

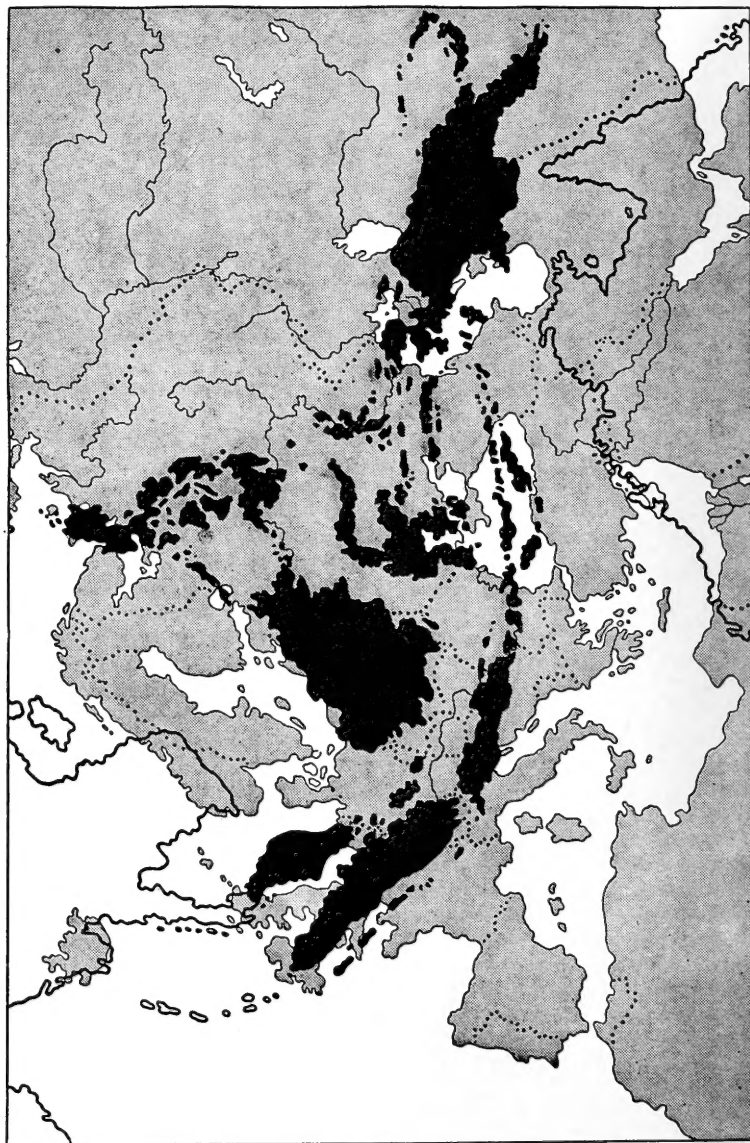
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# FLORA MALESIANA

UNDER THE AUSPICES OF  
THE BOTANIC GARDENS OF INDONESIA, BOGOR,  
AND THE RIJKSHERBARIUM, LEYDEN,  
SPONSORED BY THE FOUNDATION  
FOR PURE SCIENTIFIC RESEARCH



## NAJADACEAE (W. J. J. O. de Wilde, Leyden)

Within the *Helobieae* there has been a great deal of controversial opinion about the evaluation of the genera belonging to the *Potamogetonaceae*, among which *Najas* finds by almost unanimous opinion its closest relatives. Generally *Najas* has been accepted to represent a separate monotypic family on account of the basal ovule and the structure of the anther (with a thin, tight, 2-lipped envelope and apically escaping pollen). The closest allied genus among *Potamogetonaceae* seems to be *Zannichellia*, which is by HUTCHINSON (1934) accepted as a separate family, *Zannichelliaceae*, put together with *Najadaceae* in his order *Najadales*.

Within the *Helobieae* some authors accept the structure of *Najadaceae* as primitive, notably CAMPBELL (1897) and RENDLE (1930), but others find it a derived, advanced state within the order, cf. HUTCHINSON (1934) and LAWRENCE (1951).

An excellent concise account of opinions is given by LAWRENCE (Taxonomy of Vascular Plants, 1951, 375–378).

### NAJAS

LINNÉ, Gen. Pl. ed. 5 (1754) 445; Sp. Pl. (1753) 1015; WILLD. Mémoires. Ac. R. Sc. Berl. (1798) 85; A. BRAUN, J. Bot. 2 (1864) 274–279, 8 fig.; P. MAGNUS, Beitr. z. Kenntn. Gatt. *Najas* (1870) 1–63, t. 1–8; C. BAILEY, J. Bot. 22 (1884) 305, fig. 1–89; P. MAGNUS in E. & P. Pfl. Fam. 2, 1 (1889) 214–218; Ber. Deut. Bot. Ges. 12 (1894) 214, t. 11; K. SCH. in Mart. Fl. Bras. 3, 3 (1894) 715–734, t. 123–124; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 379–444, t. 39–42; Pfl. Reich Heft 7 (1901); DE WILDE, Act. Bot. Neerl. 10 (1961) 164, fig. 1–9.—*Caulinia* WILLD. Mémoires. Ac. R. Sc. Berl. (1798) 87, t. 1; cf. DE WILDE, Willdenowia 2 (1960) 595–597.—**Fig. 1–8.**

(Mostly) fragile, slender, submersed annuals, rooting from the base and lower nodes. Stems often forked, terete, sometimes provided with teeth (*subg. Najas*). Leaves sessile, in pseudowhorls of 3 or more, linear, sometimes more or less subulate or linguiform, 1-nerved; midrib bordered on both sides, especially clearly visible in the lower part of fullgrown leaves, by a mostly distinctly transversely septated intercellular space, here called 'cavity'. Sheath more or less auricled, or truncate, or decurrent; upper part of the sheath and margin of the blade, sometimes also the dorsal surface of the midrib, spiny-dentate or spiny to various degree; spine cells yellowish-brown, ascending. Sheath with 2 axillary intravaginal scales (see fig. 2g–l). Plants mostly monoecious. Flowers small, unisexual, solitary or sometimes 2–4 together, at the very base of an (sometimes very short) axillary shoot, each often enclosed in a membranous (sub)sessile spathe (♀ fl. in Mal. spp. espathaceous). Spathe tapering to the top, or constricted into a cylindrical neck, the edge mostly with some erect spines. ♂ Flowers consisting of one subsessile or stalked anther, which is tightly enveloped by a membranous 'perianth' apically mostly produced into 2 more or less distinct 'lobes'; anther 1- or 4- (rarely 2-)celled, basifixed, ± pore-like dehiscing at the top; 'pedicel' mostly considerably elongating just before anthesis. ♀ Flowers (in Mal.): ovary subsessile, naked, elliptical to oblong, 1-celled, style cylindrical, with (1–)2(–4) linear, often unequal stigmas. Ovule one, basal, erect, anatropous; integuments two. Fruits elliptical-oblong (to ovate); style and stigmas persistent; pericarp very thin in the herbarium, not dehiscent, tearing away at the base or dwindling by rotting.

*Seeds* oblong (to ovate), with a conspicuous raphe and a hard, (in Mal. *spp.*) distinctly areolate, mostly brownish testa; embryo straight; hypocotyl and radicle large, plumule well developed; cotyledon terminal, blunt. No endosperm.

*Distr.* About 35 *spp.*, from the tropical to the temperate parts of the world.

*Ecol.* Mostly in shallow, stagnant or sluggish waters, ditches, rice-fields, small streams in forest, pools, ponds, swamps, mostly in freshwater, but also in brackish water near coasts and inland, a few species even preferring this habitat. *N. malesiana* is the only species which is preferring streams and ponds in forests. The others are all found in eutroph waters. According to SUNIER (Treubia 2, 1922, 190) *N. indica* is usually found in freshwater sites but occurs in the brackish fish-ponds near Djakarta with a salinity of up to 32‰. *N. browniana* seems almost confined to coastal brackish water and is found inland only in the saline water of the Kuwu mudwells, SE of Semarang, as the only aquatic represented there. Further *N. marina* var. *zollingeri* is confined to the alkaline waters of Batur Lake, in Bali, with a rather high content of dissolved minerals. Stems and leaves of *Najas* are not seldom found encrusted with calcium which adds to their brittle nature. Some species are resistant to rather hot water, e.g. *N. tenuifolia* ssp. *pseudograminea* var. *pseudograminea* which is found in the craterlake of Mt Kelud, Central Java, on black mud in water of 60° C; this water contains the usual large amount of minerals in solution common in craterlakes, further sulphates, sulphides, Ca and Mg compounds, etc. BRANDIS recorded *N. graminea* from a hot spring in Burma in water of 92° F, and the first record of it in England was from hot water emitted by a factory (J. Bot. 22, 1884, 326). HERMANN recorded *N. marina* from hot springs in America (Leaf. West. Bot. 1, 1935, 182).

As to depth *Najas* species are adapted to shallow waters; during the German Limnological Sunda Expedition the greatest depth at which *Najas* occurred was fixed at c. 5 m, but these specimens proved all to be sterile (cf. VAN STEENIS, Arch. Hydrobiol. Suppl 11, 1932, 240, 271).

The relatively rare occurrence of *N. marina* in Malaysia and in many parts of its almost ubiquitous range as well, points to a sensitive and selective ecology rather than to random chance dispersal by aquatic birds, especially in connection with its rariation into geographical varieties of sometimes restricted areas. The phenomenon is also found in *Hydrocharitaceae* and *Alismataceae* (cf. Fl. Mal. I, 5, 1957, 317). In checking localities it has appeared that generally one lake seems to have only one species; *N. indica* in Toba, Ranau, Situ Bagendit, Singkang, and Gorontalo lakes, *N. graminea* var. *graminea* in Situ Gunung, Matana & Towuti lakes, *N. tenuifolia* ssp. *pseudograminea* var. *pseudograminea* in Kelud and Rawa Bening (Kediri) lakes, and the same holds for *N. browniana* and the three varieties of *N. marina* which are all found in one lake only, with no other species present. The only exception is Tondano lake, in NE. Celebes in which according to the data on the labels three species have been collected, viz *N. graminea* var. *graminea*, *N. indica*, and *N. tenuifolia* ssp. *pseudograminea* var. *celebica*.

As to altitude most species and localities prefer the lowland areas, but *N. marina* goes up to 1000 m, and several others are found in Toba Lake, 900 m, Tondano Lake, 700 m, Kelud Lake, 1000 m, the highest altitude recorded being 1400 m. In the Himalayas Malaysian species are recorded to over 2000 m.

As to climate none of the species shuns the seasonal areas, and some seem often to be more abundant in them than in everwet areas which may again point to preference for eutroph water.

*Flower biology.* Pollination takes place in submerged condition, but there are no detailed actual observations in Malaysia. The stalk of the anther elongates at maturity pushing the anther, either laterally or terminally, beyond the spathe (if there is any), then sometimes recurving. The pollen grains are either globular or ellipsoid and contain much starch; an exine is absent; they escape from the top of the anther through a hole between the two lobes which diverge. MAGNUS (in E. & P. Pfl. Fam. 2, 1, p. 216) stated that the pollen of *N. marina* germinates before leaving the anther. This has also been observed in other species by MIKI (Tokyo Bot. Mag. 49, 1935, 774, fig. 6 G, P). The pollen tube facilitates of course floating and will increase the chance to fasten to a stigmatic arm of the ♀ flower. Through this mechanical way, without aid of water animals, pollination must take place. As *Najas* mostly grows gregariously the distance between ♂ and ♀ flowers is not large, and small movements in the water may effect contact of pollen and stigmas.

Though in a few instances two species are growing in the same locality and are found mixed in collections they retain their specific characters well and I have not found any trace of hybridization.

*Morph.* The leaves of *Najas* are essentially subopposite, but appear to be placed in pseudowhorls of 3 or more. This phyllotaxis originates as follows: The sheath of the not fully amplexicaulous lower leaf of each pair imbricately overlaps the fully amplexicaulous sheath of the upper one. Only the lower leaf bears an axillary bud growing into a lateral branch. The first internode of this lateral branch is extremely short and its first node becomes in this way almost sessile; it bears a leaf pair, but of this pair only the upper one is developed as a real leaf which forms together with the 2 leaves of the main stem the pseudowhorl of three. The lower leaf of the first node is very much reduced; according to MAGNUS (1870, 1894) it is, in vegetative shoots, represented by a very small scale bearing a vegetative bud in its axil, whereas in fertile lateral shoots a flower occupies the place of this scale. Fig. 1b-c.

The flower would, therefore, be homologous with a scale plus its axillary bud. It has appeared that a fully developed flower of many *Najas* species is surrounded by a spathe (fig. 2d, 2f) and from the





Fig. 1. *Najas tenuifolia* ssp. *pseudograminea* (W. KOCH) DE WILDE var. *pseudograminea*. a. Habit (arrows pointing to an open and 2 closed ♂ flowers respectively),  $\times 5$ , b. situation at a node in which the lowest leaf has been recurved and one flower removed,  $\times 15$ , c. diagram with identical signatures as in b:—1. main axis of stem, 2. lower leaf of a pair, 3. upper leaf of the pair, 6. axis of shoot in axil of lower leaf, bearing: 4. flower (removed here) either ♂ and enveloped by spathal bract or ♀ and naked, representing lower fertile leaf of lateral shoot, and 5. leaf opposite 4, representing upper leaf of the lowest pair of lateral shoot, 6–7–8–9–10 a repetition on the next node of the lateral shoot of 1–2–3–4–5 on the node of the main axis. This drawing represents an average situation; it can be more complicated if the lower leaf pairs on axillary shoots are reduced to mere bracts. Sometimes 2, 3, and 5 form a pseudowhorl of three leaves which is always represented on sterile nodes; in this figure 2, 3, 5, 7, 8, and 10 form a pseudowhorl of six leaves (BACKER 7903).

homology it would appear that the spathe is not representing a perianth but a tubular reduced leaf, and must be understood as homologous with the scale found in its place in vegetative shoots. I have been able to find an almost complete series of transitions between an open scale and a fully closed bottle-shaped spathe (DE WILDE, 1961) and believe to have proved this homology.

In a few cases there are more flowers together with one whorl at a node. As these flowers are always different in size, hence in age, the situation can be explained in that more than one node of the lateral shoot is reduced in a similar way as the first one. This follows also from the fact that the number of leaves of the pseudowhorl may be up to 5 or more in exceptional cases.

In the ♂ flower the anther is tightly surrounded by a very thin membrane which, in *N. marina*, consists of only 2 cell layers. According to MAGNUS (1870, p. 23; 1894, p. 216) this envelope is practically ad-

nate to the anther and ends in two more or less thickened lobes. Whether this would represent a 'perianth' seems doubtful and it is not clear whether the stalk under the anther is a pedicel or a filament. Fig. 2c and 2e.

The pericarp of the fruit is almost pellicid and very thin in dried specimens, clinging very closely to the seed. According to BAILEY (1884, p. 322) and RENDLE (1899, p. 385) it would in fresh specimens be "succulent" in *N. marina* and *N. graminea*. It seems gradually to decay on the plant or separates from the seed by breaking irregularly away at the base.

Anat. As usual in water plants the structure of stem and leaf is very simple. In most species the epidermal cells of the stem closely resemble those of the underlying cells of the cortex, only in *N. marina* the epidermal cells are distinctly smaller. In a cross section of the stem the cortex appears to consist of two layers of parenchymatic cells; the outer one is always more cell layers thick, the inner one is also mostly a few cell layers thick but may consist of only one cell layer (the endodermis). These two cortical layers are connected by radial septa mostly one cell thick, which separate large intercellular cavities. The stele is small-celled and has a central cavity. Fig. 2a-b.

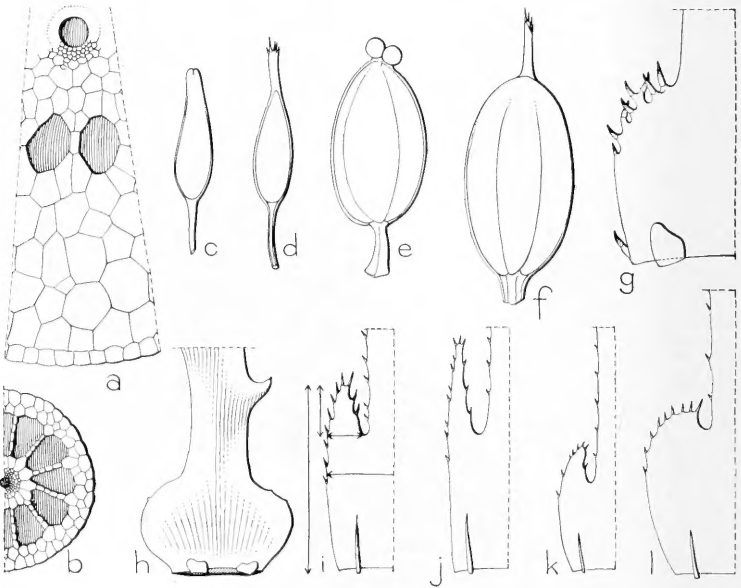


Fig. 2. Details of *Najas*. a. Partial cross-section of stem of *N. marina* var. *zollingeri* RENDLE, b. ditto of *N. kurziana* RENDLE, c. naked ♂ flower, anther 1-celled, of *N. malesiana* DE WILDE, d. spathed ♂ flower, anther 1-celled, of *N. browniana* RENDLE, e. naked ♂ flower, anther 4-celled, of *N. graminea* DEL. var. *graminea*, 'perianth lobes' extraordinarily conspicuous, f. spathed ♂ flower, anther 4-celled, of *N. tenuifolia* ssp. *pseudograminea* (W. KOCH) DE WILDE var. *pseudograminea*, g. half a sheath of *N. marina* var. *sumatrana* DE WILDE, no auricle, squamulae intravaginalis irregularly quadrangular, h. leaf base of *N. marina* L. var. *marina*, ditto, i. half a sheath of *N. tenuifolia* ssp. *pseudograminea* var. *celebica*, (KOORD.) DE WILDE, arrows indicate how and where length and width of auricles and sheath have been measured, squamulae intravaginalis linear, j. ditto of *N. graminea* DEL. var. *graminea*, k. ditto of *N. malesiana* DE WILDE, l. ditto of *N. indica* (a-b × 50, c-f × 25, g × 10, h × 5, i-l × 10; a RUTTNER 313, b VAN STEENIS 18226, c MEUER 5772 (type), d HORSFIELD s.n., e EYMA 3329, f THUNG s.n. (isotype), g JACOBSON s.n. (type), h JENSEN 298, i KOORDERS 17347 (type), j SUNIER s.n., k CLEMENS 9699, l LÖRZING 11067).

The leaf shows in cross section a midrib consisting of small cells covered above and beneath by one to two layers of larger cells and is on both lateral sides accompanied by an intercellular cavity. The blade proper consists of only two cell layers (upper and under epidermis), but has additional subepidermal cell layers in *N. marina*.

**Taxon.** The genus is very coherent in structure and I have followed A. BRAUN (1864) and K. SCHUMANN (1894) in not accepting subgenera, but merely two sections; *sect. Najas* contains only one species, *N. marina*; the other species are accommodated in *sect. Caulinia*. RENDLE found it useful to subdivide his subgenus *Caulinia* into 4 'sections' which were mostly defined according to the presence or absence of the spathe in one or both sexes. I have found (1961) that this character is variable and I have consequently refrained from accepting this subdivision.

**Uses.** According to SUNIER (Treubia 2, 1922, 222) *Najas*, which is profusely found in brackish fishponds (tambaks) near Djakarta, may be important as a source of food for fish. From the Toba Lake it is reported that *Najas* can be utilized as pig food, a use it shares with many other water plants (BACKER, Teysmannia 1911, p. 514).

**Notes.** As the vegetative characters are very uniform and show besides a rather large variability within one species, it has been impossible to frame a key to identify sterile material. Collectors should try to select fertile material either recognizable by the presence of fruit in the lower axils, or the presence of a yellowish or reddish tinged anther in the higher axils. In some species the sexual organs are very small. Dissection and examination of boiled herbarium specimens is a delicate, time-consuming work.

Attention is called to the fact that sometimes more than one species is represented in a single habitat.

Measurements of leaves as found in descriptions have been made as is shown in fig. 2i.

Thanks are due to Dr. P. W. LEENHOUTS whose help and advice I have appreciated.

## KEY TO THE SPECIES

1. Seed  $3\frac{1}{2}$ – $4\frac{1}{2}$ – $(7\frac{1}{2})$  by  $2\frac{1}{2}$ – $(3)$  mm. Intravaginal scales up to  $1\frac{1}{2}$  times as long as broad, fleshy (fig. 2g–h). Cells of epidermis distinctly smaller than underlying cortex cells. Neck of the spathe (only in ♂ fl.) up to twice as long as broad, the margin without or with a few very minute spines. Internodes sometimes dentate. **SECT. NAJAS** . . . . . **1. N. marina**
1. Seed less than  $3\frac{1}{2}$  mm long, if nearly  $3\frac{1}{2}$  mm then only c.  $2/3$ – $(\frac{3}{4})$  mm broad. Intravaginal scales lanceolate to filiform, thin (fig. 2i–l). Cells of epidermis not distinctly smaller than underlying cortex cells. Neck of the spathe more than twice as long as broad, the margin with 3–9 distinct spines. Internodes smooth. **SECT. CAULINIA**.
2. ♂ Flower enclosed in a spathe.
3. Mature anther 1-celled,  $1/3$ – $1\frac{1}{4}$  mm. Spathe up to 2 mm.
4. Seeds  $2\frac{1}{2}$ –3 mm long; areoles of testa much broader than long (ladder-like). Leaves often coarsely dentate . . . . . **2. N. minor**
4. Seeds up to 2 mm long; areoles of testa about isodiametrical. Leaves not coarsely dentate.
5. Seeds 1–1.2 by  $1/3$ – $0.4$  mm. Spathe 0.9–1.2 mm. Blade with (30–)50–60 spines on each side. Auricles mostly long-triangular,  $1/2$ – $0.8$  mm long . . . . . **3. N. kurziana**
5. Seeds  $1\frac{1}{2}$ –2 by  $1/2$ – $3/4$  mm. Spathe  $1\frac{1}{3}$ –2 mm long. Blade with 12–21 spines on each side. Auricles mostly short triangular, up to  $1/2$  mm long . . . . . **4. N. browniana**
3. Anther 4-celled, when mature  $1\frac{1}{3}$ – $2\frac{1}{4}$ – $(2\frac{1}{2})$  mm. Spathe 2– $3\frac{3}{4}$  mm long.
6. Auricles (0–)0.2–0.6(–1) mm long, mostly broader than long, the inner edge without spines. Leaf-blade flat to nearly terete or triangular in cross-section, with 1–30(–40) spines on each side, sometimes moreover with one or more dorsal spines. Fruits solitary. Seeds  $3/4$ – $0.9$  mm broad. Cavities at least half as wide as the leaf-halves, their outer edge not brown. Marginal spines well visible with the naked eye . . . . . **5. N. indica**
6. Auricles 0.6–1.6(–3) mm long, longer than broad, the inner edge with (0–)1–4 spines. Leaf-blade flat, with 15–60(–70) spines on each side, dorsally always spineless. Fruits solitary or 2(–3) together. Seeds up to  $3/4$  mm broad; cavities variable in width, from very narrow to nearly reaching the margin. Marginal spines (mostly) just visible with the naked eye . . . . . **6. N. tenuifolia**
2. ♂ Flower not enclosed in a spathe.
7. Auricles less than twice as long as broad, up to 1.1 mm long. Anther 1-celled, when mature 0.6–1 by 0.15–0.3 mm. Seeds 1–1.8 by (0.35–)0.4–0.6 mm; testa with 16–22(–26) longitudinal rows of 24–30 areoles. Leaves  $1\frac{1}{4}$ – $2\frac{1}{2}$  cm, with (10–)20–30(–50?) spines along each side. Plant slender, up to 15 cm high . . . . . **7. N. malesiana**
7. Auricles at least twice as long as broad, 1– $5\frac{1}{2}$  mm long. Anther 2- or 4-celled, when mature 1.2–2 by 0.4–1 mm. Seeds 1.8–2.7 by 0.6–0.9 mm (if less than 2 mm long then broader than 0.6 mm and with more than 25 longitudinal rows of areoles). Testa with 20–34 longitudinal rows of 30–45 areoles. Leaves  $1\frac{3}{4}$ –6 cm, with 40–185 spines along each side. Plant slender to rather coarse, up to 50(–75) cm high . . . . . **8. N. graminea**

1. Section *Najas*

*Sect. Eunajas* A. BRAUN, J. Bot. 2 (1864) 275; ASCHERS. Fl. Prov. Brand. 1 (1864) 669 (status not mentioned).—*Subg. Eunajas* ASCHERS. ex RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 389; Pfl. Reich Heft 7 (1901) 7.

Mostly coarse plants. Epidermis distinctly differentiated by smaller cells from the underlying cortex. Internodes often spiny. Leaves up to 12(–15, very rarely more) times as long as broad, mostly fleshy, coarsely dentate along the margin and mostly on (or near) either side of the lower portion of the midrib; marginal teeth up to c. 15 (very rarely more) on each side. Sheath with or without inconspicuous auricles. Intravaginal scales less than twice as long as broad, blunt, often asymmetrical, fleshy (fig. 2g–h). Dioecious. ♂ *Flowers*: spathe constricted into a short (up to twice as long as broad), (sub)cylindrical neck, the margin without, or with a few, very minute spines; anther 4-celled. ♀ *Flowers* espathaceous, bearing (2–)3(–4) stigmas. Seed 3–7½ by 2–3 mm; testa consisting of more than three layers of hardened cells. Areoles often unequal in size, not distinctly arranged in longitudinal rows.

Distr. Monotypic, ubiquitous.

1. *Najas marina* LINNÉ, Sp. Pl. (1753) 1015, incl. var. *β* et *γ*; K. SCH. in Mart. Fl. Bras. 3, 3 (1894) 723, t. 123 f. 2; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 389, t. 39 f. 1–30; *ibid.* (1900) 437; Pfl. Reich Heft 7 (1901) 7, f. 1 A–C, 3 A–Q.—*N. major* ALL. Fl. Ped. 2 (1785) 221; BENTH. Fl. Austr. 7 (1878) 181; HOOK. f. Fl. Br. Ind. 6 (1893) 569; KOORD. Exk. Fl. 1 (1911) 91; MIKI, Bot. Mag. Tokyo 49 (1935) t. 8 f. E–I.—Fig. 2a, g–h, 3.

Plant up to c. 70 cm, lower internodes 3–8 cm by 0.9–2.6 mm, glabrous to very spiny. Leaves ½–4½ cm by 1½–3½ mm, flat, sometimes triangular in section, almost always fleshy; tip acute to blunt (blade c. 3 mm below the tip 1.8–3 mm wide); margin on either side with 5–12(–40) spiny teeth; dorsal surface sometimes without, often with 1–6(–40) spines; teeth up to long triangular or conical; up to as long as the width of the blade; spine cells 0.05–0.15 mm, brownish; midrib c. 0.1 as wide as the blade, cavities occupying up to ¾ of the leaf-width, septa indistinct. Sheath on either side (without or) with 1–5(–10), mostly inconspicuous spines, 2–6½ by 3–9 mm; auricles absent or up to c. 0.2 mm long. *Flowers* solitary. Spathe of ♂ *flower* (in Mal. unknown) c. 4½ mm long (Kashmir specimens); neck about cylindrical, 0.3–0.5 mm, edge somewhat lobed, sometimes with (?) spines; anther 4-celled, c. 3½ by 2½ mm; 'perianth lobes' rather indistinct; 'pedicel' c. 0.5 mm, in anthesis longer. Spathe in ♀ *flower* absent; ♀ fl. 1.9–3.8 mm, ovary 0.8–1.2 by 0.6–0.8 mm, style 0.2–0.8 mm, with 2–4 stigmas 0.9–2 mm. *Seeds* (asymmetrical) elliptical to ovate, narrowing to the tip, somewhat compressed, (3½–)4–4.4(–7) by (2–)2.4–2.6 mm; testa shiny with rather irregularly arranged ± isodiametrical, 5–6 angular, unequal-sized areoles.

This ubiquitous species has been split up into a large number of varieties, three of which occur in Malaysia.

## KEY TO THE VARIETIES

1. Leaves 15–25 times as long as broad, flat and thin, (when dry) more or less pellucid. Stem densely dentate; leaf margin with 30–40 slender spiny teeth, ¾–1 mm long, on either side. Style narrow, longer than ½ mm var. *sumatrana*
1. Leaves less than 15 times as long as broad, somewhat fleshy, opaque. Stem smooth; leaf margin with up to 12 broad triangular (conical) spiny teeth on either side. Style thick, up to ½ mm long.
2. Leaves 3–4½ cm by 3–3½ mm; widest in the middle of the blade. Leaf margins each with (5–)8–10(–12) teeth, on the dorsal surface rarely with 1 tooth. Leaf sheath (4–)5–6½ by 7–9 mm. . . . . var. *zollingeri*
2. Leaves up to 3 cm by 3 mm, mostly broadest above the middle. Leaf margins each with (2–)4–7 teeth; dorsal surface with (0–)2–6 teeth. Leaf sheath up to 3.7 by 5.6 mm.

var. *marina*

var. *marina*.—*N. major β* *augustifolia* et *ε* *intermedia* A. BRAUN, J. Bot. 2 (1864) 275, 276.—*N. marina* var. *angustifolia* et *intermedia* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 395, 439, t. 39 f. 13, 28, 14 et 29; *ibid.* (1900) 439; Pfl. Reich Heft 7 (1901) 8, f. 3 E, O, F, P.—*N. intermedia* GORSKI, Eichw. Nat. Skizze Lithauen (1830) 126, non *vidi*.—Fig. 2h.

Plant up to 30 cm, lower internodes up to 6 cm by (1.1–)1½–2(–2½) mm. Leaves linear or slightly spatulate, (1½–)1–2½(–3) cm by 1½–2¾ mm, c. 3 mm below the tip 2–3 mm wide, flat to triangular in section, somewhat fleshy; apex blunt, rarely acute; margin on either side with (2–)4–7 coarse spiny teeth, up to the lower 7 mm sometimes without teeth; dorsal surface mostly with 1–6 spiny teeth, rarely unarmed; teeth (long) triangular to conical, up to as long as the width of the blade; spine-cells c. 0.05 mm or smaller, brown; cavities

often indistinct, occupying  $\frac{1}{2}$ – $\frac{3}{4}$  of the leaf-width. *Sheath* on either side with 1–2 inconspicuous ( $< 0.05$  mm) spines, 2–3.7 by 3–5.6 mm; auricles absent. Spathes of ♂ flower c. 1.8 mm, tip with c. 3 small hyaline spines c. 0.1 mm; anther 4-celled, elliptic c. 1 by 0.7 mm; 'pedicel' c. 0.5 mm. ♀ *Flower* 1.9–2.7 mm; ovary 0.7–1 by 0.7–0.8 mm; style 0.2–0.5 mm by 0.25–0.3 mm, with 2–3 stigmas 0.9–1.3 mm. No seeds present.

Distr. According to RENDLE this variety is very widely distributed, from NW. Europe to West Australia, Japan, and the Sandwich Is, in *Malaysia*: South Moluccas (Kei Is). In this area there are wide gaps. Fig. 4.

Note. The anther I have observed in this material, the only one I saw of *N. marina* in Malaysia, is far too small for the species and is in my opinion not normally developed. This deserves further field study.

the tip c. 2.5 mm wide, flat, fleshy; apex acute, rarely blunt; margin on either side with (5–)8–10 (–12) coarse, spiny teeth, up to the lower 3 mm sometimes without teeth; dorsal surface without or with 1 tooth; teeth triangular, up to as long as  $\frac{1}{3}$  of the width of the blade; all spine-cells c. 0.1 mm, brown; cavities as wide as to twice as broad as the midrib. *Sheath* on either side with 2–5 inconspicuous spines, 5–6(–6½) by 7–9 mm; auricles absent or up to 0.2 mm long. ♂ *Flowers* not seen. ♀ *Flowers* 2.5–3.8 mm; ovary 0.8–1.2 by 0.6–0.8 mm; style 0.2–0.5 by 0.2–0.4 mm, with 2–4 stigmas 1.6–2 mm. *Seeds* 4–4.3 by 2.4–2.6 mm.

Distr. *Malaysia*: Lesser Sunda Islands (Bali: Batur Lake). Fig. 4.

Ecol. Gregarious along the sandy shore, at c. 1030 m. The water of Lake Batur is alkaline and contains a high percentage of dissolved minerals.

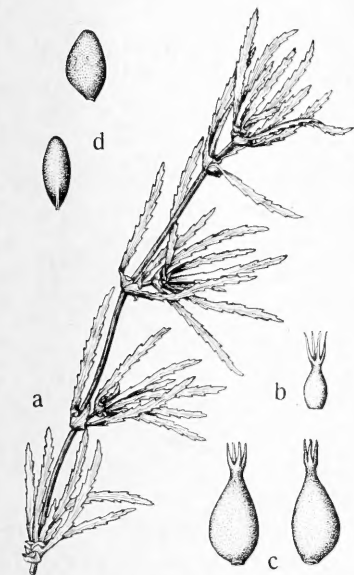


Fig. 3. *Najas marina* L. var. *zollingeri* RENDLE. a. Habit,  $\times 3/5$ , b. ♀ flower, c. fruits, d. seeds,  $\times 3$ .

var. *zollingeri* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1900) 438–439; Pfl. Reich Heft 7 (1901) 7; STEEN. Arch. Hydrobiol. Suppl. 11 (1932) 271, 272, f. 2; RUTTNER, l.c. 374, tab. II.—Fig. 2a, 3.

Up to c. 70 cm, lower internodes up to c. 8 cm by 1.2–2.6 mm, glabrous. *Leaves* linear-lanceolate,  $\frac{3}{2}$ – $\frac{4}{2}$  cm by 2.9–3.6 mm, c. 6 mm below

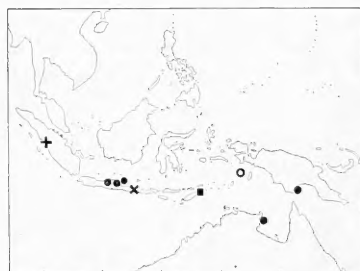


Fig. 4. Malaysian localities of *Najas marina* var. *marina* (O), var. *sumatrana* DE WILDE (+), var. *zollingeri* RENDLE (x), *N. browniana* RENDLE (●), *N. kurziana* RENDLE (■).

var. *sumatrana* DE WILDE, Act. Bot. Neerl. 10 (1961) 169.—Fig. 2g.

Up to 70 cm, lower internodes 3–7 cm, by 0.9–1.4 mm, densely set with prickles (15–20 per 2 mm stem), more densely on (and just below) the nodes. *Leaves*  $\frac{3}{2}$ – $\frac{4}{2}$  cm by 2–2½ mm, flat and thin, apex acute (to slightly obtuse), c. 3 mm below the tip c. 1.8 mm wide. Margin on either side with 30–40 conspicuous spiny teeth, often up to the lower 2 mm unarmed; dorsal surface with as much spines as along one margin, mostly on the midrib; spine-cells c. 0.15 mm, situated on several brown cells, all together  $\frac{1}{4}$ – $\frac{1}{2}$  mm; all spines (dark) brown; the whole tooth c. conical,  $\frac{3}{4}$ –1 mm,  $\frac{1}{2}$ – $\frac{1}{4}$  as wide as the blade; cavities often indistinct, as wide as the midrib. *Sheath* 3–3½ by 4–4½ mm, on either side of the margin with 7–10, on the upper  $\frac{1}{3}$  of the dorsal surface with numerous spines; auricles absent. ♂ *Flowers* not seen. ♀ *Flowers* 2½–3 mm; ovary c. 1 by 0.6 mm; style 0.6–0.8 by 0.1 mm, with 2–3 stigmas c. 1.2 mm. *Seeds* greyish-brown, 4–4½ by 2½ mm.

Distr. *Malaysia*: West Central Sumatra (Lake of Manindjau), c. 500 m. Fig. 4.

2. Section *Caulinia*

A. BRAUN, J. Bot. 2 (1864) 276; ASCHERS. Fl. Prov. Brand. 1 (1864) 67 (status not mentioned).—*Caulinia* WILLD. Mém. Ac. R. Sc. Berl. (1798) 87.—*Subg. Caulinia* ASCHERS. ex RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 398; Pfl. Reich Heft 7 (1901) 10.

Mostly slender plants. Epidermis not distinctly differentiated from the underlying cortex. Internodes smooth. *Leaves* usually much more than 15 times as long as broad, mostly thin, (mostly) finely dentate along the margin and rarely so on the lower portion of the midrib, with (0–)10–80(–180) spiny teeth on either side. *Sheath* mostly with distinct auricles. Intravaginal scales lanceolate to filiform, thin (fig. 2 i–l). Monoecious. ♂ *Flowers* with or without spathe. Anther either 1 or (2-, or) 4-celled. ♀ *Flowers* mostly without spathe, stigmas 2(–3); spathe tapering to the top, or constricted into a long cylindrical neck (more than twice as long as broad), the margin with 3–9 distinct spines. *Seed* less than 3½ mm long, if nearly 3½ mm then only c. 0.6–0.8 mm broad; testa consisting of 3 layers of hardened cells; areoles all of about the same size, except on the raphe, usually arranged in length-rows.

Distr.. About 35 spp. throughout the warm and temperate regions of the globe.

2. *Najas minor* ALL. Fl. Ped. 2 (1785) 221; A. BRAUN, J. Bot. 2 (1864) 277, *excl. var. indica* A. BR.; HOOK. f. Fl. Br. Ind. 6 (1893) 569, *excl. Caulinia indica et N. indica*; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 413, *excl. stirp.* GRIFFITH 5609/5 & 5609/7; *non* RIDL. Mat. Fl. Mal. Pen. 2 (1907) 129; *non* KOORD. Junghuhn Gedenkb. (1910) 160, *quae est N. indica*.

Up to c. 25 cm, lower internodes 2–5 cm by ½–1 mm. *Leaves* (1–)1¼–2(–3) cm by 0.4–0.6 (–0.7) mm, flat, sometimes subterete or triangular in section; apex acute to slightly obtuse (blade c. 3 mm below the tip 0.3–0.35 mm wide); margin on either side with (5–)7–15(–17) mostly conspicuous spiny teeth, up to the lower 3 mm often unarmed; dorsal surface sometimes with some spines (cf. RENDLE); all spines (dark) brown; spine-cells (0.075–)0.15(–0.2) mm; teeth up to as long as half (in the upper portion of the blade as long as) the width of the blade; midrib c. 0.1 as wide as the blade; cavities occupying half to almost the entire width of the blade, often with distinct septa. *Sheath* 1½–3(–3.5) by 1½–3 mm, on either side with 5–10(–15?) spines, the inner side of the auricle unarmed; auricles (*excl.* spines) broad to very broad triangular, truncate to rounded, (0.1–)0.2–0.5 by 0.3–0.7 mm, often shallowly lobed or lacerate. ♂ *Flowers* (mostly?) solitary, enclosed in a spathe 1½–2 mm; above the anther a conical(–cylindrical) neck 0.3(–0.4) mm, tip almost truncate or (slightly) oblique, often somewhat lacerate; anther 1-celled (? see notes), oblong, often somewhat constricted towards the top, 0.8–1.3 by 0.3–0.4 mm; ‘perianth lobes’ inconspicuous; ‘pedicel’ 1/3–2/5 mm, in anthesis 1½–2 mm. ♀ *Flowers* without spathe, often 2(–3) together, in different stages; 1.9–2.3(–2.5) mm; ovary 0.7–0.8 by c. 0.35 mm; style 0.4–0.6 mm, with 2 stigmas 0.6–1 mm. *Seeds* narrow-oblong,

the top sometimes slightly bent, 2.4–3 by c. 0.6 mm; (sometimes greyish); testa with (12–)14–16(–19), ladder-like, length-rows of many (100–150) areoles, which are much wider than high.

Distr. According to RENDLE widely distributed in Europe, tropical and North Africa, tropical and temperate Asia to Japan and Pegu (KURZ), in Malaysia: ?Java (Bogor), see below.

Notes. *N. minor* has repeatedly been reported from Malaysia. The two GRIFFITH numbers 5609/5 and 5609/7 cited by RENDLE and RIDLEY I have seen in Herb. Kew; they have no fruit; the latter number is sterile, the first has ♂ flowers with a 4-celled anther which excludes *N. minor*, but points to either *N. indica* or *N. oguraensis* MIKI. The KOORDERS record from Java is based on a specimen of *N. indica* with which this species has sometimes been confused, specially by those who referred *N. indica* as a variety to *N. minor*.

The only specimens from Malaysia which represent with certainty *N. minor* were raised at Zürich from “Schlammproben von Buitenzorg mit *Hydrilla verticillata*, im Gewächshaus von Prof. Ernst in Zürich gekeimt 1933; 1934 von mir im Warmhaus weitergezogen; fruchtend eingelegt am 3. Febr. 1935. WALO KOCH. leg. M. ERNST-SCHWARZENBACH”, in Herb. E. T. H., Zürich.

It is most remarkable that nobody has collected *N. minor* in Buitenzorg or vicinity where so many collections have been made. If these ERNST samples were extracted from the small concrete water-plant tanks in the Botanic Gardens, there is every reason to assume contamination with imported water plants. Contamination with foreign seed could possibly also have happened at Zürich. For the present *N. minor* seems very doubtfully native in Malaysia.

A closely related species is *N. oguraensis* MIKI,

Bot. Mag. Tokyo 44 (1935) 775, t. 7 A-L, which was described from Japan as a rigid plant up to 1 m long with seeds c.  $3\frac{1}{2}$  by 0.6 mm and 4-celled anthers c.  $1\frac{3}{4}$  mm long. I have seen plants from India with a slender habit, seeds (2-3- $3\frac{1}{4}$  mm and large 4-celled anthers  $1\frac{1}{4}$ - $1\frac{3}{4}$  by  $\frac{3}{4}$  mm which thus come very close to the Japanese species and could well belong to it (Herb. Persoon, in L; SAXTON 491, in K; STEWART 3347, in K).

3. *Najas kurziana* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 413, t. 41 f. 116-121; Pfl. Reich Heft 7 (1901) 15, f. 4 U; HORN AF RANTZIEN, Kew Bull. (1952) 37.—Fig. 2b.

Up to 15 cm, lower internodes 1-2 cm by 0.5-0.7(-0.8) mm. Leaves  $1\frac{1}{2}$ -2 cm by 0.45-0.95 mm, flat (and thin), apex rounded to obtuse (blade c. 3 mm below the tip 0.4-0.7 mm in width); margin on either side with 30-60 inconspicuous teeth, mainly consisting of the spine-cell, dorsal surface unarmed; spine-cells 0.05-0.1 mm, all (dark) brown; midrib 0.07-0.05 as wide as the blade, cavities occupying 0.1- $\frac{1}{2}$  of the width of the blade, often with distinct septa. Sheath on either side with (3-)-5-12 spines, often 1-3 on the inner edge of the auricle, 1.7-2.4 by 1.3-2.2 mm; auricles (broad-)triangular to long-triangular, subentire, tip obtuse or more or less rounded, (0.2-)-0.5-0.8 by 0.3-0.5 mm. Flowers mostly up to 5 together, in different stages, often with 1 male, or male solitary. Spathe of  $\sigma$  flower 0.9-1(-1.2) mm, neck mostly cylindrical, 0.3-0.4(-0.5) mm, tip almost truncate, entire to slightly lobed; anther 1-celled, oblong, (0.3-)-0.4-0.7(-1) by (0.1-)-0.15-0.25 mm; 'perianth lobes' inconspicuous. 'Pedicel' 0.1-0.2(-0.3) mm, in anthesis c. 0.8 mm. ♀ Flowers espathaceous, c. (1-)-1.4 mm; ovary c. (0.4-)-0.5 by 0.2 mm; style 0.3-0.5 mm, with 2(-1) stigmas 0.3-0.4 mm. Seeds 1-1.2 mm by 0.35(-0.4) mm; testa with 16-18 length-rows of 18-26 subquadrate or 5-6-angular areoles.

Distr. India (North Bengal between Kishenganj and Oolabena, KURZ s.n. in CALC & BM, once found), in Malaysia: Lesser Sunda Islands (Port. Timor: in Irabère R., near Uato Carabao, c. 400 m alt., VAN STEENIS 18226), once found. Fig. 4.

Notes. The Timorese collection differs from the holotype only in having c. 50-60 spiny teeth on each leaf margin (in the type there are 30-34).

According to HORN AF RANTZIEN (Kew Bull. 1952, 35-37, t. 3) the African *N. hagerupi* H. a. R. is very closely allied, the only difference being in the anther which is 1.2-1.4 mm long; its fruit is unknown.

4. *Najas browniana* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 420, t. 42, f. 163-167; Pfl. Reich Heft 7 (1901) 17, f. 5 J.—Fig. 2d.

Up to 15 cm, lower internodes 1-3(-6) cm by 0.5-0.8(-0.9) mm. Leaves  $1\frac{1}{2}$ - $2\frac{1}{4}$  cm by (0.35-)-0.4-0.7(-0.8) mm, flat, sometimes slightly fleshy, apex obtuse to rounded, sometimes acute (c. 3 mm below the tip 0.25-0.6 mm wide); margin

on either side with 12-21 spiny teeth largely in the upper portion of the blade; no spines on the dorsal surface; spine-cells < 0.05-0.15 mm, (dark) brown; teeth up to as long as 0.2 of the width of the blade; midrib c. 0.07 as wide as the blade; cavities occupying  $\frac{1}{4}$ - $\frac{3}{4}$  of the width of the blade, septa often indistinct. Sheath on either side with (1-)-3-7(-10) spines, no (?) spines on the inner edge of the auricle, (1.5-)-2(-2.3) by 1.5-2.9 mm; auricles mostly broad, seldom long-triangular, truncate-rounded to acute, sometimes acuminate, rarely falcate, (0.1-)-0.2-0.3(-0.5) by 0.25-0.75 mm, entire to lobed or lacerate (incisions up to halfway (or more) the auricle). Flowers mostly up to 3 together, in different stages, together with one male<sup>1</sup>, or the male solitary. ♂ Flowers: spathe 1.3-2 mm, neck almost cylindrical, 0.3-0.5 mm, the tip almost truncate, entire to lacerate; anther 1-celled, ovate to oblong(-lanceolate), 0.6-0.8 (-0.9) by 0.2-0.3 mm; 'perianth lobes' indistinct; 'pedicel' 0.3-0.6 mm, at anthesis 1- $1\frac{1}{2}$  mm. ♀ Flowers: spathe absent; ♀ fl.  $1\frac{1}{2}$ -2 mm; ovary 0.5-0.8 by 0.2-0.3 mm; style (0.2-)-0.5-0.7 mm, with 2 stigmas (0.3-)-0.5-0.7(-0.9) mm. Seeds (1.5- and narrow) 1.6-2 by (0.45-)-0.5-0.7 (-0.75) mm, testa with 18-30 length-rows of 27-37 subquadrate or 5-6-angular areoles.

Distr. India (once found) and Northern Territory of Australia (Cavern I.), in Malaysia: Java (SE of Semarang: Kuwu mudwells; Surabaya: Keputih tambaks; Madura I.), S. New Guinea (coast between Oriomo and Fly R.). Fig. 4.

Ecol. In the Kuwu saline mudwell area the only aquatic water plant, near Surabaya in brackish water of fish ponds, in Madura in pools near the sea, in S. New Guinea in open *Eleocharis* swamp, all localities as far as known saline and at very low altitude.

Notes. Already found by HORSFIELD at Kuwu, but that specimen was identified by RENDLE as *N. falciculata* (l.c. 1899, p. 418). In his key he placed *N. browniana* along with species possessing 4-celled anthers, although the anther depicted (l.c. t. 42 f. 165) is 1-celled. I have examined the holotype and this proves to be correct, they are mature and 1-celled.

The only specimen from continental tropical Asia is a specimen in the Kew Herbarium bearing three labels, reading: "1217/1830 Tutichorin; *N. rigidula* Herb. Wight prop.; *N. graminea* var. minor Rendle, Flora of Madras, det. C. Binker 19.4.1929".

I am not entirely satisfied that this species is specifically distinct from *N. gracillima* (A. BRAUN) MAGNUS (*N. indica* var. *gracillima* A. BR. ex ENGELM. in A. GRAY) which was originally described from eastern North America. The North American material is very distinct from the material of *N. browniana* in having much longer seeds (c. 2.6-3.3 mm) with elongated areoles and large anthers (c.  $1\frac{1}{2}$  mm). As RENDLE supposed that *N. browniana* would have 4-celled anthers, they appear in his key wide apart. This, however,

(1) Male flower often appressed to the female one.

not being correct, we are faced with the problem of their discrimination through the statements of MIKI who recorded *N. gracillima* from Japan (Tokyo Bot. Mag. 49, 1935, 773, f. 6 A-L) supplemented by many sheets collected by FAURIE in Japan and Formosa which I had on loan from the Geneva Herbarium. Through MIKI's description and FAURIE's material it appears that the plants from Japan and Formosa do not exactly match the North American plants, as they have small anthers (c. 0.7 mm) and smaller seeds (2 by  $\frac{1}{2}$  mm), to which should be added that in the Faurie material I observed seeds up to c. 3 mm long. The areoles of the Japanese plants are about twice as long as wide. The Japanese-Formosan plants are, therefore, more or less intermediate between true *gracillima* and *browniana*. It was beyond the scope of the present revision to go much deeper into this delicate situation, although it should be realized that if these species are merged into one (as three replacing subspecies) which would then possess an enormous distributional area, *N. gracillima* is the oldest binomial for it. The fact that the Japanese plants are largely from rice-fields and that *N. browniana* has, in Malaysia, an exacting natural habitat has added to my provisional decision to keep it apart.

**5. *Najas indica* (WILLD.) CHAM.** Linnaea 4 (1829) 501; KUNTH, En. (1841) 113; HASSK. Pl. Jav. Rar. (1848) 142; ZOLL. Syst. Verz. 1 (1854) 74; MIQ. Ill. Fl. Arch. Ind. (1871) 44-45, *pro parte*, incl. var. *macrodictya* et var. *rigida* A. BR., *nom. nuda*; MAGNUS, Ber. Deut. Bot. Ges. 2 (1894) 218-219; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 399, t. 39 f. 31-45; Pfl. Reich Heft 7 (1901) 10, f. 3 R-T; MERR. En. Philip. 1 (1923) 25; FISCHER, in Gamble, Fl. Madras (1931) 1603; DE WILDE, Willdenowia 2 (1960) 595; Act. Bot. Neerl. 10 (1961) 167, fig. 6-9.—*Caulinia indica* WILLD. Mém. Ac. R. Sc. Berl. (1801) 89, t. 1 f. 3; Sp. Pl. 4 (1805) 182; cf. DE WILDE (1960) l.c.—*N. palustris* BLANCO, Fl. Filip. (1837) 660; KUNTH, En. 3 (1841) 590; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 427; Pfl. Reich Heft 7 (1901) 18; MERR. Sp. Blanc. (1918) 57; En. Philip. 1 (1923) 25; VENKATESH, Bot. Notis. 109 (1956) 75-82, f. 1, 3-6, 8-18, 24-27, 29-36.—*N. lobata* BLANCO, Fl. Filip. ed. 2 (1845) 459; NAVES, *ibid.* ed. 3, 3 (1879) 65; Nov. App. (1880) 298; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 427; Pfl. Reich Heft 7 (1901) 18.—*N. tenuifolia* (non R. Br.) MIQ. Fl. Ind. Bat. 3 (1856) 224, *pro specim. sumbaw.* (ZOLL.) et *tranqueb.* (KLEIN); NAVES, Nov. App. (1880) 297.—*N. falciculata* A. BRAUN, J. Bot. 2 (1864) 278, f. 4; MARTENS, Preuss. Exp. Ost-As. Bot. Teil Tange (1866) 143; HOOK. f. Fl. Br. Ind. 6 (1893) 569; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 417, t. 42, f. 145-151; Pfl. Reich Heft 7 (1901) 15; SUNIER, Treubia 2 (1922) 190-195, f. 6; MERR. En. Philip. 1 (1923) 25; BACK. Handb. Fl. Java 1 (1925) 51; HEYNE, Nutt. Pl. (1927) 139; BACK. Onkruid, Suik. (1928) 20; FISCHER in Gamble, Fl. Madras (1931) 1604; STEEN. Arch. Hydrob. Suppl. 11 (1932)

271, t. ii; BURK. Dict. (1935) 1533; BACK. Bekn. Fl. Java (em. ed.) 10 (1949) fam. 210, p. 1.—*N. minor* var. *indica* A. BR. J. Bot. 2 (1864) 278, *excl. specim. maurit.*; MARTENS, Preuss. Exp. Ost-As. Bot. Teil Tange (1866) 143.—*N. joveolata* A. BR. ex (MAGNUS, Beitr. 1870, vii, 43, *nomen*) RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 416, t. 41, f. 139-144; *ibid.* (1900) 443; Pfl. Reich Heft 7 (1901) 15, f. 4 W; CAMUS in Fl. Gén. I.-C. 6 (1942) 1213.—*N. minor* (non ALL.) HOOK. f. Fl. Br. Ind. 6 (1893) 569, *pro majore parte*, *pro syn. indica*; KOORD. Jungh. Gedenkb. (1910) 160.—*N. kingii* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 415, t. 41 f. 126-131; *ibid.* (1900) 442; Pfl. Reich Heft 7 (1901) 15 f. 5 A-C; RIDL. Mat. Fl. Mal. Pen. 2 (1907) 129; Fl. Mal. Pen. 4 (1924) 366; CAMUS in Fl. Gén. I.-C. 6 (1942) 1213, t. 115 f. 13-19; HEINE, Aqar. & Terr. Z. (Datz) 11 (1958) 375, fig. 1-2.—*N. lacerata* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 416, t. 41 f. 132-138; Pfl. Reich Heft 7 (1901) 15, f. 5 E-F; FISCHER in Gamble, Fl. Madras (1931) 1603, 1604.—**Fig. 2 I.**

Up to c. 4.0 cm, lower internodes 2-10 cm by (0.6-0.75-1.2(-1.7) mm. Leaves (1 $\frac{1}{4}$ -2 $\frac{1}{2}$ -4 $\frac{1}{2}$  (-6) cm by (0.3-0.8-1.2(-1.6) mm, flat to subterete or triangular in section, apex acute to obtuse (blade c. 3 mm below the tip 0.2-0.4(-0.5) mm wide); margin on either side with (1-5-30(-40) conspicuous spiny teeth, sometimes up to the lower 15 mm of the blade unarmed; dorsal surface sometimes with 1-10(-30) spines; spine-cells 0.1-0.25 mm, all (dark) brown; teeth up to as long as half (in the upper part of the blade as long as) the width of the blade; midrib 0.12-0.1 times as wide as the blade; cavities occupying half or almost the entire width of the blade, often with distinct septa. Sheath (2-)2.5-4(-5) by (1.5-)2-4(-6) mm, on either side with (2-)5-12(-20) spines, but unarmed on the inner edge of the auricles; auricles absent to (long-, especially in Indian specimens) triangular, truncate to rounded or almost acute, rarely falcate, (0.1-)0.3-0.6(-1) by (0.3-)0.5-1 (-1.5) mm, mostly entire, sometimes toothed or lobed, seldom lacerate up to halfway. Flowers mostly solitary. ♂ Flowers: spathe 2.2-3.6 mm, neck mostly cylindrical, 0.3-1 mm, tip almost truncate to very oblique, entire to up to halfway lacerate; anther subsessile, 4-celled, about elliptical to oblong, (1.2-)1.5-2.2(-2.5) by 0.7-1.2 mm; 'perianth' lobes mostly distinct, ( $\pm$ ) nipple-shaped. 'Pedicel' c. 0.2 mm, in anthesis 2.7-3.5 mm. ♀ Flowers: spathe absent (except in some Indian specimens), (1.7-)2-3(-3.4) mm; ovary (0.6-)0.7-0.9(-1.2) by (0.25-)0.3-0.4(-0.45) mm, style (0.4-)0.5-0.8(-1.2) mm, with 2(-1) stigmas (0.4-)0.8-1.6(-1.8) mm. Seeds (1.5-)1.7-2.3 by 0.75-0.9 mm; testa with (14-)16-20(-25) length-rows of (17-)22-25(-30) subquadrate or 5-6-angular areoles, which are mostly slightly wider than long.

Distr. ?Africa, tropical continental Asia (Kashmir, Deccan, Bengal, Andamans, Siam, Tonkin) northward to Japan, throughout Malaysia (not yet collected in Borneo and Moluccas).



Fig. 5.

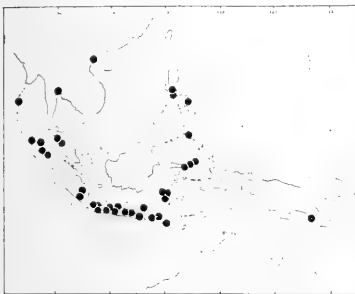


Fig. 5. Malaysian and some adjacent continental Asian localities of *Najas indica* (WILLD.) CHAM.

**Ecol.** Found in a great variety of habitats, in various biotopes of freshwater, mostly shallow but up to 5 m depth, and *c.* 1000 m altitude, also found in brackish water of fish-ponds near Djakarta with a salinity of up to 30‰ (SUNIER, *l.c.*), both in everwet regions and in those subject to a dry season. One of the commonest species in Malaysia.

**Vern.** *Lumut-siarang*, Toba, *ganggèng*, *Batavia*; Philippines: *aragan*, *ilk.*, *bangbangi*, *Bon.*, *labui*, *lg.*

**Notes.** A variable species, the variability obviously mostly due to external conditions. Specimens from India not seldom deviate to forms with thin stems and narrow leaves and rather large seeds (up to 2.3 by 0.9 mm) with many (up to 25) longitudinal rows of many (up to *c.* 30) rather small areoles of the seed coat.

In Asiatic specimens the ♀ flowers are often enclosed by a spathe, but these may be found together with naked ones on a single individual (*cf.* DE WILDE, 1961). In Malaysia the ♀ flowers are as far as known always espathaceous.

It was judged beyond the scope of this revision to make a thorough study of African material described under other various names which may possibly be referred to *N. indica* as circumscribed here. I have not the impression that this species occurs in Australia.

**6. *Najas tenuifolia*** R. BR. *Prod.* 1(1810) 345; BENTH. *Fl. Austr.* 7 (1878) 181; RENDLE, *Trans. Linn. Soc. II, Bot.* 5 (1899) 419, t. 42, f. 158-162; Pfl. Reich Heft 7 (1901) 17, f. 5 G-H.—*N. graminea* DEL. *var. tenuifolia* (R. BR.) A. BRAUN, *J. Bot.* 2 (1864) 278.—*N. celebica* KOORD. Minah. (1898) 270, 637.—*N. pseudograminea* W. KOCH, *Ber. Schweiz. Bot. Ges.* 44 (1935) 339.—**Fig. 1, 2f, i.**

Up to *c.* 40 cm, lower internodes 2-6 cm, by (0.5-)0.7-0.85(-1.2) mm. *Leaves* (1½-1)¾-4 cm by 0.6-1.2 mm, flat, tip blunt (rounded) to acute (blade *c.* 3 mm below the tip 0.3-0.9 mm

wide); margin on either side with 14-60(-70) spiny teeth; dorsal surface without spines; spine-cells (0.05-)0.1-0.2 mm, on the auricles up to 0.3 mm, on the tip of the spathe rarely up to 0.4 mm long, brownish, rarely yellowish green; teeth shallow, up to *c.* 0.16, near the tip up to *c.* 1/3 as long as the width of the blade; midrib 0.1-0.07 as wide as the blade; cavities variable in width, septa sometimes distinct. *Sheath* (1.5-) 2-4.7(-5) by (1.5-)2-3(-3.5) mm, on either side with 5-25 spines, (0-)1-3(-4) on the inner edge of the auricle; auricles long-triangular, mostly 1½-2 times as long as broad, with an obtuse (rounded) to acute apex, rarely falcate, (0.4-)0.6-1.9(-3) by (0.25-)0.6-1 mm, entire, sometimes shallowly lobed (or somewhat lacerate). *Flowers* solitary or 2-3 together. ♂ *Flowers*: spathe 2-3.8 mm, subsessile (very rarely up to 0.8 mm stalked), neck mostly cylindrical, (0.4-)0.5-1 mm, tip almost truncate to oblique, entire to lobed; anther subsessile, 4-celled, ovate-elliptical to slightly oblong, 1.2-2.5 by 0.75-1.1 mm, 'perianth' lobes distinct, (shallowly) rounded. 'Pedicel' *c.* 0.2 mm, in anthesis 1.5-2.3(-2.7) mm. ♀ *Flowers* espathaceous, 1.5-3.5 mm; ovary 0.5-0.9(-1) by 0.2-0.35 mm, style 0.4-1(-1.2) mm, with 2 stigmas 0.3-0.8(-1.7) mm. *Seeds* (1.1-)1.2-2.3 by 0.4-0.75 mm; testa with 16-36 length-rows of (15-)20(-25) or 35-45 subquadrate or 5-6-angular areoles.

**Distr.** Australia and Malaysia.

**Notes.** The anther of this species has originally been described by R. BROWN as 1-celled and so it was defined by BENTHAM (1878); RENDLE already observed, however, that this was an error and he is correct as I could verify on the holotype (in BM).

I have divided this species into two subspecies, *ssp. tenuifolia* which occurs both in Australia and Malaysia and *ssp. pseudograminea* which is confined to Malaysia. In order to facilitate identification the two subspecies are opposed here and I have added the characteristics of a closely allied species known only from continental Asia, *viz. N. brevistyla*, which is most closely allied to the Malaysian *ssp. pseudograminea*.

#### KEY TO THE SUBSPECIES

1. Leaves small, 14-24 by 0.4-0.6 mm, often somewhat fleshy, on either side with 17-33 rigid spiny teeth up to as long as the width of the blade. Spathe of ♂ fl. 1.9-2.2 mm; anther small, 1-1.3 by 0.5-0.6 mm. ♀ Flower *c.* 1.5 mm. Seeds small, 1-1.2 by 0.4-0.45 mm.

#### *N. brevistyla* RENDLE

1. Leaves (15-)17-40 by 0.6-1.2 mm, not fleshy, on either side with 14-60(-70) rather shallow spiny teeth, up to 1/3 as long as the width of the blade. Spathe of ♂ fl. 2-3.8 mm; anther 1.2-2.5 by 0.75-1.1 mm. ♀ Flower 1.5-3.5 mm. Seeds (1.1-)1.2-2.3 by 0.4-0.75 mm.

2. Leaves 21-40 mm, apex acute (or slightly obtuse), *c.* 3 mm below the tip 0.3-0.4 mm in width; margin on either side with 14-35(-42) spiny teeth (spine-cells dark brown);

cavities nearly reaching the margin (their outer edge not brown-coloured); septa often distinct. Flowers solitary. Mature anther 2–2.5 by 0.8–1.1 mm. Seeds 2–2.3 by 0.7(–0.75) mm. . . .

- 2. Leaves** (15–)17–28 mm, apex blunt (rounded), rarely slightly acute, c. 3 mm below the tip (0.5–)0.7–1 mm in width; margin on either side with 28–60(–70) spiny teeth (spine-cells light brown, rarely yellowish green); cavities occupying 0.12–0.5 of the width of the blade, their outer edge often dark-brown; septa indistinct. Flowers mostly 2–3 together. Anther 1.2–2 by 0.75–0.9 mm. Seeds (1.1–)1.2–2 by 0.4–0.65 mm.

***N. tenuifolia* ssp. *pseudograminea***

*ssp. tenuifolia*.—*N. tenuifolia* R. BR. Prod. (1810) 345; BENTH. Fl. Austr. 7 (1878) 181; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 419, t. 42 f. 158–162; *ibid.* (1900) 443; Pfl. Reich Heft 7 (1901) 17, f. 5 G–H.—*N. graminea* var. *tenuifolia* (R. BR.) A. BRAUN, J. Bot. 2 (1864) 278.

Leaves 2–3¼ cm by 0.6–1.3 mm, on either side with 14–40 (dark) brown spiny teeth. *Sheaths* on either side with 6–17 spines. *Spathe* of ♂ flowers 2.8–3.8 mm, neck 0.7–0.9 mm, bearing up to c. 0.3 mm long spine-cells; anther 2–2.5 by 0.8–1.1 mm. ♀ *Flowers* 2.3–3(–3.5) mm; ovary 0.8 by (0.25–)0.3 mm; stigmas 0.6–0.8(–1.2) mm. *Seeds* 2–2.3 by 0.7–0.75 mm; testa with 26–36 length-rows of 35–40 subquadrate or 5–6-angular areoles.

*Distr.* Australia, and ?New Caledonia (RENDLE, 1900, p. 443), in *Malaysia*: SE. Celebes (Lepo-lepo near Kendari, BECCARI sh. no. 11810 FIR), once found.

*ssp. pseudograminea* (W. KOCH) DE WILDE, *comb. nov.*—*N. celebica* KOORD. Minah. (1898) 270, 637.—*N. pseudograminea* W. KOCH, Ber. Schweiz. Bot. Ges. 44 (1935) 339.—**Fig. 1, 2f, i.**

KEY TO THE VARIETIES

1. Spathe (of ♂ fl.) 2–2.8 mm; anther 1.2–1.85 mm. ♀ Flower 1.5–2 mm, stigmas 0.3–0.7 mm. Seeds small, (1.1–)1.2–1.3(–1.4) by 0.4–0.5 mm.  
*var. pseudograminea*
1. Spathe (of ♂ fl.) 3–3.5 mm; anther 1.6–2 mm. ♀ Flower 2.7–3.5 mm, stigmas 1–1.7 mm. Seeds 1.9–2.05 by 0.5–0.65 mm. *var. celebica*

*var. pseudograminea*.—*N. graminea* (non DEL.) MIQ. Illustr. (1871) 45, *pro specim. javan.*—*N. tenuifolia* (non R. BR.) AUCT.: BACK. Teysm. 22 (1911) 514, *excl. specim. tobac.*; Handb. Fl. Jav. 1 (1925) 51; Bekn. Fl. Java (em. ed.) 10 (1949) fam. 210, p. 1.—*N. falciculata* (non A. BR.) COERT, Trop. Natuur 23 (1934) 27, f. 11.—*N. pseudograminea* W. KOCH, Ber. Schweiz. Bot. Ges. 44 (1935) 339; HORN AF RANTZIEN, Kew Bull. (1952) 37.—**Fig. 1, 2f.**

Leaves (1½–)2(–2¾) cm by (0.6–)0.9(–1.1) mm, green, margin of the blade on either side with 28–53(–63, Buru) spiny teeth, brown; *sheaths*

on either side with 5–15(–23, Buru) spines. ♂ *Flowers*: spathe 2–2¾ mm, neck (0.4–)0.5–0.6(–0.9) mm, bearing up to 0.25 mm long spine-cells; anther 1.2–1.85 mm; 'pedicel' at anthesis up to 2.3 mm. ♀ *Flower* 1½–2 mm; ovary 0.5–0.8 by 0.2–0.3 mm; stigmas 0.3–0.7 mm. *Seeds* (1.1–)1.2–1.3(–1.4) by 0.4–0.5 mm; testa with 16–18 length-rows of (15–)20–23(–25) (sub)quadrate or 5–6-angular areoles.

*Distr.* *Malaysia*: Java (also Madura I.), Lesser Sunda Islands (Bali), Philippines (Luzon; Panganga Prov.), and Moluccas (Buru). **Fig. 6.**



**Fig. 6.** Localities of *Najas tenuifolia* R. BR. *ssp. pseudograminea* (W. KOCH) DE WILDE *var. pseudograminea*.

*Ecol.* Common in Java, at low altitude, mostly in freshwater but found in brackish water in Bali (O. JAAG), twice found in the mountains, viz Rana Lake (Buru) at c. 700 m and in the rivulet and craterlake of Mt Kelud in Central Java at 1200 m abundant in sulfurous hot water (up to 60° C) on blackish, muddy soil (CLASON & COERT).

*Notes.* The identification of the Buru collection is somewhat doubtful.

One plant from Java possessed among numerous naked ♀ flowers and fruits a single one which was enveloped by a spathe (*cf.* DE WILDE, Act. Bot. Neerl. 10, 1961, 167).

*var. celebica* (KOORD.) DE WILDE, *comb. nov.*—*N. celebica* KOORD. Minah. (= Med. Lands Pl. Tuin) 19 (1898) 270, 637; RENDLE, Pfl. Reich Heft 7 (1901) 18; KOORD.-SCHUM. Syst. Verz. (Cel.) (1914) 9.—**Fig. 2i.**

Leaves 1¾–2¾ cm by 0.95–1.2 mm, often bluish-green (when dry), margin of the blade on either side with 40–60(–70) spiny teeth, yellowish green. *Sheaths* on either side with 10–25 spines. ♂ *Flowers*: spathe 3–3½ mm, neck 0.8–0.9 mm, bearing up to c. 0.4 mm long spine-cells; anther 1.6–2 mm; 'pedicel' at anthesis up to 2.7 mm. ♀ *Flowers* 2.7–3.5 mm; ovary 0.7–0.9(–1) by 0.2–0.35 mm; stigmas 1–1.7 mm. *Seeds* 1.9–2.05 by 0.5–0.65 mm; testa with 16–24 length-rows of 38–45 areoles, which are often somewhat broader than high.

Distr. *Malaysia*: NE. Celebes (Minahassa: Tonadano Lake), c. 700 m altitude.

Vern. *Sengit*, tl.

7. *Najas malesiana* DE WILDE, Act. Bot. Neerl. 10 (1961) 168.—*N. graminea* var. *minor* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 426; Pfl. Reich Heft 7 (1901) 18; CAMUS, in Fl. Gén. I.-C. 6 (1942) 1212.—*N. graminea* var. *angustifolia* RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 427, t. 42 f. 202; Pfl. Reich Heft 7 (1901) 18, f. 5 V; RIDL, Mat. Fl. Mal. Pen. 2 (1907) 128; GIBBS, J. Linn. Soc. Bot. 42 (1914) 172; MERR. En. Born. (1921) 37; RIDL, Fl. Mal. Pen. 4 (1924) 366; Disp. (1930) 180.—*N. graminea* (non DEL.) RIDL, Mat. Fl. Mal. Pen. 2 (1907) 128; Fl. Mal. Pen. 4 (1924) 365.—*N. bengalensis* HORN AF RANTZZEN, ad int. Act. Hort. Gotob. 18 (1950) 192, 193; Kew Bull. (1952) 39, in *clav. angl.*—Fig. 2c, k.

Up to 15 cm, lower internodes 1–3 cm by 0.5–0.8 mm. *Leaves* (1¼–)2(–2½) cm by (0.4–)0.5–0.7(–0.9) mm, flat, apex obtuse or slightly acute (blade c. 3 mm below the tip 0.25–0.5 mm wide); margin on either side with (20–)25–30 (–50–60) inconspicuous teeth, mainly consisting of the spine-cell; dorsal surface without spines; spine-cells (0.05–)0.1(–0.25) mm, (dark) brown; midrib c. 0.05 times as wide as the blade, cavities occupying up to half the width of the blade, often with distinct septa. *Sheaths* (1.5–)2–2.5(–3) by 1–2.5 mm, on either side with (2–)6–14 spines, 0–4 spines on the inner edge of the auricle; auricles long-triangular or linguiform, sometimes falcate, 0.5–0.8(–1.1) by 0.3–0.8 mm, entire (rarely shallowly lobed). ♀ *Flowers* often up to 3 together, in different stages, together with one male (often appressed to the ♀), or male solitary. ♂ *Flowers* without spathe; anther 1-celled, elliptical-oblong, apically sometimes narrowed, 0.6–1 by 0.15–0.3 mm; 'perianth lobes' often indistinct; 'pedicel' 0.2–0.4, at anthesis c. 1 mm. ♀ *Flowers*: spathe absent; rarely up to 0.3 mm stalked; (1.2–)1.5(–1.8) mm; ovary 0.4–0.8 by 0.2–0.3 mm; style 0.25–0.5 mm, with 2(–1) stigmas 0.3–0.6 mm.

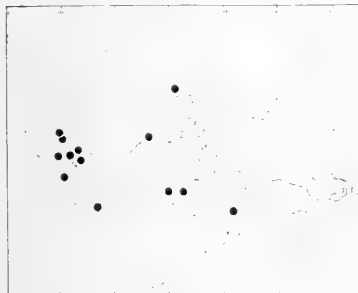


Fig. 7. Malaysian localities of *Najas malesiana* DE WILDE.

*Seeds* (0.9–)1–1.5 by (0.35–)0.4–0.5 to 1.5–1.8 by 0.5–0.6 mm; testa with 16–26 length-rows of 24–30 subquadrate or 5–6-angular areoles.

Distr. India, E. Bengal, Burma, Pegu, Lower Siam, Indo-China, throughout *Malaysia* (not yet found in New Guinea, Lesser Sunda Islands, and the larger parts of Java and Borneo), on the whole rare. Fig. 7.

Ecol. In streams and pools often in the forest, in swamp forest (Tjitjadas), more rarely in rice-fields (Setul, Padang), at low and medium altitude, once at 900–1000 m (Padang).

Vern. *Ganggeng*, S.

8. *Najas graminea* DEL. Descr. Égypt. Hist. Nat. 2 (1813) 282, t. 50 f. 3; Fl. Egypt. (1813) 138, t. 50 f. 3; KUNTH, En. (1841) 115; A. BRAUN, J. Bot. 2 (1864) 278 f. 5, *pro parte*, *excl. specim. javan. et celeb.*, *excl. var. β tenuifolia* A. BRAUN; MIQ. Illustr. (1871) 45, *excl. specim. javan.*; NAVES, Nov. App. (1880) 298; BAILEY, J. Bot. 22 (1884) 305, fig. 1–89, *pro maj. p. incl. var. delilei* MAGNUS; HOOK. f. Fl. Br. Ind. 6 (1893) 569; K. SCH. in Mart. Fl. Bras. 3, 3 (1894) 730, t. 124 f. 2; RENDLE, Trans. Linn. Soc. II, Bot. 5 (1899) 424, t. 42 f. 192–201, *excl. var. minor et angustifolia* RENDLE; *ibid.* (1900) 443; Pfl. Reich Heft 7 (1901) 18, f. 5 Q–V; KOORD. Exk. Fl. Java 1 (1911) 91; MERR. Fl. Manilla (1912) 68; En. Philip. 1 (1923) 24; FISCHER, in Gamble Fl. Madras (1931) 1603, 1604; W. KOCH, Ber. Schweiz. Bot. Ges. 44 (1935) 340; MIKI, Bot. Mag. Tokyo (1935) 774, t. 6 M–R; GUILLAUMIN, Bull. Soc. Bot. Fr. 84 (1937) 256; CAMUS, Fl. Gén. I.-C. 6 (1942) 1211; HORN AF RANTZZEN, Act. Hort. Gotob. 18 (1950) 191–193, map; Kew Bull. (1952) 33, 39; VENKATESH, Bot. Not. 109 (1956) 75–82, f. 2, 7, 19–23, 28; DE WILDE, Act. Bot. Neerl. 10 (1961) 167, fig. 1–5.—*N. seminuda* GRIFF. ex VOIGT, Hort. Suburb. Calc. (1845) 694; GRIFF. Not. 3 (1851) 184; Ic. Pl. As. t. 251, f. 2, t. 253–254.—Fig. 2e, j.

Up to 50(–75?) cm, lower internodes 1–10 cm, by (0.6–)0.7–1.5(–2.25) mm. *Leaves* (1¼–)2½–3½(–6) cm by (0.6–)0.7–1(–4) mm, flat, seldom canaliculate, apex obtuse (r-ounded), rarely somewhat acute (blade c. 3 mm below the tip 0.4–1.2 mm wide); margin on either side with (40–)60 (–185) inconspicuous spiny teeth, mainly consisting of the spine-cell; dorsal surface without spines; spine-cells 0.05–0.15 mm, yellowish brown; midrib c. 0.07–0.05 times as wide as the blade, cavities occupying up to ¼ of the width of the blade, septa (±) indistinct. *Sheath* (3–)4–5(–10.5) by (2–)3–4(–8.5) mm, on either side with (10–)15–30(–50) spines; 3–8 spines on the inner edge of the auricle; auricles long-triangular, seldom slightly falcate; apex acute, rarely obtuse or acuminate, (1–)2(–5.5) by 0.5–1(–1.5) mm, entire, rarely (shallowly) lobed. *Flowers* often up to 3 together, in different stages, together with one male, or male solitary (in the var. *robusta* all flowers probably solitary). ♂ *Flowers*: spathe 0; anther 4(–2)-celled, elliptical, rarely ovate or oblong, (1–)1.5(–2) by (0.4–)0.7(–1) mm; 'perianth lobes' distinct, rounded to globular. 'Pedicel' 0.2–0.5 mm,

at anthesis (0.7–)1–2.5 mm. ♀ *Flowers*: no spathe; (1.6–)2(–3.5) mm; ovary (0.6–)0.7(–1) by (0.2–)0.35(–0.4) mm; style (0.4–)0.7(–1.2) mm, with (1–)2(–3) stigmas (0.4–)0.8(–1.6) mm. *Seeds* (in the *var. robusta* unknown) (1.6-, broad seeds) 2.3(–2.7) by (0.6-, long seeds) 0.8(–0.9) mm; testa with 20–34 length-rows of 30–45 subquadrate to 5–6-angular areoles (often slightly higher than broad).

*Distr.* Widely distributed from North Africa and the Middle East, to tropical Asia (Punjab, Deccan, Bengal, Assam, Burma, Cochinchina, *ex lit.*), northwards to Formosa and Japan, southwards to *Malaysia* (not yet found in Borneo and Malaya, rare in Sumatra and Java), New Caledonia, and Australia. Introduced in the rice-fields in North Italy, England (BAILEY, *l.c.*), and probably in Brazil (K. SCHUMANN, 1894, RENDLE 1899, HORN AF RANTZIEN 1950, *l.c.*). Fig. 8.

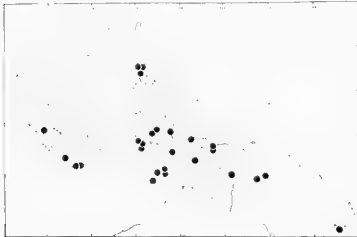


Fig. 8. Malaysian localities of *Najas graminea* DEL.

*Ecol.* Chiefly in the lowland in rice-fields, ditches, small streams, in both everwet and seasonal areas, up to 400 m, rarely at 1000 m (W. Java), once at 1400 m (Wêtar), often together with *Nitella*, *Salvinia*, *Marsilea*, *Pistia*, and other aquatics. By BRANDIS noted to occur in a hot spring in Burma at 92° F.

*Note.* As an exception, part of the ♂ flowers, seldom all on one individual, are enclosed by a more or less developed spathe; this seems to be a teratological deviation (DE WILDE, 1961).

*Vern.* *Ganggèng-leutik*, S, *ira-walaki*, Wêtar, *welâk*, *amila*, Alor; Philippines: *aragân-tamnâi*, Ilik., *rigmâu*, Tag.

#### KEY TO THE VARIETIES

1. Leaves up to c. 4 cm by 1½ mm, on either side with up to 100 spiny teeth. Stem up to 1½ mm thick. Leaf sheaths up to 6 mm, auricles up to 2½ mm long. ♀ *Flowers* up to 2½ mm long. *var. graminea*
1. Leaves 5–6 cm by 3–4 mm, on either side with 160–185 spiny teeth. Stem (1.6–)2–2½ mm thick. Leaf sheaths (4–)7½(–10½) mm, auricles (2–)4–5½ mm long. ♀ *Flowers* c. 3½ mm long. Robust plant. *var. robusta*

*var. graminea*.—Fig. 2e, j.

Up to 50(–75) cm, lower internodes 1–10 cm, by (0.6–)0.7–1.5 mm. *Leaves* (1¾–)2½–3½(–4) cm by (0.6–)0.7–1(–1.4) mm, flat, rarely canaliculate; apex obtuse (narrowed), rarely somewhat acute (blade c. 3 mm below the tip 0.4–1 mm wide); margin on either side with (40–)60(–100) spiny teeth; midrib c. 0.07–0.05 times as wide as the blade; cavities narrow, occupying up to ¼ of the blade; septa indistinct. *Sheaths* (3–)4–5(–6) by (2–)3–4(–5) mm, on either side with (10–)15–20 (–30) spiny teeth; 3–8 teeth on the inner edge of the auricle; auricles about straight, (1–)2(–2.6) by 0.5–1 mm, entire, rarely shallowly lobed. *Flowers* often up to 3 together, in different stages, together with a male, or male solitary. ♂ *Flowers*: anther 4(–2)-celled, elliptical, rarely ovate or oblong, (1–)1.5(–2) by (0.4–)0.7(–1) mm; 'perianth lobes' distinct, rounded to globular; 'pedicel' 0.2–0.5 mm, at anthesis 1–2.5 mm. ♀ *Flowers* (1.6–)2(–2.5) mm; ovary (0.6–)0.7(–1) by (0.2–)0.35(–0.4) mm; style (0.4–)0.7(–1.2) mm, with 2(–3) stigmas (0.4–)0.8(–1.6) mm. *Seeds*, see under the species.

*Distr. etc.* as under the species.

*Note.* The two collections made in the large Matana and Towuti Lakes in Central Celebes deviate slightly in having a condensed habit, short (¾–1¼ cm) rather coarsely dentate leaves with few spines (20–35), a rather short (2- or 4-celled) anther (c. 1 mm) and short stigmas only 0.3 mm long (KJELLBERG 3820 and sine coll. 4, 31–10–09 respectively).

*var. robusta* DE WILDE, Act. Bot. Neerl. 10 (1961) 169.

Up to c. 50 cm, lower internodes c. 5 cm, by (1.6–)2–2.25 mm. *Leaves* 5–6 cm by 3–4 mm, flat, apex rounded to slightly acute (blade c. 3 mm below the tip c. 1.2 mm wide); margin on either side with 160–185 spiny teeth; midrib 0.07–0.05 times as wide as the blade, cavities narrower than the midrib; septa ± distinct. *Sheaths* (4–)7½(–10½) by (4–)6.2(–8½) mm, on either side with (15–)30(–50) spiny teeth, c. 7 teeth on the inner edge of the auricle; auricles slightly falcate, 2–)4(–5.5) by (0.8–)1(–1.5) mm, rarely lobed. *Flowers* solitary. ♂ *Flowers*: anther 4-celled, elliptic(-oblong), (1.5–)1.7–1.8(–2) by 0.8–1 mm; 'perianth lobes' distinct, rounded; 'pedicel' c. 0.2 mm, in anthesis 0.7–? mm. ♀ *Flowers* c. 3.5 mm, ovary c. 0.9 by 0.35 mm; style c. 1 mm, with 2(–1) stigmas c. 1.6 mm. *Seeds* unknown.

*Distr.* *Malaysia*: Lesser Sunda Islands (Wêtar: Lake Tihu), once found.

*Ecol.* The lake lies in the *Eucalyptus* forest at c. 485–500 m.

*Note.* In a transverse section of the stem it appears that the septa between the cavities are 2–4 cell layers thick; the outer cortex layer is also well developed and consists of c. 5 cell layers. This cortex structure is also found in *N. marina*, some specimens of *N. indica*, and the African *N. horrida*.

## Excluded

*Najas obvoluta* BLANCO, Fl. Filip. ed. 2 (1845)  
460; ed. 3, 3 (1879) 66; NAVES, Nov. App. (1880)

332 is according to MERRILL, Sp. Blanc. (1918)  
49 = *Ceratopteris thalictroides* BRONGN. (*Pterido-*  
*phyta*).

## Excluded

*Lemnopsis* ZOLL. Syst. Verz. 1 (1854) 74 is according to BACKER and VAN STEENIS, cf. Fl. Mal. I, 4  
(1949) 68 = *Halophila* (*Hydrocharitaceae*).

*Najadeae* comprised with MIQUEL, Fl. Ind. Bat. 3 (1856) 223 a large number of genera now partly  
referred to *Potamogetonaceae* and partly to *Hydrocharitaceae*.

*Ruppia* has been referred to *Najadaceae* by ZOLL. Syst. Verz. 1 (1854) 74 = *Potamogetonaceae* or  
*Ruppiaceae*.



## PRIMULACEAE (P. A. J. Bentvelzen, Leyden)

Annual or perennial herbs, erect, ascending or prostrate, less than 1½ m high. *Leaves* spirally arranged or alternate (often various in one plant), or opposite, often in a basal rosette, exstipular, simple, sometimes lobed, penninerved. *Inflorences* racemose, terminal (sometimes axillary) racemes or umbels, or flowers in whorls, or solitary axillary. Bracts small or leafy. No bracteoles. *Flowers* bisexual, actinomorphic (rarely zygomorphic), isomerous, in Mal. always 5-merous, often dimorphous in sexual organs. *Calyx* dentate or cleft, persistent, sometimes leafy, rarely coloured (*Glauca*). *Corolla* connate, shallowly to deeply cleft (free in *Pelletiera*), in bud often quincuncial or contorted, variously coloured (absent in *Glauca*). *Stamens* inserted on the corolla, *epipetalous*, rarely alternating with staminodes or their vestiges; anthers dorsifixed or versatile, sometimes basifixed; cells opening with apical pores or latrose, filaments free or connate. Disk absent. *Ovary* superior (in *Samolus* semi-inferior), 1-celled with ∞ ovules on a free central placenta; style simple. *Capsule* mostly 5-valved (valves epi- or alternisepalous) or 10-valved, sometimes irregularly bursting, or circumsciss. *Seeds* mostly ∞, often angular, small; embryo straight, endosperm present; integuments 2.

*Distribution.* Genera 21 with approximately 900  *spp.*, all over the world, but mainly developed in the temperate and cold regions of the northern hemisphere; in the tropics mostly on the mountains. The largest genera, *Primula* (incl. *Androsace*) with c. 500  *spp.* and *Lysimachia* with c. 150  *spp.* are almost confined to the northern hemisphere and centre in the Sino-Himalayan region. In Malaysia and Melanesia *Primula* extends across the equator and finds its southernmost stations in the Old World. *Lysimachia* and *Anagallis* have a worldwide area. It is remarkable that the almost cosmopolitan species *Samolus valerandi* L., which occurs in the surrounding continents of Asia and Australia and is widely distributed in the Pacific (New Caledonia, Loyalty Is., Norfolk I., Chatham, Auckland Is., Kermadec, New Zealand, and Easter I.), has never been found in Malaysia.

*Ecology.* *Primulaceae* have generally a temperate thermo-ecology, hence are montane to alpine in the tropics. They are also generally heliophilous, preferring open habitats, dry or boggy. Few data are available; the dimorphous *Primulas* are apparently adapted to cross-pollination. Monomorphic (*i.e.* homostylous) *Primulas* are capable of effective self-pollination. In *P. prolifera* DOCTERS VAN LEEUWEN (Verh. Kon. Ned. Ak. Wet. 31, 1933, 215) found only twice a *Bombus* on the flowers on Mt Pangrango; self-pollination seems there the rule.

*Dispersal.* No special means of dispersal are found in the Malaysian *Primulaceae* and the only positive record is the descent of seeds of *Primula prolifera* by rainwash along the trail on Mt Gedeh. All representatives have capsules with many small seeds.

*Phytochemistry.* Many characteristic chemical compounds have been found in this family. Most of them, however, were traced hitherto only in a few genera or species.

One remarkable exception can be made to this statement. It is very probable that saponins occur in practically all species of *Primulaceae* (G. SCHNEIDER, Diss. Berlin, 1930). As in the case of most other *Dicotyledones*, the saponigenes belong to the triterpenes. This was established for the saponins of the roots and rhizomes of *Primula veris* L. and *P. elatior* (L.) HILL; both species contain primulagenin A, C<sub>30</sub>H<sub>50</sub>O<sub>3</sub>, as an aglycone of the saponins. The saponins of the rhizomes and roots of *Primulaceae* (*e.g.* *Primula*, *Cyclamen*) probably replace carbohydrates partially as carbohydrate reserve.

Concerning storage of reserve substances, *Primulaceae* are distinguished by other peculiarities. In subterranean organs some species accumulate beside saponins, reducing sugars, saccharose and starch a variable amount of fructosanes. There exists a tendency in the family to replace accumulation of starch by accumulation of fructosanes (J. LYS, Rév. Gén. Bot. 61, 1954, 154, 226, 300). Furthermore the genus *Primula* is distinguished by the replacement of part of the mono- and disaccharides of the subterranean organs by heptitols (volemitol) and heptoses (sedoheptulose) (J. BOUGAULT & G. ALLARD, C. R. Paris 135, 1902, 796; A. NORDAL & D. OEISETH, Acta Chim. Scand. 5, 1951, 1289). In this respect *Primulaceae* are similar to *Crassulaceae* and *Saxifragaceae*. The seeds contain fatty oil and hemicelluloses but no starch. The hemicelluloses (deposited in the membranes of the cells of the endosperm) belong to the so-called amyloid type (in all species investigated). Amyloid is a polysaccharide, which stains blue with iodine like starch; chemically amyloid is a galactoxyloglucan (P. KOOIMAN, Diss. T. H. Delft, 1959). Amyloid is also present in the seeds of *Plumbaginaceae* and *Myrsinaceae*.

The secondary products of metabolism of *Primulaceae* are mostly phenolic in nature. Phenolics are very common in the family. At the moment we may discern 4 different types of phenolic compounds in the family.

(i) Leucoanthocyanins occur frequently (E. C. BATE-SMITH & N. H. LERNER, *Biochem. J.* 58, 1954, 156). It is probable that the so-called "Inklusen" (tannin-containing idioblasts with a solidified vacuol content giving a red colour with HCl and vanilline), which were observed in some members of the family (*i.e.* roots and rhizomes of *Primula*), contain polymeric leucoanthocyanins.

(ii) Many *Primulaceae* contain in their subterranean parts diglycosides of volatile, odorous phenols. The sugar part of these heterosides is the disaccharide, primverose. There exists also an enzyme, primverase, which is able to split the heterosides in primverose and the aglycones. The latter are mainly derivatives of salicylic acid or of acetophenone. The presence of the heterosides and the corresponding enzyme, explains the fact that the non-odorous fresh roots of many *Primulaceae* become odorous gradually on drying or after injury. Heterosides of this type have been found in species of the genera *Primula*, *Dodecatheon*, *Lysimachia*, and *Anagallis* (A. GORIS, *Industrie de la parfumerie* 5, 1950, 121, 177).

(iii) The leaves and flowers seem to contain frequently flavonol glycosides. Rutin was isolated from *Lysimachia vulgaris* L. and a compound called primulaflavonolioside (probably a dirhamnosid of kaempferol) was extracted from *Primula veris* L. In red, pink and blue flowers anthocyanins are common (compare J. B. HARBORNE & H. S. A. SHERRATT, *Nature* 181, 1958, 25-27).

(iv) The glandular hairs of many *Primulaceae* excrete oily or granular, wax-like substances, termed farina in the latter case. In most instances flavone,  $C_{15}H_{10}O_2$ , is the main constituent of farina (W. C. BLASEDALE, *J. Am. Chem. Soc.* 67, 1945, 491; J. R. HORT, *Soc. 72*, 1947, 240; H. BRUNSWIK, *Sitz. Ber. Ak. Wiss. Wien, M.-N. Kl.*, Abt. 1, 131, 1922, 221). In species with yellow coloured farina the latter contains oxyflavones beside flavone (primetin = 5,8-dioxyflavone: W. BAKER, *J. Chem. Soc.* 1939, 956; 5-oxyflavone: P. KARRER & G. SCHWAB, *Helv. Chim. Acta* 24, 1941, 297). Flavones have been demonstrated to be present in the secretions of many species of *Primula* and in some species of *Cortusa* and *Dionysia*.

A few species (*Primula obconica* HANCE, *P. cortusoides* L., *P. sieboldii* MORREN, *P. mollis* HOOK., and *Cortusa matthioli* L.) contain allergenic substances in the secretion of their glandular hairs. The latter ("Primeltoxin", primin) produce skin irritations in persons sensitive to the allergenes. Primin is a fairly volatile, well crystallizing substance with a very high toxicity (skin irritation may be produced by 1/50 to 1/100 of a milligram) (BR. BLOCK & P. KARRER, *Vierteljahrsschr. Naturf. Ges. Zürich* 72, *Beibl.* No. 13, 1927, 1-26).

Concluding it may be stated amyloid and fatty oil in seeds and saponins in all organs are common in *Primulaceae*. The family is furthermore characterized by the accumulation of different types of phenolic substances; the distribution and chemistry of many of these compounds, however, have not yet been studied intensively. If we search for chemotaxonomical relationships we find that similarities exist between *Primulaceae* and *Saxifragaceae* (leucoanthocyanins, which are rare in herbaceous families, saponins, volemit, sedoheptulose), between *Primulaceae* and *Myrsinaceae* (saponins, amyloid) and between *Primulaceae* and some families of *Centrospermae* (leucoanthocyanins, saponins).—R. HEGNAUER.

**Taxonomy.** *Primulaceae* are affiliated with some other sympetalous families with epipetalous stamens, superior ovary with free basal placenta, and 2 integuments; for example HANDEL-MAZZETTI (*Not. R. Bot. Gard. Edinb.* 16, 1928, 70) postulated *Lysimachia solanoides* H.—M. to represent a possible link with *Myrsinaceae*. The latter are, however, almost always woody plants and are (often pellicid-) gland-dotted which rarely occurs in *Primulaceae* (*Lysimachia*, *Anagallis* spp., *Primula* spp.). According to METCALFE & CHALK these substances are not yet analyzed. An other family, which agrees more in habit, is *Plumbaginaceae*; the relation is sustained by anatomical characters brought forward by VAN TIEGHEM (*Bull. Mus. Hist. Nat. Paris* 16, 1900, 131-135) but here is only one ovule, 5 styles, and an obviously cymose inflorescence.

**Subdivision.** According to VALENTINE (*Progress Study British Flora* 1957, 80) five subfamilies can be distinguished, *viz*:

(i) *Androsaceae*. Almost confined to the northern hemisphere comprising *inter alia* *Primula* and *Dodecatheon*.

(ii) *Cyclamineae*. Central Europe and Mediterranean; only genus *Cyclamen*.

(iii) *Lysimachieae*. Worldwide, *inter alia* *Lysimachia*, *Anagallis*, and *Trientalis*.

(iv) *Samoleae*. Temperate worldwide. Only genus *Samolus* with c. 10 spp.

(v) *Corideae*. Mediterranean and Somaliland. Only genus *Coris* with 2 spp.

**Generic delimitation.** Far from the centre of the greatest development genera are often represented by few species of distant alliance; these may appear so sharply separable that they are sometimes assumed to deserve generic status in local or regional floras. In monographical studies it often appears, however, that such "genera" which are for example readily distinguishable in Europe are connected by transitional species in Asia and can therefore not be maintained. Thus, for instance, KLATT and HANDEL-MAZZETTI merged the genus *Naumburgia* MOENCH with *Lysimachia* in their monographs of the latter genus. For similar reasons P. TAYLOR, in his revision of the tropical East African species of *Anagallis*, came to the conclusion that *Centunculus* can not be maintained as a separate genus, although in Europe one would conclude from the species growing there that they are distinct genera. A similar



case is found with the pair *Primula* and *Androsace* which are in Europe and America separated by having a distinctly salver-shaped or an almost rotate corolla respectively. This single character has no great taxonomic importance in itself as for example in *Lysimachia* the length of the corolla tube is as variable as it is in *Primula* and *Androsace*. Besides transitional species are found in the Sino-Himalayan region according to FRANCHET (1886) and PAX (Bot. Jahrb. 10, 1888, 133-136). PAX did not unite them because he assumed that in the further evolution of the group the transitional species will disappear by which the two segregates will further 'diverge'. Such theoretical considerations are of course inadmissible in phytophagy; we have to deal with the present situation and this is such that these two genera are only separated by one character which does not hold. And although the consequence must be rather impopular and nomenclaturally inconvenient because of the large number of species described in *Androsace*, the two genera should be united from the scientific point of view. Although authors have shrunk from putting the reduction into practice we should not yield to such inertia. If *Androsace* had only a few species, hesitation would have been overcome more easily, as shown for example by the uniting of *Anagallis* and *Centunculus*, *Lysimachia* and *Naumburgia*, etc.. O. KUNTZE (1891) reduced *Androsace* to *Primula*.

**Cytotaxonomy.** According to DARLINGTON & WYLIE's 'Chromosome Atlas' the basic chromosome numbers do not yield a clear-cut picture for the whole family, although for instance in the genus *Primula*, BRUUN (Symb. Bot. Ups. 1, 1932, 1-239) could find a correlation between karyotypes and sections based on morphological characters. In the genus *Cyclamen* the basic numbers are 5, 11, 12, and 17 (cf. DE HAAN & DOORENBOS, Med. Landbouwhogeschool Wagen. 51, 1951, 151). In *Primula* these numbers are 8, 9, 10, 11, 12, and 13; in *P. auricula* L. the haploid number is surprisingly  $n = 31$ . Many polyploids occur in this genus; *P. kewensis* W. WATS. is a classic example of an artificially obtained good allotetraploid species (cf. W. F. NEWTON & C. PELLEW, J. Genetics 20, 1929, 405-467).

**Genetics.** Much experimental research has been performed on species of *Primula* and *Cyclamen*. Many Mendelian factors have been found responsible for characters of flower morphology and colour; especially *P. praenitens* KER GAWL. (*P. sinensis* LINDL. 1821, non LOUR. 1790) has intensively been examined.

A. ERNST has devoted many decades of his life to study the problem of heterostyly in *Primula*, on which further comment is given under the genus *Primula*.

From his work it appears that many interspecific crosses yield an entirely fertile progeny in which differential characters appear often to be of Mendelian value only. Therefore, we can conclude that such 'species' do not deserve specific status.

Cultivated, BACKER (Bekn. Fl. Java (em. ed.) 8, 1949, fam. 180) mentioned, as cultivated in Java, *Cyclamen persicum* L. and several *Primulas* (see there).

**Note.** By exception some genetical remarks are inserted because genetical work with *Primula* involved taxonomical conclusions.—V. ST.

#### KEY TO THE GENERA

1. Leaves in a basal rosette. Flowers in one or more superposed whorls. Corolla lobes imbricate (quin-cinual) . . . . . 3. *Primula*
1. Leaves cauline. Flowers not in whorls. Corolla lobes contorted. . . . .
2. Corolla mostly yellow, rarely white. Plants mostly gland-dotted. Capsule dehiscent with valves or irregularly bursting . . . . . 2. *Lysimachia*
2. Corolla white (in Mal.). Plant not gland-dotted. Capsule circumsciss. Very small plant. . . . . 1. *Anagallis*

## I. ANAGALLIS

LINNÉ, Gen. Pl. ed. 5 (1754) 189; Sp. Pl. (1753) 148; KNUTH, Pfl.R. Heft 22 (1905) 321; P. TAYLOR, Kew Bull. (1955) 321. — *Centunculus* LINNÉ, Gen. Pl. ed. 5 (1754) 135; Sp. Pl. (1753) 116; KNUTH, l.c. 334. — *Micropyxis* DUBY in DC. Prod. 8 (1844) 71. — Fig. 1.

Annual or perennial, prostrate or decumbent, small herbs. Stem terete or angled, not rarely winged. *Leaves* many, entire, opposite at least at the base of the stem, spirally arranged, or whorled. *Flowers* solitary axillary, sessile or pedicelled. *Calyx* 5-cleft, campanulate. *Corolla* rotate to urceolate, the lobes large or small. *Stamens* 5, free from each other; filaments often villous. *Capsule* circumsciss. *Seeds* ∞, planoconvex.

Distr. About 25 spp., all over the world, 14 in tropical-montane Africa, a cosmopolitan species once found in *Malaysia* (Timor).

Ecol. A characteristic temperate to warm-temperate genus; according to P. TAYLOR, l.c., it occurs in tropical East Africa between 2000–4000 m in bogs and by streamsides and in the Rhodesia-Angola region in southern tropical Africa between 1000–1500 m in marshes and on seasonally flooded ground.

Taxon. P. TAYLOR, l.c., found no reason to maintain the genus *Centunculus*. He distinguished three subgenera, viz *subg. Anagallis*, *subg. Centunculus* (L.) P. TAYLOR, and *subg. Jirasekia* (SCHMIDT) P. TAYLOR. His new conspectus makes a sound impression.

**I. *Anagallis pumila* Sw.** Prod. Veg. Ind. Occ. 1 (1788) 40; BTH. Fl. Austr. 4 (1869) 270; BAILEY, Queensl. Fl. 3 (1900) 946; KNUTH in Pfl. R. Heft 22 (1905) 331, f. 71; EWART & DAVIES, Fl. North. Terr. (1917) 217; GAMBLE, Fl. Madras 4 (1921) 747; HUTCH. & DALZ. Fl. W. Trop. Afr. 2 (1931) 184; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 236; P. TAYLOR, Kew Bull. (1955) 342, 345.—*Centunculus pentandrus* R. BR. Prod. (1810) 427; MIQ. Fl. Ind. Bat. 2 (1859) 1004.—*Centunculus indicus* ROYLE, Ill. Bot. Him. (1839) 310, nomen.—*Micropyxis pumila* DUBY in DC. Prod. 8 (1844) 71.—*Centunculus tenellus* DUBY, l.c. 72; HOOK. f. Fl. Br. Ind. 3 (1882) 506.—*Micropyxis tenella* WIGHT, l.c. 4 (1850) t. 1585.—*Centunculus pumilus* O.K. Rev. Gen. Pl. 3 (1891) 193.—*A. nana* SCHINZ, Vierteljahrshr. Naturf. Ges. Zürich 55 (1910) 244.—Fig. 1.

Slender nearly erect herb up to 25 cm, not rooting at the nodes. Stem terete, scarcely winged. *Leaves* less than twice as long as wide, more or less ovate, a few mm long. *Flowers* towards the apex in the leaf axils, short-pedicelled. *Calyx* cleft to the base, lobes lanceolate-oblong, acute, mucronate. *Corolla* white, as long as the calyx or exceeding it, subsupersistent, deeply 5-cleft; tube wide, c. 2/5 mm high; lobes acuminate, c. 2 mm long, the insertions separated by a sinus. *Stamens* as long as the corolla; filaments glabrous, c. 1 mm; anthers c. 1/8 mm. Pistil c. 2 mm long, style somewhat shorter than the ovary, with a flattened stigma. *Ovary* with granular glands. *Capsule* as high as the calyx.

Distr. Africa, India, N. Australia, South and Central America; in *Malaysia*: Timor (once collected, WALSH 448a).

Ecol. Damp grounds, swamps, etc., up to 2100

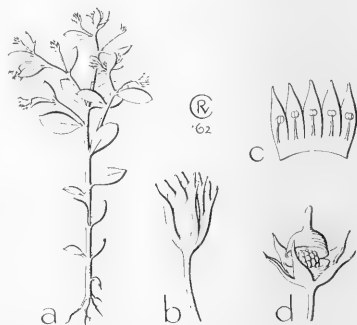


Fig. 1. *Anagallis pumila* Sw. a. Habit, nat. size, b. flower,  $\times 5$ , c. corolla laid open,  $\times 5$ , d. dehiscent fruit,  $\times 5$  (TH. THOMSON s.n. in L.).

m. The only Malaysian material was collected as a mixture with *Lobelia heyneana* R. & S. but unfortunately no altitude was indicated.

Note. The Timor material belongs to *var. pumila*; two other varieties occur in Africa (P. TAYLOR, l.c.).

## Excluded

*Anagallis arvensis* LINNÉ, Sp. Pl. (1753) 211; MIQ. Fl. Ind. Bat. 2 (1859) 1004, almost ubiquitous, has as yet not been found introduced as a weed in *Malaysia*.

## 2. LYSIMACHIA

TOURN. ex LINNÉ, Gen. Pl. ed. 5 (1754) 72; Sp. Pl. (1753) 146; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 1-45, t. 1-24; KNUTH, Pfl. R. Heft 22 (1905) 256; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 51-122; Pfl. Areale 2, 5 (1929) 39 41, maps 44-49; RAY, Illinois Biol. Monogr. 24, pts 3-4 (1956) 13.—*Cerium* LOUR. Fl. Coch. (1790) 136; ed. Willd. (1793) 167, cf. MERR. Comm. Lour. (1935) 300.—*Lubinia* VENT. Hort. Cels. (1800) 96; PAX in E. & P. Pfl. Fam. 4, 1 (1897) 112.—*Orescia* REINW. Syll. Pl. 2 (1825) 15, cf. STEEN. Bull. Bot. Gard. Btzg III, 17 (1948) 458.—*Bernadina* BAUDO, Ann. Sc. Nat. II, 20, Bot. (1843) 349, *nomen*. —**Fig. 2.**

Erect ascending or prostrate herbs. *Leaves* cauline, opposite, spiral, alternate, or whorled (sometimes various in one specimen), often glandular-punctate, margin entire or not. *Flowers* in terminal or subterminal racemes, or solitary axillary. *Calyx* deeply 5-fid. *Corolla* contorted in bud, 5-cleft, yellow or white (sometimes with purple background). *Stamens* sometimes largely connate with the corolla lobes; anthers basifixed or versatile, opening with an apical pore or with lateral slits. *Ovary* globose, style-tip as high as the anthers. *Capsule* about as high as the calyx, 5 valved or irregularly bursting. *Seeds* numerous, testa crustaceous.

Distr. About 150 *spp.*, all over the world save in northern Siberia, Greenland, northern Canada, Alaska, and New Zealand. According to HANDEL-MAZZETTI there is a distinct centre of development in the Sino-Himalaya where c. 80 *spp.* occur. With regard to these numbers it should be remembered that HANDEL-MAZZETTI employed a rather narrow specific concept. Of the 8 *spp.* which occur in Malaysia four are only found along its northern border: *L. peduncularis* WALL. ex KURZ in the Langkawi Is., *L. mauritiana* LAMK in the Batan Is. (between Luzon and Formosa), *L. capillipes* HEMSL. in Luzon and *L. sikokiana* MIQ. in the Philippines. All occur also in East or SE. Asia. The tropical-montane species have followed either the Sumatra track (*L. laxa*, *L. decurrens*, *L. montana*, *L. japonica* var. *japonica*) or the Luzon track (*L. capillipes*, *L. sikokiana*, *L. japonica* var. *papuana*, *L. decurrens*). Large-distance disjunctions occur in the distributional areas of *L. decurrens* (fig. 10) and *L. mauritiana* (fig. 9), the first a montane species, the second largely occurring on the seashore.

Ecol. Largely a genus of temperate to warm-temperate thermo-ecology, but some sections contain tropical lowland species and must be defined as eurytherm. All species occur in Malaysia above 1000 m, except *L. mauritiana* LAMK and *L. peduncularis* WALL. ex KURZ. The first one is in Malaysia and the Pacific almost bound to coastal limestone rocks; it is surprising that it ascends the coastal hills in East China to 70-400(-?700) m.

Taxon. KLATT, KNUTH, and HANDEL-MAZZETTI, who all monographed *Lysimachia*, are unanimous about a broad concept, including for example segregate genera as *Lubinia* VENT., *Coxia* ENDL., *Steironema* RAFIN., and *Naumburgia* MOENCH.

