oblong, rarely broad-elliptic, 2–9½ by 1½–4 cm; base obtuse, or acute; apex acute or obtuse, rarely acuminate; margin dentate-crenate; nerves 2–6 pairs, rather fine, obliquely spreading and loosely anastomosing near the margin; petiole 2–13 mm. *Cymes* axillary and/or extra-axillary, 1–12 cm long. Peduncle ½–8 cm. Bracts triangular, lanceolate, ½–4 mm long, caducous. Pedicels 3–5 mm. *Flowers* greenish white, 4-merous, c. 8 mm ø. *Calyx* lobes reniform or suborbicular, 1–1½ mm long, entire or slightly erose, the outer pair smallest. *Petals* subrotund, broad-ovate or -elliptic, 3½–3¾ by 2½–3½ mm, entire, sometimes erose, slightly recurved. Disk fleshy, flat or slightly concave, slightly 4-angular or subrounded, usually covered with sparse papillae, sometimes with fleshy processes especially towards the margin, or smooth (extra-Mal. material). *Stamens* inserted on the margin, sometimes in shallow notches, c. 2½ mm long; anthers broad-ovoid, ⅔–1 mm long, slightly apiculate, rarely obtuse. Pistil 1–2½ mm above the disk, sometimes slightly 4-angular towards the base; style distinct, cylindrical; stigma obscure. *Fruits* ± globose, smooth, green, c. 1 cm ø; in dehiscing the endocarp gets loose from the exocarp and on both sides of each cell it has a thickened corky-cartilaginous portion, white and crescent-shaped in cross-section; during the shrinkage of the more or less fleshy exocarp the seed, pendulous from the top of the central axis, is pushed out of the cell.

Distr. Japan, Korea, China, Ryukyu, and *Malaysia*: West Central Sumatra (Kerintji), Java (from Mt Papandajan eastwards), Lesser

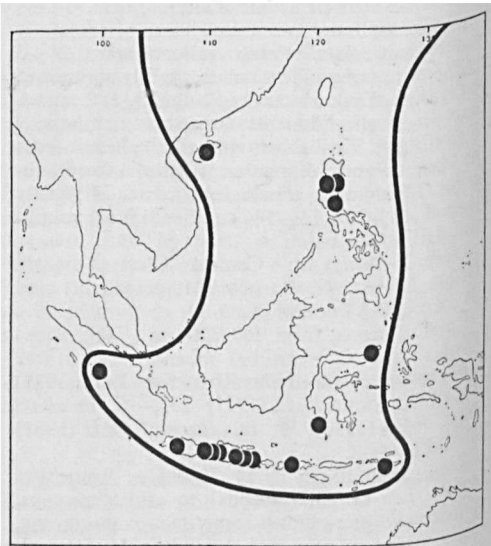


Fig. 6. Distribution of *Euonymus japonicus* THUNB. in Malaysia.

Sunda Is. (Sumbawa, Port. Timor), SW. and NE. Celebes, Philippines (Luzon: Prov. Laguna on Mt Banahao). Fig. 6.

Ecol. On edges of rain-forests, on ridges, (600-)1000-2950 m.

Uses. ROEPKE (1936, *l.c.*) found it used for hedges in Central Java where it was the host of an endemic butterfly. In temperate countries frequently used as an ornamental. For the various varieties distinguished see REHDER, *J. Arn. Arb.* 19 (1938) 75-80; *Man. Cult. Trees. & Shrubs* ed. 2 (1940) 558-559; *Bibl. Cult. Trees* (1949) 405-411; BLAKELOCK, *Kew Bull.* (1951) 262-270; HARA, *En. Sperm. Jap.* 3 (1954) 84-88.

Notes. THUNBERG based this species on *Iso Kuroggi* described in KAEMPFER's *Amoen. Exot.* fasc. 5, p. 790, giving it the short diagnosis '*foliis quadrifidis; foliis ovatis, serratis*' (1780). In 1784 he copied this brief diagnosis, citing KAEMPFER's work, and adding a detailed description (*Fl. Jap.* 100), but omitting his evaluation of 1870. *E. japonicus* L. f. of 1781 is typified by THUNBERG's specimens and is technically a later homonym.

Elaeodendron javanicum TURCZ. was based on ZOLLINGER 2958 from Java and has curiously been omitted in Javanese floras. Prof. ZEROV, Kiew, kindly sent a photograph of the type which exactly matches *E. fortunei* (TURCZ.) HAND.-MAZZ.; later an isotype was found in the Geneva Herbarium.

This species is extremely variable, which is partly due to its large range and partly to the existence of many cultivars. However, its fruit type is very characteristic as stated in the description.

There are two main groups of forms. The first, including the typical form, is erect with obovate, rather coarsely crenate, glossy, dark-green leaves. It occurs chiefly in Japan. The second form is usually procumbent or climbing by small rootlets produced by the stem and its leaves are smaller, rather elliptic, acute, serrulate, dull, and pale green. This grows chiefly in China and was described as *Elaeodendron fortunei* TURCZ. = *Euonymus fortunei* (TURCZ.) HAND.-MAZZ. REHDER, BLAKELOCK, and HARA still distinguish this as a species distinct from *E. japonicus*, but the differences are mainly vegetative and because there are many intermediate specimens, I fail to see how these two species can be maintained.

The root-climbing habit is not at all important as a character. VAN STEENIS studied this in detail in the Javanese mountains (1933, *l.c.*): in open habitats the plants are perfectly erect, but in the adjacent shaded mountain forest the seedling grows up as a very thin, hardly branched, many metres long root-climber clinging to often mossy tree trunks. Under these shady conditions it flowers seldom, but if such an inconspicuous plant becomes exposed, as he found on a scree near the summit of Mt Jang (E. Java), it starts to branch profusely with abundance of flowers and fruit. In 1953 he found both forms erect and climbing,

both flowering and fruiting, together on the summit of Mt Perdido, Port. Timor. The climbing form may grow into a fairly thick woody liana, with the stem a finger thick. The use of climbing versus erect made by *e.g.* REHDER (*Man. Cult. Trees & Shrubs* ed. 2, 1940, 554) and BLAKELOCK in their keys seems to be futile.

All Malaysian specimens, whether erect or climbing, differ in another slight character from those of China and Japan — except one specimen found in Hupei, WILSON 502, K — in that the disk in the Malaysian specimens is usually covered with scattered papillae or very rarely somewhat larger fleshy processes, the disk being smooth in the Japanese and Chinese specimens. Under the microscope both papillae and processes appear to be minute emergencies, *i.e.* outgrowths of the epidermal and subepidermal cell layers; the processes are occasionally branched and sometimes even bear a stoma at the apex (*cf.* also BERKELEY, *J. Elisha Mitchell Sc. Soc.* 69, 1953, 191). This is most significant, as these processes are essentially the same as those found in other species to grow out into spines. Of course the occurrence of spines renders the fruit an extremely showy character and the echinate-fruited species have even been arranged in a special section by NAKAI (*J. Jap. Bot.* 17, 1941, 617) and accepted by BLAKELOCK. However, both the spiny and spineless fruits are in other plant groups sometimes found in a single species, for example in species of *Datura*, *Galium* (hooked hairs), *Dentella* (emergencies), *etc.* Besides emergencies occur on the disk of certain strains of *E. japonicus* and are clearly visible at the base of the fruit (*cf.* *E. fungosus* = *E. japonicus* and FB 7878, US).

In the light of the observations made above, however, it is possible that the significance of the occurrence of spines has been much overevaluated. It is not impossible that spiny fruits and unarmed ones may occur in the same species; in this way one would get two series of parallel 'pseudospecies'. Therefore we should avoid keying out species on this single character; in absence of other additional clear differences it cannot serve for specific distinction.

11. *Euonymus benguuetensis* MERR. *Publ. Gov. Lab. Philip.* 29 (1905) 26; *En. Philip.* 2 (1923) 480; LOES. in *E. & P. Pfl. Fam.* ed. 2, 20b (1942) 119; BLAKELOCK, *Kew Bull.* (1951) 274; JACOBS, *Ann. Bog.* 3 (1958) 65, as a *Euonymus*.

A scandent or decumbent shrub. Branchlets light greenish, terete or slightly angular, usually warty, occasionally bearing rootlets (ELMER 8729, L). *Leaves* membranous to chartaceous, ovate, elliptic, sometimes broad-ovate or -elliptic, rarely obovate, 3-7½ by 1½-4 cm; base acute or cuneate, sometimes obtuse; apex acute to acuminate, rarely obtuse; margins serrulate or crenulate, sometimes entire at the lower part; nerves 3-5 pairs; petiole 2-3 mm. *Inflorescences* axillary, sometimes extra-axillary, 2-4½ cm long. Peduncle 1-3½ cm, usually 3-10-flowered, sometimes divided into two very short branches at the apex.

Bracts at the base of the peduncle and around it, triangular to lanceolate, 3–8 mm long, slightly erose. Bracteoles at the base of the pedicels triangular, c. ½ mm long, short fimbriate, persistent. Pedicels 7–9 mm. *Flowers* greenish white, or yellowish, 4-merous. *Calyx* lobes semi-orbicular, or deltoid, 1–2 mm long, the margin reddish brown, denticulate. *Petals* obovate to slightly obovate-oblong, 4–4½ by 2–3 mm, short-fimbriate, sometimes revolute. Disk obscurely 4-angular, fleshy, 2–3 mm in ø, covered with papillae. *Stamens* each attached at the margin of the disk in a shallow notch; filaments c. 3 mm, subulate; anthers broadly ovoid or subrotund, c. ¾ mm long, introrse, slightly apiculate. Pistil emerging c. 2½ mm from the disk, ± cylindric, gradually enlarged and ± 4-angular towards the base, the basal part densely papillose in very young flowers later growing out into fleshy, subulate processes gradually increasing in length after anthesis. *Fruits* globose, densely covered with prickles, up to 13 mm incl. the spines (Sumatra). Endocarp in each cell on both sides thickened and cartilaginous, loosening from the shrinking exocarp.

Distr. *Malaysia*: Sumatra (Mt Kerintji) and Philippines (Luzon: Benguet and Bontoc).

Ecol. Montane rain-forests, 1200–2300 m, once recorded on limestone cliffs.

Vern. *Tabkang*, 1g.

Note. It is rather remarkable that a Philippine mountain species is found also in Central Sumatra. Though the specimen (JACOBS 4343) is in fruit, BLAKELOCK *in sched.* identified it as 'near *E. benguetensis*'; I can find no differences between the two. Unfortunately no mature fruit is known

from the Philippines and no flowers from the Sumatran specimen.

12. *Euonymus moluccensis* BLAKELOCK, *nov. sp. in sched.*

Arbor parva, c. 6 m alta. *Folia* chartacea, elliptica vel elliptico-oblonga, raro ovata, 6½–9½ cm longa, 3–4¾ cm lata, basi cuneata, apice acuminata, margine subintegra vel leviter serrulata, nervis utrinque 4–6; petiolus 5–10 mm longus. *Infructescentiae* cymosae simplices, pedunculo 7–12 mm longo. *Pedicellus* 4–5 mm longus. *Capsula* immatura clavata, c. 16 mm longa, 7 mm lata, 4-carinata, apice obtusa.—*Typus* MAIN & ADEN 1040, L, isotypes A, BO, SING.

Small tree, c. 6 m. Branchlets terete. *Leaves* chartaceous, slightly ash-coloured, elliptic to elliptic-oblong, rarely ovate, 6½–9½ by 3–4¾ cm; base cuneate; apex acuminate; margin subentire or remotely slightly serrulate; nerves 4–6 pairs; ± obliquely spreading towards near the margin and then turning upwards; petiole 5–10 mm. *Infructescences* axillary simple cymes, sometimes on the top of a very short branchlet. Peduncle 7–12 mm. Bracts deltoid, c. ½ mm long and wide, short-ciliate. Pedicel 4–6 mm. *Flowers* unknown. *Fruits* clavate (young), 4-ridged, c. 16 by 7 mm, apex obtuse and slightly apiculate.

Distr. *Malaysia*: Moluccas (Morotai: Mt Sangawo), once collected.

Ecol. Forest, 800 m. Fr. May.

Note. This species is very characteristic by the clavate, 4-celled fruits which are very different in the other Malaysian *Euonymus* spp.

5. GLYPTOPETALUM

THWAITES in Hook. J. Bot. Kew Misc. 8 (1856) 267, t. 7B; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 125.—Fig. 7.

Shrubs or small trees. Branchlets terete or 4-angled (*G. quadrangulare*), sometimes slightly compressed or flattened at the nodes. *Stipules* small, caducous. *Leaves* decussate or opposite, sometimes subopposite at the upper part of the young branchlets, entire or crenulate. *Cymes* simple to 2–3 times forked, axillary or extra-axillary, quite often also on the internodes, with a distinct peduncle and pedicels; pedicel of the lateral flowers usually shorter than that of the central ones, often with 2 small bracteoles just below the articulation. *Flowers* bisexual, 4-merous. *Calyx* lobes spreading, the inner pair larger than the outer one. *Petals* rather fleshy, usually smooth, sometimes with a small appendage or 2 depressions on the inner side. Disk fleshy, flat, 4-angular or slightly 4-lobed, or covering the ovary and confluent with it. *Stamens* 4, inserted on the disk or on the united body of disk and pistil; filaments very short, persistent, connective dilate; anthers divergent, dehiscent at the top or introrse (*extra-Mal. sp.*). *Ovary* immersed in the disk, 4-celled; style obscure; stigma obscure or obtuse. *Ovule* one in each cell, pendulous from the inner angle of the top, anatropous. *Capsule* loculicidal, when dehiscing the valves splitting from the central axis leaving a persistent columella, 4–1-celled, 4- or 3–1-seeded by abortion, globose or subglobose, if

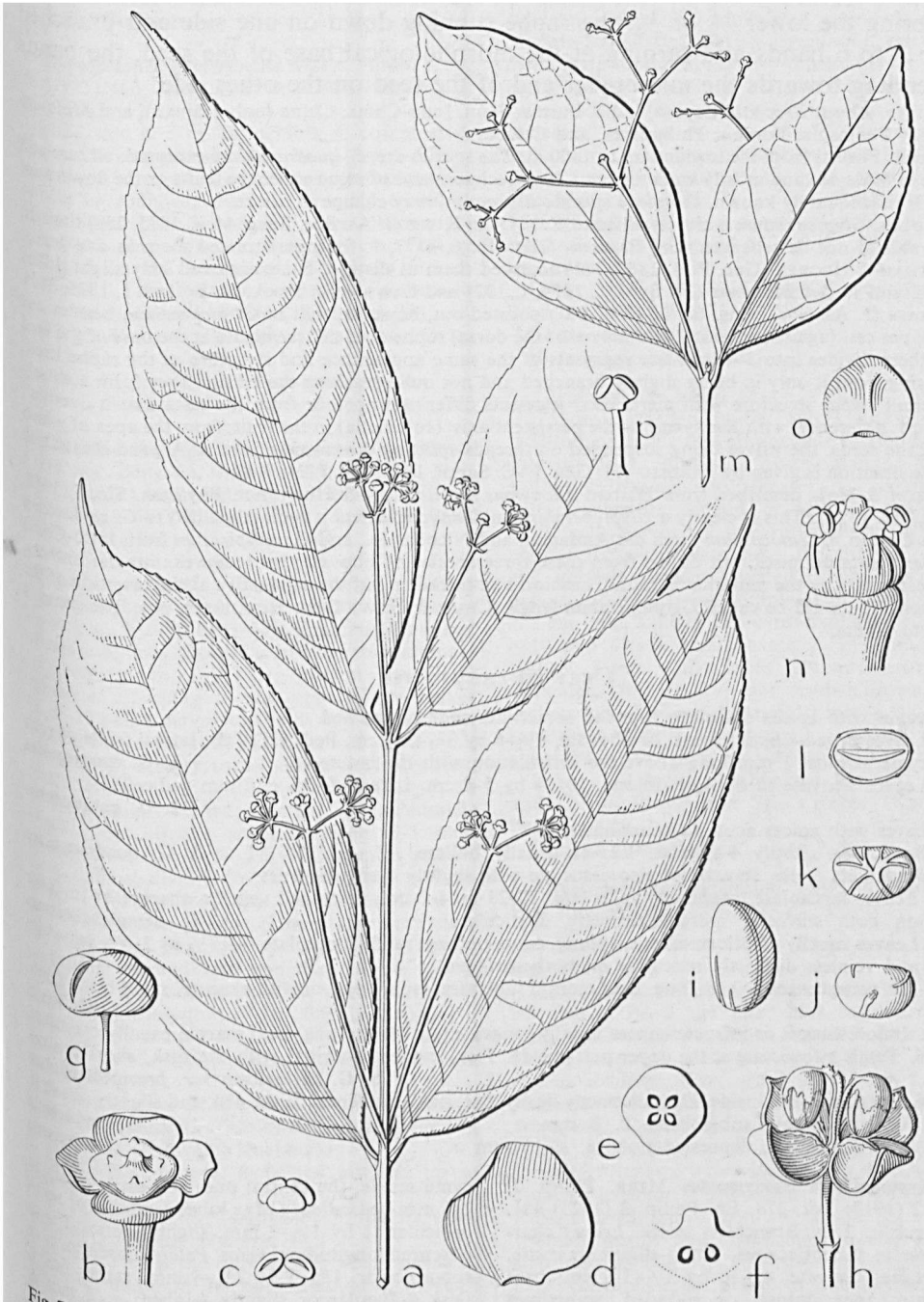


Fig. 7. *Glyptopetalum quadrangulare* PRAIN ex KING. a. Habit, $\times \frac{2}{3}$, b. flower, petals and stamens removed, $\times 6$, c. frontal and dorsal view of stamen, $\times 12$, d. petal, $\times 6$, e-f. ovary in sections, $\times 12$, g. fruit, nat. size. — *G. marivelense* (ELM.) MERR. h. Dehiscent fruit, nat. size, i-k. seed, lateral, apical, and basal views, l. seed in section, all $\times 2$. — *G. zeylanicum* THW. var. *brevipedicillatum* DING HOU. m. Habit, $\times \frac{2}{3}$, n. flower, petals and sepals removed, $\times 12$, o. petal, $\times 6$, p. stamen, $\times 12$ (a-f SF. 35405, g CORNER s.n., h EDAÑO 34166, i-l Ebaló 584, m-p RIDLEY 2652).

containing only 2 seeds transverse-oblong. *Seeds* with incomplete, fleshy aril covering the lower $\frac{1}{2}$ or $\frac{1}{3}$, the raphe running down on one side and branched into 3 to 6 bands and turning at the morphological base of the seed, the bands ascending towards the micropylar end of the seed on the other side.

Distr. About 20 spp. in Ceylon, India, Burma, Siam, Indo-China, China (only Hainan), and *Malaysia* (Malay Peninsula, Borneo, Philippines, and Celebes).

Ecol. Forests from the lowland up to 1400 m. The species are, *G. quadrangulare* excepted, all rare and local in *Malaysia* and mostly known from a few specimens and of some either the fruits or the flowers are not or inadequately known, therefore specific distinction may change in future.

Notes. *Glyptopetalum* is closely allied to *Euonymus*; KURZ (J. As. Soc. Beng. 44, ii, 1875, 259) though they should not be separated and BAILLON (Hist. Pl. 6, 1877, 1, footnote) treated them as one genus. BENTHAM & HOOKER (Gen. Pl. 1, 1862, 361) accepted them as distinct but mentioned only slight differences, and so did BEDDOME (Fl. Sylv. 1, 1874, t. 102) and LAWSON (in Hook. Fl. Br. Ind. 1, 1875, 612).

PRAIN (J. As. Soc. Beng. 60, ii, 1891, 207) pointed out, however, that in *Glyptopetalum*, besides one ovule per cell (against at least 2 in *Euonymus*) the dorsal raphe does not terminate at the base of the seed but there divides into 3-4 lacinate segments of the same appearance and structure as the raphe itself, differing from it only in being slightly branched and not quite reaching the hilum: 'they form a closely adherent arillar structure with meridional segments differing in colour from the testa that it overlies'. A third difference with *Euonymus* is the persistent axis (columella) in the fruit, from the apex of which hang the seeds, the valves being suspended on threads splitting downwards from it. A good illustration of the situation is given by TARDIEU (Fl. Gén. I.-C. Suppl. 1948, 784, f. 94: 7-8).

CHUN & HOW described from Hainan *Euonymus fengii* CHUN & HOW (Act. Phytotax. Sin. 7, 1958, 44, f. 1, t. 15, 2). This is clearly a *Glyptopetalum*; in floral characters it is closely allied to *G. zeylanicum* from Ceylon, *G. calocarpum* from the Andaman and Nicobar Is., and *G. calypratrum* from Indo-China by the pyramidal pistil, but differs from these three species by obovate, entire leaves, introrse anthers, and especially by the remarkable round, cushion-like thickening of the connective at the insertion of the filament. It should be called *Glyptopetalum fengii* (CHUN & HOW) DING HOU, *comb. nov.* The genus is new to China.

KEY TO THE SPECIES

1. Leaves with apices obtuse to rounded sometimes slightly notched.
2. Leaves broad-elliptic, ovate, or obovate, $4\frac{1}{2}$ -6 by $3\frac{1}{3}$ - $3\frac{1}{2}$ cm. Pedicels of the lateral fruits of each cyme at most 1 mm long above the articulation with the bracteoles 1. *G. euonymoides*
2. Leaves obovate to obovate-oblong, 10-14 by 5-8 cm. Lateral fruits c. 6 mm pedicelled. 2. *G. palawanense*
1. Leaves with apices acute to acuminate.
3. Branchlets sharply 4-angular. Leaves usually bullate 3. *G. quadrangulare*
3. Branchlets terete, sometimes also associate with slightly 4-angular ones.
4. Leaves lanceolate to narrow-lanceolate, 20-23 by 4-7 cm; veins and veinlets obscure or invisible on both surfaces; margin remotely denticulate 4. *G. acuminatissimum*
4. Leaves usually elliptic to elliptic-oblong, ovate-oblong, rarely lanceolate, 4- $17\frac{1}{2}$ by 2- $6\frac{3}{4}$ cm; veins and veinlets distinctly reticulate on both surfaces.
5. Infructescences c. 2 cm long. Leaf margin subentire, repandous, or with obscure, small black teeth. 5. *G. loheri*
5. Inflorescences or infructescences usually longer, up to 10 cm long. Leaf margin usually crenulate.
6. Petals bifoveolate at the upper part inside. Pistil evidently united with the disk, short-conical. 6. *G. zeylanicum* var. *brevipedicellatum*
6. Petals smooth inside. Disk distinctly fleshy, flat; pistil immersed in the disk and slightly above it.
7. Fruits small, subglobose, c. 8 mm \varnothing 7. *G. euphlebium*
7. Fruits larger, depressed-globose, c. 15 mm \varnothing 8. *G. marivelense*

1. *Glyptopetalum euonymoides* MERR. Philip. J. Sc. 12 (1917) Bot. 278; En. Philip. 2 (1923) 481.

Shrub c. 2 m. Branchlets terete. *Leaves* chartaceous to subcoriaceous, broad-elliptic or ovate, sometimes obovate, $4\frac{1}{2}$ -6 by $3\frac{1}{3}$ - $3\frac{1}{2}$ cm; base cuneate; apex obtuse, or rounded, sometimes slightly notched; margin entire, sometimes remotely crenulate; nerves 4 to 7 pairs; veins and veinlets obscure on both surfaces; petiole 5-12 mm. *Cymes* usually at the basal part of the flush, 2-3 times forked, 3-6 cm long. Peduncle $1\frac{1}{2}$ -3 cm. Pedicels none or very short: lateral flowers of the

cyme sessile, the central ones subsessile or up to $1\frac{1}{2}$ mm pedicelled. *Calyx* lobes reniform or semi-orbicular, 1 by $1\frac{1}{2}$ -2 mm, slightly concave with obscured longitudinal veins. *Petals* subreniform or suborbicular, $1\frac{3}{4}$ -3 by $2\frac{3}{4}$ -4 mm, rather fleshy. Disk 4-angular or slightly 4-lobed, c. 2 mm \varnothing . *Stamens* c. $\frac{3}{4}$ mm long, filament very short. Pistil slightly emerging from the disk. *Fruits* (young) subglobose or broadly ovoid, c. 8 mm long, usually only one seed developed. *Seeds* ellipsoid.

Distr. *Malaysia*: Philippines (Luzon: Ilocos

Norte, B.S. 27546, A, BM, K, US), once collected.
Ecol. On slope in thicket at low altitude.

4. *Glyptopetalum palawanense* MERR. Philip. J. Sc. 26 (1925) 466; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 126.

Small tree c. 5 m. Branchlets \pm compressed. Leaves coriaceous, shining, 10–14 by 5–8 cm; base acute to cuneate, sometimes attenuate; apex obtuse or rounded; margins remotely crenulate at the upper part; nerves 5–7 pairs, slender; petiole 8–12 mm. *Infructescences* 5½ cm, axillary and also on the internodes, 2–3 times forked. Peduncle 1–3 cm. Pedicels 6 mm. *Fruits* globose to depressed-globose, 1–4-celled, 8 mm by 1½ cm.

Distr. *Malaysia*: Philippines (Palawan), thrice collected.

Ecol. In primary forest at low altitude.

Vern. *Panablayan*.

3. *Glyptopetalum quadrangulare* PRAIN ex KING, J. As. Soc. Beng. 65, ii (1896) 345; RIDL. Fl. Mal. Pen. 1 (1922) 446; SYMINGTON, J. Mal. Br. R. As. Soc. 14 (1936) 350; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 126.—Fig. 7a–g.

Shrub or small tree up to 5 m. Branchlets distinctly 4-angled, sharply winged. Leaves subcoriaceous to coriaceous, elliptic to elliptic-lanceolate, 9–29½ by 3–13½ cm; base rounded or cuneate; apex shortly acuminate to acuminate (acumen up to 1½ cm); margin irregularly crenulate especially in the upper half; nerves (5–)8–12 pairs; nerves and veins depressed above, making the leaves subbullate; petiole 5–10 mm. *Cymes* 1(–2) axillary, sometimes on the internodes, rarely terminal, up to 10 cm long (in fruit up to 12 cm), usually forked near the apex. Peduncle 1½–8½ cm. Bracts small. Pedicels 2–3 mm, articulated at the base. *Flowers* greenish yellow. *Calyx* almost divided to the base, lobes \pm reniform, 1½–2 by 7–10 mm. *Petals* suborbicular, 3½ mm ϕ , rather fleshy, thinner and wavy near the edge. Disk flat, square, c. 2 mm ϕ . *Stamens* c. 1 mm, inserted near the base of the ovary. *Pistil* c. 5 mm above the disk, pyramidal; style and stigma obscure. *Fruits* slightly depressed-globose, 1½–2 by 1–1¼ cm, 3–4-celled, slightly sulcate. *Seeds* broadly-ellipsoid, 8 by 6 mm, reddish brown.

Distr. Burma (S. Tenasserim) and *Malaysia*: Central West Sumatra, Malay Peninsula (common), and Borneo (Sarawak: Kuching).

Ecol. Rain-forests, from the lowland up to 600 m.

Vern. *Cha teng*, *pérupong*, *p. bukit*, *poko kahava*, *p.restong*, *sěminy*, M.

Note. This is the only species which seems to be rather common. Its leaves remind of those of *G. euphlebi* which has, however, not the sharply angled branchlets.

4. *Glyptopetalum acuminatissimum* MERR. Philip. J. Sc. 29 (1926) 481; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 126.

Shrub up to 3 m. *Leaves* chartaceous, lanceolate

to narrow-lanceolate, 20–23 by 4–7 cm; base cuneate, obtuse or sometimes rounded; apex caudate-acuminate; margin irregularly, remotely denticulate at the upper two-thirds; nerves 9–12 pairs, spreading, arching 2–7 mm from the edge; veins and veinlets obscure or invisible on both surfaces; petiole ¾–1½ cm. *Infructescences* axillary, c. 3 cm long, simple or once branched cymes, usually found at the upper part of the branchlet. Peduncle ½–2 cm. Bracts small. Pedicels 5–8 mm. *Fruits* depressed-globose, 1½–2 cm ϕ . *Seeds* subellipsoid or slightly oblong, 8–10 by 7 mm.

Distr. *Malaysia*: Philippines (Luzon: Isabela Prov.), 3 collections.

Ecol. In forests, 100–300 m.

Vern. *Guisguis*, *Ilocamo*.

5. *Glyptopetalum loheri* MERR. Philip. J. Sc. 10 (1915) Bot. 321; En. Philip. 2 (1923) 481.

