SABIACEAE (C.F. van Beusekom & Th.P.M. van de Water, Leiden)[1]

Trees, scandent shrubs or woody climbers. *Leaves* alternate or spirally arranged, penninerved, simple or imparipinnate, the leaflets in the latter case opposite on often somewhat swollen nodes of the rachis; exstipulate. *Flowers* small, bisexual, rarely polygamo-dioecious, in terminal or axillary racemose panicles, or cymose: paniculately arranged cymes, or these reduced to solitary axillary flowers. *Sepals* (3–)5, imbricate, free or ± connate at the base, equal or unequal. *Petals* (4–)5, mostly opposite the sepals (rarely alternate: *Ophiocaryon spp.*, South America). *Stamens* (including staminodes) 5, opposite the petals, all polliniferous (*Sabia*) or only 2 inner ones opposite the reduced petals polliniferous and the other 3 staminodial. *Disk* small, annular, surrounding the base of the ovary. *Ovary* of 2(–3) carpels united to form a compound superior ovary, carpels very rarely free in the apical part, in that case tapering to 3 short styles with a capitate stigma; otherwise normally a short, cylindric or conical style; cells 2(–3), each with 1 or 2 pendulous or horizontal, axile hemitropous, unitegmic, crassinucellar ovules. *Fruit* either 1-celled or 2-coccous, drupaceous or dry, indehiscent; endocarp often wrinkled. *Endosperm* scanty or wanting. *Embryo* with a curved radicle and 2 folded or coiled cotyledons.

Distribution. Three genera: *Sabia* Indo-Malesian, from the S. Deccan and Kashmir to S. Japan, throughout Malesia as far as the Solomons; *Meliosma* with a similar range but also occurring in tropical America; *Ophiocaryon* in the Neotropics. The family is absent in Australia and Africa.

Fossils of both Malesian genera are found onwards of the Oligocene and Eocene in Asia and Europe. See under the genera.

Ecology. Tropical forests, mostly below 2000 m altitude.

Taxonomy & Delimitation. There is no concensus of opinion on the affinity, hence the systematic position of *Sabiaceae*. Some even doubt whether *Sabia* and *Meliosma* are correctly placed in one family.

After the description of *Sabia* by COLEBROOKE (1818), BLUME (1851) accommodated it in a new monogeneric family, *Sabiaceae*, suggesting its affinity with *Menispermaceae*. Shortly afterwards MIERS (see LINDLEY, 1853), while working on *Menispermaceae*, placed *Sabia* between that family and *Lardizabalaceae*. HOOKER *f.* & THOMSON (1855) considered the genus intermediate between *Menispermaceae* and *Schisandraceae*.

The scandent habit and the resemblance of the drupelets of *Sabia* with those of *Menispermaceae* undoubtedly were a major argument for supposed affinity.

Subsequently BENTHAM & HOOKER (1862) extended the then monogeneric family *Sabiaceae* to include *Meliosmaceae* ENDL., adding the genera *Meliosma* BLUME and *Ophiocaryon* SCHOMB.; both are trees, the first Asian-American, the latter tropical American. They removed the family in its new concept from the Menispermaceous affinity and accommodated *Sabiaceae* near *Sapindaceae* and *Anacardiaceae*. This position has been stable for a century and was adhered to by many leading botanists: WARBURG (1895), VON WETTSTEIN (1911), HUTCHINSON (1926, 1973), MELCHIOR (1964), TAKHTAJAN (1969), DAHLGREN (1975, 1983), and THORNE (1976, 1983). Some of these authors showed some doubt about the position and some made suggestions, *e.g.* WARBURG (*l.c.* 370), who believed one could possibly derive the flower of *Meliosma* from the Meni-

(1) Accommodated from the monographs of both authors in Blumea volumes 19 and 26, and provided with an introduction.

spermaceous scheme and mentioned that RADLKOFER was not in favour of an affinity with *Sapindaceae* or *Anacardiaceae*.

In recent years there is a tendency to return to BLUME's opinion towards affinity with *Menispermaceae*. Pollen morphology (ERDTMAN, 1952) and embryology (MAURITZON, 1936) have been interpreted in favour of a relationship with *Menispermaceae*. AIRY SHAW (1973) remarked that the opposition of calyx, corolla and stamens is a most unusual feature, but can probably be derived from the Menispermaceous type of flower. In his recent classification CRONQUIST (1981) tentatively placed *Sabiaceae* near *Menispermaceae* in the *Ranunculales*. Also FORMAN, in his treatment of the *Menispermaceae* (Fl. Males. I, 10^2, 1986, 157–253), shares this opinion.

Another matter is whether *Sabia* and *Meliosma/Ophiocaryon* should be accommodated in one family; hitherto they are represented by two tribes in *Sabiaceae* (WARBURG, 1890), differing in habit (climbers versus trees), the leaves, and in the androecium. Moreover, CRONQUIST (1981) mentioned in his discussion that, according to WOLFE, the leaf venation of *Sabia* is highly compatible with a position near *Menispermaceae*, but that of *Meliosma* more similar with some members of the *Rosidae*. There may be more arguments to accommodate *Meliosma* in a separate family *Meliosmaceae* ENDL., apart from *Sabiaceae sensu stricto*. This opinion was held by AIRY SHAW (1973).

References: AIRY SHAW in Willis, Dict. ed. 8 (1973) 1017; BENTHAM & HOOKER, Genera Plantarum 1 (1862) 413; BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 369; CRONQUIST, An integrated system of classification of flowering plants (1981) 140; DAHLGREN, Bot. Notis. 128 (1975) 126; Nordic J. Bot. 3 (1983) 144; ERDTMAN, Pollen morphology and plant taxonomy (1952) 380; HOOKER *f.* & THOMSON, Flora Indica 1 (1855) 208; HUTCHINSON, Families of flowering plants 1 (1926) 254; ed. 3 (1973) 449; LINDLEY, Vegetable kingdom ed. 3 (1853) 467; MAURITZON, Acta Hort. Goth. 11 (1936) 18; MELCHIOR, Engler's Syllabus 2 (1964) 285; TAKHTAJAN, Flowering plants: origin and dispersal (1969) 226; THORNE, Evol. Biol. 9 (1976) 61; Nordic J. Bot. 3 (1983) 106; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 367; WETTSTEIN, Handb. Syst. Bot. ed. 2 (1911) 633.

Vegetative Anatomy. – *Leaf anatomy*. Hairs unicellular in *Sabia*; uniseriate nonglandular and capitate glandular in *Meliosma*. Stomata confined to the lower leaf surface, anomocytic or paracytic. Mesophyll dorsiventral, with arm palisade cells in *Meliosma*. Veins embedded in mesophyll and sheathed by sclerenchyma. Petiole in distal end with a closed vascular cylinder. Crystalliferous cells containing clusters common near the veins.

Young stems. Cork superficial. Cortex with stone cells in some species of *Meliosma*. Pericyclic sclerenchyma forming a composite, closed ring in *Sabia*, and composed of isolated fibre groups in *Meliosma*. Phloem with broad lignified rays in *Sabia*, and with non-lignified, dilatating (triangular) rays in *Meliosma*. Vessels with mixed simple and scalariform perforations in first formed xylem. Cluster crystals common in cortex, phloem, and pith. Secretory cells with unidentified contents noted in parenchyma of several *Meliosma* species.

Wood anatomy. Vessels exclusively solitary in *Sabia*, solitary and in radial multiples or small clusters in *Meliosma*; vessel perforations typically simple in *Sabia*; mixed simple and scalariform or exclusively scalariform to reticulate in *Meliosma*. Intervessel pits alternate. Vessel–ray and vessel–parenchyma pits simple, and often large. Fibres, usually thin-walled, with minutely bordered to simple pits, and mainly confined to the radial walls in *Meliosma* (libriform fibres); with distinctly bordered pits common in both the radial and tangential walls in *Sabia*; occasionally septate. Parenchyma scanty paratracheal to vasicentric with occasional lateral extensions in *Meliosma*, very sparse to almost absent in *Sabia*, usually in 8-celled strands. Rays sometimes of two different sizes, the broad ones 4–8(–15) cells wide in *Meliosma*, up to 20 cells wide in *Sabia*, usually over 2 mm high, heterogeneous (Kribs type II), often with sheath cells.

Taxonomic note based on vegetative anatomy. The above description is mainly based on early studies of a very limited number of species, so that the information is far too limited to serve in the discussion of infrageneric classification and delimitation. The two genera are anatomically quite distinct in their leaf and wood anatomy. Partly this is related to general anatomical dif-

ferences between climbers (*Sabia*) and erect shrubs or trees (*Meliosma*). Thus, the anatomical evidence can be interpreted both in favour of the separation of *Meliosma* and *Sabia* into two families, or alternatively to retain their tribal position in the same family. Anatomically *Sabia* is quite distinct from the *Menispermaceae* to which it has been compared (see above, under taxonomy); affinity of *Meliosma* and *Sabia* with families of the *Sapindales*, especially *Anacardiaceae* seem to find more support in vegetative anatomy.

References: CARLQUIST, Aliso 11 (1985) 139–157; DESCH, Manual of Malayan Timbers 2 (1954) 522–523; METCALFE & CHALK, Anatomy of the Dicotyledons 1 (1950) 448–452; MOLL & JANSSONIUS, Mikrographie des Holzes 2 (1922) 424–437; SOLEREDER, Systematische Anatomie der Dicotyledonen (1899) 276–278; & Ergänzungsband (1908) 108–109. – P. BAAS.

Palynology. Pollen grains in *Sabiaceae* are prolate spheroidal to prolate. Size ranges from 20 to 33 μm. The apertural system is always tricolporate. Ectoapertures are long colpi, endoapertures are lalongate pori or short colpi. The shape of the endoapertures is oblong to elliptic, sometimes approximately rectangular or meridionally constricted. Exine stratification is easily to observe in the light microscope. Each layer is about uniformly thick throughout. The tectum is equally thick or up to twice as thick as the nexine. It is mostly more than twice as thick as the columellate layer. Total exine thickness is 1–2.5 μm. The ornamentation is usually finely to coarsely reticulate; sometimes it is finely or indistinctly perforate.

Meliosma and *Sabia* show only little infrageneric variation. Moreover, the ranges in both genera are rather similar. Only minor differences exist: *Sabia* mostly has a thinner exine with a finer reticulate ornamentation than *Meliosma*. Pollen morphology does not support accommodating the genera in separate families (MONDAL & MITRA, 1982).

As taxonomists, pollen morphologists are ambiguous with respect to the position of the *Sabiaceae*. ERDTMAN (1952) reported pollen similar to that of *Sabiaceae* to occur in several other families. However, he actually mentioned only the *Menispermaceae*. Pollen of *Anacardiaceae* and *Sapindaceae* was considered less similar or different. According to MONDAL & MITRA (*l.c.*) *Sabiaceae* pollen differs from that of *Aceraceae, Hippocastanaceae, Lardizabalaceae, Melianthaceae, Menispermaceae, Sapindaceae*, and *Schizandraceae*. On the basis of grain shape and size, P/E ratio, exine structure and aperture characters they suggested to classify the *Sabiaceae* nearest to the *Anacardiaceae*. It must be stressed, however, that it is extremely difficult to infer relationships from resemblances between rather simple pollen types. Obviously unrelated taxa may show very similar pollen, whereas closely related taxa sometimes have completely different pollen.

References: ERDTMAN, Pollen morphology and plant taxonomy, Angiosperms (1952) 390; MONDAL & MITRA, Geophytology 12 (1982) 166–180. – R.W.J.M. VAN DER HAM.

Phytochemistry. The only observations worth to be reported here are the presence of pentacyclic triterpenoids of the oleanene series and the absence of starch in seeds. The 3-acetates of oleanolic acid and oleanolic aldehyde were isolated from bark of *Meliosma simplicifolia*. Seeds of *Meliosma myriantha* SIEB. & ZUCC. (continental SE. Asia) were reported to give positive reactions for alkaloids and to contain 8% of protein and 10% of fatty oil but no starch.

References: DESAI *c.s.*, Indian J. Chem. 15B (1977) 291; HEGNAUER, Chemotaxonomie der Pflanzen 6 (1973) 240. – R. HEGNAUER.

Note. Though the genera are extremely clearly defined, specific delimitation has in both genera been difficult, as it seems that racial segregation is common in both. VAN DE WATER has in *Sabia* employed a finer specific distinction than VAN BEUSEKOM did in *Meliosma*.

KEY TO THE GENERA

1. Climbers or scandent shrubs. Flowers with 5 equal, fertile stamens, in usually rather few-flowered thyrses or cymes, sometimes reduced to a single axillary flower. *Leaves* simple, entire or subentire, alternate **1. Sabia**

1. Trees. Flowers in usually large, racemose, terminal or axillary panicles. Fertile stamens only 2, the other 3 abortive and reduced to scales or nectary-like bodies. Leaves uneven pinnate, leaflets opposite on ± noded rachis, rarely simple, entire or toothed, spirally arranged ..... **2. Meliosma**

1. SABIA

COLEBROOKE, Trans. Linn. Soc. Lond. 12 (1818) 355, t. 14; WALL. in Roxb., Fl. Ind. 2 (1824) 308; BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 368; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 367, f. 183A, 184A–H; CHEN, Sargentia 3 (1943) 1; VAN DE WATER, Blumea 26 (1980) 1. – *Meniscosta* BLUME, Bijdr. (1825) 28; DIETR. Syn. Pl. 2 (1840) 923 (*'Menicosta'*). – **Fig. 2–4.**

Evergreen or deciduous, woody climbers or more or less scandent shrubs (rarely recorded as small trees). *Twigs* terete, striate (see note), with ± prominent leaf cushions, unarmed, mainly in deciduous species with some cataphylls at their base, spirally arranged. *Buds* either ± globular and obtuse to rounded, or ovoid and acute; scales glabrous to pubescent, ciliolate or not, persistent at the base of the twigs. *Leaves* simple, ovate or elliptic to lanceolate, 2–25 by 1–10 cm, herbaceous to coriaceous, petioled, entire or very rarely subentire; nerves 3–12 pairs, ascending to patent, curved to straight. *Flowers* bisexual, 5-merous, actinomorphic, up to *c.* 15 mm diam., green to white, yellow, or purple, axillary, either solitary, or arranged in a few- to many-flowered cyme, appearing before or with the new leaves. *Cymes* axillary, either solitary, or, when the subtending leaves are shed or are bract-like, arranged in racemose to thyrsoid or sometimes corymbose inflorescence, pedicel ± thickened upwards in fruit; bracts ovate to lanceolate, up to 6 mm, bracteoles as bracts but usually smaller, or sepal-like, or minute and then often situated near calyx. *Sepals* 5(–7, see bracteoles), equal to very unequal mutually, mostly ± confluent at the base, variable in size and shape but often suborbicular or broad-ovate to ovate, persistent. *Petals* 5, rarely 6 or 7, episepalous, imbricate, suborbicular to lanceolate, glabrous, sometimes (sub)ciliolate, persistent or not; nerves ± parallel, branching or not, sometimes conspicuous when dark-coloured. *Stamens* 5, epipetalous, ± equal, persistent or not; filaments more or less flattened, adherent to the base of the subtending petals; anthers globular to ellipsoid, introrse, upright or inflexed. *Disk* in most species ± crown-shaped, sometimes short-cylindrical (*S. sumatrana*), truncated conical, or ± cushion-shaped; lobes and ribs, if present, alternating with the stamens. *Pistil*: style conical to cylindrical, rarely absent, persistent. *Ovary* superior, 2-celled, (sub)globose to subreniform, usually laterally somewhat compressed, very rarely subapocarpous. *Ovules* 2 per cell, more or less superimposed, attached to the septum, hemi-anatropous. *'Drupelets'* 1-seeded or very rarely with 2 seeds, (sub)globose, obovoid, oblong-obovoid (or pyriform), or subreniform, laterally ± compressed, green or white to red or deep blue when fresh; mesocarp rather thin, pulpy, sometimes with many dark 'granules', endocarp crustaceous, very often with ± prominent ribs

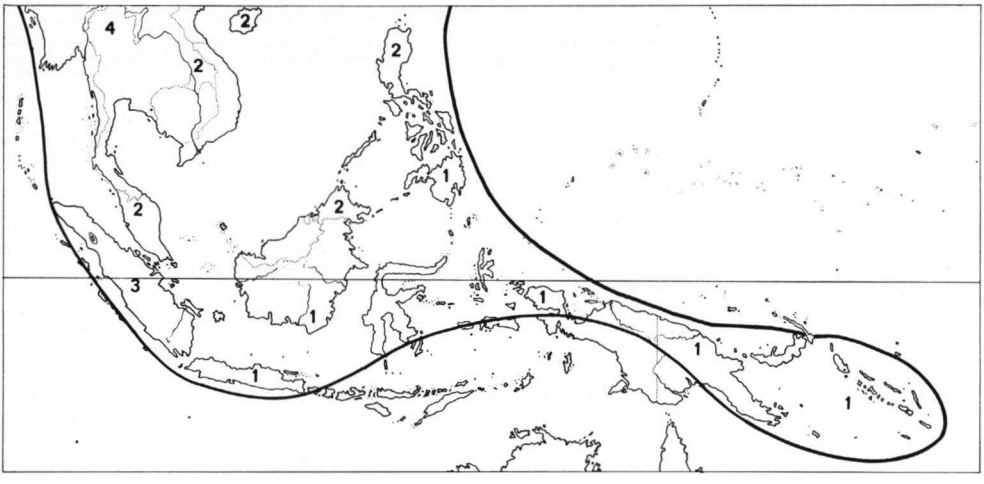

Fig. 1. The Southeast Asian and Malesian distribution area of *Sabia* COLEBROOKE. The numbers refer to the number of species in that area.

forming a fine to coarse reticulate pattern, margin sometimes distinctly keeled. *Seed* conform to the drupelet; testa usually conspicuously dark-dotted, inside often lined with a very thin layer of endosperm. *Embryo* with two flat, smooth, somewhat undulated, or sometimes strongly folded cotyledons and a cylindrical rootlet curving to the hilum.

Distr. Indo-Malesia, along the Himalayas (1 species disjunct, also in the S. Deccan) through Burma and China to S. Japan; throughout *Malesia* (not yet known from the Lesser Sunda Islands), as far as New Guinea, the Louisiades and Solomon Islands. In all 19 species, of which 7 in Malesia. Fig. 1.

Ecol. Inconspicuous climbers (rarely reported as small trees), except two continental Asian species all evergreen, found in forests and thickets, from the lowland up to *c.* 1000–1200 m altitude, *S. javanica* up to 1500 m and *S. pauciflora* to 2000 m; *S. racemosa ssp. kinabaluensis* is mainly montane, at 800–1500 m. Flowering occurs mostly throughout the year.

KEY TO THE SPECIES

1. Flowers solitary, sometimes 2 or 3 together, or arranged in a thyrsus; ovary glabrous; style in flower 3–6 mm long, conspicuous in fruit and about half as long as the adjacent side(s) of the drupelet(s) **7. S. sumatrana**
1. Flowers in cymes, these solitary, axillary, up to 30(–40)-flowered; ovary densely pubescent; style in flower 2.25–2.5 mm long; drupelets not known ..... **1. S. erratica**
1. Flowers in few- to many-flowered cymes; cymes either solitary, axillary, or arranged in an up to 15 cm long racemose to thyrsoid inflorescence, (1–)2–25-flowered; ovary glabrous; style in flower up to 1.5(–1.75) mm long, inconspicuous in fruit and much shorter than the adjacent side(s) of the drupelet(s).
2. Leaves oblong to lanceolate, 3–12(–15) by 1–5 cm, beneath usually distinctly paler than above; nerves (5–)6–9(–10) pairs, patent, straight; cymes solitary, axillary, (4–)7–25-flowered; style either absent or obscurely or normally developed, (0.75–) 1–1.5(–1.75) mm long ..... **4. S. parviflora**
2. Leaves elliptic-oblong to sublanceolate, 5–25 by 2–10 cm, beneath usually somewhat paler than above but not conspicuously so; nerves 4–8(–9) pairs, ± patent, straight to curved; cymes often arranged in an up to 15 cm long racemose to thyrsoid inflorescence, (1–)2–10(–12)-flowered, sometimes solitary, axillary, up to 4(–6)-flowered; style normal-developed, 0.2–1 mm long.
3. Cymes up to 2 cm, 1–4(–6)-flowered; petals suborbicular to elliptic, 1.75–2.5 by 1.25–2 mm, obtuse

to rounded; stamens nearly as long as petals; drupelets globular to obovoid, very compressed, 11–14 by 10–13 mm; reticulate pattern usually faint or absent ..... **3. S. limoniacea**

3. Cymes up to 1 cm, 1–4(–7)-flowered; petals either oblong-ovate to ovate-lanceolate, acute, acuminate or not, or elliptic-oblong to oblong, obtuse, 3.5–6.5 by (1.25–)1.5–2.5 mm; stamens distinctly shorter than petals; drupelets obovoid, ± compressed, *c.* 10–12 by (7–)8–10 mm; reticulate pattern rather faint but usually visible, often limited to the margin ..... **6. S. racemosa**

3. Cymes up to 2(–3.5) cm, (1–)2–10(–12)-flowered; petals oblong, 2.5–4(–4.5) by *c.* 1–1.5 mm, obtuse; stamens distinctly shorter than petals; drupelets obovoid or ± globular, ± compressed, 7.5–11 by 8–10(–11) mm; reticulate pattern usually clearly visible, sometimes obscure, limited to the margin or not.

4. Leaves oblong to sublanceolate, 5–14(–18) by 2–6(–8) cm; nerves (5–)6–8(–9) pairs; cymes either arranged in a racemose to thyrsoid inflorescence, or solitary, axillary, 1–4-flowered; style 0.6–1 mm; drupelets ± globular, sometimes somewhat obovoid, compressed, 7.5–11 by 8–10(–11) mm **5. S. pauciflora**

4. Leaves elliptic-oblong to oblong, sometimes sublanceolate, 6–19 by 2–8(–10) cm; nerves 4–7(–8) pairs; cymes usually arranged in a thyrsoid inflorescence, sometimes subtended by small leaves, 3–10(–12)-flowered; style 0.2–0.5 mm; drupelets obovoid, sometimes globular, somewhat compressed, 9–11 by *c.* 9–10 mm ..... **2. S. javanica**

1. Sabia erratica VAN DE WATER, Blumea 26 (1980) 35.

Evergreen, woody. *Twigs* glabrous to somewhat pubescent; flowering twigs up to 2.5 mm diam., ± lax-pubescent. *Buds* ovoid, acute; scales ± pubescent, ciliolate. *Leaves* oblong, 5–8 by 2.5–3 cm, index 2–2.7, pergamentaceous, above glabrous or still sparsely pubescent especially at the base and on midrib, beneath laxly pubescent especially on midrib and nerves; base acute, apex acute or short-acuminate; nerves 6–7 pairs, patent, ± straight to somewhat curved; petiole up to 1.5 cm, glabrous to pubescent. *Cymes* solitary, axillary up to 4.5 cm, up to 40-flowered, ± lax-pubescent; pedicels up to 4 mm; bracteoles oblong to oblong-ovate, up to 0.8 mm, pubescent, ciliolate. *Sepals* ovate to somewhat elliptic, 0.8–1 by 0.5–0.75 mm, obtuse to acute, ± pubescent, ciliolate. *Petals* oblong or oblong-ovate to sublanceolate or ovate-lanceolate, 3.75–4 by 1–1.5 mm, acute to narrow-obtuse, subciliolate, nerves up to 6, dark-coloured. *Stamens* 2.3–3 mm; filament flattened, 1.8–2.6 by 0.25–0.4 mm; anther ellipsoid to oblong-ellipsoid, *c.* 0.4–0.6 mm, upright. *Disk* crown-shaped; lobes very short or absent; ribs ± prominent. *Pistil* 2.75–3 mm; style narrowly-conical to cylindrical, 2.25–2.5 mm, with some hairs at the base; ovary somewhat globular to subreniform, 0.5–0.6 by 0.6–0.8 mm, densely pubescent. *Drupelets* not available.