HANDEL-MAZZETTI has subdivided the genus into five subgenera; the Malaysian species belong to subg. *Lysimachia* (*Eu-lysimachia*) and subg. *Palladia* (MOENCH) H.-M. (*L. mauritiana* and *L. decurrens*). Within the subgenera he further distinguished sections, and series. The sections seem to me acceptable but the finer division into series is not satisfactory: for instance in sect. *Apodanthera* subsect. *Ramosae* there are two series, viz *Valvatae* and *Evalves* based on the dehiscence of the capsule by valves and irregular bursting respectively. However, this character may vary within species. Another example showing that the distinction of series is going too far is found in sect. *Nummularia* in which *L. japonica* is placed in ser. *Japonicae* and *L. debilis* in ser. *Debiles*, though there is no doubt in my opinion that they are conspecific.

Note. In *Lysimachia* the stamens are always, in degree, adnate to the corolla tube. Moreover they are mutually connate in a ring or low tube, or even in a high tube; in some flowers of several species I have found them occasionally entirely free from each other. Such free stamens have a basally dilated filament.

## KEY TO THE SPECIES

1. Leaves never spiral, opposite or subopposite, the apical ones not unfrequently alternate, in Mal. broad-ovate to orbicular, often abruptly very short-apiculate. Flowers solitary axillary. Pedicels shorter than their sustaining leaf. Anthers versatile, shorter than the filaments. Prostrate herb. **6. L. japonica**
1. Leaves spiral, rarely a few subopposite.
2. Flowers in terminal or leaf-opposed, 1-5-flowered, stunted, often pseudo- or subumbellate racemes. Leaves usually ovate-acute . . . . . **4. L. montana**
2. Flowers either solitary axillary or in many-flowered, terminal, bracteate racemes.
3. Bracts almost filiform (except sometimes the lowest). Corolla white or pale purple, in Mal. with prominent, elliptic red glands in the tissue. Stamens conspicuously exceeding the corolla. **8. L. decurrens**
3. Flowers subtended by normal leaves or leafy bracts. Stamens not exceeding the corolla.
4. Filaments halfway adnate to the corolla. Leaves spatulate, blunt or bluntnish. Flowers white, yellowish in the dried state. . . . . **7. L. mauritiana**
4. Filaments adnate to the corolla at the base only. Leaves acute or acuminate, not spatulate. Flowers yellow.
5. Corolla deeply cleft, distinctly exceeding the calyx. Anthers as long as or longer than the filaments.
6. Leaf venation between the nerves, especially beneath, distinctly *prominent-reticulate* in the dried state . . . . . **1. L. sikokiana**
6. Venation not distinctly prominent-reticulate.
7. Stamens as long as the corolla. Anther cells opening with an apical pore. Flowers confined to the upper part of the stem. Leaves often truncately cut away at the base then decurrent on one or both sides. Capsule shorter than the calyx. Lax decumbent herb. . . . . **2. L. capillipes**
7. Stamens shorter than the corolla. Anther cells opening with lateral slits. Flowers present almost along the entire stem. Leaves lanceolate. Capsule somewhat exceeding the calyx. Erect rather robust plant. . . . . **3. L. laxa**
5. Corolla cleft halfway, about as long as or shorter than the calyx. Anthers shorter than the filaments . . . . . **5. L. peduncularis**

**1. *Lysimachia sikokiana*** MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 121; FRANCH. & SAV. En Pl. Jap. 1 (1875) 302; ENGL. Bot. Jahrb. 6 (1885) 64; HEMSL. J. Linn. Soc. Bot. 26 (1889) 51; KNUTH, Pfl. R. Heft 22 (1905) 270; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 74; SASAKI, Cat. Govt. Herb. (1930) 402; MASAMUNE, Fl. Stud. Yakush. (1934) 360; HARA, En. Sperm. Jap. 1 (1948) 88; MAKINO, Ill. Fl. Jap. (1954) 233.—*L. simulans* HEMSL. J. Linn. Soc. Bot. 26 (1889) 57; SASAKI, Cat. Govt. Herb. (1930) 402.—*L. ramosa* var. *typica* KNUTH, Pfl. R. Heft 22 (1905) 271, *p.p.*, *excl. typ.*; MERR. Philip. J. Sc. 2 (1907) Bot. 298; *ibid.* 5 (1910) Bot. 377; En. Philip. 3 (1923) 275; MERR. & CHUN, Sunyatsenia 1 (1930) 77; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 238, *p.p.*—*L. fragrans* HAYATA, J. Coll. Sc. Univ. Tokyo 30 (1911) 175, *ex descr.*; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 74; *ibid.* 16 (1931) 167; MERR. Sunyatsenia 1 (1934) 203; J. Arn. Arb. 19 (1938) 61; MERR. & CHUN, Sunyatsenia 5 (1940) 156, *syn. nov.*—*L. ardisioides* MASAMUNE, J. Soc. Trop. Agr. Taiwan 4 (1932) 302, *ex descr.*, *syn. nov.*—*L. garrettii* FLETCH. Kew Bull. (1936) 41.—**Fig. 2a—d.**

Erect or decumbent herb, rooting at the base, stem terete at the base, 30–60 cm. Leaves spirally arranged, elliptic-lanceolate, acute, sometimes shortly acuminate, base acute to rounded, decurrent along the stem, 2½–10 by 1–3½ cm, both surfaces glabrous, no glands; upper side very dark brown when dry, midrib and nerves depressed,

veins more or less prominent; underside glaucous, midrib, nerves, and veins prominent, nerves ascending, passing into a marginal vein; margin entire or undulate-crenate; lower leaves scale-like reduced; petiole ½–1½ cm. Flowers axillary, solitary, confined to the upper part of the plant. Pedicels as long as the sustaining leaves, drooping or ± recurved during anthesis, in fruit obliquely erect. Calyx lobes ovate, acuminate, 3–7 mm, the margins sometimes with stalked glands. Corolla yellow, deeply cleft, 10–15 mm long, lobes elliptic-oblong, acute at the apex. Stamens only adnate at the base, whether or not free from each other, 4–8 mm; anthers oblong, basifixed, 3–5 mm long, the cells opening with an apical pore. Style-tip as high as the anthers. Capsule 5-valved to the base, but often irregularly bursting.

Distr. S. Japan, Ryukyu Is., southern continental China (Yunnan, Kwang-tung), N. Siam, Hainan, Formosa; in *Malaysia*: Philippines (Luzon: Bontoc; Mindoro; Negros; Camiguin de Misamis; Mindanao). Fig. 3.

Ecol. Mossy forests, damp ravines, 1200–2300 m. Vern. Philip.: *lupo-lupo*, C. Bis., *tasig-taig*, Bag.

Notes. This species has been confused with *L. laxa* BAUDO (*L. ramosa* WALL. *ex* DUBY) by KNUTH and by MERRILL.

It differs from WALLICH's type in many characters: less flowers and these confined to the upper part of the plant; stamens with apical pores; ovate leaves discoloured in the herbarium with visible veins and not glandular-punctate.

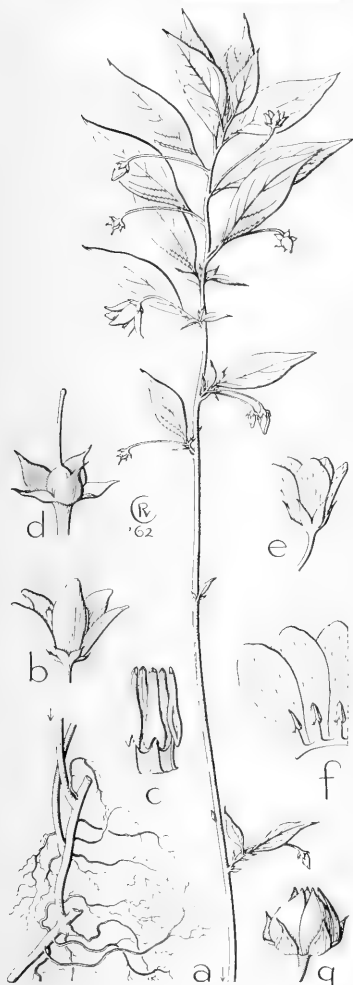


Fig. 2. *Lysimachia sikokiana* MIQ. a. Habit,  $\times \frac{1}{2}$ , b. flower, nat size, c. androecium,  $\times 2$ , d. flower, stamens and petals removed.—*L. laxa* BAUDO. e. Flower, nat. size, f. part of inside of corolla showing insertion of stamens,  $\times 2$ , g. dehiscing fruit,  $\times 2$  (a-d MERRILL BS 4383, e-g VAN STEENIS 9109).

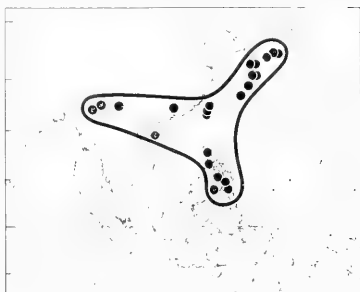


Fig. 3. Distribution of *Lysimachia sikokiana* MIQ.

After HANDEL-MAZZETTI's revision had been published MERRILL identified the Philippine specimens to belong to *L. fragrans* HAYATA which HANDEL-MAZZETTI already pointed out may run into *L. sikokiana* MIQ. I have seen MIQUEL's type and MERRILL's specimens, though less robust than the Japanese ones, are doubtless conspecific. I have not seen HAYATA's type, but material identified by HANDEL-MAZZETTI as *L. fragrans* proved to belong to *L. sikokiana*. A toptype of *L. ardisioides* MASAMUNE (TANAKA 13561) has the same habit as the Philippine plants.

**2. *Lysimachia capillipes* HEMSL.** J. Linn. Soc. Bot. 26 (1889) 48; KNUTH, Pfl. R. Heft 22 (1905) 270; PETITMENGIN, Bull. Ac. Géogr. Bot. 17 (1907) 223; MERR. Philip. J. Sc. 7 (1912) Bot. 93; En. Philip. 8 (1923) 274; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 74; J. Arn. Arb. 15 (1934) 294; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 237.—*Andrachne cavalerieri* LÉVL. in Fedde, Rep. 12 (1913) 187.—*L. cuspidata* (non BL.) HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1931) 167, pro specim. philip.

Ascending or prostrate herb, branched only at the base, 20-60 cm; stem thin, angular or ridged. Leaves alternate and spirally arranged, membranous, ovate-lanceolate, acute, sometimes acuminate, mucronate,  $1\frac{1}{2}$ -4 by  $\frac{1}{2}$ -2 $\frac{1}{2}$  cm; base unequal, acute, obtuse or truncate, decurrent along the petiole, margin entire or undulate-crenate; midrib and nerves on the upper surface slightly depressed; prominent below, veins hardly visible; no marginal vein. Flowers solitary, axillary, confined to the upper part of the stem. Pedicels  $1\frac{1}{2}$ -4 $\frac{1}{2}$  cm, obliquely erect during anthesis then drooping. Calyx lobes lanceolate, acuminate, 3-5 mm. Corolla yellow, deeply cleft, 7-10 mm; lobes oblong; broad-triangular at apex. Stamens as long as the corolla, filaments very short, at the base adnate with the corolla tube, also connate with each other in a basal ring. Style-tip as high as the stamens. Capsule 5-valved, shorter than the calyx.

Distr. China (Yunnan, Kweichow, Szechuan,

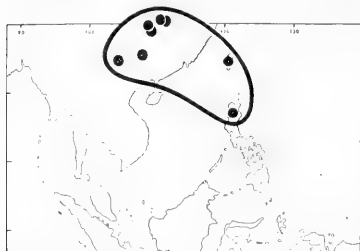


Fig. 4. Distribution of *Lysimachia capillipes* HEMS.

Hupei) and Formosa; in Malaysia: Philippines (North Luzon). Fig. 4.

Ecol. In damp thickets, along streams, 1300–1500 m, in China 1200–2000 m.

Vern. Philip.: *osiak*, Ig.

Notes. MERRILL (1912) determined some Philippine specimens with KNUTH's key, which is rather useless, especially for *sect. Alternifoliae* KNUTH, under which this species was arranged. By elimination MERRILL reached (*ex descr.*) the conclusion that his material belonged to *L. capillipes*. I have now seen the type of *L. capillipes* and can confirm MERRILL's deduction.

Later HANDEL-MAZZETTI tentatively identified some other Philippine specimens collected by CLEMENS (16264a, 16459, 18783) as *L. cuspidata* BL. (= *L. montana*), but they really represent *L. capillipes*.

3. *Lysimachia laxa* BAUDO, Ann. Sc. Nat. II, 20, Bot. (1843) 347.—*L. ramosa* WALL. [Cat. (1828) n. 1490, *nomen*] *ex* DUBY in DC. Prod. 8 (1844) 65; DE VRIESE in Miq. Pl. Jungh. (1851) 88; THWAITES, En. Pl. Zeyl. (1860) 172; MIQ. Sum. (1861) 246; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 31, t. 17; Hook. f. Fl. Br. Ind. 3 (1882) 503, *incl. var. zeylanica*; TRIM. Fl. Ceyl. 3 (1895) 65; KOORD. Nat. Tijds. Ned. Ind. 60 (1901) 273; KNUTH, Pfl. R. Heft 22 (1905) 271, *typ. incl. sed. excl. var. typica* KNUTH *pro parte et var. grandiflora* FRANCH.; KOORD. Jungh. Gedenkb. (1910) 186; Exk. Fl. Java 3 (1912) 35; Fl. Tjib. 3 (1918) 30; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 75; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 238, *p.p.*; MERR. J. Arn. Arb. 19 (1938) 61; BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 3; INGRAM, Baileya 8 (1960) 95.—*L. floribunda* ZOLL. & MOR. Nat. & Geneesk. Arch. Neerl. Ind. 2 (1845) 575; HASSK. Flora 30 (1847) 600; WALP. Ann. Bot. Syst. 1 (1848) 494; ZOLL. Syst. Verz. 3 (1855) 59.—Fig. 2e–g.

Erect herb, sometimes decumbent at the base, to a ½ m high; stem angular, often strongly branched. Leaves spirally arranged, lanceolate, acute at both ends, sometimes acuminate at apex, 3–11 by ½–2 cm; upper surface often with lax thin hairs, midrib depressed, further venation hardly visible; underside glabrous, midrib pro-

minent, nerves slightly so, ascending, veins invisible; both sides provided with scattered flat brown glands. Petiole 0–1 cm, decurrent along the stem. Flowers axillary, solitary, all along the stem. Pedicels nearly as long as the leaves, obliquely erect. Flowers during anthesis drooping; in fruit erect ascending. Calyx lobes elliptic-obovate, short-acuminate, 4–8 mm; margin sometimes provided with stalked glands. Corolla yellow, deeply cleft, somewhat longer than calyx, 5–10 mm, lobes elliptic-oblong, acute at the apex or rounded. Stamens 2–5 mm; filaments adnate to the corolla only at the base, further connate with each other in a small basal ring (in some Indian specimens the filaments are further free); anthers as long as the filaments incl. the ring, basifixed, oblong, sagittate at the base, opening with lateral slits. Style nearly as high as the corolla. Capsule exceeding the calyx, 6–10 mm, 5-valved to the base, often irregularly bursting.

Distr. Ceylon, Eastern Himalaya, Southern China, Indo-China, and Thailand; in Malaysia: Sumatra, Java, and Lesser Sunda Is. (Bali, Lombok, and Sumbawa). Fig. 5.



Fig. 5. Distribution of *Lysimachia laxa* BAUDO.

Ecol. In forests in sunny spots along trails, on volcanic walls, 1000–3000 m.

Notes. WALLICH's type of *L. ramosa* WALL. was first validated by BAUDO with a succinct description in a preliminary study for a revision of the *Primulaceae* intended for DE CANDOLLE's Prodrômus under the name *L. laxa*; this name was not taken up by DUBY a year later in DC. Prod. vol. 8. BAUDO's paper has been neglected by later monographers.

HOOKEr f. distinguished a *var. zeylanica* to which KOORDERS (1912) referred the specimens from Java. HANDEL-MAZZETTI has correctly pointed out, however, that it is impossible to uphold this variety because the differences concerned (size of the flowers, shape of the corolla lobes, etc.) have proved to be highly variable.

KNUTH (1905) and MERRILL (1923) have referred some Philippine specimens to *L. ramosa* which species does not occur in the Philippine Is.; all these sheets belong to *L. sikokiana*.

4. *Lysimachia montana* (REINW.) BAKH. f. comb. nov.—*Orescia montana* REINW. Syll. Pl. 2 (1825) 15.—*L. cuspidata* BL. Bijdr. 14 (1826) 737; DUBY in DC. Prod. 8 (1844) 67; MOR. Syst. Verz. (1846) 45, incl. var. *glabra*; DE VRIESE in Miq. Pl. Jungh. (1851) 88; MIQ. Sum. (1861) 245, non KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 36, quae est *L. klattiana* HANCE, J. Bot. 16 (1878) 236; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 144; O. K. Rev. Gen. Pl. 2 (1891) 397; KNUTH, Pfl. R. Heft 22 (1905) 272, incl. var. *glabrescens* et *hispida*; KOORD. Exk. Fl. Java 3 (1912) 35; Fl. Tjib. 3 (1918) 31; RENDLE, J. Bot. 63 Suppl. (1925) 58; HAND.—MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 75; *ibid.* 16 (1931) 167, excl. *specim. philip.*; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 237; *ibid.* III, 17 (1948) 458; BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 3.—*L. uliginosa* (non BL.) KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 36, t. 20.—*L. platyphylla* MERR. Contr. Arn. Arb. 8 (1934) 134, t. 12.—*L. chapaensis* MERR. J. Arn. Arb. 20 (1939) 350, *syn. nov.*



Fig. 6. Distribution of *Lysimachia montana* (REINW.) BAKH. f., dotted line is demarcation in Sumatra between the two varieties.

var. *montana*.—*Orescia montana* REINW.—*L. cuspidata* BL.—*L. uliginosa* (non BL.) KLATT.

Decumbent or erect herb up to ½ m high; stem angular, twisted. Leaves alternate, spirally arranged or sometimes opposite, narrow to broad elliptic, acute, mucronate, sometimes slightly acuminate, base acute to rounded, 1–6 by 0.5–2.5 cm, margin entire or slightly dentate; whether or not hairy at one or both sides; midrib depressed above; prominent underneath as are the ascending nerves, the latter passing into a marginal vein; petiole c. 1 cm. Flowers in terminal or subterminal 1–5-flowered racemes, exceeding the leaves; peduncle c. 1 cm. Pedicels 1–3 cm, each in the axil of a small leafy bract. Calyx lobes 4–7 mm, lanceolate, acute-acuminate, sometimes hairy on midrib, whether or not glandular-punctate. Corolla yellow, cleft halfway or deeper, 6–13 mm high, lobes obtuse or rounded, with stalked glands on the margin. Stamens c. 5 mm; filaments as long as anthers, adnate with the corolla only at the

base, free from each other; anthers oblong, sagittate at the base, basifixed, opening with lateral slits. Style c. 7 mm. Capsule somewhat smaller than the calyx, 5-valved.

Distr. Indo-China (Laos: KERR 21026, 21038) and Malaysia: Sumatra and Java (Dieng to Tengger Mts); Flores (not seen.) Fig. 6, partly.

Ecol. Primary forest, along trails, in shaded places, on old lava-streams, 1000–2500 m.

Notes. DR. BAKHUIZEN VAN DEN BRINK Jr suggested that the epithet *montana* has priority over *cuspidata*.

HANDEL—MAZZETTI (1931) referred some Philippine specimens collected by CLEMENS to *L. cuspidata*; they rightly belong to *L. capillipes* HEMS.

MIQUEL (1868) pointed out that KLATT had made an erroneous interpretation of BLUME's species: what KLATT described as *L. uliginosa* BL. (= *L. japonica* THUNB.) is *L. montana*, and that the Asiatic specimens which he referred to *L. cuspidata* belonged to another species (in 1878 described as *L. klattiana* HANCE). KLATT was curiously sensitive to MIQUEL's correct criticism (cf. Linnaea 37, 1873, 502).

Hitherto this species was thought to be confined to Malaysia, although KNUTH suggested that the Chinese *L. trichopoda* FRANCH. might represent only a variety of it; according to HANDEL—MAZZETTI, however, this species has stamens opening by apical pores. Also var. *platyphylla* to which *L. chapaensis* is here reduced occurs in continental Southeast Asia.

I see no reason to distinguish varieties based on hairiness of the leaves. Within specimens from a local population some were glabrous, others had leaves hairy to different degree, and of different nature, sometimes only at the underside, sometimes only at the upper side. Often the hairiness was strigose on the upper surface but villous beneath.

var. *platyphylla* (MERR.) BENTVELZEN, *stat. nov.*—*L. platyphylla* MERR.—*L. chapaensis* MERR.

Differs from the type variety by larger leaves, 5–10 by 3–6 cm, larger corolla (12–16 mm), anthers much longer (5 mm) than filaments (2 mm), which are shortly connate at the base.

Distr. Indo-China (Tonkin) and Malaysia: N. Sumatra southwards to the boundary between East Coast and Tapanuli. Fig. 6, partly.

Ecol. Flat forest ridges along stream margins or on rocks, 1000–1500 m.

Vern. *Dukut-dukut lutu*, *dukut lohut*, Toba.

Note. MERRILL distinguished *L. platyphylla* by the very much larger, broader leaves, shorter pedicels, rounded petals, and glandular-punctate sepals. The latter two characters are, however, also found in Javanese specimens of *L. montana*, in which besides the length of the pedicels is very variable. But indeed the North Sumatran plants have distinctly larger leaves and also very large anthers, a character not mentioned by MERRILL, and I have accepted it as a distinct variety. To this variety I have also referred *L. chapaensis* MERR. from Tonkin (PETELOT 6347). MERRILL thought this species to be allied to *L. ramosa*

WALL. but in my opinion the type is clearly the same as *L. montana* var. *platyphylla*.

**5. *Lysimachia peduncularis* WALL.** [Cat. (1828) n. 1489, *nomen*] ex KURZ, J. As. Soc. Beng. 46, ii (1877) 219; HOOK. f. Fl. Br. Ind. 3 (1882) 504; KNUTH, Pfl. R. Heft 22 (1905) 271; CRAIB, Kew Bull. (1911) 406; HAINES, Bot. Bihar & Orissa 4 (1922) 506; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 77; BONATI, Fl. Gén. 1.-C. 3 (1930) 760; FLETCHER, Fl. Siam. En. 2 (1938) 324; HENDERSON, J. Mal. Br. R. As. Soc. 17 (1939) 53.—*L. pierrei* PETITMENGIN, Bull. Ac. Géogr. Bot. 18 (1908) 337; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 77; MERR. J. Agr. Arb. 19 (1938) 61, ex descr. *syn. nov.*

Decumbent herb, branched above the middle, rooting at the base. Stem up to 30 cm, angular, thin, narrowly winged. Leaves spirally arranged, lanceolate, acute at both ends,  $1\frac{1}{2}$ – $5\frac{1}{2}$  cm, strigillose, faintly gland-dotted, midrib at the underside slightly prominent, nerves ascending, veins invisible; petiole  $\frac{1}{2}$ –1 cm. Flowers yellow, axillary, solitary, confined to the upper part of the plant, during anthesis drooping. Pedicels somewhat longer than the leaves, in fruit erect ascending. Calyx lobes oblong, shortly acuminate, 3–5 mm. Corolla cleft halfway,  $2\frac{1}{2}$ –4 mm high, lobes elliptic, acute. Stamens free from each other, as long as the corolla, only at the base adnate to it; filaments 2–3 mm; anthers c.  $\frac{1}{2}$  mm, oblong, sagittate at the base, basifixed, cells latrorse. Style 2–3 mm. Capsule shorter than the calyx, 5-valved, often irregularly bursting.

Distr. India (Bihar), S. Burma, Siam, South Indo-China; in Malaysia: Malay Peninsula (Langkawi Is.), once collected (HENDERSON SF 21371). Fig. 7.



Fig. 7. Distribution of *Lysimachia peduncularis* WALL. ex KURZ.

Ecol. In coastal limestone vegetation; in Burma to 420 m; according to HAINES in Bihar in damp places in bamboo forests.

Note. PETITMENGIN compared his *L. pierrei* with *L. ramosa* WALL. ex DUBY (= *L. laxa* BAUDO), *L. floribunda* ZOLL. & MOR. (= *L. laxa* BAUDO), and *L. capillipes* HEMSL. and found it to be distinct. According to HANDEL-MAZZETTI and MERRILL it will come very near to *L. pedun-*

*cularis*. The only difference is that *L. pierrei* is glabrous but as the indument in this genus is very variable this cannot warrant specific separation.

**6. *Lysimachia japonica* THUNB.** Fl. Jap. (1784) 83; LAMK, Tabl. Enc. Bot. 1 (1792) 440; THUNB. Ic. Pl. Jap. (1794) t. 16; DUBY in DC. Prod. 8 (1844) 67; SIEB. & ZUCC. Fl. Jap. 2 (1846) 139; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 34, t. 19; MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 121; BTH. Fl. Austr. 4 (1869) 269; FRANCH. & SAV. En. Pl. Jap. 1 (1875) 303; HOOK. f. Fl. Br. Ind. 3 (1882) 505; HEMSL. J. Linn. Soc. Bot. 26 (1889) 53; COLLETT, Fl. Siml. 1 (1902) 302; KNUTH, Pfl. R. Heft 22 (1905) 262; MATS. & HAYATA, J. Coll. Sc. Univ. Tokyo 22 (1906) 222; CRAIB, Kew Bull. (1911) 406; KOORD. Ek. Fl. Java 3 (1912) 34; Fl. Tjib. 3 (1918) 30; MERR. En. Philip. 3 (1923) 275; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 96; BONATI, Fl. Gén. 1.-C. 3 (1930) 759; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 237; H. J. LAM, Blumea 5 (1945) 585; HARA, En. Sperm. Jap. 1 (1948) 86, incl. var. *thunbergiana* et var. *subsessilis*; BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 3.—*L. maculata* R. BR. Prod. (1810) 428; SPRENG. Syst. Veg. 1 (1825) 572; DUBY in DC. Prod. 8 (1844) 66.—*L. debilis* WALL. in Roxb. Fl. Ind. 2 (ed. Wall.) (1824) 25; DON, Prod. Fl. Nepal. (1825) 83; BAUDO, Ann. Sc. Nat. II, 20, Bot. (1843) 348, incl. var. *minor* et *vulgaris*; DUBY in DC. Prod. 8 (1844) 66; MOR. Syst. Verz. (1846) 44; MIQ. Fl. Ind. Bat. 2 (1859) 1002; HAND.-MAZZ. Acta Hort. Gothob. 2 (1926) 118; Not. R. Bot. Gard. Edinb. 16 (1928) 92; FLETCHER, Fl. Siam. En. 2 (1938) 323.—*L. uliginosa* BL. Bijdr. 14 (1826) 737; HASSK. Tijds. Nat. Gesch. & Phys. 10 (1843) 130; DUBY in DC. Prod. 8 (1844) 67; MIQ. Fl. Ind. Bat. 2 (1859) 1002.—*L. microphylla* MERR. Philip. J. Sc. 1 (1906) Suppl. 221.—*L. siamensis* BONATI, Bull. Soc. Bot. Genève II, 5 (1913) 304, f. 6<sup>o</sup>.—*L. suborbicularis* WENT f. Nova Guinea 14 (1924) 113.—*L. minutissima* (MASAM.) MASAM. Bull. Soc. Bot. Fr. 83 (1937) 695.

var. *japonica*.—*L. maculata* R. BR.—*L. debilis* WALL. in Roxb.—*L. uliginosa* BL.—*L. siamensis* BONATI.

Slender, prostrate or decumbent, little-branched herb, 10–40 cm long. Stem angular, brown-hairy; internodes 2–5 cm. Leaves in opposite or subopposite pairs, 2–5 cm spaced, orbicular apiculate to ovate acute or subacuminate,  $1\frac{1}{2}$ – $2\frac{1}{2}$  cm, base unequal, truncate, decurrent along the petiole (0–1 cm long), upper side scanty appressed-hairy, midrib and ascending nerves slightly distinct, glandular punctate; underside more hairy, midrib and nerves slightly prominent, veins subdistinct, glands depressed. Flowers axillary, solitary, found all along the stem, drooping then obliquely erect. Pedicels 0–1 cm, always shorter than leaves. Calyx 4–8 mm long, lobes lanceolate, acuminate, undersurface scantily provided with glands, hirsute-hairy, inner surface with distinct midrib. Corolla yellow, shorter to a little longer than the calyx, deeply cleft, lobes broad-elliptic, at the apex



broad-triangular, apiculate, whether or not provided with glands. *Stamens* 3-4 mm, filaments connate in a short tube or free from each other and then dilated at the base; anthers 1 mm, versatile, opening by lateral slits. *Ovary* hirsute. Style 3-4 mm. *Capsule* shorter than the calyx, 5-valved.

Distr. Kashmir to Yunnan, Siam, Eastern China, Formosa, Ryukyu Is., Japan, also in Australia (N. S. Wales, introduced?); in *Malaysia*: Sumatra, Java (Preanger, Mt Diëng, and Mt Tengger). Fig. 8.

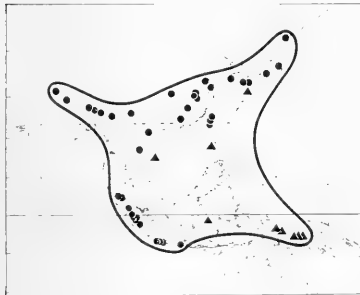


Fig. 8. Distribution of *Lysimachia japonica* THUNB. var. *japonica* (dots), var. *papuana* S. MOORE (triangles).

Ecol. Damp banks, roadsides, abandoned fields in montane rain-forest areas, 1100-2000 m.

Notes. According to HANDEL-MAZZETTI *L. debilis* WALL. would not be synonymous with *L. japonica* THUNB. He arranged the first in the *ser. Debiles*, the latter in *ser. Japonicae*. *L. debilis* would be distinct by the glandular and twice as large corolla and acute leaves. VAN STEENIS (1934, 237) pointed out that these characters do not hold and I can fully confirm this: I have seen specimens with orbicular leaves and a glandular-punctate, small corolla but there are also eglandular small-flowered ones. Also the hairiness of the calyx and length of the pedicel is very variable (2-10 mm) as is the length of the blade (19-30 by 18-22 mm). In my mind the Chinese species of *sect. Nummularia* are too finely split and a new critical synthesis with a wide species concept is necessary.

KLATT described the staminal tube of *L. japonica* as to be high and provided with glands. BONATI said the same of the specimen KERR 1146, which he called *L. siamensis*. I have seen the type and found a thickish or fleshy membrane. The 'glands' actually represent fruit bodies of a fungus and hyphae can be observed in the tissue of the corolla, and I assume the fleshy character of the staminal tube to be due to the same cause.

In Japanese specimens the filaments are often partially connate in a basal ring; in Sumatran and Javan specimens they are free.

THWAITES (En. Pl. Zeyl. 1860, 172) united *L. deltooides* WIGHT from Ceylon and India with *L. japonica* THUNB. Although they look very similar,

I think they are specifically distinct. In *L. deltooides* the pedicels are longer than the leaves and it has a much larger corolla. In passing it may be remarked that the name *L. deltooides* WIGHT is obviously a synonym of *L. procumbens* BAUDO, succinctly described (Ann. Sc. Nat. II, 20, Bot. 1843, 348): "*Subprostrata rigide hirsuta. Cor. calyce major. praecedenti (L. debilis Wall.) affinis.*" In my opinion there is no doubt that he had material of *L. deltooides* WIGHT.

The name *L. procumbens* BAUDO, 1843, has priority over *L. deltooides* WIGHT, 1851.

var. *papuana* S. MOORE, Trans. Linn. Soc. II, 9, Bot. (1916) 102; WENT f. Nova Guinea 14 (1924) 113; MERR. & PERRY, J. Agr. Arb. 29 (1948) 162.—*L. microphylla* MERR.—*L. suborbicularis* WENT f.—*L. japonica* var. *minutissima* MASAM. Prel. Rep. Veg. Yakus. (1929) 108; J. Soc. Trop. Agr. Taiwan 4 (1932) 195; HARA, En. Sperm. Jap. 1 (1948) 86.—*L. minutissima* (MASAM.) MASAM.

Small prostrate herb, 5-10 cm long. *Leaves* opposite, the pairs 0.3-2 cm spaced, scantily to dense (Papua) strigose-hairy, broad-elliptic-orbicular, 4-7 by 3-5 mm. *Corolla* c. 3-5 mm long.

Distr. Japan (Yakushima I.), Indo-China (Annam); in *Malaysia*: Philippines (Luzon), Celebes, and New Guinea. Fig. 8.

Ecol. In valleys, along river-banks, in grassland, and in dense forests, also in fields, 1300-2900 m. Vern. *Jamp*, Enga lang., Yogos, New Guinea.

Notes. According to MOORE the pubescence would be the only reliable character to separate this from the type variety. This does not hold, however, as many Javanese and Sumatran specimens of var. *japonica*, including also THUNBERG's type, are very hairy. The small, condensed habit, the small leaves, small flowers etc. are, however, very characteristic and for that reason I have accepted this variety. Its occurrence over a wide area geographical and altitudinal, and its almost replacing geographical distribution as compared with var. *japonica* justify a separate status and plead against an environmental variant.

It is not endemic in New Guinea as supposed by some authors; for that reason epithets as *microphylla* and *minutissima* would be more appropriate, but *papuana* has priority.

In the Papuan specimens the filaments are whether or not connate in a basal ring.

7. *Lysimachia mauritiana* LAMK, Encycl. 3, Bot. (1791) 572; Tabl. Encycl. 1 (1792) 440; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 147; CORDMOY, Fl. Ile Réunion (1895) 441; KNUTH, Pfl. R. Heft 22 (1905) 273, f. 58; MERR. Philip J. Sc. 3 (1908) Bot. 425; En. Philip. 3 (1923) 275; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 106; SASAKI, Cat. Govt. Herb. (1930) 402; HOSOKAWA, Trans. Nat. Hist. Soc. Form. 25 (1935) 34; KANEHIRA, En. Micron. Pl. (1935) 387; BROWN, Bull. Bish. Mus. 130 (1935) 222; GUILAUMIN, Fl. Nouv. Calé., (1948) 270; HARA, En. Sperm. Jap. 1 (1948) 87; WALKER & RODIN, Contr. U. S. Nat. Herb. 30 (1949) 463; MAKINO, Ill. Fl. Jap. (1954) 232; INGRAM, Baileya 8 (1960)

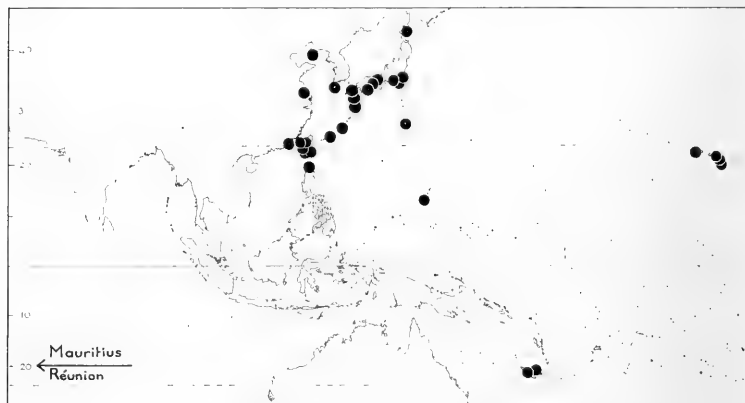


Fig. 9. Distribution of *Lysimachia mauritiana* LAMK.

97.—*Lubinia spatulata* VENT. Hort. Cels. (1800) t. 96; DUBY in DC. Prod. 8 (1844) 60; BAKER, Fl. Maur. (1877) 188.—*Lubinia mauritiana* SPRENG. Syst. Veg. 1 (1825) 572.—*L. lineariloba* HOOK. & ARN. Bot. Beech. Voy. (1841) 268; DUBY in DC. Prod. 8 (1844) 61; SIEB. & ZUCC. Abh. M.—Ph. Kl. K. Ak. Wiss. Bayern 4, 3 (1846) 140; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 31; MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 121; B. & H. Gen. Pl. 2 (1873) 635; FRANCH. & SAV. En. Pl. Jap. 2 (1879) 431; HEMSL. J. Linn. Soc. Bot. 26 (1889) 53; MATS. & HAYATA, J. Coll. Sc. Univ. Tokyo 22 (1906) 221.—*L. glaucophylla* HOOK. & ARN. Bot. Beech. Voy. (1841) 306, t. 68; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 32, t. 18; KNUTH, Pfl. R. Heft 22 (1905) 275; HAND.—MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 107, *syn. nov.*—*Bernadina laurina* BAUDO *var. stenia* BAUDO, Ann. Sc. Nat. II, 20, Bot. (1843) 349, *nom. illeg.*—*Bernadina mauritiensis* BAUDO, Ann. Sc. Nat. II, 20, Bot. (1843) 349, *nom. illeg.*—*L. lubinoides* SIEB. & ZUCC. Abh. M.—Ph. Kl. K. Ak. Wiss. Bayern 4, 3 (1846) 140; MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 121; FRANCH. & SAV. En. Pl. Jap. 1 (1875) 302.—*L. spatulata* SCHOUW, Linnaea 24 (1851) 160; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 32, t. 18, '*spatulata* KLATT'; HILLEBR. Fl. Hawaii (1888) 285.—*Lubinia lubinoides* PAX in E. & P. Pfl. Fam. 4, 1 (1897) 112.—*Lubinia lineariloba* PAX, *l.c.*—*L. nebeliana* GILG, Bot. Jahrb. 24, Beibl. 75 (1905) 57.—*L. rubida* KOIDZ. Bot. Mag. Tokyo 33 (1919) 110; HARA, En. Sperm. Jap. 1 (1948) 87.

Robust ascending or erect herb, to 50 cm; stem at the base with two lateral branches, terete, at the end branched again. *Leaves* alternate or spirally arranged, blunt, spatulate, decurrent along the petiole (0–1 cm), 2½–6 by ½–2½ cm,

coriaceous, at the underside with scattered black glands, midrib prominent, venation invisible. Upper leaves sessile. *Flowers* in head-like congested, terminal racemes, after anthesis elongated and 3–12 cm. Bracts leafy, blunt and spatulate, upwards decreasing in length. Pedicels longer than the sustaining leaves. *Calyx* campanulate, lobes lanceolate, broad-triangular or elliptic, apex acute, obtuse, or rounded, 4–7 mm, outside a prominent midrib, black-punctate, but not at the scarious margin. *Corolla* white (in the dry state yellow!), deeply cleft, lobes elliptic, obtuse, 12–16 mm. *Stamens* 9–12 mm, filaments halfway adnate to the corolla, dilated at the base, not connate with each other, anthers 1 mm, oblong, versatile, acuminate, rounded at the base, opening with lateral slits. Style 8–10 mm. *Capsule* pear-shaped, exceeding the calyx, irregularly bursting.

Distr. Mauritius and Réunion, East Asia (E. China: rare; Korean Is.; Japan; Ryukyus; Formosa), Bonin Is., Marianas, Hawaiian Is., New Caledonia, and Loyalty Is.; in *Malaysia*: Philippines (Batan Is.). Fig. 9.

Ecol. On coastal coral rocks and beaches; in China also occurring in the coastal hills to 400(–700?) m, remarkably absent in the equatorial zone between 13° NL and 18° SL.

Notes. This species has often been regarded as representing a separate genus *Lubinia* VENT. but I agree with later authors that it should be kept in *Lysimachia*. BAUDO took *L. mauritiana*, the type species of *Lubinia*, together with *L. decurrens* to represent a separate genus *Bernadina*, but he gave no generic description. It is the equivalent of *Lysimachia subg. Palladia* (MOENCH) HAND.—MAZZ.

*L. lineariloba* HOOK. & ARN. and *L. lubinoides* SIEB. & ZUCC. have been kept distinct from *L. mauritiana*, but only on the strength of very

variable characters, such as the length of the inflorescence; I agree with HANDEL-MAZZETTI to reduce them.

Both HANDEL-MAZZETTI and KNUTH suggested that *L. glaucophylla* HOOK. & ARN. might belong to *L. mauritiana*.

According to the first author it could be a local form, possibly native in the Bonin Is. I have examined the type which consists of a single specimen (in K); it bears only a few flowers of which the lowest is still in anthesis. The habit and floral characters of the specimen are exactly those of *L. mauritiana*, but the calyx differs in being more or less fleshy, with  $\pm$  twisted lobes which lack the scarious margin of typical *L. mauritiana* and measure 9 mm in length (the longest in *L. mauritiana* being 7 mm). In the Rijksherbarium there is, however, a specimen (908. 176-1390) of *L. mauritiana*, cultivated in the Botanic Garden at Groningen (27-6-1860) of which the lowest flower has a calyx of exactly the same structure as that in *L. glaucophylla*, but of which the upper flowers have the calyx structure as in typical *L. mauritiana*.

Another species which may be not different is *L. rapensis* F. B. H. BROWN (Bull. Bern. P. Bish. Mus. 130, 1935, 22, f. 32), described from Rapa I. in Polynesia; it differs by an acute leaf apex, short pedicels, 4-merous flowers, and small size; this also may be a local form. If so it would extend the distribution considerably. I have not seen the material.

**8. *Lysimachia decurrens* FORST. f. Prod. (1786) 12; LAMK, Tabl. Encycl. Bot. 1 (1793) 441; DUBY in DC. Prod. 8 (1844) 67; SEEM. Fl. Vit. (1866) 147; F. v. M. Contr. Phytogr. New Hebr. (1874) repr. p. 17; BRITTEN in Forbes, Wand. (1885) 509; HEMSL. J. Linn. Soc. Bot. 26 (1889) 51; MATS. Tokyo Bot. Mag. 14 (1900) 71, incl. var. *recurvata*; KNUTH, Pfl. R. Heft 22 (1905) 296; MERR. Philip. J. Sc. 7 (1912) Bot. 93; KOORD. Exk. Fl. Java 3 (1912) 93; Fl. Tjib. 3 (1918) 31; MERR. En. Philip. 3 (1923) 274; Lingn. Sc. J. 5 (1927) 144; HAND-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 114; MERR. Sunyatsenia 1 (1930) 762; BONATI, Fl. Gén. I.-C. 3 (1930) 762; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 238; MASAM. Fl. Stud. Isl. Yakush. (1934) 358; FLETCHER Fl. Siam. En. 2 (1938) 323; HAND-MAZZ. Acta Hort. Gothob. 13 (1939) 222; HARA, En. Sperm. Jap. 1 (1948) 86; BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 4; MAKINO, Ill. Fl. Jap. (1954) 231, incl. var. *acroadenia*; INGRAM, Baileya 8 (1960) 97.—*Cerium spicatum* LOUR. Fl. Coch. 1 (1790) 136; ed. Willd. (1793) 168, cf. MERR. Comm. Lour. (1935) 300.—*L. javanica* BL. Bijdr. 14 (1826) 736; DUBY in DC. Prod. 8 (1844) 62; ZOLL. Syst. Verz. 3 (1855) 59; MIQ. Fl. Ind. Bat. 2 (1859) 1002; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 16, t. 5; HOOK. f. Fl. Br. Ind. 3 (1882) 502.—*Bernadina parviflora* BAUDO, Ann. Sc. Nat. 11, 20, Bot (1843) 349, nom. illeg., based on *L. multiflora*.—*L. multiflora* WALL. [Cat. (1828) n. 1487, nomen] ex DUBY in DC. Prod. 8 (1844) 63;**

KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 14, t. 4; MAXIM. Bull. Ac. St. Pétersb. 12 (1868) 70; KURZ, J. As. Soc. Beng. 46, ii (1877) 219.—*L. sinica* MIQ. J. Bot. Néerl. 1 (1861) 110; HEMSL. J. Linn. Soc. Bot. 26 (1889) 57.—*L. consobrina* HANCE, Ann. Sc. Nat. V, 5 (1866) 224.—*L. keiskeana* MIQ. Ann. Mus. Bot. Lugd. Bat. 3 (1867) 120; HAND-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 113.—*L. acroadenia* MAXIM. Bull. Ac. St. Pétersb. 12 (1868) 70; FRANCH. & SAV. En. Pl. Jap. 1 (1875) 302; *ibid.* 2 (1879) 431; KNUTH, Pfl. R. Heft 22 (1905) 296, f. 61B; PETITMENGIN, Bull. Herb. Boiss. 7 (1907) 534; BONATI, Fl. Gén. I.-C. 3 (1930) 763; HARA, En. Sperm. Jap. 1 (1948) 84.—*L. recurvata* (MATS.) MASAM. J. Soc. Trop. Agr. Taiwan 4 (1932) 302.

Erect, robust, little branched herb, up to 50 cm; stem angular, provided with lenticels. *Leaves* usually opposite, sometimes subopposite or alternate, membranous, glabrous, narrowly ovate-lanceolate, 3-7 by 1-2½ cm, subacuminate, acute at both ends, decurrent along the stem; upper surface with point-like glands often confined to the margin; midrib prominent beneath; nerves slightly visible, veins obscure. *Flowers* in 1-5 terminal, sometimes leafy racemes 10-25 cm long. *Pedicels* obliquely, erect or recurved, provided with stalked glands, during anthesis 2-7 mm, lengthening to 12-18 mm. The upper flowers are sterile and monstrous. *Bracts* linear. *Calyx* lobes lanceolate, acuminate, 3-4 mm, inside with longitudinal black glands. *Corolla* white or purple, as long as the calyx or smaller, deeply cleft; lobes oblong, rounded, with prominent oblong glands; inside with scattered granular red glands. *Stamens* free from each other, 4-5 mm; filaments with small sessile glands; anthers 1 mm, rounded, versatile. *Style* 5 mm, persistent. *Capsule* longer than calyx, bursting irregularly.

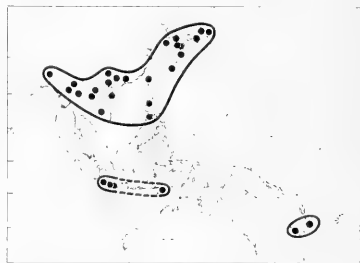


Fig. 10. Distribution of *Lysimachia decurrens* FORST. f.

Distr. Eastern Himalaya, Burma, Siam, Indo-China, Southern China, Japan, and Formosa, through Malaysia to New Hebrides, and New Caledonia. In *Malaysia*: Philippines (Luzon: Benguet), West Java (from Tugu to Tjikuraji), and Lesser Sunda Is. (Timor). Fig. 10.

Ecol. In pastures and fields, along roadsides

and trails, in brushwood and hedges, 1000–1500 m (in the Himalayas to 2000 m).

Notes. HANDEL-MAZZETTI, *l.c.*, had *L. acroadenia* MAXIM. as a synonym under *L. keiskeana* MIO., which he kept as a separate species. Because it was not included in his key, it is difficult to verify his reason for doing so. I deduce from the place he gave for *L. keiskeana* in relation to that of *L. decurrens* that he assumed *L. keiskeana* MIO. to have smaller flowers and stamens which do not exceed the corolla. I examined MIQUEL's type but could find no difference in corolla between it and that of *L. decurrens*. In many flowers the stamens exceed the corolla but this character is variable in *L. decurrens* in Java. The leaves of MIQUEL's type are not glandular-punctate but this also varies in *L. decurrens*. I have consequently reduced *L. keiskeana* to *L. decurrens*.

THENEN (Zur Phylog. der Primul. Blüte 1911, 99) stated that *L. acroadenia* MAXIM. has branched vascular bundles in the calyx which do not occur in *L. decurrens*, but I cannot see how this would warrant a separate taxonomic status.

After examining a topotype of *L. recurvata* MASAM. from Formosa (TANAKA 13596) I agree to reduce it to *L. decurrens*. Recurved pedicels are not rare in that species, even within one raceme one can find drooping and ascending ones.

#### Excluded

*Lysimachia lobelioides* WALL. in Roxb. Fl. Ind. ed. Carey & Wall. 2 (1824) 29; DUBY in DC. Prod. 8 (1844) 61; LINDL. Bot. Reg. (1842) t. 6; KLATT, Abh. Naturw. Ver. Hamb. 4, 4 (1866) 16, t. 2; HOOK. f. Fl. Br. Ind. 3 (1882) 502 was mentioned for Java by HOOKER f. but I have seen no specimen to justify this record. Dr. HUBBARD kindly informed us that there are in the Kew Herbarium no specimens to support the record from Java.

*Lysimachia obovata* HAM. ex HOOK. f. Fl. Br. Ind. 3 (1882) 502 was mentioned for Java but I have seen no specimen justifying this record. Dr. HUBBARD kindly informed us that there are in the Kew Herbarium no specimens to support the record from Java.

### 3. PRIMULA

TOURN. ex LINNÉ, Gen. Pl. ed. 5 (1754) 70; Sp. Pl. ed. 1 (1753) 142; DUBY in DC. Prod. 8 (1844) 34; PAX, Bot. Jahrb. 10 (1888) 75–241; O.K. Rev. Gen. Pl. 2 (1891) 400; PAX, Pfl. R. Heft 22 (1905) 17; BALF. f. J. R. Hort. Soc. 39 (1913) 128–183; SMITH & FORREST, Not. R. Bot. Gard. Edinb. 16 (1928) 1–50; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 168.—*Androsace* TOURN. ex LINNÉ, Gen. Pl. ed. 5 (1754) 179; Sp. Pl. (1753) 141; PAX, Pfl. R. Heft 22 (1905) 172.—*Cankrienia* DE VRIESE, Jaarb. Kon. Ned. Mij. Tuinb. (1850) 29; ZOLL. Syst. Verz. (1855) 59.—Fig. 11–12, 14–15.

Erect, sometimes robust, perennial, rarely annual herbs, up to c. 1 m high. *Leaves* radical rosulate. *Flowers* 5-merous in 1 or more superposed whorls or umbels, seldom solitary, sometimes dimorphous. *calyx* dentate or deeply cleft. *Corolla* with non-recurved lobes. *Stamens* inserted in the tube; filaments short. *Ovary* globose; style variable in length, stigma capitate. *Capsule* shortly 5–10-valved. *Seeds* numerous.

Distr. About 535 *ssp.* throughout the temperate zone of the northern hemisphere where the largest number of species and sections is found in the Sino-Himalayan region; secondary centres are found elsewhere in Asia and Europe; no section is endemic in North America.

Ecol. The thermo-ecology of the genus is cool to frigid; though at higher latitudes occurring in the lowland, the richest development is in the mountains, in shaded or open, moist or dry places.

Only in Malaysia and America the genus has extended its area over the mountains across the equatorial belt, viz in Sumatra and Java by *P. prolifera* WALL., in New Guinea by *P. umbellata* (LOUR.) BENTV., while in the Americas races of *P. farinosa* L. are found in Southern Chile and the Falklands (*cf.* BAKER, Am. Natur. 93, 1959, 225–272), for some obscure reason widely disjunct from the North American part of the population. It is significant that these southern-hemisphere populations of *P. prolifera* and of *P. farinosa* are both homostylous and have an inbreeding system which is obviously due to genetic recombination; this gives apparently a better adaptation for progressive dispersal and establishment to the marginal part of the populations.

Taxon. PAX (Bot. Jahrb. 10, 1888, 76) subdivided *Primula sens. str.* into c. 20 sections, W. W. SMITH & FORREST (1928) had even 32 sections and often of different circumscription. It is not clear whether for the nomenclature typification was always strictly followed, for example *sect. Candelabra* BALF. f. 1913 contained amongst others *P. prolifera* and *P. imperialis*, here accepted to be conspecific. In 1905 PAX had already included these species in his *sect. Cankrienia* (DE VRIESE) PAX, but still earlier, in 1889, PAX (*l.c.* p. 217 and *in clav.* p. 162) had included them in *sect. Proliferae* PAX based on *P. prolifera*



Fig. 11. *Primula prolifera* WALL. Group of plants along a brooklet on the Jang Plateau, East Java, c. 2000 m altitude, in pyrogenous mountain savannah of *Casuarina junghuhniana* MIQ., in front of a stool of *Pteris wallichiana* AGARDH (1938).

WALL. As taxa exert priority in their own rank, it is clear that for this group *sect. Proliferae* PAX is the correct name.

*Generic delimitation.* HOOKER *f.* (in B. & H. Gen. Pl. 2, 1876, 631) could find no good generic differences between *Primula* and *Androsace* (strong rhizome and vividly coloured flowers in *Primula*); at least five species are intermediate in these two respects.

FRANCHET (Bull. Soc. Bot. Fr. 33, 1886, 63) has distinctly shown that the single systematic difference between *Primula* and *Androsace*, viz a long or short tube of the corolla, is untenable because of many intermediate Asiatic species showing this character in degree. PAX (Bot. Jahrb. 10, 1888, 133-136) agrees with the presence of not a few intermediary links, but he avoided to take the consequence and merge the genera, in arguing that *Androsace* would then have to be the accepted generic name – an erroneous assumption because only based on page priority – and furthermore because he assumed that the two genera were proportionally young and therefore still connected by transitions. O. KUNTZE (Rev. Gen. Pl. 2, 1891, 399) rightly observed that the later assumption is a mere hypothesis, "ein Wechsel auf die Zukunft, der vielleicht erst nach Jahrmillionen fällig wird, den ich deshalb als vorsichtiger Mann nicht in Zahlung nehmen kann...". In phytozoology it is of course inadmissible to enter such mere theoretical considerations in practical research work. This is an illustration of a case in which two genera appeared well distinct in early time when only few species were known, but which appeared later to grade into one another when the centre of species development was gradually explored. From the standpoint of scientific taxonomy there is of course no sense in retaining such a fictitious distinction; but genera prove to have often a long life mostly due to the uneasiness of botanists connected with the disappearance of a familiar generic name.

*Cytotaxonomy.* BRUNN (Symb. Bot. Ups. 1, 1932, 1-239) made very extensive cytotaxonomical research of *Primula*. He concluded, that the species could be arranged into natural groups possessing the same karyotype and that this division would coincide with that of W. W. SMITH & FORREST (Not. R. Bot. Gard. Edinb. 16, 1928, 76), based on morphological criteria. Although the species within a section would rarely have quite identical nuclei, in general the size and shape of the chromosomes are rather stable.

These two characters together with the occurrence of constrictions he used for cytotaxonomical demarcation.

It is remarkable that in cases where the systematics are rather difficult, there are also difficulties in the distinction of the karyotypes.

For cytological evolution in *Primula* polyploidisation, accompanied by aneuploidisation, has presumably been important for speciation, but the most important has been the regrouping of chromosome parts (translocations).

*Genetics.* One of the most interesting problems of this genus is that of heterostyly, causing the flower dimorphism. Of the same species there are plants bearing flowers with a short style and highly inserted anthers (thrum type), and other individuals with a reverse situation (pin type). Thrum type styles have to be pollinated with pollen from low-inserted stamens and the reverse. It will be clear that this is genetically an outbreeding mechanism.

Already in the early days of the rediscovery of MENDEL'S laws, BATESON and GREGORY (1905) found in *Primula sinensis* LINDL. (= *P. praenitens* KER-GAWL.) heterostyly was controlled by a single pair of alleles. The dominant one giving thrum, the recessive one pin type. The thrum type corresponded normally with a heterozygous genotype; the pin type with the homozygous recessive one. In fact the legitimate crossings thrum  $\times$  pin and reciprocally were back-crossings (like sex-mechanism of fly, mouse and man), producing constantly the same genotypes.

ERNST (Arch. Klaus. Stift. 1, 1925, 13-62) detected in *P. 'hortensis'* and *P. hirsuta* ALL. the existence of homostylous "Sippen". Crossing in all directions were possible: so homost.,  $\times$  thrum and reciprocally and homost.  $\times$  pin and reciprocally. The results of these crossings he interpreted by accepting two separate, but narrowly coupled pairs of alleles. *A*—*a* controlling style length, *B*—*b* determining the place of insertion of the anthers. *A* would give a short style, *a* a long one, *B* high-inserted anthers, *b* low-inserted ones. *AB* phenotype was thrum, *ab* pin. The normal crossing is *AB/ab*  $\times$  *ab/ab*, in fact a scheme not much different from that of BATESON and GREGORY. The phenotype *Ab* corresponds with a short homostyle, *aB* with a long one.

ERNST (Z. Vererb. 71, 1936, 156-230) recognized later on differences in size of pollen grains, again controlled genetically independently of the other characters. These he explained not by means of separate genes, but erroneously by multiple alleles. According to the fashion of this time ERNST (Z. Vererb. 88, 1957, 517-599) postulated that all characters connected with heterostyly are located within one gene, which is subdivided into several subgenes.

Because of the absence of any position effect and besides the independent dominance of the factors, it is my contention that they must be separate narrowly coupled genes. According to MATHER (Evolution 4, 1950, 340-352) probably the genesis of this coupling has been promoted by natural selection. In case of free recombination namely the advantageous heterostyly will easily break down and give rise to homostyles.

According to LEWIS (Biol. Rev. 24, 1949, 472-496) the size of the stigmatic papillae is also a character tied up with heterostyly. But the essential thing of heterostyly is the selfincompatibility. Therefore he

postulated (sub)genes for incompatibility reactions of pollen tube and style. Nevertheless the situation is not so clear as LEWIS suggested. The results of ERNST's laborious experiments do not fit entirely with LEWIS's hypothesis. Possibly there exists a biochemical interaction between the four 'morphological genes' with relation to the incompatibility.

MATHER demonstrated convincingly the great pleiotropical effects of some mutants on heterostyly. Furthermore he found some influence of the genetical background ('polygenic systems' in his terminology) on the style-length *etc.* His finding that a heterozygous background produced a greater variation seems important from a general genetic point of view.

According to A. ERNST (Arch. Klaus Stift. 28, 1953, 1-159) and H. G. BAKER (Recent Advances in Botany, Toronto, 1961, 882) there might exist a correlation between polyploidy and homostyly, as found for instance in *P. farinosa* L. *sens. lat.* The latter author has two explanations for this phenomenon. First: if a plant has a tendency to produce unreduced gametes, it will only produce polyploids if it is self-compatible. Second: polyploidy would enhance crossing-over and induce in this way a breakdown of heterostyly. Without experimental evidence it will be difficult to judge whether we are dealing here with polyploidy as cause or as consequence of homostyly.

## KEY TO THE SPECIES

1. Robust. Flowers yellow in 1-6 superposed whorls. Corolla tube well-developed. Leaves obovate or spatulate-oblong, 10-50 by 4-10 cm. 1. *P. prolifera*
1. Small. White flowers in 1 whorl or umbel. Corolla tube short. Leaves broad-elliptic, 1-1½ by ½ cm. 2. *P. umbellata*

**1. *Primula prolifera* WALL.** As. Res. 13 (1820) 372A, tab.; in Roxb. Fl. Ind. ed. Carey & Wall. 2 (1824) 18; DON, Prod. Fl. Nepal. (1825) 81; ZOLL. & MOR. Nat. & Geneesk. Arch. Ned. Ind. 2 (1845) 8; DUBY in DC. Prod. 8 (1844) 34; ZOLL. ex HASSK. Flora 30 (1847) 600; MIQ. Ann. Mus. Bot. Lugd. Bat. 4 (1868) 143; HOOK. f. Fl. Br. Ind. 3 (1882) 489; in Curtis, Bot. Mag. 110 (1884) t. 6732; PAX, Bot. Jahrb. 10 (1889) 217; in E. & P. Pfl. Fam. 4, 1 (1897) 107; BLANC & DECROCK, Bull. Herb. Boiss. 6 (1898) 686; WATT, J. R. Hort. Soc. 29 (1904) 315; PAX, Pfl. R. Heft 22 (1905) 124; BALF. f. J. R. Hort. Soc. 39 (1913) 166; CRAIB, J. R. Hort. Soc. 39 (1913) 189; SMITH & FORREST, Not. R. Bot. Gard. Edinb. 16 (1928) 17; STEEN, Trop. Natuur 19 (1930) 51, 77-84 f. 1-3; Bull. Jard. Bot. Btzg III, 13 (1934) 238; Tijd. Kon. Ned. Aardr. Gen. II, 55 (1938) 729, f. 1; ERNST, Ann. Jard. Bot. Btzg 49 (1940) 150; LOOGEN, Trop. Natuur 29 (1940) 151, fotogr.; *ibid.* 30 (1941) 81; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 168; STEEN, Proc. Kon. Ned. Ak. Wet. C. 64 (1961) 435-442.—*P. imperialis* JUNGH. Tijd. Nat. Gesch. & Phys. 7 (1840) 298; HASSK. Flora 25, Beibl. 1 (1842) 29; DUBY in DC. Prod. 8 (1844) 668; MIQ. Fl. Ind. Bat. 2 (1859) 1001; WALLACE, Mal. Arch. ed. 2 (1869) 114, f. 183; WIGMAN, Teysmannia 2 (1891) 450; HOOK. f. in Curtis, Bot. Mag. 118 (1892) t. 7217; KOORD. Teysmannia 10 (1899) 446, 453, 456; WATT, J. R. Hort. Soc. 19 (1904) 315; PAX, Pfl. R. Heft 22 (1905) 124, *incl. var. gracilis*; USTERI, Vierteljahrschr. Naturf. Ges. Zürich 50 (1905) 397, 465; VALETON, Jaarb. Dep. Landb. Ned. Ind. (1907) 1; ERNST, Vegetationsbilder 7 (1909) t. 3a; KOORD. in Jungb. Gedenkb. (1910) 231, f. 1-2; Exk. Fl. Java 3 (1912) 33, f. 33; BALF. f. J. R. Hort. Soc. 39 (1913) 166; KOORD. Fl. Tjib. 3 (1918) 28; COSTERUS & SMITH, Ann. Jard. Bot. Btzg 34 (1925) 47; SMITH & FORREST, Not. R. Bot. Gard. Edinb. 16 (1928) 17; BODEGOM, Trop. Natuur 21 (1932) 43-47; DOCTERS VAN LEEUWEN, Proc. Kon. Ned. Ak. Wet. II, 31 (1933)



Fig. 12. *Primula prolifera* WALL. on Mt Sumbing, along brook in forest, c. 2500 m altitude, immature specimen, background leaflets of *Thalictrum javanicum* BL. (LOOGEN, 1940).

215–218; ERNST, Ann. Jard. Bot. Bltzg 49 (1940) 99–161; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 153; BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 1.—*P. kuhlii* BL. Jaarb. Kon. Ned. Mij. Tuinb. (1844) 70.—*Cankrienia chrysantha* DE VRIESE, Jaarb. Kon. Ned. Mij. Tuinb. (1850) 55 & tab.; Fl. des Serres 7 (1851) 53 & f. p. 58; ZOLL. Syst. Verz. 3 (1855) 59.—*Cankrienia farinosa* ZOLL. Syst. Verz. 3 (1855) 59.—*P. smithiana* CRAIB, J. R. Hort. Soc. 39 (1913) 190; BALF. f. l.c. 166, nomen; FARRER, Gard. Chron. III, 68 (1920) 20; SMITH & FORREST, Not. R. Bot. Gard. Edinb. 16 (1928) 17; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 175; LOWNDES, Quart. Bull. Alp. Gard. Soc. 12 (1944) 35, t. 29.—*P. khasiana* BALF. f. & W. W. SMITH, Not. R. Bot. Gard. Edinb. 9 (1916) 176; SMITH & FORREST, *ibid.* 16 (1928) 17; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 157.—*P. helodoxa* BALF. f. Not. R. Bot. Gard. Edinb. 9 (1916) 171; FORR. J. R. Hort. Soc. 41 (1915) 201, nomen; The Garden 80 (1916) 367 & 2 f.; Gard. Chron. III, 59 (1916) 291, f. 123, 124; KINGDON WARD, J. R. Hort. Soc. 49 (1924) 152; SMITH & FORREST, Not. R. Bot. Gard. Edinb. 16 (1928) 17; DARWELL, Gard. Chron. III, 84 (1928) 473; STAFF in Curtis, Bot. Mag. 147 (1938) t. 8899; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 150.—*P. sumatrana* MERR. Not. Nat. Ac. Nat. Sc. Philad. n. 47 (1940) 6; SMITH & FLETCHER, Trans. Bot. Soc. Edinb. 33 (1941) 150.—**Fig. 11—12, 14.**

Robust perennial herb, 25–100 cm. Leaves lanceolate-obovate, apex rounded, base acute, decurrent along the petiole, midrib passing into a thick petiole, 10–50 by 4–10 cm, margin regular-dentate; nervation more or less reticulate. Flowers in 1–7 whorls, whether or not pendulous, pedicels 2–4 cm. Bracts linear with whether or not foliaceous broadened apex. Calyx 4–8 mm, with shorter or longer toothed teeth sometimes short or long-acuminate, whether or not yellow waxy. Corolla pale, bright or golden yellow; tube 7–15 mm, limb 10–20 mm  $\phi$ . Anthers inserted halfway the corolla tube or near the limb, in Mal. specimens high-inserted (except on Mt Jang) and homostylous. Style 4–14 mm half as long as the tube or of

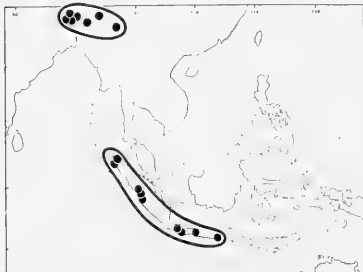


Fig. 13. Distribution of *Primula prolifera* WALL.

the same length. Capsule globose, shortly 5-valved, erect. Seeds  $\infty$ , angular, brown.

Distr. Sino-Himalaya (Assam; Khasya and Chumbi Hills; Upper Burma; S. Yunnan); in Malaysia; Sumatra (Gajo Lands, e.g. Mts Losir and Kemiri; West Coast Res.: Mts Singalang, Kerintji, and Masurai) and Java (Mts Pangrango, Papandajan, Sumbing, and Jang). Fig. 13.

Ecol. Rather open mossy forest, on damp soil along brooks and in exposed marshy places, 2000–3250 m (in the Himalayas even higher), only on mountains of which the summit reaches at least 2650 m. The small angular seeds which are produced in great quantity can be dispersed by rain-wash and by streams, as has been observed on Mts Pangrango and Papandajan in Java.

In JUNGHUHN's time this beautiful plant was on the summit zone of the extinct forest-clad

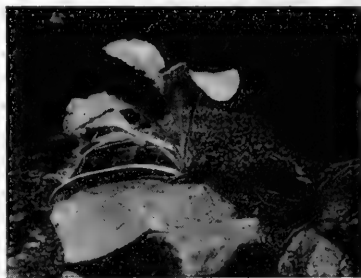


Fig. 14. Seedling of *Primula prolifera* WALL. from seed washed down along the brook in the dense forest at c. 2200 m near the Volcanological Observatory on Mt Papandajan. Specimens flower profusely at 2500 m on Tegal Alun<sup>2</sup>, but no flowering is ever observed in the present shaded locality.

Pangrango cone confined between 2900 and 3000 m; in the course of time it has succeeded to descend along the trail to the saddle between Gedeh and Pangrango at c. 2500 m and has been grown successfully near the shelter Lebak-saät at 2450 m. Attempts to introduce it on the adjacent Gedeh Peak, either by seed or plants, by TEYSMANN, DOCTERS VAN LEEUWEN, and VAN STEENIS have failed, obviously through the unsuitable soil conditions, not through seed inaccessibility.

Vern. *Babakuan, kembang konèng, S, sawi utan, Gajo M.*

Notes. HOOKER f. (1882) reduced *P. imperialis* JUNGH. to *P. prolifera*, but later he changed his opinion when he observed some specimens from West Java and the Khasya Hills growing side by side (1892); the first were more robust, had larger leaves with thicker texture, broader midrib, closer reticulate venation and bullate parenchyma, and deeper tinged flowers. These criteria are, however, derived from a few specimens, and are besides



vague and merely quantitative. They do not hold even for the Malaysian area as the size of the leaves and plants and the colour of the flower varies considerably. This has amply been demonstrated by VAN STEENIS (1930) who could show that in Java each population had its own facies. Specimens from North Sumatra and East Java have the closest similarity with those of the Khasya Hills. Specimens from the Papandajan are transitional between those of Mt Gedeh and Mt Jang in length of calyx, flower colour, amount of yellow wax on calyx, etc. It is precisely on such minor characters that the Scotch botanists have recognized further segregates of the *prolifera* complex, by describing *P. khasiana* BALF. f., *P. helodoxa* BALF. f., and *P. smithiana* CRAIB. It must of course be kept in mind that the range of a mountain plant is broken up into separate partial populations on separated mountains, and that in cultivating a few plants from each population they will differ in details, and will never be 'identical'. From this it does not follow, however, that such non-identical plants are also non-conspecific. As a matter of fact ERNST kept all Malaysian specimens apart from the continental Asian ones by the homostyly of the former, notwithstanding their variability in these details.

*P. sumatrana* was placed by MERRILL in *sect. Callianthae* PAX, but SMITH & FLETCHER classified it in *sect. Candelabra* (= *Proliferae* PAX) and suggested already its affinity with *P. imperialis*.

Genetics. The only obvious difference between this *Primula* in Malaysia and India is the homostyly of the first one. Under the genus I have already discussed the genetics of heterostyly. If we restrict a further discussion to the two characters style and height of insertion of the anthers a rare crossing-over between *A* and *B* in a thrum type will give the gametes *Ab* and *aB*. A combination of these gametes with *ab* gametes of the pin type will give the genotype I *Ab|ab* (short homostyle) and II *aB|ab* (long homostyle).

As the homozygous homostyles will perpetuate and the heterozygous homostyles will also yield partly homozygous homostyles the number of homostyles will steadily increase and after a few tens of generations consist entirely of homostylous individuals.

In the centre of the area the majority of the individuals are heterostylous; this causes heterozygosity which, as generally accepted, will be advantageous because of the greater fitness to withstand fluctuating environmental conditions. The homostylous condition is here disadvantageous.

In marginal populations the gene pool is always depauperated, hence the adaptive value of the homostylous individuals will be greater because of more abundant seed production which will lead to more rapid expansion of the range, as postulated by BAKER (Am. Natur. 93, 1959, 255-272). I assume this reasoning to hold for *P. prolifera*. Unfortunately ERNST (Arch. J. Klaus Stift. 26, 1951, 1-96; Genetica 27, 1955, 391-448) did not succeed in crossing the 'Javanese' *P. prolifera* with *P. smithiana*, but he also did not succeed in

intraspecific crossings of *P. smithiana*.

ERNST considered homostyly as a primary character of *P. 'imperialis'* but in my opinion its derivation from the continental-Asiatic population of *P. prolifera* would point to its secondary nature.

**2. *Primula umbellata* (LOUR.) BENTV. *comb. nov.***—*Drosera umbellata* LOUR. Fl. Coch. ed. 1 (1790) 186; ed. Willd. (1793) 232; PLANCH. Ann. Sc. Nat. III, 9, Bot. (1848) 304.—*Androsace saxifragifolia* BUNGE, Mém. Ac. St. Pétersb. 2 (1835) 127; DUBY in DC. Prod. 8 (1844) 53; HANCE, J. Bot. 20 (1882) 6; HOOK. f. Fl. Br. Ind. 3 (1882) 496; FORBES & HEMSL. J. Linn. Soc. Bot. 26 (1889) 45; KNUTH, Pfl. R. Heft 22 (1905) 179; MATS. & HAYATA, J. Coll. Sc. Univ. Tokyo 22 (1906) 221; GAMBLE, Fl. Madras 4 (1921) 745; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 15 (1927) 271; BONATI, Fl. Gén. I.-C. 3 (1930) 757; HAND.-MAZZ. Symb. Sin. 7 (1936) 753.—*P. saxifragifolia* O. K. Rev. Gen. Pl. 2 (1891) 400.—*P. minutiflora* FORREST, Not. R. Bot. Gard. Edinb. 4 (1908) 219, t. 29A.—*Androsace umbellata* MERR. Philip. J. Sc. 15 (1919) 237; En. Philip. 3 (1923) 274; HAND.-MAZZ. Not. R. Bot. Gard. Edinb. 16 (1928) 162; SASAKI, Cat. Govt. Herb. (1930) 401; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 237; MERR. Comm. Lour. (1935) 300; NAKAI, Rep. Exp. Manchouko sect. IV, 4 (1936) 38; Bull. Nat.

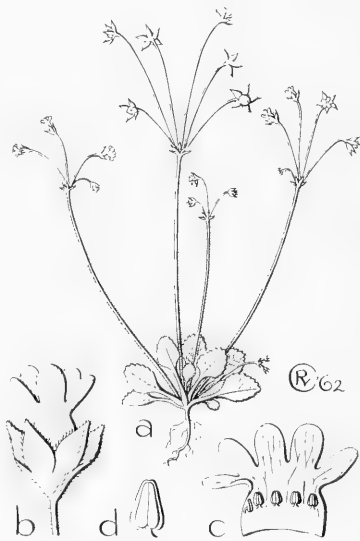


Fig. 15. *Primula umbellata* (LOUR.) BENTV. a. Habit,  $\times 2/3$ , b. flower,  $\times 4$ , c. corolla laid open,  $\times 4$ , d. stamen,  $\times 12$ , (VAN ROYEN, 4443).

Sc. Mus. Tokyo 31 (1952) 89; STEEN. Nova Guinea n.s. 6 (1955) 279; STEWARD, Pl. Lower Yangtze (1958) 299.—Fig. 15.

Slender erect herb, 4–12 cm. *Leaves* hairy, broad-elliptic, decurrent along the petiole, truncate at the base, 8–15 by 4–10 mm, margin-crenate, ciliate; midrib slightly prominent at the underside; nerves and veins indistinct; petiole 5–15 mm. *Umbels* 2–6-flowered, peduncle 3–9 cm, hairy; pedicels 1–4 cm, hairy. Bracts 1 mm linear. *Flowers* 2–5 mm long. *Calyx* cleft more than half-way, campanulate, lobes oblanceolate acute, hairy outside and on the margin. *Corolla* white, slightly exceeding the calyx; lobes oblong, rounded at the apex. *Stamens* not surpassing the style; filaments longer than the anthers, to the middle adnate with corolla. *Capsule* as high as or higher than calyx, shallowly 5-valved or irregularly bursting.

*Distr.* In India, Pakistan, and Burma widely distributed (from the Punjab to Manipur), northern Indo-China, China (Szechuan, Yunnan, Kweichow, Kwangtung, Manchuria), Korea, Japan, Ryukyu Is., and Formosa; in *Malaysia*: Philippines (N. Luzon: Mountain Prov.) and East New Guinea. Fig. 16.

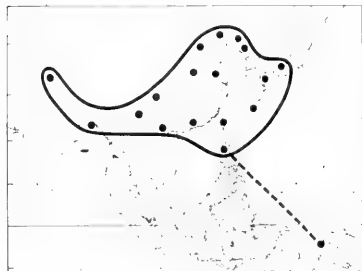


Fig. 16. Distribution of *Primula umbellata* (LOUR.) BENTV.

*Ecol.* Shaded moist places in mountain forest, 1300–1500 m.

*Notes.* This species has, according to KNUTH, sometimes been confused with *Androsace rotundifolia* HARDW. which is well characterized by its leafy, crenate bracts.

Already PLANCHON (1848) suggested that *Drosera umbellata* LOUR. would be an *Androsace* and MERRILL (1919, 1935) was convinced of this reduction, basing himself in the interpretation of LOUREIRO's very meagre description on his method of 'elimination'; in the flora of Kwangtung, from where LOUREIRO obtained his material, no other plant fits the combination of characters mentioned by LOUREIRO and, besides, *Androsace saxifragifolia* is there a common plant. HANDEL-MAZZETTI (1936) wanted to have more certainty before accepting MERRILL's conclusion, but I assume MERRILL is right.

#### Cultivated species

*Primula malacoides* FRANCH.; cf. BACKER, Bekn. Fl. Java (em. ed.) 8 (1949) fam. 180, p. 2: calyx not inflated, cleft halfway, outside white-waxy, lobes 5, recurved. A Chinese species cultivated as an ornamental in the mountains.

*Primula obconica* HANCE; cf. BACKER, *l.c.*: calyx not inflated, cleft much less than half-way, without wax, lobes 5, short and broad, erect. A Tibetan species, cultivated as an ornamental in the mountains.

*Primula praenitens* KER GAWL.; syn. *P. sinensis* LINDL. 1821, non LOUR. 1790; cf. BACKER, *l.c.*: calyx inflated, at apex with 14 or more erect laciniae, without wax. A Chinese species occasionally cultivated as an ornamental in the mountains of Java.

*Primula veris* L. var. *elatior* L. This species is cultivated in the Mountain Garden of Tjibodas, W. Java, where it does not flower at 1450 m. Specimens planted near Lebak Saät, at c. 2450 m, flower abundantly. Cf. STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 337.

#### Excluded

*Samolus valerandi* LINNÉ, Sp. Pl. (1753) 243; MIQ. Fl. Ind. Bat. 2 (1859) 1004, though almost ubiquitous, has as yet not been found in Malaysia.

## SIMAROUBACEAE (H. P. Nootboom, Leyden)

Trees or shrubs, in Mal. evergreen or almost so, usually containing very bitter substances. Twigs pithy. Hairs mostly simple and 1-cellular, sometimes glandular-capitate. *Leaves* (in Mal.) spirally arranged, simple or 1-pinnate, often articulated, often provided beneath (rarely also above) with pitted, concave, or flattish glands (in Mal. in *Ailanthus*, *Brucea*, *Samadera*, and *Soulamea*). Stipules usually absent, (in Mal.) present in *Irvingia* and *Picrasma*. *Inflorescences* usually compound, axillary, rarely terminal; plants monoecious, rarely dioecious. *Flowers* usually small, actinomorphic, uni- or bisexual, or functionally unisexual. *Sepals* 3-5, almost always partly connate, valvate to slightly imbricate. *Petals* 3-5, free, imbricate or valvate, rarely absent (in extra-Mal.), or united into a tube (extra-Mal.). *Stamens* inserted at the base of the disk, isomerous or dimerous, rarely numerous (extra-Mal.), mostly obdiplostemonous, rarely the stamens of the outer whorl doubled, not rarely with a scale at the inner base; anthers 2-celled, opening lengthwise, introrse to latrorse, versatile. Disk intrastaminal, often gynophorous, sometimes rather inconspicuous, at least when dry. *Ovary* often 2-5-lobed, 1-5-celled, or with free carpels; styles 1-5. *Ovules* 1-2 (in Mal. 2 only in *Suriana*), axile, anatropous (in *Harrisonia* and *Suriana* amphitropous). *Fruit(s)* usually indehiscent, often drupaceous, sometimes a samara, some carpels sometimes aborted. *Seed*: endosperm 0 or scant; cotyledons planoconvex; embryo straight or curved; no aril.

*Distribution*. About 30 genera, with c. 200 spp. with the main centre in tropical America, and a second centre in tropical West Africa. With the exception of *Picrasma quassioides* (D. DON) BENN., ranging as far north as North Japan and Korea, and of *Ailanthus altissima* (MILL.) SWINGLE, which is endemic in subtropical to temperate China, the species of this family are native in the tropics. The monotypic genus *Suriana* has the widest range and is almost pantropical along sandy beach, being absent only on the west coast of Africa.

A remarkable distribution is exhibited by *Soulamea*, with 6 endemic species in New Caledonia, one in Fiji, one widely ranging sandy beach species from Polynesia westwards to Borneo and one endemic species in Mahé I. (Seychelles).

Another remarkable type of distribution is displayed by *Picrasma*, which is disjunct tropical transpa-cific.

*Ecology*. Most of the Malaysian *Simaroubaceae* are inhabitants of the lowland forest; only *Brucea mollis* WALL. ex KURZ is recorded as high as 1800 m (in the Philippines)

Climatically defined areas in Malaysia are occupied by both species of *Harrisonia* and to a less degree by *Ailanthus triphyssa*, all of which distinctly avoid the everwet forest belt of West Malaysia (in Sumatra, Malaya, Borneo, and West Java), and prefer regions subject to a dry monsoon. Fig. 10, 11, and 20.

*Brucea*, *Picrasma*, and *Ailanthus integrifolia* behave rather indifferent to climate. As to soil *Irvingia* and *Samadera* are indifferent but *Eurycoma* has a distinct preference for acid, leached sandy soils and is classified as silicolous. *Quassia* § *Samadera* shows preference for temporarily inundated places.

*Suriana* and *Soulamea* both belong to the Barringtonia formation and obviously prefer calcareous or rocky beaches.

*Pollination*. Is probably performed by insects, as the flowers are often reported to be fragrant. They are either unisexual or functionally so, or bisexual.

*Dispersal*. Unfortunately little is known on this subject. The fruits of *Suriana maritima* and *Soulamea amara* are certainly dispersed by seawater and this seems to have been very effective. RIDLEY (Disp. 1930, 264) assumes dispersal by fresh-water for *Quassia* § *Samadera* which has large fruits and is frequent in alluvial forests and swamp forest. In all cases buoyancy is gained by the seed not entirely filling the fruit and leaving a cavity. The thin-winged samaras of *Ailanthus* will be wind-dispersed over small distances. See further under the genera.

*Phytochemistry*. All *Simaroubaceae* (with the exception of the *Irvingioideae* and *Surianoideae*) contain bitter principles which seem to be closely related to each other. Unfortunately their chemical structure has not yet been fully elucidated. The best known bitter principle of the family is quassin, which has been isolated from the woods and barks of *Quassia amara* AUBL. and *Aeschron excelsa* (Sw.) O. KUNTZE (*Picrasma*). According to recent investigations of ROBERTSON and collaborators (J. Chem. Soc.

1950, 3431; 1954, 3672, 4238) quassin is a mixture of two closely related compounds which were called quassin and neo-quassin. Both bitter principles contain a carbon skeleton built up from 20 C-atoms and belong probably to the diterpenoid compounds. Quassin,  $C_{20}H_{32}O_4(OCH_3)_2$  has the following functional groups: 2 methoxy, a lactone, a tertiary hydroxyl and a carbonyl group. Another bitter principle of the family was isolated from the seeds of *Simarouba glauca* (E. A. HAM *et al.*, J. Am. Chem. Soc. 76, 1954, 6066) and termed glaucarubin. Glaucarubin like quassin seems to be a derivative of a  $C_{20}$ -compound; it is, however, an ester of  $\alpha$ -methyl- $\alpha$ -hydroxybutyric acid with the diterpenoid hexahydroxylactone, glaucarubinol. A third bitter principle examined recently is cedrin from the seeds of *Simarouba cedron* PLANCHON. According to KREBS and RÜBER (Arzneimittelforschung 10, 1960, 500) cedrin is a sesquiterpenelactone of the santonin-type. The common features of all bitter principles of *Simaroubaceae* seem to be the lactonic function and the isoprenoid structure (sesquiterpenes or diterpenes). In this respect these constituents are related to the bitter principles of *Rutaceae* (limonin nomilin, obacunon); the latter, however, contain a carbon skeleton, which is related to triterpenes rather than to sesquiterpenes or diterpenes.

Many *Simaroubaceae* are used locally as therapeutic agents, especially as tonics, antidiarrhetics and anthelmintics. The bitter principles are believed to be the therapeutically most important constituents of the members of the family.

Another feature rather characteristic for the family is the common occurrence of small amounts of essential oils and large amounts of resins. These excretions are located in perimedullary resin canals said to be of schizolysigenous origin and in idioblasts occurring in the pith, phloem and cortex and in the leaves of some species. Practically nothing is known about the precise chemical nature of these essential oils and resins.

Mucilages too are wide spread in the family. They are deposited in mucilage cells in the epidermis of the leaves and in the subfamily of *Irvingioideae* in lysigenous cavities in the pith.

In *Simarouboideae* and *Irvingioideae* the epidermal cells of the leaves are heavily silicified as demonstrated by EDMAN (Svensk Bot. Tidskr. 30, 1936, 493).

There are some indications that tannins, coumarines and alkaloids are not rare in the family, but no detailed informations are available, besides the statement of ALTMAN (Bol. tecn. inst. agron. do Norte, Belém, no 31, 1956, 27) that the twigs of *Picrolemma pseudocoffea* DUROCK contain quinine. It would be very interesting to investigate *Simaroubaceae* for alkaloids and coumarines because the closely related *Rutaceae* are so rich in highly characteristic alkaloids and coumarines.

A very interesting chemical feature of the family is to be found in the composition of the fatty oils of the seeds. As a rule the seed fats of the members of a family are rather uniform in composition. In the family of *Simaroubaceae*, however, four different types of seed fats have been found up to now. The fats of the genus *Irvingia* are similar to those of *Lauraceae* and *Myristicaceae* by the high amounts of lauric and myristic acid. The genus *Picramnia* seems to be characterized by fats with the acetylenic tariric acid related by the position of unsaturation to petroselinic acid. The latter one (characteristic for the families *Umbelliferae* and *Araliaceae*) has been demonstrated to be a major fatty acid in the seed fat of *Picrasma quassioides* (D. DON) BENN. The rest of the seed oils of the family investigated (of the genera *Ailanthus*, *Brucea*, *Perriera*, *Samadera*, *Simarouba*) belong to the common and very wide spread type characterized by palmitic, oleic and linoleic acids as major fatty acids. There exist many striking phytochemical resemblances between *Rutaceae* and *Umbelliferae*. Therefore the occurrence of petroselinic acid and tariric acid as major fatty acids in the seeds of *Simaroubaceae* which seem to be closely related to *Rutaceae*, may be more than purely chemical convergence.—R. HEGNAUER.

Wood anatomy. DEN BERGER, Determinatietabel van Malesië, Veenman, Wageningen (1949) several pp., due to the occurrence of gum ducts, storied structure, the distribution of the wood parenchyma or the structure of the rays in the various genera (hand lens). HEIMSCH, Lilloa 8 (1942) 117; METCALFE & CHALK, Anat. Dic. 1 (1950) 321; MOLL & JANSSONIUS, Mikr. Holzes 2 (1908) 72; SAYA, Ann. Accad. ital. Sci. for. 4 (1955) 315; WEBBER, Am. J. Bot. 23 (1936) 577; Lilloa 6 (1941) 441. According to HEIMSCH (*l.c.* 176) the *Burseraceae* and *Anacardiaceae* are highly similar in wood structure and together are distinct from the *Rutaceae*, *Simaroubaceae*, *Meliaceae*, and *Sapindaceae*, and in general the *Simaroubaceae* simulate the *Rutaceae* rather closely (*l.c.* 177); because of the large variation in wood structure the members of the family most probably do not represent a natural group (*l.c.* 189, cf. also METCALFE & CHALK, *l.c.* 325). Note that the term septate fibre tracheids (WEBBER, *l.c.* HEIMSCH, *l.c.*) has to be replaced by septate (libriform wood) fibres (REINDERS, Trop. Woods 44, 1935, 30; Handl. Pflanzenanatomie ed. 4, 1951, 147; RECORD, Trop. Woods 78, 1944, 36). According to the definitions of SANIO-JANSSONIUS-REINDERS (REINDERS, *l.c.*) all species of this family possess libriform fibres and none of them fibre-tracheids.—C.A.R.-G.

Taxonomy. The *Simaroubaceae* are doubtless closest related with the *Rutaceae*, followed by the *Meliaceae* and *Burseraceae*, in that order. They lack homogeneity and there is no single character common to all genera and not present in the other families. The bitter substances are commonly assumed to be characteristic of the quassi family, but they are absent in the *Irvingioideae* (*Klaineodoxa* and *Irvingia*) and in the *Suriarioideae* (*Cadellia* and *Suriana*), and, besides, occur also in some *Rutaceae* and *Meliaceae* (*Trichilia*). Another very common character is the occurrence of concave or flattish but sunken spot-glands on the underside of the leaves which are also found in the meliaceous genus *Trichilia*. Both vegetatively and in sexual organs *Simaroubaceae* are diverse in character: leaves are simple or compound, stipules are present or absent, carpels are free or connate, stamens are isomerous or dimerous, and the

fruit structure displays a great variation. From this follows that delimitation against the allied families must remain arbitrary. In 1874 ENGLER (Abh. Naturf. Ges. Halle 13, 2, p. 140) considered the *Simaroubaceae* as a residue of the *Geraniales*: 'Wir sind genöthigt alle diejenigen Formen aus der Reihe der *Geraniales*, welche sich äusserlich an eine der verschiedenen *Rutaceen*-Gruppen anschliessen, in ihrem anatomischen Verhalten aber in der angegebenen Weise von denselben sich unterscheiden, zu den *Simaroubaceae* zu rechnen.'

It must be remembered, however, that *Simaroubaceae* sometimes (*Irvingia*) possess lysigenous cavities containing mucilage, METCALFE & CHALK (Anat. Dic. 1950, 317-326) recently concluded from the anatomy: 'There are very few characters common to the whole of the *Simaroubaceae*. This lack of homogeneity, which also occurs in the external morphological characters, seems to indicate that the family is unnatural, but consists of a number of groups which are themselves relatively uniform.' This diversity is also expressed in the large number of subfamilies. WEBBER (Am. J. Bot. 23, 1936, 577-587) concluded from the wood anatomy that the subfamilies *Kirkioideae*, *Irvingioideae*, *Picramnioideae*, and *Alvaradoideae* might rank as distinct families or as components of other families if these were suggested on other morphological grounds.

In phytochemical aspect it is interesting that EDMAN (Svensk Bot. Tidskr. 30, 1936, 493-514) found lack of homogeneity in the amount of silica in the leaves, a character which is generally characteristic for taxa of higher rank. In the *Simaroubaceae* it appears that the *Irvingioideae* and the subtr. *Simaroubinae* are the only groups which are highly silicified. He assumes that this is a primitive character; it is also found in the primitive members of the *Rutaceae* and *Burseraceae*; the ability to store a large amount of silica has obviously been lost by some groups of all three families.

Palynologically the family also shows a certain lack of homogeneity, according to ERDTMAN (Pollen Morph. & Tax. 1, 1952, 406-409), although a relation of *Irvingia* and *Suriana* with the true *Simaroubaceae* is probable.

The genera without bitter substances, viz *Irvingia* and *Suriana*, have often been discussed.

*Irvingia*, together with *Klainedoxa*, was by ENGLER (Pfl. Fam. 3, 4, 1896, 227) distinguished as a subtribe, and later by BOAS (Beih. Bot. Centr. 29 i, 1913, 348) and ENGLER (Pfl. Fam. ed. 2, 19a, 1931, 396) raised to subfamily rank. PIERRE (Fl. For. Coch. 4, 263) has already given it family rank in 1892, mainly because of presence of stipules and lysigenous mucilage cavities in the cortex and pith of branches and petioles. He placed the *Irvingiaceae* next to *Anacardiaceae*. VAN TIEGHEM (Ann. Sc. Nat. IX, Bot. 1, 1905, 247-320) considered the *Irvingiaceae* close to but distinct from the *Simaroubaceae*. HALLIER f. (Beih. Bot. Centr. 39, ii, 1923, 62-68) classified *Irvingia* next to the *Linaceae-Erythroxyleae*, a disposition which has recently partly been accepted by HUTCHINSON (Fam. Fl. Pl. ed. 2, 1959, 261) in placing the *Irvingiaceae* in the order *Malpighiales* next to the *Linaceae*. As EDMAN's phytochemical results are in favour of affinity between *Irvingia* with *Simaroubioideae* and as the leaves of *Irvingia* are extremely similar to those of *Quassia* & *Samadera* (though without glands), and stipules also occur in *Picrasma*, I think it is reasonable to maintain *Irvingia* within the *Simaroubaceae*. It is true that the stipules in *Irvingia* leave an annular scar, which is not the case in *Picrasma*, but in other families, e.g. *Hamamelidaceae* and *Rubiaceae* their insertion also varies in degree.

*Suriana* has also a chequered taxonomical history, and was successively classified in the *Crassulaceae* by LINNÉ, in the *Spiraeaceae* by ENDLICHER and PLANCHON, and in the *Geraniaceae* by LINDLEY. ARNOTT (W. & A. Prod. 1 (1834) 360) raised *Suriana* to family rank. J. G. AGARDH (Theor. Syst. Pl. 1858, 1899) placed the family next to the *Geraniaceae* with the following argumentation: lack of bitter substances, thin and brightly coloured clawed petals, and an ovary with 2 amphitropous ovules per cell. Amphitropous ovules occur, however, also in *Harrisonia*. AGARDH's opinion was sustained by JADIN (Ann. Sc. Nat. VIII, Bot. 13, 1901, 303) on - somewhat inadequate - anatomical characters. According to WEBBER (1936, l.c.) the anatomical structure of *Suriana* supports SOLEREDER's opinion (Syst. Anat. Dic. 1899, 207-213) of suppressing a monotypic family *Surianaceae* and classifying it with the *Simaroubaceae* as proposed by BENTHAM & HOOKER (Gen. Pl. 1, 1862, 307) and accepted by ENGLER (Pfl. Fam. ed. 2, 19a, 1931, 365) and CRONQUIST (Brittonia 5, 1944, 129), which seems still the most acceptable disposition.

Uses. All the bitter tasting genera are highly in demand for medicinal purposes by the people, and are used against a wide variety of illnesses. It seems that they have sometimes some healing properties indeed, for example the nuts of *Brucea javanica*. These are known under the name of 'Makassar-pitjes' (Dutch) or 'Kho-Sam' (Chin.). They were about 1900 imported into Europe and came highly in demand as a drug. According to MOUSSALLI (Contr. à l'étude des Simarubacées, 1939) an unidentified, much less bitter tasting drupe was often handled by crooked merchants to adulterate true 'Kho-Sam'.

Some of the toxic constituents, after having been extracted, are occasionally used as an insecticide.

None of the genera furnishes timber of general commercial importance, though some, e.g. *Ailanthus*, produces a timber that is used locally, chiefly for packing-cases and also for house building. In none of the genera the wood is very durable.

## KEY TO THE GENERA

1. Leaves simple.
  2. Stipules present, leaving annular scars. . . . . 9. *Irvingia*
  2. Stipules absent.
    3. Leaves sessile or nearly so, linear-spathulate, up to 5 mm wide. Plant not bitter . . . . . 1. *Suriana*
    3. Leaves larger, distinctly petioled. Bitter substances present.
      4. Leaves obovate. Branchlets thick. Stamens without an adaxial scale. Carpels connate. Fruits obcordate. . . . . 8. *Soulamea*
      4. Leaves subelliptic, with concave glands, usually on the undersurface. Branchlets not thick. Stamens without an adaxial scale. Carpels free. Fruit  $\pm$  semicircular. . . . . 2. *Quassia*
1. Leaves compound.
  5. Leaf-rachis winged or leaves ternate. Stamens with an adaxial scale.
    6. Branches with stipular thorns. Leaf-rachis narrowly winged or leaves ternate. Carpels united. . . . . 4. *Harrisonia*
    6. Branches without thorns. Leaf-rachis broadly winged and articulated. Carpels free . . . . . 2. *Quassia*
  5. Leaf-rachis not winged. Leaves pinnate. Stamens either with an adaxial scale or not.
    7. Stipules present, caducous. Stamens without an adaxial scale . . . . . 6. *Picrasma*
    7. Stipules absent. Stamens either with an adaxial scale or not.
      8. Leaflets sessile or nearly so, attached to the rachis with a conspicuous (constricted) articulation. Stamens with an adaxial scale, the same number as the petals, alternating with staminoid scales . . . . . 3. *Eurycoma*
      8. Leaflets distinctly stalked, not conspicuously articulated. Androecium haplo- or obdiplostemonous. Stamens either with an adaxial scale or not.
        9. Stamens twice the number of petals, either with an adaxial scale or not. Inflorescence a panicle.
          10. Stamens without an adaxial scale. Large trees. Branches thick, with large, crowded leaf scars. Fruit a samara. . . . . 7. *Ailanthus*
          10. Stamens with an adaxial scale. Branches not very thick, not with large, crowded leaf scars . . . . . 2. *Quassia*
  9. Stamens the same number as petals, without an adaxial scale. Thyse narrow . . . . . 5. *Brucea*

1. *SURIANA*

LINNÉ, Gen. Pl. ed. 5 (1754) 137; Sp. Pl. (1753) 284—Fig. 1.

Shrubs or small trees; innovations hairy, partly glandular-capitate; without a bitter taste. *Leaves* sessile, simple. Stipules 0. *Flowers* 5-merous, bisexual, in pauciflorous, axillary cymes, rarely solitary; stalks articulated at the base. Bracts persistent, foliaceous. *Sepals* persistent, connate at the base, imbricate in bud, as large as the imbricate petals. *Stamens* 10, sometimes 5 barren in 2 distinct rows, with latrorse, versatile anthers. Disk not developed. *Carpels* 5, free, each with a free, filiform, basally attached erect style; stigmas free, small, inconspicuous; ovules 2 in each carpel, collateral, basal, amphitropous, micropyle directed to the base. *Fruits* drupaceous, 3–5 together, enclosed by the calyx. *Seed* 1 in each carpel; embryo curved, albumen 0.

Distr. Monotypic, pantropical. Fig. 2.

Notes. JADIN (Ann. Sc. Nat. VIII, Bot. 8, 1901, 224–226) considered *Suriana* as representative of a monotypic family, *Surianaceae*, on behalf of the occurrence of glandular hairs (a character which he overlooked in some other genera), the number and basal attachment of the ovules, the lack of bitter substances, and some other minor characters. SOLEREDER (Verh. Bot. Ver. Brandenb. 47, 1905, 35–62) referred the genus to the *Simaroubaceae*, which was agreed to by later authors.

1. *Suriana maritima* LINNÉ, Sp. Pl. (1753) 284; DC. Prod. 2 (1825) 91; SPRENG. Gen. Pl. ed. 9 (1830) 383; W. & A. Prod. (1834) 361; DECNE, Herb. Tim. Descr. (1835) 121; BENTH. Fl. Austr. 1 (1863) 375; BENN. in Fl. Br. Ind. 1 (1875) 522; HEMSL. Bot. Chall. 1 (1885) 131; TRIMEN, Fl. Ceyl. 1 (1893) 222; WARB. Bot. Jahrb. 18 (1893) 194; BAILEY, Queensl. Fl. 1 (1899) 220; GUPPY, Observ. Natur. Pac. 2 (1906) 105; BACK. Schooff.

Java (1911) 193; MERR. Philip. J. Sc. 7 (1912) Bot. 274; GUPPY, Seeds & Curr. (1917) 239–242; LAUT. Bot. Jahrb. 56 (1920) 342; E. G. BAKER, J. Linn. Soc. Bot. 45 (1921) 285; MERR. En. Philip. 2 (1923) 345; C. T. WHITE, J. Arn. Arb. 10 (1929) 227; RIDL. Disp. (1930) 264; DÄNIKER, Viert. Jahrschr. Naturf. Ges. Zürich 77 (1932) 204; F. B. H. BROWN, Bull. Bern. P. Bish. Mus. 130 (1935) 131; GUILLAUMIN, Bull. Soc. Bot. Fr. 85

(1938) 20; Fl. Nouv. Cal. (1948) 170; PERR. DE LA BATHIE, Fl. Madag. fam. 105 (1950) 7; W. R. TAYLOR, Pl. Bikini (1950) 183; YUNCKER, Bull. Bern. P. Bish. Mus. 220 (1959) 154.—Fig. 1.

Shrub or small tree, up to 3(-8?) m, rather densely pubescent in all the younger parts; hairs partly glandular-capitate. Wood very hard. Leaves somewhat fleshy, linear-spathulate, up to  $3\frac{1}{2}$  by  $\frac{1}{2}$  cm, crowded at the end of the branchlets, leaving tuberculate scars; midrib, nerves, and veins inconspicuous. Inflorescences 2-4-flowered. Bracts lanceolate, 4-9 by 1- $1\frac{1}{2}$  mm. Pedicels up to c. 1 cm. Sepals ovate-lanceolate to ovate-oblong, 5-10 by 2-4 mm. Petals yellow,  $\pm$  obovate-oblong to orbicular, shortly clawed, about as long as the sepals. Filaments sericeous at the base, up to 5 mm; anthers with emarginate top and base, 1 mm  $\phi$ . Carpels hairy, obovoid, in anthesis up to c. 1 mm long; styles glabrous, except at the very base, up to 5 mm. Fruits hairy, subovoid, c.  $3\frac{1}{2}$  mm long.

Distr. Pantropical (but not in West Africa, not on the Asiatic and Australian<sup>1</sup> continents, and not in Hawaii), in the Pacific-Indian Oceans usually on small isolated islands or coral islets and atolls, in Malaysia: very scarce, only found in the Philippines (Lumbucan, Sulu Sea), Timor, and the Tanimbar Is (unlocalized), and East New Guinea (Kelana, Port Moresby, Misima I.). Fig. 2.

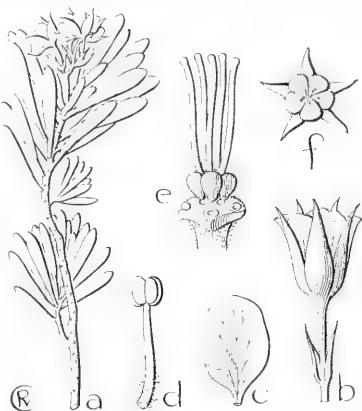


Fig. 1. *Suriana maritima* L. a. Flowering twig,  $\times \frac{1}{2}$ , b. flower,  $\times 2$ , c. petal,  $\times 3$ , d. stamen,  $\times 6$ , e. gynoecium, scars of other flower parts visible,  $\times 6$ , f. fruit,  $\times \frac{1}{2}$  (a FOSBERG 26890, b-e MCKEE 4997, f after BRITTON).



Fig. 2. Distribution of *Suriana maritima* L. in Malaysia and adjacent countries; material seen ( $\bullet$ ), from literature ( $\circ$ ), unlocalized ( $+$ ).

Ecol. A coastal shrub of the Barringtonia formation, usually rare, but locally often very common and forming thickets along the sandy beach and along coral coasts, often associated with *Messerschmidia*, *Scaevola*, *Guetarda*, etc., from sea-level up to 10 m. Fl. fr. Jan.-Dec.

In SE. Polynesia F. B. H. BROWN found that the dense branching causes it to act occasionally as a sand binder initiating the formation of small dunes. In Bikini especially common on the windward side of the islet. In the Tuamotus one of the most common littoral woody plants.

It is remarkable that almost all localities are

situated in the small islands or islets in the Malayan Pacific area, except some in East New Guinea. No specimen is known from the Australian and Asiatic continents proper, though BENNETT (*l.c.*) recorded it from the 'shores of the western Peninsula', i.e. the Deccan. Among shore plants it shares this peculiarity with *Pisonia grandis* for which it has been accepted that these localities coincide with bird colonies, and consequently guano accumulation leading to calcium phosphate coral rock; *Pisonia* would then also be dispersed by these sea birds. It is, however, unlikely that the fruits of *Suriana* are dispersed in this way.

Mr L. S. SMITH (*in litt.*) suggested that *Suriana* and other rare littoral plants avoiding continental shores (*Messerschmidia argentea*, *Soulamea amara*) might prefer highly calcareous beaches which, of course, are much more prevalent on islands than on the mainland where rivers silt the coral by outflow of freshwater and sediments.

RIDLEY (*l.c.*) dwelt at length on the peculiar distribution pattern and I agree that GUPPY's assumption (Plants, Seeds, etc. 1917, 240) that it would have been destroyed in spots as firewood by wandering islanders is unlikely.

SCHIMPER and GUPPY (Observ. 529) have established that the buoyancy power of the nuts is very great, up to at least 5 months; the floating power being due to an unfilled space in its cavity

(1) Except two localities, near Yirkalla, at the NE. corner of Arnhem Land and Look-Out Point in Queensland.

It is therefore certain that they are dispersed by sea-water, but 'they could also be carried in floating logs and pumice'; attachment in mud to birds feet is possible though unlikely as its habitat is too sandy.

In the herbaria *Suriana* is sometimes confused with *Pemphis acidula* FORST. (*Lythraceae*) which can immediately be distinguished by a lengthwise sulcate, campanulate calyx tube and 6-merous flowers.

## 2. QUASSIA

LINNÉ, Sp. Pl. ed. 2 (1762) 553., app. (1763) 1679; Gen. Pl. ed. 6 (1764) 212; PIERRE, Bull. mens. Soc. Linn. Paris n. 156 (1896) 1236; NOOTEBOOM, Blumea 11 (1962) *in press.* — For generic synonyms see under the sections. — Fig. 3-5.

Trees, shrubs, or suffrutices. *Leaves* pari- or imparipinnate, rarely simple; leaflets usually with pitted glands in the upper surface along the margin, especially at the apex; nerves and veins usually immersed or obscure, sometimes (in *sect. Quassia* and some African and American *spp.*) prominent; rachis distinctly jointed and winged in *Q. amara*, with 2 narrow ribs or terete and not jointed, or only so in the apical part in other *spp.* *Inflorescence* a simple or branched raceme, a panicle, or an umbel; bracts usually spatulate, more or less succulent, or triangular; bracteoles nearly opposite, tiny, triangular, ciliate. *Flowers* 4-6-merous, mono- or bisexual, or polygamous; pedicels jointed about the middle in *Q. amara*, either jointed at the base or not in the other *spp.* *Calyx* more or less lobed, rarely (*§ Simaba, p.p.*) closed in bud and irregularly rupturing. *Petals* imbricate or contorted in bud, longer than the calyx, sometimes very long. *Stamens* obdiplostemonous (in a single African *sp.* the outer whorl doubled), with a shorter or longer, hairy, adaxial scale with a shorter or longer free apex. *Disk*  $\pm$  cylindrical or subglobose, highly varying in size. *Ovaries* free or coherent, 4-6, on top of the disk, sometimes more or less immersed in it, the abortive ovaries of the  $\delta$  flowers in some monoecious *spp.* surrounded by a barrel-like disk; style 1, but the parts of each carpel discernible, and with as many style canals as there are carpels; stigmas more or less stellately spreading, or one slightly lobed or capitate stigma. *Fruits* 1-6, drupaceous or woody, often compressed (laterally, or in one *sp.* dorsoventrally), either bicarinate or not, sometimes very large.

*Distr.* Pantropical, c. 25 species in tropical and subtropical America, 5-10 *spp.* in Africa, 2 *spp.* in lower Burma and Cambodia, one of which also almost throughout *Malaysia* to the Bismarcks and Solomons, 1 endemic in Borneo & Sumatra, and 2 in Queensland.

*Ecol.* In *Malaysia* in rain-forests at low altitude.

*Notes.* The new North Bornean species, which could be described thanks to the generous co-operation of Mr FORMAN, Kew, necessitated a reconsideration of the trib. *Simaroubeae*. Mr FORMAN assumed it to belong to the American genus *Simaba*, but though the similarity is striking indeed, *Simaba* is defined in having bisexual flowers, and the flowers of the new species are male, with clearly reduced ovaries. Unisexual flowers occur in the likewise American genus *Simarouba*. The new species showed, however, also similarity to some African genera for example *Hannoa* and *Odyendyea*. I have come to the conclusion that all these genera, including also *Samadera* and the African genus *Pierreodendron*, cannot be separated generically and should be arranged in an enlarged genus *Quassia*, a point of view already suggested by PIERRE in 1896. This emended genus *Quassia* comprises four sections, three of which occur in *Malaysia*.