Shrub or small tree. Branchlets terete. Leaves subcoriaceous, elliptic- or ovate-oblong, 6–14 by 3–6½ cm; base acute to cuneate; apex acuminate; margin subentire, repand, or with obscure small black teeth; nerves 5–7, fine, spreading and slightly anastomosing-reticulate near the margin; veins and veinlets slightly elevated, finely reticulate; petiole 3–4 mm. *Cymes* simple or once branched, c. 2 cm long, axillary and extra-axillary. Peduncle 8–10 mm. Bracts small, ovate, c. 1½ mm long. Pedicels 3 mm. *Calyx* lobes subreniform or suborbicular, 1 by 1½–2½ mm, reddish brown near the margin. *Fruits* globose, 6–10 mm ϕ , smooth, sometimes slightly furrowed, 1–4-seeded. *Seeds* subglobose, c. 6 mm ϕ , reddish brown.

Distr. *Malaysia*: Philippines (Luzon: Rizal and Cavite Prov.) and SE. Celebes (Kendari, once found).

Ecol. Forests, lowland up to c. 400 m.

6. *Glyptopetalum zeylanicum* THW. in Hook. J. Bot. Kew Misc. 8 (1856) 267, t. 7B.

var. brevipedicellatum DING HOU, *var. nov.*—Fig. 7m–p.

Arbor parva. Folia chartacea, elliptica, 7½–10½ cm longa, 3½–5 cm lata, basi cuneata, apice acuta vel breviter acuminata, nervis utrinque 6–8, venulis laxe reticulatis; petiolus c. 5 mm longus. Cymae axillares, laxae, usque ad 8½ cm longae, pedunculo 4–5 cm longo. Pedicellus 2–3 mm longus. Flores albi. Calycis lobi subrotundi, c. 1 mm longi. Petala subrotunda, c. 2 mm longa, superne 2-foveolata. Stamina supra discum inserta. Ovarium discum adnatum, brevissime conicum.—Typus RIDLEY 2652, SING.

Small bushy tree. Branchlets terete. Leaves chartaceous, elliptic, 7½–10½ by 3½–5 cm; base cuneate; apex acute to short-acuminate; margin remotely crenulate; nerves 6–8 pairs; petiole c. 5 mm. *Cymes* divaricate, up to 8½ cm, once or twice forked. Peduncle 4–5 cm. Bracts triangular, c. 1 mm long; flower stalk c. 10 mm, articulated at about the upper 1/5. Pedicel (above articulation) 2–3 mm. *Flowers* (young) white. *Calyx* lobes suborbicular, c. 1 mm ϕ , slightly

erose on the margin. *Petals* suborbicular, slightly concave, c. 2 mm σ , bifoveolate at the upper part inside. *Stamens* 1 mm long, inserted on the lower part of the pistil. Pistil evidently united with the disk, short-conical, c. 1½ mm long and wide, slightly narrowed at the apex; style and stigma obscure.

Distr. *Malaysia*: Malay Peninsula (Pahang: Kota Glanggi), once found.

Notes. The Malayan variety differs from the Ceylonese var. *zeylanicum* by the more lax, spreading dichotomously branched inflorescences and flower stalks which are articulated at about the upper one fifth, the pedicel proper being only 2–3 mm. In var. *zeylanicum* the flower stalk is articulated in the lower one fifth, the pedicel proper being 9–12 mm.

KING cited the type (RIDLEY 2652) under *Euonymus wrayi* (J. As. Soc. Beng. 65, ii, 1896, 344) but his description of the 5-merous flowers of that species does not apply to RIDLEY's specimen which has 4-merous flowers.

7. *Glyptopetalum euphlebioides* (MERR.) MERR. Philip. J. Sc. 12 (1917) Bot. 280; En. Philip. 2 (1923) 481.—*G. marivelense* var. *euphlebioides* MERR. Philip. J. Sc. 10 (1915) Bot. 321.—*G. remotinervium* MERR. *ibid.* 12 (1917) 280; En. Philip. 2 (1923) 481.

Shrub or small tree up to 5 m. Branchlets terete. *Leaves* firmly chartaceous, elliptic- or ovate-oblong, 14–17 by 5½–6½ cm; base acute to cuneate; apex acute and short-acuminate; margins slightly recurved, obscurely and sometimes distinctly crenulate; nerves 5–6 pairs; petiole 6–8 mm. *Cymes* axillary or extra-axillary, few-flowered, sometimes depauperate. Peduncles ½–4½ cm. Pedicels c. 1½ mm (c. 4½ mm in fruit). *Flowers* (young): calyx lobes reniform or transverse-oblong, 1 by 2–2¾ mm, slightly erose, with several obscure longitudinal veins. *Petals* subreniform, 2 by 3 mm. *Stamens* small, c. ¾ mm long, inserted near the base of the ovary. Disk 4-lobed, c. 2 mm σ . Pistil emerging c. ½ mm

from the disk, conical. *Fruits* white, pink, or red, subglobose, c. 8 mm σ , usually 1-seeded. *Seeds* red, reddish brown when dry, subglobose, c. 7 mm σ .

Distr. *Malaysia*: Philippines (Palawan and Luzon: Zambales Prov.).

Ecol. Primary forests, 300–1400 m.

Vern. *Nou*, Tagb.

Note. The leaves are very similar to those of *G. quadrangulare*.

8. *Glyptopetalum marivelense* (ELM.) MERR. Philip. J. Sc. 10 (1915) Bot. 321; En. Philip. 2 (1923) 481.—*Euonymus marivelensis* ELM. Leaf. Philip. Bot. 7 (1915) 2580.—*G. reticulatum* MERR. Philip. J. Sc. 12 (1917) Bot. 277; En. Philip. 2 (1923) 482.—Fig. 7h–k.

Shrub or small tree up to 7 m. Branchlets terete, the ultimate internodes rarely 4-angular, sometimes slightly compressed near the node. *Leaves* chartaceous to coriaceous, elliptic-oblong to lanceolate, or lanceolate, 4–17½ by 2–6¾ cm; base cuneate or acute, very rarely obtuse; apex acuminate; margin subcrenate to remotely crenulate; nerves 6–10 pairs; veins densely reticulate, distinctly prominent on both surfaces, sometimes obscure beneath; petiole 3–18 mm, sometimes subsessile. *Cymes* axillary or extra-axillary, sometimes on a short axillary branch, 2¼–7 cm long (up to 10 cm in fruit), once or twice forked. Peduncle 1½–3½ cm. Bracts deltoid or lanceolate. Pedicels c. 3–5 mm. *Calyx* lobes semi-rounded or subreniform, ¾–2 by 1½–3¾ mm. Disk slightly 4-angular, with obscure papillae (B.S. 75176). *Petals* suborbicular or broad-ovate, c. 4 mm σ . *Stamens* inserted at the base of the ovary, c. ¾ mm long. Pistil emerging c. 1 mm from the disk, short-conical. *Fruits* reddish when fresh, depressed-globose, sometimes slightly wrinkled, c. 1½ cm σ , 3–4-seeded, slightly furrowed. *Seeds* broad-oblong, 9–10 by 7–8 mm, dark-brown.

Distr. *Malaysia*: Philippines (Mindoro, Luzon, and Catanduanes).

Ecol. Forests, from the lowland up to 1400 m.

6. KOKOONA

THWAITES in Hook. J. Bot. Kew Misc. 5 (1853) 379; KING, J. As. Soc. Beng. 65, ii (1896) 346; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 164; STEEN. Sarawak Mus. J. 8 (1958) 437.—Fig. 8.

Trees, (in Mal.) evergreen, sometimes buttressed. Branchlets flat at the nodes, almost always dark to black. *Stipules* very small. *Leaves* decussate (occasionally in some branches sometimes subopposite or even alternate), the midrib frequently convex causing the blades to fold when pressed for herbarium purposes. Panicles, or sometimes racemes, axillary. *Flowers* bisexual, usually on articulated pedicels, with 2 to 5 small bracts at the articulation. *Calyx* 5-lobed. *Petals* 5, contorted, slightly concave, subcoriaceous to coriaceous, sometimes punctate. Disk fleshy, cupular, subentire, corrugated, rarely 5-lobed. *Stamens* 5, inserted inside the inner edge of the disk; disk-lobes alternate with the petals; filaments

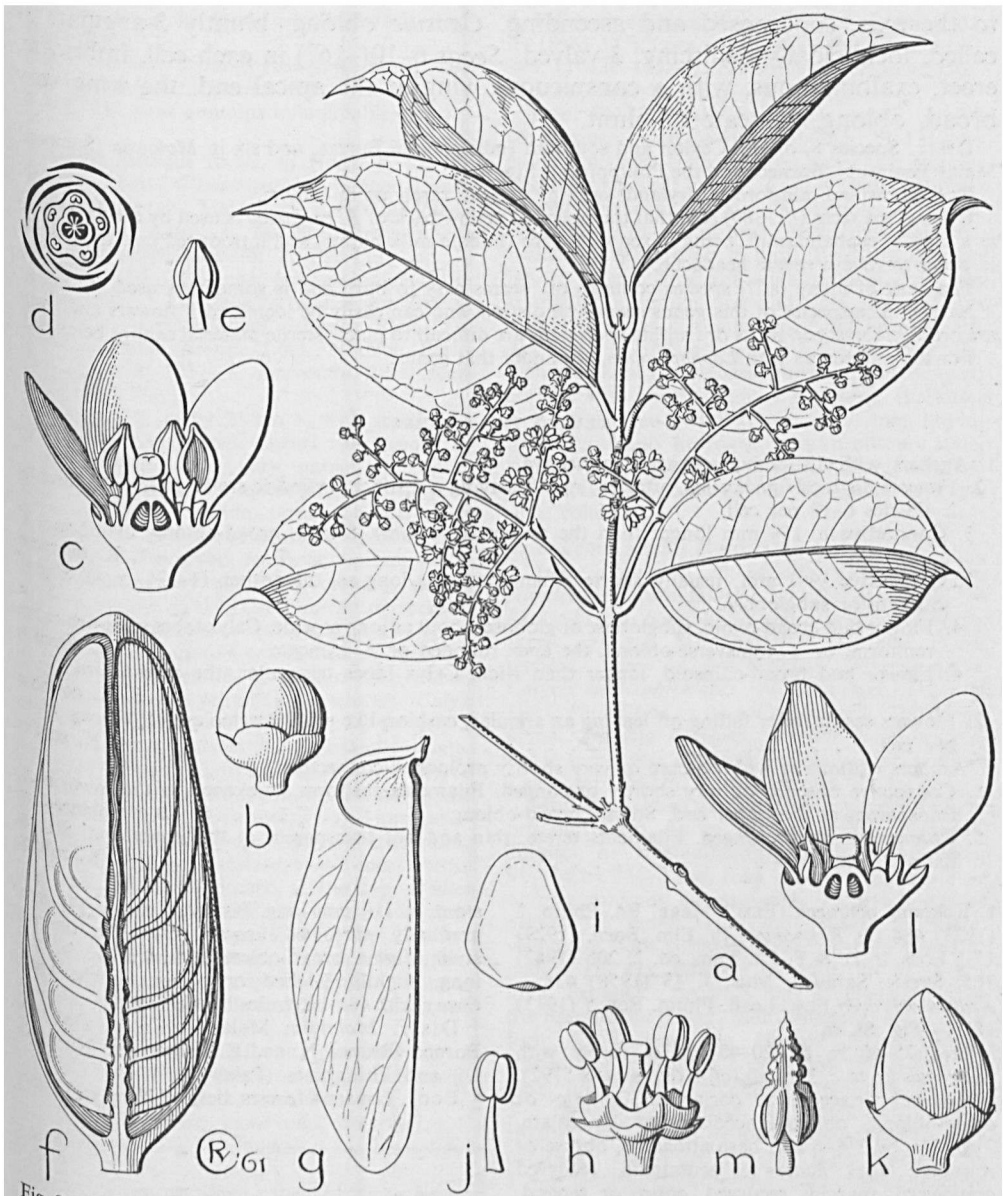


Fig. 8. *Kokoona ovatolanceolata* RIDL. a. Habit, $\times \frac{2}{3}$, b. bud, c. flower, in section, d. diagram, e. stamen, all $\times 6$, f. one fruit valve with 2 rows of imbricate seeds, g. seed, both $\times \frac{2}{3}$.—*K. reflexa* (LAWS.) DING Hou. h. Flower, petals and one anther removed, i. petal, j. stamen, all $\times 6$.—*K. ochracea* (ELM.) MERR. k. Bud, l. flower in section, m. stamen, all $\times 6$ (a-e ANDERSON 7910, f-g SAR 9291, h-j ACHMAD 945, k-m ELMER 21881).

usually fusiform, gradually or abruptly narrowed towards the apex and transparent at the upper end, very rarely terete; anthers usually with an apical, pustular, lengthened connective, rarely this obscure or obtuse. Ovary superior or sometimes partly immersed in the disk, 3-celled, gradually narrowed into an obscure style; stigma thick and short-cylindric, \pm capitate, or orbicular and flat, obtuse or sometimes obscurely 3-lobed. Ovules 6-16 in each cell, in two series, attached

to the axis, superposed and ascending. *Capsule* oblong, bluntly 3-angular, 3-celled, loculicidally dehiscent, 3-valved. *Seeds* 6-10(-16?) in each cell, imbricate, erect, exalbuminous, with a conspicuous wing at the apical end, the wing very broad, oblong, truncate or blunt.

Distr. Species 8, one in Ceylon and southern India, one in Burma, and six in *Malaysia* (Sumatra, Malay Peninsula, Borneo, and the Philippines). Fig. 9.

Ecol. Lowland rain-forests, dryland, swampy or peat, rarely up to 1500 m.

Uses. THWAITES (*l.c.* 380) said that the pounded yellow bark of *K. zeylanica* is used by the Singhalese as a kind of cephalic snuff, being mixed with ghee (buffalo milk butter) and introduced into the nostrils in order to relieve severe headache.

The bark of many (all?) species contains oil, seems easy to burn and is sometimes used for tinder.

Notes. The species of this genus seem well distinct and can easily be identified if flowers and fruits are present. Detached fruits or fruiting specimens are difficult to place; sterile material cannot be named.

For the differences with *Lophopetalum*, see under that genus.

KEY TO THE SPECIES

- 1. Anthers with distinctly prolonged connective.
- 2. Flowers distinctly pedicelled, after falling off leaving a distinct, cylindric stalk. Bracteoles usually
 - 2. Ovules 6-10 per cell.
 - 3. Connective c. 1½ mm longer than the anther (c. 1 mm). Stigma broad-oblong, cylindric.
 - 1. *K. ochracea*
 - 3. Connective ½-1 mm, usually shorter than, rarely as long as, the anther (1-1⅓ mm). Stigma capitate or subglobose.
 - 4. Flower bud broad-ovoid, subglobose or globose, about as long as wide. Calyx lobes semi-orbicular, reniform, or ± transverse-oblong, the apex rounded or ± truncate 2. *K. littoralis*
 - 4. Flower bud broad-ellipsoid, longer than wide. Calyx lobes triangular, the apex acute.
 - 3. *K. coriacea*
- 2. Flowers sessile, after falling off leaving an annular, cushion-like scar. Bracteoles 3-5. Ovules 14-16 per cell 4. *K. sessilis*
- 1. Anthers without or with obscure or very shortly prolonged connective.
- 5. Connective obscure or very shortly prolonged. Filaments fusiform, thickened in the lower part, transparent at the upper end. Stigma broad-oblong 5. *K. ovatolanceolata*
- 5. Connective not prolonged. Filaments terete, thin and not transparent at the upper end. Stigma flat and orbicular 6. *K. reflexa*

1. *Kokoona ochracea* (ELM.) MERR. En. Philip. 2 (1923) 484 (as *Kookoonia*); Pl. Elm. Born. (1929) 171; LOES. in E. & P. Fl. Fam. ed. 2, 20b (1942) 165; STEEN. Sarawak Mus. J. 13 (1958) 438.—*Ardisia ochracea* ELM. Leaflet. Philip. Bot. 5 (1913) 1819.—Fig. 8k-m.

Tree 25-40 m by 20-40 cm ø, rarely with buttresses up to c. 3 m tall (*cf.* KOSTERMANS 5792). *Leaves* subcoriaceous to coriaceous, elliptic- or ovate-oblong, oblong-lanceolate, or lanceolate, 7½-13½ by 3½-6 cm; base attenuate, obtuse or rounded; apex acute to acuminate, recurved downward; margins recurved, entire or repand, sometimes remotely crenulate; nerves 5-8 pairs, slightly elevated on both surfaces, obliquely spreading towards the margin and then upward; petiole c. 1 cm. *Panicles* up to 12 cm, solitary or paired. Peduncle up to 4 cm. Pedicels very short, sometimes up to c. 2 mm, articulated at the base. Bracts small, deltoid and acute. *Flowers* yellowish to pale brown-orange. *Calyx* lobes semi-orbicular or ± transverse-oblong, ½ by 1 mm, slightly erose. *Petals* fleshy, ovate rarely elliptic, 3½-4½ by 2½-3 mm, the margin thin and transparent. Filaments c. 1 mm; anthers including the connective c. 2½ by 1 mm, the anther proper subglobose, cordate at the base, the lengthened connective

stout, c. 1½ mm long. Pistil conical, c. 1⅓ mm, gradually narrowed upward into the obscure style; stigma broad-oblong cylindric, c. ⅔ mm long, slightly 3-lobed or obtuse at the apex. *Ovary* with (8-)10 ovules in each cell.

Distr. *Malaysia*: Malay Peninsula (Johore), Borneo (Brunei, N. and E. Borneo and Nunukan I.), and Philippines (Palawan).

Ecol. Lowland forests, below 120 m, in Tawao,

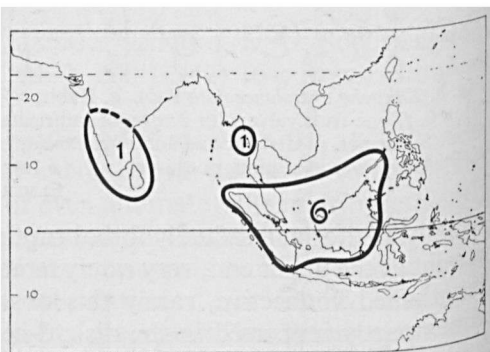


Fig. 9. Distribution of the genus *Kokoona* THW., number of species indicated.

North Borneo, once found in the forests near Nypa swamps.

Vern. Borneo: ? *batubagalang*, Pleihari, *kaju minjak*, *kēlapatiung*, Kutei, *ubar*, Brunei.

Note. The bark contains inflammable oil.

2. *Kokoona littoralis* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 617.—*Lophopetalum dubium* LAWS. l.c. 616; RIDL. Fl. Mal. Pen. 1 (1922) 450.—*K. scortechinii* KING, J. As. Soc. Beng. 65, ii (1896) 347; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 165.—*Lophopetalum maingayi* RIDL. Fl. Mal. Pen. 1 (1922) 450 (new name for *K. scortechinii*).—*Lophopetalum littoralis* RIDL. l.c.—*Solenospermum littorale* LOES. Notizbl. Berl.-Dahl. 13 (1936) 223.—*K. lanceolata* RIDL. Kew Bull. (1938) 237.

Tree up to 45 m by 75 cm ϕ , with small buttresses. Young twigs red. *Leaves* chartaceous to coriaceous, elliptic to very narrowly elliptic, broad-elliptic, ovate, or lanceolate, 4½–15½ by 1¾–7 cm; base cuneate rarely obtuse; apex acuminate, rarely blunt or acute; margins cartilaginous, slightly recurved, entire or repand, sometimes remotely very shallowly crenate; nerves 5–8 pairs; petiole ¾–1¾ cm. *Panicles* or *racemes* axillary and sometimes extra-axillary, 1½–20 cm long. Peduncle up to 6 cm. Pedicels 1–2½ mm. Bracteoles small, deltoid, c. ½ mm long, acute, denticulate. *Flowers* yellowish or whitish. *Calyx* lobes semi-orbicular, or reniform, ½ by 1½–2 mm, slightly denticulate. *Petals* broadly ovate, elliptic, sometimes suborbicular, 3½–6 by 2¾–4 mm; filaments 1–1½ mm; anthers including the connective 1½–2½ mm, connective ½–1 mm, pointed at the tip. Pistil c. 2 mm. *Ovary* ± triangular; style obscure; stigma capitate, c. 4/5 mm, obtuse sometimes slightly 3-notched at the top. *Ovules* (6–)8–10 in each cell. *Fruits* 13–18 by 3–5½ cm.

Distr. *Malaysia*: Sumatra (Morsala I., Palembang, and Indragiri), Malay Peninsula (throughout, and incl. Penang I.), and Borneo (Sarawak and Brunei).

Ecol. Primary dryland forest, from lowland up to 450–600 m, in the Cameron Highlands up to 1500 m. Monkeys eat the fruit (CURTIS).

Vern. *Babi kurus*, *mata ulat*, *mēnchali*, M. Mal. Pen., *sēpalis*, M. Palemb., *bajan garējak*, Iban.

Notes. I have examined a sheet of the authentic material of *K. littoralis* LAWS. (MAINGAY 396/2, lectotype, K), which has leafy branchlets with five detached fruits. I have also seen the type collection of *Lophopetalum dubium* LAWS. (MAINGAY 1436, K), which has three flowering branchlets with detached leaves. There are two specimens cited in the original description of *K. scortechinii* KING, i.e. CURTIS 1576 (Bo, KEP) and SCORTECHINI 2042 (lectotype K, isotypes Bo, G, KEP). All the specimens mentioned above are very similar to each other and have been accepted as conspecific.

The leaves of the present species are very variable in shape, texture and size, but the floral characters are rather homogeneous and constant.

3. *Kokoona coriacea* KING, J. As. Soc. Beng. 65, ii (1896) 347; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 165.—*Lophopetalum coriacea* RIDL. Fl. Mal. Pen. 1 (1922) 450.

Tree, 9–15 m tall. Branchlets terete. *Leaves* coriaceous, ovate to ovate-oblong, 11–12½ by 5–7½ cm; base cuneate; apex subacute; margins slightly recurved; nerves 6 or 7 pairs, slightly curved towards the margin; petiole c. 1 cm. Panicles up to 12 cm long, distinctly peduncled. Pedicels very short (c. ½ mm). Bracts ± triangular, c. ½ mm long and wide, acute. *Calyx* lobes triangular, c. ½ mm long and wide, acute. *Calyx* lobus triangular, c. ½ mm long. *Petals* broad-ovate, 4½ by 3 mm, obtuse. *Stamens* c. 2½ mm long; filaments thickened at the base, transparent at the apex; anthers with connective c. 2 mm long, the latter c. 4/5 mm. Free part of the pistil c. 1 mm, broad-ovoid, gradually narrowed into an obscure style; stigma subglobose, obscurely 3-notched at the apex.

Distr. *Malaysia*: Malay Peninsula (Perak), once collected.

4. *Kokoona sessilis* DING HOU, *sp. nov.*

Arbor usque ad 20 m alta. Folia coriacea, elliptico-vel ovato-oblonga, raro late ovata, 9½–14 by 5½–7 cm, basi obtusa, apice acuta vel obtusa, nervis utrinque 5–8; petiolus 1½ cm. Flores sessiles, basi 3–5-bracteolatae. Flores parvi. Calycis lobi orbiculares vel reniformes, 1–2 mm longi. Petala late ovata vel subrotunda, 2½–3 mm longa. Stamina breviora, antheris late ovoideis, c. 1¼ mm longis, appendicibus ½–½ mm longis.—*Typus* S.F. 36296, SING, isotypes K, L.

Monopodial tree with elongate, cylindrical crown, not buttressed, up to 20 m. *Leaves* coriaceous, elliptic- or ovate-oblong, rarely broad-ovate, 9½–14 by 5½–7 cm; base obtuse; apex acute or obtuse; margins cartilaginous, recurved, entire; nerves 5–8 pairs; veins and veinlets reticulate, visible on both surfaces rarely obscure beneath; petiole 1½ cm. *Panicles* hanging, up to 15 cm long. Peduncles up to 8 cm. Bracteoles 3–5 at the base of the flower, semi-orbicular, or ± reniform, ½–¾ mm long. *Flowers* (rather young) sessile, not fragrant. *Calyx* almost divided to the base, lobes semi-orbicular or reniform, 1–2 by 2–3 mm, slightly erose, the outer two slightly smaller. *Petals* dull yellow, broad-ovate to sub-orbicular, 2½–3 by 1¾–2½ mm; filaments c. 1 mm; anthers broad-ovoid, including connective c. 1¼ by 1 mm, the connective ¼–½ times as long as the anther. Crenulate disk and ovary orange-red. Pistil c. 1½ mm long, conical; style obscure; stigma cylindrical c. ⅔ mm, obtuse. *Ovules* 14–16 in each cell.

Distr. *Malaysia*: Malay Peninsula (Johore), once collected.

5. *Kokoona ovatolanceolata* RIDL. Kew Bull. (1938) 236 ('*ovato-lanceolata*').—*K. scortechinii* (non KING) STEEN. Sarawak Mus. J. 13 (1958) 438.—Fig. 8a–g.

Tree up to 45 by ½ m ϕ . Bark finely fissured below, smoother above. Buttresses up to c. 1 m high. *Leaves* coriaceous, shining above, rather

dull beneath, ovate, ovate-oblong to ovate-lanceolate, $7\frac{1}{2}$ –11 by 3 – $5\frac{1}{2}$ cm; base obtuse to rounded, sometimes acute; apex acuminate; margin cartilaginous, \pm entire, sometimes remotely shallow-crenulate; nerves 5–7 pairs, elevated on both surfaces, obliquely spreading and curving upward; veins and veinlets rather densely reticulate, slightly elevated on both surfaces; petiole $\frac{3}{4}$ – $1\frac{3}{4}$ cm. *Panicles* up to 14 cm long. Peduncle up to $4\frac{2}{3}$ cm. Bracts small, deltoid. Pedicels c. 1 mm. *Flowers* yellowish, fragrant. *Calyx* lobes semi-orbicular or reniform, $\frac{1}{2}$ by $1\frac{1}{2}$ mm. *Petals* ovate, $3\frac{1}{8}$ – $3\frac{3}{8}$ by 2 – $2\frac{1}{2}$ mm; anthers ovoid, $1\frac{1}{2}$ by 1 mm, acute, with a very short and obscure connective; filaments c. $1\frac{1}{2}$ mm. Pistil $1\frac{1}{2}$ –2 mm long; ovary broad-ovoid, gradually narrowed into a rather distinct style c. $\frac{1}{2}$ mm; stigma \pm broad-oblong, obtuse. *Ovules* 8–10 in each cell. *Fruit* valves narrow-oblong, 10–17 by 3–5 cm, leathery, c. 5 mm thick. *Seed* (including the wing) 7–11 by 2 – $2\frac{2}{3}$ cm, seed proper 12 by 14 mm.

Distr. *Malaysia*: Borneo (throughout).

Ecol. In primary forests, primary peat-swamp and sometimes freshwater-swamp forests from sea-level to low altitude. *Fl.* June–Sept., *fr.* Sept.–Nov.

Vern. *Akil, dian atau barak, majan*, Sarawak, *anakan*, W. Born., *badang, kayu api, mata ulat, sabong api* (Iban), Brun., *ensabung, kayu kayan*, M., *kérandji*, Sampit, *kulian, bekumpai*, SE. Born., *sépétir paya*, N. Born.

Use. The yellowish outer bark is used by natives for tinder. The timber has no commercial use.

Note. The inner side of the outer bark is bright orange which is said to be diagnostic (*vide* SMYTHIES BRUN 0822).

6. *Kokoona reflexa* (LAWS.) DING HOU, *comb. nov.*—*Lophopetalum reflexum* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 616; KING, J. As. Soc. Beng. 65, ii (1896) 352; ROLFE, Kew Bull. (1918) 48; RIDL. Fl. Mal. Pen. (1922) 449.—*Hippocratea maingayi* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 625.—Fig. 8h–i.

A tree up to 48 m by 90 cm σ , sometimes with buttresses up to $1\frac{1}{2}$ m high and c. $\frac{1}{2}$ m over the ground. *Leaves* chartaceous, elliptic-oblong, $5\frac{1}{2}$ –11 by $2\frac{1}{2}$ –4 cm; base cuneate; apex acuminate; margins remotely crenulate, rarely subentire,

slightly recurved; nerves 5 pairs; petiole $4/5$ – $1\frac{1}{2}$ cm. *Panicles* 2–18 cm long, axillary as well as extra-axillary. Peduncle up to $5\frac{1}{2}$ cm. Pedicel c. 1 mm. *Flowers* light green, or dirty yellowish white. *Calyx* lobes c. $1\frac{1}{4}$ by $\frac{1}{2}$ mm. *Petals* broad-ovate, or broad-elliptic, 3 by $2\frac{1}{2}$ mm. *Stamens* $1\frac{1}{2}$ mm; filaments terete, thin; anthers oblong, 1 by $\frac{3}{4}$ mm, obtuse at the apex, connective not produced. Pistil c. $1\frac{1}{2}$ mm long; ovary gradually narrowed into an obscure style; *ovules* 10 in each cell; stigma orbicular, flat. *Fruits* c. 12 cm long; valves c. 3 cm wide. *Seeds* including the wing 9–11 by $2\frac{1}{2}$ cm.

