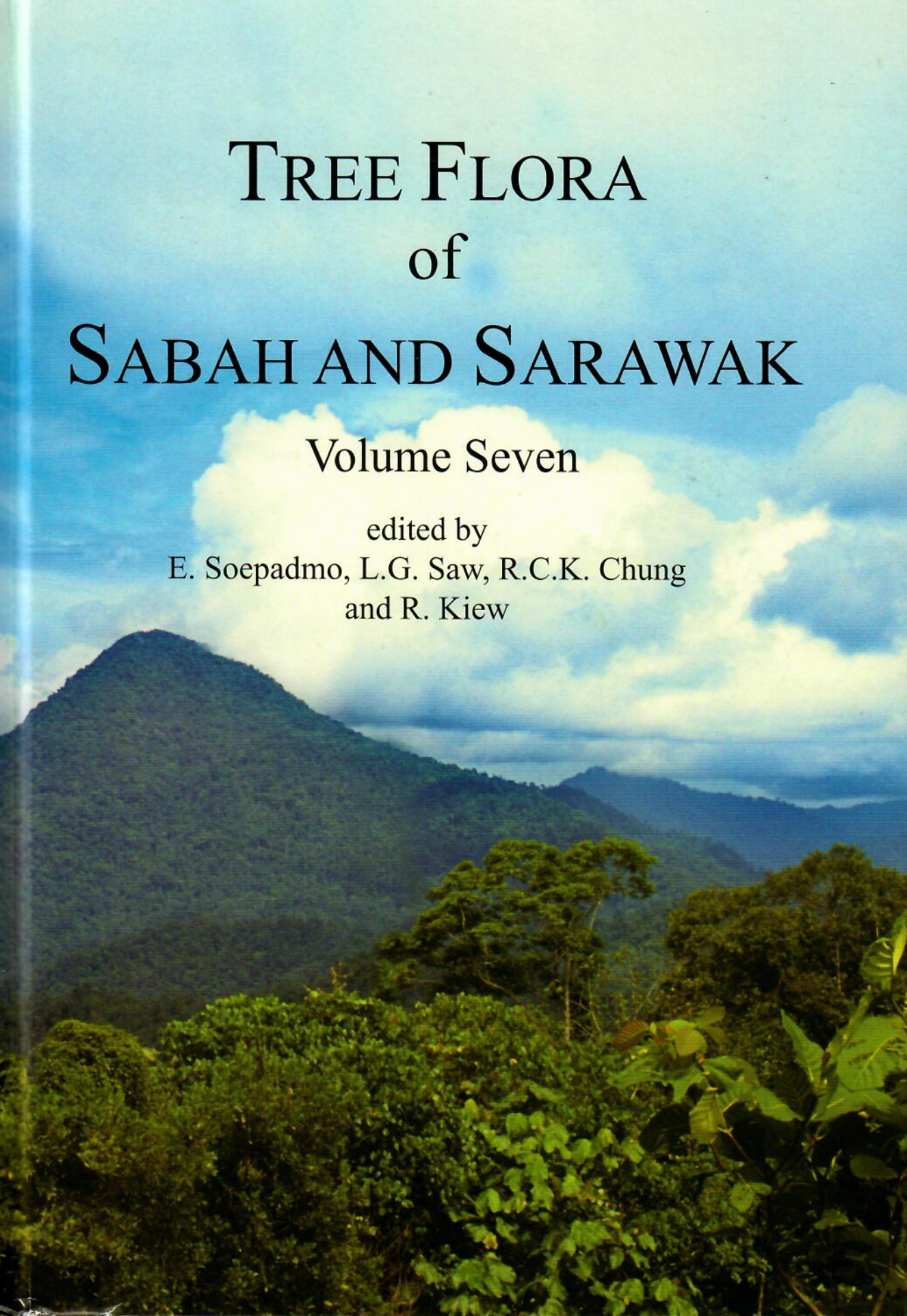
TREE FLORA of SABAH AND SARAWAK

Volume Seven

edited by
E. Soepadmo, L.G. Saw, R.C.K. Chung
and R. Kiew



Tree Flora
of
Sabah and Sarawak

Produced with the financial support of

THE GOVERNMENT OF MALAYSIA UNDER THE NINTH MALAYSIAN PLAN

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A joint publication of

Sabah Forestry Department, Malaysia

Forest Research Institute Malaysia

Sarawak Forestry Department, Malaysia

2011

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First published 28 October 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Tree Flora of Sabah and Sarawak / edited by E. Soepadmo … [*et al.*]
ISBN 978-967-5221-44-6 (v. 7)

1. Trees–Sabah–Identification. 2. Trees–Sarawak–Identification.
I. Soepadmo, E. II. Institut Penyelidikan Perhutanan Malaysia.
582.160959521

Front cover: Hill mixed dipterocarp and lower montane forests enroute to the Usun Apau Plateau in Belaga district, Sarawak. (Photograph by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E. Soepadmo.)

Printed in Malaysia by Straits Digital Sdn. Bhd., Selangor

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LAMIACEAE *s.l.*

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Martinov, Tekhno-Bot. Slovar (1820) 355, *nom. cons.*; Adanson, Fam. Pl. 2 (1763) 180 (as Labiatae *s.s.*); J.St.Hilaire, Exp. Fam. Nat. 1, 2 (1805) 245 (as Verbenaceae *s.l.*, *p.p.*); Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 807 (as Verbenaceae *s.l.*, *p.p.*) & 822 (as Labiatae *s.s.*); Schauer *in* A. de Candolle, Prodr. 11 (1847) 522 (as Verbenaceae *s.l.*, *p.p.*); Bentham *in* A. de Candolle, Prodr. 12 (1848) 27 (as Labiatae *s.s.*); Miquel, Fl. Ind. Bat. 2 (1858) 856 (as Verbenaceae *s.l.*, *p.p.*) & 934 (as Labiatae *s.s.*); C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 560 (as Verbenaceae *s.l.*, *p.p.*); Hooker *f.*, Fl. Brit. Ind. 4 (1885) 604 (as Labiatae *s.s.*); Briquet *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 132 (as Verbenaceae *s.l.*, *p.p.*) & 182 (as Labiatae *s.s.*); Prain, J. As. Soc. Beng. 74, Extra No. (1908) 699 (as Labiatae *s.s.*); Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 794 (as Verbenaceae *s.l.*, *p.p.*); H.J. Lam, Verben. Malay. Archip. (1919) 1 (as Verbenaceae *s.l.*, *p.p.*), H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 1 (as Verbenaceae *s.l.*, *p.p.*); Merrill, EB (1921) 511 (as Verbenaceae *s.l.*, *p.p.*) & 519 (as Labiatae *s.s.*), Enum. Philip. Pl. 3 (1923) 380 (as Verbenaceae *s.l.*, *p.p.*) & 519 (as Labiatae *s.s.*); Ridley, FMP 2 (1923) 611 (as Verbenaceae *s.l.*, *p.p.*) & 642 (as Labiatae *s.s.*); Masamune, EPB (1942) 638 (as Verbenaceae *s.l.*, *p.p.*) & 646 (as Labiatae *s.s.*); Keng, Gard. Bull. Sing. 24 (1969) 13 (as Labiatae *s.s.*), FM 1, 8 (1978) 301 (as Labiatae *s.s.*); Kochummen, TFM 3 (1978) 301 (as Verbenaceae *s.l.*, *p.p.*); Keng, OFMSP (1983) 287 (as Verbenaceae *s.l.*, *p.p.*) & 208 (as Labiatae *s.s.*); Coode *et al.* (eds.), CLBD (1996) 148 (as Labiatae *s.s.*) & 329 (as Verbenaceae *s.l.*, *p.p.*); Corner, WSTM 4th. edition 2 (1997) 742 (as Verbenaceae *s.l.*, *p.p.*); Argent *et al.* (eds.), MNDT-CK 2 (1997) 652 (as Verbenaceae *s.l.*, *p.p.*); Kessler (ed.), Secondary Forest Trees Kalimantan (2000) 191 (as Verbenaceae *s.l.*, *p.p.*); Beaman *et al.*, PMK 4 (2001) 389 (as Lamiaceae *s.s.*); Beaman & C. Anderson, PMK 5 (2004) 452 (as Verbenaceae *s.l.*, *p.p.*); Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 167 (as Labiatae *s.l.*); Brummitt *in* Heywood *et al.*, Flow. Pl. Fam. World (2007) 179 (as Lamiaceae *s.l.*); Mabberley, PB 3rd. edition (2008) 460 (as Labiatae *s.l.*); Bremer *et al.*, APG III (2009) 117 (as Lamiaceae *s.l.*).

Trees, shrubs, lianas, or herbs, aromatic or not. **Leaves** simple or compound, opposite, decussate or whorled, rarely alternate, without stipules. **Inflorescences** cymose with the cymes often arranged in terminal lax or congested thyrses that appear as corymbs, panicles, spikes, umbels, racemes or occasionally reduced to single flower; bracts usually present, sometimes leaf-like. **Flowers** bisexual, rarely unisexual; calyx actinomorphic (radially symmetrical) to weakly zygomorphic (bilaterally symmetrical), campanulate (bell-shaped), cup-shaped or tubular, rim truncate or (2–)3–5(–7)-lobed, sometimes 2-lipped; corolla actinomorphic or zygomorphic, limb 4–6(–7)-lobed, often 2-lipped, tube straight, hypocrateriform (salver-shaped) or funnel-shaped; stamens 4–6(–7), sometimes with 1 or more staminodes present, equal or didynamous, included or exserted, anther thecae parallel or divergent; ovary superior, unlobed to shallowly 4-lobed, 4–5(–7)-locular, each locule

with 1–2 ovules, style terminal or subterminal, stigma bi-lobed, rarely peltate or capitate (in *Callicarpa*). **Fruits** drupaceous with (1–2)4–10(–14) one-seeded pyrenes, or dry and indehiscent, or schizocarps splitting into 2 two-seeded or 4 one-seeded mericarps (nutlets); mericarps often sculptured, tuberculate, hairy or rarely winged; mucilage cells often present. **Seeds** with or without endosperm; embryo straight or bent; germination epigeal.

Distribution. The Lamiaceae (*sensu* Harley *et al.* 2004, see discussion below) family, with *c*. 236 genera and *c*. 7000 species, has a cosmopolitan distribution. In Borneo, it is represented by 27 genera, including *c*. 130 species. The genus *Faradaya* F.Muell. is excluded from this treatment as it has only ever been recorded once in Borneo, from Sandakan. This specimen either represents a failed introduction or is mislabelled (de Kok & Mabberley, Blumea 44 (1999) 321).

Ecology. Primary or secondary vegetation; many species are common in open areas. Some genera (*Callicarpa* and *Teijsmanniodendron*) are rich in species with a narrow distribution range confined to primary rainforest. A significant number of genera are represented by introduced pantropical weeds (e.g., *Hyptis*, *Leonurus*) some of which have become naturalised.

Uses. The genus *Tectona* has long been of interest to the timber industry due to the highly valuable *Tectona grandis*, commonly known as teak. In addition, wood of some species of *Vitex*, *Teijsmanniodendron*, *Peronema* and *Gmelina* is also of commercial value. Documented medicinal uses of many genera and species are wide-ranging (*cf.* PROSEA 12, 1 (1999) 403–409, 413–417, 438–442, 497–502; *ibid.* 12, 2 (2001) 129–133, 171–178, 278–281, 443–445; and *ibid.* 12, 3 (2003) 54–55, 211–212, 218–219, 256–259, 267–268, 298–299, 355–356, 378–379).

Notes. The Lamiaceae *s.l.*, as presented here, follows the currently accepted classification of Harley *et al.* (2004). In this circumscription the Lamiaceae *s.l.* includes a number of genera that in the past were considered part of the Verbenaceae *s.l.*, *sensu* Briquet. In Briquet's (1895) classification, the Verbenaceae *s.l.* was subdivided into 7 subfamilies and 13 tribes. Of these only the subfam. Verbenoideae, with its characteristic racemose inflorescence, represented in SE Asia by *Verbena* L. and several introduced genera (e.g., *Lantana* L., *Lippia* L., *Stachytarpheta* Vahl., *Duranta* L., *Citharexylum* L. and *Petrea* L.) are now considered truly verbenaceous (Atkins *in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 449–468). All other subfamilies (Caryopteridioideae, Chloanthoideae, Viticoideae *sensu* Briquet) have been transferred to the Lamiaceae *s.l.* (see Harley *et al.* (2004) for a detailed overview). This transfer is based on the increased understanding of morphological characters as well as molecular phylogenetic relationships within these groups.

The Verbenaceae *s.s.* have an indeterminate racemose inflorescence and a salver-shaped corolla with stamens included in the tube; the Lamiaceae *s.l.* have a cymose inflorescence with determinate, usually opposite cymes, and the corollas are tubular and usually bilabiate (occasionally more or less actinomorphic), with the stamens usually exserted from the tube (rarely held within). The cymes in the Lamiaceae *s.l.* can be arranged along an indeterminate axis, forming a thryse. Occasionally cymes are reduced to single flowers, leading the inflorescence to appear raceme-like. However, in these cases, the bracteoles subtend the flowers revealing the cymose nature of the inflorescence.

On an anatomical scale, the Verbenaceae *s.s.* can be distinguished by the thickened pollen exine near the apertures, and by ovules that are attached marginally on the carpel margin. In

the Lamiaceae *s.l.*, the pollen exine is not thickened near the aperture, and the ovules are attached submarginally.

For genera formerly included in the Labiatae *s.s.* or Lamiaceae *s.s.* (*cf.* Keng, Gard. Bull. Sing. 24 (1969) 13–180 and FM 1, 8 (1978) 301–394), comprising herbs, lianas, or shrubs of less than 5 m tall or trees of the former Verbenaceae *s.l.*, which are not native to Sabah and Sarawak, only brief descriptions are given in the key to genera.

The trees and shrubs treated in full here belong mostly to genera transferred from the Verbenaceae *s.l.* Now considered as Lamiaceae *s.l.*, the genera fall within subfam. Viticoideae (*Vitex*, *Premna*, *Teijsmanniodendron*, *Gmelina*) and subfam. Ajugoideae (*Clerodendrum*, *Rotheca* and *Volkameria* L.). However, a number of other genera remain unplaced (*Peronema*, *Tectona* and *Callicarpa*). Bramley *et al.* (Taxon 58, 2 (2009) 500–510) suggested that subfam. Viticoideae is not monophyletic, its members being spread between a number of clades which include genera currently recognised as *incertae sedis* (*Peronema*, *Petraeovitex* and *Tectona*). *Vitex* and *Teijsmanniodendron*, as well as other allied genera that do not occur in Borneo, form a well supported clade.

Key to genera

1. Trees, lianas or shrubs, very rarely herbs. Style terminal. Fruit drupaceous or dry, indehiscent or splitting into clavate basally winged nutlets.....2
   Herbs or shrubs. Style usually gynobasic, sometimes subterminal. Fruit a schizocarp, dividing into 4 nutlets, rarely 1 or 2 aborted.....20

2. Leaves pinnately compound with 4–19 leaflets; rachis often winged. Stamens 2 fertile, 2 reduced.....

   Peronema Jack

   (Greek, *peros* = disabled, *nema* = thread; referring to the two reduced thread-like stamens)

   Malay. Misc. 2 (1822) 46; Miquel, Fl. Ind. Bat. 2 (1858) 908; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 857; H.J. Lam, Verb. Malay. Archip. (1919) 321; Merrill, EB (1921) 518; Ridley, FMP 2 (1923) 636; Masamune, EPB (1942) 642; Backer & Bakhuizen *f.*, FJ 2 (1965) 612; Kochummen, TFM 3 (1978) 306; Corner, WSTM 4th. edition 2 (1997) 749; Argent *et al.* (eds.), MNDT-CK 2 (1997) 653; Kessler (ed.), Secondary Forest Trees Kalimantan (2000) 196, fig. 198; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 268.

   Evergreen or deciduous shrubs or small to medium-sized trees to 30 m tall, to 70 cm diameter; non-aromatic. Twigs tetragonal in cross-section. Leaves pinnately compound; rachis often winged; leaflets 4–19, alternate to subopposite, sessile or subsessile; blades elliptic to lanceolate. Inflorescences cymose, forming large, terminal panicles. Flowers bisexual, small; calyx actinomorphic, non-accrescent, 5-lobed, lobes deltoid, reflexed in fruit; corolla zygomorphic, limb 5-lobed, anterior lobe largest, other lobes equal; anterior stamens 2, fertile, posterior pair reduced to staminodes, included to slightly exserted; ovary unlobed, style with equal or unequal stigma-lobes; disc poorly developed or absent. Fruits dry, globose, villous, 4-seeded, indehiscent or splitting into two or four mericarps. Seeds pendulous; endosperm absent.

   A genus with one species, *P. canescens* Jack, distributed from Peninsular Thailand to Sumatra, Peninsular Malaysia and Borneo (Kalimantan only). Possibly has been introduced to Java (Backer & Bakhuizen *f. op. cit.*)

Leaves simple, unifoliolate or digitately compound with 3–9 leaflets. Stamens 4–5, all fertile.....3

3. Leaves digitately compound; leaflets 3–9.....4
Leaves simple or unifoliolate.....6

4. Lianas. Fruits dry; fruiting calyx with 5 greatly enlarged lobes (wings).....
Petraeovitex Oliv.
(Named after the two genera *Vitex* and *Petrea*, with which it superficially shares some characters)
Hooker's Icon. Pl. 15 (1883) *t.* 1420; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 858; H.J. Lam, Verb. Malay. Archip. (1919) 323; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 97; Merrill, EB (1921) 518, Enum. Philip. Pl. 3 (1923) 406; Ridley, FMP 2 (1923) 637; Masamune, EPB (1942) 642; Munir, Gard. Bull. Sing. 21 (1965) 215; Coode *et al.* (eds.), CLBD (1996) 331; Beaman & C. Anderson, PMK 5 (2004) 452; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc, Pl. 7 (2004) 268.
Lianas. Leaves ternately or biternately compound, opposite or ternate to biternate; blades ovate to obovate, margin entire (rarely few-toothed). Inflorescences axillary, cymose, often forming lax paniculiform thyrses. Flowers bisexual; calyx actinomorphic, accrescent in fruit, 5-lobed, lobes greatly elongated and wing-like in fruit; corolla white to yellow, 5-lobed, nearly actinomorphic or 1-lipped; stamens 4. Fruits dry, indehiscent, 2-loculed, 1–2-seeded (the other ovules aborting), turbinate.
Eight species occur in the forests from Myanmar, Peninsular Thailand and Malesia (except northern parts of the Philippines, Java and the Lesser Sunda Islands) to the Solomon Is. Five species occur in Borneo.
Trees or shrubs, seldom lianas. Fruits fleshy with enlarged calyx lobes to dry without enlarged calyx lobes.....5

5. Petioles conspicuously swollen or thickened at both ends. Fruit with only 1 one-seeded mericarp, usually dry or leathery.....**5. Teijsmanniodendron** (in part)
Petioles not swollen at both ends. Fruit with 1–4 one-seeded mericarps, usually somewhat fleshy.....**6. Vitex** (in part)

6. Leaf base usually with conspicuous discoid glands; lower leaf surface usually with peltate scales. Corolla yellow or white, widely funnel-shaped, greatly enlarged at throat .....**3. Gmelina**
Leaf base not as above, any glands present match those on the rest of leaf blades; lower leaf surface usually without peltate scales. Corolla white, purple or blue, rarely yellow, more or less actinomorphic to narrowly funnel-shaped or salver-shaped, not greatly enlarged at throat.....7

7. Lianas or woody climbers.....8
Trees, shrubs, prostrate shrubs or herbs.....13

8. Inflorescence with inconspicuous bracts.....9
Inflorescence subtended by showy, conspicuous bracts.....11

9. Fruit dry; fruiting calyx with 5 greatly enlarged lobes (wings).....
.....**Petraeovitex** Oliv. (in part, see above)
Fruit fleshy; fruiting calyx without enlarged lobes.....10

10. Inflorescence axillary; inner surface of corolla glabrous or with scattered hairs.....**1. Callicarpa** (in part)
    Inflorescence terminal; inner surface of corolla with dense white hairs.....
    .....**4. Premna** (in part)

11. Inflorescence with large orange bracts; cymes lax, flowers not clustered together. Fruits with long beak.....
    Hosea Ridl.
    (Reverend George Frederick Hose, 1838–1922, Bishop of Singapore, Labuan and Sarawak 1881–1908)
    J. Str. Br. Roy. As. Soc. 50 (1908) 124; Merrill, EB (1921) 517; Masamune, EPB (1942) 641; Coode *et al.* (eds.), CLBD (1996) 331; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 200. Synonym: *Hoseanthus* Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 114, *nom superfl.*
    Lianas; lenticels raised. Leaves simple, decussate, opposite. Inflorescences axillary and terminal, determinate thyrses; first order bracteoles conspicuous, orange-pink. Flowers bisexual; corolla salver-shaped, 4-lobed, deciduous, fragile; stamens 4, exserted. Fruit compound; mericarps 4, but by abortion only 1 or 2 developing.
    One species in Sarawak and Brunei (*Hosea lobbii* (C.B.Clarke) Ridl.).
    Inflorescence and fruits not as above; cymes capitate, 3–9-flowered.....12

12. Involucral bracts 3–4; corolla zygomorphic, 2-lipped and 5-lobed.....
    Congea Roxb.
    (Latinised version of the Bengali name *kungea*)
    Pl. Corom. 3 (1819) 90, *t.* 293; Miquel, Fl. Ind. Bat. 2 (1858) 911; H.J. Lam, Verb. Malay. Archip. (1919) 336; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 100; Ridley, FMP 2 (1923) 640; Backer & Bakhuizen *f.*, FJ 2 (1965) 612; Munir, Gard. Bull. Sing. 21 (1966) 259; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 193.
    Climbing shrubs; branches usually tomentose with mixed simple and stellate hairs. Leaves simple, opposite, margin entire. Inflorescences terminal or axillary panicles; cymes capitate, pedunculate, 3–9-flowered; involucral bracts 3–4. Flowers bisexual; corolla bilabiate, 5-lobed, oblique; stamens 4. Fruit a drupe, obovoid, nearly dry.
    Ten species occur in the forests from Bangladesh and the eastern part of India to SW China and southward to Sumatra and Peninsular Malaysia. In Borneo, only one introduced species, *C. tomentosa* Roxb., has been recorded.
    Involucral bracts 6; corolla actinomorphic, 5–6-lobed.....
    Sphenodesme Jack
    (Greek *sphênos* = wedge, *desmê* = bundle; referring to the wedge-shaped calyces which are bundled together into a dense inflorescence)
    Malay Misc. 1 (1820) 19; Miq., Fl. Ind. Bat. 2 (1858) 909; H.J. Lam, Verb. Malay. Archip. (1919) 331; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 99; Merrill, EB (1921) 518; Masamune, EPB (1942) 643; Ridley, FMP 2 (1923) 637; Munir, Gard. Bull. Sing. 21 (1966) 315; Coode *et al.* (eds.), CLBD (1996) 331; Beaman & C. Anderson, PMK 5 (2004) 457; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 192.
    Woody climber. Leaves simple, opposite, decussate, margin entire. Inflorescences terminal or axillary panicles; cymes capitate, opposite in the axils of leafy bracts, 3-, 5- or 7-flowered; involucral bracts 6, accrescent, much longer than flowers. Flowers bisexual; corolla more or less actinomorphic, lobes 5(–6), sub-equal, imbricate in bud; stamens 5(–7). Fruit a drupe, globular or obovoid, included in the capsule formed by accrescent calyx.

