TREE FLORA of SABAH AND SARAWAK

Volume One

edited by
E. Soepadmo and K.M. Wong

ITTO
International Tropical Timber Organization

Government of Malaysia

ODA
Overseas Development Administration, U.K.

TREE FLORA
of
SABAH AND SARAWAK

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SIMAROUBACEAE

Julius Kulip & K.M. Wong

Forest Research Centre,
Sabah Forestry Department,
Sandakan, Malaysia

Merrill, EB (1921) 315; Ridley, FMP 1 (1922) 360; Masamune, EPB (1942) 361; Nooteboom, FM 1, 6 (1962) 193, FM 1, 6 (1972) 968, Blumea 11 (1962) 509; Keng, OFMSP (1969) 178; Kochummen, TFM 2 (1972) 345; Cockburn, TS 1 (1976) 217; Anderson, CLTS (1980) 322; Corner, WSTM 2 (1988) 696; Whitmore, Tantra & Sutisna, CLK 2,1 (1990) 329.

Trees or shrubs (some sprawling), usually *containing very bitter substances*. Hairs mostly simple and unicellular, sometimes with a glandular head. **Leaves** *spirally arranged, simple* or *pinnate*, sometimes (in *Ailanthus, Brucea* and *Soulamea*) with pitted, concave, or flattish glands on the lower surface; stipules usually absent except in *Allantospermum, Irvingia* and *Picrasma*. **Inflorescences** usually compound, axillary, rarely terminal; *plants monoecious or dioecious*. **Flowers** usually small, *regular, unisexual or bisexual; sepals 3–5*, almost always partly united; *petals 3–5*, free; stamens inserted at the base of the disc, sometimes arranged in two whorls, with the inner whorl alternate with the petals and the outer whorl (if present) opposite the petals, anthers 2-celled, opening lengthwise; disc intrastaminal, sometimes rather inconspicuous; *ovary superior, 2–5-lobed, with 1–5 chambers*, or with free carpels; *ovule one* in each carpel, *anatropous*, placentation axile. **Fruits** usually not splitting, often *drupe-like*, sometimes a *samara* or in *Allantospermum* septicidally splitting into 5 valves. **Seeds** with scant or no endosperm.

Distribution. Some 30 genera and 200 species, distributed in the tropics and subtropics and some in temperate Asia. In Sabah and Sarawak, represented by 9 genera with 11 species of which only one (*Harrisonia*) includes scrambling shrubs.

Ecology. Simaroubaceae species are found mostly in lowland forest. *Quassia indica* shows preference for temporarily inundated areas while *Eurycoma longifolia* has a distinct preference for acidic, leached, well-drained soils. *Soulamea amara* occurs in the *Barringtonia*-formation of the coastal vegetation and prefers calcareous or rocky beaches. Pollination is probably by insects as the flowers are often reported to be fragrant.

Uses. *Ailanthus, Allantospermum* and *Irvingia* are the only genera reaching timber size. All the bitter-tasting genera are used locally in the preparation of traditional medicines, especially as tonics, antidysenterics and antihelminthics, and the roots of *Eurycoma longifolia* has been reported to contain biologically active compounds useful as anti-malaria drugs (Chan *et al*., Planta Medica 52 (1986) 105).

Taxonomy. The Simaroubaceae are closely related to the Burseraceae, Meliaceae and Rutaceae. While the genera are quite distinctly recognised, the limits of these families overlap somewhat. Forman (Kew Bull. 19 (1965) 517) placed *Irvingia* in the Irvingiaceae and *Allanthospermum* in the Ixonanthaceae but Nooteboom (*l.c.* (1972) 970) concluded that

the morphological, phytochemical and palynological evidence favoured including these genera in the Simaroubaceae.

Key to genera

1. Sprawling or scrambling spiny shrubs.....
   Harrisonia R. Brown *ex* A. Juss.
   Mem. Mus. Hist. Nat. Paris 12 (1825) 517; Masamune *l.c.* 362; Nooteboom, FM 1,6 (1962) 207.
   3–4 species in the Old World Tropics. 1 species, *H. perforata* (Blanco) Merr., occurs in Sabah. Scandent prickly shrub; branches with thorns; leaf-stalk winged.
   Lowlands to 400 m, also on Banggi island. Vernacular names: Sabah—*bogua* (Dusun Banggi), *kait-kait* (Tenom Murut), *kukualang* (Malay).

   Shrubs or trees, unarmed.....2

2. Leaflets margin toothed.....**3. Brucea**
   Leaves or leaflets margin entire.....3

3. Leaves simple 4
   Leaves pinnate 7

4. Leaves spirally arranged, densely clustered at shoot tips, obovate, stalks 3–8 cm long .....**8. Soulamea**
   Leaves spiral to alternate and well-spaced along the shoots, elliptic, stalks 0.5–2 cm long.....5

5. Leaves with pitted glands. Stipules absent.....**7. Quassia** (in part)
   Leaves without such glands. Stipules either conspicuous conical structures or present only in leaf buds on young shoots and falling off early.....6

6. Twigs with annular stipule-scars, not swollen at leaf insertion. Leaf-stalks 10–20 mm long.....**5. Irvingia**
   Twigs without annular stipule-scars, swollen at points of leaf insertion. Leaf-stalks 5–44 mm long.....**2. Allantospermum**

7. Leaflets sessile.....**4. Eurycoma**
   Leaflets distinctly stalked.....8

8. Leaflets very unequal at base. Fruits winged.....**1. Ailanthus**
   Leaflets symmetric at base. Fruit a drupe.....9

9. Veins sunken on both upper and lower leaflet surfaces; stipules absent.....
   .....**7. Quassia** (in part)
   Veins prominent on both upper and lower leaflet surfaces; stipules present, sub-orbicular.....**6. Picrasma**

1. **AILANTHUS** Desf., nom. cons.

(from the Amboinese plant name *aylanto*)

Mem. Phys. Math. Ac. R. Sc. Paris (1786) 270, *t.* 8; Nooteboom, FM 1,6 (1962) 215; Kochummen *l.c.* 346; Whitmore, Tantra & Sutisna *l.c.* 329.

Dioecious trees with straight bole but without buttresses. **Bark** pale grey, smooth or lenticellate; inner bark yellowish brown. **Sapwood** pale white. Twigs thick, with large leaf-scars. **Leaves** more or less tufted at the ends of twigs, *pinnate*, to 60 cm long, *without a terminal leaflet; leaflets* 10–13 pairs, 7.5–12.5 x 2.5–5 cm, hairy below, *with scattered glands* in the forks of the veins on the underside; *base very unequal, margins entire,* apex pointed; the leaves eventually drooping with bowed stalk. **Flowers** *5–6-merous;* calyx small, 5–6-lobed, closed in bud and later irregularly splitting (often 2-lobed) to the base, rarely cupular; petals 5–6, induplicate-valvate in bud, concave; stamens 10, in male flowers inserted below the outer margin of the disc, in female flowers either of subnormal size (but without pollen), or vestigial, or absent, anthers opening laterally or externally, the 2 cells free in their lower half; ovary 2–5-carpellate, carpels free, flat, in the male flower vestigial or absent; styles 2–5, free or united; ovule 1 in each carpel. **Fruit** *a samara*, elliptic or oblong-lanceolate. **Seeds** flat, orbicular or obovate or somewhat triangular, without endosperm.

Distribution. 5 species in tropical and subtropical SE Asia from Turkestan and India to China, through Malesia to Solomon Islands, Queenslands and northern New South Wales in Australia. In Sabah and Sarawak, 2 species are known.

Ecology. In Sabah and Sarawak, both species are uncommon and found mainly in lowland forests below 1000 m, in valleys, along streams, and open places.

Key to *Ailanthus* species

Leaflets with lower surface glabrous and with a pair of large glands.....**1. A. integrifolia**

Leaflets with lower surface hairy or sparsely hairy and with scattered small glands..... .....**2. A. triphysa**

1. **Ailanthus integrifolia** Lam.

(Latin, *integer* = entire, *folia* = leaves or leaflets; the leaflet margins)

Dict. 3, 2 (1792) 417; Merrill, Interpr. Rumph. (1917) 299; Nooteboom, FM 1, 6 (1962) 218; Kochummen *l.c.* 346; Cockburn *l.c.* 219; Whitmore, Tantra & Sutisna, *l.c.* 229. **Type:** *Rumphius Herb. Amb. 3:205, t. 132*. **Synonyms:** *A. blancoi* Merr., Sp. Blanc. (1918) 205; *A. peekelii* Melch., Notizbl. Berl. Dahl. 10 1930) 893; *Dysoxylum dasyphyllum* Miq., Ann. Mus. Bot. Lugd. Bat. 4 (1868) 19.

Tree to 55 m tall, 65 cm diameter. **Bark** smooth, light brown or grey. **Sapwood** white, yellow, pale brown or creamish, very soft; heartwood absent. **Leaves** 30–200 cm long, stalks 5–20 cm long; *leaflets* 2–9 pairs, 3.5–14 x 3.3–6.2 cm, *glabrous on both surfaces;* base very oblique or sickle-shaped, apex blunt-acute; stalks 0.5–1.5 cm long; lateral veins

6–13 pairs; *glands on lower surface large*, black, flat, oblong, *0.5–5.0 mm diameter*, mostly *paired* near the base. **Inflorescences** to *c.* 40 cm long, glabrous, pedicels to *c.* 15 mm long. **Flowers** with calyx more or less pubescent, closed in bud, rupturing and toothed irregularly, rarely cupular, 1–4 mm high, rarely caducous; petals puberulous, acute or bluntish, to *c.* 9 x 3 mm; filaments with many long spreading hairs to glabrous, usually thickened downwards, *c.* 0.5 mm in female flowers, to 4 mm long in male flowers; anthers *c.* 1 mm in female flowers, to 2.5 mm long in male flowers; ovary 5, usually densely puberulous; styles 5, connate at the base, including the long, stellately spreading stigmas, to *c.* 6 mm long. **Fruits** of (1–)3–5 samaras, each somewhat elliptic, 11–22 x 2.5–5 cm, the vein reticulations distinct on the outside, pale green; stalk 2.5–5 cm long. **Seeds** flat; testa thin; cotyledons 2.