Distr. *Malaysia*: Sumatra (Indragiri, Asahan, Palembang; also Simalur I.), Malay Peninsula (Kedah, Perak, Dindings, Selangor, and Singapore), and Borneo (W. Borneo: Melawi; E. Borneo: Samarinda; SE. Borneo: Pleihari).

Ecol. Lowland dryland forests, sometimes up to c. 250 m, common but always in \pm scattered individuals.

Vern. Sumatra: *useu-useu uding*, Simalur, *kémpas sakam*, Indragiri, *pasir*, Batak, *négris hitam, n. pinang, sépalis*, Palembang, *rèsak, sajab*, M; Borneo: *barjau, sabong api*, Iban, *batu bagalang*, M, Pleihari, *bintan*, Sampit, *kaju minjak*, Samarinda.

Notes. The type of *Lophopetalum reflexum* LAWS. (Herb. MAINGAY 393/2, K) from Malacca is a rather poor specimen which consists of three defoliate branchlets and a fourth one bearing still a leaf. There are a few detached flower buds. The characteristic floral characters (petals convolute, disk cupular, and stamens inserted inside the disk) make it easy to recognize it as a *Kokoona*. Its chartaceous and greyish leaves, terete filaments, obtuse anthers, and triangular disk lobes represent the characters of a distinct and rather wide distributed species, *K. reflexa*.

The type of *Hippocratea maingayi* LAWS. was correctly placed by ROLFE (*l.c.*) under *L. reflexum* of which I have examined the type.

Excluded

Kokoona luzoniensis MERR. Philip. J. Sc. 27 (1925) 32. I have not yet seen the authentic material (LOHER 12754 & 13391). According to the characters of the inflorescences (paniculate) and stamens (3) indicated in the original description, this seems to belong to *Loeseneriella* A. C. SM.

7. LOPHOPETALUM

WIGHT *ex* ARN. Ann. Mag. Nat. Hist. I, 3 (1839) 150; WIGHT, I11. 1 (1840) 177; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 160.—*Solenospermum* ZOLL. Nat. Tijd. Ned. Ind. 14 (1857) 168; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.—*Lophopetalum subg. Solenospermum* (ZOLL.) VAL. Ic. Bog. 1 (1901) 43.—
Fig. 10, 12–13.

Small to tall (in Mal.) evergreen trees. Buttresses sometimes present and up to 8 m high. Branchlets mostly dark, terete (except *L. sessilifolium*) and mostly

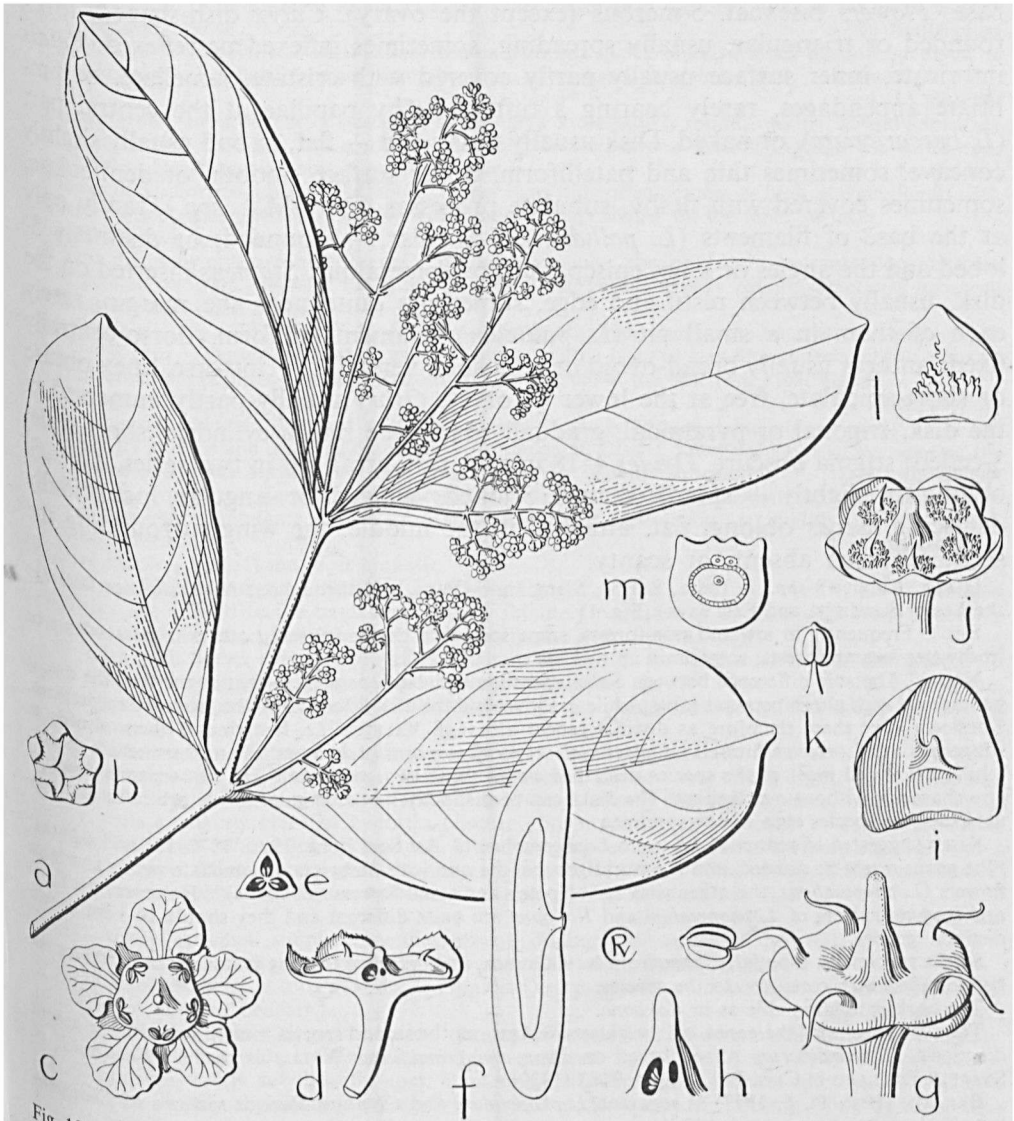


Fig. 10. *Lophopetalum beccarianum* PIERRE. *a.* Habit, $\times \frac{2}{3}$, *b-c.* bud and open flower, seen from above, $\times 6$, *d.* flower, in section, petals removed, *e.* ovary in section, both $\times 8$, *f.* seed surrounded by wing, $\times \frac{2}{3}$ —*L. macranthum* (LOES.) DING HOU. *g.* Flower, petals and sepals removed, *h.* pistil in section, *i.* petal, from inside, all $\times 6$.—*L. pallidum* LAWS. *j.* Flower, petals and anthers removed, *k.* stamen, *l.* petal, from inside, all $\times 6$.—*L. rigidum* RIDL. *m.* Section of petiole at distal end, $\times 6$ (*a-e* SAN 16022, *f* bb 10797, *g-i* GJELLERUP 701, *j-l* KL 1566, *m* HAVILAND 2235).

flattened at the nodes. Leaves decussate, or opposite, sometimes subopposite (occasionally a few leaves spiral on the upper part of a branchlet), distinctly sometimes very shortly petioled, rarely \pm sessile, blade rarely subpeltate; margin entire, sometimes cartilaginous. Stipules a tuft of hair-like processes, caducous. Thyrses axillary, 1(–2–3), sometimes branched from the very base, divaricate. Peduncle distinct sometimes very short or \pm absent. Bracts deltoid or lanceolate, usually short-ciliate or -fimbriate. Pedicels distinct, usually articulated at the

base. *Flowers* bisexual, 5-merous (except the ovary). *Calyx* dish-shaped, lobes rounded or triangular, usually spreading, sometimes inflexed or reflexed. *Petals* imbricate, inner surface usually partly covered with cristate, lamellate, or fimbriate appendages, rarely bearing a tuft of fleshy papillae at the central part (*L. beccarianum*), or naked. Disk usually fleshy and \pm flat, in bud usually slightly concave, sometimes thin and patelliform, upper surface smooth, or denticulate, sometimes covered with fleshy, subulate processes (extra-Mal. *spp.*), rarely only at the base of filaments (*L. pallidum*), 5-angular, \pm rounded, or distinctly 5-lobed and the angles or lobes episepalous, or epipetalous. *Stamens* inserted on the disk, usually between pistil and edge, sometimes quite near the margin, rarely each of them in a small pit (*L. pallidum*); filaments filiform, dorso-centrally fixed; anthers usually broad-ovoid or -ellipsoid, versatile, \pm introrse, apex obtuse or short-apiculate, free at the lower $\frac{1}{3}$ or $\frac{1}{2}$. *Ovary* usually partly immersed in the disk, trigonal or pyramidal, gradually narrowed into a cylindrical, short style, 3-celled; stigma obscure. *Ovules* 4-18 in each cell, arranged in two series. *Capsule* oblong, or slightly \pm spindle-shaped, 3-lobed, -winged, or -angular, loculicidally dehiscent. *Seeds* oblong, flat, attached in the middle, the wing surrounding the seed; albumen absent, or scanty.

Distr. About 18 *spp.*, in India, Burma, Siam, Indo-China, and throughout *Malaysia* (not found in the Lesser Sunda Is. and East Java). Fig. 11.

Ecol. Frequently in lowland rain-forests, some species in dryland forests, others in peat-swamp or freshwater-swamp forests, sometimes up to 1500 m.

Notes. The sole difference between *Solenospermum* and *Lophopetalum* is that in the first the disk is pentagonal with alternipetalous lobes, while in the second the disk is lobed and the lobes are epipetalous. LOESENER kept them therefore as distinct genera although VALETON *l.c.* had treated them already as subgenera and LOESENER himself indicated *Solenospermum macranthum* LOES. as an intermediate species. I have examined most of the species described under those two genera and can not separate them by any character without overlapping. The disks can be distinctly lobed, angular, or \pm orbicular and may vary in some species even in one specimen.

KURZ suggested to reduce *Kokoona* to *Lophopetalum* (J. As. Soc. Beng. 39, ii, 1870, 73) and said that "the genus might be divided into 2 natural groups, the one with fimbriate or lamellate petals and large flowers (*Lophopetalum*), the other with naked petals and small flowers (*Kokoona*)". However, the floral and seed characters of *Lophopetalum* and *Kokoona* are quite different and they should be kept as distinct genera.

Sterile specimens, especially those from New Guinea, and detached fruiting material can hardly or not be identified with certainty, to the species.

The bark is inflammable as in *Kokoona*.

The type species of the genus is *L. wightianum* ARN., as the second species mentioned with the generic diagnosis, *L. grandiflorum* ARN., based on *Euonymus grandiflorus* WALL., is really a *Euonymus*; cf. STAFF & BALLARD in Curt. Bot. Mag. t. 9183 (1930).

BAILLON (Hist. Pl. 6, 1877, 3) regarded *Lophopetalum* and *Glyptopetalum* as sections of *Euonymus*, but this lumping seems not justified.

KEY TO THE SPECIES

1. Flowers buds \pm flat or wider than high. Petals without appendage on the inner surfaces (except some papilla-like ones sometimes occurring in *L. beccarianum*).
2. Branchlets distinctly 4-angular. Leaves large, 17-38 by 5½-12½ cm. Inflorescences usually very long, 18-45 cm. Pedicels 7-15(-20) mm 1. *L. sessilifolium*
2. Branchlets usually terete. Leaves smaller, usually 4-15½ by 2-7 cm. Inflorescences shorter, less than 13½ cm long. Pedicels c. 2 mm.
3. Disk dish-shaped, distinctly 5-lobed, the edge turning slightly upward and forming a rim. Petiole usually flat or furrowed above and round beneath, vascular strand appearing arc-shaped with the arms bent upward and inward on a transverse section through the distal end.
4. Leaves often olivaceous above, rather yellowish green beneath when dry; apex usually obtuse, acute, sometimes short-acuminate 2. *L. beccarianum*
4. Leaves often reddish brown on both surfaces when dry; apex acuminate.
5. Petiole distinct, 5-8 mm. Inflorescences densely rusty puberulous on the young parts, usually

- glabrescent. Calyx patent at anthesis, distinctly larger than the disk, apex of the lobes usually flat and obtuse 3. *L. floribundum*
- 5. Petiole very short, c. 2 mm. Inflorescences glabrous. Apex of calyx lobes turning upcurved at anthesis; calyx hardly larger than the disk; calyx lobes acuminate and ± pointed. 4. *L. glabrum*
- 3. Disk ± flat, suborbicular or obscurely 5-angular. Petiole usually round, vascular strand appearing cylindric and enclosing 1-3 medullary bundles on a transverse section through the distal end. (Leaves usually coriaceous, rigid, subsessile.) 5. *L. rigidum*
- 1. Flower buds short conical or subglobose, higher than wide or sometimes as high as wide. Petals with distinctly cristate, lamellate, or rarely with fimbriate appendages on the inner surfaces.
- 6. Disk 4½-9½ mm ø at anthesis.
- 7. Disk distinctly or sometimes obscurely 5-lobed or -angular, the lobes or angles epipetalous; anthers apiculate. Flowers generally 10-18 mm ø at anthesis. Petiole usually round, sometimes furrowed near the distal end above.
- 8. Petals slightly reniform, c. 6 by 8½ mm, one small appendage at the base of each petal. Disk 7-9½ mm ø. Leaves coriaceous, usually covered with a layer of wax-like material above, densely covered with papillae beneath. (Petiole usually inserted at the base of the leaf blade.) 6. *L. pachyphyllum*
- 8. Petals suborbicular, 3-4 mm in ø, appendages distinctly cristate, lamellate, or rarely fimbriate, usually 3-lobed and covering the upper ½ of the petal. Disk c. 5 mm ø. Leaves subcoriaceous, the upper and lower surfaces not like above. (Leaves usually subpeltate.) 7. *L. wightianum*
- 7. Disk ± round, or sometimes obscurely 5-angular and the angles usually episepalous; anthers acute or short-acuminate. Flowers c. 1 cm ø at anthesis. Petiole flat and slightly furrowed above, round beneath 8. *L. macranthum*
- 6. Disk smaller, 1-3(-4) mm ø at anthesis.
- 9. Calyx almost divided to the base. Disk smooth. 9. *L. micranthum*
- 9. Calyx not divided to the base. Disk usually minutely papillose or covered with fleshy, subulate processes (smooth in *L. torricellense* and usually also in *L. ledermannii*).
- 10. Disk with fleshy, subulate processes around the base of the filaments. Leaves chartaceous to thin-coriaceous, usually pale ash-coloured when dry 10. *L. pallidum*
- 10. Disk usually minutely papillose or smooth. Leaves usually coriaceous and brown to reddish brown when dry.
- 11. Inner surface of the petal with a conspicuous, lobed appendage.
- 12. Petals smooth on the dorsal surface, sometimes thinner near the margin, the overlapping margins just flatly pressed on the others. Nerves usually 5-8 (rarely more) pairs; veins reticulate, slightly elevated beneath, obscure above. (Petiole 1½-2 cm.) 11. *L. javanicum*
- 12. The inner two or three petals with 2 distinct grooves on the dorsal surface, the overlapping margins fitting in these grooves. Nerves usually 10-15 pairs; veins densely reticulate, elevated beneath, usually obscure sometimes distinct above. (Petiole 1¼-3 cm.) 12. *L. multinervium*
- 11. Appendage small, simple, sometimes obscure on the upper surface of the petal.
- 13. Leaves ovate, elliptic, ovate-oblong to lanceolate, acute or acuminate.
- 14. Anthers twice as long as wide, acuminate. Disk papillose. Veins of the leaves usually invisible or obscure beneath 13. *L. ledermannii*
- 14. Anthers slightly longer than wide, obtuse, apiculate. Disk smooth. Veins of the leaves usually distinct beneath, sometimes on both surfaces 14. *L. torricellense*
- 13. Leaves mostly subobovate, apex blunt or slightly emarginate, short-apiculate, the pointed part usually slightly concave and ± sac-like. Anthers obtuse, about as long as wide. Disk papillose 15. *L. subobovatum*

1. *Lophopetalum sessilifolium* RIDL. Kew Bull. (1931) 37.

Small tree up to 5 m. Branchlets distinctly 4-angular, sometimes slightly winged, reddish brown. Leaves chartaceous, elliptic-oblong to lanceolate, 17-38 by 5½-12½ cm; base attenuate, sometimes obtuse; apex acuminate; nerves 10-14 pairs, slightly elevated on both surfaces; petiole very short to obscure. Thyrses profusely branched, sometimes almost from the base, 18-45 cm. Peduncle very short, sometimes up to 7 cm. Pedicels 7-15(-20) mm. Flower buds flat, distinctly 5-angular, open flowers patent, 7 or 8 mm ø. Calyx lobes triangular, 1¼ by 1 mm, acuminate, the apex curved upward,

margins short-fimbriate. Petals suborbicular or deltoid, c. 3 mm long, acute or round at apex, entire or sometimes slightly wavy. Disk distinctly 5-angular, acute or obtuse. Stamens small, c. ⅔ mm long; anthers obtuse. Ovary almost immersed in the disk. Fruits (young) c. 7 cm long, tuberculate, stalk up to 2½ cm. Seeds (including wing) 5½ by 1½ cm, the wing c. 2 mm wide around the seed proper. Lectotype HAVILAND 1744, K.

Distr. Malaysia: W. Borneo (Sarawak and Sg. Landak).

Ecol. Once noted, peat-swamp forest (ANDERSON).

Vern. *Lipeh*, Sarawak.

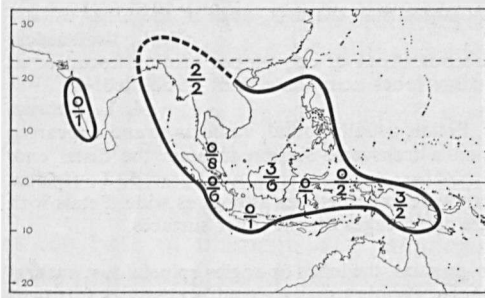


Fig. 11. Distribution of the genus *Lophopetalum* WIGHT ex ARN. For each subarea the number of species has been indicated, endemic above the hyphen, non-endemic below the hyphen.

2. *Lophopetalum beccarianum* PIERRE, Fl. For. Coch. 4 (1894) sub t. 307; MERR. EN. BORN. (1921) 354.—*L. scortechinii* KING, J. As. Soc. Beng. ii (1896) 350; RIDL. Fl. Mal. Pen. 1 (1922) 448.—*L. havilandii* RIDL. Kew Bull. (1931) 37.—Fig. 10a-f.

Tree up to c. 30 m by 40 cm \varnothing . *Leaves* chartaceous to subcoriaceous, elliptic-oblong to lanceolate, oblong, sometimes ovate-oblong or lanceolate, rarely broad-elliptic, obovate or obovate-oblong, (7–)11–15½(–30) by 3½–7(–12) cm; base cuneate; apex usually obtuse, acute, sometimes short-acuminate; nerves 5–8 pairs, obliquely spreading upwards, elevated and ridged beneath, depressed sometimes plane above; petiole ¾–1½ cm. *Thyses* up to 18 cm long, (1–)2–5 in an axil, sometimes branched quite from near the base, usually glabrous, very rarely puberulous on the young parts. Peduncle up to 4 cm, sometimes very short. Pedicels c. 2 mm. *Flowers* yellowish, c. 4½ mm \varnothing , patent. *Calyx* lobes triangular or suborbicular, c. 1 mm long, entire sometimes slightly erose, rarely short-fimbriate, sometimes with small papillae on the outer surface. *Petals* suborbicular or broad-ovate, 1¼–2½ by 1¾–2 mm, naked, sometimes with villa-like appendages on the inner side, rarely on both surfaces, sometimes with distinct venation. Disk rather thin, dish-shaped, c. 2–3 mm \varnothing , 5-lobed, lobes obtuse or rounded. *Stamens* short, sometimes the tissue of the disk cushion-like thickened round the base of the filament; anthers suborbicular, small, c. ½ mm long, obtuse, slightly acute, or very short-apiculate; filaments usually reflexed after anthesis. Pistil partly immersed in the disk, the free part pyramidal, c. ½ mm; style and stigma obscure. *Ovules* 3–4(–8) in each cell. *Fruits* 11 cm long, pericarp leathery. *Seeds* (including the wing) 4½ by 1¼ cm.

Distr. *Malaysia*: Malay Peninsula (Perak) and Borneo (N. Borneo, Sarawak, Brunei, Bulungan, W. Kutai, and Sangkulirang; Labuan I.).

Ecol. Primary forest, frequently on crests of hills, on sandstone, sand, or tuff, once noted on clay, from the lowland up to c. 400 m.

Vern. Borneo: *aras*, *memagahas*, Dusun, *bulalangbuk*, Kujau, *dual bukit*, Kedayan, *kandis*

mudah, Bajau, *kapas*, *pěrupok*, *sisilao*, Sarawak, *kapas kapas*, Sungai, *kėkan bukit*, Brunei, *kėrupuk gunung*, Nunukan I., *sinlolosu*, Tenggara, *winong kora*, Dusun & Tambato.

Notes. I have chosen SCORTECHINI 1941, K, as lectotype of *L. scortechinii* KING.

The leaf-tips of all the specimens available are mostly damaged.

3. *Lophopetalum floribundum* WIGHT, Ill. 1 (1840) 178; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 616.—*L. reflexum* (non LAWS.) KING, J. As. Soc. Beng. 65, ii (1896) 352, *pro specim.* CURTIS 1502.

Tree 15 m tall, 40(–80) cm \varnothing . *Leaves* chartaceous to thin-coriaceous, elliptic-oblong, or lanceolate, acuminate, entire, 7–10 by 2½–3½(–5) cm; base acute to attenuate; nerves 5–8 pairs, spreading and gradually curving upwards, slightly elevated on both surfaces; petiole 5–8 mm. *Panicles* solitary sometimes branched from the base, up to 8 cm, densely rusty puberulous (uniseriate, multicellular hairs) when young, usually glabrescent; peduncles 0(–2) cm. Pedicels c. 2 mm. *Calyx* usually patent at anthesis, lobes deltoid, c. 1½ by 1½ mm, exceeding the disk lobes, ciliate. *Petals* suborbicular, c. 3 mm \varnothing , entire sometimes slightly erose. Disk dish-shaped, c. 2½ mm \varnothing , edge slightly curved upward, 5-lobed, lobes deltoid and obtuse. *Stamens* before the disk lobes, sometimes the tissue of the disk slightly depressed around the base of the filaments; filaments c. ½ mm; anthers broad-ovoid or suborbicular, c. ½ mm long and wide, obtuse. Pistil partly immersed in the disk, free part pyramidal, very short; style and stigma obscure. *Ovules* 4–6 in each cell. *Fruits* c. 8 cm long; pericarp rather thin, c. 1 mm \varnothing . *Seeds* including wing c. 6 by 1½ cm, seed proper c. 4 by ¾ cm.

Distr. Burma (Mergui: GRIFFITH 620, 864, K) and *Malaysia*: Malay Peninsula (Penang I.; once in Pahang).

Ecol. Rain-forests, 150–360 m.

Vern. *Kongkor*, Pahang.

4. *Lophopetalum glabrum* DING HOU, *nov. sp.* *Arbor parva*, c. 6 m *alta*. *Folia chartacea, elliptico-oblonga*, 8–13½ cm *longa*, 3–4½ cm *lata*, *basi anguste cuneata*, *apice acuminata*, *marginē integra*, *nervis utrinque 5–7*, *venulis laxē reticulatis*; *petiolus c. 2 mm longus*. *Inflorescentiae usque ad 9 cm longae, glabrae*. *Pedicellus 5–7 mm longus*. *Flores flavescētes*. *Calyx 5-lobatus, lobis deltoideis*, c. 1 mm *longis, acuminatis*. *Petala subrotunda*, c. 2 mm *longa*. *Discus patelliformis, 5-lobus*. *Stamina breviora*. *Pistillum pyramidatum*. *Ovula in loculis 4*.—*Typus* RUTTEN 83, U, isotypes Bo.

Small tree c. 6 m by 20 cm \varnothing . Branchlets terete sometimes slightly angular. *Leaves* chartaceous, elliptic-oblong, 8–13½ by 3–4½ cm; base narrowly cuneate; apex acuminate; nerves 5–7 pairs, elevated below and slightly depressed above, obliquely spreading towards near the margin and then turning upward; petiole very short, c. 2 mm, furrowed above, round beneath. *Panicles* up to

9 cm long, usually branched from the base. Peduncle very short. Pedicels 5-7 mm. *Flowers* yellowish. *Calyx* almost as large as or slightly exceeding the disk; lobes deltoid, c. 1 mm long and wide; margins short-fimbriate, apex acuminate, ± pointed and turning upwards at anthesis. *Petals* suborbicular, c. 2 by 2 mm, entire sometimes slightly erose. Disk dish-shaped, the margin slightly curved upwards, 5-lobed, lobes deltoid, c. 1 mm long and wide. *Stamens* very short; anthers suborbicular, c. ½ mm ø, obtuse. Pistil c. ½ mm emerging from the disk, pyramidal; style and stigma obscure. *Ovules* 4 in each cell.

Distr. *Malaysia*: Borneo (Brunei; E. Borneo; Bulungan).

Ecol. On ridge, lowland forest.

5. *Lophopetalum rigidum* RIDL. Kew Bull. (1931) 38.—*L. subsessile* RIDL. l.c. 37.—Fig. 10 m.

Small tree up to 12 m by 10 cm ø, sometimes with swollen stem-base (in swamp!), bark smooth. Branchlets terete, sometimes slightly angular or compressed, light to dark-brown, usually swollen at the node. *Leaves* usually coriaceous, rigid, rarely subcoriaceous, ovate-oblong, 4½-12½ by 2-6 cm; base cuneate or obtuse; apex acuminate; nerves 4-11 pairs, elevated or flat on both surfaces, sometimes obscure beneath, obliquely spreading and slightly curved to the margin; petiole short, c. 3(-8) mm, ± terete, stout. *Panicles* up to 10 cm, usually stout, solitary, sometimes branched almost from near the base. Peduncle very short, sometimes up to 3½ cm. Pedicels 2-3 mm. *Flowers* yellowish green, 3½-6 mm ø. *Calyx* lobes and petals with small, papilla-like processes outside. *Calyx* lobes ovate or triangular, c. 1½-1½ by 1 mm, apex acuminate, ± pointed and turning upward at ± right angles, short-ciliate. *Petals* triangular or suborbicular, 1-2½ by 1-2 mm. *Stamens* c. 1 mm long; anthers small, very short-apiculate. Disk ± flat, suborbicular or obscurely 5-angular, 1½-3½ mm ø, smooth, or sometimes slightly tuberculate on the upper surface. Pistil c. 1 mm emerging from the disk, pyramidal, at the apex contracted into a short but distinct cylindrical style. *Ovules* 4(-6) in each cell. *Fruits* up to 11 cm long, short-tuberculate on the outer surface. *Seeds* including wing 5½ by 1½ cm.

Distr. *Malaysia*: Borneo (N. Borneo, Brunei, Sarawak, and Buntok).

Ecol. Understorey tree of freshwater-swamp forests, also on dryland, in heath forest; all in the lowland, thrice found on hill top at 650, 1000, and 1380 m.

Vern. *Galagah*, *parupuk*, Born., *kèrupok*, Dyak.

6. *Lophopetalum pachyphyllum* KING, J. As. Soc. Beng. 65, ii (1896) 348; RIDL. Fl. Mal. Pen. 1 (1922) 448; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

In general small buttressed tree, up to 36 m by 40 cm ø. Bark greyish white, fissured. Branchlets terete. *Leaves* coriaceous, greyish waxy above,

pale olivaceous beneath by a dense cover of minute unicellular papillae, ovate-, sometimes elliptic-oblong, 11-17 by 5-10 cm; base obtuse or rounded; apex acute to short-acuminate, usually damaged in the herb.; margin cartilaginous and slightly recurved; nerves 7-9 pairs, obliquely curving and ascending; petiole 1-2 cm, almost terete, not grooved above; blade sometimes subpeltate. *Panicles* up to 21 cm long, 1(-2-3) in an axil. Peduncle very short, sometimes up to 6 cm. Pedicels 8-15 mm. *Flowers* yellowish, large, c. 18 mm ø. *Calyx* almost as large as the disk, slightly lobed, lobes round. *Petals* reniform, c. 6 by 8½ mm, entire, the appendage at the base inside, small, sometimes obscure. Disk ± orbicular, slightly convex towards the center near the ovary, 7-9½ mm ø, obscurely 5-lobed. *Stamens* inserted near the ovary; filaments c. 2½ mm; anthers ellipsoid or slightly ovoid, 1½ by 1 mm, slightly apiculate. *Ovary* emerging c. 2 mm from the disk, narrowed towards the apex; *ovules* 16 in each cell.