Fourteen species occur from S and E India to S China and southward to Sumatra and Borneo. Six species in Borneo.

13. Petioles conspicuously swollen or thickened at both ends.....
.....**5. Teijsmanniodendron** (in part)
Petioles not swollen or thickened at either end.....14

14. Fruit often somewhat lobed. Corolla tube salver-shaped, rarely tubular.....15
Fruit not lobed. Corolla tube funnel-shaped or tubular.....17

15. Flower bud markedly asymmetrical; corolla expanding abruptly on lower side only, anterior corolla lobe frequently much larger than the other four; anthers usually basifixed (occasionally approaching versatile); stigma lobes frequently unequal.....
Rotheca Raf.
(thought to be the latinisation of the Malayalam *cheriya* = small and *thekku* = teak)
Fl. Tellur. 4 (1836) 69; Steane & Mabberley, Novon 8 (1998) 204; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 198.
Shrubs and perennial herbs (rarely lianas or small trees). Leaves simple, opposite or whorled. Inflorescence a terminal thyrse (usually lax, paniculiform) or axillary cyme, occasionally reduced to solitary, axillary flowers. Flowers bisexual; corolla (blue in Borneo), sub-actinomorphic to 1-lipped and then with only anterior lip present, 5-lobed; stamens 4, long-exserted. Fruits drupaceous, 4-lobed, the lobes sometimes elongating greatly during development, eventually separating into fleshy one-seeded mericarps.
About 50–60 species in Africa and Asia. Only one species, *Rotheca serrata* (L.) D.A.Steane & Mabb. is recorded from Borneo.
Flower bud symmetrical or if asymmetrical, the corolla usually expanding abruptly on upper side, anterior corolla lobe only slightly (if at all) larger than the other four; anthers versatile; stigma lobes equal.....16

16. Calyx accrescent, larger than fruits, often brightly coloured. Fruits often fleshy, with brightly coloured contrasting calyx.....**2. Clerodendrum**
Calyx rarely accrescent, smaller than fruits, enclosing the fruit base, not brightly coloured. Fruit usually somewhat dry, not brightly coloured.....
Volkameria L.
(Johann Volkamer, 1616–1693, a German botanist)
Sp. Pl. 2 (1753) 637; Yuan *et al*., Taxon 59, 1 (2010) 131.
Shrubs, sometimes subherbaceous, lianes, rarely small trees. Twigs more or less tetragonal in cross-section, usually ash-grey; nodes swollen. Leaves simple, decussate (to ternate), subglabrous, with entire margin, never spiny; venation arcuate-reticulate. Inflorescences axillary to supra-axillary cymes. Flowers bisexual, usually fragrant; calyx campanulate, only rarely accrescent, margin with 5 broadly triangular small teeth; corolla hypocrateriform, white, sometimes pink or purple, lobes unequal; stamens 4 (or 5), didynamous, inserted within corolla tube, exserted; ovary cylindrical; stigma shortly bifid. Fruits generally globose to obovoid, becoming black or brown and separating into 4 corky pyrenes, each with 1 seed.
Approximately 25–30 species, pantropical. Only one species, *V. inermis* L., is recorded from Borneo.

17. Corolla strongly 2-lipped. A small or prostrate shrub, often suckering, found along sandy beaches or sandy banks of river estuaries.....
.....**6. Vitex** (in part: *V. trifolia* subsp. *litoralis*)
Corolla weakly 2-lipped or actinomorphic. Shrubs or trees of primary or secondary forests, if found on beaches then not small or prostrate shrubs.....18

18. Calyx conspicuously accrescent, somewhat inflated, surrounding the mature fruit. Large trees.....

Tectona L. *f.*

(Latinised Malayalam name for the tree, "*thekka*")

Suppl. Pl. 20 (1782) 151; Blume, Bijdr. Fl. Ned. Ind. 12 (1826) 821; Schauer *in* A. de Candolle, Prodr. 11 (1847) 829; Miquel, Fl. Ind. Bat. 2 (1858) 900; Bentham & Hooker *f.*, Gen. Pl. 2, 2 (1876) 1152; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 570; Briquet *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 167; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 808; H.J. Lam, Verb. Malay. Archip. (1919) 93; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 28; Merrill, Enum. Philip. Pl. 3 (1923) 389; Backer & Bakhuizen *f.*, FJ 2 (1965) 601; Moldenke & Moldenke, Rev. Handb. Fl. Ceylon 4 (1983) 303; Tewari, Monogr. Teak (1992) 1; Corner, WSTM 4th. edition 2 (1997) 750; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 267.

Trees. Leaves simple, opposite, rarely alternate, deciduous. Inflorescences terminal and/or axillary, dichotomously cymose panicles. Flowers bisexual; calyx campanulate, 5–7-lobed, lobes unequal, greatly accrescent in fruit; corolla actinomorphic, funnel-shaped, 5–7-lobed, lobes subequal, tube short; stamens 5–6, shortly exserted, not didynamous; ovary 4-locular, with one ovule in each locule, placentation axial, style with 2 stigma-lobes. Fruits globose, drupaceous, 1–4-seeded. Seeds without endosperm.

A genus comprising 3 species, naturally occurring in Peninsular India, Myanmar, Thailand, Laos and the Philippines. Whereas *Tectona hamiltoniana* Wall. (the Dahat Teak) is endemic and confined to Myanmar and *T. philippinensis* Bentham & Hook. *f.* is an endemic to the Philippines, *T. grandis* L. *f.* (the Common Teak) has been introduced and widely cultivated in many tropical countries. In Peninsular Malaysia, most teak plantations (*c.* 2,852 ha) are found in Kedah and Perlis. In Borneo, teak plantations of about 607 ha are mainly found in Sabah.

Timber of *T. grandis* possesses many favourable properties making it suitable for a wide variety of uses.

Calyx not conspicuously accrescent, not inflated, subtending or occasionally half enclosing the mature fruit. Small trees or shrubs.....19

19. Inflorescences axillary. Inner surface of corolla glabrous or with scattered hairs.....
.....**1. Callicarpa** (in part)
Inflorescences terminal. Inner surface of corolla with dense white hairs.....
.....**4. Premna** (in part)

20. Stamens divergent or ascending under posterior corolla lip.....21
Stamens declinate, held over or included within anterior corolla lip….....28

21. Calyx with two entire lips, pressing together in fruit to form a capsule. Cymes 1–(3)-flowered.....

Scutellaria L.

(Latin, *scutellum* = shield; referring to the folding of the posterior calyx lip)

Sp. Pl. (1753) 598; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 839; Miquel, Fl. Ind. Bat. 2 (1858) 972; Hooker *f.*, Fl. Brit. Ind. 4 (1885); Prain, J. As. Soc. Beng. 74, Extra No. (1908) 713;

Ridley, FMP 2 (1923) 649; Backer & Bakhuizen *f.*, FJ 2 (1965) 620; Keng, Gard. Bull. Sing. 24 (1969) 164, FM 1, 8 (1978) 323; Paton, Kew Bull. 45 (1990) 399; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 211.

Herbs. Leaves simple, opposite, usually petiolate. Inflorescences terminal. Flowers bisexual; calyx 2-lipped, accrescent, lips entire, rounded, becoming appressed at maturity, the upper lip detaching to release nutlets at maturity, posterior lip usually folded to produce a scutellum; corolla zygomorphic, recurved from the base, 4-lobed, the posterior lip hooded, anterior lip 3-lobed; stamens 4, usually included. Fruit a mericarp of 4 dry nutlets.

About 360 species, cosmopolitan but poorly represented in moist tropical lowland forests. One species, *Scutellaria discolor* Wall. *ex* Benth. recorded from Borneo, but rarely collected.

Calyx with (4–)5–10 teeth. Cymes 1–many-flowered.....22

22. Stamens spreading.....

Pogostemon Desf.

(Greek, *pogo* = beard; *stemon* = stamens; referring to the bearded filaments)

Mem. Mus. Hist. Nat. Paris 2 (1815) 154; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 825; Miquel, Fl. Ind. Bat. 2 (1858) 961; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 631; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 707; Merrill, EB (1921) 519; Ridley, FMP 2 (1923) 647; Masamune, EPB (1942) 647; Backer & Bakhuizen *f.*, FJ 2 (1965) 632; Keng, Gard. Bull. Sing. 24 (1969) 151, FM 1, 8 (1978) 351; Coode *et al.* (eds.), CLBD (1996) 148; Bhatti & Ingrouille, Bull. Nat. Hist. Mus. Lond. (Bot.) 27 (1997) 77; Beaman *et al.* PMK 4 (2001) 392; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 214. Synonym: *Dysophylla* Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 826, Merrill *op. cit.* (1921) 520, Ridley *op. cit.* (1923) 647, Masamune *op. cit.* 646, Backer & Bakhuizen *f. op. cit.* 633, Keng *op. cit.* (1969) 67.

Herbs or undershrubs. Leaves simple, opposite or whorled, sessile or petiolate. Inflorescences thyrsoid, formed of densely flowered cymes. Flowers bisexual; calyx tubular, zygomorphic, subequally 5-lobed, sometimes anterior lobes longer; corolla tubular, weakly 2-lipped, 4-lobed, posterior lip entire, anterior lip 3-lobed; stamens 4, exserted, straight and spreading, filaments bearded. Fruit a mericarp of 4 dry nutlets.

About 80 species, mostly in forest or damp places, from S and SE Asia to China; a few species in south tropical Africa, Australia, Taiwan and Japan. Three or four species recorded from Borneo.

Stamens ascending under posterior lobe.....23

23. Calyx 6–10-lobed.....

Leucas Burm. *ex* R.Br.

(Greek, *leuco-* = white; referring to the white corolla or the white hairs on its posterior lip)

Prodr. Fl. Nov. Holl. (1810) 504; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 680; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 717; Merrill, EB (1921) 519; Ridley, FMP 2 (1923) 650; Masamune, EPB (1942) 647; Backer & Bakhuizen *f.*, FJ 2 (1965) 622; Keng, Gard. Bull. Sing. 24 (1969) 100, FM 1, 8 (1978) 337; Coode *et al.* (eds.), CLBD (1996) 148; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 227.

Herbs or undershrubs. Leaves simple, opposite. Inflorescences thyrsoid. Flowers bisexual; calyx zygomorphic, 8–10-lobed; corolla tubular, zygomorphic, 2-lipped, the posterior lip hooded, bearded with white hairs, the anterior lip 3-lobed, midlobe lip largest; stamens 4, included or shortly exserted. Fruit a mericarp of 4 dry nutlets.

About 100 species, mostly in dry or disturbed ground, in tropical Africa, Arabian Peninsula, Iran to S China, Taiwan, Japan, Indo-China and Malesia; some species have been introduced, naturalised and become weedy elsewhere. Two species recorded from Borneo, both apparently rare.

Calyx 5-lobed.....24

24. Calyx zygomorphic, 2-lipped, upper lip 2-lobed, lower lip 3-lobed, lobes unequal.....
Clinopodium L.
(Greek, *klíno* = bed, *pódion* = foot; referring to the shape of cymule pairs resembling that of the turned knobs of antique roman/greek bed foots)
Sp. Pl. (1753) 587; Cantino & Wagstaff, Brittonia 50 (1998) 63; Harley & Granda Paucar, Kew Bull. 55 (2000) 917; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 241. Synonyms: *Calamintha* Mill., Gard. Dict. 4th. edition (1754) 1, Miquel, Fl. Ind. Bat. 2 (1858) 967, Hooker *f.*, Fl. Brit. Ind. 4 (1885) 650, Prain, J. As. Soc. Beng. 74, Extra No. (1908) 711, Ridley, FMP 2 (1923) 648, Keng, Gard. Bull. Sing. 24 (1969) 41; *Satureja auct. non* L. (1754): Backer & Bakhuizen *f.*, FJ 2 (1965) 629, Keng, FM 1, 8 (1978) 360, Beaman *et al.*, PMK 4 (2001) 392.
Herbs, often prostrate; stems sometimes rooting on lower nodes. Leaves simple, opposite. Inflorescences lax, many-flowered verticillasters in axils of upper leaves, sometimes condensed to form terminal thyrse. Flowers bisexual; calyx zygomorphic, 5-lobed, 10–13-nerved; corolla tubular, tube straight, zygomorphic, 2-lipped, posterior lip 2-lobed, anterior lip 3-lobed; stamens 4, barely exserted. Fruit a mericarp of 4 dry nutlets.
About 100 species, mostly in New World (temperate and tropical) and temperate Eurasia, a few in Old World. One species, *Clinopodium gracile* (Benth.) Kuntze occurs (rarely) in Borneo. Keng (1978) treats *Clinopodium gracile* as *Satureja gracilis* (Benth.) Nakai, but following Harley *et al.*'s circumscription of *Clinopodium* and *Satureja*, the species should be included in *Clinopodium*.

Calyx more or less actinomorphic or sometimes slightly lipped but the lobes equal to subequal.....25

25. Leaves deeply divided.....
Leonurus L.
(Greek, *leon* = lion, *oura* = tail; perhaps referring to the dense white hairs around the flowers)
Sp. Pl. (1753) 584; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 827; Miquel, Fl. Ind. Bat. 2 (1858) 977; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 677; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 720; Ridley, FMP 2 (1923) 651; Backer & Bakhuizen *f.*, FJ 2 (1965) 623; Keng, Gard. Bull. Sing. 24 (1969) 97, FM 1, 8 (1978) 335; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 223.
Herbs, perennial or annual. Leaves simple, opposite, palmately lobed to deeply serrate. Inflorescences thyrsoid. Flowers bisexual; calyx zygomorphic, often weakly so, 5-lobed, lobes equal to subequal, spinose; corolla zygomorphic, strongly 2-lipped, posterior lip hooded, anterior lip 3-lobed; stamens 4, not exserted. Fruit a mericarp of 4 dry nutlets.
About 25 species, Eurasia (except the Arctic and desert areas), but some species, especially *Leonurus japonicus* Houtt., occur as weeds in the tropics, including Borneo.

Leaves entire to serrate.....26

26. Indumentum with some stellate hairs.....
Gomphostemma Wall. *ex* Benth.

(Greek, *gompho-* = nail, peg or club-shaped, *stemma* = garland or wreath; perhaps referring to the shape of the inflorescence).

In Edward's Bot. Reg.15 (1830) *t*. 1292; Miquel, Fl. Ind. Bat. 2 (1858) 985; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 696; Prain, J. As. Soc. Beng. 74, Extra No (1908) 722; Merrill, EB (1921) 519; Ridley, FMP 2 (1923) 652; Masamune, EPB (1942) 646; Backer & Bakhuizen *f.*, FJ 2 (1965) 618; Keng, Gard. Bull. Sing. 24 (1969) 79, FM 1, 8 (1978) 319; Coode *et al.* (eds.), CLBD (1996) 148; Beaman *et al.*, PMK 4 (2001) 389; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 215; Walsingham & Bramley, Kew Bull. 65, 3 (2010) 479.

Perennial herbs or undershrubs; roots sometimes tuberous. Leaves simple, opposite, indumentum often comprising stellate or branched hairs. Inflorescences terminal or axillary, cymose rarely appearing racemose. Flowers bisexual; calyx zygomorphic, 5-lobed, lobes subequal; corolla tubular, often funnel-shaped, zygomorphic, posterior lobe entire, sometimes hooded, anterior lip broadly 3-lobed; stamens 4, not or barely exserted. Fruit a mericarp with 1–4 fleshy nutlets, rarely all 4 developing.

About 36 species; SW China, India to Indo-China, Malesia. Four species recorded in Borneo.

Indumentum with simple hairs only.....27

27. Stamens not projecting from below posterior corolla lip; corolla white or pale yellow, not variegated.....

Paraphlomis (Prain) Prain

(Greek, *para* = beside; a genus closely allied to *Phlomis* L.)

J. As. Soc. Beng. 74, Extra No. (1908) 721; Merrill, EB (1921) 519; Ridley, FMP 2 (1923) 651; Masamune, EPB (1942) 648; Backer & Bakhuizen *f.*, FJ 2 (1965) 619; Keng, Gard. Bull. Sing. 24 (1969) 135, FM 1, 8 (1978) 348; Beaman *et al.*, PMK 4 (2001) 391; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 221. Basionym: *Phlomis* sect. *Paraphlomis* Prain, Ann. Roy. Bot. Gard. Calc. 9 (1901) 60.

Herbs or undershrubs. Leaves simple, opposite, membranaceous. Inflorescences thyrsoid. Flowers bisexual; calyx weakly zygomorphic, 5-lobed, lobes equal or subequal; corolla zygomorphic, strongly 2-lipped, posterior lobe hooded, pubescent outside, anterior lip broadly 3-lobed; stamens 4, not or barely exserted. Fruit a mericarp with 4 dry nutlets.

About 20 species; from NE India to Taiwan, Vietnam and Malesia (not in New Guinea). One species, *Paraphlomis javanica* (Blume) Prain, occurs in Borneo.

Stamens far projecting from below posterior corolla lip; corolla white or with a purple lower lip.....

Anisomeles R.Br.

(Greek, *aniso* = unequal, *mele* = beaker; probably referring to the unequal lips of the corolla)

Prod. Fl. Nov. Holl. (1810) 503; Miquel, Fl. Ind. Bat. 2 (1858) 975; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 672; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 714; Merrill, EB (1921) 519; Ridley, FMP 2 (1923) 649; Masamune, EPB (1942) 646; Backer & Bakhuizen *f.*, FJ 2 (1965) 624; Keng, Gard. Bull. Sing. 24 (1969) 33, FM 1, 8 (1978) 328; Bhatti & Ingrouille, Fontqueria 44 (1996) 77; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 217.

Perennial herbs or subshrubs. Leaves simple, opposite. Inflorescences thyrsoid; cymes 5–many-flowered. Flowers bisexual; calyx weakly zygomorphic, 5-lobed, lobes equal to subequal; corolla zygomorphic, strongly 2-lipped, posterior lip slightly hooded, anterior lip longer, 3-lobed; stamens 4, slightly exserted, filaments bearded. Fruit a mericarp of 4 dry nutlets.

Three species, tropical Africa, S and SE Asia, NE Australia. One species in Borneo, *A. indica* (L.) Kuntze.

28. Calyx with 5 subequal lobes. Nutlets with a bilobed scar.....
Hyptis Jacq.
(Greek, *huptios* = turned back; referring to the abrupt turning down of the lobes of the anterior corolla lip)
Collectanea 1 (1786) 101; Miquel, Fl. Ind. Bat. 2 (1858) 958; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 630; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 704; Merrill, EB (1921) 520; Ridley, FMP 2 (1923) 645; Masamune, EPB (1942) 646; Backer & Bakhuizen *f.*, FJ 2 (1965) 633; Keng, Gard. Bull. Sing. 24 (1969) 90, FM 1, 8 (1978) 367; Coode *et al.* (eds.), CLBD (1996) 148; Beaman *et al.*, PMK 4 (2001) 390; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 258.
Herbs or subshrubs. Leaves simple, opposite. Inflorescences thyrsoid; cymes lax or congested, often forming involucrate capitula. Flowers bisexual; calyx actinomorphic to weakly zygomorphic, 5-lobed, lobes usually equal; corolla zygomorphic, posterior lip 2-lobed, anterior lip 2-lobed; stamens 4, declinate, exserted. Fruit a mericarp of 4 dry nutlets; nutlets with a bilobed scar.
About 280 species; almost entirely New World tropics, a few weedy species extending into the Old World; three or four species occurring in Borneo as naturalised weeds.

Calyx various, not as above. Nutlets with a small inconspicuous scar.....29

29. Anterior and posterior pairs of stamens adjacent at attachment to corolla on the anterior side of the corolla throat.....
Plectranthus L'Hér.
(Greek, *plektron* = spur, *anthos* = flower; probably referring to the spurred/ culcullate anterior lip of the corolla)
Stirp. Nov. Fasc. 4 (1788) *t.* 41; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 835; Miquel, Fl. Ind. Bat. 2 (1858) 944; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 616; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 705; Ridley, FMP 2 (1923) 646; Backer & Bakhuizen *f.*, FJ 2 (1965) 635; Keng, Gard. Bull. Sing. 24 (1969) 141, FM 1, 8 (1978) 384; Coode *et al.* (eds.), CLBD (1996) 148; Beaman *et al.*, PMK 4 (2001) 391; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 264. Synonym: *Coleus* Lour., Fl. Coch. (1790) 372, Miquel *op. cit.* (1858) 915, Hooker *f. op. cit.* 624, Prain *op. cit.* 706, Merrill *op. cit.* (1921) 520, Ridley *op. cit.* (1923) 646, Masamune *op. cit.* 646, Backer & Bakhuizen *f. op. cit.* 636, Keng *op. cit.* (1969) 48.
Annual or perennial herbs or undershrubs. Leaves simple, opposite. Inflorescences thyrsoid; cymes condensed or lax. Flowers bisexual; calyx zygomorphic, 5-lobed, posterior lip lanceolate to obovate, 2 lateral lobes lanceolate to rounded, 2 anterior lobes lanceolate to subulate; corolla zygomorphic, strongly 2-lipped, posterior lip 4-lobed, anterior lip cucullate or concave; stamens 4, declinate, held within anterior lip or exserted. Fruit a mericarp of 4 dry nutlets.
About 300 species in Old World tropics. Two or three species in Borneo.