Distr. *Malesia*: Singapore (Bt. Timah Res.), only known from the type, collected in 1940.

Notes. In habit somewhat resembling *S. parviflora* but readily distinguished by floral characters.

On the label noted as a 'tree, 100 ft', but this is suspected to be a wrong annotation or field observation or a wrong label.

2. Sabia javanica (BLUME) BACKER *ex* CHEN, Sargentia 3 (1943) 59; BACKER & BAKH.*f.* Fl. Java 2 (1965) 144; VAN DE WATER, Blumea 26 (1980) 39. – *Meniscosta javanica* BLUME, Bijdr. (1825) 29. – *Meniscosta scandens* BLUME *ex* SPRENG. Syst. Veg. 4, 2 (1827) 114, *nom. illeg.*; DIETR. Syn. Pl. 2 (1840) 923. – *Sabia meniscosta* BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 369, f. 44, *nom. illeg.*, *incl. var. firma* BLUME, *var. latifolia* BLUME *et var. glabriuscula* BLUME; MIQ. Fl. Ind. Bat. 1, 2 (1859) 618 (*'menicosta'*); Fl. Arch. Ind. (1870) 71; *ibid.* (1871) pl. 31, *incl. var. elliptica* MIQ.; HOOK.*f.* Fl. Brit. India 2 (1876) 3 (*'menescorta'*); BACKER, Schoolfl. Java (1911) 273; KOORD. Exk. Fl. Java 2 (1912) 544. – *Sabia elliptica* (MIQ.) MIQ. Sum. (1861) 203, 521. – *Sabia javanica* (BLUME) CHEN *var. glabriuscula* (BLUME) CHEN, Sargentia 3 (1943) 61.

Evergreen woody climber or scandent shrub, up to 10 m. *Twigs* glabrous; flowering twigs up to 5 mm diam., glabrous or ± pubescent. *Buds* ovoid, up to 2 mm, acute; scales glabrous or with few hairs, ± ciliolate. *Leaves* elliptic-oblong to sublanceolate, 6–19 by 2–8(–10) cm, index 2–3(–4), pergamentaceous to pergamentaceous-coriaceous, above and beneath glabrous or with some hairs on midrib; base acute to rounded, apex acute, acuminate; nerves 4–7(–8) pairs, patent, curved to straight; petiole up to 2.5 cm, glabrous to sparsely pubescent, ± (fine-) wrinkled. *Cymes* arranged in an axillary, up to 12 cm long, glabrous to pubescent, thryrsoid inflorescence, subtended by bracts or sometimes by small leaves and then inflorescence up to 17 cm long; cymes up to 3 cm, forming a lax to dense cluster of 3–10(–12) flowers, subglabrous to pubescent. Bracts ovate to sublanceolate, up to 5 mm, subglabrous to more or less pubescent, ± ciliolate; bracteoles as bracts but

smaller, or bracteoles minute or sepal-like and then situated near calyx; pedicel up to 4 mm. *Flowers* green to yellow or white. *Sepals* sometimes 6 (see bracteoles), ± ovate or broad-ovate, 0.75–1(–1.25) by 0.5–0.8(–1) mm, acute to obtuse, ± pubescent, ciliolate. *Petals* oblong, 2.5–3.5(–4) by 1–1.5 mm, obtuse, nerves up to 5, often dark-coloured and then conspicuous. *Stamens* (1–)1.25–1.5 mm; filament ± flattened, (0.75–)1–1.25 mm long, 0.25–0.5 mm wide; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; ribs sometimes faint or absent. *Pistil* 0.8–1.2 mm; style ± conical, 0.2–0.5 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.7 mm, glabrous. *Drupelets* obovoid or sometimes globular, ± compressed, 9–11 by 9–10 mm, without persistent petals and stamens at the base; reticulate pattern often coarse and limited to the margin. *Embryo* with somewhat undulated or faintly folded cotyledons.

Distr. *Malesia*: Sumatra (East Coast Res., Indragiri, Lampongs), W. Java. In all *c.* 30 collections.

Ecol. Forests, at (20–)200–1500 m. *Fl. fr.* Jan.–Dec.

Vern. Java: *areuj bebentjojan, a. kahawatang, a. katjapi,* S.

Notes. *Sabia javanica* strongly resembles *S. pauciflora* from the Philippines, the Moluccas, New Guinea, and the Solomon Islands. It can be distinguished from that species by its often more-flowered cymes, its shorter style, and some other slight differences. Since both species are geographically separated, it was also possible to combine them into one species and give them the rank of subspecies. Although the differences are rather small, I believe that *S. javanica* and *S. pauciflora* represent two different, well-delimited, but very closely related species. Moreover, a reduction of both species to a single one would increase the variability of several taxonomic important characters, in consequence of which the delimitation with some other related species, like *S. parviflora* and *S. racemosa,* and possibly also *S. limoniacea,* would become less distinct. Finally, this might result into a far-going lumping and a reduction of all these species to, say, subspecies. Contrary to the situation in the extra-Malesian species *S. campanulata* WALL., however, in this case I believe that the differences between these taxa have reached a higher level already, resulting in the distinction of mutually closely related but ± well-delimited species, each with its own specific combination of characters.

In vegetative characters and in drupelets *S. javanica* resembles *S. racemosa* from Borneo. It can, however, easily be distinguished from that species by its more-flowered inflorescences and its floral characters, especially its petals.

3. Sabia limoniacea WALL. [Cat. (1829) *n.* 1000, *nom. nud.*] *ex* HOOK.*f.* & Th. Fl. Ind. 1 (1855) 210; WALP. Ann. 4 (1857) 139; BENTH. Fl. Hongk. (1861) 70; HOOK.*f.* Fl. Brit. India 2 (1876) 3; KURZ, J. As. Soc. Beng. 45, ii (1876) 204, *excl. syn. Sabia sp.* GRIFFITH (= *S. parviflora ssp. parviflora*); For. Fl. Burma 1 (1877) 300 (*'limonacea'*); FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 144; KING, J. As. Soc. Beng. 65, ii (1896) 454; PRAIN, Beng. Pl. 1 (1903) 246; BRANDIS, Indian Trees (1906) 194; DUNN & TUTCHER, Kew Bull. Add. Ser. 10 (1912) 68; RIDLEY, Fl. Mal. Pen. 1 (1922) 513; MERR. Lingnan Sc. J. 5 (1927) 19; KANJILAL *c.s.* Fl. Assam 1, 2 (1936) 326; CHEN, Sargentia 3 (1943) 56, f. 7; BISWAS, Pl. Darj. Sikkim Himal. 1 (1966) 261; VAN DE WATER, Blumea 26 (1980) 44, *f.* 6b, 8. – *Androglossum reticulatum* CHAMP. *ex* BENTH. Hook. J. Bot. Kew Gard. Misc. 4 (1852) 42; BENTH. Fl. Hongk. (1861) 70; CHEN, Sargentia 3 (1943) 58, *non S. reticulata* ELMER (1909). – *Sabia celastrinea* MUELL. in Walp., Ann. 6 (1865) 1269. – *Sabia malabarica* BEDD. Ic. Pl. Ind. Or. 1 (1874) 39, t. 177; HOOK.*f.* Fl. Brit. India 2 (1876) 2; BRANDIS, Indian Trees (1906) 194; GAMBLE, Fl. Pres. Madras 1 (1918) 254; CHEN, Sargentia 3 (1943) 48. – **Fig. 2, 3.**

Evergreen woody climber, up to 10 m. *Twigs* glabrous or sometimes sparsely pubescent; flowering twigs up to 5 mm diam., glabrous to lax-pubescent. *Buds* broad-ovoid to ovoid, up to 2.5 mm, acute; scales (sub)glabrous, often ciliolate. *Leaves* oblong-ovate to lanceolate, 4–18 by 1.5–6.5(–8) cm, index 2–4(–4.5), ± pergamentaceous-coriaceous, above and beneath glabrous or with some hairs especially on midrib; base acute to rounded, apex acute, sometimes obtuse, acuminate or not; nerves 5–9 pairs, ± patent, sometimes somewhat ascending, curved to straight; petiole up to 2.5 cm, glabrous to lax-pubescent. *Cymes* either solitary, axillary, subtended by small and often herbaceous leaves, or when either the leaves are fallen or the cymes are subtended by bracts arranged in an up to 15 cm long, glabrous to ± lax-pubescent or tomentellous, racemose to thyrsoid inflorescence, cymes up to 2 cm, 1–4(–6)-flowered; pedicels up to 7 mm; bracts oblong, up to 4 mm, glabrous to pubescent, ciliolate; bracteoles ovate to oblong, up to 1.75 mm, glabrous to pubescent, ciliolate, often situated near calyx. *Flowers* green to yellow or white. *Sepals* sometimes 6 or 7 (see bracteoles), broad-ovate to elliptic, 0.7–1.2(–1.5) by 0.6–1 mm, acute to rounded, glabrous to ± pubescent, ciliolate. *Petals* suborbicular to elliptic or ± obovate, 1.75–2.5 by 1.25–2 mm, obtuse to rounded, sometimes broad-acute, nerves 5, usually obscure. *Stamens* 1.5–2 mm; filament somewhat flattened, 1.25–1.75 by 0.3–0.4 mm; anther ellipsoid, 0.25–0.35 mm, inflexed. *Disk* crown-shaped, thin; ribs often faint or absent. *Pistil*

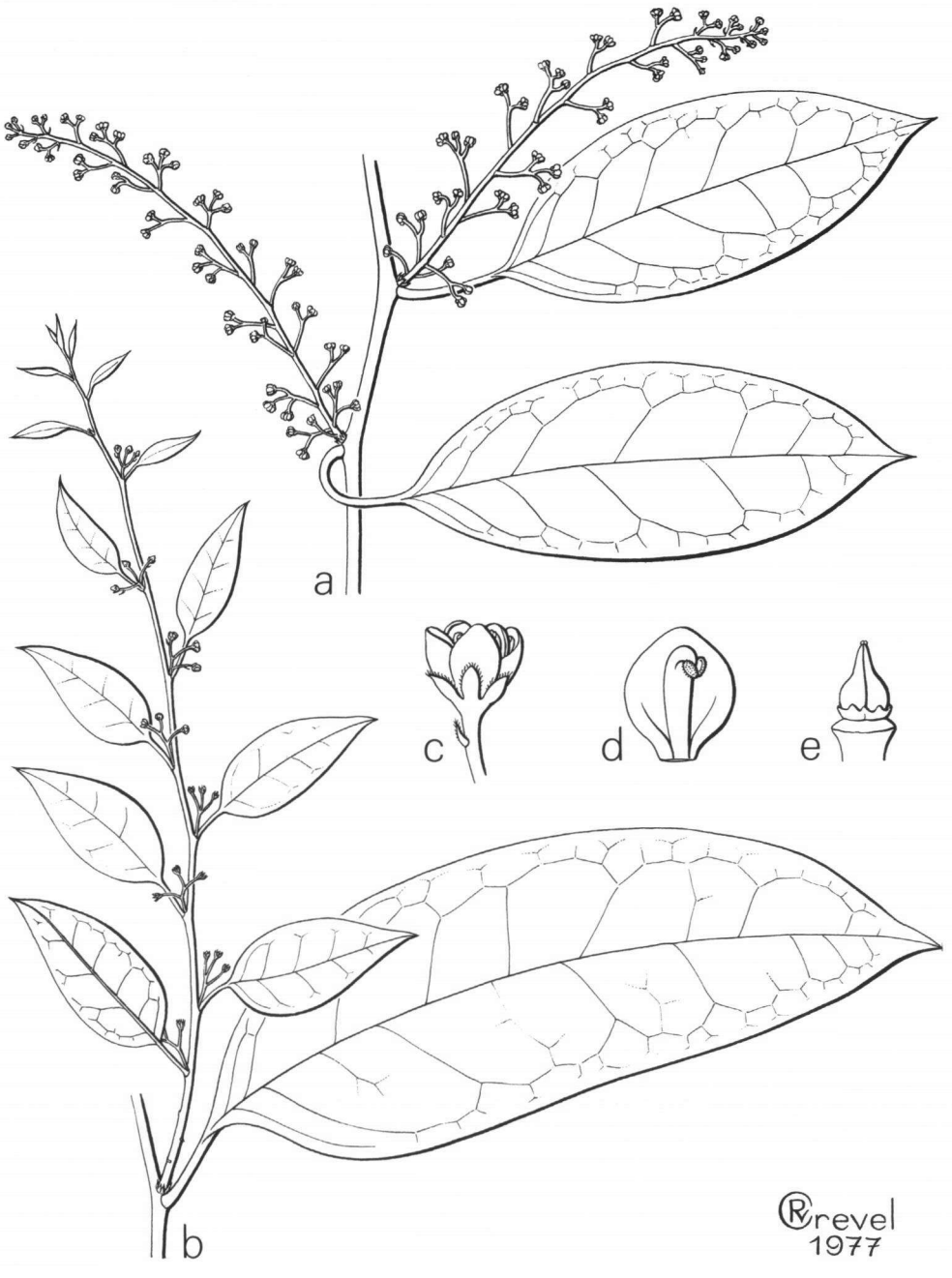

Fig. 2. *Sabia limoniacea* HOOK.*f.* & THOMS. *a.* Habit, ×2/3; *b.* ditto, with axillary cymes, ×2/3; *c.* open flower, ×4; *d.* petal and the opposed stamen, ×8; *e.* disk and pistil, ×8 (*a* & *c–e* C.W. WANG 79409; *b* WALLICH 1000).

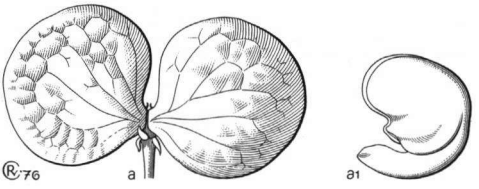

Fig. 3. *Sabia limoniacea* HOOK.*f.* & THOMS. *a.* fruit; *a*^{1}. embryo, both ×1.5 (*a* POILANE 24769; *a*^{1} POILANE 18918).

0.7–1.2 mm; style conical to cylindrical, 0.2–0.6 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.8 mm, glabrous. *Drupelets* globular to obovoid, strongly compressed, 11–14 by 10–13 mm, red to blue or black when fresh, without persistent petals and stamens at the base; reticulate pattern usually faint or absent, sometimes more prominent at the margin. *Embryo* with somewhat undulated cotyledons.

Distr. Continental SE. Asia (throughout India, Burma, Bangladesh, Thailand and Indochina to China); in *Malesia*: Malay Peninsula (incl. also P. Penang), Central Sumatra and Borneo (Sarawak), in all 7 collections.

Ecol. Thickets and forest, 300–1200 m altitude. *Fl.* Sept.–Jan., *fr.* Dec.–April.

4. Sabia parviflora WALL. in ROXB., Fl. Ind. 2 (1824) 310; G.DON, Gen. Hist. 2 (1832) 69; WALP. Rep. 1 (1842) 557; HOOK.*f.* & Th. Fl. Ind. 1 (1855) 210; WALP. Ann. 4 (1857) 139; HOOK.*f.* Fl. Brit. India 2 (1876) 2; STAPF, Trans. Linn. Soc. Lond. 4, 2 (1894) 142; BRANDIS, Indian Trees (1906) 194; LECOMTE, Fl. Gén. I.-C. 2 (1908) 2, *incl. var. harmandiana* LECOMTE, Bull. Soc. Bot. Fr. 54 (1907) 674; KANJILAL *c.s.* Fl. Assam 1, 2 (1936) 325; CHUN, Sunyatsenia 4 (1940) 242; MERR. Brittonia 4 (1941) 112; CHEN, Sargentia 3 (1943) 64; GAGNEP. & VIDAL, Fl. Camb. Laos, Vietnam 1 (1960) 16; BISWAS, Pl. Darj. Sikkim Himal. 1 (1966) 261; SEN GUPTA, Bull. Bot. Soc. Beng. 22, ii (1968) 196; HARA, Fl. E. Himal. 2 (1971) 74; SEN GUPTA, Rec. Bot. Surv. India 20, 2 (1973) 65; HARA & WILLIAMS, Enum. Fl. Pl. Nepal 2 (1970) 100; VAN DE WATER, Blumea 26 (1980) 48, f. 3c, 9. – *Sabia harmandiana* PIERRE, Fl. For. Coch. 5 (1897) pl. 360B; CRAIB, Fl. Siam. Enum. 1 (1926) 340. – *Sabia philippinensis* ROBINS. Bull. Torrey Bot. Club 35 (1908) 70; MERR. Enum. Philip. 2 (1923) 516; CHEN, Sargentia 3 (1943) 67.

For a complete synonymy, see VAN DE WATER (1980).

Evergreen climber or scandent shrub, up to 6 m. *Twigs* glabrous to laxly pubescent; flowering twigs up to 4 mm diam., glabrous to pubescent. *Buds* broad-ovoid to ovoid, up to 2 mm, acute; scales glabrous to short-pubescent, ciliolate. *Leaves* oblong to (sub)lanceolate, 3–12(–15) by 1–5 cm, index 2–4 (–4.5), ± pergamentaceous, above glabrous to subglabrous or sometimes sparsely pubescent especially when young, beneath glabrous to lax-pubescent especially on midrib; base acute to rounded, attenuate or not; apex acute, acuminate; nerves (5–) 6–9(–10) pairs, patent, straight or sometimes ± curved; petiole up to 1.5 cm, glabrous to mainly above lax-pubescent. *Cymes* solitary, axillary, 1.5–8 (–10) cm long, 4–25-flowered, sometimes widely spreading, lax, and with up to 35 or more flowers, glabrous to sparsely pubescent; pedicels up to 1 cm; bracts ovate to lanceolate, up to 2 mm or, when subtending a cyme up to 6 mm, subglabrous to pubescent, ciliolate; bracteoles as bracts. *Flowers* green to yellow or white. *Sepals* broad-ovate to ovate, 0.7–1.5 by 0.5–1 mm, acute to rounded, glabrous to pubescent, ciliolate. *Petals* elliptic-oblong to lanceolate or sometimes oblong-ovate, 2–4(–4.5) by 0.7–1.3 mm, acute to obtuse; nerves up to 7, dark-coloured or sometimes obscure. *Stamens* 1.2–2.25 (–2.5) mm; filament flattened, 0.9–2(–2.25) by 0.25–0.5 mm; anther ellipsoid to ovoid, 0.25–0.4 mm, often ± inflexed. *Disk* crown-shaped, usually thin; lobes often distinct, relatively long and narrow, sometimes short or margin of disk irregular; ribs often faint or absent. *Pistil* 1–2(–2.5) mm; style either absent or obscure, or conical, (0.75–)1–1.5 (–1.75) mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.4–0.7 by 0.5–0.75 mm, glabrous. *Drupelets* globular to somewhat obovoid, ± compressed, 7–9 by 6–8 mm, green to red or blue when fresh, without persistent petals and stamens at the base; reticulate pattern rather fine, but often inconspicuous or obscure. *Embryo* with faintly wrinkled cotyledons.

Distr. Widely ranging in SE. Asia from Nepal to China; in *Malesia*: N. Borneo (Sabah) and the Philippines (Luzon).

KEY TO THE SUBSPECIES

1. Style normally developed, distinctly conical, (0.75–)1–1.5(–1.75) mm long
a. *ssp.* **parviflora**
1. Style usually absent or obscure, the upper part of the pistil carpel-like, sometimes normally developed and then up to 0.75 mm
b. *ssp.* **philippinensis**

a. *ssp.* **parviflora** – *Sabia parviflora* WALL. – *Sabia harmandiana* PIERRE.

Leaves oblong, sometimes oblong-ovate to (sub) lanceolate, 3–12(–15) by 1–5 cm. *Cymes* 2–8(–10)

cm long, 7–25-flowered, sometimes widely spreading, lax, and with up to more than 35 flowers. *Petals* oblong to lanceolate, sometimes oblong-ovate, 2.25–4(–4.5) by 0.7–1.25 mm. *Style* distinctly conical, (0.75–)1–1.5(–1.75) mm long.

Distr. SE. Asia; in *Malesia*: Borneo (Sabah), 9 collections.

Ecol. Roadsides, in thickets, and in forests, mainly 600–2000 m altitude. *Fl. fr.* probably throughout the year.

b. *ssp.* philippinensis (ROBINS.) VAN DE WATER, Blumea 26 (1980) 50. – *Sabia philippinensis* ROBINS. – **Fig. 4.**

Leaves oblong or oblong-ovate to lanceolate, 3–11 by 1–3.5 cm. *Cymes* 1.5–4.5 cm, 4–20-flowered. *Petals* elliptic-oblong to sublanceolate, 2–3.5 by 1–1.25 mm. *Style* absent or obscure and often carpel-like, sometimes normal-developed and then up to 0.75 mm. *Fruits* not seen.

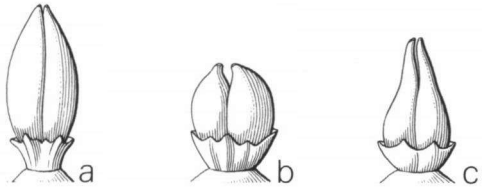

Fig. 4. *Sabia parviflora ssp. philippinensis* (ROBINSON) VAN DE WATER. *a.* & *b.* disk and pistil showing the absence of a style; *c.* a feebly developed one; all ×12 (*a* RAMOS 26973; *b* JACOBS 7402; *c* MERRILL 7708).

Distr. *Malesia*: Philippines (Luzon: Benguet Prov.), 11 collections.

Ecol. Forests, ?1000–2100 m. *Fl.* mainly Febr.–April.

Vern. *Baybayok, kopdas, uakal, udok*, Ig.

Notes. *Ssp. philippinensis* can be distinguished rather easily from *ssp. parviflora* by the absence of a normally developed style. In all the specimens I have seen (except one) the upper parts of the two carpels of each flower are not connate with each other and differentiated into a style as usual, but remain free and carpel-like, although the tip of each carpel is sometimes slightly stigmatic. Moreover, the margins of the upper part of a carpel are not fused, so that the upper half of each carpel remains open. Although this phenomenon is unique within the genus, I have reduced *S. philippinensis* to a subspecies of *S. parviflora* because it agrees very well with that species in all other main characters.