Distr. *Malaysia*: Sumatra (Djambi) and Malay Peninsula (Perak, Dindings, Selangor, Negri Sembilan, and Johore).

Ecol. Dryland forests, on hill slopes, and limestone cliffs, from the lowland up to 450 m. Vern. *Tèrupuk*, M.

Note. As lectotype I have selected KING's coll. 7525, L (by error cited as 7325).

7. *Lophopetalum wightianum* ARN. Ann. Nat. Hist. 3 (1839) 151; WIGHT, Ic. 1 (1839) t. 162; Ill. 1 (1840) 178; BEDD. Fl. Sylv. 1 (1869) t. 145; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 615; PIERRE, Fl. For. Coch. 4 (1894) t. 307B, incl. var. *macrocarpum* PIERRE; PITARD, Fl. Gén. I.-C. 1 (1912) 876, f. 109; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 161, f. 45.—*L. fimbriatum* WIGHT, Ill. 1 (1840) 178; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 615; KING, J. As. Soc. Beng. 65, ii (1896) 349; RIDL. Fl. Mal. Pen. 1 (1922) 448; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162; TARDIEU, Suppl. Fl. Gén. I.-C. (1948) 807; Not. Syst. 14 (1950) 48.—*Euonymus fimbriatus* BAILL. ex LANESS. Pl. Util. Col. Franç. (1886) 312.—*L. winkleri* LOES. Notizbl. Berl.-Dahl. 13 (1936) 221; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

Tree up to 50 m by 65(-195) cm ø, sometimes buttressed. Branchlets terete, sometimes slightly 4-angular. *Leaves* subcoriaceous, often elliptic to elliptic-oblong, sometimes ovate to ovate-oblong, rarely obovate or broad-obovate, 8-25 by 4-10 cm; base obtuse to rounded, sometimes cuneate, usually subpeltate; apex acute, sometimes acuminate (acumen up to 1 cm), rarely apiculate, usually dried and breaking off in the herb.; nerves 6-12 pairs; petiole terete, rarely sulcate above near the distal end, 1½-2½ cm. *Panicles* up to 12 cm long, sometimes branching from near the base, branchlets rather stout, obliquely spreading. Peduncle obscure, sometimes up to 7 cm. Pedicels 5-9 mm. *Flowers* 10-13 mm ø. *Calyx* almost as large as the disk, distinctly 5-lobed, lobes triangular, acute, short-ciliate. *Petals* broadly ovate or suborbicular

with undulating margins, yellow, 3–4 mm long and wide, appendage transverse cristate or lamellate, rarely fimbriate, usually manifest (sometimes small especially on the specimens from Borneo), attached at the lower half or sometimes at about the middle, sometimes divided into 3, and the middle one almost reaching the apex of petals. Disk red, concave and cup-shaped in the bud, flat or dish-shaped at anthesis, c. 5 mm ϕ , distinctly 5-lobed to almost orbicular, lobes epipetalous. *Stamens* inserted near the ovary; filaments c. 2½ mm; anthers oblong or slightly ovoid, apiculate, c. 1½ by 1 mm. Pistil red, c. 2 mm emerging from the disk. *Ovary* triangular and narrowed upwards into the style; ovules 12–18 in each cell. *Fruits* 10–15 cm long. *Seeds* (incl. wing) 6½ by 1½ cm, seed proper 4¾ by 1 cm.

Distr. India (Deccan, from the Concan southwards to Cape Comorin, and Assam), E. Pakistan (Chittagong), Burma (Tenasserim, Amherst), Cochinchina, and *Malaysia*: Sumatra (Palembang and Banka), Malay Peninsula (Kedah Dindings, Selangor, Negri Sembilan, Malacca, Penang, Langkawi, and Singapore), and Borneo (E. Kutai, K. Panya, Pleihari, and Hayup).

Ecol. Everwet lowland forests, in riverine forest, temporarily inundated forests, sometimes near the shore just behind high-water mark, but also on sandy dryland and coral limestone; in India ascending to 900 m (BEDDOME, l.c.).

Vern. Sumatra: *bau langit*, East Coast, *p̄rupuk*, *p. talang*, *t̄rupuk talang*, M, *trupuk*, Banka; Mal. Pen.: *k̄ruiē*, Lakai, *mata ulat*, Kedah, *m̄dang assam*, Malacca, *p̄rupok*, Langkawi; Borneo: *bura*, Dyak, *nasi-nasi*, Brunei, *p̄rupuk unung*, M.

Notes. *L. fimbriatum*, based on GRIFFITH'S collection from Mergui, Burma, would be distinct from *L. wightianum* by the thinner and membranous leaves, the fimbriated crest of the petals, as well as the flowers being scarcely half the size. In the authentic material of *L. fimbriatum* (K) the inflorescences have mostly flower buds with a few open flowers which are rather wrinkled. From the specimens available, the differential characters indicated by WIGHT are variable and intermediate forms are commonly found sometimes even on the same specimen.

Specimens from India, Burma, and Indo-China usually have disks with distinctly broad-oblong lobes and petals bearing manifest appendages, while those from Borneo usually have the disk obscurely lobed, angular, or \pm orbicular and petals with sometimes small and obscure appendages. Judging from the variations and intermediate forms of the specimens available, the three names mentioned above belong to one widely distributed species.

8. *Lophopetalum macranthum* (LÖES.) DING HOU, *comb. nov.*—*Solenospermum macranthum* LOES. Notizbl. Berl.-Dahl. 13 (1936) 222; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.—Fig. 10g–i.

Tree up to 12 m. Branchlets terete, sometimes subterete. *Leaves* coriaceous, ovate-oblong, rarely

oblong-lanceolate, 9–16 by 4–6 cm; base obtuse or \pm rounded; apex obtuse, or obscurely short-acuminate; nerves 6–7 pairs, obliquely ascending; veins reticulate, prominent on both surfaces; petiole 7–10 mm. *Panicles* solitary, up to 18 cm long, divaricate, lax, branched almost from the base. Peduncle very short. Pedicels 5–6 mm. *Flowers* yellowish white, fragrant, c. 1 cm ϕ . *Calyx* lobes semi-orbicular, or \pm reniform, 1 by 2½ mm, \pm entire. *Petals* ovate or broadly ovate, sometimes even suborbicular, 4–4½ by 3–4 mm, wavy on the margin, appendage very small, inserted at the middle or lower half, triangular with a very broad base. Disk fleshy, \pm rounded to obscurely 5-angular, the obscure angles epispalous or epipetalous, c. 4½ mm ϕ , smooth. *Filaments* inserted \pm between pistil and edge of disk, c. 2¼ mm; anthers broad-ovoid, 1¼ by 4/5 mm, acute or short-acuminate. Pistil emerging c. 2 mm above the disk. *Ovary* slightly 3-angular, narrowed into a cylindrical style. *Ovules* 8 in each cell.

Distr. *Malaysia*: New Guinea (Hollandia), once collected; possibly a few sterile sheets from Papua.

Ecol. In lowland rain-forest on hill, 25 m.

9. *Lophopetalum micranthum* LOES. Nova Guinea 8 (1910) 279.—*Solenospermum micranthum* LOES. Notizbl. Berl.-Dahl. 13 (1936) 225; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

Tree. Branchlets terete. *Leaves* coriaceous, obovate to slightly obovate-oblong, rarely elliptic-oblong, 3–6½ by 1½–3¼ cm; base cuneate to attenuate; apex acute; nerves 5–7; veins slightly elevated beneath. invisible above; petiole c. 2 mm. *Panicles* up to 3 cm long, few-flowered. Peduncle short, sometimes up to 1 cm. Pedicel c. 1½ mm. *Flower* yellowish green. *Calyx* almost divided to the base, lobes deltoid or semi-orbicular, 1 by 1–1½ mm, obtuse, short-fimbriate. *Petals* ovate to broadly ovate, 1½–2 by 1¼–1½ mm, acute or obtuse, \pm entire, appendage simple, small. Disk fleshy, \pm orbicular or obscurely obtuse-5-angular, c. 1½ mm ϕ . *Stamens* inserted on the edge of disk; anthers ovoid, c. 4/5 by ½ mm, obtuse or very short-apiculate; filaments c. 5 mm. Pistil emerging c. 1 mm from the disk; *ovary* triangular at base, narrowed into a short style; stigma obscure. *Ovules* 8 in each cell. *Fruit* unknown.

Distr. *Malaysia*: New Guinea (Hellwig Mts: Nepenthes Hill), once found, possibly also Mt Arfak at 2200 m.

10. *Lophopetalum pallidum* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 615; RIDL. Fl. Mal. Pen. 1 (1922) 449, incl. var. *curtisii* (KING) RIDL.—*L. curtisii* KING, J. As. Soc. Beng. 65, ii (1896) 351.—*Solenospermum pallidum* LOES. Notizbl. Berl.-Dahl. 13 (1936) 225.—Fig. 10j–l.

Tree up to c. 40 m by 60 cm ϕ , sometimes buttressed. Branchlets terete. *Leaves* chartaceous to thin-coriaceous, ash-coloured above, elliptic to elliptic-oblong, sometimes ovate to ovate-oblong, 7–12 by 3½–5½ cm; base obtuse or

cuneate; apex acute to short-acuminate; nerves 8-10 pairs; petiole 1½-2 cm, grooved above. Panicles sometimes extra-axillary, 3-7 cm long; peduncle 1-3 cm. Pedicels 2½-3 mm. Flowers yellow. Calyx lobes semi-orbicular, reniform, or triangular, 1 by 1½-2 mm, entire. Petals deltoid, 2½-3 by 2½-3 mm, entire or slightly erose, with fleshy, lobed processes ± in the central part. Stamens inserted between pistil and disk margin in pits surrounded by fleshy, subulate processes (½-½ the length of the filament); filaments ½-1½ mm; anthers broadly ovoid, ⅔-1 mm long, acute. Disk dish-shaped, red, 5-angular, obtuse, 3-4 mm ø, usually covered with papillae. Pistil triangular, emerging c. 1 mm from the disk, gradually narrowed into a cylindric, short style. Ovules 10 in each cell. Fruits c. 15½ cm long; pericarp hard, c. ½ cm thick. Seeds including wing 9 by 2¼ cm, seed proper 5¼ by 1 cm.

Distr. *Malaysia*: S. Sumatra (Palembang), Malay Peninsula (Kedah, Selangor, Negri Sembilan, Malacca, and Penang) and Borneo (Sanggau, Pasir, and Balikpapan).

Ecol. Dryland primary rain-forest, often on hillsides or in sandy country, lowland up to 200 m.

Vern. *Dorojolang*, Pasir, *kéroi*, Temuan, *kéroie*, Lakai, *kèlèmpait*, *kéroeh*, *manau*, *pèlantan gunung*, *tiada tahu*, *tjangèl*, M.

Use. Used as dart poison ingredient in Malaya.

Notes. I have examined both the types of *L. pallidum* (MAINGAY 393, K) and *L. curtisii* (CURTIS 1577, K) in the Kew Herbarium and there is no doubt that they are conspecific.

The most characteristic characters of this species are the fleshy, subulate processes around the base of the filaments and the ash-coloured leaves.

It is quite closely related to the continental SE. Asian *L. celastroides* LAWS. and *L. wallichii* KURZ. In these the disk is entirely covered with fleshy, subulate processes and the leaves are wider, ovate or broad-elliptic and usually brown to reddish brown when dry. I have seen both the types of *L. celastroides* and *L. wallichii* and several other flowering specimens in the Kew Herbarium collected in Burma, Siam, and Indo-China; they are similar to each other, and in my opinion *L. celastroides* LAWS. should be reduced to *L. wallichii* KURZ.

11. *Lophopetalum javanicum* (ZOLL.) TURCZ. Bull. Soc. Nat. Hist. Mosc. 36, i (1863) 598, as *javanum*; K. & V. Bijdr. 7 (1900) 95; VALETON, Ic. Bog. 1 (1901) 43, t. 90; KOORD. Exk. Fl. Java 2 (1912) 523.—*Soienospermum javanicum* ZOLL. Nat. Tijds. Ned. Ind. 14 (1857) 169; LOES. Notizbl. Berl.-Dahl. 13 (1936) 223; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162, f. 46.—*L. fuscescens* KURZ, J. As. Soc. Beng. 44, ii (1875) 202, *ex descr.*; KING, J. As. Soc. Beng. 65, ii (1896) 352; RIDL. Fl. Mal. Pen. 1 (1922) 448.—*L. fimbriatum* (non WIGHT) F.-VILL. Nov. App. (1880) 46; VIDAL, Sinopsis (1883) 20, t. 31, f. G.—*Hippocratea maingayi* (non LAWS.) VIDAL, l.c. f. F.—*L. oblongum* KING, J. As. Soc. Beng. 65, ii (1896) 350; RIDL. Fl. Mal. Pen. 1 (1922) 448; CRAIB, Fl. Siam. En. 1 (1926)

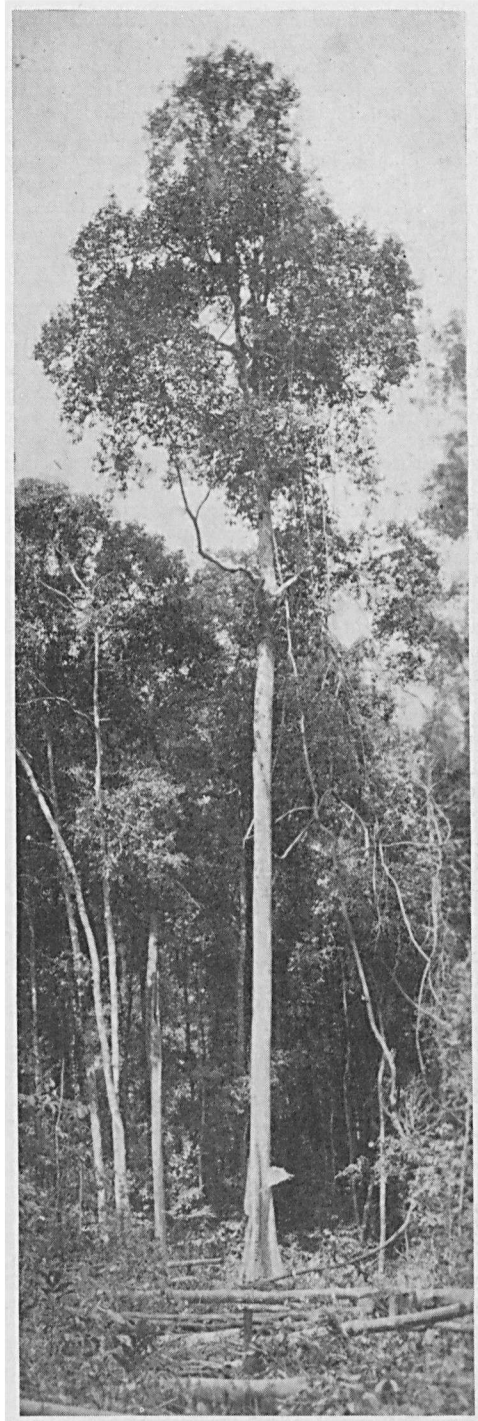


Fig. 12. *Lophopetalum* sp. Habit of a large tree (Palembang, THORENAAR, 1924).

282.—*L. oblongifolium* KING, J. As. Soc. Beng. 65, ii (1896) 351; RIDL. Fl. Mal. Pen. 1 (1922) 449; LOES. Notizbl. Berl.-Dahl. 13 (1936) 225.—*L. toxicum* LOHER, Ic. Bog. 1 (1897) 55, t. 16; MERR. En. Philip. 2 (1923) 481.—*L. celebicus* KOORD. Minah. (1898) 623.—*L. intermedium* RIDL. Fl. Mal. Pen. 1 (1922) 449.—*L. paucinerivium* MERR. Philip. J. Sc. 20 (1922) 402.—*Solenospermum paucinerivium* LOES, Notizbl. Berl.-Dahl. 13 (1936) 223.—*Solenospermum toxicum* LOES. l.c.; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.—*Solenospermum oblongifolium* LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

Tree up to 45 by 1 m \varnothing , sometimes slightly buttressed when growing in swamps. *Leaves* subcoriaceous to coriaceous, elliptic-oblong or elliptic, ovate-oblong to lanceolate, rarely obovate or ovate, 5½–18 by 2½–10 cm; base acute to cuneate, sometimes obtuse; apex acute to short acuminate, very rarely obtuse and apiculate; nerves 5–8 pairs (very rarely more); petiole 1½–2 cm. *Panicles* up to 19 cm, sometimes branched almost from the very base; occasionally furfuraceous, glabrescent; peduncle very short, sometimes up to 4½ cm. *Pedicels* 3–3½ mm. *Flowers* white, light green or yellowish green, c. 9 mm \varnothing . *Calyx* lobes almost patent or sometimes the apices curved upwards, rarely reflexed, slightly or c. ½ mm exceeding the margin of the disk lobes, acute, short ciliate. *Petals* broad-ovate, or -oblong, 2–3 by 1¾–2½ mm, obtuse or slightly erose, sometimes slightly fimbriate at the apex, appendages lobed or dentate, usually \pm 3-lobed, the central lobe often prominent and longer than the lateral ones. Disk fleshy, thick, flat sometimes concave in the bud, obscurely 5-angular or \pm rounded, 2½–3 (–4) mm \varnothing , usually minutely papillose on the upper surface. *Stamens* inserted between ovary and edge of disk or sometimes quite near the margin; filaments c. 1½ mm; anthers broad-ovoid, acuminate, c. 1 by ½ mm, apiculate. *Pistil* emerging c. 1½ mm from the disk. *Ovary* slightly triangular, narrowed into a cylindrical style; stigma obscure. *Ovules* 5–8 in each cell. *Fruits* 6½–11 cm long; pericarp leathery, rather thin, smooth or sometimes minutely tuberculate. *Seeds* with a wing c. 6½ by 1½ cm.

Distr. Siam (Puket, sec. CRAIB) and *Malaysia*: Sumatra (Tapus, West Coast, Palembang, Lampung, Simalur I., Nias, Banka, and Riouw), Malay Peninsula (Perak, Kedah, and Penang), Java (rare, mainly Central Java), Borneo (common), Philippines (Luzon, Mindoro, Samar, Sulu Is., and Palawan), Celebes (Muna, Minahassa, Malili, Bone, Aanaiwoi), Moluccas (Morotai and Taliabu Is.), and New Guinea (Japen and Hollandia).

Ecol. Usually in dryland rain-forests in the lowland, several collections found on loam soil and limestone rocks, rarely in temporarily inundated forest or peat swamp, sometimes also found at higher altitudes, e.g. 1000 m (Central Java) and 1500 m (Mt Kinabalu).

Vern. Sumatra: *bĕhu*, Nias, *bintol langsa bungo*, *tĕradih uding*, Simalur, *dilau rumba*,

ĕmpidingan, *kumbang*, *marpitis*, M, *madang-gambici*, Batak, *madan landjut*, Pariaman; Mal. Pen.: *kachang rimba*, Kedah; Java: *mandalaksa*, J; Borneo: *mĕdang bora*, m. *tolei*, Balikpapan, *agar-agar*, *dampal*, *djĕrĕndjang*, *pĕrupuk*, p. *gunung*, *sĕraya puteh*, *takau*, *tulang*, M, *duah*, Dusun & Kedayan, *kaju api*, E. Kutei, *kayu malam pĕrampuan*, *ranau*, Sungei, *kĕdjĕ woos*, *kĕtapang*, *marĕndai*, Kutei, *bura*, *maratĕmon*, *pĕndjolawat*, *sang*, Dyak, *pisang pisang*, *tapatung*, Dusun, *mĕmagahar*, *tanggom apui*, N. Born.; Philip.: *sampol*, Bis., *abúab*, *abútab*, *bokbok*, *butiŕgi*, *dayandang*, Tag., *buyun*, Sul., *ditá*, Neg., *kalibambāngan*, Mand., *puti-i-babáe*, *puti-i-laláki*, Lan., *sudkad*, P. Bis.; Celebes: *bongkorio*, *kulilawa puté*, Muna, *kabalo*, Malili, *kalĕleng*, Bone, *totorintek*, Minahassa; Moluccas: *mómu*, Sula; New Guinea: *ra ai*, Ambai, *tatokwa*, Hollandia.

Notes. ZOLLINGER cited two collections 779 (*non vidi*) and 3254 (lectotype G, FI); TURCZANINOW cited the latter number by error as 3654.

The inflorescences of some specimens show witches' broom malformations, e.g. KOSTERMANS 9580.

12. *Lophopetalum multinervium* RIDL. Kew Bull. (1931) 39.—*Lophopetalum* sp., THORENAAR, Trop. Natuur 16 (1927) 76; ENDERT, Verslag M.O. Born. Exp. (1927) 221.—*Solenospermum aquatile* RIDL. Kew Bull. (1938) 236.—Fig. 13.

Tree up to 45 m by 70 cm \varnothing . Buttresses up to 80 cm high, extending 8 m over the ground, sometimes with knee-roots. *Leaves* coriaceous, ovate to ovate-oblong, elliptic to elliptic-oblong, 10½–18 by 4½–8 cm; base obtuse or rounded, sometimes cuneate; apex acuminate; nerves 10–15 pairs; petiole (1–)1¾–3 cm. *Panicles* up to 12 cm long, sometimes scurfy on the young parts. Peduncle up to 6 cm long. *Pedicels* 3½–4 mm. *Flowers* light or yellowish green, rarely white, c. 7 mm \varnothing . *Calyx* triangular, ¾ by 1½ mm, acute, short-ciliate. *Petals* broad-ovate, 2½–3 by 1¾–2 mm, acuminate, appendage with broad base inserted at the lower ½, lobes rather small, the inner two or three always with 2 grooves on the dorsal side. Disk fleshy, flat, c. 3 mm \varnothing , obscurely 5-angular, densely covered with minute papillae. *Stamens* inserted between the ovary and the disk margin; filaments c. 1¾ mm; anthers broad-ellipsoid or -ovoid, 1 by ½ mm. *Pistil* emerging c. 1¼ mm from the disk. *Fruits* 7–8½ cm long; pericarp leathery, hard, furfuraceous outside. *Seeds* (including the wing) c. 5 by 1¼ cm.

Distr. *Malaysia*: Sumatra (East Coast, Indragiri, Riouw and Palembang), Banka, Malay Peninsula (Perak, Pahang and Singapore), and Borneo (common).

Ecol. In lowland forests, usually occurring in peat swamps (on shallow peat) and inundated forest, rarely found at higher altitude (Mt Kinabalu at 1350–1500 m).

Galls. There are small, club-shaped or ellipsoid galls, c. 1 mm long, occurring on the upper surfaces of the leaves; sometimes a few subglobose,

fruit-like galls *c.* 1 cm \emptyset are found on the inflorescences.

Vern. Sumatra: *Pérupuk*, *p. talang*, Palembang, *pupu*, Bengkalis; Borneo: *bako*, Dyak, *dual*, N. Born., *pasana*, *pérupuk*, M, Iban, & Banka.

Note. The type of *Solenospermum aquatile*, MOTLEY 861 (K), has been recorded as growing in water (*cf.* RIDL, 1938, *l.c.*). The specimen is a rather young branchlet and has rather young flowers and fruits. In addition to the ecological habit, it matches *L. multinervium* very well.



Fig. 13. *Lophopetalum multinervium* RIDL. Pneumatophores in swamp forest of Sugut For. Res., *c.* 39 miles N of Sandakan (MEIJER, 1961).

13. *Lophopetalum ledermannii* (LOES.) DING HOU. *nov. comb.*—*Solenospermum ledermannii* LOES. Notizbl. Berl.-Dahl. 13 (1936) 224; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

Tree up to 26 m by 56 cm \emptyset . Branchlets terete. Leaves coriaceous, rigid, opaque, ovate-oblong to lanceolate, sometimes ovate, 5–10 by 2½–4½ cm; base acute or obtuse; apex acuminate or acute; nerves 5–8 pairs; petiole 7–10 mm. Panicles up to 9 cm, solitary, branched almost from the base.

Peduncle very short, sometimes up to 1½ cm. Pedicels 2–3 mm. Flowers white, 6–7 mm \emptyset . Calyx patent or slightly reflexed in bud, lobes deltoid to broad-triangular, ½ by ½–1¼ mm, acute or obtuse, sparsely, very short-fimbriate. Petals ovate or deltoid, 2–3 by 1¾–2 mm, obtuse; appendage small, lanceolate, in the centre. Stamens inserted usually between the edge of the disk and the base of the ovary, sometimes quite close to the margin; anthers ovoid-oblong, 1 by ½ mm, short-acuminate; filaments *c.* ⅔ mm. Disk \pm rounded, fleshy, *c.* 2 mm \emptyset , smooth, sometimes with sparse papillae. Pistil pyramid, 1–1¼ mm above the disk; style and stigma obscure. Ovules 7–8 in each cell. Fruits unknown.

Distr. Malaysia: Moluccas (Morotai) and New Guinea (also in Mios Noem and Japen I.).

Ecol. Primary, rarely secondary forests, from the lowland up to 850 m.

Vern. *Sewaidjakas*, Manikiong, *sidomokoe*, Galela, *tenggarenop*, Pápua, *wajarora*, Wanapi, *weekal* or *weekar*, Tor.

Note. There are three specimens cited in the original description of which I have selected DOCTERS VAN LEEUWEN 9622 as lectotype (L; isotypes Bo & K).

14. *Lophopetalum torricellense* LOES. in K. Sch. & Laut. Nachtr. (1905) 303.—*Solenospermum torricellense* LOES. Notizbl. Berl.-Dahl. 13 (1936) 224, *ex descr.*, *incl. var. opacum* LOES.; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 162.

Tree up to 29 m by 36 cm \emptyset . Bark greyish, fairly rough. Branchlets terete sometimes slightly 4-angular. Leaves coriaceous, rigid, opaque, ovate, or broad-ovate, rarely elliptic-oblong, or obovate, (3–)4½–8 by (1½–)2½–4½ cm; apex acute to short acuminate, rarely obtuse; base obtuse, cuneate, or round; nerves 4–6 pairs; petiole 3–7 mm. Panicles solitary. Peduncle very short, sometimes up to 8 mm. Pedicels 3–4 mm. Flowers yellowish green, 6–7 mm \emptyset . Calyx lobes triangular, ½–½ by 1 mm, short-fimbriate, in bud the lobes patent sometimes slightly inflexed at the apex. Petals triangular 2½ by 1½ mm, obtuse; appendages very small, inserted almost at the centre. Stamens *c.* 1½ mm, inserted almost on the margin of the disk; anthers broad-ellipsoid or -ovoid, ⅔ by ⅔ mm, obtuse and short-apiculate. Disk \pm rounded, fleshy, *c.* 2 mm \emptyset , smooth, sometimes sparsely short-papillose. Pistil emerging *c.* 1 mm from the disk. Ovules 6 in each cell. Fruits 6–8 cm long. Seeds (*incl. wing*) 3½ by 1 cm.

Distr. Malaysia: North New Guinea.

Ecol. Primary forests usually *c.* 1000–2200 m, rarely occurring at 600 m.

Vern. *Hemouw*, Manikiong.

Note. The available specimens (BRASS & VERSTEEGH 11901, 11905, 12564; BRASS 12326) are very homogeneous. They match very well the isotype of *Solenospermum torricellense* var. *opacum* (LEDERMANN 10059, L) and agree also with the description of *Lophopetalum torricellense* (type: SCHLECHTER 14507, not seen).

15. *Lophopetalum subobovatum* KING, J. As. Soc. Beng. 65, ii (1896) 349, as '*sub-obovatum*'; RIDL. Fl. Mal. Pen. 1 (1922) 448.—*Solenospermum apiculatum* RIDL. Kew Bull. (1938) 235.