Anterior and posterior pairs of stamens separated by a clear gap at point of insertion in corolla tube, anterior pair usually attached at corolla throat, posterior pair attached at corolla mid-point, or nearer the corolla base, if near the throat, then more regularly spaced not all together on the anterior side of the throat.....30

30. Cymes with bracts and bracteoles.....
Isodon (Schrad. *ex* Benth.) Sprader *ex* Spach
(Greek, *iso* = equal, *don* = tooth; referring to the more or less equal calyx lobes)
Hist. Nat. Vég. 9 (1840) 162; Li, J. Arn. Arb. 69 (1988) 289; Paton & Ryding, Kew Bull. 53 (1998) 723; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 256. Basionym: *Plectranthus* L'Her. sect. *Isodon* Schrad. *ex* Benth., Lab. Gen. Sp. (1832) 40. Synonyms: *Elshotzia* Willd. sect. *Rabdosia* Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 825; *Rabdosia*

(Blume) Hassk., Flora 25, Beibl. 2 (1842) 25. (For other synonyms *cf*. Keng *op. cit.* (1969), *op. cit.* (1978) and Harley *op. cit.* 2004).

Perennial herbs. Leaves simple, opposite. Inflorescences thyrsoid with pedunculate cymes. Flowers bisexual; calyx zygomorphic, gibbous at base in fruit, 5-lobed, lobes subequal; corolla zygomorphic, strongly 2-lipped, posterior lip 4-lobed, anterior lip horizontal, cucullate; stamens 4, held within or rarely exceeding anterior lip. Fruit a mericarp of 4 dry nutlets.

About 100 species in tropical Asia, two species in Africa; one species, *Isodon teysmannii* (Miq.) H.W.Li, in Borneo.

Cymes with bracts only; bracteoles absent.....31

31. Stigma capitate-clavate; stamens long-exserted, to 2 cm.....
Orthosiphon Benth.

(Greek, *ortho* = straight, *siphon* = tube; referring to the straight corolla tube)

In Edwards' Bot. Reg.15 (1830) *t*. 1300; Miquel, Fl. Ind. Bat. 2 (1858) 942; Hooker *f*., Fl. Brit. Ind. 4 (1885) 612; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 703; Merrill, EB (1921) 521; Ridley, FMP 2 (1923) 645; Masamune, EPB (1942) 647; Backer & Bakhuizen *f*., FJ 2 (1965) 640; Keng, Gard. Bull. Sing 24 (1969) 132, FM 1, 8 (1978) 379; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 261.

Herbs or undershrubs. Leaves simple, opposite. Inflorescences thyrsoid; cymes sessile. Flowers bisexual; calyx zygomorphic, posterior lip rounded, broad, 2 lateral lobes deltoid, 2 anterior lobes subulate; corolla zygomorphic, strongly 2-lipped, posterior lip 4-lobed, anterior lip horizontal, concave; stamens 4, declinate, long-exserted; stigma capitate-clavate. Fruit a mericarp of 4 dry nutlets.

About 40 species in Old World tropics. Only *Orthosiphon aristatus* (Blume) Miq. has been recorded in Borneo.

Stigma bifid; stamens exserted for less than 1 cm.....32

32. Bracts basally pale or coloured, rarely uniformly green. Posterior stamens basally swollen or with a flattened blade-like basal appendage. Nutlets minutely striate or reticulate.....
Platostoma P.Beauv.

(Greek, *plato* = flat, *stoma* = mouth; referring to the flattened calyx mouth)

Fl. Oware 2 (1818) 61; Hooker *f*., Fl. Brit. Ind. 4 (1885) 611; Paton, Kew Bull. 52 (1997) 257; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 263. Synonyms: *Masona* Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 838, Hooker *f. op. cit.* 611, Merrill, EB (1921) 520, Masamune, EPB (1942) 647, Backer & Bakhuizen *f*., FJ 2 (1965) 637, Keng, Gard. Bull. Sing. 24 (1969) 113, FM 1, 8 (1978) 373; *Acrocephalus* Benth. *in* Edwards' Bot. Reg.15 (1829) *t.* 1282 & 1300, *in* Bentham & Hooker *f*., Gen. Pl. 2 (1876) 1173, Miquel, Fl. Ind. Bat. 2 (1858) 941, Hooker *f. op. cit.* 611, Ridley, FMP 2 (1923) 644, Backer & Bakhuizen *f. op. cit.* 638, Keng *op. cit.* (1969) 25, *op. cit.* (1978) 364; *Geniosporum* Wall. *ex* Benth. *in* Edwards' Bot. Reg.15 (1829 & 1830) *t.* 1282 & 1300, Hooker *f. op. cit.* 609; *Nosena* Prain, J. As. Soc. Beng. 73 (1904) 20, Keng *op. cit.* (1969) 122, *op. cit.* (1978) 375. (For other synonyms, *cf.* Harley *et al.* 2004).

Annual herbs. Leaves simple, opposite. Inflorescences in terminal and axillary condensed capitula or short dense spikes. Flowers bisexual; calyx zygomorphic, posterior lip broad, rounded, anterior lip shorter than posterior, with 4-lobes, lanceolate; corolla inconspicuously zygomorphic, posterior lip shortly 4-lobed, anterior lip entire, longer; stamens 4, declinate, included. Fruit a mericarp of 4 dry nutlets.

Forty five species in tropical Africa and Asia, also in NE Australia. *Platostoma hispidum* (L.) A.J.Paton, previously known as *Acrocephalus indicus* (Burm.*f*.) Kunze, is present in Borneo.

Bracts uniformly green, rarely uniformly coloured. Posterior stamens not basally swollen, if appendiculate then appendage knee-shaped. Nutlets various, not striate.....

Ocimum L.

(Greek *okimon* = smell; referring to the aromatic plant parts)

Sp. Pl. (1753) 833; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 831; Miquel, Fl. Ind. Bat. 2 (1858) 936; Hooker *f.*, Fl. Brit. Ind. 4 (1885) 607; Prain, J. As. Soc. Beng. 74, Extra No. (1908) 700; Merrill, EB (1921) 520; Ridley, FMP 2 (1923) 643; Furtado, Gard. Bull. Sing. 4 (1929) 416; Masamune, EPB (1942) 647; Backer & Bakhuizen *f.*, FJ 2 (1965) 638; Keng, Gard. Bull. Sing. 24 (1969) 125, FM 1, 8 (1978) 376; Beaman *et al.*, PMK 4 (2001) 390; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 260.

Herbs or shrubs, often highly aromatic. Leaves simple, opposite. Inflorescences thyrsoid; cymes sessile. Flowers bisexual; calyx zygomorphic, posterior lip rounded, 2 lateral lobes deltoid to truncate, 2 anterior lobes deltoid to subulate, sometimes closing the calyx throat; corolla zygomorphic, strongly 2-lipped, posterior lip 4-lobed, anterior lip horizontal, flat or slightly concave; stamens 4, exserted. Fruit a mericarp of 4 dry nutlets.

Sixty-five pantropical species, mostly African, a few species widespread across Malesia, possibly naturalised; 2–3 species in Borneo.

1. **CALLICARPA** L.

(Greek, *callos* = beautiful, *carpos* = fruit; with beautiful fruits)

bilau, *sabal besi* (Iban)

Sp. Pl. 1 (1753) 111; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 817; Miquel, Fl. Ind. Bat. 2 (1858) 884; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 566; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 802; H.J. Lam, Verb. Malay. Arch. (1919) 45; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 9; Merrill, EB (1921) 512; Ridley, FMP 2 (1923) 614; Masamune, EPB (1942) 638; Backer & Bakhuizen *f.*, FJ 2 (1965) 600; Kochummen, TFM 3 (1978) 301; J.A.R. Anderson, CLTS (1980) 343; Munir, J. Adelaide Bot. Gard. 6 (1982) 5; Coode *et al.* (eds.), CLBD (1996) 329; Argent *et al.* (eds.), MNDT-CK (1997) 653; Kessler, Secondary Forest Trees Kalimantan (2000) 191; Beaman & C. Anderson, PMK 5 (2004) 452; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 267; Bramley, Bot. J. Linn. Soc. 159 (2009) 416. **Synonym:** *Geunsia* Blume, Cat. Gew. Buitenz. 11 (1823) 48, *op. cit.* (1826) 819, C.B. Clarke *op. cit.* 566, Gamble *op. cit.* 800, H.J. Lam *op. cit.* 28, Merrill *op. cit.* (1921) 511, Ridley *op. cit.* (1923) 613, Masamune *op. cit.* 641, Backer & Bakhuizen *f. op. cit.* 600, Kochummen *op. cit.* 305, Argent *et al.* (eds.) *op. cit.* 653, Kessler *op. cit.* 194.

Shrubs or small trees, *or woody climbers*, non-aromatic. **Indumentum** of young twig, leaf, inflorescence and flower consisting of simple, variously branched, stellate, or gland-tipped hairs and occasionally also peltate scales. **Twigs** 4-angular or rarely subterete in cross-section; internodes often variable in length. **Leaves** *simple*, opposite, decussate, sometimes with one apparently alternate leaf between opposite pairs, petiolate or decurrent to twig, *base without conspicuous glands*; *petioles not swollen or thickened at either ends*. **Inflorescences** *axillary*, ramiflorous or cauliflorous, cymose or thyrsoid; *bracts inconspicuous*, rarely conspicuous (*C. involucrata*). **Flowers** bisexual, radially or weakly bilaterally symmetrical; calyx cupular or more or less tubular, 4–7-lobed near the apex, persistent, *not conspicuously accrescent in fruit*, *not inflated*, sometimes *remaining intact and enclosing more than half of mature fruit*, or sometimes breaking open and partly falling away then *subtending mature fruit*; *corolla white*, *pale pink or purple*, narrowly *funnel-shaped*, *tube less than 1 cm long*, *not greatly enlarged at throat*, *inner surface glabrous or*

sparsely hairy, *weakly 2-lipped or symmetrically 4–7-lobed*, lobes erect, patent, or reflexed; *stamens 4–5*, epipetalous, inserted at or near the base of the corolla tube, part of filaments and the anthers exserted or anthers exserted only, anthers with numerous yellow sessile glands where they attach to the connective, either ovoid or ellipsoid and dehiscing through longitudinal slits, or oblong and dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as anthers mature; ovary 4–7-locular, each locule with 1–2 ovules; *style terminal*, stigma capitate, sometimes with 4–5(7) symmetric lobes, glandular. **Fruit** *a drupe*, *usually not lobed*, *with a fleshy exocarp* over 4–10(12–14) one-seeded pyrenes. **Seeds** without endosperm.

Distribution. About 150 species; 33 in N and S America, particularly Caribbean Islands (Cuba), one in Madagascar, *c.* 58 in Temperate Asia, particularly China, 52 in Malesia, seven in Australia, and three in the Pacific. In Borneo, 23 species, 19 of which occur in Sabah and Sarawak.

Ecology. In primary or secondary forest, disturbed areas such as roadsides, at altitudes from sea-level to 1600 m.

Uses. In Sabah and Sarawak, only the timber of *Callicarpa pentandra* is used for house-building and light construction. The leaves and root bark of a few species, e.g., *C. candicans*, *C. longifolia* and *C. pentandra* have been reported to have some traditional medicinal usage to treat various illness and discomfort. (For more details, *cf.* PROSEA 5, 3 (1998) 129–130; *ibid.* 12, 2 (2001) 129–133 and *ibid.* 12, 3 (2003) 221–222).

Notes. The genus *Geunsia* Blume is included here following Bramley (2009). The systematic position and phylogenetic relationship of the genus *Callicarpa* within the Lamiaceae *s.l.* remains unresolved. Harley *et al.* (2004) assigned it together with nine other genera in the Labiatae *s.l.*, *incertae sedis*.

Key to *Callicarpa* species

1. Mature leaves (more or less) glabrous on lower surface (rarely with a few randomly scattered hairs).....2
   Mature leaves densely to sparsely hairy on lower surface; the hairs not randomly scattered.....4

2. Bracts ovate, conspicuous around young cymes.....**8. C. involucrata**
   Bracts linear, inconspicuous.....3

3. Inflorescence a lax pedunculate cyme; pedicels constitute parts of open branching pattern of the inflorescence.....**5. C. glabrifolia**
   Inflorescence more or less sessile cyme or on a peduncle to 1 cm long; pedicels arising from a congested base.....**14. C. stapfii**

4. Calyx usually *c.* 1 mm long; filaments well-exserted from corolla tube, anthers ellipsoid, dehiscing through longitudinal slits.....5
   Calyx (1–1.5)2–5 mm long; filaments barely exserted from corolla tube, anther oblong, dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as it matures.....10

5. Leaves obovate or rarely elliptic, at least 25 cm long; lower surface obscured by dense indumentum of greyish plumose hairs.....**13. C. scandens**
Leaves narrowly elliptic to narrowly ovate, usually less than 20 cm long (if longer than 20 cm, the lower surface with stellate hairs that do not obscure the surface); lower surface not obscured or obscured by whitish short-branched, stellate or gland-tipped hairs, or by pale matted plumose hairs.....6

6. Upper leaf surface glabrous; lower leaf surface appearing whitish, distinctly different in colour from that of upper surface. Calyx surface obscured by dense plumose or stellate hairs.....7
Upper leaf surface with simple gland-tipped hairs; lower leaf surface not distinctly different in colour from that of upper surface. Calyx surface visible, hairs present but not dense.....8

7. Ovary with stellate hairs. Fruit with scattered branched hairs. Twig, lower leaf surface and calyx surface with dense plumose hairs.....**3. C. erioclona**
Ovary and fruit glabrous. Twig, lower leaf surface and calyx surface with dense stellate hairs.....

C. candicans (Burm. *f.*) Hochr.

(Latin, *candicans* = white; referring to the white indumentum on the lower leaf surface and inflorescence)

Candollea 5 (1934) 190; Backer & Bakhuizen *f. op. cit.* 601; Kochummen *op. cit.* 301; Bramley *op. cit.* 428. Basionym: *Urtica candicans* Burm. *f.*, Fl. Ind. (1768) 197. Type: *s. coll.*, *s.n.*, Java (G). Heterotypic synonym: *Callicarpa cana* L., Mant. Pl. 2 (1771) 198, Blume *op. cit.* (1826) 817, Miquel *op. cit.* (1858) 885, C.B. Clarke *op. cit.* 568, Gamble *op. cit.* 806, H.J. Lam & Bakhuizen *op. cit.* 20, Merrill *op. cit.* (1921) 512, Ridley *op. cit.* (1923) 616, Masamune *op. cit.* 638.

Shrub less than 5 m tall. Twigs stellate-hairy. Leaves narrowly elliptic to narrowly ovate, base attenuate, margin serrate, apex acuminate; lower surface with dense stellate hairs, appearing pale. Inflorescences open-branched cymes. Flowers: calyx surface with dense stellate hairs; anthers ovoid, dehiscing through longitudinal slits; ovary glabrous. Fruits maturing purple, glabrous.

Indo-China through Malesia to NE Australia. Rarely recorded in Borneo; known from Kudat district in Sabah (e.g., *Creagh s.n.*) and Kalimantan (e.g., *Motley 243*).

8. Inflorescence inserted *c*. 5 mm above leaf axil; outer surface of calyx with gland-tipped hairs.....**15. C. superposita**
Inflorescence axillary, ramiflorous or cauliflorous; outer surface of calyx with scattered stellate or short-branched hairs.....9

9. Mature fruits white. Widespread.....**10. C. longifolia**
Mature fruits red to dark blue. Endemic to W Kalimantan and possibly Sarawak.....
.....**16. C. teneriflora**

10. Corolla usually 5-lobed, purple; stamens usually 5, pink or purple. Shrub or tree to 20 m tall.....**11. C. pentandra**
Corolla 4(–7)-lobed, white to yellow or pale pink; stamens 4(–7). Shrub or small tree to 10 m tall.....11

11. Leaf base auriculate, often sac-like and inhabited by ants.....**12. C. saccata**
Leaf base acute, attenuate or decurrent, not inhabited by ants.....12

12. Leaves more or less obovate, longer than 33 cm, base decurrent.....**2. C. barbata**
Leaves elliptic, ovate or obovate, shorter than 33 cm, base acute to attenuate….....13

13. Fruiting calyx surrounding and enclosing more than half of the mature fruit.....14
Fruiting calyx subtending mature fruit like a saucer (or enclosing less than one third of the fruit).....18

14. Inflorescence distinctly pedunculate; flowers congested in globose cymes.....15
Inflorescence sessile, or if pedunculate, flowers more laxly spaced in bifurcating cymes.....16

15. Plant with a dense indumentum of simple and short-branched hairs that are patent or erect. Calyx *c.* 5 mm long; corolla 6–8 mm long.....**9. C. kinabaluensis**
Plant with a dense indumentum of branched hairs that are interwoven and matted. Calyx 2–4 mm long; corolla *c.* 4 mm long.....
C. clemensorum Moldenke
(Joseph Clemens, 1862–1936) and Mary Strong Clemens, 1873–1968, who made large collections of plant specimens in the Malesian region)
Phytologia 5 (1954) 7; Bramley *op. cit.* 429. Type: *Clemens* & *Clemens 34036*, Borneo, Sabah, Panataran river basin (holotype BO; isotype K).
Shrub or small tree; indumentum of much-branched hairs with scattered warty growths; lower leaf surface often vesiculose. Inflorescence with cymes almost globose.
Endemic to Borneo; apparently confined to Mt. Tambuyokun and area around Mt. Kinabalu, Sabah (e.g., *SP 4831*, *SP 10275*, *SP 12059* and *SP 12257*).

16. Bracts and bracteoles narrowly ovate.....**1. C. anomala**
Bracts and bracteoles linear.....17

17. Inflorescence sessile; surface of axes scarcely visible.....
C. coriacea Bramley
(Latin, *coriaceus* = leathery; referring to the texture of leaf blade)
Bot. J. Linn. Soc. 159 (2009) 430. Type: *Sugau SAN 134293*, Borneo, Sabah, Kinabatangan district, summit of Bt. Tawai (holotype K; isotypes A, BO, KEP, SAN, SING).
Shrub. Twigs markedly quadrangular, with appressed silky indumentum. Leaves leathery, with many yellow sessile glands. Inflorescence sessile.
Apparently endemic to Borneo; so far known only by the type collection from Sabah.
Inflorescence pedunculate; at least the surface of the lower axes visible.....
.....**7. C. hispida**

18. Leaves obovate, 5–17 × 2–7 cm; lower surface with peltate scales clustered along the midrib, and with hairs to 1 mm long.....**4. C. fulvohirsuta**
Leaves elliptic to narrowly elliptic, rarely obovate, 9–28 × 3–8 cm; lower surface lacking peltate scales, with hairs 1–3 mm long.....**6. C. havilandii**

1. **Callicarpa anomala** (Ridl.) B.L.Burtt

(Latin, *anomalus* = unusual; referring to the occasionally pseudo-ternate or pseudo-quadrate leaves).

Notes Roy. Bot. Gard. Edinburgh 29 (1969) 149; Bramley *op. cit.* 422. **Basionym:** *Geunsia anomala* Ridl., Bull. Misc. Inform. Kew (1929) 260. **Type:** *Haviland 760*, Borneo, Sarawak, Kuching district, Penkuelen Ampat (holotype K).

Small tree to 5 m tall, 4–7 cm diameter. **Bark** cracked, sometimes flaking, brownish. **Twigs** with patent red-brown hairs 3–6 mm long and shorter branched hairs when young, becoming more glabrous when older. **Leaves** occasionally appear ternate or quadrate; *blades elliptic to more or less obovate*, *10–22 × 6–13 cm*, *base more or less acute*, *not inhabited by ants*, margins shallowly dentate, apex acuminate; upper surface with simple or branched more or less appressed hairs, *lower surface with dense branched hairs* and yellow sessile glands; midrib sunken above, with short-branched hairs towards the base; petioles 1–2 cm long. **Inflorescences** cauliflorous or ramiflorous; *individual cymes bifurcately branching from a central axis 2–8 cm long*, axis with hairs 3–6 mm long; *bracts narrowly ovate*, 5–8 × 2–4 mm, especially hairy at the margins; pedicels 1–2 mm long, with hair 3–6 mm long around base; *bracteoles narrowly ovate*, 5–6 × 2–3 mm, especially hairy at the margins, also with 3–6 mm long hairs around base. **Flowers:** *calyx* narrowly cupular, *4–5 mm long*, 4-lobed, lobes triangular, 0.5–1 mm long, outer surface with hairs especially conspicuous at the tips, also with numerous yellow sessile glands, inner surface more or less glabrous; *corolla white*, 7–8 mm long, *4-lobed*, lobes *c.* 2 mm long, outer surface with numerous yellow sessile glands, edges of lobes with short papillae, inner surface more or less glabrous; *stamens 4*, *filaments* 5–6 mm long, *barely exserted*, *anthers oblong*, 2–2.5 mm long, exserted, *dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as anthers mature*; stigma capitate, glandular. **Fruits** maturing red, 0.4–0.5 cm diameter, *enclosed by the persistent calyx*, *the lobes of which almost covering the upper part of the fruit*; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo. In Sarawak recorded from Kuching district (e.g., *Beccari 2759*, *Burtt & Martin B 4720* and *Haviland 760*). Also known from E Kalimantan (e.g., *Ambriansyah* & *Meijer AA 1359* and *Kessler 2056*). Not known in Sabah and Brunei.

Ecology. In secondary, logged-over forest and edges of primary forest, at 30–120 m altitude.

2. **Callicarpa barbata** Ridl.

(Latin, *barbatus* = provided with tufts of long weak hairs; referring to the dense red-brown indumentum of young twig and lower leaf surface)

Bull. Misc. Inform. Kew (1929) 260; Bramley *op. cit.* 427. **Type:** *Haviland 3043*, March 1893, Borneo, Sarawak, Rejang, Kapit district (holotype K; isotype SAR). **Heterotypic synonym:** *Callicarpa borneensis* Moldenke, Phytologia 4 (1953) 285.