Like in all *Sabia* species the leaves are dark above, paler beneath, but in the present one the contrast is especially conspicuous. In *ssp. philippinensis* the pale margins and undersides of the leaves provide a useful character to distinguish vegetative specimens from those of *S. pauciflora*, another Philippine species

5. Sabia pauciflora BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 370; MIQ. Fl. Ind. Bat. 1, 2 (1859) 619; Fl. Arch. Ind. (1870) 72; *ibid.* (1871) pl. 32; CHEN, Sargentia 3 (1943) 61; VAN DE WATER, Blumea 26 (1980) 51. – *Sabia papuana* WARB. in K.Sch. & Laut., Fl. Deut. Schutzgeb. Südsee (1900) 425. – *Sabia reticulata* ELMER, Leafl. Philip. Bot. 2 (1909) 579; MERR. Enum. Philip. Fl. Pl. 2 (1923) 516; CHEN, Sargentia 3 (1943) 62.

Evergreen woody climber or scandent shrub, up to 20 m. *Twigs* glabrous; flowering twigs up to 5 mm diam., glabrous or sparsely pubescent. *Buds* ovoid, up to 2.5 mm, acute; scales glabrous to pubescent, (sub)ciliolate. *Leaves* oblong to sublanceolate, 5–14 (–18) by 2–6(–8) cm, index (2–)2.5–3.5(–4), above and beneath glabrous or with very few hairs on midrib, pergamentaceous; base acute to rounded, apex acute, acuminate; nerves (5–)6–8(–9) pairs, patent, straight to curved; petiole up to 2 cm, glabrous to sparsely pubescent. *Cymes* either arranged in an axillary, up to 12 cm long, glabrous to sparsely pubescent, racemose to thyrsoid inflorescence, subtended by bracts, or solitary, axillary, often subtended by small leaves, up to 3.5 cm, 1–4-flowered, glabrous to sparsely pubescent; bracts oblong to lanceolate, up to 3.5 mm, subglabrous to somewhat pubescent, (sub)ciliolate; bracteoles as bracts but smaller, or minute, or sepal-like and then often situated near calyx; pedicels up to *c.* 1 cm. *Flowers* green to yellow or white. *Sepals* sometimes 6 (see bracteoles), ovate to broad-ovate, 0.75–1.25 by 0.7–1 mm, acute to obtuse, glabrous to somewhat pubescent, (sub)ciliolate. *Petals* oblong, sometimes somewhat oblong-ovate, 2.5–4(–4.5) by (0.75–)1–1.3(–1.5) mm, (narrow-)obtuse, sometimes subciliolate, nerves up to 5, sometimes dark-coloured and then conspicuous. *Stamens* (1–)1.25–1.75(–2) mm; filament flattened, (0.75–)1–1.5(–1.75) by 0.25–0.5 mm; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; lobes often short or irregular; ribs sometimes faint or absent. *Pistil* 1.3–1.7 mm; style conical, 0.6–1 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.7 by 0.5–0.8 mm, glabrous. *Drupelets* ± globular, sometimes somewhat obovoid, compressed, 7.5–11 by 8–10(–11) mm, white to red or dark-blue when fresh, without persistent petals and stamens, reticulate pattern fine to rather coarse, sometimes indistinct, limited to the margin or not. *Embryo* with somewhat undulated or faintly folded cotyledons.

Distr. *Malesia*: Moluccas (Buru, Halmaheira, Batjan), Philippines (Luzon, Negros, Mindanao), New Guinea; Solomon Islands.

Ecol. Forests, from sea-level up to 2300 m. *Fl. fr.* throughout the year.

Uses. Fresh leaves eaten against wound fever in New Guinea.

Vern. Philippines: *bungoi, dadabu,* Bag.; New Guinea: *hambui,* Poio, Enga lang., *kubiakan,* Hagen-Chimbu, Yoowi dial., *mongolya ka,* Northern Prov., *pehkuma,* Mumuni, Orokaiva lang, *pipi,* E. Highlands, *pukhabu,* S. Highlands.

Note. This species is closely related to *S. javanica* from Java and Sumatra, but can be distinguished from that species by its always few-flowered cymes, its longer style, and its often ± globular drupelets (*S. javanica* often obovoid).

6. Sabia racemosa CHEN, Sargentia 3 (1943) 36, f. 2; VAN DE WATER, Blumea 26 (1980) 54.

Evergreen woody climber or scandent shrub, up to 6 m. *Twigs* glabrous; flowering twigs up to 4 mm diam., glabrous or somewhat short-pubescent. *Buds* ovoid, up to 1.5 mm acute; scales (sub)ciliolate or not. *Leaves* oblong or somewhat oblong-ovate, 6–25 by 2–10 cm, index 2–3(–3.5), pergamentaceous, glabrous or with some hairs on midrib, rarely beneath all over sparsely short-pubescent; base acute to rounded, apex acute, acuminate; nerves 4–8 (or 9) pairs, ± patent, curved to straight; petiole up to 2.5 cm, glabrous or with some very short hairs. *Cymes* arranged in an axillary, up to 8 cm long, glabrous to puberulous or short-tomentellous, racemose to thyrsoid inflorescence, subtended by bracts but often bracts fallen or sometimes leaf-like, cymes up to 1 cm, 1–4(–7)-flowered, glabrous to somewhat puberulous or short-tomentellous; bracts ovate to oblong, up to 3 mm, glabrous to somewhat pubescent, (sub)ciliolate; bracteoles as bracts but usually smaller, or minute and then often situated near calyx; pedicels up to 4 mm. *Flowers* (pale-)green to yellow. *Sepals* ± ovate to broad-ovate, 0.6–1.3 by 0.5–1 mm, acute to obtuse, glabrous to somewhat pubescent, (sub)ciliolate. *Petals* elliptic-oblong to ovate-lanceolate, 3.5–6.5 by (1.25–)1.5–2.5 mm, acute to obtuse, or ± acuminate, or gradually narrowed, nerves up to 7, thin but distinct. *Stamens* 1.2–2.2 mm; filament flattened, 1–2 by 0.2–0.5 mm; anther globular to ellipsoid, 0.2–0.3 mm, inflexed. *Disk* crown-shaped; lobes sometimes very short or indistinct; ribs sometimes faint or absent. *Pistil* 1–1.5 mm; style ± conical, 0.5–0.9 mm, much shorter than the adjacent side(s) of the drupelet(s); ovary globular to subreniform, 0.5–0.6 by 0.5–0.7 mm, glabrous. *Drupelets* obovoid, ± compressed, 10–12 by (7–)8–10 mm, white to pink or red when fresh, without persistent petals and stamens at the base; reticulate pattern faint to rather coarse, often limited to the margin. *Embryo* with somewhat to very wrinkled or folded cotyledons.

Distr. *Malesia*: Borneo.

Note. In vegetative characters and somewhat in the fruit this species resembles *S. javanica.* It differs, however, from that species in its inflorescence (few-flowered cymes) and in its floral characters, especially the petals.

Since the fruiting collections of *ssp. racemosa* bear only immature or damaged fruit, the description of the drupelets has mainly been based on the fruit of *ssp. kinabaluensis.*

The two subspecies can easily be distinguished from each other by the difference in the shape of their petals. Since they can be distinguished from each other only when flowers are available, the identification of most of the vegetative and fruiting specimens has mainly been based on the locality from where they have been collected.

KEY TO THE SUBSPECIES

1. Petals oblong-ovate to ovate-lanceolate, acute, somewhat acuminate or tapering to the apex
a. *ssp.* **racemosa**
1. Petals elliptic-oblong to oblong, acute to obtuse
b. *ssp.* **kinabaluensis**

a. *ssp.* **racemosa** – *Sabia racemosa* CHEN.

Sepals 0.6–1.1 by 0.5–1 mm. Petals oblong-ovate to ovate-lanceolate, (3.5–)4.5–6.5 by (1.25–)1.5–2.5 mm, acute, somewhat acuminate or tapering to the apex. Pistil 1–1.2 mm; style 0.5–0.7 mm long.

Distr. *Malesia*: Borneo (Kalimantan), 7 collections.

Ecol. Low altitudes, up to 100 m. *Fl. fr.* throughout the year.

b. *ssp.* **kinabaluensis** VAN DE WATER, Blumea 26 (1980) 55.

Sepals 0.9–1.3 by 0.6–1 mm. Petals elliptic-oblong to oblong, 3.5–5 by 1.5–2.5 mm, acute to obtuse. Pistil 1.2–1.5 mm high; style 0.6–0.9 mm long.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu), 15 collections.

Ecol. Forests, mainly at 800–1500 m altitude. *Fl. fr.* throughout the year.

7. Sabia sumatrana BLUME, Mus. Bot. Lugd.-Bat. 1 (1851) 370; MIQ. Fl. Ind. Bat. 1, 2 (1859) 619; Fl. Arch. Ind. (1870) 72; *ibid.* (1871) pl. 33; KING, J. As. Soc. Beng. 65, ii (1896) 454; RIDLEY, Fl. Mal. Pen. 1 (1922) 513; CHEN, Sargentia 3 (1943) 39; VAN DE WATER, Blumea 26 (1980) 56.

Evergreen woody climber, up to *c.* 3.5 m. *Twigs*

glabrous; flowering twigs up to 4 mm diam., glabrous. *Leaves* elliptic to oblong, sometimes (sub) lanceolate, (5–)7–15(–18) by (1.5–)2.5–7(–10) cm, index 2–3(–4), pergamentaceous, above and beneath glabrous; base acute, apex acuminate to subcuspidate; nerves 5–7 pairs, patent, curved to straight; petiole up to 2 cm, glabrous. *Flowers* yellowish-green to white, either solitary, sometimes 2 or 3 together, axillary, or arranged in a thyrsoid, axillary, up to 6.5 cm long, glabrous inflorescence; pedicels up to 2.5 cm, glabrous, with few small budscales at the base when flowers solitary; bracts ± oblong-ovate, up to 1.5 mm long, glabrous, ciliolate; bracteoles as bracts. *Sepals* broad-ovate to ovate, 1.25–1.75(–2) by (0.75–)1–1.75 mm, acute to obtuse, glabrous, (sub)ciliolate or not. *Petals* oblong or ovate-lanceolate, *c.* 6–10 by 1.5–2.5 mm, sometimes the upper part somewhat channeled, tapering to the apex, acute to narrow-obtuse, nerves obscure. *Stamens* 3.5–7.5 mm; filament ± flattened, 3–7 by 0.4–0.75 mm; anther ellipsoid, 0.5–0.7 mm, upright. *Disk* short-cylindrical, small, the upper part not enclosing the base of the ovary and without lobes; ribs ± prominent. *Pistil* 3.5–c. 7 mm; style narrow-conical, 3–6 mm, ± half as long as the adjacent side(s) of the drupelet(s); ovary somewhat globular to subreniform, 0.5–0.8 by 0.7–1 mm, glabrous. *Drupelets* obovoid, somewhat compressed, 11–13 by 8–9 mm, white to blue when fresh, without persistent petals and stamens, reticulate pattern absent, often more or less rugged on the outside.

Distr. *Malesia*: Sumatra (W. Coast Res., Palembang), 7 collections.

Ecol. Forests, 60–1000 m altitude. *Fl.* May–Aug., *fr.* July–Sept., Febr.

Note. Only a few collections are available. For that reason no buds and embryos could be described, whereas the description of the flowers has partly been based on rather young ones.

Excluded

Sabia densiflora MIQ. Sum. (1861) 203, 520 = *Meliosma angulata* BLUME: K. & V. Bijdr. 9 (1903) 131 = *Meliosma simplicifolia* (ROXB.) WALP. *ssp. simplicifolia*: VAN BEUSEKOM, Blumea 19 (1971) 476; Fl. Males. 10⁴ (1989) 698 (this issue).

Sabia floribunda MIQ. Sum. (1861) 203, 521 = *Meliosma angulata* BLUME: K. & V. Bijdr. 9 (1903) 131 = *Meliosma simplicifolia* (ROXB.) WALP. *ssp. simplicifolia*: *l.c.*

2. MELIOSMA

BLUME, Cat. (1823) 32; Rumphia 3 (1849) 196; MIQ. Fl. Ind. Bat. 1, 2 (1859) 612; BENTH. & HOOK.*f.* Gen. Pl. 1 (1862) 414; HOOK.*f.* Fl. Brit. India 2 (1876) 3; BOERL. Handl. Fl. Ned. Ind. 1 (1890) 290; WARB. in E. & P., Nat. Pfl. Fam. 3, 5 (1895) 371; VAN BEUSEKOM, Blumea 19 (1971) 355. – *Millingtonia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254, *non* LINN.*f.* (1781), *nec* DONN (1807). – *Kingsboroughia* LIEBM. Vid. Medd. Nat. For. Kjøbenhavn 2 (1850) 67; WALP. Ann. 2 (1852) 834. – **Fig. 5–8, 10, 12.**

For a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen or sometimes deciduous shrubs or trees, up to 42 m, 1 m diam., sometimes buttressed. *Twigs* more or less lenticellate, often with conspicuous leaf-scars. *Buds* densely pubescent. *Leaves* simple or imparipinnate with (sub)opposite leaflets, ending in 3 or 1 leaflet(s), in the latter case its petiolule articulated with the rachis; leaves or leaflets entire or dentate, with or without hairy domatia beneath; rachis and petioles, usually also petiolules, with a usually shallow and narrow, more or less conspicuous longitudinal groove above, usually with swollen base, articulately attached. *Inflorescence* terminal, sometimes axillary, a pyramidal panicle, poor to usually profuse, up to 4 times ramified, with alternate, articulately attached, often lenticellate axes. Bracts small, those of lower order usually soon caducous; cataphylls often present. Bracteoles absent, but sometimes one (or two) bracteole-like sepals present,

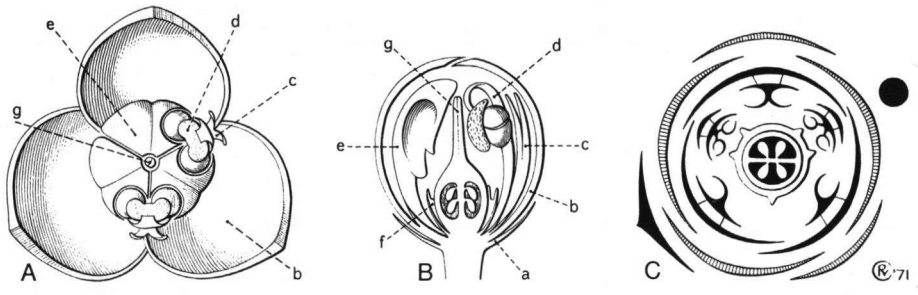

Fig. 5. Flower of *Meliosma*. *A*. Semi-diagrammatical sketch of flower (*subg. Meliosma*) with opened outer petals, but stamens still in bud position. *B*. Semi-diagrammatical length section of bud (*subg. Meliosma*). *C*. Diagram (*subg. Kingsboroughia* and *subg. Meliosma*). Names of the flower parts: *a*. sepals; *b*. outer petals; *c*. inner petals; *d*. fertile stamens; *e*. staminodes; *f*. disk; *g*. style.

lowered on the pedicel. *Flowers* numerous, sessile or short-pedicelled, small, bisexual. *Sepals* 5, by reduction sometimes 4, rarely 3, sometimes by addition of empty bracts seemingly more, up to *c.* 13, and together forming a kind of involucre, usually unequal and then mostly 3 about equal. *Petals* 5, episepalous, 3 outer ones more or less unequal, alternisepalous, mostly suborbicular and convex, rarely the largest one much wider than long and more or less reniform, the smaller ones irregularly shaped; 2 inner ones equal, much smaller, reduced, opposite the fertile stamens and more or less adherent to the base of the filaments, entire to bifid. *Disk* generally present, sometimes very reduced or absent, often irregularly shaped, as a rule with 5 more or less developed teeth, 4 of which paired, 1 unpaired, each pair opposite a fertile stamen. *Stamens* 5, epipetalous, 2 fertile, filament short, strap-shaped, flat, incurved at the top, abruptly terminating in a wide, varyingly shaped cup which bears two globose to elliptic transversely dehiscent anther-cells which are ripe in bud, springing back elastically when the flower opens; 3 staminodial, opposite the larger petals and more or less adherent to the base of these, deformed, broad, irregularly shaped, with 1 or 2 holes near the top in which fit the anther-cells of the fertile stamens, often coherent and forming a cup over the pistil. *Ovary* globose to ovoid or conical, 2-, very rarely 3-locular, apically contracted in a rather short, simple or 2-partible, cylindric or subulate to conical, rarely minute style, with simple or somewhat bifid, minute stigma. *Ovules* 2 (or 1) in each cell, more or less superimposed, attached to the partition, hemi-anatropous. *Fruit* a drupe, subglobose to pyriform, small, glabrous, with one stone; rarely two ovules instead of one per ovary develop, resulting in a didymous fruit; mesocarp pulpy, mostly thin; endocarp globose, pyriform, or semiglobose, 1-celled, stony to crustaceous, splitting in two valves, inside with a basilar rounded projection over which the seed is curved. *Vascular bundle* connecting pedicel and seed either running outside the endocarp wall (free in the pulpy mesocarp or in a groove on the ventral endocarp wall), or through a canal inside the endocarp

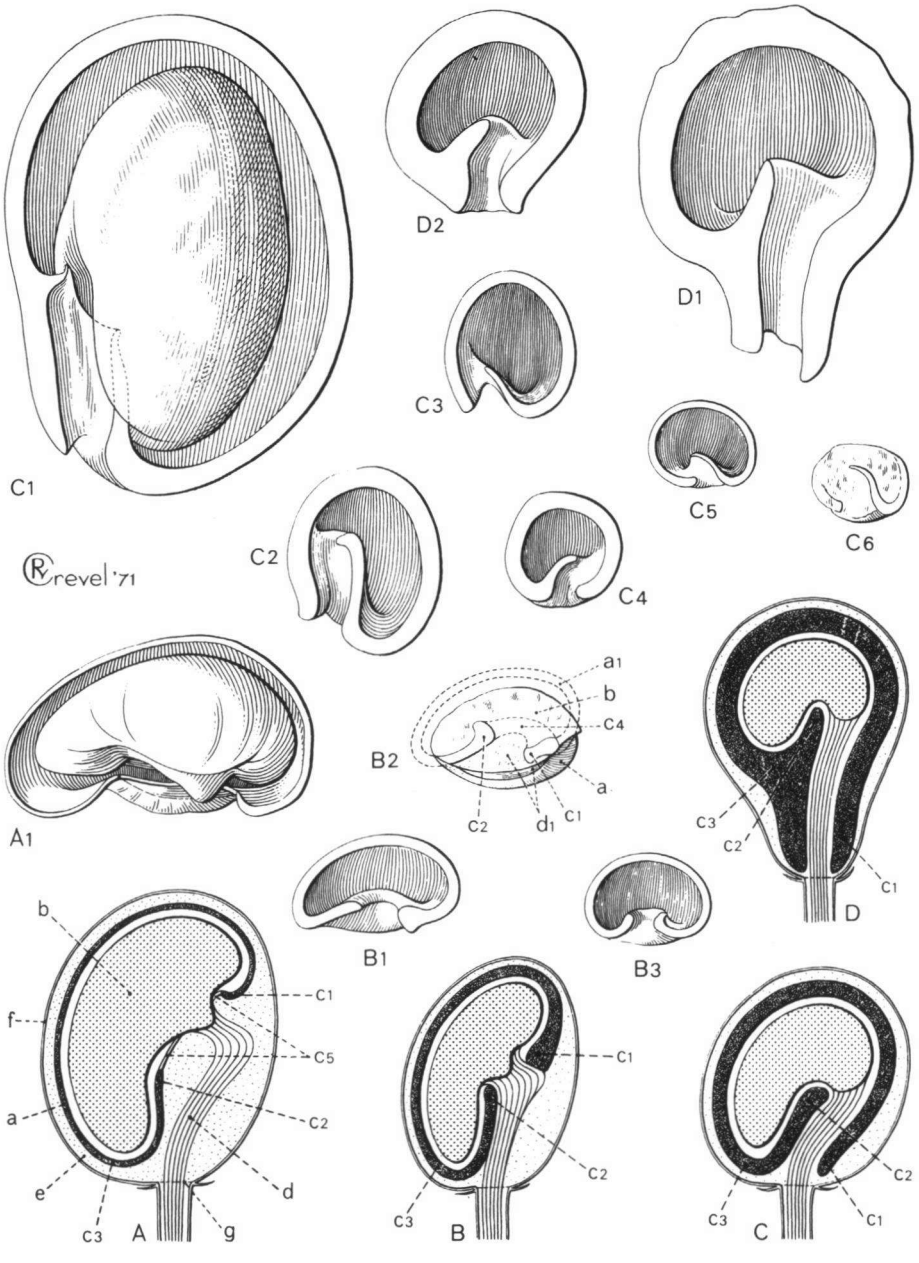

Fig. 6. Diagrammatical length sections of three types of fruit in *Meliosma*. *A. Subg. Kingsboroughia sect. Hendersonia*: vascular bundle running freely in the mesocarp. *B. Subg. Kingsboroughia sect. Kingsboroughia*: vascular bundle running in a groove of the endocarp, entering the wall through the ventral pore. *C. Subg. Meliosma sect. Meliosma*: similar to B, but the marginal canal lengthened through the endocarp. All ×3.

wall. *Seed* sub- to semiglobose, more or less concave at the ventral side, with membranous testa, without endosperm. *Embryo* with rather long, 2–3 times folded radicle and more or less folded cotyledons.

Distr. About 20–25 species, 15 of which in SE. Asia, and not more than *c.* 10 in Central and South America. In *Malesia*: 8 species.

The New World species belong to *Meliosma subg. Meliosma sect. Lorenzanea*, a section restricted to the New World; besides, there is one species of *subg. Kingsboroughia* which is widely spread in China but also occurs in Mexico (*M. alba* WALP.).

Correctly named fossils from the Tertiary are found widely distributed on the northern hemisphere, in Europe, Asia, and North America; see VAN BEUSEKOM, *l.c.* 384–424, fig. 16–18 (maps). The oldest known fossils, of both subgenera, date from the Eocene. All localities lie south of the 60° parallel of latitude and almost all beyond the present range of the genus. It is remarkable that still in the Pliocene the genus occurred in Europe, S. Russia, but no longer in North America. Only in southern Japan Pliocene fossils and recent species are found together.

Ecol. In primary and secondary forests, especially on hills and mountains up to *c.* 3300 m, but also in lowlands. All or almost all species prefer everwet to moist, tropical to subtropical conditions. Some are hardy in mild temperate climates; these are deciduous and grow flush-wise.

Morph. Trees, mostly small, sometimes shrubs, rarely mentioned to be subscandent, but *M. pinnata ssp. ferruginea* and *ssp. macrophylla* are recorded to reach 42 m height and *M. lanceolata* to reach 30 m by 1 m diam.