Distribution. Malesia: all islands, except Java and the Lesser Sunda Islands, and Melanesia (Bismarcks and Solomons). In Sabah, the species has been recorded from the Sandakan and Beaufort districts. In Sarawak, once collected at Suai, Miri, 4th Div. (*S. 39203*). Also in Kalimantan.

Ecology. In primary rain forest or rarely secondary forest, very rare.

Uses. In New Guinea and the Bismarcks, the timber is made into planks for house construction (Nooteboom *l.c.*).

2. **Ailanthus triphysa** (Dennst.) Alston Fig. 1.

(Greek, *tri* = 3-partite, *phusis* = in character; the calyx-tube)

Handb. Fl. Ceyl. 6, Suppl. (1931) 41; Nooteboom, FM 1,6 (1962) 219; Kochummen *l.c.* 346; Cockburn *l.c.* 219; Whitmore, Tantra & Sutisna *l.c.* 329. **Basionym:** *Adenanthera triphysa* Dennst., Schluss. Hort. Mal. (1818) 32. **Type:** *Dennst., Schluss. Hort. Mal. (1818) t. 32*. **Synonyms:** *A. philippinensis* Merr., Publ. Gov. Lab Philip. 35 (1906) 25; *Hebonga obliqua* Radlk., Philip. J. Sc. 6 (1911) Bot. 366.

Tree to 60 m tall and 50 cm diameter. **Bark** pale brown, smooth to lenticellate; inner bark yellowish brown, mottled. **Sapwood** white. Twigs thick, reddish brown hairy. **Leaves** to 30 cm long, rachis slightly pubescent; *leaflets* almost sickle-shaped, *c.* 18 pairs, *7.5–11.7 x 3– 4 cm*, membranous, upper surface glabrous, *lower surface densely hairy;* base distinctly unequal (one side sharply acute, the other side rounded), margin wavy, apex pointed; lateral veins 8–20 pairs, more or less sunken above; *glands small, scattered over the whole surface especially on the midrib and veins.* **Inflorescences** many-flowered, more or less pubescent, *c.* 20–60 cm long; bracts small, ovate to triangular, falling early; pedicels to *c.* 4 mm. **Flowers** with calyx pubescent, less than 1 mm high, the triangular acute lobes as long as the tube or a little longer; petals glabrous or nearly so, 3–5 x 1–1.5 mm; filaments twisted-folded in bud, filiform or sometimes attenuating from the base to the top; anthers *c.* 1.2 mm long, 1 mm wide in male flowers, smaller in female flowers. **Fruits** of 1–3(–4) samaras, each somewhat obovate, 4.5–8 x 1.5–2.5 cm, ripening red; stalk 0.8–2 cm long.

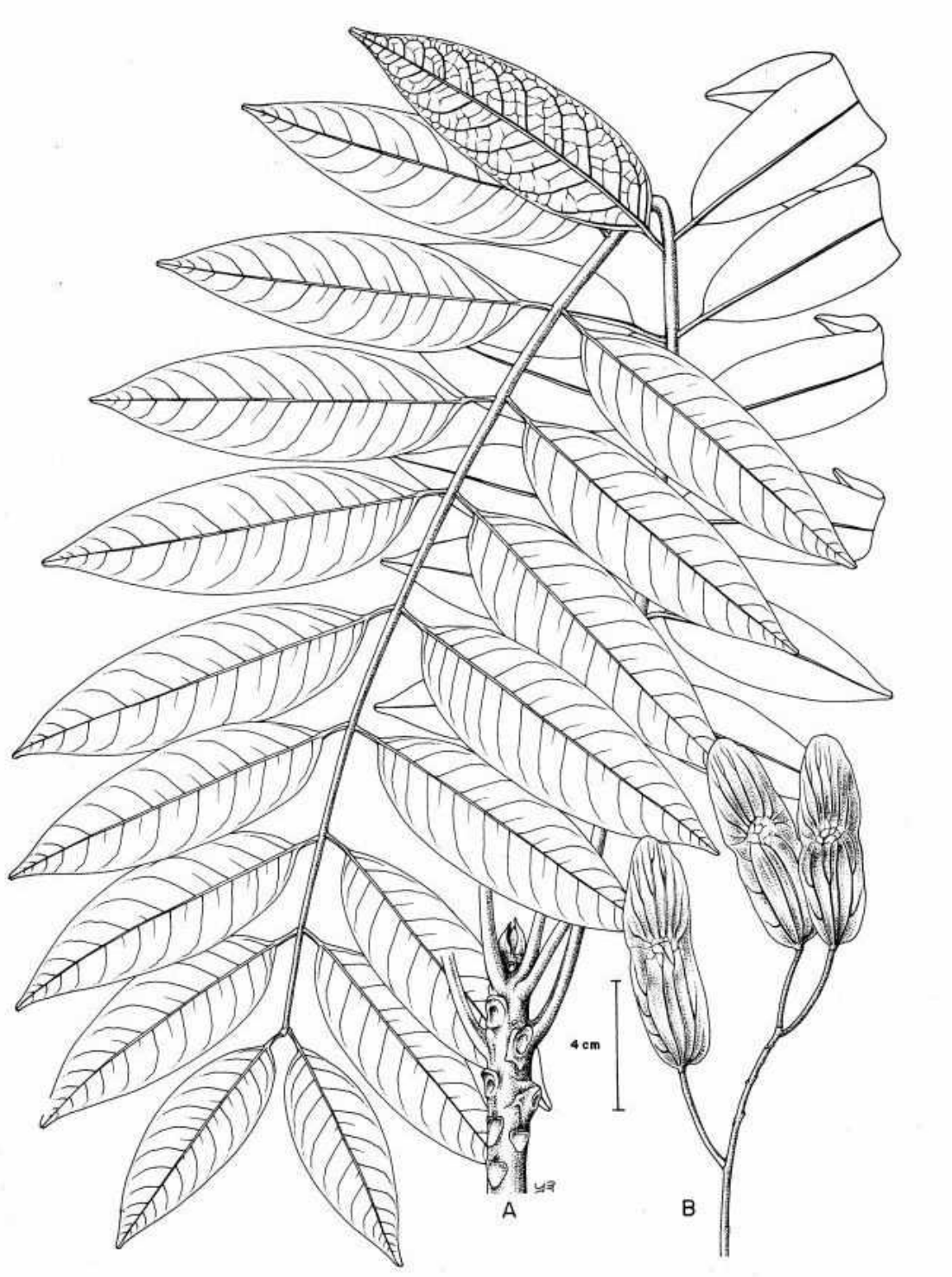

Fig. 1. *Ailanthus triphysa.* A, leafy twig; B, infructescence. (A from *SAN 59251,* B from *SAN 49456.*)