### KEY TO THE SPECIES

1. Leaves compound.
  2. Leaf-rachis winged, conspicuously articulated. Flowers in racemes . . . . . 1. *Q. amara*
  2. Leaf-rachis not winged, not articulated. Flowers in panicles . . . . . 3. *Q. borneensis*
1. Leaves simple. Flowers in pseudo-umbels. . . . . 2. *Q. indica*

### 1. Section *Quassia*

Leaves pinnate, with a more or less winged and conspicuously articulated rachis. Racemes terminal, either branched or not. Pedicels articulated about the



middle, with 2 tiny bracteoles below the joint. Flowers bisexual. Petals 5, contorted, oblong, erect, much longer than the calyx. Disk large, nearly as high as broad. Styles long, with a small, slightly 5-lobed stigma.

Distr. One *sp.* native in Brazil and introduced in all tropical countries for medicinal and ornamental purposes.

1. *Quassia amara* LINNÉ, Sp. Pl. ed. 2 (1762) 553, app. (1763) 1679; BACK. Fl. Bat. 1 (1907) 256; Schoolfl. Java (1911) 190; LECOMTE, Fl. Gén. I.-C. (1911) 689; MERR. Fl. Manila (1912) 272; En. Philip. 2 (1923) 346; CRAIB, Fl. Siam. En. 1 (1926) 239; HEYNE, Nutt. Pl. (1927) 870; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 3.

Very bitter, erect shrub, 2-3 m high. Leaves with broadly winged rachis; rachis + petiole c. 5-16 cm; leaflets usually 5, apical ones reduced to 3-1; flush purple; almost sessile, obovate-oblong. Racemes 10-25 cm long, often branched. Pedicels 8-14 mm, accrescent. Bracts spatulate, the lower-

most sometimes foliaceous, 3-14 mm long. Calyx patent, bright red, 7-8 mm. Petals bright red outside, whitish inside, 27-32 by 5-6 mm. Stamens longer than the petals, slightly unequal, 3½-4 cm. Drupes 1-5, purple-black, 12-13 mm long.

Distr. Native of Brazil, in Malaysia cultivated, occasionally naturalized.

Uses. The *Quassi*-wood is used as a tonic in case of stomach diseases and as an insecticide to destroy for instance plant lice. The active constituent of the wood consists of a number of bitter substances (HEYNE, *l.c.*).

## 2. Section *Samadera*

(GAERTN.) NOOTEBOOM, *nov. stat.*—*Locandi* ADANS. Fam. Pl. 2 (1763) 449, based on RHEEDE, Hort. Mal. 6 (1686) t. 18, *nom. gen. rejic.*; O.K. Rev. Gen. Pl. 1 (1891) 104.—*Samadera* GAERTN. Fruct. 2 (1791) 352, t. 156, 'f. 3', *nom. gen. cons.*; BOERL. Ned. Kruidk. Arch. II, 5 (1890) 520-524.—*Vitmannia* VAHL, Symb. Bot. 3 (1794) 51, t. 60.—*Niota* [POIR. in Lamk, Tabl. Enc. Méth. (1792) t. 299] LAMK, Enc. Méth. 4 (1797) 490.—*Biporeia* PETIT-THOUARS, Gen. Nov. Madag. (1806) 14, *nom. illeg.*—*Mauduita* COMM. ex DC. Prod. 1 (1824) 592, *nom. inval.*—*Manungala* BLANCO, Fl. Filip. (1837) 306.—*Samandura* LINNÉ [Fl. Zeyl. (1747) 202, *pro specim. Herm., excl.* RHEEDE t. 21] ex BAILLON, Hist. Pl. 4 (1873) 491, *nom. illeg.*; Bot. Méd. 2 (1884) 845, 874; PIERRE in De Laness. Pl. Utiles Col. Fr. (1886) 305; BAILL. Dict. Bot. 4 (1892) 11.

Leaves simple, with more or less scattered concave glands, usually on the undersurface. Flowers bisexual, in axillary or terminal, peduncled pseudo-umbels or in racemes. Calyx lobes 3-5, imbricate in bud, obtuse, in the centre with a concave gland. Petals 3-5, contorted, much longer than the calyx, usually hairy on the back. Disk large, as high as broad, gynophore-like. Style with a terminal inconspicuous stigma. Fruits rather large. (in Mal.) laterally compressed with a narrow unilateral sharp-edged thinner part in the apical half (in the Indo-Chinese *sp.* very large and dorsoventrally compressed).

Distr. Two *sp.*, Madagascar and from lower Burma and Cambodia throughout Malaysia (except Java and the Lesser Sunda Islands) to the Bismarcks and Solomons. *Q. indica* is cultivated in Java.

Ecol. Usually at low altitude under everwet climate conditions.

Note. BACKER (1907) defined the flowers as 3-5-merous. In *Q. indica* I have only seen 4-merous ones.

2. *Quassia indica* (GAERTN.) NOOTEBOOM, *comb. nov.*—*Samadera indica* GAERTN. Fruct. 2 (1791) 352, t. 156, f. 3; W. & A. Prod. (1834) 151; HOOK. Ic. Pl. 1 (1837) t. 7; GRAH. Cat. Bomb. Pl. (1839) 37; PLANCH. in Hook. Lond. J. Bot. 5 (1846) 562; THWAITES, En. (1858) 70; MIQ. Fl. Ind. Bat. 1, 2 (1859) 677; BENN. in Hook. f. Fl. Br. Ind. 1 (1875) 519; KURZ, For. Fl. Burma 1 (1877) 200; BLANCO, Fl. Filip. ed. 3, 4 (1880) 38; VIDAL, Sin. Atlas (1883) 19, t. 26, f. c.; PHAN. Cuming. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; TRIMEN, Fl. Ceyl. 1 (1893) 231; GRESHOFF, Schetsen (1894)

17-19, t.; MERR. Gov. Lab. Publ. Philip. n. 27 (1905) 29; BACK. Fl. Bat. (1907) 258, *incl. var. brevipetala* (SCHEFFER) BACK.; Schoolfl. Java (1911) 191; LAUT. Bot. Jahrb. 56 (1920) 342, *incl. var. papuana* LAUT.; MERR. Sp. Blanc. (1918) 206; En. Born. (1921) 315; RIDLEY, Fl. Mal. Pen. 1 (1922) 363; MERR. En. Philip. 2 (1923) 345; BACK. Bekn. Fl. Java (em. ed.) 4 (1948) fam. 146, p. 2; CAPURON, Adans. 1 (1961) 83.—*Karin-Njoti* RHEEDE, Hort. Mal. 6 (1686) t. 18.—*Vitmannia elliptica* VAHL, Symb. Bot. 3 (1794) 51, t. 60.—*Niota pentapetala* POIR. in Lamk,

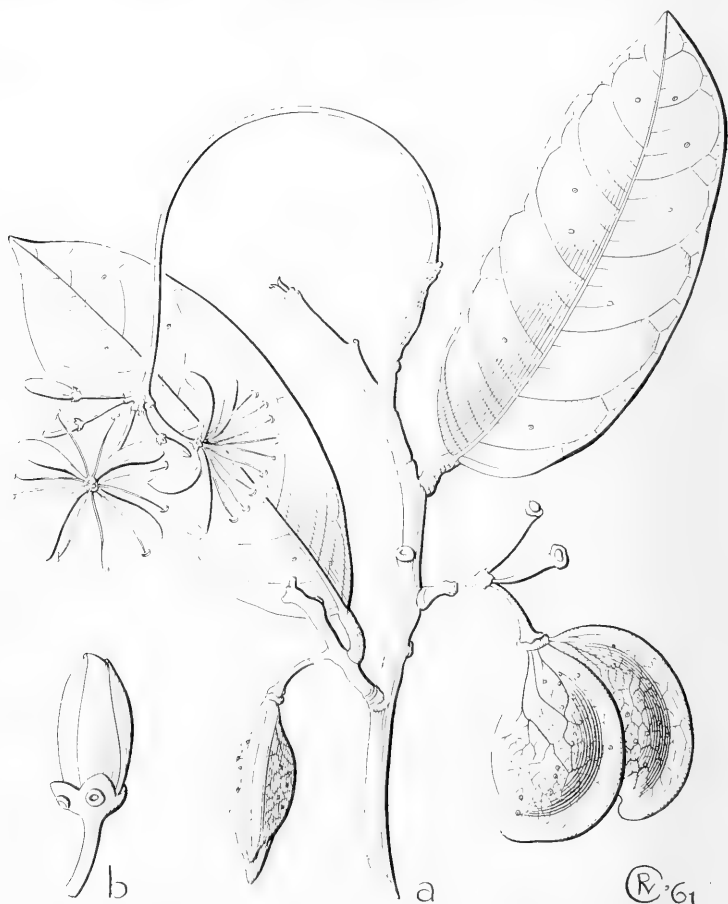


Fig. 3. *Quassia indica* (GAERTN.) NOOTEBOOM. *a*. Twig with flowers and fruit,  $\times \frac{2}{3}$ , *b*. bud, with glands on calyx,  $\times 3$  (*a* after GRESHOFF, *b* BOET 48).

Encycl. 4 (1797) 490; DC. Prod. 1 (1824) 592; BLANCO, Fl. Filip. ed. 2 (1845) 213.—*Niota tetrapetala* POIR. in Lamk, Tabl. Encycl. Méth. (1792) t. 299; in Lamk, Encycl. 4 (1797) 490; DC. Prod. 1 (1824) 592; BLANCO, Fl. Filip. ed. 2 (1845) 213.—*Niota commersonii* PERS. Syn. 1 (1805) 416, *nom. inval.*—*Mauduita penduliflora*

COMM. *ex* DC. Prod. 1 (1824) 592, *nom. inval.*—*Samadera madagascariensis* JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 516, t. 27, n. 46, *nom. illeg.*—*Niota lamarekiana* BL. Bijdr. 5 (1825) 251, *nom. illeg.*—*Niota lucida* WALL. Pl. As. Rar. 2 (1831) 54, t. 168.—*Samadera tetrapetala* G. DON, Gard. Dict. 1 (1831) 811.—*Samadera*

*pentapetala* G. DON, l.c.—*Samadera glandulifera* PRESL, Symb. Bot. 2 (1833) 1, t. 51.—*Manungala pendula* BLANCO, Fl. Filip. (1837) 306.—*Vitmannia lucida* STEUD. Nomencl. ed. 2 (1841) 779.—*Samadera brevipetala* SCHEFF. Nat. Tijds. N.I. 32 (1871) 410.—*Samadura indica* BAILL. Bot. Méd. 2 (1884) 874; PIERRE in De Laness. Pl. Utiles Col. Fr. (1886) 305.—*Locandia indica* O.K. Rev. Gen. Pl. 1 (1891) 104.—*Locandia* O.K. l.c.—*Locandia madagascariensis* O.K. l.c.—*Samadura mekongensis* PIERRE, Fl. For. Coch. 4 (1892) t. 262, t.; LECOMTE, Fl. Gén. I.—C. 1 (1911) 694.—*Locandia glandulifera* PIERRE, Fl. For. Coch. 4 (1892) sub t. 262, text.—*Locandia mekongensis* PIERRE, l.c. t. 262, text.—*Locandia merguensis* PIERRE, l.c. sub t. 262, text, nomen.—*Locandia pendula* PIERRE, l.c. sub t. 262, text.—*Samadera mekongensis* ENGL. in E. & P. Pfl. Fam. 3, 4 (1896) 210.—*Samadura madagascariensis* PERRIER DE LA BATHIE, Fl. Madag. Fam. 105 (1950) 6, t. 2.—Fig. 3.

Glabrous evergreen shrub or tree, up to 20 m. *Branchlets* with a small pith, the base of each shoot provided with some stiff persistent scales. *Leaves* elliptic-oblong to lanceolate, rather acute or sometimes rounded or even subcordate at the base, blunt, more or less acuminate or sometimes rounded at the apex, 12–30 by 4–12 cm, midrib, nerves, and distinctly reticulated veins conspicuously prominent at either surface, always with internodal veins, usually with 2 pitted glands at the base beneath and similar ones scattered on the surface, less so above; petiole 1–2½ cm. *Flowers* up to 20 or more in an umbelliform, glabrous or puberulous inflorescence. Peduncle more or less flattened, thickened at apex, terminal or axillary, sometimes on old wood, 1–30 cm. *Pedicels* jointed in the lower half, ½–2½ cm, growing during anthesis, in fruit to more than 3 cm. *Bracts* minute. *Calyx* 4-lobed, 2–3 mm high, lobes about as long as the tube or longer, ± semiorbicular, puberulous outside. *Petals* 4, free, dorsally puberulous, obtuse, usually narrowed to the base, growing during anthesis, creamy-green to violet, purplish or brownish, up to 3 by 1 cm. *Filaments* puberulous, hairy except towards the apex, up to 2½ cm, inserted at the base of the disk; anthers lanceolate to oblong, c. 4 by 1–2 mm. *Disk* glabrous or nearly so, c. 2 by 1½ mm. *Carpels* 4, free, more or less puberulous, c. 2 by 2 mm; styles up to 2 cm. *Fruits* 1–4 together, flattened, with ± straight inner and ± semicircular outer margin, which is sharp and thinner in the upper half, the apex more or less overtopping the subapical styler scar, 4–9 by 2½–5 cm; pericarp with similar glands as the leaf. *Seed* with an apical plumule and an adaxial conspicuous chalazal; testa thin; endosperm none; cotyledons planoconvex, up to 3½ by 2½ cm.

Distr. Madagascar, Ceylon, S. Concan, Malabar, Lower Burma (Martaban, Tenasserim),

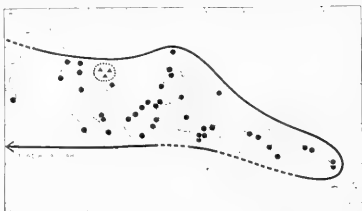


Fig. 4. Distribution of *Quassia indica* (GAERTN.) NOOTEBOOM (delineated and dots) and *Q. harmandiana* (PIERRE) NOOTEBOOM (dotted delineation with localities in triangles).

Andamans, and Cochinchina, throughout *Malaysia* (not in Sumatra, Java, and the Lesser Sunda Islands) to the Bismarcks and Solomons; cultivated in Java and elsewhere. Fig. 4.

Ecol. Usually very rare, but locally rather common in the eastern part of its area, preferably in wet places in lowland, forests below 150 m, sometimes in localities which are periodically inundated by fresh or by salt water, for example on edge of the mangrove, in East North Borneo common in young swamp forests back of the mangrove. *Fl. fr.* Jan.—Dec.

Uses. In Sarawak the wood is used for making handles of knives, in the Solomons the macerated leaves, mixed with coconut oil, are applied to hair for cleansing purposes.

The seeds are given as an emetic and purgative, and sometimes in bilious fevers. In the Philippines chips of wood are put in coconut oil which is drunk as a purgative. The same oil is used as a liniment for rheumatism and bruises. The plant is also used against malignant fevers, as a tonic, and as insecticide, specially against ants.

The seeds contain oil to the extent of one third of their weight, but by difficulty of getting a sufficient supply it is not commercial (GRESHOFF, Schets. 1, 1894, 19; HEYNE, Nutt. Pl. 1927, 869; BURK. Dict. 2, 1935, 1945; QUIS. Medic. Pl. Philip. 1951, 475).

Vern. Philip.: *darapat*, *linatog-anat*, *lintong-gamai*, *mabingdato*, *palagarium*, *palugium*, *ponoan*, *Bis.*, *maluñggál*, *móngal*, *Tag.*, *manuñggál*, *Tag.*, *Bik.*, *Pamp.*, *P. Bis.*, *Lan.*, *Ibn.*, *palo santo*, Spanish, *rapus* (tree), *kélépis*, *kliplis* (fruit), *Banka*, *kaju pait*, Borneo, *gatép pait*, Java, *onne*, Ternate.

Notes. According to CAPURON l.c. the species is doubtless native in Madagascar and not rare in the substage of swampy forests along the east coast, rarely ascending on crests to 400–600 m.

The leaves show a resemblance to those of *Irvingia* and *Inocarpus* but are distinguished by the occurrence of scattered concave glands.

### 3. Section Simaba

PIERRE, Bull. mens. Soc. Linn. Paris n. 156 (1896) 1236.—*Quassia* sect. *Odyendyea*



Fig. 5. *Quassia borneensis* NOOTEBOOM. a. Habit,  $\times \frac{1}{2}$ , b.  $\sigma$  flower,  $\times 5$ , c. ditto, from above, stamens and petals removed, the disk seemingly consists of two rings, the star-shaped structure in the centre represents the 5 vestigial carpels,  $\times 10$ , d. frontal and dorsal view of stamen (a-d MEYER San 20499).

PIERRE, *l.c.* 1238.—*Simaba* AUBL. Hist. Pl. Guian. (1775) 400, t. 153.—*Aruba* AUBL. *l.c.* 293, t. 115.—*Hamoia* PLANCH. in Hook. f. Lond. J. Bot. 5 (1846) 566.—*Mannia* HOOK. f. in B. & H. Gen. Pl. 1 (1862) 309.—*Hyptiandra* HOOK. f. *l.c.* 293, 990.—*Odyndyca* (PIERRE) ENGL. in E. & P. 3, 4 (1896) 215.—*Pierreodendron* ENGL. Bot. Jahrb. 39 (1906) 575.—*Simarubopsis* ENGL. Bot. Jahrb. 46 (1911) 276.

Leaves pinnate or simple, if simple more than thrice as long as broad. Flowers bisexual or trees polygamous, in terminal or axillary panicles, which are sometimes reduced to few-flowered, axillary, umbel-like clusters, or to pseudo-umbels with forked peduncles. Petals imbricate or contorted. Scales of the stamens sometimes nearly as long as the filament and somewhat coherent. Stigmas short, or only one 4-5-lobed or punctate stigma.

Distr. Pantropical, c. 20 spp. in tropical South and Central America, c. 5-10 spp. in Africa, 1 sp. in Malaysia, and 2 spp. in Australia.

3. *Quassia borneensis* NOOTEBOOM, *nov. spec.*—Fig. 5.

*Arbor mediocris, foliis paripinnatis vel imparipinnatis, 2-3-jugatis. Foliola elliptico-oblonga vel obovato-oblonga, abrupte acuminata, glabra, margine superne glandulis parvis munita, 8-12 cm longa, 4-4½ cm lata. Flores ♂ sepalis puberulis basi coalitis 1 mm longis; petalis imbricatis vel contortis, elliptico-oblongis vel ovato-oblongis, glabris, 3 mm longis 2 mm latis, staminibus squama pilosa apice emarginata ½-1 mm longa semiadnata instructis; disco insigni, basi 2 mm lato, apice 1 mm lato, ½ mm alto; vestigiis carpellorum ¼ mm longis, stylo carpellis longitudine aequanti.*—*Typus* MEIJER SAN 20499, in L, isotypes K, SAN.

Tree, 14 m by 25 cm ♂; outer bark densely fissured, brittle and corky. Leaves spirally arranged, pari- or imparipinnate; leaflets 2-3 pairs, glabrous, elliptic to obovate-oblong, shortly rounded-acuminate, 8-12 by 4-4½ cm; upper surface shining, lower surface opaque; very small pitted glands along the margins and in the acumen on the upper surface; nerves sunken in both upper and lower surface, or obscure, ending in a marginal vein; veins obscure; petiole c. 5 cm, as the rachis ± terete; petiolules 1-1½ cm, articulated at the base. Panicle puberulous in all its parts, not quite as long as the leaves. Bracts spatulate, succulent in the apical part, up to 2½ mm long. ♂ Flowers 4-5-merous. Pedicels up to 7 mm. Calyx c. 1 mm high, outside puberulous, lobes ovate to triangular, longer than the tube. Petals contorted or imbricate in bud, glabrous, elliptic to ovate-oblong, c. 3-4 by 2 mm. Stamens slightly shorter than the petals; filaments sigmoid-folded in bud, with a hairy adaxial scale at the base; scale

free for ½ of its length, more or less emarginate, c. ½-1 mm long; anthers oblong, latrorse, c. ½-1 mm long. Disk c. ½ mm high, at the basis c. 2 and at the apex c. 1 mm wide, the upper half distinct from the lower half and folded around the barren ovaries. Carpels free, c. ¼ mm high; style as long as the carpels, with a small 4-5-lobed stigma. ♀ Flowers unknown. Fruits drupaceous, 1-5 from each flower, if more than one diverging radially from a thickened torus, prune-shaped, dark purple-red when ripe *sec. coll.*; in dry state slightly flattened-ellipsoid, with a faint dorsal and ventral ridge, c. 2-3 by 1½ cm; pericarp thin but hard. Seed with a thin testa; plumule short; cotyledons large, green, plano-convex; no endosperm (BURGESS 2849).

Distr. Malaysia: Central Sumatra (Indragiri), Borneo.

Ecol. Primary rain-forest at low altitude, often in peat-swamp forest, also on mineral soil.

Notes. Obviously closely allied to the African species described by PIERRE in *Quassia sect. Odyndyca*. All these species have the filaments sinuously folded in bud, a condition not observed in other species of *Quassia*.

#### Excluded

*Niota globosa* BLANCO, Fl. Filip. ed. 2 (1845) 214 is, according to MERR. Sp. Blanc. (1918) 225 = *Cleidion spiciflorum* (BURM. f.) MERR. (*Euphorbiaceae*).

*Niota polyandra* BUCH. HAM. ex W. & A. Prod. (1834) 63, *nomen subnudum*; *Vitmannia polyandra* STEUD. Nomencl. ed. 2, 4 (1841) 779 = *Brownlowia tersa* (L.) KOSTERM. (*Tiliaceae*).

### 3. EURYCOMA

JACK, Mal. Misc. 2 (1822) 45; ROXB. Fl. Ind. 2 (1824) 307; PIERRE, Fl. For. Coch. 4 (1892) t. 292, t. 293; ENGL. in E. & P. Nat. Pl. Fam. ed. 2, 19a (1931) 380.—*Picroxylon* WARB. in Fedde, Rep. 16 (1919) 256.—Fig. 6, 7a-e.

Trelets or rarely shrubs, up to c. 10 m high, monoecious or dioecious. Leaves imparipinnate, usually multijugate, long and numerous, crowded at the tips of the rather thick, pithy branches, leaving large scars. Leaflets opposite or subopposite, slightly oblique, ovate-lanceolate to obovate-lanceolate, rarely ovate-oblong (or linear extra-Mal.), sessile or nearly so, attached to the rachis with a conspicuous articulation; midrib slightly prominent on the upper surface, prominent beneath; nerves inconspicuous above and below, or slightly sulcate beneath, straight, ending



Fig. 6. Habit of *Eurycoma longifolia* JACK (Photogr. W. MEIJER, Sandakan, June 1960).

in an intramarginal, looped vein. Panicles axillary, mostly large and lax, puberulous, usually also with thickish, short, stiff, capitate-glandular hairs. *Flowers* bisexual, ♀ or ♂; ♀ flowers always with rather large but sterile stamens, ♂ flowers always with a sterile pistil. *Calyx* small, 5(-6) lobed, lobes ovate to triangular, acute or bluntish, longer than the tube. *Petals* 5(-6), induplicate-valvate in bud, lanceolate or ovate- to obovate-oblong. *Stamens* 5(-6), episepalous, filaments narrowing to the top, usually with a very small (*c.*  $\frac{1}{5}$  mm long) adaxial ligule at the base, alternating with 5(-6) small entire, emarginate or cleft staminodes, which are usually connate with the abaxial and lateral sides of the base of the filaments; sometimes there is a second row of still smaller entire staminodes outside the stamens; stamens and staminodes sometimes connate with the base of the petals; filaments glabrous or sparsely hairy. Disk inconspicuous. *Carpels* 5(-6), free, the style attached adaxially near the top and mutually connate or coherent; stigma peltate, 5(-6)-lobed. Each ovary with 1 anatropous ovule with adaxial placenta. *Fruits* up to 5, *c.* 3 mm stalked, spreading, ellipsoid or ovoid, slightly bicarinate nuts with very thin exocarp and hard endocarp. *Seed* exalbuminous with 2 planoconvex cotyledons and a short plumule.

*Distr.* Three  *spp.* in tropical SE. Asia (Lower Burma, Siam, Indo-China), Sumatra, the Malay Peninsula, Borneo, and the S. Philippines. Fig. 8, 14.

*Ecol.* Preferably on sandy soils below 1200 m, sometimes flowering at an early age.

*Uses.* The roots, and particularly the bark of the roots, are used as a febrifuge. The Malays give it also as a tonic, *e.g.* after childbirth. In Borneo a decoction of the bark is drunk to relieve pain in the bones and a decoction of the leaves is used for washing itches. The Malayan name *bédara laut* is also used for *Strychnos*, which has the same uses (*cf.* BURKILL, *Dict.* 1, p. 984).

*Vern.* (for both *Mal. spp.*). Malay Peninsula: *bédara mərəh, b. puteh, b. pahit, bumi, lèmpèdu pahit, muntah, payong ali, pènarwar pahit, pètala bumi, tongkit ali, t. baginda, M; akar jangat sèman, duak, jèlas, Sakai*; Sumatra: *bègu-gad-jan, bèsan, bèsèng, Karo; bidara laut, b. putih, M; kaju pètimah, k. porhis potala, Alas; njatu suria, Taram; kaju pulau, mèmpeleh, Banka; parie potala, Padang; Borneo: bina, kabal kabal bèrang, sèrirama, tongkat ali; babi kurus, J for the drug.*

*Note.* Though in current classifications *Eurycoma* is referred to the subtribe *Eurycominae* and the genus *Quassia* to the subtribe *Simaroubinae*, of the tribe *Simaroubeae*, I find it unsatisfactory to divorce *Eurycoma* from *Quassia* which show an astonishing similarity in both vegetative and generative aspects, save that whereas *Eurycoma* has 5 stamens and 5 staminodes, valvate petals and a less developed disk, there are in *Quassia* 10 stamens, contorted or imbricate petals, and a well-developed disk. In my opinion they represent a couple of closely related genera of one tribe.

#### KEY TO THE SPECIES

1. Leaflets ovate-lanceolate to obovate-lanceolate, rarely ovate-oblong, more than  $\frac{1}{2}$  cm wide.
2. Leaflets not or slightly acuminate, but the apex rather acutish as compared with next species. Petals about twice as long as wide. Anthers *c.*  $\frac{1}{4}$  mm long. Styles rather long, stigma *c.* 1 mm above the ovaries . . . . . 1. *E. longifolia*
2. Leaflets usually rather abruptly very blunt-acuminate. Petals linear 4 or more times as long as wide. Anthers *c.*  $\frac{3}{4}$  mm long. Styles very short, stigma sessile . . . . . 2. *E. apiculata*
1. Leaflets linear, up to 7 by *c.*  $\frac{1}{2}$  cm, hard coriaceous, leaves 8-18 cm long. Dwarf tree or shrub, up to 1 m high. Petals pubescent on both sides. Anthers *c.*  $\frac{3}{4}$  mm long. Panicles without glandular hairs. (Siam and Cambodia.) . . . . . 3. *E. harmandiana*

**1. *Eurycoma longifolia*** JACK, *Mal. Misc.* 2 (1822) 45; ROXB. *Fl. Ind.* 2 (1824) 307; DC. *Prod.* 2 (1825) 86; MIQ. *Fl. Ind. Bat.* 1, 2 (1859) 681; BENN. in Hook. *f. Fl. Br. Ind.* 1 (1875) 521; F-VILL. *Nov. App.* (1880) 39; VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 78; PIERRE, *Fl. For. Coch.* 4 (1892) t. 292, t. 293, *incl. var. merguensis* and *var. cochinchinensis*; KING, *J. As. Soc. Beng.* 62, ii (1893) 229; RIDL. *J. Str. Br. R. As. Soc.* 30 (1897) 205, *err. latifolia*; J. Str. Br. *Med. Assoc. n.* 5 (1897) 127, *ditto*; LECOMTE, *Fl. Gén.* 1.-C. 1

(1911) 695; BACK. *Schoolfl. Java* (1911) 193; MERR. *Philip. J. Sc.* 10 (1915) Bot. 190; EN. BORN. (1921) 316; RIDLEY, *Fl. Mal. Pen.* 1 (1922) 362; MERR. *En. Philip.* 2 (1923) 346; CRAIB, *Fl. Siam. En.* 1 (1926) 242; MERR. *Pl. Elm. Born.* (1929) 116.—*E. merguensis* PLANCH. in Hook. *Lond. J. Bot.* 5 (1846) 584.—*E. tayoyana* WALL. *Cat.* (1847) n. 8523, *nomen*.—*Picroxyylon siamense* WARB. in Fedde, *Rep.* 16 (1919) 256.—*Manotes asiatica* GAGN. *Bull. Soc. Bot. Fr.* 98 (1951) 207 (VIDAL, *in litt.*).

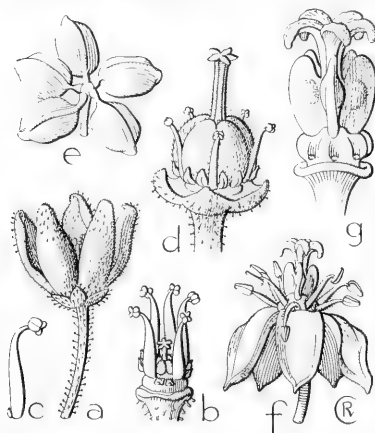


Fig. 7. *Eurycoma longifolia* JACK. a. ♂ Flower,  $\times 8$ , b. ditto, petals and sepals removed,  $\times 8$ , c. stamen,  $\times 16$ , d. ♀ flower, petals removed,  $\times 8$ , e. fruits, nat. size.—*Ailanthus integrifolia* LAMK. f. Flower,  $\times 2$ , g. ovary,  $\times 4$  (a-d MEIJER 6712, e KOSTERMANS 6654, f-g C.H.B. III-E-2).

*ssp. longifolia*.—Fig. 6, 7a-e.

Leaves up to c. 1 m long. Leaflets lanceolate to obovate-lanceolate, rarely ovate-oblong, sometimes slightly acuminate with a bluntish or acute apex, c. 5–20 by 1½–6 cm. Panicles, pedicels, sepals, and calyx puberulous and with capitate-glandular hairs. Flowers reddish. Bracts triangular, very small, up to c. 1 mm, caducous. Pedicels rather thick, up to c. 7 mm. Calyx small, lobes c. 1 mm long. Petals puberulous on both surfaces, lanceolate to ovate- or obovate-oblong, c. 4½–5½ by 2–3 mm. Stamens usually longer than the calyx, c. 1½–2½ mm long, anthers c. ¼ mm long. Staminodes from ½ mm in ♀ flowers to c. 2



Fig. 8. Distribution of *Eurycoma longifolia* JACK (delineated, dots) and its var. *eglandulosa* (MERR) NOOTEBOOM (2 lined dots).

mm in ♂ flowers. Styles rather long, with a peltate 5(–6)-lobed stigma elevated c. 1 mm above the ovaries. Fruits 10–17(–20) by 5–12 mm.

Distr. Lower Burma, Siam, Laos, Cambodia, Indo-China; in Malaysia: Sumatra, Malay Peninsula, and Borneo. Fig. 8.

Ecol. Frequent at low altitude in beach forests on sandy soil, in primary and secondary forest as an understorey treelet, according to RICHARDS (J. Ecol. 24, 1936, 22) in mixed dipterocarp rain-forest, in heath forest and in low forest on ridge crests in Sarawak on Mt Dulit, on sandstone and dry kerangas, a characteristic silicicolous species, locally frequent, generally at low altitude, rarely up to 500 or even 1000 m. Fl. fr. Jan.–Dec.

Note. *Eurycoma longifolia* JACK *ssp. longifolia* has been recorded from the Philippines by F-VILLAR and VIDAL, but this record rested on an erroneously localized specimen (LOBB 486) which according to MERRILL (1915) probably came from Borneo or Malaya.

*ssp. eglandulosa* (MERR.) NOOTEBOOM, *nov. stat.*—*E. eglandulosa* MERR. Philip. J. Sc. 17 (1920) 266; En. Philip. 2 (1923) 346.

Panicles, pedicels, and flowers puberulous, without glandular hairs. Petals 5–6½ mm long.

Distr. Malaysia: Philippines (Mindanao: Surigao; Dinagat), twice collected. Fig. 8.

Ecol. In forests at low altitudes.

2. *Eurycoma apiculata* BENN. in Hook. f. Fl. Br. Ind. 1 (1875) 522; KING, J. As. Soc. Beng. 62, ii (1893) 230; RIDL. Fl. Mal. Pen. 1 (1922) 363.

Leaves c. 40 cm long. Leaflets usually rather abruptly very blunt-acuminate, c. 8–14 by 2–4 cm. Panicles, pedicels, calyx, and petals with thick, stiff, capitate-glandular hairs. Bracts small, linear, up to c. 1 mm long. Pedicels rather slender, up to c. 7 mm long. Calyx lobes c. 1½–2 mm long. Petals puberulous, with glandular hairs outside, glabrous within, linear, rarely lanceolate, c. 4–9 by 1–1½ mm. Stamens usually as long as the calyx or shorter, c. 2 mm long, anthers c. ¼ mm long; ligule usually absent; staminodes in 1 or 2 rows, up to c. ¼ mm, small or absent. Styles very short, with a 5-lobed sessile stigma. Fruit as in former species.

Distr. Malaysia: Sumatra, Malay Peninsula. Fig. 14.

Ecol. Similar as in *E. longifolia*, but usually at higher altitude, up to c. 1200 m. Fl. fr. Jan.–Dec.

3. *Eurycoma harmandiana* PIERRE, Fl. For. Coch. 4 (1892) t. 292 B; LECOMTE, Fl. Gén. I.–C. 1 (1911) 696; CRAIB, Fl. Siam. En. 1 (1926) 242.

#### Excluded

*Eurycoma dubia* ELMER, Leaf. Philip. Bot. 2 (1908) 481 is according to HALLIER, Rec. Trav. Bot. Néerl. 15 (1918) 55 and MERRILL, En. Philip. 2 (1923) 329 = *Evodia meliaefolia* (HANCE) BENTH. (Rutaceae).



## 4. HARRISONIA

R. BROWN *ex* A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 517, *nom. gen. cons. prop., non* ADANS. *ex* LEMAN, 1821; *cf.* Taxon 10 (1961) 243.—*Ebelingia* RCHB. Consp. (1828) 199.—*Lasiolepis* BENN. Pl. Jav. Rar. (1844) 202.—**Fig. 9.**

Thorny, erect or sprawling shrubs, rarely small trees, up to 12 m. Branches pithy, older ones glabrous, lenticellate; stipular thorns accrescent, conical, finally caducous, slightly recurved, up to 7 mm; annual shoots at the base with small persistent bud-scales and sometimes spines. *Leaves* imparipinnate or ternate; rachis narrowly winged; leaflets subentire to lobed,  $\pm$  sessile, the apical one whether or not with a longer petiole than the lateral ones but without articulation, rhomboid to ovate-lanceolate, blunt. *Flowers* bisexual, 4–5-merous, in bracteate axillary cymes or terminal, rarely axillary thyrses. *Calyx* small, lobes acutish-triangular, about as long as the tube or longer. *Petals* much longer than the calyx, slightly imbricate in bud. *Stamens* attached at the base of the disk, twice as many as petals; filaments with an adnate 2-lobed or emarginate hairy ligule free at its top; anthers latrorse, cells diverging in lower half; filament attached between the cells. *Ovary* 4–5-celled, slightly lobed, seated on a rather thick disk; ovules 1 per cell, amphitropous, pendent from the adaxial side near the top; styles 4–5, connate or sometimes free at the very base; stigma knob-shaped, slightly 4–5-lobed. *Drupe* depressed-globose, sometimes  $\pm$  lobed; exocarp fleshy or coriaceous; endocarp hard; fertile cells 2–5, each with a perforation of the hard endocarp at the base of the styler canal. *Seed* with a thin testa, endosperm present; cotyledons horse-shoe-shaped, radicle pointing upwards.

Distr. About 3–4  *spp.* in tropical Africa and from SE. Asia through *Malaysia* (2  *spp.*) to North Australia.

Ecol. The Malaysian  *spp.* usually on dry, open, hot places, often on limestone rocks, under distinctly seasonal conditions, usually at low altitude, up to 700 m, locally sometimes extremely common in thickets, less common in open monsoon forests.

Uses. In some parts of Malaysia the shoots are used as a drug against diarrhoea. In the Philippines a decoction of the bark and roots is used against diarrhoea and dysentery, and apparently also against cholera (HEYNE, Nutt. Pl. 1927, 871; BURK. Dict. 1935, 1128).

Note. The leaves resemble some species of *Zanthoxylum* (*Fagara*) but these are gland-dotted.

## KEY TO THE SPECIES

1. Leaves ternate. Flowers usually 4-merous, c. 4 mm long. Fruits 4–5 by 7–9 mm . . . . . **1. H. brownii**  
 1. Leaves imparipinnate, (1–) 3–8 (–13)-jugate. Flowers usually 5-merous, 6–10 mm long. Fruits 4–9 by 11–15 mm. . . . . **2. H. perforata**

**1. *Harrisonia brownii*** A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 540, pl. 28, n. 47; GAUDICH. Bot. Freyc. Voy. (1826) t. 103, *non* *vidi*; DECNE. Herb. Tim. Descr. (1835) 120; MIQ. Fl. Ind. Bat. 1, 2 (1859) 677; BENTH. Fl. Austr. 1 (1863) 376; F.-VILL. Nov. App. (1880) 39; VIDAL, Phan. Cuming. Philip. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; BAILEY, Queensl. Fl. 1 (1899) 221; BACK. Schoolfl. Java (1911) 194; MERR. En. Philip. 2 (1923) 346; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 4.—*Ebelingia brownii* STEUD. Nom. ed. 2 (1840) 535; O.K. Rev. Gen. Pl. 1 (1891) 103.—**Fig. 9f.**

*Leaves* ternate; apical leaflet gradually narrowing into a 0–1 cm long petiolule,  $1\frac{1}{2}$ –8(–13) by  $\frac{1}{2}$ –

5(–8) cm; lateral leaflets usually oblique, cuneate towards the rachis, 1–5 by  $\frac{1}{2}$ –2 $\frac{1}{2}$  cm; petiole  $\frac{1}{2}$ –3 cm. *Cymes* and *thyrses* up to 5(–7) cm long. *Bracts* persistent, triangular, pubescent, c.  $1\frac{1}{2}$  mm long, once found like a small leaflet. *Flowers* 4(–5)-merous. *Pedicels* up to 6 mm. *Calyx* glabrous or sparsely hairy, c.  $\frac{1}{2}$  mm high. *Petals* lanceolate to oblong,  $3\frac{1}{2}$ –5 by  $1\frac{1}{2}$ –2 $\frac{1}{2}$  mm. *Anthers*  $1\frac{1}{2}$ –2 by 1 mm; filaments c. 2 mm; ligule 1–1 $\frac{1}{2}$  mm. Disk  $\pm$  short-cylindrical, slightly 8- or 10-lobed below the margin,  $\frac{1}{4}$ – $\frac{1}{2}$  mm high. *Ovary* c.  $\frac{1}{2}$ –1 mm high, rather deeply lobed; style  $\frac{1}{2}$ –2 $\frac{1}{2}$  mm. *Drupe* c. 4–5 by 7–9 mm; exocarp thin, fleshy; endocarp hard; each cell with an abaxial suture.

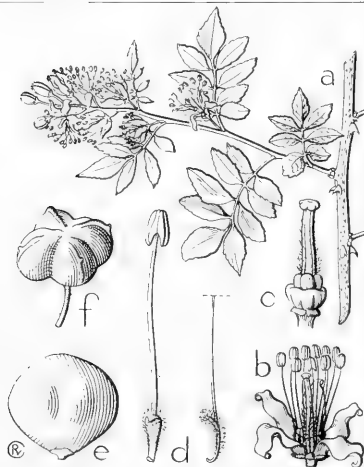


Fig. 9. *Harrisonia perforata* (BLCO) MERR. a. Flowering twig,  $\times \frac{2}{3}$ , b. flower,  $\times 2$ , c. gynaecium and disk,  $\times 4$ , d. stamens,  $\times 8$ , e. fruit, nat. size.—*H. brownii* A. JUSS. f. Fruit,  $\times 2$  (a MERRILL 433, b-d TEYSMA & DE VRIESE s.n., e KOORDERS 30017, f BACKER 19469).

Distr. North Australia (islands in the Gulf of Carpentaria), S. Andaman, and Malaysia: S. Philippines (Palawan, Mindanao, Cebu, Bohol, Siquijor), E. Celebes (Banggai Pen., Muna I.), E. Java (also Madura and Kangean), Lesser Sunda Islands (Bali, Sumba, Sumbawa, Flores, Timor, Wetar), S. Moluccas (Babar and Tanimbar Is), and SE. New Guinea. Fig. 10.

Ecol. and Uses. See under the genus.

Vern. Philip.: *kankasira*, Tagb., *malomanhak*, C. Bis.; *kaju bilis*, Md, *tadaibana*, *tara kedauk*, Sumba, *kai tudu*, Timor.

Notes. In one sheet I found detached fruits of which the cells had dehisced along the suture.

The species has erroneously been recorded from Malaya by KING (J. As. Soc. Beng. 62, ii, 1893, 227) and RIDLEY (Fl. Mal. Pen. 1, 1922, 360) in confusion with *H. perforata*.

The leaves of the S. Andaman specimen (KING s.n. 7-3-1891, in SING) agree with those of *H. brownii*, but the buds are immature and fruit is lacking, defeating proper identification. KURZ also with doubt referred material from the Andamans to *H. brownii* (Rep. Veg. Andam. 1870, 33) but his material was lost. Plant-geographically the Andamans represent a marked and unexpected extension of the range towards the west.

2. *Harrisonia perforata* (BLANCO) MERR. Philip. J. Sc. 7 (1912) Bot. 236; Fl. Manila (1912) 272; Sp. Blanc. (1918) 206; En. Philip. 2 (1923) 346;

CRAIB, Fl. Siam. En. 1 (1926) 243; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1946) 659; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 4; FORMAN, Kew Bull. 1957 (1958) 503.—*Paliurus perforatus* BLANCO, Fl. Filip. (1837) 174, ed. 2 (1845) 122, ed. 3, 1 (1877) 220.—*Paliurus dubius* BLANCO, ll. cc. 175, 123, and 221.—*Lasiolepis paucijuga* BENN. Pl. Jav. Rar. (1844) 202, t. 42.—*Lasiolepis multijuga* BENN. l.c. 204.—*Lasiolepis bennettii* PLANCH. in Hook. Lond. J. Bot. 5 (1846) 570, nom. illeg., incl. var. *a paucijuga* (BENN.) PLANCH. and var.  $\beta$  *multijuga* (BENN.) PLANCH.; MIQ. Fl. Ind. Bat. 1, 2 (1859) 678.—*Limonia pubescens* WALL. ex HOOK. f. Fl. Br. Ind. 1 (1875) 507.—*H. paucijuga* OLIV. Fl. Trop. Afr. 1 (1868) 312, in obs.; BACK. Fl. Bat. 1 (1907) 257; Schoolfl. Java (1911) 194; HEYNE, Nutt. Pl. (1927) 871.—*H. bennettii* BENN. in Fl. Br. Ind. 1 (1875) 519, nom. illeg.; KURZ, For. Fl. Burma 1 (1877) 203; F.-VILL. Nov. App. (1880) 39, incl. var. *paucijuga* and var. *multijuga*; VIDAL, Sinops. Atlas (1883) 19, t. 26 f. A; Phan. Cum. Philip. (1885) 101; Rev. Pl. Vasc. Filip. (1886) 78; LEC. Fl. Gén. I.-C. 1 (1911) 689; RIDL. Fl. Mal. Pen. 1 (1922) 360.—*Fagara piperita* (non L.) NAVES in Blanco, Fl. Filip. ed. 3, 1 (1877) t. 23, excl. syn. DC., cf. F.-VILL. Novis. App. (1880) 39 and MERR. Sp. Blanc. (1918) 206.—*Ebelingia paucijuga* O.K. Rev. Gen. Pl. 1 (1891) 103.—*H. citrinaecarpa* ELM. Leaf. Philip. Bot. 8 (1915) 2828.—*Ferri-niella pubescens* TANAKA, Bull. Mus. Hist. Nat. Paris II, 2 (1930) 161; ENGL. Pfl. Fam. ed. 2, 19a (1931) 354; SWINGLE in The Citrus Industry 1 (1943) 470; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1946) 651.—Fig. 9a-e.

Leaves 1-15-jugate, up to c. 20 cm; rachis narrowly winged, usually with a rib above, more or less pubescent, especially above; leaflets 10-20 by 5-15 mm; petiole  $\frac{1}{2}$ -3 cm. Branches of cymes and thyrses usually for some length adnate to the peduncle. Pedicels up to 2 mm. *Calyx* c.  $1\frac{1}{2}$  mm high, lobes c.  $\frac{3}{4}$  mm. *Petals* lanceolate, rarely oblong, 6-9 by 2-4 mm. *Anthers* c.  $1\frac{1}{2}$ - $4\frac{1}{2}$  mm; filaments 7-10 mm; ligule densely woolly at the margin, c. 2 mm. Disk cup-shaped, 1-2 mm high. *Ovary*  $\frac{1}{2}$ -1 mm high, slightly lobed; style pubescent, 5-8 mm. *Fruit* 4-9 by 11-15 mm; exocarp coriaceous, at least 1 mm thick; endocarp hard; no suture in the endocarp.



Fig. 10. Distribution of *Harrisonia brownii* A. Juss.

Distr. SE. Asia (Hainan, Cochinchina, Cambodia, Siam, and Burma) and *Malaysia*: Malay Peninsula (Perlis, ?Kedah, ?Perak), Philippines, N. Borneo (Sandakan), Celebes (also Buton), Java (also Madura and Kangean), S. Sumatra (Lampongs), and Lesser Sunda Islands (Bali). Fig. 11.

Ecol. and Uses. See under the genus.

Vern. Philip.: *asimau*, *laiya*, *mamigil*, Tag., *bakit*, *sapsapang*, Ilk., Pang., *dagiangas*, Mbo., *kamungi*, Sul., *muntani*, Bis., *sapleng*, Sbl.; *ri keng-keng*, J, Md., *garut*, *sēsēpang*, Lamp.

Note. In the sterile state sometimes difficult to distinguish from certain spp. of *Fagara* (*Zanthoxylum*) which have pellucid glands in the leaf and large glands along the margin near the teeth. However, in *H. perforata* the latter may occasionally also be observed.

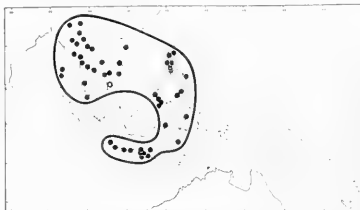


Fig. 11. Distribution of *Harrisonia perforata* (BLCO) MERR., from Asia following the drought corridor through Central Malaysia.

## 5. BRUCEA

J. F. MILL. Icon. (1779) t. 25, *nom. gen. cons.*; L' HÉRIT. Stirp. (1784) 19, t. 10; BRUCE, Travels 5, App. (1789) 69, tab.; Cartes & Fig. Voy. Nub. & Abess. (1792) t. 21; ENGLER, Nat. Pfl. Fam. ed. II, 19a (1931) 386.—*Lussa* RUMPH. [Herb. Amb. 7 (Auct.) (1755) 27, t. 15, *nom. inval.*] ex O.K. Rev. Gen. Pl. 1 (1891) 104.—*Gonus* LOUR. Fl. Coch. (1790) 158.—Fig. 12.

Very bitter, monoecious or dioecious shrubs or small trees; at least the younger parts pubescent or puberulous. *Leaves* exstipulate, imparipinnate, petiolar base and rachis-joints shrunken in the herb.; leaflets 3–15, more or less oblique, ovate to lanceolate, acuminate, entire or not, on the undersurface with scattered, flat, spot-like glands along the margin, situated under the teeth if these are present. *Flowers* uni- or bisexual, in axillary inflorescences (in Mal.) which consist of small cymes, united into bracteate, mostly unbranched raceme-like thyrses. *Sepals* 4, connate at the base, imbricate in bud, ovate-elongate or triangular, small. *Petals* 4, free, imbricate in bud, ovate-oblong, oblong or linear, small. *Disk* thick, with 4 lobes. *Stamens* 4, with short filaments, inserted between the lobes under the outer margin of the disk; filaments attached in the middle, basal, between the divergent latrorse cells of the cordate-ovate anthers. Stamens vestigial or absent in the ♀ flowers. *Ovaries* 4, free, ovate; ovule 1, anatropous, pendent, attached above the middle at the adaxial side. *Styles* free or coherent at the base, absent laterally, adaxially, short, subulate, widened in a thickened or club-shaped stigma, bent outward over the top of the ovary. Fruit ± drupaceous, hardly fleshy. Mature dried *nuts* ovoid, with 2 ribs; pericarp thin, endocarp wrinkled and hard. *Seeds* ovoid, with a thin testa and a thin to very thin endosperm; embryo with a short plumule and 2 planoconvex cotyledons.

Distr. Old World tropics, c. 4 spp. in tropical Africa and 2 in tropical Asia (to S. China & S. Formosa), Malaysia and North Australia; *B. javanica* introduced in Fiji and Ponape.

Notes. *Brucea* was on the list of *nomina generica conservanda* because of the name *Lussa* RUMPH., but as the RUMPHIUS names have no nomenclatural standing this conservation is unnecessary.

BACKER (Fl. Bat. 1907, 260) mentioned the rare occurrence of 5-merous flowers in *B. javanica*; I have not observed them.

MILLER'S *Icones* is in the B. M. Library; although cited generally as *Icones Animalium et Plantarum* the original title was *Various Subjects in Natural History* (STEARNS in litt.).



Fig. 12. *Brucea javanica* (L.) MERR. a. Twig in flower and fruit,  $\times \frac{2}{3}$ , b.  $\sigma$  flower,  $\times 8$ , c.  $\text{f}$  flower,  $\times 8$ , d. fruits,  $\times 2$ .—*Brucea mollis* WALL. ex KURZ. e. Leaf,  $\times \frac{2}{3}$ , f. fruit,  $\times 2$  (a after GRESHOFF, b ELBERT 2807, c COLFS 174, d ENDERT 1971, e-f RAMOS 13612).

## KEY TO THE SPECIES

1. Dried fruits 4-5 (-7) mm long, with pedicels of 2-6 mm. Endosperm 1/5-1/2 mm thick. Pedicels of the ♀ flowers up to 2 1/2 mm long! Leaflets always bluntly serrate or crenate with 6-15 pairs of nearly parallel nerves which without anastomosing directly end in a marginal gland; insertions of the lateral nerves 1-10 (-17) mm apart. . . . . **1. B. javanica**
1. Dried fruits 9-13 mm long, with pedicels of 4-10 mm. Endosperm membranous. Pedicels of the ♀ flowers up to 6 mm long. Leaflets entire or a little toothed, sometimes bluntly serrate, crenate or undulate, with 4-9 (-11) pairs of mostly not parallel nerves which usually anastomose before reaching the margin; insertions of the lateral nerves 3-30 mm apart . . . . . **2. B. mollis**

**1. Brucea javanica** (L.) MERR. J. Arn. Arb. 9 (1928) 3; BACKER, Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 5; A. C. SMITH, J. Arn. Arb. (1955) 279; NAIR & SUKAMARAN, Bot. Gaz. 121 (1960) 175-185 (floral morph. and embryol.).—*Rhus javanica* LINNÉ, Sp. Pl. (1753) 265; ed. 2 (1762) 380 (T. in LINNÉ).—*Lussa radja* RUMPH. Herb. Amb. (Auct.) 7 (1755) 27, t. 15.—*Gonus amarissimus* LOUR. Fl. Coch. (1790) 658 (T. in P.).—*Ailanthus gracilis* SALISB. Prod. (1796) 171.—*B. sumatrana* ROXB. Hort. Beng. (1814) 12, based on *Lussa radja* RUMPH.; SPRENG. Syst. Veg. 1 (1825) 441; DC. Prod. 2 (1825) 88; BLUME, Bijdr. 17 (1826) 1167; ROXB. Fl. Ind. ed. Carey 1 (1832) 449; BENN. Pl. Jav. Rar. (1844) 200; MIQ. Fl. Ind. Bat. 1, 2 (1859) 680; BTH. Fl. Austr. 1 (1863) 373; BENN. in Hook. f. Fl. Br. Ind. 1 (1875) 521; BAILEY, Queensl. Fl. 1 (1899) 218; BACKER, Fl. Bat. (1907) 260; Schoolfl. Java (1911) 192; LECOMTE, Fl. Gén. I.-C. (1911) 698; RIDL. Fl. Mal. Pen. 1 (1922) 361.—*B. sumatrensis* SPRENG. Pl. Min. Cogn. 2 (1815) 90.—*B. gracilis* DC. Prod. 2 (1825) 88.—*B. glabrata* DECNE, Nouv. Ann. Mus. Par. 3 (1834) 447, t. 20; Herb. Timor. Descr. (1835) 119; MIQ. Fl. Ind. Bat. 1, 2 (1859) 680.—*B. amarissima* DESV. ex GOMES in Mem. Acad. Sc. Lisb. n.s. 4, pars 1 (1872) 30; MERR. Philip. J. Sc. 10 (1915) Bot. 18; Int. Rumph. (1917) 299; BACKER, Trop. Natuur 11 (1922) 134; MERR. En. Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 241; N. C. NAIR, J. Bomb. Nat. Hist. Soc. 57 (1960) 237-238, t.—**Fig. 12a-d.**

Shrub or small tree, 0.3-10 m, up to 10 cm ø. Leaves 20-50 cm long; leaflets 3-15, ovate-oblong to ovate-lanceolate, sparsely hairy above, more or less pubescent beneath, sometimes completely glabrous, 3 1/2-11 by 1 1/2-5 cm, the younger ones usually densely pubescent; petiole 5-10 cm, lateral petiolules 2-9 mm, terminal one 3-40 mm. Peduncle almost absent, rachis 7-60 cm. Bracts deltoid, small. Flowers greenish-white to greenish-red or purple.—♂: Pedicels very slender, up to c. 3 mm long, sepals pubescent, sometimes toothed, c. 1/2-1 by 1/3-1/2 mm; petals sparsely pubescent to nearly glabrous, sometimes toothed, 1-2 by 1/2-1 mm; filaments subulate, c. 0.6 mm, anthers c. 0.4 mm long.—♀: Pedicels up to 2 1/2 mm, sepals and petals as in ♂; stamens 0 or vestigial. Mature dried drupes 1-4 together, 4-5(-7) mm long, pedicels 2-6 mm.

Distr. From Ceylon and the Deccan through

SE. Asia to S. China and S. Formosa, throughout Malaysia to N. Australia (N. Territory and N. Queensland); introduced in Fiji (A. C. SMITH, l.c.) and Micronesia: Ponape (KANEHIRA, En. Micr. Pl. 1935, 343), Fig. 13. It is most remarkable that the localities of this very tolerant plant are very scattered in East Malaysia; there is no material from the central Moluccas (Buru, Ceram, Ambon) and only one recent sheet from the Wassi Kussa area in New Guinea. RUMPHIUS knew it only from the Lesser Sunda Islands. From this distribution pattern it can be deduced that man has probably imported it in several places of its area, but this cannot be traced or proved in detail. Fig. 13.

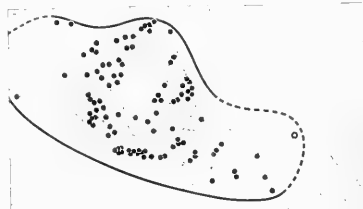


Fig. 13. Distribution of *Brucea javanica* (L.) MERR. (open dot after literature).

Ecology. A common, tolerant species, preferring open sites and light secondary forest and thickets, forest edges and ridges, even occurring in sunny places in sandy dunes and on limestone rocks, under both everwet and seasonal conditions (0-900 m).

In 1907 BACKER stated that all specimens he had seen had bisexual flowers; in 1911 he had received material from Semarang with ♂ and ♀ flowers. According to BACKER (1922) in Java specimens with bisexual flowers would be found only west of the line Semarang-Djokjakarta, plants with unisexual flowers east of it. In my opinion unisexual flowers prevail.—Fl. Jan.-Dec.

Uses. The very bitter roots and fruits are used as a medicine against dysentery and other fevers, and against diarrhoea. The leaves are applied against splenomegaly and internal pains, scurf, ringworm, boils, and centipede-bites. The fruits are well known under the name of *Makassar kernels*, E, and *Makassaarse pitjes*, D (GRES-

(1) The length of the pedicels in flower and fruit has been measured above the last bract or bracteole.

HOFF, Nutt. Ind. Pl. 1894, 71; HEYNE, Nutt. Pl. Ned. Ind. 1927, 871; BURKILL, Dict. Econ. Prod. Mal. Penin. 1, 1935, 370).

Vern. Malaya: *abëlor*, *chërëk jantan*, *ëmbalau*, *ë. bëtina*, *ë. padang*, *hëbëlur*, *hëmpëdu bëruang*, *kusum* (from the Chinese), *lada barau*, (*më*)*lada pait*, *malau*, *sarai pusur*, *sërajat*, *sisek manek*, *suntang hutan*; Sumatra: *dadih-dadih*, Karo, *tambar-si-pogu*, Toba Mal., *malur*, *sikalur*, *tambar bui*, *tambar sipago*, Batak, *bërul*, Lamp.; Java: *këndung peutjang*, *ki padësa*, *kuwalot*, *trawalot*, *walot*, S. *kwalot*, *tambara maritja*, J. *morindja*, M.; Philippines: *balaniog*, Chab., *bogo-bogo*, P. Bis., C. Bis., *magka payos*, S. L. Bis., *manongao-bobi*, C. Bis., *selte*, Yakan.

2. *Brucea mollis* WALL. [Cat. (1848) 8483] ex KURZ, J. As. Soc. Beng. 42, ii (1873) 64; BENN. Fl. Br. Ind. 1 (1875) 521; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 104; LECOMTE, Fl. Gén. 1.—C. 1 (1911) 698; MERR. En Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 241; MERR. & CHUN, Sunyatsenia 5 (1940) 89.—*B. luzoniensis* VIDAL, Sinops. Atlas (1883) 19 t. 26, f. B; MERR. Publ. Gov. Lab. Philip. no. 35 (1906) 26; Philip. J. Sc. 1 (1906) Suppl. 70.—*B. membranacea* MERR. Philip. J. Sc. 1 (1906) Suppl. 70.—*B. macrobotrys* MERR. Philip. J. Sc. 10 (1915) Bot. 19; En. Philip. 2 (1923) 347.—*B. stenophylla* MERR. Philip. J. Sc. 12 (1917) Bot. 274.—*B. acuminata* LI, J. Arn. Arb. 24 (1943) 445, *ex descr.*—Fig. 12e-f.

Shrub or small tree, 1–8 m, stem 3–10 cm ø. Leaves 20–60 cm long; leaflets 3–9(–13), ovate-oblong to ovate-lanceolate or lanceolate, entire, toothed, undulate, bluntly serrate, or crenate, glabrous or pubescent, 5–16 by 1–8 cm; petiole 2–13 cm, lateral petiolules 2–10 mm, terminal one 3–40 mm. *Inflorescence* and *flowers* as in *B. javanica*, but the pedicels of the ♀ flowers up to 6 mm long. Flowers white, creamy, green or red. Mature dried drupes 1–2(–3) together, 9–13 mm long.

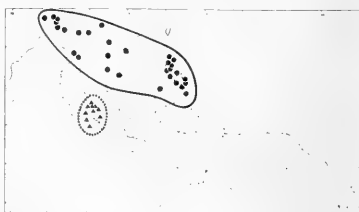


Fig. 14. Distribution of *Brucea mollis* WALL. ex KURZ (delineated, dots) and *Eurycoma apiculata* BENN. (dotted delineation, triangles).

Distr. From the East Himalayas, Burma, Siam, Laos, Cambodia, and Hainan, to *Malaysia*: throughout the Philippines. Fig. 14.

Ecol. Always in open forests, often in damp places, usually on slopes and ridges, 0–1800 m. Fl. Jan.–Aug.

Vern. Philippines: *makamara*, Mag., *suga*, Ig. Notes. The form with narrow leaflets, distinguished by MERRILL as *B. stenophylla*, occurs only above 1500 m. The form with large leaflets, distinguished by him as *B. macrobotrys*, occurs only at a low altitude. In my opinion these variations are only due to the influence of the altitude. As I saw a complete series of transitional forms I reduced both to *B. mollis*. *B. mollis* is more variable than *B. javanica*.

#### Excluded

*Brucea quercifolia* SEEM. Fl. Vit. (1865) 33, based on SEEMANN 105, coll. a. 1860 (K), is according to A. C. SMITH & W. L. STERN, Brittonia 14 (1962) 237–241, 16 fig. = *Dysoxylum quercifolium* (SEEM.) A. C. SMITH (*Meliaceae*).

## 6. PICRASMA

BLUME, Bijdr. 5 (1825) 247.—*Nima* HAM. ex A. JUSS. Mém. Mus. Hist. Nat. Paris 12 (1825) 516.—*Aeschrion* VELLOSO, Fl. Flum. (1825) 58, Ic. (1835) t. 152.—*Picraena* LINDL. Fl. Med. (1838) 208.—*Muenteria* WALP. Rep. 5 (1846) 398.—*Triscaphis* GAGNEP. Not. Syst. 13 (1948) 190; cf. Fl. Mal. I, 6 (1960) 49.—Fig. 15.

Monoecious or dioecious trees or shrubs. Branches pithy, almost glabrous. Leaves imparipinnate; base of the petiole and usually the rachis nodes swollen, ± shrunken when dry; leaflets opposite or subopposite. Stipules early caducous, triangular, ovate or orbicular, sometimes seemingly absent, but present on innovations. *Inflorescences* axillary, longish peduncled, compound-cymose, unisexual. Bracts small, whether or not early caducous. Pedicels articulated in the lower half. *Flowers* 4–5-merous, unisexual or functionally ♀, the ♀ ones usually twice as large as the ♂. *Sepals* small, free to united halfway up, persistent. *Petals* valvate or subvalvate in bud, the mucronate tips incurved, persistent in ♀ flowers, much longer than the sepals and sometimes accrescent. *Stamens* 4–5; anthers latrorse, emarginate.



Fig. 15. *Pircasma javanica* BL. a. Flowering twig,  $\times \frac{2}{3}$ , b. fullgrown stipules,  $\times \frac{2}{3}$ , c. ♂ flower,  $\times 6$  d. ♀ flower, petals and sepals removed,  $\times 6$ , e. fruits, nat. size (a, d DE VRIESE & TEYSMANN s. n., b NGF 10115, c JUNGHUHN s.n., e KOSTERMANS 431).

nate at the top, split from the base to halfway up, basidorsifixed, versatile; filament inserted at the narrowed base of the disk (torus). *Disk* rather thick, sometimes accrescent in fruit. *Carpels* up to 7, free, vestigial or absent in ♂ flowers; styles connate except at the base, sometimes 1 or 2 free; stigmas free, rather long, filiform. *Ovule* 1, basal. *Fruits* 1-4, drupaceous; exocarp thin, fleshy, wrinkled when dry, endocarp hard. *Seed* with a broad hilum; placenta adaxial, basal; testa rather thick and hard; no endosperm.

Distr. About 6 spp. in America (Mexico, West Indies, Venezuela, Brazil, Argentina), 2 spp. in Asia (Korea, Japan, S. China, and SE. Asia), one of which through *Malaysia* to the Solomon Is.

Note. *Triscaphis* GAGN., described in *Staphyleaceae*, is reduced here at the instigation of Mr AIRY SHAW.

1. *Picrasma javanica* BLUME, Bijdr. 5 (1825) 248; BENN. Pl. Jav. Rar. (1844) 197, t. 41; MIQ. Fl. Ind. Bat. 1, 2 (1859) 679; BENN. in Fl. Br. Ind. 1 (1875) 520; KURZ, For. Fl. Burma 1 (1877) 201; KING, J. As. Soc. Beng. 62, ii (1893) 227; K. & V. Bijdr. 4 (1896) 8; MERR. Bull. Bur. For. Philip. 1 (1903) 27; BACK. Schooffl. Java (1911) 192; LECOMTE, Fl. Gén. I.-C. 1 (1911) 699; KOORD. Atlas 2 (1914) t. 319; LAUT. Bot. Jahrb. 56 (1920) 344; RIDL. Fl. Mal. Pen. 1 (1922) 361; MERR. En. Philip. 2 (1923) 347; CRAIB, Fl. Siam. En. 1 (1926) 240; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1946) 667; BACK. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 6.—*Brucea dubia* STEUD. Nomencl. 1 (1841) 230, nomen.—*P. nepalensis* BENN. Pl. Jav. Rar. (1844) 201; in Fl. Br. Ind. 1 (1875) 520.—*P. andamanica* KURZ ex BENN. in Fl. Br. Ind. 1 (1875) 520.—*P. philippinensis* ELM. Leaf. Philip. Bot. 5 (1913) 1837.—*Triscaphis kerrii* GAGN. Not. Syst. 13 (1948) 190; Fl. Gén. I.-C. Suppl. 1 (1950) 999, f. 128 3-8.—Fig. 15.

Tree, up to 20 m, bole up to 15 m and 35 cm ø. Bark grey to brown, smooth, fissured. *Leaves* 2-3(-4)-jugate; petiole 2-6 cm, as the rachis terete, sparsely puberulous to glabrous; petioles 0-7 mm; leaflets entire, sometimes with a wavy or wrinkled margin, usually rather abruptly blunt-acuminate, cuneate at the base, 4-20 by 1-10 cm; nerves 3-8 pairs; on upper surface midrib crested, nerves narrowly sulcate, venation indistinct; underneath nerves and reticulate venation prominent. Stipules foliaceous, flabellate veined, nearly orbicular with rounded apex and acute base, 7-25 by 5-20 mm, usually early caducous, leaving a rather large scar. *Inflorescences* up to 20 cm long, planoconvex. Bracts obovate, rounded, very early caducous. *Flowers* 4-merous, white to yellow or green. Pedicels c. 10 mm in ♀ and up to 7 mm in ♂ flowers. *Sepals* glabrous to puberulous, triangular to ovate, acutish, c. 1 mm. *Petals* ovate-oblong or oblong, often acute-acuminate to mucronate, glabrous or sparsely hairy, with a conspicuous midrib, in ♂ flowers 2-5 by 1-2 mm; in ♀ flowers 3-7 by 3-5 mm, accrescent to 10-15(-20) by c. 7(-10) mm. *Disk* hairy, 4-lobed, ½-1 mm high. *Stamens* usually longer than petals in ♂ flowers, shorter than petals in ♀ flowers; filaments gradually thinner towards the top, hairy at the base, ½-2 mm in ♀ and 1-5 mm in ♂ flowers; anthers 1-2 by ¾-1½ mm in ♂ and up to 1 by ½ mm and barren in ♀ flowers. *Carpels* up to 4, glabrous or puberulous; styles 1-1½ mm, stigmas

c. 2 mm. *Fruits* 1-4, green to red or blue, ovoid to depressed-globose, c. 9-10 by 7-12 mm.

Distr. Tropical SE. Asia (from Sikkim, Assam, Burma, and Tonkin southward), throughout *Malaysia* to the Solomon Is. Fig. 16.



Fig. 16. Distribution of *Picrasma javanica* BL.

Ecol. Usually rather scarce, scattered in rain forests from sea-level up to 1500 m. *Fl. fr.* Jan.-Dec.

Uses. The bark contains quassin, which gives it a bitterness and causes it to be used in Burma and Java in lieu of quinine, though there is no alkaloid in it. In Java the leaves may be applied to sores. The trunk is too small for timber and the wood is not durable (HEYNE, Nutt. Pl. 1927, 872; BURK. Dict. 1935, 1723).

Vern. Philip.: *nalis*, Sul., *palumpang*, Bag.; Celebes: *tambara tédong*, Bonthain; Sumatra: *tuba lalat*, Karo, *t. ulét*, Palembang, *èmpèdu kajau*; Java: *ki bagara*, *k. brahma*, *k. pahit*, *k. tjaän*, *k. tjanting*, *k. tjitan*, *S. pati laler*, *J. kajau chutu*, Minah.; New Guinea: *snippa*, Numfoor, *annamur*, Biak.

Note. The second Asiatic species, *P. quassoides* (D. DON) BENN., occurs from the Himalayas to Japan and Korea; it is medicinal and is sometimes cultivated in Europe for ornamental purpose.—It is easily distinguished by its crenate or serrate leaflets, 5-merous flowers and smaller fruit (c. 5 mm).

#### Excluded

*Picrasma denhamii* SEEM. Fl. Vit. (1865) 33 from Aneityum, New Hebrides, is according to Mr J. E. DANDY (*in litt.*) = *Evodia triphylla* DC. Prod. 1 (1824) 724 (*Rutaceae*).



## 7. AILANTHUS

DESF. Mém. Phys. Math. Ac. R. Sc. Paris (1786) 270 t. 8, *nom. gen. cons.*; DC. Prod. 2 (1825) 88 (*Ailantus*); PIERRE, Fl. For. Coch. 4 (1892) t. 294-295; ENGLER in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 223; ed. 2, 19a (1931) 390; VAN TIEGHEM, Ann. Sc. Nat. IX, 4 (1906) 272.—*Pongelion* ADANS. Fam. Pl. 2 (1763) 319; VAN TIEGHEM, Ann. Sc. Nat. IX, 4 (1906) 272.—*Albonia* BUCHOZ, Herb. Color. Am. (1783) t. 57, *sine descr.*—*Hebonga* RADLK. Philip. J. Sc. 6 (1911) Bot. 365. Fig. 7f-g, 17, 18.

Tall, fast-growing, sometimes deciduous, dioecious trees. Branches thick, pithy; leaf-scars large. *Leaves* large, imparipinnate or paripinnate (with a prolonged rachis), sometimes on a single tree, more or less tufted at the ends of the twigs, multijugate, base of petiole often shrunken when dry; leaflets opposite or subopposite, oblique, usually acuminate, (in Mal.) entire, rachis and petiole terete, pithy, nearly always with some glands on the undersurface, usually near the base; midrib and lateral nerves prominent on the undersurface; petiole, rachis, petiolules, and branchlets of the panicles usually striate when dry. *Flowers* in axillary panicles, 5(-6)-merous. *Calyx* small, 5(-6)-lobed or closed in bud and later irregularly dehiscent (often 2-lobed) to the base, rarely cupular. *Petals* 5(-6), induplicate-valvate in bud, concave, oblong to narrowly oblong, still enlarging during anthesis. *Stamens* 10, in ♂ flowers inserted below the outer margin of the disk, in ♀ flowers either of subnormal size (but without pollen) or vestigial or absent; anthers oblong to broadly oblong, latrorse to extrorse, filaments dorsally attached halfway, the 2 cells free in their lower half. *Carpels* 2-5, free, flat, in the ♂ flowers vestigial or absent; styles 2-5, free or connate, inserted above the middle on the adaxial side; ovule 1, epitropous, anatropous, adaxially attached in the middle. *Fruit* a linear or oblong-lanceolate samara. *Seed* flat, orbicular or obovate or somewhat triangular, exalbuminous; testa thin; cotyledons 2, flat, planoconvex, radicle pointing upwards.

Distr. Five spp. in tropical and subtropical SE. Asia from Turkestan and India to China through Malaysia to the Solomon Islands, Queensland, and northern New South Wales; in Malaysia 2 species, not yet found in the Malay Peninsula. The seed of the Chinese *A. altissima* (MILL.) SWINGLE was received in England in 1751. The species was soon cultivated in Europe and N. America where it became widely naturalized and now occurs as a common weed on the outskirts of large cities; also naturalized in Australia.

According to the fossil record (fruits!) *Ailanthus* occurred during the Tertiary in Europe and North America.

Ecol. In Malaysia both in the rain-forest and in monsoon forest, below 1000 m, on the whole rather uncommon and never gregarious, in valleys, along streams, and in open places.

In literature it has often been suggested that the flowers might also be bisexual (e.g. by ENGLER, 1931) or the trees monoecious (ROXBURGH). I have, however, never observed bisexual flowers. The trees PRAIN observed (Ind. For. 28, 1902, 131-134, 210-211, t. 1-3; Contr. Ind. Bot. 1906, 1-6, t. 1-3) were all dioecious, as is the commonly cultivated *A. altissima* (MILL.) SWINGLE. The stamens which are often present in ♀ flowers do not contain pollen.

During anthesis the ♂ flowers emit a fetid, disgusting smell and for that reason ♂ trees are not desirable to cultivate as an ornamental.

The rarity of the species is remarkable as trees produce an immense number of membranous samaras fit for dispersal by wind. And if the species might be shade-intolerant one would expect them to settle as a nomad tree in glades, clearings, and open secondary forests.

Uses. See under the species.

Taxon. PIERRE, *l.c.*, subdivided the genus (*Pongelion*) into two sections, *Eupongelion* RUMPH. ex PIERRE and *Ailanthus* PIERRE, according to the occurrence of 1-3 or 5 styles respectively, but he placed *P. moluccanum* DC. erroneously in the first section. ENGLER, 1896, *l.c.*, accepted the sectional names of PIERRE, changing *Ailanthus* into *Euailanthus*, but distinguished them on another character, viz *Eupongelion* with free styles and *Euailanthus* with connate styles, thereby redistributing the species in a different way. No use was ever made of the structure of the calyx which seems to me a third character worthy of

consideration. Among the five species which I admit under the genus, one, *A. altissima*, has free styles, one, *A. triphysa*, has (2-) 3(-4) styles, and one, *A. integrifolia*, has a calyx closed in bud rupturing irregularly during anthesis. As these three characters are obviously not correlated, it appears that they are of specific value and cannot serve for subdividing the genus. This was also the opinion of VAN TIEGHEM, *l.c.* 272-280, who, in an elaborate anatomical study of the leaves proposed to distinguish two genera based on vegetative characters, *viz.* *Pongelion* with entire leaflets without glands and *Ailanthus* with dentate leaflets with under each tooth a gland. However, in the species with entire leaves also glands occur, either at the base or scattered, or in the forks of the lateral nerves near the margin. As the situation of the glands varies with the species, I can only conclude to the specific value of this character.

RICKETT & STAFLEU (Taxon 8, 1959, 302) erroneously assumed that *Pongelion* ADANS. is a *Leguminosa*. NOTES. The name of the genus is derived from RUMPHIUS'S Amboinese vernacular name *aylanto*, meaning tree of heaven, alluding to the lofty size of the Moluccan species.

Due to inadequacy of the material and the rarity of the species, specific distinction has been in great confusion. I felt necessitated to extend my study to all species described and could examine the types of many specific names. I have come to the conclusion that only 5 species can be distinguished; it is remarkable that DE CANDOLLE had four of them. Although only two of them have as yet been found in Malaysia, it is of interest to give a key to and synonymy of all of them. Though variable they can easily be distinguished in flower, fruit, and vegetatively.

In the herbarium flowers and fruit are never present on one sheet; field collectors are therefore requested to mark flowering trees to collect fruit later.

#### KEY TO THE SPECIES

##### based on flowering material

#### 1. Leaflets entire.

2. Petals puberulous. ♀ Flowers with 5 carpels. Stigmas long, stellately spreading. Leaflets ovate to elliptic-oblong, rarely ovate-lanceolate, usually with a few glabrous, large, black glands on the under-surface mostly near the base . . . . . **1. *A. integrifolia***
2. Petals glabrous or nearly so. Leaflets without large glands near the base, but some small glands may occur over the surface, either scattered or in vein-forks.
3. Calyx lobes as long as the tube or longer. ♀ Flowers with 3-4 glabrous carpels. Stigmas connate, peltate, slightly 3-4-lobed. Leaflets ovate to oblong-lanceolate, rarely ovate to elliptic-oblong. In the forks of the dichotomous-branching nerves usually a more or less hairy, often pitted gland, sometimes obscured by a hair tuft. . . . . **2. *A. triphysa***
3. Calyx lobes shorter than the tube. ♀ Flowers with 5 puberulous carpels. Stigmas free, stellately spreading. Leaflets as in *A. integrifolia* but not with large black basal glands; a few small flat glands scattered on the undersurface. (Hongkong.) . . . . . **5. *A. fordii***

#### 1. Leaflets toothed.

4. Leaflets coarsely toothed or lobed. Petiolules long, c. 2-4 cm. Petals glabrous or nearly so. Filaments as long as the anthers or shorter. Carpels sparsely longish hairy or pubescent; styles attached near the top, very short, free or connate, with long, outwards curling stigmas. (India and Ceylon.) . . . . . **3. *A. excelsa***
4. Leaflets with a few short, rarely rather large teeth near the base. Petiolules short, 1/2(-1) cm. Petals densely woolly hairy on the lower half of the margins and on the inner surface. Filaments twice as long as the anthers or longer. Carpels glabrous; styles attached nearly halfway, connate, c. 1 1/2 mm long, with a peltate, 5-lobed stigma c. 1 mm above the carpels. (China.) . . . . . **4. *A. altissima***

#### KEY TO THE SPECIES

##### based on fruit characters

#### 1. Leaflets entire.

2. Main vascular bundle towards seed in the margin of the samara . . . . . **1. *A. integrifolia***
2. Main vascular bundle towards seed intramarginal.
3. Samaras 4 1/2-7 1/2 cm long. Scar of style at the same level as the middle of the seed. . . . . **2. *A. triphysa***
3. Samaras 3-5 cm. Scar of style at the same level as the apex of the seed . . . . . **5. *A. fordii***

#### 1. Leaflets toothed.

4. Scar of style nearly at the same level as the apex of the seed. Main vascular bundle towards seed intramarginal . . . . . **3. *A. excelsa***
4. Scar of style nearly at the same level as the middle of the seed. Main vascular bundle towards seed in the margin of the samara . . . . . **4. *A. altissima***



Fig. 17. Leaflets of *Ailanthus* spp. a. *A. integrifolia* LAMK, b. *A. triphysa* (DENNST.) ALSTON, c. ditto, glandular domatium, d. *A. excelsa* ROXB., e. *A. altissima* (MILL.) SWINGLE, all  $\times \frac{2}{3}$  (a WATERHOUSE 664, b-c VILLAMIL 20972, d DRUMMOND 21597).

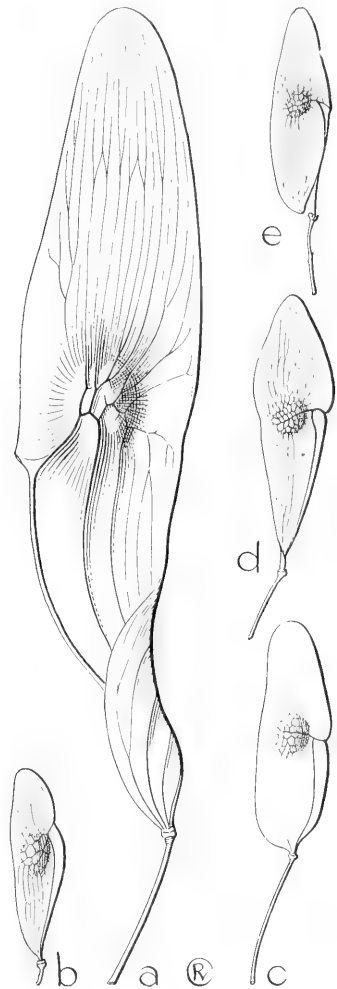


Fig. 18. Fruits of *Ailanthus* spp. a. *A. integrifolia* LAMK, b. *A. fordii* NOOTEBOOM, c. *A. triphysa* (DENNST.) ALSTON, d. *A. excelsa* ROXB., e. *A. altissima* (MILL.) SWINGLE, all  $\times \frac{2}{3}$  (a WATERHOUSE 664, b. HANCE 1497, c CURRAN 3847, d DRUMMOND 21597).

**1. *Ailanthus integrifolia* LAMK, Dict. 3, 2 (1792) 417, based on *Arbor coeli sive Caju langit*, RUMPH. Herb. Amb. 3 (1743) 205, t. 132; MERR. Int. Rumph. (1917) 299.—*A. pongelion* GMEI. Syst. Veg. 1 (1791) 726, *nom. illeg.*, *pro parte*, *tab. Rumph.*; BLOO, Fl. Filip. (1837) 380; ed. 2 (1845) 268; ed. 3, 2 (1878) 134, *excl. syn. malab.*—*A. moluccana* DC. Prod. 2 (1825) 89, *nom. illeg.*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 679; KOORD. Minah. (1898) 374, *incl. var. mollis* (K. & V.) KOORD.; VAL. Ic. Bog. 1 (1901) t. 82; BACK. Schoofl. Java (1911) 191; KOORD. Atlas 2 (1914) t. 321, 1–K.—*Dysoxylum dasyphyllum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 19, *pro sched. de VR. & T.*, *cf. KOORD. Minah. (1898) 374.*—*A. malabarica* (*non DC.*) F.-VILL. Nov. App. (1883) 349, *non vidi*; K. & V. Bijdr. 4 (1896) 3, *incl. var. mollis* K. & V. *pro parte.*—*A. calycina* PIERRE, Fl. For. Coch. 4 (1892) t. 294 A (plate); LECOMTE, Fl. Gén. I.-C. 1 (1911) 696; KOORD. Exk. Fl. Java 2 (1912) 432; Atlas 2 (1914) t. 321 A–H; KOORD.-SCHUM. Syst. Verz. 1 § 1 fam. 138 (1913) 18; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 6 (1948) fam. 146, p. 7.—*Pongelion calycinum* PIERRE, Fl. For. Coch. 4 (1892) t. 294 A (text).—*A. grandis* PRAIN, Ind. For. 28 (1902) 131, t. 1, 210, repr. Contr. Ind. Bot. (1906) 1, 5.—*Pongelion grandis* VAN TIEGH. Ann. Sc. Nat. IX, 4 (1906) 278.—*A. blancoi* MERR. Sp. Blanc. (1918) 205; En. Philip. 2 (1923) 348.—*A. peekelii* MELCH. Notizbl. Berl.-Dahl. 10 (1930) 893; C. T. WHITE, J. Arn. Arb. 31 (1950) 91, *incl. var. glabrata.*—**Fig. 7f–g, 17a, 18a.****

Tree, up to 60 m high, bole occupying c.  $\frac{3}{4}$  of the length, up to 75(–175) cm  $\phi$ ; bark smooth, light brown or grey; crown dense. *Leaves* 2–9-jugate (apical leaflet mostly vestigial), c. 30–200 cm long; leaflets very oblique, usually falcate and acuminate with an obtuse tip, glabrous above, sometimes more or less pubescent beneath, especially on the midrib and the 6–13 pairs of nerves, 10–40 by 4–15 cm; usually a few black, flat, orbicular or oblong glands c.  $\frac{1}{2}$ –5 mm  $\phi$  mostly near the base of the undersurface sometimes seemingly separated from the parenchyma as a loose membrane; petiole glabrous or puberulous, 5–20 cm; petiolules glabrous or puberulous,  $\frac{1}{2}$ –1 $\frac{1}{2}$  cm. *Panicles* loose, up to c. 40 cm or more, glabrous or pubescent. Bracts small, triangular, very early caducous. Pedicels up to c. 15 mm in anthesis. *Calyx* more or less pubescent, closed in bud, rupturing and toothed irregularly, rarely cupular, 1–4 mm high, rarely caducous. *Petals* puberulous, acute or bluntish, up to c. 9 by 3 mm. *Filaments* with many long spreading hairs to glabrous, usually thickened downwards, c.  $\frac{1}{2}$  mm in  $\sigma$  to 4 mm long in  $\delta$ ; anthers c. 1 mm in  $\sigma$  to 2 $\frac{1}{2}$  mm long in  $\delta$ . *Carpels* 5, usually densely puberulous; styles 5, connate at the base, including the long, stellately spreading stigmas, up to c. 6 mm long. *Samaras* (1–)3–5, with obtuse apex, more or less prominently reticulate or lengthwise striate, c. 11–22 by 2 $\frac{1}{2}$ –5 cm; main vascular bundle to the seed in the adaxial margin; scar of the style beneath the seed; pedicel 2 $\frac{1}{2}$ –5 cm.

Note. Of *A. integrifolia* LAMK two replacing races can be distinguished which differ in the size of the flowers, but unfortunately cannot be discriminated in sterile state or in fruit. I have mapped the localities of flowering specimens through which it appeared that the small-flowered race is apparently restricted to seasonal regions in SE. Asia and Central to East Java, whereas the large-flowered form occurs only in the everwet forest. The type of *A. integrifolia* LAMK, obviously belongs to the large-flowered race.

*ssp. integrifolia.*—*A. integrifolia* LAMK.—*A. pongelion* GMEI.—*A. moluccana* DC.—*A. moluccana* var. *mollis* (*non K. & V.*) KOORD. 1898.—*Dysoxylum dasyphyllum* MIQ.—*A. blancoi* MERR.—*A. peekelii* MELCH., *incl. var. glabrata.*

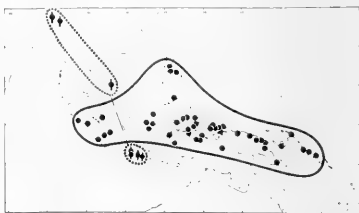


Fig. 19. Distribution of *Ailanthus integrifolia* LAMK *ssp. integrifolia* (delineation with continuous line) and *ssp. calycina* (PIERRE) NOOTEBOOM (delineation with dotted line).

Pedicels up to 15 mm. Calyx 2–3 mm high. Petals 6–10 mm long, evenly hairy outside.

Distr. Melanesia (Bismarcks and Solomons), in Malaysia: all islands, except Java and the Lesser Sunda Islands. Fig. 19.

Ecol. In primary rain-forest, very rare, locally rather common in North New Guinea, in New Ireland said to be commoner than *Pometia*, *Alstonia*, and *Octomeles*, both in the primary and secondary forest, from the lowland up to 900 m. Fl. Jan.–Dec., fr. March, April, Nov.

Uses. Made into planks for housing etc. in New Guinea and the Bismarcks; the sapwood is white, yellow, pale brown or creamish, and is very soft and not durable; heartwood is absent (HEYNE, Nutt. Pl. Ned. Ind. 1927, 1499).

Vern. Philippines: *balokas*, Tagb., *makaisa*, *malaadiás*, *malasapsáp*, Tag.; *aylanto*, *kaju langit*, Ambon; New Guinea: *won*, Karoon lang., *broes*, Mooi lang., *aisasa*, Upper Waria, *limoetiti*, Kebar lang., *kokop*, *kun-kun*, New Britain.

*ssp. calycina* (PIERRE) NOOTEBOOM, *comb. nov.*—*A. malabarica* var. *mollis* K. & V., *pro parte.*—*A. calycina* PIERRE.—*Pongelion calycinum* PIERRE.—*A. grandis* PRAIN.—*Pongelion grandis* VAN TIEGH.

Pedicels up to 5 mm. Calyx shorter than 2 mm. Petals c. 4 mm long, the margins densely, the outer surface laxly hairy.

Distr. SE. Asia (Assam, Sikkim, Cochinchina), in Malaysia: Central to East Java. Fig. 19.

Ecol. Mixed primary forest, obviously under seasonal conditions.

Vern. *Raden, tawa, J.*

2. *Ailanthus triphysa* (DENNST.) ALSTON, *Handb. Fl. Ceyl.* VI, Suppl. (1931) 41.—*A. integrifolia* var.  $\beta$  LAMK, *Dict.* 3, 2 (1792) 417, *typ. rheed.*—*Adenalthera triphysa* DENNST. Schüss. *Hort. Mal.* (1818) 32, based on *Pongelion* RHEDE, *Hort. Mal.* 6 (1686) 27 t. 15.—*A. malabarica* DC. *Prod.* 2 (1825) 89, *nom. illeg.*; W. & A. *Prod.* (1834) 150; WIGHT,  *Ic.* (1850) t. 1604; DALZ. & GIBS. *Bomb. Fl.* (1861) 46; BRANDIS, *For. Fl.* (1874) 58; BENN. in *Hook. f. Fl. Br. Ind.* 1 (1875) 518; PIERRE, *Fl. For. Coch.* 4 (1892) t. 294 B; TRIMEN, *Handb. Fl. Ceyl.* 1 (1893) 230; K. & V. *Bijdr.* 4 (1896) 4, *incl. var. mollis* K. & V. *pro parte*; PRAIN, *Ind. For.* 28 (1902) 132, t. 3 A, repr. *Contr. Ind. Bot.* (1906) 132; LECOMTE, *Fl. Gén. I.-C.* 1 (1911) 692; BACK, *Schoolfl. Java* (1911) 191; FRANCIS, *Austr. Rain-For. Trees* (1929) 174, t. 110, 111; ed. 2 (1951) 196, t. 112, 113; KOORD. *Atlas* 2 (1914) t. 320; BAKH. *f.* in *Back. Bekn. Fl. Java* (em. ed.) 6 (1948) fam. 146, p. 6.—*A. imberbiflora* F. v. M. *Fragm.* 3 (1862) 42; BENTH. *Fl. Austr.* 1 (1863) 373; BAILEY, *Queensl. Fl.* 1 (1899) 217; FRANCIS, *Austr. Rain-For. Trees* (1929) 174, t. 110, 111; ed. 2 (1951) 196, t. 112, 113.—*A. fauveliana* PIERRE, *Fl. For. Coch.* 4 (1892) t. 295 B (plate); LECOMTE, *Fl. Gén. I.-C.* 1 (1911) 692; CRAIB, *Fl. Siam. En.* 1 (1926) 240.—*Pongelion fauvelianum* PIERRE, *Fl. For. Coch.* 4 (1892) t. 295 B (text).—*Pongelion malabaricum* PIERRE, *l.c.* t. 294.—*Pongelion imberbiflora* PIERRE, *l.c.* t. 294.—*A. kurzii* PRAIN, *Ind. For.* 28 (1902) 133, t. 3 B, repr. *Contr. Ind. Bot.* (1906) 3.—*A. philippinensis* MERR. *Publ. Gov. Lab. Philip.* no 35 (1906) 25; Philip. *J. Sc.* 1 (1906) Suppl. 70; *ibid.* 2 (1907) Bot. 431.—*Hebonga obliqua* RADLK. *Philipp. J. Sc.* 6 (1911) Bot. 366; BOAS, *Beitr. Anat. Syst. Simar.* (1912) 49; repr. in *Fedde, Rep.* 13 (1914) 290; MERR. *En.* 2 (1923) 348.—*Hebonga mollis* RADLK. *l.c.* 367; BOAS, *l.c.*; MERR. *l.c.*—*Hebonga siamensis* RADLK. *ex* CRAIB, *Kew Bull.* (1912) 264; *Fl. Siam. En.* 1 (1926) 243; GAGNEP. *Fl. Gén. I.-C.* Suppl. 1 (1946) 668.—Fig. 17b-c, 18c.

Tree, up to 45 m high and  $\frac{3}{4}$  (1-1/2) m  $\phi$ . *Leaves* 6-17(-30)-jugate, 20-70 cm long; leaflets glabrous above, more or less pubescent beneath, obliquely ovate-lanceolate to oblong-lanceolate, rarely ovate or oblong, falcate, acuminate, (5-) 9-15(-26) by  $2\frac{1}{2}$ -5 $\frac{1}{2}$  cm; nerves 8-20 pairs; usually at the end of the midrib beneath a hairy gland, making the apex obtuse or even emarginate, apex rarely acute; on the undersurface in the forks of the usually dichotomous-branching nerves usually a circumvallate, more or less hairy, often pitted gland, sometimes obscured by a hair tuft. *Panicles* dense and many-flowered, more or less pubescent, c. 20-60 cm long. Bracts small, ovate to triangular, caducous. Pedicels up to c. 4 mm. *Calyx* pubescent, less than 1 mm high, the trian-

gular, acute lobes as long as the tube or a little longer. *Petals* glabrous or nearly so, c. 3-5 by 1-1 $\frac{1}{2}$  mm. *Filaments* tortuous-folded in bud, filiform or sometimes attenuating from the base to the top, usually with spreading hairs beneath, c. 1-3 mm long in  $\phi$  and c. 3-6 mm long in  $\sigma$  flowers; anthers c. 1.2 by 1 mm in  $\sigma$  flowers, smaller in  $\phi$  flowers. *Carpels* (2-)3(-4), glabrous, c. 2-2 $\frac{1}{2}$  by 1-1 $\frac{1}{2}$  mm; styles free or coherent at the base, connate at the top, c. 1-1 $\frac{1}{2}$  mm; stigma (2-)3(-4)-lobed, peltate, c. 2 mm  $\phi$ . *Samaras* 1-3(-4), obtuse at the apex, main vascular bundle towards the seed intramarginal, scar of the style at the same level as the seed, c. 4 $\frac{1}{2}$ -8 by 1 $\frac{1}{2}$ -2 $\frac{1}{2}$  cm; pedicels 8-20 mm.

Distr. SE. Asia: India (Concan, Malabar, Canara), Ceylon, Burma, Siam, Vietnam, through Malaysia (except the Malay Peninsula, Sumatra, the Lesser Sunda Is, and New Guinea) to Queensland and the north of New South Wales. Fig. 20.

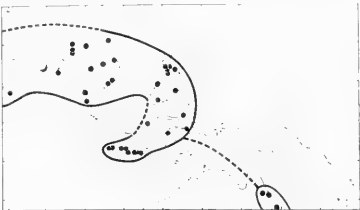


Fig. 20. Distribution of *Ailanthus triphysa* (DENNST.) ALSTON.

Ecol. In forests, usually very rare, under both everwet and seasonal conditions, according to BURKILL intolerant of shade, from the lowland up to  $\pm$  600 m. Fl. Jan.-Dec.

Uses. The resin, obtained by making incisions in the bark, is used as incense and medicinally in India. In Indo-China the bark is burned as incense. The bark and the leaves are in great repute as a tonic, especially in debility after childbirth. They also possess febrifuge properties and are useful in dyspeptic complaints. The wood is used for making wooden shoes in Luzon; in India for fishing floats, catamarans, sword-handles, and spear-sheaths, and in Ceylon for teaboxes (BURKILL, *Dict. Ec. Prod. Mal. Pen.* 1, 1935, 79).

Vern. *Ki pahit, S, sèlangkè*, Central J; *Philipp.: empau, Tagb., kalauag, Bik., hebong, makaisa, malaaduás*, Tag.

3. *Ailanthus excelsa* ROXB. *Pl. Corom.* 1 (1795) 24, t. 23; DC. *Prod.* 2 (1825) 89; ROXB. *Fl. Ind.* ed. Carey 2 (1832) 450; W. & A. *Prod.* (1834) 150; GRAH. *Cat. Bomb. Pl.* (1839) 37; WIGHT, *Ill. Ind. Bot.* 1 (1840) 170 t. 67; BENN. in *Hook. f. Fl. Br. Ind.* 1 (1875) 518; PIERRE, *Fl. For. Coch.* 4 (1892) t. 295 A; PRAIN, *Ind. For.* 28 (1902) t. 2 B; VAN TIEGH. *Ann. Sc. Nat.* IX, 4 (1906) 277.—*Pongelion excelsum* PIERRE, *Fl. For. Coch.* 4 (1892) t. 295 A.—*Pongelion wightii* VAN TIEGH.

Ann. Sc. Nat. IX, 4 (1906) 277.—**Fig. 17d, 18d.**  
Distr. South, Central, and NW. India (in the last probably introduced) and Ceylon.

NOTE. VAN TIEGHEM, *l.c.*, rightly observed that there is a discrepancy between the figures given by ROXBURGH and by WIGHT, the latter being in entire accordance with the material, that of ROXBURGH deviating by very short petiolules and very long filaments. As there is only one species on the Coromandel Coast with dentate leaflets I assume that ROXBURGH's plate is inaccurate in detail. Therefore I have reduced *Pongelion wightii* TIEGH., based on WIGHT's plate, to the synonymy. Dr. SANTAPAU (*in litt.*), after having examined the specimens in the Blatter Herbarium, agreed with this interpretation.

4. *Ailanthus altissima* (MILL.) SWINGLE, J. Wash. Ac. Sc. 6 (1916) 495; REHDER & WILSON, J. Arn. Arb. 9 (1928) 86; CRONQUIST, Brittonia 5 (1944) 146; E. ANDERSON, Bull. Mo. Bot. Gard. 49 (1961) 105–107, 2 fig.—*Toxicodendron altissimum* MILL. Gard. Dict. ed. 8 (1768) n. 10.—*Rhus cacodendron* EHRH. Hann. Mag. (1783) 227, non vidi.—*Albionia peregrina* BUCHOZ, Herb. Color. Am. (1783) t. 57.—*A. glandulosa* DESF. Mém. Math. Phys. Ac. R. Sc. Paris (1786) 265, t. 8; AITON, Hort. Kew. 3 (1789) 443; DC. Prod. 2 (1825) 89; W. & A. Prod. (1834) 150; MIQ. Fl. Ind. Bat. 1, 2 (1859) 678; KOCH, Dendrol. 1 (1869) 569; BAILEY, Queensl. Fl. 1 (1899) 218; PRAIN, Ind. For. 28 (1902) t. 2. A.—*A. cacodendron* L'HÉRIT. Stimp. Nov. 6 (1790) 179; SCHINZ & THELL. Mém. Soc. Nat. Sc. Cherbourg IV, 38 (1911–12) 679.—*A. pongelion* GMEL. Syst. Veg. 1 (1791) 246, nom. illeg., pro parte, cit. tab. Desfont.—*A. procera* SALISB. Prod. (1796) 171, ex Ind. Kew.—*A. rhodoptera* F. v. M. Fragm. 3 (1862) 43, ex descr.—*A. erythrocarpa* CARR. Rev. Hortic. (1867) 419.—*Pongelium glandulosum* PIERRE, Fl. For. Coch. 4 (1892) t. 294.—*A. macrophylla* ex Handl. Trees Kew pt 1 (Polypet.) (1894) 53, cult., ex Ind. Kew.—*A. mascula* *l.c.*—*A. rubra* *l.c.*—*A. vilmoriniana* DODE, Rev. Hortic. (1904) 444.—*Pongelium vilmorinianum* VAN TIEGH. Ann. Sc. Nat. IX, 4 (1906) 278.—*A. giraldii* DODE, Bull. Soc. Dendr. Fr. (1907) 191.—*A. sutchuensis* DODE, *l.c.*—*Pongelion cacodendron* FARWELL, Am. Midl. Nat. (1930) 67.—*A. peregrina* F. A. BARKLEY, Ann. Mo. Bot. Gard. 24 (1937) 264.—**Fig. 17e, 18e.**

Distr. Native in China, cultivated in nearly all countries of the world with a temperate or subtropical climate, and often naturalized.

NOTE. The type specimen (from a cultivated tree) of *A. vilmoriniana* DODE agrees in all respects save that the branches and leaf rachis bear small spines which are further unknown in the genus.

5. *Ailanthus fordii* NOOTEBOOM, *nov. sp.*

*Arbor parva, teste collectore palmae habitu conspicua. Foliola 6–13-juga, integrae, subtus glandulis parvis applanatis sparse munita. Pedicelli 1–2 mm. Flores paniculati, ultimi 1–3 aggregati.*

*Calyx cupulatus* c. ½ mm longus, breviter obtuse 5-lobatus. *Petala* 5, glabra, oblonga, 2–3 mm longa, c. 1 mm lata. *Stamina glabra, in floribus ♂ in alabastro plicata* c. 3–5 mm longa, in floribus ♀ c. 1–3 mm longa. *Discus superne* 5-lobatus, ½–1 mm altus. *Carpella* 5, dense puberula, stylis connatis ½–1 mm longis terminata. *Stigmata* 5, libera, basi excepta excavata, 1–1½ mm longa. *Samara* 3–5 cm longa, 1–1¼ cm lata; fasciculus vasorum seminem versus intramarginalis; styli cicatrix seminis apici opposita.—*Typus*: CH. FORD *s.n.* (K; isotype BM), Hongkong, Cape Aquilar.—**Fig. 18b.**

Small but conspicuous tree, *sec. coll.* 'the bare trunk surmounted with foliage like a palm'. *Leaves* c. 40 cm long; leaflets 6–13 pairs, opposite to subopposite, entire, glabrous or nearly so, with few, small, flat glands scattered on the undersurface; petiole 7–13 cm; rachis puberulous to glabrous. *Panicle* large, dense-flowered, pyramidal, 20–40 cm long and c. 20 cm wide at the base; branches of the first, and sometimes also of the 2nd and 3rd order with a conspicuous constricted articulation at the base. *Pedicels* 1–2 mm. *Bracts* small, triangular, not early caducous. *Flowers* 1–3 together, unisexual, the ♀ ones with reduced stamens. *Calyx* cupular, c. ½ mm high, with 5 short, obtuse lobes. *Petals* 5, glabrous, ± oblong, 2–3 by c. 1 mm. *Stamens* glabrous, in ♂ flowers sinuous in bud, 3–5 mm long, in ♀ flowers c. 1–3 mm long; anthers c. ¾ mm long, sterile in ♀ flowers. *Disk* 5-lobed on top, ½–1 mm high. *Carpels* 5, densely puberulous; styles connate, ½–1 mm high, more or less puberulous; stigmas 5, free, except at the very base, recurved-curved outwards, 1–1½ mm long. *Samara* 3–5 by 1–1¼ cm; main vessel to seed intramarginal; stylar scar at the same level as the apex of the seed.

Distr. Hongkong, near Cape Aquilar quite common (FORD; 1884–1886); emergent from shrubberies along ravines.

NOTE. This species differs from *A. triphysa* in having 5 pubescent carpels, long free stigmas, a very short lobed cupular calyx, the stylar scar being at the same level as the apex of the seed. It differs from *A. integrifolia* in the leaflets never having 2 large glands at the base, in the flowers being much smaller and the petals being glabrous, and in the main vascular bundle towards the seed in the samara which is intramarginal.

#### Excluded

*Ailanthus mairei* GAGNEP. Not. Syst. 11 (1944) 164 from Yunnan = *Toona sinensis* (JUSS.) ROEM. (Meliaceae).

*Ailanthus punctata* F. v. M. Fragm. 3 (1862) 42, cf. BENTH. Fl. Austr. 1 (1863) 373 = *Pentaceras australis* HOOK. f. (Rutaceae).

*Ailanthus scripta* GAGNEP. Not. Syst. 11 (1944) 165 from Yunnan = *Rhus vernicifera* DC. (Anacardiaceae).

## 8. SOULAMEA

LAMK, Dict. Enc. Méth. 1 (1783) 449; GUILLAUMIN, Bull. Soc. Bot. Fr. 85 (1938) 20.—*Cardiocarpus* REINW. Syll. Ratisb. 2 (1826) 14, 48, *nom. illeg.*—*Cardiophora* BENTH. in Hook. Lond. J. Bot. 2 (1843) 216.—*Amaroria* A. GRAY in Wilkes, U.S. Expl. Exp. 1 (1854) 356, t. 40.—**Fig. 21.**

Shrubs or small trees. *Leaves* simple (imparipinnate in some New Cal. *ssp.*), sometimes with a few glands underneath. *Flowers* in axillary racemes or narrow thyrses, 3(–4–5)-merous, bisexual or unisexual (in New Cal. and the Seychelles); floral parts persistent. Bracts minute. *Sepals* more or less connate at the base, slightly imbricate in bud. *Petals* not touching, longer than sepals. Stamens twice as many as petals, in 2 distinct rows, inserted under the lower outer margin of the disk; filaments attached adaxially, versatile; cells latrorse, diverging at both ends, connective very short. Disk 3(–4–5)-lobed, each lobe forked. *Carpels* (1)–2(–3), connate; ovules sessile, anatropous; style horizontally adnate to its carpel, except for a short free patent tip; stigma small, rarely reniform. *Fruit* dry, (1)–2(–3)-celled, indehiscent, flattened, distinctly winged, more or less emarginate, rarely flattened, ovoid, acute. *Seed* attached adaxially nearly halfway down, with more or less albumen; testa thin; cotyledons planoconvex.

Distr. One *sp.* endemic in the Seychelles (Mahé I.), one *sp.* widely distributed in *Malaysia* and *Polynesia*, 6 *ssp.* in New Caledonia, and one in Fiji.

*Notes.* The monotypic Fijian genus *Amaroria* can in my opinion not be upheld against *Soulamea*. It differs merely by having one carpel, against 2–3 in *Soulamea*. The characteristic, emarginate fruit shape of the 2-celled *Soulameas* cannot be expected to occur in the 1-celled *Amaroria*, as this shape is precisely caused by the presence of 2 not entirely connate cells and absence of a terminal style; the difference in fruit shape is thus a compulsory structural consequence. Geographically it fits well with the distribution of the genus. Like the other inland species of the genus, *S. soulameoides* (A. GRAY) NOOTEBOOM, *comb. nov.* (*Amaroria soulameoides* A. GRAY, *l.c.*) has unisexual flowers.

The specimen I saw of *S. terminalioides* BAKER, from the Seychelles, is strongly suggestive of *S. amara* LAMK. It differs in the leaves (rounded apex), fruit (3-winged), and unisexual flowers.

All New Caledonian species have also unisexual flowers and besides less emarginate fruits. They differ *inter se* hardly in their generative parts, and are obviously very closely allied. The main differences are in their leaf structure, varying from 1–11 leaflets, and the indument. The first character is, however, not particularly important taxonomically as JADIN has demonstrated that simple and compound leaves may occur on a single plant (Ann. Sc. Nat. VIII, 13, 1901, 283–285, t. 1).

Although the littoral *S. amara* has not been found in New Caledonia it seems that whereas the largest (phenotypic and genetic) variability occurs in that island, and that inland, the origin of the genus and its distribution must have taken place in Melanesia. It is not impossible that in its primitive state it was unisexual – and in that case the Seychelles 'species' could be considered a marginal relic – and that it has later become bisexual by selection on the littoral.

The 'escape' of a littoral species from an inland aggregate finds a marked parallel in *Casuarina*, *Spinifex*, and some other genera.

*Soulamea* shows a striking resemblance in habit with *Lunasia* (*Rutac.*).

**I. *Soulamea amara*** LAMK, Dict. Enc. Méth. 1 (1783) 449; BL. Bijdr. 2 (1825) 60; ENDL. Ann. Mus. Wien 1 (1836) 188, t. 16; BENTH. Voy. Sulphur (1844) 181, t. 56, *textu*; MIQ. Fl. Ind. Bat. 1, 2 (1859) 129; HEMSLEY, Bot. Chall. 3 (1885) 235; WARB. Bot. Jahrb. 13 (1891) 341; BACK. Schoolfl. Java (1911) 193; MERR. Int. Rumph. (1917) 300; LAUT. Bot. Jahrb. 56 (1920) 344; HEYNE, Nutt. Pl. (1927) 872; STEEN. Bull. Jard. Bot. Btzg III, 12 (1932) 259, f. 13 map 3; KANEHIRA, J. Dep. Kyushu Imp. Un. 4, 6 (1935) 343; K. SCH. & LAUT. Fl. Schutzgeb. Südsee (1901) 378 ('*Sulamea*'); GUILLAUMIN, Ann. Mus. Col. Mars. 55/56 (1948) 28.—*Rex amaroris* RUMPH. Herb.