The margin of leaf or leaflet may be entire or dentate and is often variable. In saplings, watershoots and seedlings the margin is mostly dentate. In species with pinnate leaves the size of the leaflets mostly increases apically and their greatest width tends to shift towards the upper half. The leaves, when pinnate, have 1 or 3 top-leaflets; in the first case the petiolule of the top-leaflet has an articulation with the rachis.

The inflorescence consists of a racemosely arranged, rich-flowered panicle.

VAN BEUSEKOM (*l.c.* 361–364, fig. 2 & 3) amply discussed the peculiar flower structure. Although BAILLON assumed the flower to be basically 3-merous, he agrees with the majority of authors that it is 5-merous. The 3 outer petals are differently shaped from the 2 inner ones; the latter may be of the lanceolate or bifid type, and taxonomically their shape is important.

The structure of endocarp and seed (*l.c.* 364–369, fig. 4) is of great importance. The ovary contains 4 ovules but only one develops into a seed (exceptionally 2, resulting in an anomalous didymous fruit). The fruit is a drupe with rather thin, pulpy mesocarp and a stony to crustaceous endocarp, more or less globular to pyriform, smooth or often with a reticulate surface. When dehiscent, it splits into two valves, the plane of dehiscence usually marked by a ± prominent keel running all around the endocarp. At the ventral side there is a usually narrow pore through which the seed is connected with the vascular bundle towards the pedicel. There are two main types: 1) endocarps which only enclose the seed, whereas the vascular bundle connecting pedicel and seed is running outside the endocarp wall; 2) endocarps which enclose both seed and vascular bundle, the latter being situated in a marginal canal inside.

Taxon. The subdivision of the genus *Meliosma* is as follows:

1. Leaves simple or pinnate; when pinnate rachis terminating in 3 leaflets (anomalously 2 or 1). Sepals mostly 5. Outer petals narrowly imbricate, subrotund to broad-elliptic, all regularly shaped. Vascular bundle connecting pedicel and seed situated in a long or short marginal canal inside the endocarp. About 12 species in SE. Asia. *Spp. 1–7* ..... *Subg.* **Meliosma**
2. Leaves simple or pinnate. Ovary glabrous or pubescent. Endocarp wall relatively thin, not drawn out around the ventral perforation; endocarp mostly (sub)globose, sometimes semiglobose, or ellipsoid to obovoid. About 12 spp. in SE. Asia. *Spp. 1–7*..... *Sect.* **Meliosma**
3. Leaves simple. *Spp. 1 & 2*..... *Subsect.* **Simplices** (WARB.) BEUS.
4. Deciduous shrubs or small trees. Nerves all or almost all straight or almost straight. Continental Asia *Ser.* **Rectinervia** BEUS.
4. Evergreen shrubs or trees. Nerves all or almost all distinctly ascending. *Spp. 1 & 2* *Ser.* **Curvinervia** BEUS.
3. Leaves pinnate. *Spp. 3–7* ..... *Subsect.* **Pinnatae** (WARB.) BEUS.
2. Leaves simple. Ovary always glabrous. Endocarp wall relatively thick, more or less drawn out around the

ventral perforation which often gives the mostly (sub)globose endocarp a somewhat pyriform shape. About 10 species in Central and tropical South America ..... *Sect.* **Lorenzanea** (LIEBM.) BEUS.

1. Leaves pinnate, petiolule of terminal leaflet articulate with the rachis. Sepals mostly 4. Outer petals widely imbricate, the largest one widely reniform, much wider than long, the smaller ones of irregular shape ± not wider than long. Vascular bundle connecting pedicel and seed situated outside the endocarp, either running in a groove at the ventral side or freely in the pulpy mesocarp
Subg. **Kingsboroughia** (LIEBM.) BEUS.
5. Deciduous trees. Vascular bundle connecting pedicel and seed running in a ventral groove of the endocarp wall. Two species. SE. Asia and S. Mexico ..... *Sect.* **Kingsboroughia**
5. Evergreen trees. Vascular bundle connecting pedicel and seed running freely in the mesocarp. One species. Malay Peninsula, N. Borneo. *Sp. 8* ..... *Sect.* **Hendersonia** BEUS.

KEY TO THE SPECIES

1. Leaves simple. *Subg. Meliosma sect. Meliosma subsect. Simplices.*
2. Petioles 1/5–1/3 the length of the lamina. Panicles mostly axillary or sometimes ramiflorous, sometimes terminal. Inner petals bifid or entire. Endocarps ellipsoid to obovoid, with reticulate to smooth surface, rarely (sub)globose and then smooth, 6–14 cm diam. ..... **1. M. lepidota**
2. Petioles 1/20–1/5 the length of the lamina. Panicles always terminal. Inner petals always bifid. Endocarps always (sub)globose, always with reticulate surface, 3.5–8 mm diam. ..... **2. M. simplicifolia**
1. Leaves pinnate. *Subg. Meliosma* and *subg. Kingsboroughia.*
3. Leaf-rachis terminating in 3 (sometimes 2, rarely 1) leaflets. Outer petals widely ovate to orbicular, entire. Endocarps inside with a marginal canal in which runs the vascular bundle connecting pedicels and seed. *Sect. Meliosma subsect. Pinnatae.*
4. Leaves 2–5(–6)-jugate; leaflets usually glabrous, sometimes (in Bornean specimens) pubescent beneath, above always with a prominent midrib. Inner petals (1.2–)1.5–2(–3) mm, entire to retuse or slightly bifid at apex. Ovary glabrous. Endocarps 0.7–2 cm diam. ..... **3. M. sumatrana**
4. Leaves 2–23-jugate; leaflets glabrous or pubescent, midrib usually flat to sulcate above. Inner petals (0.3–)0.5–1(–1.5) mm, always distinctly and rather deeply bifid. Ovary glabrous or pubescent. Endocarps 0.2–1 cm diam.
5. Leaves (3–)6–18(–23)-jugate, with (10–)20–100 cm long rachis. Leaflets only very rarely with slight pubescence on midrib and nerves above. Panicles large and lax, 0.5–1.5 m, pendulous, usually suddenly bent down at the base, with up to 90 cm long primary side-axes which are never subtended by (small) leaves.
6. Leaflets in middle and upper part of the leaf elliptic to lanceolate, very rarely a few linear-lanceolate, index (0.5–)2–5(–7). Petiolules 2–30 mm ..... **4. M. lanceolata**
6. Leaflets in middle and upper part of the leaf linear-lanceolate, index 5–10. Lateral petiolules absent or very short, to *c.* 1 mm ..... **5. M. hirsuta**
5. Leaves 2–7(–9)-jugate, rachis up to *c.* 40(–60) cm. Leaflets usually more or less pubescent on midrib and nerves above, sometimes glabrous. Panicles lax to dense but not very large, 10–50(–70) cm, usually erect, sometimes ± pendulous, but almost never suddenly bent down at the base, with up to 35(–60) cm long side-axes which may be subtended by decrescent leaves.
7. Sepals pubescent. Outer petals glabrous. *Leaves* 2–3(–4)-jugate. Endocarps 7–8 mm diam. Small trees ..... **7. M. sarawakensis**
7. Sepals glabrous (rarely with a few hairs), sometimes pubescent but then also outer petals pubescent. Leaves 2–7(–9)-jugate. Endocarps 3–9(–10) mm diam. Small to large trees.
8. Plants from Malesia except Sumatra and Java ..... **6. M. pinnata**
8. Plants from Sumatra and Java.
9. Leaflets pubescent at least on midrib and nerves, usually entire. Panicles often with decrescent leaves. Lowland and mountains up to 2500 m ..... **6. M. pinnata**
9. Leaflets (sub)glabrous, usually (obscurely) dentate. Panicles without decrescent leaves. Mountains, 1300–2900 m ..... **4. M. lanceolata** *f.* **nervosa**
3. Leaf-rachis terminating in 1 (or 2) leaflets of which the short petiolule is always well markedly articulated with the rachis. Outer petals mostly widely reniform, or of irregular shape, mostly wider than long, with ± irregular margin and often emarginate. Endocarps inside without a marginal canal in which runs the vascular bundle, large, wider than 1 cm. Inner petals hardly or not incised at apex. *Subg. Kingsboroughia sect. Hendersonia* ..... **8. M. rufo-pilosa**

1. Meliosma lepidota BLUME, Rumphia 3 (1849) 199; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203; VAN BEUSEKOM, Blumea 19 (1971) 451, *f.* 25. – **Fig. 7.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen shrub or tree, up to *c.* 15(–22) m. *Flowering twigs* pubescent when young, glabrescent. *Leaves* elliptic or obovate to lanceolate, 2–32 by 0.7–12(–18) cm, index (1.2–)1.5–3(–4), at the base acute, at apex acute to caudate, rarely obtuse, usually entire, sometimes remotely spinously dentate towards the apex, beneath sometimes pubescent on midrib and nerves, without domatia; nerves 7–15 pairs, usually strongly ascending, petioles usually rather long, 1–10 cm, 1/5–1/3 as long as the blade. *Panicles* usually axillary and erect, widely to usually narrowly pyramidal, 3–30(–200) cm, usually densely pubescent, bearing numerous solitary to crowded flowers which are sometimes spicately arranged; side-axes usually many, usually short, up to *c.* 15 (–40) cm, sometimes subtended by normal to small leaves; bracts ovate to linear-lanceolate, up to *c.* 2(–6) mm, usually densely pubescent. *Pedicels* absent or present, up to *c.* 3(–5) mm. *Mature buds* 1.5–3 mm diam. *Sepals* (4) 5, (round-)ovate, subequal, 1–2 mm, or the outer 1 or 2 smaller, often one lowered on the pedicel, all entire, ciliolate. *Outer petals* glabrous. *Inner petals* ± lanceolate and entire, or bifid, (0.6–)0.8–2.5 mm, glabrous or somewhat ciliolate at margin or tip, when bifid never with a central lobule. *Filaments* 0.7–1.5 mm. *Ovary* 0.5–1 mm, very exceptionally pubescent. *Fruit* (sub)globose, sometimes elliptic, when ripe 5–10 mm diam.; endocarp globose to ellipsoid, 6–8(–9) mm diam., usually with a slightly elevated rather fine reticulum; median keel distinct, more or less prominent; ventral pore whether or not sunken but never spouted.

Distr. SE. & E. Asia; in *Malesia* (with 4 subspecies): Sumatra, Malay Peninsula, W. Java, N. Borneo (Sabah), and the Philippines (Luzon, Mindoro).

Ecol. In evergreen forests under tropical or subtropical conditions, at medium to high altitudes; for details, see under the subspecies.

Notes. *Meliosma lepidota* displays a rather wide variation, especially in the ramification of its panicles which covers almost the whole range of possibilities found throughout *Meliosma*.

Within *M. lepidota* seven subspecies are recognized, four of which in Malesia. The differences between them are on the same level as in other subspecies in *Meliosma*. Transitional forms between these subspecies, however, occur in only a few cases, which is logical since there is perfect geographical isolation between most of them. See further the notes under the subspecies.

KEY TO THE SUBSPECIES

1. Inner petals distinctly bifid.
   2. Leaves 1.5–2(–2.5) times as long as wide; petiole 1/4–2/3 as long as the blade. Panicles 5–15 cm. Mature buds 2–2.5 mm diam. Endocarps ellipsoid to obovoid ..... **d.** *ssp.* **kinabaluensis**
   2. Leaves (1.6–)2–3 times as long as wide; petiole (1/6–)1/5–1/3 (–1/2) as long as the blade. Panicles 3–30 cm. Mature buds 1.5–2(–2.2) mm diam. Endocarps long- to short-ellipsoid (always distinctly higher than wide) .... **a.** *ssp.* **lepidota**
1. Inner petals entire, usually lanceolate.
   3. Inner petals 2.5 mm. Panicles distinctly axillary or ramiflorous. Mature buds 2.5–3 mm diam. **b.** *ssp.* **dolichomischa**
   3. Inner petals 1–1.5 mm. Panicles terminal or crowded at the end of the twigs, rarely distinctly axillary. Mature buds 2–2.5 mm diam. **c.** *ssp.* **vulcanica**

a. *ssp.* **lepidota.** – *Meliosma lepidota* BLUME, Rumphia 3 (1849) 199; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203; Illustr. (1871) 73. – *Meliosma pedicellata* K. & V. Bijdr. 9 (1903) 134; KOORD. Exk. Fl. Java 2 (1912) 545; Atlas 2 (1914) t. 379; BACKER & BAKH.*f.* Fl. Java 2 (1965) 144.

Leaves oblong, sometimes somewhat ovate-oblong, rarely elliptic, 5–26 by (1.5–)2–12 cm, entire, base acute, apex acute to caudate, glabrous when mature; nerves 8–12(–14) pairs; petiole 1.5–6 cm. *Panicles* axillary, rarely terminal or ramiflorous, often several together near the end of a branch, 3–30 cm, rather poor and lax, ramified up to the 2nd order; primary (essentially secondary!) side-axes short, up to *c.* 6(–10) cm. *Mature buds* 1.5–2 mm diam. *Inner petals* about halfway bifid, 0.7–1 mm; lobes rather narrow. *Endocarp* obovoid to ellipsoid, (8–)9–14 mm long, 5.5–8 mm diam., with or without rather wide and feeble reticulum; median keel distinct, more or less prominent, blunt to rather sharp, at one or both ends running out into a ventral, often somewhat beak-like processus; ventral pore rather wide, somewhat sunken.

Distr. *Malesia*: Sumatra (not uncommon in Aceh, Tapanuli, and West Coast), W. Java.

Ecol. Primary montane rain-forest; 900–2600 m altitude in Sumatra, 1050–1600 m in Java.

Field notes. Outer bark dark brown, finely corky, 0.5 mm; inner bark turning redbrown, 0.5 cm; wood ochre with reddish stripes.

Vern. Sumatra: *antuang, hontuang*, Batak lang., Toba, *kalompang bagèh*, Gn. Talamau.

Note. *Ssp. lepidota* is similar and probably most closely related to the adjacent *ssp. dolichomischa* and *ssp. kinabaluensis*. However, *ssp. lepidota* also

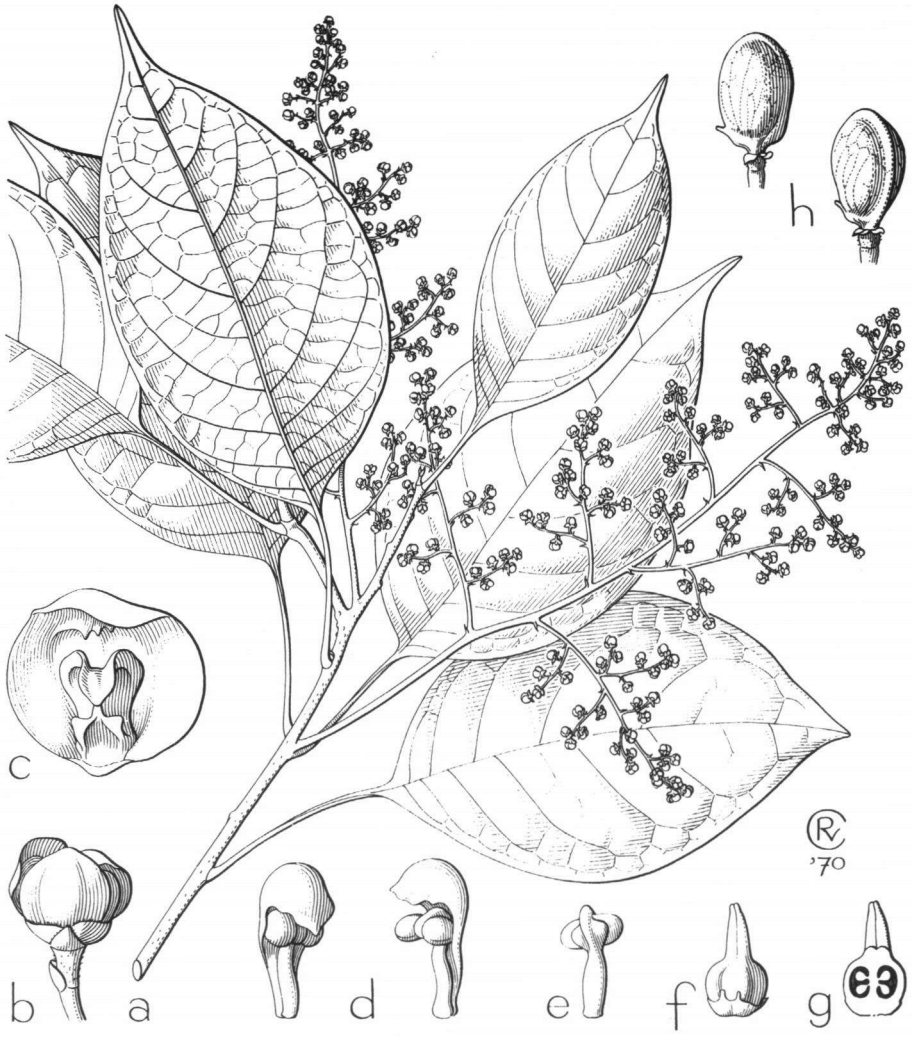

Fig. 7. *Meliosma lepidota* BLUME *ssp. dolichomischa* (VIDAL) BEUS. *a*. Flowering twig; ×0.5; *b*. half-opened flower, ×4.5; *c*. outer petal with adhering staminode; *d*. stamen with adhering inner petal, adaxial view; *e*. stamen, abaxial view; *f*. pistil with surrounding disk; *g*. ovary, length section, all ×9; *h*. fruit, ×1.5 (*a–g* HENDERSON SF 23488; *h* HENDERSON SF 23492).

shows a close resemblance to certain forms of *ssp. longipes* (MERR.) BEUS. from Vietnam, from which it can sometimes only be distinguished by the shape of the endocarp.

b. *ssp.* **dolichomischa** (VIDAL) BEUS. Blumea 19 (1971) 458, f. 25. – *Meliosma dolichomischa* VIDAL, Not. Syst. 16 (1960) 304. – *Meliosma monophylla* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 54 (1910) 40, *nom. illeg.*, *non* MERR. (1909); Fl. Mal. Pen. 1 (1922) 514; VIDAL, Not. Syst. 16 (1960) 306. – **Fig. 7.**

Leaves elliptic to oblong, 4–22 by 2–10 cm, entire, base mostly attenuate, apex usually cuspidate, glabrous or subglabrous, nerves 7–13 pairs, petiole (1–)3–10 cm. *Panicles* axillary or ramiflorous, solitary or a few together, 6–25 cm, rather poor and lax, ramified up to the 2nd or 3rd order; primary (essentially secondary!) side-axes up to *c.* 10 cm. *Mature buds* 2.5–3 mm diam. *Inner petals* lanceolate, *c.* 2.5 mm, entire, hooding over the stamens,

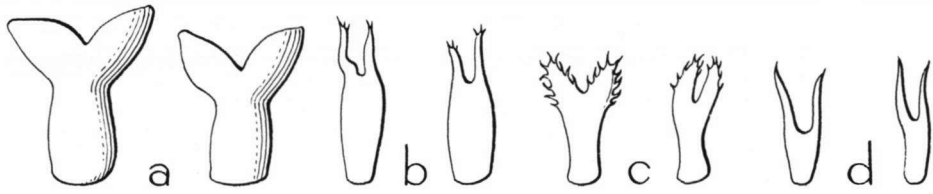

Fig. 8. Various types of inner petals in *Meliosma simplicifolia* WALP. *a. ssp. pungens* (WALP.) BEUS., *b. ssp. rigida* (SIEB. & ZUCC.) BEUS., *c. ssp. fruticosa* (BLUME) BEUS., *d. ssp. simplicifolia*; all ×18.

glabrous. *Endocarp* as in *ssp. lepidota*.

Distr. *Malesia*: Malay Peninsula (Pahang: Fraser's Hill, Cameron Highlands; Perak: Hermitage Hill, once).

Ecol. Primary montane rain-forest, *c.* 1200–1500 m altitude.

Field notes. Bark thick, red. Wood first white when cut, darkening to orange-brown. Leaves glaucous below.

c. *ssp.* **vulcanica** (MERR.) BEUS. Blumea 19 (1971) 460. – *Meliosma vulcanica* MERR. Philip. J. Sc. 11 (1916) Bot. 15; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Machilus nervosa* MERR. Philip. J. Sc. 4 (1909) Bot. 262; Enum. Philip. Fl. Pl. 2 (1923) 189; SALVORE & LAGRIMAS, Philip. J. For. 4 (1941) 309; *cf.* KOSTERM. Reinwardtia 5 (1960) 377; Bibl. Laur. 1 (1964) 919. – *Meliosma bontocensis* MERR. Philip. J. Sc. 20 (1922) 403; Enum. Philip. Fl. Pl. 2 (1923) 517; KOSTERM. Reinwardtia 5 (1960) 377.

Leaves obovate-oblong or oblong, 5–16 by 2–6 cm, base acute, apex acute to acuminate or sometimes rounded, glabrous or subglabrous; nerves 8–11 pairs; petiole 2–4 cm. *Panicles* terminal, sometimes axillary, 3–20 cm, rather profuse to poor, ramified up to the 3rd or 4th order; primary side-axes (mostly essentially primary!) up to *c.* 15 cm, usually subtended by normal to reduced leaves. *Mature buds* 2–2.5 mm diam. *Inner petals* lanceolate, 1–1.5 mm, entire, sometimes frayed at the tip. *Endocarp* subglobose, rather oblique, 6–7 mm diam., apart from a few ribs smooth, median keel distinct, rather prominent, at one end running out into a minute ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Philippines (Luzon, Mindoro).

Ecol. Primary rain-forest, low altitude up to *c.* 2000 m.

Note. *Ssp. vulcanica* is the only subspecies of *M. lepidota* in which normal terminal panicles have been found. In general habit it is more similar to certain forms of *ssp. longipes* from Vietnam than to *ssp. squamulata* (HANCE) BEUS. from Taiwan or to *ssp. kinabaluensis* from Borneo, to which it is obviously less closely related.

d. *ssp.* **kinabaluensis** BEUS. Blumea 19 (1971) 455. – *Meliosma pedicellata* (*non* K. & V.) MERR. & PERRY, J. Arn. Arb. 20 (1939) 356.

Leaves elliptic, rarely oblong, 3–15 by 1.5–9 cm, usually entire, base acute to rounded and somewhat attenuate, cuspidate, above glabrous or ± pubescent on the midrib, subglabrous beneath, usually with a white waxy layer beneath, which gives a glaucous appearance; nerves 8–14 pairs; petiole 1–7.5 cm. *Panicles* terminal or axillary, solitary or a few together, 5–15 cm, rather poor and lax, ramified up to the 2nd (3rd) order; primary (essentially secondary!) side-axes up to *c.* 8 cm. *Mature buds* 2–2.5 mm diam. *Inner petals* halfway or somewhat less bifid, 1–1.2 mm; lobes rather narrow. *Endocarp* ± obovoid, *c.* 8 mm long, *c.* 6 mm diam., with rather wide and feeble reticulum; median keel only slightly elevated, blunt, at one end running out into a minute ventral processus; ventral pore wide, not sunken.