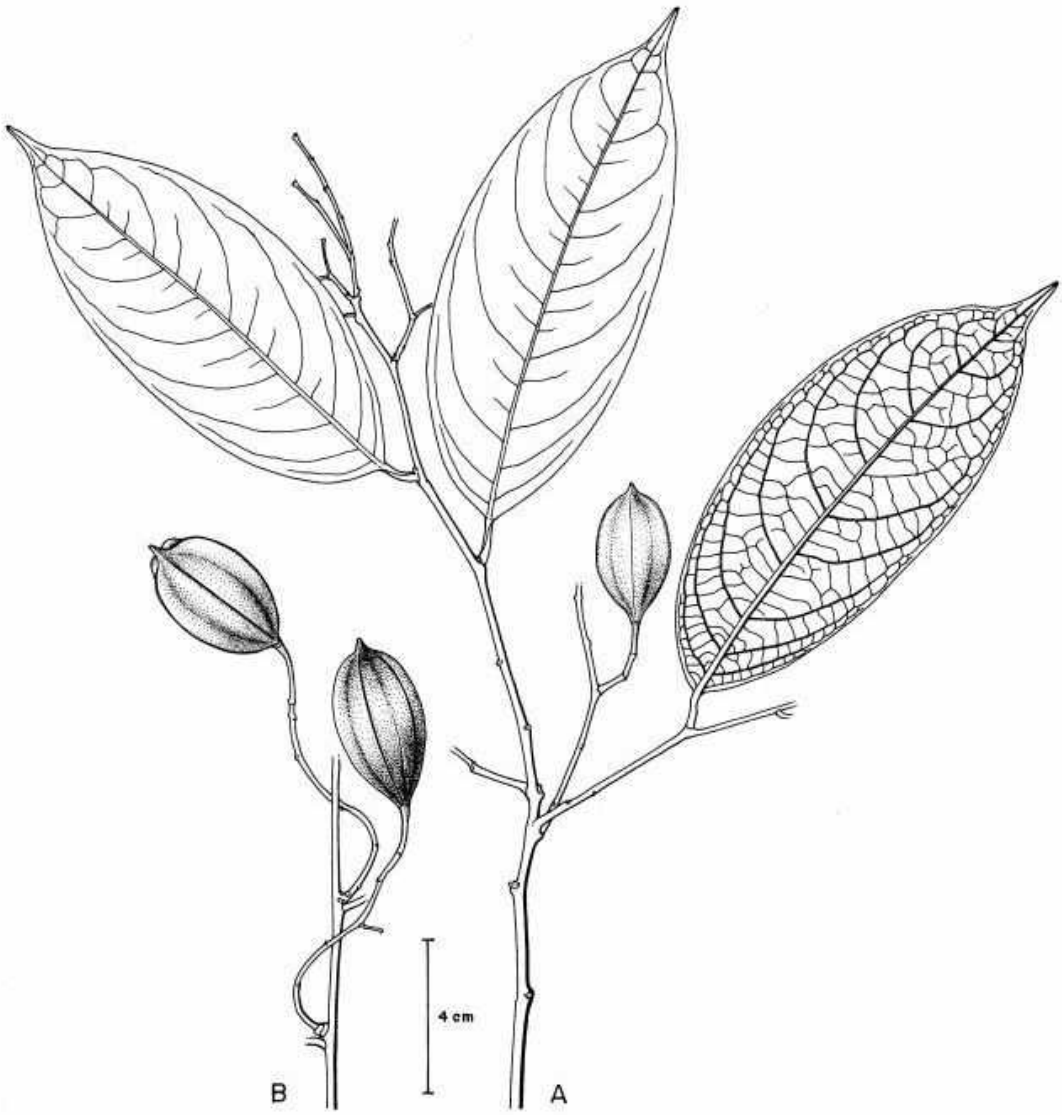

Fig. 2. *Allantospermum borneense* subsp. *borneense*. A, fruiting leafy twig; B, infructescence. (All from *S. 15016*.)

Distribution. India, Sri Lanka, Burma, Thailand, Vietnam, through Malesia (except Sumatra, Peninsular Malaysia, Lesser Sunda Is., and New Guinea) to Queenslands and the northern parts of New South Wales. In Sabah uncommon, recorded from the interior parts at Sook, Keningau and Tenom, and in the east coasts at Lahad Datu. Not yet recorded in Sarawak. Also in Kalimantan.

Ecology. In primary lowland and hill forests.

Uses. The resin is tapped and used as incense and traditional medicine in India. In Indo-China the bark is burned as incense. The bark and the leaves are used for making a tonic, especially for post-childbirth. They also possess febrifuge properties and are used for treating dyspeptic complaints. The wood is used for making wooden shoes in Luzon (the Philippines), for fishing floats, catamarans, sword-handles, and spear-sheath in India, and for tea-boxes in Sri Lanka (Nooteboom *l.c.*).

2. **ALLANTOSPERMUM** Forman

(Greek, *ala* = wing, *sperma* = seed; the winged seeds)

Kew Bull. 19 (1965) 516; Nooteboom *l.c.* (1972) 968; Kochummen *l.c.* 347; Cockburn *l.c.* 217; Whitmore, Tantra & Sutisna *l.c.* 329.

Trees. Twigs *without annular stipular scars, swollen at points of leaf insertion*. **Leaves** *simple*, entire. **Inflorescence** a panicle. **Flower** *bisexual, 5-merous;* sepals 5; petals 5; stamens 10, free, anthers versatile; disc 10-lobed, intrastaminal; ovary superior, shallowly 5-lobed, stigma with a tiny papillose head. **Fruit** a *capsule*, broadly ellipsoidal, twisted after *splitting into 5 valves* along the septa, leaving a central columella. **Seeds** cylindrical, ellipsoid, shiny and waxy.

Distribution. 2 species, 1 in Malesia (Peninsular Malaysia and Borneo) and the other in Madagascar (*A. multicaule* (Capuron) Noot.).

Allantospermum borneense Forman Fig. 2.

(of Borneo)

l.c. 517, *t.* 1; Nooteboom *l.c.* 1972) 972; Kochummen *l.c.* 347; Cockburn *l.c.* 217; Whitmore, Tantra & Sutisna *l.c.* 329. **Type:** *Galau S. 15262*, Sarawak, 1st Div., Semengoh Forest Reserve (holotype K; isotypes L, SAN, SAR).

Tree, to 90 m tall and 60 cm diameter; bole fluted and often crooked; buttresses sharp and spreading, to 3 m high. **Bark** pale brown with grey patches, smooth or with distant, adherent, large, thinnish scales, minutely lenticellate; inner bark pink, mottled white. **Sapwood** yellowish brown. *Twigs* brown, slender, *more or less zig-zag*. **Leaves** elliptic to oblong, 6.5–15 x 1.7–3.3 cm, glossy above, dull beneath; base cuneate to broadly rounded, apex blunt-acuminate; midrib and veins prominent on both surfaces; lateral veins 5–10 pairs, intermediate veins extending about half-way to the margin; stalks blackish, channelled

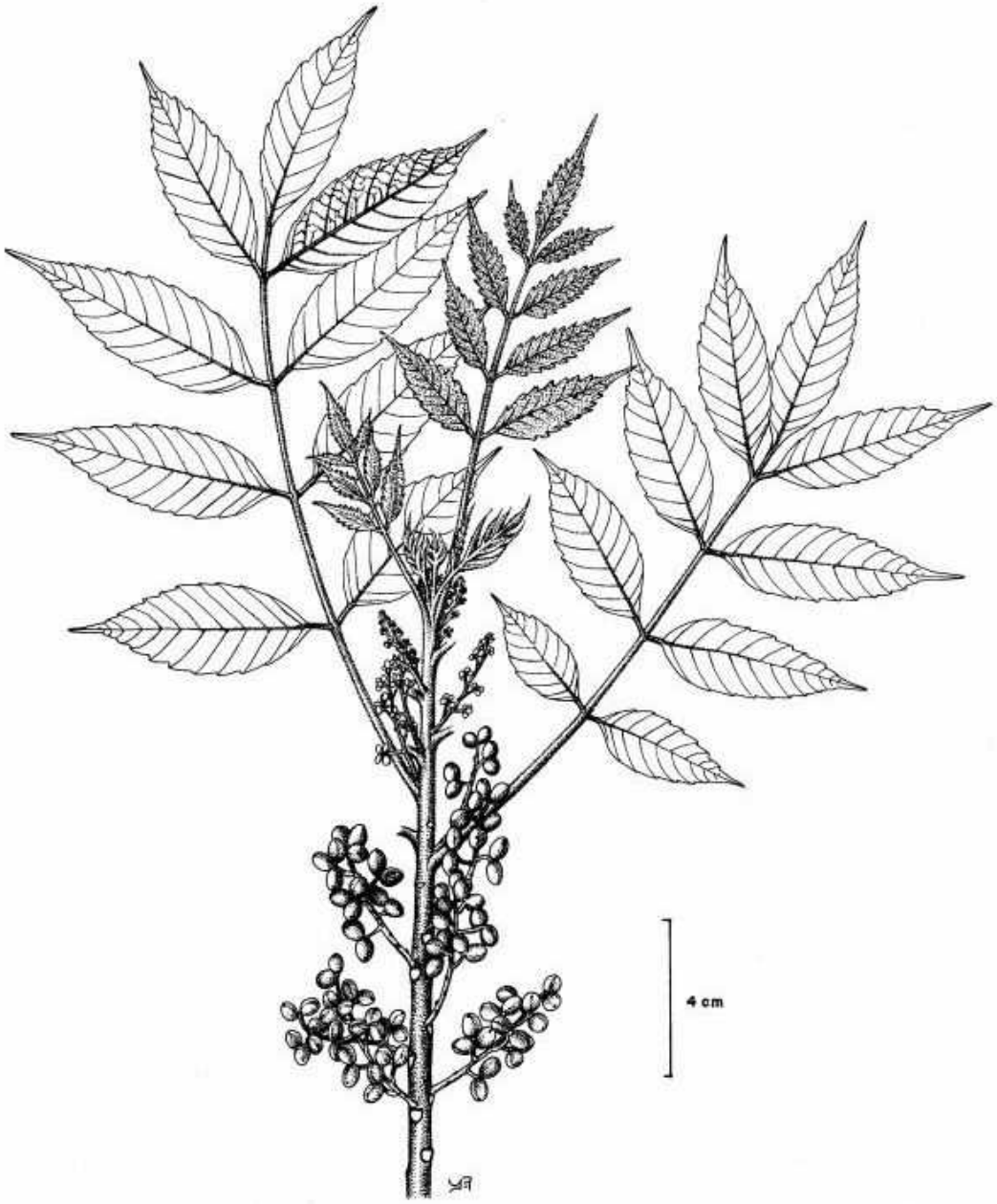

Fig. 3. *Brucea javanica.* Fruiting leafy twig. (From *Zainuddin 1713.*)

above, 0.5–4.4 cm long. **Inflorescences** *(1–)3.3–5.9 cm long*, bearing the scars of early caducous bracts. **Flowers** with a stalk 7–9 cm long; sepals white, boat-shaped, 3–4 x 2 mm, rounded at the apex, reflexed at anthesis; petals white, elliptic to obovate, 4–5 x 2.5–3 mm, membranous, reflexed at anthesis, caducous; stamens to 6 mm long, anthers *c.* 1 mm long; disc *c.* 1.5 mm diameter and 0.5 mm thick; ovary 5-lobed, *c.* 1.5 x 2 mm, style filiform, 3–4 mm long, purple, stigma knob-like. **Fruits** broadly ellipsoid, 5-lobed, 2.8–4.2 x 1–3.5 cm, apical beak 2–10 mm long. **Seeds** cylindrical, often slightly curved, 2–2.5 x 4–6 mm.

Key to subspecies

Leafy branches conspicuously zig-zag. Infloresences 3.3–5.9 cm long, laxly branched. Fruits 2–3.5 cm wide, apical beak 2–4 mm long.....
subsp. **borneense**
Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei, Kalimantan). In primary mixed dipterocarp forest on sandy humult ultisols; in Sabah also on ultramafic soils. Apparently gregrariously flowering and fruiting at several year intervals.