Amb. 2 (1743) 129, t. 41.—*Cardiocarpus amarus* REINW. Syll. Ratisb. 2 (1826) 14.—*Cardiophora hindsii* BENTH. in Hook. Lond. J. Bot. 2 (1843) 216; Voy. Sulphur (1844) 181, t. 56, *ic.*—**Fig. 21.**

Shrub or small tree, up to 5(–15) m. Innovations rusty tomentose. Branchlets 5–15 mm  $\sigma$ , rather abruptly narrowed at the apex, with a thick pith. *Leaves* simple, crowded at the apex of the branchlets, leaving large scars, obovate-oblong and with a blunt but never rounded apex which is sometimes mucronate, cuneate at the base, hairy on midrib, nerves and veins below, 10–35 by 4–12 cm; midrib slightly immersed or inconspicuous above, strongly



Fig. 21. *Soulamea amara* LAMK. a. Fertile twig,  $\times \frac{2}{3}$ , b. flower,  $\times 8$ , c. ditto, in section, pistil removed,  $\times 8$ , d. fruit, nat. size (a, d FOSBERG 33912, b, c FOSBERG 26162).

prominent beneath; nerves straight, parallel, ending in an intramarginal looped vein, sulcate, slightly prominent or inconspicuous above, prominent beneath; veins inconspicuous above, finely dense-reticulate beneath; petiole pithy, shrunken at the base when dry, sometimes also at the apex, hairy, 3–8 cm. Racemes erect, shorter than the leaves, 3–12 cm. Flowers bisexual,

3(–4–5)-merous, c. 2 mm long. Pedicels up to 5 mm. Sepals puberulous, erect, appressed, c.  $\frac{1}{2}$ –1 mm long. Petals concave, spreading, finally reflexed, sparsely hairy to glabrous, accrescent to  $2\frac{1}{2}$  by 1 mm. Filaments glabrous, up to 1 mm long; anther cells c.  $\frac{3}{4}$  mm long. Disk c.  $\frac{1}{2}$  mm high. Carpels 2(–3), never more than 2 fertile, connate, except at the top, rather large, growing during



anthesis. Fruit obcordate, up to 2 by  $2\frac{1}{2}$  cm, strongly emarginate, wings often nearly touching by the inward curved style-bases; pericarp hard-corky.

Distr. From SW. Borneo eastwards to Micronesia (West and East Carolines and Marshalls) and Melanesia (New Britain, Solomons, New Hebrides), not in Australia and not in New Caledonia; in Malaysia: N. and SW. Borneo (only Banguay, Sarawak, Karimata I.), Moluccas (Halmaheira, Sula, Batjan, Gebe, Buru, Ceram, Ambon, Banda), and New Guinea (also Admiralty Is). Fig. 22.

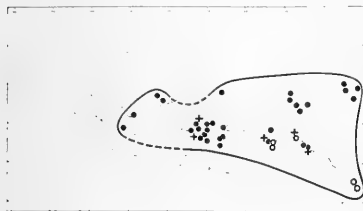


Fig. 22. Distribution of *Soulamea amara* LAMK, sheets seen (●), from literature (○), unlocalized (+).

It was recorded from Java by MIQUEL, but this rests on an error.

Ecol. A typical constituent of the Barringtonia formation, but much rarer than most of the species belonging to that formation, though locally common on the sandy beach and behind coral reefs, below 3 m, associated with *Messerschmidia*

*argentea*, *Scaevola taccada*, and *Ochrosia*, sometimes (but not in Malaysia) dominant as a rather small shrub along the shore, and of more scattered occurrence as a treelet more inland. Under the parent plant seedlings may be found in great profusion. The majority of the localities are situated on small islands or islets, and atolls, a peculiarity which it shares with very many other beach plants, such as *Pisonia grandis*, *Suriana maritima*, etc. Though its distribution is less erratic as compared with *Suriana*, it is less common than could be expected; the reason of its preference will probably rather lie in a sort of exacting habitat than in the chances offered by dispersal. Though not expressly stated and justified by experiments I agree with RIDLEY (Disp. p. 264) that the fruits possess buoyancy power and seem adapted to dispersal by seawater; HEMSLEY recorded that seeds have been found in the crop of birds in the Admiralty Is.

The reason why it is absent in West Malaysia, the Philippines, Celebes, Java, and the Lesser Sunda Islands, save for four localities in Borneo, must remain a rather fascinating problem, similar to that found in the erratic distribution of the beach *Triumfetta*, *Scaevola plumierii*, *Launaea pinnatifida*, *Spilanthes urens*, etc.

Uses. The roots and fruits of this very bitter plant are often used against cholera, pleurisy, and other fevers. Powdered and mixed with water the beverage is taken against colic and cough. In poisoning, e.g. by snake bites, the fruits are wholesome by urging the patient to vomit (RUMPHIUS, l.c., HEYNE, l.c.).

Vern. *Bona atti*, *buwa hati*, *kaju sulamu*, M, *pənarwar pipis*, *sulamu pohon*, Ternate, *dschiri pangpang*, Tami.

## 9. IRVINGIA

HOOK. f. Trans. Linn. Soc. 23 (1860) 167; BENTH. & HOOK. f. Gen. Pl. 1 (1862) 314; PIERRE, Fl. For. Coch. 4 (1892) t. 263; VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 247-320; ENGLER, in E. & P. Pfl. Fam. 19a (1931) 398.—*Irvingella* VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 276.—Fig. 23, 24.

Large trees. Branchlets with conspicuous annular scars of the stem-clasping, very early caducous stipules forming a narrow-conical cap surrounding the terminal bud. Leaves simple, glabrous, entire; midrib sulcate; petiole with a groove above between the very narrow wings. Panicles terminal or axillary. Bracts small, early caducous. Flowers (4-)5-merous, bisexual. Sepals connate at the base, imbricate in bud. Petals exceeding the sepals, imbricate in bud. Stamens twice as many as petals, inserted beneath the disk; filaments slender, long, dorsally attached; anthers latrorse, emarginate at base and apex. Disk large, cushion-shaped, intrastaminal. Ovary 2-celled, conical or somewhat flattened, sessile on the torus-like disk; style 1, with an inconspicuous terminal stigma; ovules solitary, anatropous, attached adaxially and apically. Drupe large, 1-(2)-seeded, resembling a mango. Albumen 0 or small (e.g. in *I. malayana*).



Fig. 23. *Irvingia malayana* OLIV. ex BENN. in cleared area with secondary forest behind, grassland and *Musa* in foreground, near Gemas, Malay Peninsula (Photogr. CORNER).

Distr. About 3 spp. in tropical Africa and 1 sp. in tropical SE. Asia and W. Malaysia.

Ecol. The African species are sometimes a conspicuous constituent of the tropical rain-forest. The Asiatic species is not seldom frequent in the lowland forest. Because of its hard wood and big buttresses it is often left in forest clearings and thus by its great size stands out on the landscape (CORNER).

Uses. The fruit of all species is edible, but usually only the seeds are eaten. The cotyledons (as the bark and pith of branchlets and petioles) contain large lysigenous arabin-containing mucilaginous cells, surrounded by cells containing fat. The seeds are used for the manufacturing of wax, cacao, and soap.

***I. Irvingia malayana*** OLIV. ex BENN. in Fl. Br. Ind. 1 (1875) 522; OLIV. in Hook. Ic. Pl. (1877) t. 1247; PIERRE, Fl. For. Coch. 4 (1892) t. 263 A; KING, J. As. Soc. Beng. 62, ii (1893) 230; BACK, Schoolfl. Java (1911) 194; CRAIB, Fl. Siam. En. 1 (1926) 243; RIDLEY, Fl. Mal. Pen. 1 (1922) 364; HEYNE, NUIL. Pl. (1927) 872; BURK. Dict. 2 (1935) 1251; CORNER, Ways. Trees (1940) 604; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1946) 669.—*I. oliveri* PIERRE, Fl. For. Coch. 4 (1892) t. 263 B; LECOMTE,

Fl. Gén. I.-C. 1 (1911) 701; CRAIB, Fl. Siam. En. 1 (1926) 243; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1946) 670.—*Irvingella malayana* VAN TIEGH. Ann. Sc. Nat. IX, 1 (1905) 276.—*Irvingella oliveri* VAN TIEGH. l.c.—*Irvingella harmandiana* VAN TIEGH. l.c. 279.—*I. harmandiana* PIERRE [in De Lanes. Pl. Ut. Col. Fr. (1886) 306, nomen] ex LECOMTE. Fl. Gén. I.-C. 1 (1911) 701.—*I. longipedicellata* GAGNEP. *ibid.* Suppl. 1 (1946) 670.—Fig. 23, 24,

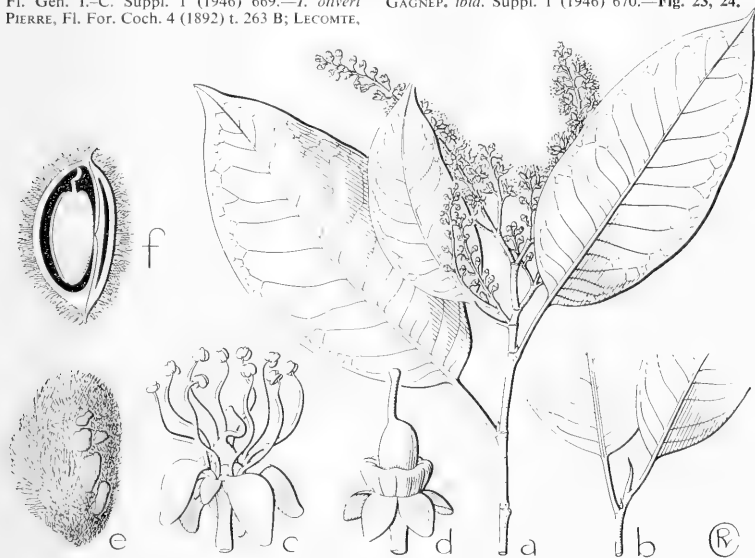


Fig. 24. *Irvingia malayana* OLIV. ex BENN. a. Flowering twig,  $\times \frac{2}{3}$ , b. stipules clasping terminal bud,  $\times \frac{2}{3}$ , c. flower,  $\times 4$ , d. ditto, petals and stamens removed,  $\times 4$ , e. withered fruit showing fibrous mesocarp and remains of exocarp, f. ditto, in section,  $\times \frac{2}{3}$  (a THORENAAR 29-E-1P-362, b bb 8375, c-d 29-E-1P-424, e-f 29-E-1P-484).

More or less deciduous large tree, up to 60 m and 1½ m ø; bole straight with very prominent, thin, steep buttresses; bark grey, sometimes peeling off in large pieces. Leaves elliptic-oblong to lanceolate, slightly acuminate, broad-cuneate to roundish, or even subcordate at the base, distinctly prominent-reticulate-veined at either side, 8–20 by 2½–9 cm; petiole 1–2 cm. Stipules surrounding the buds as a sharp, narrow-conical cap up to 3(–4) cm long. Panicles 5–15 cm long.

Bracts ovate, acute, c. 1½ mm. Pedicels up to 3(–5) mm, articulate at the base. Flowers glabrous, greenish-white or yellowish. Calyx c. 1½ mm long, the lobes rounded, with membranous margin, c. 1 by ¾–1 mm. Petals elliptic-oblong, rounded, finely reticulate, c. 3–4 by 2 mm, spreading finally or reflexed and with often involute margin in the upper half. Disk plicate outside and with sinuous margin, apex excavated in the middle. Filaments sinuous in bud, 3–6 mm, their base situated in the

concavities of the disk; anthers c.  $\frac{1}{2}$  by  $\frac{1}{2}$  mm. Ovary c. 1 mm high, style 1-2 mm, sinuous in bud. *Drupe* with thick, fleshy, very fibrous, orange exocarp and hard endocarp, somewhat flattened-ellipsoid, up to 6 by 4 cm when dry. Seed with small albumen, only at the back of the cotyledons.

Distr. Siam, Indo-China (Laos, Cambodia, Cochinchina); in *Malaysia*: Sumatra, Malay Peninsula, Borneo, and Bawean. Fig. 25.

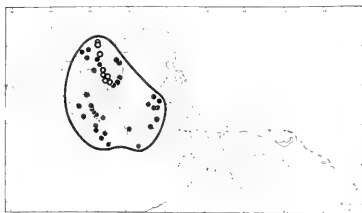


Fig. 25. Distribution of *Irvingia malayana* OLIV. ex BENN., examined sheets (●), from literature (○).

Ecol. Scarce or rather common, scattered in dryland primary rain-forest, below 250 m. Flowers before or with the new leaves. *Fl. fr.* Jan.-Dec.

Uses. The yellow-coloured wood is too hard to manufacture, and, besides, not very durable. MAINGAY recorded its use for making kris-handles and FOXWORTHY for handles of tapping knives (BURKILL).

The seeds contain a white or sometimes yellow fat with an agreeable smell and taste, which is known as 'dika' fat in Europe and is used for making soap, wax, and candles. The seeds are also eaten (HEYNE, *l.c.*; FOXWORTHY, *Mal. For. Rec.* 8, 1930, 26; BURKILL, *l.c.*).

Vern. Mal. Pen.: *bunga paukijang, kēbayang, mērēlang, mirlang, pauh kidjang, pauh kijang, M, perseh*, Sakai; Sumatra: *ēmplas batu, kulut*, Lampong, *pauh bayan, p. kijang, p. rusu, sēpah bongin, s. bungin*, Palembang, *kalēk karsik*, Minangk.; *kaju bongin, sēpah*, Kubu, *pauh mēnté*; Borneo: *kaju batu, k. tulang, k. tulang, kērangi, kēranji, pauh kijang, M, tēngilan*, Kedayan, *malenna gunung*.

Note. The vegetative parts show some resemblance to those of *Samadera* and *Inocarpus* (*Legum.*) but are easily distinguished by the conspicuous stipules leaving annular scars.

#### Excluded

*Ailantopsis poilanei* GAGNEP. *Not. Syst.* 11 (1944) 163, a monotypic genus from Indo-China, was reduced to *Heynea* by GAGNEPAIN at the instigation of PELLEGRIN, *Not. Syst.* 13 (1947) 63; *Fl. Gén. I.-C. Suppl.* 1 (1948) 727 is according to BENTVELZEN, *Act. Bot. Neerl.* 11 (1962) 14 — *Trichilia connaroides* (W. & A.) BENTVELZEN f. *connaroides* (*Meliaceae*).

*Philagonia* BL. referred by MIQUEL, *Fl. Ind. Bat.* 1, 2 (1859) 679 to the *Simaroubaceae* = *Evodia* (*Rutaceae*).

*Picroderma laotica* THOREL ex GAGNEP. *Not. Syst.* 11 (1944) 165 is according to BENTVELZEN, *Act. Bot. Neerl.* 11 (1962) 17 — *Trichilia connaroides* (W. & A.) BENTVELZEN f. *glabra* BENTVELZEN (*Meliaceae*).

*Quassia simaruba* (non L.) BLCO, *Fl. Filip.* ed. 2 (1845) 247, ed. 3, 2 (1878) 94 is according to MERRILL, *Sp. Blanc.* (1918) 241 — *Guioa koelreuteria* (BLCO) MERR.; RADLKOFER, *Pfl. R. Heft* 98 (1933) 1273 reduced it with doubt to *Arytera litoralis* BL. Anyway it belongs to *Sapindaceae*.

*Quassia tricarpa* BLCO, *Fl. Filip.* (1837) 351; ed. 2 (1845) 206, ed. 3, 2 (1878) 94, t. 388, *p. p.* is according to MERRILL, *Sp. Blanc.* (1918) 238 and RADLKOFER, *Pfl. R. Heft* 98 (1932) 642 — *Sapindus saponaria* L. (*Sapindaceae*).

*Tetramyxis* GAGNEP. *Not. Syst.* 11 (1944) 166, of which 3 species were described, is, according to FORMAN, *Kew Bull.* 16 (1962) 158 and TARDIEU-BLOT, *Fl. Cambodge etc. n. 2* (1962) 130-131 = *Allospodias lakonensis* (PIERRE) STAFP (*Anacardiaceae*).

## 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 aerenchyma (*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* (ROTTB.) 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 aerenchymes (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 tidal 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 multiserial trichomes which function as collectors exuding blastocolia 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 *Mystroxyton* 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. GUNDEL & T. P. HILDITCH, J. Chem. Soc. 1938, 1980).

It is interesting to note that the insecticidal alkaloids of the Chinese *Tripterygium wilfordii* Hook. f. are also polyesters yielding acetic acid, benzoic acid, furan- $\beta$ -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- $\beta$ -carboxylic acid was 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 digitonigenin; CH. TAMM & J. P. ROSSELET, *Helv. Chim. Acta* 36, 1953, 1309), the rootbark of *Euonymus atropurpureus* JACQ. (glycosides of digitonigenin; 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  $\beta$ -amyirin (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 norpseudoephedrine (= 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.* 15<sup>1</sup> (1941) 77; *ibid.* 15<sup>2</sup> (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 & JANSSON 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, 'Kurrimiacees' (*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 LOESENER (in E. & P. Fl. 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 Asia 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 unarimed . . . . . 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. **Xyloxyum**

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.
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 (*Pleurostyliia*). 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. *Pleurostyliia*

## 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.
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. *Pleurostyliia*

## I. 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* § *Eucleastrus* W. & A. Prod. (1834) 158. —*Monocelastrus* WANG & TANG, Acta Phytotax. Sin. 1 (1951) 36.—Fig. 1.

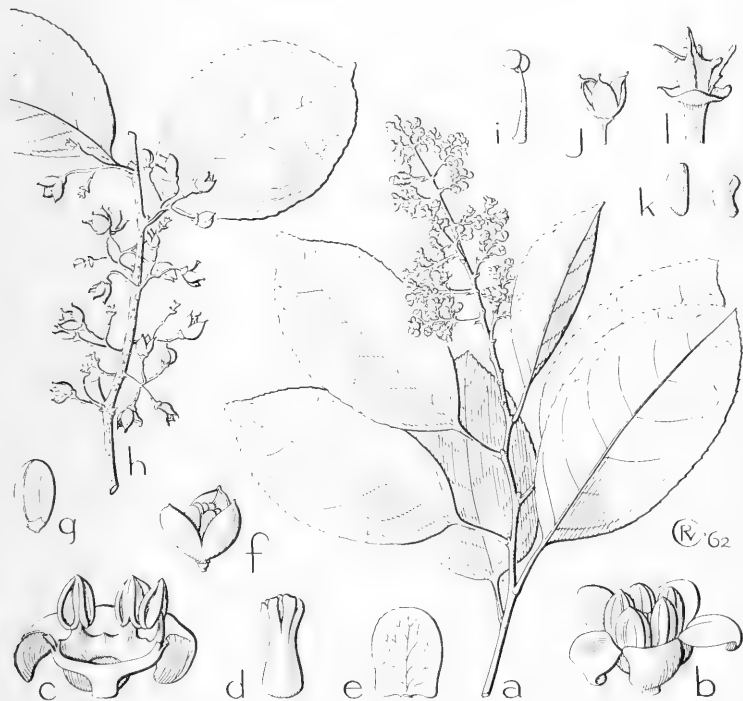


Fig. 1. *Celastrus novoguineensis* MERR. & PERRY. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 6$ , c. section of flower, pistil removed,  $\times 6$ , d. pistil,  $\times 12$ , e. petal,  $\times 6$ , f. dehiscent fruit, nat. size, g. seed, aril largely removed,  $\times 2$ .—*C. stylosus* 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 lacinate 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 *Monoclastrus* 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 '*Monoclastrus*' 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 ± obliquely erect. Pedicel distinct usually  $1\frac{1}{2}$ -3½ 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  $\sigma$  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. hindii*
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. 1 (1906) Suppl. 85; BACKER, Schoolfl. (1911) 234; PITARD, Fl. Gén. 1.-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. Pf. Fam. ed. 2, 20b (1942) 132, f. 31, K & L; TARDIEU, Suppl. Fl. Gén. 1.-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. subsipicatus* HOOK. Ic. Pl. 5 (1842) t. 482; DING HOU, Ann. Mo. Bot. Gard. 42 (1955) 236, map 1.—*Alsodia 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.— $\sigma$ : *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.— $\rho$ : *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 1-2 1/3 cm. *Panicles* terminal, up to 20 cm, divaricately branching, usually thrice compound. Pedicels c. 1/2 mm (c. 1 mm on fruits), distinctly articulated.—♂: *calyx* lobes subreniform, slightly erose, c. 1 mm long. *Petals* oblong, obtuse, subentire, scarious-marginate, 2 1/2 by 1 1/2 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. 1 1/2 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 2 1/2-3 1/2 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*, *remohremohn*, Enga language.

3. *Celastrus hindii* 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, J. 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. J. Gén. I.-C. (1948) 802; DING HOU, Taiwania 1 (1950) 175; Ann. Mo. Bot. Gard. 42 (1955) 249, f. 7, map 2, 10.—*C. racemosus* HASSK. Hort. Bogor. Descr. 1 (1858) 155, non FRANCH. 1886; MIQ. Fl. Ind. Bat. 1, 2 (1859) 590; BACKER, Schoofl. (1911) 234; KOORD. Exk. Fl. Java 2 (1912) 524; Fl. Tjib. (1923) 145.—*Fliegeea 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, J. 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, 4-14 1/2 by 1 1/2-6 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 1/2-1 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 2 1/2 cm. Pedicels obsolete, or very short (1/2-1 1/2 mm), rarely up to 4 mm.—♂: *calyx* lobes semi-orbicular, imbricate, obtuse, short-ciliate, sometimes erose, c. 1 1/2 mm long. *Petals* oblong or obovate, obtuse, glandular-ciliate, 2-5 by 1 1/2-2 1/2 mm. Disk cup-shaped, lobes usually deltoid, rarely slightly oblong, shortly acute, rounded, or slightly dentate. *Stamens* c. 2 1/3 mm; filaments subulate, glabrous; anthers ovoid, obtuse, cordate. Sterile pistil ovoid, c. 1 1/2 mm long.—♀: *calyx* lobes, *petals*, and disk as in the males, but the petals smaller. Sterile *stamens* c. 1 1/2 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*, *reunglias 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 2 1/2-7 1/2 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 1 1/2-3 1/2 cm, sometimes very short or obscure. Pedicels 3 1/2-5 mm, the articulation at the base.—♂: *calyx* lobes suborbicular, c. 2/3 mm long, entire, short-ciliate, sometimes erose. *Petals* oblong or oblong-elliptic, (1-1 1/2-2 1/2 mm long, obtuse or rounded, entire, usually pink-punctate. Disk fleshy, flat, obscurely lobed, the lobes transverse-oblong. *Stamens* 1 1/2-2 1/2 mm, attached slightly under the margin of the disk; filaments filiform; anthers ovoid, obtuse; sterile pistil conoid, c. 1/2 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. ROBIJNS, 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.—*Aglaioopsis 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 Rijksherbarium = *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 laciniate, 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 dehiscing 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. 1/8 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 1/2-3 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 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, ± compressed (not known in *M. cupularis*).
4. Plant with axillary and/or terminal spines. Leaves obovate-oblong, oblanceolate, or broad-obovate, 1 1/2-4 1/2 by 1/2-2 cm; apex obtuse, sometimes slightly emarginate . . . . . 4. *M. diversifolia*
4. Plant unarmed. Leaves elliptic, 7 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-obovate, 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. ¾ 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; HASK. 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. Lc. 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, Voortl. Fl. Java (1908) 55, *pro var. littoralis* BACKER; Schoofl. (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. Agr. 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 fasciated 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, ½-¾ 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*, LOESNER (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 fasciated 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 vitensis* (A. GRAY) DING HOU, *comb. nov.* (*Catha vitensis* 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, dehiscent, 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  $\sigma$ , 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*, *marginem serrulata*, *nervis utrinque* 7-10. *Inflorescentiae racemiformes, vel paniculatae, axillares*, 1½-2½ cm *longae*. *Pedicellus* c. 1½ mm *longus*. *Flores albi*. *Calyx* 5(-4)-lobatis, *lobis late ovatis*, c. 1 mm *longis*. *Petalata* 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, 1½-2½ 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. 1½ 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 hermaphroditi, tetrameri; ovarium disco semimmersum, ovulis in loculis circiter 10, biseriatis. 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, ± 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 ⅓. 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. 2/5 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 ± 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.—*Quadriptygium* TARDIEU, 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, ± depressed-oblong, or broad-ovoid, obtuse or short-apiculate, slightly free at the base, dehiscent on the top,

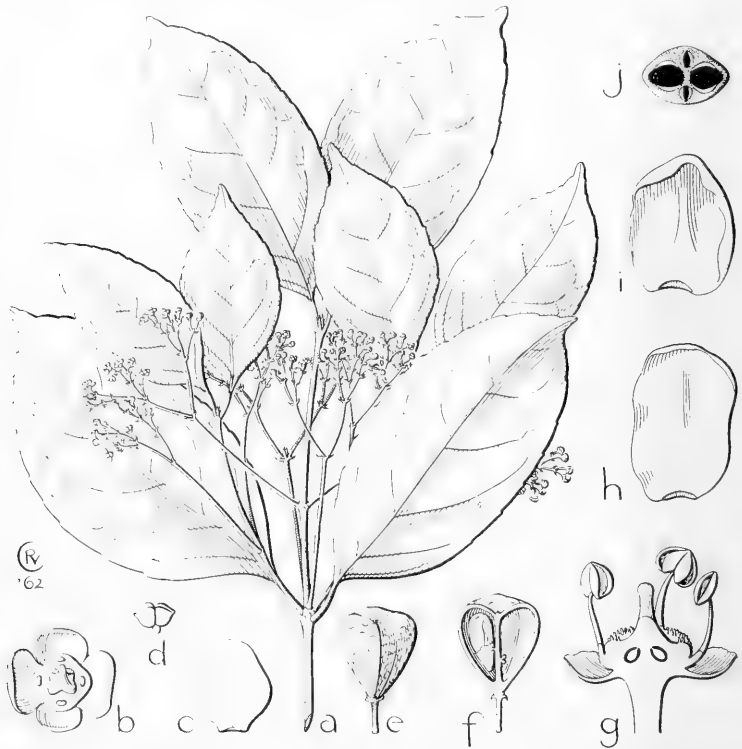


Fig. 4. *Euonymus castaneifolius* RIDL. a. Twig with flowers,  $\times 3\frac{1}{2}$ , b. flower, petals and stamens removed,  $\times 6$ , c. petal,  $\times 6$ , d. young stamen,  $\times 12$ , e. fruit, f. one valve, both nat. size. — *E. japonicus* THUNB. g. Flower, in section,  $\times 6$ , h-i. petals,  $\times 6$ , j. fruit, in section, seeds removed,  $\times 2$  (a-d KOSTERMANS 7476, 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 episealous. 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 oblate-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 oblate-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 *Quadripterigium 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*. *Quadripterigium 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  $\frac{1}{8}$ - $\frac{1}{2}$  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  $\phi$  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  $\phi$  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 subsobolanceolate 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  $\phi$ , smooth. Stamens inserted between the pistil and the edge of the disk, c.  $\frac{1}{3}$  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-baras*, Ilk., *burubatuhan*, Tag., *kayum-bakui*, 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) 1146; BENN. & R. BR. Pl. Jav. Rar. (1840) 130, t. 28; HASSK. Tijds. 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. Tijds. 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, Linnaea 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* MIQ. Sum. (1861) 513; KURZ, Nat. Tijds. 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  $\phi$ , 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– $\infty$  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, 1–3 $\frac{1}{2}$ –5 by 1 $\frac{1}{2}$ –4(–6) mm, slightly concave, minutely denticulate. Petals light green or yellowish, broadly obovate or suborbicular, 4 $\frac{1}{2}$ –5 by 3 $\frac{1}{2}$ –6 $\frac{1}{2}$  mm, areolate, fimbriate. Disk fleshy, 2 $\frac{1}{2}$ –3 mm  $\phi$ , 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. 2 $\frac{1}{2}$  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 1 $\frac{1}{2}$ –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*, *lamélul*, *simani dotan*, *tutun bintol lantja*, Simalur, *kaju kumbang ketjil*, *kumbang*, Palembang, *kienjiens*, Banka; Mal. Pen.: *bélimbing hutan*, *kémuning*



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

*ayer*, *k. gading*, *logan*, Temuan, *bélungkas*, Perak, *gading*, Pahang; Java: *atiati*, E. Java, *djambon*, *djirak*, *pajangan*, *ragen*, *sapén*, Central Java, *képing*, M, *kakatang*, *ki keujeup*, *kihapit lalaki*, *ki-katang*, S; Lesser Sunda Is.: *aadakurang*, *aitada kuru*, Sumba; Natuna Is.: *gunu*; Philip.: *kalimotas*, *malasangki*, *surag*, *tubatubhán*, Tag., *tabáan*, Mbo., *talangutiñgon*, C. Bis.; Celebes: *sandu molaba*, *tadugheho*, Tobela; Moluccas: *ligisatá'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 orbiculate 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* suborbicular 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 4½ 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  $\sigma$ , short-ciliate. Disk fleshy, orbicular, c. 2 $\frac{1}{2}$  mm  $\sigma$ . *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) subobovate or subfusiform,  $\frac{1}{2}$  by  $\frac{1}{2}$  cm.

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

**7. *Euonymus acuminifolius* BLAKELOCK**, Kew Bull. (1951) 253, 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  $\sigma$ . *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* orbiculate, 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  $\sigma$ . 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  $\sigma$ , 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,  $2\frac{1}{4}$ –3 by 2–3 mm, slightly erose, with a few, longitudinal veins. Disk obscurely 4-angular, c.  $1\frac{1}{4}$  mm  $\phi$ . *Stamens* small; anthers slightly depressed-oblong,  $\frac{1}{2}$  by  $\frac{4}{5}$  mm, dehiscing at the top; filaments very short, inserted between the pistil and the edge of the disk. Pistil c.  $\frac{1}{2}$  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; ROEFKE, 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. Bitz 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, i (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.—*Pragmotessara 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,  $2\text{--}9\frac{1}{2}$  by  $1\frac{1}{2}$ –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  $\frac{1}{2}$ –8 cm. Bracts triangular, lanceolate,  $\frac{1}{2}$ –4 mm long, caducous. Pedicels 3–5 mm. *Flowers* greenish white, 4-merous, c. 8 mm  $\phi$ . *Calyx* lobes reniform or suborbicular, 1– $1\frac{1}{2}$  mm long, entire or slightly erose, the outer pair smallest. *Petals* subrotund, broad-ovate or -elliptic,  $3\frac{1}{2}$ – $3\frac{3}{4}$  by  $2\frac{1}{2}$ – $3\frac{1}{2}$  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.  $2\frac{1}{2}$  mm long; anthers broad-ovoid,  $\frac{2}{3}$ –1 mm long, slightly apiculate, rarely obtuse. Pistil 1– $2\frac{1}{2}$  mm above the disk, sometimes slightly 4-angular towards the base; style distinct, cylindrical; stigma obscure. *Fruits*  $\pm$  globose, smooth, green, c. 1 cm  $\phi$ ; 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

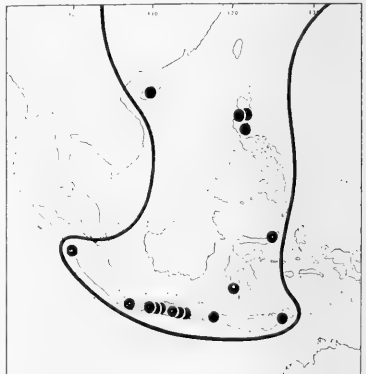


Fig. 6. Distribution of *Euonymus japonicus* THUNB. in Malaysia.

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 Kurogi* described in KAEMPFER's *Amoen. Exot.* fasc. 5, p. 790, giving it the short diagnosis '*floribus 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, Kiev, 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, obtuse, 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 benguetensis* MERR. Publ. Gov. Lab. Philip. 29 (1905) 26; En. Philip. 2 (1923) 480; LOES. in E. & P. Pf. Fam. ed. 2, 20b (1942) 119; BLAKELOCK, Kew Bull. (1951) 274; JACOBS, Ann. Bot. 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*, Ig.

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 longae. *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 dehiscent 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



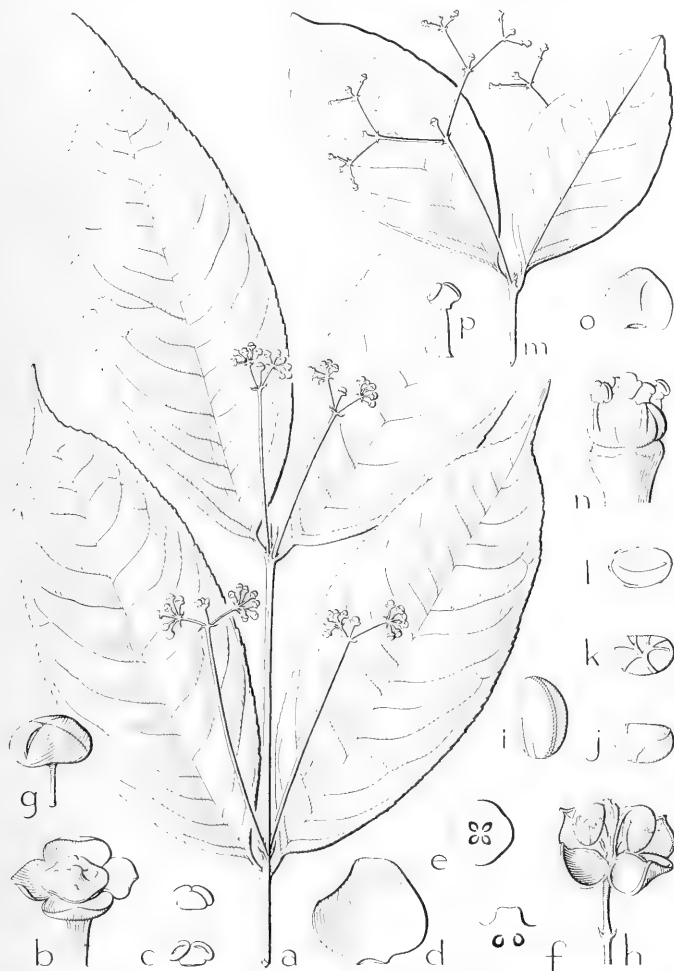


Fig. 7. *Glyptopetalum quadrangulare* PRAIN ex KING. a. Habit,  $\times \frac{2}{3}$ , b. flower, petals and stamens removed,  $\times 6$ , c. frontal and dorsal view of stamen,  $\times 12$ , d. petal,  $\times 6$ , e-f. ovary in sections,  $\times 12$ , g. fruit, nat. size.—*G. marivelense* (ELM.) 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. *brevipedicellatum* 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) thought they should not be separated and BAILLON (Hist. Pl. 6, 1877, 1, footnote) treated them as one genus. BENTHAM & HOOKER (Gen. Pl. I, 1862, 361) accepted them as distinct but mentioned only slight differences, and so did BEDDOME (Fl. Sylv. I, 1874, t. 102) and LAWSON (in Hook. Fl. Br. Ind. I, 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. Infructescences 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  $\phi$  . . . . . 7. *G. euphlebium*
  7. Fruits larger, depressed-globose, c. 15 mm  $\phi$  . . . . . 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  $\phi$ . *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.

**2. *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*  $5\frac{1}{2}$  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  $1\frac{1}{2}$  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  $1\frac{1}{2}$  cm); margin irregularly crenulate especially in the upper half; nerves (5–)8–12 pairs; nerves and veins depressed above, making the leaves subulate; 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  $1\frac{1}{2}$ –8½ cm. Bracts small. Pedicels 2–3 mm, articulated at the base. *Flowers* greenish yellow. *Calyx* almost divided to the base, lobes  $\pm$  reniform,  $1\frac{1}{2}$ –2 by 7–10 mm. *Petals* suborbicular,  $3\frac{1}{2}$  mm  $\phi$ , rather fleshy, thinner and wavy near the edge. Disk flat, square, c. 2 mm  $\phi$ . *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,  $1\frac{1}{2}$ –2 by  $1\frac{1}{4}$  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, p̄rupong, p. bukit, poko kahava, p. restong, s̄eminyh, M.*

Note. This is the only species which seems to be rather common. Its leaves remind of those of *G. euphlebium* 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  $\frac{3}{4}$ –1½ cm. *Infructescences* axillary, c. 3 cm long, simple or once branched cymes, usually found at the upper part of the branchlet. Peduncle  $\frac{1}{2}$ –2 cm. Bracts small. Pedicels 5–8 mm. *Fruits* depressed-globose,  $1\frac{1}{2}$ –2 cm  $\phi$ . *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  $1\frac{1}{2}$ –2½ mm, reddish brown near the margin. *Fruits* globose, 6–10 mm  $\phi$ , smooth, sometimes slightly furrowed, 1–4-seeded. *Seeds* subglobose, c. 6 mm  $\phi$ , 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,  $7\frac{1}{2}$ – $10\frac{1}{2}$  by  $3\frac{1}{2}$ –5 cm; base cuneate; apex acute to short-acuminate; margin remotely crenulate; nerves 6–8 pairs; petiole c. 5 mm. *Cymes* divaricate, up to  $8\frac{1}{2}$  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  $\phi$ , slightly

erose on the margin. *Petals* suborbicular, slightly concave, c. 2 mm  $\sigma$ , 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 euphlebiium* (MERR.) MERR.** Philip. J. Sc. 10 (1917) Bot. 280; En. Philip. 2 (1923) 481.—*G. marivelense* var. *euphlebiium* 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 2–2¼ 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  $\sigma$ . Pistil emerging c. ½ mm

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

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 1½–2¾ mm. Disk slightly 4-angular, with obscure papillae (B.S. 75176). *Petals* suborbicular or broad-ovate, c. 4 mm  $\sigma$ . *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  $\sigma$ , 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,  $\cdot \frac{2}{3}$ , *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  $\times 6$ .—*Kochracea* (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, cylindrical stalk. Bracteoles usually 2. Ovules 6–10 per cell.
3. Connective *c.* 1½ mm longer than the anther (*c.* 1 mm). Stigma broad-oblong, cylindrical.
  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. ovato-lanceolata*
  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 *Kokoonia*); *Pl. Elm. Born.* (1929) 171; LOES. in *E. & P. Pl. Fam. ed.* 2, 20b (1942) 165; STEEN. *Sarawak Mus. J.* 13 (1958) 438.—*Ardisia ochracea* ELM. *Measf. 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.* 1½ mm, gradually narrowed upward into the obscure style; stigma broad-oblong cylindrical, *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. Pl. 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  $\sigma$ , with small buttresses. Young twigs red. *Leaves* chartaceous to coriaceous, elliptic to very narrowly elliptic, broad-elliptic, ovate, or lanceolate,  $4\frac{1}{2}$ – $15\frac{1}{2}$  by  $1\frac{3}{4}$ –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  $\frac{3}{4}$ – $1\frac{3}{4}$  cm. *Panicles* or *racemes* axillary and sometimes extra-axillary,  $1\frac{1}{2}$ –20 cm long. Peduncle up to 6 cm. Pedicels 1– $2\frac{1}{2}$  mm. Bracteoles small, deltoid, c.  $\frac{2}{3}$  mm long, acute, denticulate. *Flowers* yellowish or whitish. *Calyx* lobes semi-orbicular, or reniform,  $\frac{1}{2}$  by  $1\frac{1}{2}$ –2 mm, slightly denticulate. *Petals* broadly ovate, elliptic, sometimes suborbicular,  $3\frac{1}{2}$ –6 by  $2\frac{3}{4}$ –4 mm; filaments 1– $1\frac{1}{2}$  mm; anthers including the connective  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm, connective  $\frac{1}{2}$ –1 mm, pointed at the tip. *Pistil* c. 2 mm. *Ovary*  $\pm$  triangular; style obscure; stigma capitate, c.  $\frac{4}{5}$  mm, obtuse sometimes slightly 3-notched at the top. *Ovules* (6–)8–10 in each cell. *Fruits* 13–18 by 3– $5\frac{1}{2}$  cm. *Seeds* including the wing  $7\frac{1}{2}$ – $12\frac{1}{2}$  by  $2\frac{1}{2}$  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. Pl. 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– $12\frac{1}{2}$  by 5– $7\frac{1}{2}$  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.  $\frac{1}{2}$  mm). Bracts  $\pm$  triangular, c.  $\frac{1}{2}$  mm long and wide, acute. *Calyx* lobes triangular, c.  $\frac{1}{2}$  mm long and wide, acute. *Calyx* lobus triangular, c.  $\frac{1}{2}$  mm long. *Petals* broad-ovate,  $4\frac{1}{2}$  by 3 mm, obtuse. *Stamens* c.  $2\frac{1}{2}$  mm long; filaments thickened at the base, transparent at the apex; anthers with connective c. 2 mm long, the latter c.  $\frac{4}{5}$  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, elliptica-vel ovato-oblonga, raro late ovata,  $9\frac{1}{2}$ –14 by  $5\frac{1}{2}$ –7 cm, basi obtusa, apice acuta vel obtusa, nervis utrinque 5–8; petiolus  $1\frac{1}{2}$  cm. Flores sessiles, basi 3–5-bracteolatae. Flores parvi. Calycis lobi orbiculares vel reniformes, 1–2 mm longi. Petala late ovata vel subrotunda,  $2\frac{1}{2}$ –3 mm longa. Stamina breviora, antheris late ovoideis, c.  $1\frac{1}{2}$  mm longis, appendicibus  $\frac{1}{3}$ – $\frac{1}{2}$  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,  $9\frac{1}{2}$ –14 by  $5\frac{1}{2}$ –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  $1\frac{1}{2}$  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  $\pm$  reniform,  $\frac{1}{2}$ – $\frac{3}{4}$  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 suborbicular,  $2\frac{1}{2}$ –3 by  $1\frac{3}{4}$ – $2\frac{1}{2}$  mm; filaments c. 1 mm; anthers broad-ovoid, including connective c.  $1\frac{3}{4}$  by 1 mm, the connective  $\frac{1}{4}$ – $\frac{1}{2}$  times as long as the anther. Crenulate disk and ovary orange-red. *Pistil* c.  $1\frac{1}{2}$  mm long, conical; style obscure; stigma cylindrical c.  $\frac{2}{3}$  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  $\frac{1}{2}$  m  $\sigma$ . 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,  $3\frac{1}{3}$ – $3\frac{2}{3}$  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 mm, 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., *énsabung, 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  $\sigma$ , 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, sèpang*, 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, III. 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. *Thyrse*s 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 episealous, 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 two 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  $5\frac{1}{2}$ - $12\frac{1}{2}$  cm. Inflorescences usually very long, 18-45 cm. Pedicels 7-15(-20) mm . . . . . 1. *L. sessilifolium*
2. Branchlets usually terete. Leaves smaller, usually 4- $15\frac{1}{2}$  by 2-7 cm. Inflorescences shorter, less than  $13\frac{1}{2}$  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  $\pm$  pointed.
3. Disk  $\pm$  flat, suborbicular or obscurely 5-angular. Petiole usually round, vascular strand appearing cylindrical 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  $4\frac{1}{2}$ - $9\frac{1}{2}$  mm  $\phi$  at anthesis.
7. Disk distinctly or sometimes obscurely 5-lobed or -angular, the lobes or angles epipetalous; anthers apiculate. Flowers generally 10-18 mm  $\phi$  at anthesis. Petiole usually round, sometimes furrowed near the distal end above.
8. Petals slightly reniform, c. 6 by  $8\frac{1}{2}$  mm, one small appendage at the base of each petal. Disk  $7$ - $9\frac{1}{2}$  mm  $\phi$ . 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  $\phi$ , appendages distinctly cristate, lamellate, or rarely fimbriate, usually 3-lobed and covering the upper  $\frac{2}{3}$  of the petal. Disk c. 5 mm  $\phi$ . Leaves subcoriaceous, the upper and lower surfaces not like above. (Leaves usually unpetalose.) . . . . . 7. *L. wightianum*
7. Disk  $\pm$  round, or sometimes obscurely 5-angular and the angles usually episepalous; anthers acute or short-acuminate. Flowers c. 1 cm  $\phi$  at anthesis. Petiole flat and slightly furrowed above, round beneath . . . . . 8. *L. macranthum*
6. Disk smaller, 1-3(-4) mm  $\phi$  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  $1\frac{1}{2}$ -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  $1\frac{1}{4}$ -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  $\pm$  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  $5\frac{1}{2}$ - $12\frac{1}{2}$  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  $\phi$ . Calyx lobes triangular,  $1\frac{1}{4}$  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.  $\frac{2}{3}$  mm long; anthers obtuse. Ovary almost immersed in the disk. Fruits (young) c. 7 cm long, tuberculate, stalk up to  $2\frac{1}{2}$  cm. Seeds (including wing)  $5\frac{1}{2}$  by  $1\frac{1}{2}$  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.

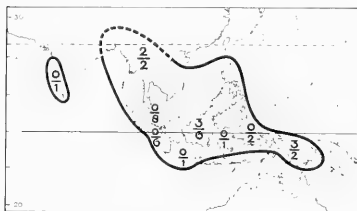


Fig. 11. Distribution of the genus *Lophopetalum* WIGHT ex ARN. For each subarea the number of species has been indicated, endemic above the hyphen, non-endemic below the hyphen.

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  $\sigma$ . *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. *Thyrse* 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  $\sigma$ , 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  $\sigma$ , 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, p̄rupok, sisilao, Sarawak, kapas kapas, Sungai, k̄kan bukit, Brunei, k̄rupuk gunung, Nunukan I., silolosu, Tengara, 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  $\sigma$ . *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  $\sigma$ , entire sometimes slightly erose. Disk dish-shaped, c. 2½ mm  $\sigma$ , 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  $\sigma$ . *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, margine integra, nervis utrinque 5–7, venulis laxae reticulatis; petiolus c. 2 mm longus. Inflorescentiae usque ad 9 cm longae, glabrae. Pedicellus 5–7 mm longus. Flores flavescens. 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  $\sigma$ . 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,  $\pm$  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.  $\frac{1}{2}$  mm  $\sigma$ , obtuse. *Pistil* c.  $\frac{1}{3}$  mm emerging from the disk, pyramidal; style and stigma obscure. *Ovules* 4 in each cell.

*Dist. 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  $\sigma$ , 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,  $4\frac{1}{2}$ - $12\frac{1}{2}$  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,  $\pm$  terete, stout. *Panicles* up to 10 cm, usually stout, solitary, sometimes branched almost from near the base. Peduncle very short, sometimes up to  $3\frac{1}{2}$  cm. Pedicels 2-3 mm. *Flowers* yellowish green,  $3\frac{1}{2}$ -6 mm  $\sigma$ . *Calyx* lobes and petals with small, papilla-like processes outside. *Calyx* lobes ovate or triangular, c.  $1\frac{1}{3}$ - $1\frac{1}{2}$  by 1 mm, apex acuminate,  $\pm$  pointed and turning upward at  $\pm$  right angles, short-ciliate. *Petals* triangular or suborbicular, 1-2 by 1-2 mm. *Stamens* c. 1 mm long; anthers small, very short-apiculate. Disk  $\pm$  flat, suborbicular or obscurely 5-angular,  $1\frac{1}{2}$ - $3\frac{1}{2}$  mm  $\sigma$ , 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  $5\frac{1}{2}$  by  $1\frac{1}{2}$  cm.

*Dist. 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., kërupuk, 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  $\sigma$ . 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  $\sigma$ . *Calyx* almost as large as the disk, slightly lobed, lobes round. *Petals* reniform, c. 6 by  $8\frac{1}{2}$  mm, entire, the appendage at the base inside, small, sometimes obscure. Disk  $\pm$  orbicular, slightly convex towards the center near the ovary, 7-9  $\frac{1}{2}$  mm  $\sigma$ , obscurely 5-lobed. *Stamens* inserted near the ovary; filaments c.  $2\frac{1}{2}$  mm; anthers ellipsoid or slightly ovoid,  $1\frac{1}{2}$  by 1 mm, slightly apiculate. *Ovary* emerging c. 2 mm from the disk, narrowed towards the apex; *ovules* 16 in each cell.

*Dist. 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.* *Terupuk*, 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  $\sigma$ , 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,  $1\frac{1}{2}$ - $2\frac{1}{2}$  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  $\sigma$ . *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  $\phi$ , 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, *pèrupuk*, *p. talang*, *tèrupuk talang*, *M. trupuk*, Banka; Mal. Pen.: *kèruie*, Lakai, *mata ulat*, Kedah, *médang assam*, Malacca, *pèrupok*, Langkawi; Borneo: *bura*, Dyak, *nasi-nasi*, Brunei, *pèrupuk 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*** (LOES.) 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  $\phi$ . *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  $\phi$ , 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, ovate 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  $\phi$ . *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  $\phi$ , 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  $1\frac{1}{2}$ -2 cm, grooved above. Panicles sometimes extra-axillary, 3-7 cm long; peduncle 1-3 cm. Pedicels  $2\frac{1}{2}$ -3 mm. Flowers yellow. Calyx lobes semi-orbicular, reniform, or triangular, 1 by  $1\frac{1}{2}$ -2 mm, entire. Petals deltoid,  $2\frac{1}{2}$ -3 by  $2\frac{1}{2}$ -3 mm, entire or slightly erose, with fleshy, lobed processes  $\pm$  in the central part. Stamens inserted between pistil and disk margin in pits surrounded by fleshy, subulate processes ( $\frac{1}{2}$ - $\frac{1}{2}$  the length of the filament); filaments  $\frac{2}{3}$ - $1\frac{1}{2}$  mm; anthers broadly ovoid,  $\frac{2}{3}$ -1 mm long, acute. Disk dish-shaped, red, 5-angular, obtuse, 3-4 mm  $\sigma$ , usually covered with papillae. Pistil triangular, emerging c. 1 mm from the disk, gradually narrowed into a cylindrical, short style. Ovules 10 in each cell. Fruits c.  $15\frac{1}{2}$  cm long; pericarp hard, c.  $\frac{1}{2}$  cm thick. Seeds including wing 9 by  $2\frac{1}{4}$  cm, seed proper  $5\frac{1}{4}$  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, *keroi*, Temuan, *këruie*, Lakai, *këllëmpait*, *këruéh*, *manau*, *pëlantang gunung*, *tiada tahu*, *tjagël*, 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.—*Solenospermum javanicum* ZOLL. Nat. Tijd. 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. paucinervium* MERR. Philip. J. Sc. 20 (1922) 402.—*Solenospermum paucinervium* LOES, Notizbl. Berl.-Dahl. 13 (1936) 223.—*Solenospermum toxicum* LOES. l.c.; in E. & P. Pl. Fam. ed. 2, 20b (1942) 162.—*Solenospermum oblongifolium* LOES. in E. & P. Pl. Fam. ed. 2, 20b (1942) 162.

Tree up to 45 by 1 m  $\sigma$ , sometimes slightly buttressed when growing in swamps. Leaves subcoriaceous to coriaceous, elliptic-oblong or elliptic, ovate-oblong to lanceolate, rarely obovate or ovate,  $5\frac{1}{2}$ –18 by  $2\frac{1}{2}$ –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  $1\frac{1}{2}$ –2 cm. Panicles up to 19 cm, sometimes branched almost from the very base; occasionally furfuraceous, glabrescent; peduncle very short, sometimes up to  $4\frac{1}{2}$  cm. Pedicels  $3$ – $3\frac{1}{2}$  mm. Flowers white, light green or yellowish green, c. 9 mm  $\sigma$ . Calyx lobes almost patent or sometimes the apices curved upwards, rarely reflexed, slightly or c.  $\frac{1}{2}$  mm exceeding the margin of the disk lobes, acute, short ciliate. Petals broad-ovate, or -oblong, 2–3 by  $1\frac{3}{4}$ – $2\frac{1}{2}$  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,  $2\frac{1}{2}$ –3 (–4) mm  $\sigma$ , usually minutely papillose on the upper surface. Stamens inserted between ovary and edge of disk or sometimes quite near the margin; filaments c.  $1\frac{1}{2}$  mm; anthers broad-ovoid, acuminate, c. 1 by  $\frac{2}{3}$  mm, apiculate. Pistil emerging c.  $1\frac{1}{2}$  mm from the disk. Ovary slightly triangular, narrowed into a cylindrical style; stigma obscure. Ovules 5–8 in each cell. Fruits  $6\frac{1}{2}$ –11 cm long; pericarp leathery, rather thin, smooth or sometimes minutely tuberculate. Seeds with a wing c.  $\frac{6}{2}$  by  $1\frac{1}{2}$  cm.

Distr. Siam (Puket, sec. CRAIB) and Malaysia: Sumatra (Tapus, West Coast, Palembang, Lampongs, 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: *béhu*, Nias, *bintol langsa bungo*, *téradih uding*, Simalur, *dilau rumba*,

*émpidingan*, *kumbang*, *marpitis*, M, *madang-gambici*, Batak, *madan landjut*, Pariaman; Mal. Pen.: *kachang rimba*, Kedah; Java: *mandalaksa*, J; Borneo: *médang bora*, m. *tolei*, Balikpapan, *agar-agar*, *dampal*, *djèrèndjiang*, *pèrupuk*, p. *gunung*, *séraya puteh*, *takau*, *tulang*, M, *dual*, Dusun & Kedayan, *kaju api*, E. Kutei, *kayu malam pèrampuan*, *ranau*, Sungei, *kédjō woos*, *kétapang*, *maréndang*, Kutei, *buru*, *maratémón*, *péndjolarawat*, *sang*, Dyak, *pisang pisang*, *tapatung*, Dusun, *mémagahar*, *tanggom apui*, N. Born.; Philip.: *sampol*, Bis., *abúab*, *abútub*, *bokbok*, *butingi*, *dayandang*, Tag., *buyun*, Sul., *ditá*, Neg., *kalibambangan*, Mand., *puti-i-babáe*, *puti-i-laláki*, Lan., *sudkak*, P. Bis.; Celebes: *bongkorio*, *kulilawa puté*, Muna, *kabalo*, Malili, *kaléng*, 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, F); TURCZANOW 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  $\sigma$ . 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,  $10\frac{1}{2}$ –18 by  $4\frac{1}{2}$ –8 cm; base obtuse or rounded, sometimes cuneate; apex acuminate; nerves 10–15 pairs; petiole  $(1)$ – $1\frac{3}{4}$ –3 cm. Panicles up to 12 cm long, sometimes scurfy on the young parts. Peduncle up to 6 cm long. Pedicels  $3\frac{1}{2}$ –4 mm. Flowers light or yellowish green, rarely white, c. 7 mm  $\sigma$ . Calyx triangular,  $\frac{3}{4}$  by  $1\frac{1}{2}$  mm, acute, short-ciliate. Petals broad-ovate,  $2\frac{1}{2}$ –3 by  $1\frac{3}{4}$ –2 mm, acuminate, appendage with broad base inserted at the lower  $\frac{1}{2}$ , lobes rather small, the inner two or three always with 2 grooves on the dorsal side. Disk fleshy, flat, c. 3 mm  $\sigma$ , obscurely 5-angular, densely covered with minute papillae. Stamens inserted between the ovary and the disk margin; filaments c.  $1\frac{3}{4}$  mm; anthers broad-ellipsoid or -ovoid, 1 by  $\frac{2}{3}$  mm. Pistil emerging c.  $1\frac{1}{4}$  mm from the disk. Fruits  $7$ – $8\frac{1}{2}$  cm long; pericarp leathery, hard, furfuraceous outside. Seeds (including the wing) c. 5 by  $1\frac{1}{4}$  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  $\sigma$  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 (MEIER, 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  $\sigma$ . 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  $\sigma$ . 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. ⅓ mm. Disk  $\pm$  rounded, fleshy, c. 2 mm  $\sigma$ , 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*, *Pápu*, *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  $\sigma$ . 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  $\sigma$ . 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 ⅓ mm, obtuse and short-apiculate. Disk  $\pm$  rounded, fleshy, c. 2 mm  $\sigma$ , 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 ø. Bark rough, fissured, greyish sometimes dark-brown. Branchlets terete. Leaves coriaceous, subobovate sometimes elliptic, 4½–13 by 2½–7 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 ½–1½ 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, ½–⅔ by 1 mm, slightly ciliate. Petals triangular, or slightly ovate-oblong, 3–3½ by 2–2½ mm, slightly erose, appendage rather small, at the upper half. Disk slightly angular, fleshy,

usually covered with minute papillae, c. 3 mm ø. Stamens inserted between pistil and edge of disk; filaments c. 1½ mm; anthers slightly deltoid, c. ⅓ mm long and wide, obtuse. Pistil c. 1½ 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 4¾–6 by 1–1½ 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. tetrameris*), 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 on ring-shaped adnate disk, *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  $\sigma$ . 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, 2½–1½ by 1–2½ mm. Anthers c. 2/3 by 1/2 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 ± cylindrical, 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 (1½-2 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, 1-1¾ 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 cylindrical style; stigma obscurely 2-lobed, or obtuse. Fruits ellipsoid, 11-15 by 7-10 mm, subfurfuraceous.

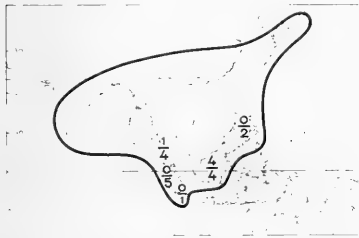


Fig. 15. Distribution of the genus *Microtropis* WALL. ex MEISN.; species density in Malaysia, endemic above the hyphen, non-endemic below it; in Asia c. ? 40 spp.

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, ¼ by ⅓ mm, obtuse, the lower half free. Pistil c. 2¼ mm long; ovary ovoid and gradually narrowed into a cylindrical 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. tenuis* 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 ⅓, 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, 1¼-6 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* ± cylindrical, 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.—*Paraclastrus bivalvis* MIQ. *Fl. Ind. Bat. 1*, 2 (1859) 591; F. N. WILLIAMS, *Bull. Herb. Boiss. 11*, 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.  $\frac{1}{5}$  mm, united at the lower half or lower  $\frac{1}{2}$ ; 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  $\frac{1}{8}$ – $1$  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  $\frac{1}{5}$ – $\frac{2}{3}$ ; anthers broad-oblong,  $\frac{1}{5}$ –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 $\beta$ , Bo, not 21297 $\beta$ ) 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 VALETTEON'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. 2½ mm ø, 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.

Notes. 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  $\frac{1}{4}$ – $1\frac{1}{2}$  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.  $\frac{1}{8}$  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. *Thyrses* 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  $2\text{--}3\frac{1}{2}$  mm, concave, stiff, smooth inside, usually irregularly split, short-lacinate, venation visible but not elevated. *Petals* oblong,  $3\text{--}3\frac{1}{2}$  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*, *dĕlok*, *kudang pajo*, *lala-lalar dĕlok*, *soe'ah-baseum*, *surin*, *tĕradih*, 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. *Thyrses* 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 ø, 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  $\frac{4}{5}$  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).  
Ecology. 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. Lc. 305.—*M. basilanensis* MERR. & FREEM. Lc. 306.—*M. borneensis* MERR. & FREEM. Lc. 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,  $\frac{1}{2}$ - $\frac{4}{5}$  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).

Ecology. 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. Lc.**

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,  $2\frac{1}{2}$ - $3\frac{1}{2}$  by  $1\frac{1}{2}$ -2 mm, obtuse. *Stamens* c.  $2\frac{1}{2}$  mm long; anthers broad-oblong or ovoid, c.  $\frac{2}{3}$ - $\frac{4}{5}$  by  $\frac{3}{5}$ - $\frac{4}{5}$  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  $\frac{1}{2}$  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.—*Trochisantra* 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  $\pm$  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  $\frac{1}{2}$ – $\frac{2}{3}$ . 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 1). 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 subtire. 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 1–1¼(–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. Pl. 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. Pl. 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  $\phi$ , buttresses up to 2 m. Bark smooth, light brown, thin. *Stipules* lanceolate, 1¼–3 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* 1–1¼(–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 siarang daja*, East Coast, *hajodolok rawang*, *kalumpang*, Batak., *kaju djambu*, *k. tulang*, *pimpoeh*, Palembang, *lagan bunga*, Pematang, *kérindjing rénak*, *mèrlantañ rawang*, *sétomuhila*, M, *ponau*, *sèngafoh-balah*, *s. dèlok*, *s. ètèn bungo*, *s. uding*, *tutum sèngafoh*, Simalur; Billiton: *kèrangji*, M; Banka: *mèlabung*; Mal. Pen.: *bènga mèdang ayèr*, Temuan, *biko-biko*, *banak*, M, *mèdang tandok*, m. tjoeh, Negri Sembilan, sapan, Selangor; *aha tung*, *bintan*, *madang bura*, *mèdang latah*, *nga*, *tjanggal*, Dyak, *asam pau*, S. Born., *duhat burung*, *rèngas*, Balikpapan, *kayu minyak*, *rèsak buntun*, *sulang sulang*, Sarawak, *mèdang*

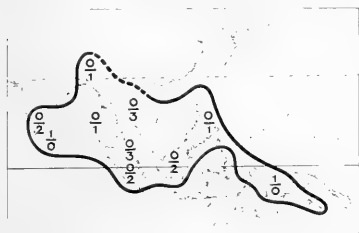


Fig. 17. Distribution of the genus *Bhesa* HAM. ex ARN. Species density, endemic above the hyphen, non-endemic below it.

*kuning, pangil-pangil, sarunai*, Brunei, *rarasas tatahan, sampaka*, Dusun, *ruwas, M, sanggam, W. Born., sēmita*, 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 attacked 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  $\sigma$ . *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. 2½ by 1¼ mm, obtuse. Disk flat, subentire. *Stamens* inserted on the margin of the disk and continuous with it. *Ovary* broad-obovate or subglobose, c. 1½ by 2 mm, glabrous, or sometimes slightly hairy at the top; styles almost divided to the base. *Fruit* 2-lobed to the lower  $\frac{1}{2}$ - $\frac{1}{3}$ , sometimes one of the lobes small and abortive, 2½-3½(-5½) cm long. *Seeds* ellipsoid, 2½-2½ by 1½-1¾ cm, sometimes slightly flattened, the aril covering its lower  $\frac{1}{4}$  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. Tijd. 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. thorelli* 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  $\sigma$ . 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 2½-8½ 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, 1½-2 by 1-1¼ mm, obtuse. *Petals* oblong-elliptic, 2½-3 by  $\frac{2}{3}$ -1¼ 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  $\sigma$ , 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, 3-3½ by 1-1¼ 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 (Chit-tagong 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*, *bêngkinang*, M, *balam budju*, *katian*, *tjabé*, Palembang; Billiton: *djanting*, M; Banka: *djurung laki*, M; Mal. Pen.: *boko-boko*, *médang 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 ø. 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 ½ mm, free for lower ⅓, introrse, slightly apiculate; filament a continuation of the disk. Disk shallow-cupular, usually glabrous. *Ovary* subglobose, c. 1¼ mm ø; 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, *djéra*, 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<sup>2</sup> (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 ± 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 *Mystroxydon* 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*, *Mystroxydon*, and two other genera. SONDER (Fl. Cap. 1, 1860, 451–452) had them as five different gen-

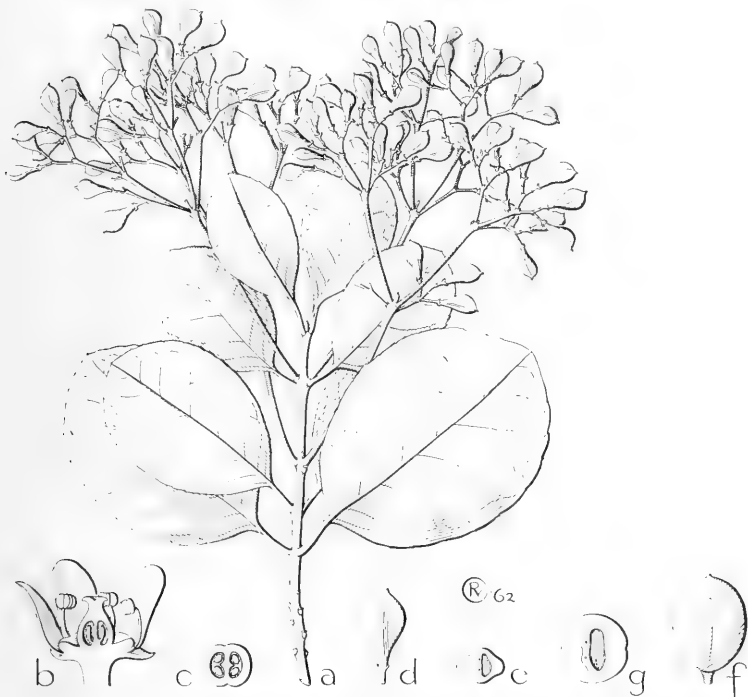


Fig. 18. *Cassine viburnifolia* (JUSS.) DING HOU. *a.* Habit, in fruit,  $\times \frac{2}{3}$ , *b.* flower, in section,  $\times 8$ , *c.* section of ovary,  $\times 16$ , *d.* fruit, *e.* ditto in section, both nat. size. — *C. glauca* (ROTTB.) O.K. var. *cochinchinensis* PIERRE. *f.* Fruit, *g.* ditto 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 *Mystroxyton* 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 BATHIE, 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, 1¼–2 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, mēmpēnai* or *mēta pēlandok, 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, guruh*, 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.*—*Elaeodendron 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.

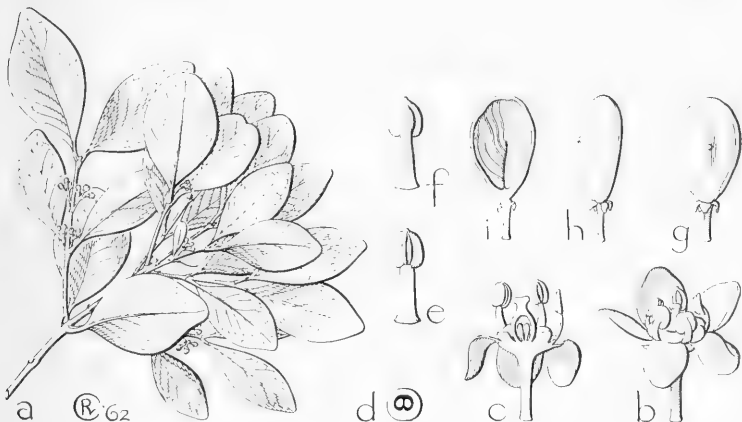
#### Excluded

*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 BÂTHIE, *Fl. Madag. fam.* 116, 1946, 54).

## II. 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.** *Pleurostyliopsis 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. *Pleurostyla 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 *Pleurostyla 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 *Pleurostyla*.

## 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,

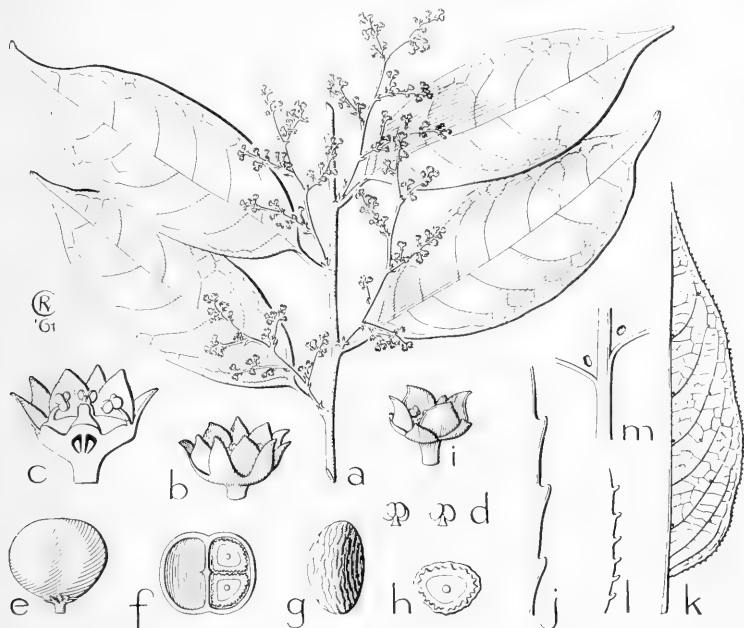


Fig. 21. *Perrottetia alpestris* (BL.) LOES. *ssp. moluccana* (BL.) DING HOU. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 6$ , c. ditto, in section,  $\times 8$ , d. young stamen, frontal and dorsal view,  $\times 12$ , e-f. fruit and its cross section,  $\times 3$ , g-h. seed and its cross 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 domatia,  $\times \frac{2}{3}$ , l. leaf margin,  $\times 3$ , m. domatia enlarged (a ROBBINS 368, b-d HOOGLAND & SCHULTE 7385, e-h ZIPPELIUS 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 *ssp.*, in Central China (E. Szechuan and W. Hupeh, 1 *sp.*), Formosa (1 *sp.*), throughout Malaysia to NE. Queensland and Solomons (2 *ssp.*), the Hawaiian Is. (1 *sp.*), and Central America (Mexico to Columbia, c. 10 *ssp.*). 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. Schoofl. (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  $\phi$ . 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  $\sigma$ . Calyx lobes 5, deltoid, ½–2/3 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 3/2–1 mm, sparsely puberulous on both surfaces, sometimes only puberulous on the margins. Disk shallow cupular, c. 1½ mm  $\sigma$ . Stamens c. 2/3 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.

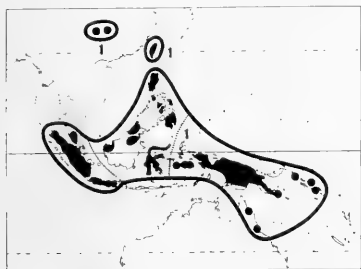


Fig. 22. Old World distribution of the 3 species of the genus *Perrottetia*; in the Malaysian *P. alpestris* (BL.) LOES. there are three replacing subspecies, separated by dotted lines.

Vern. Sumatra: *bĕrbah*, Bencoolen, *kaju attarasa pidong*, *k. si lando*, Asahan, *kaju musang*, W. Coast; Mal. Pen.: *kayu tungas*, Perak; Java: *kibĕlut*, *ki-bĕmok*, *ki dagĕ*, *kihiris*, *ki-hurang*, *ki-kiris*, *ki purut*, *kipūt*, *kitarasi*, S, *kĕmalon*, *kĕmaluhan*, *wadĕran*, 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*, Chimu, *fonanitur*, Onjob lang., *gamaha*, Asaro, *ihira*, Mairi, *kunguna*, Hagen, *togump*, Togaba, *tsiltsibi*, Tomba, *waljamahp*, *walmap*, 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* STAPE, 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. 21j.

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.: *balakbĕkan*, Buk., *bubayug*, Ig., *daĕgĕlis*, 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*).



## LOGANIACEAE (P. W. Leenhouts, Leyden)

Trees, shrubs, woody climbers, or herbs. Hairs simple, stellate, or glandular-capitate; colleters often present in the axils of the leaves, stipules, and sepals (among Mal. genera absent in *Buddleja* only). *Leaves* nearly always opposite, entire or nearly so, penninerved, rarely 3–7-plinerved (*Strychnos*) or curvinerved (*Mitrasacme*); *stipules* interpetiolar (in many genera reduced to a stipular line) and in some genera moreover intrapetiolar. *Flowers* in cymose to thyrsiform (rarely racemose or spicate) inflorescences or solitary, 5-(rarely 4-, in *Anthocleista* up to 16-)merous, nearly always bisexual, actinomorphic (in some genera slightly zygomorphic). *Disk* sometimes present (not in Mal. *spp.*). *Sepals* united or free. *Corolla* gamopetalous, very rare with a corona. *Stamens* isomerous in Mal. *spp.* (in 2 extra-Mal. genera less), alternating, inserted on the corolla tube (with one exception in *Buddleja*), included or exerted; anthers basifixed or sometimes slightly dorsifixed (in the *Spigeliaceae*), slightly to deeply bifid at base, lengthwise dehiscent. *Ovary* superior (in *Polypremum*, *Cynoctonum*, and *Mitrasacme p.p.* semi-inferior), (1-)2(-4)-celled, placentas axile (parietal if 1-celled), often peltate; ovules 1-∞ per cell, amphitropous or anatropous; style usually one. *Fruit* always superior, capsular, baccate, or drupaceous. *Seeds* 1-∞, with copious endosperm; embryo minute, straight, cotyledons small.

**Distribution.** About 28 genera with some 600 *spp.*, almost confined to the tropics of both eastern and western hemispheres, a few genera extending to the warm-temperate regions, mainly towards the south. In Malaysia 11 genera with 80 *spp.*

**Ecology.** The majority of the genera and species are confined to the everwet tropical lowland. A few are indifferent to climate (e.g. *Cynoctonum mitreola*, *Fagraea racemosa*, and *F. fragrans*); a few others are characteristic for areas subject to distinct periodical drought, e.g. *Strychnos lucida* (fig. 29), *Mitrasacme (M. elata)*, fig. 41, and a few others). As to altitude almost all representatives occur below 2000 m, *Buddleja asiatica* and a few species of *Fagraea* and *Geniostoma* are ascending to the lower border of the subalpine zone, but none is found above 3000 m.

Almost all species occur in dryland sites; *Fagraea crenulata* is confined to temporarily or permanently inundated swamps (fig. 18), several *Neuburgias* occur in damp alluvial forest, *Fagraea racemosa* can also stand marshy conditions.

The role played by *Loganiaceae* in vegetation is small as none occurs gregariously. Only very few species are sizeable trees, notably old specimens of *Fagraea fragrans*, *F. elliptica*, *F. crenulata*, both *Norrisias*, and further a few *Neuburgias*. A temporary preponderance in seral vegetation types is found with *Buddleja asiatica* which is a characteristic shrub of disturbed terrain and *Fagraea fragrans* which is rather fire-resistant (fig. 20).

Flowers are usually whitish and frequently fragrant, mainly attracting insects; some obviously nocturnal (certain *Fagraeas*); it has been suggested that some large-flowered *Fagraeas* are visited by birds, or even bats, but this matter is insufficiently investigated.

The seeds from species with capsular fruits are mostly very light and often winged (*Norrisia*, *Gelsemium*, *Buddleja*); they are dispersed by wind; the small to rather big baccate fruits of some genera are swallowed by birds and bats who will be responsible for the dispersal of the seeds. *Neuburgia* seems to possess buoyant fruits, possibly dispersed by water.

**Wood-anatomy.** DEN BERGER, Determinatietabel houtsoorten van Malesië, Veenman, Wageningen (1949) 20, 21, 27, 60; DESCH, Mal. For. Rec. 15<sup>1</sup> (1941) 302 (hand lens); CHALK & CHATTAWAY, Trop. Woods 50 (1937) 1; METCALFE & CHALK, Anat. Dic. 2 (1950) 928; MOLL & JANSSONIUS 4 (1926) 652; PEARSON & BROWN, Commercial timbers of India 2(1932) 738. According to CHALK (METCALFE & CHALK *l.c.*) the woods of the family suggest more than one distinct group, but according to them the material available for examination was insufficient to justify any more detailed conclusions. JANSSONIUS (MOLL & JANSSONIUS *l.c.*) studying *Geniostoma rupestre* FORST. (= *G. haemospermum* STEUD., *G. miquelianum* K. & V., *G. oblongifolium* K. & V.), *Buddleja asiatica* LOUR. and *Fagraea racemosa* JACK *ex* WALL. (= *F. morindaefolia* BL.) and *F. blumii* G. DON(= *F. obovata-javana* BL.) has claimed that they belong to two families, one including *Geniostoma* and *Buddleja*, the other *Fagraea*. It seems to me that the differences between the genera are not large enough to justify such a conclusion and that for the present, there is no evidence against LEENHOUTS' subdivision into tribes.—C.A.R.—G.

Phytochemistry. From this family the great pantropic genus *Strychnos* has attracted the attention of many phytochemists. It was known early that most species are toxic and contain alkaloids. Today many pure *Strychnos* alkaloids are known and all of them proved to be indol derivatives. Most South American species contain highly complex curarizing quaternary bases in the barks. The most recent reviews of these alkaloids are those of BERNAUER (Fortschr. Chemie Org. Naturstoffe 17, 1959, 183; *Planta Medica* 9, 1961, 340). On the other hand Asiatic and Australian *Strychnos* species contain convulsive alkaloids of the strychnine-type. Strychnine, brucine, and closely related bases were demonstrated to be present in many species from Asia, Malaysia, and Australia. The alkaloids of the African species of *Strychnos* have not yet been investigated thoroughly. Indole-alkaloids occur also in the African genus *Mostuea* and in the Chinese and North-American genus *Gelsemium*. In other genera alkaloids have been demonstrated to be present but their chemistry is unknown. Complex indole-alkaloids are restricted, as far as we know, among Angiosperms to the families of *Loganiaceae*, *Apocynaceae*, and *Rubiaceae*. This may well indicate that they are all phylogenetically closely related as suggested by HUTCHINSON.

Besides alkaloids some *Loganiaceae* accumulate pseudo-indicans, i.e. glycosides producing blue colours under certain conditions. Loganin and loganic acid were found in many species of *Strychnos* (A. DENOËL et al., Contribution à l'étude chimique des *Strychnos* du Congo Belge, Bruxelles 1953; publ. par Ministère des Colonies, Direction de l'Agriculture). Loganin has also been isolated from *Meynantes trifoliata* (*Gentianaceae*). In the genus *Buddleja* loganin is replaced by the related glycoside aucubin, which is a characteristic compound of many families of *Tubiflorae* (CHASLOT, Thèse [Pharm.] Univ. Paris 1955). This may indicate rather clear relationships between *Buddlejeae* and some families of *Tubiflorae*. This assumption is strengthened by the fact that still other types of glycosides are common to *Buddlejeae* and different taxa of *Tubiflorae*. The flavonoid compound buddleo-flavonolioside is known to be identical with linarin from *Linaria* (*Scrophulariaceae*) and according to a recent suggestion of HARBORNE & CORNER (*Biochem. J.* 81, 1961, 242) the third heteroside (= buddleioside) known to occur in *Buddleja* is probably identical with orobanchoside from several species of *Orobanche* (*Orobanchaceae*). The recent elucidation of the structures of loganin, aucubin, and other pseudo-indicans (for instance asperuloside from *Rubiaceae*) and related compounds (gentiopicroin and gentianin from *Gentianaceae*) seems to be highly interesting for taxonomy (for structures compare R. THOMAS, *Tetrahedron Letters* 1961, 544-553). It is very probable that many constituents isolated from species belonging to families of the orders *Loganiales*, *Contortales*, *Tubiflorae*, and *Rubiales* are biochemically intimately related.

As a whole, the *Loganiaceae* have hitherto not been studied intensively by phytochemists. Most of the research has been concentrated on the alkaloid-bearing species of *Strychnos*. Chlorogenic acid, some triterpenes, rubber (fruit of *Fagraea*), bitter principles (*Fagraea*) and saponins were demonstrated to be present in some species. The distribution and chemistry of these compounds is not yet sufficiently well known to permit their use for chemotaxonomical speculations. On the other hand, as already mentioned, *Loganiaceae* are biochemically related to *Apocynaceae* and *Rubiaceae* by the glycosides and alkaloids of the subfamily of *Loganioideae* and to *Scrophulariaceae* and derived families by the different types of glycosides present in the subfamily of *Buddlejoideae*.—R. HEGNAUER.

Morphology. *Stipules*. The leaf-bases are probably all developed into *vaginae connatae*. They can be developed as a stipular line only, can form a sheathlike connection between the petioles (*vaginae interpetiolares*; fig. 23b), or can be moreover connected in the leaf-axils as an ocrea (fig. 10b). In the last case either the interpetiolar part may be strongest developed (interpetiolar stipules, fig. 31a) or the axillary part is predominant ('axillary scales' of *Fagraea*, fig. 3, 6, 20f). The stipules resemble those of the *Rubiaceae*; they are persistent except in *Mostuea* where the upper portion withers. Some species of *Fagraea* have auricles at the base of the petiole outside of (and sometimes hiding) the ocrea; they may be taken at first sight as stipules, but are of distinctly laminar origin (fig. 3c-d). Most genera of the *Buddlejeae* show a (sometimes faint) stipular line. In *Buddleja* the lamina is often decurrent along these stipular lines; in that case there may be a pair of auricles at the leaf-base, or these may be combined into an 'interpetiolar stipule' on either side of the node, or the leaves may be perfoliate. In some *Buddlejas* the interpetiolar stipules develop into a second pair of (slightly smaller) leaves decussate to and inserted between the normal leaf pair (analogous to those of *Galium* and *Asperula* in the *Rubiaceae*). Whether the stipular line of the *Buddlejeae* is comparable with the *vaginae connatae* of the other *Loganiaceae* deserves further study. It seems to me that there is a gradual series from the stipules of the *Loganiaceae* to those of the *Rubiaceae*, the latter usually being better developed organs. In the related *Apocynaceae* axillary scales similar to those found in *Fagraea* are also known, for example in *Conopharyngia*, but they also occur in other families, for instance *Guttiferae*. HASSELBERG (*Symb. Bot. Upsal.* 2, 3, 1937, 1-170) gave an extensive account of the morphology of the stipules in the *Loganiaceae*.

*Aestivation of the corolla-lobes*. The aestivation of the corolla-lobes can be valvate, imbricate, or contorted. This character seems to be of some systematical importance; in most of the tribes, and in all genera with only one exception, we find only one type of aestivation:

*Potalieae*: contorted.

*Buddlejeae*: mostly imbricate, valvate in *Peltanthera* and *Nuxia*.

*Antonieae*: valvate.

*Gelsemieae*: imbricate.

*Strychnoeae*: valvate.



*Loganiaceae*: *Logania imbricate*, *Geniostoma imbricate* or contorted, *Labordia* contorted.

*Spigeliaceae*: *Spigelia* and *Mitrasacme* valvate, *Cynoctonum* and *Polypremum* imbricate.

Delimitation and subdivision. *Loganiaceae* are considered to be a heterogenous family. Especially the position of *Buddleja* and related genera has given rise to controversial opinion. To gain a better insight in this matter I felt compelled to study all genera, from almost all of which herbarium material was available and has been analyzed; in few cases my work was supplemented by examining published descriptions and plates. Furthermore, I have used data derived from anatomy, cytology, palynology, embryology, and phytochemistry.

From these studies emanated the following subdivision into tribes, to which have been added the names of genera which I have accepted:

- A. *Potalieae*: (1) *Potalia*, (2) *Anthocleista*, (3) *Fagraea*.  
 B. *Buddlejeae*: (4) *Peltanthera*, (5) *Sanango*, (6) *Nuxia*, (7) *Androya*, (8) *Gomphostigma*, (9) *Buddleja*, (10) *Emorya*, (11) *Adenopluia*, (12) *Adenoplea*.  
 C. *Antonieae*: (13) *Bonyunia*, (14) *Antonia*, (15) *Norrisia*, (16) *Usteria*.  
 D. *Gelsemieae*: (17) *Gelsemium*, (18) *Mostuea*.  
 E. *Strychnaeae*: (19) *Strychnos*, (20) *Gardneria*, (21) *Neuburgia*.  
 F. *Loganieae*: (22) *Geniostoma*, (23) *Labordia*, (24) *Logania*.  
 G. *Spigeliaceae*: (25) *Polypremum*, (26) *Cynoctonum*, (27) *Spigelia*, (28) *Mitrasacme*.  
 Genera dubia: *Retzia*, *Desfontainea*.

I agree with SOLEREDER (in E. & P. Nat. Pfl. Fam. 4, 2, 1892-95, 19-50) that the *Loganiaceae* represent a well-circumscribed family, and that at least some of the tribes show clear mutual relationships. From this follows that I disagree with HUTCHINSON (Fam. Fl. Pl. ed. 2, 1, 1959, 370-378) who raised nearly all tribes to family rank, keeping only the *Loganieae* and *Gelsemieae* in *Loganiaceae* in the restricted sense; he largely maintained the suprageneric taxa of BENTHAM & HOOKER. His delimitation of some of the tribes differs from that of SOLEREDER; therefore, his families are sometimes less homogeneous and less sharply defined than SOLEREDER's tribes. For the rest, the raising of tribes to the rank of families leads, it seems to me, not to scientific gain if these families are mutually kept in the same position within an order.

Critical remarks in more detail follow below; all generic names mentioned by either SOLEREDER or HUTCHINSON are included, as well as some more recently ascribed to the family.

A. *Potalieae*. For a survey, see LEEUWENBERG, Act. Bot. Neerl. 10 (1961) 1-53.

(1) *Potalia*. Monotypic; tropical South America. Shows distinct relationships to both other genera.  
 (2) *Anthocleista*. 14 spp.; tropical Africa. For a revision see LEEUWENBERG, l.c. Closest allied to *Fagraea*.  
 (3) *Fagraea*. c. 35 spp.; SE. Asia, Malaysia, tropical Australia, and the southwestern Pacific. Distinctly related to both other genera.

B. *Buddlejeae*. This is a group of mutually distinctly related genera, the systematic position of which is still a source of controversial opinion. In fact this all comes to the same thing: its position with either the *Scrophulariaceae* or the *Loganiaceae*, as a tribe or a subfamily, or as a family of its own. Up to and including EICHLER (Blüthendiagr. 1, 1875, 210) this generic assemblage was mostly treated as a tribe of the *Scrophulariaceae*. BENTHAM & HOOKER (Gen. Pl. 2, 1876, 787) were apparently the first who included it in the *Loganiaceae* (as a subtribe of the tribe *Euloganieae*), probably on account of the presence of stipules. SOLEREDER, l.c., raised it to the rank of a subfamily, and opposed it to the other *Loganiaceae*, mainly on anatomical grounds, remarking that, apart from the stipules, they could as well be included in the *Scrophulariaceae*. WILHELM (Die Samenpfl. 1910, 90) was apparently the first who raised this group to family rank. These *Buddlejeae* were usually placed near the *Loganiaceae*, but sometimes near the *Scrophulariaceae*. Recently HARTL (Oest. Bot. Z. 103, 1956, 185-242) included them again as a tribe in the *Scrophulariaceae*, in which he was followed by some German authors (WAGENITZ, TROLL).

The main differences between the *Buddlejeae* and the other *Loganiaceae* mentioned are:

- (i) Intraxylary phloem. Absent in the *Buddlejeae* and *Polypremum*, present in all other *Loganiaceae*.  
 (ii) Glandular-capitate hairs. Present in *Buddlejeae* except *Peltanthera*, in *Mostuea* (on the style), in *Logania* (on the ovary), and in *Mitrasacme* (on the calyx, sec. KLETT in Mez, Bot. Arch. 5, 1924, 327), absent in all other *Loganiaceae*.  
 (iii) Stellate hairs. Present in the *Buddlejeae* (except *Peltanthera* and *Sanango*) and in *Spigelia*, absent in all other *Loganiaceae*.  
 (iv) Unicellular or uniseriate hairs. Absent in most of the *Buddlejeae*, present in *Peltanthera* and *Sanango* of the *Buddlejeae* and in the other *Loganiaceae*.  
 (v) Pericyclic cork in the *Buddlejeae* except *Peltanthera* and probably *Sanango*, superficial cork in the other *Loganiaceae*.  
 (vi) Colleters. Absent in the *Buddlejeae* and *Polypremum*, present in the other *Loganiaceae*, at least in the leaf axils.

The genera usually included in the *Buddlejeae* (those cited in the survey above under B, plus *Polypremum*) are thus still marked off from the other *Loganiaceae* by the absence of intraxylary phloem and of colleters. Data derived from cytology, palynology, embryology, and phytochemistry sustain in general a relationship with the *Scrophulariaceae*. However, these data are very incomplete and comparisons often based on one or a few genera which are only distantly related (for example *Spigelia* and *Buddleja*). These arguments may therefore lose significance if all genera are examined, as for example has already appear-

ed in palynology and chromosome numbers which have yielded a very varied pattern within the *Loganiaceae*. A comparison in these fields of *Peltanthera* with the *Antonieae* and of *Polypremum* with the *Spigeliae* would be highly desirable.

Two other facts are in favour of a closer relationship between the *Buddlejeae* and the *Loganiaceae*. The genus *Peltanthera* (and the closely related *Sanango*) is on the one side closely related to *Nuxia*, but shows on the other side a distinct alliance to the *Antonieae*, and was in fact included by HUTCHINSON in the *Antoniaceae*. *Polypremum* has been included mostly in the *Buddlejeae*, but HUTCHINSON included it in the *Loganiaceae sensu stricto*; in my opinion it should be included in the *Spigeliae* on account of the herbaceous habit, the membranous, sheath-like interpetiolar stipules, the partly inferior ovary, and the nearly basally inserted peltate placentas, all characters which are unusual in the *Buddlejeae*. Inclusion of *Polypremum* in the *Spigeliae* as accepted here entails the breakdown of the only two characters by which the *Buddlejeae* deviate from the other *Loganiaceae*.

Concluding, the affinity of the *Buddlejeae* is clearly with both the *Loganiaceae* and the *Scrophulariaceae*. But on account of the unsharp delimitation against the *Loganiaceae* and especially the distinct relationships with the *Antonieae* I prefer to include them in the *Loganiaceae*. In the *Scrophulariaceae* they would represent an isolated basal offshoot; within the *Loganiaceae* they are definitely less isolated than the *Potalieae* and the *Spigeliae*.

(4) *Peltanthera*. Monotypic; tropical Central and South America. Especially related to *Sanango* and to *Nuxia*, furthermore to the *Antonieae* (included by HUTCHINSON in the *Antoniaceae*).

(5) *Sanango*. Monotypic; tropical South America. Related to *Peltanthera*.

(6) *Nuxia* (syn. *Lachnopylis*). About 20 spp.; South Africa and Madagascar. Close to *Peltanthera* and to *Sanango*.

(7) *Androya*. Monotypic; Madagascar. Closely related to *Nuxia* but sufficiently different. Originally described in the *Oleaceae*.

(8) *Gomphostigma*. A few spp.; South Africa.

(9) *Buddleja* (syn. *Chilanthus* and *Nicodemia*). More than 100 spp.; in the tropics and subtropics, worldwide with the exception of the western half of Africa, Australia, and the Pacific. *Emorya*, *Adenopplusia*, and *Adenoplea* are closely related and should probably be united with it.

(10) *Emorya*. Monotypic; southwestern North America. Probably to be included in *Buddleja*.

(11) *Adenopplusia*. A few spp.; Madagascar and East Africa. Closely related to *Adenoplea*; both should possibly better be sunk in *Buddleja*.

(12) *Adenoplea*. A few spp.; Madagascar. Should probably be combined with *Adenopplusia*, and both possibly with *Buddleja*.

#### C. *Antonieae*.

(13) *Bonyunia*. About 2-5 spp.; tropical South America. Close to the next two genera.

(14) *Antonia*. Monotypic; tropical South America. Close to both *Bonyunia* and *Norrisia*.

(15) *Norrisia*. Two spp.; Malaysia. Close to the foregoing two genera.

(16) *Usteria*. Monotypic; tropical Africa. Somewhat isolated.

#### D. *Gelsemieae*.

(17) *Gelsemium*. Three spp.; southern North and northern Central America and SE. Asia (also in Malaysia). Shows also relationship to the *Antonieae*.

(18) *Mostuea* (syn. *Coinochlamys*). Eight spp.; tropical Africa and northern South America. Revision: LEEUWENBERG, Med. Landbouwhoges. Wageningen 61, 4 (1961) 1-31. Shows also relationship to the *Strychnaeae*.

#### E. *Strychnaeae*.

(19) *Strychnos* (syn. *Scyphostrychnos*; see LEEUWENBERG, Act. Bot. Neerl. 11, 1962, 47-50). About 150-200 spp.; worldwide in the tropics and subtropics.

(20) *Gardneria* (syn. *Pseudogardneria*). Five spp.; SE. and E. Asia, Malaysia. Revision: LEENHOUTS, Bull. Jard. Bot. Brux. 32 (1962) 431-439.

(21) *Neuburgia* (syn. *Couthovia* and *Crateriphytum*). About 10-12 spp.; Malaysia and the southwestern Pacific. Shows also affinities to the *Loganiaceae*.

#### F. *Loganiaceae*.

(22) *Geniostoma*. About 20-40 spp.; Malaysia and the Pacific. Close to *Labordia*.

(23) *Labordia*. About 20 spp.; Hawaii. Hardly generically different from *Geniostoma*.

(24) *Logania*. About 20-30 spp.; Australia (also Tasmania and New Zealand) and New Caledonia.

#### G. *Spigeliae*.

(25) *Polypremum*. Monotypic; subtropical North and South America. By SOLEREDER and most subsequent authors included in the *Buddlejeae*, by HUTCHINSON in the *Loganiaceae sensu stricto*. Distinctly related to *Mitrasacme* and *Cynoctonum*; compare also the notes to the *Buddlejeae*.

(26) *Cynoctonum* (syn. *Mitreola*). Six spp.; tropical and subtropical America, Madagascar, SE. Asia, Malaysia, and North Australia.

(27) *Spigelia* (syn. *Pseudospigelia*). About 50 spp.; tropical and subtropical America, 1 species naturalized in Africa and Malaysia.

(28) *Mitrasacme*. About 40 spp.; Australia (also Tasmania and New Zealand), SE. and E. Asia, Malaysia, the Carolines, and New Caledonia.

*Mitrasacmopsis*, a monotypic genus from Madagascar, described by JOVET in the *Loganiaceae-Spigeliaceae* and accepted as such by HUTCHINSON, should be excluded from this family. The leaves show abundant raphides, a character which is absent in the *Loganiaceae*, but characteristic of many *Rubiaceae*, as Dr C. E. B. BREMEKAMP informed me. It should be included in the *Rubiaceae-Hedyotideae* and seems to be especially close to the African genus *Diotocranus*.

*Desfontainea*. Monotypic; Andine South America. Included by HUTCHINSON in the *Potaliaceae*, also occasionally placed in or near the *Solanaceae*.

*Retzia*. Monotypic; South Africa. Relationships uncertain.

Systematic affinities. The relationships of the *Loganiaceae* are threefold:

Especially the *Potalieae* are distinctly related to the *Apocynaceae-Tabernaemontaninae*. The main characters in which they differ from the *Apocynaceae* are the absence of laticiferous vessels (but *Fagraea* has a laticiferous tissue under the epidermis of the fruits) and of the more complicated type of stigma characteristic of the latter family.

The *Spigeliaceae* show a distinct relationship to the *Rubiaceae-Hedyotideae*. As a whole, superior versus inferior ovary is a good distinguishing character between *Loganiaceae* and *Rubiaceae*. In this case the character is, however, not sharp: in the *Spigeliaceae* the ovary is superior or partly inferior, in the *Hedyotideae* it is often only halfway inferior or even less. The best distinguishing characters are the absence of raphides and the always superior fruit in the *Spigeliaceae*.

The *Buddlejeae* show an indubitable affinity to the *Scrophulariaceae*, as discussed above. The main difference with the latter family is the stipular line which is present in most genera.

Possibly there is some relationship with the *Oleaceae* which must then be found with the *Antonieae* and *Gelsemieae*.

The morphological relationships are mainly confirmed by the data provided by the auxiliary sciences. I agree with HUTCHINSON in accommodating the *Loganiaceae* in an order *Loganiales*, from which the orders *Contortae* (*Gentianales*), *Tubiflorae* (*Scrophulariales*), and *Rubiales* can be derived. The *Oleaceae* should possibly be included in the *Loganiales*, as proposed for example by SOLEREDER and by HUTCHINSON.

Uses. Some species are reputed for their alkaloids. Best known of these are strychnine and brucine in the seeds of several *Strychnos* spp., especially *S. ignatii* and *S. nux-vomica*; furthermore the very poisonous gelsemin from the roots of *Gelsemium*. Some species of *Fagraea* and the *Norrissias* are good timber-trees. A few species, mainly of *Fagraea* and *Buddleja*, are planted as ornamentals.

Notes. Many years ago Dr C. A. BACKER started a revision of this family but had to give up on account of failing eyesight; his MSS were put at my disposal. I have further cooperated with Dr A. J. M. LEEUWENBERG, Wageningen, who is revising the African *Loganiaceae*, by exchange of MSS.

## KEY TO THE GENERA

1. Woody plants.
  2. Flowers 4-merous. At least underside of leaf always tomentose; hairs stellate or glandular-capitate. **2. *Buddleja***
  2. Flowers 5-merous. Plants mostly  $\pm$  glabrous; underside of leaf not tomentose; hairs neither stellate nor glandular-capitate.
  3. Leaves 3-5-plinerved. Tendrils often present . . . . . **5. *Strychnos***
  3. Leaves penninerved. No tendrils.
    4. Inflorescences terminal, sometimes also lateral.
      5. Corolla-lobes valvate in bud.
        6. Corolla outside densely tomentose, without a hair-ring in the mouth. Capsule 2-valved, densely hairy. Seeds many, minute, spindle-shaped . . . . . **3. *Norrissia***
        6. Corolla outside glabrous, inside with a hair-ring in the mouth. Fruit drupaceous, indehiscent, glabrous. Seeds 1-2, large, spindle-shaped, remaining in a stone . . . . . **7. *Neuburgia***
      5. Corolla-lobes imbricate or contorted in bud.
        7. Corolla-lobes contorted. Trees, shrubs, or epiphytes. Fruit baccate, almost never dehiscent. Seeds many, angular, embedded in pulp . . . . . **1. *Fagraea***
        7. Corolla-lobes imbricate. Liana or straggling shrub. Fruit a dry capsule, 2-valved. Seeds c. 8, elliptic to bean-shaped, winged all around . . . . . **4. *Gelsemium***
    4. Inflorescences exclusively lateral.
      8. Fruits baccate, indehiscent.
        9. Corolla-lobes contorted in bud. Seeds small, angular . . . . . **1. *Fagraea***
        9. Corolla-lobes valvate in bud. Seeds fairly large ( $\frac{1}{2}$ -1 cm), orbicular or elliptic. **6. *Gardneria***
      8. Fruits capsular, with 2 caducous valves. Seeds small, embedded in a red or orange placenta. **8. *Geniostoma***
1. Annual, rarely perennial herbs.
  10. Flowers 4-merous. Leaves 1-nerved or curvinerved. . . . . **11. *Mitrasacme***
  10. Flowers 5-merous. Leaves penninerved.
    11. Stem with some pairs of small leaves and at the base of the inflorescence a pseudowhorl of 4 larger leaves. Inflorescences unbranched . . . . . **10. *Spigelia***
    11. No whorled larger leaves at the base of the inflorescence. Inflorescences dichasially branched. **9. *Cynoctonum***



Fig. 1. A strangling *Fagraea* sp. at Pondok Patjet, Mt Singalang, Central Sumatra (W. MEYER, 1956).

## 1. FAGRAEA

THUNB. Vet. Acad. Handl. Stockh. 3 (1782) 132, t. 4; LEENH. Bull. Jard. Bot. BRUX. 32 (1962) 418-431.—*Bertuchia* DENNST. Schluess. Hort. Malab. (1818) 30, *nom. inval.*—*Cyrtophyllum* REINW. [ex BL. Cat. (1823) 47; Isis 1 (1823) 313-314, *nom. nud.*] Syll. Pl. Ratisb. 2 (1826) 8.—*Kuhlia* REINW. [ex BL. Cat. (1823) 51, *nom. nud.*] Syll. Pl. Ratisb. 2 (1826) 6, *nom. illeg.*, non H.B.K. (1825).—*Picrophloeus* BL. Bijdr. (1826) 1019.—*Utania* G. DON, Gard. Dict. 4 (1838) 663.—*Kentia* STEUD. Nomencl. ed. 2, 1 (1840) 845, *nom. illeg.*—*Flemingia* HUNTER in Ridl. J. Str. Br. R. As. Soc. n. 53 (1909) 83, *nom. inval.*, non ROXB. ex AIT. (1812).—**Fig. 1-23.**

Terrestrial, epiphytic, or hemi-epiphytic, often scrambling shrubs, woody climbers, or small to fairly large trees, glabrous in all parts. *Stipules* connate into an ocrea which usually early splits (interpetiolarly) into 2 axillary scales, these free or partly to entirely adnate to the base of the petiole; axillary colleters all around the node. *Leaves* petioled or sometimes sessile, coriaceous or more or less fleshy, nearly always entire (crenulate in *F. crenulata*), base usually decurrent and sometimes auriculate; penninerved, nerves often, veins nearly always inconspicuous to invisible. *Flowers* solitary, in twos, or in 3- to many-flowered cymose (rarely glomerulous, thyrsoid, or by reduction racemose or spicate) inflorescences, nearly always terminal, usually with a pair of strong basal branches in the upper leaf-axils; peduncle nearly always quadrangular in section, slightly compressed, sometimes terete, branches usually distinctly compressed. Bracts (except lower ones) small and scale-like. Bracteoles usually present, mostly similar to the bracts, but smaller, in some species large and enveloping the calyx, in that case often 2(-3) pairs present (fig. 21). *Calyx* thick-fleshy to coriaceous, in some species even almost woody, lobes imbricate, nearly always rounded, thick with a thin margin, inside with colleters at the base. *Corolla* fleshy, sometimes very thick, creamy-white (outside sometimes greenish or pinkish), the second day turning to yellow or orange, tube consisting of a tubular, thin(walled) basal part which may be very short and included in the calyx but can form the greater part of the tube, and a thicker-walled upper part which is either tubular and only slightly widened towards the mouth, or narrowly to widely funnel-shaped; lobes contorted, overlapping to the right, variable in length but always shorter than the tube, rounded. *Stamens* inserted in the throat (between the basal and the upper part of the tube), in some species on a thickened ring (fig. 23b); filaments broadened at and geniculate just above the base, strap-shaped, sometimes filiform; anthers basifixed, either deeply bifid at the base and blunt-ellipsoid, or shallowly bifid and acute-linear; cells dehiscing lengthwise, introrse. *Ovary* ellipsoid, tapering into a filiform to cylindrical (*in sicco* deeply lengthwise grooved) style about as long as the tube or distinctly exserted; stigma capitate, obconical, peltate, or 2-lobed; ovary either 1-celled with 2 parietal placentas, or 2-celled with axile placentas; placentas peltate, elliptic, with  $\infty$  ovules. *Fruit*: berry, but in some large-fruited species 4-valved; usually globular to ellipsoid, crowned by the style-base, pale greyish-green or whitish or turning *via* yellow and orange to bright red; under the epidermis with a sticky white latex; calyx not or slightly enlarged (caducous in some forms of *F. blumei*). *Seeds*  $\infty$ , irregularly angular, c. 1 mm long, minutely warty, brown.

Distr. About 35 spp., from Ceylon and the Malabar coast through SE. continental Asia to South China, Hainan, and the southern peninsula of Formosa, throughout *Malaysia*, in the Northern Territory and NE. Queensland, and in the Pacific from the Marianas to the Marquesas and the Tubuai Is. and New Caledonia in the southwest; distinctly centered in *Malaysia*. LEENH. Pac. Pl. Areas 91. Fig. 3.

Ecol. Mostly heliophilous plants, along forest edges, on river-banks, in open places, also shrubs or trees in light forest and savannahs; from sea-level up to c. 3000 m. As epiphytic shrubs they are usually found on the trunk of large trees, clasping the stem with their roots; the latter may reach the soil whereby the plant becomes a hemi-epiphyte (fig. 13). Some collectors noted that the same species could be found as an epiphyte at lower altitudes, terrestrial at a higher altitude. *F. crenulata* is adapted to permanent or periodical swamp conditions. As to climate, most species grow under everwet conditions, a few only are tolerant to seasonal conditions (for example *F. fragrans*).

Flowers are mainly visited by insects (especially *Xylocopa* spp. and butterflies), some large-flowered species also by birds, possibly some species by bats (see DEX. Ann. Bog. 1, 1950, 50). The anthesis of an individual flower apparently lasts for two days, opening is after sunset; in *F. blumei*, *F. auriculata*, and possibly in all large-flowered species the free halves of the lobes are released within 5–10 minutes, standing out as the blades of a turbine after which the limb expands suddenly. The flowers are protandrous (see BURCK, Teysmannia 3, 1892, 201–203).

Dispersal is mainly effected by birds, not rarely by bats, apparently sometimes also by ants. At least some or several species are myrmecophilous: they possess extra-floral nectaries near the leaf-base, on the leaf-blades, and on the calyces; in a few species with large auricles at the petiole ants live in the shelter provided by these. For the possible protection, given by these ants, see BURCK, Ann. Jard. Bot. Btzg 10 (1891) 95–98, and Mrs NIEUWENHUIS-VON ÜNKÜLL-GÜLDENBANDT, *ibid.* 21 (1907) especially p. 252 and t. 27 f. 60 & 67.

Anat. See VON GUTTENBERG, Ann. Jard. Bot. Btzg 44 (1934) 35–41, f. 34–40; for the extrafloral nectaries see also ZIMMERMANN, Ann. Jard. Bot. Btzg 18 (1901) 1, f. 1–7.

Uses. A few species are good timber trees, notably *F. crenulata*, *F. elliptica*, and *F. fragrans*. The latex under the epidermis of the fruits is widely in use as a glue. Some of the species with large flowers are locally cultivated as ornamentals.

Morph. The *rebranching* is mainly sympodial (also in the two species with axillary inflorescences). The lower two or three internodes of the axillary shoots are in several species much longer than the further ones of the same shoot; this is especially conspicuous in the species of *sect. Cyrtophyllum*, in which a shoot of some strongly lengthened internodes abruptly ends in a number of densely crowded leaf-pairs (fig. 6).

The *stipules* are as well intra- as interpetiolar connate and form an annulus around the twig. This annulus is nearly always highest in the leaf-axils and often shows a suture between the leaf-bases. With very few exceptions it soon splits into two 'median stipules', which I have called axillary scales (fig. 2a).

The *auricles* which are present in some species (fig. 2b–d) are no stipules but appendages of the base of the blade; they are always inserted outside the stipules. In petioled leaves the blade is often decurrent as a narrow wing along the petiole broadening at the base into the auricle, but in others the terete petiole bears no trace of such wings. See HASSELBERG, Symb. Bot. Upsal. 2, n. 3 (1937) 49–50.

The *ovary* can be 2-celled with axile placentation, or 1-celled with 2 parietal placentas. The latter may be the more primitive condition. The systematic value of this character cannot be thoroughly studied in the herbarium. I tried to get a rough impression by making sections of one or two ovaries of several species, of one ovary of several specimens of *F. gracilipes* (belonging to 'elata', 'muelleri', and 'cambagei'), and of several ovaries of one specimen of *F. gracilipes*. I found that the ovary in one specimen is constant, 'elata' and 'cambagei' both showed only 1-celled ovaries, but in 'muelleri' both types occurred. In some other species there was also a difference between my observations and descriptions or figures published. The tentative conclusion is that the inner structure of the ovary is variable and anyhow cannot serve for sectional or specific discrimination. During this investigation I found several ovaries which were solid, which may point to a tendency of dioecism, or dioecio-polygamism. This matter should be examined in more detail with plenty of fresh material.

Taxon. The genus has been subdivided here into three sections, *sect. Cyrtophyllum* with 3 spp., *sect. Racemosae* with *F. racemosa* as only species, and *sect. Fagraea* with 27 spp.

A further subdivision of *sect. Fagraea* into sharply separated infrageneric taxa is not well possible. The flowers provide still the best characters, especially the form of the stigma, 2-lobed or not, seems to be important. There is a group of species characterized by a 2-lobed stigma associated with linear anthers and inside the corolla with a ring on which the stamens are inserted (fig. 23). Unfortunately *F. annulata* has the ring but not the other two characters and *F. gardenioides* has linear anthers but no ring and no 2-lobed stigma.