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

Ecol. Montane forest, 1700–2700 m altitude.

Field notes. The lower surface of the leaves is often said to be white to light grey; in herbarium specimens indeed a whitish waxy layer can be observed often. The general colour of the leaves is reported to be glaucous.

Note. *Ssp. kinabaluensis* has a very low degree of variability, a characteristic which is also found in some other subspecies of *M. lepidota*. It is most similar to *ssp. dolichomischa* from the Malay Peninsula and to *ssp. lepidota* from Sumatra, with which it shares, amongst others, the more or less ellipsoid endocarp; all other subspecies have (sub)globose endocarps.

2. Meliosma simplicifolia (ROXB.) WALP. Rep. 1 (1842) 103; HASSK. Cat. Hort. Bog. (1844) 226; MIQ. Fl. Ind. Bat. 1, 2 (1859) 613; Sum. (1861) 203; VAN BEUSEKOM, Blumea 19 (1971) 462, f. 28. – *Millingtonia simplicifolia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254. – **Fig. 8, 10.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971).

Evergreen shrub or tree, up to 20 m. *Leaves* elliptic

or obovate to lanceolate, 3–50 by 1–18 cm, base cuneate, apex acute to acuminate, rarely caudate or rounded, entire to spinously dentate, sometimes with hairy domatia; nerves 7–25 pairs, ± ascending, sometimes looped; petiole 0.5–6(–7) cm, 1/20–1/3 as long as the blade. *Panicles* terminal, very rarely axillary, erect, lax to rather dense, widely to narrowly pyramidal, (4–)10–50(–60) cm, usually profusely branched up to the 2nd–4th order, bearing numerous solitary to crowded or glomerulate flowers which are usually spicately arranged; primary side-axes usually many, up to *c.* 25 cm, often subtended by leaves; bracts ovate to linear-lanceolate, up to *c.* 8 mm. Pedicels sometimes present, up to *c.* 3 mm. *Mature buds* (1–)1.5–3 mm diam. *Sepals* (4) 5, sometimes by addition of empty bracts seemingly more, up to 11(–13), (round-)ovate, equal or usually more or less unequal, the inner ones 0.7–2 mm, the outer one(s) smaller, often minute. *Inner petals* more or less deeply bifid, 0.5–1.5 mm, with glabrous, sometimes fimbriate or ciliolate lobes, never with a central lobule. Filaments 0.5–1.5 mm. *Ovary* 0.5–0.7(–1) mm. *Mature fruit* (sub)globose, 4–10 mm diam.; endocarp globose to subglobose, often depressed or oblique, 3–9 mm diam., with very vague to very strong and prominent reticulum; median keel more or less prominent; ventral pore somewhat sunken to somewhat spouted.

Distr. Continental SE. Asia (from Ceylon to China, Taiwan and S. Japan); in *Malesia*: Sumatra, Malay Peninsula, Borneo, Java, and Lesser Sunda Islands. Fig. 9.

Ecol. Subtropical to tropical forests, under various conditions, usually in mountains up to *c.* 3000 m, but also at sea-level. For details see under the subspecies.

Note. *Meliosma simplicifolia* is a very variable species, covering an enormous area in which it is adapted to many different habitats. It can be divided into eight well-marked subspecies, five of which centre in SW. Yunnan, and diverge over different parts of the area.

KEY TO THE SUBSPECIES

1. Sepals (4–)5.
   2. Panicles branched up to the 2nd (3rd) order, nearly always (very) densely tomentose; primary side-axes rarely subtended by leaves. Leaves sparsely to densely but always distinctly pubescent to tomentose, at least on midrib and nerves; without domatia. Style *c.* 1.5–2 times as long as the ovary ..... **b. *ssp.* rigida**
   2. Panicles branched up to the (2nd) 3rd or 4th order, sparsely pubescent to moderately tomentose; lower primary side-axes often subtended by normal to small or reduced leaves. Leaves glabrous to densely pubescent, rarely tomentose, with or without domatia. Style about as long as the ovary or shorter.
      3. Leaves with or without domatia; midrib on the upper side of the full-grown leaf glabrous or nearly so, more or less prominent, rarely flat. Inner petals with entire lobes, which are sometimes slightly fimbriate or ciliolate at the very tips. Endocarps 3.5–5(–7) mm diam. **a. *ssp.* simplicifolia**
      3. Leaves with or without domatia; midrib on the upper side of the full-grown leaf more or less but distinctly pubescent, ± impressed to flat. Inner petals usually with fimbriate, rarely entire lobes which are rarely minutely ciliolate at the very tips. Endocarps (4.5–)5.5–8 mm diam. **c. *ssp.* fruticosa**
1. Sepals (8–)9–11(–13). Leaves usually with domatia. Endocarps 3.5–5.5 mm diam. **d. *ssp.* pungens**

a. *ssp.* simplicifolia. – *Millingtonia simplicifolia* ROXB. [Hort. Beng. (1814) 3, *nomen*] Pl. Corom. 3 (1820) 50, t. 254; Fl. Ind. 1 (1820) 103; NEES, Flora 8 (1825) 106; GRIFF. Not. Pl. As. (1854) 162; Ic. Pl. As. (1854) t. 442; ANON. Ic. Roxb. 4 (1970) 40, t. 20; VAN BEUSEKOM, Blumea 19 (1971) 476. – *Meliosma simplicifolia* WALP. Rep. 1 (1842) 103; HASSK. Cat. Hort. Bog. (1844) 226; THW. Enum. Pl. Zeyl. (1858) 59; MIQ. Fl. Ind. Bat. 1, 2 (1859) 613; Sum. (1861) 203; Illustr. (1871) 73; BEDD. Fl. Sylv. 3 (1871) 77; BRANDIS, For. Fl. (1874) 116; HOOK.*f.* Fl. Brit. India 2 (1876) 5; KURZ, J. As. Soc. Beng. 45, ii (1876) 204; Fl. Burma 1 (1877) 301; Trim. Fl. Ceyl. 1 (1893) 315; PRAIN, Bengal Pl. 1 (1903) 246; BRANDIS, Indian Trees (1906) 194; MERR. Contr. Arn. Arb. 8 (1934) 95; Brittonia 4 (1941) 110; VIDAL, Not. Syst. 16 (1960) 307. – *Meliosma angulata* BLUME, Rumphia 3 (1849) 197; WALP. Ann. 2 (1852) 224; K. & V. Bijdr. 9 (1903) 131; KOORD. Exk. Fl. Java 2 (1912) 545; Atlas 2 (1914) t. 378; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30; VIDAL, Not. Syst. 16 (1960) 304. – *Sabia densiflora* MIQ. Sum. (1861) 203, 520. – *Sabia floribunda* MIQ. *l.c.* 203, 521; KURZ, J. As. Soc. Beng. 39, ii (1870) 74. – **Fig. 8d.**

Leaves obovate-oblong to -lanceolate, up to *c.* 50 by 18 cm, base cuneate, apex acute to short-cuspidate, beneath often with domatia; nerves 8–23 pairs. *Panicles* rather lax, 10–45 cm, branched up to the 3rd or 4th order; axes sparsely to densely pubescent but never tomentose, the lower primary ones subtended by leaves. *Flowers* more or less crowded to solitary, (sub)sessile; mature buds 1.5–2 mm diam. *Sepals* 5 (4). Inner petals 0.6–0.8 mm, usually over halfway bifid, lobes more or less divergent, narrow, glabrous, sometimes slightly fimbriate or ciliolate at the very tips. *Style* about as long as ovary or shorter.

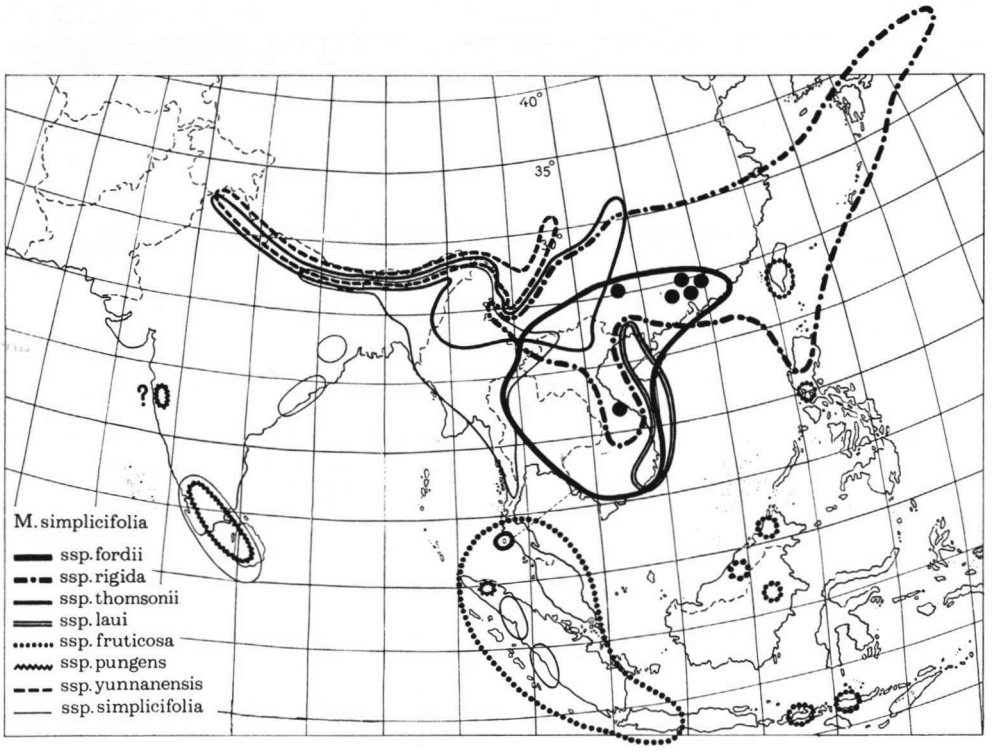

Fig. 9. Generalized areas of the subspecies of *Meliosma simplicifolia* WALP.

Endocarps subglobose, usually rather oblique, nearly triangular at ventral view, 3.5–5(–7) mm diam., with more or less prominent, rather coarse reticulum; median keel usually very prominent, at one end sometimes running out into a minute ventral processus; ventral pore somewhat or not sunken, not spouted.

Distr. Widely distributed in continental SE. Asia; in *Malesia*: northern half of Sumatra, W. Java (not found since BLUME's time). Fig. 9.

Ecol. Primary and secondary evergreen forest, from sea-level up to *c.* 1200(–1500) m altitude. It is often reported to occur along watercourses.

Vern. Sumatra: *medang sungu*, M, *simulingga, sumpa mana belawah*, Karo, *kayu gadis*, West Coast.

Note. A rather uniform, well recognizable subspecies all over its area.

b. *ssp.* rigida (SIEB. & ZUCC.) BEUS. Blumea 19 (1971) 473. – *Meliosma rigida* SIEB. & ZUCC. Abh. K. (Bayer.) Ak. Wiss. M.-Ph. Kl. München 4, 2 (1845) 153; MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 93; Cat. Mus. Bot. 1 (1870) 23, *incl. var. angustifolia* MIQ., *nomen*; MAXIM. Bot. Jahrb. 6 (1884) 60; FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 145, *p.p., excl. M. pungens*; DUNN, J. Linn. Soc. Bot. 38 (1908) 358; HAYATA, Ic. Pl. Formos. 1 (1911) 161; DUNN & TUTCH. Kew Bull. Add. Ser. 10 (1912) 68; CHUN, Sunyatsenia 1 (1933) 180; HAND.-MAZZ. Beih. Bot. Centralbl. 52 (1934) 166; KANEH. Formos. Trees ed. 2 (1936) 416, f. 372; CUFOD. Oest. Bot. Z. 88 (1939) 267, *incl. var. patens*; HARA, Enum. Sperm. Japon. 3 (1954) 121; MAKINO, Ill. Fl. Jap. (1954) 348, f. 1044; WALKER, Imp. Trees Ryukyu Is. (1954) 200, f. 121; How, Acta Phytotax. Sin. 3 (1955) 444; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 47, *in obs.*; LIU, Ill. Lign. Pl. Taiwan 2 (1962) 925, f. 762; LI, Woody Fl. Taiwan (1963) 503; OHWI, Fl. Japan (1965) 613. – *Quercus jama-buwa* SIEB. *in sched. ex* MIQ. Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 93, *nom. inval.* – *Meliosma pungens auct. non* (W. & A.) WALP.: HOOK.*f.* Fl. Brit. India 2 (1876) 4, *p.p., quoad pl. Japon.* – *Meliosma patens* HEMSLEY *ex* FORBES & HEMSLEY, J. Linn. Soc. Bot. 23 (1886) 145. – *Meliosma harmandiana* PIERRE, Fl. For. Cochinch. 5 (1897) t. 360. – *Meliosma glomerulata* REHD. & WILS. in Sarg., Pl. Wils. 2

Fig. 10. *Meliosma simplicifolia* WALP. *ssp. fruticosa* (BLUME) BEUS. *a*. Fruiting twig, ×0.5; *b*. detail of leaf undersurface, ×2.5; *c*. endocarp, in different positions, ×2.5 (*a–c* KADIM & NOOR 395).

(1914) 203. – *Meliosma loheri* MERR. Philip. J. Sc. 10 (1915) Bot. 38; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma pannosa* HAND.-MAZZ. Anz. Ak. Wiss. Wien M.-N. Kl. 58 (1921) 179; HOW, Acta Phytotax. Sin. 3 (1955) 442; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 50, *in obs., p.p.* – *Meliosma costata* CUFOD. Oest. Bot. Z. 88 (1939) 266; HOW, Acta Phytotax. Sin. 3 (1955) 444; GAGNEP. & VIDAL, Fl. Camb. Laos & Vietnam 1 (1960) 45; VIDAL, Not. Syst. 16 (1960) 304. – *Meliosma evrardii* GAGNEP. Not. Syst. 14 (1952) 273, *p.p.*

Leaves usually obovate-oblong to obovate-lanceolate, sometimes oblong to lanceolate, 4–25(–32) by 1.5–8(–11) cm, base long-cuneate to acute, apex acute to cuspidate, without domatia; nerves 7–19 pairs. *Panicles* lax to rather dense, 10–30 cm, branched up to the 2nd (3rd) order; axes more or less tomentose, sometimes woolly-pubescent, the primary ones only exceptionally subtended by small leaves. *Flowers* more or less crowded, usually in dense glomerules, sessile; mature buds 1.7–2.2 mm diam. *Sepals* 5 (4). *Inner petals* 0.6–0.8 mm, usually less than halfway bifid, lobes hardly or not divergent, rather narrow, fimbriate or ciliolate at the tips. *Style* about (1.5–)2 times as long as ovary. *Endocarps* (sub)globose, not or not much oblique, (3.5–)4–5 mm diam., with fine reticulum; median keel blunt to rather sharp, hardly to distinctly prominent, often at one end running out into a minute ventral processus or tubercle; ventral pore not sunken, often somewhat spouted.

Distr. Widely distributed in continental SE. Asia, incl. China, Laos, S. Vietnam (only at Hué), Taiwan (incl. Pescadores), Ryu Kyu Islands, Japan; in *Malesia*: Philippines (Luzon: Mountain Province). Fig. 9.

Ecol. In evergreen broad-leaved or laurophyllous forests, on different soils; in dry as well as in wet places; altitude usually 100–1000 m, but in Luzon reported from 1200–1600 m.

Field notes. Bark grey, smooth. Branches brown. Leaves lustrous green above, sometimes glaucous beneath. Fruit blue-purple to purplish black.

Vern. Philippines: *gahatan*, If., Luzon; *lasuit*, Bondoc dial.

Notes. *Ssp. rigida* is variable in quite some characters in its area outside Luzon, for instance in the degree of pubescence, leaf shape, and dentation. In continental SE. Asia the area of *ssp. rigida* borders on or overlaps the areas of five or six other subspecies of *M. simplicifolia*, which substantially adds to the chance of confusing them, several specimens being hybrids. It is probable that these subspecies are ecologically isolated to a large extent and thus contact between them is prevented.

Quercus gilva var. procera BLUME, Mus. Bot. Lugd.-Bat. 1 (1850) 306, was included in the synonymy of *M. rigida* by HARA, *l.c.*, but I found it to belong to *Quercus gilva* BLUME.

c. *ssp.* **fruticosa** (BLUME) BEUS. Blumea 19 (1971) 477, f. 28. – *Meliosma fruticosa* BLUME, Rumphia 3 (1849) 198; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Illustr. (1871) 73; K. & V. Bijdr. 9 (1903) 133; KOORD. Exk. Fl. Java 2 (1912) 545. – *Meliosma elliptica* HOOK.*f.* Fl. Brit. India 2 (1876) 5, *p.p., excl. Sabia floribunda* MIQ.; KING, J. As. Soc. Beng. 65, ii (1896) 456; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; Fl. Mal. Pen. 1 (1922) 514; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 364. – *Meliosma lancifolia* HOOK.*f.* Fl. Brit. India 2 (1876) 5; KING, J. As. Soc. Beng. 65, ii (1896) 456; RIDLEY, Fl. Mal. Pen. 1 (1922) 514. – *Meliosma monophylla* MERR. Philip. J. Sc. 4 (1909) Bot. 286; Enum. Philip. Fl. Pl. 2 (1923) 517; VIDAL, Not. Syst. 16 (1960) 306. – **Fig. 8c, 10.**

Leaves usually oblong to lanceolate, 5–40(–45) by 2–15 cm, base acute, apex acute to acuminate, densely pubescent on midrib and sometimes on nerves and lamina, beneath glabrous to tomentose, sometimes with domatia; nerves 7–25 pairs. *Panicles* usually lax, sometimes more dense, 10–50 cm, branched up to the 3rd (4th) order; axes pubescent to short-tomentose, the lower primary ones subtended by small leaves or not. *Flowers* more or less crowded to solitary, (sub)sessile; mature buds 1.5–2 mm diam. *Sepals* 5 (4). *Inner petals c.* 0.7 mm, about halfway or somewhat less bifid; lobes divergent or not, usually rather narrow, more or less fimbriate, sometimes entire. *Style* about as long as ovary or shorter. *Endocarps* globose or ± ellipsoid, (4.5–)5.5–8 mm diam., with rather wide, coarse reticulum; median keel prominent, at one end often running out into a minute ventral processus; ventral pore not or not much sunken, not spouted.

Distr. S. Peninsular Thailand (Surat) and Taiwan; in *Malesia*: common in the Malay Peninsula and Sumatra; W. Java, Lesser Sunda Islands (Sumbawa, Flores), Borneo (Central Sarawak, Kinabalu, W. Kutai), and the Philippines (Luzon). Fig. 9.

Ecol. Primary rain-forest, on various soil types, reported to occur on limestone, sand, volcanic loam, and andesite; altitude from sea-level up to 2400 m.

Field notes. Bark smooth, grey to brown, lenticellate, paperthin. Inner bark pale brown to dark brownred. Wood reddish to redbrown. Fruit yellow to pale red when ripening, dark red to brown when ripe.

Vern. (all once noted). Malay Peninsula: *bua palu*, Selangor, *medang kerkulu, mengading*, Malacca; Sumatra: *lelagan*, Gajo lang., Aceh, *kaju djarap, k. gasir, k. si raga*, Asahan, *kaju ardong ardong*, Toba, *kabung kabung*, Tapanuli, *masadih pajo*,

Simalur, *kendung*, Palembang, *redjang*, Djambi; Java: *ki tiwu*, Preanger; Flores: *kaju sar*; Philippines: *malaligas*, Tag.

d. *spp.* **pungens** (WALL. *ex* W. & A.) BEUS. Blumea 19 (1971) 466. – *Millingtonia pungens* WALL. *ex* W. & A. Edinb. New Phil. J. 15 (1833) 178; Prod. 1 (1834) 115; WIGHT, Ic. 3 (1845) t. 964/3. – *Meliosma pungens* (WALL. *ex* W. & A.) WALP. Rep. 1 (1842) 423; Ann. 1 (1848) 135; THW. Enum. Pl. Zeyl. (1858) 59; BEDD. Fl. Sylv. 3 (1871) 77; *ibid.* t. 160; MERR. Contr. Arn. Arb. 8 (1934) 94; VIDAL, Not. Syst. 16 (1960) 306. – *Meliosma wightii* PLANCH. *ex* BRANDIS, For. Fl. (1874) 116; HOOK.*f.* Fl. Brit. India 2 (1876) 4. – **Fig. 8a.**

Leaves elliptic to oblong, sometimes lanceolate, 5–20(–30) by 2–8(–10) cm, without or with some distant teeth, acute to rounded at the base, acute to acuminate at the apex, usually distinctly pubescent on midrib and sometimes on nerves above, sparsely to moderately pubescent beneath especially on midrib and nerves, usually with domatia; nerves 7–18 pairs. *Panicles* lax to dense, (5–)10–55 cm, branched up to the 2nd (3rd) order; axes rather coarse, densely short-tomentose, the lower primary ones almost always subtended by small leaves. *Flowers* crowded in dense glomerules, sessile; mature buds 2–2.5 mm diam. *Sepals* (8–)9–11(–13). *Inner petals c.* 1 mm, slightly bifid; lobes divergent, wide, glabrous. *Style* about as long as ovary. *Endocarps* (sub)globose, often rather irregular, 3.5–5.5 mm diam., with usually lax reticulum; median keel distinct but not very prominent, not running out into a ventral processus; ventral pore hardly or not sunken, not spouted.

Distr. Sri Lanka and Deccan Peninsula; in *Malesia*: N. Sumatra (Gajo Lands, Takengon), one collection. Fig. 9.

Ecol. Mountain forest, 1500–2000 m altitude.