Leafy branches only slightly zig-zag. Inflorescences 1–2 mm long, condensed. Fruits about 1.1 cm wide, apical beak 6–10 mm long.....
subsp. **rostratrum** Noot.
l.c. (1972) 972; Cockburn *l.c.* 217; Whitmore, Tantra & Sutisna *l.c.* 330. Type: *Agama SAN 36068*, Sabah, Lahad Datu, Pulau Sakar (holotype L; isotypes K, SAN).
Known only from Sabah (Sandakan and Lahad Datu areas).

Vernacular names. Sarawak—*nyalin* (Iban). Brunei—*kayu tulang* (Malay), *tulang* (Iban).

3. **BRUCEA** J.F. Mill., *nom. cons.*

(J. Bruce, 1730–1794, a Scottish scholar and explorer)

Icon. (1779) *t.* 25; Merrill *l.c.* (1921) 316; Ridley *l.c.* 361; Masamune *l.c.* 361; Corner *l.c.* 697; Nooteboom, FM 1, 6 (1962) 209; Kochummen *l.c.* 348; Cockburn *l.c.* 219; Anderson *l.c.* 322.

Shrubs or small trees. **Leaves** *pinnate, with a terminal leaflet; leaflets with toothed margins;* stipules none. **Flowers** *unisexual*, in axillary inflorescences; *sepals 4*, united at base; *petals 4*, free; disc thick with 4 lobes; *stamens 4*, with short filaments, vestigial or absent in female flowers; ovary *4-carpellate*, carpels free, styles free or united at base; ovules 1 in each carpel, attached above the middle. **Fruit** *a drupe*, hardly fleshy, with a stone. **Seeds** with very thin endosperm.

Distribution. 6 species in tropical Africa and Asia, including 2 in Malesia. In Sabah and Sarawak one species.

Brucea javanica (L.) Merr. Fig. 3.

(of Java)

J. Arn. Arb. 9 (1928) 3; Kochummen *l.c.* 348; Cockburn *l.c.* 219; Nooteboom, FM 1, 6 (1962) 210; Anderson *l.c.* 322. **Basionym:** *Rhus javanica* L., Sp. Pl. (1753) 265. **Type:** *Osbeck, s.n.*, Java (L).

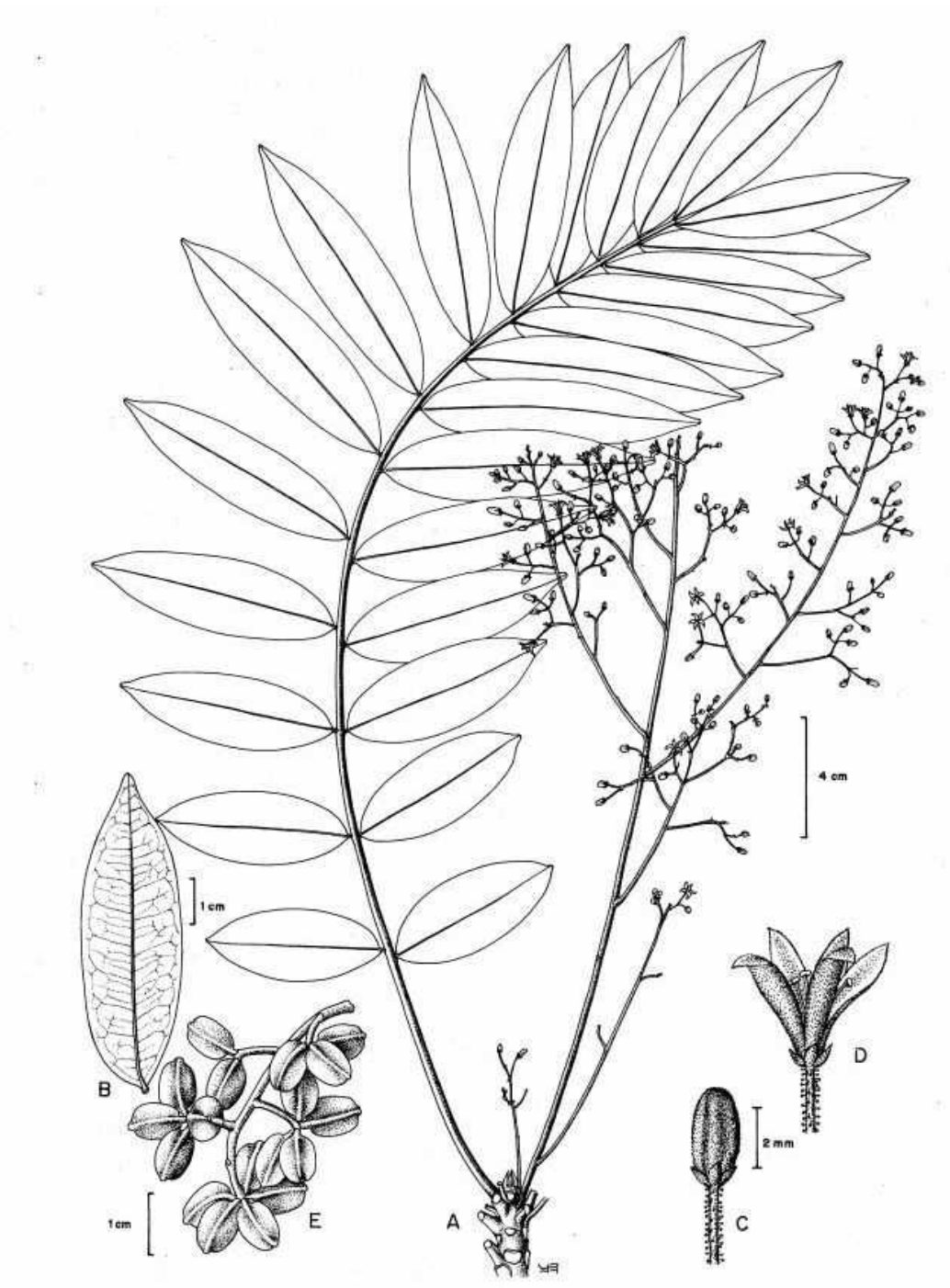

Fig. 4. *Eurycoma longifolia*. A, flowering leafy twig; B, lower side of leaf; C, flower bud; D, open flower; E, infructescence. (A–D from *SAN 88096*, E from *SAN 73999*.)

Synonyms: *Lussa radja* Rumph., Herb. Amb. (*Auct.*) 7 (1755) 27, *t*. 15; *Brucea sumatrana* Roxb., Hort. Beng. (1814) 12; *Brucea sumatrensis* Spreng., Pl. Min. Cogn. 2 (1815) 90; *Brucea amarissima* Desv. *ex* Gomes, Mem. Acad. Sc. Lisb. n.s. 4, 1 (1872) 30.

Shrub or small tree to 5 m high. **Leaves** 20–40 cm long; leaflets ovate to oblong-lanceolate, 3–15, 4.5–11 x 1.5–4 cm, sparsely hairy above, more or less pubescent below, sometimes glabrous; stalks 2–5 mm, the terminal one much longer. **Flowers** greenish white to greenish red or purple. **Fruits** 1–4 together, 4–5 mm long.

Vernacular names. Sabah—*kuinin* (Dusun/Kadazan Tambunan), *mara* (Maga), *pait-pait* (Dusun/Kadazan Kinabatangan), *payas* (Dusun/Kadazan Ranau), *tongkat ali* (Papar Malay; in common with *Eurycoma*). Sarawak—*jaloot* (Murut).

Distribution. From Sri Lanka and the Deccan Peninsula through SE Asia to S China and S Formosa, throughout Malesia and N Australia. In Sabah, it is found all over the state. In Sarawak, it has been recorded from the 1st, 2nd, 4th and 7th Div. Also in Brunei.

Ecology. A common, light-tolerant plant, preferring open sites and secondary forest and thickets, forest edges and ridges, even occurring in sunny places in sandy dunes and on limestone rock. Flowering and fruiting throughout the year.

Uses. The roots and fruits contain bitter principles which possess medicinal value and used as concoctions in the treatment of dysentery, diarrhoea and fever.

4. **EURYCOMA** Jack

(Greek, *eurus* = broad, *kome* = tuft or crust; the leaves crowded at the ends of branches)

Mal. Misc. 2 (1822) 45; Merrill *l.c.* (1921) 316; Ridley *l.c.* 361; Burkill, EPMP (1935) 984; Masamune *l.c.* 361; Corner *l.c.* 698; Nooteboom, FM 1, 6 (1962) 203; Kochummen *l.c.* 349; Cockburn *l.c.* 219; Anderson *l.c.* 323.

Trees, treelets or shrubs. Twigs stout with large leaf-scars. **Leaves** *pinnate, with terminal leaflet, crowded at branch ends; leaflets sessile*, opposite or subopposite; base slightly oblique, attached to the rachis with a prominent joint; *lateral veins inconspicuous* above and below. **Inflorescence** a downturned axillary panicle; plants monoecious or dioecious. **Flowers** *unisexual*, female always with large sterile stamens, males always with a pistillode; calyx small, 5–6-lobed; petals 5–6; stamens 5–6, on the sepals alternating with 5–6 small staminodes, stamens and staminodes sometimes united with the base of petals; disc inconspicuous; carpels 5–6, each with 1 ovule, free, the styles slightly united, stigma peltate, 5–6-lobed. **Fruit** a nut, to 5 per flower, each on a short stalk *c.* 3 mm long, ellipsoid or ovoid. **Seeds** without endosperm.