The remaining species have a globular, obconical, or truncate stigma, which is, however, sometimes grooved with a tendency to be slightly 2-lobed. There are two groups of species, one of which is characterized by auricles at the leaf-base, the other lacking this character. Though this character is constant for the species it cannot serve for further infrageneric subdivision as it occurs in various degree of development and seems to be of minor importance systematically.

As to other specific characters the shape of the stipules is fairly constant.

In general it has been found necessary to adopt a rather wide specific delimitation because it was often difficult to find reliable characters; especially the size of the corolla shows great but grading variation. *F. auriculata*, *F. berteriana*, *F. blumei*, *F. ceilanica*, and *F. gracilipes* are such species with wide circumscription.

*Nomenclature.* The name *Bertuchia* DENNST. is considered to be invalid as it is not fully in accordance with Art. 42 of the Montreal Code.

The name *Kuhlia* REINW. is illegitimate, being a later homonym of *Kuhlia* H. B. K.; *Utania* and *Kentia* were both published as substitutes, the latter superfluously.

*Flemingia* HUNTER is not validly published as RIDLEY's publication of the old MS of HUNTER's was only for historical reasons, and not to validate any name.



Fig. 2. Different kinds of stipules and auricles in *Fagraea*. a. Axillary scales and very faint auricles in *F. eymae* BACK. (BW. 8908), b. not-reflexed auricles in *F. fastigiata* BL. (KOORDERS 4329), c. small reflexed auricles in *F. tacapala* LEENH. (EYMA 2473), d. well developed auricles in *F. auriculata* JACK (SINCLAIR s.n.). All  $\times \frac{3}{4}$ .

#### KEY TO THE SPECIES

1. Leaves minutely crenulate. Stem and branches prickly. . . . . 12. *F. crenulata*
1. Leaves entire. Stem and branches unarmed.
2. Inflorescences exclusively axillary.
3. Inflorescences thyrsoid, usually corymbose, mostly many-flowered; peduncle slender. Stamens and style far exserted . . . . . 2. *F. fragrans*
3. Inflorescences condensed racemose, umbelliform, few-flowered; peduncle short and thick. Stamens and style hardly exserted. . . . . 3. *F. umbelliflora*
2. Inflorescences terminal (the lowest pair of strong branches often in the upper leaf-axis).
4. Flowers and fruits small (calyx 2-3 mm, corolla-tube  $3\frac{1}{2}$ -8 mm, fruits 5-8 mm  $\phi$ ). Inflorescences many-flowered, corymbose . . . . . 1. *F. elliptica*
4. Flowers and fruits distinctly larger. Inflorescences rarely corymbose.
5. Leaves with distinct auricles (reflexed or not) at or slightly above the base (fig. 2b-d).
6. Auricles reflexed. Young leaves not connate. Inflorescence without an involucre of reduced leaves.
7. Auricles on the petiole distinctly above the axillary scale (fig. 2b). Calyx 7 mm long, sepals connate for more than  $\frac{2}{3}$  of their length . . . . . 11. *F. fastigiata*
7. Auricles at the very leaf-base, clasping the axillary scale (fig. 2c-d). Calyx (8-10 mm or more, sepals for their greater part (mostly nearly completely) free.
8. Flowers in many-flowered inflorescences. Bracteoles one pair, attached to the lower half of the pedicel. Corolla-tube 2-3 cm.
9. Leaves blunt to acute at the apex; nerves 8-10 pairs. Inflorescences about corymbose (branches erecto-patent and not of the same length). Bracteoles ( $\frac{1}{2}$ -)1-1  $\frac{1}{2}$  cm. Calyx  $1\frac{1}{4}$ -2  $\frac{1}{2}$  cm long, sepals nearly free. Corolla-tube widely funnel-shaped. . . . . 14. *F. tacapala*
9. Leaves rounded (apart from the acumen) at the apex; nerves 7-8 pairs. Inflorescences pyramidal (branches transverse to the rachis and of nearly the same length). Bracteoles 2  $\frac{1}{2}$ -3 mm. Calyx 8-10 mm, sepals connate for  $\frac{1}{4}$ - $\frac{1}{3}$ . Corolla-tube slenderly funnel-shaped. . . . . 15. *F. widdiana*
8. Flowers solitary or inflorescences up to 5(-7)-flowered. Bracteoles 1-3 pairs, attached to the upper half of the pedicel. Corolla-tube 4  $\frac{1}{2}$ -15 cm.
10. Calyx enveloped by 2(-3) pairs of decussate bracteoles, the upper of which being at least half as long as the calyx (fig. 21). Flowers solitary.
11. Nerves hardly visible. Sepals rounded (fig. 18b) . . . . . 19. *F. involucrata*

11. Nerves distinctly prominent on the lower side. Sepals long and acute (fig. 21e).
10. One or two pairs of small appressed bracteoles at the base of the calyx, much smaller than the latter. Inflorescences 1-3(-7)-flowered . . . . . **20. F. macrocypha**
6. Auricles not reflexed. Leaves connate when young. Inflorescence with an involucre of reduced leaves. . . . . **18. F. auriculata**
12. Corolla-tube tubular, slender, c. 11 cm. Sepals nearly halfway up connate. **16. F. longiflora**
12. Corolla-tube funnel-shaped, 3-3½ cm. Sepals connate for about ¼ of their length. . . . . **17. F. carstensis**
5. Leaves without distinct auricles (fig. 2a).
13. Stipules, even in full-grown leaves, connate around the twig into an ocrea which is hardly longer in the leaf-axils than between the petioles (fig. 10b). Inflorescences distinctly and mostly fairly long-peduncled, racemiform to spiciform, usually with many spaced, decussate, rather short, cymose glomerules (sometimes corymbiform or the whole inflorescence reduced to one fairly long-stalked glomerule) (fig. 9) . . . . . **4. F. racemosa**
13. Stipules soon interpetiolarly (nearly) fully split, distinctly lengthened in the axils (fig. 23f). Inflorescences not distinctly peduncled; flowers either solitary, or in few-flowered sessile glomerules, or with a pair of strong basal branches in the upper leaf-axils. . . . . **4. F. racemosa**
14. Full-grown stigma distinctly 2-lobed (fig. 23d). Stamens inserted on a fleshy ring in the corolla-tube; anthers linear, only slightly bifid at the base (fig. 23b).
15. Nervation seemingly dense, as between every two nerves an intermediate vein is nearly as strongly developed as these, together c. 20 pairs (nervation not very conspicuous). Leaves relatively large and especially broad (9-23 by 4½-14 cm). Inflorescences usually widely and laxly branched . . . . . **31. F. berteriana**
15. Nervation (nearly) invisible, nerves spaced, 4-12 pairs. Leaves usually smaller and often narrower (4-15 by 2½-7½ cm). Inflorescences rather dense. . . . . **28. F. salticola**
16. Leaf-base subcordate to rounded, rarely broadly cuneate, distinctly set off from the petiole. Bracteoles, if present, apical, appressed to the calyx . . . . . **28. F. salticola**
16. Leaf-base acute, decurrent. Bracteoles attached about halfway the pedicel.
17. Corolla-tube tubular or narrowly funnel-shaped, 1½-4 cm. Axillary scale usually distinctly broader than the base of the petiole, 3-10 mm long. Leaf apex often shortly and broadly acuminate. Fruits broadly ellipsoid to subglobose, contracted into a strong conical beak. . . . . **29. F. bodenii**
17. Corolla-tube long-tubular, 7-11 cm. Axillary scale inconspicuous, 3-5 mm long. Leaf-apex blunt to rounded, not acuminate. Fruits oblong-ellipsoid, acute . . . . . **30. F. gitingensis**
14. Full-grown stigma capitate, obconical, or peltate (in the latter case sometimes slightly 2-lobed). Stamens not inserted on a ring (*F. annulata* excepted); anthers oblong to elliptic, about halfway bifid (*F. gardenioides* excepted).
18. Corolla-tube 6-14 cm, cylindrical or almost so.
19. Calyx ½-1 cm long; anthers 4 mm. Flowers in sessile glomerules, rarely solitary. . . . . **8. F. tubulosa**
19. Calyx 1½-5 cm; anthers 7 mm long or more. Flowers solitary or in up to about 5-flowered cymes. . . . . **21. F. resinosa**
20. Calyx enveloped by an involucre consisting of two pairs of large bracteoles.
20. Calyx not enveloped by such an involucre.
21. Anthers linear, bifid at the very base only. Stipules conspicuous. . . . . **23. F. gardenioides**
21. Anthers oblong to elliptic, bifid till about the middle. Stipules not very conspicuous.
22. Flowers in c. 5-flowered cymes. Bracteoles small, attached about halfway the pedicel, patent. Calyx 1½-1¾ cm high. Anthers 7 mm long. Fruits subglobose, 5 cm ø. Axillary scale truncate to slightly emarginate. The Ceylonese form . . . . . **5. F. ceilanica**
22. Flowers solitary or rarely in twos. Bracteoles ½-1 cm long, attached just below and appressed to the calyx. Calyx (1½-)-2-5 cm high. Anthers 1-1¾ cm long. Fruits ellipsoid, 4-7 cm long. Axillary scale rounded . . . . . **22. F. carnosa**
18. Corolla-tube less than 6 cm, funnel-shaped.
23. Flowers sessile, in 3-7-flowered glomerules.
24. Calyx ¾-1¼ cm high. Axillary scale inconspicuous, rounded, appressed to the twig. Leaves 7-24 by 3¾-10 cm; midrib slender, rounded beneath, nerves invisible. **7. F. acuminatissima**
24. Calyx 2½-3 cm high. Axillary scale conspicuous, 2-lobed, adnate to the petiole. Leaves 20-38 by 8-18 cm; midrib bold, keeled beneath, nerves conspicuous. **13. F. truncata**
23. Flowers either solitary or distinctly pedicelled in few-flowered, or in widely branched and many-flowered inflorescences.
25. Inflorescences warty-lenticellate . . . . . **10. F. blumei**
25. Inflorescences not warty-lenticellate (at least during anthesis!).
26. Calyx partly enveloped by an involucre consisting of 1 or 2 pairs of large bracteoles.



27. Involucrum composed of one pair of confluent bracteoles (fig. 14c). 5. *F. ceilanica*  
 27. Involucrum composed of two pairs of free bracteoles . . . . . 25. *F. calcarea*  
 26. Calyx without involucrum.  
 28. Nerves distinctly prominent beneath . . . . . 9. *F. ridleyi*  
 28. Nerves either impressed, or inconspicuous to invisible.  
 29. Stamens inserted on a distinct thickened ring about halfway the corolla-tube. 6. *F. annulata*  
 29. Stamens not inserted on a distinct thickened ring.  
 30. Leaves subsessile, rounded to subcordate at base, faintly auriculate (fig. 2a); nerves 5-6 pairs. Inflorescences usually 2-flowered . . . . . 27. *F. eymae*  
 30. Leaves nearly always petioled, acute to decurrent at base; mostly more nerves (one form of *F. ceilanica* has a rounded to subcordate leaf-base, but is not auriculate and has 4-15-flowered inflorescences).  
 31. Axillary scale conspicuous, rounded, truncate, or emarginate at the apex. Inflorescences up to 5-flowered. Pedicels robust. Anthers  $7\frac{1}{2}$  mm long or more. Stigma peltate.  
 32. Leaves often slightly auriculate at the base; midrib keeled beneath; nerves inconspicuous, up to 20 pairs. Sepals connate for half their length or less. Fruits ellipsoid, 6-7 cm long, not distinctly beaked . . . . . 18. *F. auriculata* ssp. *parviflora*  
 32. Leaves never auriculate; midrib rounded beneath; nerves about invisible, up to 10 pairs. Sepals connate for half their length or more. Fruits subglobular, up to 5 cm long, with a long and slender beak . . . . . 24. *F. curtisii*  
 31. Axillary scale inconspicuous, rounded, rarely truncate at the apex. Inflorescences mostly more than 5-flowered. Pedicels nearly always slender. Anthers up to  $7\frac{1}{2}$  mm long. Stigma capitate, obconical, or more exceptionally peltate.  
 33. Usually a shrub or climber. Midrib flat or prominulous above, nerves usually invisible. Calyx  $1-2\frac{3}{4}$  (-4) cm long (in the form '*khasiana*' 6- $7\frac{1}{2}$  mm). Anthers usually more than 5 mm long. Stigma obconical to peltate . . . . . 5. *F. ceilanica*  
 33. Usually a tree. Midrib mostly grooved above, nerves delicately grooved on both sides. Calyx  $\frac{1}{4}-\frac{3}{4}$  (- $1\frac{1}{2}$ ) cm long. Anthers up to 5 mm long. Stigma capitate to subobconical . . . . . 26. *F. gracilipes*

### 1. Section *Cyrtophyllum*

(REINW.) BL. *Rumphia* 2 (1838) 34.—*Cyrtophyllum* REINW. 1826.—*Picrophloeus* BL. 1826.—*Fagraea* subg. *Cyrtophyllum* MIQ. Fl. Ind. Bat. 2 (1857) 375.—*Fagraea* sect. *Parviflorae* BTH. J. Linn. Soc. Bot. 1 (1856) 100.—*Flemingia* HUNTER in RIDL. 1909, *nom. inval.*

Leaves not auriculate. Inflorescences corymbose, with many small flowers; corolla-tube always tubular; stamens and style far exserted (except in *F. umbelliflora*); fruits globular, small.

1. *Fagraea elliptica* ROXB. [Hort. Beng. (1814) 84, *nom. nud.*] Fl. Ind. ed. Wall. 2 (1824) 32; ed. Carey 1 (1832) 462; DC. Prod. 9 (1845) 30; MIQ. Fl. Ind. Bat. 2 (1857) 376; K. & V. Bijdr. 9 (1903) 84; Atlas 2 (1914) f. 330; KOORD. Fl. Tjib. 3 (1918) 48; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 316; HEYNE, Nutt. Pl. (1927) 1270; БАКН. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 13.—*Picrophloeus javanensis* BL. Bijdr. (1826) 1020; DON, Gard. Dict. 4 (1837) 66; DC. Prod. 9 (1845) 32.—*Cyrtophyllum speciosum* BL. Bijdr. (1826) 1022; DC. Prod. 9 (1845) 31; RIDL. Fl. Mal. Pen. 5 (1925) 322, *incl. var. montanum*.—*Willughbeia elliptica* SPRENG. Syst. Veg. 4 (1827) Cur. Post. 71.—*F. speciosa* BL. Rumphia 2 (1838) 35, t. 81; Mus. Bot. 1 (1850) 172; *non* RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 122 (= *F. fragrans*); MERR. Philip. J. Sc. 11 (1917) Bot. 306.—*F. picrophloeae* BL. Rumphia 2 (1838) 36, *nom. illeg.*; Mus. Bot. 1 (1850) 173; MIQ. Fl. Ind. Bat. 2 (1857) 377.—*F. kimanga* BL. Mus.



Fig. 3. Distribution of *Fagraea* in and around Malaysia. The number above the hyphen refers to the total number of species, that below the hyphen to the number of endemic species in each island or district.

Bot. 1 (1850) 173; Walp. Ann. 3 (1852) 76, *sphalm. kimanga*; MIQ. Fl. Ind. Bat. 2 (1857) 377.

—*F. valida* MIQ. Fl. Ind. Bat. 2 (1857) 376.—*F. sumatrana* MIQ. Fl. Ind. Bat. 2 (1857) 377; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 318.—*F. aurantiodora* S. MOORE, J. Bot. 66 (1928) 105.—*F. pseudoelliptica* KAN. & HATUS. Bot. Mag. Tokyo 56 (1942) 161, f. 5.—*F. javanensis* BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 12; Blumea 6 (1950) 382.—*F. pusilliflora* BAKH. f. [in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 13, Dutch descr.] Blumea 6 (1950) 383.—Fig. 4.



Fig. 4. *Fagraea elliptica* ROXB., Sandakan (North Borneo) (MEYER, 1960).

Tree up to 45 m by 0.15–1½ m ø, sometimes with buttresses up to 1 m high, or shrub, rarely a vine. Leaves usually lanceolate or oblong to obovate, sometimes broadly obovate, 7½–24(–32) by 1¾–15 cm, thinly to thickly coriaceous, base acute to slightly attenuate, apex mostly short- to long-acuminate, less often obtuse, rarely broadly rounded or subretuse; nerves 6–20 pairs, faintly to distinctly conspicuous, often slightly impressed above, beneath usually distinctly prominulous or (in thick leaves) hardly visible; petiole varying from rather thin to robust, 1–4 cm long. Stipules connate into a 1½–7½ mm long ocrea which may split into rounded axillary scales, partly adnate to the petiole. Inflorescences terminal and often also in the topmost leaf-axils, up to 30 cm wide, often much smaller, very many-flowered; peduncle 1–13 cm; pedicels during anthesis 1–4 mm (later up to 6 mm), often provided with 2 minute bracteoles inserted about halfway or somewhat lower down. Calyx campanulate, 2–3 mm

long, divided ± halfway. Corolla: tube narrow, cylindrical, 3½–6(–8) mm. Stamens erect or later reflexed; anthers oblong, 1½ mm long, cells free in the basal half. Style (accrescent during anthesis?) varying from 1½ mm and included to 1¾ cm and far exserted; stigma small, capitate, very obscurely 2-lobed. Berry globose, ½–¾ cm ø, tipped by a minute circular style-rest, orange-coloured to brick-red.

Distr. Malaysia, except Central and East Java, the Lesser Sunda Is., and the Philippines.

Ecol. In very different sites, both on dry and on marshy or temporarily inundated soils, mostly on sand, often along rivers, in humid forests, open forests, shrubberies, heath forest, grass wastes, rocky strand forest, also as a shrub on open dry hill-tops, from sea-level up to 1800 m. Fl. (mainly April–June), fr. Jan.–Dec.

Uses. The brownish to pale yellow, medium to very hard, very durable wood is used for house-building, for bridges, and for padi pounders. Also used medicinally against stomach-ache.

Vern. *Kaju badjam*, *k. galumbang batu*, *k. kadjang*, *k. kisa*, *k. labih*, *k. rama-rama*, *k. sabo*, *k. si margalugur*, *k. si margapuk*, *randa tiung*, *ruku biruwang*, *sëlura*, *sêpukan*, *sibatukon*, *simar tarasa*, *têmbësu kêtam*, *t. rawah*, *t. rawang*, *t. talang*, Sum., *rubi*, *tênggêl dotan*, *tutum tênggêl dêlok*, Simalur, *têmbësu*, Nias & Billiton, *kaju bujuk*, *k. sabo* (or *sobo*), *têmbësu samsu*, Banka, (jênis) *têmbasu*, Mal. Pen., *ki mangle*, *ki mangu*, *ki minjak*, *ki tandu*, *ki têrong badak*, *rangkot tandus* (or *tando*), Java S., *bintulu*, *brut-brut*, *têmasu* (*kbini*), *têmbaso bangang*, *têmbusu*, Born., *tariwan*, Cel.; Moluccas: *bientaus*, Sula, *kau wadil*, Buru, *atieso*, Ceram, *tonki tonki*, Ambon; *niperen*, New Guinea.

Note. *F. picrophloea* BL. is illegitimate, being based upon *Picrophloeus javanensis*; the epithet *javanensis* should, and could, have been used.

2. *Fagraea fragrans* ROXB. [Hort. Beng. (1814) 84, *nom. nud.*] Fl. Ind. ed. Wall. 2 (1824) 32; ed. Carey 1 (1832) 461; DON, Gard. Dict. 4 (1837) 68; BL. Mus. Bot. 1 (1850) 172; BTH. J. Linn. Soc. Bot. 1 (1857) 100; MIQ. Fl. Ind. Bat. 2 (1857) 375; SCHEFF. Nat. Tijds. N.I. 31 (1870) 22; KURZ, Fl. Burm. 2 (1877) 205; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 85; VIDAL, Sinops. (1883) t. 69 f. A; WATT, Dict. 3 (1890) 312; AHERN, Compil. Timber Tree P. I. (1901) 88, pl.; K. & V. Bijdr. 9 (1903) 86; KING, J. As. Soc. Beng. 74, ii (1908) 611; RIDL, J. Str. Br. R. As. Soc. n. 50 (1908) 121; EIM. Leaf. Philip. Bot. 2 (1909) 597; DOP, Fl. Gén. I.–C. 4 (1914) 177; K. & V. Atlas (1914) f. 332; ENDERT, Tectona 13 (1920) 132; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 318; FOXW. Mal. For. Rec. n. 3 (1927) 157; HEYNE, Nutt. Pl. (1927) 1270; HOLTUM, Gard. Bull. S. S. 9 (1935) 73; ESSENBERG, Tectona 28 (1935) 606, fig.; DE GRAAF, Tectona 28 (1935) 611; VAN DER VOORT, Trop. Natuur 28 (1939) 207, f. 9–10; CORNER, Ways. Trees (1940) 424, t. 122–123; KERR in Craib, Fl. Siam. En. 3 (1951) 55; BROWNE, For. Trees Sar. & Brun. (1955) 244, t. 32. —

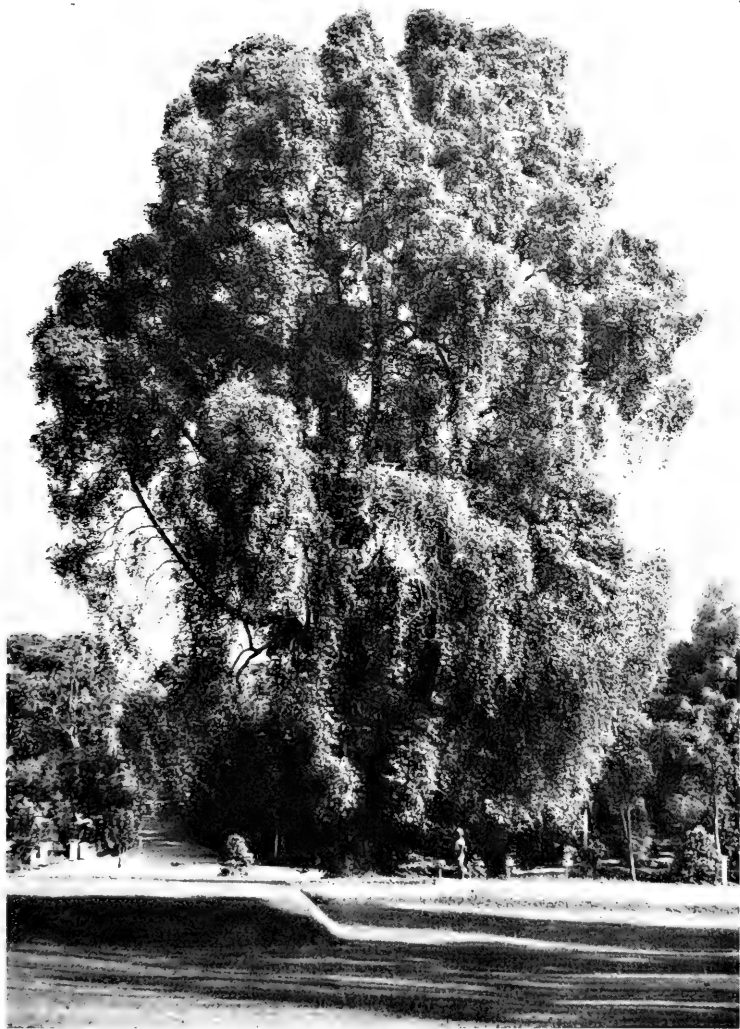


Fig. 5. *Fagraea fragrans* ROXB. at Tanglin Barracks, Singapore (CORNER).



Fig. 6. *Fagraea fragrans* ROXB. a. Habit, with flowers and fruits,  $\times \frac{2}{3}$ , b. opened corolla with the long-exserted stamens,  $\times 2$ , c. pistil,  $\times 2$ , d. small part of twig, showing the axillary scales,  $\times 2$  (a after Rumphia 2, t. 80, b-d BLUME in herb. L 908.127-224).



Fig. 7. Burned-over savannah with *Fagraea fragrans* ROXB., Padang Bolak, Sumatra East Coast Res. Corky bark charred by fire (VAN DER VOORT, 1939).

*Cyrtophyllum peregrinum* REINW. [ex BL. Cat. (1823) 47, *nom. nud.*; Isis 1 (1823) 313 & 314, *nom. nud.*] Syll. Pl. Ratisb. 2 (1826) 9; BL. Bijdr. (1826) 1022; DC. Prod. 9 (1845) 31; RIDL. Fl. Mal. Pen. 2 (1923) 421; HOLTUM, Gard. Bull. S.S. 5 (1931) 189.—*Willughbeia fragrans* SPRENG. Syst. Veg. 4 (1827) Cur. Post. 71.—*F. peregrina* BL. Rumphia 2 (1838) 34, t. 80; Mus. Bot. 1 (1850) 172; SCHEFF. Nat. Tijds. N. I. 31 (1870) 22.—*Cyrtophyllum fragrans* DC. Prod. 9 (1845) 31; RIDL. Trans. Linn. Soc. Bot. 3 (1893) 323.—*Cyrtophyllum lanceolatum* DC. Prod. 9 (1845) 31; RIDL. Fl. Mal. Pen. 2 (1923) 421.—*F. lanceolata* WALL. [Cat. (1829) n. 1599, *nom. nud.*] SCHNIZL. Iconogr. 2 (1851) t. 131, fig. 1, *nom. illeg.*, non BL. 1826; MIQ. Fl. Ind. Bat. 2 (1857) 376; BURK. Dict. (1935) 995.—*F. wallichiana* BTH. J. Linn. Soc. Bot. 1 (1856) 98; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 85; KING, J. As. Soc. Beng. 74, ii (1908) 607; CORNER, Ways. Trees (1940) 426.—*F. speciosa* (non BL.) RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 122.—*Flemingia fragrans* HUNTER in Ridl. J. Str. Br. R. As. Soc. n. 53 (1909) 83, *nom. inval.*—*F. caudata* RIDL. J. Str. Br. R. As. Soc. n. 79 (1918) 97.—*F. gigantea* RIDL. l.c. 98; FOXW. Mal. For. Rec. n. 3 (1927) 157, pl.; BURK. Dict. (1935) 995; CORNER, Ways. Trees (1940) 425; BROWNE, For. Trees Sar. & Brun. (1955) 245.—*Cyrtophyllum caudatum* RIDL. J. Str. Br. R. As. Soc. n. 79 (1918) 98, *nom. altern.*, *illeg.*—*Cyrtophyllum wallichii* RIDL. l.c., *nom. altern.*,

*illeg.*—*F. cochinchinensis* A. CHEV. Cat. Pl. J. Bot. Saigon (1919) 65, *pro specim.*, *excl. basionym*; BROWN, Min. Prod. Philip. For. 3 (1921) 220; MERR. En. Philip. 3 (1923) 314; BURK. Dict. (1935) 994; BROWN, Useful Pl. Philip. 3 (1950) 223.—*Fagraea* sp. ENDERT, Tectona 13 (1920) 142.—*F. sororia* J. J. SMITH in Cammerl. Bull. Jard. Bot. BTz III, 5 (1923) 319, f. 5; HEYNE, Nutt. Pl. (1927) 1270; STEUP, Tectona 24 (1931) 1132–1133; Trop. Natuur 22 (1933) 110.—*Cyrtophyllum giganteum* RIDL. [J. Str. Br. R. As. Soc. n. 79 (1918) 98, *nom. altern.*, *inval.*] Fl. Mal. Pen. 2 (1923) 421.—*F. ridleyi* GANDOGER, Bull. Soc. Bot. Fr. 70 (1924) 921, *nom. illeg.*, non K. & G. 1908.—Fig. 5–8.

Tree (sometimes a shrub), 8–25(–55) m tall, up to 1.35(–2½) m ø, sometimes with buttresses up to 2½ m. Leaves petioled, oblong-lanceolate to lanceolate or obovate-oblong, 4–15 by 1½–6 cm, mostly thinly, rarely firmly coriaceous, sometimes more or less bullate, the base acute or shortly attenuate, the apex rarely blunt to acute, usually short- to long-acuminate, sometimes to caudate, obtuse; nerves 4–9 pairs, rarely more or fewer, sunken above, slightly prominent or invisible beneath; petiole thin, 1–2½ cm; axillary scale rounded, c. 1–2 mm long, partly free from the petiole. Inflorescences in the higher leaf-axils, (1–)3- to ∞-flowered, often rather dense; peduncle thin, 1½–7½ cm; pedicels thin, ½–2½ cm, often with 2 minute bracteoles in or below the middle



Fig. 8. *Fagraea fragrans* ROXB., cult. in Botanic Gardens, Singapore (HENDERSON, 1949)

(in few-flowered inflorescences sometimes with a second pair near the base). *Calyx* campanulate,  $2\frac{1}{2}$ –8 mm long, divided over  $\frac{1}{2}$ – $\frac{3}{4}$  of its length. *Corolla*-tube narrowly funnel-shaped,  $\frac{3}{4}$ – $2\frac{1}{4}$  cm. *Anthers* oblong-linear to oblong-elliptic,  $1\frac{1}{4}$ –3 mm long, cells free in the basal half. *Style*  $1\frac{1}{4}$ –6 cm long; stigma small, capitate or obconical, faintly 2-lobed. *Berry* broadly ellipsoid, tipped by the short but distinct style-rest,  $\frac{3}{4}$ –1 cm  $\sigma$ , red or orange.

Distr. Bengal (near Calcutta, wild?), Lower Burma (from Rangoon southward), the Andaman Is. (CLARKE, *l.c.*), Siam, South Indo-China (N. to Tourane, Central Annam), and Malaysia: Sumatra, Malay Peninsula, W. Java (naturalized), Bawean, Borneo, SW. Philippines (Balabac, Palawan, Busuanga, Culion, Mindoro), Celebes, and Japen I. near NW. New Guinea.

According to MIQUEL, *l.c.*, also in the Moluccas; I do not know on what collection this assertion was based. The statements "China" and "Japan" in older literature go back to ROXBURGH and BLUME, who gave this as the possible origin of cultivated specimens.

Ecol. Humid, often seasonally but not constantly swampy, light forest, secondary forests, lalang fields, in the Malay Peninsula also along the beach; it does very well in poorly aerated, compact or swampy soils, but also on poor sands or podsols; from sea-level up to c. 800 m. *Fl.* mainly April–June, *fr.* mainly July–Nov. Flowering (and consequently fruiting) is distinctly periodical: HOLTUM (Gard. Bull. S. S. 9, 1935, 73–78)

found in Singapore that "... general flowering is in progress about four months after the onset of the dry weather." and "... the time from the stimulus to flower-development to the ripening of fruit is about seven months and a half" (p. 75). RIDLEY (Trans. Linn. Soc. Bot. 3, 1893, 323) cited as flower-visitors, mainly in the evening, "innumerable butterflies, of the *Hesperidae* section, and humming-bird hawk-moths (*Macroglossa luteata* and *M. insipida*)." The fruits are mainly eaten by bats (*Pteropus edulis* and *Cynopterus spp.* according to RIDLEY, Disp. 1930, 348), furthermore by birds (*Otocompsa analis*, RIDL. *l.c.* 481), and possibly also by fruit-eating ants (*Polyrachis sp.*, RIDL. *l.c.* 526). A light-demanding tree, often a pioneer on burned-over areas (VAN DER VOORT, *l.c.*) (fig. 7).

Uses. This beautiful tree is often planted, especially along roads and as a shade tree, mainly in Siam, Sumatra, Singapore, and locally in Java. Furthermore it is commonly planted for reforestation, as the timber is highly valued, being hard and very durable – even in the soil or in water – though not very beautiful. A decoction of the bark is used as a febrifuge, e.g. for malaria, a decoction of the leaves and twigs is drunk in Kedah, Malaya, for passing blood in stools, such as happens in dysentery.

Vern. Ironwood, E. The common Malayan name is *těmběsu* (*lěměsu*, *sěměsu*, *tamasu*, *taměsu*, *těmasu(k)*, *těmběsi*, *těmbusu*, *těmě(n)stu*, *těmusu*) in many combinations. *Kayu musuh-musuh*, *k. tammusuh padang-padang*, *k. těmbusu*, *pohon su-*

*mĕjar*, *tĕmbĕsu bukit*, *t. kapur*, *t. langkanang*, *t. lilin*, *t. paya*, *t. pĕmatang*, *t. rawang*, *t. rĕnah*, *t. talang*, Sum., *kayu tĕmbusu*, *pako* (or *poko(k)*) *tĕmbusu*, *p. tummōsōh paya*, *rĕriang*, *riang-riang*, *tamsao*, *tĕmbĕsu bukit*, *t. hutan*, *t. kĕmpang* (or *kampong*), *t. luar*, *t. padang*, *t. talang*, *t. tĕmbaga*, *t. tikus*, Mal. Pen., *ki badak*, Java S., (*s*)*aminaton* (or *binaton* or *tombiaton*), *long*, *mahoel*, *marambungkam*, *pĕrĕpat*, *sĕranai*, *tambiaton*, *tĕmbĕsu butat*, *t. danau*, *t. hutan*, *t. laut*, *t. padang*, *t. pasir*, *t. rĕbong*, *t. rusa*, *t. tanduk*, *tibuan*, Born.; Philip.: *dōlo*, *dūlo*, *ūling*, Tagb., *susulin*, Tag., *tĕka*, *wring*, *ūring*, *Kuy*; *anrali*, *bitjoro*, *nosu*, (pohon) *kulahi* (or *kolahi*), Cel., *mana hurudu*, *manderi*, Japen.

Notes. On the whole this species is fairly uniform. Only two of the synonyms were based upon clearly distinguishable forms, viz *F. wallichiana* (= *F. lanceolata* SCHNIZL. = *Cyrtophyllum lanceolatum* DC.) and *F. caudata*, the former comprising all the specimens known from P. Penang near the Malay Peninsula, the latter described from Borneo. Both are characterized by (1)–3-flowered inflorescences with relatively large flowers and by lanceolate leaves, tapering at both ends, distinctly caudate in the latter form.

Furthermore, foresters, especially in Malaya, distinguish between *F. fragrans*, being a fairly small tree of the secondary forest, and *F. gigantea*, a canopy tree of the high lowland forest; there are also differences in the bark, which is dark-brown and deeply irregularly fissured in the first mentioned form, brown or reddish brown with closer, narrower and more regularly longitudinal ridges and fissures in the second one; in the leaves, being flat and with *c.* 8 pairs of nerves in *F. fragrans*, having a wavy, undulating margin and 5–6 pairs of nerves in *F. gigantea*; the timber of *F. fragrans* is also more heavy than that of *F. gigantea*. *F. fragrans* is often mentioned to propagate freely, *F. gigantea* would not propagate or only exceptionally. In my opinion these are merely ecotypes, or even only specimens of different age: *F. fragrans* is a light-demander, thus a pioneer of open country, where it can maintain itself fairly well, being fire-resistant. The name *F. gigantea* is probably applied to the few old specimens left after the forest has restored itself, or – as there seems to be mostly a small group of specimens – which filled up a glade. And these old specimens stand in an ecological position in which propagation is impossible.

In old literature the inflorescences are often said to be axillary and terminal; the latter statement is apparently based upon inaccurate observation, and then copied again and again.

Sterile specimens can be distinguished from the related *F. elliptica* especially by the stipules: in *F. elliptica* they form together an annular ocrea closely appressed to the twig, in *F. fragrans*

they are mutually nearly free and form small cups in the leaf-axils (fig. 6d).

For the name *Flemingia fragrans* HUNTER see under the notes to the genus.

The basionym of *F. cochinchinensis* A. CHEV. is *Aidia cochinchinensis* LOUR. (type in BM). This was reduced by MERR. *Comm. Lour.* (1935) 365 to *Randia cochinchinensis* (LOUR.) MERR. (*Rubiaceae*).

### 3. *Fagraea umbelliflora* GILG & BENED. Bot. Jahrb. 54 (1916) 193, f. 12.

Treelet or shrub, 2–5 m tall. *Leaves* petioled, broadly ovate to obovate or lanceolate, 8–18 by 3–9 cm, thin to stiff-coriaceous, base broadly to acutely cuneate, attenuate, apex broadly rounded, rather abruptly terminated by a short and slender acumen or acute and hardly acuminate; nerves 5–10 pairs, inconspicuous to invisible, sometimes prominulous beneath; petiole slender, 2½–5 cm; axillary scale for the greater part adnate, 3–5 mm long, cup-shaped, rounded at the apex. *Inflorescences* axillary, umbelliform, nearly sessile or with an up to *c.* 1 cm long, thick peduncle, *c.* 4–10 fairly long-pedicelled flowers, pedicels slender, without bracteoles, 1–1½ (in fruit –2) cm. *Calyx* campanulate, 4–6 mm long, divided somewhat less than halfway down. *Corolla*-tube nearly tubular, 2–2½ cm, slightly widened towards the mouth. *Anthers* oblong-sagittate, 2–3 mm long, cells free in their basal half. *Stigma* small, narrowly cuneate, truncate. *Fruits* subglobular, *c.* 1 cm  $\phi$ ; pedicels hardly thickened, calyx appressed.

Distr. *Malaysia*: New Guinea (Japen I., Vogelkop Peninsula, Sepik region).

Ecol. In dense, very humid high-stemmed primary forest, 60–1200 m. *Fl.* July, Nov., fr. Nov.

Vern. *Niejap*.

Notes. The type is cited as LEDERMANN 9714; the only original specimen I did see, which is apparently an isotype (in L) bears the number 9614.

In principle the inflorescences seem to be umbelliform condensed racemes, terminal on short axillary shoots or knobs, but with the exception of some minute bracts these shoots are quite leafless. Therefore it comes very near to a really axillary inflorescence, as we find in this genus only in *F. fragrans*.

Though the affinity of *F. umbelliflora* is not fully clear I have tentatively included it in *sect. Cyrtophyllum*; it differs from the other species amongst other characters, by the stamens and style which are only very slightly exerted. Within *sect. Cyrtophyllum* it seems to be closest to *F. fragrans*. Outside the section it may have some affinity with *F. gracilipes*.

## 2. Section Racemosae

BTH. J. Linn. Soc. Bot. 1 (1856) 99 & 73.—*Kuhlha* REINW. 1826, non H.B.K. 1825.—*Utania* G. DON, 1838.—*Kentia* STEUD. 1840, nom. illeg.—*Fagraea* *sect.*

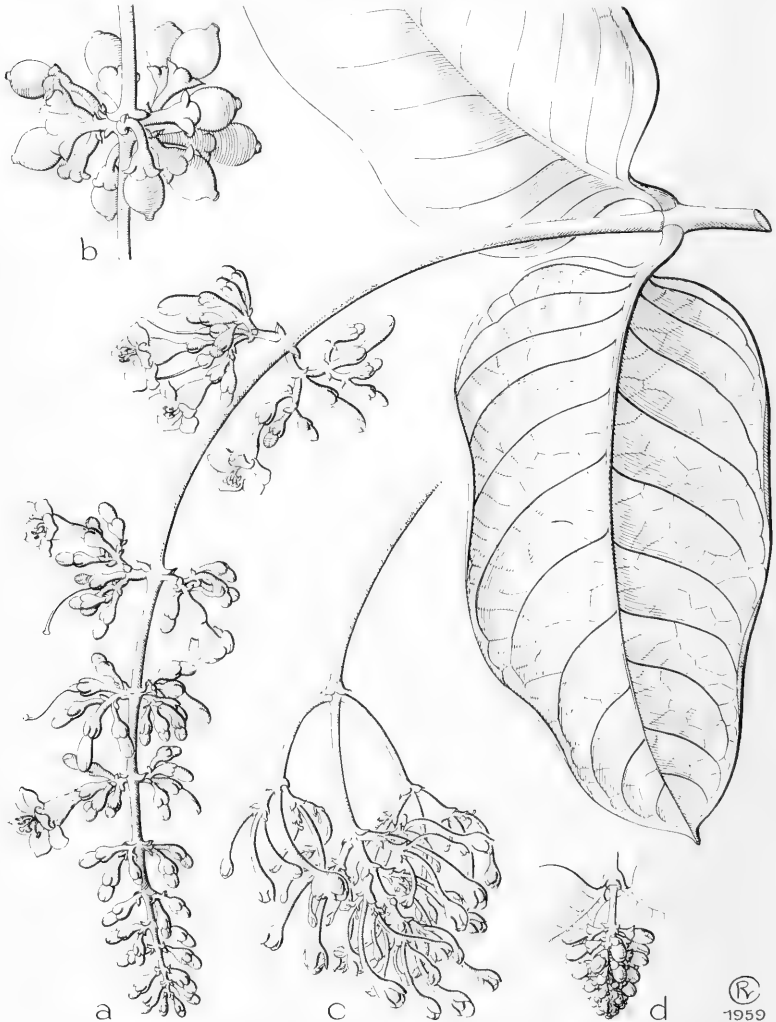


Fig. 9. *Fagraea racemosa* WALL. a, well-developed normal inflorescence,  $\times \frac{1}{2}$ , b, part of infructescence,  $\times 1$ , c, inflorescence of '*F. pendula*',  $\times \frac{1}{2}$ , d, inflorescence of '*F. spicata*',  $\times \frac{1}{2}$  (a partly after Rumphia 2, t. 79, the leaves from WOMERSLEY NGF 3870, b WOMERSLEY NGF 3870, c CLEMENS 21546, d AGAMA BS 553).



*Pseudoracemosae* SOLER. in E. & P. Nat. Pfl. Fam. 4, 2 (1892) 43.

Leaves not auriculate; stipules connate in an ocrea. Inflorescences peduncled, racemiform, with a number of distant decussate pairs of small cymes (sometimes basal cymes long-stalked, sometimes all cymes sessile and close together, sometimes the whole inflorescence reduced to a long-stalked, few-flowered glomerule). Stamens and style not or only slightly exerted.

4. *Fagraea racemosa* JACK ex WALL. in ROXB. Fl. Ind. 2 (1824) 35; DC. Prod. 9 (1845) 29, *incl. var. grandis* [WALL. Cat. (1829) n. 1601-2, *nom. nud.*]; BENTH. J. Linn. Soc. Bot. 1 (1856) 99; MIQ. Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 218, *incl. var. coarctata*; BENTH. Fl. Austr. 4 (1869) 367; KURZ, Fl. Burm. 2 (1877) 205; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 84; K. SCH. & HOLLER. J. Kais. Wilh. Land (1889) 109; F. M. BAIL. Queensl. Fl. 3 (1900) 1023; KING, J. As. Soc. Beng. 74, ii (1908) 608, *incl. var. pauciflora*; RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 118; DOP, Fl. Gén. I.-C. 4 (1914) 175; BURK. J. Str. Br. R. As. Soc. n. 73 (1916) 215, 226, 259; GILG & BENED. Bot. Jahrb. 54 (1916) 184; MERR. Sp. Blanc. (1918) 306; En. Philip. 3 (1923) 315; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 310; RIDL. Fl. Mal. Pen. 2 (1923) 418; BURK. & HENDERS. Gard. Bull. S. S. 3 (1925) 399; LANE-POOLE, For. Res. (1925) 134; BURK. Dict. (1935) 996; CORNER, Ways. Trees (1940) 425; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 10; F. S. WALKER, For. Br. Sol. Is. (1948) 137; BROWN, Useful Pl. Philip. 3 (1950) 224, f. 87; KERR in Craib, Fl. Siam. En. 3 (1951) 57; MERR. J. Arn. Arb. 33 (1952) 225; BROWNE, For. Trees Sar. & Brun. (1955) 246.—*F. volubilis* WALL. in Roxb. Fl. Ind. 2 (1824) 36; DON, Gard. Dict. 4 (1837) 68; DC. Prod. 9 (1845) 30; MIQ. Fl. Ind. Bat. 2 (1857) 367; VIDAL, Sinopsis (1883) t. 69 f. B.—*Kuhlia morindaefolia* REINW. [ex BL. Cat. (1823) 51, *nom. nud.*] Syll. Pl. Ratisb. 2 (1826) 7, *nom. illeg.*; BL. Bijdr. (1826) 777.—*F. malayana* MART. Nov. Gen. Sp. 2 (1826) 91; DON, Gard. Dict. 4 (1837) 68; DC. Prod. 9 (1845) 30.—*Willughbeia racemosa* SPRENG. Syst. Veg. 4 (1827) Cur. Post. 71.—*Willughbeia volubilis* SPRENG. l.c.—*F. morindaefolia* BL. Rumphia 2 (1838) 32, t. 73 f. 2, t. 79, *incl. var. robusta*; DC. Prod. 9 (1845) 29; BL. Mus. Bot. 1 (1850) 169; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 84; K. & V. Bijdr. 9 (1903) 74; ELM. Leaf. Philip. Bot. 2 (1909) 596; K. & V. Atlas (1914) f. 331, "*morindifolia*".—*F. cordifolia* BL. Rumphia 2 (1838) 33; Mus. Bot. 1 (1850) 171; MIQ. Fl. Ind. Bat. 2 (1857) 368.—*F. coarctata* BL. Rumphia 2 (1838) 33; Mus. Bot. 1 (1850) 170; MIQ. Fl. Ind. Bat. 2 (1857) 368, *incl. var. ligustrina*; VAL. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 45.—*F. ligustrina* BL. Rumphia 2 (1838) 33; Mus. Bot. 1 (1850) 171, *incl. var. disparifolia*; BENTH. J. Linn. Soc. Bot. 1 (1856) 100, *incl. var. brachystachya*; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 85; KING, J. As. Soc. Beng. 74, ii (1908) 609; RIDL. Fl. Mal. Pen. 2 (1923) 420.—*Utania morindaefolia* DON, Gard. Dict. 4 (1838) 663.—*Kentia morin-*

*daefolia* STEUD. Nomencl. ed. 2 (1840) 845, *nom. illeg.*—*F. scholaris* BLCO, Fl. Filip. ed. 2 (1845) 93; ed. 3, 1 (1877) 171.—*F. appendiculata* BL. Mus. Bot. 1 (1850) 169; Walp. Ann. 3 (1852) 76.—*F. cuspidata* BL. Mus. Bot. 1 (1850) 170; Walp. Ann. 3 (1852) 76; MIQ. Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 218; MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 237; En. Philip. 3 (1923) 314.—*F. robusta* BL. Mus. Bot. 1 (1850) 170; Walp. Ann. 3 (1852) 76.—*F. subreticulata* BL. Mus. Bot. 1 (1850) 171; Walp. Ann. 3 (1852) 76; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 10.—*F. crassipes* BTH. J. Linn. Soc. Bot. 1 (1856) 99; MIQ. Fl. Ind. Bat. 2 (1859) 1080; GIBBS, J. Linn. Soc. Bot. 42 (1914) 111.—*F. latifolia* MIQ. Fl. Ind. Bat. 2 (1857) 369.—*F. thwaitesii* F. v. M. Fragm. 2 (1861) 137.—*F. maingayii* CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 84; KING, J. As. Soc. Beng. 74, ii (1908) 608; RIDL. Fl. Mal. Pen. 2 (1923) 419; FOXW. Mal. For. Rec. n. 3 (1927) 159.—*F. spicata* BAKER, Kew Bull. (1896) 25; MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 237.—*F. rodatzii* K. SCH. & LAUT. Fl. Schutzgeb. (1901) 499.—*F. congestiflora* ELM. Leaf. Philip. Bot. 8 (1915) 2741.—*F. grandifolia* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 231; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 338.—*F. cymosa* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 234; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 338.—*F. stenophylla* BECC. [For. Born. (1902) 524, f. 65(1), *nom. nud.*] ex MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 236; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 337.—*F. pauciflora* RIDL. Fl. Mal. Pen. 2 (1923) 419, f. 110; BURK. & HENDERS. Gard. Bull. S. S. 3 (1925) 399; BURK. Dict. (1935) 996.—*F. eucalyptifolia* CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 312, f. 2.—*F. teysmannii* CAMMERL. l. c. 314, f. 3.—*F. gracilis* CAMMERL. l. c. 316, f. 4.—*F. pendula* MERR. Pl. Elm. Born. (1929) 251.—*F. minor* (NON BL.) HEINE, Pfl. Clemens Kinabalu (1953) 91. — Fig. 9-12.

Tree, 2-10(-16 or even -35?) m, up to c. 30 cm ø, shrub or sometimes a straggling climber. Leaves varying from broadly ovate via elliptic, obovate-oblong and oblong to oblong-lanceolate or rarely even linear, 5-50 by 1-23 cm, thinly to thickly coriaceous or almost fleshy, sometimes bullate between the nerves; base cuneate, obtuse, rounded or often slightly to distinctly cordate; apex acute, obtuse, rounded or very often shortly to rather long acuminate; nerves usually 4-12 pairs, sunken or less often flat to very slightly prominent above, distinctly prominent beneath; reticulations lax, more or less distinctly visible; petiole ¼-5 cm, thin to stout; stipules connate into an annular,



Fig. 10. *Fagraea racemosa* WALL. a. Fruiting twig of 'F. ligustrina',  $\times \frac{2}{3}$ , b. ocrea,  $\times 1\frac{1}{2}$ , c. leaf of 'F. teysmannii',  $\times \frac{2}{3}$ , d. leaf of 'F. eucalyptifolia',  $\times \frac{2}{3}$  (a KEP 15425, b WHITEHOUSE in herb. BRI 016414, c PURSEGLOVE 4500, d BROOKE 10668).

up to  $\frac{3}{4}$  cm high ocrea which clasps the twig. Inflorescences erect, nodding, or very often drooping, 2–60 cm long (incl. the 1–30 cm long, slender to robust peduncle); usually thyrsoid with decussate, spaced, nearly sessile cymes of c. 7 (the higher ones less) long-stalked flowers; by reduction spiciform if the internodes are short combined with sessile cymes and short-stalked flowers, corymbose if all cymes or at least the lower ones are long-stalked, laxly branched, and many-flowered, racemiform if the cymes are sessile and few-flowered or in the apical part even 1-flowered, or glomerulous if the whole inflorescence is reduced to 5–7 flowers crowded on a long stalk; pedicels (0)– $\frac{3}{4}$ –3 cm, thin to stout, 2-bracteolate at the base. Calyx campanulate to subglobose,  $\frac{1}{4}$ – $1\frac{1}{2}$  cm, divided about halfway down or slightly deeper. Corolla-tube 2–4 cm, funnel-shaped. Anthers rather thick oblong, c.  $3\frac{1}{2}$  mm long, cells free in their basal half. Stigma (broadened) obconical, up to c.  $1\frac{1}{2}$ –2 mm broad, subtruncate, faintly 2-lobed. Berry globose-ellipsoid-ovoid, tipped by the very short but distinct style-base, up to  $2\frac{1}{2}$  cm long, said to be sky-blue (or red?) when ripe.

Distr. SW. Indo-China, Siam, South Burma, the Andamans and Nicobars, throughout Malaysia (except the eastern half of Java, Madura I., and the Lesser Sunda Is.), Solomon Is., and North Australia (Northern Territory: Victoria River, Providence Hill; Queensland: Cape York Peninsula).

Ecol. Light to rather dense, often secondary forests on swampy to dry soil, on muddy riverbanks, podsolized sand, sometimes in savannahs and lalang fields, 0–2000 m. Fl. mainly April–Sept., fr. July–Nov.

The flowers have a smell of butter or butter-milk, as they produce diacetyl (see DERX, Ann. Bog. 1, 1950, 49–52), a substance which is characteristic of bat-visited flowers; there are, however, no observations that *Fagraea* flowers are visited by bats. According to RIDLEY (Disp. 1930, 421) the fruits are probably dispersed by bats. For galls see GIBBS, J. Linn. Soc. Bot. 42 (1914) 111, and DOCTERS VAN LEEUWEN, Zoococidia (1926) 464, f. 887.

Uses. The soft to moderately hard timber is used for construction and as firewood. Decoctions of the leaves, bark, and roots play a role in Malayan medicine, mainly as tonics (see BURK. Dict. l.c.); in the Philippines the bark and the flowers are used as an antidote for snake bites.

Vern. False Coffee-Tree, E, *gluguh babi*, *kaju buliga*, *k. isop-isop dahjong*, *k. kapis*, *k. kopi-kopi*, *k. obi*, *k. rupun-rupun*, *k. si markopi-kopi*, *lengugu*, *rampisi*, *tuma taveuh pajo*, Sum., *tuma tafeu*, Simalur, *kayu naga*, Enggano, *coffee utan*, *dada kora* (or *kuwa*), *daun pepulit*, *d. puleh*, *glam tikus jantan*, *kahwa hutan*, (*kaju*) *lidah rusa(h)*, (*k.*) *rumpo-rumpo*, *k. skobang*, *katiduran puak*, *kela* (*payam*), *kemusang*, *kopi* (*hutan*), *lambüsü* (or *lumbüsü*) (*pajah*), *membëra gading*, *mëngkudu badak*, *m. hutan*, *mumpuleh*, (or *mëmpuleh*, or *mumpulih*), *pëpulit*, (*pokô*) *pakan paya*, *p. sätübal paya*, *p. suruas jantan*, (*p.*) *sëpuleh*, *riang-riang*



Fig. 11. *Fagraea racemosa* WALL. in secondary vegetation, Brunei (Borneo) (ASHTON, 1960).



Fig. 12. *Fagraea racemosa* WALL., close-up from the tree of fig. 11 (ASHTON, 1960).

*gēlugot*, *sapooli*, *sēbērotut*, *sēkombang*, *sēpulis*, *sērawas*, *sērawas*, *sētēbal*, *sūtābal*, *tahi musang*, *tēmbusu* (or *tumpusu*), *t. bukit*, *t. jantan*, *t. paya* (or *gajah*, or *kaya*), *wa nam*, Mal. Pen., *kendung badak*, *ki tjankuda*, *kopi mētado*, *mangu leweng*, *tjangkudu* (or *tjangkuda*) *badak*, *t. gunung*, *t. lōwōng*, *t. utan*, *tjang-tjangkuduan*, *S. baros*, *melingu*, *J. dawun sukung*, *engkudu hutan*, *gēmpar*, *kadamphok*, *kafi hutan*, *kalam kubak*, *kasadapan*, *katiaturan puak*, *kayu badal*, *k. ranau*, *kēlagikong*, *lankonis*, *legkau*, *lundus*, *mambunal*, *manggapuak*, *nya gohong*, *puak bulan*, *sankaniap*, *sukong* (or *sukung*), *tapapan puak*, *tapa labie*, *tēmhusu* (or *tēmasuk*) *gaja*, *tēnggilan* (or *tinggiran*) *puah* (or *puak*), *(t)(o)dopon* (or *dapan*) *puak*, *ukudu ayēr*, *Born.*; *Philip.*: *baāgu*, *Bag.*, *bagontapai*, *poŋgabu*, *Mbo.*, *bakau*, *balat-buayu*, *kabāl*, *libākan*, *talob-ālak*, *Tag.*, *bogosalā*, *S. L. Bis.*, *bulobuāya*, *hambuāia*, *himbubūya*, *lambuāya*, *malabuāya*, *salak*, *P. Bis.*, *cuđman*, *gatibuka*, *makatibuga*, *sinalas*, *Sub.*, *kukodmōn*, *Bik.*, *kakāo-ita*, *magusayak*, *Sul.*, *kibuāia*, *Laguna*, *malabago*, *Cebu*; *leraa*, *Cel.*, *kore haru*, *Halmaheira*, *barua*, *batteriengien*, *herean*, *bisip*, *bogabogōia*, *dābe*, *fohkipeh*, *galud*, *kankanis*, *kubugup*, *mahobaatje*, *makereko*, *malar*, *misal*, *omborupa*, *sibēh*, *simbe*, *New Guinea*, *gwaret*, *Aru Is.*

**Notes.** Wide-spread, polymorphous species, described under a host of names. The extreme forms look so different that one might feel warranted to keep them wide apart, but on close examination of a sufficient number of specimens they prove to be connected by numerous intergrades which render a sharp delimitation impossible. Notwithstanding the differences all specimens have a certain habit in common so that the species can nearly always be recognized at first sight.

The most common form is fairly coarse, with thick twigs, relatively large, ovate, thick-coriaceous leaves, rounded to subcordate at the base,

long thyrsoid inflorescences, and medium-sized flowers (fig. 9a). An extremely coarse form, with larger and thicker leaves, nerves less conspicuous, and large flowers was described from the Malay Peninsula as '*F. maingayi*'. Another coarse form, characterized by corymbose inflorescences with short rachis and long lower branches, is the Bornean '*F. pendula*' (fig. 9c). '*F. spicata*' differs from the typical form only by its fairly short, contracted inflorescences with sessile cymes or flowers (Borneo) (fig. 9d). Other Bornean forms, characterized by narrow leaves, are '*F. teysmannii*' with lanceolate leaves (fig. 10c), and '*F. eucalyptifolia*' and '*F. stenophylla*' with linear leaves, tapering at both ends (fig. 10d); these narrow-leaved forms have moreover small few-flowered inflorescences with small flowers; they occupy a rheophytic habitat (gravelbeds of stream-banks). '*F. pauciflora*' (Mal. Pen.) differs from the normal form by being more slender in all parts, and especially in the inflorescence which has less and relatively small flowers. The most extreme form is represented by '*F. ligustrina*' (Mal. Pen. to Moluccas, not uniform), with slender twigs, small, elliptic leaves, tapering at base and apex, nervation not very conspicuous, glomerulous inflorescences, and flowers with a very small calyx and a slender corolla; in this form the fruit is also distinctly smaller (fig. 10a).

The names *Kuhlia morindaefolia* BL. and *Kentia morindaefolia* STEUD. are illegitimate as these generic names were illegitimate.

MARTIUS erroneously described *F. malayana*, of which I saw the type in the Brussels Herbarium, with a 6-merous corolla and 6 stamens and wrongly assumed it to be related to *F. elliptica*. BENTHAM J. Linn. Soc. Bot. 1 (1856) 100, who only knew the deficient description, took it for possibly synonymous with *Tabernaemontana corymbosa* ROXB. (*Apocynaceae*).

### 3. Section *Fagraea*

*Sect. Fagraeae verae & sect. Eufagraea* BL. Mus. Bot. 1 (1850) 163 & 169 *resp.*  
—*Sect. Corymbosae* BTH. J. Linn. Soc. Bot. 1 (1856) 97.—*Subg. Eufagraea* MIQ. Fl. Ind. Bat. 2 (1857) 367.—*Sect. Pseudocorymbosae* SOLER. in E. & P. Nat. Pfl. Fam. 4, 2 (1892) 42.

Leaves auriculate or not. Inflorescences corymbose, dichasial, glomerulous, or flowers solitary; always terminal and usually with a pair of strong branches in the upper leaf-axils, therefore the inflorescence as a whole mostly sessile. Stamens and style hardly or not exerted.

*5. Fagraea ceilanica* THUNB. Vet. Acad. Handl. Stockh. 3 (1782) 132, t. 4; Nov. Gen. Pl. (1782) 35; BL. Rumphia 2 (1838) 29, t. 78 f. 2 ('*zeylanica*'); HOOK. Bot. Mag. (1874) t. 6080; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 83, *incl. var. brevituba*; TRIMEN, Fl. Ceyl. 3 (1895) 170; GAMBLE, Fl. Madras 5 (1923) 865; LEENH. Bull. Jard. Bot. Brux. 32 (1962) 420.—*Modagam* RHEEDE, Hort. Mal. 4 (1673) 119, t. 58.—*F. obovata* WALL.

in Roxb. Fl. Ind. 2 (1824) 33, *non* BL. (1826), *quae est F. blumei*; DC. Prod. 9 (1845) 29; HOOK. Bot. Mag. (1846) t. 4205; GRIFF. Notul. 4 (1854) 35; Ic. Pl. Ind. Or. 4 (1854) t. 382; *non* MIQ. Sum. (1861) 226 & 550, *incl. var. latifolia* (= *F. blumei*); KURZ, Fl. Burm. 2 (1877) 205; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 83, *p.p.*, *incl. var. gardneri*; RIDL. Trans. Linn. Soc. Bot. 3 (1893) 323; TRIMEN, Fl. Ceyl. 3 (1895) 171; *non* F. M.

BAIL. Queensl. Agr. J. 3 (1898) 157, *incl. var. papuana* (= *F. berteriana*); KING, J. As. Soc. Beng. 74, ii (1908) 606, *p.p.*; ELM. Leaf. Philip. Bot. 2 (1909) 598; 3 (1910) 857; DOP, Fl. Gén. I.-C. 4 (1914) 174, *excl. syn. p.p.*; *non* CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 322 (= *F.*



Fig. 13. *Fagraea ceilanica* THUNB., a young specimen encircling the trunk of a tree with its roots. Bogor (Java) (JACOBS, 1958).

*blumei*); GAMBLE, Fl. Madras 5 (1923) 865; MERR. En. Philip. 3 (1923) 315, *p.p.*; RIDL. Fl. Mal. Pen. 2 (1923) 418, *p.p.*; SASAKI, Cat. Gov. Herb. Formosa (1930) 414; *non* MERR. Contr. Arn. Arb. 8 (1934) 138 (= *F. blumei*); BURK. Dict. 1

(1935) 996, *p. min. p.*; HENDERS. J. Mal. Br. R. As. Soc. 17 (1939) 58; KANJILAL & DAS, Fl. Assam 3 (1939) 318; *non* BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 11, *nec* in Blumea 6 (1950) 382, *incl. var. brevicealyx* (both = *F. blumei*); KERR in Craib, Fl. Siam. En. 3 (1951) 56; *non* HEINE, Pfl. Clemens Kinabalu (1953) 91 (= *F. blumei*).—*F. litoralis* BL. Bijdr. (1826) 1021; Rumphia 2 (1838) 28, t. 74, *incl. var. amboinensis*; DC. Prod. 9 (1845) 30 (*'littoralis'*); BL. Mus. Bot. 1 (1850) 166; MIQ. Fl. Ind. Bat. 2 (1857) 374; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 217, *incl. var. moluccana & forstenii*; RACIBORSKI, Ann. Jard. Bot. Btzg 17 (1900) 43, f. 23; K. & V. Bijdr. 9 (1903) 82; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 328; DOCT. VAN LEEUWEN, Zoococcidia (1926) 463, f. 886; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 11.—*F. lanceolata* BL. Bijdr. (1826) 1021, *non* WALL. (1829), *nec* MIQ. (1857); Rumphia 2 (1838) 31, t. 77; DC. Prod. 9 (1845) 29; BL. Mus. Bot. 1 (1850) 167; MIQ. Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 218; K. & V. Bijdr. 9 (1903) 81; K. & G. J. As. Soc. Beng. 74, ii (1908) 607; KOORD. Fl. Tjib. 3 (1918) 47; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 329; RIDL. Fl. Mal. Pen. 2 (1923) 420; *non* HENDERS. Gard. Bull. S.S. 4 (1927) 99 (= *F. carnososa*); BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 12.—*F. minor* REINW. *ex* BL. [Cat. (1823) 47, *nom. nud.*] Bijdr. (1826) 1021; Rumphia 2 (1838) 27, t. 73 f. 1; DC. Prod. 9 (1845) 30; BL. Mus. Bot. 1 (1850) 166; MIQ. Fl. Ind. Bat. 2 (1857) 370; *non* HEINE, Pfl. Clemens Kinabalu (1953) 91 (= *F. racemosa*).—*F. malabarica* BL. Rumphia 2 (1838) 29.—*F. rostrata* BL. Rumphia 2 (1838) 31, t. 76 f. 2; DC. Prod. 9 (1845) 30; BL. Mus. Bot. 1 (1850) 168; MIQ. Fl. Ind. Bat. 2 (1857) 374; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 38.—*F. crassifolia* BL. Rumphia 2 (1838) 31, t. 78 f. 1, *non* WALL. (1829) (= *F. ridleyi*); DC. Prod. 9 (1845) 30; BL. Mus. Bot. 1 (1850) 166; BTH. J. Linn. Soc. Bot. 1 (1856) 98; MIQ. Fl. Ind. Bat. 2 (1857) 373; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 217.—*F. coromandelina* WIGHT, Ic. 4 (1850) t. 1316.—*F. malabarica* WIGHT, l.c. t. 1317, *nom. illeg.*, *non* BL. (1838).—*F. amboinensis* BL. Mus. Bot. 1 (1850) 166; Walp. Ann. 3 (1852) 75; MERR. Int. Rumph. (1917) 424, *excl. syn. Rumph. (p.p. ?)*; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 329.—*F. forstenii* BL. Mus. Bot. 1 (1850) 166; Walp. Ann. 3 (1852) 75; *non* KOORD. Minah. (1898) 540 and KOORD.-SCHUM. Syst. Verz. 3 (1914) 105 (= *F. truncata*).—*F. celebica* BL. Mus. Bot. 1 (1850) 167; Walp. Ann. 3 (1852) 75.—*F. heterophylla* BL. Mus. Bot. 1 (1850) 168; Walp. Ann. 3 (1852) 75; MIQ. Fl. Ind. Bat. 2 (1857) 375.—*F. congesta* BL. Mus. Bot. 1 (1850) 168; Walp. Ann. 3 (1852) 75.—*F. fuscescens* BL. Mus. Bot. 1 (1850) 168; Walp. Ann. 3 (1852) 75.—*F. splendens* BL. Mus. Bot. 1 (1850) 168; Walp. Ann. 3 (1852) 75.—*F. khasiana* BTH. J. Linn. Soc. Bot. 1 (1856) 99; CLARKE in Hook. *f.* Fl. Br. Ind. 4 (1883) 84; BRANDIS, Ind. Trees (1906) 476; KANJILAL & DAS, Fl. Assam 3 (1939) 319.—*F. oxyphylla* MIQ. Fl. Ind. Bat. 2 (1857)

371, *nom. illeg.*—*F. gardneri* THWAITES, En. (1860) 200; BEDDOME, Fl. Sylv. (1869) 164.—*F. ternatana* MIQ. Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 217; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 333; *non* HOLTH. & LAM, Blumea 5 (1942) 230 (= *F. gitingensis*).—*F. oblonga* K. & G. J. As. Soc. Beng. 74, ii (1908) 612; RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 121; Fl. Mal. Pen. 2 (1923) 417; BURK. & HOLT. Gard. Bull. S.S. 3 (1923) 61; BURK. & HENDERS. Gard. Bull. S.S. 3 (1925) 399.—*F. sasakii* HAYATA, Ic. Pl. Formos. 3 (1913) 151, t. 29; KANEH. Formosan Trees, rev. ed. (1936) 623, f. 581.—*F. gardeniaeflora* WERNH. Trans. Linn. Soc. Bot. 9 (1916) 111.—*F. macrodendron* GILG & BENED. Bot. Jahrb. 54 (1916) 187.—*F. birmanica* GANDOGER, Bull. Soc. Bot. Fr. 65 (1918) 58.—*F. prainii* GANDOGER, l.c.—*F. lutea* CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 330, f. 8; *non* MERR. Contr. Arn. Arb. 8 (1934) 138 (= *F. blumei*).—*F. chinensis* MERR. Philip. J. Sc. 23 (1923) 261.—*F. loheri* MERR. *ibid.* 27 (1925) 49.—*F. pyriformis* S. MOORE, J. Bot. 63 (1925) Suppl. p. 70.—*F. sperei* HENDERS. Gard. Bull. S.S. 7 (1933) 114, t. 28 A.—*F. rahmatii* MERR. Pap. Mich. Ac. Sc. 23 (1938) 189.—*F. angiensis* KANEH. & HATUS. Bot. Mag. Tokyo 56 (1942) 160, f. 3.—*F. archboldiana* MERR. & PERRY, J. Arn. Arb. 23 (1942) 412.— Fig. 13-15.

Epiphytic or (more rarely) terrestrial shrub, climber, or small tree, up to 15 m. Leaves very variable as to shape and size, varying from ovate to obovate (to spatulate in the Deccan and Ceylon) via oblong or oblong-obovate to narrowly lanceolate,  $4\frac{1}{2}$ –35 by  $1\frac{1}{2}$ –9 cm, fleshy or coriaceous, base attenuate and decurrent, cuneate, or rounded to subcordate, apex rounded to acute, usually (and mostly gradually) acuminate, acumen short to long and blunt to acute; nerves 4–8(–12) pairs, inconspicuous or mostly invisible (only in the typical form from Ceylon and S. Deccan slightly prominent beneath); petiole slender to robust,  $\frac{1}{2}$ – $3\frac{1}{2}$ (–5) cm, exauriculate, the axillary scale appressed to the twig or (more rarely) partly or entirely adnate to the petiole, mostly inconspicuous, rarely somewhat broader than the petiole,  $\frac{1}{4}$ – $\frac{3}{4}$ (–1) cm long, usually rounded, rarely truncate or emarginate, often slightly confluent between the leaves. Inflorescences dichasial, branched from the base, usually rather dense, sometimes laxly thyrsoid and up to 15 cm long, (1–)3–17-flowered; pedicels slender (then usually thickened towards the calyx) to stout,  $\frac{1}{4}$ – $3\frac{1}{2}$  cm long; bracteoles 2, inserted from about halfway the pedicel to just below the calyx, very small to c. 2½ cm long (usually the more apical the larger), sometimes confluent at the base and together encasing the calyx. Calyx campanulate to slightly urceolate, 1– $2\frac{3}{4}$ (–4) cm long (in Assam 6– $7\frac{1}{2}$  mm), connate for  $\frac{1}{4}$  to more than  $\frac{1}{2}$ . Corolla widely to slenderly funnel-shaped, tube 2–5 cm (in the typical form from Ceylon and SW. Deccan  $8\frac{1}{2}$ –10 cm). Anthers oblong to ovate, ( $3\frac{1}{2}$ –) 5– $7\frac{1}{2}$ (– $12\frac{1}{2}$ ) mm long, cells free at the base for  $\frac{1}{2}$ – $\frac{1}{2}$ . Stigma obconical, slightly cup-shaped to

peltate, 1–5 mm  $\sigma$ . Fruits ovoid or ellipsoid to subglobular, 3–5 cm long (specimens from Assam  $1\frac{1}{4}$  cm), slightly to strongly beaked, glaucous-white (sometimes mentioned as being coffee-brown or black); calyx often warty-lenticellate, lobes appressed, spreading, or reflexed.

Distr. Ceylon, SW. Deccan, Assam, Burma, Siam, Indo-China, SW. China (SW. Yunnan), Hainan, Hongkong, Formosa (S. peninsula only), and throughout Malaysia.

Cited by SASAKI, l.c. (as *F. obovata*) from Ponape (Carolines); I saw no material from there; confusion with small-flowered *F. berteriana* seems probable.

Ecol. Occupying a wide range of habitats, in open localities and along forest edges but also in primary and secondary forests, both on dry and on marshy or periodically inundated soils, under everwet as well as under seasonal conditions, from sea-level up to 2500 m. Fl. mainly in the dry season, fr. in the rainy period.

Uses. Sometimes cultivated as an ornamental shrub.

Vern. *Kaju djottik*, Sum., *angilaan bilu*, *bani bani luam*, *olor arèlah*, Simalur, *ara burong*, Mal. Pen., *kikunteh*, *kiterong*, *S, kèmrungèn*, *kèpitu*, J, *rauai kajarok*, Sumba, *salang mapit*, Born.; Philip.: *bankalon*, Bag., *busalsal*, Sbl., *kotohogan*, Mbo., *malatunog*, C. Bis., *mamagon*, Bik., *panagang*, Tagb., *pospusug*, *pukut*, Ig.; *papatjeda bangan*, *p. utan*, *pasi gunung*, Ternate, *tonki utan*, Ambon, *mèngando*, Moluccas (?), *kulaken* (or *kuleka*), N. G.

Notes. In the circumscription given here an extremely variable species. Both inside and outside Malaysia it comprises several local forms, some of which have very conspicuous characters; it is quite understandable that they were described as distinct species, sometimes not even thought to be closely related. After a careful study of a large number of specimens from all parts of the area I feel convinced that all these forms belong to one species. Most of the more extreme ones are in fact not sharply delimited but grade into other forms. In a few cases where there is a really sharp demarcation this depends on characters which are ephemeral and of no systematic importance in this species. Though it would not be impossible to subdivide this species into a (fairly large) number of forms and varieties I have refrained from doing so. I confine myself to an enumeration of the more important local forms in Malaysia with the synonyms belonging to them:

*F. litoralis* is the most common form to which most of the synonyms belong; it occurs throughout Malaysia: leaves medium-sized to small, elliptic, acute at the base, gradually acuminate at apex, nerves invisible; axillary scale appressed to the twig, small, rounded; inflorescence 3–5-flowered; bracteoles inserted about halfway the pedicel, small; calyx 1– $1\frac{3}{4}$  cm, sepals free for at least half their length; anthers  $\frac{1}{2}$ – $\frac{3}{4}$  cm long; stigma up to  $3\frac{1}{2}$  mm  $\sigma$ , mostly about obconical; fruits subglobular, not strongly beaked, calyx spreading.

'Kinabalu-race' (Borneo: Mt Kinabalu): differs

from '*F. litoralis*' by lanceolate leaves, solitary flowers, and the calyx which is appressed to the fruit. It comes close to the type of '*F. sasakii*' from Formosa.

'*F. pyriformis*' (Sumatra): differs from '*F. litoralis*' mainly in its calyx, which is  $1\frac{3}{4}$ – $2\frac{1}{2}$  cm long and slightly constricted in the mouth, the sepals being halfway connate.

'*F. oblonga*' (Sumatra, Malay Peninsula): a very characteristic form which differs from '*F. litoralis*' by long and narrow leaves (11–35 by 2–9 cm), when dried greyish green, beneath lighter or brownish, apex usually long and slender acuminate; nerves 10–12 pairs, visible though inconspicuous; petiole long and slender (2–5 cm); axillary scale slightly broader and truncate; inflorescence relatively many-flowered; calyx  $1\frac{1}{2}$  cm long, slightly constricted at the mouth.

'*F. sperei*' (Sumatra, Malay Peninsula): a characteristic form which differs from '*F. litoralis*' by small (7–10 by  $3\frac{1}{4}$ –5 cm) stiff leaves with a blunt to slightly acuminate apex; inflorescences 1–9-flowered; calyx large ( $2\frac{1}{4}$ – $2\frac{3}{4}$  cm); bracteoles inserted just below and appressed to the calyx, c.  $\frac{3}{4}$  cm long, lanceolate.

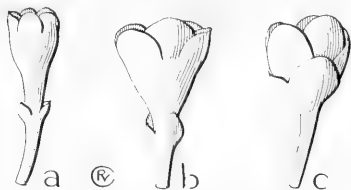


Fig. 14. *Fagraea ceilanica* THUNB., calyxes and bracteoles of Philippine specimens. a. Bracteoles small and attached about halfway the pedicel, b. bracteoles slightly larger, attached just below the calyx, c. bracteoles connate, forming a cupule around the calyx, all  $\times \frac{2}{3}$  (a WILLIAMS 1316, b BS 45700, c WENZEL 936).

'Philippine-race' (Philippines: Mindoro, Luzon, Catanduanes, Leyte, Negros, Mindanao) mainly differs from '*F. litoralis*' by a large calyx ( $2\frac{1}{2}$  cm) which at its base is enveloped by a cupule composed of the confluent,  $1\frac{1}{2}$  cm long bracteoles. '*F. loheri*' is intermediate between this form and '*F. litoralis*': it has a long calyx and high-inserted bracteoles, but these are smaller, patent, and not confluent at the base (Luzon) (fig. 14).

'*F. ternatana*' (Luzon, Moluccas, New Guinea) differs from '*F. litoralis*' by somewhat broader leaves, a blunt to rounded, slightly acuminate apex; axillary scale adnate to the petiole, slightly larger, truncate to emarginate; calyx large ( $2\frac{1}{4}$ – $2\frac{1}{2}$  cm), slightly constricted at the mouth; anthers long and narrow (1 cm); stigma broadly peltate (5 mm  $\phi$ ); fruit distinctly beaked. '*F. angiensis*' from New Guinea differs only from '*F. ternatana*' by its leaves, which are more similar to those of '*F. litoralis*' but slightly obovate (fig. 15).

'*F. gardeniaeflora*' (incl. *F. archboldiana*; New

Guinea) differs from the closely related '*F. ternatana*' and '*F. angiensis*' by a  $2\frac{3}{4}$ –4 cm long calyx, enveloped by a cupule composed of the strongly enlarged ( $1\frac{3}{4}$ – $2\frac{1}{2}$  cm long) partly connate bracteoles; anthers 1– $1\frac{1}{4}$  cm long.

'*F. minor*' (best developed in Borneo) differs mainly from '*F. litoralis*' by the ovate leaves which are rounded to subcordate at the base.

'*F. forstenii*' and '*F. celebica*' (Celebes) differ mainly from '*F. litoralis*' by the spindle-shaped fruits, the latter furthermore by the broad, almost deltoid axillary scale.

The affinity of '*F. ceilanica*' is especially with 6. *F. annulata* and 10. *F. blumei* (see under these species for differences and further remarks).

The pseudo-axillary inflorescences, as mentioned by CAMMERLOHER in a note to his description of '*F. lutea*', are apparently only the normal, axillary lower branches of a furthermore broken terminal inflorescence.

According to MERRILL's description, in '*F. loheri*' the tube of the corolla would be 11 mm long, the lobes 16 mm; in fact, the measurements are exactly the reverse.

The leaves are always exauriculate, but in '*F. gardeniaeflora*' on both sides of the broadened petiolar base a distinct wart (probably a gland) can be found, which may look like a rudimentary auricle.

*Funis toaccae* RUMPHIUS, Herb. Amb. 5 (1747) 481, t. 179 has been referred by MERRILL, Int. Rumph. (1917) 424 to '*F. amboinensis* BL. but as he rightly remarked, the fruits doubtless belong to an *Apocynaceae*; the latex mentioned to occur in the twigs points to the same family. See also HEYNE, Nutt. Pl. (1927) 1292, under *Apocynaceae*. On the other hand the large flowers (according to the figure they must be about 10 cm) with 5 free stamens may represent some *Fagraea* (though not the present species).

*F. oxyphylla* MIQ. was published as a new more appropriate name after combination of three earlier species and is therefore illegitimate.

6. *Fagraea annulata* HIERN, Nova Guinea 8 (1909) 202; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 333, f. 10.

Tree, 6–8 m tall. Leaves petioled, (oblong-)ovate to (oblong-)obovate, 5–14 by  $2\frac{1}{4}$ – $5\frac{1}{2}$  cm, firmly herbaceous or thinly coriaceous, base acute, often subcontracted and decurrent, apex very shortly acute-acuminate; nerves c. 10 pairs, very thin and hardly visible above, invisible beneath, veins inconspicuous except sometimes some intermediate ones; petiole slender,  $\frac{3}{4}$ – $2\frac{1}{2}$  cm; exauriculate; axillary scale adnate to the petiole,  $\frac{1}{4}$ – $\frac{1}{2}$  cm long, fairly broad (much broader than the base of the petiole), truncate to faintly 2-lobed. Inflorescences cymose, 2–15-flowered, dense; pedicels thick,  $\frac{1}{2}$ –12 mm long, often 2-bracteolate above the middle and then thickened above the bracteoles. Calyx campanulate, often with recurved lobes,  $\frac{3}{4}$ –1 cm long, divided about halfway. Corolla-tube funnel-shaped,  $2\frac{3}{4}$ – $3\frac{1}{2}$  cm, inside about halfway with a distinct horizontal rim bear-





Fig. 15. *Fagraea ceilanica* THUNB., a flowering specimen of '*F. angiensis*', Mt Gwamongga at 2450 m (W. New Guinea) (SLEUMER, 1962).

ing the stamens. *Anthers* oblong, c.  $\frac{3}{4}$  cm long, to about halfway bifid. *Stigma* subpeltate, c.  $2\frac{1}{2}$  mm  $\sigma$ . *Fruits* (unripe) ellipsoid-oblong, c.  $1\frac{1}{4}$  by  $\frac{3}{4}$  cm.

*Distr. Malaysia*: SW. New Guinea (Noord River), once collected.

*Ecol.* On river-bank at low altitude. *Fl.* June.

*Note.* Doubtless very close to *F. ceilanica*; in fact the only difference with that species is the thickened annulus in the corolla-tube bearing the stamens. This character it has in common with the small group of species with a 2-lobed stigma (*F. berteriana* and allies). As only one specimen is known it is not impossible that it is of hybrid origin, the more so as in New Guinean specimens of *F. ceilanica* there seems to be a slight introgression

of *berteriana*-characters, especially concerning the leaves.

7. *Fagraea acuminatissima* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 232; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 330, f. 9.—*F. obovata* (non WALL.) KING, J. As. Soc. Beng. 74, ii (1908) 606, p.p.; RIDL. Fl. Mal. Pen. 2 (1923) 418; BURK. Dict. (1935) 996.—*F. longicuspis* GANDOGER, Bull. Soc. Bot. Fr. 65 (1918) 58.

Usually a shrub or small tree, sometimes a climber. *Leaves* petioled (suborbicular to) oblong to lanceolate or subobovate, 7–24 by  $3\frac{3}{4}$ –10 cm, thickly coriaceous (fleshy when fresh); base acute and decurrent, apex obtuse or rounded, abruptly contracted into a narrowly triangular, acute,

$\frac{3}{4}$ –(2) cm long acumen; nerves invisible; petiole robust,  $1\frac{1}{4}$ –5 cm long, exauriculate; axillary scale appressed to the twig, inconspicuous, rounded. *Inflorescences* subsessile, subglomerulous, 3–5-flowered; pedicels thick,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long, about halfway with a pair of small, appressed to patent bracteoles. *Calyx* campanulate,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm long, deeply divided (about  $\frac{2}{3}$ – $\frac{3}{4}$  of its length). *Corolla-tube* funnel-shaped,  $2\frac{1}{2}$ – $4\frac{1}{2}$  cm long. *Anthers* oblong, thick,  $\frac{2}{6}$ – $\frac{3}{4}$  cm long, cells free in their basal half. *Stigma* broadly obconical to peltate, c.  $1\frac{1}{2}$  mm  $\phi$ . *Fruits* ellipsoid to globular, c.  $1\frac{1}{2}$ –2 cm  $\phi$ ; calyx appressed.

*Distr. Malaysia:* Sumatra (also Banka and Riouw Is.), Malay Peninsula, W. and N. Borneo.

*Ecol.* Mainly in peat-swamp forests, sometimes also in bamboo forests, up to 750 m. *Fl.* Febr.–Nov., *fr.* Febr., July, Sept.

*Vern.* *Malikoh*, Banka, *akar tunkoo beavak, tēmbusu*, Mal. Pen., *baruas babi, dawi-dawi, nyatu*, Born.

*Notes.* This species belongs to the wider relationship of *F. ceilanica* (in the Malay Peninsula it has always been identified with *F. obovata*). Its most distinctive characters are the often blackish, round twigs, the dull- to olive-brown upper and smooth red-brown lower side of the very stiff dried leaves, and the small,  $\pm$  sessile, glomerulous inflorescences, with the small calyces. Apart from the flowers which are very long and slenderly tubular in *F. tubulosa* there is a great resemblance with that species; a good difference is found in the midrib, which is rounded beneath in the present species, strongly keeled in *F. tubulosa*.

**8. *Fagraea tubulosa*** BL. *Mus. Bot.* 1 (1850) 167; *Walp. Ann.* 3 (1852) 75; *Miq. Fl. Ind. Bat.* 2 (1857) 373; KING, *J. As. Soc. Beng.* 74, ii (1908) 604; CAMMERL. *Bull. Jard. Bot. Btzg III*, 5 (1923) 326; RIDL. *Fl. Mal. Pen.* 2 (1923) 415.

Straggling climbing shrub. *Leaves* petioled, ovate-oblong, oblong, or oblong-lanceolate, 10–22 $\frac{1}{2}$  by 5–10 cm, thinly coriaceous, base broadly cuneate or obtuse, narrowly decurrent, apex abruptly short- to long-subcaudate; nerves 5–7 pairs, invisible or almost so above, faintly visible or quite inconspicuous beneath; petiole  $1\frac{1}{2}$ –3 cm long; exauriculate; the axillary scale inconspicuous, adnate to the petiole, blunt, 3 mm long. *Flowers* 1–6 in sessile glomerules; pedicels very short with 1–2 pairs of small bracteoles. *Calyx* campanulate,  $\frac{1}{2}$ –1 cm long, divided somewhat less than halfway down. *Corolla-tube* tubular, very slender, 8–9 cm. *Anthers* elliptic, c. 4 mm long, cells in their basal half free. *Stigma* peltate, 2 mm  $\phi$ . *Fruit* unknown.

*Distr. Malaysia:* Sumatra, Malay Peninsula (Perak).

*Ecol.* In forests, c. 900 m. *Fl.* June.

*Note.* A very distinct species, well characterized by its glomerulous, long and slender, fragile flowers. Apart from this character much alike (and possibly related to) *F. acuminatissima*, which has the midrib rounded beneath, not keeled as it is here.

**9. *Fagraea ridleyi*** K. & G. *J. As. Soc. Beng.* 74, ii (1908) 612, *non* GANDOGGER (1924); RIDL. *J. Str. Br. R. As. Soc.* n. 50 (1908) 118; *Fl. Mal. Pen.* 2 (1923) 417.—*F. crassifolia* WALL. *Cat.* (1829) n. 1602, *nom. nud.*, *non* BL. (1838) (= *F. ceilanica*).—**Fig. 16.**

Liana or big straggling shrub. *Leaves* petioled, obovate to suborbiculate, 13–24 by 9–18 cm, thick-coriaceous, base acute, somewhat decurrent, apex rounded, with or without an abrupt short and blunt acumen; nerves 4–10 pairs, flattish or slightly impressed above, prominent beneath; petiole 2–4 cm, robust, exauriculate; stipules connate in a 4 mm high creca which in older leaves is split between the petioles. *Inflorescences* cymose, 3–9 flowered; pedicels  $\frac{1}{2}$ –2 cm, thick, tapering into the calyx, usually with a pair of small patent bracteoles somewhat above the middle. *Calyx* campanulate, 2–2 $\frac{1}{2}$  cm high, tube woody, lobes  $1\frac{1}{4}$ – $1\frac{3}{4}$  cm, thick-coriaceous. *Corolla-tube* funnel-shaped,  $3\frac{1}{2}$ –4 cm. *Anthers* bifid to halfway, oblong,  $\frac{3}{4}$  cm long. *Stigma* subpeltate,  $2\frac{1}{2}$  mm  $\phi$ . *Fruits* inversely pear-shaped to globular and conically beaked, c. 5 by  $3\frac{1}{4}$  cm; calyx loosely appressed.

*Distr. Malaysia:* Malay Peninsula, Lingga Arch., and Borneo (Sarawak, Brunei).

*Ecol.* In the Malay Peninsula in Borneo in primary forests on sandstone hills, 0–300 m. *Fl.* May, Aug., *fr.* April, May, and Sept.

*Vern.* *Buah rēlan kēnyalang*, Born. (this means: the fruit which is swallowed by the hornbills).

*Notes.* Specimens from Borneo differ slightly from those of the Malay Peninsula; the main difference is in the fruits, which are globular with a strong conical beak in Borneo, inversely pear-shaped in the Malay Peninsula.

The relationship of *F. ridleyi* is doubtless with *F. blumei* (which differs by warty-lenticellate inflorescences and conspicuous axillary scales) and with *F. ceilanica* (which differs by invisible nerves).

As lectotype I have designated RIDLEY 5845 (SING; dupl. BM, K).

**10. *Fagraea blumei*** G. DON, *Gard. Dict.* 4 (1837) 69 (*'blumii'*); STEUD. *Nomencl.* ed. 2, 1 (1840) 624; DC. *Prod.* 9 (1845) 30.—*F. obovata* BL. *Bijdr.* (1826) 1021, *nom. illeg.*, *non* WALL. (1824).—*F. obovato-javana* BL. *Rumphia* 2 (1838) 29, t. 75, *nom. superfl.*, *incl. var. bebeak*; *Mus. Bot.* 1 (1850) 164; *Miq. Ann. Mus. Bot. Lugd.-Bat.* 2 (1866) 217, *incl. var. latifolia*; K. & V. *Bijdr.* 9 (1903) 78; KOORD. *Exk. Fl. Java* 3 (1912) 59; *Fl. Tjib.* 3 (1918) 47; HOCHR. *Candollea* 6 (1936) 473.—*F. leschenaultii* BL. *Rumphia* 2 (1838) 30; *Mus. Bot.* 1 (1850) 164; *Miq. Fl. Ind. Bat.* 2 (1857) 370.—*F. plumeriaeflora* DC. *Prod.* 9 (1845) 29; BENTH. *J. Linn. Soc. Bot.* 1 (1856) 98 (*'plumeriaefolia'*); *Miq. Fl. Ind. Bat.* 2 (1857) 375; *ELM. Leaf. Philip.* *Bot.* 2 (1909) 598; *ibid.* 3 (1910) 857; *MERR. En. Philip.* 3 (1923) 315, *excl. spec. Celeb.*; *non* KOORD. *Minah.* (1898) 540, *nec* KOORD.—SCHUM. *Syst. Verz.* 3 (1914) 105 (both are *F. truncata*).—*F. obovata*

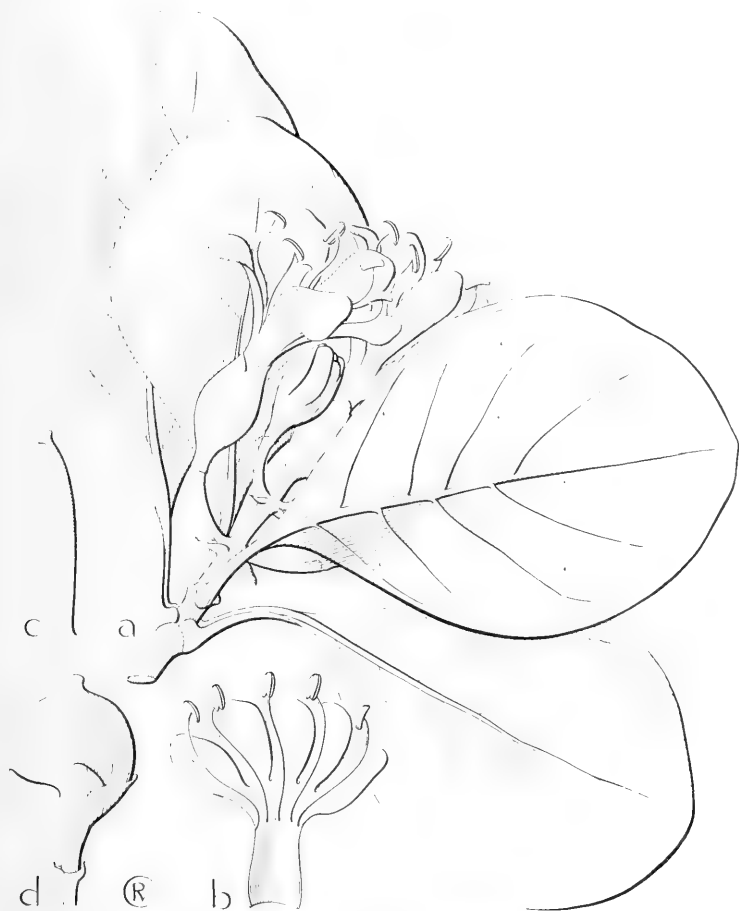


Fig. 16. *Fagraea ridleyi* K. & G. a. Habit (note the glands on the lower side of the leaf), b. opened corolla, c. style and stigma, d. fruit, all  $\times \frac{2}{3}$  (RIDLEY 5845).

(non WALL.) MIQ. Fl. Ind. Bat. 2 (1857) 369; Sum. (1861) 226, incl. var. *latifolia*; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 83, p.p.; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 322; MERR.

En. Philip. 3 (1923) 315, p.p.; DOCT. VAN LEEUWEN, Zoocecidia (1926) 463; MERR. Contr. Arn. Arb. 8 (1934) 138; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 11; Blumea 6 (1950)



Fig. 17. *Fagraea blumei* G. DON. a. Habit,  $\times \frac{2}{3}$ , b. opened corolla,  $\times 1$ , c. stigma,  $\times 5$ , d. anther,  $\times 2$  (a-d BÜNNEMEYER 4950).

382, incl. var. *brevicalyx*.—*F. vaginata* K. & G. J. As. Soc. Beng. 74, ii (1908) 610; RIDL. Fl. Mal. Pen. 2 (1923) 418; S. MOORE, J. Bot. 63 (1925) Suppl. 69; BURK. Dict. 1 (1935) 997.—*F. negrosensis* ELM. Leaf. Philip. Bot. 2 (1909) 599; MERR. En. Philip. 3 (1923) 315.—*F. cuernosensis* ELM. Leaf. Philip. Bot. 2 (1909) 600; MERR. En. Philip. 3 (1923) 314.—*F. intermedia* RIDL. J. Fed. Mal. St. Mus. 8, n. 4 (1917) 63.—*F. spatiosa* S. MOORE, J. Bot. 63 (1925) Suppl. 69.—*F. lutea* (non CAMMERL.) MERR. Contr. Arn. Arb. n. 8 (1934) 138.—Fig. 17.

Tree up to 26 m, scandent or erect, epiphytic or terrestrial shrub, or climber. *Leaves* mostly obovate, sometimes elliptic to oblong, rarely lanceolate, 7–60 by 2–30 cm, thin- to stiff-coriaceous, base acute, mostly long-attenuate, apex rounded to cuneate, nearly always acuminate, acumen tapering to abrupt, short and broad to fairly long and

slender; nerves 3–15 pairs, usually slightly though distinctly prominent on both surfaces, rarely inconspicuous to invisible; petiole  $\frac{1}{2}$ –4 cm, mostly robust, often narrowly winged, exauriculate; axillary scale for the greater part adnate to the petiole but distinctly broader, 4 mm– $1\frac{1}{2}$  cm long, usually 2-lobed to truncate, rarely rounded. *Inflorescences* terminal with 2 strong branches in the upper leaf-axils, cymose to corymbose, lax to rather dense, (1–)7–c.50-flowered, sparsely to densely warty-lenticellate (still more conspicuously so in fruit); pedicels usually stout,  $\frac{1}{4}$ – $2\frac{1}{2}$  cm, 2-bracteolate in the lower two-thirds. *Calyx* cupular to campanulate, very slender to rather broad, 4–20 mm long, sepals connate for  $\frac{1}{3}$ – $\frac{2}{3}$ . *Corolla*-tube narrowly to widely funnel-shaped,  $1\frac{1}{2}$ –4 cm, lobes varying from about  $\frac{1}{3}$  to nearly as long as the tube. *Anthers* thickly ovate-oblong to lanceolate, 4–10 mm, to halfway bifid. *Stigma* capitate

to peltate, 1-5 mm  $\sigma$ . Fruits either subglobose (sometimes beaked) and 3-4 cm  $\sigma$ , or spindle-shaped and 5-7 by 1 $\frac{3}{4}$ -2 $\frac{1}{2}$  cm, said to be black (Sumatra) or yellow (Philippines); calyx with loosely appressed to spreading or caducous lobes.

Distr. *Malaysia*: Sumatra, Malay Peninsula (Perak, Pahang, Selangor), Java, Borneo, and the Philippines; a few dubious specimens from Celebes.

This species comprises two subspecies, as follows:

*ssp. blumei*.—*F. blumei* G. DON.—*F. obovata* BL.—*F. obovato-javana* BL., incl. var.—*F. leschenaultii* BL.—*F. obovata* (non WALL.) AUCT., incl. var.—*F. vaginata* K. & G.—*F. negrosensis* ELM.—*F. intermedia* RIDL.—*F. spatiosa* S. MOORE.—*F. lutea* (non CAMMERL.) MERR.

Axillary scale  $\pm$  flat, dark-brown. Leaves obovate, up to 27 by 13 cm, thick- and stiff-coriaceous, dark-brown when dry, base long-attenuate, apex rounded with a minute, broadly triangular acumens; nerves 3-6 pairs, distinctly forked towards the margin, conspicuous beneath. Pedicels up to 1 cm, with a pair of bracteoles about halfway. Calyx up to 1 $\frac{1}{2}$  cm. Corolla-tube up to 2 $\frac{1}{2}$  cm. Anthers up to 7 mm. Stigma usually 1-2 $\frac{1}{2}$  mm  $\sigma$ . Fruits (sub)globose, calyx persistent.

Distr. Sumatra, Malay Peninsula, Java, rare in Borneo and the Philippines (Negros).

Ecol. Preferably on a fertile wet soil and in light shade, in and especially along primary and secondary forests, on river-banks, etc.; usually under everwet, in East Java also under seasonal conditions. Rarely under 500 m (except in the Malay Peninsula), usually 1200-1800(-2200) m. *Fl. fr.* Jan.-Dec.

Uses. The rubbed leaves are used as a medicine against fever and headache; latex from the fruits used to make lime-twigs for catching birds. The fruits are said to be poisonous.

Vern. *Akar konjal, kaju djottik, kama lojang, Sum., akar terong kusang, arèng kidjamudju, bebeak, kalang mangga, ki minjak, kitèrong areui, S, djeruk utan, (èn)dog-(èn)dogan, kèmplèk, ki hurip (or horip), ki kèndal, ki terong, salisor, wuru, J, njam plongolos, Md, dirung, Born.; Philip.: buton, dolis, Bag., maganònok, Sub.*

*ssp. plumeriaeflora* (DC.) LEENH. nov. stat.—*F. plumeriaeflora* DC.

Axillary scale concave, greenish. Leaves elliptic, 17-60 by 6-30 cm, thin-coriaceous, greyish green when dried, base not long-attenuate, apex blunt, abruptly terminated by a slender acumens; nerves 9-15 pairs, looped and joined near the margin, visible on both sides. Pedicels 1 $\frac{1}{2}$ -2 $\frac{1}{2}$  cm, bracteoles at the base. Calyx 1 $\frac{3}{4}$ -2 cm. Corolla-tube 3 $\frac{1}{2}$ -4 cm. Anthers 6-10 mm. Stigma c. 4 mm  $\sigma$ . Fruits spindle-shaped, calyx caducous.

Distr. Philippines (Luzon, Catanduanes, Samar, Leyte, Panay, Mindanao).

Ecol. Humid primary forests, 500-2000 m. *Fl. fr.* Jan.-Dec. The very fragrant flowers are visited by butterflies.

Vern. *Butoon ta-usà, Bag., kalaynig, Buk.*

Notes. This species is related to *F. ceilanica*, *F. fastigiata*, and *F. tacapala*. The conspicuous stipules, the distinctly prominent nerves, and the warty lenticellate inflorescences are good characters to distinguish it from *F. ceilanica*; only some forms from the Philippines and from Sumatra have about the same leaves as the latter species. *F. fastigiata* is doubtless very close to *ssp. blumei*, but differs by the auricles inserted slightly above the leaf-base; it could be conspecific. *F. tacapala* comes near *ssp. plumeriaeflora*, is also different by the presence of auricles.

Typical specimens of the two subspecies are so different that one would prefer to distinguish them as good species. There are, however, two series of intermediate specimens; the type of *F. cuernosensis* and several other specimens I have not referred to a subspecies.

The first series is formed by the specimens from Negros (among which the types of *F. negrosensis* and *F. cuernosensis*), several specimens from Mindanao, and one from Luzon (FB 8996). The Negros specimens come close to *ssp. blumei* and differ mainly by their *ceilanica* ('litoralis')-like leaves; most of the Mindanao specimens have the same kind of leaves, but the inflorescences and flowers look more like those of *ssp. plumeriaeflora*, with which they have also the spindle-shaped fruits in common; the calyx is not caducous, however. The latter character is the main difference between the remaining specimens and *ssp. plumeriaeflora*.

The second series goes via Borneo. Among the Bornean specimens one (BECCARI PB 3032) comes close to *ssp. blumei*, from which it differs only by the greater number of nerves. All other Bornean specimens combine the leaves of *ssp. plumeriaeflora* with the inflorescences, flowers, and fruits of *ssp. blumei*.

Especially *ssp. blumei* shows a wide range of variability; this mainly concerns the inflorescences and the flowers (many- to few-flowered inflorescences, small to big calyces and corollas, the former cupular to campanulate and with short to long lobes, the latter slender to wide). This variability is gradual, and in Java nearly the full range of specimens is found. Some local races with deviating characters are restricted to Central Sumatran volcanoes. The specimens from Mt. Merapi are mainly aberrant by the caducous calyx under a globose fruit. Those of Mt. Kerintji differ only from typical *blumei* in the large, many-flowered inflorescence and the small flowers (calyx cupular, 4 mm high, less than halfway connate, corolla-tube 1 $\frac{1}{2}$  cm long). The specimens from Mt. Singalang have oblong, acute leaves, the nerves of which are invisible, a very lax, few-flowered inflorescence and the smallest flowers (calyx tubular, 4 mm long, more than halfway up connate, corolla-tube c. 5 mm). On account of the leaf-shape, the inflorescences, and the small flowers, the latter race is sometimes confused with *F. fragrans* (which has, however, lateral inflores-

cences). Specimens from Mt. Sibajak are mainly characterized by elliptic, acute leaves, the nerves of which are nearly invisible, by short-stalked and densely crowded inflorescences of 3–9 flowers, with big (6 by 10 mm) bracteoles clasping the calyx, and by sepals connate for only  $\frac{1}{4}$ .

The nomenclature of *F. blumei* is somewhat confused. BLUME, who was the first to recognize and publish it in 1826, named it *F. obovata*, apparently unaware of the fact that WALLICH had used the same epithet already two years earlier for another species. Later on G. DON, BLUME himself, and STEUDEL corrected this error, using the epithets *blumii*, *obovato-javana*, and *blumei* respectively. All these names were clearly based upon *F. obovata* BL.

**11. *Fagraea fastigiata* BL.** Rumphia 2 (1838) 30, t. 76 f. 1; DC. Prod. 9 (1845) 30; BL. Mus. Bot. 1 (1850) 164; MIQ. Fl. Ind. Bat. 2 (1845) 369; K. & V. Bijdr. 9 (1903) 80; KOORD. Exk. Fl. Java 3 (1912) 59; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 322, *pro spec. Jav., fr. excl.*; БАХ. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 11, *p.p.*; *non* RIDL. J. Str. Br. R. As. Soc. n. 30 (1897) 167,  *nec* ENDERT, Tectona 13 (1920) 117 (= *F. crenulata*).—Fig. 2b.

Liana, epiphytic shrub, or small tree, up to 13 m by c. 10 cm  $\sigma$ . *Leaves* sessile, oblong-obovate, 13–27 by 6–12 cm, thin-coriaceous, base narrowly cuneate, long-decurrent, again somewhat broadened and subauriculate slightly above the twig, completely hiding the axillary scale which is adnate to the midrib,  $\pm \frac{3}{4}$  cm long and rather narrow; apex blunt to faintly blunt-acuminate; nerves 5–7 pairs, inconspicuous above, prominent to prominent beneath. *Inflorescences* corymbose, laxly branched, with c. 15–20 subsessile flowers; bracteoles small, appressed, just below the calyx. *Calyx* slender-campanulate, c. 7 mm, less than  $\frac{1}{3}$  divided. *Corolla*-tube widely funnel-shaped, 3 cm. *Anthers* ovate-lanceolate, 7 mm, cells in their basal half free. *Stigma* unknown. *Fruits* globose, 2 cm  $\sigma$ ; pedicels slender, calyx-lobes reflexed.

*Distr. Malaysia:* Malay Peninsula (Perak: Ijok F. R.) and West and Central Java.

*Ecol.* Forests, c. 600–1000 m. *Fr.* June. For a gall see DOCTERS VAN LEEUWEN, *Zoococcidia* (1926) 463, f. 885.

*Vern. Lanupa*, S.

*Note.* This species is closely related to *F. blumei* ssp. *blumei*; it is even possible that it will finally appear to be conspecific with that species, from which it mainly differs by its auriculate leaf-base. By this character it seems to link up *F. blumei* with the group of species (*n.* 14–20) with well-developed auricles.

**12. *Fagraea crenulata* MAINGAY ex CLARKE** in Hook. f. Fl. Br. Ind. 4 (1883) 83; KING, J. As. Soc. Beng. 74, ii (1908) 610; DOP, Fl. Gén. I.—C. 4 (1914) 176; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 321; RIDL. Fl. Mal. Pen. 2 (1923) 420; FOXW. Mal. For. Rec. n. 3 (1927) 160, plates;

HEYNE, Nutt. Pl. (1927) 1269; DE VOOGD, Trop. Natuur 21 (1932) 60, f. 1; BURK. Dict. 1 (1935) 994; CORNER, Ways. Trees (1940) 423, t. 121.—*F. fastigiata* (*non* BL.) RIDL. J. Str. Br. R. As. Soc. n. 30 (1897) 167; ENDERT, Tectona 13 (1920) 117.—Fig. 18.



Fig. 18. *Fagraea crenulata* CLARKE in marshes near Palembang (Sumatra) (DE VOOGD).

Tree, up to 23 m by 50 cm  $\sigma$ , trunk and branches with simple or divided prickles. *Leaves* sessile or subsessile, broadly obovate, 18–45 by 14–25 cm, thin-coriaceous to stiff-herbaceous, base narrowed, then widened again into a pair of amplexicaulous or recurved auricles, margin finely crenulate, apex very broadly rounded to nearly truncate; nerves 5–7 pairs, clearly visible above, prominent beneath; axillary scale fully adnate to the petiole or midrib, fairly narrow, acute,  $1\frac{1}{2}$ –2 cm, completely enveloped by the leaf-base. *Inflorescences* corymbose, widely branched and many-flowered, up to 25 cm; pedicels 1–2 cm, gradually thickened towards the apex; bracteoles appressed, not very large, usually about halfway the pedicel. *Calyx* 1 cm long, divided to quite near the base. *Corolla*-tube funnel-shaped,  $1\frac{3}{4}$ –2 cm. *Anthers* oblong, 6 mm, cells free in their basal third. *Stigma* peltate,  $1\frac{1}{2}$ –2 mm  $\sigma$ , faintly 2-lobed. *Fruits* ellipsoid,  $2\frac{1}{2}$  cm or longer; calyx more or less spreading.

*Distr.* South Indo-China and Malaysia: along the east coast of Sumatra, the west coast of the Malay Peninsula, and the southwest and south coast of Borneo.

*Ecol.* Permanent or periodical swamps behind

the mangrove belt, along rivers, up to 10 m. *Fl.* fr. Jan.-Dec.

Uses. Furnishes a good, though cross-grained, timber; wood very valuable for piling, resists *teredo* borers when used with the bark on; furthermore used as firewood. In Bengkalis (Sum.) planted on yards.

Vern. *Cabbage tree*, E, *bēbira*, *bira bira*, *babira*, *malabira*, *melabira*, Sum., *bērah*, *bira(h)*, *malabēra*, *mal(a)bira*, Mal. Pen., *kayu bulan*, Born.

Notes. The tree reminds in habit of *Terminalia catappa* L.

Young trees have densely spiny trunks (LÖRZING in Herb. Bo). These sharp conical prickles form part of the bark and are apparently corky in nature.

This is the only species of which the leaves are not entire. Its affinity seems to be with *F. blumei*.

13. *Fagraea truncata* BL. Mus. Bot. 1 (1850) 165; Walp. Ann. 3 (1852) 75; Miq. Fl. Ind. Bat. 2 (1857) 372; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 216; non KOORD. Minah. (1898) 540, KOORD.-SCHUM. Syst. Verz. 3 (1914) 105 (= *F. nov. sp. aff. longiflora*).—*F. plumeriaeflora* (non DC.) KOORD. Minah. (1898) 540, *sphalm. plumeriaeflora*; KOORD.-SCHUM. Syst. Verz. 3 (1914) 105.—*F. forstenii* (non BL.) KOORD. Minah. (1898) 540; KOORD.-SCHUM. Syst. Verz. 3 (1914) 105.