Small tree to 8 m tall, 8–15 cm diameter. **Bark** smooth, brownish. **Twigs** (young) with a dense red-brown indumentum of short hairs with many branches and longer hairs that have short branches near the apex, becoming less pubescent and more woody with age. **Leaves:** *blades more or less obovate*, *33–52 × 14–32 cm*, *base decurrent*, *not inhabited by ants*; margins shallowly dentate, ciliate with branched hairs, apex acuminate; upper surface with simple or branched more or less appressed hairs with thickened bases, *lower surface with much-branched short hairs and longer hairs that have short branches near the apex*; midrib sunken above, raised below, with dense branched hairs especially towards the leaf base, also with yellow sessile glands; petioles 1–3 cm long. **Inflorescences** cauliflorous or

ramiflorous; individual cymes either congested on a short woody axis, or sometimes the axis 1–17 cm long, making the inflorescence becomes more lax; bracts linear, *c*. 3 mm long; pedicels to 2 cm long; bracteoles linear, 1–2 mm long. **Flowers:** *calyx* cupular, *2–3 mm long*, 5-lobed, lobes shallow and marked by slight tips, outer surface with branched hairs; *corolla white*, 6–7 mm long, *5-lobed*, lobes *c.* 2 mm long, outer surface with short papillae/hairs; *stamens 5*, *filaments c.* 3 mm long, *barely exserted*, *anthers oblong*, 3–4 mm long, *dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature*; stigma capitate, glandular. **Fruits** maturing red, 0.5–0.7 cm diameter, outer surface glandular; with 4–5 one-seeded locules maturing into 4–5 one-seeded pyrenes.

Vernacular name. Sarawak—*sabal besi besar* (Iban).

Distribution. Endemic to Borneo. In Sarawak, recorded from Belaga, Bintulu, Kapit, Marudi and Tatau districts (e.g., *Jacobs 5459*, *S 17621*, *S 41314*, *S 72467* and *S 94691*) and in E Kalimantan from Mt. Kemul, W Kutei (e.g., *Endert 3723*). Not known in Sabah and Brunei.

Ecology. In undisturbed and disturbed forest on slopes, on sandy-clay loam or clay-rich alluvium soils, at 160–1100 m altitude.

3. **Callicarpa erioclona** Schauer

(Greek, *erio-* = woolly, *clonos* = twig; referring to the woolly indumentum of the twig)

In A.P. de Candolle, Prodr. 11 (1847) 643; Miquel *op. cit.* (1858) 889; H.J. Lam & Bakhuizen *op. cit.* 19; Merrill, J. Malay. Br. Roy. As. Soc. 1 (1923) 32; Masamune *op. cit.* 638; Bramley *op. cit.* 432. **Type:** *Cuming 911*, the Philippines, Luzon (holotype B, *n.v.*, destroyed?; isotypes BM, E, NY [scanned image seen], K! Barcode K 000194942, TCD *n.v.*).

Shrub or small tree to 9 m tall. **Twigs** *with dense pale indumentum of woolly plumose hairs*, hairs sometimes becoming darker near the tips; with slight interpetiolar ridge resembling a stipule scar. **Leaves** opposite; *blades narrowly elliptic* to more or less oblanceolate, *15–19 × 5–8.5 cm*, base shortly attenuate, margins dentate, sometimes irregularly so, apex acute to shortly acuminate; *upper surface glabrous*, almost shiny when dry, *lower surface whitish*, *distinctly different in colour from the upper surface*, *with a pale indumentum of matted plumose hairs*, the hairs on the venation standing more erect, some becoming darker near the tips; petioles 1.5–2.5 cm long, indumentum as twigs. **Inflorescences** axillary; peduncles 10–20 mm long, indumentum as twigs; bracts linear, 1–2 mm long; pedicels 1–2 mm long, indumentum as twigs; bracteoles linear, 1–2 mm long, inconspicuous. **Flowers:** *calyx* cupular, *c. 1 mm long*, 4-lobed, lobes conspicuous, shallow, triangular, *outer surface with dense indumentum as twigs*, inner surface more or less glabrous; *corolla* white, 1.5–2.5 mm long, 4-lobed, lobes 0.5–1 mm long, outer surface glabrous with occasional branched hair, edges of lobes with tiny papillae, inner surface more or less glabrous; *stamens* 4, *filaments* 3–4 mm long, *well-exserted*, arising 0.25–0.5 mm from the base of the corolla tube, *anthers ellipsoid*, *c.* 0.5 mm long, with numerous yellow sessile glands where they attach to the connective, *dehiscing through longitudinal slits*; *ovary stellate hairy*, stigma capitate, *c*. 1 mm wide, surface glandular. **Fruits** *c*. 0.2 cm diameter, *outer surface with scattered branched hairs*, glandular, subtended by calyx; with 4 one-seeded locules maturing into 4 one-seeded pyrenes.

Vernacular name. Sabah—*ulas* (Dusun Banggi).

Distribution. Vietnam, Java, Borneo, Sulawesi, the Philippines and New Guinea. In Borneo, known only by two collections (*Agama 1049* and *SAN 40794*) from Banggi Is., Kudat district, Sabah.

Ecology. Not recorded in Borneo but reported from open areas in secondary forest in the remainder of its distribution.

4. **Callicarpa fulvohirsuta** Merr.

(Latin, *fulvus* = tawny, *hirsutus* = covered with stiff, long, erect or ascending straight hairs; referring to the twig, leaf and inflorescence).

J. Str. Br. Roy. As. Soc. 76 (1917) 113, *op. cit.* (1921) 512; Masamune *op. cit.* 638; Beaman & C. Anderson *op. cit.* 452; Bramley *op. cit.* 433. **Type:** *Clemens 9846*, 29 Oct. 1915, Borneo, Sabah, Mt. Kinabalu, Kibayau to Kaung (holotype PNH probably destroyed; isotypes A, K).

Small shrub or tree to 8 m tall, to 20 cm diameter. **Bark** grey-brownish or yellowish, inner bark greenish. **Sapwood** white. **Twigs** with a dense indumentum of short-branched (more or less stellate) red-brown hairs, and longer spreading red-brown (branched at base) hairs when young, becoming woodier and more or less glabrous when older. **Leaves** occasionally with pairs of markedly subequal blades; *blades obovate*, *5–17 × 2–7 cm*, *base attenuate*, *not inhabited by ants*, margins minutely to shallowly dentate, apex shortly acuminate; upper surface with short stiff appressed hairs, *lower surface with an indumentum of appressed short-branched hairs*, *scattered longer* (*to 1 mm long*) *spreading hairs that are branched at base only*, *yellow sessile glands*, *and peltate scales clustered near the midrib*; midrib sunken above, raised below, covered with short-branched and longer hairs that are branched at base only; petioles 1–2 cm long, indumentum as twigs. **Inflorescences** axillary, sometimes arising in axils of fallen leaves; *peduncles 5–7 mm long*, indumentum as twigs; bracts linear, 2–3 mm long; pedicels 2–5 mm long, indumentum as twigs; bracteoles linear, 0.5–1 mm long. **Flowers:** *calyx* cupular, *1–1.5 mm long*, 4-lobed, lobes shallow, outer surface with simple hairs especially on the vein-ridges that lead to the lobe tips, also with yellow sessile glands and occasional peltate scales, inner surface with scattered simple hairs; *corolla white*, *c.* 3 mm long, *4-lobed*, lobes *c.* 1 mm long, outer surface with yellow sessile glands, inner surface papillose, tube more or less glabrous; *stamens 4*, *filaments c*. 2 mm long, *barely exserted*, *anthers oblong*, *c*. 1 mm long, *dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as anthers mature*; stigma capitate, *c.* 1 mm wide, surface glandular. **Fruits** maturing red, 0.3–0.4 cm diameter, 4-lobed at apex, surface glandular, *subtended by saucer-shaped calyx*; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo. Known in Sabah from Beaufort, Keningau, Kinabatangan, Labuk Sugut, Pensiangan, Ranau, Sandakan and Tawau districts (e.g., *Beaman 6780*, *SAN 60441*, *SAN 91258*, *SAN 105256*, *SAN 118823* and *SAN 141199*) and in Brunei by a single doubtful record from Bt. Bahak, Rambai, Tutong district (*Kirkup 463*). Not known from Kalimantan and Sarawak.

Ecology. In disturbed areas on hillsides such as roadsides or burnt forest, on ultramafic substrate.

5. **Callicarpa glabrifolia** S.Atkins

(Latin, *glabrus* = without hairs, *folium* = leaf; referring to the lack of hairs on leaf surfaces)

Kew Bull. 52 (1997) 227; Coode *et al*. (eds.) *op. cit.* 329; Bramley *op. cit.* 434. **Type:** *J. Dransfield et al. 7160*, 22 Feb. 1992, Brunei, Temburong district, Bukit Belalong (holotype K Barcode K 000194835; isotypes BRUN, KEP, L, SAR).

Shrub or small tree to 8 m tall, to 8 cm diameter. **Bark** smooth, grey-brown; inner bark creamy green. **Sapwood** orange. **Twigs** more or less glabrous, with a conspicuous interpetiolar ridge resembling a stipule scar and also with yellow sessile glands. **Leaves:** blades more or less elliptic, 11–33 × 3.5–12 cm, base acute, margins almost entire or with minute, broadly spaced teeth, apex long-acuminate, acumen to 6 cm long; *both surfaces glabrous* but with numerous yellow sessile glands; venation raised and conspicuous on lower surface; petioles 1–3.5 cm long. **Inflorescence** *an* axillary, *lax pedunculate cyme*; peduncles 5–20 mm long, indumentum as twigs; *bracts linear*, 2–5 mm long, *inconspicuous*; *pedicels part of open branching pattern*, 4–7 mm long; bracteoles linear, 1–3 mm long. **Flowers:** calyx cupular to almost square, *c*. 2 mm long, 4-lobed, lobes shallow, marked with thickened tips, outer surface glabrous, with yellow sessile glands, inner surface more or less glabrous; corolla white, 4–5 mm long, 4-lobed, lobes *c*. 2 mm long, outer surface glabrous, with yellow sessile glands, inner surface more or less glabrous; stamens 4, exserted for 0.5 mm, filaments *c*. 3 mm long, anthers oblong, *c*. 1.5 mm, dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as anthers mature; stigma capitate. **Fruits** maturing white, 0.3–0.4 cm diameter, outer surface glandular, subtended by calyx; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo. In Sabah known only by a single collection from Sg. Maga, Sipitang district (*de Vogel 8415*) and in Sarawak recorded from Kapit, Lawas, Limbang, Marudi and Tatau districts (e.g., *S 19184*, *S 22185*, *S 36289*, *S 47853* and *S 52433*). Also reported from Brunei (e.g., *J. Dransfield JD 7160* and *Coode 7902*) and E Kalimantan (e.g., *Kessler PK 2087*).

Ecology. Mixed dipterocarp forest, often along rivers or on steep banks, or disturbed areas, at 50–1600 m altitude.

6. **Callicarpa havilandii** (King & Gamble) H.J.Lam Fig. 1, Plate 1A & B.

(George Darby Haviland, 1857–1901, surgeon and naturalist, Director of the Raffles Museum Singapore, Medical officer of Sarawak Government and Curator of the Government Museum, Kuching)

Verb. Malay. Arch. (1919) 52; H.J. Lam & Bakhuizen *op. cit.* 17; Merrill *op. cit.* (1921) 512; Masamune *op. cit.* 638; Burtt *op. cit.* 151; J.A.R. Anderson *op. cit.* 343; Coode *et al*. (eds.) *op. cit.* 329; Kessler (ed.) *op. cit.* 192; Bramley *op. cit.* 436. **Basionym:** *Geunsia havilandii* King & Gamble, Bull. Misc. Inform. Kew (1908) 105, Gamble *op. cit.* (1909) 801. **Lectotype** (Bramley, 2009)**:** *Haviland & Hose 3549*, Borneo, Sarawak (K; isolectotype L Barcode L 0003858). **Heterotypic synonyms:** *Geunsia beccariana* Briq. *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1894) 165, *nom. nud.*; *Callicarpa kinabaluensis* Bakh. & Heine var. *tonsa* Moldenke, Phytologia 4 (1952) 127.

Shrub or small tree to 8 m tall, to 20 cm diameter. **Bark** smooth, grey-brown; inner bark brown or yellow-green. **Sapwood** yellow. **Twigs** with a dense indumentum of short-

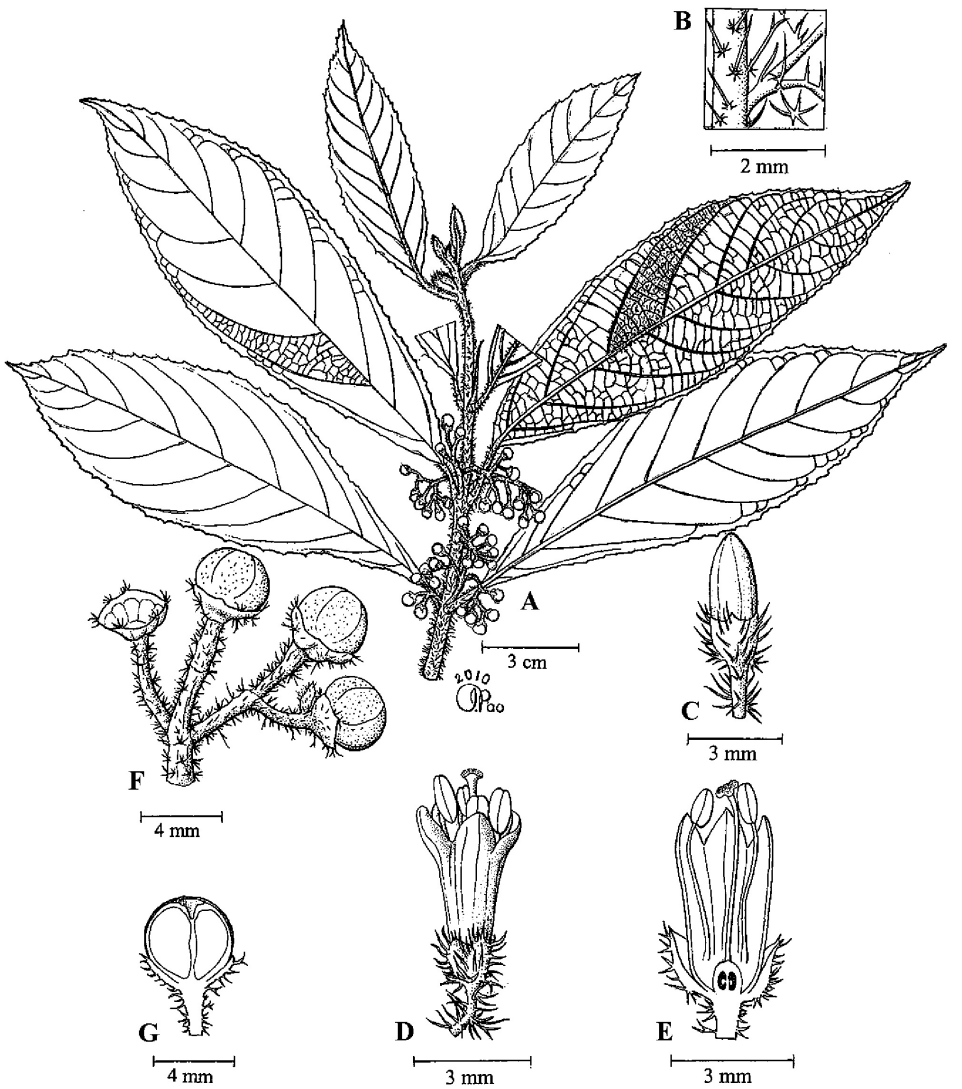

Fig. 1. *Callicarpa havilandii*. A, fruiting leafy twig; B, indumentum on lower leaf surface; C, flower bud; D, open flower; E, longitudinal section of open flower; F, infructescence; G, longitudinal section of fruit. (A–B from *SAN 128123*, C–E from *D. Simpson 2038*, F–G from *SAN 128123*.)

branched, red-brown hairs, and longer spreading red-brown hairs 2–4 mm long when young, becoming woodier and more or less glabrous when older. **Leaves** occasionally with pairs of subequal blades; *blades elliptic to narrowly elliptic or obovate*, *9–28 × 3–8 cm*, *base acute to shortly attenuate*, *not inhabited by ants*, margins minutely to shallowly dentate, apex acuminate; upper surface with short stiff hairs, *lower surface with an indumentum of short-branched hairs close to the surface*, *also with longer spreading hairs 1–3 mm long* and yellow sessile glands *but without peltate scales*; midrib sunken above, covered with short-branched hairs and longer simple hairs, or simple hairs that have short branches at base only, raised below and densely covered with long spreading hairs; petioles 1.5–3 cm long, indumentum as twigs. **Inflorescences** axillary, sometimes arising in axils of fallen leaves; peduncles 5–15 mm long, indumentum as twigs; bracts linear, 2–3 mm long; pedicels 3–7 mm long, indumentum as twigs; bracteoles 0.5–1 mm long, inconspicuous; **Flowers:** *calyx* cup-shaped, *c. 2 mm long*, 4–5-lobed, lobes shallow, outer surface densely covered with short-branched hairs, also with longer simple hairs 1–2 mm long and yellow sessile glands, inner surface more or less glabrous; *corolla white*, 3–5 mm long, *4–5-lobed*, lobes 1–2 mm long, outer surface with yellow sessile glands, inner surface more or less glabrous; *stamens 4–5*, *filaments c*. 2 mm long, *barely exserted*, *anthers oblong*, *c*. 2 mm long, *dehiscing through a pore-like opening at the apex then splitting longitudinally towards the base as anthers mature*; stigma capitate, *c*. 1 mm wide, surface glandular. **Fruits** maturing red, 0.3–0.4 cm diameter, outer surface glandular, *subtended by saucer-shaped calyx*; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Vernacular name. Sarawak—*sabal besi* (Iban).

Distribution. Endemic to Borneo. In Sabah, recorded from Keningau, Labuk Sugut, Lahad Datu, Pensiangan, Sandakan and Tawau districts (e.g., *SAN 73326*, *SAN 83298*, *SAN 100242* and *SAN 128123*) and in Sarawak from Belaga, Bintulu, Kapit, Limbang, Lundu, Marudi, Miri and Tatau districts (e.g., *S 16616*, *S 36148*, *S 46759*, *S 50541*, *S 60993* and *S 70919*). Also known in Brunei (e.g., *Niga NN 11*, *Simpson 2253* and *Coode 6823*) and Kalimantan (e.g., *Ambriansyah AA 2027*, *Argent 93177*, *van Balgooy 5712* and *Kessler 1622*).

Ecology. Common in disturbed forest, roadsides or along riversides in mixed dipterocarp forest, at 50–1000 m altitude.

7. **Callicarpa hispida** (Moldenke) Bramley Plate 1C.

(Latin, *hispidus* = with rough, stiff simple hairs; referring to the twig, leaf and inflorescence)

Bot. J. Linn. Soc. 159 (2009) 437. **Basionym:** *Callicarpa havilandii* (King & Gamble) H.J.Lam var. *hispida* Moldenke, Phytologia 43 (1979) 222. **Type:** *Kowaka & Hotta 1245*, 15 Nov. 1969, Borneo, Sabah, Lahad Datu district, between Kampong Silah and summit of Mt. Silam (holotype SAN; isotype L).

Shrub or small tree to 6 m tall. **Bark** smooth, pale brown; inner bark pale grey. **Sapwood** pale brown. **Twigs** when young, with a dense indumentum of short-branched, red-brown hairs more or less appressed to the surface, and longer patent red-brown hairs, becoming woodier and more or less glabrous when older. **Leaves** occasionally with an alternate leaf present close to opposite pair so appearing pseudo-ternate, sometimes the pairs subequal; *blades elliptic to obovate*, *8–22 × 4–10 cm*, *base acute to shortly attenuate*, often

asymmetric, *not inhabited by ants*, margins dentate, teeth irregular, apex acute to acuminate; upper surface with stiff simple hairs (with an enlarged base) that especially dense along the sunken midrib, *lower surface with an indumentum of short-branched hairs and longer hairs with few branches*, *2–4 mm long*, on the margins and midrib which is raised, also with yellow sessile glands; petioles 1–2.5 cm long, indumentum as twigs. **Inflorescences** axillary, sometimes appearing in axils of fallen leaves; *surface of lower axes visible*; *peduncles 5–20 mm long*, indumentum as twigs; *bracts* inconspicuous, *linear*, 3–5 mm long; *flowers laxly spaced in bifurcating cymes*; pedicels 2–5 mm long, indumentum as twigs; *bracteoles* inconspicuous, *linear*, 1–3 mm long. **Flowers:** *calyx* cup-shaped, *4–5 mm long*, 6–7-lobed, lobes shallow, subulate, outer surface densely covered with branched hairs of varying lengths, also with yellow sessile glands, inner surface more or less glabrous; *corolla white*, 6–7 mm long, *6–7 lobed*, lobes *c*. 2 mm long, often patent to the tube, outer surface with yellow sessile glands, inner surface more or less glabrous; *stamens 6–7*, *filaments c*. 5 mm long, *barely exserted*, *anthers oblong*, *c*. 2 mm long, *dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature*; stigma capitate, *c*. 1 mm wide, surface glandular. **Fruits** maturing red, 0.6–0.7 cm diameter, outer surface glandular; *calyx enclosing more than half of the fruit*; with 6–7 two-seeded locules maturing into 12–14 one-seeded pyrenes.

Distribution. Endemic to Borneo; known only in Sabah from Mt. Silam and surrounding area in Lahad Datu district (e.g., *SAN 25573*, *SAN 52788*, *SAN 57280*, *SAN 116923* and *SAN 145389*).

Ecology. In forest on ultramafic substrate.

8. **Callicarpa involucrata** Merr. Plate 1D.

(Latin, *involucratus* = surrounded by a ring of bracts at the base; referring to the young cymes)

J. Malay. Br. Roy. As. Soc. 1 (1923) 31; Masamune *op. cit.* 638; J.A.R. Anderson *op. cit.* 343; Coode *et al.* (eds.) *op. cit.* 330; Bramley *op. cit.* 438. **Type:** *Ramos 1395*, Sept.–Dec. 1920, Borneo, Sabah, Batu Lima near Sandakan (holotype PNH probably destroyed; isotypes A, K Barcode K K000194454, L).