Distribution. 3 species in tropical SE Asia, Sumatra, Borneo and S Philippines. In Sabah and Sarawak, only 1 species.

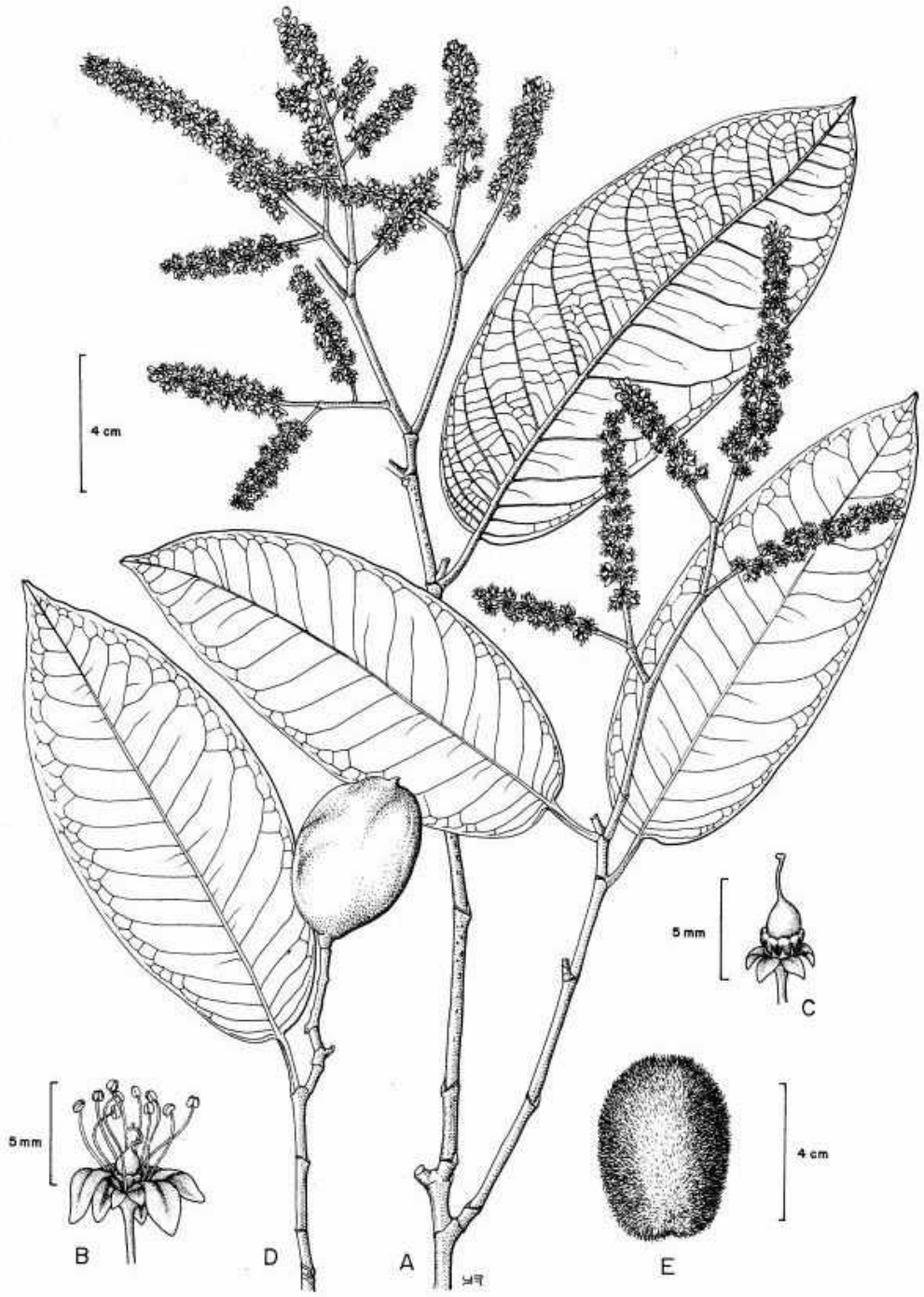

Fig. 5. *Irvingia malayana.* A, flowering leafy twig; B, flower; C, flower with petals and stamens removed; D, twig with young fruit; E, fibrous mesocarp of fruit. (A–C from *SAN 43118,* D from *SAN 63884,* E from *SAN 74993.*)

Eurycoma longifolia Jack Fig. 4.

(Latin, *longus* = long, *folium* = leaves)

l.c. 45; Ridley *l.c.* 362; Merrill *l.c.* (1921) 316, PEB (1929) 116; Masamune *l.c.* 361; Burkill *l.c.* 984; Corner *l.c.* 604; Nooteboom, FM 1, 6 (1962) 205; Kochummen *l.c.* 349; Cockburn *l.c.* 219; Anderson *l.c.* 323. **Type:** *Jack s.n.*, Sumatra (holotype K). **Synonyms:** *E. merguensis* Planch. in Hooker, Lond. J. Bot. 5 (1846) 584; *Picroxylon siamense* Warb., Fedde Rep. 16 (1919) 256; *Manotes asiatica* Gagn., Bull. Soc. Bot. Fr. 98 (1951) 207.

Spindly unbranched tree or shrub, to 8 m tall and 15 cm diameter, or with a few upright branches, each crowned by an umbrella-like rosette of leaves. **Bark** greyish brown, smooth. **Leaves** to 100 cm long; leaflets lanceolate to obovate-lanceolate, rarely oblong, 5–20 x 1.5–6 cm; base oblique, apex blunt to slightly acuminate; midrib raised on both surfaces; lateral veins inconspicuous above and sunken below. **Flowers** reddish; petals hairy on both sides, *c.* 4.5–5.5 x 1.5–2.5 mm; styles rather long, stigma *c.* 1 mm above the ovaries. **Fruits** 10–17(–20) x 5–12 mm.

Vernacular names. Sabah—*ionadiandau, nuad-mandau* (Runggus), *tombuid* (Dusun/Kadazan Tambunan), *tongkat ali* (Malay), *tongkat langit* (Kuala Penyu Malay). Sarawak—*bedara* (Semantan Malay), *sengkanyat* (Iban), *sengkayap* (Iban), *tongkat ali* (Santubong & Miri), *tungkat ali* (Lundu).

Distribution. Lower Burma, Thailand, Laos, Cambodia, Indo-China; Malesia: Sumatra, Peninsular Malaysia, and Borneo. Common throughout both Sabah and Sarawak; also in Brunei and Kalimantan

Ecology. Abundant on well-drained sandy soils below 1200 m, in primary and secondary mixed dipterocarp, heath and submontane forests.

Uses. In Sabah the roots are mixed with other medicinal plants, e.g., *Cinnamomum* species, and used to prepare a health tonic. In Brunei, the bark is used as a blood coagulant in complication during childbirth. The young leaves can be eaten raw to cure stomach-aches. In Peninsular Malaysia, Chan *et al.* (Planta Medica 52 (1986) 105) reported that methanol-extracts of roots contained biologically active compounds showing a strong antiplasmodial activity against a multi-drug resistant K1 strain of *Plasmodium falciparum* from Thailand. The putative aphrodisiac properties of the roots have, as yet, been substantiated by rigorous experiment.

5. **IRVINGIA** Hook.*f.*

(E.G. Irving, 1816–1855, Scottish botanist)

pauh kijang

Trans. Linn. Soc. 23 (1860) 167; Ridley *l.c.* 363; Corner *l.c.* 699; Nooteboom, FM 1, 6 (1962) 223; Kochummen *l.c.* 350; Cockburn *l.c.* 221; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330.

Large trees; buttresses steep, to 6 m high. **Bark** fawn, smooth with distant loose scales, minutely lenticellate; inner bark mottled, cream-yellow. **Sapwood** orange-brown. *Twigs with stipules forming a narrow, conical cap* surrounding the terminal buds, soon falling, leaving conspicuous *annular scars*. **Leaves** *simple*, glabrous, entire. **Inflorescences** axillary

and terminal *panicles*. **Flowers** (4–)5-merous, *bisexual;* sepals connate (united) at the base; petals overlapping in buds; stamens twice as many as petals, inserted beneath the large, cushion-shaped, intrastaminal disc; ovary 2-chambered, conical or somewhat flattened, sessile; style 1, stigma inconspicuous; ovules solitary. **Fruit** a *drupe*, large, 1–2-seeded, *resembling* a *mango*.

Distribution. 3 species in tropical Africa and 1 species in tropical SE Asia and W Malesia.

Ecology. Frequent in lowland forests.

Uses. The fruit of all species is edible, but usually only the seeds are eaten.

Irvingia malayana Oliv. *ex* A.W. Benn. Fig. 5.
(of Malaya)

in Hooker *f*., Fl. Brit. Ind. 1 (1875) 522; Ridley *l.c.* 364; Corner *l.c.* 699; Nooteboom, FM 1, 6 (1962) 223; Kochummen *l.c.* 350; Cockburn *l.c.* 221; Burgess TBS (1966) 455; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330. **Type:** *Maingay 298*, Malacca (holotype K). **Synonyms:** *Irvingia oliveri* Pierre, Fl. For. Coch. 4 (1892) *t.* 263 B; *Irvingella malayana* van Tiegh., Ann. Sc. Nat. 9, 1 (1905) 276; *Irvingella oliveri* (Pierre) van Tiegh. and *Irvingella harmandiana* van Tiegh. *l.c.* 279; *Irvingia harmandiana* (van Tiegh.) Pierre *ex* Lecomte, Fl. Gen. I.-C. 1 (1911) 701; *Irvingia longipedicellata* Gagnep., Fl. Gen. I.-C. Suppl. 1 (1946) 670.