3. Meliosma sumatrana (JACK) WALP. Ann. 1 (1848) 135; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Sum. (1861) 203; Illustr. (1871) 75; HOOK.*f.* Fl. Brit. India 2 (1876) 6; KOORD. Minah. (1898) 408; Suppl. Cel. 2 (1922) 7, t. 56; *ibid.* 2 (1922) 28; MERR. Enum. Born. (1921) 363; Enum. Philip. Fl. Pl. 2 (1923) 518; Contr. Arn. Arb. 8 (1934) 95; MERR. & PERRY, J. Arn. Arb. 20 (1939) 357; VAN BEUSEKOM, Blumea 19 (1971) 485. – *Millingtonia sumatrana* JACK, Mal. Misc. 2 (7) (1822) 30; HOOK. J. Bot. 1 (1834) 378; MERR. J. Arn. Arb. 33 (1952) 236. – *Meliosma nitida* BLUME, Cat. (1823) 32; NEES, Flora 8 (1825) 106; HASSK. Tijd. Nat. Gesch. Phys. 10 (1843) 139; Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 202, t. 169, *incl. var. tridenta* BLUME, *var. cerasiformis* BLUME *et var. splendens* BLUME; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Sum. (1861) 203, 520; Illustr. (1871) 74; KING, J. As. Soc. Beng. 65, ii (1896) 457; K. & V. Bijdr. 9 (1903) 117; KOORD. Exk. Fl. Java 2 (1912) 546, f. 81; Atlas 2 (1914) 377; RIDLEY, Fl. Mal. Pen. 1 (1922) 515; BAKER *f.* in RENDLE, J. Bot. 62 (1924) Suppl. 30; BURK. & HEND. Gard. Bull. Str. Settl. 3 (1925) 364; HEYNE, Nutt. Pl. (1927) 1002; MERR. & PERRY, J. Arn. Arb. 20 (1939) 357; Backer & BAKH.*f.* Fl. Java 2 (1965) 145. – *Irina integerrima* BLUME, Bijdr. (1825) 231, *non* HASSK. Pl. Jav. Rar. (1848) 284 (*'Irine'*); WALP. Rep. 1 (1849) 416; BLUME, Rumphia 3 (1849) 202, *in syn. sub M. nitida.* – *Millingtonia nitida* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103. – *Meliosma confusa* BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Sum. (1861) 203, 520; Illustr. (1871) 74. – *Meliosma cuspidata* BLUME, Rumphia 3 (1849) 202; MIQ. Fl. Ind. Bat. 1, 2 (1859) 617; Illustr. (1871) 74; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; MERR. Enum. Born. (1921) 362. – *Meliosma pinnata* (*non* WALP.) KOORD. Minah. (1898) 408. – *Meliosma diepenhorstii* VALET. Ic. Bog. 2 (1904) 195, t. 150. – *Meliosma elmeri* MERR. Pl. Elm. Born. (1929) 177. – *Meliosma philippinensis* MERR. & PERRY, J. Arn. Arb. 20 (1939) 357.

Evergreen tree, up to 15–20(–25) m. *Leaves* 2–5(–6)-jugate; rachis terete, 6–50 cm, including the up to *c.* 25(–30) cm long petiole, up to *c.* 10(–15) mm across, rarely slightly pubescent, usually with distinctly swollen base; leaflets usually elliptic to lanceolate, (3–)5–35(–50) by (1.5–)2.5–15(–20) cm, base cuneate to rounded, shortly narrowed into the petiole, apex acuminate to caudate, usually entire, beneath rarely more or less pubescent, without domatia; midrib slightly prominent above; nerves (5–)7–13(–19) pairs, ascending, nearly always looped and joined; petiolules very short or up to *c.* 6 cm, usually distinctly swollen at the base especially in older leaves. *Panicles* usually terminal, usually narrowly, sometimes widely pyramidal, 7–50(–75) cm, usually profusely branched up to the 4th order, rather stiff and coarse, puberulous, bearing numerous crowded flowers; primary side-axes usually rather short, up to *c.* 30 cm, the lower ones exceptionally subtended by small to reduced leaves; bracts ovate to narrowly triangular, up to *c.* 6 mm, ± puberulous. *Pedicels* absent or short, up to *c.* 2 mm. *Mature buds* (1.5–)2–3(–3.5) mm diam. *Sepals* 5 or 4, ovate, unequal, the inner 3 or 4 *c.* 1–2 mm, the outer 1 or 2 usually smaller, often minute, sometimes lowered on the pedicel, sometimes puberulous outside, especially the outer ones, with entire or 2- or 3-lobed, often ciliolate margin. *Outer petals* glabrous. *Inner petals* elliptic to lanceolate or strap-shaped with wide-truncate tip, (1.2–)1.5–2(–3) mm, acute to slightly bifid or retuse and frayed at the tip. *Ovary*

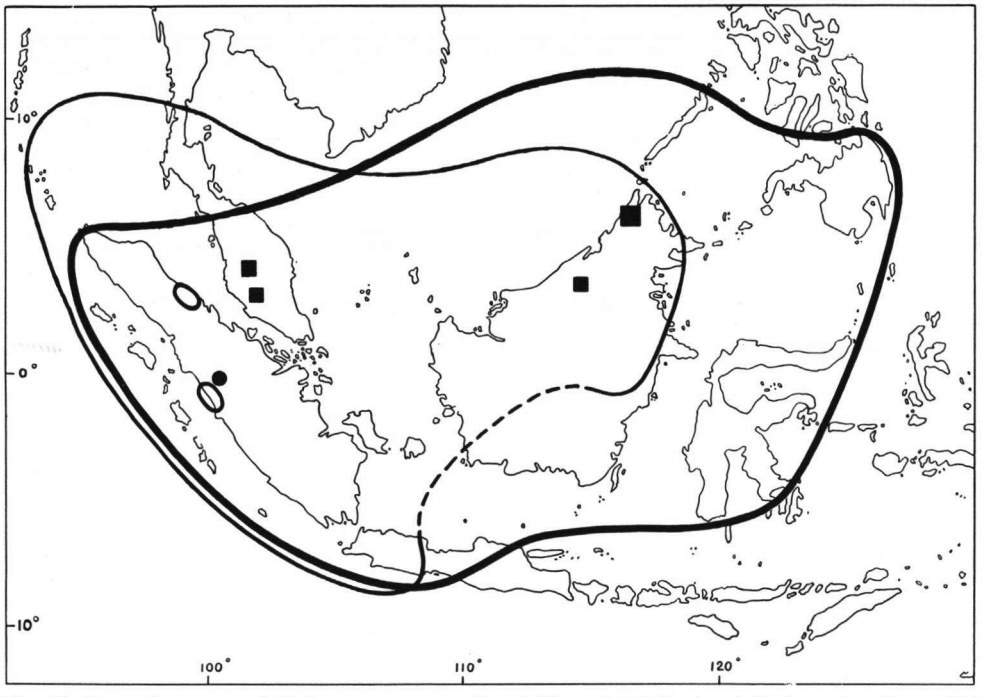

Fig. 11. Generalized areas of *Meliosma sumatrana* (JACK) WALP. (thick line) and *M. lanceolata* BLUME (thin line); the small oval areas indicate the localities of *M. lanceolata var. polyptera* (MIQ.) BEUS. The distribution of *M. hirsuta* BLUME is indicated by a dot, that of *M. rufo-pilosa* HEND. by squares.

0.5–1 mm, glabrous. *Fruit* globose to short-ellipsoid, when ripe 1–3 cm diam., with rather thick spongy to pulpy mesocarp; endocarp ellipsoid, sometimes nearly globose, 0.7–2 cm diam., with almost smooth to somewhat lumpy surface, often with a few faint to sharply prominent ribs; median keel distinct, slightly elevated to sharply prominent, at one end often running out into a more or less prominent curving, at the other end sometimes into a minute tubercle; ventral pore mostly rather wide, usually somewhat sunken.

Distr. *Malesia*: Sumatra (incl. Nias, Batu & Sipora Is., Banka), Malay Peninsula (incl. Penang I.), Anambas Is., W. half of Java, throughout Borneo, Sulawesi, and the Philippines (Mindanao, Palawan). Common. Fig. 11.

Ecol. Primary and secondary lowland and montane rain-forest, up to *c.* 2200 m altitude. Found on various soils, fertile as well as infertile, in dry to wet localities, in dense to open forests, by streams as well as on hilltops and ridges.

Field notes. Often a crooked tree, irregularly branched. Trunk sometimes with small buttresses. Bark surface grey to brown, smooth, with lenticels, often with shallow fissures, sometimes said to be dimpled, patchy or scaly. Inner bark 0.5–1 cm thick, soft, fibrous, light yellow or dirty white, soon turning pink, brownish, reddish, or rusty after exposure. Sapwood said to be whitish, yellowish, creamy orange, or brownish. Sap without special smell or taste. Leaves bright green on both sides. Flower colour varying from white, cream, or greenish, to partly or entirely pinkish to red. Fruit first yellow, then yellow with red to red when ripe; pulp white, turning quickly blood-red on exposure, finally becoming black, sweetish to tasteless.

Uses. The species was proposed by KOORDERS & VALETON, *l.c.*, for reforestation purposes. In Mindanao the triturated bark and leaves are several times reported to be in use as a medicine applied for wounds, to soothe itchy skin or – charred and put in water – against tympanites. It was also said to be used in agricultural rituals. The fruits are many times reported to be edible.

Vern. Malay Peninsula: *pa-ang*, Saki name, and *mengading besar*, both from Pahang, *buah mata ikan*, Temuan, Selangor, *pokoh haran*, Negri Sembilan, *kaju kahwa kantu, membuloh, pokoh graô*

jantan, p. mata gajah, p. pai gigi, p. pinang plandog, p. ravoa antoo, pudding utan, Malacca, *pelantu*; Sumatra: *laon, si paturut, sringkut*, Karo country; *kaju durung durung, k. ining ining*, Tapianuli, *tampa bussie*, Priaman, *marazat*, Mt Kerinci; Java: *ki tiwu (landuk) (bodas)*, S, *ki huut*, Udjong Kulon; Borneo, Sarawak: *bulitiap*, Kenyah dial., *malak*, Kayan dial., *bulu manuk*, Iban, *bitonok*, Dyak; Sabah: *bung lai*, Sungai, *gapas gapas, kapas kapas, keriyan*, Dusun, *illulal, limpangot, tunjang*, Murut; SE. Borneo: *tambalilin, tandao*, Dyak, Tidung dial.; *djangkanggunung*, Bandjar lang., Riom dial.; Sulawesi: see KOORD. Minah. (1898) 408; *enggolokia*, W. Toradja dial., *putu putu, situi*, Tobela lang., Malili, *pobumengo*, Gorontalo; *dama*, Torai dial., Menado; Philippines: *carabo-rabo, daborabo, kadabudabo, karabu-rabu, magobaylung, mahagkol, yagabogan*, Mbo, Buk., *bentinguasay, gepulu*, Zamboanga, *waat*, Cebuano, Mt Apo, *salalab*, Moro dial., *garong, gimbingimbing*, Sub., *sumagasa*, Bag.

Notes. *Meliosma sumatrana* is very constant in its discriminative characters (especially the prominent midrib and entire inner petals), but there is nevertheless some geographical variation, especially in the northern part of Borneo (Sarawak, Sabah). As general tendencies may be noticed that towards the centre of the area leaflets and fruits increase in size and dentate leaflets become more common. Moreover, the number of leaflet pairs decreases when the leaflets are larger.

Sterile hybrids between *M. sumatrana* and *M. pinnata ssp. ridleyi* are rarely found (Sabah).

DOCTERS VAN LEEUWEN (Zoocecidia Neth. East Indies, 1926, 339, f. 612) described a leaf-gall on a specimen from Sulawesi. This type of galls (usually ball-shaped, *c.* 4 mm, ending in a short mucro, and surrounded by a calyx-like circumvallation) is rather commonly met with in this species, not only in specimens from Sulawesi, but also from Borneo, Sumatra, and the Malay Peninsula. The galls do not only occur on the lower surface of the leaflets, but occur also on the upper surface, and on rachis and petiolules, often very many crowded together.

4. Meliosma lanceolata BLUME, Cat. (1823) 32; NEES, Flora 8 (1825) 106; HASSK. Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 200, t. 168, *p.p., incl. var. pendula* BLUME, *var. membranacea* BLUME, *var. chartacea* BLUME *et var. obliqua* BLUME; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Sum. (1861) 203, 520; Illustr. (1871) 74, *p.p.*; HOOK.*f.* Fl. Brit. India 2 (1876) 7; KING, J. As. Soc. Beng. 65, ii (1896) 458; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; K. & V. Bijdr. 9 (1903) 125; HALL.*f.* Med. Rijksherb. 1 (1910) 2, *in obs.*; KOORD. Exk. Fl. Java 2 (1912) 546; MERR. Enum. Born. (1921) 363; RIDLEY, Fl. Mal. Pen. 1 (1922) 516, f. 51; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30; CRAIB, Fl. Siam. Enum. 1 (1926) 340; RIDLEY, Kew Bull. (1926) 63; MERR. Pl. Elm. Born. (1929) 176; HOCHR. Candollea 6 (1936) 467, *incl. var. genuina* HOCHR.; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145; VAN BEUSEKOM, Blumea 19 (1971) 489. – *Millingtonia lanceolata* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103. – *Meliosma polyptera* MIQ. Sum. (1861) 203, 520; Illustr. (1871) 73. – *Meliosma levis* KING, J. As. Soc. Beng. 65, ii (1896) 457; RIDLEY, Fl. Mal. Pen. 1 (1922) 515. – *Meliosma nervosa* K. & V. Bijdr. 9 (1903) 129; KOORD. Exk. Fl. Java 2 (1912) 546; Atlas 2 (1914) t. 376; Fl. Tjibodas 2 (1923) 158; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359, *in obs.*; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145.

Evergreen tree, up to *c.* 25(–30) m. *Twigs* often with conspicuous leaf-scars. *Leaves* (3–)7–18(–25)-jugate; rachis terete, (10–)30–100 cm, including the 5–30 cm long petiole, up to *c.* 8 mm diam., usually with distinctly swollen base, usually ± lenticellate; leaflets usually oblong to lanceolate, hardly or not asymmetrical, 5–20 by 2–7 cm, not or only slightly increasing in size towards the top of the leaf, often the lowermost pairs much smaller, base usually acute to rounded, apex acuminate to cuspidate, glabrous to moderately pubescent, always without domatia; midrib usually deeply impressed above; nerves 5–16 pairs, ascending, looped. *Panicles* terminal, nearly always pendulous and lax, rarely erect (then also small), pyramidal, usually large, (15–)50–150 cm and profusely branched up to the 3rd order, ± pubescent, bearing numerous glomerulate or crowded flowers which are usually spicately arranged, the glomerules often with regular space; main axis terete, often bent down abruptly at the base; primary side-axes many, usually long, up to *c.* 90 cm, never subtended by leaves; bracts ovate to narrowly triangular, up to *c.* 5 mm, ± pubescent. *Pedicels* absent, up to *c.* 1 mm. *Mature buds* 1.5–2 mm diam. *Sepals* 5 (4), ovate, more or less unequal, the inner 3 or 4 *c.* 1 mm, the outer 2 or 1 usually much smaller, often minute and sometimes slightly keeled, sometimes somewhat lowered on the pedicel, all glabrous, and with an entire margin. *Outer petals* 1.5–2 mm. *Inner petals* about halfway bifid, *c.* 0.6 mm, with ciliolate, rarely glabrous lobes, usually with a minute central lobule. *Filaments c.* 1 mm. *Ovary* (0.5–)0.7(–1) mm, usually densely, sometimes sparsely pubescent, rarely glabrous. *Fruit* (sub)globose, when ripe 7–10 mm diam.; endocarp subglobose, often somewhat depressed to applanate at the ventral side, usually strongly oblique, (5–)6–9 mm diam., with usually distinct, rather coarse, mostly sharply prominent reticulum; median keel sharp

and prominent, at one end often running out into a small to minute ventral processus or tubercle; ventral pore not or not much sunken.

Distr. Nicobar Is., extreme South of Peninsular Thailand; in *Malesia*: Sumatra (incl. Simalur, Batu, and Banka Is.), W. Java, Borneo (northern half). Not uncommon, scarce in Borneo. Fig. 11.

Ecol. Primary and often secondary forests, at low and medium altitudes, occasionally ascending to 1500 m, *f. nervosa* to 2900 m, on various soil types.

Field notes. Outer bark grey to brown, rather smooth, later with longitudinal cracks, thin, often lenticellate. Inner bark 0.5–1 cm, several times said to be (light) red, orange brown, or redbrown, also dirty white and then turning rusty after exposure. Wood soft, white or pale yellow to light yellow brown. Crown low, irregular and lax, with few usually crooked branches. The conspicuous large leaves are rather crowded at the end of the twigs. Leaflets when young red-brownish. *Flowers* white or yellowish to pink or red (sometimes different colours in the same panicle). *Fruits* first dirty red, then bluish black when ripe.

Vern. Malay Peninsula: *medang siri*, Malacca; Sumatra: *kabung kabung (blumut)*, Batak lang., Simelungun dial., *bulung manuk*, Batak lang., Karo dial., *sondang, sontang*, Timor on N. Sumatra, *kaju buluk hudjan*, Lampong, *angké foluh pajo, silaora, surin sito bulung, tutun surin or seulang (pajo), t. tungké ali*, Simalur I.; W. Java: *ki tiwu*, S, often used as well for *M. pinnata* and *M. sumatrana* (also with the addition *lalaki, mindi bodas* or *persawon*), *surén leuweung*, S. See also under *var. lanceolata f. nervosa* and *var. polyptera*.

Notes. *Meliosma lanceolata* is generally very well characterized by its large pendulous panicles and its long leaves with many usually lanceolate leaflets. Nevertheless it shows a wide variation especially in number but also in shape and size of the leaflets and the panicles. On the islands west of Sumatra (Simalur, Nias, Batu) specimens are found with normal inflorescences but only 3–5-pinnate leaves, and elliptic, sometimes subrotund, large leaflets. Transitions to this extreme are common. There is another deviating form, however, which takes a separate position. It has many small, mostly lanceolate leaflets which otherwise do not differ from those of *M. lanceolata*. Also the panicles agree with that species. In view of the wide variability in the leaves of *M. lanceolata*, I prefer to include it here and I have reduced it to a variety. The varieties and forms can be distinguished as follows:

a. *var.* lanceolata.

Leaves (3–)6–18-jugate, with up to *c.* 100 cm long rachis (including the petiole); leaflets elliptic to lanceolate, medium-sized to large, 5–20(–25) by (2–)2.5–7(–10) cm, index (1.5–)2–5(–6), without or with teeth, glabrous or pubescent.

Notes. In the lowland parts of its area *var. lanceolata* is nearly always very constant in the main characters. Mainly at higher elevations, however, forms occur which deviate considerably, often to such an extent that it is very difficult to separate them from less typical forms of the otherwise well distinct *M. pinnata ssp. ferruginea* and *ssp. ridleyi*; in a few cases, especially when the material is incomplete, this can only be done by a specialist who is thoroughly acquainted with habitus and variability of both species.

For instance, a form with erect, unusually short panicles (sometimes only 15 cm long) and other deviating characters may be met with. It occurs mainly in the montane zone; transitional forms are found lower, and these show a more or less gradual fading of typical *lanceolata* characters. Specimens of this mountain form have been described from Java by KOORDERS & VALETON, *l.c.*, as *M. nervosa*. In my opinion this species should be reduced to the rank of a form only; see below.

forma **lanceolata.**

Leaves (3–)6–18-jugate, with elliptic to lanceolate, glabrous to pubescent leaflets. Panicles pendulous, usually much longer than 50 cm. Inner petals ciliolate. Ovary pubescent.

forma **nervosa** (K. & V.) BEUS. Blumea 19 (1971) 493. – *M. nervosa* K. & V., *vide supra*.

Leaves not more than 8(–10)-jugate, with usually elliptic glabrous leaflets. Panicles erect, shorter than *c.* 50 cm, minimum length *c.* 15 cm. Inner petal mostly glabrous. Ovary pubescent to glabrous.

Distr. *Malesia*: Sumatra (G. Leuser, G. Talakmau), W. Java.

Ecol. Mountain forest, 1300–2900 m altitude. The tree can reach a height of 30 m by 1 m diam.

Vern. Java: *ki tjermèh badak, ki tjermèh beureum*, S.

b. *var.* polyptera (MIQ.) BEUS. Blumea 19 (1971) 492. – *M. polyptera* MIQ., *vide supra*.

Leaves 12–25-jugate, with at most 50 cm long rachis (including the petiole); leaflets oblong to linear-lanceolate, small, 4–11 by 1–2 cm, entire, glabrous.

Distr. *Malesia*: Sumatra (Asahan, W. Coast). Fig. 11.

Ecol. At low altitudes.

Vern. Sumatra: *badar badar*, Lubuk Alung, *tandikat batu*, Priaman, *simarpapàhu*, Huta Padang.

5. Meliosma hirsuta BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Sum. (1961) 203; Illustr. (1871) 74;


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MERR. Enum. Born. (1921) 363; VAN BEUSEKOM, Blumea 19 (1971) 493.

Evergreen small tree, *c.* 5 m. *Leaves* 15–20-(or probably more-)jugate; rachis 50–100 cm including the 10–20 cm long petiole, up to *c.* 6 mm across, more or less hirsute, usually with distinctly swollen base, sometimes sparsely lenticellate; leaflets (sub) sessile, those in medium and upper part of the leaf linear-lanceolate, 10–20(–25) by (1.5–)2–3 cm, index 5–10, the lower ones (ovate-)lanceolate to ovate, gradually decreasing in length towards the base of the leaf, up to only *c.* 3 cm, base rounded to acute, sometimes slightly oblique, apex acuminate to caudate, with entire to remotely spinously dentate margin, thin-chartaceous, above glabrous except for some pubescence on the midrib, beneath moderately to sparsely hirsute especially on midrib and nerves, without domatia; midrib above flat to slightly impressed; nerves widely apart, (5–)8–12 pairs, ascending, looped and joined into a distinct marginal nerve situated at 2–4 mm from the margin; venation distinct, wide, reticulate; petioles absent or up to *c.* 1 mm, terminal one often longer, up to *c.* 8 mm, densely hirsute, not swollen at the base. *Panicles* and *flowers* as in typical *M. lanceolata*, but sepals up to *c.* 1.5 mm. *Fruit* as in *M. lanceolata*.

Distr. *Malesia*: Sumatra (West Coast: G. Malintang), only one collection. Fig. 11.

Notes. This species was by BLUME erroneously recorded to occur in S. Borneo.

Meliosma hirsuta is doubtless very closely related to *M. lanceolata*, but very well distinct by its leaf characters.

See also *Pimela angustifolia* under the dubious species.

6. Meliosma pinnata (ROXB.) MAXIM. Bull. Ac. Imp. Sc. St. Pétersb. 12 (1867) 64; Mélanges 6: 263. – *Millingtonia pinnata* ROXB. Fl. Ind. 1 (1820) 103. – **Fig. 12.**

For further synonyms, see under the subspecies; for a complete synonymy, see VAN BEUSEKOM (1971: 494).

Evergreen, sometimes deciduous tree, small to up to *c.* 42 m. *Twigs* often with conspicuous leaf-scars. *Leaves* 2–11-jugate; rachis terete, (2–)5–40(–60) cm, including the up to *c.* 15(–25) cm long petiole; leaflets usually ovate, elliptic, or obovate to ovate-oblong, sometimes lanceolate, often asymmetric, 1.5–25 by 1–10 cm, usually increasing in size towards the top of the leaf, base usually acute to rounded, rarely slightly emarginate, apex acuminate to cuspidate, entire or dentate, usually slightly to densely pubescent, often with domatia; midrib flat to impressed above; nerves 3–15 pairs, ascending, looped; petiolules up to 5 cm, terminal one usually longest, not or not much swollen at the base. *Panicles* terminal, erect, sometimes somewhat pendulous, dense to lax, widely to narrowly pyramidal, 10–55(–70) cm, usually profusely branched up to the 4th order, bearing numerous solitary to usually crowded flowers; primary side-axes usually many, up to 35(–60) cm, lower ones sometimes subtended by small to reduced leaves; bracts ovate to narrowly triangular, up to *c.* 5(–10) mm, more or less pubescent. *Pedicels* absent or up to 3(–4) mm. *Mature buds* (1.5–)2(–3) mm diam. *Sepals* 5 or 4, ovate, unequal, the 3 or 4 inner ones 1–1.5 mm, the outer 1 or 2 usually smaller, often minute, sometimes lowered on the pedicel, sometimes slightly keeled, glabrous or pubescent outside, all entire, usually ciliolate. *Outer petals* usually glabrous. *Inner petals* more or less deeply bifid, (0.3–)0.6(–1) mm, glabrous, ciliolate or fimbriate at the tips, often with a minute central lobule, often frayed at the tips. *Filaments c.* 1 mm. *Fruit* (sub)globose to obovoid, when ripe (3–)4–10(–11) mm diam., with thin mesocarp; endocarp (sub)globose, oblique or not, (2.5–)3.5–9(–10) mm diam., with more or less prominently reticulate surface; median keel usually distinct and more or less prominent, at one end sometimes running out into a small to minute processus or tubercle, and sometimes curving outwards at the other end; ventral pore usually rather narrow, whether or not sunken.