Tree up to 39 m by 70 cm ϕ . Bark rough, fissured, greyish sometimes dark-brown. Branchlets terete. *Leaves* coriaceous, subobovate sometimes elliptic, $4\frac{1}{2}$ –13 by $2\frac{1}{2}$ –7 cm; base cuneate; apex obtuse and apiculate, the pointed part usually slightly folded upwards and shallow-sac-like, sometimes obscurely acute, rarely notched; nerves 4–6 pairs; petiole $\frac{1}{2}$ – $1\frac{1}{2}$ cm. *Panicles* solitary, up to 10 cm. Peduncle very short, sometimes up to c. 4 cm. Pedicels 3–6 mm. *Flowers* white. *Calyx* lobes patent or the apex slightly curved upwards, triangular, $\frac{1}{2}$ – $\frac{2}{3}$ by 1 mm, slightly ciliate. *Petals* triangular, or slightly ovate-oblong, 3 – $3\frac{1}{2}$ by 2 – $2\frac{1}{2}$ mm, slightly erose, appendage rather small, at the upper half. Disk slightly angular, fleshy,

usually covered with minute papillae, c. 3 mm ϕ . *Stamens* inserted between pistil and edge of disk; filaments c. $1\frac{1}{2}$ mm; anthers slightly deltoid, c. $\frac{2}{3}$ mm long and wide, obtuse. Pistil c. $1\frac{1}{2}$ mm emerging from the disk, triangular at the base, gradually narrowed into a cylindrical style. *Ovules* 6 in each cell. *Fruits* c. 7 cm long, usually minutely tuberculate. Seeds including the wing $4\frac{3}{4}$ –6 by 1 – $1\frac{1}{2}$ cm.

Distr. *Malaysia*: Sumatra (Riouw, Indragiri), Malay Peninsula (Penang, Pahang, and Johore), and Borneo (common).

Ecol. Dryland lowland rain-forests, below 400 m, twice recorded from 600–700 m in North Borneo.

Vern. *Duol*, *dual*, Brunei, *kadjo*, Dyak, *kungkur*, *mata ulat*, *paropo*, *pèrupok*, *tjauto putih*, M.

8. MICROTROPIS

WALL. [Cat. (1830) n. 4337–40, *nomen*] ex MEISN. Pl. Vasc. Gen. Tabul. Diagn. (1837) 68, *nom. gen. cons. prop.*; Comment. (1837) 49, *non* E. MEY. 1836; cf. Taxon 11 (1962) 226; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 276; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 126.—*Microtropia* REICHB. Nomencl. (1841) 190.—*Paracelastrus* MIQ. Fl. Ind. Bat. 1, 2 (1859) 590; F. N. WILLIAMS, Bull. Herb. Boiss. II, 5 (1905) 224.—Fig. 14.

Shrubs or small trees. Terminal node of each flush usually with one, sometimes two pairs of subsistent incipient bracts. *Stipules* minute, early caducous, or exstipulate (?). *Leaves* decussate or opposite, glabrous (except in one extra-Mal. sp.), entire. *Flowers* sessile or subsessile, in axillary or extra-axillary dichotomous or paniculate cymes, sometimes condensed to sessile clusters, at the base of the flush, bisexual (sometimes unisexual by abortion in extra-Mal. spp.), 5- or 4-merous. *Calyx* deeply lobed, lobes almost free, persistent, imbricate, unequal in size, the outer 2 or 3 usually smallest. *Petals* slightly united at the base, sometimes free (*M. bivalvis*), imbricate, erect. *Stamens* usually dorsifixed; filaments subulate, usually united at the base into (? inserted on) a ring or short tube (the ring sometimes interpreted as a disk) (except in Mal. in *M. tenuis* and *M. trameris*), the united part free from the petals or sometimes adnate to them (in *M. tenuis* stamens even inserted in the mouth of the corolla); anthers broad-ovoid or ovoid, introrse, rarely extrorse (*M. discolor*). *Ovary* free, completely or incompletely 2-celled. *Ovules* 2 in each cell, erect, collaterally attached to the axis towards the base at the inner angle (see below); style very short or cylindrical; stigma obscure, or discoid, sometimes slightly 2–4-lobed. *Capsule* short-apiculate to beaked, rarely obtuse, lengthwise striate, laterally split along one side, sustained by a persistent calyx. *Seed* usually 1, erect, on a knob-like thickened placenta, albuminous, enveloped by the aril, usually wrinkled, testa similar to aril, smooth, soft, red or red-brown.

Distr. About 70 spp., distributed in Central America (4 spp.), SE.–E. Asia, and Malaysia, from Ceylon and India (Deccan Peninsula, Silhet, Assam) eastward to S. China (Yunnan, Szechuan, Kwantung, Fukien), Hainan, Formosa, central Japan, Riukiu, southward through Burma, Siam and Indo-China to Malaysia (Sumatra, Malay Peninsula, West Java (once found), Borneo, and the Philippines). Fig. 15.

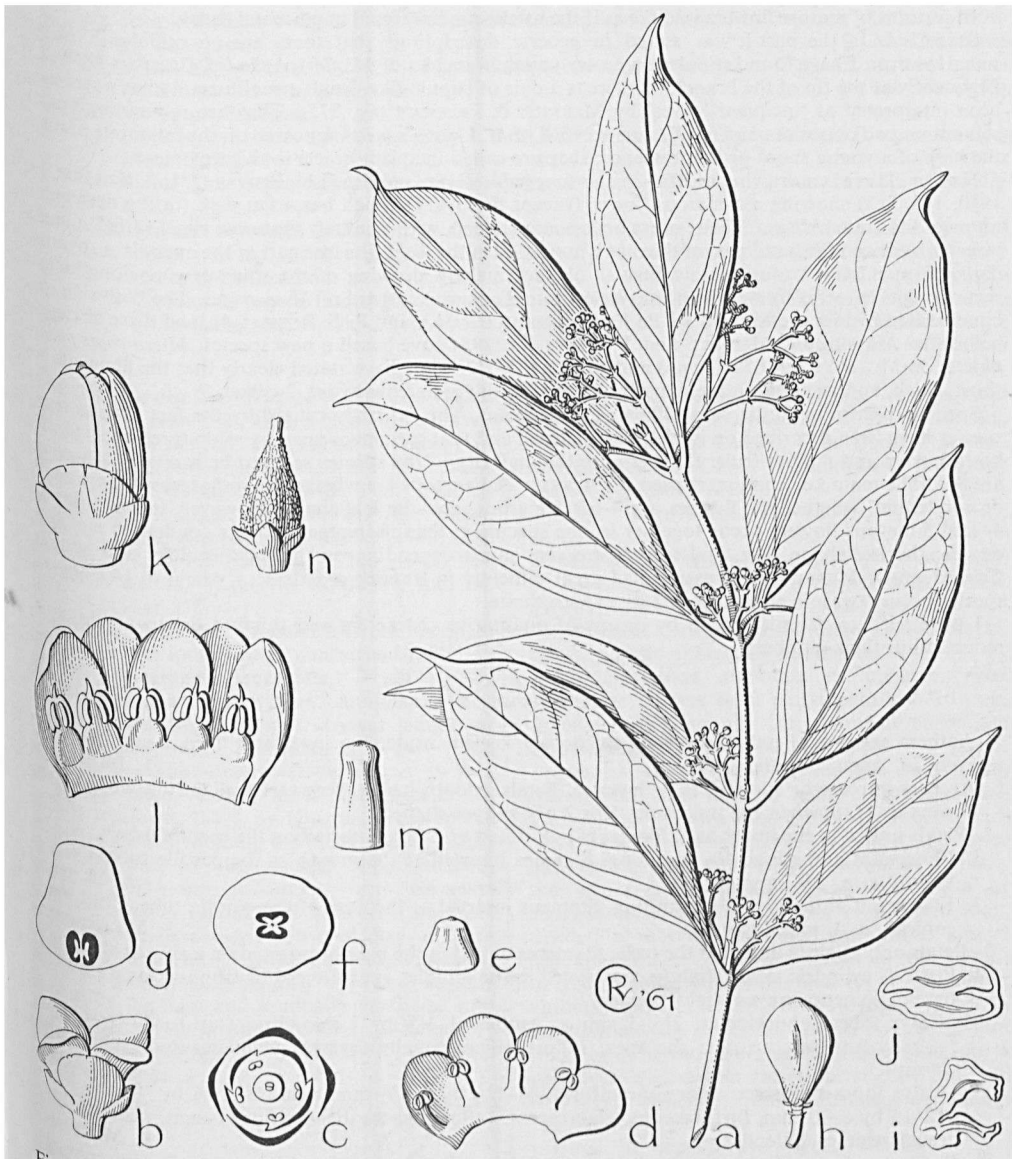


Fig. 14. *Microtropis tetrameris* DING HOU. *a*. Habit, $\times \frac{2}{3}$, *b*. flower, *c*. diagram, *d*. corolla with stamens, *e*. pistil, all $\times 6$, *f-g*. ditto, section, $\times 12$, *h*. fruit, nat. size, *i-j*. sections of fruit, pericarp removed, obviously the remaining placenta containing 2 seeds, $\times 3$.—*M. elliptica* KING. *k*. Flower, *l*. corolla with stamens $\times 6$, *m*. pistil, all $\times 6$, *n*. young fruit $\times 2$ (*a-g* KOSTERMANS 7312, *h, j* ditto 4482, *i* ditto 4399, *k-m* RAHMAT SI TOROES 5591, *n* ISMAEL 60).

Ecol. Forests, from the lowland up to 2700 m.

Embryol. I have not succeeded in observing the exact situation of the ovules and seeds. Mr W. VAN HEEL has made a series of microtome sections of flower buds of *M. curranii* and *M. tetrameris*. It appears that in each cell the placentas are distinctly axile and 2-lobed, but show no trace of distinct ovules. In one slide one of the placental lobes would seem to contain an incipient embryo-sac, but the insertion or immersion of the ovules on or in the placental tissue must wait pending the examination of sufficient fixed material. Obviously the formation of ovules occurs rather late in the development. In the longitudinal sections it appeared that in bud the septum is not complete at the apex, but closes later.

In sections of mature flowers it looks as if the ovules are immersed in placental tissue.

Stipules. In the past it was stated in generic descriptions that there are no stipules in this genus. However, I have found stipules on a very young branchlet of *M. platyphylla* (cf. CLEMENS 31809, L). Frequently at the tip of the branchlet, there is a pair of stipule-like, small aciculiform bodies which have been interpreted as 'incipient leaves' by MERRILL & FREEMAN (l.c. 275). They are resembling bracts; sometimes two opposite pairs (cf. CLEMENS 29518 of *M. kinabaluensis*) appeared on the internode towards the base of a young shoot or inflorescence; they are called incipient bracts in this treatment.

Notes. There is a drawing of *Microtropis longifolia* WALL, published by BISWAS (J. Ind. Bot. Soc. 19, 1940, 143, f. 3) showing a 5-merous flower (except the ovary) which has a flat disk (in the description on page 144 stated 'disk annular, more or less cup-shaped, with minutely fimbriate rim') with 5 stamens inserted on it and the basal part of the ovary immersed in the disk. The free part of the ovary is \pm pyramidal, c. 1 mm long. Unfortunately BISWAS did not make a drawing of the transverse or longitudinal section of it. It seems to me this flower belongs to *Euonymus* instead of *Microtropis*. The flowering specimens cited by him are MAUNG BA PE 13105, BURKILL 30313, and P. T. RUSSELL 41, and these obviously belong to *Microtropis*. MERRILL and FREEMAN (l.c. 298) have based a new species, *Microtropis pachyphylla*, on MG. PO CHIN 6553 (type) and BURKILL 30313. They have stated clearly that the filaments are short, thick, and inserted on the margin of the disk; ovary narrow-ovoid, 2-celled.

Specific discrimination is very difficult in this genus. This is partly caused by the fact that so many species have been described on inadequate material and that specimens are very seldom represented with both flowers and mature fruit. Furthermore the majority of the species seem to be rare and collections are few. The main key characters used by MERRILL & FREEMAN are whether the inflorescences are ample or condensed, whether the flowers are 4- or 5-merous, and the leaf-shape. However, in many species 4- and 5-merous flowers occur together in one specimen; the inflorescences occur condensed merely in degree; the leaf-shape, size, and texture are very much depending on the local ecology and altitude. Consequently, MERRILL & FREEMAN had great difficulty in framing a satisfactory key: in 14 cases one species occurs twice in their key, in 2 cases even thrice.

I have tried to delimit species by means of qualitative characters and this has led to a substantial reduction in their number.

KEY TO THE SPECIES

1. Anthers extrorse. Petals always conspicuously keeled inside, the innermost 1 or 2 slipper-shaped even in open flowers 1. *M. discolor*
1. Anthers introrse or sometimes \pm latrorse. Petals smooth inside, very rarely slightly keeled in some flowers in *M. bivalvis*, the innermost 1 or 2 not slipper-shaped.
2. Petals united in the lower half; filaments not united in a ring, inserted on the corolla tube.
 3. Flowers at anthesis c. 4½ mm long. Stamens inserted at the mouth of the corolla tube. Pistil \pm flask-like, c. 2½ mm long 2. *M. tenuis*
 3. Flowers at anthesis c. 2½ mm long. Stamens inserted at the base of the corolla tube. Pistil short-conical, c. 1 mm long 3. *M. tetrameris*
2. Petals only slightly united at the base; filaments united at the base or inserted on a ring or short tube.
4. Pistil \pm cylindrical, often slightly constricted in the middle; apex discoid or truncate, as wide as the base or sometimes even slightly wider.
 5. Calyx lobes suborbicular, 2½-3 mm ϕ . Anthers 1-1½ by 1 mm. Fruits up to 20 by 12 mm, usually furfuraceous near the apex. Inflorescences usually thyrses, peduncles and rachis rather stout 4. *M. valida*
 5. Calyx lobes suborbicular or subreniform, 2/3-1½ by 1-2½ mm. Anthers c. 2/3 by ½ mm. Fruits 12-15 by 8-10 mm, furfuraceous, glabrescent. Inflorescences dichotomous cymes, peduncles and rachis thin and slender 5. *M. bivalvis*
4. Pistil ovoid, ovoid-oblong, or short-conical (\pm cylindrical in *M. ovata*), more or less gradually narrowed towards the apex; apex obtuse, slightly notched or 4(-6)-toothed, narrower than the base.
6. Connective broad and prominent on both sides and separating the thecae. Peduncles and rachis when present distinctly furfuraceous 6. *M. elliptica*
6. Connective invisible at least on the inner side. Peduncles and rachis when present glabrous.
7. Calyx lobes transparent (when boiled), from the base with 1-5 longitudinal, few-branched veins, distinct or conspicuous on both surfaces. Fruits rounded at the apex, mucronate by the persistent style.
8. Leaves elliptic-oblong to lanceolate, 11-22 cm long. Pistil \pm flask-shaped.
 7. *M. kinabaluensis*
 8. Leaves obovate, obovate-oblong, elliptic, rarely suborbicular, 3½-7 cm. Pistil short-conical.
 8. *M. curranii*
7. Calyx lobes rather dull and only transparent at the margin, venation usually invisible, sometimes loosely reticulate and slightly visible on both surfaces. Fruits as far as known acute to short-acuminate or rostrate, terminating in the persistent style.
9. Apex of pistil 4(-6)-toothed (sometimes obtuse when young).

- 10. Petiole distinct, 1-2 cm. Calyx lobes suborbicular or reniform, 2 by 2-3 mm. Anthers obtuse at the apex 9. *M. sumatrana*
- 10. Petiole very short (c. 2 mm) or none. Calyx lobes suborbicular, 3 by 2½ mm. Anthers short-acuminate at the apex 10. *M. rigida*
- 9. Apex of pistil obtuse.
 - 11. Pistil ± cylindric, smooth, c. 2 by 1 mm. Branchlets distinctly 4-angular. (Leaves sessile.) Fruit unknown 11. *M. ovata*
 - 11. Pistil ± short-conical, usually longitudinally striate, 1-1½ by 1-1¼ mm. Branchlets usually terete.
 - 12. Thyrses or rarely dichotomous cymes, peduncle distinct (½-2 cm), rachis or internodes distinct to the naked eye. Fruits 1½-2¼ by 1-1¼ cm; apex acute to short-acuminate, or rostrate, furfuraceous near the apex 12. *M. platyphylla*
 - 12. Condensed cymes, fascicles or glomerules, sessile or subsessile, rachis or internodes obscure or invisible to the naked eye. Fruits smaller, c. 1 by ½ cm, obtuse, furfuraceous.
 - 13. *M. wallichiana*

1. *Microtropis discolor* (WALL.) WALL. Cat. (1830) n. 4337; ARN. Ann. Nat. Hist. 3 (1839) 152; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 614; KURZ, For. Fl. Burma 1 (1877) 251; KING, J. As. Soc. Beng. 65, ii (1896) 341; RIDL. Fl. Mal. Pen. 1 (1922) 444; CRAIB, Fl. Siam. En. 1 (1926) 281; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 292; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129. —*Cassine discolor* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 378.

Shrub or small tree. Branchlets terete. Incipient bracts 3-8 mm long. Leaves chartaceous, elliptic-oblong, sometimes lanceolate, 7½-14½ by 2-5½ cm; base attenuate; apex acuminate; nerves 5-7 pairs; petiole 5-10 mm. Cymes simple or thrice dichotomously branched, c. 1 cm long; peduncle 3-8 mm. Bracteoles deltoid, c. ½ mm long and wide. Calyx lobes suborbicular to slightly reniform, 1-1¼ by 1½ mm, erose on the margin. Petals ± oblong, distinctly keeled inside, the inner one or two usually slipper-shaped, 2-3½ by 1-1½ mm. Stamens 1½ mm; filaments subulate, slightly dilated and united at the base; anthers dorso-basifixed, slightly oblong or ellipsoid, c. ¾ mm long, extrorse, distinctly apiculate. Pistil 1-1½ mm long, slightly wrinkled, slightly swollen at the base and gradually narrowed into a cylindric style; stigma obscurely 2-lobed, or obtuse. Fruits ellipsoid, 11-15 by 7-10 mm, subfurfuraceous.

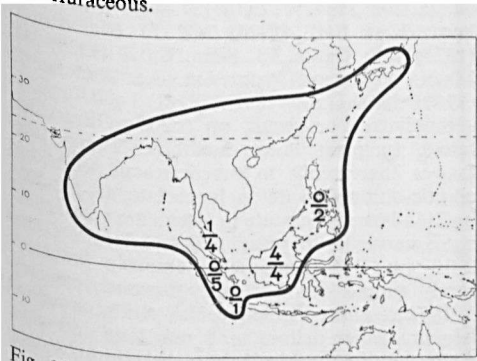


FIG. 15. Distribution of the genus *Microtropis* WALL. ex MEISN.; species density in Malaysia, endemic above the hyphen, non-endemic below it; in Asia c. ? 40 spp.

Distr. India (Sikkim, Khasia, Assam, and Bengal), Burma (rather common), Siam (Betong, Kaw Chang, and Lasau), Indo-China (Bienhoa and Lakhon), S. China (Yunnan) and *Malaysia*: Malay Peninsula (Penang).

Ecol. Rain-forests, 300-1260 m.

2. *Microtropis tenuis* SYMINGTON, J. Mal. Br. R. As. Soc. 14 (1936) 350, t. 19; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 304.

Small tree. Branchlets subterete. Leaves chartaceous, elliptic-oblong to lanceolate, 4½-9½ by 2-4½ cm; base attenuate or cuneate; apex acuminate; nerves 6-10 pairs; petiole 6-10 mm. Inflorescences simple or elongate-paniculate cymes, rarely 1-flowered; peduncle 1-2½ cm. Bracteoles at the base of the flowers deltoid, transparent, the margin reddish brown, short-fimbriate, c. 1½ mm long. Calyx lobes suborbicular or broadly obovate, 2½-3½ mm ø, the lower half rather thick and slightly wrinkled outside, the upper half irregularly splitting, erose or short-lacerate. Corolla whitish, c. 4½ mm long, divided at about the upper half, lobes almost oblong, obtuse. Stamens inserted at the mouth of the corolla; filaments free for c. 1½ mm; anthers dorso-basifixed, broad-ovoid, ¾ by ⅔ mm, obtuse, the lower half free. Pistil c. 2¼ mm long; ovary ovoid and gradually narrowed into a cylindric style; stigma discoid or slightly capitate.

Distr. *Malaysia*: Malay Peninsula (Pahang: Mt Tapis).

Ecol. In dipterocarp forest, 750 m.

Note. Known only from the authentic collection (SF 28818, SING, L) which was printed erroneously as "S'p. 28878" in the original description.

3. *Microtropis tetrameris* DING HOU, nov. sp.—Fig. 14a-j.

A *M. tenui* SYMINGTON, cui affinis, foliis ellipticis raro ovatis, floribus subsessilibus, minoribus, staminibus basi in tubum insertis, ovario conico, circiter 1 mm longo differt.—*Typus* KOSTERMANS 7312, L, isotypes Bo, K.

Small tree up to 15 m by 30 cm ø. Branchlets terete. Incipient bracts 2-7 mm. Leaves chartaceous to subcoriaceous, elliptic rarely ovate, 7-11 by 3½-5 cm; base attenuate; apex short-acuminate

to acuminate, sometimes acute; nerves 4-7 pairs; petiole 5-8 mm. *Inflorescences* paniculate-cymose, up to 4½ cm long, few- to many-flowered; peduncle 7-14 mm. *Flowers* green or greenish-white; bracteoles broad-ovate, c. 1 mm long, sometimes keeled outside. *Calyx* lobes suborbicular, 1-1½ mm ø, two opposite pairs, denticulate. *Corolla* c. 2½ mm long, the lobes very broad-oblong, or ± quadrangular, 1-1½ mm long, obtuse. *Stamens* c. 1½ mm long; anthers suborbicular, free at the lower ½, c. ⅔ mm long, obtuse or slightly apiculate, usually perpendicularly bent towards the center; filaments subulate, fleshy, c. 1 mm, inserted at the base of the corolla tube and usually the lower half adnate to it; anthers dorso-basifixed. Pistil short-conical, c. 1 by 1 mm, obtuse, slightly furrowed. *Fruits* ellipsoid or slightly obovoid, 12-15 by 8-10 mm, obtuse, furfuraceous; persistent calyx lobes patent.

Distr. *Malaysia*: Borneo (Balikpapan: KOSTERMANS 7312, 4242, 4399, 4482; Pleihari: bb 10372).

Ecol. Primary forest, from lowland up to 700 m.

Vern. *Masintan*, Born., *ratubégalang*, *M.*

Note. The specimens cited above are very homogeneous and bear both flowers and fruit. *M. tetrameris* is very closely allied to *M. tenuis* especially by the leaf-shape, inflorescences, 4-merous flowers, and stamens not united into a tube. It differs, however, from it by the characters indicated in the key, by the nervation, and also by the geographical distribution. The structure of the seeds (fig. 14i-j) is not clear.

4. *Microtropis valida* RIDL. J. Str. Br. R. As. Soc. n. 75 (1917) 19; Fl. Mal. Pen. 1 (1922) 445; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 304.—*M. bicolor* MERR. & FREEM. l.c. 298.—*M. pauciflora* BOERL. ex MERR. & FREEM. l.c. 303.

Shrub or small tree up to 5 m. Branchlets terete. Incipient bracts 3-8 mm. *Leaves* subcoriaceous to coriaceous sometimes chartaceous, ovate to lanceolate, elliptic-oblong or elliptic, 11-27½ by 4½-12 cm; base rounded, acute, or cuneate to attenuate; apex acute to acuminate, sometimes obtuse or short-apiculate; nerves 6-14 pairs; petiole 1-2 cm. *Inflorescences* usually paniculiform, 1½-6 cm, rarely a simple cyme or fasciculate less than 1 cm; peduncles 1-4 cm, sometimes very short. Bracteoles slightly ovate or suborbicular, 1¼-2 mm long. *Flowers* 4(-5)-merous. *Calyx* lobes suborbicular, 2½-3 mm ø, concave, slightly wrinkled outside, margin transparent, slightly erose. *Petals* broad-elliptic or -oblong, 2½-3 by 1¾-2½ mm, obtuse. *Stamens* c. 1½ mm long; anthers very broadly oblong, c. 1-1½ mm long, obtuse and short-apiculate, connective distinct, broad on the dorsal side; filament flat, c. 1 mm, distinctly united at the lower ⅓. Pistil ± cylindric, slightly constricted at the middle, slightly furrowed, c. 2 mm long, truncate or discoid at the top, rarely notched. *Fruits* ellipsoid, c. 21 by 11 mm, acute to acuminate and furfuraceous at the apex, terminating in a very short, persistent style.

Distr. *Malaysia*: Sumatra (no precise locality), Malay Peninsula (Perak, Pahang, and Johore), and Borneo (Sarawak).

Ecol. Rain-forests from lowland up to 1800 m, once collected in mossy forest (KEP 36566).

Notes. The flower of *M. bicolor* is unknown. In the characters of the leaves and the persistent calyx lobes this species is similar to *M. valida* with the exception that the fruits (two collections) are fasciculate. There is a sterile specimen, BECCARI (PB 1488, K), which has large leaves up to 27 by 8½ cm with rather obscure venation underneath. There are galls on the upper surfaces, which are pale, corky bodies lobed but globose in outline, c. 3-4 mm ø. This specimen matches the type collection, BECCARI (PB 2617, K) which also bears these characteristic galls.

The authentic material of *M. pauciflora* was collected by KORTHALS (*s.n.*, L) in West Central Sumatra. The specimens are rather poor with detached flower-buds and young fruit. One specimen had two flowers still attached to the inflorescence; the one I dissected was 5-merous as indicated in the original description. The vegetative and floral characters are quite similar to those of the *M. valida* with the exception that the flowers as far as we know are 5-merous.

5. *Microtropis bivalvis* (JACK) WALL. List (1830) n. 4340; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 614; KING, J. As. Soc. Beng. 65, ii (1896) 341; RIDL. Fl. Mal. Pen. 1 (1922) 444; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 301; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129.—*Celastrus bivalvis* JACK, Mal. Misc. 1, 5 (1821) 19; ROXB. Fl. Ind. ed. Carey & Wall. 2 (1824) 399.—*Paracelastrus bivalvis* MIQ. Fl. Ind. Bat. 1, 2 (1859) 591; F. N. WILLIAMS, Bull. Herb. Boiss. II, 5 (1905) 224.—*M. filiformis* KING, J. As. Soc. Beng. 65, ii (1896) 342; RIDL. Fl. Mal. Pen. 1 (1922) 444; BURK. & HENDERSON, Gard. Bull. S.S. 3 (1925) 360; CRAIB, Fl. Siam. En. 1 (1926) 281; MERR. Pap. Mich. Ac. Sc. 1938, 24 (1939) 79; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 300; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129, f. 35.—*M. peduncularis* RIDL. Kew Bull. (1924) 262; Fl. Mal. Pen. 5 (1925) 298; CRAIB, Fl. Siam. En. 1 (1926) 282; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 300.

Small tree or shrub, up to 7 m. Branchlets terete. Incipient bracts small, c. 2 mm long. *Leaves* chartaceous to subcoriaceous, elliptic to elliptic-oblong, ovate to lanceolate, (6-)12-20½ by 2½-8 cm; base acute to attenuate; apex acuminate; nerves 6-10 pairs; petiole 5-8 mm. *Cymes* 2-10 cm, 2-5 times dichotomously branched, rarely simple, few- to many-flowered; peduncle 1-7½ cm. *Flowers* pale-greenish-yellow or yellowish; bracteoles deltoid, c. 1 mm long and wide. *Calyx* lobes suborbicular to subreniform, ⅔-1½ by 1-2½ mm, very short-fimbriate or slightly erose and transparent on the margin. *Petals* free, oblong or oblong-ovate, sometimes slightly contracted at the base, the inner one or two con-

cave or laterally folded, $2\frac{1}{2}$ – $3\frac{3}{4}$ by $1\frac{1}{4}$ – $1\frac{3}{4}$ mm. *Stamens* c. $1\frac{1}{3}$ mm long; filaments flat, basifixed, c. $\frac{4}{5}$ mm, united at the lower half or lower $\frac{1}{3}$; anthers oblong, c. $\frac{2}{3}$ mm long, obtuse. Pistil c. $1\frac{1}{2}$ mm long, cylindrical, slightly contracted at the middle, slightly ridged; stigma discoid. *Fruits* ellipsoid, $1\frac{1}{4}$ – $1\frac{1}{2}$ by $\frac{4}{5}$ –1 cm, furfuraceous, glabrescent; style persistent.

Distr. Siam (Kasum), Burma (Tenasserim), and Malaysia: Sumatra (Asahan and Pajakumbuh) and Malay Peninsula (Kedah, Perak, Dindings, Kelantan, Trengganu, Pahang, Selangor, Langkawi Is., and Penang).

Ecol. Chiefly in primary forests, rarely in secondary forests, 300–1800 m.

Vern. *Kaju bile-bile*, *k. borhum*, *sungai buloh*, Asahan.

Notes. The chief differences between *M. bivalvis*, *M. filiformis* and *M. peduncularis* are found in the length of inflorescences and the size of leaves and flowers. These differences hold only for the type specimens but in additional specimens one can find the intermediate sizes sometimes even on a single specimen.