Small tree to 10 m tall, to 15 cm diameter. **Bark** greenish brown, verrucose. **Twigs** more or less glabrous, becoming woody, with scattered lenticels and a conspicuous interpetiolar ridge resembling a stipule scar. **Leaves:** blades obovate, 14–45 × 5.5–15 cm, base cuneate to attenuate, margins shallowly dentate, apex shortly acuminate; upper surface with scattered hairs when very young, soon becoming more or less glabrous, also with yellow sessile glands, *lower surface more or less glabrous*, with yellow sessile glands and peltate scales *c*. 1 mm diameter concentrated at the leaf base but occasionally scattered near the midrib; petioles 1.5–2.5 cm long. **Inflorescences** cauliflorous or ramiflorous, thyrsoid, with individual cymes very congested on a woody axis (*c*. 1 cm wide), at first appearing almost sessile but later extending to 25 cm long, often with prominent scars marking the position of fallen cymes; peduncles 1–5 mm long; *bracts conspicuous*, *forming an involucre around each young cyme*, caducous, 5–8 mm long, more or less glabrous, with peltate scales; pedicels 1–2 mm long. **Flowers:** calyx more or less tubular, 3–5 mm long, 4–5-lobed, lobes shallow, triangular, outer surface with scattered hairs, also with yellow sessile glands and some peltate scales, inner surface more or less glabrous, venation pattern conspicuous when dry; corolla white, 5–6 mm long, 4(–5)-lobed, lobes *c*. 2.5 mm long, outer surface with

occasional hairs and yellow sessile glands, inner surface more or less glabrous, with some papillae on the lobes, especially the margins; stamens 4, exserted or partly exserted for 1–3 mm, filaments 2.5–3.5 mm long, anthers oblong, *c*. 3 mm long, dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature; stigma more or less capitate, *c*. 1 mm wide, surface glandular. **Fruits** maturing red, *c*. 0.3–0.5 cm diameter, outer surface glandular, subtended by calyx, most of which has broken away, sometimes remaining more intact; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Vernacular name. Sarawak—*bilau* (Iban).

Distribution. Endemic to Borneo. In Sabah, widespread, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Pensiangan, Sandakan and Tawau districts (e.g., *Beaman 10204*, *SAN 84852*, *SAN 90993*, *SAN 109486*, *SAN 111154* and *SAN 143973*) and in Sarawak known from Belaga, Kapit, Limbang, Marudi, Miri and Tatau districts (e.g., *Hansen 354*, *S 21818*, *S 39862*, *S 45491*, *S 46613* and *S 91091*). Also occurs in Brunei (e.g., *Atkins 488*, *BRUN 16745*, *Dransfield JD 7090*, *Sands 5852* and *Simpson 2412*) and Kalimantan (e.g., *van Balgooy 5713*, *Endert 3836* and *Sidiyasa & Arifin 2164*).

Ecology. In primary dipterocarp forest or in areas of secondary regrowth, often on streambanks or hillsides, on sandy clay loam soils, at altitude to 1200 m.

Notes. The youngest cymes at the apex of the inflorescence, often hanging down away from the trunk on the long woody axis, are sometimes covered with a jelly-like mucous that perhaps protect the young buds from insect damage.

9. **Callicarpa kinabaluensis** Bakh. *f.* & Heine
(of Mt. Kinabalu)

In Feddes Repert. Spec. Nov. Regni Veg. 54 (1951) 246; Beaman & C. Anderson *op. cit.* 452; Bramley *op. cit.* 440. **Type:** *Clemens & Clemens 31348*, 24 Jan. 1933, Borneo, Sabah, Penibukan (holotype BO; isotypes A, BM, K Barcode K 000194830, L Barcode L 0003852). **Synonyms:** *Callicarpa kinabaluensis* Bakh. *f. ex* Moldenke, Phytologia 4 (1952) 42, *nom. illeg.*; *C. kinabaluensis* var. *gibotii* Moldenke, Phytologia 43 (1979) 222, *nom. illeg.*

Shrub or tree to 10 m tall, to 20 cm diameter. **Twigs** *with a dense indumentum of yellow-brown*, *patent or erect hairs that are simple or with short branches near the apex* and yellow sessile glands, becoming woody and more glabrous when older. **Leaves:** *blades elliptic to narrowly ovate*, *11–19 × 5–10.5 cm*, *base acute* to obtuse, *not inhabited by ants*, margins dentate, teeth with thickened apices, apex acute; *when young both surfaces densely covered with simple or short-branched*, *yellow-brown hairs*, when older more or less glabrous except for the sunken midrib and lateral veins which have some branched hairs, *lower surface either densely or sparsely covered with branched hairs*, vesiculose and with many yellow sessile glands; petioles 2–5 cm long, indumentum as young twigs. **Inflorescences** axillary, *distinctly pedunculate*; *peduncles 25–35 mm long*, *flowers congested in globose cymes*, indumentum as young twigs; bracts narrowly ovate, 10–20 mm long, with dense hairs 2–3 mm long; *pedicels 0.5–1 mm long*, *not easily visible*; bracteoles 4–6 mm long, with dense simple or scarcely branched hairs 2–3 mm long. **Flowers:** *calyx* cupular, *c. 5 mm long*, 4-lobed, lobes triangular, *c*. 1 mm long, outer surface densely covered with simple or scarcely branched hairs, also with yellow sessile glands, inner

surface more or less glabrous; *corolla white*, *sometimes with a pinkish tinge*, *6–8 mm long*, *4-lobed*, lobes *c.* 2 mm long, outer surface glabrous except for 2–3 mm long hairs and yellow sessile glands, inner surface more or less glabrous or papillose; *stamens 4*, *filaments* 5–6 mm long, *barely exserted*, *anthers oblong*, pale yellow, 2.5–3 mm long, *dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature*; stigma capitate, 4-lobed, surface glandular. **Fruits** maturing purple, 0.2–0.3 cm diameter, with slight depression near apex, outer surface glandular, *surrounded by calyx that covers more than half of the fruit*; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo and known only in Sabah from Kinabatangan, Kota Belud and Ranau districts (e.g., *Nais SNP 4565*, *J. Clemens 33200*, *M.S. Clemens 11273*, *SAN 134293* and *SAN 134756*).

Ecology. In scrub on ultramafic substrate, upper montane forest, exposed sedge-dominated vegetation, and forest area on open plateau, at 1600–2500 m altitude.

10. **Callicarpa longifolia** Lam. Plates 1E & 2A.

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

Encycl. 1 (1785) 563; Blume *op. cit.* (1826) 817; Miquel *op. cit.* (1858) 887; C.B. Clarke *op. cit.* 570; Gamble *op. cit.* 807; H.J. Lam & Bakhuizen *op. cit.* 26; Merrill *op. cit.* (1921) 512, EB (1929) 262; Ridley *op. cit.* (1923) 616; Masamune *op. cit.* 638; Kochummen *op. cit.* 301; J.A.R. Anderson *op. cit.* 343; Munir *op. cit.* 11; Beaman & C. Anderson *op. cit.* 453; Bramley *op. cit.* 441. **Type:** *Sonnerat s.n.*, Peninsular Malaysia, Malacca (holotype P-LA, microfiche). **Heterotypic synonyms:** *Callicarpa rhynchophylla* Miq. *op. cit.* (1858) 888; *?C. japonica* var. *rhombifolia* H.J.Lam *op. cit.* 90. (For other synonyms, *cf.* Bramley 2009).

Shrub to 6 m tall, occasionally scrambling over other vegetation. **Twigs** with a mealy indumentum of branched hairs, also with yellow sessile glands, usually becoming woodier and more or less glabrous when older, with a conspicuous interpetiolar ridge resembling a stipule scar. **Leaves** opposite, occasionally pairs subequal; *blades elliptic to narrowly ovate*, *7–20 × 3–6 cm*, base acute to shortly attenuate, margins serrate, apex acuminate; *upper surface with scattered branched hairs* and yellow sessile glands, *lower surface not distinctly different in colour to the upper surface*, *with an indumentum of stellate or short-branched hairs close to the surface*, especially dense on the raised midrib and venation, also with numerous yellow sessile glands; petioles 1–2.5 cm long, indumentum as twigs. **Inflorescences** *axillary*; peduncles 5–10 mm long, indumentum as twigs; bracts linear, 0.5–2 mm long; pedicels *c.* 0.5 mm long, indumentum as twigs; bracteoles linear, less than 1 mm long, inconspicuous. **Flowers:** *calyx* narrowly funnel-shaped, *c. 1 mm long*, 4-lobed, lobes shallow, marked with thickened tips, *outer surface visible*, *with sparse stellate or short-branched hairs*, also with yellow sessile glands and occasional peltate scales, inner surface more or less glabrous; corolla pale pink to lilac, 2–2.5 mm long, 4-lobed, lobes 0.5–0.75 mm long, outer surface with appressed branched hairs, edges of lobes papillate, also with yellow sessile glands, inner surface more or less glabrous; stamens 4, arising 0.25–0.5 mm from the base of the corolla tube, *filaments exserted for 0.2–0.3 cm*, *anthers ellipsoid*, 0.5–1 mm long, with numerous yellow sessile glands where they attach to the connective, *dehiscing through longitudinal slits*; stigma capitate, *c.* 1 mm wide, surface glandular. **Fruits** *maturing white*, 0.2–0.3 cm diameter, outer surface glandular, subtended by reduced calyx most of which has broken away; with 4 one-seeded locules maturing into 4 one-seeded pyrenes.

Distribution. India, Indo-China, Malesia and northern Australia. In Borneo widespread, recorded in Sabah from most districts (e.g., *Beaman 10158*, *de Kok 1029*, *SAN 20835*, *SAN 68591*, *SAN 115691*, *SAN 120695* and many others); in Sarawak also common, recorded from Bau, Kuching, Lubok Antu, Lundu, Marudi and Tatau districts (e.g., *S 19223*, *S 36489*, *S 40689*, *S 49542*, *S 56331* and *S 67460*). Also known from Brunei (e.g., *Coode 6998* and *van Niel 3918*) and Kalimantan (e.g., *Ambriansyah & Arifin AA 302*, *Argent & Saridan 9370*, *Kessler PK 2255* and *Wilkie 93335*).

Ecology. In secondary forest and disturbed areas such as roadsides or open patches in primary forest, at 0–1200 m altitude.

11. **Callicarpa pentandra** Roxb. Fig. 2, Plate 2B & C.

(Greek, *penta* = five, *andros* = males (anthers); referring to the presence of five anthers in each flower; in *Callicarpa* the typical number of anthers is four)

Fl. Ind. 1 (1820) 409, *ibid.* edit. Carey 1 (1832) 395; Schauer *op. cit.* 646; Miquel *op. cit.* (1858) 885; H.J. Lam & Bakhuizen *op. cit.* 11; J.A.R. Anderson *op. cit.* 343; Coode *et al.* (eds.) *op. cit.* 330; Beaman & C. Anderson *op. cit.* 453; Bramley *op. cit.* 443. **Homotypic synonym:** *Geunsia pentandra* (Roxb.) Merr., Philip. J. Sci. 11 (1916) 309, H.J. Lam *op. cit.* 33, Argent *et al.* (eds.) *op. cit.* 653, Kessler (ed.) *op. cit.* 195. **Lectotype** (Bramley 2009)**:** *Rel. Robins. 1860*, 24 Oct. 1913, Amboina, Soja (K). **Heterotypic synonyms** (for Borneo only)**:** *Geunsia farinosa* Blume *op. cit.* (1823) 12, *op. cit.* (1826) 819, C.B. Clarke *op. cit.* 566, Gamble *op. cit.* 800, Merrill *op. cit.* (1921) 511, Ridley *op. cit.* (1923) 614, Masamune *op. cit.* 641, *Callicarpa pentandra* Roxb. var. *typica* (Schauer) Bakh. forma *farinosa* (Blume) Bakh. *in* H.J. Lam & Bakhuizen *op. cit.* 13; *G. quaternifolia* Hallier *f.*, Meded. Rijksherb. Leiden 37 (1918) 24, Merrill *op. cit.* (1921) 511, *C. quaternifolia* (Hallier *f.*) Govaerts, World Checklist Seed Plants 3, 1 (1999) 12, **type:** *Amdjah 665*, Borneo, E Kalimantan, Sg. Tulit (holotype L Barcode L 0003897/3898; isotype BO), ***syn. nov.***; *G. subternata* Hallier *f.*, *op. cit.* 25, *C. subternata* (Hallier *f.*) Govaerts *op. cit.* 12; *G. homeophylla* Hallier *f. op. cit.* 26, Merrill *op. cit.* (1921) 511, Masamune *op. cit.* 641, *C. homeophylla* (Hallier *f.*) Govaerts *op. cit.* 12, **type:** *Hallier f. B 348*, Borneo, W Kalimantan, Lombok Utan Isl. (holotype L Barcode L 0003895; isotype BO), ***syn. nov.***; *G. serrulata* Hallier *f. op. cit.* 27, *C. serrulata* (Hallier *f.*) Govaerts *op. cit.* 12; *G. anisophylla* Hallier *f. op. cit.* 29, *G. serrulata* Hallier *f.* forma *anisophylla* (Hallier *f.*) Moldenke, Phytologia 50 (1982) 378; *G. hexandra* (Teysm. & Binn.) Koord. var. *macrophylla* Moldenke, Phytologia 49 (1981) 430; *G. farinosa* Blume var. *callicarpoides* H.J.Lam *ex* Moldenke, Phytologia 50 (1982) 220.

Shrub or tree to 20 m tall, to 30 cm diameter. **Bark** light brown, more or less smooth; inner bark yellowish, fibrous. Young **twigs** with a dense indumentum of brown plumose or short-branched hairs, often farinose, also with yellow sessile glands. **Leaves** often with apparently alternate leaves between opposite pairs; blades elliptic to subovate, 11–19 × 4–10 cm, base acute to attenuate, margins more or less entire to shallowly dentate, apex acuminate, sometimes shortly so; upper surface more or less glabrous or with simple hairs and hairs that are branched near the base, or in young leaves farinose, with scattered branched hairs, *lower surface either with an indumentum of short-branched hairs on the venation only* (including tertiary), *or also with a dense pale coloured indumentum of matted plumose hairs on the blades*, in this case the leaves discolorous, in both cases also with yellow sessile glands; petioles 1.5–3.5 cm long, indumentum as twigs. **Inflorescences** axillary; peduncles 40–90 mm long, indumentum as twigs; bracts inconspicuous, linear, 4–10 mm long; pedicels 2–2.5 mm long, indumentum as twigs; bracteoles inconspicuous, 0.2–0.5 mm long. **Flowers:** *calyx* cupular, *1–2 mm long*, more or less truncate or shallowly 5-lobed, outer surface densely covered with short-branched or more or less plumose hairs, in the latter case the surface obscured, also with yellow sessile glands and occasional peltate scales, inner

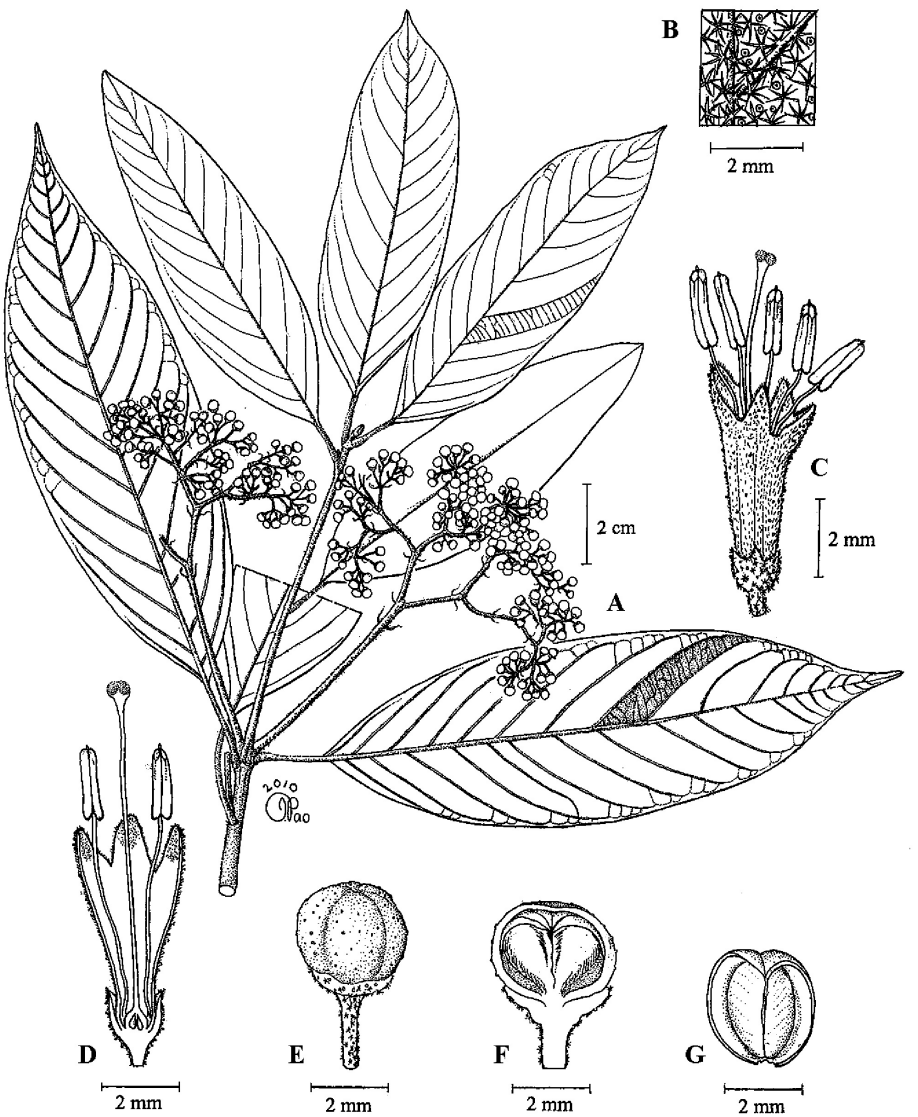

Fig. 2. *Callicarpa pentandra*. A, fruiting leafy twig; B, details of indumentum on lower leaf surface; C, side view of open flower; D, longitudinal section of open flower; E, fruit; F, longitudinal section of fruit; G, side view of two pyrenes. (A–B from *SAN 136840*, C–D from *SAN 135275*, E–G from *SAN 136840.*)

surface more or less glabrous; *corolla purple*, sweetly scented, 4–6 mm long, (*4–*)*5-lobed*, lobes 1–2 mm long, often reflexed, outer surface with short hairs or papillae and yellow sessile glands, sometimes also with longer branched hairs, inner surface more or less glabrous or papillose, especially on the lobes; *stamens* (*4–*)*5*, exserted for 4–5 mm, *filaments purple*, 5.5–8.5 mm long, *barely exserted*, *anthers oblong*, *pink or purple*, 2–2.5 mm long, *dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature*; stigma capitate, (4–)5-lobed, surface glandular. **Fruits**, maturing red, 0.2–0.4 cm diameter, with slight depression near apex, outer surface glandular, subtended by the calyx, most of which has broken away, sometimes the calyx remaining more intact; with 5 two-seeded locules maturing into 10 one-seeded pyrenes.

Vernacular name. Sarawak—*bilau* (Iban).

Distribution. Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku and New Guinea. Widespread throughout Sabah (e.g., *Beaman 9679*, *SAN 59570*, *SAN 107772*, *SAN 111161*, *SAN 120895* and many others) and Sarawak (e.g., *S 24305*, *S 33198*, *S 44453*, *S 52974* and *S 56683*). Also recorded from Brunei (e.g., *Wong WKM 215*, *Atkins 447*, *Coode 6795* and *Coode 7359*) and Kalimantan (e.g., *Church 655*, *Kessler Berau 184*, *Sidiyasa PBU 124* and *Wilkie 94132*).

Ecology. Mainly in disturbed areas such as roadsides, occasionally in secondary forest or along margins of primary forest, at 15–1500 m altitude.

Uses. Wood used for parang handles and in light construction. Fruits edible.

Notes. A variable species, especially in the leaf indumentum. To make sense of this variation, many intraspecific names have been applied to this taxon. These we consider to confuse matters further, as variation is apparently continuous, and satisfactory boundaries cannot be drawn between intraspecific groups. This problem is compounded by the wide distribution of *C. pentandra*. Here we list synonymous names applied to the taxa in Borneo; revisionary work will result the reduction to synonymy of a large number of names in use across Malesia, especially in the Philippines.

12. **Callicarpa saccata** Steenis

(Latin, *saccatus* = pouch- or bag-shaped; referring to the auriculate sac-like lobes at the leaf base)

Blumea 15 (1967) 147; J.A.R. Anderson *op. cit.* 343; Bramley *op. cit.* 446. **Type:** *Sibat ak Luang S 23637*, Borneo, Sarawak, Bukit Iju, Ulu Arip, Balingian (holotype L Barcode L 0003856; isotypes K, KEP Barcode KEP 74012, SAN, SAR, SING).

Small tree to 5 m tall. **Twigs** when young, with a dense indumentum of short-branched, red-brown hairs, and longer spreading red-brown hairs 3–6 mm long, becoming woody and more or less glabrous when older. **Leaves** occasionally with pairs subequal; blades more or less elliptic, rarely cordate, 7–30 × 4.5–12 cm, *base auriculate*, *lobes sac-like and inhabited by ants*, margins minutely dentate, ciliate, apex acute to acuminate; upper surface with long, appressed, thickened-base hairs 3–6 mm long, *lower surface with an indumentum of appressed short-branched hairs*, *longer spreading hairs* 3–6 mm long (especially dense on the raised midrib and lateral veins), yellow sessile glands, and peltate scales scattered around the midrib and leaf base; petioles 0.8–3 cm long, indumentum as twigs.

Inflorescences axillary (on young twigs) or cauliflorous (on older twigs), when cauliflorous the main axis condensed, thick, corky and close to twig, when axillary more lax; peduncles to 5 cm long; indumentum as twigs; bracts inconspicuous; pedicels 3–10 mm long, tending to be longer in cauliflorous inflorescences, indumentum as twigs; bracteoles 0.5–1 mm long, inconspicuous. **Flowers:** *calyx* cup-shaped, *2–5 mm long*, 4–5-lobed, lobes shallow, outer surface densely covered with short-branched and longer (to 5 mm) simple hairs, inner surface more or less glabrous, with some sessile glands; *corolla white*, 6–7 mm long, *4–5*(–*7*)*-lobed*, lobes *c.* 2.5 mm long, outer surface with yellow sessile glands, inner surface more or less glabrous; *stamens 4–5*(–*7*), *filaments c.* 4 mm long, *barely exserted*, *anthers oblong*, *c.* 2 mm long, completely exserted, *dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature*; stigma capitate, *c*. 1.5 mm wide, surface glandular. **Fruits** maturing red, 0.2–0.5 cm diameter, outer surface glandular, subtended by calyx or sometimes the calyx remaining more intact and surrounding the fruit; with 4 two-seeded locules breaking up into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo; found in Sarawak from Belaga, Kapit, Lubok Antu, Mukah and Tatau districts (e.g., *S 18286*, *S 23886*, *S 33122*, *S 41772* and *S 84178*) and W Kalimantan (e.g., *Ambriansyah et al. AA 2230*). Not known from Brunei and Sabah.