Medium-sized to large tree reaching 50 m tall and 50 cm diameter, with big limbs; buttresses steep, plank-like and spreading, to 3 m high. **Bark** greyish to whitish, scaly to flaky, sometimes smooth, minutely lenticellate. **Leaves** elliptic-oblong to lanceolate, 8–20 x 2.5–9 cm, upper surface shiny, lower surface slightly glaucous especially when fresh; base often rounded, apex usually pointed; midrib raised above; lateral veins 10–16 pairs, looping and joining at margin, prominent on both surfaces; stipule-cap 3–4 cm long. **Flowers** greenish white or yellowish, small. **Fruits** ellipsoid, *c.* 6 x 4 cm, slightly glaucous. **Seedling** with first two leaves opposite; germination epigeal.

Vernacular names. Sabah—*mengkudu* (Dusun/Kadazan Tuaran/Ranau; doubtful, as this name normally refers to *Morinda* in the Rubiaceae), *pauh kijang* (Malay), *selangan tandok* (Malay), *tenghilan* (Dusun/Kadazan Tuaran). Sarawak—*patok entilit* (Iban).

Distribution. Thailand, Indo-China, and Malesia (Sumatra, Peninsular Malaysia, Borneo and Bawean). Widespread in Sabah and Sarawak. Also in Brunei and Kalimantan.

Ecology. Scattered in mixed dipterocarp forest on clay-rich soils, to 300 m.

Timber. Burgess (*l.c.* 455) summarises the timber properties of this species. *Pauh kijang* produces a very strong and springy timber, hard to saw and work, due to the high density. It takes a very fine finish, and requires very little filling, and turns very well. In Sandakan, furniture of this timber glued with synthetic resin glues has tended to fail at the glue-line.

Uses. The yellow wood is too hard to work with and not very durable. In Peninsular Malaysia, it has been used for making *kris*-handles and handles of tapping knives (Nooteboom, *l.c.*). The seeds contain a creamy yellow, nice-smelling fat known as "dika" fat in Europe, used for making soap, wax, and candles. The seeds can also be eaten (Nooteboom, *l.c.*).

6. **PICRASMA** Blume

(Greek, *pikros* = bitter, *osme* = smell or taste; the bark and other parts)

Bijdr. 5 (1825) 247; Ridley *l.c.* 361; Burkill *l.c.* 1723; Nooteboom, FM 1, 6 (1962) 212; Kochummen *l.c.* 351; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330.

Trees or shrubs. **Leaves** *pinnate, with terminal leaflet, stalk base and rachis nodes usually swollen*; *leaflets* opposite or subopposite, *entire, veins prominent on both upper and lower surfaces; stipules present, suborbicular* and falling off early. **Inflorescences** axillary, long-peduncled, compound-cyme, unisexual (plants monoecious or dioecious). **Flowers** 4–5-merous, female usually twice as large as male; sepals small, free to united half way up; petals persistent in female, much longer than the sepals; stamens 4–5; disc thick; carpels up to 7, free, each with 1 ovule, vestigial or absent in male; styles united except at base, sometimes 1 or 2, free; stalks jointed in the lower half. **Fruit** 1–4, drupe-like; exocarp thin, fleshy, wrinkled when dry; endocarp hard. **Seeds** without endosperm.

Distribution. About 8 species, 6 in tropical America, 2 species in Asia including 1 in Malesia.

Uses. *Picrasma* species contain alkaloids, the source of quassia chips used in insecticide.

Picrasma javanica Blume Fig. 6.

(of Java)

l.c. 248; Ridley *l.c.* 361; Burkill *l.c.* 1723; Nooteboom, FM 1, 6 (1962) 213; Kochummen *l.c.* 351; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330. **Type:** *Blume, s.n.*, Java (holotype L). **Synonyms:** *P. nepalensis* A.W. Benn., Pl. Jav. Rar. (1844) 201; *P. andamanica* Kurz *ex* A.W. Benn. in Hooker *f. l.c.* (1875) 520; *P. philippinensis* Elmer, Leafl. Philip. Bot. 5 (1913) 1837.

Tree to 24 m tall and 25 cm diameter; bole fluted. **Bark** dark, smooth, brittle; inner bark dull yellow. **Sapwood** with clearly visible vessels. **Leaves** with 5–7 leaflets, stalk 2–6 cm long; leaflets entire, 4–20 x 1–10 cm; base wedge-shaped, margin wavy or wrinkled, apex acuminate; lateral veins 3–8 pairs, petiolules to 7 mm long; stipules leafy, nearly rounded, 7–25 x 5–20 mm, usually falling off early leaving a large scar. **Inflorescences** to 20 cm long. **Flowers** *4-merous*, white to yellow or green; sepals glabrous to puberulous, triangular to ovate, *c.* 1 mm; petals ovate-oblong or oblong, often acute-acuminate to mucronate, glabrous, or sparsely hairy, with a conspicuous midrib; stamens usually longer than petals in male flowers, shorter than petals in female flowers, filaments gradually thinner towards the top, hairy at base, 0.5–2 mm long in female flowers and 1–5 mm in male flowers, anthers 1–2 mm long in male and to 1 mm and empty in female flowers; ovary 4-lobed, 4-carpellate, glabrous to hairy, styles 1–1.5 mm long, stigmas *c.* 2 mm. **Fruits** green to red or blue, ovoid to depressed globlose, 9–10 x 7–12 mm. **Seeds** with a broad hilum; testa rather thick and hard.

Vernacular names. Sabah—*balimbing, panguban* (Dusun/Kadazan Tambunan). Sarawak—*kayu pahit* (Malay).

Distribution. Tropical SE Asia (from Sikkim, Assam, Burma and Tonkin southward to Malesia). In Borneo, recorded in Sarawak only at about 400 m on the Gunung (Mt.) Api limestone, at Mulu, and in Sabah on the west coasts.

Ecology. Uncommon, usually scattered in rainforests from near sea-level to 1500 m.

Uses. The bark contains quassin, which gives its bitter taste. In Java, the leaves have been applied for treating sores (Nooteboom *l.c.*). The trunk is too small for timber and the wood is not durable (Burkill *l.c.*).

7. **QUASSIA** L.

(named after a slave in Surinam who reported
the medicinal properties of the wood to Dalberg, friend of Linnaeus)

Sp. Pl. ed. 2 (1762) 553, *l.c.* (1763) 1679; Merrill *l.c.* (1921) 315 (as *Samadera*); Ridley *l.c.* 363; Burkill *l.c.* 1945; Masamune *l.c.* 362 (as *Samadera*); Nooteboom, FM 1, 6 (1962) 198, Blumea 11 (1982) 514; Kochummen *l.c.* 352; Cockburn *l.c.* 217.

Trees or shrubs. **Leaves** pinnate or simple, *with pitted glands on the upper surface* along the margin and especially at the apex; stipules and scars absent. **Inflorescence** a simple or branched raceme, a panicle, or an umbel. **Flowers** *4–6-merous, unisexual or bisexual, or polygamous;* petals imbricate or contorted in bud, longer than the calyx, sometimes very long; stamens hairy, adaxial scale with a shorter or longer free apex; disc cylindrical or subglobose; carpels free, more or less puberulous; style 1, with a terminal, inconspicuous stigma. **Fruits** 1–6 per flower, *drupaceous or woody*, often compressed laterally, with a narrow, unilateral, sharp-edged thinner part in the apical half. **Seeds** with a thin testa, without endosperm.

Distribution. Pantropical, *c*. 25 species in tropical and subtropical America, 5–10 species in Africa, 2 species in lower Burma and Cambodia (one of which is found almost throughout Malesia), 1 species endemic to Borneo and Sumatra, and 2 species in Queenslands.

Ecology. In lowland rain forests.

Key to *Quassia* species

Leaves pinnately compound. Flowers in panicles. Fruits 1–5 from each flower, drupaceous, slightly flattened, ellipsoid.....**1. Q. borneensis**