Distr. Throughout SE. Asia, from Sri Lanka and China to Japan; throughout *Malesia* as far as New Guinea (incl. New Britain). Fig. 13.

Ecol. Forests under moist tropical to subtropical, sometimes warm-temperate conditions, on various soils, from sea-level up to *c.* 3000 m altitude.

Notes. *Meliosma pinnata* covers a very large area in which it has developed a complex and wide variation pattern. It can be divided up into nine well-marked subspecies. Four of these are widely distributed, whereas five have a limited distribution. The first group, the subspecies *arnottiana, ridleyi, macrophylla* and *ferruginea*, are considered primary

Fig. 12. *Meliosma pinnata* (ROXB.) WALP. *ssp. macrophylla* (MERR.) BEUS. *a.* Flowering twig, ×0.33; *b.* half-opened flower, ×5; *c.* outer petal with adhering staminode; *d.* flower with outer petals removed and stamens snapped backward; *e–g.* stamen with adhering inner petal, in different positions; *h.* pistil with surrounding disk; *i.* ovary, length section, all ×10; *j.* ripe fruit, ×3; *k–l.* endocarp in different positions, ×3 (*a–i* SULIT PNH 32941, *j–l* KOSTERMANS 6911).

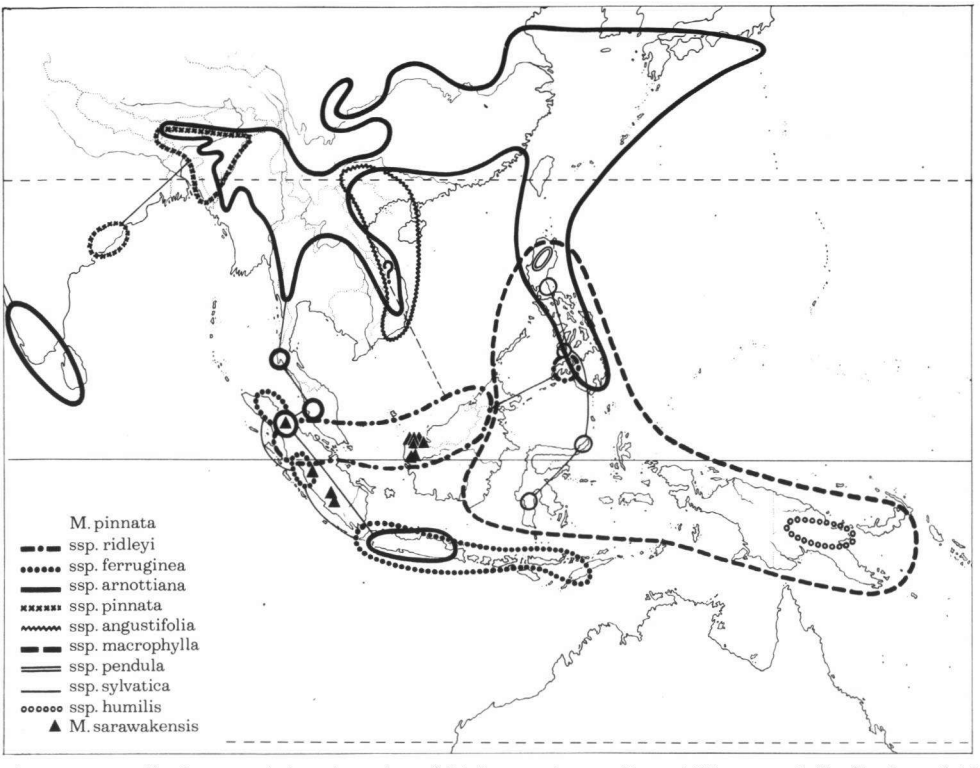

Fig. 13. Generalized areas of the subspecies of *Meliosma pinnata* (ROXB.) WALP., and distribution of *M. sarawakensis* RIDLEY.

subspecies; they centre in W. Malesia. The subspecies of the second group occur scattered at the periphery of the area of *M. pinnata*; I consider them secondary offsplits from the primary subspecies, *viz. ssp. pinnata* and *ssp. angustifolia* (MERR.) BEUS. from *ssp. arnottiana*, and *ssp. pendula, ssp. sylvatica*, and *ssp. humilis* from *ssp. macrophylla*.

The areas of the secondary subspecies fall partly or entirely within the area of the primary subspecies from which they are derived, but they are ecologically isolated from these, usually by preference for different altitudinal zones; transitional or hybrid forms are sometimes found. The areas of the four primary subspecies, on the other hand, all touch or only slightly overlap mutually, but generally they are perfectly replacing, and usually there is also different ecological preference. Due to the scarcity of collections from critical regions, especially Sumatra, Borneo and Sulawesi, it is mostly not clear how the relation is in contact zones. There is some evidence that one or two mutually may behave as good species, where one or two others may be connected by transitional forms, but in general the evidence required is still wanting. In this respect the picture is not so complete as it is in *M. simplicifolia*.

The type subspecies does not occur in Malesia.

KEY TO THE SUBSPECIES

1. Ovary glabrous or only with a few hairs. Sepals and petals always glabrous.
   2. Leaves 3–5-jugate; leaflets dentate (sometimes only a few teeth), with domatia in the axils of the nerves beneath which are sometimes obscured by very dense tomentum of the leaf-blade
      g. *ssp.* humilis
   2. Leaves (3–)4–6(–7)-jugate; leaflets dentate or not, without domatia, never with very dense tomentum.
      3. Leaflets entire, index (1–)1.5–3, mostly rounded or obtuse to truncate or emarginate at the base. Medium-sized to large trees
         d. *ssp.* macrophylla
      3. Leaflets dentate (sometimes very sparsely), index (1–)1.5–4(–5), acute or rounded, obtuse, truncate or emarginate at the base. Small to medium-sized trees, rarely shrubs.

4. Leaflets moderately to rather densely villous-pubescent (often more or less glabrescent when older), mostly (especially lower ones) rounded to truncate at the base, index 1.5–3(–4). Endocarps 6–7 mm diam., without ventral processus. Above *c.* 1800 m alt. **e.** *ssp.* **pendula**
4. Leaflets sparsely to densely short-pubescent, rarely subglabrous, mostly with acute base, index 1.5–4(–5). Endocarps 5–7.5 mm diam., mostly with a small but distinct ventral processus. Below *c.* 1000 m altitude.
5. Leaves (3–)4–6(–7)-jugate; leaflets acute at the base ..... **f.** *ssp.* **sylvatica**
5. Leaves 3–5(–6)-jugate; lateral leaflets rounded to truncate at the base **d.** *ssp.* **macrophylla** (Celebes form)

1. Ovary entirely, rarely partly, but always densely pubescent. Sepals and petals glabrous or pubescent.
6. Sepals and usually also outer petals moderately to densely pubescent on the outside. Leaflets entire, index (1–)1.5–3 ..... **c.** *ssp.* **ferruginea**
6. Sepals and petals glabrous or rarely a few hairs on the outer sepals only. Leaflets entire or dentate, index (1–)1.5–4(–5).
7. Endocarps 4.5–9(–10) mm diam., usually with more or less sunken ventral pore. Inner petals with fimbriate or ciliolate, rarely glabrous lobes. Leaflets never with domatia **b.** *ssp.* **ridleyi**
7. Endocarps (2.5–)3–4.5 mm diam., not with sunken ventral pore. Inner petals with usually glabrous, sometimes at the tips ciliolate or frayed lobes. Leaflets with or without domatia **a.** *ssp.* **arnottiana**

a. *ssp.* **arnottiana** (WIGHT) BEUS. Blumea 19 (1971) 499. – *Sapindus ? microcarpus* W. & A. Prod. 1 (1834) 112, *nom. illeg.*, *non* R. & P. (1804); WIGHT, Ill. Ind. Bot. 1 (1840) 142; WALP. Rep. 1 (1842) 416, 423. – *Millingtonia arnottiana* WIGHT, Ill. Ind. Bot. 1 (1840) 144, t. 53. – *Wellingtonia arnottiana* MEISN. Pl. Vasc. Gen. (Comm.) 2 (1840) 207, *in nota.* – *Millingtonia sambucina* JUNGH. Tijd. Nat. Gesch. Phys. 8 (1841) 365. – *Meliosma arnottiana* WALP. Rep. 1 (1842) 423; THW. Enum. Pl. Zeyl. (1858) 59; BEDD. Fl. Sylv. 3 (1871) 77; *ibid.* t. 160; HOOK.*f.* Fl. Brit. India 2 (1876) 6; TRIM. Fl. Ceyl. 1 (1893) 315; BRANDIS, Indian Trees (1906) 195; GAMBLE, Fl. Pres. Madras 1 (1918) 256. – *Meliosma glauca* BLUME, Rumphia 3 (1849) 200, t. 168B, *nom. illeg.*; WALP. Ann. 2 (1852) 225; HASSK. Hort. Bog. 1 (1858) 140; MIQ. Fl. Ind. Bat. 1, 2 (1859) 615; K. & V. Bijdr. 9 (1903) 135, *incl. var. floribunda* (BLUME) K. & V.; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; KOORD. Exk. Fl. Java 2 (1912) 546; Fl. Tjibodas 2 (1923) 157; BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30. – *Meliosma floribunda* BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 615; Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 137; HALL.*f.* Meded. Rijksherb. 1 (1910) 2; KOORD. Exk. Fl. Java 2 (1912) 546. – *Meliosma sambucina* MIQ. Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 137, *in obs.* – *Meliosma luzonensis* MERR. Publ. Govt. Lab. Philip. 29 (1905) 24; ELMER, Leafl. Philip. Bot. 2 (1908) 492, *in obs. ('luzonica')*; MERR. Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma multiflora* MERR. Publ. Govt. Lab. Philip. 29 (1905) 25; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Melliosma ferruginea* (*non* BLUME) KOORD. Gedenkb. Jungh. (1910) 177. – *Meliosma apoensis* ELMER, Leafl. Philip. Bot. 10 (1939) 3784, *descr. angl.* – *Meliosma cannarioides* ELMER, Leafl. Philip. Bot. 10 (1939) 3785, *descr. angl.* – *Meliosma ferruginea* (*non* BLUME) BACKER & BAKH.*f.* Fl. Java 2 (1965) 145, *p.p., quoad M. glauca et floribunda.*

Small to medium-sized, rarely big tree, up to *c.* 20(–30) m. *Leaves* (2–)3–7(–8)-jugate; leaflets ovate to ovate-oblong, elliptic, or lanceolate, small to up to *c.* 25 by 10 cm, index (1–)1.5–4(–5), acute to truncate at base, entire or dentate, chartaceous to coriaceous, often with domatia. *Panicles* erect, spreading, lax to dense, lower primary side-axes usually subtended by small or reduced leaves. *Sepals* glabrous or the outer ones rarely with a few hairs. *Petals* glabrous, inner ones sometimes a bit ciliolate or frayed at the tips of the lobes. *Ovary* densely pubescent, very rarely subglabrous. *Endocarps* (sub) globose, not or not much depressed, hardly or not oblique, (2.5–)3–4.5 mm diam., with distinct, more or less prominent, fine reticulum, with slightly to rather strongly prominent, blunt to rather sharp median keel which does not run out into a ventral processus or tubercle; ventral pore not sunken, sometimes a bit elevated.

Distr. Sri Lanka throughout SE. Asia to China, S. Korea, Japan and Taiwan; in *Malesia*: N. Sumatra (Karo), Malay Peninsula, W. & Central Java, Philippines (Batan Is., Luzon, Mindanao). Rare in W. Malesia. Fig. 13.

Ecol. Primary or secondary montane rain-forest, 600–2500 m altitude, on loamy or volcanic soils, also on limestone if the climate is wet enough. At higher altitudes the subspecies is deciduous. In Malesia buttresses are sometimes developed, up to 1.5 m high.

Field notes. Bark dark to light grey, smooth, in old trees sometimes distantly shallowly fissured. Inner bark soft, fibrous, with 'fingers' tapering outwards into granular tissue, pale pinkish brown to dull red or redbrown, also said to be white, and turning salmon red on exposure. Wood light and soft, fibrous, easily split, white, with large pores and beautiful grain, with prominent rays, heartwood in older trees striped reddish and white. Leaflets be-

neath pale green, often glaucous. *Fruits* said to be reddish, green brown, or black when ripe.

Vern. Sumatra: *kabung sillang bulung*, Batak lang.; Java: *dangdur bulu, kawayang, ki surn, ki tiwu lalaki*, S; Philippines: *adope, adupong, aropong, bantinan, kamug*, Ig., *bae*, If.

Notes. Attention should be given to the relation between *ssp. arnottiana* and *ssp. pendula* in the Philippines (for the relation to *ssp. macrophylla*, see under that subspecies). In the mountains of Luzon both subspecies have been collected, *ssp. pendula* above 1800 m altitude and *ssp. arnottiana* from *c.* 800–900 m up to *c.* 2400 m. Locally, *e.g.* on Mt Santo Thomas, they have been found together, but doubtless intermediate specimens are not observed. It is possible that in such localities these subspecies mutually behave as species; population studies in the field might yield more evidence with regard to this.

The same problem arises in W. Malesia, where *ssp. arnottiana* has been collected (rarely). In Sumatra and in Java its relation to *ssp. ferruginea* is interesting since there is an altitudinal zone of overlap between both, though *ssp. ferruginea* generally occurs lower than *ssp. arnottiana*. In Java the situation is as follows: *ssp. ferruginea* is by far the most common of both, *ssp. arnottiana* having only been collected on a few mountains. Of these it is only G. Salak and G. Gedeh where both subspecies have been found. Only of G. Gedeh more detailed ecological evidence is available: KOORDERS (Fl. Tjibodas 2, 1923, 157) stated that *ssp. ferruginea* occurs at *c.* 1400 m altitude and that *ssp. arnottiana* (*'M. glauca'*) occupies a zone between 1800 and 2400 m, being especially abundant at *c.* 2200 m. This does suggest the existence of ecological differentiation, but since *ssp. arnottiana* on other mountains also grows at lower altitudes, the situation remains unclear.

b. *spp.* ridleyi (KING) BEUS. Blumea 19 (1971) 505. – *Meliosma ridleyi* KING, J. As. Soc. Beng. 65, ii (1896) 458; RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 33 (1900) 67; Fl. Mal. Pen. 1 (1922) 516. – *Meliosma elegans* RIDLEY, J. Str. Br. Roy. As. Soc. *n.* 54 (1910) 40; Fl. Mal. Pen. 1 (1922) 515. – *Meliosma paucinervia* MERR. Philip. J. Sc. 10 (1915) Bot. 39; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma trichocarpa* MERR. Pap. Mich. Ac. Sc. 24 (1938) 80, *nom. illeg., non* HAND.-MAZZ. (1934). – *Meliosma bartlettii* MERR. & PERRY, J. Arn. Arb. 20 (1939) 356. – *Meliosma confertiflora* MERR. & PERRY, *l.c.* 359.

Shrub or tree, up to *c.* 20 m. *Leaves* 3–7-jugate; leaflets oblong to lanceolate, small to usually medium-sized, up to *c.* 20 by 6 cm, base acute, rarely rounded, usually entire, densely villous to glabrous, without domatia. *Panicles* erect, usually rather lax and slender; lower primary side-axes mostly subtended by small leaves. *Sepals* and *outer petals* glabrous. *Inner petals* with fimbriate or ciliolate tips, rarely glabrous. *Ovary* densely pubescent. *Endocarps* subglobose to very depressed and oblique, 4.5–9 (–10) mm diam., with vague to distinct, more or less prominent, rather wide reticulum, with slightly to strongly prominent, blunt to very sharp median keel which often at one end runs out into a minute ventral processus, the curving at the other end sometimes far drawn out into a blunt beak; ventral pore hardly to rather deeply sunken.

Distr. *Malesia*: Central Sumatra, Malay Peninsula, Borneo (Sarawak, Sabah, W. Kutai), Philippines (Mindoro). Fig. 13.

Ecol. Primary and secondary rain-forest, both in mixed dipterocarp and in heath forest, on various soil types, from sea-level up to 1400 m altitude.

Field notes. Bark mostly smooth, sometimes somewhat scaly or slightly fissured, grey to brown. Inner bark fibrous, pinkish to red or redbrown, turning brown after exposure. Young branches, inflorescence-axes, and leaf-rachises are sometimes (Singapore) covered with a dense layer of soft dark reddish brown hairs. Sepals sometimes said to be purple. *Fruit* often ± hairy (*'trichocarpa'*), once said to be bright purple.

Vern. Sumatra: *kaju rokkam, k. rube gala, k. si hasur, k. si (mardjuhut) (ni) manuk*, Asahan, *modang halimponan*, Tapanuli.

Notes. *Ssp. ridleyi* is rather variable when compared to the other subspecies of *M. pinnata*, especially in number and dentation of leaflets, in the degree of pubescence, and in shape and size of the endocarps. In the Malay Peninsula, for instance, a form with few subglabrous and somewhat dentate leaflets has been found (*'M. elegans'*), as well as a beautiful, densely rufous-pubescent form with distinctly more and entire leaflets (*'M. ridleyi'*). It is not astonishing that such different plants have been described as separate species; only by studying material from Borneo it becomes clear that these extremes are connected by a range of transitions. Another form from Dallas (Kinabalu), which has rather condensed panicles, has been described as *M. confertiflora*. This again is merely a local form without any systematical significance, as is *M. paucinervia*, with very lax panicles, from Mindanao. Yet, in spite of this variation, it is obvious that *ssp. ridleyi* is a natural unit, probably most closely related to the adjacent *ssp. arnottiana* from which it differs least of all subspecies, mainly in shape and size of the endocarps, but also in some less important characters; an especially close resemblance has been observed between *ssp. ridleyi* and some deviating specimens from South Vietnam which have been tentatively included in *ssp. arnottiana*. Furthermore, the area of *ssp. ridleyi* borders on or somewhat overlaps the areas of *ssp. ferruginea* and *macrophylla*. The rela-

tion between *ssp. ridleyi* and these subspecies has been discussed under *ssp. macrophylla.*

Finally, it should be noted that the area of *ssp. ridleyi* fully overlaps that of *M. sarawakensis*; this is not accidental, since the latter probably is a derivative of *ssp. ridleyi* (see the note under *M. sarawakensis*).

c. *ssp.* ferruginea (BLUME) BEUS. Blumea 19 (1971) 507. – *Meliosma ferruginea* BLUME, Cat. (1823) 32, *non* SIEB. & ZUCC. *ex* HOOK.*f.* (1876), *nec* KURZ *ex* KING (1896); NEES, Flora 8 (1825) 106; HASSK. Cat. Hort. Bog. (1844) 226; BLUME, Rumphia 3 (1849) 200; WALP. Ann. 2 (1852) 225; MIQ. Fl. Ind. Bat. 1, 2 (1859) 616; Illustr. (1871) 74; K. & V. Bijdr. 9 (1903) 121; KOORD. Exk. Fl. Java 2 (1912) 546; Atlas 2 (1914) t. 375; Fl. Tjibodas 2 (1923) 157; BACKER & BAKH.*f.* Fl. Java 2 (1965) 145, *p.p., excl. M. glauca et floribunda.* – *Millingtonia ferruginea* SCHULT. & SCHULT. Syst. Veg. Mant. 3, add. 2 (1827) 250; DIETR. Syn. Pl. 1 (1839) 103.

Medium-sized to big tree, up to *c.* 42 m. *Leaves* 2–6(–7)-jugate; leaflets elliptic to oblong, basal ones sometimes a bit ovate, upper ones sometimes ± obovate, usually rather large, up to 25(–38) by 10(–18) cm, base rounded to truncate, sometimes acute, entire, firmly coriaceous, pubescent, rarely subglabrous, rarely with domatia. *Panicles* erect, spreading, lax to rather dense; lower primary side-axes usually subtended by small leaves. *Sepals* usually densely pubescent, rarely on the outside sparsely so to subglabrous. *Outer petals* pubescent outside, rarely glabrous. *Inner petals* with fimbriate or ciliolate tips. *Ovary* partly or entirely but almost always distinctly and densely pubescent, very rarely nearly glabrous. *Endocarps* subglobose, often somewhat depressed and oblique, 3.5–5.5(–8) mm diam., with rather vague to distinct, ± prominent reticulum, with usually very prominent, rather sharp median keel which does not run out into a ventral processus or tubercle; ventral pore not or not much sunken.

Distr. *Malesia*: N. & Central Sumatra, throughout Java, and the Lesser Sunda Islands (Bali, Sumbawa, Flores, Timor), locally common, especially in Java. Fig. 13.

Ecol. Rain-forest, preferably on fertile, often volcanic soils, 250–1600 m altitude.

Field notes. Bole cylindrical, straight, sometimes crooked, at the base up to *c.* 2.5 m diam. Bark on the surface grey to brown, smooth, sometimes a bit peeling or shallowly fissured to (deeply) cracked, about 0.7–1.5 cm thick, easily detachable. Inner bark pale brown to brownred or orange, with streaks, also said to be dirty white and turning orange brown when exposed to the air as a result of the discolouring of the initially colourless watery exudation. Wood soft, yellowish to pinkish white. Leaflets pale greyish to glaucous green beneath. Fruits brownred to black when ripe.

Uses. Advocated for reafforestation purposes by KOORDERS.

Vern. Sumatra: *sekapong*, Takengon, *sontang*, Simelungun, *sihubung*, Kerinci; Java: *ki tiwu, ki tjermè badak*, S, *gempong, gijubuk, gompong*, J; Lesser Sunda Is.: *gempong, sambuk*, Bali, *mladja, tanggo, tawu*, Flores, Endeh lang., *lohot, raok*, Flores, *kaju mangkok*, W. Sumbawa.