Ecology. Primary forest, sometimes near streams, at 50–500 m altitude.

13. **Callicarpa scandens** (Moldenke) Govaerts

(Latin, *scandens* = climbing; notes on Moldenke's type specimen suggest a climbing habit, in fact this is anomalous and this species is a small tree)

World Checklist Seed Plants 3, 1 (1999) 12; Bramley *op. cit.* 447. **Basionym:** *Geunsia scandens* Moldenke, Phytologia 49 (1981) 430. **Type:** *Aban & Petrus SAN 90680*, 10 Nov. 1979, Borneo, Sabah, Kinabatangan district, Ulu Sg. Lokan (holotype SAN; isotype K).

Shrub or small tree to 6 m tall. **Bark** brown, lenticellate; inner bark green-yellow to grey-brown. **Sapwood** pale yellow or white. **Twigs** surface obscured by a dense grey-brown indumentum of short stellate hairs and longer plumose hairs when young, becoming woodier and more or less glabrous when older. **Leaves:** *blades obovate*, *less commonly elliptic*, *25–48 × 11–21 cm*, base attenuate almost to twig, margins entire, apex acuminate to acute; upper surface glabrous, *lower surface with an indumentum of greyish*, *appressed*, *short stellate hairs*, *longer plumose hairs and yellow sessile glands*; petioles 1–3 cm long, indumentum as young twigs. **Inflorescences** cauliflorous or ramiflorous; peduncles 1.5–3 cm long, indumentum as young twigs; bracts linear, 2–3 mm long; pedicels 1–2 mm long, indumentum as young twigs; bracteoles linear, *c*. 1 mm long. **Flowers:** *calyx* narrowly cupular, *c. 1 mm long*, shallowly 4-lobed, outer surface with some short hairs at lobe tips, occasional peltate scales *c*. 0.5 mm in diameter, and yellow sessile glands, inner surface more or less glabrous; corolla pale pink, 2–5 mm long, 4-lobed, lobes 0.5–1 mm long, outer surface with tiny papillae, inner surface more or less glabrous; stamens 4, *filaments* 2.5–6 mm long, *well-exserted*, *anthers* yellow, *ellipsoid*, 0.8–1.5 mm long with numerous yellow sessile glands where they attach to the connective, *dehiscing through longitudinal slits*; stigma capitate, surface glandular. **Fruits** greenish pink, maturing purple, 0.2–0.3 cm diameter, outer surface glandular, subtended by the calyx, most of which has broken away, sometimes the calyx remaining more intact; with 4 one-seeded locules maturing into 4 one-seeded pyrenes.

Distribution. Endemic to Borneo. In Sabah, known from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 30558*, *SAN 83041*, *SAN 90680*, *SAN 101407* and *SAN 124339*). Also recorded from G. Bentuang and Nunukan Is. in Kalimantan (e.g., *Burley NGS 2820* and *Meijer 2119*). Not known from Brunei and Sabah.

Ecology. In primary dipterocarp forest, occasionally at forest margins.

14. **Callicarpa stapfii** Moldenke Plate 2D.

(Otto Stapf, 1857–1933, Austrian botanist, 1909–1922 Keeper of the Kew Herbarium, 1922–1933 editor of the Botanical Magazine and Index Londinensis)

Phytologia 43 (1979) 222; Beaman & C. Anderson *op. cit.* 453; Bramley *op. cit.* 448. **Basionym:** *Premna cauliflora* Stapf, Trans. Linn. Soc. London, Bot. 4 (1894) 215; Merrill *op. cit.* (1921) 513; Masamune *op. cit.* 642. **Lectotype** (Bramley 2009)**:** *Haviland 1305*, Borneo, Sabah, Mt Kinabalu (K; isolectotypes K, SAR). **Heterotypic synonym:** *Callicarpa woodii* Merr., Philip. J. Sci. 30 (1926) 86; Masamune *op. cit.* 639. **Type:** *D.D. Wood 1194*, Borneo, Sabah, "Limbo", 8 April 1924 (holotype A), ***syn. nov.***

Small tree to 6 m, to 15 cm diameter. **Bark** smooth, greenish brown; inner bark reddish. **Sapwood** yellowish. **Twigs** more or less glabrous, becoming woody, with scattered lenticels and a conspicuous interpetiolar ridge resembling a stipule scar. **Leaves** occasionally ternate; blades narrowly elliptic, narrowly obovate to oblanceolate, 8.5–30 × 3–10 cm, base cuneate to shortly attenuate, margins shallowly dentate, apex acuminate; upper surface more or less glabrous, but with yellow sessile glands and peltate scales *c.* 1 mm diameter clustered around leaf base, *lower surface more or less glabrous*, with yellow sessile glands and peltate scales concentrated at the leaf base but occasionally scattered near the midrib; petioles 1–2 cm long. **Inflorescences** cauliflorous or axillary, *axis almost completely reduced*, *cymes arising from the axis*, *either sessile or on a peduncle to 1 cm long*; *bracts linear*, *inconspicuous*; pedicels 5–15 mm long, occasionally with white lenticels; bracteoles not easily visible. **Flowers:** calyx cupular, *c*. 2 mm long, shallowly 4-lobed, outer surface with a short and sparse stellate indumentum, also with yellow sessile glands and ocassional peltate scales; corolla white, 4–6 mm long, 4-lobed, lobes 1.5–2 mm long, outer surface glabrous; stamens 4, filaments 2.5–3.5 mm long, anthers oblong, *c*. 3 mm long, exserted or partly exserted for 1–3 mm, dehiscing through a pore-like opening at the apex which splits longitudinally towards the base as anthers mature; stigma capitate. **Fruits** maturing red, 0.5–0.6 cm diameter, with depression and sometimes appearing lobed when dry, outer surface glandular, subtended by remains of calyx; with 4 two-seeded locules maturing into 8 one-seeded pyrenes.

Distribution. Endemic to Borneo; so far known only in Sabah from Keningau, Kinabatangan, Kota Belud, Penampang, Ranau and Tuaran districts (e.g., *Beaman 10426*, *Chew W.L. et al. 1674*, *Clemens & Clemens 27520*, *SAN 53952*, *SAN 110924* and *SAN 147250*).

Ecology. In hill dipterocarp forest, often near rivers or at higher altitudes in lower montane forest, at 1000–1500 m altitude.

Notes. Originally described by Stapf (1894) as *Premna cauliflora*, this taxon was later given the name, *Callicarpa stapfii*, by Moldenke (1979), as *Callicarpa cauliflora* had earlier been used by Merrill (Philip. J. Sci. Bot. 7, 5 (1912) 350) to describe another species from the Philippines.

15. **Callicarpa superposita** Merr.

(Latin, *supra* = above, *positus* = positioned; referring to the inflorescence which is inserted *c*. 5 mm above, rather than, in the leaf axils)

Philip. J. Sci. 30 (1926) 86; Masamune *op. cit.* 638; Bramley *op. cit.* 451. **Type:** *Evangelista* (*D.D.Wood 1227*), Borneo, Sabah, Semporna, 14 July 1924 (holotype PNH *n.v.*, destroyed?; isotypes A, K Barcode K K000194727).

Shrub or small tree to 5 m tall. **Twigs** with simple gland-tipped hairs and sessile glands when young, becoming woodier and more or less glabrous when older. **Leaves** opposite; *blades narrowly elliptic to narrowly ovate* (lanceolate), *9.5–16 × 2.3–4.7 cm*, base truncate, occasionally somewhat asymmetric, margins serrate, serrations with mucronate tips, apex markedly acuminate; *upper surface with simple gland-tipped hairs*, *lower surface with simple gland-tipped hairs*, somewhat more dense on the raised midrib and lateral veins, *also with yellow sessile glands*, *not distinctly different in colour to the upper surface*; petioles 0.6–0.8 cm long, indumentum as twigs. **Inflorescences** *inserted c. 5 mm above leaf axils*; peduncles 10–20 mm long, indumentum as twigs; bracts inconspicuous, 2–3 mm long; pedicels 0.5–1 mm long, indumentum as twigs; bracteoles 0.5–1 mm long, inconspicuous. **Flowers:** *calyx* cup-shaped, *c. 1 mm long*, shallowly 4-lobed, *outer surface with simple gland-tipped hairs*, *also with yellow sessile glands and occasional peltate scales*, inner surface more or less glabrous; corolla pink or purple, 2–2.5 mm long, 4-lobed, lobes 0.5–1 mm long, outer surface with occasional gland-tipped hairs, inner surface more or less glabrous; *stamens* 4, *filaments* 3–3.5 mm long, *well-exserted*, *anthers* yellow, *ellipsoid*, *c.* 0.5 mm long, with numerous yellow sessile glands where they attach to the connective, *dehiscing through longitudinal slits*; stigma capitate. **Fruits** maturing purple, *c.* 0.2 cm diameter, with depression at the apex, outer surface with yellow sessile glands, subtended by saucer-shaped calyx; with 4 one-seeded locules maturing into 4 one-seeded pyrenes.

Distribution. Endemic to Borneo. In Sabah, recorded from P. Sakar in Lahad Datu district and P. Timbun Mata in Semporna district (e.g., *Jibrin Sibil 137*, *Keith NBFD 9470*, *SAN 26994* and *SAN 36039*). Also known from E Kalimantan (e.g., *Kessler B 1587*). So far not yet recorded from Brunei and Sarawak.

Ecology. In disturbed and primary forest on hillsides, at 30–100 m altitude.

16. **Callicarpa teneriflora** Bramley Fig. 3.

(Latin, *tener* = delicate, *florum* = flower; referring to the rather delicate branching of the inflorescence)

Bot. J. Linn. Soc. 159 (2009) 452. **Type:** *Church et al. 2062*, 18 Feb. 1995, Borneo, W Kalimantan, Serawai, Sg. Merah, 2 km to SW along perennial stream of Sg. Labang (holotype K; isotypes A, BO, L).

Small tree to 5 m tall. **Bark** beige. **Twigs** when young, with dense stellate hairs, rarely with occasional plumose hairs, becoming glabrous and with a conspicuous interpetiolar ridge resembling a stipule scar when older. **Leaves** occasionally in subequal pairs; *blades narrowly elliptic*, *rarely obovate*, *11–27 × 4–11 cm*, base shortly attenuate, margins finely dentate, apex markedly acuminate, acumen to 3 cm long; *upper surface* more or less

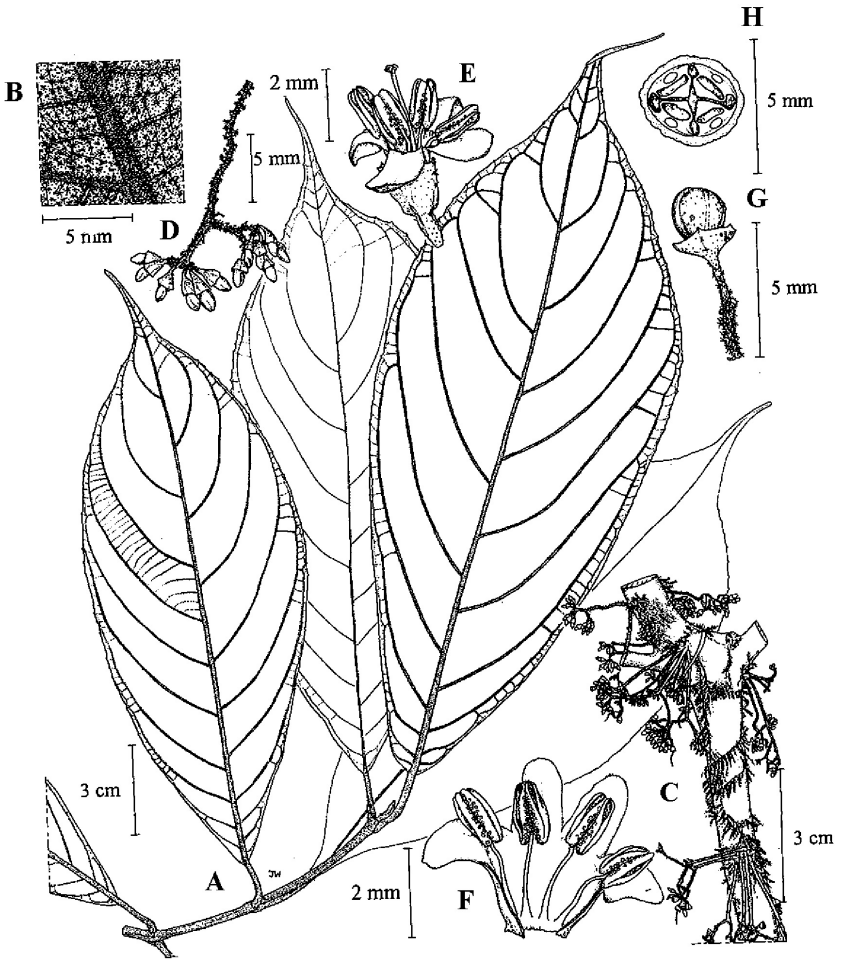

Fig. 3. *Callicarpa teneriflora*. A, leafy twig; B, indumentum on lower leaf surface; C, inflorescences; D, detail of inflorescence indumentum; E, open flower; F, opened up corolla showing stamens; G, fruit; H, cross-section of young fruit showing four developing ovules. (A, E and F from *Church et al. 2045*, B–D and G from *Church et al. 2062*, H from *Church 207*.). Drawn by and reproduced with permission from Juliet Beentje.

glabrous but with yellow sessile glands, *lower surface not distinctly discolorous to the upper surface*, *with stellate hairs on the veins and blade*, *rarely with some darker plumose hairs*, *also with yellow sessile glands and some scattered peltate scales*; midrib impressed above, with stellate hairs in the furrow; petioles 1–2 cm long, indumentum as twigs. **Inflorescences** *cauliflorous or ramiflorous*, finely branching; peduncles 1–2 cm long, axes with stellate hairs; bracts inconspicuous, linear, 0.5–1 mm long, with stellate hairs; pedicels 1–2 mm long; bracteoles as bracts. **Flowers:** *calyx* cupular, *c. 1 mm long*, with 4 tiny lobes, *outer surface with scattered branched/stellate hairs or more or less glabrous*, inner surface more or less glabrous; *corolla* yellow-orange, 3–3.5 mm long, 4-lobed, lobes *c*. 1 mm long, outer surface with scattered yellow sessile glands, edges of lobes with short papillae, inner surface more or less glabrous; *stamens* 4, *exserted for the length of the anthers if corolla lobes reflexed*, filaments *c*. 2 mm long, *anthers ellipsoid*, *c*. 1 mm long, *dehiscing through longitudinal slits*; stigma capitate, glandular. **Fruits** *yellow turning red to dark blue*, *c*. 0.3 cm diameter, covered with sessile glands, subtended to half enclosed by the persistent calyx; with 4 one-seeded pyrenes.

Distribution. Endemic to Borneo; mainly known in W Kalimantan (e.g., *Church et al. 2045*, *Burley & Tukirin 3203* and *Suzuki et al. K 3393*), but possibly also occurs in Kapit district, Sarawak (e.g., *S 55777*; see notes below).

Ecology. In primary forest, at 300–600 m altitude.

Notes. An anomalous but clearly closely related collection, *Othman & Jawa S 55777* from Kapit, Sarawak, resembles *C. teneriflora* in its leaf shape but its inflorescence is unusual, being of a much more branched structure. It is, however, closest to this species as it resembles no other.

2. **CLERODENDRUM** L.

(Greek, *klêros* = fate or chance, *dendron* = tree; referring to the poisonous or medicinal nature of many species and the difficulty in making the right identification)

with contributions from

James A. Wearn & David J. Mabberley

Sp. Pl. 2 (1753) 637; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 807; Schauer *in* A. de Candolle, Prodr. 11 (1847) 658 ("*Clerodendron*"); Miquel, Fl. Ind. Bat. 2 (1858) 867 ("*Clerodendron*"); Bentham *in* Bentham & Hooker *f.*, Gen. Pl. 2, 2 (1876) 1155 ("*Clerodendron*"); C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 589 ("*Clerodendron*"); Briquet *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 174 ("*Clerodendron*"); Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 825 ("*Clerodendron*"); H.J. Lam, Verb. Malay. Archip. (1919) 238 ("*Clerodendron*"); H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 73 ("*Clerodendron*"); Merrill, EB (1921) 515 ("*Clerodendron*"), Enum. Philip. Pl. 3 (1923) 400; Ridley, FMP 2 (1923) 623 ("*Clerodendron*"); Masamune, EPB (1942) 639 ("*Clerodendron*"); M.R. Henderson, Malay. Wild Flowers – Dicotyledons Part 2 (1950) 385; Backer & Bakhuizen *f.*, FJ 2 (1965) 607; Kochummen, TFM 3 (1978) 302; J.A.R. Anderson, CLTS (1980) 343; Moldenke & Moldenke, Rev. Handb. Fl. Ceylon 4 (1983) 407; Moldenke, Phytologia 58 (1985) 178; Munir, J. Adelaide Bot. Gard. 11, 2 (1989) 101; Coode *et al.* (eds.), CLBD (1996) 330; Corner WSTM 4th. edition 2 (1997) 744 ("*Clerodendron*"); Kessler (ed.), Secondary Forest Trees Kalimantan (2000) 193; Beaman & C. Anderson, PMK 5 (2004) 454; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 199. **Synonyms:** *Siphonanthus* L., Sp. Pl. 1 (1753) 109; *Cryptanthus* Osbeck, Dagb. Ostind. Resa (1757) 215.

Trees, *shrubs or lianas*, *rarely herbaceous perennials*. **Leaves** *simple*, opposite-decussate or whorled; blades without conspicuous glands at base, margins entire, toothed or lobed; *petioles not swollen at either ends*. **Inflorescences** terminal and/or axillary panicles or heads, often with lateral cymes. **Flowers** bisexual, bilaterally symmetrical; calyx campanulate to tubular, 5-lobed, often coloured, usually accrescent into a star-like plate in fruit; *corolla with a narrow*, *usually long salver- shaped tube*, 2-lipped, 5-lobed, *lobes usually unequal*; stamens 4(–5), didynamous, inserted within corolla tube, usually long-exserted, *anthers versatile*; ovary imperfectly 4-locular, each locule with 1 ovule, *style terminal*, elongate, shortly 2-lobed, *lobes equal*. **Fruit** *a drupe*, *often 4-sulcate or 4-lobed*; endocarp tough, separating into 4 one-seeded pyrenes or a schizocarp with 4 fleshy (rarely dry) one-seeded (or rarely 2 two-seeded) mericarps.

Distribution. About 400 species in tropical and subtropical regions especially in the eastern hemisphere. In Borneo about 25 species are recorded but only two (*C. adenophysum* and *C. disparifolium*) can be described as trees; the others are all herbs or shrubs. A key to all *Clerodendrum* species is not included here, as a revision of the genus in Borneo is necessary to ensure satisfactory delimitation of the taxa.

Ecology. Mostly understorey shrubs, two species a small tree, very common in open disturbed areas.

Uses. In SE Asia, a number of species (e.g., *Clerodendrum chinense* (Osbeck) Mabb., *C. indicum* (L.) Kuntze, *C. paniculatum* L. and *C. thomsonae* Balf. *f.*) are planted as ornamentals in gardens and parks or for their various traditional medicinal usage.

Key to *Clerodendrum* tree species

Leaves (broadly) ovate, base rounded to cordate; lower leaf surface with large glands clustered around base……**1. C. adenophysum**

Leaves broadly to narrowly elliptic, base acute to obtuse; lower leaf surface not as above……..……**2. C. disparifolium**

1. **Clerodendrum adenophysum** Hallier *f.* Fig. 4.

(Greek, *adênos* = gland, *phusa* = bellows or bladder; referring to the bladder-like glands on the lower leaf surface)

Meded. Rijks.-Herb. Leiden 37 (1918) 66; Merrill *op. cit.* (1921) 515; H.J. Lam *op. cit.* 272; Masamune *op. cit.* 639; J.A.R. Anderson *op. cit.* 343; Kessler (ed.) *op. cit.* 194, fig. 195; Beaman & C. Anderson *op. cit.* 454. **Syntypes:** *Korthals s.n.*, Sumatra, Palembang, Dukuh (*n.v.*); *Hallier f. B2506*, 12 Feb. 1894, Borneo, W Kalimantan, Kelam Mts., near Sintang (BO *n.v.*); *Korthals s.n.*, Borneo, SE Kalimantan, Martapura (L Barcode L 0062788).