Liana, shrub, or tree, up to 12 m high. Leaves oblong, oblong-obovate or oblanceolate, 20-38 by 8-18 cm, coriaceous, base broadly to narrowly cuneate, apex broadly cuneate to rounded, abruptly, up to 1½ cm long, blunt- or acute-acuminate; nerves 7-10 pairs, slightly impressed above, prominulous beneath; petiole 2-3 cm, narrowly winged over the whole length, exauriculate; axillary scale adnate, c. 1 cm long, broadened towards the apex, 2-lobed. Inflorescences glomerulous, 3-7-flowered; pedicels ½-1½ cm, with a pair of 1-2 cm long, lanceolate bracteoles. Calyx widely campanulate, 2½-3 cm long, slightly less than half way connate. Corolla-tube widely funnel-shaped, 4 cm. Anthers oblong, 1 cm, split halfway. Stigma obconical-peltate, c. 3 mm ø. Fruits ellipsoid, ± 3½ by 2½ cm, orange; calyx loosely appressed.

Distr. *Malaysia*: Celebes (Minahasa).

Ecol. Primary forests, 700-1250 m. *Fl.* July, fr. Jan., April.

Vern. *Matenga*, *simbēlan*, *sumering*.

Notes. Doubtless related to *F. fastigiata* of Java and to *F. blumei* ssp. *plumeriaeflora* from the Philippines.

The leaves are exauriculate, but sometimes there is a pair of gland-like structures on both sides of the leaf-base.

14. *Fagraea tacapala* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 430.—*F. fastigiata* (non BL.) CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 322, *pro specim. Celeb.*, 2c.

Treelet (up to 3 m high), tall epiphytic or terrestrial shrub, or woody climber. Leaves (sub)

sessile or distinctly petioled, (oblong-)obovate, rarely elliptic, 20-35 by 7-17 cm, thin-coriaceous, base (narrowly) cuneate or attenuate, usually decurrent, auriculate, apex blunt to broadly cuneate or shortly acuminate; nerves 8-10 pairs, prominulous on both sides; petiole (0-)2-5 cm, axillary scale adnate to the petiole, large (nearly 1-1½ cm), much broader than the petiole, distinctly bilobed. Inflorescences broadly corymbose, laxly branched, with up to c. 30 flowers; pedicels ½-2 cm, at the base to somewhat less than half way provided with a pair of ovate to lanceolate, (½-)1-1½ cm long bracteoles. Calyx campanulate, 1¼-2½ cm long, confluent at base. Corolla-tube funnel-shaped, 2½ cm. Anthers oblong, ½-1 cm long, cells free in their basal half. Stigma peltate, funnel-shaped or discoid, 2½-4 mm ø. Fruits subglobular to spindle-shaped, up to 7 cm long; calyx more or less spreading.

Distr. *Malaysia*: Celebes, Moluccas (Ceram).

Notes. This species, with its three subspecies, is more or less intermediate between *F. blumei* ssp. *plumeriaeflora* on one side and *F. woodiana* on the other. Especially ssp. *gracilis* comes in its leaves very close to *F. blumei* ssp. *plumeriaeflora*; a constant difference between these two species is the presence of (mostly small) auricles in *F. tacapala*, their absence in *F. blumei*.

The three subspecies, in the sequence *gracilis-ceramensis-tacapala* form together a series from slender to very coarse.

#### KEY TO THE SUBSPECIES

1. Leaves distinctly petioled. Calyx 1¼ cm, slender . . . . . ssp. *gracilis*
1. Leaves sessile. Calyx 1¼-2½ cm, fairly wide to wide.
  2. Calyx 2½ cm long, strongly warty-lenticellate. . . . . ssp. *tacapala*
  2. Calyx 1¼-1½ cm long, smooth or with few lenticels . . . . . ssp. *ceramensis*

ssp. *tacapala*.—*F. fastigiata* BL. *sensu* CAMMERL. p.p.

Leaves sessile; axillary scale 1½ cm long, much broader than the petiole, deeply 2-lobed. Inflorescence very coarse, densely warty-lenticellate; pedicels 1 cm, thick; bracteoles lanceolate to ovate, 1-1½ cm, usually inserted about halfway the pedicel, sometimes both or one of them nearly apical. Calyx 2½ cm long, strongly warty-lenticellate, very broad; anthers 7½-10 mm; stigma discoid-peltate.

Distr. SW. Celebes.

Ecol. In primary and secondary forests, along forest-edges and waysides; on volcanic tuff, at 1000-2000 m alt. *Fl.* Jan., June.

Vern. *Ta'kapala*.

ssp. *gracilis* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 431.

Leaves distinctly petioled; axillary scale somewhat less than 1 cm long, relatively narrow. Inflorescence not very coarse, not warty-lenticellate;

pedicels slender, 1–2 cm; bracteoles oblong, c.  $\frac{3}{4}$ –1 cm. Calyx slender,  $1\frac{1}{4}$  cm; anthers 5 mm; stigma funnel-shaped.

Distr. Celebes.

Ecol. Rain-forests, along streams or on marshy soil, 500–1200 m. *Fl.* June–July.

Vern. *Pulularé*.

*ssp. ceramensis* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 430.

Leaves sessile; axillary scale nearly  $1\frac{1}{2}$  cm long, broadly cup-shaped, faintly 2-lobed. Inflorescence large, fairly coarse, smooth or sparsely warty-lenticellate; pedicels moderately slender,  $\frac{1}{2}$ –1 cm; bracteoles ovate, c.  $\frac{3}{4}$ –1 cm. Calyx fairly broad,  $1\frac{1}{4}$ – $1\frac{1}{2}$  cm long; anthers 6 mm; stigma disk-shaped.

Distr. Moluccas (Ceram).

Ecol. In forests, 500–800 m. *Fl.* Jan., May.

**15. *Fagraea woodiana*** F. v. M. Austr. J. Pharm. (Sept. 1886) 323; Bot. Centralbl. 29 (1887) 241; S. MOORE, J. Bot. 61 (1923) Suppl. 35.—*F. anthocleistifolia* GILG & BENED. Bot. Jahrb. 54 (1916) 192.

Tree, up to 20 m by 41 cm  $\sigma$ , shrub, or liana. *Leaves* sessile, oblong-obovate, 25–50 by 10–20 cm, thin-coriaceous, base attenuate and decurrent, ending in a pair of auricles c.  $\frac{1}{2}$ – $1\frac{1}{2}$  cm  $\sigma$ , apex broadly rounded and emarginate to slightly acuminate; nerves 7–8 pairs, prominent on both sides, mainly underneath; axillary scale for the greater part or entirely adnate to the petiole, c.  $1\frac{1}{2}$ –2 cm long, very broad and deeply 2-lobed to truncate. *Inflorescences* pyramidal-thyrsoid with c. 3 pairs of horizontal branches, these up to 3 cm long, rebranched or not, at the end with a more or less dense 5–7-flowered cyme, the total inflorescence about 20 cm long; pedicels  $\frac{1}{2}$ –1 cm, bracteoles inserted at their base or up to halfway, small and thin. *Calyx* campanulate, 1 cm, divided for c.  $\frac{2}{3}$ . *Corolla*-tube funnel-shaped, c. 2–3 cm. *Anthers* bifid to about halfway, sagittate, 6– $7\frac{1}{2}$  mm. *Stigma* peltate, faintly 2-lobed,  $2\frac{1}{2}$ –3 mm  $\sigma$ . *Fruits* ovoid, c. 2–3 cm long, yellow; pedicel warty-lenticellate, calyx more or less spreading.

Distr. *Malaysia*: New Guinea.

Ecol. In primary and secondary forests, either temporarily inundated or not, from sea-level up to 1600 m. *Fl.* Aug., Oct., Dec., *fr.* Aug., Oct. The flowers are fragrant like those of jasmine.

Vern. *Amiundam*, *subekwa*, *wuribéding*.

Notes. Apparently related to *F. tacapala*.

The type is wrongly cited as FORBES 741, this must be 744.

**16. *Fagraea longiflora*** MERR. Philip. J. Sc. 3 (1908) Bot. 260; ELM. Leaf. Philip. Bot. 2 (1909) 597; MERR. En. Philip. 3 (1923) 315.—*F. macgregorii* MERR. Philip. J. Sc. 13 (1918) Bot. 51.

Epiphytic shrub. *Leaves* sessile, broadly to narrowly obovate, 35–70(–100) by 10–32 cm, thin-coriaceous, narrowed towards the base, at the base widened into a pair of rounded, sometimes more or less reflexed wings at both sides of

the axillary scale, apex more or less rounded with a distinct, small (up to 2 cm long) and narrow, acute acumen; nerves 9–12 pairs, prominent on both sides; axillary scale adnate to the midrib,  $1\frac{1}{2}$  cm long, acute at the apex, completely hidden by the leaf-base. *Inflorescences* glomerulous, with 4–c. 15 subsessile flowers, enveloped by an involucre of reduced leaves. *Calyx* campanulate,  $2\frac{1}{2}$  cm (–6 cm in fruit), slightly more than half-way divided. *Corolla*-tube tubular, slender, c. 11 cm. *Anthers* narrowly ovate, 7 mm long, cells free to slightly above the middle. *Stigma* peltate,  $\frac{1}{2}$ – $\frac{3}{4}$  cm  $\sigma$ . *Fruits* subglobular, ovate, or ellipsoid, 3– $4\frac{1}{2}$  by  $2\frac{3}{4}$  cm; calyx accrescent, the fruits moreover enveloped by the long bracts.

Distr. *Malaysia*: Philippines (Luzon, Cauduanes); a dubious specimen from Mindanao (BS 38650).

Ecol. In forests, 100–1400 m. *Fl.* April, Oct.–Dec., *fr.* May.

Vern. *Sapiag*, *Klg*.

Notes. Probably near to *F. blumei* *ssp. plumeriaeflora*; distinguishable, however, at first sight by the glomerulous inflorescences and the long corolla-tube. Possibly also related to *F. carstensensis* from New Guinea.

As lectotype I have designated FB 8026 (PNH,  $\dagger$ ; dupl. K), the only syntype I have seen.

MERRILL erroneously cited the type number of *F. macgregorii* as BS 17938, this should be BS 17938.

**17. *Fagraea carstensensis*** WERNH. Trans. Linn. Soc. Bot. 9 (1916) 111.—**Fig. 19.**

Small tree (c. 3 m). *Leaves* sessile, broadly obovate to obovate-oblong, 17–35 by 5–17 cm, coriaceous, base subcordate by a broadly rounded, probably flat wing (apparently not auriculate), connate when young, apex rounded, shortly acute-acuminate; nerves 5–12 pairs, conspicuous though flat above, prominent beneath; axillary scale fully adnate to the midrib,  $1\frac{1}{2}$ – $1\frac{3}{4}$  by c.  $1\frac{1}{2}$  cm, quadrangular; the reduced leaves at the base of the inflorescence are connate and much broadened at the base,  $\pm$  perfoliate. *Inflorescences* sessile and glomerulous, c. 15-flowered; bracts and (one pair of) bracteoles relatively large ( $1\frac{1}{2}$  and 1 cm long resp.), encircling the calyx. *Calyx* c. campanulate, 2 cm long, fairly slender, sepals free for c.  $\frac{3}{4}$  of their length. *Corolla*-tube funnel-shaped, c.  $3\frac{1}{4}$  cm long. *Anthers* elliptic, c.  $6\frac{1}{2}$  mm long, thecae free in their basal third. *Stigma* obconical-peltate, 3 mm  $\sigma$ . *Fruit* unknown.

Distr. *Malaysia*: W. New Guinea (Mt Tamrau and Mt Carstensz), twice collected.

Ecol. Forests, 200–860 m.

Note. Probably nearest related to *F. longiflora* and *F. woodiana*.

**18. *Fagraea auriculata*** JACK. Mal. Misc. 2, n. 7 (1822) 82; WALL. in Roxb. Fl. Ind. 2 (1824) 34 & 573; BL. Bijdr. (1826) 1020; WALL. Pl. As. Rar. 3 (1832) 16, t. 229; JACK in Hook. Comp. Bot. Mag. 1 (1836) 254; BL. Rumphia 2 (1838) 26, t. 72, *excl. syn.* *Valli-Modagam* RHEEDE; DC.





Fig. 19. *Fagraea carstensensis* WERNH., Tamrau Mts, Vogelkop Peninsula, W. New Guinea (VAN ROYEN & SLEUMER 7755) (VAN ROYEN, 1961).

Prod. 9 (1845) 29; HASSK. Flora 28 (1845) 246; BL. Mus. Bot. 1 (1850) 165; MIQ. Fl. Ind. Bat. 2 (1857) 371; KURZ, For. Fl. Burma 2 (1877) 204 ('auricularia'); CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 83; SOLER, in E. & P. Nat. Pil. Fam. 4, 2 (1892) 42, f. 23; RIDL. Trans. Linn. Soc. Bot. 3 (1893) 322; K. & V. Bijdr. 9 (1903) 76; KING, J. As. Soc. Beng. 74, ii (1908) 605; RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 119; ELM. Leaflet. Philip. Bot. 2 (1909) 599; KOORD. Exk. Fl. Java 3 (1912) 59; DOP, Fl. Gén. I.-C. 4 (1914) 173, f. 21 (5-7); BURK. J. Str. Br. R. As. Soc. n. 73 (1916) 258; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 326; MERR. En. Philip. 3 (1923) 314; RIDL. Fl. Mal. Pen. 2 (1923) 416; BEUMÉE, Trop. Natuur 15 (1926) 208, cum fig.; HEYNE, Nutt. Pl. (1927) 1269; RIDL. Disp. (1930) 420; STEEN. & RUTTNER, Arch. Hydrobiol. Suppl. 11 (1932) 319, f. 16, 20, 21; BURK. Dict. 1 (1935) 993; BAKH. f. in Back.

Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 10; KERR in Craib, Fl. Siam. En. 3 (1951) 54; MERR. J. Arn. Arb. 33 (1952) 224.—*F. javanica* REINW. ex BL. Cat. (1823) 47, nom. nud.—*Willughbeia auriculata* SPRENG. Syst. 4 (1827) Cur. Post. 71.—*F. imperialis* MIQ. Fl. Ind. Bat. 2 (1857) 372; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 216, t. 5 & 6; BURCK, Ann. Jard. Bot. Btzg 10 (1891) t. 8 f. 1-2; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 327.—*F. euneura* SCHEFF. in Hassk. Flora 52 (1869) 308; Nat. Tijds. N.I. 31 (1869?) 20; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 328.—*F. borneensis* SCHEFF. in Hassk. Flora 52 (1869) 309; Nat. Tijds. N.I. 31 (1869?) 21; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 326.—*F. nonok* ELM. Leaflet. Philip. Bot. 3 (1910) 858; MERR. En. Philip. 3 (1923) 315.—*F. epiphytica* ELM. Leaflet. Philip. Bot. 8 (1915) 2743.—*F. jackii* ELM. l.c. 2744.—*F. curranii* MERR. Philip. J. Sc. 13 (1918)

Bot. 50; En. Philip. 3 (1923) 314.—*F. fastigiata* (non BL.) CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 322, *pro specim. Simalur*.—*F. bracteosa* CAMMERL. *l.c.* 323, f. 6–7.—Fig. 2d, 20.

Epiphytic, more rarely terrestrial, shrub or climber, with age sometimes becoming a small to medium-sized tree (up to 20 m by c. 25 cm  $\phi$ ). Twigs often sharply 4-angled, each ridge crowned by a small acute spine (which in large specimens may be developed into a small extra auricle). Leaves mostly distinctly petioled, varying from narrowly oblanceolate to oblong or obovate, 9–40(–60) by 4–25 cm, usually thickly coriaceous, base broadly cuneate to narrowly acute, more or less decurrent, apex rounded to acute, mostly terminated by a narrowly triangular, acute acumen; nerves 5–20 pairs, often inconspicuous to invisible; petiole robust, often about quadrangular in cross-section, 2–4(–8) cm, at the base (faintly to distinctly auriculate, auricles about orbicular, somewhat convex, appressed to the twig; axillary scale for the greater part adnate to the petiole, loosely appressed to the twig,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long, fairly broad, rounded to slightly 2-lobed at the apex. Flowers solitary or in 2–7-flowered cymes; pedicels robust, 1–5 cm, quite near the top or somewhat lower down with 1 or 2 pairs of appressed, small to fairly large bracteoles. Calyx campanulate, 2–7 $\frac{1}{2}$  cm long, mostly divided to near the base, sometimes only slightly more than halfway down. Corolla thin to very thickly fleshy-leathery (in the herbarium sometimes nearly woody), tube widely to narrowly funnel-shaped, 4 $\frac{1}{2}$ –15 cm, limb wide-spreading (in the fresh state the whole corolla may be up to nearly 30 cm long and more than 30 cm across). Anthers bifid to about the middle or somewhat lower down, elliptic to oblong,  $\frac{3}{4}$ –2 cm, thick. Stigma peltate, flat or slightly hollowed, 4–8 mm  $\phi$  (*in vivo* up to 2 cm). Fruits oblong-ellipsoid to ovoid, crowned by the persistent style-base, 6–15 cm long, greyish-white when ripe, dehiscing with 4 lobes; seeds embedded in an orange to red pulpa (which is derived from the placentas); calyx somewhat accrescent, mostly more or less spreading.

Distr. Lower Burma (Sandoway, Tenasserim), Siam, South Indo-China, and Malaysia; Sumatra, Malay Peninsula, Java, Bali, Borneo, Philippines, and Moluccas (Halmahera and surrounding islands). In older literature also often cited for India (Malabar), but this is based upon a wrong interpretation of RHEEDE'S *Valli-Modagam*.

Ecol. In primary and secondary rain-forests, often along clearings, river-banks, paths, etc., sometimes in mangrove swamps on tidal waterways, on coastal rocks, in along-along fields and scrub, from sea-level up to 1500(–1900) m. Fl. fr. Jan.–Dec. The flower biology of this magnificent and gigantic flower is relatively well known: it is protandrous, and visited by insects and birds (see RIDL, J. Str. Br. R. As. Soc. n. 50, 1908, 119, and BURCK, Ann. Jard. Btzg 10, 1891, 97). The seeds are dispersed by birds and ants (see RIDL, *l.c.* and Disp. 1930, 421).

Uses. The sticky fluid under the epidermis of

the fruit is used in Sumatra as a glue, especially as a bird-lime. Forms with large flowers are cultivated as ornamentals.

Vern. *Bira-bira*, *kayu tulang*, *kembang* (or *kembang*) *hutan*, *puleh*, *sikaso udieng*, *simbu badak*, *térentang langit*, *térong térong*, Sum., *pelir musang*, *sagam*, Mal. Pen., *ki nangka*, *ki térong* (*badak*), *kontol buta*, *mangando badak*, Java S.; Philip.: *nato*, *tumakos*, Mbo., *nonok*, P. Bis., *piakang*, Buk.

Notes. *F. auriculata* is nearest related to *F. involucrata* and *F. macroscypha*, both especially characterized by the involucre of large bracteoles around the calyx, moreover by the slender, terete petiole.

The auricles are usually described as being green, once, however, they were mentioned to be orange. They provide shelter to ants (see BURCK, Ann. Jard. Bot. Btzg 10, 1891, 95).

SCHEFFER'S names were apparently published for the first time in a review by HASKARL, dated June 9th, 1869, and published July 1st, 1869, in *Flora*. Though SCHEFFER'S paper was dated July 1868, it was not yet published at August 21st, 1869, as appears from the annual report of the 'Koninklijke Natuurkundige Vereeniging in Nederlandsch Indië'. So probably HASKARL had received either a proof or a pre-issued reprint.

#### KEY TO THE SUBSPECIES

1. Corolla widely funnel-shaped.
2. Flowers large; calyx 3 $\frac{1}{2}$ –7 $\frac{1}{2}$  cm, corolla-tube 5–15 cm. Auricles at the leaf-base well developed . . . . . *ssp. auriculata*
2. Flowers small; calyx 2–3 $\frac{1}{2}$  cm, corolla-tube c. 5 cm. Auricles at the leaf-base small or almost absent . . . . . *ssp. parviflora*
1. Corolla slenderly funnel-shaped. . . . . *ssp. borneensis*

*ssp. auriculata*.—*F. auriculata* JACK.—*F. javanica* BL.—*Willughbeia auriculata* SPRENG.—*F. imperialis* MIQ.—*F. epiphytica* ELM.

Auricles well developed, up to 2 by 2 $\frac{1}{2}$  cm; leaves shortly petioled to subsessile. Inflorescences 1–3(–6)-flowered. Calyx 3 $\frac{1}{2}$ –7 $\frac{1}{2}$  cm. Corolla-tube 5–15 cm long, widely funnel-shaped. Fruits 8–15 cm long; calyx-lobes often appressed.

Distr. Burma, Siam, South Indo-China, and Malaysia; Sumatra, Malay Peninsula, Java, Bali, Borneo, and SE. Philippines (Panay, Mindanao).

*ssp. borneensis* (SCHEFF.) LEENH., *nov. stat.*—*F. borneensis* SCHEFF.—*F. nonok* ELM.—*F. jackii* ELM.—*F. bracteosa* CAMMERL.

Auricles usually well developed, though not very large ( $\frac{3}{4}$ –1 $\frac{1}{2}$  cm  $\phi$ ); leaves mostly distinctly petioled. Inflorescences 3–7-flowered. Calyx 2 $\frac{1}{2}$ –3 $\frac{1}{2}$  cm. Corolla-tube 8–9 cm long, narrowly funnel-shaped (basal half narrowly tubular). Fruits 6–7 cm long; calyx-lobes spreading.

Distr. Malaysia: Northern half of Borneo and W. Philippines (Palawan, Mindoro, Sibuyan).

*ssp. parviflora* LEENH., *nov. ssp.*—*F. euneura* SCHEFF.—*F. curranii* MERR.



Fig. 20. *Fagraea auriculata* JACK; the giant flower of 'F. imperialis', cult. Hort. Bog. (Hj. JENSEN).

Auricles small or almost absent (up to  $\frac{3}{4}$  cm  $\sigma$ ); leaves mostly distinctly petioled. Inflorescences (1-)3-5-flowered. Calyx 2-3 $\frac{1}{2}$  cm. Corolla-tube 4 $\frac{1}{2}$ -5 $\frac{1}{2}$  cm long, widely funnel-shaped. Fruits 6-7 cm long; calyx-lobes spreading.

Distr. *Malaysia*: Philippines (Luzon) and Moluccas (Halmahera and adjacent islands).

Note. *Ssp. parviflora* has been based upon *F. curranii* MERR.

19. *Fagraea involucrata* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 233; non var. *longipetiolata* MERR. Pl. Elm. Born. (1929) 251 (= *F. macroscypha*).—*F. macroscypha* (non BAKER) HEINE, Pfl. Clemens Kinabalu (1953) 91.—*F. uniflora* (non MERR.) Heine, l.c. 92.—Fig. 21a-d, 22.

Epiphytic shrub or liana which later can become a fairly slender tree. Leaves petioled, oblong to lanceolate, (9-)12-25 by 4-8 cm, thickly coriaceous, base cuneate or slightly contracted, acute, apex rather abruptly and shortly acute acuminate; nerves c. 15 pairs, on either side nearly always inconspicuous to invisible, or slightly prominent on the lower surface; petiole 1 $\frac{1}{2}$ -4 $\frac{1}{2}$  cm, mostly terete, auriculate; axillary scale largely free from

the petiole,  $\frac{1}{2}$ -1 cm long, rounded. Flowers solitary; pedicel very robust,  $\frac{3}{4}$ -2 $\frac{1}{2}$  cm, thickened upwards, bearing in its upper part (2-)3 closely approximate, decussate pairs of appressed, coriaceous, ovate, 2-6 cm long bracteoles which enclose the lower part of the calyx (inner bracteoles distinctly larger than outer ones). Calyx 7-9 cm long, divided to quite near its base, segments oblong, rounded, leathery, very concave. Corolla inside green with 5 broad cream streaks, tube at base tubular, abruptly widened in its upper third part, 14-15 cm, the upper part inside rather densely tomentose. Anthers oblong, very thick, 1 $\frac{1}{2}$ -1 $\frac{3}{4}$  cm, cells free to distinctly below their middle. Stigma peltate-cup-shaped,  $\frac{3}{4}$  cm  $\sigma$ . Fruits ovoid, about 4 $\frac{1}{2}$  by 4 cm; calyx spreading.

Distr. *Malaysia*: Borneo.

Ecol. In forests, on river-banks and along paths up to 1800 m. Fl. fr. probably Jan.-Dec.

Vern. *Kaju ara jangkit*.

Note. Closely related to *F. macroscypha* (see there) and to *F. auriculata*, especially its *ssp. borneensis*, different from the latter by the solitary flowers with much larger calyx, by the greater number of exceptionally large bracteoles, and by the abruptly widened corolla-tube.



Fig. 21. *Fagraea involucrata* MERR. a. Habit,  $\times \frac{1}{3}$ . b. flower-bud,  $\times \frac{1}{3}$ . c. apical part of style and stigma,  $\times \frac{1}{3}$ . d. young fruit, calyx partly removed,  $< \frac{1}{3}$ .—*F. macroscypha* BAKER. e. Calyx with involucre,  $\times \frac{1}{3}$ . (a SF 26733, b ENDERT 4613, c CLEMENS 30072, d SAN 16380, e CREAGH s.n.).



Fig. 22. *Fagraea involucrata* MERR., Bundu Tukan, North Borneo (W. MEYER, 1960).

20. *Fagraea macrosicypha* BAKER, Kew Bull. (1896) 25.—? *F. involucrata* MERR. var. *longipetiolata* MERR. Pl. Elm. Born. (1929) 251.—Fig. 21e.

Epiphytic shrub, climber, or finally a tree. *Leaves* petioled, oblong-lanceolate,  $7\frac{1}{2}$ –27 by  $3\frac{1}{2}$ – $6\frac{1}{2}$  cm, thick coriaceous, base acute, apex obtuse or rounded, tapering into a long and narrow acute acumen; nerves 10–15 pairs, inconspicuous above, prominulous beneath; petiole 2–3 cm, rather robust, terete towards the base, auriculate; axillary scale nearly free, loosely appressed to the twig, 3 mm high, rounded. *Flowers* solitary, pedicel very thick,  $\frac{3}{4}$ –1 cm, at the apex with 2 decussate pairs of large ( $2\frac{1}{2}$ –3 cm), appressed bracteoles, these together embracing the base of the calyx. *Calyx* campanulate,  $6\frac{1}{2}$ –9 cm long, divided to near the base, lobes ovate-lanceolate, tapering

into a long and slender acumen. *Corolla* white to cream with a broad green medium stripe, tube 12–14 cm, tubular, slightly widened upwards. *Anthers* divided to below the middle. *Stigma* peltate, slightly hollowed, 5 mm or more  $\sigma$ . *Fruits* reversed pear-shaped or acutely obovoid, c. 7 by 4 cm.

*Distr.* Malaysia: Borneo.

*Ecol.* In logged area, up to 200 m. *Fl.* March, Sept.

*Vern.* Kayu ara jangkit.

*Notes.* Closely related to *F. involucrata*, mainly different by the long and acute sepals and by the nerves which are prominent on the lower surface of the leaves.

As far as I can judge from sterile specimens, *F. involucrata* var. *longipetiolata* comes closer

to this species than to any other one. MERRILL, in describing this variety, already had some doubt about its identity.

**21. *Fagraea resinosa* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 429.**

Leaves distinctly petioled, oblong to lanceolate, 10-16 by 4-7 cm, stiffly coriaceous, base acute, apex blunt, abruptly terminated by a short, narrow, and acute point; nerves c. 15-20 pairs, inconspicuous above, invisible beneath; petiole  $2\frac{1}{2}$ -4 cm, terete or slightly flattened above, exauriculate, axillary scale partly adnate to the petiole, 4-5 mm, rounded. Flowers solitary, known only in bud, pedicel relatively slender,  $\frac{1}{2}$ - $1\frac{1}{2}$  cm, at the apex with 2 pairs of bracteoles, all broadly rounded and embracing the basal part of the calyx, the upper  $2\frac{1}{2}$  cm, the lower  $1\frac{1}{2}$  cm long. Calyx campanulate,  $3\frac{1}{2}$  cm, deeply divided, lobes broadly rounded. Anthers broadly oblong, 6 mm long, slightly bifid at the base only. Stigma dish-shaped,  $2\frac{1}{2}$  mm  $\sigma$  (or more?). Fruits ovoid,  $4\frac{1}{2}$  by 3 cm; calyx appressed.

Distr. *Malaysia*: Borneo (Brunei: Bt Belalong; W. Borneo: Mt Amai Ambit).

Ecol. Forests, c. 700 m. Fr. April.

Notes. Related to, but distinctly different from, *F. macroscypha* and *F. involucreata*.

In its vegetative parts resembling *F. carnosa* which differs by its smaller, slender calyx not enveloped by large bracteoles, and by the smaller number of nerves (c. 6 pairs).

**22. *Fagraea carnosa* JACK, Malay. Misc. 2, n. 7 (1822) 81; in Hook. Comp. Bot. Mag. 1 (1836) 254; DC. Prod. 9 (1845) 30; Miq. Fl. Ind. Bat. 2 (1857) 374; KURZ, Fl. Burm. 2 (1877) 204; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 82; KING, J. As. Soc. Beng. 74, ii (1908) 604; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 323; RIDL. Fl. Mal. Pen. 2 (1923) 416; HENDERS. J. Mal. Br. R. As. Soc. 17 (1939) 58.—*F. monantha* MIQ. Fl. Ind. Bat. 2 (1857) 373; Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 218; SCHEFF. Nat. Tijds. N.I. 31 (1870) 21.—*F. rotundifolia* RIDL. J. Str. Br. R. As. Soc. n. 50 (1908) 117; Fl. Mal. Pen. 2 (1923) 416.—*F. uniflora* MERR. J. Str. Br. R. As. Soc. n. 77 (1917) 235; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 337.—*F. flavidula* RIDL. Fl. Mal. Pen. 5 (1925) 322.—*F. lanceolata* (non BL.) HENDERS. Gard. Bull. S.S. 4 (1927) 99.**

Epiphytic (rarely terrestrial) shrub or climber. Leaves petioled, (suborbicular to) elliptic to lanceolate or oblong-obovate,  $7\frac{1}{2}$ -16 by  $3\frac{1}{2}$ - $8\frac{1}{2}$  cm, thickly and rigidly coriaceous, base cuneate, sometimes shortly contracted, apex acute to rounded or even slightly emarginate, and in both latter cases shortly acutely acuminate; nerves 6-7 pairs, at both surfaces inconspicuous or almost so, sometimes slightly sunken above; petiole  $\frac{3}{4}$ -3 cm, exauriculate; axillary scale halfway up to nearly completely adnate to the petiole,  $\frac{1}{2}$ - $\frac{3}{4}$  cm long, obtuse or rounded, not very conspicuous. Flowers 1(-2), pedicel very thick,  $\frac{1}{2}$ -2 cm, bracteoles 1 or 2 pairs, apical, appressed,  $\frac{1}{2}$ -1 cm long. Calyx

slender, ( $\frac{1}{2}$ -)2-5 cm long, divided  $\pm$  halfway down or slightly less. Corolla-tube rather slender, tubular, 7-14 cm. Anthers oblong, 1- $1\frac{3}{4}$  cm, cells free to somewhat below the middle. Stigma capitate to peltate-cupular, 4-5 mm  $\sigma$ . Fruits (oblong) ellipsoid, 4-7 cm, greyish blue; calyx appressed.

Distr. Lower Burma (Moulmein) and *Malaysia*: Sumatra, Malay Peninsula, and Borneo.

Ecol. Forests on limestone, also along the beach, from sea-level up to 2000 m. Fl. mainly Jan., fr. Jan., Aug., Nov.

Vern. *And. hagal*, Sum., *numpang*, Born.

Notes. *F. uniflora* was apparently based upon an anomalous specimen, with 6 calyx-lobes and 8-9 corolla-lobes; I have not seen the type specimen.

This species is best characterized by the slender though rather large, spindle-shaped calyx, furthermore by the very stiff, usually minutely pointed leaves and the smooth, greyish-yellow twigs.

JACK's type specimen is apparently lost. Among the few Sumatran specimens at my disposal none fits his original description very well, and there is no later collection from the type-locality, cited as Bencoolen, S. Sumatra. The only specimen which is well in accordance with the original diagnosis is ROSTADO s.n. from Tringganu, Bundi, Malaya, collected Febr. 1904 (K), the type of *F. rotundifolia* RIDL.

**23. *Fagraea gardenioides* RIDL. J. Fed. Mal. St. Mus. 5 (1914) 42; Fl. Mal. Pen. 2 (1923) 416.**

Epiphytic shrub or possibly sometimes a treelet. Leaves petioled, (oblong or elliptic to) obovate,  $6\frac{1}{2}$ -13 by 4- $6\frac{1}{2}$  cm, coriaceous (*in vivo* probably thick fleshy), base cuneate, attenuate, apex rounded or blunt, without or with a short acumen; nerves c. 7-8 pairs, mostly invisible, sometimes minutely grooved beneath; petiole 1-2 cm, exauriculate; axillary scale partly adnate to the petiole,  $\frac{1}{4}$ - $\frac{3}{4}$  cm long, about square, truncate to 2-lobed, distinctly broader than the petiolar base. Inflorescences terminal; flowers 1-5 in a sessile cyme; pedicel  $\frac{1}{2}$ -2 cm; bracteoles appressed to the calyx, ovate to roundish,  $\frac{1}{2}$ - $\frac{3}{4}$  cm long. Calyx campanulate,  $1\frac{1}{2}$ -3 cm long, connate for  $\frac{1}{2}$ - $\frac{2}{3}$ . Corolla-tube tubular, 6-7 cm. Anthers linear (-lanceolate), 9 mm, up to c.  $\frac{1}{3}$  bifid at the base. Stigma subpeltate, sometimes slightly 2-lobed, 3-5 mm  $\sigma$ . Fruits (young) ovoid to ellipsoid, 4 cm or more long, tapering into a conical beak; calyx loosely appressed.

Distr. *Malaysia*: Malay Peninsula, Borneo.

Note. On the one side closely related to *F. curtisii*, which differs by the short corolla-tube and the longer and relatively narrower, acute leaves. On the other side especially *ssp. borneensis* shows some relationship to *F. berteriana* and allies.

*ssp. gardenioides.*

Rather coarse. Petioles narrowly winged; axillary scale  $\frac{3}{4}$  cm long; blade up to 13 by  $7\frac{1}{2}$  cm, not acuminate. Flowers up to 3; pedicel up to 2 cm,

thick. Calyx  $2\frac{1}{2}$ –3 cm, less than halfway up connate. Corolla-tube relatively wide. Stigma obconical with a membranous margin, c. 5 mm  $\phi$ .

Distr. Malay Peninsula.

Ecol. On hills, c. 1400–1900 m. *Fl. Jan.*, April, July, Aug.

*ssp. borneensis* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 425.

Rather slender. Petioles not winged; axillary scale  $\frac{1}{4}$ – $\frac{1}{2}$  cm long; blade 7–10 by 4–6 $\frac{1}{2}$  cm, fairly abruptly, shortly and broadly acute-acuminate. Flowers up to 5; pedicel up to  $\frac{3}{4}$  cm, rather slender. Calyx  $1\frac{1}{2}$  cm, connate for  $\frac{2}{3}$ . Corolla-tube slender. Stigma cupular-peltate, slightly 2-lobed, c. 3 mm  $\phi$ .

Distr. Borneo (Sarawak: near Kuching).

Ecol. *Fl. Dec.*

**24. *Fagraea curtisii* K. & G. J. As. Soc. Beng. 74, ii (1908) 605; RIDL. Fl. Mal. Pen. 2 (1923) 417; KERR in Craib, Fl. Siam. En. 3 (1951) 55.**

Low spreading tree or (sometimes epiphytic) shrub. Leaves petioled, elliptic, ovate-elliptic, or oblong-obovate, 10–21 by 5–8 $\frac{1}{2}$  cm, firmly coriaceous, base cuneate or contracted, apex shortly and often abruptly triangular-acuminate; nerves 7–10 pairs, invisible on both surfaces; petiole 1–1 $\frac{1}{2}$  cm, robust; exauriculate; axillary scale for the greater part adnate to the petiole,  $\frac{1}{2}$ – $\frac{3}{4}$  cm long, narrowed towards the truncate to slightly 2-lobed apex. Flowers in (1–)2–4-floriferous cymes; pedicels stout,  $1\frac{1}{4}$ – $2\frac{1}{2}$  cm; 1–2 pairs of bracteoles near the apex, appressed, broadly ovate,  $\frac{1}{2}$ –1 cm long, caducous. Calyx campanulate,  $1\frac{3}{4}$ – $3\frac{1}{2}$  cm long, divided  $\pm$   $\frac{1}{3}$  to nearly halfway down. Corolla-tube funnel-shaped, c. 4 $\frac{1}{2}$  cm. Anthers oblong, thick,  $\pm$  8 mm, bifid to about the middle. Stigma peltate, c.  $2\frac{1}{2}$  mm  $\phi$ . Fruits subglobose or broadly (ob)ovoid,  $3\frac{3}{4}$ –5 cm long; calyx funnel-shaped, loosely appressed.

Distr. North Burma (Kachin State) and Malaysia: Malay Peninsula (Puket, Kedah, Kelantan, Langkawi I.).

Ecol. From sea-level up to 1300 m (in Burma), on limestone. *Fl. Aug.–Sept.*, *fr. Febr.*

Note. On the one side closely related to *F. gardenioides*, on the other to *F. calcarea*. The former differs by its long tubular corolla, the other by its large bracteoles.

**25. *Fagraea calcarea* HENDERS. Gard. Bull. S.S. 7 (1933) 113, t. 28 B.**

Climbing shrub. Leaves petioled, elliptic to broadly ovate or obovate, 12–17 $\frac{1}{2}$  by 6–9 cm, thinly coriaceous, base cuneate, somewhat decurrent, apex rounded, without or with an abrupt very short, triangular acumen; nerves 8–10 pairs, very faint on both surfaces; petiole  $1\frac{1}{2}$ –3 cm, fairly slender, exauriculate; axillary scale adnate to the petiole,  $\frac{3}{4}$ –1 cm long, truncate, not very conspicuous. Flowers 1(–3); pedicels stout,  $\frac{1}{4}$ – $1\frac{1}{2}$  cm; bracteoles 2 pairs, the outer ovate or ovate-lanceolate, acute, up to 3 cm long, the inner ovate, rounded, 2 cm long, all embracing the basal

part of the calyx. Calyx ovoid,  $3\frac{1}{2}$ –4 cm long, divided for about  $\frac{2}{3}$ . Corolla-tube funnel-shaped, c. 5 cm. Anthers oblong, c. 1 cm. Stigma broadly funnel-shaped. Fruits unknown.

Distr. Malaysia: Malay Peninsula (Pahang: B. Chintamani near Bentong), once collected.

Ecol. Climbing on a limestone rock face, at low altitude. *Fl. Oct.*

Note. Evidently allied to *F. curtisii* but differing in the thinner, wider and more rounded leaves, the flowers of the single specimen known being mostly solitary (in a few inflorescences in threes), and somewhat larger, and in the much larger and more deeply cut calyx. Possibly also related to *F. involucreata*.

**26. *Fagraea gracilipes* A. GRAY, Proc. Am. Ac. Arts Sc. 4 (1859) 323; SEEMANN, Fl. Vit. (1866) 165; A. C. SMITH, J. Arn. Arb. 33 (1952) 113; LEENH. Bull. Jard. Bot. Brux. 32 (1962) 426.—*Gardneria fagraeacea* F. v. M. Fragm. 6 (1868) 130.—*F. muelleri* BTH. Fl. Austr. 4 (1869) 368, *nom. illeg.*; F. M. BAIL. Queensl. Fl. 3 (1900) 1023.—*F. dolichopoda* GILG & BENED. Bot. Jahrb. 54 (1916) 196.—*F. fagraeacea* DRUCE, Rep. Exch. Cl. Brit. Is. 1916 (1917) 623.—*F. amabilis* S. MOORE, J. Bot. 61 (1923) Suppl. 36.—*F. cambagei* DOMIN, Bibl. Bot. 89 (1929) 1071; MERR. & PERRY, J. Arn. Arb. 23 (1942) 413.—*F. elata* MERR. & PERRY, l.c.—*F. obtusifolia* MERR. & PERRY, l.c. 415; F. S. WALKER, For. Br. Solomon Is. (1948) 137.—*Fagraea* sp. KAN. & HATUS. Bot. Mag. Tokyo 56 (1942) 163.**

Small to medium tree, usually up to 15 m, rarely up to 40 m by 45 cm  $\phi$ ; sometimes a scrambling shrub. Leaves petioled, broadly elliptic or elliptic obovate to oblong, (6–)9–17(–23) by (2 $\frac{1}{2}$ –)4 $\frac{1}{2}$ –8 $\frac{1}{2}$ (–10) cm, coriaceous, base narrowly acute to broadly cuneate, nearly always attenuate, apex blunt, usually terminated by a short, broad, and blunt acumen; midrib grooved above, towards the base sometimes flattish; nerves 5–8(–9) pairs, minutely grooved above, grooved to prominent beneath, usually inconspicuous or sometimes invisible; petiole 1–4 cm, mostly slender, exauriculate; axillary scale more than halfway up to nearly completely adnate to the petiole, but appressed to the twig, not conspicuous,  $2\frac{1}{2}$ –5 mm long, blunt to rounded. Inflorescences cymose, few- to many-flowered, dense to lax, always relatively small, the branches often more or less drooping, pedicels sometimes very slender,  $\frac{1}{2}$ –3 cm, with 1(–3) pairs of small bracteoles, inserted from about halfway to just below the calyx. Calyx campanulate, c. 6–7 mm(–1 $\frac{1}{2}$  cm), divided about halfway or somewhat more. Corolla-tube funnel-shaped (basal half mostly tubular), slender,  $2\frac{1}{4}$ –5 cm long. Anthers bifid to c.  $\frac{1}{3}$ – $\frac{1}{2}$  from the base, oblong (to elliptic), 3–5 mm. Stigma small, subobconical, slightly 2-lobed or entire. Fruits broadly ellipsoid-obovoid to -ovoid, abruptly terminated by a strong long-conical beak, the whole fruit 3–4 cm long, orange or red; pedicels apparently somewhat lengthened, calyx appressed, slightly accrescent.

Distr. Fiji, Santa Cruz Is., Solomon Is. (Santa Isabel, New Georgia), Australia (NE. Queensland) in *Malaysia*: New Guinea (also Aru Is.). *Cf.* LEENHOUTS, Pac. Pl. Areas map 91.

**Ecol.** In and along the edges of rain-forests, as well on a dry as on a swampy or temporarily inundated soil, furthermore in secondary forests, in palm-swamps and in mossy oak forests, 0–1530 (–2000) m. *Fl.* Jan.–Dec., *fr.* April, June–Nov.

**Uses.** A hard, heavy timber, very durable, esteemed by the natives, who use it for making combs, houseposts, canoes, etc., also suitable for survey-marks, heavy construction, and turnery. In Fiji tea made from the bark and leaves is used medicinally. The fruits are sometimes pickled and eaten.

**Vern.** *Mulgrave plum*, *E. besron*, *boggong*, *ibelaka*, *iedewob*, *i(eg)berakka*, *mofruta*, *nasam*, *ngorarien*, *nietsamber*, *numae*, New Guinea.

**Notes.** A variable species; the Papuan specimens are rather uniform and well characterized by the brown to blackish twigs and the thick, fleshy-coriaceous, broadly elliptic to obovate leaves, which are distinctly attenuate at the base and obtuse or rounded, but always shortly and bluntly acuminate at the apex, and with the nerves delicately grooved on both surfaces. Some small-leaved and small-flowered specimens remind of the Australian form known as *F. muelleri*; a few specimens, with large oblong leaves, come close to the other Australian form which was described under the name of *F. cambagei*.

The relationships are not fully clear to me. On the one side it reminds of *F. berteriana*, on the other hand it has several characters in common with *F. umbelliflora*.

The name *F. muelleri* is illegitimate, as it had been based upon *Gardneria fagraeacea* F. v. M., and the epithet of the latter should have been used.

**27. *Fagraea eymae* BACKER in Leenh. Bull. Jard. Bot. Brux. 32 (1962) 425.—Fig. 2a.**

Shrub. *Leaves* subsessile to shortly petioled, oblong to elliptic, c. 9–10 by 4½–5½ cm, firmly coriaceous, base rounded or subcordate, faintly auriculate, margin recurved, apex obtuse or minutely obtusely pointed; nerves 5–6 pairs, on the upper surface faintly visible, beneath inconspicuous or almost so; axillary scale for the greater part adnate to the petiole, ½–¾ cm long, about quadrangular to slightly bilobed, boat-shaped, nearly completely hidden by the leaf-base. *Inflorescences* usually 2-flowered, pedicels thick, 1–2 cm long; bracteoles near the apex, ovate to oblong, ¾–1½ cm long. *Calyx* campanulate, 2–2½ cm long, divided somewhat over halfway down. *Corolla*-tube distinctly funnel-shaped, 4½ cm, lobes exceptionally short, rounded. *Anthers* oblong, thick, 8–11 mm long, cells free in their basal half. *Stigma* ± cupular-peltate, 2½ mm ø. *Fruits* globose, 2½–3 cm ø; calyx appressed.

**Distr. *Malaysia*:** West New Guinea (Wissel Lake area).

**Ecol.** In permanently inundated, secondary

forest on peat at c. 1750 m. *Fl.* Jan.

**Vern.** *Ipu* or *iepo*.

**Note.** Apparently related to *F. salticola* and *F. monticola*.

**28. *Fagraea salticola* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 429.—Fig. 2b.**

Tree, up to c. 25 m high by 35 cm ø. *Leaves* shortly petioled, elliptic to slightly obovate, 4–11 by 2½–7 cm, somewhat convex, very thickly and stiffly coriaceous (fleshy when fresh), the base slightly cordate to rounded, rarely broadly cuneate, apex rounded to blunt; nerves c. 5 pairs, nearly invisible, sometimes slightly sunken above; petiole ½–1 cm, thick, exauriculate; axillary scale adnate to the petiole, distinctly broader than this and convex, 4–7 mm long, widened towards the 2-lobed apex. *Inflorescences* cymose, rather dense, with 3–10 flowers; pedicels ½ cm long, thick, tapering towards the calyx, either without or with a pair of bracteoles appressed to the calyx. *Calyx* ellipsoid-campanulate, 1¼–1½ cm long, divided about halfway up. *Corolla*-tube funnel-shaped, 2½ cm long. *Stamens* inserted on a thickened ring in the inside of the corolla; anthers attached just above the base, lanceolate, c. 7 mm. *Stigma* bilobed, 3–4 mm ø. *Fruits* ellipsoid, acute, 3½ by 1½ cm, orange; calyx appressed.

**Distr. *Malaysia*:** East New Guinea (Western and Eastern Highlands).

**Ecol.** In mossy and *Podocarpus-Libocedrus* forests at 2500–2850 m. *Fl.* fr. July–Aug.

**Uses.** Wood previously used by natives for making spears.

**Vern.** *Banda, mama, mband, tihl*.

**Notes.** A very characteristic species, which only shows a distinct resemblance to *F. eymae* as to the vegetative parts. Apart from *F. annulata*, *F. salticola*, *F. bodenii*, and *F. berteriana* – with which it is connected by the annulus inside the corolla and as to the latter three also by the only very slightly bifid anthers and the bilobed stigma – it may be related to *F. monticola* GILG & BENED. (1916), and it would even be possible that it is identical with *F. melanochlora* GILG & BENED. (1916), from which, however, it differs in some points.

**29. *Fagraea bodenii* WERNH. Trans. Linn. Soc. Bot. 9 (July 1916) 111; MERR. & PERRY, J. Arn. Arb. 23 (1942) 414.—*F. jasminodora* GILG & BENED. Bot. Jahrb. 54 (Oct. 1916) 190.—*F. ampla* S. MOORE, J. Bot. 61 (1923) Suppl. 35.—*F. suaveolens* CAMMERL. Nova Guinea 14 (1924) 117, t. 13.—*F. papuana* MERR. & PERRY, J. Arn. Arb. 23 (1942) 414.**

Tree, up to 30 m by 50 cm, or erect shrub, sometimes epiphytic. *Leaves* petioled, elliptic to oblong-obovate to oblong, 5–15 by 2½–7½ cm, rigidly coriaceous, base acute or shortly contracted, apex obtuse or rounded, often terminated by a short and broad, obtuse and often recurved point; nerves c. 6–10 pairs, not or hardly visible on the upper surface, very faintly visible or obsolete beneath; petiole firm to slender, ¾–3 cm long,

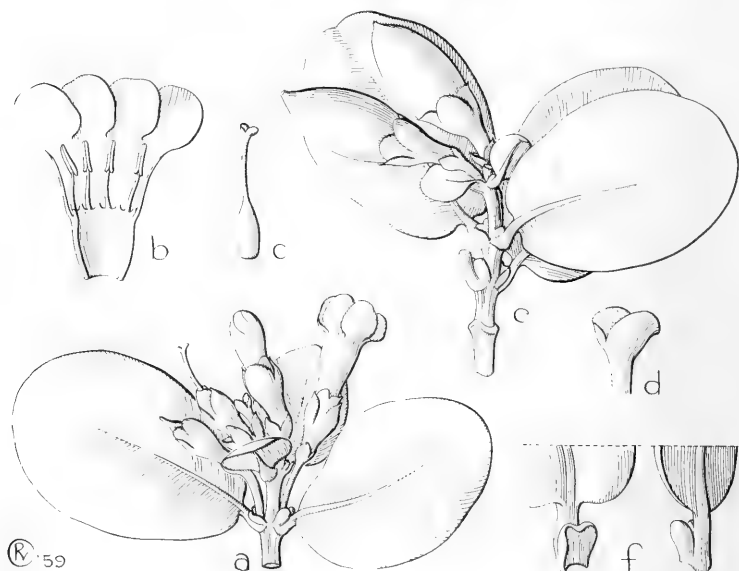


Fig. 23. *Fagraea salticola* LEENH. a. Habit with flowers,  $\times \frac{2}{3}$ , b. opened corolla,  $\times 1$ , c. pistil,  $\times 1$ , d. stigma,  $\times 3$ , e. twig with fruits,  $\times \frac{2}{3}$ , f. leaf-bases, showing the axillary scale,  $> 1$  (a-f HOOGLAND & PULLEN 5623).

exauriculate; axillary scale adnate to the petiole, usually distinctly broader than this,  $\frac{1}{3}$ –1 cm long, rounded or obtuse. *Inflorescences* cymose, mostly short and dense, 2–15-flowered; pedicels thick,  $\frac{3}{4}$ – $3\frac{1}{2}$  cm; bracteoles halfway. *Calyx* narrowly campanulate,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm long, divided slightly less to somewhat more than halfway down. *Corolla* deep-olive outside, cream-coloured to white inside, tube tubular or narrowly obconical,  $1\frac{1}{2}$ –4 cm. *Stamens* inserted on a thickened ring in the tube, anthers linear-lanceolate,  $\frac{3}{4}$ – $1\frac{1}{4}$  cm, slightly bifid at base. *Stigma* distinctly 2-lobed, 2–3 mm  $\phi$ . *Fruits* broadly ellipsoid-subglobose, contracted into a long conical, robust beak, c. 4 by  $2\frac{1}{4}$  cm, orange; calyx appressed.

Distr. *Malaysia*: New Guinea.

Ecol. Forests and shrubberies on slopes, on limestone hills, etc., 80–2840 m. *Fl.* Oct.–Febr., May, Aug., fr. Oct.–Febr.

Notes. Distinctly related to *F. gitingensis* and in less degree to *F. annulata*.

Specially characterized by the conspicuous, boat-shaped stipules and the strongly beaked fruit on a short, stiff pedicel. *F. gracilipes* has also beaked fruits, but its pedicels are usually

distinctly longer and more slender, even drooping; *F. salticola* has the same kind of stipules, but they are less conspicuous.

30. *Fagraea gitingensis* ELM. Leaf. Philip. Bot. 3 (1910) 859; MERR. En. Philip. 3 (1923) 315.—*F. ternatana* (non MIQ.) HOLTH. & LAM, Blumea 5 (1942) 230.

Gnarled tree or subarborescent shrub, 3–10 m, trunk up to 25 cm  $\phi$ . *Leaves* petioled, (obovate-)oblong to (obovate-)lanceolate,  $7\frac{1}{2}$ –12 by  $2\frac{1}{2}$ –4 cm, thickly coriaceous, base tapering, decurrent, apex very obtuse or rounded; nerves 5–12 pairs, faintly visible above, subinconspicuous beneath; petiole  $1\frac{1}{2}$ –3 cm, rather slender, narrowly winged towards the lamina; exauriculate; axillary scale adnate to the petiole,  $\frac{1}{2}$ – $\frac{1}{2}$  cm long, truncate or slightly emarginate. *Inflorescences* 3–9-flowered cymes, pedicels not very thick,  $\frac{1}{2}$ – $1\frac{1}{2}$  cm; bracteoles about halfway. *Calyx* narrowly campanulate, 1–2 cm long, divided  $\pm$  halfway down. *Corolla*-tube long-cylindric, narrow, slightly widened in the upper part, 7–11 cm. *Anthers* narrowly linear-lanceolate with a narrowed apex, c. 1 cm, slightly bifid at base. *Stigma* 2-lobed with oblong



lobes, 4-5 mm  $\phi$ . *Fruits* oblong-ellipsoid, acute,  $3\frac{1}{2}$ -4 by  $1\frac{1}{4}$  cm, shining orange-red; calyx appressed.

Distr. *Malaysia*: Philippines (Sibuyan: Mt Giting-Giting) and N. Moluccas (Talaud I.: G. Piapi), twice collected.

Ecol. Woods on very sandy, gravelly soil, open sunny slopes, 300-400 m. *Fl.* April, *fr.* May. Vern. *Tenggeh*, Talaud.

Note. Distinctly related to *F. bodenii* and *F. salticola*, both from New Guinea.

31. *Fagraea berteriana* A. GRAY ex BTH. J. Linn. Soc. Bot. 1 (1856) 98; SEEM. Fl. Vit. (1866) 164; F. B. H. BROWN, Bull. Bish. Mus. 130 (1935) 228, f. 34; YUNCKER, Bull. Bish. Mus. 220 (1959) 217; LEENH. Bull. Jard. Bot. BRUX. 32 (1962) 419.—*Carissa grandis* BERT. ex GUILLEMIN, Ann. Sc. Nat. Bot. II, 7 (1837) 248, *nom. nud.*—*F. grandis* PANCH. & SÉBERT in Sébert, Not. Bois Nouv. Cal. (1874) 184, *nom. superfl.*—*F. obovata* WALL. var. *papua* F. M. BAIL. Queensl. Agr. J. 3 (1898) 157.—*F. peekelii* GILG & BENED. Bot. Jahrb. 54 (1916) 185, f. 10.—*F. pachypoda* GILG & BENED. Lc. 186.—*F. calophylloides* GILG & BENED. Lc. 188, f. 11.—*F. schlechteri* GILG & BENED. *ibid.* 56 (1921) 550, *nom. superfl.*; SARLIN, Bois et Forêts de la Nouv. Calédonie. (1954) 264, t. 127.—*F. ksidi* GILG & BENED. Bot. Jahrb. 56 (1921) 552; KANEH. Fl. Micron. (1933) 317, f. 161.—*F. salomonensis* GILG & BENED. Bot. Jahrb. 56 (1921) 554.—*F. samoensis* GILG & BENED. Lc. 551.—*F. vitiensis* GILG & BENED. Lc. 553, *non* SEEM. (1861).—*F. galilai* GILG & BENED. Lc. 555; KANEH. Fl. Micron. (1933) 316, f. 160.—*F. sair* GILG & BENED. Bot. Jahrb. 56 (1921) 555, f. 3; KANEH. Fl. Micron. (1933) 318, f. 162.—*F. affinis* S. MOORE, J. Bot. 61 (1923) Suppl. 36.—*F. novae-guineae* CAMMERL. Nova Guinea 14 (1924) 117, t. 14.—*F. pluvialis* S. MOORE, J. Bot. 67 (1929) 49.—*F. kusaiana* HOSOKAWA, Trans. Nat. Hist. Soc. Form. 24 (1934) 202.—*F. rosenstromii* C. T. WHITE, Proc. R. Soc. Queensl. 47 (1936) 71.

Usually a small, often shrub-like tree, up to 15 (-30) m by 50 cm  $\phi$ , sometimes an epiphytic or terrestrial, erect or scrambling shrub. *Leaves* petioled, elliptic or oblong, sometimes slightly ovate or obovate, 9-16 by  $4\frac{1}{2}$ -12 cm, fleshy-coriaceous, base acute, attenuate, apex rounded; nerves c. 10 pairs (and between every pair an intermediate vein which is slightly less conspicuous), faintly visible on the upper surface, almost or quite invisible beneath; petiole  $1\frac{1}{2}$ -4 cm, usually slender, exauriculate; axillary scale partly adnate to the petiole, 8-9 mm long, boat-shaped, 2-lobed at the apex. *Inflorescences* cymose, often widely branched, few- to rather many-flowered, pedicels  $\frac{1}{2}$ - $1\frac{1}{2}$  cm, thick, especially towards the calyx, ebracteolate. *Calyx* rather narrowly campanulate,  $1\frac{1}{4}$ - $2\frac{1}{2}$  cm long, usually divided for c.  $\frac{1}{3}$ , rarely up to halfway down. *Corolla*-tube tubular, 3-8 cm long when dry (up to 15 cm when alive). *Stamens* inserted on a thickened ring in the tube, anthers narrowly linear with an attenuate apex,

1- $1\frac{1}{2}$  cm, slightly bifid at their base. *Stigma* distinctly 2-lobed (the halves in bud, however, folded upwards and appressed), lobes oblong, c.  $\frac{3}{4}$ -1 cm  $\phi$ . *Fruits* ellipsoid to globular, orange to red when ripe, 3-5 $\frac{1}{2}$  by  $2\frac{1}{2}$ -4 $\frac{1}{2}$  cm; calyx-lobes spreading.

Distr. SE. Polynesia (Marquesas: Nukuhiva, Hiva Oa; Tubuai Is.: Tubuai, Rapa; Society Is.: Tahiti, Tahaa; Cook Is.: Rarotonga), SW. Polynesia (Tonga Is.: Niue, Tonga; Samoa), Melanesia (Fiji, New Caledonia, Loyalty Is.; New Hebrides: Vanikoro, Oba, Aneityum; Solomon Is.), Australia (NE. Queensland: Mossman R.), Micronesia (Carolines: Palau Is., Truk, Ponape, Kusaie; Marianas: Guam, Rota), and *Malaysia*: New Guinea (also in the Bismarcks and Louisiades). Cf. LEENHOUTS, Pac. Pl. Areas map 91.

Ecol. In open to dense, wet to dry, primary and sometimes secondary forests, preferably along the edges, along river-banks, creeks, etc., also in open country, on rocks, even along the beach, also in the mangrove; from sea-level up to 500 (-1600) m. *Fl.* Jan.-Dec., mainly July-Febr., *fr.* mainly Aug. The fruits are eaten by birds, mainly pigeons (cf. BROWN, Lc.); for possible occasional dispersal by water see RIDLEY, Disp. (1930) 219.

Uses. The timber is hard, and locally used for house posts, other constructions, and for tools. The very fragrant flowers are in many Pacific islands highly appreciated for decoration (crowns, leis) and for making perfumes. In New Caledonia the boiled leaves are used as a medicine against rash and skin irritation. The natives of the Solomon Is. use the fruit as a flytrap by first removing the epicarp to expose the sticky interior.

Vern. *Argook*, *kaunomori*, New Britain.

Note. This species belongs to the group with a 2-lobed stigma, linear anthers, and a thickened ring inside the corolla-tube on which the stamens are inserted; through these characters it is related to *F. giitingensis*, *F. bodenii*, *F. salticola*, and in a less degree to *F. annulata*.

#### Doubtful

*Fagraea alteniana* F. v. M. Vict. Nat. 6 (1889) 45, *nom. nud.*

I saw no specimen bearing a label with this name.

*Fagraea dasyantha* GILG & BENED. Bot. Jahrb. 54 (1916) 195.

Possibly related to or conspecific with *F. gracilipes*. None of the syntypes seen, probably all lost at Berlin.

*Fagraea ledermannii* GILG & BENED. Bot. Jahrb. 54 (1916) 191.

The description of the vegetative parts fits very well with *F. salticola*, but the flowers are much smaller in all parts and remind more of *F. gracilipes* or *F. bodenii*.

*Fagraea melanochlora* GILG & BENED. Bot. Jahrb. 54 (1916) 192.

Possibly identical with *F. salticola* or with *F. bodenii*.

*Fagraea monticola* GILG & BENED. Bot. Jahrb. 54 (1916) 189.

Apparently related to *F. salticola* or *F. bodenii*.

#### Excluded

*Fagraea cardinalcarpa* ELM. Leaf. Philip. Bot. 10 (1939) 3759, *nom. illeg.*—Based upon ELMER 15492, a duplicate of which is preserved in the Herbarium of the Arnold Arboretum. This was distributed under the manuscript name of *Ternstroemia megacarpa* ELM. According to Dr VAN STEENIS it probably represents some *Rubiaceae*, possibly *Cephaelis*. It is doubtful whether the fruit and the twig belong together. The name is illegitimate as the description was in English only.

*Fagraea dubia* WALL. Cat. (1831) n. 4456,

*nom. nud.*—This was the base of *Ternstroemia ? penangiana* CHOISY, Mém. Soc. Phys. Hist. Nat. Genève 14 (1855) 108 (*Guttiferae*).

*Fagraea pachyclados* K. SCH. in Sch. & Laut. Nachtr. (1905) 349.—This is the basionym of *Mastixiodendron pachyclados* (K. SCH.) MELCH. Bot. Jahrb. 60 (1925) 167 (*Rubiaceae*).

*Fagraea tetragona* SPAN. Linnaea 15 (1841) 326.—MIQUEL (Fl. Ind. Bat. 2, 1857, 409) based hereon his *Alyxia spanogheana* (non *Alyxia tetragona* R. BR. 1810) (*Apocynaceae*).

*Fagraea vitiensis* SEEM. Bonplandia 9 (1861) 257, *nom. nud.*; *ibid.* 10 (1862) 37, *nom. nud.* = *Linociera vitiensis* A. C. SMITH, Bull. Torr. Bot. Cl. 70 (1943) 549 (*Oleaceae*). See A. C. SMITH, J. Arn. Arb. 33 (1952) 112.

## 2. BUDDLEJA

HOUST. *ex* LINNÉ, Gen. Pl. ed. 5 (1754) 51; Sp. Pl. 1 (1753) 112; GAGNEPAIN, Not. Syst. 2 (1912) 182; MARQUAND, Kew Bull. (1930) 177. Spelled *Buddleia* by most authors.—*Nicodemia* TENORE, Cat. Orto Bot. Napoli (1845) 88.—**Fig. 24-25.**

Shrubs, rarely trees or suffrutescent herbs; twigs, leaves (especially underneath) and inflorescences usually covered with a dense tomentum of stellate hairs (sometimes and in some parts intermingled with capitate-glandular hairs); colleters absent. *Branches* terete or quadrangular, in the latter case sometimes narrowly winged. *Leaves* opposite or nearly so (in some non-Mal. *spp.* alternate), either auriculate at the base or connected by a stipular line, or by leafy 'interpeltolar stipules', in a few species perfoliate, entire, serrate-dentate, or rarely lobed. *Inflorescences* terminal and/or axillary, thyrsoïd, racemose, clustered-cymose, or pseudo-verticillate, especially the terminal panicles often long and many-flowered. Bracts linear. *Flowers* 4-merous. *Calyx* gamosepalous, outside usually densely tomentose, inside glabrous. *Corolla* salver-shaped, sometimes campanulate, outside tomentose or glabrous, inside usually sparsely hairy; tube straight or curved, lobes imbricate in bud. *Stamens* adnate to the corolla-tube (the only exception being *B. gynandra*, in which they are described as attached to the ovary); anthers subsessile, cleft at base, introrse, mostly included. *Ovary* 2-celled, placentas thickened, with  $\infty$  ovules; stigma conical or club-shaped. *Fruit* a septicidal 2-valved capsule (*subg.* *Buddleja*) or a 'berry' (*subg.* *Nicodemia*). *Seeds*  $\infty$ , small, often winged; endosperm fleshy.

*Distr.* About 100-120 *spp.* in the tropics and subtropics of America, Africa, and Asia; in *Malaysia* one species native, a few others naturalized or cultivated.

*Ecol.* Heliophilous shrubs of open terrain, shrubby vegetation, and forest borders, often invading disturbed places, from the lowland to high up in the mountains (especially some andine species). Many species have fragrant flowers and are frequented by many insects; the widely cultivated *B. davidii* is well known to attract many butterflies. The seeds of the species with capsular fruits are wind-dispersed; those from the species bearing berries may be dispersed by birds or other animals.

*Uses.* The leaves of some species are used as a wash on account of the presence of saponin; for the same reason some species are used as a fish-poison. Moreover, some are used in medicine. A few species are commonly planted as ornamentals.

*Morph.* The flowers are normally 4-merous; in *B. officinalis* MAXIM., however, I found in the same inflorescence between many 4-merous flowers some 5-merous ones and some with only the calyx 5-merous; HOOK. f. (Bot. Mag. t. 6323) mentions also 5-merous flowers for *B. asiatica*.

GAGNEPAIN and MARQUAND attached much value to the place of insertion of the stamens. In many species, e.g. *B. asiatica*, this character seems to be very constant indeed. In some cases, however, it seems to represent the only differentiating character between a pair of sympatric closely related species. A possible example is *B. curviflora* H. & A. and *B. japonica* LINDEN; furthermore, I found many specimens which fully agreed with *B. lindleyana* with the exception of the stamens which were inserted about halfway the corolla-tube instead of at its base; according to the key given by MARQUAND these specimens should represent *B. venenifera* MAKINO; a third case may be the pair *B. paniculata* WALL. and *B. crispa* BTH. Whether these could be examples of heterostyly should be examined in the field.

The fruits in *Buddleja* and related genera are principally capsular; they are 2-, or (in *Adenoplea*) 4-celled, with many seeds, the cavities neither completely filled up by the seeds, nor by a pulp. In the African genera *Adenoplea* and *Adenoplusia*, and in *Buddleja* subg. *Nicodemia* they are indehiscent, in the other genera involved and in *Buddleja* subg. *Buddleja* they are septical with 2 valves. The fruits of *Adenoplea* and of *Buddleja* subg. *Nicodemia* have thin fleshy walls; in *Adenoplusia* the walls are also thin-fleshy, but the endocarp is chartaceous; in the genera with dehiscent fruits the walls are dry and chartaceous or leathery. A typical character is the occurrence of large spherical glands on the inner side of the pericarp in *Adenoplea* and *Adenoplusia*, in the first named genus all over the surface, in the last named one only in the axils of the dissepiment. I agree with BRUCE & LEWIS (Fl. Trop. E. Afr. Logan. 1960, 40, footnote) that it is misleading to describe the fruits of *Adenoplea* and of *Buddleja* subg. *Nicodemia* as 'berries', as is usually done, or even those of *Adenoplusia* as 'drupes'; 'a non-dehiscent fleshy capsule' would be a better description, in the latter case with the addition 'with chartaceous endocarp'.

TAXON. I have recombined the genus *Nicodemia* with *Buddleja*, as was tentatively proposed by some authors, for instance by BRUCE & LEWIS, l.c. 35, 41; they only differ in the fruit characters cited above. The merging of these two genera is supported by the karyological data published by R. J. MOORE (Am. J. Bot. 34, 1947, 527-538): the diploid number of chromosomes of *Nicodemia* is 38 which is also the basic number of *Buddleja*, and morphologically the chromosomes are indistinguishable. The few phytochemical data known also point to a close relationship; anatomically there seems to be no clear difference; palynological and embryological data on *Nicodemia* are still unknown.

## KEY TO THE SPECIES

1. Ovary and style glabrous. Fruit a dehiscent capsule.
2. Tube of the corolla  $2\frac{1}{2}$ - $4\frac{1}{2}$  mm long, about as long as or slightly longer than the calyx; corolla outside densely stellate-hairy . . . . . 1. *B. asiatica*
2. Tube of the corolla 9-12 mm long, 3-4 times as long as the calyx; corolla outside either glabrous or glandular-pubescent.
3. Corolla straight, outside glabrous. Interpetiolar stipules distinct, leafy, often divided into 2 auricles. Inflorescences paniculate . . . . . 2. *B. davidii*
3. Corolla slightly curved, outside densely glandular-pubescent. Stipules represented by an inconspicuous rim. Inflorescences slender, spike-like. A native from China and Japan, in *Malaysia* sometimes cultivated . . . . . *B. lindleyana* FORTUNE
1. Ovary and style pubescent. Fruit fleshy, indehiscent . . . . . 3. *B. madagascariensis*

1. Subgenus *Buddleja*

## Fruit a dry capsule, dehiscent.

Distr. The area of the genus, apparently with the exception of Madagascar and the Mascarenes.

1. *Buddleja asiatica* LOUR. Fl. Coch. (1790) 72; ed. Willd. (1793) 90; BTH. in DC. Prod. 10 (1846) 446; MIQ. Fl. Ind. Bat. 2 (1857) 363; BTH. Fl. Hongk. (1862) 231; BEDDOME, Flor. Sylv. 3 (1872) 163, t. 21 (IV); BRANDIS, For. Fl. (1874) 318; KURZ, Fl. Burm. 2 (1877) 250; HOOK. f. Bot. Mag. (1877) t. 6323; CLARKE in HOOK. f. Fl. Br. Ind. 4 (1883) 82; K. & V. Bijdr. 9 (1903) 89, incl. var. *densiflora*, *salicina*, & *sundaica*; BRANDIS, Ind. Trees (1906) 475; KING, J. As. Soc. Beng. 74, ii (1908) 600; TALBOT, For. Fl. Bombay 2 (1911) 262; GAGNEP. Not. Syst. 2 (1912) 189; KOORD. Exk. Fl. Java 3 (1912) 60; DOP, Fl. Gén. 1.-C. 4 (1912) 160, f. 20 (5-9); KOORD. Atlas (1914) f. 325-326, incl. var. *brevispica*; MERR. Sp. Blanc. (1918) 306; EN. Philip. 3 (1923) 316; RIDL. Fl. Mal. Pen. 2 (1923) 414; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 334; BOYNTON,

Addisonia 13 (1928) 5, t. 419; MARQUAND, Kew Bull. (1930) 195; REHDER, J. Arn. Arb. 15 (1934) 309; MERR. Comm. Lour. (1935) 310; KANEHIRA, Formosan Trees, rev. ed. (1936) 622, f. 580; KANJILAL & DAS, Fl. Assam 3 (1939) 312; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 14; KERR in Craib, Fl. Siam. En. 3 (1951) 53.—*B. salicina* LAMK., Ill. 1 (1792) 291; POIRET, Encycl. Suppl. 1 (1810) 744; BL. Bijdr. (1826) 742.—*B. neemda* BUCH. HAM. ex ROXB. Fl. Ind. 1 (1820) 411; REICH. Ic. Bot. Exot. (1824) t. 21; CHAM. & SCHLECHT. Linnaea 2 (1827) 598, incl. var. *philippensis*; ROXB. Fl. Ind. ed. Carey 1 (1832) 396; BTH. in DC. Prod. 10 (1846) 446; MIQ. Fl. Ind. Bat. 2 (1857) 363; HANCE, J. Linn. Soc. Bot. 13 (1873) 112; F.-VILL. Nov. App. (1880) 136; VIDAL, Sinopsis Atlas (1883) t. 69 C; MARQUAND, Kew Bull. (1930) 195.—*B. acuminata*



Fig. 24. *Buddleja asiatica* LOUR. a. Habit,  $\times \frac{1}{2}$ , b. connate leaf-sheaths,  $\times 2$ , c. flower,  $\times 5$ , d. opened corolla,  $\times 10$ , e. pistil,  $\times 10$ , f. fruit,  $\times 5$ , g. seeds,  $\times 10$  (a RAHMAT 11423, b HOLSTVOOGD 571, c-e HOOGLAND & PULLEN 5355, f-g KOORDERS 4343).

*tissima* BL. Bijdr. (1826) 743.—*B. densiflora* BL. Bijdr. (1826) 743; BTH. in DC. Prod. 10 (1846) 447; Miq. Fl. Ind. Bat. 2 (1857) 364.—*B. sundaica* BL. Bijdr. (1826) 743; BTH. in DC. Prod. 10 (1846) 446.—*B. virgata* (non L. f.) BLCO, Fl. Filip. (1837) 57; ed. 2 (1845) 38; ed. 3, 1 (1877) 70.—*B. amentacea* KRÄNZL. Bull. Jard. Imp. Bot. St. Pétersb. 13 (1913) 89 & 92; MARQUAND, Kew Bull. (1930) 184.—*B. arfakensis* KAN. & HAT, Bot. Mag. Tokyo 56 (1942) 157, f. 1.—Fig. 24-25.

Evergreen shrub, suffrutex, or sometimes small tree, 1-7 m high. Branches terete or subterete, when young densely appressed- or woolly-, white-, grey-, or fulvous-hairy. Leaves opposite, those in the inflorescence often more or less alternate; connected by an, often inconspicuous, stipular line, narrowly to oblong- or ovate-lanceolate, 4-30 by  $\frac{3}{4}$ -7 cm, herbaceous, glabrous to rather densely hairy above, underneath densely short to rather long woolly-hairy; base acute, margin remotely serrate-dentate to subentire, apex long-acuminate, acute, nerves and veins often impressed above; petioles  $\frac{3}{4}$ -1 cm, tomentose. Inflorescences terminal and/or axillary, thyrsoid, spiciform, up to 25 by  $\frac{3}{4}$ -2 cm, densely tomentose; flowers in crowded or more or less remote, (sub) sessile, 1-3 (rarely more-) flowered cymes, each cyme in the axil of a linear bract. Pedicels  $\frac{1}{4}$ -2 mm. Flowers 4-merous, a few occasionally 5-merous. Calyx campanulate, 2-4 $\frac{1}{2}$  mm long, cleft to  $\frac{1}{3}$ - $\frac{1}{2}$ , outside more or less densely tomentose, lobes triangular-oblong, acute. Corolla white, sometimes light-violet or greenish, outside stellate-hairy, inside from halfway the tube to the basal part of the lobes woolly; tube  $2\frac{1}{2}$ -4 $\frac{1}{2}$  mm, lobes oblong-ovate, 1-1 $\frac{1}{2}$  mm long, rounded or obtuse. Stamens inserted near the throat, anthers  $\frac{3}{4}$  mm long, deeply 2-lobed at the base. Ovary and style glabrous, style 1 mm, including the club-shaped stigma. Capsule ovate or oblong, flattened, 3-5 by 2 $\frac{1}{2}$ -3 mm, glabrous, brown. Seeds ellipsoid, laxly enveloped by the testa which is at both ends prolonged into a short wing; the endosperm c. 1 mm long.

Distr. SE. Asia from W. Pakistan and the Deccan to South China and Formosa, the Marianas (Guam, Saipan), and throughout Malaysia. Sometimes cultivated and naturalized in tropical and subtropical regions.

Ecol. In open, often disturbed or secondary vegetation, apparently more or less a pioneer of secondary growth, in pyrogenous grassland, in gravel-beds, on lavastreams, and landslides, from the lowland up to about 3000 m, locally often gregarious. Fl. fr. Jan.-Dec.

Uses. Probably mainly on account of its saponin-content sometimes used as fish-poison and in native medicine for several purposes (see BURKILL, Dict. 1935, 379; QUIS, Med. Pl. Philip. 1951, 710). In Assam the flowers are eaten "cooked with rats' meat" (KANJILAL & DAS, l.c.); in the Philippines used in making rice-wine. Sometimes used for fuel. Cultivated as an ornamental in many tropical and subtropical to even temperate regions.

Vern. White butterfly bush, E, kaju saladang,



Fig. 25. *Buddleja asiatica* LOUR., Leson Creek, Markham River (E. New Guinea) (P. VAN ROYEN, 1961).

tjëmara angin, Sum., (d)jugul, ki hirisian, (ki) monjènjèn, kipirit, ki urug, sumbing luna, Java S., (daun)putihan, godijan, gutëhan, sanggal puting, J, barakadjër, Sumba, hu touis, Timor, lälawal, lawähmas, tubilit, Alor, bandau, pati-ata, Born.; Philip.: alatin, Bag., lagündi-salasä, Bis., maligus, Bon., duñgalau, Ibn., anaöp, dumdumani, If., amunging, Ig., lagiën-ti-sibusub, tugnan, Ilk., ilentud ulangan, mengayan, Sub., malasambüng, salibug, samböngkala, taliknòno (talianono), Tag., doknam, Ting.; kukuru-in-talun, malelema, Cel., deraidauti, hagaiahas, hifaäta, jamp, mukorrere, taggaras, tunun, uganga, wihadzaha, wold, New Guinea.

Notes. A variable species, especially in Java. It is not possible, however, to subdivide it into well circumscribed varieties.

*Buddleja amentacea* KRÄNZL. was based upon the apical part of a flowering shoot with alternate leaves as occurs in many species. This is one of the fairly exceptional cases in which the leaves in the inflorescence are strongly developed and conspicuous. The two leaves under the inflorescence, however, are opposite in the type specimen; MARQUAND, l.c., erroneously included this species in his sect. *Alternifoliae*. There is further no reason to doubt Java as its provenance; in fact, among the Javanese material of *B. asiatica* I found some specimens which match the type of *B. amentacea* quite well.

2. *Buddleja davidii* FRANCH. Nouv. Arch. Mus. Hist. Nat. Paris II, 10 (1887) 65; GAGNEP. Not. Syst. 2 (1912) 188; BOYNTON, *Addisonia* 2 (1917) 9, t. 45; MARQUAND, Kew Bull. (1930) 196; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 14.

Large bush up to 2½ m. Branches subquadranal, when young densely grey to white tomentose. Leaves oblong-elliptic or -ovate, 8–10 by 3–4 cm, herbaceous, glabrous above except on the base of the midrib, densely tomentose beneath; base cuneate, attenuate, margin minutely serrate-dentate, apex acute-acuminate; petiole c. ½ cm long, densely tomentose, glabrescent, at the base with auriculate, usually not connate, often relatively large stipules. Inflorescences terminal, sometimes moreover lateral, thyrsoid, composed of mostly short-stalked, lax, many-flowered cymes, c. 12–20 by 3½ cm, sparsely pubescent. Bracts linear, up to c. ½ cm. Flowers subsessile, very fragrant. Calyx slender-campanu-

late, 3 mm long, outside sparsely pubescent, lobes c. ½–¾ the total length of the calyx, acute. Corolla lilac, the mouth orange-yellow, outside glabrous, inside sparsely hairy above the insertion of the stamens, tube slender, 9 mm, slightly swollen halfway, lobes semiobovate, 2–2½ mm long, their margin crisped. Stamens inserted halfway the tube, anthers 1 mm long, 2-parted at base, apiculate. Pistil glabrous, style 2 mm including the club-shaped stigma. Capsule lanceolate-ellipsoid, 8 by 1½–2 mm, glabrous. Seeds thread-like, 4 mm, in the centre only slightly thickened.

Distr. Tibet and Central China (Szechuan, Hupeh); in Malaysia and elsewhere commonly cultivated as an ornamental, naturalized in the Malay Peninsula (Cameroon Highlands, above Pavit Falls).

Ecol. In a clearing in jungle. Fl. fr. Jan.–Dec. Vern. Summer lilac, orange eye butterfly bush, E. Japanese sering, Dutch.

## 2. Subgenus *Nicodemia*, nov. stat.

*Nicodemia* TENORE, Cat. Orto Bot. Napoli (1845) 88.

Fruit indehiscent, with a thin fleshy pericarp.

Distr. Apparently restricted to Madagascar and the Mascarenes.

3. *Buddleja madagascariensis* LAMK, Encycl. 1 (1785) 513; HOOK. Bot. Mag. (1828) t. 2824; BTH. in DC. Prod. 10 (1846) 447; KING, J. As. Soc. Beng. 74, ii (1908) 601.—*Nicodemia madagascariensis* R. N. PARKER, For. Fl. Punjab, ed. 2 (1924) 357.—*Adenoplea madagascariensis* EASTW. Leaf. West. Bot. 1 (1936) 197.

Shrub, 2–3 m. Branches terete, densely silvery-white (in the herb. rusty-)tomentose, as are the petioles, the undersurface of the leaves, and the inflorescences. Leaves connected by an inconspicuous stipular line, ovate-oblong to ovate-lanceolate, 9–11 by 3–4½ cm, more or less coriaceous, somewhat bullate, glabrous above, densely tomentose beneath; base rounded to acute, margin entire, apex tapering, acute; petiole c. 1½ cm. Inflorescences terminal, thyrsoid with some rather long thyrsoid basal branches, c. 20 cm long, with relatively long-stalked (c. 1 cm), rather dense, c. 7-flowered, patent lateral cymes. Bracts linear, up to c. 1½ cm. Flowers subsessile, sweet-scented. Calyx campanulate, 3 mm long, outside densely tomentose, lobes c. ½ mm, broadly triangular. Corolla orange, outside densely tomentose, inside glabrous, tube slender, c. 6 mm, lobes 2 mm long, rounded. Stamens inserted slightly below the mouth; anthers 1¼ mm long, shortly split at the base. Ovary (except at base) and style densely hairy, style slender, 4½ mm including the club-shaped stigma. Fruit globular, c. 2½ mm, pubes-

cent, at first white, when ripe purple-blue. Seeds ellipsoid, c. 1 mm long, smooth, brown.

Distr. A native of Madagascar, cultivated and naturalized in tropical and subtropical regions; in Malaysia naturalized in the Malay Peninsula (Penang, Perak).

Ecol. Open jungle, 700–800 m. Fl. Oct.–Febr.; I saw no fruiting specimens from Malaysia.

Uses. According to STANDLEY (Contr. U.S. Nat. Herb. 23, 1924, 1143) in Madagascar "the leaves were formerly employed ... as a soap substitute and the plant is used as a remedy for asthma, coughs, and bronchitis."

### Excluded

*Buddleja indica* LAMK, Encycl. 1 (1785) 513.—*B. diversifolia* VAHL, Symb. 3 (1794) 15, nom. illeg.; BTH. in DC. Prod. 10 (1846) 445.—*Nicodemia diversifolia* TENORE, Cat. Orto Bot. Napoli (1845) 88, nom. illeg.

A native from the Mascarenes and Madagascar, twice wrongly described from Java, as already mentioned by BENTHAM, l.c. The name *B. diversifolia* was illegitimate as *B. indica* LAMK was cited as a synonym.

*Buddleja otophylla* HASSK. Versl. Med. Kon. Ak. Wet. Af. Nat. 5 (1857) 97 = *B. brasiliensis* JACQ. f.

Apparently based on a specimen cultivated in the Botanical Garden, Bogor.

## 3. NORRISIA

GARDN. in Hook. J. Bot. Kew Misc. 1 (1849) 326.—Fig. 26.

Trees. Twigs gradually thickening from the nodes upwards, rusty pubescent when young. *Leaves* petioled; connected by very broadly triangular, about 1 mm high, blunt stipules. *Inflorescences* terminal and axillary, dichasially branched to thyrsoid, dense and many-flowered, densely rusty tomentose; bracts narrowly triangular. *Flowers* 5-merous, subsessile, with two pairs of decussate, minute bracteoles. *Calyx* cupular,  $\frac{3}{4}$ (-1) mm high, tube very short, lobes broadly rounded, densely tomentose outside, inside glabrous, without colleters. *Corolla* salver-shaped, thin-fleshy, outside densely tomentose, creamy to yellowish; lobes valvate in bud. *Stamens* inserted between the corolla-lobes, glabrous, exerted filaments filiform, c. 6 mm; anthers latrorse, cells free in the lower half. *Ovary* obovoid, for the greater part densely and shortly erect-hairy; 2-celled, with elliptic peltate placentas; ovules  $\infty$ ; style terete, slender, glabrous, caducous, stigma faintly capitate and slightly bilobed. *Capsule* septicial, 2-valved, valves outside densely fulvous-tomentose except the margins. *Seeds* few to many, small, slenderly spindle-shaped, smooth and glabrous; endosperm fleshy.

Distr. Two closely related species, restricted to *Malaysia*: Sumatra, Malay Peninsula, Borneo, and the Philippines.

Ecol. Small to medium trees of lowland forests. Insect-pollination seems probable; the tiny seeds are in all probability wind-dispersed.

## KEY TO THE SPECIES

1. Anthers oblong,  $\frac{4}{5}$  mm long. Mouth of the corolla glabrous or with a few long hairs only. Most of the nerves distinctly looped and joined at some distance from the margin. Twigs usually conspicuously lenticellate . . . . . **1. N. malaccensis**
1. Anthers orbicular,  $\frac{1}{2}$  mm  $\phi$ . Mouth of the corolla densely tomentose. Nervation for the greater part open, only the upper two or three pairs of nerves looped and joined close to the margin. Twigs rarely distinctly lenticellate . . . . . **2. N. maior**

**1. *Norrisia malaccensis* GARDN.** in Hook. J. Bot. Kew Misc. 1 (1849) 327; MIQ. Fl. Ind. Bat. 2 (1857) 359; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 85; KING, J. As. Soc. Beng. 74, ii (1908) 602, incl. var. *pubescens*; RIDL. Fl. Mal. Pen. 2 (1923) 414, var. *malaccense* only; BURK. Dict. (1935) 1561, p.p.—*Antonia griffithii* WIGHT, Ill. Ind. Bot. 2 (1850) 172, t. 156 b.—*N. philippinensis* ELM. Leaf. Philip. Bot. 4 (1912) 1482; MERR. En. Philip. 3 (1923) 311.—Fig. 26g, l.

Tree 10–30 m by 32–40 cm  $\phi$ . Twigs terete, nearly always densely set with minute, warty, white lenticles. *Leaves* faintly pubescent to glabrous, elliptic to oblong,  $6\frac{1}{2}$ –10 by  $2\frac{3}{4}$ –4 cm, thin-coriaceous, base cuneate, attenuate, apex usually shortly acute-acuminate, rarely blunt; midrib prominent and keeled beneath, nerves 6–8 pairs, usually distinctly ascending, fairly strongly curved, usually distinctly looped and joined at some distance from the margin, flat above, prominulous beneath; petiole  $\frac{1}{2}$ –1 cm, slender. *Inflorescences* terminal, often thyrsoid,  $4\frac{1}{2}$ –8 $\frac{1}{2}$  cm long incl. the  $2\frac{1}{2}$ –4 $\frac{1}{2}$  cm long peduncle. Largest bracts  $1\frac{1}{2}$ –2 mm long. Tube of the corolla  $4\frac{1}{2}$  mm, inside sparsely hairy, the base excepted. *Anthers* oblong, c.  $\frac{4}{5}$  mm. *Ovary* 1 mm; style 6–7 $\frac{1}{2}$  mm. *Fruits* apparently scarce, 2–3 $\frac{1}{2}$

by  $1\frac{3}{4}$  mm. *Seeds* few, c. 2 mm long, very delicate.

Distr. *Malaysia*: Sumatra (West Coast Res.), Malay Peninsula (southern half only), and the Philippines (Sibuyan, Mindanao).

Ecol. In and along primary forests, up to 920 m. Fl. March–Nov., fr. Nov.

Vern. *Balang, bareh bareh, Sum., kayu kar-karas, kèlat, sèrapoh bukit, Mal. Pen.*

Notes. Specimens from the Philippines differ slightly from those of the Malay Peninsula and Sumatra in the following points: petioles 5–6 mm versus 7–10 mm, nerves 7–8 pairs, more or less spreading versus 6–7 pairs and distinctly ascending.

*Antonia griffithii* WIGHT was based upon material collected by GRIFFITH in Malacca. This was probably GRIFFITH K.D. 3731. The specimens, distributed under this number belong, however, to both species of *Norrisia*. I did not see any specimen clearly bearing the name in WIGHT's handwriting; the figure can refer to both species; the same holds for the description, the only point in favour of *N. malaccensis* being "leaves . . . glabrous on both sides".

**2. *Norrisia maior* SOLER.** in E. & P. Nat. Pfl. Fam. 4, 2 (1892) 37; KING, J. As. Soc. Beng. 74, ii (1908) 602.—*N. malaccensis* (non GARDN.) MERR.

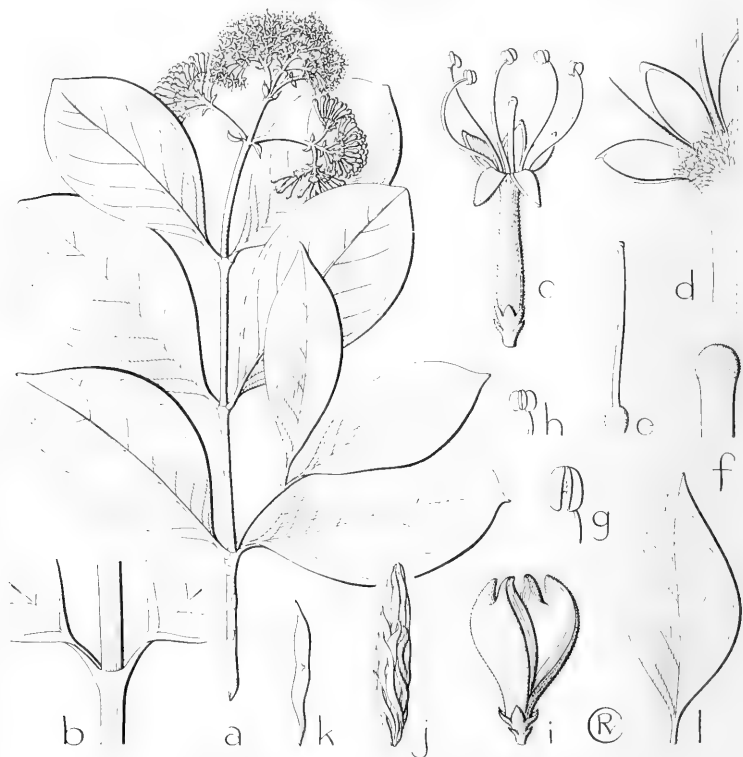


Fig. 26. *Norrisia maior* SOLER. a. Habit,  $\times \frac{2}{3}$ , b. connate leaf-sheaths,  $\times 2$ , c. flower,  $\times 4$ , d. detail of opened corolla, showing the bearded mouth,  $\times 8$ , e. pistil,  $\times 4$ , f. stigma,  $\times 20$ , h. anther,  $\times 8$ , i. fruit,  $\times 4$ , j. placenta with seeds,  $\times 4$ , k. seed,  $\times 6$ .—*N. malaccensis* GARDN. g. Anther,  $\times 8$ , l. leaf,  $\times \frac{2}{3}$  (a-f, h RIDLEY 6828, g, l SF. 40586, i-k KEP 15224).

En. Born. (1921) 490; CAMMERL. Bull. Jard. Bot. Btz III, 5 (1923) 302; HEYNE, Nutt. Pl. (1927) 1267; BURK. Dict. (1935) 1561, p.p.—*N. malaccensis* var. *major* RIDL. Fl. Mal. Pen. 2 (1923) 414.—Fig. 26a-f, h-k.

Tree 10-45 m by 10-75 cm  $\phi$ , heavily buttressed up to 4 m high; twigs terete, lenticels inconspicuous to nearly invisible. *Leaves* elliptic, 5½-10 by 2½-5 cm, thin-coriaceous, usually minutely tomentose on the midrib above, sparsely hairy on midrib, nerves, and sometimes veins beneath; base cuneate, attenuate, apex blunt or rounded to fairly abruptly to tapering acuminate, acumen short and broad, blunt to acute; midrib prominent

and rounded beneath, nerves 6-10 pairs, spreading, faintly curved, not looped and joined with the exception of the upper 2 or 3 pairs, petiole (4-) 6 mm. *Inflorescences* terminal and usually in the axils of the upper pair of reduced leaves, usually compoundly cymose, 3-6½ cm long, including the peduncle, which is up to 3¼ cm; bracts up to 2½ mm. *Corolla*-tube 5-6 mm long, inside about the mouth densely tomentose, further glabrous. *Anthers* suborbicular, c. ½ mm  $\phi$ . *Ovary* 1½ mm; style 7-8 mm. *Fruits* always many, 4-10 by 2-4 mm. *Seeds* c. 5-20 per cell, 4 mm long, delicate.

*Distr. Malaysia:* Sumatra (Palembang), Banka, Riouw, Malay Peninsula (southern half only), and



Borneo.

Ecol. Primary and secondary forests, apparently often along river-banks, in swamp forests or in temporarily inundated places, up to 450 m. *Fl. Jan., July-Oct., fr. Febr.-April, Aug., Oct.-Nov.*

Uses. In the Malay Peninsula the timber is locally used in house building. In Sumatra the

light and soft wood is used for floors of houses and indoor constructions, but even then it lasts for only 3-4 years; from the buttresses, handles of tools and oars are made.

Vern. (B) *ĕngkaras, mĕrkaras, Sum., kayu tankat, lĕmak hutam (or kĕtam ?), otak hudang, sĕrapak paya, Mal. Pen., bandung, kĕlait, masilan putih, simpopoit, tabak, Born.*

#### 4. GELSEMIUM

JUSSIEU, Gen. Pl. (1789) 150.—*Medicia* GARDN. & CHAMP. in Hook. J. Bot. Kew Misc. 1 (1849) 324.—*Leptopteris* BL. Mus. Bot. 1 (1850) 240.—Fig. 27.

Straggling shrubs. Twigs slender, terete. *Leaves* petioled; stipules reduced to an interpetiolar line. *Inflorescences* terminal and axillary, thyrsoid to 1-flowered. *Flowers* 5-merous (in *G. sempervirens* heterostylous). *Calyx*: sepals free, glabrous or ciliate. *Corolla* funnel-shaped, lobes imbricate. *Stamens* glabrous, exerted; filaments strap-shaped; anthers sagittate, cells free, latrorse. *Pistil* glabrous; ovary 2-celled, ovules several per cell; style filiform, stigma twice forked. *Capsule* septicidal, 2-valved. *Seeds* several, winged.

Distr. Three species, one in SE. Asia, the others in SE. North America, Mexico, and Guatemala. Cf. LEENH. Pac. Pl. Areas map 30.

Ecol. Shrubby vegetation at low to medium altitudes.

**1. *Gelsemium elegans*** (GARDN. & CHAMP.) BTH. J. Linn. Soc. Bot. 1 (1856) 90; MIQ. Fl. Ind. Bat. 2 (1857) 359; BTH. Fl. Hongk. (1861) 229; KURZ, Fl. Burma 2 (1877) 249; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1889) 117; BRANDIS, Ind. Trees (1906) 476; DOP, Fl. Gén. I.-C. 4 (1914) 162, f. 21<sup>1-4</sup>; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 295; HU & CHUN, Ic. Pl. Sinic. (1929) t. 97; MERR. & CHUN, Sunyatsenia 2 (1935) 305; KANJILAL & DAS, Fl. Assam 3 (1939) 314; HERKLOTS, Hongk. Natur. 10 (1940) 28, f. 1-2.—*Medicia elegans* GARDN. & CHAMP. in Hook. J. Bot. Kew Misc. 1 (1849) 324; BTH. in *ibid.* 5 (1853) 56.—*Leptopteris sumatrana* BL. Mus. Bot. 1 (1850) 240, f. 34.—*G. sumatrana* BOERL. Handl. 2 (1899) 448, 457; GIBBS, J. Linn. Soc. Bot. 42 (1914) 111.—Fig. 27.

Usually a straggling half-shrub, sometimes a large, woody climber; twigs glabrous. *Leaves* ovate-lanceolate (to ovate), (7-10)-12 by 2-5½ cm, thin-chartaceous to pergamentaceous, base rounded to cuneate, apex long and slenderly acute-acuminate; midrib sunken above; nerves c. 5-8 pairs; petioles ¾-1 cm. *Inflorescences* terminal and in the upper leaf-axils, together making a pyramidal leafy panicle; lower axillary branches up to 6 cm, the terminal inflorescence c. 3 cm, all sparsely pubescent. Bracts acutely triangular to subulate, up to 4 mm long, ciliate and pubescent on the prominent midrib beneath.

Pedicels c. ¼ cm, bibracteolate. *Sepals* oblong-ovate, 2½-3½ by 1¼-1¾ mm, acute, erect, outside glabrous or slightly pubescent on the thickened to keeled midrib, inside glabrous; no colleters. *Corolla* 1-1½ cm long, bright yellow to orange, the tube outside brownish, mouth spotted with red, the tube 7-9 mm, thin, fully glabrous, lobes blunt to acute. *Stamens* inserted about the middle of the tube, filaments 3½-4 mm long, anthers oblong-ovate to lanceolate, 1½-2 mm long, acute. *Ovary* oblong to obovoid-lanceolate, 2-2½ mm; style 8-12½ mm. *Fruits* ellipsoid, 4-10 by 3-4 mm, smooth and glabrous, papery, the valves split at the top. *Seeds* c. 8 per cell, elliptic to bean-shaped, 3½ mm  $\phi$ , warty, the central part hairy, winged all around.

Distr. Assam, N. Burma, N. Siam, Indo-China, S. and SE. China, Hainan, and Malaysia: Sumatra, Borneo.

Ecol. In scrubby forests and thickets, 250-2000 m. *Fl. June-Aug., Nov., Dec., fr. June-July, Nov.*

Uses. Reputed to be very poisonous, especially the leaves and roots; mentioned to be used for murder and suicide. The poisonous element is the alkaloid gelsemidin.

Vern. *Liman*, Borneo.

Note. In specimens from N. Burma the fruits are usually slightly larger (12 by 6 mm).

#### 5. STRYCHNOS

LINNÉ, Gen. Pl. ed. 5 (1754) 86; Sp. Pl. 1 (1753) 189; A. W. HILL, Kew Bull. (1917) 121.—Fig. 28, 30-32.

Usually lianas, sometimes shrubs or treclats; usually provided with axillary,



Fig. 27. *Gelsemium elegans* (GARDN. & CHAMP.) BTH. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 2$ , c. opened corolla,  $\times 2$ , d. pistil,  $\times 4$ , e. anther,  $\times 6$ , f. fruit,  $\times 2$ , g. seed,  $\times 4$  (a-e BALANSA 1041, f-g BECCARI herb. 6642).

simple or double tendrils and sometimes with axillary thorns; stems and older branches in some species spiny. *Stipules* reduced to a mostly ciliate and straight rim connecting the leaf-bases. *Leaves* mostly inserted upon distinct leaf-cushions, 3-5(-7)-plinerved, *i.e.* apart from the midrib nearly always provided with one or a few pairs of nearly equally strongly developed basal nerves which do not fully reach the leaf apex; penninerved in a few African species. Some pairs of scale-like *cataphylls* are present at the base of new shoots, of inflorescences, and of the branches of the latter. *Inflorescences* terminal or axillary, thyrsoid. Bracts scale-like. *Flowers* (4-)5-merous. *Calyx* nearly completely divided, lobes in Mal. *spp.* always broad, scale-like, and brown (in African and American *spp.* sometimes lanceolate and green), outside usually very sparsely hairy, ciliate along the margin, inside at the base provided with colleters. *Corolla* rotate to salver-shaped, white to yellowish or greenish, thin-fleshy, always more or less thickened towards the lobes, the basal part included by the calyx much thinner, outside usually distinctly densely papillose, mostly glabrous, inside variously hairy except the thin basal part; lobes valvate in bud, spreading to reflexed when open. *Stamens* exerted; anthers mostly slightly bifid at the base, introrse. *Ovary* 2-(in some African *spp.* 1-)celled, with many ovules; style cylindrical, stigma faintly 2-lobed. *Berry* usually globose or ellipsoid, the thin to thick shell in Mal. *spp.* always hard, outside smooth or minutely warty, glabrous, orange to red when ripe; pulp fleshy, usually orange. *Seeds* ∞, or 2-1, either lenticular, orbicular to elliptic and usually convex on one and concave on the other side with a silky or felty testa (fig. 28g, k), or irregular castorbean-shaped and glabrous (fig. 28j); endosperm bony.

*Distr.* About 150-200 *spp.* in the tropics and subtropics.

*Ecol.* Large lianas in the forests or scrambling or erect shrubs or treelets in more open vegetations.

The dispersal of the seeds is still incompletely known; in all probability this is largely due to animals, both mammals and birds which digest the fruit pulp; according to KRUKOFF (Brittonia 4, 1942, 258) toucans may be mainly responsible for it in America.

*Uses.* Many species are poisonous as they contain a sometimes high amount of alkaloids in their seeds, roots, bark, and leaves. Most important among these alkaloids are strychnine and brucine (in American *spp.* these are replaced by curare), which are used in medicine; the main source of these alkaloids are the seeds of *S. nux-vomica*, and locally those of *S. ignatii*. The natives, especially those in Borneo and the Malay Peninsula, make use of the poison from roots and bark in composing arrow-poison. The lianas are used as ropes. For further details see BURKILL, Dict. (1935) 2091-2100.

*Taxon.* It is not yet possible to give a satisfactory subdivision of the whole genus. Best known and still in use is that by PROGEL (in Mart. Fl. Bras. 6, 1, 1868, 271), modified and made suitable for the whole genus by SOLEREDER (in E. & P. Nat. Pfl. Fam. 4, 2, 1892, 37). They distinguished 3 sections, *viz*:

*Sect. Longiflorae*: corolla-tube distinctly longer than the lobes.

*Sect. Intermediae*: corolla-tube about as long as the lobes.

*Sect. Breviflorae*: corolla-tube distinctly shorter than the lobes.

This division is obviously rather artificial because lines of alliance based on a complex of other characters sometimes go across it.

In his revision of the Asiatic species HILL, *l.c.*, accepted SOLEREDER's classification but divided *sect. Intermediae* into two sections by using as an additional character the kind of indument on the inner side of the corolla. In this way he came to the following subdivision:

*Sect. Brevitubae*: identical with SOLEREDER's *Breviflorae* (fig. 30b-c).

*Sect. Lanigeratae*: *Intermediae sensu* SOLEREDER in part, with long woolly hairs at the mouth (fig. 32).

*Sect. Penicillatae*: *Intermediae sensu* SOLEREDER in part, with a line of erect bristle-like hairs either across the base or across the middle of the inner face of the corolla lobes (fig. 30g).

*Sect. Tubiflorae*: identical with SOLEREDER's *Longiflorae* (fig. 28).

As far as the Asiatic species are concerned this subdivision is more satisfactory. Especially the *Penicillatae* and the *Tubiflorae* (the latter section with the exception of *S. angustiflora* Bth.) seem to be natural taxa. Among the *Lanigeratae* a few species are somewhat anomalous (*S. polytrichantha*, *S. curtisii*, and *S. lanata*), the Asiatic *Brevitubae* showing the greatest diversity.

Though this is a fairly good subdivision of the Indo-Malayan species, it proved to be of very little use for the African ones. In Africa the genus shows its greatest development, and any subdivision of the genus

as a whole will primarily have to be framed on the African species. DUVIGNEAUD (Bull. Soc. R. Bot. Belg. 85, 1952, 9) attempted this and distinguished 17 sections and some subsections, based upon as many characters as possible. I feel incapable of judging the full merits of his system; in trying to fit the Asiatic species into it I got the impression that the number of subdivisions may be somewhat too large.

In the present account I have refrained from giving a sectional subdivision, confining myself to the mentioning of six groups of distinctly related species:

- (i) *S. ignatii*, *S. nux-vomica*, and *S. lucida* (*Tubiflorae* HILL; nearest to DUVIGNEAUD's *Floribundae*).
- (ii) *S. maingayi*, *S. ovata*, and *S. villosa* (*Brevitubae* HILL, close to DUVIGNEAUD's *sect. Sambae*).
- (iii) *S. curtisii*, *S. polytrichantha*, *S. oleifolia*, and *S. lanata* (different from HILL's *Lanigerae* by the relatively short tube; according to the description almost identical with DUVIGNEAUD's *sect. Ligustroides*).
- (iv) *S. colubrina*, *S. quadrangularis*, *S. borneensis*, *S. ledermannii*, *S. lanceolaris*, and *S. flavescens* (*Lanigerae* HILL, about identical with DUVIGNEAUD's *Booneae* according to the description).
- (v) *S. luzoniensis* (close to the next group, but with a short corolla-tube).
- (vi) *S. axillaris* and *S. ridleyi* (*Penicillatae* HILL).

Nomenclaturally the sectional and subsectional names must be typified and corrected, starting with those of PROGEL.

Notes. A fairly complete account of the morphology and of the variability of many characters, based upon extensive field-studies, was given by KRUKOFF & MONACHINO, *Brittonia* 4 (1942) 253-259.

Though after some experience it may be possible to recognize the leaves of many species, flowers are absolutely necessary to come to a trustworthy identification. In many cases the fruits are possibly also of value for specific distinction, but up till now the available material of undamaged fruits is insufficient as they were usually dried and pressed, instead of preserved in liquor. According to DUCKE, *Bol. Tecn. Inst. Agr. Norte n. 30* (1955) the seeds show also distinct specific characters but they should also be preserved in liquor: seeds prepared out of dried fruits are nearly worthless, as the typical testa-characters usually have been lost by then.