According to MERRILL & FREEMAN (*l.c.* 272 & 301), WALLICH n. 4340 (BM, G, K, and L) is made up of material collected in Penang by JACK and PORTER and it is reasonably safe to assume that this WALLICH number does represent the type collection of *Celastrus* ? *bivalvis* JACK. They have also pointed out that JACK, who described his species with 'corolla none', concluded to this from specimens with fallen petals; this inadequacy led MIQUEL (*l.c.*) to propose for it the new generic name *Paracelastrus*, based solely on JACK's original description of *Celastrus bivalvis*.

6. *Microtropis elliptica* KING, J. As. Soc. Beng. 65, ii (1896) 340; RIDL. Fl. Mal. Pen. 1 (1922) 444; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 296; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129.—*M. ophirensis* RIDL. J. Str. Br. R. As. Soc. n. 35 (1901) 10; Fl. Mal. Pen. 1 (1922) 444; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 297.—*M. vinculans* BOERL. & KOORD. in Koord.-Schum. Syst. Verz. 2 (1911) 33; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129.—*M. bivalvis* (non WALL.) KOORD. Exk. Fl. Java 2 (1912) 524; KOORD.-SCHUM. Syst. Verz. 1 (fam. 158) (1912) 3; KOORD. Atlas 1 (1913) t. 138.—*M. javanica* MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 295.—*M. longirostris* MERR. & FREEM. *l.c.* 303.—Fig. 14k–n.

Shrub or small tree up to 15 m. Branchlets terete. Incipient bracts $\frac{1}{2}$ –1 cm. *Leaves* chartaceous to coriaceous, elliptic to elliptic-oblong, sometimes ovate to lanceolate, $4\frac{1}{2}$ –22 by 2–11 cm; base cuneate; apex acute to acuminate; nerves 5–9 pairs; petiole 3–13 mm. *Inflorescences* usually in several leaf-axils along the branchlet, sometimes extra-axillary near the base of a young shoot, rarely ramiflorous, \pm condensed or short to distinct-peduncled, rather laxly cymose, 1–5 cm long, few-flowered; peduncles when present $\frac{1}{2}$ – $1\frac{1}{2}$ cm, densely furfuraceous. Bracteoles

deltoid, c. $\frac{1}{2}$ mm long. *Flowers* white, 5-merous, occasionally a few flowers 4-merous. *Calyx* lobes \pm semi-orbicular, sometimes subreniform, 1– $1\frac{1}{2}$ by $1\frac{1}{2}$ – $2\frac{1}{4}$ mm, in full developed flowers 3– $4\frac{1}{2}$ mm. *Petals* elliptic- or ovate-oblong, or slightly oblong, 3–4 by $1\frac{1}{3}$ –2 mm, up to 5 by 3 mm. *Stamens* c. 2– $2\frac{1}{2}$ mm, finally $3\frac{1}{2}$ mm long; filaments flat, united at the lower $\frac{1}{3}$ – $\frac{2}{3}$; anthers broad-oblong, $\frac{4}{5}$ –1 mm long, obtuse; connective broad and prominent on both sides, shortly sometimes distinctly protruding beyond the anther-cells. Pistil ovoid-oblong, 2–3 by $\frac{3}{4}$ –1 mm, slightly, gradually narrowed to the apex; apex obtuse, sometimes obscurely notched. *Fruits* ellipsoid or obovoid, irregularly, obscurely striate in the dry state, $1\frac{1}{2}$ –2 by $\frac{3}{4}$ – $1\frac{1}{3}$ cm, furfuraceous; apex short-acuminate, sometimes forming a distinct beak 5–12 mm.

Distr. Malaysia: Sumatra (Tapanuli, Taram, and Djambi), Malay Peninsula (Perak, Trengganu, Pahang, Malacca, Johore, and Penang), and West Java (Bantam: Mt Pulasari, Udjong Kulon).

Ecol. In primary forests, 90–1500 m, once found on sandstone near Tjampo R. in W. Sumatra (coll. ISMAEL).

Notes. The type of *M. vinculans* was collected by KOORDERS (21279 β , Bo, not 21297 β as cited by MERRILL & FREEMAN) at Pang Kalan-Dula, Central Sumatra. There is only one sheet of the type with a few detached leaves, a piece of root, and some fragments of flowers. From these fragments left I could unfortunately not verify any floral character. The leaves are similar to those of *M. elliptica*.

The type of *M. javanica* was collected by KOORDERS (n. 9921, B, L) at Mt Pulasari, Bantam, W. Java, at 1250 m, in June 1892; it has extra-axillary, short-peduncled, few-flowered, condensed inflorescences and very young 5-merous flowers. The flowers were apparently associated with some 4-merous ones as indicated by VALETON's note on the type. Only in Nov. 1960 rich additional material was collected by KOSTERMANS at Mt Pajung, Udjong Kulon, c. 100 km southwest of the type locality at 300–470 m. Two of these specimens have very well preserved and developed, distinctly peduncled, dichotomous cymes (up to 4 times branched and c. $3\frac{1}{2}$ cm long). There are many flowers in different stages of development; I have dissected more than twenty of them and so far I have seen only 5-merous ones. The characters of leaves, inflorescences and flowers fall within the range of *M. elliptica*.

As lectotype of *M. elliptica* I have chosen MAINGAY 945/2, in K, isotype sheets in L; there are several good sheets of this collection at Kew, bearing both flowers and fruits.

7. *Microtropis kinabaluensis* MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 304, incl. var. *acuminata*.—*M. sterrophylla* MERR. & FREEM. *l.c.* 305.

Shrub or small tree up to c. 3 m. Branchlets terete. Incipient bracts up to $1\frac{1}{2}$ cm long. *Leaves*

chartaceous to subcoriaceous, elliptic-oblong to lanceolate, 11–22 by $3\frac{1}{2}$ – $9\frac{1}{2}$ cm; base cuneate to attenuate; apex acuminate; nerves 6–12 pairs; petiole 1– $2\frac{1}{4}$ cm. *Paniculate cymes* $1\frac{1}{2}$ – $2\frac{1}{2}$ cm long. *Flowers* (young) dull white; bracteoles $1\frac{1}{2}$ –2 mm long. *Calyx* lobes suborbicular, c. $2\frac{1}{2}$ mm \varnothing , transparent, slightly concave, with 3–5 longitudinal veins, margin slightly erose. *Petals* ovate- or broad-elliptic, $2\frac{1}{2}$ –3 by $1\frac{1}{2}$ –2 mm, obtuse. *Stamens* c. 2 mm long; anthers broadly ovoid to subrotund, $\frac{2}{3}$ mm long, slightly apiculate; filaments c. $1\frac{1}{4}$ mm, united at the lower 1 mm. *Pistil* c. $1\frac{1}{2}$ mm long, \pm flask-shaped. *Fruits* yellowish orange, red when ripe, ovoid or broad-ellipsoid, $1\frac{1}{2}$ –2 by 1 cm, slightly furrowed, the obtuse apex crowned by the persistent style.

Distr. *Malaysia*: N. Borneo (Mt Kinabalu). Ecol. Primary forests, 900–1500 m.

Note. The distinctions between *M. kinabaluensis*, its var. *acuminata*, and *M. sterrophylla* are chiefly based on leaf characters. However, they share the very characteristic calyx lobes which are transparent when boiled, bearing 3–5 longitudinal veins, and the fruit-shape, rounded at the apex, crowned by a mucro of the persistent style, from which I conclude that they are conspecific.

8. *Microtropis curranii* MERR. Philip. J. Sc. 3 (1908) Bot. 238; En. Philip. 2 (1923) 482; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 287, incl. var. *zambalesensis* et var. *obovata* MERR. & FREEM.; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 29.

Small tree or shrub up to 9 m. Branchlets terete, or sometimes slightly 4-angular. Leaves subcoriaceous to coriaceous, obovate, obovate-oblong, elliptic, rarely suborbicular, $3\frac{1}{2}$ –7 by $1\frac{1}{2}$ – $3\frac{3}{4}$ cm; base cuneate to attenuate, sometimes decurrent; apex acute, rarely short-acuminate, sometimes obtuse and apiculate, the tip usually damaged; nerves 4–7 pairs; petiole 2–10 mm. *Cymes* up to $1\frac{1}{2}$ cm, (1)–3-flowered, occasionally a central axis elongated above the first pair of flowers and more-flowered; peduncle $\frac{1}{4}$ – $1\frac{1}{3}$ cm. *Flowers* white. Bracteoles ovate, c. 1 mm long. *Calyx* lobes suborbicular to subreniform, 2– $2\frac{1}{2}$ by $2\frac{1}{2}$ – $3\frac{1}{3}$ mm, erose. *Petals* elliptic, $3\frac{3}{4}$ by 2 mm. *Stamens* c. $1\frac{1}{2}$ mm long; anthers subglobose, c. $\frac{4}{8}$ by $\frac{3}{4}$ mm, slightly apiculate; filaments flat, $1\frac{3}{4}$ mm long, gradually dilated towards the base, united at the lower half. *Pistil* short-conical, $1\frac{1}{2}$ by 1 mm, slightly longitudinally striate, obtuse or sometimes obscurely 2-lobed. *Fruits* (young) ellipsoid, furfuraceous.

Distr. *Malaysia*: Philippines (Luzon: Zambales, Benguet and Rizal Prov.).

Ecol. In mossy forest and on exposed ridges on the higher mountains, 1500–2500 m.

Note. There are several specimens cited in the original description of *M. curranii*, but the type has not been designated. Since the epithet is '*curranii*' I have chosen CURRAN FB 4966 (US, isotype in K) as lectotype. The authentic collec-

tions cited in the original description of var. *zambalesensis* are RAMOS BS 4698 (K) and CURRAN & MERRITT 8071 (K), and the former is here selected as the lectotype. The two varieties differ only slightly in leaf-size, texture, and shape; in my opinion they do not deserve distinction, especially because these differences may be due to different altitude.

9. *Microtropis sumatrana* MERR. Pap. Mich. Ac. Sc. 1933, 19 (1934) 164, t. 26; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 304.

Small tree up to 17 m. Branchlets terete. Incipient bracts conspicuous, 7–15 mm long. *Leaves* chartaceous to subcoriaceous, elliptic- or ovate-oblong, 12–23 by 6–11 cm; base acute; apex acute to acuminate; nerves 6–11 pairs; petioles 1–2 cm. *Thyrse*s and/or *cymes* up to $4\frac{1}{2}$ cm, simple or 2–3 dichotomously branched; peduncle 1–3 cm, rarely very short. *Flowers* white; bracteoles small, $1\frac{1}{2}$ –2 mm long, short-fimbriate. *Calyx* lobes suborbicular or reniform, 2–3 by 2– $3\frac{1}{2}$ mm, concave, stiff, smooth inside, usually irregularly split, short-lacerate, venation visible but not elevated. *Petals* oblong, 3– $3\frac{1}{2}$ by $1\frac{1}{4}$ – $1\frac{1}{2}$ mm, obtuse. *Stamens* $1\frac{1}{2}$ – $1\frac{3}{4}$ mm long; filaments dorso-basifixed, flat, gradually dilated towards the base, united at the lower half; anthers suborbicular, $\frac{1}{4}$ mm long, obtuse, sometimes obscurely apiculate. *Pistil* c. $1\frac{1}{2}$ mm long, gradually narrowed towards the apex; apex 4-lobed, or obtuse (in young flowers). *Fruits* ellipsoid, broad-obovoid, or ovoid-oblong, 15–17 by 8– $11\frac{1}{2}$ mm, furfuraceous, glabrescent, slightly rugose, acuminate at the apex.

Distr. *Malaysia*: Sumatra (Simalur and Batu Is., Sum. East Coast Res.: Marbau) and Borneo (Sipitang and Balikpapan).

Ecol. In lowland and mossy forest (800–1050 m); in Sumatra at low altitude, once noted on sandstone.

Vern. *Anuntus, dëlök, kudang pajo, lala-lalar dëlök, soe'ah-baseum, surin, tēradih*, Sum.

Note. MERRILL & FREEMAN (*l.c.*) made an erroneous correction of an error in the original description in which 'stipules', *i.e.* incipient bracts, are not 7 cm but 7 mm long.

10. *Microtropis rigida* RIDL. Kew Bull. (1931) 36; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 297.

Leaves coriaceous, elliptic-oblong, 7–12 by $2\frac{1}{2}$ –6 cm; base obtuse; apex acuminate; nerves c. 5 pairs; petiole very short. *Thyrse*s up to $2\frac{1}{2}$ cm long; peduncle c. 1 cm. Bracteoles ovate, c. 2 mm long. *Calyx* lobes suborbicular, c. 3 by $2\frac{1}{2}$ mm, sometimes irregularly split, smooth inside, slightly wrinkled outside, very short fringed. *Petals* oblong, obtuse, 2 by 1 mm, the lower part adnate to the disk. *Stamens* c. 2 mm long; anthers ovoid c. $\frac{2}{3}$ mm long, short-apiculate; filaments $1\frac{1}{2}$ mm, subulate, the lower $\frac{2}{3}$ united, dorso-fixed, the connective distinct on the dorsal side. *Pistil* c. $2\frac{1}{2}$ mm long; *ovary* \pm globose, c. 2 mm \varnothing , narrowed to the apex; style very

short; stigma obscurely 4-6 lobed. *Fruits* (immature) oblong.

Distr. *Malaysia*: Borneo (Sarawak), twice collected.

11. *Microtropis ovata* MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 297.

Shrub up to 3 m. Branchlets 4-angular. *Leaves* coriaceous, ovate to ovate-oblong, $4\frac{1}{2}$ -10 by 2-7 cm; base rounded, sometimes obscurely cordate; apex acute; nerves 5-9 pairs; petiole very short or none. *Cymes* (rather young) condensed, less than 1 cm; peduncle very short. Bracteoles broad-ovate, c. $1\frac{1}{2}$ mm long, \pm keeled outside. *Calyx* lobes suborbicular to subreniform, $2\frac{1}{4}$ - $2\frac{1}{2}$ by $2\frac{1}{2}$ -3 mm, short-lacerate. *Petals* broadly ovate or ovate-oblong, $2\frac{1}{2}$ -3 by 2 mm. *Stamens* c. $1\frac{1}{2}$ mm; anthers transverse broad-oblong, $\frac{2}{3}$ by $\frac{4}{8}$ mm, notched at the apex; filaments c. 1 mm, united at the lower half. Pistil ovoid-oblong, c. 2 by 1 mm. *Fruits* unknown.

Distr. *Malaysia*: Borneo (Mt Kinabalu).

Ecol. Forests, 1200-1500 m.

12. *Microtropis platyphylla* MERR. Philip. J. Sc. 10 (1915) Bot. 319; En. Philip. 2 (1923) 482;

MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 306, incl. var. *ellipticifolia* MERR. & FREEM.;

LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 129.—*M. philippinensis* MERR. Philip. J. Sc. 13 (1918)

Bot. 306; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 304.—*M. rostrata* MERR. Philip. J.

Sc. 17 (1920) 275; En. Philip. 2 (1923) 482;

MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 306; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942)

129.—*M. fasciculata* QUIS. & MERR. Philip. J. Sc. 37 (1928) 162; LOES. in E. & P. Pfl. Fam. ed. 2,

20b (1942) 129.—*M. chartacea* MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 303.—*M. rubra*

ELM. [ex MERR. En. Philip. 2 (1923) 482, in obs., pro syn.] ex MERR. & FREEM. l.c. 305.—*M. basilanensis* MERR. & FREEM. l.c. 306.—*M. borneensis* MERR. & FREEM. l.c. 296.

Shrub, 2-7 m tall. Branchlets terete or sometimes slightly angular. Incipient bracts 4-12 mm long. *Leaves* chartaceous to subcoriaceous, elliptic to elliptic-lanceolate, ovate to lanceolate, sometimes obovate, rarely broad-elliptic, $4\frac{1}{2}$ -24 by $4\frac{1}{2}$ -11 cm; base acute to cuneate; apex acute to short-acuminate; nerves 6-12 pairs; petiole $1\frac{1}{4}$ -2 cm. Panicle and/or sometimes dichotomous *cymes* up to $3\frac{1}{2}$ cm long, rarely fascicles and cauline; peduncles usually present, rather stout, 1- $1\frac{1}{2}$ cm, sometimes very short or none. Bracteoles suborbicular or ovate, 1-2 mm long, slightly erose. *Flowers* 5(-4)-merous. *Calyx* lobes suborbicular or subreniform, 2- $3\frac{1}{4}$ by 2- $3\frac{1}{2}$ mm, slightly concave and wrinkled outside, erose. *Petals* elliptic or broad-ovate, $2\frac{1}{2}$ -3 by $1\frac{3}{4}$ mm, obtuse. *Stamens* $1\frac{3}{4}$ - $2\frac{3}{4}$ mm long; anthers broad-oblong, -ovoid, or subglobose, $\frac{1}{2}$ - $\frac{4}{8}$ mm long, obtuse, or short-apiculate; filaments $1\frac{1}{4}$ - $1\frac{3}{4}$ mm, united at the lower $\frac{3}{4}$ -1 mm. Pistil short-conical, $1\frac{1}{2}$ - $1\frac{3}{4}$ mm long; apex obtuse rarely

notched. *Fruits* ovoid or ellipsoid, 1- $2\frac{1}{2}$ by 1- $1\frac{1}{4}$ cm; apex acute, short-acuminate, or rostrate, furfuraceous near the tip.

Distr. *Malaysia*: Philippines (Luzon: Prov. Nueva Ecija, Rizal, Tayabas, Camarines Norte and Camarines Sur, and Alabat I.; Catanduanes, Panay, Basilan I, and Siargao I.) and N. Borneo (Mt Kinabalu).

Ecol. In forests at low and medium altitudes up to 500 m; a mountain form found in mossy forest of Mt Kinabalu, 1500-2700 m.

Notes. The authentic material of the present species and all its synonyms cited here had been collected from the central Philippines (except one sheet from Basilan and several from Mt Kinabalu respectively) at low and medium altitudes not higher than 500 m (except several mountain form from Mt Kinabalu at 1500-2700 m, described as *M. borneensis*). All species described from the Philippines are similar to one another, as was already remarked by MERRILL & FREEMAN. The characters which they used to distinguish them are chiefly the leaf-shape, size and texture, the structure of the inflorescences or infructescences (cymose, paniculate-cymose, or fasciculate), the number of floral parts (5- or 4-merous), and the apex of the fruit (rostrate or not). After studying the authentic material and additional collections, the differences appear to be only quantitative and gradual; in my opinion only one species is concerned.

13. *Microtropis wallichiana* WIGHT ex THWAITES, En. Pl. Zeyl. (1858) 71; Laws. in Hook. f. Fl. Br. Ind. 1 (1875) 613; TRIMEN, Fl. Ceyl. 1 (1893) 269; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 283; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 127.—*M. ramiflora* (non WIGHT) THWAITES, En. Pl. Zeyl. (1858) 72; STAFF, Trans. Linn. Soc. II, Bot. 4 (1894) 140; MERR. En. Born. (1921) 354.—*Paracelastrum wallichianus* F. N. WILLIAMS, Bull. Herb. Boiss. II, 5 (1905) 224.—*M. zeylanica* MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 282.—*M. suborbiculata* MERR. & FREEM. l.c.

Shrub or small tree. Branchlets terete or slightly 4-angular. Incipient bracts 3-8 mm. *Leaves* subcoriaceous to coriaceous, elliptic to elliptic-lanceolate, sometimes broad-elliptic or -obovate, 3-18 by 1-6 cm; base cuneate to attenuate, or rounded to subtruncate, rarely cuneate; apex acuminate, or rounded, sometimes acute, rarely shallowly notched; nerves 4-9 pairs; petiole obsolete to $1\frac{1}{2}$ cm. Condensed *cymes* less than 1 cm long, few- to many-flowered; peduncle very short or none, sometimes up to 2-3 mm. *Flowers* yellowish. Bracteoles small, ovate, 1-2 mm long. *Calyx* lobes subreniform, c. $1\frac{1}{2}$ -2 by 2-3 mm, erose or short-lacerate. *Petals* rather fleshy, elliptic-oblong, broad-ovate, -elliptic, or -obovate, $2\frac{1}{3}$ - $3\frac{1}{2}$ by $1\frac{2}{3}$ -2 mm, obtuse. *Stamens* c. $2\frac{1}{2}$ mm long; anthers broad-oblong or ovoid, c. $\frac{2}{3}$ - $\frac{4}{8}$ by $\frac{2}{3}$ - $\frac{4}{8}$ mm, obtuse or slightly notched, acute or slightly apiculate; filaments flat, $1\frac{1}{2}$ - $1\frac{3}{4}$ mm, united at the lower $\frac{1}{2}$ - $\frac{2}{3}$. Pistil short-conical, $1\frac{1}{2}$ by 1

mm, obtuse, striate-furrowed, sometimes slightly contracted at the base. *Fruits* slightly oblong-ellipsoid or oblong-obovoid, c. 1 by ½ cm, furfuraceous, obtuse and crowned by the persistent style.

Distr. Ceylon and *Malaysia*: Sumatra (Atjeh) and Borneo (Mt Kinabalu).

Ecol. In forest, 1250–2500 m.

Notes. This species has two altitudinally differentiated forms, which is clearly demonstrated in a series of excellent specimens collected by VAN STEENIS in Atjeh, N. Sumatra. The floral and fruiting characters show no variation in these forms, but the leaves are variable especially in shape and venation. Specimens collected from 1250–c. 2000 m have leaves which are elliptic to elliptic-lanceolate, cuneate to attenuate at the base, distinctly petioled, and with rather dense-reticulate venation; leaves of specimens collected

between c. 2000 and 2500 m are commonly sub-orbicular, usually rounded to subtruncate at the base, more or less sessile and with rather loose-reticulate venation. This phenotypic variation in leaf-shape with altitude agrees with the general scheme outlined by VAN STEENIS in this Flora, cf. vol. 5, p. clxxx, fig. 3–4.

Excluded

Microtropis? coriacea WALL. [Cat. (1831) n. 4338, *nomen*] ex ETtingsh. Denkschr. Ak. Wiss. Wien Math.-Nat. Cl. 13 (1857) 64, t. 4 f. 12, *descr. fol.*; MERR. & FREEM. Proc. Am. Ac. Arts Sc. 73 (1940) 306, based on specimens collected by PORTER in Penang = *Salacia* sp.

Microtropis lanceolata BOERL. & KOORD. in Koord.-Schum. Syst. Verz. 2 (1911) 33 is according to MERRILL & FREEMAN (Proc. Am. Ac. Arts Sc. 73, 1940, 307) = *Linociera* sp. (*Oleaceae*).

9. BHESA

HAM. ex ARN. Edinb. New Phil. J. 16 (1834) 315; DING HOU, *Blumea* Suppl. 4 (1958) 150.—*Kurrimia* WALL. [List (1831) n. 4334–4336, 7200, *nomen, pro maj. part.*] ex ARN. Nov. Act. Ac. Caes. Leop.-Car. 18 (1836) 328; LOES. in E. & P. Pfl. Fam. 3, 5 (1892) 210; ed. 2, 20b (1942) 158, *non Kurrimia* WALL. ex MEISN. Pl. Vasc. Gen. 1 (1837) 67; *ibid.* 2 (1837) 48, *quae est Itea (Saxifr.)*.—*Pyrospermum* MIQ. Sum. (1861) 402.—*Nothocnestis* MIQ. Sum. (1861) 530.—*Trochisandra* BEDD. Fl. Sylv. 1 (1871) 120, t. 120.—Fig. 16.

Buttressed evergreen trees. Branchlets terete, light to dark-brown, their tips enclosed by caducous, convolute stipules. *Stipules* finely lengthwise veined, usually with colleters at the base inside, leaving large scars. *Leaves* spiral, coriaceous, entire, midrib and nerves prominent on both sides, with distinct crossbar veins; petiole terete or slightly furrowed above, long, knee-like thickened at the upper end underneath. *Racemes* solitary or paired. *Panicles* axillary, sometimes crowded at the tips of twigs sustained by stipules only and pseudoterminal (*B. paniculata*), but a terminal bud always present between them. Pedicels with an articulation. Bracts small, caducous. *Flowers* 5-merous, occasionally some flowers 4-merous, whitish to greenish, fragrant. *Calyx* deeply lobed, lobes imbricate, sometimes ± valvate. *Petals* contorted. *Stamens* inserted on the disk or just beneath the outer margin; anthers lengthwise dehiscent, introrse, latrorse or extrorse, basifixed, obtuse or short-apiculate; cells free for the lower ½–⅔. Disk fleshy, subentire or lobed, glabrous, sometimes puberulous (*B. robusta*). *Ovary* free, usually with a tuft of hairs at the top, 2-celled; styles 2, filiform, free or slightly united at the base; stigma small. *Ovules* 2 in each cell, erect, anatropous. *Capsule* entire or 2-lobed, 1–2-celled, lengthwise dehiscent loculicidally by 2 valves or on one side, mostly 1–2-seeded. *Seeds* completely or partly covered by the fleshy aril; albumen abundant, fleshy; cotyledons linear-oblong.

Distr. Species 5, four of them found in Malaysia, a fifth endemic in Ceylon, distributed from Ceylon to SE. Asia (India, Pakistan, Burma, Siam, and Indo-China); in *Malaysia*: Sumatra, Malay Peninsula, Borneo, the Philippines, and New Guinea as far east as the Louisiades (Sudest I.). Fig. 17.

Ecol. Rain-forests at low and medium altitudes, sometimes found up to 2150 m.

Uses. See under *B. paniculata*.

Note. Sterile specimens show a resemblance to those of *Ventilago (Rhamnac.)* especially by the venation; the latter lack, however, the knee-like thickened apex of the petiole as found in *Bhesa*.



Fig. 16. *Bhesa archboldiana* (MERR. & PERRY) DING HOU. a. Habit, in fruit, $\times \frac{2}{3}$, b. stipule, from inside, $\times 3$, c. flower, $\times 4$, d. ditto in section, pistil removed, $\times 4$, e. pistil, f-g. ditto in sections, $\times 8$, h. seed with aril, i. seed in section, both nat. size.—*B. indica* (BEDD.) DING HOU. j. 2-lobed fruit, both lobes dehiscent, k. seed enveloped by aril, both nat. size.—*B. paniculata* Arn. l. Flower, $\times 4$, m. ditto in section, pistil removed, $\times 8$, n. pistil, $\times 8$, o. fruit, one lobe barren, nat. size.—*B. robusta* (ROXB.) DING HOU. p. Flower, $\times 4$, q. ditto in section, pistil removed, $\times 8$, r. pistil, $\times 8$, s. fruit, nat. size (a BRASS 7754, b-g BRASS 28084, h-i BRASS 7754, j KEP 10158, k SF. 4177, l-n ASHTON 2613, o CLEMENS 27396, p-r KOSTERMANS 10319, s ditto 9716).

KEY TO THE SPECIES
(based on flowering material)

1. Flowers in panicles.
 2. Disk deeply 5-lobed. Filaments inserted between the lobes of the disk. Anthers extrorse. Ovary always with a tuft of woolly hairs at the top 1. *B. paniculata*
 2. Disk subentire. Filaments a continuation of the disk. Anthers introrse. Ovary glabrous or sometimes slightly hairy at the top 2. *B. indica*
1. Flowers in racemes.
 3. Calyx lobes broad-ovate or subrotundate, 1½–2 mm long. Petals 2½–3 by ⅔–1¼ mm. Anthers latrorse. Disk usually puberulous. Filaments inserted just below the outer disk margin. Ovary with a tuft of woolly hairs at the top. Styles entirely free. Flowers subsessile to shortly pedicelled (c. 1 mm) 3. *B. robusta*
 3. Calyx lobes obovate, c. 3 mm long. Petals 4–4½ by 2 mm. Anthers introrse. Disk usually glabrous. Filaments a continuation of the disk. Ovary glabrous. Styles shortly united at the base. Flowers distinctly pedicelled (3–7 mm) 4. *B. archboldiana*

KEY TO THE SPECIES
(based on fruiting material)

1. Infructescences paniculate. Fruits obovoid, obcordate, broadly ellipsoid to suborbicular, the blunt apex (often unequally) 2-lobed.
 2. Fruits 1–1¾(–2) cm long, acute to attenuate at the base. Aril covering most of the seed. 1. *B. paniculata*
 2. Fruits 2½–3½(–5½) cm long, obtuse at the base. Aril covering only the lower ⅓ or ½ of the seed. 2. *B. indica*
1. Infructescences simple racemes. Fruits ovoid-oblong or elliptic-oblong, attenuate and pointed to the apex, not lobed.
 3. Pedicels (2½–)1 mm or less. Leaves 2–3½(–4) times as long as broad, with (11–)13–15(–19) pairs of nerves 3. *B. robusta*
 3. Pedicels 3–7 mm. Leaves 1½–2 times as long as broad, with 9–11 pairs of nerves. 4. *B. archboldiana*

1. *Bhesa paniculata* ARN. Edinb. New Phil. J. 16 (1834) 315; WALP. Rep. 1 (1842) 538 ('*Rhesa*'); DING HOU, Blumea Suppl. 4 (1958) 151.—*Kurrimia paniculata* WALL. [List (1831) n. 4336, nomen] ex ARN. Nov. Act. Ac. Caes. Leop.-Car. 18 (1836) 328; KURZ, J. As. Soc. Beng. 39, ii (1870) 73; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 622; KING, J. As. Soc. Beng. 65, ii (1896) 355; MERR. En. Born. (1921) 354; RIDL. Fl. Mal. Pen. 1 (1922) 452; MERR. En. Philip. 2 (1923) 483; CRAIB, Fl. Siam. En. 1 (1926) 286; CORNER, Ways. Trees (1940) 190, t. 43, f. 49; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 160; BROWNE, For. Trees Sar. & Brun. (1955) 78.—*Schmidelia conferta* BLANCO, Fl. Filip. ed. 2 (1845) 217 (*sphalm. Schmidellia*).—*Pyrospermum calophyllum* MIQ. Sum. (1861) 402.—*Kurrimia luzonica* VIDAL, Rev. Pl. Vasc. Filip. (1886) 88; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 160.—*Kurrimia minor* RIDL. Kew Bull. (1938) 235, excl. BECCARI 2624, *quae est Kurrimia robusta*.— Fig. 161-o.