Shrub or tree to 25 m tall, to 12 cm diameter. **Bark** smooth or slightly flaky, pale brown or grey. **Sapwood** yellowish. **Twigs** round to obtusely quadrangular in cross-section, with dense hairs. **Leaves** decussate; *blades* (*broadly*) *ovate*, 11–27 × 6.5–20 cm, *base rounded to cordate*, margins entire, apex acute to slightly caudate; upper surface hairy when young, glabrous when mature, *lower surface with* yellow sessile glands and *larger glands to 2 mm*

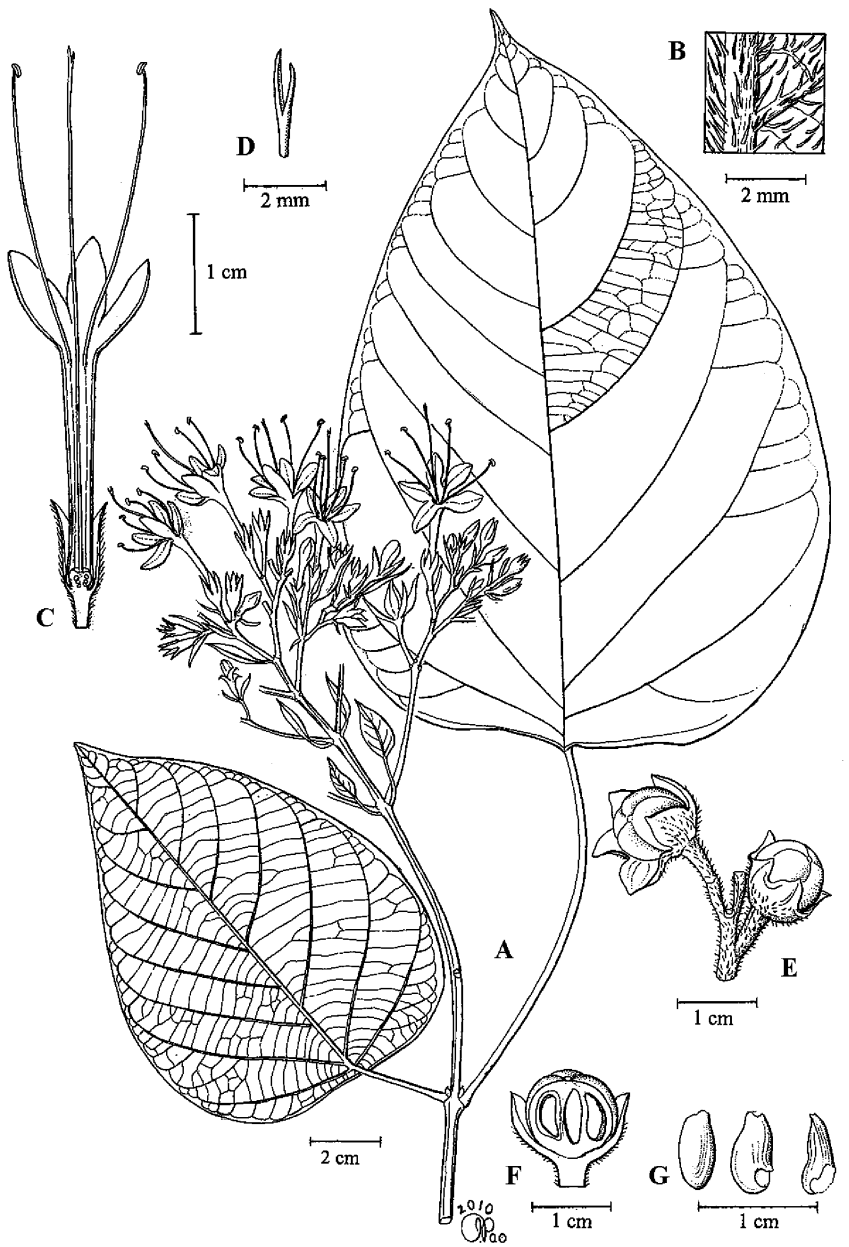

Fig. 4. *Clerodendrum adenophysum*. A, flowering leafy twig; B, indumentum on lower leaf surface; C, longitudinal section of open flower; D, stigma; E, fruits; F, longitudinal section of fruit; G, different view of seeds. (A–D from *Lugas LL 2898*, E–G from *S 33890*.)

wide clustered around the base; petioles 2.5–12 cm long. **Inflorescences** terminal, paniculate, subtended by leaf-like bracts. **Flowers:** calyx green, 4–10 mm long, 5-lobed, lobes narrowly triangular, 3–5 mm long, outer surface with short hairs; corolla white to whitish pink or greenish, tube 12–20 mm long, glabrous, 4-lobed, lobes 5–8 mm long; stamens white, 30–45 mm long, well exserted, anthers dark purple; style green, 30–45 mm long, stigma pale green. **Fruits** globose, green, 0.5–1 cm diameter (in dry specimens); calyx reddish pink, enclosing the fruit, lobes often becoming more broadly triangular.

Vernacular names. Sarawak—*bepanggal*, *pepanggil* (Iban). Kalimantan—*pangir putih* (Dajak Benuang).

Distribution. Thailand to Sumatra and Borneo. Widespread in both Sabah (e.g., *SAN 28062*, *SAN 29570*, *SAN 73837*, *SAN 101843* and *SAN 136050*) and Sarawak (e.g., *S 16016*, *S 23618*, *S 36435*, *S 56200* and *S 57851*). Also known in Kalimantan (e.g., *Sidiyasa 1228*, *Arbainsyah 1895* and *Kessler PK 2188*) but not yet recorded from Brunei.

Ecology. Primary and secondary forest, often near streams, on sandy or sandy clay soils, at 50–1450 m altitude.

2. **Clerodendrum disparifolium** Blume

(Latin, *dispar* = unequal, *folium* = leaf; referring to its leaves sometimes unequal in size/shape)

Bijdr. Fl. Ned. Ind. 14 (1826) 809; Schauer *op. cit.* 672; Miquel *op. cit.* (1858) 871; C.B. Clarke *op. cit.* 589; Gamble *op. cit.* 829; H.J. Lam & Bakhuizen *op. cit.* (1921) 83; Merrill *op. cit.* (1921) 516; Ridley *op. cit.* (1923) 625; Masamune *op. cit.* 639; J.A.R. Anderson *op. cit.* 343. **Lectotype** (Mabberley 2010, submitted)**:** *Blume* '*795*', Java, G. Seribu (L; isolectotype (image) NY).

Shrub, treelet or small tree, 1–12(–14) m tall, to 15 cm diameter; branchlets slender and pendent. **Twigs** subquadrangular to round in cross-section, grey-brown, glabrous to puberulent, lenticellate. **Leaves** decussate, sometimes anisophyllous; *blades broadly to narrowly elliptic*, 5–19 × 2–8 cm, *base acute to obtuse*, margin entire, subentire or shallowly serrate, apex acute to acuminate (sometimes abruptly so), membranous, upper surface glabrous to subglabrous, *lower surface* paler and *glabrous to puberulent*, *sometimes with pubescent venation*; lateral veins 5–6 pairs; petioles variable in length, 0.8–7.2 (mostly *c.* 3) cm long, slender. **Inflorescences** paired axillary cymes with substending leaf-like or reduced bracts, often giving the appearance of a delicate, terminal panicle that extends to 30 cm long; individual cymes 5–8 cm diameter, axes trichotomous; peduncles and pedicels subglabrous to pubescent; pedicels 6–16 mm long. **Flowers:** calyx with lobes acute to narrowly lanceolate, 4–7 × 1.5–2 mm, glabrous to puberulent, accrescent in fruit, increasing in size to 8–13 × 2.5–4 mm, dark-red to purple; corolla pale yellow (green in bud), tube to 2.2 cm long, glabrous to puberulent; stamens 4, exserted, extending to 1.3 cm from the corolla tube. **Fruit** a drupe, globose, *c.* 6 mm diameter, olive, ripening to blue-green and blue-black.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Java and Borneo. In Borneo recorded in Sabah from Kinabatangan, Lahad Datu, Tawau and Tenom districts (e.g., *SAN 44030*, *SAN 79691*, *SAN 90759*, *SAN 117707* and *SAN 123942*), and in Sarawak from Bau, Bintulu, Kuching and Lundu districts (e.g., *Haviland 3559A*, *S 21450*, *S 37419*, *S 41872* and *S 47065*). Also known from Brunei (e.g., *BRUN 665* and *S 1108*) and E and S

Kalimantan (e.g., *Ambriansyah AA 1243*, *van Balgooy 5739*, *Kessler PK 2365*, *Leighton 1038* and *de Vogel 1653*).

Ecology. Common in lowland and hill forests and forest-edges but is also found to 1280 m altitude.

3. **GMELINA** L.

(Johann George Gmelin, 1709–1755, Professor of medicine, botany and chemistry in Tübingen, Germany, and explorer in Siberia)

enkaleh (Iban)

Sp. Pl. 2 (1753) 626; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 814; Schauer *in* A. de Candolle, Prodr. 11 (1847) 678; Miquel, Fl. Ind. Bat. 2 (1858) 865; Bentham & Hooker *f.*, Gen. Pl. 2, 2 (1876) 1153; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 581; Briquet *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 173; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 823; H.J. Lam, Verb. Malay. Archip. (1919) 214; Merrill, EB (1921) 515; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 64; Ridley, FMP 2 (1923) 622; Masamune, EPB (1942) 641; Backer & Bakhuizen *f.*, FJ 2 (1965) 606; Kochummen, TFM 3 (1978) 306; Munir, J. Adelaide Bot. Gard. 7, 1 (1984) 91; Moldenke & Moldenke, Rev. Fl. Ceylon 4 (1983) 388; Coode *et al.* (eds.), CLBD (1996) 330; Corner, WSTM 4th. edition 2 (1997) 747; Kessler (ed.), Secondary Forest Trees Kalimantan (2000) 195; Beaman & C. Anderson, PMK 5 (2004) 455; Mabberley *in* Mabberley & de Kok, Fl. Nouv.-Caled. (2004) 22; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 195.

Trees, *lianas or rarely tall shrubs*. **Twigs sometimes with spines,** almost terete in cross-section, pubescent or glabrous. **Leaves** *simple*, decussate, *usually with conspicuous discoid glands at base beneath*. **Inflorescences** terminal or axillary, dense to lax cymes. **Flowers** bisexual, bilaterally symmetrical; calyx tubular or campanulate, 4–5-lobed; *corolla* more or less 2-lipped, (4–)5-lobed, white, yellow, brownish, *tube widely funnel-shaped*, *greatly enlarged at throat*, posterior lip usually 2-lobed, anterior lip 3-lobed, mid-lobe largest; stamens 4, didynamous, anterior pair longer, inserted halfway up the corolla tube, anthers with distinct cracks; ovary 2-carpelate, 4-locular, ovule 1 in each locule, *style terminal*, stigma 2-lobed, lobes unequal. **Fruits** *drupaceous*, with very fleshy mesocarp and hard endocarp, 4- or rarely 2-locular. **Seeds** solitary in each locule, without endosperm.

Distribution. About 33 species, distributed from Pakistan, India, Sri Lanka and S China to Malesia, N and W Australia, Fiji, New Zealand and New Caledonia. Five species in Borneo; two (*G. elliptica* and *G. uniflora*) are native; *G. arborea*, *G. asiatica* and *G. philippinensis* are introduced and cultivated as ornamentals; *G. arborea* is also used as a nursing tree or in large-scale forest plantations.

Ecology. Flat land or hillsides.

Uses. The timber of *Gmelina arborea* (Yemane) is suitable for general utility purposes, particularly for light construction and structural work, carpentry, packaging, carvings, utility furniture and decorative veneers. In addition, the wood produces good quality pulp suitable for manufacturing carton board and writing paper. The leaves, bark and roots of several species have been reported to have various traditional medicinal properties (PROSEA 5, 1 (1994) 215–221, *ibid.* 12, 2 (2001) 278–281).

Key to *Gmelina* species

1. Climbing shrubs, usually with spines. Leaf margins sometimes lobed. Calyx margin truncate; corolla 4-lobed……...2
   Trees or lianas, without spines. Leaf margin entire. Calyx margin distinctly dentate or lobed; corolla 5-lobed……...4

2. Leaves densely villous beneath……**1. G. elliptica**
   Lower leaf surface glabrous or with only few hairs……3

3. Inflorescence without colourful bracts (to 6 mm wide)……..
   G. asiatica L.
   (of Asia)
   Sp. Pl. 2 (1753) 626; Blume *op. cit.* (1826) 814; Schauer *op. cit.* 679; Miquel *op. cit.* 866; C.B. Clarke *op. cit.* 582; Gamble *op. cit.* 823; H.J. Lam *op. cit.* 221; H.J. Lam & Bakhuizen *op. cit.* 69 (var. *typica*); Merrill *op. cit.* (1921) 515; Masamune *op. cit.* 641; Ridley *op. cit.* (1923) 622; Kochummen *op. cit.* 306; Moldenke & Moldenke *op. cit.* 394; Coode *et al.* (eds.) *op. cit.* 330; Rajendran & Daniel, Indian Verb. (2002) 161. Type: *Herb. Linn. 780-2* (LINN).
   Shrubs, *sometimes climbing*, 2–4 m high; *spines usually present*, to 25 mm long. Leaves ovate to elliptic or deltoid, 0.5–5 × 0.5–3.3 cm, *5-lobed* or unlobed, base round to cuneate, margins entire, apex round to acute, papery, upper surface glabrous, or with a few hairs on veins, dark green, shiny, *lower surface glabrous*, sometimes with hairs on veins, whitish, *covered with small peltate scales*; lateral veins 3–4 pairs, the first pair often starting from the very base of the midrib; petioles 0.5–3 cm long, glabrous or with a few hairs, small glands absent to many. Inflorescences terminal, sometime appearing axillary on short side shoots, 1.5–10 cm long, pendulous or erect, sparsely hairy; *bracts not colourful*, linear to lanceolate, *c. 10 × 5–6 mm*, apex cuspidate, caducous. Flowers: calyx with discoid glands, flowering calyx 4–6 mm high, 3.5–4 mm across, lobes 4–5, acute, to 1 mm long, fruiting calyx 7–8 mm diameter, erect to patent; corolla covered with yellow hairs, lower lip 3-lobed, mid-lobe oblong, 12–35 × 10–15 mm, apex round, patent, cuspidate, margins sometimes reflexed, side lobes 4–10 × 5–8 mm, sometimes oblique, apex acute, erect to reflexed, upper lip oblong, *c.* 3.5 × 6 mm, apex round, tube 10–23 mm long; stamens inserted at apex of corolla tube, glabrous, 10–18 mm long. Fruits (dried) clavoid, 13–30 mm long, 8–30 mm diameter, glabrous, yellow when mature.
   Native of India and Sri Lanka; introduced and sometimes cultivated throughout the tropics (including Borneo).
   Inflorescences with big colourful bracts (more than 10 mm wide)……
   G. philippinensis Cham. Plate 2F.
   (of the Philippines)
   Linnaea (1832) 109; Merrill, Sp. Blancoanae (1918) 333, Enum. Philip. Pl. (1923) 399; Backer & Bakhuizen *f.*, *op. cit.* 607; Kochummen *op. cit.* 306; Moldenke & Moldenke *op. cit.* 399. Homotypic synonym: *Gmelina asiatica* L. var. *philippinensis* (Cham.) Bakh. *in* H.J. Lam & Bakhuizen *op. cit.* 70). Type: *Zoffiana s.n.*, Philippines (holotype LE, *n.v.*).
   Shrub or small tree, 2–3 m high. Twigs sparsely hairy, *spines usually present*. Leaves elliptic to ovate, 2.5–5.5(–7) × 1.4–4.5 cm, *rarely shallowly 3-lobed*, base cuneate to decurrent, margins entire, apex round to acute, upper surface glabrous, sometimes with a few hairs on main vein, *lower surface glabrous with some hairs on the veins*, peltate scales present, sometimes with discoid glands at base; lateral veins 3–4 pairs, the first pair often starting from the very base of the midrib;

petioles 9–22 mm long, channelled, sparsely hairy. Inflorescences terminal, 3–7 cm long, erect to patent, sparsely hairy; *bracts ovate-lanceolate*, *9–13 × 10–21 mm*, apex acute, cuspidate, caducous, sometimes with discoid glands. Flower: calyx densely to sparsely pubescent, becoming more glabrous over time, lobes 0–5, discoid glands present, flowering calyx 3–4 mm high, 2.5–3 mm across, lobes *c*. 0.2 mm long, apex acute, fruiting calyx 4–10 cm diameter, margin straight to undulate, patent; corolla covered with yellow hairs, lower lip 3-lobed, mid-lobe 4–9 × 6.5 mm, apex acute, patent, side lobes 3.5–7 mm long, apex round, slightly oblique, upper lip *c*. 4.5 mm long, corolla tube 10–16 mm long. Fruits (dried) obovoid, 15–20 mm long, 9–12 mm diameter, glabrous, yellow when mature.
Endemic to the Philippines. Cultivated throughout the tropics as an ornamental.

4. Tree. Leaf base cordate or rounded, lower surface pubescent. Calyx 2–7 mm long; corolla covered with yellow hairs outside……..……..……..
G. arborea Roxb. Plate 2E.
(Latin, *arbor* = tree; referring to the growth habit of the species)
Pl. Corom. 3 (1815) 41, Fl. Ind. edit. Carey 3 (1832) 84; C.B. Clarke *op. cit.* 381; H.J. Lam *op. cit.* 219; H.J. Lam & Bakhuizen *op. cit.* 68; Moldenke & Moldenke *op. cit.* 390. Type: *Rheed*, *Hort. Malab. 1* (*1678*) *t. 41*. Synonyms: *Gmelina rheedii* Hook., Bot. Mag. 74 (1848) *t*. 4395, *nom. illeg*.; *Gmelina arborea* Roxb. var. *glaucescens* C.B.Clarke *op. cit.* 582; *Gmelina arborea* Roxb. var. *canescens* Haines, Forest Fl. Chota Nagpur (1910) 82.
Tree 5–30 m high. Bark whitish to greyish or reddish brown, smooth. Twigs densely tomentose, without spines. Leaves: blades broadly ovate, 10–25 × 5–8 cm, *base rounded to cordate*, margin entire, apex round to acuminate; upper surface with hairs on veins only, lower surface covered with hairs, peltate scales present, clustered glands occur around the base; lateral veins 3–5 pairs; petioles terete, 3.5–10 cm long. Inflorescences erect, narrow thyrses; peduncles 10–20 cm long; bracteoles lanceolate to linear, to 15 mm long. Flowers: calyx 2–7 mm high, 4–5 mm across, velutinous, not accrescent in fruit, *margin distinctly lobed*, lobes acute at apex, outer surface with scattered discoid black glands; corolla (reddish) yellow, outer surface hairy, inside glabrous, sparsely glandular, tube 15–20 mm long, anterior lip 3-lobed, mid-lobe spathulate 15–20 × 15–25 mm, other lobes 10–15 mm long; posterior lip entire or slightly 2-lobed, 6–7 × 6–12 mm; stamens 15–20 mm long, anthers *c*. 2 mm long; ovary glabrous, glandular, style 20 mm long, stigma *c*. 1 mm long. Fruits ellipsoid to obovoid-ellipsoid, 1.2–2 cm long, 1–1.5 cm diameter, glabrous, dark purple when mature.
Native of Pakistan, Bhutan, India, Myanmar, and China, the species has been extensively introduced and planted in SE Asia, tropical Africa and Brazil. In Sabah and Sarawak rarely collected; so far recorded from Labuk Sugut, Sandakan and Tawau districts (e.g., *Kadir SAN A 971*, *SAN 30999*, *SAN 100594* and *SAN 147214*) and in Sarawak from Kuching district (e.g., *S 29349*). The timber is reported to be reasonably strong for its weight. It is used for various purposes including construction, furniture, and musical instruments. The species also has a wide range of traditional, medicinal uses.
Tree or liana. Leaf base rounded to acute, lower surface with silvery shine, seldom pubescent. Calyx more than 15 mm long; corolla white, glabrous……..**2. G. uniflora**

1. **Gmelina elliptica** Sm.

(Latin, *ellipticus* = elliptical; referring to the leaf shape)

In Rees, Cycl. 16 (1810) sect. 1, part 31; Merrill *op. cit.* (1923) 399, Philip. J. Sci. 24 (1926) 415; Masamune *op. cit.* 641; Backer & Bakhuizen *f. op. cit.* 606; Kochummen *op. cit.* 306; Munir *op. cit.* (1984) 95; Corner *op. cit.* (1997) 748; Rajendran & Daniel *op. cit.* 166. **Type:** East Indies, undated (LINN, microfiche). **Heterotypic synonyms:** *Gmelina villosa* Roxb., Fl. Ind. edit. Carey 3 (1832) 86, Schauer *op. cit.* 679, Miquel *op. cit.* 867, C.B. Clarke *op. cit.* 582, Gamble *op. cit.* 824, H.J. Lam *op. cit.* 217, Merrill *op. cit.* (1921) 515, Ridley *op. cit.* (1923) 623; *G. asiatica* L. var. *villosa* (Roxb.) Bakh. *in* H.J. Lam & Bakhuizen *op. cit.* 70.

Climbing shrub to small tree, 1–3(–10) m high, 2–12(–45) cm diameter. **Bark** smooth, pale brown to whitish. **Twigs** *usually with spines*, minutely hairy when young. **Leaves:** blades ovate to obovate, 3–10 × 2.2–8.5 cm, base cuneate, *margins 5-lobed* or unlobed, apex round to acuminate, upper surface glabrous, sometimes with hairs on veins, *lower surface densely to sparsely villous*, whitish, peltate scales present, usually also with glands at base; lateral veins 3–4 pairs; petioles 0.5–4.5 cm long. **Inflorescences** terminal, usually pendulous, few- to many-flowered thyrses. **Flowers:** calyx 3–6 mm high, 2.4–4 mm across, densely pubescent, *margin truncate*, with scattered black discoid glands; corolla covered with yellow hairs, sparsely glandular, tube 10–22 mm long, anterior lip 3-lobed, mid-lobe oblong, 5–10 × 5–8 mm long, apex round, patent, other lobes 3–4 mm long, apex round, posterior lip 5–6 mm long, entire, apex round; stamens 10–20 mm long, with few glandular hairs, anthers 2–2.5 mm long; style 10–15 mm long. **Fruits** ovoid to obovoid, 0.8–2 cm long, 0.7–1.5 cm diameter, glabrous, (greenish) yellow when mature.

Vernacular names. Sabah—*bulangan* (Malay), *tangginang* or *kutang* (Dusun), *kutang* (Murut), *taring pelandok* (Kadayan), *belingkot* (Murut). Brunei—*rukam* (Iban).

Distribution. India to S China, southeastward to Indo-China, Thailand, Malesia (except New Guinea) and introduced into Australia (Queensland). In Borneo known in Sabah from Keningau, Kudat, Lahad Datu, Pensiangan, Ranau, Sandakan, Semporna, Tambunan, Tawau and Tenom districts (e.g., *SAN 15304*, *SAN 31238*, *SAN 85929*, *SAN 96465*, *SAN 107475* and *SAN 136062*) and in Sarawak recorded from Kuching district (e.g., *Haviland 318* and *van Balgooy 7348*). Also known in E and S Kalimantan (e.g., *Ambriansyah AA 1199*, *Kessler PK 1780* and *Winkler 2270*).

Ecology. Secondary forest, grasslands and heath forest, often in disturbed areas on white sandy or clay soils, sometimes over basalt or limestone bedrock, at altitudes to 600 m.

Notes. The leaves on young shoots tend to be more lobed than those on more mature shoots.

2. **Gmelina uniflora** Stapf Fig. 5.

(Latin, *unus* = one, *florus* = flower; referring to the 1-flowered inflorescence)

In Hooker's Icon. Pl. 24 (1895) *t.* 2391; H.J. Lam *op. cit.* 217; Merrill *op. cit.* (1921) 515; H.J. Lam & Bakhuizen *op. cit.* 65; Masamune *op. cit.* 641; Coode *et al.* (eds.) *op. cit.* 331; Beaman & C. Anderson *op. cit.* 455. **Type:** *Motley 1204*, 1857–1858, Indonesia, S Kalimantan, Banjermassing (Banjarmasin) (holotype K Barcode K 000192583). **Synonyms:** *Gmelina uniflora* Stapf var. *typica* Bakh. *in* H.J. Lam & Bakhuizen *op. cit.* 66; *G. uniflora* Stapf var. *villosa* Bakh. *in* H.J. Lam & Bakhuizen *op. cit.* 66.