#### KEY TO THE SPECIES

1. Tube of the corolla distinctly longer than the limb.
  2. Inflorescences axillary. Leaves distinctly slender-(to caudate-)acuminate. Fruits 4-12 cm  $\phi$ , many-seeded . . . . . 1. *S. ignatii*
  2. Inflorescences terminal, eventually on axillary twigs with at least one pair of leaves. Leaves either not acuminate, or with a short and broad, triangular acumen. Fruits 2-4(-6) cm  $\phi$ , 2-4-seeded.
  3. Petiole 6-11 mm. Branchlets smooth. Leaves large, 4½-15 by 3½-11 cm, apex blunt to shortly and broadly triangular-acuminate, mucronulate. Inflorescences many-flowered. Style sparsely woolly hairy. Seeds c. 2 cm  $\phi$ , sericeous . . . . . 2. *S. nux-vomica*
  3. Petiole 2-4 mm. Branchlets scabrous by many small warty lenticels. Leaves small, 2½-10 by 1½-6 cm, apex blunt to emarginate, not mucronulate. Inflorescences few-flowered. Style glabrous. Seeds c. 1-1½ cm  $\phi$ , tomentose . . . . . 3. *S. lucida*
1. Tube of the corolla about as long as or shorter than the limb.
  4. Corolla inside partly or nearly completely woolly, very rarely fully glabrous, never with a whorl of erect, bristle-like hairs (fig. 30c, 31c, 32c).
  5. Tube of the corolla distinctly shorter than the limb.
    6. Corolla 2-4 mm long.
      7. Calyx inside thinly pubescent. Inflorescences terminal and in the upper leaf-axils, 5-20 cm long, lax, long-peduncled . . . . . 6. *S. villosa*
      7. Calyx inside glabrous. Inflorescences axillary and terminal, up to 7 cm long, dense, short-peduncled.
      8. Corolla outside glabrous. Filaments 1½-2 mm; anthers oblong to lanceolate. . . . . 4. *S. maingayi*
      8. Corolla outside sparsely hairy. Filaments short, up to 1¾ mm; anthers ovate. . . . . 5. *S. ovata*
    6. Corolla 5½-10 mm long.
    9. Corolla 5½-7 mm long.
      10. Anthers 1 mm long, glabrous; filaments 2 mm. Indument of the pistil appressed and short. Inflorescences dense, 2-4½ cm . . . . . 7. *S. curtisii*
      10. Anthers 1¼-2 mm long, bearded; filaments 1-1½ mm. Indument of the pistil woolly. Inflorescences lax, 6-8 cm . . . . . 10. *S. lanata*
  9. Corolla 8-10 mm long.
    11. Corolla outside glabrous, inside woolly with the exception of the basal part of the tube. Filaments 2½-4 mm; anthers lanceolate. Pistil 9 mm. Nerves strongly prominent beneath, nearly unbroken till near the apex; venation very conspicuous on both sides. . . . . 8. *S. polytrichantha*
    11. Corolla outside with some scattered hairs about the mouth and along the sutures, inside woolly

from slightly above the base till about halfway the lobes. Filaments 2 mm; anthers elliptic. Pistil 6 mm. Nerves moderately prominent, broken into arches and feeble towards the apex; venation not very conspicuous . . . . . 9. *S. oleifolia*

5. Tube of the corolla about as long as the limb.  
 12. Corolla about 9 mm long . . . . . 13. *S. borneensis*  
 12. Corolla up to 6½ mm long.  
 13. Corolla inside only with a few woolly hairs near the apex of the lobes . . . . . 15. *S. lanceolaria*  
 13. Corolla inside woolly especially in the mouth, sometimes fully glabrous.  
 14. Ovary pubescent. Filaments 1–1½ mm long, anthers often 1 mm or more. 11. *S. colubrina*  
 14. Ovary glabrous, style often with some hairs. Anthers subsessile, c. ¼ mm long (compare also 12. *S. quadrangularis*, the flowers of which are still unknown).  
 15. Corolla glabrous outside. Leaves 5–7-plinerved . . . . . 14. *S. ledermannii*  
 15. Corolla pubescent outside. Leaves 3-plinerved . . . . . 16. *S. flavescens*  
 4. Corolla on the inner surface provided with a whorl of erect, stiff, bristle-like hairs, either at the base of the lobes or up to about halfway on these, very rarely moreover pubescent (fig. 30g).  
 16. Calyx inside pubescent. Corolla-lobes inside fairly densely patently short-hairy above the bristles. 19. *S. ridleyi*  
 16. Calyx inside glabrous. Apart from the bristles corolla-lobes inside glabrous.  
 17. Corolla 2½ mm long, tube shorter than the limb. Pistil pubescent . . . . . 17. *S. luzonensis*  
 17. Corolla 3–4 mm long, tube about as long as the limb. Pistil glabrous . . . . . 18. *S. axillaris*

1. *Strychnos ignatii* BERG. Mat. Med. 1 (1778) 146; FLUCKIGER & MEYER, Pharm. J. III, 12 (1881) 1–6, cum fig.; VIDAL, Rev. Pl. Vasc. Filip. (1886) 449, p.p., t. 2; BAILL. Hist. Pl. 9 (1888) f. 387–388; OLIVER in Hook. Ic. (1892) t. 2212; HILL, Kew Bull. (1911) 290, t. opp. 281; *ibid.* (1917) 200; MERR. Sp. Blanc. (1918) 306; BROWN, Min. Prod. Philip. For. 3 (1921) 70 & 221; MERR. En. Philip. 3 (1923) 312; BURK. Dict. (1935) 2095; BROWN, Usef. Pl. Philip. 3 (1950) 225, f. 88.—*Ignatia amara* L. f. Suppl. (1781) 149, pro fr.; see OLIVER in Hook. Ic. (1892) t. 2212.—*Ignatia philippinica* LOUR. Fl. Coch. (1790) 126, pro fr., nom. illeg.; see MERR. Comm. Lour. (1935) 309.—*S. tieute* LESCH. Ann. Mus. Hist. Nat. Paris 16 (1810) 479 & 480, t. 23; BL. Bijdr. (1826) 1019; Rumphia 1 (1836) 66, t. 24; Miq. Fl. Ind. Bat. 2 (1857) 380; HILL, Kew Bull. (1911) 292; KOORD. Exk. Fl. Java 3 (1912) 58; HILL, Kew Bull. (1917) 200; HEYNE, Nutt. Pl. (1927) 1268; non v. MALM in Fedde, Rep. 34 (1934) 285, quae est *Ervatamia sphaerocarpa* (BL.) BURK. (Apoc.); BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 8.—*S. ovalifolia* WALL. [Cat. (1829) n. 1592, nomen] ex G. DON, Gard. Dict. 4 (1837) 65; BTH. J. Linn. Soc. Bot. 1 (1856) 103; GAMBLE, J. As. Soc. Beng. 74, ii (1908) 616, fr. excl.; HILL, Kew Bull. (1917) 201; RIDL. Fl. Mal. Pen. 2 (1923) 425; BURK. Dict. (1935) 2097.—*S. philippinensis* BLCO, Fl. Filip. ed. 2 (1845) 61; ed. 3, 1 (1877) 116; F.-VILL. Nov. App. (1880) 136.—*S. maingayi* CLARKE var. *fructuosa* CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 88.—*S. beccarii* GILG, Notizbl. Berl.-Dahl. 1 (1897) 267; HILL, Kew Bull. (1911) 291.—*S. cuspidata* HILL, Kew Bull. (1909) 359; *ibid.* (1911) 288; *ibid.* (1917) 199.—*S. pseudotieute* HILL, *ibid.* (1911) 287.—*S. balansae* HILL, *ibid.* (1917) 200.—*S. krabiensis* HILL, *ibid.* (1940) 199; in Craib, Fl. Siam. En. 3 (1951) 58.—Fig. 28a–j.

Large liana (in Borneo sometimes a shrub or treelet); twigs glabrous; branches greyish brown, more or less scabrous. Leaves ovate or elliptic to lanceolate, 4–18(–22) by 2¼–9(–12) cm, thin-

to coriaceous-chartaceous, glabrous, acute to rounded at the base, always slightly attenuate, apex distinctly acuminate, acumens up to 1¾ cm long, slender and blunt or acute; triplinerved at or above the base; petiole ½–1 cm. *Inflouescences* axillary, mostly in the axils of already fallen leaves, laxly branched, 2–4(–7) cm long, with some 10–20 flowers, minutely pubescent. *Calyx* 1–1½ mm high, sepals ovate, acute, outside densely minutely tomentose, inside glabrous. *Corolla* salver-shaped, 7–17 mm long, tube 5–12 mm, inside in the lower half with some long woolly hairs. *Stamens* inserted in the mouth, filaments short, anthers deeply cleft, oblong, 1¼–2 mm long, apiculate, glabrous. *Ovary* globular, c. 1 mm ø, glabrous; style c. 5–12 mm, glabrous or rarely with a few long woolly hairs about the middle; stigma truncate. *Fruits* few on strongly thickened branches, (ellipsoid to) globular, 4–12 cm ø, pericarp up to 5 mm thick, hard and woody, smooth and glabrous. *Seeds* usually several, either lenticular, elliptic to orbicular, c. 20–35 by 16–20 by 8–9 mm, and silky to felty (fig. 28g), or irregular castorbean-shaped, c. 2 by 1 by 1 cm, rough but glabrous (fig. 28j).

Distr. Tonkin and Malaysia: Malay Peninsula, Borneo, Java, and the SE. Philippines (Biliran, Samar, Leyte, Mindanao).

Ecol. Apparently often in Dipterocarp forests on a sandy soil, furthermore in mixed rain-forests, and sometimes along river-banks, from the lowland up to c. 1500 m. Fl. Jan.–Sept., fr. Jan.–Dec. According to RIDLEY, Disp. (1930) 342 & 352, the fruits are eaten by monkeys and civet-cats.

Uses. The seeds are the *Saint Ignatius beans* of commerce, one of the sources of strychnine. The bark and the seeds are used as a febrifuge in the Philippines. In the Malay Peninsula, Java, and Borneo the roots are used for poisoning arrows; moreover, in the Malay Peninsula a fish-poison is made from it.

Vern. *Saint Ignatius bean*, E, *pepita de San Ignacio*, Sp, *akar ipoh* (pèrah), a. *tontong*, *bèlai*

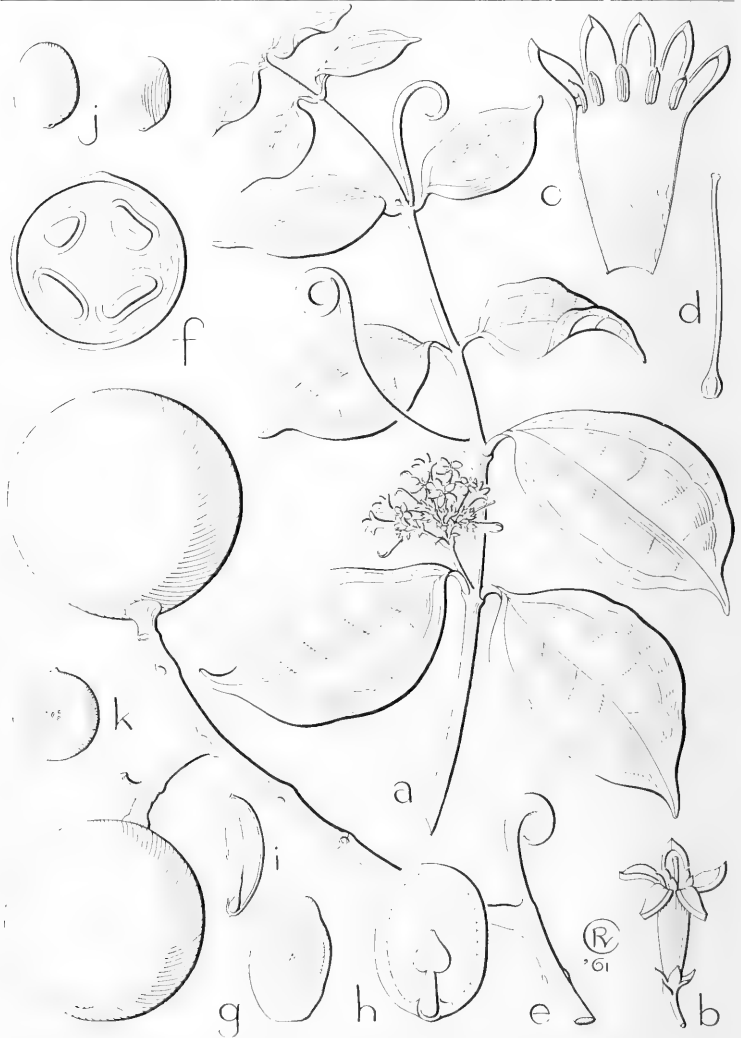


Fig. 28. *Strychnos ignatii* BERG. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 2$ , c. opened corolla,  $\times 4$ , d. pistil,  $\times 4$ , e. twig with fruits,  $\times \frac{2}{3}$ , f. cross-section of fruit, the seeds embedded in the pulpa,  $\times \frac{2}{3}$ , g. lenticular-shaped seed,  $\times \frac{2}{3}$ , h. *ditto* in length-section, showing the embryo,  $\times \frac{2}{3}$ , i. *ditto*, showing the endosperm which is split for the greater part,  $\times \frac{2}{3}$ , j. irregular shaped seeds ('*St Ignatius Beans*'),  $\times \frac{2}{3}$ .—*S. nuxvomica* L. k. Seed,  $\times \frac{2}{3}$  (a after Rumphia l, t. 24, b-d Hort. Bogor X-G-46a, e & g RIDLEY s. n., f. Hort. Bot. Bogor X-G-46, h-i KL 1929A, j herb. L Carpol. 1194, k herb. L Carpol. 1202).

*hitam, ipoh akar (bĕsar), i.a. buah kĕchul, pokok ipoh, ya mu lek, Mal. Pen., pokru, S, ijĕtĕk, J, bahan-lak, bina(h), b. kalikis, b. sangang, ipu kajo, sireh-sireh, talinga basing, Born.;* Philip.: *aguason, dankagi, kantĕra, katalōnga, mananāng, pangaguason, pepita-sa-katbalōgan, Bis., (i)gasud, S. L. Bis., C. Bis., (pepita-sa)-katbalōnga(n), Tag., Pamp., yangi-ilagan, Mbo.*

Notes. A fairly variable species comprising three forms. The specimens from the Philippines (*S. ignatii sens. str.*), part of those from Borneo (*S. cuspidata*), *S. krabiensis* from the Malay Peninsula, and *S. balansae* from Tonkin are characterized by large, relatively thin leaves which are dark-green when dried; the nerves are distinctly looping in the upper part, as some of the veins are fairly strongly developed. Furthermore, these specimens have the largest flowers. A second group is formed by the commonest form from the Malay Peninsula (*S. ovalifolia*) and the other part of the Bornean ones (*S. beccarii*): these have small leaves with a less conspicuous nervation, especially those of the Bornean ones are slightly more coriaceous and are brown when dry, while the flowers are smaller; the leaves are distinctly acuminate like in the large-leaved group. The third form, *S. tieute* from Java, is more or less intermediate; it has small thin leaves, which show a fairly coarse nervation, they are not conspicuously acuminate, and greyish green when dried; the flowers are small.

As to the seeds, from the Philippines I saw only irregular-shaped ones, from Borneo and Java only lenticular ones, and from the Malay Peninsula I had both types of seeds from plants which otherwise showed no difference. Therefore I conclude that this character cannot be used for specific distinction; KRUKOFF & MONACHINO (Brittonia 4, 1942, 258) reached the same conclusion for the American species. The value, formerly laid upon this character, will have been caused by the pharmaceutical use of the lenticular-shaped seeds of *S. nux-vomica* and the irregular shaped ones of *S. ignatii* from the Philippines.

The type of *S. krabiensis* is KERR 18582 (in K), not 18532 as cited in the original publication.

*S. spiraena* DOP (Bull. Soc. Bot. Fr. 57, Mém. n. 19, 1910, 19), described from Laos, is either closely related to or conspecific with *S. ignatii*; as already remarked by HILL (Kew Bull. 1917, 199) the corolla-lobes were erroneously described as being hairy inside.

*Ignatia amara* L. f. was apparently based upon flowering material of the American *Rubiacea Posoqueria longiflora* AUBL. and a fruit of *S. ignatii*. *Ignatiana philippinica* LOUR. was no more than a superfluous new name, fully based upon the diagnosis of LINNÉ f. BLANCO originally (Fl. Filip. ed. 1, 1837, 82) also adopted the name *Ignatia amara* and copied the original diagnosis, in the later editions he changed the name into *S. philippinensis*, and gave a new description of flowering material of the true *S. ignatii*, correctly including only the fruit from the original mixtum. In doing thus he restricted the name *Ignatia amara*

to the flowering, Rubiaceae part.

2. *Strychnos nux-vomica* LINNÉ, Sp. Pl. 1 (1753) 189; MIQ. Fl. Ind. Bat. 2 (1857) 378, excl. *specim. Mal. et f. depauperata* quoad est *S. lucida*; non F. v. M. Fragm. 4 (1863) 44 (= *S. lucida*); CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 90; SOLER. in E. & P. Nat. Pfl. Fam. 4, 2 (1892) 37, f. 20 E-J; TRIMEN, Fl. Ceyl. 3 (1895) 175; non BOERL. Handl. 2 (1899) 460 (= *S. lucida*); HILL, Kew Bull. (1917) 183, cum fig., 341; J. M. HILLIER, Kew Bull. (1919) 238; GAMBLE, Fl. Madras 5 (1923) 868; BURK. Dict. (1935) 2096; KANJILAL & DAS, Fl. Assam 3 (1939) 315; QUIS. Philip. J. Sc. 77 (1947) 141; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 8; HILL in Craib, Fl. Siam. En. 3 (1951) 59.—Fig. 28k.

Liana or tree up to 20 m high. Twigs slightly pubescent, glabrescent; branches yellowish grey, not rough, sometimes with axillary thorns. Leaves broadly ovate to elliptic, (4½–)7½–15 by (3½–)6½–11 cm, pergamentaceous to chartaceous, glabrous, faintly cordate to rounded at the base, apex blunt or gradually acuminate, in the latter case with a broadly triangular acumen, often mucronulate; 3–5-plinerved, the inner pair diverging slightly above the base, the outer pair mostly faint, midrib often with two additional stronger nerves in the upper leaf-half; petioles 6–11 mm. Inflorescences terminal on short axillary branchlets with usually one pair of normal leaves, mostly laxly pyramidal and fairly many-flowered, 4–4½ cm long, thinly tomentose. Calyx 1–1¼ mm high, sepals ovate, blunt to acute, outside fairly densely pubescent, inside glabrous. Corolla salver-shaped, 10–12 mm long, tube 6½–9 mm, inside in the lower half sparsely woolly, margins of the lobes thickened and minutely tomentose. Stamens inserted in the mouth, anthers subsessile, cleft to slightly below the middle, elliptic, 1¼ mm, blunt, glabrous. Ovary ovoid, 1 mm, glabrous; gradually narrowed into the style, the latter 10 mm, sparsely woolly hairy about the middle; stigma orbicular. Fruits few on strongly thickened branches, globular, c. 3–4(–6) cm ø, somewhat scabrous. Seeds c. 4, lenticular, orbicular to elliptic, 2–2¼ by 1¼–2 cm by c. 4 mm, densely sericeous.

Distr. Ceylon, India, Siam, Indo-China, and Malaysia: N. Malay Peninsula (Puket, cf. HILL), naturalized in the Philippines (Mindoro, Oriental Prov., on the shore of the Puerto Galera Bay).

Ecol. In forests and along the shore, at low altitudes.

Uses. Cultivated for its seeds, which are used in pharmacy as the main source of strychnine.

Note. *S. nux-blanda* HILL, distributed in Burma, Siam, and Indo-China, differs only slightly from *S. nux-vomica*, mostly by its larger, more-nerved and more distinctly acuminate leaves and its c. 2 mm long, mostly narrower and more acute sepals. Furthermore by the sweet seeds which contain no or only a very small percentage of strychnine. Probably this is only a variety or form of *S. nux-vomica*.

**3. *Strychnos lucida* R. BR.** Prod. (1810) 469; BTH. Fl. Austr. 4 (1869) 369; BAILEY, Queensl. Fl. 3 (1900) 1024; HILL, Kew Bull. (1911) 287; *ibid.* (1917) 194.—*Lignum colubrinum timorense* RUMPH. Herb. Amb. 2 (1741) 121, t. 38.—*S. colubrina* L.: WILLD. Sp. Pl. 1, 2 (1797) 1052, *et auct. div. p.p., typ. excl.*—*S. muricata* KOST. Allg. Med.-Pharm. Fl. 3 (1834) 1072; MIQ. Fl. Ind. Bat. 2 (1857) 380; MERR. Int. Rumph. (1917) 423; MEYER DREES, Comm. For. Res. Inst. n. 33 (1951) 74.—*S. ligustrina* BL. Rumphia 1 (1836) 68, t. 25; HILL, Kew Bull. (1911) 286; KOORD. Exk. Fl. Java 3 (1912) 58; HILL, Kew Bull. (1917) 193; HEYNE, Nutt. Pl. (1927) 1267; BURK. Dict. (1935) 2095; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 8.—*S. nux-vomica* L.: BTH. J. Linn. Soc. Bot. 1 (1856) 103, p.p.; MIQ. Fl. Ind. Bat. 2 (1857) 378, *pro spec. Mal., incl. f. depauperata*; F. v. M. Fragm. 4 (1863) 44; BOERL. Handl. 2 (1899) 460; K. & V. Bijdr. 9 (1903) 66.—*S. roborans* HILL, Kew Bull. (1925) 424; in Craib, Fl. Siam. En. 3 (1951) 60.

Small, often crooked tree or shrub, up to 12 m by 24 cm  $\phi$ , spiny when young. Twigs sparsely pubescent, soon glabrescent (Australian specimens glabrous from the beginning); branches greyish, rough by many small lenticels. *Leaves* ovate or elliptic to suborbicular, 2½–10 by 1½–6 cm, thin-chartaceous, glabrous, below granular and dull (somewhat glaucous), base cuneate to faintly cordate, usually attenuate, apex blunt to rounded, sometimes slightly emarginate, rarely tapering and acute; mostly 3-plinerved at the base (to 5-plinerved); petiole 2–4 mm. *Inflorescences* terminal, sometimes with a pair of strong basal branches in the upper leaf-axils, 2½–3 cm long, with c. 9 flowers, fairly densely, minutely pubescent. *Calyx* 1–1¼ mm long, sepals broadly cordate, acute, outside short-tomentose, inside glabrous. *Corolla* salver-shaped, 1–1½ cm long, tube 7–12 mm, inside sometimes with a few woolly hairs. *Stamens* inserted in the mouth, glabrous, filament short, anther cleft to about or slightly below the middle, oblong, 1½–1¾ mm. *Ovary* globular, c. 1 mm  $\phi$ , conically narrowed into the c. 1¼ cm long style, both glabrous; stigma truncate. *Fruits* few, globular, 2–2½ cm  $\phi$ , smooth, glabrous. *Seeds* 2–3, nearly disk-shaped, 12–15 by 10–12 by 1½–5 mm, densely short pubescent.

*Distr.* Siam (Nakawn Sawan, Rachasima, Ayuthia, Rachaburi) to Australia (W. Australia: Prince Regent River; Northern Territory: Arnhem Land; N. Queensland: Cook Peninsula); in *Malaysia*: E. Java (also Madura and Kangean), Lesser Sunda Is. (Bali to Timor), S. Moluccas (Tanimbar Is.). Fig. 29.

*Ecol.* A characteristic plant of land subject to a dry monsoon, in S. Malaysia and Siam in teak and other dryland forests, in secondary forest, shrubberies, and savannahs, in Siam also on limestone rocks, in Australia mainly in open to dense savannah woodland, open places in monsoon forests, scrubby forest, etc., up to c. 200–(400) m. *Fl.* May, Sept.–Dec., fr. June–Dec. (for both only very few exact dates are available).

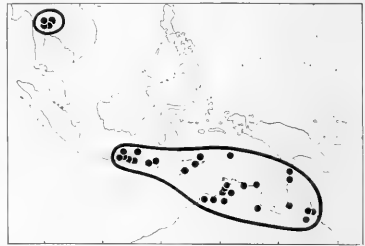


Fig. 29. Distribution of *Strychnos lucida* R. BR., a species of drier regions.

*Uses.* The bark, the bitter wood, and the root are medicinally used.

*Vern.* *Doro laut, kaju-bidara-pait, widoro gunung, J, bidara patis, Md, dergunung, Kangean, kaju bidara laut, Bali, songga, Sumbawa, ai baku moruk, bidara laut, kaju-nassi, (daon) kaju ular, maba muti (or putih), Timor, botniawe, Tanimbar Is.*

*Notes.* The leaves are deciduous, they turn yellow before falling.

HILL (Kew Bull. 1917, 193) already stressed the close affinity of *S. lucida* and *S. ligustrina*; in fact he distinguished them only upon one character: the first-named would be a shrub, the second one a tree, but he already was in doubt as to the reliability as well as the value of this character. From the large range of Australian specimens in the herbaria at Brisbane and Melbourne it is quite clear that this only 'difference' does not exist. The species is very homogeneous in spite of the large area from Siam to N. Australia and the considerable gap in the everwet parts of Malaysia.

**4. *Strychnos maingayi* CLARKE** in Hook. f. Fl. Br. Ind. 4 (1883) 88, *excl. var. fructuosa* (= *S. ignatii*); GAMBLE, J. As. Soc. Beng. 74, ii (1908) 614, p. maj. p.; HILL, Kew Bull. (1917) 141, *cum fig.*; RIDL. Fl. Mal. Pen. 2 (1923) 423.—*S. laurina* DC.: CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 88, *pro fr.*

*Liana.* Twigs glabrous; branches purplish-brown with many orbicular, small, light yellow lenticels. *Leaves* elliptic to oblong (to lanceolate), 5–10 by 2½–5½ cm, chartaceous to thin-coriaceous, glabrous, base broadly cuneate to rounded, apex tapering acute-acuminate; 3-plinerved at the base, nerves near the margin; petiole 5–7 mm. *Inflorescences* axillary and terminal or pseudo-terminal, axillary ones usually on a quadrangular 1–1½ cm long peduncle, and often with a pair of strong basal branches, thyrse oblong, (2–)5–6 cm long, laxly branched and fairly many-flowered, densely and shortly tomentose-pubescent. *Calyx* 0.9 mm, sepals broad-ovate, blunt to rounded, outside subglabrous, inside glabrous. *Corolla* rotate, 3–4 mm long, glabrous outside, inside



in the mouth long woolly hairy, tube  $\frac{1}{2}$ –1 mm, lobes linear, acute. *Stamens* inserted in the mouth, filaments  $1\frac{1}{2}$ –2 mm long, glabrous, anthers bifid at the base, oblong to lanceolate, 1 mm long, slightly acuminate, densely barbate to long-ciliate all around. *Ovary* ellipsoid,  $\frac{1}{2}$  mm, for the greater part sparsely shaggy hairy, grading into the style, the latter 2–2½ mm long and fairly thick, hairy in the basal part; stigma semi-globular. *Fruits* fairly many, globular, c. 2½ cm  $\sigma$ . *Seeds* 1–2.

*Distr. Malaysia:* Malay Peninsula (Perak and Singapore); a specimen from Borneo (ENDERT 4838, W. Kutai) with only very young flower-buds may also belong to this species.

*Ecol.* Dense jungle at low altitude. *Fr.* July.

*Notes.* The leaves look like those of *S. curtisii* and of *S. ignatii* ('ovalifolia'); the former has usually the nerves more distinctly diverging above the base, and the latter differs by the coarser venation, the more abruptly acuminate leaf apex, and the green colour of the dried leaves (in *S. maingayi* the dried leaves are reddish brown). The flowers of these three species cannot be confused, as they belong to different sections.

The relationship of *S. maingayi* is mainly with *S. andamanensis* HILL (Andamans) and *S. ovata*, but they are both sufficiently different.

**5. *Strychnos ovata* HILL, Kew Bull. (1909) 360; *ibid.* (1917) 143; MERR. En. Philip. 3 (1923) 313; non Pl. Elm. Born. (1929) 252 (= *S. axillaris*).—*S. panayensis* HILL, Kew Bull. (1917) 148, *cum fig.*; MERR. En. Philip. 3 (1923) 313.—*Strychnos* sp. 1, HILL, Kew Bull. (1917) 206.—**Fig. 30a-f.****

Climber or shrub. Twigs glabrous; branches yellowish-brown to yellowish-grey. *Leaves* ovate to elliptic or oblong, 6–10 by 3–6 cm, chartaceous, glabrous, base broadly cuneate to rounded, mostly attenuate, apex blunt, acute, or tapering acute-acuminate; 3–5-plinerved, the nerves nearer to the margin than to the midrib; petiole 4–10 mm. *Inflorescences* axillary and pseudoterminal or terminal, 2½–7 cm long, laxly to densely branched, fairly many-flowered, sparsely pubescent. *Calyx* 1–1¼ mm, sepals ovate, blunt, outside slightly tomentose, inside glabrous. *Corolla* rotate, 3–4½ mm long, thin to fairly thick-fleshy, especially the lobes, outside sparsely appressed-pubescent, mainly towards the tip of the lobes, rarely glabrous, inside in the mouth and on the bases of the lobes (sometimes very sparsely) woolly, tube 1–1¼ mm long, lobes oblong-ovate to linear. *Stamens* inserted in the mouth, filament short ( $\frac{3}{4}$ –1¼ mm), glabrous or pubescent, anthers broadly ovate to elliptic,  $\frac{3}{4}$ –1 mm long, bearded. *Ovary* globular to ovoid, 1–1¼ mm high, glabrous or shaggy hairy in the upper part, style 1–2½ mm, in the basal half likewise hairy; stigma truncate to semi-globular, somewhat broadened. *Fruits* few, ellipsoid to globular, 1–2½ cm, smooth, thin-walled, with 1–2 seeds. *Seeds* orbicular, flat, 1 cm  $\sigma$ , felty.

*Distr. Malaysia:* Borneo, Philippines (Palawan, Calamianes, Mindoro, Babuyan Is., Luzon, Ticao, Panay), and N. Celebes (Gorontalo); possibly

also on P. Penang near the Malay Peninsula.

*Ecol.* In thickets and forests, along river-banks, from sea-level up to c. 250 m. *Fl.* May–June, *fr.* Febr., May.

*Vern. Philip.:* *Igasid*, Bis.

*Notes.* In the original diagnosis the length of the petiole is given as 0.5 mm; this should be 0.5 cm.

The Bornean specimens are slightly different from those of the Philippines by less conspicuous, parallel (instead of reticulate) veins, distinctly acuminate leaves, oblong-ovate (instead of linear) corolla-lobes, and smaller and broader anthers.

KERR *s.n.* (coll. 26–10–1926) collected on P. Penang (herb. E) comes very close to the Bornean specimens; it mainly differs in some minute flower-characters (pubescence inside of the corolla mainly towards the tips of the lobes; anthers sometimes ovary and style fully glabrous).

The relationships of *S. ovata* are with *S. maingayi* (Malaya and ? Borneo) and *S. confertiflora* MERR. & CHUN (Hainan). The latter differs by its shorter and more dense inflorescences and by some flower details.

Apart from the flowers, *S. ovata* looks much alike *S. axillaris* ('*impressinervis*'), but differs by the usually more ovate and dull greyish green (instead of shining brown) leaves, in fruit moreover by the larger and more lax infructescences with larger fruits.

**6. *Strychnos villosa* HILL, Kew Bull. (1911) 296; KOORD. Exk. Fl. Java 3 (1912) 58; HILL, Kew Bull. (1917) 143; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 7.—*S. laurina* (non DC.) K. & V. Bijdr. 9 (1903) 68.—*S. horsfieldiana* (non MIQ.) KOORD.-SCHUM. Syst. Verz. 1 (1913) fam. 245, 164.—*Strychnos* sp. A & B, KOORD.-SCHUM. Lc. 165 & 166 *resp.*—*S. hirsutiflora* HILL, Kew Bull. (1917) 144, *cum fig.*, RIDL. Fl. Mal. Pen. 2 (1923) 423.**

Liana. Twigs thinly tomentose, glabrescent. *Leaves* ovate or elliptic to oblong, 7–17 by 3–8 cm, chartaceous, glabrous to pubescent on the nerves beneath, base broadly cuneate to subcordate, attenuate, apex tapering to abruptly acuminate, acumen short, deltoid, acute; 5-plinerved, inner nerves diverging at  $\frac{1}{2}$ –1¼ cm above the base; petiole  $\frac{1}{2}$ –1 cm. *Inflorescences* terminal and in the upper leaf-axils, 5–20(–30) cm long, laxly branched, many-flowered, thinly tomentose, peduncle up to 10 cm long. *Calyx*  $\frac{3}{4}$ –1 mm, sepals elliptic or ovate, acute to blunt, outside pubescent to glabrous, inside thinly pubescent. *Corolla* 2(–4) mm, less than halfway connate, outside fairly densely hirsute to subglabrous, inside partly or nearly completely (the base always excepted) woolly or hirsute. *Stamens* inserted in the mouth, filaments up to  $\frac{3}{4}$  mm, glabrous or sparsely pubescent, anthers ovate,  $\frac{1}{2}$ –¾ mm, apiculate and slightly bearded. *Pistil* 1½–4 mm, glabrous to hirsute. *Fruits* several, ellipsoid to globular, 1¾–2¼ cm, the wall thin and hard. *Seeds* 1–4, elliptic, 15 by 12½ by 3½ mm, woolly-tomentose.

*Distr. Malaysia:* Malay Peninsula (Perak,

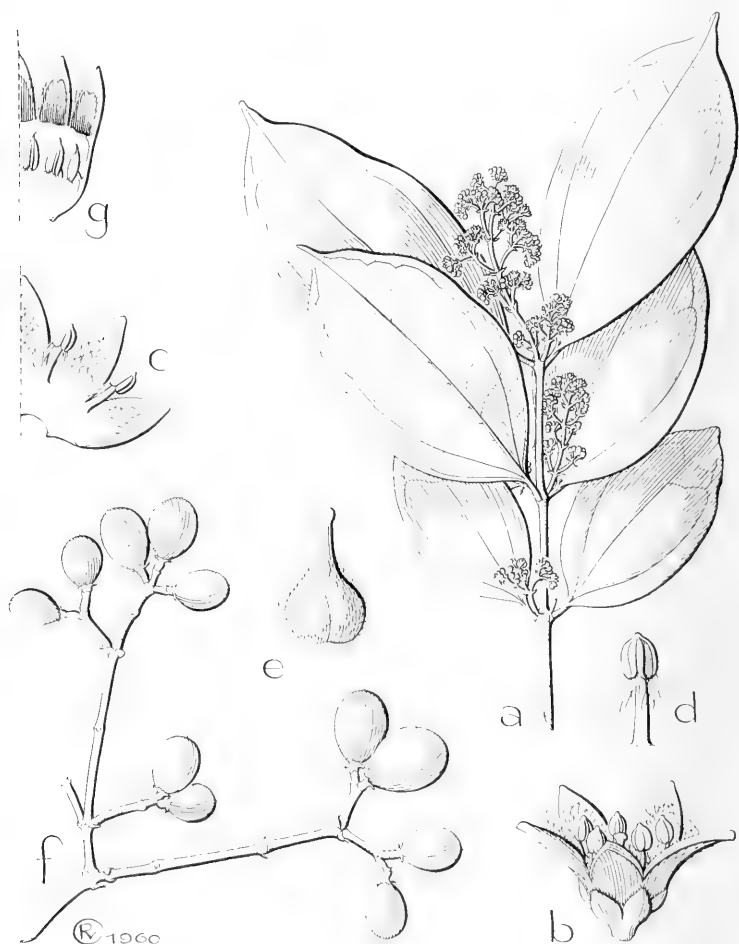


Fig. 30. *Strychnos ovata* HILL. *a.* Habit,  $\times \frac{2}{3}$ , *b.* flower,  $\times 8$ , *c.* opened corolla,  $\times 8$ , *d.* stamen,  $\times 16$ , *e.* pistil,  $\times 16$ , *f.* infructescence,  $\times \frac{2}{3}$ .—*S. axillaris* COLEBR. *g.* Opened corolla to show the type of hairiness of the *Penicillatae* (*a-e* SAN 15268, *f* KOSTERMANS 4946, *g* CURTIS 3494).

Johore), Simalur (off NW. Sumatra), N. Borneo, Java, and Lesser Sunda Is. (Bali, Sumbawa).

Ecol. Apparently indifferent to climatic seasons, in and along rain-, beach-, and teak-forests; up to 600 m. *Fl.* Jan., June–July, *fr.* Aug., Nov.

Vern. *Akar tandu dotan*, Simalur.

Notes. Well characterized by the large and lax terminal inflorescences with small and mostly hairy flowers.

This species shows, apart from the small and short-tubed flowers, a distinct resemblance to *S. colubrina*.

**7. *Strychnos curtisii* K. & G. J. As. Soc. Beng. 74, ii (1908) 614, excl. specim. KING's coll. 10281 & 10438 (= *S. colubrina*); HILL, Kew Bull. (1917) 164, cum fig., fr. excl. (= *S. colubrina*); RIDL, Fl. Mal. Pen. 2 (1923) 424, fr. excl.**

Climber. Twigs glabrous, yellowish brown, later on slightly scabrous by scattered lenticels. *Leaves* elliptic, 8–9 by 3¼–5 cm, subcoriaceous, glabrous, base rounded and slightly attenuate, apex rounded, more or less abruptly, shortly and bluntly acuminate; (sub)5-plinerved, the inner nerves diverging at c. ½ cm above the base; petioles 7 mm. *Inflorescences* axillary and (pseudo?)terminal, 2–4½ cm long, rather dense and many-flowered, minutely tomentose. *Calyx* 1½ mm, sepals broad, rounded, glabrous on both surfaces. *Corolla* rotate, 6 mm long, outside glabrous, inside the lower half of the linear-lanceolate lobes densely woolly, tube 2 mm long. *Stamens* inserted in the mouth, filaments 2 mm, glabrous, anthers oblong-lanceolate, 1 mm long, apiculate, glabrous. *Pistil* 4½ mm, densely appressed-short-pubescent on the upper half of the ovary and the greater part of the style. *Fruit* unknown.

Distr. *Malaysia*: Malay Peninsula.

Ecol. Evergreen forest, 200–650 m. *Fl.* April–June.

Vern. *Sēmijo akar*.

Notes. Very close to *S. polytrichantha* and *S. oleifolia*. The differences between these three species are mainly in such characters as larger or smaller flowers, inside completely or only partly woolly, and in the shape and nervation of the leaves. Possibly they only represent a Malayan, Bornean, and Philippine subspecies of one species, but for the moment I prefer to keep them separate.

As a lectotype I have designated CURTIS 2973, from which I saw two duplicates from SING.

**8. *Strychnos polytrichantha* GILG, Notizbl. Berl.-Dahl. 1 (1897) 267; HILL, Kew Bull. (1911) 298, cum fig.; *ibid.* (1917) 156.**

Climber. Twigs glabrous, branchlets yellowish brown, fairly scabrous by scattered small lenticels. *Leaves* ovate or elliptic to lanceolate, 6½–14 by 2–7½ cm, chartaceous to subcoriaceous, glabrous, base rounded to acute, attenuate, apex broadly rounded, more or less abruptly acuminate, acumen short and blunt; 5-plinerved, inner nerves diverging slightly above the base, nearly as strong as the midrib, veins mainly transverse, minute and dense, prominulous on both sides; petiole 6–7 mm.

*Inflorescences* axillary and terminal, 2–8 cm long, laxly branched to fairly compact, few- to many-flowered, minutely tomentose, glabrescent. *Calyx* 1–2 mm, sepals ovate, blunt, inside glabrous. *Corolla* 8–10 mm, tube 3 mm, inside densely woolly the basal part of the tube excepted. *Stamens* inserted in the mouth, filaments 2½–4 mm, glabrous, anthers lanceolate, 1¼ mm, minutely apiculate, barbate or not. *Pistil* 9 mm long, ovary and at least the basal half of the style shaggy hairy. *Fruits* few, globular, 5 cm ø, scabrous. *Seeds* probably many.

Distr. *Malaysia*: Borneo.

Ecol. Up to 1800 m. *Fl.* April–July, Dec.

Notes. Closely related to *S. curtisii* (Mal. Pen.) and to *S. oleifolia* (Philipp.); see under the first-named species. Among these three species *S. polytrichantha* is the one best characterized by its large, woolly flowers and its very typical nervation and venation.

**9. *Strychnos oleifolia* HILL, Kew Bull. (1917) 156; MERR. En. Philip. 3 (1923) 313.**

Liana. Twigs glabrous, branchlets yellowish brown, more or less scabrous by many small lenticels. *Leaves* ovate-oblong to lanceolate, c. 11–12 by 4 cm, chartaceous, glabrous, base broadly cuneate, slightly attenuate, apex gradually acuminate; 3–5-plinerved, the inner nerves diverging at c. 2 mm above the base; petiole 6–10 mm. *Inflorescences* terminal, 7–8 cm long, fairly laxly branched and many-flowered, thinly short-hairy. *Calyx* 1¼ mm, sepals ovate, blunt, sparsely hairy outside, inside glabrous. *Corolla* 8 mm, outside with some scattered short hairs about the mouth and along the sutures, inside woolly from slightly above the base of the tube to about halfway the lobes; tube 3½ mm long. *Stamens* inserted in the mouth, filaments 2 mm, glabrous, anthers elliptic, 1½ mm long, glabrous. *Pistil* 6 mm, thinly shaggy hairy on the upper half of the ovary and all along the style. *Fruit* unknown.

Distr. *Malaysia*: Philippines (Palawan, possibly also in Luzon).

Ecol. In forests at low altitudes. *Fl.* May.

Notes. A specimen from Luzon (RAMOS 1388), which might also belong to this species, shows a large infructescence with branches which are only slightly thickened and with several small, 2-seeded fruits. Vegetatively this specimen is about identical with the type from Palawan, but as flowers are absent nothing can be said with certainty. These fruits however, are one reason more to keep this species apart from *S. polytrichantha*, with which it is distinctly related. Other reasons are the differences in the leaves and in some flower characters.

On the other side the whole group of three species (*S. curtisii*, *S. polytrichantha*, and *S. oleifolia*) is distinctly related to *S. colubrina*, the main difference being the relatively very short tube of the corolla. *S. oleifolia* especially, is quite close to some Philippine forms of *S. colubrina*.



Fig. 31. *Strychnos colubrina* L. a. Habit of '*S. forbesii*',  $\times \frac{2}{3}$ , b. flower,  $\times 4$ , c. opened corolla,  $\times 6$ , d. stamen,  $\times 6$ , e. pistil,  $\times 6$ , f. twig with infructescences,  $\times \frac{2}{3}$ , g. and h. frontal and lateral view of seed,  $\times 1$  (a BRASS 5890, b-e RAHMAT 652, f VAN ROYEN 4272, g-h ELMER 8960).

**10. *Strychnos lanata*** HILL, Kew Bull. (1911) 299, *cum fig.*; *ibid.* (1917) 165; MERR. En. Philip. 3 (1923) 312.

Liana. Twigs glabrous; branchlets brown, with many minute lenticels. *Leaves* oblong-(ovate), 6½–18 by 3½–9 cm, chartaceous, glabrous, base cuneate to rounded, sometimes slightly attenuate, apex blunt or gradually blunt-to acute-acuminate; 5-plinerved; petioles ½–1 cm long. *Inflorescences* axillary, 6–8 cm long, laxly branched, many-flowered, tomentose. *Calyx* 1¼–2 mm, sepals ovate, blunt to acute, glabrous. *Corolla* 5½–7 mm, inside from about halfway the tube to at least halfway the lobes woolly; tube 2–2¼ mm. *Stamens* inserted in the mouth, filaments 1–1½ mm, glabrous, anthers oblong to ovate-lanceolate, 1¼–2 mm, apiculate, barbate. *Pistil* 5–6 mm, ovary woolly, style in the lower half with a few long woolly hairs. *Fruit* unknown.

Distr. *Malaysia*: Philippines (Mindanao).

Ecol. Rain-forest along river, at 350–700 m. Fl. Sept.

Vern. *Bebekang-ulongen*, Sub., *tolanan*, Bo.

Note. This species is about intermediate between *S. oleifolia* and *S. colubrina*; from the former differing in some flower details, from the latter mainly by the short corolla-tube.

**11. *Strychnos colubrina*** LINNÉ, Sp. Pl. 1 (1753) 189; NON SPAN. in Hook. Comp. Bot. Mag. 1 (1835) 347, *nec* Linnaea 15 (1841) 325 (= *S. lucida*); HILL, Kew Bull. (1917) 157; GAMBLE, Fl. Madras 5 (1923) 868; BURK. Dict. (1935) 2095.—*Sirioides* & *Sirioides alter* RUMPH. Herb. Amb. 5 (1747) 49, t. 29 f. 1.—*Camotain* BLCO, Fl. Filip. (1837) 85; ed. 2 (1845) 62; ed. 3, 1 (1877) 116.—*S. laurina* WALL. [Cat. (1829) n. 1591, *nom. nud.*; G. DON, Gard. Dict. 4 (1837) 65, *in syn.*] ex DC. Prod. 9 (1845) 13; *non* K. & V. Bijdr. 9 (1903) 68 (= *S. villosa*); HILL, Kew Bull. (1911) 297; *ibid.* (1917) 150, *cum fig.*, *incl. var. thorelii*; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 7; *non* HEINE, Pfl. Samml. Clemens Kinabalu (1953) 90 (= *S. borneensis*).—*S. acuminata* WALL. [Cat. (1829) n. 1593, *p.p.*, *nom. nud.*] ex DC. Prod. 9 (1845) 14; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 86; HILL, Kew Bull. (1911) 302.—*S. multiflora* BTH. J. Linn. Soc. Bot. 1 (1856) 102; F.-VILL. Nov. App. (1880) 136; OLIVER in Hook. Ic. (1892) t. 2213; HILL, Kew Bull. (1911) 300, t. opp. p. 301; *ibid.* (1917) 162; BROWN, Min. Prod. Philip. For. 1 (1920) 406; *ibid.* 3 (1921) 221; MERR. En. Philip. 3 (1923) 312; BROWN, Usef. Pl. Philip. 3 (1950) 227.—*S. potatorum* (*non* L. f.) F.-VILL. Nov. App. (1880) 136; VIDAL, Sinopsis (1883) 33, t. 69 f. D, *pro var. multiflora* VIDAL.—*S. hypogyna* CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 86, *pro specim. Born.*, *typo excl.*; cf. HILL, Kew Bull. (1917) 146.—*S. septemnervis* CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 88; GAMBLE, J. As. Soc. Beng. 74, ii (1908) 619; HILL, Kew Bull. (1917) 149, *cum fig.*, *incl. var. imberbis*; RIDL. Fl. Mal. Pen. 2 (1923) 423.—*S. ignatii* (*non* BERG.) VIDAL, Rev. Pl. Vasc. Filip. (1886) t. 1.—*S. bancroftiana* F. M. BAIL.

Rep. Exp. Bellenden-Ker (1889) 49; Syn. Queensl. Fl. Suppl. 3 (1890) 47; Queensl. Fl. 3 (1900) 1025, t. 43; Compr. Cat. Queensl. Pl. (1913) 340; HILL, Kew Bull. (1911) 301; *ibid.* (1917) 208.—*S. celebica* KOORD. Med. Lands Pl. Tuin 19 (1898) 540 & 631.—*S. minahassae* KOORD. ex BOERL. Handl. 2 (1899) 460, *nom. nud.*—*S. kerstingii* GILG & K. SCH. in K. Sch. & Laut. Fl. Schutzgeb. (1901) 498; GILG & BENED. Bot. Jahrb. 54 (1916) 164.—*S. luzonensis* ELM. Leaf. Phil. Bot. 1 (1908) 332, *p.p.*, *typo excl.*—*S. barbata* HILL, Kew Bull. (1909) 359, *non* CHIOV. (1932); *ibid.* (1911) 297; *ibid.* (1917) 153; MERR. Int. Rumph. (1917) 423.—*S. forbesii* HILL, Kew Bull. (1909) 360; *ibid.* (1911) 295; *ibid.* (1917) 150, *fr. excl.*—? *S. merrillii* HILL, Kew Bull. (1911) 297; *ibid.* (1917) 161; MERR. En. Philip. 3 (1923) 312.—*S. dubia* HILL, Kew Bull. (1911) 298, *cum fig.*; *ibid.* (1917) 156; MERR. En. Philip. 3 (1923) 312.—*S. similis* HILL, Kew Bull. (1912) 38; *ibid.* (1917) 153; MERR. En. Philip. 3 (1923) 313.—*S. pycnonera* GILG & BENED. Bot. Jahrb. 54 (1916) 164, f. 4; HILL, Kew Bull. (1917) 162.—*S. cinnamophylla* GILG & BENED. Bot. Jahrb. 54 (1916) 166; HILL, Kew Bull. (1917) 148.—*S. myriantha* GILG & BENED. Bot. Jahrb. 54 (1916) 167, f. 5; HILL, Kew Bull. (1917) 162; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 303.—*S. leuconera* GILG & BENED. Bot. Jahrb. 54 (1916) 169.—*S. curtisii* K. & G.: HILL, Kew Bull. (1917) 164, *pro fr.*; RIDL. Fl. Mal. Pen. 2 (1923) 424, *pro fr.*—*S. silvicola* HILL, Kew Bull. (1930) 156; in Craib, Fl. Siam. En. 3 (1951) 61.—*S. polytoma* (*non* GILG & BENED.) KAN. & HAT. Bot. Mag. Tokyo 53 (1939) 11.—**Fig. 31.**

Liana, sometimes a tree (?). Twigs glabrous, branchlets greyish and fairly smooth. *Leaves* ovate or suborbicular to lanceolate, 8–25 by 3–12 cm, chartaceous to stiff-coriaceous, glabrous, base subcordate to broadly cuneate, apex blunt to rounded and rather abruptly shortly blunt-acuminate to gradually acute-acuminate, sometimes even caudate; 3–5(–7)-plinerved, inner nerves usually diverging fairly high above the base (up to c. 2 cm) and in the eastern races usually at a different height, venation often coarse-scalariform; petiole 3–15 mm. *Inflorescences* axillary and/or terminal, usually large (up to c. 15 cm long), widely branched and many-flowered (in some western races only a few cm long and with some flowers), partly or completely thinly tomentose or subglabrous. *Calyx* 1–3 mm, outside (glabrous to) sparsely to densely short-tomentose, inside glabrous, sepals broad-ovate to suborbicular, blunt to rounded, rarely acute. *Corolla* 3–6½ mm long, about halfway connate, outside glabrous (except sometimes in young buds) inside at least about the mouth, at most from about halfway the tube to the mouth, rarely also on the lobes, (mostly densely) woolly, lobes slightly thickened only. *Stamens* inserted in the mouth, filament up to 1½ mm, glabrous, anther ovate to ovate-lanceolate or elliptic to oblong, ¾–1½ mm long, blunt or minutely apiculate, glabrous or barbate. *Pistil* 2–6 mm, ovary completely or for the greater part hairy, style

often glabrous, sometimes in the basal half, rarely completely hairy, indument sparse to fairly dense, shaggy to woolly. *Fruits* many, globular, 2½–3 cm ø, sometimes ellipsoid and 3½ cm long, thin-walled, glabrous and smooth to minutely warty. *Seeds* 1–8, often 2, lenticular, 12–15 by 10–12 by 2–4 mm, minutely densely tomentose.

*Distr.* From Ceylon, India, Cochín-China, through *Malaysia*: Malay Peninsula, Simalur I. off NW. Sumatra, Borneo, Philippines, Celebes, Moluccas, New Guinea, and New Britain, to the Solomon Is. and Australia (NE. Queensland, mainly the coastal region between Cairns and Innisfail).

*Ecol.* Primary and secondary forests, in New Guinea also in mixed *Araucaria* forests, from sea-level up to 1850 m. *Fl.* mainly July–Nov., fr. Jan.–Dec.

*Uses.* The wood, bark, and roots are medicinally used (*snake-wood*). A decoction of these parts is used as a poison for arrows, the vine for tying purposes.

*Vern.* *Snake-wood*, E, *tali siri* (*kētjil*), M, *olor sikasa ilir dotan*, Simalur, *lèngkoyan*, *sēmijo akar*, Mal. Pen., *tao kwang du tuk*, Mal. Pen. Surat, *ipu ako*, i. tanah, Born.; Philip.: *abukobukò*, *bukúan*, Ibn., *batlåg*, Pint., Sbl., *batul pamulaklak*, *tibanglân*, Tag., *bugahin*, Bis., *bukúan*, Neg., *dañgilan Bag.*, *fantandok*, Ill., *malaitmo-balaein*, Dun.; *ranosandang*, Cel., *akar pamali*, *aywaa umali*, *hutuu*, *wale ammelau*, *wari ammo*, Moluccas.

*Notes.* Very variable species, comprising a great number of local races. Many of these races were treated by HILL as separate species, and some more he either did not have available or could not identify. The differences between these races are mostly very small and mainly concern the following characters: larger or smaller flowers, corolla more or less pubescent, anthers barbate or glabrous, style either glabrous or partly or entirely hairy, furthermore differences in shape, size, nervation of the leaves, and larger or smaller inflorescences. Many of these characters proved to be variable in one or some of the races and are therefore useless for specific distinction. Even only very few races can clearly be characterized: best recognizable are '*S. bancroftiana*' and '*S. forbesii*' from Australia and New Guinea, with oblique, oblong to lanceolate leaves, the inner nerves of which distinctly diverge at a different height, and '*S. multiflora*' from the Philippines with large and many-flowered inflorescences, large flowers, and large, ovate, coarsely reticulate leaves. Towards the west the leaves, inflorescences, and flowers are smaller; moreover, the leaves of the continental Asiatic forms are usually narrow and long-acuminate.

Though I did not see good specimens of *S. merrillii*, I scarcely doubt its conspecificity with the present species; the only difference, according to HILL's description, is apparently the pubescence of twigs, leaves, and the outside of the corolla.

The nearest relative of *S. colubrina* is apparently *S. quadrangularis*, different by the glabrous pistil and seed.

**12. *Strychnos quadrangularis* HILL**, Kew Bull. (1917) 205; RIDL. Fl. Mal. Pen. 2 (1923) 426; BURK. Dict. (1935) 2099.

Climbing shrub or liana. Twigs slender, mostly sharply quadrangular, glabrous; branches rounded quadrangular. *Leaves* (ovate-)oblong to elliptic, 13–20 by 5½–11 cm, thin-chartaceous to papery, glabrous, beneath copper-coloured to yellowish brown or green when dried, base cuneate to rounded, apex (caudate-)acuminate; 3–5-plinerved; petiole 4–5 mm. *Inflorescences* axillary, 4–6 cm long, laxly branched, fairly many-flowered, minutely pubescent. *Sepals* broadly ovate, acute, glabrous on either side. *Corolla* small; *stamens* unknown. *Pistil* glabrous. *Fruits* globular, c. 2 cm ø, said to be white. *Seed* 1, semiglobular, c. 1 cm ø and 8 mm thick, glabrous.

*Distr. Malaysia*: Malay Peninsula (Perak, Selangor).

*Ecol.* Dense jungle, from the lowland to above 1000 m. Fr. Sept.

*Uses.* The bark of the roots is used for arrow-poison. See BURKILL, l.c.

*Vern.* *Akar ipoh chelak*, a.i. *padi*, a.i. *siat gunong*, a.i. *tontong*, *ipoh akor*.

*Note.* Inadequately known, doubtless closely related to *S. colubrina*, mainly different by the glabrous pistil and seed, both characters being usually constant.

**13. *Strychnos borneensis* LEENH.** Bull. Jard. Bot. Brux. 32 (1962) 458.—*S. laurina* (non DC.) HEINE, Pfl. Samml. Clemens Kinabalu (1953) 90.—Fig. 32.

Liana. Twigs glabrous; branchlets (yellowish) brown, smooth or scabrous by many small lentils. *Leaves* oblong or elliptic-oblong, 7½–9½ by 3–4 cm, chartaceous, glabrous, base cuneate, slightly attenuate, apex gradually to caudate acute-acuminate, acumen up to 1½ cm; 3–5-plinerved, nerves diverging at or slightly above the base, distinct, not far from the margin, venation dense, transverse; petiole 6–7 mm. *Inflorescences* axillary, 2–7 cm long, larger ones long-peduncled and with a pair of strong branches at the base, laxly branched, relatively few-flowered, at least the terminal parts fairly densely rusty tomentose. *Calyx* 1½–1¾ mm, inside sometimes at the base with a line of erect hairs, sepals ovate, rounded to nearly truncate. *Corolla* c. 9 mm long, halfway connate, very thin, outside glabrous, inside densely woolly from slightly above the base to about halfway the lobes, most densely so in the mouth. *Stamens* inserted in the mouth, filament 1¼–2½ mm long, glabrous, anthers elliptic to lanceolate, 1¼–1¾ mm long, minutely apiculate, glabrous or with a few hairs at the base of the cells. *Pistil* 8–9 mm, fairly densely shaggy short-hairy from about halfway the ovary upwards. *Fruit* (possibly not quite normal and galled!) on a strongly thickened branch, globular, c. 2 cm ø, slightly scabrous. *Seeds* unknown.

*Distr. Malaysia*: North Borneo.

*Ecol.* Forests, from sea-level to c. 1600 m. *Fl.* Nov., Jan.

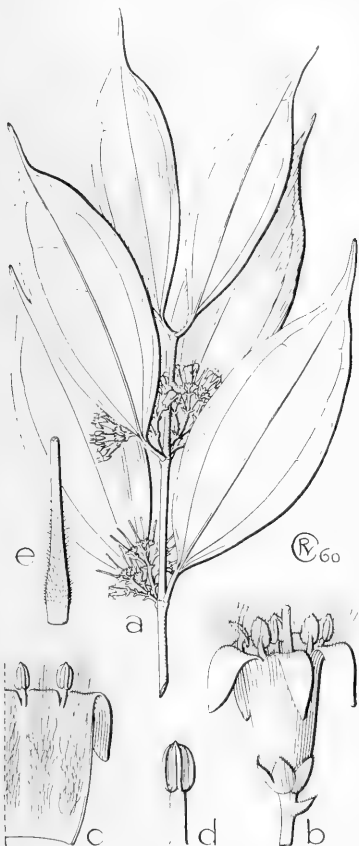


Fig. 32. *Strychnos borneensis* LEENH. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 4$ , c. opened corolla,  $\times 4$ , d. stamen,  $\times 8$ , e. pistil,  $\times 4$  (all from PUASA 4190).

Vern. *Bina, kabuh*.

Note. A characteristic species, possibly related to *S. polytrichantha*, but differing by the corolla of which the tube is about half the total length. The leaves are very similar to those of *S. vanprukii* CRAIB (Siam).

14. *Strychnos ledermannii* GILG & BENED. Bot. Jahrb. 54 (1916) 169; HILL, Kew Bull. (1917) 179.

Liana. Twigs subglabrous; branchlets grey, smooth. Leaves ovate to oblong-elliptic, 7–13 by 3–5½ cm, coriaceous to chartaceous, glabrous, base cuneate to broadly rounded, apex gradually acute-acuminate; 5–7-plinerved above the base, nerves irregular, venation coarse; petiole 5–7 mm. Inflorescences axillary and terminal, laxly branched, up to c. 5 cm long, few-flowered, subglabrous. Flowers seen in bud only. Calyx 1 mm, sepals elliptic to broadly ovate, blunt, glabrous on both surfaces. Corolla 3 mm, halfway up connate, outside glabrous, inside woolly about the mouth. Stamens inserted in or slightly below the mouth, anthers subsessile, elliptic, ¾–1 mm, glabrous. Pistil 2¼ mm, with some patent long hairs on the style. Fruit unknown.

Distr. Malaysia: New Guinea (NE. New Guinea, Etappenberg).

Ecol. Dense forest, 850 m. Fl. Oct.

Notes. HILL, who did not see any specimen, placed this incorrectly in his section *Penicillatae*.

The only one of the syntypes apparently still preserved, LEDERMANN 9435 (dupl. in K, L), I have indicated as lectotype.

15. *Strychnos lanceolaris* MIQ. Sum. (1861) 551 & 227; HILL, Kew Bull. (1911) 295.

Probably a liana. Twigs glabrous; branchlets yellowish, scabrous. Leaves lanceolate, 6½–9 by 2–2½ cm, coriaceous, glabrous, base acute, apex caudate-acuminate, acute; 3-plinerved above the base, nerves usually not far from the margin, veins transverse, minute, and dense; petiole 4–6 mm. Inflorescences axillary, lax, c. 2½ cm long, narrow and with few flowers, thinly tomentose. Calyx 1½ mm, outside sparsely pubescent, inside glabrous. Corolla 3 mm, halfway up connate, outside very sparsely pubescent, inside with some short woolly hairs near the apex. Stamens inserted in the mouth, filaments short, glabrous, anthers broad-ovate, ½ mm long, apiculate, slightly barbate. Pistil 2 mm, sparsely pubescent. Infructescences with strongly thickened branches, torus 1 cm thick. Fruits probably large and many-seeded.

Distr. Malaysia: Sumatra.

Vern. *Tēmēras akar*.

Note. A species of unclear relationships.

16. *Strychnos flavescens* K. & G. J. As. Soc. Beng. 74, ii (1908) 617; HILL, Kew Bull. (1917) 155; RIDL, Fl. Mal. Pen. 2 (1923) 423.

Liana. Twigs usually glabrous, sometimes sparsely minutely pubescent; branchlets whitish yellow-brown, fairly smooth. Leaves elliptic-lanceolate to ovate-oblong, 5–12 by 3–6½ cm, thin-chartaceous to coriaceous, glabrous, very glossy light yellow-green when dried, base cuneate to subcordate, slightly attenuate, apex gradually acuminate, more or less caudate, acute; 3-plinerved at the base, nerves near the margin, distinctly more faint than the midrib; petiole ½–1 cm. Inflorescences terminal and axillary, up to 10 cm long, laxly branched, many-flowered, sparsely minutely pubescent. Flowers (4–)5-merous. Calyx 1 mm, outside with some scattered hairs, inside

glabrous, sepals ovate, blunt. *Corolla* 2-3 mm, halfway connate or somewhat less, outside thinly tomentose, inside about the mouth woolly or fully glabrous; lobes often strongly thickened. *Stamens* inserted in the mouth, anthers subsessile, ovate,  $\frac{1}{2}$ - $\frac{2}{3}$  mm, minutely apiculate, glabrous or barbate. *Pistil*  $1\frac{1}{2}$ -2 mm, glabrous or the style slightly hairy. *Fruits* many, subglobular, c.  $1\frac{1}{2}$ -2 cm  $\sigma$ , smooth or slightly warty. *Seeds* 1 or 2, lenticular, 14-16 by  $11\frac{1}{2}$  mm, thin.

Distr. *Malaysia*: Malay Peninsula, Banka.

Ecol. Swampy forests, along streams, at low altitudes. Fl. April-May, Nov.

Vern. *Akar kalikut, kèlikuh*, Banka.

**17. *Strychnos luzonensis*** ELM. *Leafl. Philip. Bot.* 1 (1908) 332, p.p.; *em. HILL, Kew Bull.* (1911) 297; *ibid.* (1917) 180, *cum fig.*; MERR. *En. Philip.* 3 (1923) 312, p.p.

Scandent shrub. Twigs thinly, minutely pubescent. *Leaves* oblong-ovate,  $7\frac{1}{2}$ -10 by  $3\frac{1}{2}$ -4 cm, thin-chartaceous, midrib on both sides slightly pubescent near the base or glabrous beneath; base rounded, attenuate, apex tapering acute-acuminate; 3-5-plinerved; petiole  $7\frac{1}{2}$  mm. *Inflorescences* terminal, with a pair of strong branches in the upper leaf-axils, c. 5-7 cm long, lax, many-flowered, thinly short-pubescent. *Calyx* 1 mm, outside subglabrous, inside glabrous, sepals ovate, blunt to acute. *Corolla*  $2\frac{1}{2}$  mm, tube 1 mm, lobes thickened towards the apex, inside with a line of erect, bristle-like hairs about halfway the free lobes (these hairs sometimes missing in older flowers!). *Stamens* inserted in the mouth, filaments  $\frac{1}{2}$  mm, glabrous, anther broad-ovate (subquadrangular),  $\frac{1}{2}$  mm, apiculate, slightly barbate. *Pistil*  $1\frac{1}{2}$  mm, thinly pubescent. *Fruit* unknown.

Distr. *Malaysia*: Philippines (Luzon), once collected.

Ecol. Humid forest, 500 m. Fl. May.

Notes. The combination of a short corolla-tube and a line of erect bristle-hairs is unique among the Malaysian species.

As mentioned already by HILL, ELMER included in his original description two different elements; the above description has been based exclusively upon ELMER 8251, in accordance with HILL's emendation. The other specimen, ELMER 7885, is here referred to *S. colubrina*.

Vegetatively, *S. luzonensis* closely resembles *S. ovata*; the latter species is *inter alia* different by the glabrous twigs and the often blunt leaves with the nerves closer to the margin.

**18. *Strychnos axillaris*** COLEBR. *Trans. Linn. Soc.* 12 (1819) 356, t. 15; WALL. in Roxb. *Fl. Ind.* 2 (1824) 266; BL. *Bijdr.* (1826) 1019; CLARKE in Hook. *f. Fl. Br. Ind.* 4 (1883) 89; HILL, *Kew Bull.* (1917) 169.—*S. malaccensis* BTH. *J. Linn. Soc. Bot.* 1 (1856) 101; GAMBLE, *J. As. Soc. Beng.* 74, ii (1908) 618; HILL, *Kew Bull.* (1917) 177; RIDL, *Fl. Mal. Pen.* 2 (1923) 425.—*S. horsfieldiana* MIQ. *Fl. Ind. Bat.* 2 (1857) 379; HILL, *Kew Bull.* (1911)

294, *cum fig.*; *ibid.* (1917) 179; BAKH. *f. in Back. Bekn. Fl. Java* (em. ed.) 7 (1948) fam. 170, p. 7.—*S. monosperma* MIQ. *Fl. Ind. Bat.* 2 (1857) 381; HILL, *Kew Bull.* (1917) 207.—*S. palembanica* MIQ. *Sum.* (1861) 551 & 227; HILL, *Kew Bull.* (1911) 293; *ibid.* (1917) 179; CAMMERL. *Bull. Jard. Bot. Btzg III*, 5 (1923) 304, *excl. spec. Simalur*.—*S. psilosperma* F. v. M. *Fragm.* 4 (1863) 44; BTH. *Fl. Austr.* 4 (1869) 369; F. M. BAIL. *Queensl. Fl.* 3 (1900) 1024; *Compr. Cat. Queensl. Pl.* (1913) 337, f. 316; HILL, *Kew Bull.* (1917) 171 & 341.—*S. pubescens* CLARKE in Hook. *f. Fl. Br. Ind.* 4 (1883) 89; GAMBLE, *J. As. Soc. Beng.* 74, ii (1908) 620, *incl. var. scortechinii* K. & G.; HILL, *Kew Bull.* (1911) 292; DOP, *Fl. Gén. I.-C.* 4 (1914) 165; HILL, *Kew Bull.* (1917) 166; RIDL, *Fl. Mal. Pen.* 2 (1923) 424; BURK. *Dict.* (1935) 2098.—*S. pilgeriana* GILG, *Notizbl. Berl.-Dahl.* 1 (1897) 268.—*S. rufa* CLARKE: GAMBLE, *J. As. Soc. Beng.* 74, ii (1908) 617, p.p.—*S. schmidtii* GILG, *Bot. Tidsskr.* 32 (1915) 312; HILL, *Kew Bull.* (1917) 170; in Craib, *Fl. Siam.* En. 3 (1951) 61.—? *S. oophylla* GILG & BENED. *Bot. Jahrb.* 54 (1916) 170, f. 6; HILL, *Kew Bull.* (1917) 181.—*S. polytoma* GILG & BENED. *Bot. Jahrb.* 54 (1916) 173, f. 7; HILL, *Kew Bull.* (1917) 182; non KAN. & HAT. *Bot. Mag. Tokyo* 53 (1939) 11 (= *S. colubrina*).—*S. wenzelii* MERR. *Philip. J. Sc.* 11 (1916) Bot. 202; HILL, *Kew Bull.* (1917) 178; MERR. *En. Philip.* 3 (1923) 313.—*S. quintuplinervis* HILL, *Kew Bull.* (1917) 166; RIDL, *Fl. Mal. Pen.* 2 (1923) 424.—*S. robinsonii* HILL, *Kew Bull.* (1917) 168.—*S. scortechinii* HILL, *l.c.*, *cum fig.*; RIDL, *Fl. Mal. Pen.* 2 (1923) 425; BURK. & HOLT. *Gard. Bull. S.S.* 3 (1923) 61.—*S. armata* HILL, *Kew Bull.* (1917) 170.—*S. plumosa* HILL, *l.c.* 171, *cum fig.*; in Craib, *Fl. Siam.* En. 3 (1951) 60.—*S. arborea* HILL, *Kew Bull.* (1917) 172, *cum fig.*—*S. penicillata* HILL, *l.c.* 178; RIDL, *Fl. Mal. Pen.* 2 (1923) 425; BURK. *Dict.* (1935) 2098.—*S. impressinervis* HILL, *Kew Bull.* (1917) 180; MERR. *En. Philip.* 3 (1923) 312.—*S. mucronata* HILL, *Kew Bull.* (1917) 181; in Craib, *Fl. Siam.* En. 3 (1951) 58.—*S. tesseroidea* HILL, *Kew Bull.* (1917) 206; MERR. *En. Philip.* 3 (1923) 313.—*S. cenabrei* MERR. *Philip. J. Sc.* 20 (1922) 433; *En. Philip.* 3 (1923) 312.—*S. viridiflora* HILL, *Kew Bull.* (1925) 424, *nom. illeg.*, non DE WILD. (1923).—*S. kawber* HILL, *Kew Bull.* *l.c.* 425; in Craib, *Fl. Siam.* En. 3 (1951) 58.—*S. ovata* (non HILL) MERR. *Pl. Elm. Born.* (1929) 252.—*S. chloropetalata* HILL, *Kew Bull.* (1930) 175; HENDERS. *J. Mal. Br. R. As. Soc.* 17 (1939) 58; HILL in Craib, *Fl. Siam.* En. 3 (1951) 57.—*Strychnos sp. HILL* in Craib, *Fl. Siam.* En. 3 (1951) 62.—**Fig. 30g.**

Usually a liana, sometimes a shrub or small tree. Twigs densely to sparsely minutely pubescent and glabrescent or glabrous; axillary spines sometimes present. *Leaves* rhomboid to suborbicular and elliptic to lanceolate,  $1\frac{3}{4}$ -18 by 1-9 cm, chartaceous (rarely  $\pm$  herbaceous) to coriaceous, smooth to densely minutely warty on the lower surface, above glabrous to tomentose on the midrib and the bases of the nerves, beneath mainly on mid-



rib, nerves, and veins, sometimes sparsely all over the leaf; base cuneate to subcordate, often attenuate (in Australian specimens sometimes decurrent to the base of the petiole), apex tapering acute-acuminate to slightly emarginate, occasionally mucronate; 3-5-plinerved at the base; petiole  $1\frac{1}{2}$ - $7\frac{1}{2}$  mm. *Inflorescences* axillary and/or terminal, 1-5 cm long, subsessile or distinctly peduncled, dense to lax, always fairly many-flowered, densely minutely tomentose to glabrous. *Calyx* 1-2 mm, sepals ovate to suborbicular, acute to rounded, outside glabrous to densely tomentose, inside glabrous. *Corolla* 3-4 mm long, about halfway connate, lobes strongly thickened in their upper part, outside glabrous or very rarely sparsely tomentose, inside with a row of erect bristle-like hairs at the base of or up to halfway on the lobes. *Stamens* inserted at c.  $\frac{1}{4}$  the length of the corolla below the hair ring, filaments short, glabrous, anthers (broadly) ovate,  $\frac{2}{3}$ -1 mm long, usually minutely apiculate, barbate, rarely moreover ciliate all around. *Pistil*  $1\frac{1}{4}$ -2 mm, glabrous. *Fruits* some to many, either oblique-ovoid,  $1\frac{1}{2}$ -2 by  $\frac{3}{4}$ - $1\frac{1}{4}$  cm, and slightly scabrous, or globular,  $\frac{3}{4}$ - $1\frac{1}{2}$  cm  $\phi$  and smooth, pericarp thin, corneous. *Seeds* 1-2, either elliptic,  $7\frac{1}{2}$ -15 by 6-10 by 3-5 mm, or orbicular, 6- $7\frac{1}{2}$  mm  $\phi$ .

*Distr.* Continental SE. Asia from Assam through Siam to Cochin-China, throughout Malaysia (except the Lesser Sunda Is.) to Australia (E. Queensland from about Innisfail to the MacPherson Range just over the NSW frontier).

*Ecol.* In and along primary and secondary forests, in dry as well as in swampy localities, sometimes on coastal rocks, up to 2000 m. *Fl.* mainly March-Aug., fr. Jan.-Dec.

*Uses.* In the Malay Peninsula apparently sometimes used for the composition of an arrow-poison.

*Vern.* *Akar kuling*, Sum., *akar bidara utan*, *a. ipoh*, *a. lada lada*, *bédara utara*, *bélaï bésar*, *ipoh batang*, *i. burong*, *kio ngu*, *lep rawk*, *opoh batang*, Mal. Pen., *tjantèlan*, *J. tangang*, Born.; Philip.: *malaigasud*, S. L. Bis., (*mara*) *igasud*; *apu'u laáwan*, Talaud, *kebrai pakrik*, New Guinea.

*Notes.* This is the most variable species of the genus in Indo-Malaysia; it comprises a fairly large number of local races, most of them distinguished by HILL (1917 and later) as different, though related, species. In my opinion they can be treated only as local races as most of the differences between these forms are either gradual or concern vegetative characters only; the flowers are surprisingly uniform. Only the fruits - and accordingly the seeds - show two distinctly different forms which are geographically almost replacing one another: the oblique-ellipsoid, large fruits with large elliptic seeds are found in Asia and West Malaysia, reaching as far east as the Philippines (*S. tesseroidea*) in the north and the Tanimbar Is. (*S. horsfieldiana*) in the south; the smaller globular fruits with orbicular seeds are known from the Philippines, East Malaysia, and Australia. I do not set much value on these

fruit and seed characters as they do not correlate with others; besides from many forms no ripe and undamaged fruits are available.

The races can be arranged into four groups which possibly deserve the status of subspecies; part of the races may be subordinated as varieties; in the present state of our knowledge I prefer not to go too far into details.

These four groups are:

*Group A.* Spines often present. Leaves usually oblong to lanceolate, about rhomboid with the greatest width near the base, mostly thinly chartaceous, black when dried, smooth and usually glabrous; base broadly cuneate, apex acute; mostly 3-plinerved, veins inconspicuous or invisible. *Inflorescences* axillary, rarely moreover terminal. Fruits oblique-ellipsoid. Seeds elliptic. Throughout Siam and Cochin-China, the Malay Peninsula, and Sumatra.

Especially the species distinguished by HILL in this group can only be separated either with great difficulty, or by characters which in my opinion are of very slight importance. '*S. armata*' is characterized by the spines which are more often present and more numerous than in the other forms; '*S. plumosa*' is the form with twigs which are most densely tomentose, but only '*S. schmidtii*' is fully glabrous. '*S. kawbet*' and '*S. chloropetala*' are nearly indistinguishable from '*S. plumosa*'.

Two forms deserve some more attention as they are the links with two other groups. They are the only representatives of group A in Malaysia. The first is '*S. scortechinii*' from Malaya, which is aberrant in this group by the pubescent leaves with the nerves diverging distinctly above the base, and which apart from the colour of the dried leaves could as well be included in group B. The second is '*S. quintuplinervis*' from Malaya and Sumatra, with larger and firmer leaves, more nerves, and coarser veins; it is intermediate between groups A and C.

*Group B.* Spineless. Greatest width of the leaf usually slightly below or about the middle, either rounded and attenuate, or very broadly cuneate towards the base, apex usually more or less distinctly acute-acuminate; mostly coriaceous and fairly stiff, the dried leaf olive- or yellowish-brown, apparently in most forms full of cystoliths, as the lower surface is often densely minutely warty; usually pubescent on the nerves beneath, often thinly pubescent all over the lower surface; 3-5-plinerved at some distance above the base, venation visible beneath, but minute and not conspicuous. *Inflorescences* axillary and/or terminal. Fruits oblique-ellipsoid, seeds elliptic. Assam, Malay Peninsula, Borneo, Palawan, Sumatra, Java, and Tanimbar Is. The main races distinguishable are:

*S. axillaris sens. str.* (incl. also *S. palembanica* and *S. horsfieldiana*), best characterized by the rarely absent pubescence in the axils of the nerves beneath; occurs in Assam, Malay Peninsula, Sumatra, Java, and the Tanimbar Is.; it is nearly indistinguishable from '*S. impressinervis*' from Palawan.

'*S. penicillata*', characterized by the distinctly densely and minutely warty lower surface of the leaves, with scattered appressed hairs, and by nearly exclusively terminal inflorescences, is restricted to the Malay Peninsula (apparently confined to Perak and P. Penang).

'*S. pubescens*' mainly differs from the preceding form in the lower surface of the leaves which is less rough, but with all the hairs inserted upon a larger and distinct wart; inflorescences are in Malayan specimens always axillary, in Bornean ones usually more or less terminal; it occurs in SW. Malay Peninsula (Singapore to Selangor) and Borneo.

'*S. malaccensis*', differing from '*S. penicillata*' mainly by the smooth and glabrous leaves which are thick and shining (those of '*S. penicillata*' are usually dull) occurs in the Malay Peninsula (Malacca and Singapore).

**Group C. Spineless.** Leaves on the average distinctly larger than in the preceding two groups, greatest width in or slightly below the middle, towards the base either slightly attenuate, or very broadly cuneate to rounded, apex acute or slightly acute-acuminate; firmly chartaceous, dried leaves usually shining brown to purplish-brown beneath, grey to purple-black above, smooth and glabrous; 3-5-pinnerved, nerves diverging only slightly above the base, main veins transverse, strong, conspicuous beneath. Inflorescences axillary. Fruits globular and seeds orbicular as far as known. Borneo, Philippines, and Moluccas (Halmahera).

This group can be considered to represent one race; in HILL's classification it corresponds to '*S. wenzelii*'.

One specimen, PNH 12436, is aberrant by a row of hairs at the base inside the calyx.

**Group D. Spines in Australian specimens sometimes present, in Malaysian ones absent.** Leaves variable in shape, size, nervation, and colour, always coriaceous; base and apex very variable. Inflorescences variable, but often relatively large and lax. Fruits globular, seeds orbicular. East Malaysia and Australia.

This eastern group is morphologically less clearly defined than the other ones, yet it is not well possible to subdivide it into well defined races, like the first two groups.

Two specimens from Celebes represent the most western and morphologically also the most deviating form. They are characterized by large ovate leaves, with a subcordate base and a blunt apex, and by axillary, laxly branched inflorescences c. 5 cm long, with a peduncle of about 2 cm. These specimens show also some relationship to '*S. wenzelii*' (group C).

'*S. robinsonii*' (Celebes and Amboin) and '*S. polytoma*' (New Guinea) are more or less intermediate between these specimens from Celebes and the Australian races.

The Australian races '*S. psilosperma*' and '*S. arborea*' are both characterized by the (apparent) absence of tendrils, the occasional presence of spines, and furthermore by the fairly small, mucronate leaves. '*S. psilosperma*' is the

more variable race and is distributed all over the area in Australia (moreover, part of the New Guinean specimens are nearly identical); its leaves are usually greenish when dried, they are mostly 5-pinnerved and thus relatively broad; its inflorescences are mainly terminal, large, and lax. '*S. arborea*' is restricted to the vicinity of Brisbane; the dried leaves are dark-brown, and usually 3-pinnerved, the base is cuneate and decurrent to near the base of the petiole; the inflorescences are mainly axillary, small, and dense.

It is surprising that these Australian races, occupying the southeastern part of the specific range, are, apart from the fruits (those are, however, unknown from most Asiatic forms), nearly indistinguishable from the continental Asiatic forms which occupy the northwestern part of the vast area of this species.

I am not quite certain about the identity of *S. oophylla*. The type is apparently lost; I saw two specimens, which I think represent *S. oophylla* (BECCARI sheet n. 6659, FI; NGF 11008, L), but these two specimens are different from '*S. polytoma*', the common New Guinean race of *S. axillaris* to which I have referred them with some doubt. According to the original diagnosis the corolla of *S. oophylla* would be only 1½ mm long, but from the figure it is clear that the flowers were in bud.

**19. *Strychnos ridleyi* K. & G. J. As. Soc. Beng. 74, ii (1908) 621; non DOP, Bull. Soc. Bot. Fr. 57, Mém. n. 19 (1910) 16 and Fl. Gén. 1.-C. 4 (1914) 165 (p.p. = *S. axillaris*); HILL, Kew Bull. (1917) 167; RIDL, Fl. Mal. Pen. 2 (1923) 424.**

A climbing shrub. Twigs thinly pubescent. Leaves oblong, rarely ovate-oblong, 8-10 by 4-4½ cm, thin-chartaceous, glabrous except for small tufts in the nerve-axils beneath, base broadly cuneate to rounded, apex gradually acuminate, acumen short, broad, and acute; 3-pinnerved from the base, veins obliquely transverse; petiole 6-11 mm. Inflorescences axillary, 1½-2 cm long (peduncle ¾-1 cm), few-flowered, peduncle fairly densely, the other parts thinly pubescent. Calyx 1 mm, sepals suborbicular, acute, outside glabrous, inside fairly densely appressed short-hairy. Corolla 4 mm, up to 2½ mm connate, inside with a whorl of erect, bristle-like hairs at the base of the lobes and fairly densely, shortly, patently hairy above this whorl. Stamens inserted halfway the corolla-tube, anthers subsessile, broadly ovate, c. 0.8 mm long, bearded. Pistil 1½ mm, glabrous. Fruit unknown.

Distr. Malaysia: Malay Peninsula (Singapore only).

Ecol. Fl. May.

Note. Doubtless related to *S. axillaris*, but distinctly different by the calyx and the corolla-lobes which are pubescent inside.

Insufficiently known

Probably good species, but flowers unknown.

**20. *Strychnos rufa* CLARKE** *Hook. f. Fl. Br. Ind.* 4 (1883) 89; GAMBLE, *J. As. Soc. Beng.* 74, ii (1908) 617, *p.p.*; HILL, *Kew Bull.* (1917) 203; RIDL, *Fl. Mal. Pen.* 2 (1923) 426.

Large liana. Twigs patently rufous-hairy. *Leaves* ovate to oblong, 9–16½ by 4–6½ cm, papyraceous to chartaceous, above minutely pubescent mainly on the midrib and the basal half of the nerves, beneath sparsely patently pubescent all over the surface, more densely so on nerves and veins, moreover fairly densely minutely warty; base rounded to faintly cordate, apex gradually acute-acuminate; 3- to faintly 5-plinerved at the base; petiole 3–4 mm. *Flowers* unknown, according to the collector small and yellow. *Infructescences* axillary, c. 2 cm long, with thick branches and strongly broadened torus, pubescent like the twigs; 1 or few fruits. *Fruits* globular, c. 3½–4 cm ø, red. *Seeds* many, elliptic, flattened, 19 by 12½ mm.

*Distr. Malaysia:* Malay Peninsula (Selangor, Malacca).

*Ecol.* Mountain forest.

*Uses.* Dart-poison.

*Vern.* *Akar ipoh tanah.*

*Note.* The pubescence and the warty lower surface of the leaf remind of *S. axillaris* ('*penicillata*'), but the shape and size of the leaves, and above all the large and many-seeded fruits are quite different. The latter might point to alliance with *S. ignatii*.

**21. *Strychnos thorelii* PIERRE** *ex DOP*, *Bull. Soc. Bot. Fr.* 57, *Mém. n.* 19 (1910) 20; *Fl. Gén. I.–C.* 4 (1914) 171, t. 3 f. 11–13; HILL, *Kew Bull.* (1917) 207; in Craib, *Fl. Siam. En.* 3 (1951) 62.

Liana. Twigs thinly patently pubescent, glabrescent. *Leaves* oblong-ovate to lanceolate,

4½–10 by 2–4 cm, chartaceous to coriaceous, shining above, sometimes sparsely patently hairy on the midrib beneath, otherwise glabrous; base broadly cuneate to subcordate, slightly attenuate, apex gradually acute-acuminate; 3–5-plinerved above the base; petiole ½–1 cm, pubescent. *Infructescences* axillary and terminal, up to c. 10 cm long, lax, minutely pubescent, with some fruits only, branches slender, torus somewhat broadened. *Fruits* ovoid to oblong-ellipsoid, 2½ by 1½ cm, thin-shelled. *Seed* 1, elliptic-lenticular, 2 by 1¼ cm.

*Distr.* Cochinchina, Siam, and Burma, in *Malaysia:* northern part of the Malay Peninsula.

*Ecol.* In and along evergreen and bamboo forests, up to c. 200 m. *Fr.* March–April.

*Note.* I have designated as a lectotype *PIERRE* 1703 (P) (erroneously cited as 1702 by DOP).

#### Dubious

No material seen, description insufficient.

*Strychnos melanocarpa* GILG & BENED. *Bot. Jahrb.* 54 (1916) 172; HILL, *Kew Bull.* (1917) 181.

*Distr.* NE, New Guinea (Sepik, Malu).

From the description it is not clear whether the indument in the mouth consists of one row of bristle-like hairs or is woolly. In the first-named case this species would be closely related to *S. axillaris* (different, however, by the hairy ovary), otherwise it might be identical with *S. colubrina*.

#### Excluded

*Strychnos grandis* WALL. *Cat.* (1831) n. 4454, *nom. nud.* = *Anisophyllea grandis* (BTH.) BURK. (*Rhizophoraceae*).

### 6. GARDNERIA

WALL. in Roxb. *Fl. Ind.* 1 (1820) 400; LEENH. *Bull. Jard. Bot. Brux.* 32 (1962) 431.—**Fig. 33.**

Mostly climbing or creeping, glabrous shrubs. Twigs terete, sometimes with 4 faint ridges. *Leaves* petioled, connected by interpetiolar stipular rims; at the base of the new shoots a number of persistent, acute-triangular bud-scales. *Infructescences* axillary, dichasial, usually few-flowered or flowers solitary, sometimes lax and many-flowered; bracts narrowly triangular, 1–2 mm long. *Flowers* long-pedicelled, 4–5-merous. *Calyx* small, deeply lobed, lobes rounded, sometimes acuminate, shortly ciliate, for the rest glabrous, inside with colleters at the base. *Corolla* rotate, thin-fleshy, creamy to yellow, lobes valvate in bud. *Stamens* exerted, filaments very short, flat; anthers bifid at the base, introrse, 4- or 2-celled (if 4-celled the outer cells much bigger than the central ones). *Pistil* glabrous; ovary small, 2-celled, with 1–4 ovules per cell; style mostly long and slender; stigma capitate to 2-parted. *Berry* globular, red. *Seeds* 1 or more, elliptic to orbicular, concave on the hilar side, convex on the other; testa thin, endosperm thick, cartilaginous.

*Distr.* Five species in SE. and E. Asia, from India to Central Japan and Java; in *Malaysia* 1 species.

*Note.* The relationship of this genus is clearly with *Strychnos*.



Fig. 33. *Gardneria ovata* WALL. a. Habit,  $\times \frac{2}{3}$ , b. flower (note the cohering anthers),  $\times 3\frac{1}{2}$ , c. anther, 2-celled,  $\times 6$ , d. ditto, lateral view,  $\times 6$ , e. ditto, cross-section,  $\times 6$ , f. calyx with pistil,  $\times 8$ , g. ovary in cross-section, showing the two ovules,  $\times 16$ , h. fruit,  $\times 1\frac{1}{2}$ , i. seeds,  $\times 2$ , j. ditto in length-section showing the small embryo embedded in the endosperm,  $\times 2$ , k. embryo, frontal and lateral view,  $\times 4$  (a herb. L 908.127-599, b-g sine coll., s.n. in herb. E, h-k HENRY 10906).

1. *Gardneria ovata* WALL. in Roxb. Fl. Ind. 1 (1820) 400; Pl. As. Rar. 3 (1832) 17, t. 231; BUREAU, Fam. Logan. (1856) f. 32-34; BTH. J. Linn. Soc. Bot. 1 (1856) 109; KURZ, Fl. Burm. 2 (1877) 227; RACIBORSKI, Rozpr. Wydz. Mat.-Przyrod. Ak. Umiej. Krak. 32 (1896) 315, f. 1-5; Bull. Int. Ac. Sc. Cracovie (1896) 206; GAMBLE, Fl. Madras 5 (1923) 869; KANJILAL & DAS, Fl. Assam 3 (1939) 320; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 9; KERR in Craib, Fl. Siam. En. 3 (1951) 63; LEENH. Bull. Jard. Bot. Brux. 32 (1962) 437.—*G. wallichii* WIGHT ex WALL. Pl. As. Rar. 3 (1832) 49, t. 281.—Fig. 33.

Vine or shrub. *Leaves* (ovate or) oblong to lanceolate, 6-13(-16) by 2½-5½(-8) cm, chartaceous to thin-coriaceous, acute and slightly decurrent at the base, gradually acute-acuminate to caudate and sometimes mucronulate; nerves 4-10 pairs. *Inflorescences* erect to pendulous, 4-8 cm long, 1-3-flowered to laxly thyrsoid and more-

flowered, sometimes with a serial solitary flower in the same axil; peduncle ¾-2 cm, pedicels ½-2 cm, bibracteolate. *Flowers* 4-merous. *Sepals* ¾-1½ by 1½-2 mm. *Corolla* yellow to orange, waxy, tube ½-1½ mm long, lobes ovate to elliptic, acute, inside papillose-pubescent, 3-4½ mm. *Stamens* inserted just above the base of the corolla-tube (rarely halfway), anthers cohering mutually, erect, broadly ovate or elliptic to ovate-lanceolate, 1½-4 mm long, truncate, 2-celled. *Ovary* ½-1½ mm, tapering into the ½-2 mm long style, stigma faintly 2-4-lobed to 2-parted. *Ovules* 1 per cell. *Berry* ¾ cm ø, 1- or 2-seeded. *Seeds* orbicular, ½ cm ø, smooth, dull grey.

Distr. NE. and SE. India, Ceylon, Yunnan, Siam, and *Malaysia*: N. Sumatra (Tapanuli) and W. Java (Preanger: Tjadas Malang), twice collected.

Ecol. Along forest edges and climbing over limestone rocks, at 50-2250 m. *Fl.* March-June, *fr.* May-Nov.

## 7. NEUBURGIA

BLUME, Mus. Bot. 1 (1850) 156; MARKGRAF, Bot. Jahrb. 61 (1927) 222.—*Couthovia* A. GRAY, Proc. Am. Ac. Arts Sc. 4 (1859) 324.—*Crateriphytum* SCHEFF. ex KOORD. [Nat. Tijds. N.I. 55 (1896) 345, *nom. nud.*] Med. Lands Pl. Tuin 19 (1898) 540.—Fig. 34-35.

Trees or shrubs; branches glabrous. Lateral branches mostly up to c. 1 cm high coalescent with the main branch (fig. 34i). *Stipules* interpetiolar, adnate to the petioles, obdeltoid, in older leaves often split along a distinct suture. *Leaves* petioled to subsessile; midrib often forked towards the apex, venation obscure. *Inflorescences* terminal, thyrsoid, the ends cincinnate; bracts semi-amplexicaulous, scale- to ridge-like, minute, ciliate. *Flowers* sessile, 5-merous. *Sepals* confluent at base, suborbicular, mostly ciliate, inside at the base often with hairs and/or col-leters. *Corolla* rotate to salver-shaped, white, tube thin-fleshy, the valvate lobes thicker; with a hair ring in the mouth, inner surface of the tube either glabrous or hairy. *Stamens* inserted on the upper half of the corolla-tube, usually just below the mouth, included; filaments strap-shaped, usually very short, glabrous; anthers introrse, 2-celled, cells up to about halfway free, the apices mostly, the bases sometimes ending in a short sterile tip, the latter often, the former rarely bearded. *Pistil* mostly glabrous; ovary 2-celled with ~ ovules on a strongly thickened placenta; style early caducous; stigma always about reaching the mouth, mostly ± ellipsoid, ½-¾ mm high, faintly grooved, hollow (in *N. sarcantha* broadly truncate). *Fruits* drupaceous, mesocarp dry, rather hard and very fibrous, these fibres originating from the woody, rugose stone; cells slenderly spindle-shaped, slightly curved. *Seed* one per cell (and usually only one per fruit), slenderly spindle-shaped.

Distr. About 10-12  *spp.*, in *East Malaysia* (from the Philippines and Celebes to New Guinea), Carolines, Solomons, New Hebrides, New Caledonia, and the Fiji Is. Cf. LEENH. Pac. Pl. Areas 38.

Ecol. Shrubs or small to medium-sized trees in the undergrowth or substage of primary, rarely secondary forests, rarely canopy trees, often in marshy or temporarily drained localities, largely confined to everwet lowland. The clustered, small, white, scented flowers probably attract insects. Once it has been stated that the fruits were eagerly eaten by pigeons, but the rather dry, thick, corky mesocarp and the hard pyrene make the impression that they are normally dispersed by water.

Notes. *Neuburgia* was assigned by BLUME to the *Apocynaceae*: he mentioned two species, *N. tuber-*

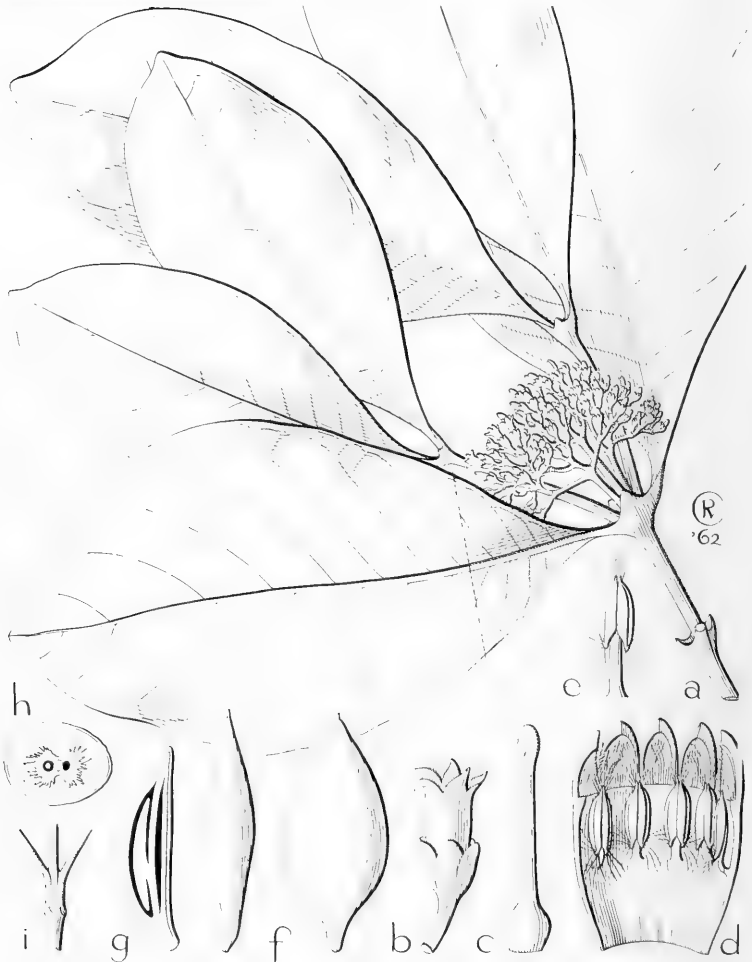


Fig. 34. *Neuburgia rumphiana* LEENH. a. Habit (part of leaf showing the indumentum on the lower side),  $\times \frac{2}{3}$ , b. flower,  $\times 2$ , c. pistil,  $\times 6$ , d. opened corolla,  $\times 6$ , e. stamen,  $\times 6$ , f. lateral and frontal view of fruit,  $\times 1$ .—*N. moluccana* (BOERL.) LEENH. g. Longitudinal section of fruit, showing the one-seeded fertile cell and the sterile one,  $\times 1$ .—*N. celebica* (KOORD.) LEENH. h. Cross-section of fruit (note the corky mesocarp, the woody putamen, the two cells, one of which is fertile, and the soft tissue in the centre),  $\times 1$ .—*N. corynocarpa* (A. GRAY) LEENH. i. Detail of branching, showing the coalescence between the lateral branches and the main branch,  $\times \frac{2}{3}$  (a–e LAM 7787, f BW 7526, g Hort. Bot. Bog. IV-E-92, h FRI Cel III-40, i SAUNDERS 195).

*culata* and *N. tubiflora*. MARKGRAF, l.c., transferred the genus to the *Loganiaceae*; he already suggested the identity with *Crateriphytum*. MERRILL (J. Arn. Arb. 23, 1942, 416) typified the genus by *N. tubiflora*.

KOORDERS already realized the close relationship between the monotypic *Crateriphytum* (= *N. moluccana*) and *Couthovia*. Of the two main generic differences he mentioned, the long corolla-tube provided with a rim in the mouth, shared also by *N. tubiflora*, is still a conspicuous character, but I cannot attach generic value to it; the rim is much less conspicuous than depicted by him.

CAMMERLOHER (Bull. Jard. Bot. Btzg III, 5, 1923, 306) laid special stress on a supposed third difference, the 2-lobed stigma which is also clearly depicted by KOORDERS. However, this appears to be an artefact sometimes caused by the pressing of herbarium specimens; the stigma is slightly grooved and hollow when mature, it ruptures fairly easily when pressed, and the papillae are of course found on the outside of the 'lobes'; in many young fruits I found an undamaged unlobed stigma!

## KEY TO THE SPECIES

1. Corolla-tube c. 1½ cm long.
2. Corolla-tube inside glabrous. Leaves broadly elliptic to obovate, 17½–30 by 11–22 cm. Nerves 6–8 pairs . . . . . 6. *N. moluccana*
2. Corolla-tube inside hairy except at the base. Leaves oblong-obovate, 16–20 by 8–10 cm. Nerves 4–6 pairs . . . . . 7. *N. tubiflora*
1. Corolla-tube less than 1 cm long.
3. Style 4½–6 mm. Calyx 2¼–4 mm high. Corolla 8–10 mm.
4. Leaves about orbicular. Corolla-tube inside laxly hairy from the insertion of the stamens to the mouth. Anthers glabrous. Stigma broadly truncate . . . . . 2. *N. sarcantha*
4. Leaves lanceolate to elliptic. Corolla-tube inside glabrous. Anthers bearded. Stigma club-shaped to ovoid . . . . . 4. *N. rumphiana*
3. Style up to 1½ mm. Calyx up to 2½ mm high. Corolla up to 6 mm.
5. Leaves thick and stiff, coriaceous when dry . . . . . 1. *N. corynocarpa*
5. Leaves thin, papyraceous to thin-pergamentaceous when dry.
6. Leaves elliptic to lanceolate, tapering at both ends, midrib reaching the apex. Fruit 5–6 cm long, acute . . . . . 3. *N. kochii*
6. Leaves broad-elliptic to broad-obovate, blunt at the apex, midrib forked near the apex. Fruit 3½–4 cm long, blunt . . . . . 5. *N. celebica*

1. *Neuburgia corynocarpa* (A. GRAY) LEENH. nov. comb.—*Couthovia corynocarpa* A. GRAY, Proc. Am. Ac. Arts Sc. 4 (1859) 324; SEEMANN, Fl. Vit. (1866) 165, t. 32; GILLESPIE, Bull. Bish. Mus. n. 83 (1931) 28, f. 35; A. C. SMITH, Sargentia 1 (1942) 102.—*Couthovia seemanni* A. GRAY, Proc. Am. Ac. Arts Sc. 5 (1862) 320; GILLESPIE, Bull. Bish. Mus. n. 83 (1931) 29, f. 36.—*Couthovia densiflora* K. SCH. Bot. Jahrb. 9 (1887) 215; GILG & BENED. *ibid.* 54 (1916) 178.—*Couthovia rhynchocarpa* GILG & BENED. l.c. 176.—*Couthovia terminaloides* GILG & BENED. l.c. 177.—*Couthovia pachypoda* GILG & BENED. l.c. 178, f. 8.—*Couthovia brachyura* GILG & BENED. l.c. 179; LANE-POOLE, For. Res. (1925) 134.—*Couthovia nymani* GILG & BENED. Bot. Jahrb. 54 (1916) 180.—*Couthovia astyla* GILG & BENED. l.c. 183.—*Couthovia brassii* S. MOORE, J. Bot. 67 (1929) 50.—*Couthovia novobritannica* KAN. & HAT. Bot. Mag. Tokyo 53 (1939) 9, f. 4; MERR. & PERRY, J. Arn. Arb. 23 (1942) 410.—*Couthovia collina* A. C. SMITH, Sargentia 1 (July 1942) 101.—*Couthovia leucocarpa* MERR. & PERRY, J. Arn. Arb. 23 (Oct. 1942) 412.—*Couthovia yunzaingensis* MERR. & PERRY, *ibid.* 29 (1948) 163.—Fig. 34i.

Tree, 4–40 m by up to 75 cm ø, sometimes with buttresses. Leaves oblong to broad-obovate or orbicular, 6½–17 by 3–12 cm, thin- to thick-coriaceous, glabrous; base cuneate to subcordate, decurrent; apex blunt to rounded, rarely short-acuminate; midrib distinctly forked or

not, nerves (4)–7–9(–11) pairs; petiole ¼–1¼ cm. Inflorescences 4–10 cm long, widely branched and many-flowered, glabrous, the terminal parts sometimes sparsely tomentose, flowers often crowded. Calyx 1–2½ mm, outside mostly glabrous, rarely minutely pubescent, inside with or without collectors and/or hairs at the base. Corolla outside glabrous, 4–6 mm long, tube inside usually laxly woolly at the insertion of the stamens, lobes 1½–2½ mm long. Anther-cells free for c. ⅓–½, hastate, 1½–2 mm long, corniculate at apex, glabrous to bearded at base. Style 1–1½ mm, stigma club-shaped, c. ½ mm. Fruits clavate, blunt to acute, straight to curved, 1¾–4 by ¾–1½ cm, white.

Distr. Melanesia (Solomon Is., Fiji) and Malaysia: New Guinea (also Kei and Aru Is., Los Negros, Admiralty Is., and New Britain).

Ecol. Primary (and sometimes old secondary) rain- and swamp-forests, also on temporarily flooded (freshwater) localities, from sea-level up to c. 2000 m. According to SEEMANN the fruits are much eaten by pigeons in Fiji. Fl. mainly Jan.–June, fr. Febr., July–Sept.

Uses. In the Solomon Is. the macerated bark is applied to skin diseases.

Vern. *Metan*, Aru Is, *masosen*, Schouten I., *kuma*, *rantiepi*, Japen, *aifm*, Numfor, *badjagi*, *belik*, *bokon*, *elieuw*, *falaka*, *fenam*, *gramgusun*, *inkwam*, *katadi*, *konote*, *kumo*, *maduwi*, *mafui*, *mai-long*, *male*, *mingo*, *namooi*, *niesebuk*, *pao*, *pegamba*,

*seruahika, situahiga, somuk, tamu, tani, teguk, teitakka or têtaka, ufi, waffer waffer, yako(m)*, New Guinea.

Notes. *N. corynocarpa* is a widespread species and consists of a reticulate relationship of local races, both in New Guinea and in the Pacific. In the Papuan area (from the Aru Is. to the Solomons) there is a fairly distinct clinal variation as to the hairiness of the flower: the corolla-tube is inside glabrous in the Aru Is., pubescent in New Guinea and the Solomons, the anthers are bearded in the Aru Is. and New Guinea, glabrous in part of the material from E. New Guinea and in the Solomons. The variation in Fiji is mainly altitudinal, *Couthovia collina* being a small-leaved form of mainly higher altitudes, *N. corynocarpa sensu stricto* with larger leaves is mainly restricted to the lowlands; these two forms are grading. As to the other species described from the Pacific (from which I had not enough material at hand to come to a definite conclusion) *Couthovia alata* A. C. SMITH (Sargentina 1, 1942, 104; Fiji) and *Couthovia novocaledonica* GILG & BENED. (Bot. Jahrb. 56, 1921, 547; New Caledonia) should probably, *Couthovia macroloba* A. C. SMITH (l.c.; Fiji) and *Couthovia neo-ebudica* GUILLAUMIN (J. Arn. Arb. 13, 1932, 23; New Hebrides: Aneityum) possibly be combined with *N. corynocarpa*; *Couthovia macrocarpa* A. C. SMITH (l.c. 105; Fiji) and *Couthovia pachyantha* A. C. SMITH (l.c. 106; Fiji) may represent 2 (or only 1?) separate, though related species. Furthermore *N. corynocarpa* shows relationship with *N. sarcantha*.

The type of *Couthovia rhynchocarpa* has wrongly been described as lacking the hairs in the corolla-tube.

Throughout the genus the style is rather early caducous after fertilization, leaving a usually somewhat broadened, flat scar; in one case GILG & BENEDICT mistook this for a sessile stigma, and based their *Couthovia astyla* on that character.

Large-leaved specimens can vegetatively be distinguished from *N. celebica* not only by the thicker leaves, but also by the more spaced, and thus less numerous nerves.

**2. *Neuburgia sarcantha* (GILG & BENED.) LEENH. nov. comb.—***Couthovia sarcantha* GILG & BENED. Bot. Jahrb. 54 (1916) 181, f. 9; non CAMMERL. Nova Guinea 14 (1924) 116, *quae est N. celebica*.

Tree, 15–23 m by c. 30 cm  $\phi$ ; branches glabrous. Leaves broadly obovate to nearly orbicular, 10–25 by 8–25 cm, coriaceous, glabrous; base cuneate to cordate, decurrent; apex rounded; midrib forked, nerves 6–7 pairs; petiole  $\frac{3}{4}$ –2 $\frac{1}{2}$  cm. *Inflorescences* 5–7 cm long, widely branched, fairly many-flowered, glabrous. *Calyx* 2 $\frac{3}{4}$  mm, sepals thick-fleshy, glabrous, inside with hairs and colleters at the base. *Corolla* 8 mm long, outside glabrous, inside laxly woolly between the mouth and the insertion of the stamens, lobes 4 mm long. *Anthers* oblong, 2 mm long, the cells free for c.  $\frac{1}{4}$ , corniculate at apex, rounded at base, glabrous. *Style* thick-cylindrical, 4 $\frac{1}{2}$  mm, stigma broadly truncate,  $\frac{1}{2}$

mm thick, 1 $\frac{1}{4}$  mm  $\phi$ . *Fruits* ovoid, constricted at base, 4 by 2 $\frac{1}{2}$  cm, blunt, white.

Distr. *Malaysia*: New Guinea (Upper Digul River, Western Highlands, and Sepik River, 'Felsspitze' of the LEDERMANN-expedition, probably not far from Malu).

Ecol. In forests and *Pandanus* swamps, 400–1900 m. *Fl.* Sept., fr. Aug.

Vern. *Bandih, mehmin*.

Notes. GILG & BENEDICT had only material in bud; for that reason the description given here differs in several points from the original diagnosis. When analyzing flower-buds of new material I found some of the characters specially stressed by them: a thick-fleshy corolla of which the tube is glabrous inside.

As apparently both syntypes (LEDERMANN 13005 and 13056) are lost, I propose as a neotype HOOGLAND & PULLEN 6207 (L, dupl. in BRI, CANB, and MEL), an excellent flowering specimen which has mainly served for the description given here.

*N. sarcantha* is best characterized by large flowers and a truncate stigma. It seems to be nearest related to *N. corynocarpa*.

**3. *Neuburgia kochii* (VAL.) LEENH. nov. comb.—***Couthovia kochii* VAL. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 46.—*Couthovia urophylla* GILG & BENED. Bot. Jahrb. 54 (1916) 176.—*Couthovia undulatifolia* KAN. & HAT. Bot. Mag. Tokyo 56 (1942) 158, f. 2.