Note. *Ssp. ferruginea* is usually well recognizable by its outside pubescent sepals and petals. However, in N. Sumatra and the Lesser Sunda Islands specimens occur in which these characters are imperfectly or not developed, and they may also lack the pubescence on the ovary and may have almost glabrous leaves. They are not easily identifiable and may be confused with *M. lanceolata var. lanceolata f. nervosa* or with the closely related *M. pinnata ssp. macrophylla* and *ssp. ridleyi.*

d. *ssp.* macrophylla (MERR.) BEUS. Blumea 19 (1971) 510. – *Meliosma macrophylla* MERR. Philip. J. Sc. 7 (1912) Bot. 294; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma lanceolata var. obliqua* (*non* BLUME) KOORD. Minah. (1898) 408; Suppl. 2 (1922) 7, t. 55; *ibid.* 3 (1922) 28. – *Meliosma wallichii* (*non* PLANCH. *ex* HOOK.*f.*) KOORD. Minah. (1898) 408. – *Meliosma tongcalingii* ELMER, Leafl. Philip. Bot. 8 (1915) 2815. – *Meliosma megalobotrys* MERR. Philip. J. Sc. 11 (1916) Bot. 16; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma macrocarpa* ELMER, Leafl. Philip. Bot. 10 (1939) 3786, *descr. angl.* – *Meliosma ferruginea* (*non* BLUME) MERR. & PERRY, J. Arn. Arb. 20 (1939) 356. – **Fig. 12.**

Medium-sized to large tree, up to *c.* 42 m. *Leaves* (3–)5–9-jugate; leaflets elliptic to oblong to ovate-oblong, medium-sized to rather large, up to *c.* 20 by 9 cm, base rounded or obtuse to truncate, entire, rarely with a few teeth (Sulawesi), chartaceous to firmly coriaceous, very sparsely to densely pubescent, always without domatia. *Panicles* erect and spreading, lax and slender to rather dense; lower primary side-axes usually subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous, rarely with a few scattered hairs. *Endocarps* subglobose, sometimes more obovoid or depressed, more or less oblique, 3.5–5 mm diam., exceptionally 5–7.5 mm diam. (Sulawesi), with vague to distinct and prominent reticulum, with rather sharp and prominent median keel which at one end mostly runs out into a small but distinct ventral processus or tubercle; ventral pore somewhat sunken.

Distr. *Malesia*: E. Borneo (E. Sandakan, Berao, W. & E. Kutai, Tandjung), Sulawesi (Minahasa, Malili), Moluccas (Halmahera, Seram), Philippines (Luzon, Leyte, Mindanao, Palawan), throughout

New Guinea (incl. New Britain). Fairly common in most parts of the area. Fig. 13.

Ecol. Usually in primary, rarely in secondary rain-forest, at low to medium altitudes; in Borneo only collected below 100 m, in the other parts of the area also higher, up to *c.* 1100–1200 m, in W. New Guinea once at 1800 m. In Borneo usually found in lowland dipterocarp forests. Generally reported to occur on clayish, loamy, or sandy clayish soils, also on red earth, on volcanic soil, and on loamsoil on limestone. It is rarely found in occasionally submerged areas. Once (New Guinea) said to occur on peaty soil, and there developing stiltroots.

Field notes. Bole mostly straight, cylindrical, up to at least 1 m diam. at the base, usually developing 1.5–2.5 m high buttresses, sometimes without buttresses, once observed stiltrooted. Bark grey to brown, or patchy brown-white-grey, smooth, sometimes with shallow vertical cracks, not or little peeling, with vertical rows of lenticels. Inner bark *c.* 1 cm thick, soft, light brown or pink to brownred, inside paler, sometimes said to be streaked with cream, with some colourless sticky exudate (which is also said to be redbrown!); it is said to be rapidly darkening upon exposure or 'a bright orange-brown stain quickly appears between bark and sapwood.' Wood very light and soft; sapwood white to pale pink or brown, when fresh with bright brown sap streaks, heartwood absent or present, darker than the sapwood. The fruit is said to be brown to black.

Vern. Borneo: *surian*, E. Kutai; Sulawesi: *kajusaut-rintek*, Tooelooe lang., *papako*, Tontemboan lang., *mumping*, Tonsea lang., *liasan*, Ratahan lang.; Moluccas: *bais*, Seram; Philippines: *arocong*, Ig., *agosos, balilang-uak* (a corruption of *barilan ng uak*), Tag., *morau*, S.L.Bis., *muñgapong*, Bik., *magasorod*, Bag.; New Guinea: *sebotebuk, tubuk*, Mooi, *serajema*, Manikiong, *marwaskeipi*, Japen, *bagare*, Kapauku lang., *biedewon, iediewat*, Muju, *morrotuno, waito*, Wapi, *frikipa*, Orne lang., *tapuha*, Managalase, *kufi*, Kutubu, *uliga*, Madang, *kombowase*, Waskuk, *wagebi*, Wagu.

Notes. *Ssp. macrophylla* is the most common and widespread of the East Malesian subspecies group, characterized by a glabrous ovary by which it is readily distinguished from the West Malesian subspecies. Within its large area a few other subspecies occur, *viz. ssp. pendula, sylvatica*, and *humilis*, which have much more limited areas and probably represent offsplits from it. These three subspecies are ecologically well isolated from *ssp. macrophylla*.

In Borneo the area of *ssp. macrophylla* is, as far as can be judged from the available evidence, sharply delimited against that of the West Malesian *ssp. ridleyi*, which, moreover, appears to prefer a higher altitudinal zone (only in Borneo *ssp. macrophylla* seems to be restricted to lowland forests below *c.* 100 m altitude!). To the SW the area of *ssp. macrophylla* borders on that of *ssp. ferruginea* which inhabits the Lesser Sunda Islands. The latter two subspecies are huge trees, very similar in general habit, and sometimes they have been confused. Nevertheless, they are usually well distinct, mainly by flower characters, though in both subspecies there is a tendency to lose some of these characters.

In the Philippines *ssp. macrophylla* is sympatric with *ssp. arnottiana*, but they prefer different altitudinal zones, the first being a lowland subspecies not exceeding *c.* 900 m altitude, the latter being a montane subspecies occurring from *c.* 800 up to *c.* 2400 m (once recorded from *c.* 600 m).

e. *spp.* **pendula** (MERR.) BEUS. Blumea 19 (1971) 512. – *Meliosma pendula* MERR. Publ. Govt. Lab. Philip. 29 (1905) 25; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma reticulata* MERR. Philip. J. Sc. 5 (1910) Bot. 195; Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma macgregorii* MERR. Philip. J. Sc. 10 (1915) Bot. 37; Enum. Philip. Fl. Pl. 2 (1923) 517.

Small to medium-sized tree, up to *c.* 20 m. *Leaves* (3–)4–6-jugate; leaflets elliptic to oblong, rarely lanceolate, up to 18(–20) by 7(–11) cm, the lower ones at the base nearly always rounded or (sub)truncate to obtuse, the upper ones more or less acute, nearly always distinctly dentate, villous-pubescent, ± glabrescent, without domatia. *Panicles* erect and spreading to somewhat pendulous and rather flaccid, slender and rather lax; lower primary side-axes mostly subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarps* subglobose, slightly oblique, 6–7 mm diam., with rather vague, slightly elevated reticulum, with hardly to moderately prominent, blunt median keel, the latter not running out into a distinct ventral processus or at most into a very minute tubercle; ventral pore hardly or not sunken.

Distr. *Malesia*: Philippines (Luzon: Mountain Prov.). Fig. 13.

Ecol. Montane rain-forest, 1800–2500 m altitude. In mossy forest, in ravines as well as on exposed ridges.

Field notes. Bark thick, checked. Wood soft, said to be soon assuming an orange-brown colour.

Uses. The leaves are once said to be used for smoking by the Igorots.

Vern. *Anitap*, Ig.

Note. *Ssp. pendula* replaces the lowland and lower hill *ssp. macrophylla* at high elevations (in this respect being comparable to *ssp. humilis* from New Guinea).

f. *ssp.* **sylvatica** (ELMER) BEUS. Blumea 19 (1971) 513. – *Meliosma sylvatica* ELMER, Leafl. Philip. Bot.

2 (1908) 492; MERR. Enum. Philip. Fl. Pl. 2 (1923) 518. – *Meliosma acuminatissima* MERR. Philip. J. Sc. 10 (1915) Bot. 36; Enum. Philip. Fl. Pl. 2 (1923) 517. – *Meliosma brachybotrys* MERR. Philip. J. Sc. 12 (1917) Bot. 275; Enum. Philip. Fl. Pl. 2 (1923) 517.

Slender shrub or treelet, up to *c.* 5 m. *Leaves* (3–)4–6(–7)-jugate; leaflets elliptic to usually oblong or lanceolate, usually medium-sized, up to *c.* 18 by 6 cm, acute at the base, sparsely to rather closely, always distinctly dentate, very sparsely to moderately pubescent, without domatia. *Panicles* erect, spreading, usually slender and rather lax; primary side-axes (mostly?) not subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarp* subglobose, often somewhat ellipsoid, more or less oblique, 5–6 mm diam., with distinct, more or less prominent reticulum, with rather sharp and prominent median keel which at one end runs out into a small but distinct ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Sulawesi (Minahasa, Latimodjong Mts), Philippines (Luzon, Negros). Fig. 13.

Ecol. Lowland rain-forest, usually not above 750 m altitude, growing in the shrub layer.

Field notes. Slender, suberect or bent shrub or treelet of a sparsely branched habit. Bark smooth, grey and brown mottled. Wood white, soft, easily breakable. Leaves once said to be light bluish green beneath.

Note. *Ssp. sylvatica* is closely related to *ssp. macrophylla*. The most striking difference between them is found in their physiognomy, the former being a small undergrowth treelet, the latter a large forest tree. The main systematical differences are found in the dentation and the shape of the base of the leaflets. These fit nicely in the spectre of character combinations present in the subspecies of *M. pinnata*, and it seems justified to consider *ssp. sylvatica* a subspecies of that species, instead of a separate species.

g. *spp.* **humilis** (MERR. & PERRY) BEUS. Blumea 19 (1971) 514. – *Meliosma humilis* MERR. & PERRY, J. Arn. Arb. 20 (1939) 358; *ibid.* 22 (1941) 263, *in obs.* – *Meliosma schlechteri* MERR. & PERRY, J. Arn. Arb. 22 (1941) 262.

Small to medium-sized tree, up to *c.* 20 m. *Leaves* 3–5 jugate; leaflets elliptic to oblong, rarely short-lanceolate, usually rather small, up to *c.* 15(–24) by 6(–9) cm, the base acute, lower leaflets sometimes rounded at the base, sparsely to rather closely dentate, beneath subglabrous to rather densely pubescent, sometimes densely villous-tomentose, always with more or less distinct domatia in the axils of the nerves beneath (obscure in densely tomentose leaflets). *Panicles* erect, spreading, mostly rather lax and with slender axes; lower primary side-axes often subtended by small leaves. *Sepals* and *petals* glabrous. *Ovary* glabrous. *Endocarps* subglobose, somewhat depressed and rather oblique, 5.5–7.5 mm diam., with more or less vague, slightly elevated reticulum, with very prominent, rather sharp median keel which at one end runs out into a small but distinct ventral processus; ventral pore somewhat sunken.

Distr. *Malesia*: Papua New Guinea (Highlands Provinces, Madang, Morobe, Milne Bay). Common. Fig. 13.

Ecol. Montane rain-forests, 1000–3000 m altitude. Observed as an understorey tree in dense *Castanopsis-Nothofagus* forest, on ridges as well as on streambanks, but also often reported from several kinds of disturbed forest, such as bamboo regrowth, old garden land, transition between coniferous forest and treefern grassland, and even from open grassland. Once reported from limestone ridge.

Field notes. Bark greybrown, smooth, with big lenticels. Inner bark straw-coloured to pink, red, or reddish brown (due to discolouring, as in other subspecies?), exuding 'resin'. Wood white to light brown, with conspicuous rays and clear growth rings, said to be of moderate weight and hardness. Petioles, peduncle, and pedicels purplish to red-brown; buds reddish. *Fruits* dark red to black when ripe.

Uses. Once said to be used as housing timber, free from borers.

Vern. *Mansalong*, Finschhafen, *kokopong*, Nako lang., E. Madang Prov., *kass*, Maring lang., *mappam*, Enga lang., W. Highl. Prov.

Notes. *Ssp. humilis* is closely allied to *ssp. macrophylla*, mainly differing by its dentate leaflets with domatia. In Papua New Guinea it replaces *ssp. macrophylla* mainly found below 1000 m altitude (*cf. ssp. pendula* from Luzon). It is remarkable that *ssp. humilis* has as yet been collected, even rather abundantly, only in Papua New Guinea and not in W. New Guinea.

7. **Meliosma sarawakensis** RIDLEY, Kew Bull. (1933) 193; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359. – *Meliosma grandifolia* LECOMTE, Bull. Soc. Bot. Fr. 54 (1909) 676, *nom. illeg.*, *non* URBAN (1895); MERR. Enum. Born. (1921) 362; VAN BEUSEKOM, Blumea 19 (1971) 515. – *Meliosma confusa var. laxior* BAKER *f.* in Rendle, J. Bot. 62 (1924) Suppl. 30. – *Meliosma latifolia* RIDLEY, Kew Bull. (1933) 193; MERR. & PERRY, J. Arn. Arb. 20 (1939) 359, *in obs.*

Evergreen, small tree, up to *c.* 10 m. *Leaves* 2–3(–4)-jugate; rachis terete, 12–30 cm, including the 6–15 cm long petiole, up to *c.* 5 mm diam., densely short-tomentose, later ± glabrescent; leaflets usually elliptic to oblong, the lower ones often

more or less ovate to ovate-oblong, the upper ones often more or less obovate to obovate-oblong, sometimes ± asymmetrical, (2–)5–22 by (1.5–)3–12 cm, mostly distinctly increasing in size towards the top of the leaf, base acute to rounded, apex more or less acuminate, sometimes subacute or cuspidate, with entire to remotely spinously dentate margin, chartaceous, moderately to rather densely pubescent especially beneath and on midrib and nerves, often partly glabrescent when older, never with domatia; midrib more or less impressed above; nerves 6–12 pairs, ascending, usually looped; venation distinct, reticulate; petiolules up to *c.* 1.5(–3) cm, terminal one usually longest, tomentose. *Panicles* terminal, usually more or less pendulous, flaccid, lax, narrowly pyramidal, (20–)25–55 cm, not profusely branched up to the 2nd or 3rd order, branches spreading, ± flaccid, usually slender, densely tomentose, bearing numerous flowers crowded in dense spikes; primary side-axes few to rather many, up to *c.* 25(–35) cm, the lower ones usually subtended by reduced leaves; bracts ovate to usually narrowly triangular or linear-lanceolate, up to *c.* 4 mm, densely pubescent. *Pedicels* (almost) absent. *Mature buds* *c.* 2 mm diam. *Sepals* 5 (4), ovate to ovate-lanceolate, the 3 or 4 inner ones 1–1.5 mm, the outer 1 or 2 usually much smaller, often minute, densely pubescent on the outside, with entire margin. *Outer petals* glabrous. *Inner petals* about halfway or somewhat less bifid, 0.5–0.7 mm, glabrous, sometimes with a minute central lobule. *Filaments* *c.* 1 mm. *Ovary* 0.5–0.7 mm, densely pubescent. *Fruit* (sub)globose, when ripe 0.7–1 cm diam.; *endocarp* depressed-globose, applanate at the ventral side, strongly oblique, 6–7(–8) mm diam., with usually distinct, more or less sharply prominent reticulum; median keel sharp and very prominent, not at one end running out into a ventral processus or tubercle, at the other end rather far curving outwards; ventral pore rather sunken.

Distr. *Malesia*: Sumatra (Asahan to Palembang) and NW. Borneo (Sarawak, around Kuching and Pontianak; common). Fig. 13.

Ecol. Lowland rain-forest, up to *c.* 800 m altitude.

Field notes. The sepals are redbrown to purple.

Vern. Sumatra: *kaju rube boras*, Asahan; Borneo: *bulu manok*, Iban name, Kuching.

Note. The closest affinity of *M. sarawakensis* is doubtless with *M. pinnata ssp. ridleyi* to which it is very similar in all characters (they even share the red sepals). Only after some hesitation *M. sarawakensis* is maintained as a separate species and not made a subspecies of *M. pinnata*. It would fit rather well into that species but is distinguished from it by a wider range of characters. The most important of its characters are the 2- or 3-jugate leaves and the densely pubescent sepals. These characters indeed are also found in *M. pinnata ssp. ferruginea*, but this subspecies is quite different from *M. sarawakensis* in various other aspects. An additional argument to the specific status of *M. sarawakensis* is found in the fact that it is found together with *M. pinnata ssp. ridleyi* in the same area and at the same altitudes in Sarawak (near Kuching) and in Sumatra (Asahan), without any sign of hybridization.

8. Meliosma rufo-pilosa HEND. Gard. Bull. Str. Settl. 7 (1933) 96, t. 18; MERR. & PERRY, J. Arn. Arb. 20 (1939) 360; VAN BEUSEKOM, Blumea 19 (1971) 517.

Evergreen rather large tree up to *c.* 30 m. *Flowering twigs* terete, 5–10 mm diam., stout, abruptly terminating in a tuft of leaves and inflorescences, glabrous, often with many large conspicuous leaf-scars. *Leaves* (6–)7–9-jugate; rachis terete, (13–)25–50 (–65) cm, including the (3.5–)6–16 cm long petiole, pubescent, not swollen at the base, hardly or not lenticellate; leaflets elliptic to oblong, sometimes ovate (-oblong), 3–15 by 2–6 cm, base obtuse to truncate, apex acuminate, entire, glabrous or ± puberulous on nerves above, (sub)glabrous beneath, pubescent on nerves, always without domatia; midrib impressed above; nerves 7–18 pairs, ascending, looped; venation fine, very distinct, reticulate; petiolules 1–6 mm, densely pubescent. *Panicles* terminal, one or a few crowded together at the end of a twig, erect, rather dense to lax, pyramidal, 30–50 cm, including the 0–20 cm long peduncle, profusely branched up to the 4th order, branches spreading, ± flaccid, densely pubescent, bearing numerous solitary flowers; primary side-axes well-spaced, *c.* 8–15, up to *c.* 30 cm, not lenticellate, the lower ones never subtended by small or reduced leaves; bracts narrowly triangular to lanceolate, up to *c.* 4 mm, densely pubescent. *Pedicels* 1–3 mm, densely pubescent. *Sepals* (3) 4, ovate, (sub)equal, *c.* 1.5–2 mm, the outer one often much smaller, rarely minute, usually lowered on the pedicel, glabrous or somewhat pubescent outside; margin flimsy, more or less ciliolate, entire or sometimes with some coarse irregular teeth. *Outer petals* *c.* 1.5 by 1.5–2.5 mm. *Inner petals* ligular, usually somewhat widened towards the top, 0.7–1 mm; top entire or with a shallow incision, blunt, minutely ciliolate. *Filaments* 0.7–1 mm. *Ovary* 0.5–0.7 mm, glabrous. *Fruit* globose, when ripe 1.5–2 cm diam., with moderately thick, fleshy mesocarp; endocarp semiglobose, broad-ovate to subcordate at ventral view, 11–13 mm long and wide, 7–8 mm high, with relatively thin wall, with slightly lumpy surface, especially lumpy and somewhat furrowed at the ventral curving of the wall; median keel faint, hardly elevated but at one end drawn out into a conspicuous, laterally flattened, downwards-curved,

blunt beak; ventral side rather deeply concave with a smooth, wide-ovate to suborbicular central part from the centre of which protrudes the ± conical hilum of the seed.

Distr. *Malesia*: Malay Peninsula (Pahang), Borneo (Sarawak, Sabah, Kinabalu complex). Fig. 11.

Ecol. Montane rain-forest, 1350–1700 m altitude.

Field notes. Large tree with deep, rounded crown, once reported with *c.* 2 m high buttresses. Bark smooth, grey to brown, with lenticels in vertical rows ('scarred', 'dippled'). Inner bark soft, fibrous, orange to reddish outside, pale fawn to white towards the cambium. Sapwood pale brown. Twigs pale brown, rough, lenticellate, with darker leaf-scars. Leaves pale green. Fruit yellow to orange when ripe.

Vern. Malay Peninsula: *sengkuang*, Genting Highlands.

Excluded and dubious

Meliosma celebica WARB. *ex* DIHM, Beih. Bot. Centralbl. 21, 1 (1907) 125, *nomen.* – I have not seen the type specimen (WARBURG 15416, Sulawesi, Bojong), which probably got lost during World War II.

Meliosma laurina BLUME, Rumphia 3 (1849) 198; WALP. Ann. 2 (1852) 224; MIQ. Fl. Ind. Bat. 1, 2 (1859) 614; Illustr. (1871) 73; MERR. Enum. Born. (1921) 363; HALL.*f.* Beih. Bot. Centralbl. 39, 2 (1921) 161; KOSTERM. Bibl. Laur. 1 (1964) 951. – As was noted by HALLIER *f.*, *l.c.*, the type specimens (S. MÜLLER *s.n.*, Borneo, G. Sakumbang) consist of a mixture, *viz.* inflorescences of *M. sumatrana* and leaves of *Cryptocarya reticulata* BLUME (*Lauraceae*).

Meliosma petiolaris MIQ. Sum. (1861) 519, 203; Illustr. (1871) 73, *in obs.* – This species was later referred by MIQUEL himself to *Xylosma leprosipes* CLOS which is now known as *Bennettiodendron leprosipes* (CLOS) MERR. (*Flacourtiaceae*).

Meliosma timorensis BLUME *ex* BLENK, Flora 67 (1884) 370, *nomen.* – This name was cited in an enumeration of *Meliosma* species having leaves with pellucid dots; it was probably copied from a label on a sheet. The specimen could not be traced.

Pimela angustifolia BLUME, Mus. Bot. Lugd.-Bat. 1 (1850) 226. – *Canariopsis angustifolia* BLUME *ex* MIQ. Fl. Ind. Bat. 1, 2 (1859) 653. – *Canarium angustifolium* MIQ. Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 117; H.J.LAM, Bull. Jard. Bot. Btzg III, 12 (1932) 179, t. 11 f. 71d, *sub C. rigidum* ZIPP.; LEENH. Fl. Males. I, 5 (1956) 296.

The material under this name was excluded from the *Burseraceae* by LEENHOUTS, *l.c.*, and tentatively assigned to MELIOSMA. This may be correct, and it should then be placed close to *M. lanceolata* and *M. hirsuta*. At first sight it is very similar to the latter species, but there are important differences in nervation and pubescence. If it belongs to *Meliosma* it would certainly be a new species, but I refrain from including it because I am not sure about its identity. Unfortunately, the specimens consist of young leaves only, with many characteristic narrow leaflets, but in absence of woody parts it cannot be identified with certainty. Moreover, on the original labels (ZIPPEL *s.n.*) the place of origin is mentioned as being 'Nova Guinea', in BLUME's handwriting. However, this would not fit in the distribution pattern of *Meliosma*, since species of this kind only occur in western Malesia; if New Guinea indeed is the correct locality, *'Canarium angustifolium'* can hardly belong to *Meliosma*. Its identity will probably remain uncertain until more satisfactory material has been found.