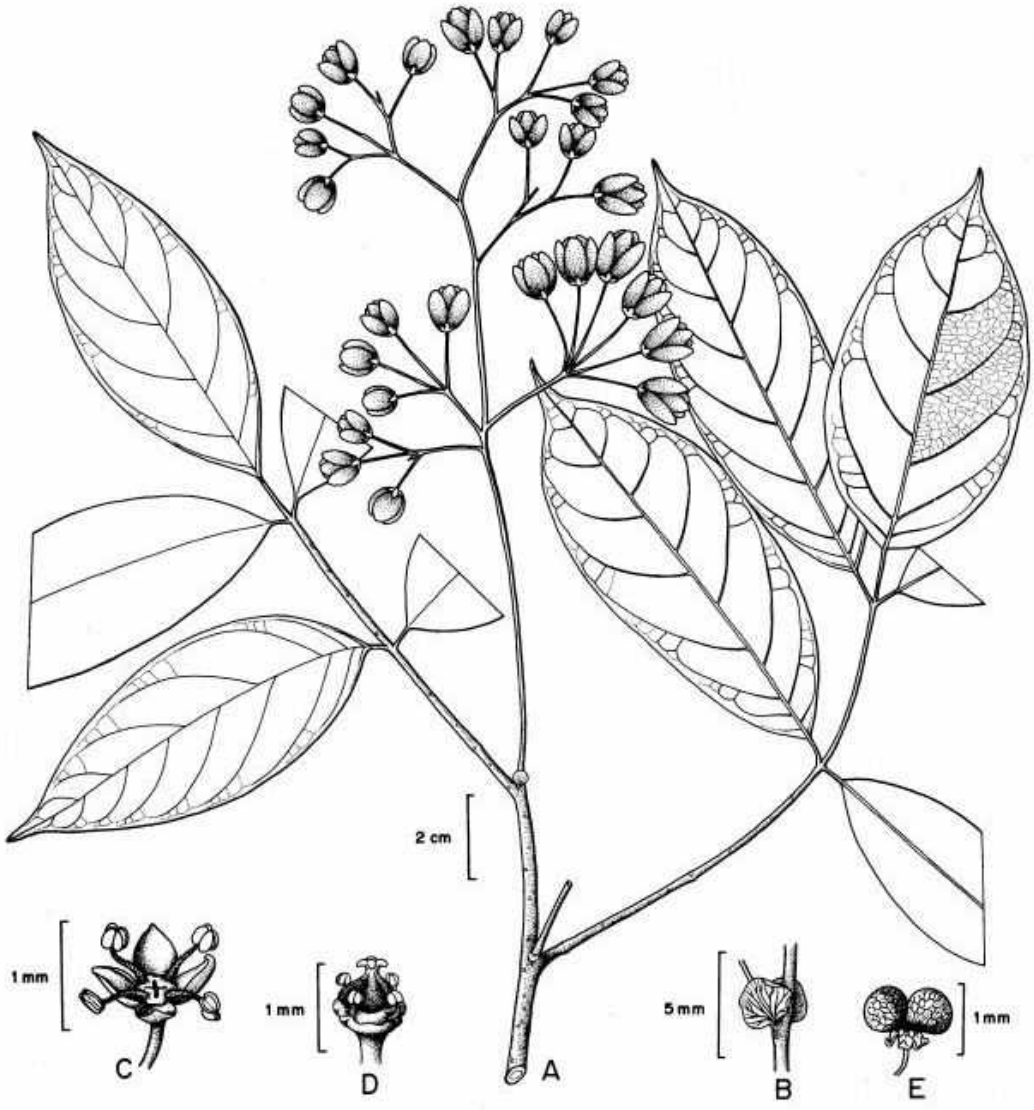

Fig. 6. *Picrasma javanica.* A, flowering leafy twig; B, stipules; C, male flower; D, female flower; E, fruits. (A from *de Wilde & de Wilde-Duyfjes 14843,* B–E after FM 1, 6 (1962) 213, fig. 15.)

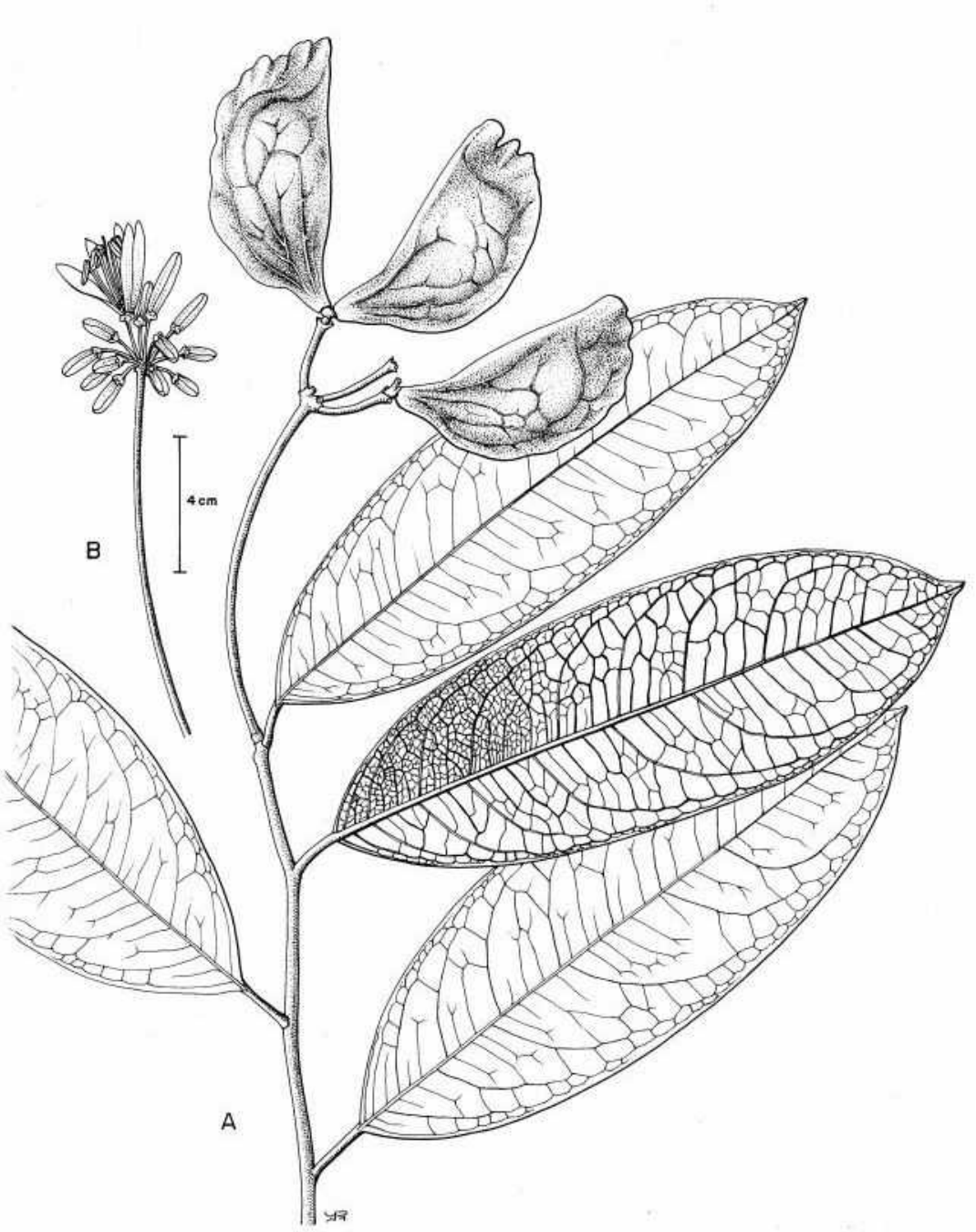

Fig. 7. *Quassia indica.* A, fruiting leafy twig; B, inflorescence. (A from *S. 42968,* B from *S. 16407.*)

Leaves simple. Flowers in umbel-like clusters. Fruits 14 from each flower, strongly flattened, with straight inner and semicircular outer margin.....**2. Q. indica**

1. **Quassia borneensis** Noot.
(of Borneo)

FM 1, 6 (1962) 203, Blumea 11 (1962) 518; Cockburn *l.c.* 219; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330. **Type:** *Meijer SAN 20499,* Sabah (holotype L; isotypes K, SAN).

Tree to 25 m tall and 25 cm diameter; buttresses low. **Bark** pale yellow to greyish brown, densely fissured-corky. **Sapwood** white. **Leaves** *pinnate, spirally arranged; leaflets 2–4 pairs, elliptic to obovate-oblong,* 8–12 x 4–4.5 cm, glabrous, upper surface shiny, lower surface dull; with small pitted glands along the margins and in the acumen on the upper surface; base cuneate, *apex shortly rounded to acuminate; lateral veins sunken on both surfaces,* obscure, ending in a marginal vein; stalk *c.* 5 cm long, rachis terete, petiolules 1–1.5 cm long, articulated at the base. **Inflorescences** puberulous all over, shorter than the leaves. **Flowers** (male) *4–5-merous,* pedicels to 7 mm long; calyx *c.* 1 mm high; petals contorted or imbricate in bud, glabrous, elliptic to ovate-oblong, 3–4 x 2 mm; stamens slightly shorter than the petals, anthers oblong; disc *c.* 0.5 mm high, at the base *c.* 2 mm wide and at the apex *c.* 1 mm wide, the upper half distinct from the lower half and folded around the barren ovaries. **Fruits** *1–5 in each flower, drupaceous,* prune-shaped, dark purple-red when ripe, slightly flattened-ellipsoid, with a faint dorsal and ventral ridge, 2–3 x 1.5 cm; pericarp thin but hard. **Seeds** with a thin testa; cotyledons large, green, plano-convex.

Vernacular names. Sabah—*mamungal* (Malay), *pait-pait* (Malay). Sarawak—*medang pahit* (Malay).

Distribution. Malesia: Sumatra (Indragiri), Borneo (Sabah and Sarawak). Uncommon.

Ecology. Primary mixed dipterocarp forest on humult ultisols; also, rarely, in peat swamp and *kerangas* (heath) forests.

2. **Quassia indica** (Gaertn.) Noot. Fig. 7.
(of the Indies)

FM 1, 6 (1962) 199, Blumea 11 (1962) 517; Kochummen *l.c.* 352; Cockburn *l.c.* 217; Anderson *l.c.* 323; Whitmore, Tantra & Sutisna *l.c.* 330. **Basionym:** *Samadera indica* Gaertn., Fruct. 2 (1791) 352, *t.* 156, f. 3. **Type:** *Gaertner, Fruct. 2 (1791) 352, t. 156, f. 3.* **Synonyms:** *Manungala pendula* Blanco, Fl. Filip. (1837) 306; *Samadera brevipetala* Scheff., Nat. Tijd. Ned. Ind. 32 (1871) 410.