Tree up to 35 m by 90 cm ø, buttresses up to 2 m. Bark smooth, light brown, thin. *Stipules* lanceolate, 1¾–3 cm. *Leaves* elliptic-oblong to lanceolate, rarely ovate-oblong, 6–39 by 2–15 cm; base obtuse or cuneate; apex shortly acuminate or obtuse; nerves 11–20 pairs; petiole 1–10 cm. *Panicles* crowded at the ends of the twigs, up to 38 cm long; rachis puberulous, glabrescent. *Pedicels* 2–3 mm. *Calyx* lobes deltoid, sometimes broadly-oblong, ⅔–1 by ⅔–1 mm, puberulous

outside. *Petals* oblong, broad-ovate, 1¾–2 by 1–1½ mm, obtuse, puberulous inside. *Stamens* 1½–2 mm long; anthers triangular, ½ by ½ mm, obtuse. Disk 5-lobed, lobes broad-oblong, truncate. *Ovary* ellipsoid, 1½–2 by 1 mm; styles free, about half as long as the ovary. *Fruits* 1–1¾(–2) by ⅔–1½ cm, usually 2-lobed, turning yellow, then pink, red or dark red. *Seeds* 2–4, broad-ellipsoid, subglobose, 9–11 by 6–8 mm, pale brown, usually largely covered by the pink aril.

Distr. Common and widely distributed in southern India, S. Siam, and Malaysia: Sumatra, Malay Peninsula, Borneo, and the Philippines.

Ecol. Primary and secondary forests on dry-land or in peat swamp, or periodically inundated forests, from the lowland up to 450 m, a few specimens collected from 900–1500 m (Perak and Mt Kinabalu). *Fl.* March–Dec., *fr.* Jan.–Dec.

Vern. Sumatra: *arang*, Benkoelen, *damas*, *djung*, *kaju si darang daja*, East Coast, *hajodotok rawang*, *kalumpun*, Batak., *kaju djambu*, *k. tulang*, *pimpoèh*, Palembang, *lagan bunga*, Pematang, *kèrindjing rênak*, *mèrlantaàn rawang*, *sètomuhila*, M., *ponau*, *səngafoh-balah*, *s. dèlok*, *s. ètèn bungo*, *s. uding*, *tutum səngafoh*, Simalur; Billiton: *kèrangji*, M.; Banka: *mèlabung*; Mal. Pen.: *bəngu mēdang ayēr*, Temuan, *biko-biko*, *bunak*, M., *mēdang tandok*, *m. tijoh*, Negri Sembilan, *sapan*, Selangor; *aha tung*, *bintan*, *madang bura*, *mēdang latak*, *nga*, *tjanggam*, Dyak, *asam pau*, S. Born., *duhat burung*, *rəngas*, Balikpapan, *kayu minyak*, *rəsak buntun*, *sulang sulang*, Sarawak, *mēdang*

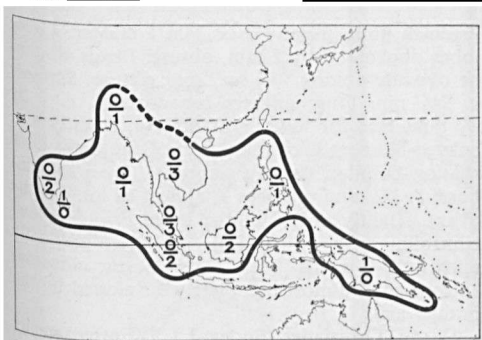


Fig. 17. Distribution of the genus *Bhesa* HAM. ex ARN. Species density, endemic above the hyphen, non-endemic below it.

kuning, pangil-pangil, sarunai, Brunei, *rasan tatahon, sampaka*, Dusun, *ruwas*, M, *sangam*, W. Born., *sēmīta*, Boeloengan, *simun*, Iban.

Uses. The dull-brown wood is rather hard and is used for house-building purposes; it is durable under the roof, is not attached by insects, and is not liable to cracking. The black, acid fruits are eaten similarly as *Nephelium* (HEYNE, Nutt. Pl. 1927, 984; BURKILL, Dict. 1, 1935, 1288).

Note. Sterile herbarium material of *B. paniculata* and *B. robusta* can not be distinguished with certainty. The stipular scars are usually oblique in *B. robusta* and \pm transverse in *B. paniculata*. However, this is not a constant character.

2. *Bhesa indica* (BEDD.) DING HOU, *Blumea* Suppl. 4 (1958) 152.—*Trochisandra indica* BEDD. Fl. Sylv. 1 (1871) 120, t. 120.—*Kurrimia bipartita* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 622.—*Kurrimia indica* GAMBLE, Fl. Madras 2 (1918) 207; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 160.—Fig. 16j-k.

Tree up to 20 m by 60 cm ϕ . *Stipules* lanceolate, 2-3 cm. *Leaves* oblong-ovate to lanceolate, 11-40 by 4-15 cm; base rounded or obtuse; apex acute to short-acuminate; nerves 16-21 pairs; petiole up to 11 cm. *Panicles* up to 15 cm, rachis and stalks puberulous when young; peduncle up to 4 cm. *Pedicels* c. 2 mm, puberulous. *Calyx* lobes elliptic-lanceolate, c. 1 by $\frac{2}{3}$ mm. *Petals* slightly obovate-oblong or sometimes elliptic-oblong, c. $\frac{2}{3}$ by $1\frac{1}{4}$ mm, obtuse. Disk flat, subentire. *Stamens* inserted on the margin of the disk and continuous with it. *Ovary* broad-obovate or subglobose, c. $1\frac{1}{2}$ by 2 mm, glabrous, or sometimes slightly hairy at the top; styles almost divided to the base. *Fruit* 2-lobed to the lower $\frac{1}{3}$ - $\frac{1}{5}$, sometimes one of the lobes small and abortive, $2\frac{1}{2}$ - $3\frac{1}{2}$ (- $5\frac{1}{2}$) cm long. *Seeds* ellipsoid, $2\frac{1}{3}$ - $2\frac{1}{2}$ by $1\frac{1}{2}$ - $1\frac{3}{4}$ cm, sometimes slightly flattened, the aril covering its lower $\frac{1}{3}$ or $\frac{1}{2}$.

Distr. S. India, Burma (Mergui), Lower Siam (Kopal, Sarat, and Kao Nom Sao), and Malaysia: Malay Peninsula (Kedah, Selangor, and Malacca).

Ecol. Dense, moist forests usually at 800-2150 m, rarely also occurring at low altitude (KERR 12263 and SF 4177).

Vern. *Bēnak, biku biku, buah chēndara, hashim*, M, *malayray*, Temuan.

Note. This is a new record for Malaysia. It is closely allied to, but quite distinct in flower and fruit from, *B. paniculata* to which LAWSON (l.c.) reduced it.

3. *Bhesa robusta* (ROXB.) DING HOU, *Blumea* Suppl. 4 (1958) 152.—*Celastrus robustus* ROXB. Fl. Ind. 2 (1824) 395; ed. Carey 1 (1832) 626.—*Kurrimia pulcherrima* WALL. [List. (1831) n. 4334, nomen] ex LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 622, nomen illegit. pro cit. prior.; KING, J. As. Soc. Beng. 65, ii (1896) 354; RIDL. Fl. Mal. Pen. 1 (1922) 452; KANJILAL, DAS & PURK. Fl. Assam 1, 2 (1937) 270; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 159; TARDIEU, Fl. Gén. I.-C. Suppl. 1 (1948) 807; Not. Syst. 14 (1950) 46.—*Kurrimia calophylla* WALL. [List. (1831) n. 4335, nomen].—*B. moja* HAM. ex ARN. Edinb. New Phil. J. 16 (1834) 315; WALP. Rep. 1 (1842) 538 (*sphalm. Rhesa*).—*Nothocnestis sumatrana* MIQ. Sum. (1861) 531.—*Kurrimia robusta* KURZ, J. As. Soc. Beng. 39, ii (1870) 73; SCHEFF. Nat. Tijds. N. I. 34 (1874) 98; KURZ, For. Fl. Burm. 1 (1877) 253; PIERRE, Fl. For. Coch. 4 (1893) t. 296B, incl. var. *roxburghii* PIERRE et var. *thorelii* PIERRE; PITARD, Fl. Gén. I.-C. 1 (1912) 893, f. 112, 3-8; CRAIB, Fl. Siam. En. 1 (1926) 286; CORNER, Ways. Trees (1940) 190, f. 49; MERR. J. Arn. Arb. 35 (1954) 141.—*Kurrimia maingayi* LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 622; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 159.—Fig. 16p-s.

Tree up to 40 m by 62 cm ϕ . Bark rather rough, brown, peeling off profusely in strips 2-3 cm wide and 2 mm thick. Buttresses up to 4 m high, c. $\frac{3}{4}$ m out. *Stipules* lanceolate, 5-10 mm. *Leaves* elliptic or oblong-elliptic, sometimes ovate-oblong or obovate-oblong, 6-16 by $2\frac{1}{2}$ - $8\frac{1}{2}$ cm; base obtuse or cuneate; apex acute to short-acuminate; nerves (11-)-13-15(-19) pairs, slightly elevated or flat above; petiole 1-3 cm. *Racemes* up to 15 cm long, 1(-2) in a leaf-axil; peduncle short. *Flowers* subsessile. *Calyx* lobes broad-ovate or subrotundate, $1\frac{1}{2}$ -2 by $1-1\frac{1}{4}$ mm, obtuse. *Petals* oblong-elliptic, $2\frac{1}{2}$ -3 by $\frac{2}{3}$ - $1\frac{1}{4}$ mm, obtuse. *Stamens* c. 2 mm long, attached beneath the outer margin of the disk; anthers almost deltoid, c. $\frac{1}{2}$ mm long and wide, obtuse, free for the lower $\frac{2}{3}$, latrorse. Disk cupular, subentire or obscurely notched, the rim usually puberulous. *Ovary* subglobose c. 1 mm ϕ , with a tuft of hairs at the apex; styles free, longer than the ovary. *Fruits* ovoid-oblong to lanceolate, with 2 vertical grooves, much tapered to the apex, $3-3\frac{1}{2}$ by $1-1\frac{1}{4}$ cm, usually 1-seeded. *Seeds* \pm oblong, usually on a knob-like thickened placenta, completely or sometimes only the lower half enveloped by the aril.

Distr. NE. India, Bhotan, E. Pakistan (Chittagong Hills), Burma (Martaban, Pegu, Tenasserim), Andaman Is., Siam (Chantaburi, Sarat, and Sriracha), Indo-China (Tonkin, Laos, Cambodia), and Malaysia: Sumatra, Malay Peninsula, and Borneo.

Ecol. Chiefly in primary lowland forests, sometimes in periodically inundated forests, rarely up to 1075 m. *Fl.* Feb.–Aug., *fr.* Jan.–Dec.

Vern. Sumatra: *adjan*, *bėngkinang*, *M*, *balam budju*, *katian*, *tjabė*, Palembang; Billiton: *djanting*, *M*; Banka: *djurung laki*, *M*; Mal. Pen.: *boko-boko*, *mėdang gidap*, *m. tijoh*, *pauh rusa*.

Use. The wood is used for house building and beams.

Note. The young racemes sometimes start as strobilaceous buds, the lower part of the raceme being covered by numerous, imbricate, small pairs of tardily caducous stipules (KOSTERMANS 7172, 10319, ENDERT 123E 1P 789).

4. *Bhesa archboldiana* (MERR. & PERRY) DING HOU, *Blumea* Suppl. 4 (1958) 152.—*Kurrimia archboldiana* MERR. & PERRY, *J. Arn. Arb.* 20 (1939) 335; LOES. in E. & P. *Pfl. Fam.* ed. 2, 20b (1942) 159.—Fig. 16a–i.

Tree up to 30 m by 50 cm \varnothing . Buttresses up to 3 m. Bark pale brown, hard, fissured. Branchlets light brown. *Stipules* lanceolate, 4–11 mm. *Leaves* elliptic to elliptic-oblong, sometimes ovate-oblong, 8–16 by 3½–8 cm; base rounded or acute; apex acute to short-acuminate; nerves 9–11 pairs; petiole 1–4½ cm. *Racemes* 1(–2) in a leaf-axil; peduncle very short. *Pedicels* 3–8 mm. *Flowers*

greenish pink, usually 2 or 3 in a cluster. *Calyx* lobes obovate, 3 by 2 mm, obtuse. *Petals* elliptic or obovate-oblong, 4½ by 2 mm, obtuse. *Stamens* c. 2¼ mm long; anthers broad-ovoid, c. 1 by ⅔ mm, free for lower ⅓, introrse, slightly apiculate; filament a continuation of the disk. Disk shallow-cupular, usually glabrous. *Ovary* subglobose, c. 1¼ mm \varnothing ; styles 2, almost as long as the ovary, slightly united at the base. *Fruits* yellow, ellipsoid, with 2 vertical grooves, gradually narrowed towards both ends. *Seeds* ellipsoid, 18 by 9 mm, almost completely enveloped by the orange aril.

Distr. Louisiades (Sudest I.), D'Entrecasteaux Is. (Normanby I.), and Malaysia: New Guinea (Waigeo I., Manokwari, Japen I., Hollandia, W. Division, E. Division, and Koitaki).

Ecol. Primary forest, from the lowland up to 530 m.

Vern. *Diik*, Amberbakan, *djėra*, Papua, *kar*, Selogof, *onggotu*, Depapre, *seborereko*, *Manikiong*.

Excluded

Kurrimia gracilis VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 89, is according to MERRILL, *En. Philip.* 2 (1923) 521 = *Ventilago dichotoma* (BLANCO) MERR. (*Rhamnac.*).

[10. CASSINE

LINNÉ [*Gen. Pl.* (1737) 338]; *Sp. Pl.* (1753) 268; LOES. in E. & P. *Pfl. Fam.* ed. 2, 20b (1942) 176.—*Elaeodendron* JACQ. *f. ex* JACQ. *Ic. Pl. Rar.* 1^a (1782) t. 48; MURRAY, *Syst.* ed. 14 (1784) 241, as *Elaeodendrum*; JACQ. *f. Nov. Act. Helvet.* 1 (1787) 38, f. 2; SPRAGUE, *Kew Bull.* (1929) 43; LOES. in E. & P. *Pfl. Fam.* ed. 2, 20b (1942) 172.—Fig. 18.

Shrubs or trees. *Stipules* small, caducous. *Leaves* decussate (occasionally some leaves alternate), or alternate (*Afr. spp.*), subcoriaceous or coriaceous, entire or crenulate. *Cymes* axillary or extra-axillary, distinctly peduncled. *Flowers* bisexual (unisexual in some extra-Mal. *spp.*), 4–5-merous. *Calyx* lobes imbricate. *Petals* imbricate, spreading. *Stamens* inserted on or slightly under the outer margin of the disk; filaments subulate; anthers subglobose, or deltoid, versatile, introrse. Disk fleshy, flat, orbicular to lobed. Pistil short-conical, or \pm flask-like, the base slightly united with the disk, or partly immersed in it. *Ovary* 2-celled (3–4-celled in extra-Mal. *spp.*); style very short or obscure; stigma obscure or slightly 2-lobed. *Ovules* 2 in each cell, erect, attached at the base. *Fruits* indehiscent, 1–2-celled, the exocarp thin or fleshy, the endocarp firm-leathery, or mostly a stone, very rarely the mesocarp corky (*C. viburnifolia*). *Seeds* 1–2, exarillate, albuminous.

Distr. About 80 *spp.* (if the African genus *Mystroxylon* with spiral leaves is included), cosmopolitan in the tropics of both hemispheres but the bulk of the species in Africa; in Malaysia only 2 *spp.*; not yet found in New Guinea. Fig. 19.

Ecol. The two species in Malaysia behave very different. *C. viburnifolia* is a typical mangrove plant, *C. glauca* is a characteristic, though rare, constituent of the monsoon forest.

Notes. The genus *Elaeodendron* is mostly cited from 1787 but fig. 2 of that reference has also been published in 1782 as t. 48.

There has been some disagreement about the status of the distinction between *Cassine*, *Elaeodendron*, *Mystroxylon*, and two other genera. SONDER (*Fl. Cap.* 1, 1860, 451–452) had them as five different gen-

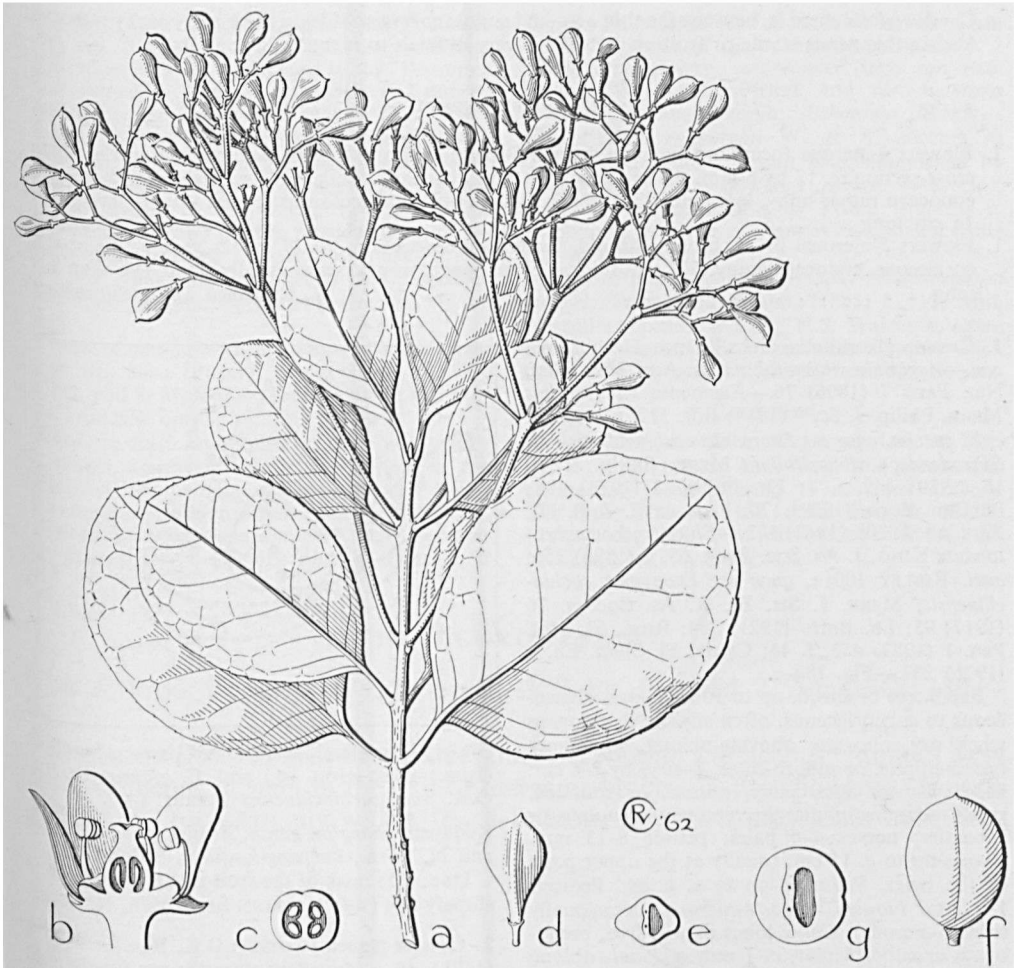


Fig. 18. *Cassine viburnifolia* (Juss.) DING HOU. *a.* Habit, in fruit, $\times \frac{2}{3}$, *b.* flower, in section, $\times 8$, *c.* section of ovary, $\times 16$, *d.* fruit, *e.* ditto in section, both nat. size. — *C. glauca* (ROTTB.) O.K. var. *cochinchinensis* PIERRE. *f.* Fruit, *g.* ditto in section, both $\times \frac{2}{3}$ (*a, d-e* SAN A 2895, *b-c* SAN 10390, *f-g* KOORDERS 30189).

era; in *Cassine* the drupe was defined as juicy with a thin crust-like putamen, in *Elaeodendron* it being rather dry, with a very hard ligneous putamen. BENTHAM & HOOKER (Gen. Pl. 1, 1862, 363, 367) kept *Cassine* and *Elaeodendron* separate, but BAILLON (Hist. Pl. 1, 1877, 33) recognized only the latter. In 1892 LOESENER reduced *Elaeodendron* to *Cassine* and distinguished them as two different sections of *Cassine* subg. *Elaeodendron*, adding that sect. *Elaeodendron* would have vessels with scalariform, rarely also simple perforations, and *Cassine* simple, round or elliptic perforations. Later, however, he reinstated *Cassine*, *Elaeodendron*, and *Mystroxydon* as distinct genera (in E. & P. Pfl. Fam. Nachtr. 1897, 223; Bot. Jahrb. 28, 1900, 154; in E. & P. Pfl. Fam. ed. 2, 20b, 1942, 110).

In 1927 DAVISON (Bothalia 2, 289) merged *Elaeodendron* and some other genera with *Cassine* concluding that there are no generic differences between them. PERRIER DE LA BÂTHIE, though agreeing that these two genera cannot be distinguished, arranged all species of Madagascar under *Elaeodendron* (Not. Syst. 10, 1942, 196–200). Recently also BLAKELOCK followed DAVISON (Kew Bull. 1956, 556), especially because METCALFE & CHALK (Anat. Dic. 1, 1950, 393) had found that the anatomical characters of the vessels do not hold in conjunction with the other characters. The recognition of only one genus, *Cassine*, seems therefore to be final.

The structure of the pericarp is variable, in some Australasian species both endocarp and exocarp are rather thin, in others the endocarp is a bony, thinner or thicker stone, and this may be covered with a pulpy (when fresh probably juicy) exocarp, or the stone may be covered with a thin dry pericarp;

in *C. viburnifolia* there is, between the thin exo- and endocarp on two sides, a thick pithy corky mesocarp. Also in this genus sterile or fruiting material is very difficult to identify, if at all.

KEY TO THE SPECIES

1. Flowers 4-merous (occasionally some flowers 5-merous). Fruits obovoid-oblong, often rhombic in cross-section, c. 12 by 6 mm, the exocarp very thin, mesocarp swollen and soft-corky on both sides, endocarp rather bony, less than 1 mm thick. Leaves usually discolorous; cymes usually large, up to 11 cm long 1. *C. viburnifolia*
1. Flowers 5-merous. Fruits broad-ellipsoid, terete in cross-section, 20–25 by 12–20 mm, the exocarp coriaceous, endocarp stony, 5–7 mm thick. Leaves concolorous; cymes usually small, less than 3 cm long 2. *C. glauca* var. *cochinchinensis*

1. *Cassine viburnifolia* (JUSS.) DING HOU, *comb. nov.*—*Aegiphila viburnifolia* JUSS. Ann. Mus. Hist. Nat. Paris 7 (1806) 76.—*Euonymus viburnifolius* MERR. Philip. J. Sc. 9 (1914) Bot. 312, *pro comb., excl. specim. quae est Euonymus cochinchinensis.*—*Elaeodendron viburnifolium* MERR. Philip. J. Sc. 16 (1920) 449, t. 1; En. Philip. 2 (1923) 484; Pl. Elm. Born. (1929) 170; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 173.—*Elaeodendron subrotundum* KING, J. As. Soc. Beng. 65, ii (1896) 356, *excl. RIDLEY 1001a, quae est Euonymus cochinchinensis*; MERR. J. Str. Br. R. As. Soc. n. 76 (1917) 93; En. Born. (1921) 354; RIDL. Fl. Mal. Pen. 1 (1922) 453, f. 44; CRAIB, Fl. Siam. En. 1 (1926) 287.—Fig. 18a–e.

Small tree or shrub, up to 10 m. *Leaves* chartaceous to subcoriaceous, often slightly discolorous when dry, obovate, obovate-oblong, sometimes broad-elliptic, or suborbicular, 4–10½ by 2–6 cm; base cuneate; apex acute, obtuse, or rounded, rarely acuminate; margin remotely crenulate or subentire; nerves 4–6 pairs; petiole 8–13 mm. *Cymes* up to c. 11 cm, usually at the upper parts of the twigs. Peduncle up to c. 6 cm. Pedicels 1–2 mm. *Flowers* white, 4-merous (occasionally some 5-merous). *Calyx* lobes almost free, broad-ovate or suborbicular, c. 1 mm ø. *Petals* oblong or slightly oblong-ovate, 1¾–2 by 1–1¼ mm, obtuse. Disk c. 1½ mm ø. *Stamens* just inserted beneath the outer disk margin, erect, c. 1½ mm. Pistil ovoid. *Fruits* obovoid-oblong, often rhombic on cross-section, sometimes slightly compressed, the lower ⅔ gradually narrowed towards the base, c. 12 by 6 mm; mesocarp thick corky and soft on both sides, endocarp rather bony; usually 1-seeded. *Seeds* obovate-oblong, 6 by 3 mm.

Distr. Siam (Puket, *ex* CRAIB), Andaman Is. and *Malaysia*: NE. Sumatra (Belawan; also in Banka and Billiton), Malay Peninsula (Kedah, Perak, Selangor, Johore, and Singapore), Borneo (common), Philippines (Sulu Arch.? *cf.* MERRILL 1923), and Central Celebes (Mengkoka Mts: Talala).

Ecol. In or along the mangrove swamps and on the edge of tidal rivers. In the genus the fruit structure is unique and is clearly adapted to dispersal by water (RIDL. Disp. 1930, 120, 267, 357, 426).

Vern. Borneo: *Barak laut, barat barat, landing-landing, mëmpênai* or *mëta pëlandok, rambai laut, M, api-api*, Kedayan and M, *damak-damak,*

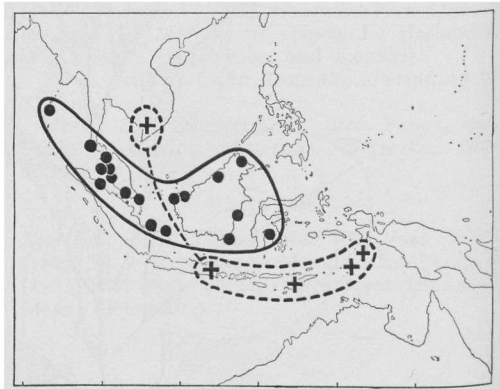


Fig. 19. Area and localities of *Cassine viburnifolia* (JUSS.) DING HOU (●) and *C. glauca* (ROTTB.) O.K. var. *cochinchinensis* PIERRE (+).

Kedayan, *changlin, gurah*, Brunei, *pungsu*, Brunei and N. Born., *kachang-kachang*, Tidung.

Use. The husk of the fruit is said to be used to stupefy fish (*fide* NOORDIN SAN 10574, N. Born.).

2. *Cassine glauca* (ROTTB.) O.K. Rev. Gen. Pl. 1 (1891) 114.—*Mangifera glauca* ROTTB. Nye Samml. Vid. Selsk. Skrift. 2 (1783) 534, t. 4 f. 1.—*Celastrus glaucus* VAHL, Symb. Bot. 2 (1791) 42, non R. BR. (1814), *nomen.*—*Elaeodendrum glaucum* PERS. Syn. 1 (1805) 241; K. & V. Bijdr. 7 (1900) 100.—*Neerija dichotoma* ROXB. Fl. Ind. 1 (1820) 646.—*Elaeodendron roxburghii* W. & A. Prod. (1834) 157.—*Elaeodendron ellipticum* DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 478; MIQ. Fl. Ind. Bat. 1, 2 (1859) 591.—*C. elliptica* O.K. Rev. Gen. Pl. 1 (1891) 114.

var. *cochinchinensis* PIERRE, Fl. For. Coch. 4 (1893) t. 296A, *ex descr.*—*Elaeodendron ellipticum* DECNE.—*Elaeodendron glaucum* var. *macrocarpa* K. & V. Bijdr. 7 (1900) 101–102; BACK. Schoolfl. (1911) 235; Bekn. Fl. Java (em. ed.) 6 (1948) fam. 133, p. 7.—Fig. 18f–g.