Shrub or treelet, 2–4(–6) m; branches glabrous. Leaves elliptic to lanceolate (sometimes oblanceolate or slightly ovate), tapering at both ends, 13–17 $\frac{1}{2}$  by 5–7 $\frac{1}{2}$  cm, thin-papyraceous, above slightly scabrous (as are the stipules), beneath glabrous or rarely sparsely, shortly appressed-pubescent; base cuneate, decurrent; margin usually slightly undulate; apex tapering acuminate, slender, blunt to acute; midrib not forked; nerves (4–) 7–8(–9) pairs; petiole  $\frac{1}{2}$ –1 $\frac{1}{2}$  cm. *Inflorescences* 1 $\frac{1}{2}$ –5 cm long, densely to laxly branched, minutely pubescent. *Calyx* 1 $\frac{3}{4}$ –2 mm high, outside glabrous, inside at the base usually with colleters, sometimes with hairs. *Corolla* 4 $\frac{1}{2}$ –6 mm long, inside usually glabrous or nearly so, lobes 1 $\frac{1}{2}$ –3 mm long, outside glabrous or rarely slightly pubescent. *Anthers* hastate, 1 $\frac{1}{4}$ –2 mm long, cells free for  $\frac{1}{3}$ – $\frac{1}{5}$ , corniculate at apex, not or only slightly bearded at base. *Style* c. 1–1 $\frac{1}{2}$  mm, stigma slenderly club-shaped,  $\frac{3}{4}$ –1 mm. *Fruits* curved, lanceolate to ovoid, flattened, tapering towards the acute apex, 5–6 by 2–2 $\frac{1}{4}$  by 1 cm, red or white.

Distr. *Malaysia*: New Guinea.

Ecol. Primary and secondary forests, from sea-level up to 1100 m. *Fl.* March, May, Aug., Sept., fr. March, May, July.

Vern. *Arora, osiwai*.

Notes. Young long shoots are characterized by 4 ribs, decurrent from the leaf-bases.

The roughness of the stipules and the upper side of the leaves is caused by numerous minute, yellow warts, probably from cystoliths.

Ripe fruits seem to be red in Western New



Guinea, white in the eastern half; this character is not distinctly correlated with any other.

4. *Neuburgia rumphiana* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 457.—Fig. 34a-f.

Shrub or treelet, 3–6 m high; branches glabrous. Leaves elliptic to lanceolate, sometimes slightly asymmetric, 16–25 by  $4\frac{3}{4}$ –14 cm, chartaceous to thin-coriaceous, glabrous above, mainly on midrib and nerves beneath sparsely and shortly appressed-pubescent, or glabrous; base acute, attenuate; margin slightly undulate; apex shortly acuminate, blunt or acute; midrib not forked, nerves 9–15 pairs; petiole  $\frac{3}{4}$ –3 cm. Inflorescences c. 5 cm long, fairly dense, rather many-flowered, densely shortly ferruginous-pubescent, sometimes glabrescent. Calyx  $3\frac{1}{2}$ –4 mm high, outside glabrous, inside at the base with hairs and collectors. Corolla 8–10 mm long, glabrous except the mouth, lobes  $2\frac{1}{2}$ –3 mm long. Anthers linear, 2– $2\frac{1}{2}$  mm, cells free for  $\frac{1}{4}$ – $\frac{1}{3}$ , corniculate and sometimes with a few bristles at the apex, bearded at the base. Style slender,  $4\frac{1}{2}$ –6 mm, stigma club-shaped to ovoid,  $\frac{3}{4}$  mm. Fruits flattened-ellipsoid, acute,  $4\frac{1}{2}$ –5 by  $1\frac{3}{4}$ – $2\frac{1}{4}$  cm, orange-(brown).

Distr. Malaysia: West New Guinea (around Hollandia and on Japen I.).

Ecol. Primary and secondary, sometimes swampy forests below 100 m. Fl. July, Oct., Febr., fr. July.

5. *Neuburgia celebica* (KOORD.) LEENH. nov. comb.—*Couthovia celebica* KOORD. Med. Lands Pl. Tuin 19 (1898) 537; Suppl. Minah. 1 (1918) 7, t. 2; MERR. En. Philip. 3 (1923) 313.—*Couthovia calophylla* GILG & BENED. Bot. Jahrb. 56 (1921) 548, f. 2; KANEH. Fl. Micron. (1933) 313, f. 158; J. Dep. Agr. Kyushu Imp. Univ. 4 (1935) 390.—*Couthovia sarkantha* (non GILG & BENED.) CAMMERL. Nova Guinea 14 (1924) 116.—*Couthovia toua* KAN. Bot. Mag. Tokyo 46 (1932) 490; Fl. Micron. (1933) 313, f. 159; J. Dep. Agr. Kyushu Imp. Univ. 4 (1935) 390.—*Couthovia macrophylla* MERR. & PERRY, J. Arn. Arb. 23 (1942) 411.—Fig. 34h.

Tree or large shrub, 7–30 m by 35–80 cm  $\sigma$ , often with small buttresses; branches glabrous, rarely densely tomentose. Leaves (mostly broad-jelliptic to broad-obovate, 13–30 by 9–25 cm, herbaceous to paperyaceous, rarely chartaceous, glabrous or sometimes partly or entirely densely short-tomentose beneath; base subcordate to cuneate, decurrent; margin slightly undulate; apex rounded; midrib forked, nerves (7–)9–14 (–16) pairs; petiole 1– $3\frac{1}{2}$  cm. Inflorescences 15–25 cm long, glabrous but for the minutely tomentose ultimate branches, widely branched, many-flowered. Calyx 1–2 mm high, mostly glabrous, rarely outside more or less densely minutely tomentose. Corolla 4– $4\frac{1}{2}$  mm long, outside glabrous to sparsely pubescent, tube inside pubescent near the insertion of the stamens, lobes  $1\frac{1}{2}$ –2 mm long. Anthers narrowly hastate,  $1\frac{1}{4}$ – $1\frac{1}{2}$  mm, cells up to halfway free, distinctly corniculate, glabrous. Style  $\frac{1}{2}$ –1 mm, stigma capitate to club-shaped,  $\frac{1}{2}$  mm. Fruits ellipsoid, usually stipitate, blunt or rarely

acute,  $3\frac{1}{2}$ –4 by  $1\frac{1}{4}$ – $1\frac{3}{4}$  by  $1\frac{1}{2}$  cm, orange to red.

Distr. Micronesia (Carolines: Palau Is.) and Malaysia: Philippines (Mindoro, Mindanao), Celebes, Moluccas, and S. New Guinea.

Ecol. Dryland and swampy rain-forests, often along river-banks, sometimes in *Phragmites* swamps, in some localities periodically flooded by fresh or salt water, from sea-level up to c. 400 m. Fl. mainly Jan.–May, fr. Jan., March, July.

Uses. Timber sometimes used, mainly for indoor-constructions.

Vern. Philip.: *bali-bali*, C. Bis., *pagi-pagi*, Mbo., *salinuok*, P. Bis., *tanalak*, Bag.; *achera lika*, *dongkina puté*, *éewé*, *léa léa*, *rondo rondo*, Cel., *a'sili*, Talaud I., *tampel putih*, Batjan, *gérépiw*, *porojit*, New Guinea.

Notes. *Couthovia celebica* was based by KOORDERS upon two collections, viz KOORDERS 18628 and 18741 (cf. KOORD.-SCHUM. Syst. Verz. 3, 1914, 105). I have chosen as a lectotype KOORDERS 18741 (Bo; dupl. in L.).

The specimens from the Carolines, described as *Couthovia toua*, differ partly by slightly larger dimensions of the flowers and fruits, and by more coriaceous leaves. These characters, however, are grading and some of the collections agree entirely with Malaysian material.

6. *Neuburgia moluccana* (BOERL.) LEENH. nov. comb.—? *Fructus musculiformis* RUMPH. Herb. Amb. 2 (1741) 184, t. 60, *pro fruct.*—? *Cerbera musculiformis* LAMK. Enc. 1 (1783) 62, *pro fruct.*—non *Banksia musculiformis* GAERTN. Fruct. 1 (1788) 221.—? *N. tuberculata* BL. Mus. Bot. 1 (1850) 157, *nom. illeg.*—? *N. musculiformis* MIQ. Fl. Ind. Bat. 2 (1856) 403, *pro typo*, *excl. syn.* *N. tubiflora*; MERR. Int. Rumph. (1917) 425.—*Crateriphyllum moluccanum* SCHEFF. ex BOERL. Handl. 2 (1899) 456, 460; KOORD. Bull. Inst. Bot. Btzg 16 (1903) 10; Abb. Besch. Crateriphyllum moluccanum (1919) 3, t. 1; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 306.—Fig. 34g–35.

Shrub or treelet, 8–10 m high, rarely tree, up to 30 m by 45 cm  $\sigma$ , with buttresses; branches glabrous. Leaves broad-elliptic (sometimes nearly orbicular) to obovate,  $12\frac{1}{2}$ –30 by 8–22 cm, thin-coriaceous, glabrous; base cuneate to cordate, decurrent; margin slightly undulate; apex rounded; midrib forked just below the apex, nerves 6–8 pairs; petiole 1–4 cm. Inflorescences 5–11 cm long, widely branched, few- to many-flowered, glabrous. Calyx 3–4 mm high, outside glabrous, inside at the base with or without collectors. Corolla 2 (when fresh 2.4) cm long, slender, glabrous apart from the hair-ring in the mouth which is inserted on a thickened, lobed rim; lobes  $\frac{1}{2}$  cm long, very thick-fleshy. Stamens inserted c. 4–7 mm below the mouth; anthers linear,  $3\frac{1}{2}$  mm, cells free for  $\frac{1}{4}$ – $\frac{1}{5}$ , faintly corniculate at apex and with an acute membranous base, glabrous. Style slender, c.  $1\frac{1}{4}$  cm, stigma ellipsoid,  $\frac{1}{2}$ – $\frac{3}{4}$  mm. Fruits ovoid, more or less flattened, slightly curved, tapering



Fig. 35. *Neuburgia moluccana* (BOERL.) LEENH.; note the long-tubed flowers and the stipules, especially between the leaf pair at the left. Cult. Hort. Bot. Bogor II-I-18 (from Ambon) (JACOBS, 1958).

towards the acute apex,  $4\frac{1}{2}$ –7 by  $2$ – $2\frac{3}{4}$  (when fresh –4) by  $1\frac{1}{4}$ – $1\frac{3}{4}$  cm, orange.

Distr. *Malaysia*: Moluccas (Halmahera, Batjan, Ceram, Ambon).

Ecol. Rain-forests, on river-banks, from sea-level up to c. 600 m. Fl. fr. Jan.–Dec.

Vern. *Dodalaim, pèpèkè ma tuhu*, Halmahera, *banàtau*, Ceram.

Notes. *N. celebica*, the only sympatric species which has moreover also rather large leaves, can vegetatively easily be distinguished, as the leaves are much thinner and the number of nerves is larger.

RUMPHIUS'S *Fructus musculiformis* was originally based on fruit-kernels washed ashore on the island of Ceram. I am almost certain that they belong to a *Neuburgia* and, in view of the dimensions mentioned, probably to the present species. In an appendix to his description, and on his plate, he associated these fruits with a tree found on the shore of Ceram, apparently some *Apocynacea*, probably *Cerbera* or a related genus. LAMARCK based his *Cerbera musculiformis* exclusively upon RUMPHIUS'S description and plate which are discordant elements. Moreover it will hardly be possible to assign RUMPHIUS'S fruits with certainty to a species. LAMARCK'S name can therefore not be used as the oldest basionym.

*N. tuberculata* BL. is again fully based on RUMPHIUS'S description and plate, but the epithet is illegitimate. BLUME was the first who apparently

correctly interpreted RUMPHIUS'S plant by including it in his new genus *Neuburgia*. MIQUEL made the legitimate combination *N. musculiformis*; moreover he combined the two species distinguished by BLUME, with which I do not agree.

GAERTNER'S *Banksia musculiformis* was based upon material of an Australian species of *Banksia* (*Proteaceae*); he cited RUMPHIUS'S name in synonymy with a question-mark, obviously taking the specific epithet from it.

The name *Crateriphytum moluccanum* was originally based upon material from three plants in the Bogor Botanic Garden, viz II-1-1, IV-E-92, and IV-E-92a. As a lectotype I have chosen IV-E-92 (= KOORDERS 42708) (Bo, dupl. in L, WAG).

7. *Neuburgia tubiflora* BL. Mus. Bot. 1 (1850) 156; MARKGRAF, Bot. Jahrb. 61 (1927) 203, 222; MERR. & PERRY, J. Arn. Arb. 23 (1942) 416.—*N. musculiformis* MIQ. Fl. Ind. Bat. 2 (1856) 403, *typo excl.*

Treelet; branches glabrous. Leaves oblong-obovate, 16–20 by 8–10 cm, herbaceous to thin-coriaceous, glabrous; base cuneate; apex blunt to slightly blunt-acuminate; midrib forked just below the apex, nerves 4–6 pairs; petioles  $1\frac{1}{2}$ –5 cm. Inflorescences c. 6 cm long, laxly branched, few-flowered, glabrous. Calyx 3 mm high, outside glabrous, inside at the base with colleters. Corolla c. 2 cm long, slender, outside glabrous, the hair-

ring in the mouth inserted on a thickened, lobed rim, tube inside shortly patent-hairy from the mouth to c. 1-2 mm from the base, mainly on the main nerves; lobes c.  $\frac{1}{2}$  cm long. *Stamens* inserted at c.  $5\frac{1}{2}$  mm above the base of the tube; anthers lanceolate, 3 mm long, cells free for c.  $\frac{1}{3}$ , corniculate at apex, membranous and acute at base, glabrous. *Style* c. 1 cm, stigma ellipsoid,  $\frac{1}{2}$ - $\frac{3}{4}$  mm. *Fruit* curved spindle-shaped, acute,  $5\frac{1}{2}$  by  $1\frac{3}{4}$  cm (if 2-seeded broad-ovoid, shortly stipitate, 4 by 2 by  $1\frac{1}{4}$  cm).

*Distr. Malaysia:* W. New Guinea, twice col-

lected; according to BLUME also in the Moluccas, but probably erroneous.

*Ecol.* Lowland forest, c. 50 m. *Fl.* May.

*Note.* The thickened rim in the throat is stronger developed than in *N. moluccana* which is distinctly the nearest related species.

As a lectotype I have chosen ZIPPELIUS 147a (L).

#### Excluded

*Neuburgia ? sumatrana* (MIQ.) BOERL. Handl. 2 (1899) 392 based on *Orchipeda sumatrana* MIQ. Sum. (1861) 553 = *Voacanga* sp. (*Apocynaceae*).

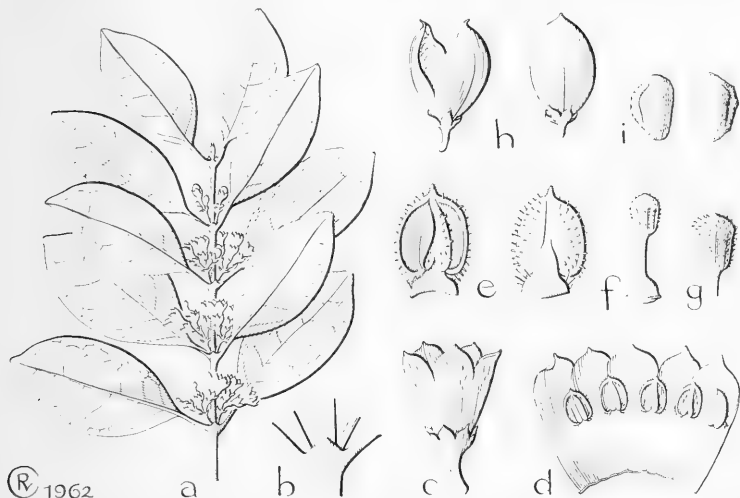


Fig. 36. *Geniostoma randianum* MERR. & PERRY. a. Habit,  $\times \frac{2}{3}$ , b. stipules,  $\times 3$ , c. flower,  $\times 3$ , d. opened corolla,  $\times 4$ , e. stamen from in- and outside,  $\times 8$ , f. pistil,  $\times 4$ , g. stigma,  $\times 8$ , h. fruit,  $\times 1$ .—*G. rupestre* FORST. i. Seeds,  $\times 8$  (a-b BRASS 22598, c-g BRASS 4522, h BRASS 4995, i JUNGHUHN s.n.).

### 8. GENIOSTOMA

FORST. Char. Gen. Pl. (1776) 12, t. 12; VALETON, Bull. Inst. Bot. Btzg 12 (1902) 1-28.—*Anasser* JUSS. Gen. (1789) 150.—*Haemospermum* REINW. Syll. Pl. Ratisb. 2 (1826) 9.—**Fig. 36.**

Shrubs or small trees. Indument consisting of simple hairs. Twigs terete or quadrangular, sometimes 4-winged. *Leaves* petioled or rarely sessile, at the base with a short ocrea. *Inflorescences* axillary or sometimes (partly) ramiflorous, cymose, often pseudo-umbellate or glomerulous, sometimes uniflorous. Bracteoles present, mostly minute. *Flowers* 5-merous (exceptionally in some flowers 4-merous), gynodioecious. *Sepals* usually only confluent at the very base, inside usually with colleters at the base, thick, thinned out towards the almost always ciliate margin. *Corolla* campanulate to rotate, (greenish-)white, tube thin-fleshy, lobes thicker, imbricate or contorted in bud, outside glabrous or short-pubescent, inside glabrous

or densely woolly pubescent, especially in the mouth, sometimes also near the base. *Stamens* inserted in the mouth, exerted, recurved beyond anthesis; filaments usually short; anthers 2-celled, often with a distinct appendage (especially distinct in ♀ flowers). *Ovary* 2-celled, with ∞ ovules; style often very short; stigma club-shaped or ellipsoid to globular, about as large as the ovary. *Capsules* 2-valved, septicidal or septifragal, black or possibly in some species green when ripe. *Seeds* ∞, ellipsoid to subglobular, intruded on the hilar side, minutely warty, brown to black, embedded in a juicy yellow to red pulp; endosperm thick, chartaceous.

*Distr.* About 20–40  *spp.*, mainly in the Pacific region as far east as the Society Is. and as far north as Kyushu (S. Japan), absent from the Asiatic mainland, especially richly developed in New Caledonia; in Australia, Lord Howe I., and New Zealand represented by 1 species each; in *Malaysia* at least 4 species (3 of which are restricted to New Guinea); furthermore 2 species in the Mascarenes. *Cf.* LEENH. *Pac. Pl. Areas* 39.

*Ecol.* Small substage trees in the rain-forest and heliophilous shrubs in more open places, also in mossy forests, under everwet conditions, from sea-level up to c. 2800 m.

*Morph.* The dehiscence of the fruit is primarily from bottom to top, secondarily also from top to bottom, therefore the valves are coherent longest slightly below the apex; in the end the valves are shed, and only the central part of the fruit, consisting of the dissepiment, the placenta, and the seeds, covered by the orange-red pulpa, remains. Birds are probably mainly responsible for the dispersal of the seeds.

*Specific delimitation.* Both the variability of many characters and the constancy of combinations of these differ considerably in different parts of the area of distribution. Therefore, botanists have come to different conclusions concerning specificity of characters, hence specific delimitation, depending on the area they studied.

In New Caledonia specific delimitation is clear: here are 12–14 well defined species, mostly endemic. With one or two exceptions they are not closely related to those of *Malaysia* and other parts of the Pacific. (See GUILLAUMIN, *Fl. Nouv. Cal.* 1948, 85.)

In the other islands of the Pacific and in *Malaysia* the material is distinctly more homogeneous, but one still meets a great variation especially in flower-characters: sepals differ in shape and size, the corolla is sparsely or densely and short- or long-hairy in the mouth, sometimes moreover provided with a second hair-ring near the base, stamens vary greatly in shape and size, are hairy or glabrous, and are provided with or lack an apical appendage which also may vary considerably in shape and size, finally the pistil may be glabrous or hairy, and the length of the style and shape of the stigma may differ considerably; furthermore, differences may be found in the degree of branching of the cymes and in the shape and size of the leaves.

The Pacific material comprises several small isolated island-populations, each characterized by a combination of these differential characters, without much variation. Most of them appear closely allied and of clearly reticulate affinity. Nevertheless, here one could gain the impression that these characters and their combinations carry sufficient weight for specific delimitation. (See A.C. SMITH & B. STONE, *Contr. U. S. Nat. Herb.* 37, 1962, 1–41, pl. 1–3.)

Application of the same standard in *Malaysia* (which in fact has been done by VALETON, *Bull. Inst. Bot. Btsg* 12, 1902, 1–28, pl. 1) led me to the distinction of about 35 local populations which are also mutually distinctly and reticulately allied, similarly as in the Pacific. However, they are mostly far less clearly delimited and are often connected by transitional forms. What is worse, the characters cited above do not appear to be constant: they show variation not only within one form, but also in otherwise almost identical specimens from the same locality, and even between the flowers of one specimen; the sepals and stamens may even vary within one flower. Obviously, this break-down of the constancy of characters is primarily due to the fact that the much larger Malaysian islands offer larger continua of land through which the effect of isolation, hence homogeneity of local populations as occurs in the Pacific, is prevented; a second cause is probably some degree of dioecism especially in the Javanese populations.

As a result of the detail examination of a large amount of Malaysian material I have come to the conclusion that the above-mentioned characters can not be trusted for specific delimitation in the *G. rupestre* affinity. Those which seem to me useful and constant are the size of the corolla, the presence *c.g.* absence of hairs on its inner surface, and the size (and possibly the shape) of the fruit. A further character may be found in the presence or absence of a light-coloured membranous margin along the valves of the latter, depending on the mode of dehiscence of the fruit, septicidally or septifragally respectively.

*Note.* The relationship is especially with the Hawaiian genus *Labordia* GAUDICH., which differs by terminal inflorescences and a corolla-tube which is distinctly longer than the lobes.

## KEY TO THE SPECIES

1. Corolla hairy inside, at least in the mouth.
2. Fruits up to 1½ cm long. Corolla 2-4½ mm long . . . . . 1. *G. rupestre*
2. Fruits 2 by ¾-1¼ cm. Corolla 6-7 mm long . . . . . 2. *G. randianum*
1. Corolla inside glabrous.
3. Corolla 5½ mm long. Flowers long-stalked, in pseudo-umbels. Fruits c. 10 by 7½ mm. Leaves usually 10-19 by 5-9 cm, thin . . . . . 3. *G. weinlandii*
3. Corolla 2-4 mm long. Flowers short-stalked, in fascicles or cymes. Fruits 3-5 mm ø. Leaves rarely more than 5 by 2 cm, stiff . . . . . 4. *G. arfakense*

1. *Geniostoma rupestre* FORST. Char. Gen. Pl. (1776) 12, t. 12; VAL. Bull. Inst. Bot. Btzg 12 (1902) 12 & 17, f. 1; A. C. SMITH & STONE, Contr. U. S. Nat. Herb. 37, 1 (1962) 34.—*Haemospermum arboreum* REINW. Syll. Pl. Ratisb. 2 (1826) 10; BL. Bijdr. (1827) 1018; HASSK. Flora 28 (1845) 246 (*Haematosperma arborens*).—*G. haemospermum* STEUD. Nomencl. (1840) 669, nom. illeg.; BL. Mus. Bot. 1 (1850) 238, incl. var. *angustifolia*, *elongata*, *erosa*, *laevigata*, et *rugulosa*; MIQ. Fl. Ind. Bat. 2 (1857) 365; VAL. Bull. Inst. Bot. Btzg 12 (1902) 21, f. 9, 10, 15 & 18; K. & V. Bijdr. 9 (1903) 56; KOORD. Atlas 2 (1914) f. 328; Fl. Tijb. 3 (1918) 45.—*G. micranthum* DC. Prod. 9 (1845) 27; F.-VILL. Nov. App. (1880) 135.—*G. montanum* Z. & M. in Mor. Syst. Verz. (1846) 58; BTH. J. Linn. Soc. Bot. 1 (1856) 97; MIQ. Fl. Ind. Bat. 2 (1857) 366, t. 33.—*G. lasiostemon* BL. Mus. Bot. 1 (1850) 239, f. 35, incl. var. *moluccanum*; MIQ. Fl. Ind. Bat. 2 (1857) 365.—*G. reticulata* BL. Mus. Bot. 1 (1850) 239.—*G. lanceolatum* Z. & M. ex MIQ. Fl. Ind. Bat. 2 (1856) 33, nom. illeg., non BOJER ex DC. 1845; HOCHR. Candollea 6 (1936) 471.—*G. cumingianum* BTH. J. Linn. Soc. Bot. 1 (1856) 97; MERR. En. Philip. 3 (1923) 310.—*G. australium* F. v. M. Fragm. 5 (1865) 19; BTH. Fl. Austr. 4 (1869) 367; F. M. BAIL. Queensl. Fl. 3 (1900) 1022; VAL. Bull. Inst. Bot. Btzg 12 (1902) 17, f. 2.—*G. arboreum* O.K. Rev. Gen. Pl. (1891) 425, incl. var. *laevigatum*; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 3.—? *G. avene* VAL. Bull. Inst. Bot. Btzg 12 (1902) 23 & 16.—*G. celebicum* VAL. l.c. 19 & 15, f. 7 & 13.—*G. miquelianum* K. & V. ex VAL. l.c. 22 & 14, f. 11, 12 & 16; K. & V. Bijdr. 9 (1903) 58; KOORD. Exk. Fl. Java 3 (1912) 56 & 57; Atlas 2 (1914) t. 327; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 297; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 3.—*G. moluccanum* VAL. Bull. Inst. Bot. Btzg 12 (1902) 19 & 15, f. 4; Ic. Bog. 2 (1904) 143, t. 130; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 297.—*G. oblongifolium* K. & V. ex VAL. Bull. Inst. Bot. Btzg 12 (1902) 20 & 15, f. 5, 6 & 14; K. & V. Bijdr. 9 (1903) 60; KOORD. Atlas 2 (1914) f. 329; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 3; MEYER DREES, Comm. For. Res. Inst. n. 33 (1951) 74.—*G. caulocarpum* K. Sch. in K. Sch. & Laut. Nachtr. (1905) 348; GILG & BENED. Bot. Jahrb. 54 (1916) 161.—*G. philippinense* MERR. Philip. J. Sc. 3 (1908) Bot. 259.—*G. batanense* MERR. *ibid.* 3 (1909) Bot. 427; En. Philip. 3 (1923) 309.—*G. stenophyllum*

MERR. Philip. J. Sc. 7 (1912) Bot. 329, non GILG & BENED. 1916; En. Philip. 3 (1923) 310.—? *G. pulgarensis* ELM. Leafl. Philip. Bot. 5 (1913) 1808; MERR. En. Philip. 3 (1923) 310.—*G. brevipes* MERR. Philip. J. Sc. 9 (1914) Bot. 384; En. Philip. 3 (1923) 309.—*G. laxa* ELM. Leafl. Philip. Bot. 8 (1915) 2746; MERR. En. Philip. 3 (1923) 310.—*G. mindanaense* ELM. Leafl. Philip. Bot. 8 (1915) 2747.—*G. acuminatissimum* GILG & BENED. Bot. Jahrb. 54 (1916) 159, f. 3, non MERR. 1922.—*G. antherotrichum* GILG & BENED. l.c. 158, f. 2.—*G. psychotrioides* GILG & BENED. l.c. 160.—*G. dasyneurum* GILG & BENED. l.c. 161.—*G. schlechteri* GILG & BENED. l.c. 162.—*G. longipes* MERR. Philip. J. Sc. 12 (1917) Bot. 296; En. Philip. 3 (1923) 310.—*G. nigrescens* (BLCO) MERR. Sp. Blanc. (1918) 305, *pro specim.*, *typo excl.*; En. Philip. 3 (1923) 310.—*G. pachyphyllum* MERR. Philip. J. Sc. 14 (1919) 448; En. Philip. 3 (1923) 310.—*G. lancilimum* MERR. Philip. J. Sc. 17 (1921) 304; En. Philip. 3 (1923) 310.—*G. ramosii* MERR. Philip. J. Sc. 17 (1921) 304; En. Philip. 3 (1923) 310.—*G. pullei* CAMMERL. Nova Guinea 14 (1924) 115, t. 12.—*G. fasciculata* QUIS. & MERR. Philip. J. Sc. 37 (1928) 190.—*G. aff. rupestris* FORST.; CHRISTOPHERSEN, Bull. Bish. Mus. n. 128 (1935) 176.—*G. dallmannense* KAN. & HAT. Bot. Mag. Tokyo 56 (1942) 164, f. 8.—**Fig. 361.**

Shrub or treelet, up to 6(–10) m high. Branches mostly terete, rarely quadrangular, glabrous or the young twigs shortly brown- to fulvous-tomentose. Leaves ovate to lanceolate, 1½–17 by ½–6½ cm, herbaceous to chartaceous, rarely coriaceous, glabrous or (mainly on the midrib beneath) shortly tomentose; base rounded to acute, rarely emarginate; margin entire or rarely faintly crenulate; apex blunt or acute to long-acuminate, aristulate or not; nerves (3–)6–10(–11) pairs; petiole ¼–1(–1¼) cm. Inflorescences mostly axillary, sometimes partly ramiflorous, often glomerulous, not rarely laxly paniculate, sometimes umbelliform, with (1-)several flowers, ½–1½ (–4½) cm, sparsely (to densely) shortly appressed-hairy, sometimes glabrous. Pedicels 1–5 mm. Calyx (2½–)1–2(–2¼) mm high, sepals elliptic or ovate to broad-triangular, blunt to acute, outside glabrous to densely short-tomentose. Corolla (1½–)2½–4½ mm long, outside glabrous or rarely fairly densely papillose-hairy, inside the throat densely to sparsely hairy, sometimes a second ring of hairs near the base of the tube; lobes (¾–)1–2½ mm long, usually blunt, rarely acute. Stamens variable, especially as to hairiness;

filaments  $(\frac{1}{5}-\frac{1}{2})-\frac{3}{4}$  (-1) mm, glabrous to rather densely hairy; anthers  $\frac{3}{4}-1\frac{1}{4}$  mm long, glabrous or hairy, appendage of the connective absent to as long as the cells, in the latter case (mainly in ♀ flowers) triangular above the adnate cells. Ovary glabrous to densely shortly tomentose; style usually very short (less than  $\frac{1}{8}$  mm), in some forms (mainly in Sumatra, W. Java, and the Philippines) about 1(-2) mm, glabrous or rarely slightly pubescent. Fruits mostly slightly flattened-globose, rarely ellipsoid, ovoid, or obovoid,  $4-7\frac{1}{2}$  (-12) by 4-6(-9) mm, black when ripe (sec. MERRILL whitish in *G. philippinense*, red in *G. stenophyllum*), septifragal (but see note).

Distr. Widely distributed, throughout Malaysia (except in the Malay Peninsula), E. Queensland (around Innisfail, Ravenshoe, and Rockingham Bay), and the West Pacific (at least as far north as the Marianas and east as far as Samoa).

Ecol. Very variable, in the substage of the rain-forest, but apparently preferring more open places, often in exposed sites, along forest edges and river-banks, in young secondary forests and shrubberies, on steep slopes and in grass fields, under everwet conditions, in regions subject to a dry season only, in the montane rain-forest, for example in the Lesser Sunda Is. only between 700-2200 m; from sea-level up to 2800 m.

Wood anat. JUTTE, Nova Guinea n.s. 9 (1958) 360, f. 8 (sub *Geniostoma* sp.).

Vern. Itit biru, kaju tain, kitelong, S, maniran (or maniran-idju (or -idjo), tumon telong, J; Philip.: bitig-bitig, Neg., gagadang, Iv., sañ-guadan, Mbo., tagobinlod, C. Bis., umum, Ig.; bochogan, kaju-im-bulut, kaju-tai, kopopojoan-wewene, mawotai, Cel., gandarusa-utan, Ambon.

Notes. As has been alluded to under the genus, *G. rupestre* is extremely variable, both in vegetative and in floral characters; fruit characters are less variable. There are a number of geographically more or less restricted races. Part of these are very local and often known from a few specimens only; others are locally sometimes sharply delimited but in other regions connected by intermediates. I deem it premature to venture on a subdivision of this species and it is doubtful that this will ever be possible on more than a local scale.

Some of these local forms, and some single specimens, have only with some doubt been included in *G. rupestre*. *G. pulgarensis* is known only from the type-collection (ELMER 13197, Mt Pulgar, Palawan, Philippines; fruiting specimen), and deviates from the mountain form described from Luzon as "*G. cumingianum*"; it seems to be more closely related to the form of Mt Kinabalu, Borneo. The type specimen of *G. avene* (TEYSMANN s.n., P. Gebeh, E. Moluccas; fruiting specimen) also comes close to *G. pulgarensis*, with the exception only of the fruits which are septical with light-coloured, membranous margins.

TWO specimens from New Guinea (DOCTERS VAN LEEUWEN 10345 & 10415) are characterized by small, narrowly lanceolate leaves ( $2\frac{1}{2}$ -5 by  $\frac{1}{2}$ -1 $\frac{1}{2}$  cm) and small flowers (calyx 0.8 mm, corolla 2 mm); these specimens were collected

near the Rouffaer River, on the river-bank between stones, at 250-300 m.

Among the Celebes specimens, KJELLBERG 2775 from Matano (at 400 m) is mainly aberrant by the relatively large (11-12 by 7 mm), ellipsoid to ovoid fruits. KJELLBERG 2681 (Central Celebes at 1200 m) and EYMA 470 & 2051 (both from Ceram, at 1550-2600 m) are deviating by very small flowers (calyx  $\frac{3}{4}-\frac{1}{6}$  mm, corolla  $1\frac{1}{2}$ -2 mm, anthers subsessile, 0.4 mm long).

Nomencl. The name *G. haemospermum* STEUD. is illegitimate as it had been based upon *Haemospermum arboreum* REINW., and the epitheton *arboreum* should have been used.

The name *G. lanceolatum* Z. & M. ex MIQ. is illegitimate primarily as being a later homonym of *G. lanceolatum* BOJER ex DC. (1845), and secondarily as this name, apparently erroneously printed under the plate, was corrected in the text by MIQUEL to *montanum*, hence not accepted by him.

2. *Geniostoma randianum* MERR. & PERRY, J. Arn. Arb. 23 (1942) 409.—*G. obtusum* MERR. & PERRY, l.c. 410.—Fig. 36a-h.

Shrub or treelet, 2-6 m high, glabrous. Leaves often inserted on distinct leaf-cushions, obovate or elliptic to lanceolate,  $3\frac{1}{2}-4\frac{3}{4}$  by  $1\frac{1}{2}-2\frac{1}{2}$  cm, stiff-coriaceous; base cuneate; apex blunt or acute to shortly, broadly, and acutely acuminate, aristulate; nerves 5-7 pairs; petiole 6-8 mm. Inflorescences axillary, 1-5-flowered, dichasial, 1-2 cm. Pedicels c.  $\frac{1}{2}$  cm. Calyx  $1\frac{1}{3}-3$  mm high, up to about halfway connate, glabrous, lobes acute. Corolla 6-7 mm long, outside glabrous, inside more or less densely hairy in and sometimes above the mouth; lobes acute,  $2\frac{1}{2}-4$  mm. Filaments  $\frac{1}{2}-\frac{2}{3}$  mm, glabrous; anthers  $1\frac{1}{4}-1\frac{1}{2}$  mm long, entirely or partly lax-hairy, appendage of the connective c. 0.1- $\frac{1}{4}$  mm. Pistil glabrous; style  $\frac{1}{2}-3$  mm. Fruits usually 1 per axil, flattened-ovoid to obovoid, 2 by  $\frac{3}{4}-1\frac{1}{2}$  cm, septifragal.

Distr. Malaysia: New Guinea (Central Div.; Milne Bay Distr.).

Ecol. On forest fringes in mossy forest and shrubberies, 2230-2840 m.

Notes. In describing *G. obtusum*, MERRILL and PERRY observed already that it is closely related to *G. randianum*, and though there are some differences in fruit, flowers, and leaves, I think they should be combined.

Well characterized by the large-sized flowers and fruit.

3. *Geniostoma weinlandii* K. SCH. in K. Sch. & Laut. Nachtr. (1905) 349; GILG & BENEDE. Bot. Jahrb. 54 (1916) 157, f. 1.—*G. acutifolium* HIERN, Nova Guinea 8 (1909) 201.

Shrub or treelet, 2-5 m, glabrous or the young twigs sometimes thinly tomentose. Leaves ovate to oblong (to lanceolate), (6 $\frac{1}{2}$ -)10-21 by (3 $\frac{1}{2}$ -)5-9 cm, tough-papyraceous to thin-chartaceous, base rounded to cuneate, apex tapering to rather abruptly acuminate, acumen short and triangular to long and slender, acute; nerves 5-8(-10) pairs;

petiole  $\frac{1}{3}$ – $1\frac{1}{2}$  cm. *Inflorescences* axillary and partly ramiflorous, umbelliform, short-stalked, 3–5(– $\pm$  15)-flowered, 1–2 cm long. Pedicels slender, (0.6–)0.8–1.3 cm. *Calyx* 2– $2\frac{1}{2}$  mm high, outside rather densely shortly tomentose, lobes semi-orbicular. *Corolla*  $5\frac{1}{2}$  mm long, glabrous on both sides, lobes  $3\frac{1}{4}$  mm, slightly acuminate, broadly imbricate in bud. *Stamens* glabrous, filaments up to 1 mm, anthers 1– $1\frac{1}{2}$  mm long, the appendage of the connective small. *Pistil* glabrous, style  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm. *Fruits* obovoid to ellipsoid, c. 1 by  $\frac{3}{4}$  cm, sutures distinct.

*Distr.* *Malaysia*: New Guinea and ? Moluccas (Aru Is.).

*Ecol.* Mainly along forested river-banks, also on *Saccharum*-covered shoals in river-beds, 50–1750 m. *Fl. fr.* probably Jan.–Dec.

*Vern.* *Djangdjangalie*, Aru Is., *marau*, New Guinea.

*Notes.* The species had been based upon two specimens, SCHLECHTER 14495 (still represented in BM, BRSL, K) and WEINLAND s.n. (BO, BRI, BRSL, SING), both from Kaiser Wilhelmsland, "am mittleren Bumifluss". As the WEINLAND specimen bears both flowers and fruits (especially the Wroclaw-sheet is a good one) I choose this as lectotype; the holotype is lost in Berlin.

A sterile specimen from the Aru Is. (bb. 25404) probably belongs to this species, though it is not quite impossible that it represents *G. rupestre* which is vegetatively not well distinguishable.

**4. *Geniostoma arfakense* KAN. & HAT.** *Bot. Mag. Tokyo* 56 (Apr. 20, 1942) 163, f. 7.—*G. archboldianum* MERR. & PERRY, *J. Arn. Arb.* 23 (Oct. 1942) 408.

Shrub or small tree, up to 10(–13?) m high. Branches glabrous or the young parts sometimes sparsely pubescent. *Leaves* glabrous or rarely ciliate when very young, (ovate-)elliptic to lanceolate, ( $\frac{3}{4}$ –)1 $\frac{1}{2}$ –5(–10) by ( $\frac{1}{2}$ –)1–2(– $4\frac{1}{2}$ ) cm, chartaceous to coriaceous, base broadly to narrowly cuneate, sometimes slightly rounded, apex blunt to gradually long and slender acute-acuminate, sometimes aristulate; nerves 4–8 pairs; petiole ( $1\frac{1}{2}$ –)2 $\frac{1}{2}$ –5(–7) mm. *Inflorescences* axillary, glomerulous to laxly cymose,  $\frac{3}{4}$ –2 cm long, up to c. 10-flowered; pedicels slender,  $1\frac{1}{2}$ –6 mm. *Sepals* mostly acute, 1– $1\frac{1}{2}$  mm long, outside glabrous or minutely pubescent. *Corolla* 2–4 mm long, lobes blunt to acute,  $1\frac{1}{2}$ – $2\frac{1}{4}$  mm, glabrous (rarely outside papillose-tomentose). *Stamens* mostly shortly patent-hairy, filaments very short to  $\frac{3}{4}$  mm, anthers  $\frac{3}{4}$ – $1\frac{1}{2}$  mm, appendage of the connective up to about half as long. *Ovary* glabrous or sometimes hairy around the style base; style almost absent or up to c.  $\frac{1}{2}$  mm, glabrous or pubescent. *Fruits* globular to slightly ellipsoid, 3–5 mm  $\phi$ , septifragal; suture inconspicuous.

*Distr.* *Malaysia*: New Guinea.

*Ecol.* In and mainly along primary, rarely secondary forests, along river-banks, on grassy deforested slopes, and in low regrowth on peaty soil, mainly 1700–2600 m. *Fl.* (March, April) June–Dec., *fr.* June–Nov.

*Vern.* *Kegopa*, *kiaugupa*, *mongemandimand*, *raurau*, *tuoparimoh*, *tuwapalimo*.

*Notes.* There is some variation in details, mainly in the shape and size of the leaves and the number of flowers per inflorescence.

The alliance is with *G. oleifolium* S. MOORE from New Caledonia, but it comes also very close to some E. Malaysian forms of *G. rupestre* ('*G. pullei*' and '*G. pugarensis*' especially) from which it only differs by the glabrous mouth of the corolla.

#### Dubious

*Anassera rumphii* SPANOGHE, *Linnaea* 15 (1841) 325, *nom. nud.*

Neither the specimen, nor the drawing ("Icon. n. 27") could be localized.

*Geniostoma gilgii* MERR. & PERRY, *J. Arn. Arb.* 23 (1942) 409.—*G. stenophyllum* GILG & BENED. *Bot. Jahrb.* 54 (1916) 162, *nom. illeg., non* MERR. 1912.

Described from New Guinea. Possibly a synonym of *G. rupestre*, but the description shows some discrepancies with that species and authentic material could not be localized.

#### Excluded

*Anasser moluccana* LAMK, *Illustr.* 2 (1793) 40, is according to BAKKER, *Fl. Mal. I*, 5 (1957) 356–359 = *Pittosporum moluccanum* (LAMK) MIQ. (*Pittosporaceae*).

*Anasser laniti* BLOCO, *Fl. Filip.* (1837) 112, is according to MERRILL, *Sp. Blanc.* (1918) 313 = *Wrightia laniti* (BLOCO) MERR. (*Apocynaceae*).

*Geniostoma acuminatissima* MERR. *Philip. J. Sc.* 20 (1922) 432, *nom. illeg., non* GILG & BENED. 1916, is according to BREMEKAMP, *Candollea* 16 (1957) 93 = *Lasianthus furcatus* (MIQ.) BREMEK. (*Rubiaceae*).

*Geniostoma acuminatum* WALL. in ROXB. *Fl. Ind.* 2 (1824) 316, is according to BENTHAM, *J. Linn. Soc. Bot.* 1 (1856) 69 = *Urophyllum streptopodium* WALL. (*Rubiaceae*).

*Geniostoma crassifolium* BTH. *J. Linn. Soc. Bot.* 1 (1856) 96. A species described from the Isle of Pines near New Caledonia, in *Index Kewensis* erroneously cited as from the Philippines.

*Geniostoma nigrescens* (BLOCO) MERR. *Sp. Blanc.* (1918) 305.—*Tayottum nigrescens* BLOCO, *Fl. Filip.* (1837) 105; ed. 2 (1845) 76; ed. 3, 1 (1877) 141. MERRILL wrongly referred BLANCO's description to *G. philippinense*; the 'illustrative specimen' distributed by him (MERRILL, *Sp. Blanc.* 878) I reckon to belong to *G. rupestre*. FERN.-VILLAR (Nov. App. 1880, 136) was also mistaken by reducing BLANCO's species to *Norrisia malaccensis* GARDN. In fact BLANCO's monotypic genus cannot represent any *Loganiaceae*; the fruit which is said to be enveloped by the calyx, excludes it from that family.



Fig. 37. *Cynoctonum sphaerocarpum* LEENH. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 8$ , c. ditto, longitudinal section,  $\times 8$ , d. fruit,  $\times 4$ , e. seed,  $\times 20$ .—*C. mitreola* (L.) BRITT. f. Habit,  $\times \frac{2}{3}$ , g. fruit,  $\times 4$ , h. seed,  $\times 20$  (a combined from CLEMENS 29469 and JAHERI 286, b-e CLEMENS 29469, f-h HOOGLAND 4365).



## 9. CYNOCOTONUM

Gmel. Syst. (1791) 443.—*Mitreola* LINNÉ, Gen. Pl. ed. 1 (1737) 377.—*Ophiorhiza* LINNÉ, *ibid.* ed. 5 (1754) 74, p.p.—*Mitrcola* BOEHMER in Ludwig, Def. Gen. Pl. (1760) 31, *nom. illeg.*, p.p.—*Mitreola* SCHAEFF. Bot. Exped. (1760) 11, *nom. illeg.*—*Selenocera* ZIPP. ex SPAN. Linnaea 15 (1841) 316.—*Parophiorrhiza* CLARKE in Hook. f. Fl. Br. Ind. 3 (1880) 85.—**Fig. 37.**

Herbs, annual and erect or perennial and creeping at the base. *Leaves* petioled or sessile; interpetiolar stipules well developed or reduced to a transverse ridge. *Inflorescences* terminal and/or axillary, usually long-peduncled, dichasial with long cinnate branches. *Flowers* on short pedicels to subsessile, 5-merous. *Calyx* almost parted to the base. *Corolla* urceolate, lobes short, imbricate in bud, mouth closed by a dense ring of hairs. *Stamens* short, included; anthers introrse, cells free. *Pistil* semi-inferior; ovary 2-celled, each cell with many, small, anatropous ovules; styles 2, short, sometimes absent; stigmas more or less adnate to each other. *Capsules* 2-horned, rarely globular, almost free from the calyx, both carpels dehiscent along the ventral suture. *Seeds* ∞, small, with fleshy endosperm.

Distr. Six spp. in tropical and subtropical America (1 endemic), Madagascar (2 endemic), SE. Asia (1 endemic), Malaysia (1 endemic), and North Australia (Arnhem Land). Cf. LEENH. Pac. Pl. Areas 33.

Ecol. Preferably on wet spots under seasonal conditions, on heavy clay soils or limestone, not or slightly shaded.

Notes. In defining the genus *Ophiorhiza*, LINNAEUS included two species, viz *O. mungos* and *O. mitreola* (Sp. Pl. 1753, 150). The former species is an *Ophiorhiza* (*Rubiaceae*) in the current sense and the type of the genus; the latter was based upon *Mitreola* L. 1737, which is the present *Cynoctonum mitreola*. LUDWIG based his genus *Mitreola* upon LINNAEUS Gen. Pl. 1737; as he cited, however, *Ophiorhiza* L. as a synonym, his name is superfluous, hence illegitimate.

In the same year as LUDWIG, SCHAEFFER described his (new) genus *Mitreola*, without a reference to LINNÉ, but clearly distinguishing it from *Ophiorhiza* L. The preface of SCHAEFFER's publication is dated October 1760; though the month of LUDWIG's publication is unknown, it is at least probable that it appeared earlier in the year and antedated SCHAEFFER's name.

The genus is especially closely related to *Mitrasacme*, the main differences being the 5-merous flowers and the semi-inferior ovary.

## KEY TO THE SPECIES

1. Annual erect herb. Pistil with two distinct styles. Fruits 2-horned . . . . . **1. *C. mitreola***  
 1. Perennial herb, creeping in the basal part and rooting at the nodes. Pistil with sessile stigmas. Fruits globular, only slightly bilobed at the top . . . . . **2. *C. sphaerocarpum***

**I. *Cynoctonum mitreola*** (L.) BRITT. Mem. Torr. Bot. Cl. 5 (1894) 258; HOCHR. Bull. N.Y. Bot. Gard. 6 (1910) 284, *incl. var. orthocarpa*; MERR. & PERRY, J. Arn. Arb. 29 (1948) 163; BAKH. f. in B. ck. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 4, *incl. var. lilacina*; Blumea 6 (1950) 382; GLEASON in Britton & Brown, Ill. Fl. U.S. ed. 2, 3 (1952) 54, fig. p. 55.—*Ophiorhiza mitreola* LINNÉ, Sp. Pl. (1753) 150.—*C. petiolatum* Gmel. Syst. 2 (1791) 443.—*Mitreola paniculata* WALL. ex G. DON, Gard. Dict. 4 (1837) 171; DC. Prod. 9 (1845) 9; WIGHT, Ic. 4 (1850) 14, t. 1600; Illustr. 2 (1850) t. 156 b fig. 1 (15–21); HOOK. Ic. Pl. (1852) t. 828; MIQ. Fl. Ind. Bat. 2 (1857) 361; PROGEL in Mart. Fl. Bras. 6, 1 (1865) 266, t. 71; KOORD. Ekx. Fl. Java 3 (1912) 57; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 298, *incl. var. lilacina* BACK.; BACK. Onkr. Suiker. (1931) 485.—*Mitreola oldenlandioides* G. DON, Gard. Dict. 4 (1837) 172, *nom. illeg.*; DC. Prod. 9 (1845) 9; HOOK. Ic. Pl. (1852) t. 827; BTH. J. Linn. Soc. Bot. 1 (1856) 91; MIQ. Fl. Ind. Bat. 2 (1857) 360;

BTH. Fl. Austr. 4 (1869) 349; CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 79; BOERL. Handl. 2 (1899) 449 & 458; KING, J. As. Soc. Beng. 74, ii (1908) 598; DOP, Fl. Gén. L.-C. 4 (1912) 155, f. 20 (1–2); GILG & BENED. Bot. Jahrb. 54 (1916) 163; *ibid.* 56 (1921) 547; RIDL. Fl. Mal. Pen. 2 (1923) 413; GAMBLE, Fl. Madras 5 (1923) 863; KANJILAL & DAS, Fl. Assam 3 (1939) 310; HENDERS. Mal. Nat. J. 6 (1950) 303, f. 287; KERR in Craib, Fl. Siam. En. 3 (1951) 52.—*Selenocera secundiflora* ZIPP. ex SPAN. Linnaea 15 (1841) 316.—*Mitreola petiolata* TORR. & GRAY, Fl. N. Am. 2 (1841) 45; DC. Prod. 9 (1845) 8; BTH. J. Linn. Soc. Bot. 1 (1856) 91; PROGEL in Mart. Fl. Bras. 6, 1 (1865) 266, t. 82 (1); MERR. Philip. J. Sc. 11 (1917) Bot. 307; SPECHT, Rec. Am. Austr. Exp. Arnhem Land 3 (1958) 468.—*Mitreola inconspicua* Z. & M. in Mor. Syst. Verz. (1846) 55.—*C. paniculatum* B. L. ROB. Proc. Am. Ac. Arts Sc. 45 (1910) 396; MERR. Pap. Mich. Ac. Sc. 23 (1938) 188.—**Fig. 37f-h.**

Erect, annual herb, simple or branched from



Fig. 38. *Spigelia anthelmia* L. a. Habit,  $\times \frac{1}{2}$ , b. stipules,  $\times 3$ , c. flower,  $\times 3$ , d. longitudinal section of corolla with pistil,  $\times 4\frac{1}{2}$ , e. calyx with persistent basal part of fruit,  $\times 4\frac{1}{2}$ , f. fruit,  $\times 3$ , g. seeds,  $\times 6$  (a-b, e COERT 624, c-d HOLSTVOOGD 78, f-g RAHMAT 8401).

the base, 5-80 cm high. Stem quadrangular to narrowly 4-winged, glabrous. *Leaves* with broadly deltoid, 1-1½ mm high, interpetiolar stipules, ovate to ovate-oblong, 1½-7 by 1-3½ cm, herbaceous, very sparsely appressed-pubescent or glabrous apart from the appressed-ciliate entire margin, base obtuse or acute, usually decurrent, apex obtuse to acute; nerves 4-10 pairs, ascending; petiole grooved, ½-3 cm long. *Inflorescences* partly terminating the stem and few-leaved branches, partly in the highest leaf-axils, widely branched, the ultimate branches 2-15 cm, slender, glabrous or shortly ciliate under the nodes. Bracts narrowly deltoid, 1½-2 mm long. *Flowers* shortly pedicelled to subsessile. *Calyx* obconical, 1¼ mm, sepals ovate, acute, with broad, membranous margins, glabrous. *Corolla* 1-2 mm, halfway connate, lobes oblong-ovate, acute; corolla outside and lobes inside papillose. *Stamens* inserted just above the base of the corolla-tube, glabrous; filaments ¼-½ mm. *Pistil* glabrous, with 2 free styles ¼-½ mm long; stigmas globular, connate or not. *Capsules* 2-horned, 2-3½ mm long, ciliate on midrib and along the margins or fully appressed-pubescent, the horns either straight and divaricating or curved inwards. *Seeds* ellipsoid, ½-¾ mm long, concave on one side, smooth.

Distr. SE. United States, Central and tropical South America, SE. Asia from Bombay to Tonkin, in *Malaysia*: Malay Peninsula (peninsular Siam and Langkawi Is.), N. Sumatra, Java (especially common in the teak-forests of the eastern half), Bawean, Kangean, Bali, Timor, Tanimbar Is., S. Celebes (also Buton I.), Philippines (Luzon, Mindoro, Bohol), New Guinea, and N. Australia (Arnhem Land). Introduced in the Carolines (Yap and Palau).

*Ecol.* Forest edges, along roads, on grassy plains, sometimes as a weed on fields, on sawah-dikes etc.; on slightly shaded, badly drained, preferably marly soils, up to 600 m alt.; in Java especially along fire brakes in teak-forest, on Langkawi I. on limestone rocks near the sea; obviously bound to areas subject to a dry season. *Fl.* at the end of the rainy season.

Vern. *Ki fatu*, Timor; Philip.: *tagarinuk maginding*, Mang.

*Notes.* The flowers are usually white. BACKER described a *var. lilacina* based upon specimens from Central Java which were characterized by violet flowers and straight fruit lobes; the specimens from Langkawi I. are also said to have pale

mauve flowers, and here the fruit lobes are also straight. HOCHREUTNER distinguished three varieties based upon the shape of the fruit. As his varieties are neither sharply delimited (*var. intermedia* comprises all specimens which do not show one of the extreme fruit forms) nor geographically restricted (only the frequency may be different) they seem to have no taxonomic value.

JOVET (Bull. Mus. Nat. Hist. Nat. II, 6, 1934, 291-301) described two species from Madagascar: *Mitreola perrieri* and *Mitreola turgida*, which are closely related to the present species; both are especially different in the shape and size of the fruit.

The name *Mitreola oldenlandioides* WALL. was not validly published by G. DON, as it was not accepted by him as a species.

## 2. *Cynoctonum sphaerocarpon* LEENH. Bull. Jard. Bot. BRUX. 32 (1962) 417.—Fig. 37a-e.

Perennial herb, in the basal part creeping and rooting at the nodes. Stem terete to faintly quadrangular, at the top with two narrow wings most distinct below the nodes; glabrous. *Leaves* glabrous, with narrowly triangular, 1½ mm long, acute, soon shrivelling interpetiolar stipules, (elliptic-)oblong, 6-14 by 3-6 cm, thin-papyraceous, base cuneate and decurrent, apex tapering acute-acuminate; nerves c. 8 pairs; petiole flat above, 1-1½ cm. *Inflorescences* terminal and axillary, glabrous, rather dense, 2-3 cm long, 7-8 cm peduncled, ultimate branches short. Bracts narrowly deltoid, up to 1½ mm. Pedicels slender, 1-1½ mm. *Calyx* obconical, 1-¼ mm long, sepals oblong-ovate, acute, with broad membranous margins, glabrous. *Corolla* 2 mm long, white, lobes c. ⅔ mm, elliptic, rounded, papillose inside. *Stamens* inserted about halfway the corolla-tube, glabrous, filaments ¼-½ mm, anthers elliptic-ovate, ½ mm long. *Pistil* glabrous, stigmas subsessile, connate. *Fruits* broad-ovoid, bilobed, not or only very slightly split at the apex, c. 3 mm o. *Seeds* about hemispherical to tetraedrical, c. ¼ mm, minutely warty.

Distr. *Malaysia*: Borneo (twice collected: Mt Kinabalu, at about 1800 m, *fl. fr.* May; Bt Liangbatu).

*Note.* Apparently closely related to *C. pedicellatum* (BTH.) B. L. ROB., a species described from the Sikkim and also cited from S. China (Yunnan, Kweichow); it differs from the Bornean one mainly by distinct styles and mitre-shaped fruits.

## 10. SPIGELIA

LINNÉ, Gen. Pl. ed. 5 (1754) 74; Sp. Pl. 1 (1753) 149; L. B. SMITH, Wrightia 2 (1960) 90 (Am. spp.).—Fig. 38.

Annual or perennial herbs or undershrubs. *Leaves* often partly in (pseudo) whorls at the base of the inflorescence, short-petioled or sessile, the bases connected by interpetiolar stipules or sheaths. *Inflorescences* terminal and/or in the upper leaf-axils, cincinnous, sometimes reduced to a few flowers. *Flowers* sessile or almost so, 5-merous. *Calyx*: sepals free or connate at the base, inside at the base

with some colleter. *Corolla*: tube tubular, lobes valvate in bud, shorter than the tube. *Stamens* included, anthers dorsifixed, introrse, lanceolate or ovate, 2-celled. *Ovary* superior, 2-celled, with many ovules. *Capsule* 2-lobed, 2-celled, 4-valved, valves caducous with the exception of a cupular basal part (fig. 38e). *Seeds* some per cell, globose to angular, verrucose; endosperm fleshy or cartilaginous.

Distr. About 50 spp. in tropical and subtropical America, one naturalized in W. Africa and in *Malaysia*.

1. *Spigelia anthelmia* LINNÉ, Sp. Pl. 1 (1753) 149; SIMS, Bot. Mag. (1822) t. 2359; DC. Prod. 9 (1845) 7; BISSCHOP GREV. Pl. N. I. (1883) 611; BACK, Trop Natuur 1 (1913) 65, f. 1-4; HEYNE, Nutt. Pl. (1927) 1267; BACK, Onkr. Suiker. (1931) 484; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 4; L. B. SMITH, Wrightia 2 (1960) 98; LEEUWENB. Acta Bot. Neerl. 10 (1961) 460, f. 1, map 1.—Fig. 38.

Annual herb, 2-25(-70) cm high, unbranched or with some pairs of strong branches near the base; stems erect, terete, glabrous, with a few remote pairs of rather small leaves and an apical pseudowhorl of 4 larger ones. *Leaves* connected by interpetiolar, broadly triangular, blunt, glabrous stipules, ovate-oblong to ovate-lanceolate, 3-10 by ¼-5 cm, herbaceous, scabrous above, glabrous beneath, cuneate and often decurrent at the base, attenuate at the apex; nerves 4-5 pairs, strongly ascending; petiole 0-1 cm. *Inflorescences* terminal and usually in the axils of the whorled upper leaves, up to 15 cm long, peduncle very short, glabrous or nearly so; bracts lanceolate, 2-3 mm long. *Flowers* spaced, (sub)sessile. *Sepals* free, quincuncial in bud, somewhat unequal in length, ovate-linear-lanceolate, 2-3½ mm, acute, glabrous or outside sparsely puberulous, pale green. *Corolla* salver-shaped, glabrous, white to red or purplish;

tube 6½-15 mm, lobes exduplicative-valvate in bud, triangular, 2-2½ mm long. *Stamens* glabrous, inserted slightly below the middle of the tube, filaments filiform, ± 1 mm, anthers attached slightly above the base, lanceolate, 1¼-1¾ mm, obtuse. *Ovary* glabrous, subglobose, ½-¾ mm ø, style cylindrical, ¾ mm; stigma ovate-lanceolate, 2 mm, pubescent near the tip, caducous. *Capsule* 4-5 by 5-6 mm, squamulate-tuberculate mainly in the upper half. *Seeds* obliquely ellipsoid or ovoid, 2-3 by 1½-2 mm, dull brown, tuberculate.

Distr. Native in America from Mexico and Florida to Peru and Brazil, naturalized in tropical West Africa and in *Malaysia*: Sumatra, Java (mainly West and Central), and Lesser Sunda Is. (Sumba).

Ecol. A weed of sandy seashores, river-banks, fields, gardens, roadsides, waste places, from the beach up to 600 m; locally often common, but on the whole rather rare. A self-pollinating plant; the flowers are open from 2-5 in the afternoon. *Fl. fr.* Jan.-Dec.

Uses. A decoction of the roots is well known to be a very effective vermifuge.

Vern. *Wormgrass*, E, *sammondjo*, Sum., *djukut puntir*, *taih manuk*, S, *platikan*, J.

Note. Reported to be very poisonous.

## II. MITRASACME

LABILL. Nov. Holl. Pl. Spec. 1 (1804) 35, t. 49; LEENH. Bull. Jard. Bot. Brux. 32 (1962) 440.—Fig. 39-47.

Annual or perennial herbs. *Leaves* in pairs along the stem or rosulate, (sub)sessile, connected at base by a membrane, stipules not separately distinguishable; one- or curvi-nerved. *Flowers* either solitary in the leaf-axils, rarely terminal, or in terminal and/or axillary cymose inflorescences, 4-merous. *Calyx* 4-, rarely 2-lobed, sepals about halfway connate; colleter few or absent. *Corolla* urceolate, campanulate, or salver-shaped, membranous to thin-fleshy, often bearded in the mouth; lobes exduplicate-valvate in bud. *Stamens* inserted on the lower half of the corolla-tube, mostly included, filaments usually filiform; anthers 2-celled, introrse, extrorse, or rarely latrorse. *Pistil* superior or slightly inferior, glabrous, ovary 2-celled with many ovules per cell; styles 2, usually free in their basal and connate in the upper part, rarely entirely connate or completely free; stigma truncate to 2-lobed; anthers and stigma always at about the same height. *Capsule* opening by apical loculicidal slits, 2-horned, the horns terminated by the styles, which may be torn loose (e.g. fig. 39i) or remain partly connate (e.g. fig. 42f). *Seeds* ∞, minute, ellipsoid or angular; testa thin, endosperm fleshy.

Distr. About 40 spp., mainly Australian, furthermore in Tasmania, New Zealand, New Caledonia, Malaysia, the Carolines, and in Asia from the Deccan and Ceylon to Central Japan and Korea.

Ecol. Heliophilous plants from dry to wet open places, locally often gregarious, from sea-level to above 3000 m.

Notes. This largely Australian genus is in urgent need of revision. In the past the habit of the plant played a great part in specific delimitation. For that reason some species, for example *M. polymorpha* R. BR. and *M. alsinoides* R. BR., were supposed to have an extensive area of distribution, reaching from New South Wales (both were originally described from Sydney) to continental Asia and Japan. During the revision of the Malaysian species I found very useful and constant characters in the flower morphology and the seed-coat, coinciding with sometimes small but constant characters in the stem, leaves, inflorescences, and pubescence, but not with habit. In my opinion *M. polymorpha* and *M. alsinoides* are restricted to subtropical eastern Australia. What, in Malaysian literature, was called "*M. polymorpha*" is the lowland form of *M. pygmaea*, though the habit is quite different from that of Australian specimens. The Indo-Malaysian material formerly included in "*M. alsinoides*" comprises at least 4 well defined species which possess nearly the same habit.

It fell outside the scope of this work to verify the subdivision of the genus as proposed by R. BROWN and later authors, the more so because for distinction I have used a number of characters formerly neglected.

Many species look very much alike some of the smaller species of *Hedyotis* (*Rubiaceae*). *Mitrasacme* is easily distinguished by the superior fruit (in *Hedyotis* distinctly adnate to the calyx for the greater part) which is typically mitre-shaped, the superior ovary, and the short corolla-lobes (in *Hedyotis* about as long as the tube) and included stamens; furthermore by the absence of raphides in the leaves (in *Hedyotis* and related genera these are very conspicuous).

Morph. CLARKE (in Hook. f. Fl. Br. Ind. 4, 1883, 80) mentioned of *M. 'polymorpha'*: "stems . . . glandular hairy below". KLETT (in Mez, Bot. Arch. 5, 1924, 327) mentioned the presence of capitate-glandular hairs in *M. tenuiflora* BTH. Neither in these nor in any other species could I find them.

The inflorescence, if many-flowered, can be best described as irregularly repeatedly umbellate. At every node of the rachis there are 2 lateral branches; each of these bears usually 1 or more collateral much feebler or often uniflorous ones. Both these branches or only one of them may represent the peduncle of the next umbel; the continuation of the rachis is mostly much feebler or fully suppressed (fig. 42a).

The corolla is very thin in most species and usually much shrunk in herbarium specimens; the absolute dimensions (especially the lower values) are therefore not very reliable.

The degree to which the styles are connate is different in anthesis and fruit, usually less in the latter state.

#### KEY TO THE SPECIES

1. Flowers in distinct terminal inflorescences. Styles during anthesis free for c.  $\frac{1}{4}$ – $\frac{1}{3}$ ; stigma distinctly 2-lobed (fig. 39j, 42e).
2. Corolla salver-shaped, 1– $\frac{1}{4}$  cm long. Fruits 5– $\frac{1}{2}$  by 2– $\frac{3}{2}$  mm; styles only connected by the stigma or free. Peduncle with some pairs of appressed, bract-like leaves . . . . . **1. *M. elata***
2. Corolla urceolate to campanulate, up to  $\frac{1}{2}$  cm long. Fruits c. 1 $\frac{1}{2}$  mm  $\sigma$ ; styles still about halfway connate. Peduncle without appressed, bract-like leaves . . . . . **2. *M. pygmaea***
1. Flowers solitary, axillary, sometimes terminal, not in distinct peduncled inflorescences. Styles during anthesis at least halfway free; stigma truncate or rarely slightly 2-lobed (e.g. fig. 45e).
3. Stem distinctly 4-ribbed to narrowly 4-winged, usually glabrous. Testa coarsely reticulate. **3. *M. indica***
3. Stem terete to somewhat flattened, nearly always pubescent. Testa minutely reticulate (fig. 47g–h) or more often densely warty (fig. 46g).
4. Leaves on the lower surface with distinctly thickened midrib and margins, c.  $\frac{2}{2}$  by  $\frac{1}{2}$  mm; internodes about as long as the leaves. Sepals distinctly more than halfway connate. **4. *M. saxatilis***
4. Midrib and margins not distinctly thickened, leaves longer and narrower, at least 4 by 1 mm; internodes at least in the upper part of the plant much longer than the leaves. Sepals about halfway connate.
5. Leaves and sepals with a narrow white membranous margin. Calyx  $\frac{3}{2}$  mm, glabrous. Anthers sagittate, 1 mm long, introrsely dehiscent . . . . . **5. *M. albomarginata***
5. Leaves and sepals without a white margin. Calyx up to  $\frac{2}{2}$  mm, ciliate. Anthers about elliptic, up to  $\frac{1}{2}$  mm long, extrorsely dehiscent.
6. Flowers terminal and in the upper leaf-axils. At least the lower leaves elliptic, 4–6 mm long, squamulate-ciliate along the margin . . . . . **6. *M. neglecta***
6. Flowers exclusively in the upper leaf-axils. All leaves lanceolate, 5–9 mm long, glabrous. **7. *M. bogoriensis***

**I. *Mitrasacme elata* R. BR.** Prod. (1810) 453; DC. Prod. 9 (1845) 11; F. v. M. Fragm. 1 (1859) 132; BTH. Fl. Austr. 4 (1869) 354; F. M. BAIL. Queensl. Fl. 3 (1900) 1018; Compr. Cat. Queensl. Pl. (1913) f. 313; EWART & DAVIES, Fl. North. Terr. (1917) 219.—*M. nudicaulis* REINW. ex BL. Bijdr. (1826) 849; DC. Prod. 9 (1845) 12; MIQ. Fl. Ind. Bat. 2 (1857) 361; BOERL. Handl. 2 (1899) 458; non BTH. in Hook. J. Bot. Kew Misc. 5 (1853) 56, et AUCT. DIV. (= mostly *M. pygmaea* var. *pygmaea*, sometimes var. *malaccensis*, or *M. erophila* LEENH.).—*M. trinervis* SPAN. Linnaea 15 (1841) 335; DC. Prod. 9 (1845) 560; MIQ. Fl. Ind. Bat. 2 (1857) 361.—*M. longiflora* F. v. M. ex BTH. Fl. Austr. 4 (1869) 354; F. M. BAIL. Queensl. Fl. 3 (1900) 1018; EWART & DAVIES, Fl. North. Terr. (1917) 219.—Fig. 39–40.

Erect annual, 35–85 cm. *Leaves* radical, rosulate (often already withering during anthesis), sessile, oblong to lanceolate,  $\frac{1}{2}$ – $4\frac{1}{2}$  by  $\frac{1}{4}$ – $1\frac{1}{2}$  cm, fleshy, glabrous, narrowed at the base, apex blunt, 3(–5)-nerved. *Inflorescences* terminal and sometimes axillary, laxly paniculate with up to 4 lateral branches per node (usually irregular and few-flowered); peduncle long, c.  $1\frac{1}{2}$  mm  $\phi$ , terete, smooth to minutely fluted, glabrous to minutely tomentose especially near the base, with some distant pairs of appressed bract-like leaves, acute-lanceolate, c. 5 mm long, connate at the base, minutely ciliate. Bracts similar but smaller and patent. Pedicels 2– $3\frac{1}{2}$  cm. *Calyx* campanulate, 3–8 mm long, for  $\frac{1}{2}$ – $\frac{3}{4}$  connate, glabrous, tube membranous, lobes oblong and acute or semi-orbicular and apiculate, thickened. *Corolla* salver-shaped, inside sparsely pubescent in the lower half of the tube, and with a thickened fimbriate rim in the mouth, outside (creamy or) salmon-pink to brownish, inside creamy to white; tube slender, 1– $1\frac{3}{4}$  cm, lobes elliptic to oblong, (2–) 4–12 mm, shortly acuminate. *Filaments* c. 6 mm long, anthers basifixed, ovate-lanceolate to linear or sagittate, 1–2 mm, blunt, latero-introrse. *Ovary* 1–2 mm, tapering into the styles, which are connate for the far greater part, 5–9 mm long, slender; stigma 2-lobed, 1 mm long. *Capsule* for the greater part enveloped by the persistent calyx, slender-to globular-mitre-shaped, 5– $7\frac{1}{2}$  by 2– $3\frac{1}{2}$  mm, styles either torn loose or only connected by the stigma when mature. *Seeds* angular, minutely warty.

Distr. Tropical Australia and SE. *Malaysia*: Lesser Sunda Is. (Sumba, Solor, Timor), and New Guinea. Fig. 41.

Ecol. Savannas and parklands, up to 2000 m.



Fig. 39. *Mitrasacme elata* R. BR. var. *elata*. a. Habit,  $\times \frac{2}{5}$ , b. flower,  $\times 1$ , d. calyx,  $\times 2$ , f. opened corolla-tube,  $\times 2$ , g. anther,  $\times 7$ , h. pistil,  $\times 3\frac{1}{2}$ , i. ovary,  $\times 7$ , j. stigma,  $\times 7$ , k. cross-section of ovary,  $\times 7$ , l. fruit,  $\times 2$ , m. seeds,  $\times 4$ , n. embryo,  $\times 48$ .—var. *brevicalyx* LEENH. c. flower,  $\times 1$ , e. calyx,  $\times 2$  (a–b, d, f–m VAN ROYEN 5027, c and e SPANOGHE in herb. L 908.127–526).



Fig. 40. *Mitrasacme elata* R. BR., Andjai, Kebar Valley, W. New Guinea (VAN ROYEN & SLEUMER 6756) (SLEUMER, 1961).

var. *elata*.—*M. elata* R. BR.

Calyx 4–8 mm long, connate for  $\frac{1}{2}$ – $\frac{2}{3}$ , lobes oblong, acute (fig. 39d). Fruit oblong, 6–7 $\frac{1}{2}$  mm long.

Distr. Australia (Arnhem Land) and Malaysia: New Guinea (also in Fergusson I.).

Ecol. Dry savannahs and parklands, from sea-level up to 2000 m. *Fl. fr.* Jan.–Dec.

var. *brevicalyx* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 446.—*M. nudicaulis* REINW. ex BL.—*M. trinervis* SPAN.—*M. longiflora* F. v. M. ex BTH.

Calyx c. 3 mm long, connate for  $\frac{2}{3}$ – $\frac{3}{4}$ , lobes mostly semi-orbicular and apiculate (fig. 39e). Fruits subglobular, c. 5 mm  $\sigma$ .

This var. *brevicalyx* is primarily based upon, and thus typified by *M. trinervis* SPAN. (holotype SPANOGHE s.n. in L.).

Distr. Australia (Northern Territory and Queensland), in Malaysia: Lesser Sunda Is. (Sumba, Solor, Timor), and some dubious specimens from E. New Guinea.

Ecol. Grassland and bare slopes, at 450–1000 m. *Fl. fr.* March–June.

Notes. '*M. elata*' and '*M. longiflora*' are clearly distinguishable in Australia, as there, apart from the varietal characters cited above, the former is a distinctly more robust plant with much larger flowers. The differences fade away in New Guinea, however, where many of the specimens are very slender and have small flowers as '*M. longiflora*', but share the long calyx and oblong fruit with typical *M. elata*. These proved to be the only "either . . . or . . ." characters.



Fig. 41. Distribution of *Mitrasacme elata* R. BR., representative for those species restricted to tropical Australia and adjacent parts of Malaysia.

The structure of the inflorescence is somewhat complicated. In a well developed specimen the lower one or two nodes have four lateral branches, two collateral ones in every axil. In many specimens the central axis is less well developed or completely suppressed, the number of lateral branches may be less, and their size may differ considerably.

The nearest related species is *M. connata* R. BR. from tropical Australia which differs by the following characters: leaves not rosulate but some

pairs close to each other at the base, linear-lanceolate, cauline leaves  $\frac{3}{4}$ –1 cm long, inflorescence more-flowered, styles fully connate, stigma truncate.

Another closely allied species is the Australian *M. exserta* F. v. M., which is at first sight different by its dense, umbellate inflorescences.

2. *Mitrasacme pygmaea* R. BR. Prod. (1810) 453; DC. Prod. 9 (1845) 11; BTH. J. Linn. Soc. Bot. 1 (1856) 92; Fl. Austr. 4 (1869) 357; F. M. BAIL. Queensl. Fl. 3 (1900) 1019; BANKS & SOL. Bot. Cook's Voy. 2 (1901) t. 208; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 6; HARA, J. Jap. Bot. 30 (1955) 23, incl. var. *malaccensis*, excl. syn. *M. nudicaulis* et *trinervis*; LEENH. Bull. Jard. Bot. Brux. 32 (1962) 452.—*M. polymorpha* (non R. BR.) CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 80, incl. var. *parishii*, excl. syn. *M. trinervis*; FORBES & HEMSL. J. Linn. Soc. Bot. 26 (1889) 118, incl. var. *grandiflora*; BOERL. Handl. 2 (1899) 450 & 458; KING, J. As. Soc. Beng. 74, ii (1908) 599; DOP, Bull. Soc. Bot. Fr. 57, Mém. n. 19 (1910) 5; Fl. Gén. I.-C. 4 (1914) 158, f. 20 (3–4); GAMBLE, Fl. Madras 5 (1923) 864; MERR. En. Philip. 3 (1923) 311; RIDL. Fl. Mal. Pen. 2 (1923) 413; MERR. & CHUN, Sympatzenia 5 (1940) 171; GUILLAUMIN, Fl. Nouv. Cal. (1948) 285; HENDERS. Mal. Nat. J. 6 (1950) 304, f. 288; KERR in Craib, Fl. Siam. En. 3 (1951) 53; MAKINO, Ill. Fl. Japan, rev. ed. (1954) 217, f. 650.—*M. capillaris* WALL. in Roxb. Fl. Ind. 1 (1820) 420; D. DON, Prod. Nepal. (1825) 129; DC. Prod. 9 (1845) 11; BTH. J. Linn. Soc. Bot. 1 (1856) 92, excl. syn. *M. trinervis*; MIQ. Fl. Ind. Bat. 2 (1857) 362; BTH. Fl. Hongk. (1861) 230; NAKAI, Fl. Korea 2 (1911) 96.—*M. nudicaulis* (non BL.) BTH. in Hook. J. Bot. Kew Misc. 5 (1853) 56, p.p., excl. syn. *M. chinensis* GRISEB.; Fl. Hongk. (1861) 230; Fl. Austr. 4 (1869) 355; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1889) 117; K. SCH. & LAUT. Nachtr. (1905) 348; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 120; DOP, Fl. Gén. I.-C. 4 (1914) 157; GILG & BENED. Bot. Jahrb. 54 (1916) 163; EWART & DAVIES, Fl. North. Terr. (1917) 219; GILG & BENED. Bot. Jahrb. 56 (1921) 547; MERR. En. Born. (1921) 490; En. Philip. 3 (1923) 311; RIDL. Fl. Mal. Pen. 2 (1923) 413; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 301; Nova Guinea 14 (1924) 116; STEEN. Trop. Natuur 25 (1936) 41–42, 159 f. 3; HARA, J. Jap. Bot. 16 (1940) 155; En. Sperrm. Jap. 1 (1948) 130; GUILLAUMIN, Fl. Nouv. Cal. (1948) 285; KERR in Craib, Fl. Siam. En. 3 (1951) 52.—*M. malaccensis* WIGHT, Ic. 4, 4 (1850) 15, t. 1601.—*M. alsinoides* (non R. BR.) MERR. Philip. J. Sc. 1 (1906) Suppl. 116.—*Androsace tonkinensis* BONATI, Bull. Soc. Bot. Genève II, 5 (1914) 298.—*M. micrantha* DOMIN, Bibl. Bot. 89 (1929) 1071.—*M. setosa* (non HANCE) MASAMUNE, J. Geobot. 10 (1961) 1, f. 43.—Fig. 42–43.

Erect, annual herb, up to c. 35 cm, branched mainly at the base. Stem terete, slightly fluted, fairly densely white hirsute in the lower part, sometimes glabrescent or subglabrous. Leaf pairs

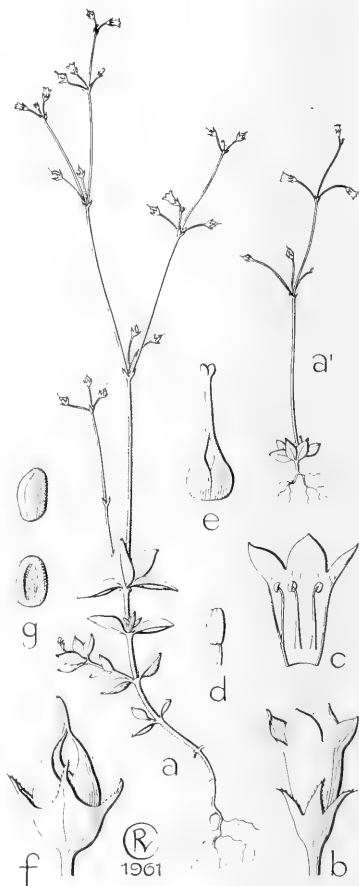


Fig. 42. *Mitrasacme pygmaea* R. BR. var. *pygmaea*. a'. Habit,  $\times \frac{3}{4}$ , f. fruit,  $\times 7$ .—var. *malaccensis* (WIGHT) HARA. a. Habit,  $\times \frac{3}{4}$ , b. flower,  $\times 7$ , c. opened corolla (note the extrorse anthers),  $\times 7$ , d. anther,  $\times 22\frac{1}{2}$ , e. pistil,  $\times 12$ , g. seeds,  $\times 22\frac{1}{2}$  (a MERRILL 3093, a' RAHMAT 6059, b–e BS 19208, f VAN STEENIS 6006, g FORBES 3884).



spaced, the upper 2 pairs sometimes rosulate at the base of the inflorescence, in small specimens (nearly) all the leaves radical rosulate; ovate or elliptic to linear-lanceolate,  $2\frac{1}{2}$ –19 by 1–6 mm, herbaceous, subglabrous to rather densely hirsute above, hirsute along the margin and beneath on the midrib and sometimes on the nerves, base cuneate, apex blunt to acute, 1–3-nerved. *Inflorescences* terminal, umbellate-paniculate, up to c. 25 cm, long-peduncled, lax,  $\frac{1}{2}$ –1-flowered, usually glabrous; peduncle terete to distinctly grooved. Bracts oblong-ovate to lanceolate, up to 3 mm long, ciliate along the margin and sometimes along the midrib beneath. Pedicels slender, angular, up to  $\frac{1}{2}$  cm (in fruit up to  $1\frac{1}{4}$  cm). *Calyx* conical to conical-campanulate,  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm, about halfway connate or somewhat less, glabrous except some bristles along the margin or at the top of the acute-triangular lobes. *Corolla* urceolate to campanulate, 3–5 mm long, inside often with a few scattered hairs in the mouth, yellow, outside white to pink with brownish or pale orange dots or streaks, lobes  $\frac{3}{4}$ – $1\frac{1}{2}$  mm, rounded. *Filaments*  $1\frac{1}{2}$ –3 mm, anthers basifixed, extrorse, oblong-ovate to sagittate, c.  $\frac{1}{2}$  mm long, acute. *Pistil* 2– $4\frac{1}{2}$  mm, ovary  $\frac{3}{4}$ –1 mm, styles free in their basal  $\frac{1}{4}$ – $\frac{1}{3}$  part, stigma 2-lobed. *Capsule* globular-mitre-shaped, c.  $1\frac{1}{2}$  mm  $\phi$ , the styles remaining connate for the greater part. *Seeds* angular-ellipsoid, densely minutely warty.

*Distr.* Tropical Australia, New Caledonia, through *Malaysia* to the Carolines (Jap, Palau), and SE. Asia from Nepal to Korea and Japan.

*var. pygmaea*.—*M. pygmaea* R. BR.—*M. nudicaulis* AUCT.

Up to 12(–20) cm. Leaves radical rosulate, up to 8 by 3 mm, 1-nerved (fig. 42a).

*Distr.* NW. India (Garhwal, Kumaon), Siam (Rachasima, Prachinburi), Cambodia, South China (Yunnan), Formosa, Korea, Japan (Honshu to Ryukyus), Caroline Is. (Jap), Australia (Northern Territory, E. Queensland), New Caledonia, in *Malaysia*: Malay Peninsula (Malacca: Bukit Sialang near Sampang Ampat), North and Central Sumatra, Java (Preanger, Mt Merapi, Mt Iden), Lesser Sunda Is. (Bali, Lombok, Alor, Timor), Philippines (Luzon), S. Moluccas (Aru Is.), and New Guinea (also Goodenough I.).

*Ecol.* On rocks, in grasslands, open spots in savannas, in Eucalypt forest, along roadsides, near solfataras and fumaroles, at (0–)1000–1800 (–3150) m. *Fl. fr.* Jan.–Dec., mainly May–July. The abnormal high altitude of 3150 m is near the fumaroles on summit of Mt Agung, Bali; VAN STEENIS (1936) discussed this peculiar habitat and considers the seed to have been dispersed epizoically to this spot by the pilgrimage of man, or by monkeys, deer or other animals. See fig. 43.

*Vern.* *Kanaquilla*, *lassak*, *watakiki*, Alor Is. *var. malaccensis* (WIGHT) HARA (1955).—*M. polymorpha* AUCT.—*M. capillaris* WALL.—*M. malaccensis* WIGHT.—*Androsace tonkinensis* BONATI.—*M. micrantha* DOMIN.

Up to 35 cm. Leaves not rosulate (or only the

upper 2 pairs), usually 8–19 by 2–6 mm, often 3-nerved (fig. 42a).

*Distr.* Nepal, Burma, Siam, Indo-China, S. China, Hainan, Formosa, Japan (Okinawa, Kyushu, Honshu), Caroline Is. (Palau), to Australia (Northern Territory, Queensland), in *Malaysia*: Malay Peninsula, Sumatra (also Riouw Arch. and Billiton), E. Java (Besuki: Situbondo), Lesser Sunda Is. (Bali, Alor, Timor), Borneo (also Anambas Is.), Philippines (Luzon), SE. Celebes, Moluccas (Sula Is., Ambon, Tanimbar Is.), and New Guinea (also Sudest I.).

*Ecol.* In rocky localities, on bare soil, open spots in savannas, along fields, lawns, roadsides, *Melaleuca* forest, both in very dry spots and in marshy places, from sea-level to 1000(–2000) m. The flowers are only open in the middle of the day. *Fl. fr.* Jan.–Dec., mainly Sept.–April.

*Vern.* *Bingbis-lupa*, Philip. Tag., *gomme gomme*, *gommoh gumiseh*, New Guinea.

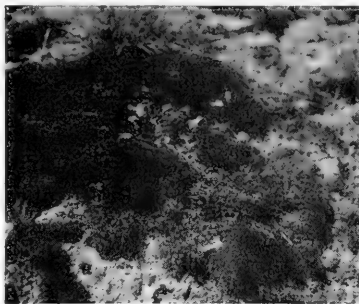


Fig. 43. *Mitrasacme pygmaea* R. BR. *var. pygmaea* between mosses near fumaroles at 3150 m, Mt Agung, Bali (VAN STEENIS, 1936).

*Notes.* Apart from the two varieties cited above, there are two more: *var. parishii* (CLARKE) LEENH. from Burma and *var. grandiflora* (HEMEL.) LEENH. from SE. China and Tonkin. Both are characterized by distinctly larger flowers; the former is connected with *var. malaccensis* by intergrades, mainly in Indo-China.

As the varieties *pygmaea* and *malaccensis* are mainly altitudinal vicariants, not every specimen can be included in one of them. Moreover, especially towards the north (Japan) the differences become vague also in the lowland specimens.

The only difference I found between the Australian specimens of *var. pygmaea* and the Malaysian ones is that the former have a sparsely hirsute inflorescence.

The synonymy cited above clearly shows that there has been considerable confusion about the correct name of this species. This was mainly caused by BENTHAM'S misinterpretation of *M. nudicaulis* (and of *M. trinervis* which he put into

the synonymy of *M. capillaris*) and by CLARKE's concept of the Australian *M. polymorpha* in which he included with some doubt the Nepalese *M. capillaris*. The interpretations of these prominent botanists were commonly followed. Only recently HARA (1955), in his careful studies on the typification of Japanese plants, showed the correct application of these names.

Indeed, *var. malaccensis* is in habit closely alike *M. polymorpha* R. BR., a species restricted to subtropical E. Australia. The latter species differs mainly from *M. pygmaea var. malaccensis* in the following characters: pedicels long (2–3 cm in flower, up to 3½ cm in fruit), calyx long (5 mm), corolla large (7 mm, the lobes 3 mm), connective ending in a liguliform incurved appendix, stigma truncate, fruit exceeded by the calyx, larger (c. 2½ mm ø), and with free styles, seeds ellipsoid, rounded at both ends, rather large (0.6 mm instead of 0.35–0.4 mm), shining black instead of brown, sparsely warty.

*Var. pygmaea* is since BENTHAM (1853) confused with an overlooked species from Assam, *M. erophila* LEENH. This species differs from *var. pygmaea* by the following characters: the presence of sterile bracts along the peduncle (these are very exceptional in *var. pygmaea*), the slightly zygomorphic corolla with relatively long lobes and a more densely pubescent mouth, stamens which are inserted above the middle of the corolla-tube (in *M. pygmaea* distinctly below the middle), short styles which are nearly fully connate during anthesis, but free in fruit, and the fairly coarsely reticulated seeds.

In his description of *M. micrantha*, DOMIN mentioned by error a 5-lobed calyx; in all three type-specimens it is 4-merous.

In herbaria, *Mollugo nudicaulis* LAMK (*Aizoaceae*) is sometimes mixed up with this species on account of a superficial resemblance.

3. *Mitrasacme indica* WIGHT, Ic. 4, 4 (May 1850) 15, t. 1601; Illustr. Ind. Bot. 2 (1850) t. 156 f. 1–13; BTH. in Hook. J. Bot. Kew Misc. 5 (1853) 56; J. Linn. Soc. Bot. 1 (1856) 92; Fl. Austr. 4 (1869) 356; F. M. BAIL. Queensl. Fl. 3 (1900) 1019; EWART & DAVIES, Fl. North. Terr. (1917) 219.—*M. pusilla* DALZ. in Hook. J. Bot. Kew Misc. 2 (May 1850) 136.—*M. crystallina* GRIFF. Not. 4 (1854) 87; Icon. (1854) t. 383 f. 2.—*M. alsinoides* (non R. BR.) CLARKE in Hook. f. Fl. Br. Ind. 4 (1883) 80; FORB. & HEMSLEY, J. Linn. Soc. Bot. 26 (1889) 117; TRIMEN, Fl. Ceyl. 3 (1895) 170; BOERL. Handl. 2 (1899) 450 & 458; DOP, Bull. Soc. Bot. Fr. 57, Mém. n. 19 (1910) 4; Fl. Gén. I.—C. 4 (1912) 157; CAMMERL. Bull. Jard. Bot. Btzg III, 5 (1923) 300; GAMBLE, Fl. Madras 5 (1923) 864; MERR. En. Philip. 3 (1923) 311; RIDL. Fl. Mal. Pen. 2 (1923) 413; BACKER, Onkr. Suiker. (1931) 487; MERR. & PERRY, J. Agr. Arb. 23 (1942) 410; BAKH. f. in Back. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 170, p. 5; MASAMUNE & SYOZI, Act. Phytotax. Geobot. 12 (1950) 202; KERR in Craib, Fl. Siam. En. 3 (1951) 52; MAKINO, Ill. Fl. Japan, rev. ed. (1954) 217, f. 649; HARA,

J. Jap. Bot. 30 (1955) 24, incl. *var. indica*.—*Oldenlandia brachyphylla* MERR. Fl. Manila (1912) 448.

Annual, up to 15 cm. Stems usually branched, slender, distinctly 4-ribbed to narrowly 4-winged, often slightly compressed, glabrous or nearly so; internodes 2–4 times as long as the leaves. *Leaves* lanceolate to ovate, 4–7 by 1½–2½ mm, herbaceous, glabrous, apex acute, 1-nerved. *Flowers* solitary in the upper leaf-axis. *Pedicels* 3–7 (in fruit 5–25) mm, glabrous to scabrous. *Calyx* conical, 1¾–2 mm long, glabrous, about halfway connate, lobes lanceolate, acute. *Corolla* about campanulate, 3–4 mm long, shortly and thinly bearded in the mouth, white, lobes 1–1½ mm long, rounded. *Filaments* 1 mm; anthers basifixed, introrse, elliptic, rarely sagittate, c. 2/3 mm long, sometimes with an apical appendix. *Pistil* 1½ mm, ovary nearly ½ mm, styles far apart at the base, connate in the upper half, stigma broadly truncate (to 2-lobed). *Capsules* subglobular, c. 2 mm ø, styles connate only at the apex. *Seeds* angular-ovoid, 0.2 mm, brown, coarsely reticulate.



Fig. 44. Distribution of *Mitrasacme indica* WIGHT, as an example of a wide-spread species.

*Distr.* Ceylon, Deccan Peninsula, Upper Burma, Indo-China (Tonkin), coastal regions of China as far north as Shantung (Chefoo Mts), Korea (Chemulpo), Japan (Honshu to Ryukyus), Formosa, Hainan, Australia (Northern Territory, Queensland), in *Malaysia*: Sumatra (West Coast), Malay Peninsula (Surat, Puket, Kelantan), Java (also Madura and Kangean Is.), Lesser Sunda Is. (Sumba), SW. Celebes (Malino), Philippines (Luzon), and Southern New Guinea. All citations from Borneo seem to go back to CLARKE (1883, l.c.); I did not see any specimen from that island. Fig. 44.

*Ecol.* Open places of all kinds, on poor to heavy soils, dry to marshy, sandy or on limestone, from sea-level to c. 500 m. *Fl. fr.* Jan.–Dec., mainly March–June.

*Notes.* One of the species usually referred to as *M. alsinoides* R. BR. Well distinguishable by its

glabrous, ribbed to winged stems and its coarsely reticulated seeds.

The names *M. indica* WIGHT and *M. pusilla* DALZ. were apparently both published in May 1850. BENTHAM (1853, *l.c.*) was the first who reduced *M. pusilla* to *M. indica*. DALZIELL & GIBSON (Bombay Fl. 1861, 155) stated under *M. pusilla*: "This was afterwards named *M. indica* by Wight *l.c.* 1601." This remark does not necessarily refer to the dates of actual publication.

**4. *Mitrasacme saxatilis* BACK.** in Cammerl. Bull. Jard. Bot. Btzg III, 5 (1923) 301, f. 1; Onkr. Suiker. (1931) 487.

Erect, annual (or perennial?) herb, up to 12 cm, branched at the base. Stems terete, canaliculate, scabrous, internodes about as long as the leaves. *Leaves* sessile, ovate,  $2\frac{1}{2}$  by  $1\frac{1}{2}$  mm, stiff, glabrous, broadly cuneate at base, apex acute to aristulate, margin revolute, distinctly thickened as is the midrib on the lower surface. *Flowers* solitary in the upper leaf-axils. Pedicels  $1\frac{1}{2}$ – $2\frac{1}{2}$  mm, slender, scabrous. *Calyx* campanulate,  $1\frac{1}{2}$  mm long, glabrous, connate for  $\frac{2}{3}$ , lobes triangular, acute, midrib strongly thickened as are the margins near the apex. *Corolla* 2 mm long, bearded in the mouth, white, lobes  $\frac{2}{3}$  mm long, nearly acute. *Anthers* subsessile, introrse,  $\frac{1}{4}$ – $\frac{1}{3}$  mm long. *Pistil* small, styles  $\frac{1}{3}$  mm long, far apart at the base, connate in the upper half. *Capsules* broadly mitre-shaped, c.  $1\frac{1}{2}$  mm high, styles torn loose. *Seeds* ellipsoid, brown, minutely warty.

Distr. *Malaysia*: E. Java (near Banjuwangi) and Madura I.

Ecol. In open vegetation, on cliffs and dry limestone hills, locally gregarious; from sea-level up to 400 m. *Fl. fr.* May–July.

Note. A very characteristic species: stiff and erect, dense, with sessile, small, ovate leaves which have conspicuously thickened margins and midrib, calyx with relatively short lobes which also have strongly thickened margins and midrib, fruit nearly completely enveloped by the calyx and with very short styles.

**5. *Mitrasacme albomarginata* LEENH.** Bull. Jard. Bot. Brux. 32 (1962) 442.—Fig. 45.

Annual herb, up to c. 10–15 cm. Stems flattened (also *in vivo*?), minutely appressed-pubescent, internodes up to about twice as long as the leaves. *Leaves* lanceolate (rarely ovate-lanceolate) 5–6 by  $1\frac{1}{2}$  mm, herbaceous with a narrow, white, membranous margin, glabrous, contracted at base, aristulate at apex, 1-nerved. *Flowers* solitary in the upper leaf-axils. Pedicel  $\frac{1}{2}$ –1 cm, minutely pubescent. *Calyx* conical-campanulate,  $3\frac{1}{2}$  mm long, glabrous, about halfway connate, lobes acute-triangular, with a narrow white membranous margin and aristulate like the leaves. *Corolla* white, campanulate,  $4\frac{1}{2}$  mm, inside with long bristles in the mouth and some short hairs at the apex of the lobes; lobes elliptic, acute, 2 mm long. *Stamens* short, filaments 1.2 mm, strap-shaped; anthers basifixed, introrse, sagittate, 1 mm long, acute and with some short bristles at the

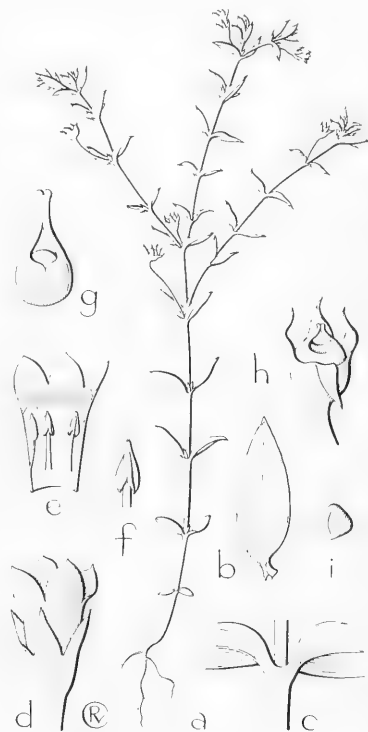


Fig. 45. *Mitrasacme albomarginata* LEENH. a. Habit,  $\times 5$ , b. leaf (note the membranous margin),  $\times 5$ , c. connate leaf-sheaths,  $\times 5$ , d. flower,  $\times 5$ , e. opened corolla,  $\times 5$ , f. anther,  $\times 10$ , g. fruit,  $\times 10$ , h. pistil,  $\times 5$ , i. seed,  $\times 20$  (all from VAN ROYEN 4847).

apex. *Pistil* 2 mm, ovary globular,  $\frac{3}{4}$  mm, styles inserted far apart, connate in their upper half, stigma truncate. *Fruit* globular,  $1\frac{1}{4}$  mm  $\phi$ , completely enveloped by the calyx-tube, styles soon separating from each other. *Seeds* angular, 0.2 mm, minutely warty.

Distr. SW. New Guinea, once collected.

Ecol. In grasslands, open places with very low vegetation, c. 8 m alt., locally common. *Fl. fr.* Sept.

Note. Similar to the East Australian *M. paludosa* R. BR. which is distinctly different in several floral characters, amongst others a fleshy corolla and extrorse anthers with a robust apical hook.

6. *Mitrasacme neglecta* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 449.—Fig. 46.

Annual herb, up to 15 cm, simple or branched, mainly near the base. Stems terete, especially near the base, minutely fluted, fairly densely squamulate-hairy to subglabrous, internodes several times as long as the leaves. *Leaves* ovate or elliptic, upper ones often (ovate-)lanceolate, 6 by 3 to 4 by 1 mm, herbaceous, with squamulate hairs on the margin, otherwise glabrous, apex acute; 1-nerved. *Flowers* terminal and in the upper leaf-axils; as the leaves gradually become smaller and narrower higher up, and the internodes become longer, the upper part may assume the appearance of a lax raceme. Pedicel 6–7 mm (in fruit up to 1 cm) long, scabrous. *Calyx* widely conical, 2 mm high, about halfway connate, lobes lanceolate, acute, ciliate, especially towards the apex. *Corolla* subcampanulate, white, 3 mm long, inside with some bristles in the mouth, lobes rounded, 1 mm long. *Filaments* c.  $\frac{2}{3}$  mm; anthers basifixed, extrorse, ovate to elliptic,  $\frac{1}{2}$  mm long, with a minute apical appendix. *Pistil*  $1\frac{1}{2}$  mm, ovary broad-cylindrical,  $\frac{1}{2}$  mm high, styles inserted far apart, connate in the upper  $\frac{1}{2}$ – $\frac{1}{4}$  part, stigma truncate. *Fruits* globular-mitre-shaped,  $1\frac{1}{2}$  mm  $\phi$ , styles connected only by the stigma. *Seeds* elliptic, slightly flattened, minutely papillose.

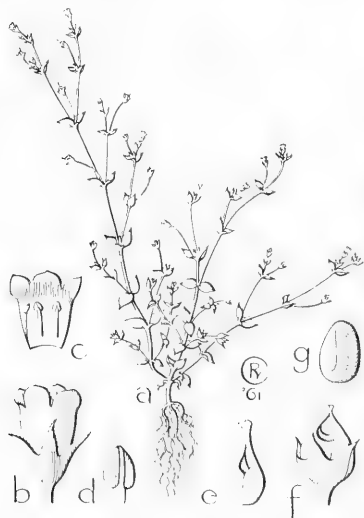


Fig. 46. *Mitrasacme neglecta* LEENH. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 4$ , c. opened corolla (note the extrorse anthers),  $\times 4$ , d. anther,  $\times 16$ , e. pistil,  $\times 8$ , f. fruit,  $\times 4$ , g. seed,  $\times 30$  (a–e sine coll., s.n. in herb. L 909.67–695, f–g COERT 917).

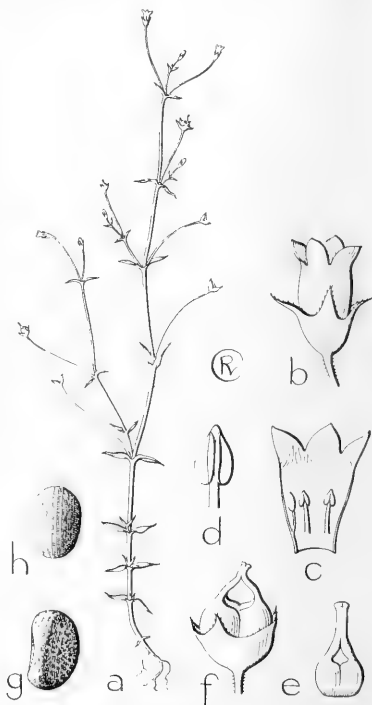


Fig. 47. *Mitrasacme bogoriensis* LEENH. a. Habit,  $\times \frac{2}{3}$ , b. flower,  $\times 4$ , c. opened corolla,  $\times 4$ , d. anther,  $\times 16$ , e. pistil,  $\times 8$ , f. fruit,  $\times 4$ , g. and h. seeds,  $\times 42$  (all from BACKER 6218).

Distr. Australia (Arnhem Land) and Malaysia: E. Java, Madura, Lesser Sunda Is. (Bali, Sumba, Timor), and SW. Celebes (Bt Parangpeda near Banto Parang).

Ecol. On beach walls, in fields, in rocky localities, on limestone hills, on bare rocks, between grass and low scrub; from sea-level up to 925 m. *Fl. fr.* March–April (July).

Note. From the closely related *M. indica* immediately distinguished by the terete, pubescent stem and the slight though distinct differentiation between the non-flowering and the flower-bearing part of the plant.

7. *Mitrasacme bogoriensis* LEENH. Bull. Jard. Bot. Brux. 32 (1962) 444.—Fig. 47.

Erect annual herb up to c. 18 cm, simple or branched in the upper half. Stems terete, rather

densely squamulate-hairy, internodes about as long as the leaves, the upper ones much longer. *Leaves* (ovate-)lanceolate, decreasing in size upwards, 5-9 by 1-1½(-2¼) mm, herbaceous, glabrous, margin revolute, apex acute, aristulate; 1-nerved. *Flowers* solitary in the upper leaf-axils, by the long internodes, small leaves, and long spreading pedicels seemingly forming a lax raceme. *Pedicel* c. ¾-2½ cm long, pubescent. *Calyx* conical-campanulate, 1½-2½ mm, about halfway connate, lobes acute-triangular, sparsely ciliate along the margin and on the prominent midrib towards the apex. *Corolla* white, urceolate-campanulate, 3-4½ mm long, bearded in the mouth,

lobes ¾-1½ mm, rounded. *Filaments* ¾ mm; anthers basifixed, extrorse, oblong-ovoid, 0.3-½ mm long, truncate. *Pistil* 1½ mm, ovary 0.4 mm, styles inserted far apart, connate in their upper half, stigma broadened truncate, slightly 2-lobed. *Fruits* globular-mitre-shaped, 2 mm ø, styles still connate in their upper half. *Seeds* angular, rather minutely reticulate, brown.

Distr. W. Java (Bogor), three collections.

Ecol. In grass fields, along grassy roadsides, 100-400 m. *Fl. fr.* April, Dec.

Note. Well characterized by its slender habit and narrow leaves.

#### Excluded

*Cleisocratera* KORTH. Kruidk. (1844) 256 was originally as a monotypic genus assigned to the *Rubiaceae*, but MIQUEL (Fl. Ind. Bat. 2, 1857, 384) included it tentatively in the *Loganiaceae*. MERRILL (En. Born. 1921, 576) remarked that it had been referred incidentally to *Psychotria* but believed this to be wrong. KORTHALS himself already remarked its close proximity to *Saprosma* and VALETON (Ic. Bog. 3, 1909, 209) reduced it to the latter genus, an opinion which, after examination of the type specimen, is also shared by Dr BAKHUIZEN VAN DEN BRINK *f.* and Dr VAN STEENIS (*Rubiaceae*).

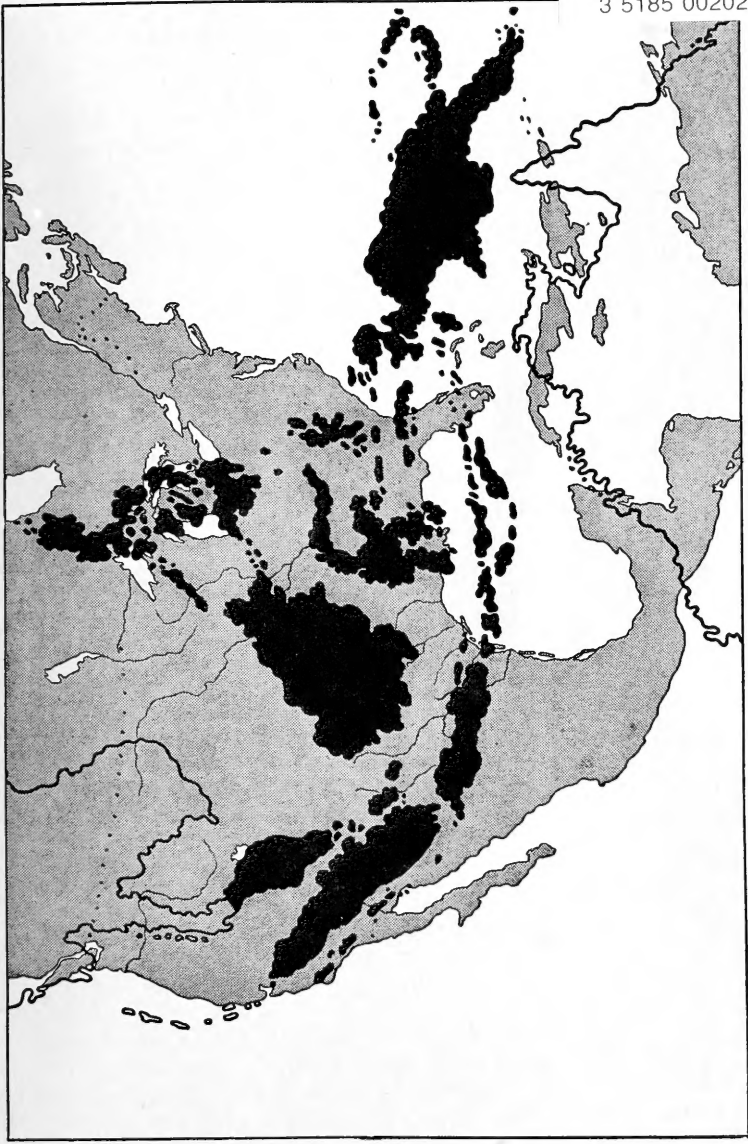
*Dolianthus* C. H. WRIGHT, Kew Bull. (1899) 106 was originally assigned to *Loganiaceae*, but according to BREMEKAMP (Kew Bull. 1936, 103) it is *Rubiaceous* and is allied to *Amaracarpus*. MERRILL & PERRY (J. Arn. Arb. 27, 1946, 221) accept it as belonging to a set of Papuan, high altitude species of that genus (*Rubiaceae*).

*Gaertnera* LAMK, Tabl. Enc. Bot. Ill. 2 (1791) 273, t. 167 was originally placed in *Loganiaceae* and has up to the present often been treated as belonging to this family. On account of the resemblance in flower structure (apart from the more or less superior ovary), in stipules, habit, and anatomy to the *Rubiaceae-Psychotrieae*, with which it also shares the presence of raphides, recent authors on *Rubiaceae* include it in that family and tribe. See PETIT, Bull. Jard. Bot. Brux. 29 (1959) 377 and VERDCOURT, *ibid.* 28 (1958) 238 (*Rubiaceae*).





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# FLORA MALESIANA

## SCIENTIFIC COMMUNICATIONS

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