Tree or shrub, to 20 m and 8 cm diameter. **Bark** brownish green, smooth; inner bark pinkish. **Sapwood** pale yellow; cambium yellow. Branchlets with small pith, with several stiff persistent scales at the base of each shoot. **Leaves** simple, elliptic-oblong to lanceolate, 12–13 x 4–12 cm; base acute or sometimes rounded, or subcordate, apex blunt or acuminate or sometimes rounded; midrib, lateral and intercostal veins prominent on both

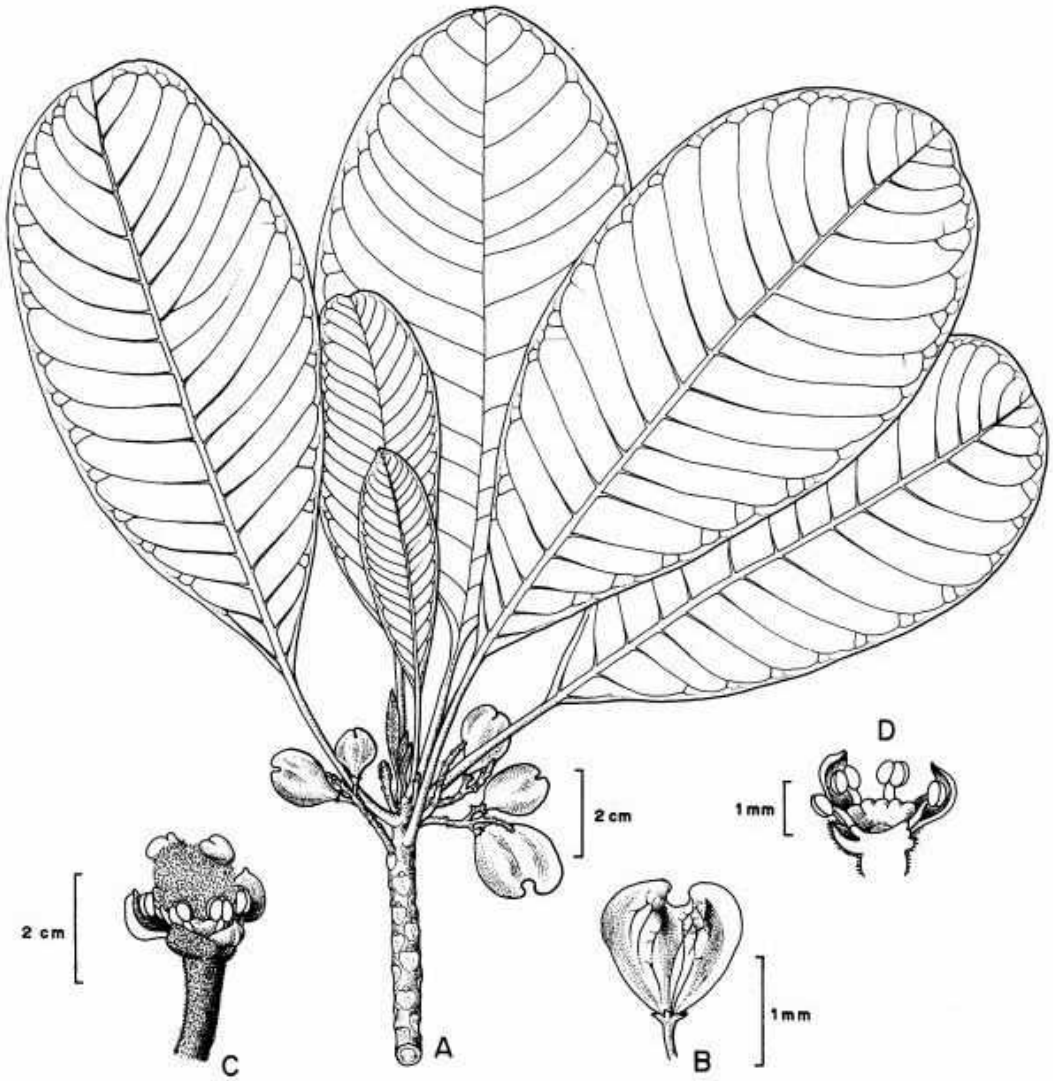

Fig. 8. *Soulamea amara*. A, fruiting leafy twig; B, fruit; C, flower; D, longitudinal section of flower with pistil removed. (After FM 1, 6 (1962) 222, fig. 21.)

surfaces; stalks 1–2.5 cm long. **Inflorescences** jointed at the lower half, 0.5–2.5 cm, growing during anthesis; bracts minute. **Flowers** to 20 or more; calyx 4-lobed, 2–3 mm long, lobes about as long as or longer than the tube, puberulous outside; petals 4, free, dorsally puberulous, obtuse, usually narrowed to the base, creamy green to violet, to 3 x 1 cm; filaments puberulous, hairy except toward the apex, to 2.5 cm long, inserted at the base of the disc, anthers lanceolate to oblong, *c.* 4 x 2 mm; styles to 2 mm long. **Fruits** *1–4 together, flattened, with straight inner and semicircular outer margin*, which is sharp and thinner in the upper half, the apex more or less overtopping the subapical stylar scar, 4–9 x 2.5 cm.

Vernacular names. Sabah—*kacang-kacang* (Malay), *kelapahit* (Sook Murut). Sarawak—*manuggal* (Iban).

Distribution. Madagascar, Sri Lanka, S Concan, Malabar, Lower Burma (Martaban, Tenasserim), Andamans, and Cochinchina, through Malesia to the Bismarcks and Solomons. In Sabah, it is found mainly in the east coast (Sandakan & Lahad Datu districts), with only a few records from the west coast (Sipitang district). In Sarawak, it is found throughout the state.

Ecology. Locally abundant in tidal swamp forests below 150 m, sometimes in localities which are periodically inundated by fresh or salt water, for example on the edge of mangroves. Occasional in freshwater swamp forest; also occurs in mixed dipterocarp forest.

Uses. In Sarawak, the wood is used for making knife-handles. The seeds are given as an emetic and purgative, and sometimes in bilious fevers (Nooteboom *l.c.*).

8. **SOULAMEA** Lam.

(*soelamoe*, a Ternatean name for the plant)

Dict. Enc. Meth. 1 (1783) 449; Masamune *l.c.* 362; Nooteboom, FM 1,6 (1962) 221; Cockburn *l.c.* 217.

Shrubs or small trees. **Leaves** *simple, obovate, spirally arranged, densely clustered at shoot tips,* sometimes with few glands underneath. **Flowers** in axillary racemes or narrow thyrses, *3(–4–5)-merous, bisexual;* floral parts persistent; sepals more or less connate at the base, slightly imbricate in bud; petals longer than sepals; stamens twice as many as petals, in 2 distinct rows, inserted under the lower outer margin of the disc, anthers versatile; disc 3(–4–5)-lobed, each lobe forked; ovary (1–)2–3-carpellate, styles horizontally adnate to their carpels, stigmas small; ovules sessile. **Fruits** dry, (1–)2(–3)-celled, indehiscent, flattened, *distinctly winged,* more or less emarginate, rarely flattened, ovoid, acute. **Seeds** attached adaxially nearly halfway down; testa thin; cotyledons plano-convex.

Distribution. 9 species. One species is endemic to the Seychelles, 6 species occur in New Caledonia, and one species in Fiji. One species is widely distributed in Malesia and Polynesia, and it occurs in Sabah and Sarawak.

Soulamea amara Lam. Fig. 8.

(Latin, *amarus* = bitter; the taste of the tissues)

l.c. (1783) 449; Miquel, Fl. Ind. Bat. 1, 2 (1859) 129; Masamune *l.c.* 362; Nooteboom, FM 1, 6 (1962) 221; Cockburn *l.c.* 217. **Type:** *Rumphius Herb. Amb. t. 415* (L). **Synonyms:** *Rex amaroris* Rumph., Herb. Amb. 2 (1743) 129, *t.* 41; *Cardiocarpus amarus* Reinw., Syll. Ratisb. 2 (1826) 14; *Cardiophora hindsii* Benth. & Hook. *f.*, Lond. J. Bot. 2 (1843) 216.

Shrub or small tree to 5(–15) m tall; young shoots and buds rusty tomentose. **Leaves** crowded at the apex of the branchlets, on dropping leaving large scars; blade obovate-oblong, 10–35 x 4–12 cm; base cuneate, apex blunt but sometimes mucronate; midrib and veins hairy below; midrib slightly immersed or inconspicuous above, strongly prominent beneath; lateral veins straight, parallel, ending in an intramarginal looped vein, sulcate, slightly prominent or inconspicuous above; intercostal veins finely dense-reticulate beneath; *stalks* pithy, shrunken at the base when dry, sometimes also at apex, hairy, *3–8 cm long*. **Inflorescences** erect, shorter than the leaves, 3–12 cm long. **Flowers** *c.* 2 mm long; pedicels to 5 mm long; sepals puberulous, erect, appressed, 0.5–1.0 mm long; petals concave, spreading, finally reflexed, sparsely hairy to glabrous, accrescent, to 2.5 x 1 mm; stamens with glabrous filaments to 1 mm long, anthers *c.* 0.75 mm long; ovary 2–3-carpellate, never with more than 2 carpels fertile, carpels connate except at the top. **Fruits** obcordate, to 2 x 2.5 cm, strongly emarginate; pericarp hard and corky; wings often nearly touching near the inward curved style-bases. **Seeds** round, 0.5–1 cm across.

Distribution. From Borneo eastwards to Micronesia (West and East Carolines and Marshalls) and Melanesia (New Britain, Solomons, New Hebrides); in Malesia: Borneo (Sabah, Sarawak, Karimata Is.), Moluccas, and New Guinea.

Ecology. A typical constituent of the *Barringtonia*-formation of the beach vegetation, but much rarer than most of the species belonging to that formation, though locally common on the sandy beaches and behind coral reefs.

Uses. None known in Sabah and Sarawak. The roots and the fruits of this very bitter plant have been used to treat cholera, pleurisy, and other fevers; a beverage prepared from powdered leaves is taken against colic and cough, and the fruits have been used to induce vomitting in treating snake bites (Nooteboom *l.c.*).