Tree, 18–25 m by 53–95 cm ø. *Leaves* subcoriaceous, elliptic to elliptic-oblong, obovate, broad-obovate, ovate, or ovate-oblong, 5½–15 by 2½–6 cm; base cuneate, obtuse; apex obtuse or rounded, sometimes short-acute; margins crenulate, or subentire; nerves 4–9 pairs; petiole c. 4–10 mm. *Cymes* few-flowered, usually at the

upper part of the branchlets, up to 3 cm. Peduncle 1–2½ cm. Pedicels 2–5 mm. *Flowers* 5-merous. *Calyx* lobes slightly reniform, ½ by 1½ mm. *Petals* oblong, c. 3 by 1½ mm. Disk c. 2 mm ø. *Stamens* inserted on the outer margin of the disk, c. 1 mm; pistil partly immersed, the emerging part short-conical, c. 1 mm long. *Fruit* a stone covered by a thin leathery exocarp + mesocarp, broad-ellipsoid, 2–2½ by 1¼–2 cm, usually with 2 longitudinal furrows on the outside; exocarp + mesocarp coriaceous, thin, endocarp stony, up to 7 mm thick, usually 1-celled and 1-seeded. *Seeds* oblong-elliptic, obtuse at both ends, 1½ by 1 mm.

Distr. Cambodia (Prov. Dongnai) and *Malaysia*: SE. Java (Puger), Lesser Sunda Is. (W. Timor), and S. Moluccas (Tanimbar and Kai Is.), four localities only.

Ecol. In East Java found in periodically very dry places, weathered coral chalk ground in the teak-forest and in heterogeneous primary forest with numerous deciduous tree species below 300 m.

Notes. *Elaeodendron ellipticum* DECNE is known only from the type (RIEDLÉ *s.n.*, P) collected in

Timor. Its vegetative and floral characters are similar to those of the Javanese specimens.

The type variety, *var. glauca* (incl. *var. roxburghii* (W. & A.) PIERRE and *var. montana* (THW.) PIERRE.—*Neerija dichotoma* ROXB.—*Elaeodendron roxburghii* W. & A.) occurs in Ceylon and India and can be distinguished by longer, lax, many-flowered cymes (4–6 cm), larger flower (petals 4½ by 3 mm; stamens c. 2 mm long, and disk c. 3 mm ø) and smaller fruits (12–18 mm long).

Cassine australe (VENT.) O.K.—*Elaeodendron australe* VENT. Jard. Malm. (1805) t. 117, from Australia (Queensland and N.S. Wales), is allied but differs in having drupes with a rather thick fleshy exocarp and unisexual, 4-merous flowers.

Excluded

Elaeodendron pauciflorum TULASNE, Ann. Sc. Nat. IV, 8 (1857) 109. In Ind. Kew. this species has erroneously been referred to as from Malaya. The type, BERNIER 6182, came from St. Marie, Madagascar (cf. PERRIER DE LA BATHIE, Fl. Madag. fam. 116, 1946, 54).

11. PLEUROSTYLIA

W. & A. Prod. 1 (1834) 157; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 180.—**Fig. 20.**

Shrubs or trees. *Leaves* decussate, subcoriaceous to coriaceous. *Stipules* very small, caducous. *Cymes* in the axil of leaves or bracts, (1–)few-flowered. *Flowers* bisexual, 5– (occasionally with a few 4-)merous flowers. *Calyx* lobes imbricate.

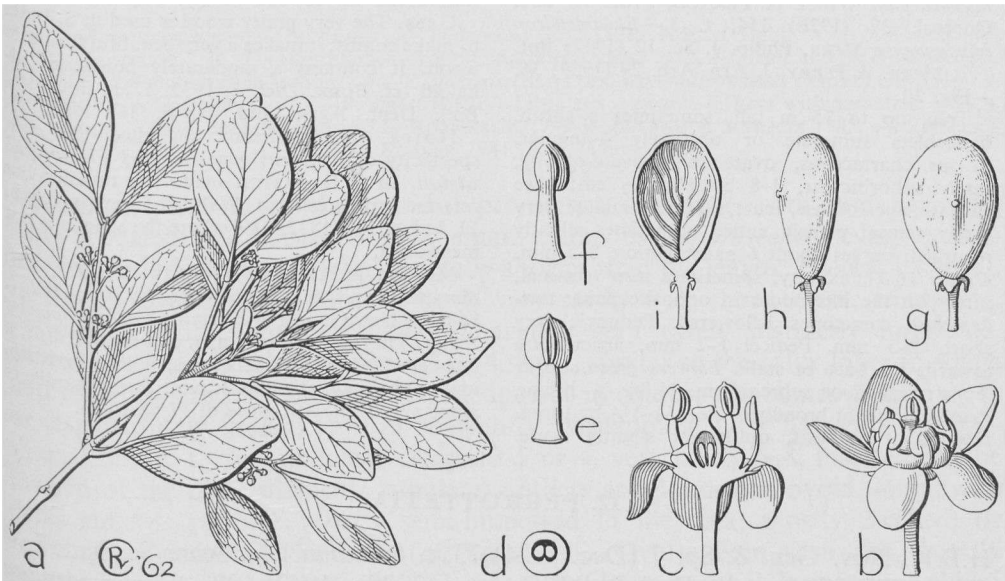


Fig. 20. *Pleurostyliya opposita* (WALL.) ALSTON. *a*, habit, $\times \frac{2}{3}$, *b*, flower, $\times 6$, *c*, ditto in section, $\times 6$, *d*, ovary in section, $\times 12$, *e-f*, frontal and dorsal view of stamen, $\times 12$, *g-h*, frontal and lateral view of fruit, *i*, fruit in section, showing endocarp, all $\times 3$ (*a-f* RAMOS BS. 22350, *g-i* BRASS 6257).

Petals imbricate. Disk cupular, fleshy. *Stamens* inserted outside the disk; anthers subbasifixed, introrse, with thick dorsal connective. Pistil conical or flask-shaped. *Ovary* free or slightly united with the disk at the base, 2-celled or usually only 1-celled by abortion; style short, terminal, slightly dilated at the top; stigma capitate or slightly peltate. *Ovules* 2(-8 in extra-Mal. sec. LOES.) in each cell, erect. Nuts 1-(also 2?-)celled, with a prominent persistent hardened style on the lateral side; exocarp + mesocarp thin-coriaceous, endocarp crustaceous, thin, inside glossy and irregularly ridged, easily separated from the meso- + exocarp, with several irregular clefts at the base around the hilum of the seed. *Seeds* 1(-2). Aril evidently absent.

Distr. About 6 spp. in the tropics and subtropics of Africa, Madagascar, Mascarenes, Ceylon, Indo-Malaysia, Queensland, and New Caledonia; in *Malaysia* one species.

Note. WIGHT & ARNOTT (*l.c.*) stated the 1-celled ovary and fruit to be due to abortion and that the rudimentary one can be scarcely traced. In the Malaysian material I have examined there is only one cell in the ovary and fruit; there is a faint indication of a septum (fig. 20d) in cross-section. I have not traced a single mature, undamaged developed seed!

1. *Pleurostylia opposita* (WALL.) ALSTON in Trimen, Fl. Ceyl. 6 (Suppl.) (1931) 48; MERR. & METCALF, Lingn. Sc. J. 16 (1937) 394.—*Celastrus opposita* WALL. in Roxb. Fl. Ind. ed. Wall. 2 (1824) 398.—*P. wightii* W. & A. Prod. (1834) 157; WIGHT, Ic. (1839) 155; LAWS. in Hook. f. Fl. Br. Ind. 1 (1875) 617; TRIMEN, Fl. Ceyl. 1 (1893) 271; LOES. Bot. Jahrb. 39 (1907) 171, incl. var. *neocaledonica* LOES.; MERR. Philip. J. Sc. 12 (1917) Bot. 281, pro var. *neocaledonica*; RIDL. Fl. Mal. Pen. 1 (1922) 453, as *Pleurostylis*; MERR. En. Philip. 2 (1923) 484, pro var. *neocaledonica*; CRAIB, Fl. Siam. En. 1 (1926) 283; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 180, f. 31, J.—*P. heynei* W. & A. Prod. (1834) 157.—*Elaeodendron microcarpum* WHITE & FRANCIS, Proc. R. Soc. Queensl. 37 (1926) 154, t. 3.—*Elaeodendron mindanaense* MERR. Philip. J. Sc. 12 (1917) Bot. 277; MERR. & PERRY, J. Arn. Arb. 29 (1939) 36.—Fig. 20.

Tree, up to 15 m tall, sometimes a shrub. Branchlets subterete or obscurely 4-angular. *Leaves* chartaceous, ovate to obovate-oblong, rarely suborbicular, 3-8 by 1½-5½ cm; base cuneate; apex obtuse, acute, rarely acuminate, very rarely retuse; margin entire, sometimes slightly recurved; nerves about 6 pairs; petiole 2-5 mm. *Cymes* 1(-2), axillary, sometimes also terminal, rarely on the internodes in opposite pairs, few-flowered, sometimes 1-flowered. Peduncle very short, 2-3 mm. Pedicel 1-2 mm, articulation towards the base of stalk. *Flowers* green. *Calyx* lobes rounded or subreniform, ½ by ¾-1 mm. *Petals* elliptic, or broadly ovate, 1¼-1½ by 1 mm, reflexed at anthesis, obtuse or slightly acute.

Disk fleshy, cup-shaped, margin slightly crenate. *Stamens* 1-1½ mm, attached just beneath the margin of the disk; filaments subulate, fleshy, slightly flattened; anthers slightly ovoid, c. ½ mm long, slightly apiculate. Pistil flask-like, the base adnate to the disk; style very short; stigma capitate. *Fruits* ellipsoid or sometimes slightly obovoid, 5-7 by 4-5 mm, obtuse, 1(-2)-seeded, sustained by the usually persistent floral parts.

Distr. Ceylon, S. India, Siam (Puket, *vide* CRAIB), China (Hainan), through *Malaysia*: Malay Peninsula (Penang, Langkawi Is.), Philippines (Luzon and Mindanao), and New Guinea to Queensland and New Caledonia.

Ecol. In lowland primary and secondary light rain-forest, up to 650 m (*cf.* MERRILL, 1917).

Uses. The very pretty wood is used in S. India to make combs; it makes a very beautiful furniture wood. It contains a moderately poisonous alkaloid (*cf.* BURK. Dict. 2, 1935, 1771; BOORSMA, Bull. Dépt. Agric. Ind. Néerl. 16, 1908, 5).

Notes. CRAIB already suggested the conspecificity of *Celastrus oppositus* and *Pleurostylia wightii*. In 1931 ALSTON made the transfer but referred erroneously to 'Wall. ex Carey in Roxb. Fl. Ind. ed. II (1832) 389' where the species is not mentioned.

MERRILL & PERRY (J. Arn. Arb. 20, 1939, 336) identified two specimens collected by BRASS (6257, 8685) in New Guinea as *Elaeodendron mindanaense* MERR. They have, however, a cup-shaped disk, a one-celled ovary with 2 ovules, a thin pericarp, and entire and reticulate leaves; these characters agree very well with those of *Pleurostylia*.

12. PERROTTETIA

H.B.K. Nov. Gen. & Sp. 7 (Dec. 1824) 73, t. 622, non DC. Ann. Sc. Nat. I, 4 (Jan. 1825) 95; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 191.—*Caryospermum* BL. Mus. Bot. Lugd. Bat. 1 (1850) 175.—Fig 21.

Shrubs or small trees. Branchlets smooth, usually zigzag. *Leaves* alternate,

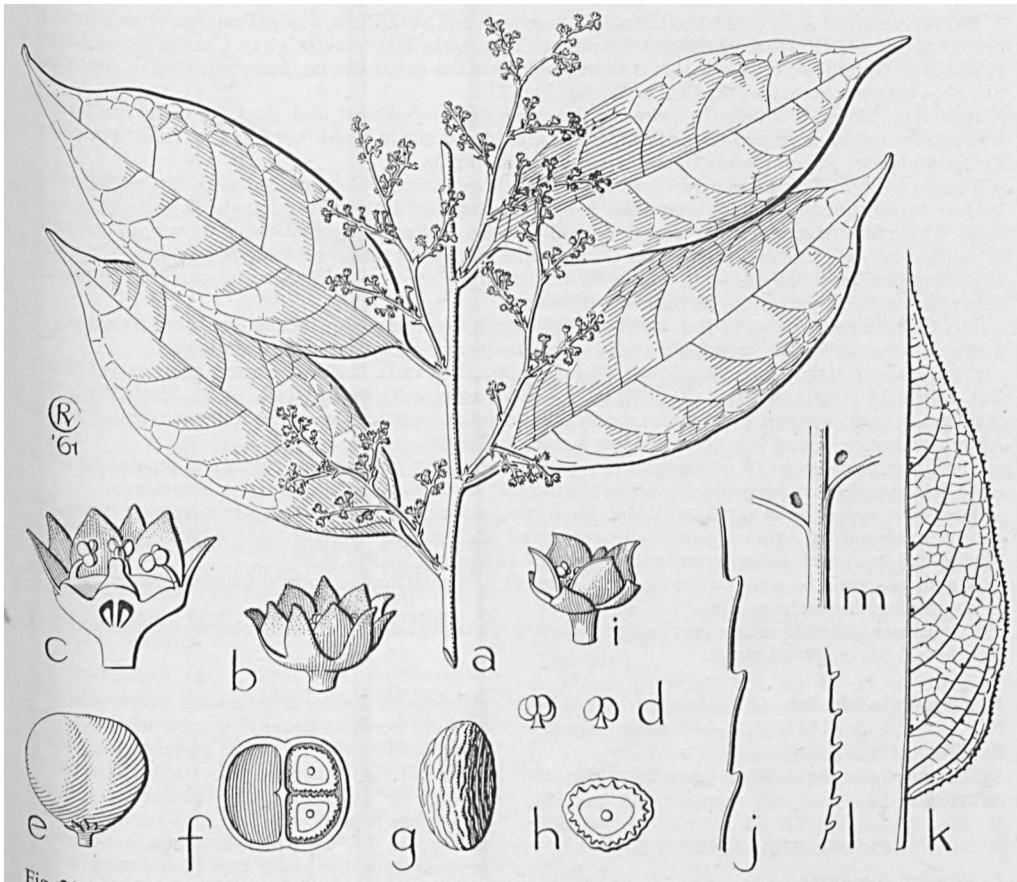


Fig. 21. *Perrottetia alpestris* (BL.) LOES. *ssp. moluccana* (BL.) DING HOU. a. Habit, $\times \frac{2}{3}$, b. flower, $\times 6$, c. *ditto*, in section, $\times 8$, d. young stamen, frontal and dorsal view, $\times 12$, e-f. fruit and its cross section, $\times 3$, g-h. seed and its cross section, $\times 5$.—*P. alpestris* (BL.) LOES. *ssp. philippinensis* (VIDAL) DING HOU. i. Flower, $\times 6$. j. leaf margin, $\times 3$.—*P. alpestris* (BL.) LOES. *ssp. alpestris*. k. Leaf with domatiae, $\times \frac{2}{3}$, l. leaf margin, $\times 3$, m. domatia enlarged (a ROBBINS 368, b-d HOOGLAND & SCHULTE 7385, e-h ZIPPILIUS 64/d, i-j STEINER 1941, k-m MEIJER 1616).

sometimes spiral (extra-Mal.), midrib prominent, sometimes with domatia in the axils of midrib and nerves. *Stipules* small, caducous. *Inflorescences* cymose, axillary in small divaricate thyrses generally shorter than the leaves. *Flowers* bisexual, rarely unisexual. *Calyx* lobes 5 or 4, very rarely 6–8, short, erect, triangular, valvate or with slightly imbricate margins, very rarely distinctly imbricate. Floral envelopes persistent. *Petals* 5 or 4, erect, similar to the calyx lobes in shape and equal in size or somewhat larger, but not in colour, sometimes ciliate, more or less distinctly keeled, valvate or slightly overlapping. Disk flat, cup- or ring-shaped, entire or fine-undulate. *Stamens* 5 or 4, very rarely 6–8, inserted on the margin of the disk; filaments subulate; anthers subglobose or ovoid, lengthwise dehiscent, \pm introrse. *Ovary* semi-immersed in the disk, mostly 2-celled, or seemingly 4-celled at the base (cf. LOES. *l.c.*). Ovules 2 in each cell, basally attached, erect. *Berry* globose, 2–4-seeded. *Seeds* erect, subglobose, thin arillate; testa thick, muricate-foveolate, or tuberculate, crustaceous, fleshy outside; endosperm thin; embryo small.

Distr. About 15 *spp.*, in Central China (E. Szechuan and W. Hupeh, 1 *sp.*), Formosa (1 *sp.*), throughout Malaysia to NE. Queensland and Solomons (2 *spp.*), the Hawaiian Is. (1 *sp.*), and Central America (Mexico to Columbia, c. 10 *spp.*). It is remarkable that the genus has not been recorded in continental SE. Asia between Sumatra and Central China. Fig. 22.

Ecol. In Malaysia chiefly in primary and secondary rain-forest and thickets, from the foothills through the montane zone up to 2640 m, sometimes also in the lowland, not found in East Java and the Lesser Sunda Is. and obviously bound to an everwet climate.

Taxon. The Malaysian material falls apart into three groups which are, however, distinguished only by two minor though constant characters while their geographical distribution shows exactly replacing areas. These taxa have, therefore, here been distinguished as geographical races and have been designated as subspecies. All of them have a rather considerable altitudinal range in Malaysia and show the normal morphological response of woody plants by reduction of leaf-size, thicker leaf texture, and more condensed habit in proportion to increase of altitude.

The Chinese species was in Ind. Kew. wrongly attributed to Japan with the erroneous basionym *Celastrus racemosus* TURCZ. from Java (not Japan). Its proper synonymy runs as follows:

P. racemosa (OLIV.) LOES. Bot. Jahrb. 24 (1897) 201, 200; in E. & P. Pfl. Fam. Nachtr. 1 (1897) 224; Bot. Jahrb. 29 (1900) 447; *ibid.* 30 (1901) 474.—*Ilex racemosa* OLIV. in Hook. Ic. Pl. 19 (1889) t. 1863. It differs from *P. alpestris* by glabrous sepals, ciliate petals, very long exerted stamens (similar to some American species!), and less nerves; it has 5-merous flowers.

The Formosan species, *P. arisanensis* HAYATA is distinct by very narrow petals and sepals and is said to be deciduous; it has 4-merous flowers as the Central Malaysian *P. alpestris ssp. philippinensis*.

The heavy reduction in number of Malaysian species accepted here may also be necessary in the New World species when these are critically compared and revised; CUATRECASAS already observed that 'they differ from each other by minute characters' (Lloydia 11, 1948, 223).

Attention should be given to the tendency towards unisexual flowers and monoecism, or even dioecism, in comparing floral characters.

It is remarkable that such a block of very closely related species shows such enormous disjunctions in its colossal geographical range.

1. *Perrottetia alpestris* (BL.) LOES. in E. & P. Pfl. Fam. 3, 5 (1892) 220.—*Celastrus alpestris* BL. Bijdr. (1826) 1145.

The synonyms have been arranged under the subspecies

KEY TO THE SUBSPECIES

1. Flowers 5-merous.
2. Leaf margins distinctly and rather closely glandulose-serrulate or -crenulate, the upper part of the teeth callose; base usually rounded.
 - ssp. alpestris*
2. Leaf margins entire, or with sparse, remote, minute, pointed teeth; base acute or cuneate, rarely obtuse *ssp. moluccana*
1. Flowers 4-merous. Leaves serrulate.
 - ssp. philippinensis*

ssp. alpestris.—*Celastrus alpestris* BL. Bijdr. (1826) 1145.—*Caryospermum serrulatum* MIQ. Fl. Ind. Bat. 1, 2 (1859) 592; K. & V. Bijdr. 7 (1900) 97.—*Caryospermum alpestre* O.K. Rev. Gen. Pl. 1 (1891) 113.—*P. alpestris* LOES. in E. & P. Pfl. Fam. 3, 5 (1892) 220; Nachtr. (1897) 224; Bot. Jahrb. 24 (1897) 200; K. & V. Ic. Bog. 2 (1904) 137, t. 127; BACK. Schoolfl. (1911) 235; KOORD. Exk. Fl. Java 2 (1912) 526, f. 80; RIDL. Fl. Mal. Pen. 1 (1922) 454; KOORD. Fl. Tjib. 2 (1923) 146; BURK. & HENDERSON, Gard. Bull. S.S. 3 (1925) 360; BARTLETT, Pap. Mich. Ac. Sc. 6 (1926) 53; HENDERSON, Gard. Bull. S.S. 4 (1927) 95; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 193.—*Maesa perakensis* RIDL. J. Fed. Mal. St. Mus. 4 (1909) 45.—Fig. 21k-m.

An evergreen shrub or a small tree up to 8 m by 10 cm ø. Branchlets puberulous when young,

glabrescent. Leaves chartaceous, nerves and veins on both surfaces usually covered with appressed hairs, sometimes the upper surfaces glabrescent; ovate-oblong, lanceolate, or sometimes ovate, 6½–23 by 2½–9 cm; base obtuse or rounded, sometimes slightly cordate; apex acuminate (acumen up to 1½ cm); margin glandulose-serrulate, or -crenulate, the upper part of the teeth callose, usually black, sometimes yellowish, blunt; petiole 7–15 mm. Inflorescences usually 1–2 cm long, sometimes even shorter, rarely up to 5 cm, sometimes branched almost near the base; peduncle very short, sometimes up to 2 cm. Bracts small, c. 2 mm long. Pedicels short, ½–1½ (–2½) mm. Flowers white, or light greenish, small, c. 3 mm ø. Calyx lobes 5, deltoid, ½–¾ mm long, sparsely puberulous on both surfaces, sometimes only on the inside especially towards the upper part. Petals 5, triangular, or ovate, ½–1¼ by ⅔–1 mm, sparsely puberulous on both surfaces, sometimes only puberulous on the margins. Disk shallow cupular, c. 1½ mm ø. Stamens c. ⅔ mm long; filaments much longer than the disk. Pistil slightly united with the disk at the base, conical, c. ½ mm long, narrowed into a short style; stigma obscurely 2-lobed. Fruits globose or subglobose, 2½–3½ mm, reddish black, 3–4-seeded, glabrous. Seeds subglobose, or slightly obovate, 1½–2 mm long, sometimes cuneate at the base, foveolate-rugulose or tuberculate.

Distr. Malaysia: commonly distributed in Sumatra, Malay Peninsula, and Java (as far E as Mt Lawu). Fig. 22.

Ecol. Everwet primary and secondary forests and thickets in the colline and montane zones, 500–2500 m, chiefly above 1000 m.

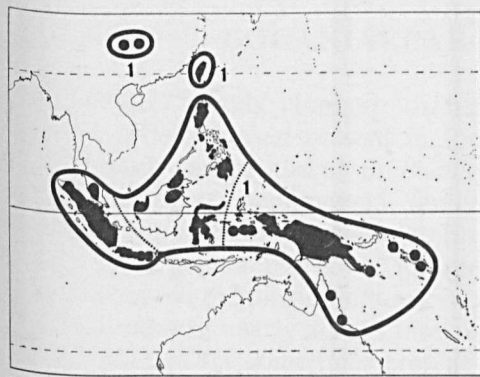


Fig. 22. Old World distribution of the 3 species of the genus *Perrottetia*; in the Malaysian *P. alpestris* (BL.) LOES. there are three replacing sub-species, separated by dotted lines.

Vern. Sumatra: *bərbah*, Bencoolen, *kaju atarasa pidong*, *k. si lando*, Asahan, *kaju musang*, W. Coast; Mal. Pen.: *kayu tungas*, Perak; Java: *kibélut*, *ki-bémok*, *ki dagè*, *kihiris*, *ki-hurang*, *ki-kiris*, *ki purut*, *kipiüt*, *kitarasi*, S, *kémalon*, *kémaluhan*, *wadéran*, J.

ssp. moluccana (BL.) DING HOU, *comb. nov.*—*Vertifolia rubra* RUMPH. Herb. 3 (1741) 100, t. 67.—*Caryospermum moluccanum* BL. Mus. Bot. Lugd. Bat. 1 (1850) 176.—*Caryospermum arborescens* F. v. M. Fragm. Phyt. Austr. 6 (1868) 202; *ibid.* 8 (1874) 279; BAILEY, Queensl. Fl. 1 (1899) 258.—*P. moluccana* (BL.) LOES. in E. & P. Pfl. Fam. 3, 5 (1892) 220; Nachtr. (1897) 224; Pfl. Fam. ed. 2, 20b (1942) 193.—*P. arborescens* (F. v. M.) LOES. Bot. Jahrb. 24 (1897) 200; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 193.—*P. grandifolia* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 30; MERR. & PERRY, J. Arn. Arb. 20 (1939) 336; LOES. in E. & P. Pfl. Fam. ed. 2, 20b (1942) 193.—*P. nervosa* RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 30.—*P. lauterbachiana* LOES. Notizbl. Berl.-Dahl. 12 (1934) 36, *incl. f. β macrophylla* LOES.; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 193.—*P. schlechteri* LOES. Notizbl. Berl.-Dahl. 12 (1934) 37; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 193.—*P. traumatophylla* MERR. & PERRY, J. Arn. Arb. 22 (1941) 261.—Fig. 21a-h.

Treelet 5–10 m, rarely tree up to 24 m. Leaves at the base cuneate to attenuate, rarely obtuse. Peduncles 1–5 cm, sometimes almost none. Fruits 2½–6 mm ø.

Distr. Solomon Is. (Bougainville, Isabel, and Guadalcanal Is.), Australia (NE. Queensland, rare), and *Malaysia*: Moluccas (Ceram, Ambon, and Buru) and New Guinea (rather common; also Fergusson I.), Fig. 22.

Ecol. Forests, from lowland up to 2640 m.

Vern. Moluccas: *kasubuwa*, Ceram; New Guinea: *aimbeh*, Wahgi, *bopeh*, Chimbu, *fonanitur*, Onjob lang, *gamaha*, Asaro, *ihira*, Mairi, *kunguna*, Hagen, *togump*, Togaba, *tsiltsibi*, Tomba, *waljamahp*, *walumap*, Enga lang.

ssp. philippinensis (VIDAL) DING HOU, *comb. nov.*—*Caryospermum philippinense* VIDAL, Rev. Pl. Vasc. Filip. (1886) 89.—*P. philippinensis* LOES. in E. & P. Pfl. Fam. 3, 5 (1892) 220; Bot. Jahrb. 24 (1897) 200; in E. & P. Pfl. Fam. ed. 2, 20b (1942) 191.—*P. alpestris* var. *philippinensis* STAPP, Trans. Linn. Soc. II, Bot. 4 (1894) 141; LOES. in E. & P. Pfl. Fam. Nachtr. (1897) 224; MERR. Philip. J. Sc. 5 (1910) Bot. 200; GIBBS, J. Linn. Soc. Bot. 42 (1914) 64.—*P. alpestris* (non (BL.) LOES.) KOORD. Minah. (1898) 396; MERR. En. Born. (1921) 354; En. Philip. 2 (1923) 484.—Fig. 21i-j.

Shrub or small tree up to 16 m. Leaf-base rounded, sometimes cuneate. Inflorescences (1–) 5–12(–21) cm long. Fruits c. 3 mm ø.

Distr. *Malaysia*: Philippines (Luzon, Mindoro, Panay, Camiguin de Misamis, and Mindanao), Borneo (N. Borneo, Sarawak, and Kutai), and Celebes (Minahasa to SW. Celebes). Fig. 22.

Ecol. Rain-forests and thickets, (350–)700–2700 m.

Vern. Borneo: *maesa*, Sarawak; Philip.: *balakbdkan*, Buk., *bubayug*, Ig., *dañgdilis*, Bag., *tigaundako*, C. Bis.; Celebes: *kaju-werang*, *mahawerang*, *mukuwerung*, Minahasa, *lotong matjula*, Polewali.

Excluded

Perrottetia caudata RIDL. Trans. Linn. Soc. II, Bot. 9 (1916) 31, from New Guinea, leg. BODEN KLOSS, in K, BM, is, according to kind information of Mr L. L. FORMAN, Kew = *Rhus cf. linguata* W. SLIS (*Anacardiaceae*).