Small tree, 4–25 m high, 15–30 cm diameter or liana. **Bark** light to reddish brown, smooth. **Sapwood** white to pale orange. **Twigs** with yellow hairs. **Leaves:** blades papery, broadly

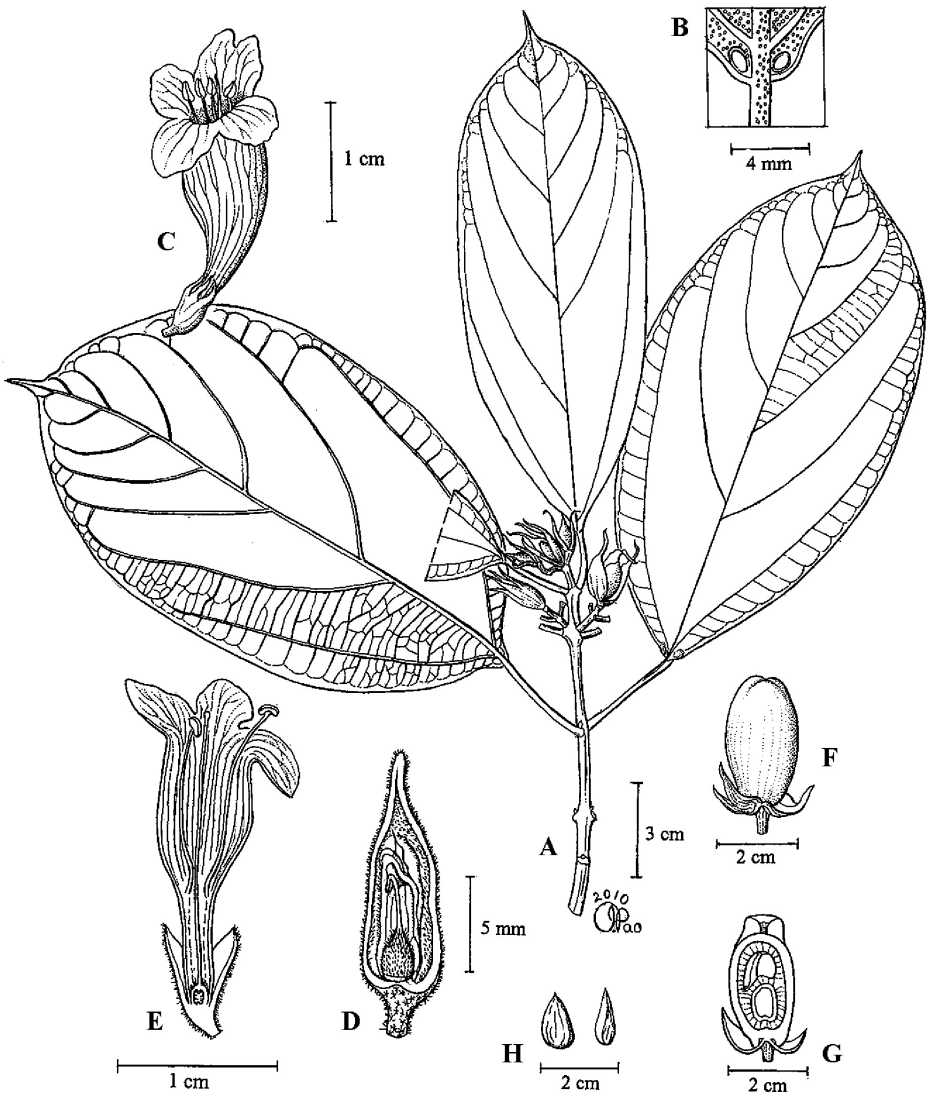

Fig. 5. *Gmelina uniflora*. A, fruiting (young) leafy twig; B, discoid glands and indumentum on the lower surface of leaf base; C, open flower; D, longitudinal section of flower bud; E, longitudinal section of open flower; F, fruit; G, longitudinal section of fruit; H, seeds. (A–B and D from *SAN 60078*, C and E from *FD FMS 35504*, F–H from *SAN 132859*.)

elliptic or obovate-elliptic, 10–20 × 7–12 cm, base round to cuneate, apex obtuse or shortly acuminate; upper surface glabrous, lower surface sometimes with hairs on veins, often with a silver sheen, peltate scales present, also with glands at base; lateral veins 4–6 pairs, the first pair often starting from the very base of the midrib; petioles 1.5–4 cm long. **Inflorescences** usually consisting of a single flower, axillary; bracts leaf-like. **Flowers:** pedicels to 1.5 cm long; bracteoles to 12 mm long, lanceolate, apex acuminate; calyx 15–20 mm high, 7–10 mm across, velutinous, not accrescent in fruit, *margin lobed*, lobes 9–10 mm long, apex acuminate; corolla white, tube 20–30 mm long, lip 3-lobed, mid-lobe 10–13 × 10–12 mm, apex round, glabrous, other lobes 7–8 × 7–8 mm, apex round, posterior lip with two small semicircular lobes, lobes 5–6 × 6–7 mm, apex round; stamens 10–17 mm long, anthers 3–4 mm long; ovary covered with hairs at apex, style 15–20 mm long, stigma *c.* 3 mm long. **Fruits** ellipsoid, 2.5–3.5 cm long, 1.5–2 cm diameter, pale yellow, smooth.

Vernacular names. Sarawak—*susu-susu* (Kedayan). Brunei—*akar inklis* (Iban), *paginggi* (Brunei).

Distribution. Endemic to Borneo; widespread in Sabah (e.g., *SAN 60078*, *SAN 92508*, *SAN 110133*, *SAN 119450* and *SAN 135971*) and Sarawak (e.g., *Haviland 919*, *S 12126*, *S 39629*, *S 59169* and *S 62317*). Also recorded from Brunei (e.g., *Dransfield JD 7488* and *Symington FMS 35504*) and Kalimantan (e.g., *Argent 9627* and *Veldkamp 8453*).

Ecology. Primary and secondary forest on yellow sandy clay or clay soils, at 30–800 m altitude.

Uses. In Sarawak, it is used for treating goitres, by first pounding the leaf and rubbing the paste on the affected part.

4. **PREMNA** L.

(Greek, *premnon* = the bole or stump of a tree; the first species described had a dwarf habit)

singkel (Malay)

Mant. 2 (1771) 154; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 815; Schauer *in* A. de Candolle, Prodr. 11 (1847) 630; Miquel, Fl. Ind. Bat. 2 (1858) 890; Bentham & Hooker *f.*, Gen. Pl. 2, 2 (1876) 1152; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 571; Briquet *in* Engler & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 170; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 810; H.J. Lam, Verb. Malay. Archip. (1919) 100; Merrill, EB (1921) 512; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 31; Ridley, FMP 2 (1923) 617; Masamune, EPB (1942) 642; Backer & Bakhuizen *f.*, FJ 2 (1965) 602; Kochummen, TFM 3 (1978) 307; Moldenke & Moldenke, Rev. Fl. Ceylon 4 (1983) 308; Munir, J. Adelaide Bot. Gard. 7 (1984) 1; Coode *et al.* (eds.), CLBD (1996) 331; Corner, WSTM 4th. edition 2 (1997) 749; Rajendran & Danial, Indian Verb. (2002) 213; Beaman & C. Anderson, PMK 5 (2004) 456; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 194; Leeratiwong *et al.*, Nat. Hist. J. Chulalongkorn Univ. 9, 2 (2009) 113. **Synonyms:** *Gumira* Rumph. *ex* Hassk., Flora 25, 2 Beibl. (1842) 26; *Holochiloma* Hochst., Flora 24 (1841) 371; *Tatea* F.Muell., Trans & Proc. Roy. Soc. S. Austr. 6 (1883) 33; *Pygmaeopremna* Merr., Philip. J. Sci. 5 (1910) 225; *Surfacea* Moldenke, Phytologia 46 (1980) 59. (For further synonyms, *cf.* de Kok, Kew Bull. 65, 4 (2011), in press).

Trees, *shrubs or woody lianas*, rarely small herbs. **Leaves** *simple*, (sub)opposite or in whorls of 3–4, *without conspicuous glands at base*, often aromatic; *petioles not swollen or thickened at either ends*. **Inflorescences** *terminal*, lax to (very) dense cymes or corymbs;

bracts inconspicuous. **Flowers** *bisexual*; *calyx* tubular or cup-shaped, *slightly or not accrescent in fruit*, actinomorphic to sometimes 2-lipped; *corolla funnel- or salver-shaped*, *not greatly enlarged at throat*, *2-lipped* (*occasionally more or less actinomorphic*), 4–5-lobed (rarely 1–3-lobed), posterior lip usually entire, rarely 2-lobed, anterior lip 3-lobed, the two lateral lobes usually distinct from the larger median lobe, *inner surface densely white hairy*; *stamens 4*, didynamous, exserted, hairy at base; ovary, (2–)4-locular, each locule with 1–2 ovules, sometimes only one ovule developing, the others suppressed, *style terminal*, stigma 2-lobed. **Fruits** *drupaceous*, globose or obovoid, *not lobed*, indehiscent, 4-seeded or 1-seeded by abortion. **Seeds** with or without endosperm.

Distribution. About 50 (Mabberley, PB 3rd. edition (2008) 698) to 200 (Harley *et al. op. cit.* and Leeratiwong *et al. op. cit.*) species, in tropical and subtropical Asia, Africa, Australia and Pacific Islands. In Malesia 14 species of which 6 species are known in Sabah and Sarawak.

Ecology. In evergreen, decidous or secondary forests at altitudes to 1800 m. Typically found in vegetation on sandstone bedrock, near streams and in open areas.

Notes. The discrepancy in estimates of the numbers of species of *Premna* reflects the fact that this genus is in need of taxonomic revision. No generally accepted infrageneric classification is available, the last such work being that of Briquet (*op. cit.*). Current treatments only exist for Australia (Munir *op. cit.*) and Thailand (Leeratiwong *op. cit.*). Revision of *Premna* in Malesia (de Kok, Kew Bull. 65, 4 (2011), in press) is underway.

Key to *Premna* species

1. Mature leaves with hairs not only on the main veins, but also on both surfaces of the blades, often dense……2
   Mature leaves glabrous on both surfaces or with only a few hairs on the main veins…..3

2. Tree, rarely liana. Calyx 5-lobed. Fruits 4-seeded, globose and smooth……
   ……...**2. P. odorata**
   Liana, rarely small tree. Calyx 4-lobed. Fruits 1-seeded, clavoid ….....**1. P. oblongata**

3. Calyx 4-lobed or unlobed. Young twigs with a series of bracts at base. Fruits clavoid, 1-seeded……4
   Calyx 5-lobed or unlobed. Young twigs without a series of bracts at base. Fruits globose, 4-seeded……**4. P. serratifolia**

4. Fruits warty when dried…….……...……..
   P. clavata de Kok
   Kew Bull. (65, 4 (2011), in press)
   Climber, 5–7 m long. Leaves (sub-)opposite; blades elliptic to ovate, sparsely hairy on both surfaces, often triveined from the base. Fruits globose to clavoid, 1-seeded; endocarp warty. Endemic to Borneo, known only from Sabah (e.g., *SAN 119464*, *SAN 119518* and *SAN 120965*) and Sarawak (e.g., *Beccari 2887*).
   Fruit smooth or with faint ridges……..5

5. Leaves membranous; glands on lower surface sunken; a conspicuous false intramarginal vein present…….**3. P. pallescens**

Leaves membranous to chartaceous; glands on lower surface not sunken; intramarginal vein absent……..**5. P. trichostoma**

1. **Premna oblongata** Miq.

(Latin, *oblongatus* = somewhat longer than broad; possibly referring to the shape of leaf blades)

Fl. Ind. Bat. 2 (1858) 893; Backer & Bakhuizen *f. op. cit.* (1965) 603. **Homotypic synonyms:** *Premna integrifolia varietas* Blume *op. cit.* (1826) 815; *Gumira oblongata* (Miq.) Kuntze, Rev. Gen. Pl. 2 (1891) 508. **Neotype** (de Kok, Kew Bull. 65, 4 (2011), in press)**:** *Koorders 38261ß*, E Java, Pasoeroean (= Pasuruan), G. Arjuna, 10 Nov. 1899 (K Barcode K 000646762; isoneotype L). **Heterotypic synonym:** *Premna rotundifolia* Koord. & Valeton, Meded. Lands Plantentuin 42 (1900) 182, Backer & Bakhuizen *f. op. cit.* (1965) 603. **Type:** *Koorders 14360ß*, E Java, Res. Besoeki (= Besuki), Idjenplateau, 6 Nov. 1893 (holotype BO; isotypes BO, K Barcode K 000646766, L).

Climber, *shrub or small tree* (often with gnarled trunk), 1.5–18 m high, to 30 cm diameter. **Twig** usually with a ridge between petioles, velutinous when young; base of young twigs surrounded by bracts. **Leaves** alternate to (pseudo-)opposite; blades orbicular, ovate to narrowly ovate or obovate, 5–28 × (3–)6–18 cm, base rounded to cordate, margin entire, undulate, apex rounded to acuminate; *velutinous on both surfaces or at least at leaf base*, glands few; often triveined from the base; main lateral veins 5–7 pairs; petioles 1–7 cm long, covered with curly to straight hairs. **Inflorescences** 5–15 cm long, velutinous; bracts linear, to 1 mm long. **Flowers:** *calyx* 1.5–2 mm long, pale green, *4-lobed*, lobes (sub)equal, 0.3–0.5 mm long, apex rounded to acute; corolla white to whitish green or yellow, weakly 2-lipped or more or less actinomorphic, glabrous outside apart from some hairs on lobes, inside long- hairy at mouth, tube 2–2.5 × 1–1.5 mm, lobes equal, 1–2 × 1–1.2 mm, reflexed when mature, apices rounded to acute; stamens 2–3.5 mm long, greatly exceeding corolla tube, sometimes didynamous, anthers 0.3–0.5 mm long; ovary globose, 0.5–1 mm diameter, glabrous, glands few at apex or absent, style 2–4.5 mm long, stigma 0.5–1 mm long, apex acuminate. **Fruits** *1-seeded*, *clavoid*, 2.5–4 mm long, glabrous, glands absent, dark or yellow green; endocarp smooth.

Vernacular name. Sabah—*puluran* (Dusun).

Distribution. Sumatra, Java, Borneo, Sulawesi and the Philippines. In Borneo, found in Sabah especially the eastern parts (e.g., *SAN 71082*, *SAN 77256*, *SAN 84974*, *SAN 108873* and *SAN 119484*), Sarawak (e.g., *Native Collector 2674* and *S 25698*) and Kalimantan (e.g., *Kostermans 5486*).

Ecology. Common in primary and secondary forest on yellow clay soil over ultrabasic or basaltic bedrock at 240–1600 m altitude. In Java, the trees sometimes growing on bare and hardly eroded lava blocks. Flowering from February to August; fruiting from April to August.

2. **Premna odorata** Blanco

(Latin, *odoratus* = smelling; referring to the aromatic flower)

Fl. Filip. (1837) 488; Miquel *op. cit.* (1858) 900; Merrill, Sp. Blanc. (1918) 331; H.J. Lam *op. cit*. 153; Munir *op. cit.* 35. **Homotypic synonym:** *Gumira odorata* (Blanco) Kuntze, Rev. Gen. Pl. 2 (1891) 508. **Neotype** (Munir 1984)**:** *Tadena PNH 9602*, the Philippines, Laguna Prov., Mt. Makiling, 28 Feb.

1949 (BRI; isoneotype BM). **Heterotypic synonyms:** *Premna flavescens* var. *rubescens* C.B.Clarke *op. cit.* 578, *P. rubescens* (C.B.Clarke) Ridl. *op. cit.* (1923) 618, Kochummen *op. cit.* 307; *P. pubescens* var. *β odorata* H.J.Lam *op. cit.* 153, H.J. Lam & Bakhuizen *op. cit.* 44; *P. ruttenii* H.J.Lam *op. cit.* 114, Merrill *op. cit.* (1921) 513, Masamune *op. cit.* 643.

Small tree or shrub, 1–10(–25) m tall, 15–30 cm diameter, or liana. **Bark** smooth to flaky, fissured, cream-grey to brownish ochre. **Sapwood** cream to ochre. **Twigs** velutinous when young, with or without ridge between petioles, densely brownish pubescent; base of young twigs without bracts. **Leaves** opposite, producing disagreeable smell when crushed; *blades* membranous or subchartaceous, ovate to orbicular or obovate to lanceolate, 2.5–16(–20) × (2–)4–10(–13.5) cm, base emarginate to cordate, margin entire to serrate, apex emarginate to acuminate; yellowish green above, whitish below; *pubescent*, rarely glabrous, hairs single, erect, covering both surfaces or rarely only on veins with few hairs on blade, glands present; venation often triveined from base, main lateral veins 3–7 pairs; petioles 0.3–7 cm long, velutinous to sparsely hairy. **Inflorescences** 4–15 cm long, puberulous; bracteoles linear, to 1 mm long. **Flowers:** *calyx* usually 2-lipped, *5-lobed*, 1.5–3 mm long, densely pubescent, slightly accrescent in fruit, lobes sub-equal with the posterior ones slightly bigger than the others, 0.5–1 mm long, apex acute to rounded; corolla yellow-orange to pinkish white or greenish white, aromatic, (weakly) 2-lipped, lobes glabrous to sparsely hairy, tube 1–3 mm long, 1–2 mm across, posterior lip ovate-orbicular or oblong to spathulate, 1.5–2 × 0.8–2 mm, apex rounded to obtuse, anterior lip with lateral and middle lobes 1–1.5 × 0.8–1.5 mm, apex rounded; stamens 1–3 mm long, more or less didynamous, exserted, anthers 0.2–0.5 mm long; ovary globose, *c.* 1 mm diameter, glabrous but sometimes with a few hairs at apex, sometimes covered with glands, style 2–7 mm long, exserted, stigma 0.1–0.5 mm long, apex acute. **Fruits** *globose*, *smooth*, 3–5 mm diameter, glabrous, sometimes with a few hairs at apex, sometimes covered with glands, black to purple when mature, *4-seeded*; endocarp smooth.

Distribution. Sri Lanka and east coast of India to S China and southeastwards to Papua New Guinea and Australia Northern Territories and Queenslands. Rarely collected in Sumatra, Peninsular Malaysia, Borneo, Java, the Lesser Sunda Islands, the Philippines, Maluku and New Guinea. In Borneo, so far recorded only in Sabah from Ranau and Sandakan districts (e.g., *SAN 24797*, *SAN 76763* and *SAN 82440*).

Ecology. Usually common in primary and secondary vegetation at 25–1800 m altitude, on clay soil, sometimes over limestone or ultrabasic bedrock. Flowering all year round; fruiting from March to November.

3. **Premna pallescens** Ridl.

(Latin, *pallescens* = becoming pale; referring to the pale lower leaf surface)

Bull. Misc. Inform. Kew (1929) 261. **Type:** *Haviland 3052*, Borneo, Sarawak, Kuching, 24 March 1893 (holotype SING; isotype K Barcode K 000646786).

Tree, 6–18 m tall, 15–20 cm diameter, or climber. **Bark** reddish brown to silver-beige; inner bark orange. **Twigs** without an interpetiolar ridge, sparsely hairy to glabrous; *base of young twigs surrounded by bracts*. **Leaves** opposite to alternate; *blades membranous*, elliptic to obovate, 7–22 × 2.5–7.5 cm, base cuneate to rounded, margins entire, apex acuminate to long-acuminate; *glabrous on both surfaces when mature*, *with hairs on veins when young*, lime-green above, pale whitish green beneath, *with many sunken glands below*; main lateral veins 5–8 pairs; *conspicuous false intramarginal vein present*; petiole 0.5–4.5 cm long,

channelled, glabrous or sparsely hairy with short hairs. **Inflorescences** 3.5–10 cm long, sparsely hairy, dull green; bracteoles linear, to 3 mm long. **Flowers:** *calyx 4-lobed* or unlobed, 2-lipped, with prominent reticulate venation when dried, 2–2.2 mm long, outer surface glabrous with yellow-white sessile glands, lobes almost equal, 0.8–1 mm long, apex rounded; corolla weakly 2-lipped, outside glabrous apart from some hairs on apex of lobes, inside long-hairy at mouth, tube 1–1.8 mm long, posterior lip 0.8–1 × 1–0.8 mm, spathulate, apex rounded, reflexed when mature, anterior lip with lateral and middle lobes 0.5–1 × 0.5–0.8 mm, apex rounded, reflexed when mature; stamens 1.5–2 mm long, inserted on top of tube and just exceeding it, not didynamous, anthers rounded, *c.* 0.2 mm long; ovary globose, *c*. 1 mm diameter, glabrous, style 1.5–3.5 mm long, stigma lobes *c*. 0.2 mm long. **Fruits** *smooth*, *1-seeded*, *clavoid*, 3–4.5 mm long, *c.* 1.5 mm diameter, with glands; *endocarp smooth*.

Distribution. Endemic to Borneo; found in W Sarawak (e.g., *Native Collector 586*, *Hotta 946*, *S 19303* and the type) and W Kalimantan (e.g., *Church et al. 1907*, *Church et al. 2039* and *Nooteboom 4755*).

Ecology. In primary and disturbed dipterocarp forest along streams, on basalt-derived soils, at 250–550 m altitude. Flowering and fruiting from October to March.

4. **Premna serratifolia** L. Fig. 6, Plate 3A.

(Latin, *serratus* = finely and sharply toothed, *folium* = leaf; referring to the leaf margin)

Mant. Pl. 2 (1771) 253; Blume *op. cit.* (1826) 815; Schauer *op. cit.* 632; Munir *op. cit*. 13; Coode *et al.* (eds.) *op. cit.* 331; Beaman & C. Anderson *op. cit.* 456. **Homotypic synonyms:** *Gumira serratifolia* (L.) Kuntze, Rev. Gen. Plant. 2 (1891) 507; *Premna obtusifolia* var. *serratifollia* (L.) Moldenke, Phytologia 28 (1974) 403; *P. obtusifolia* forma *serratifolia* (L.) Moldenke, Phytologia 36 (1977) 438. **Lectotype** (Munir 1984)**:** *Koenig s.n.* (= *Herb. Linn. 782.4*), India (LINN). **Heterotypic synonyms:** *Premna foetida* Reinw. *ex* Blume *op. cit.* (1826) 816, Schauer *op. cit.* 630, Miquel *op. cit.* (1858) 891, Gamble *op. cit.* 814, Merrill *op. cit.* (1921) 513, Ridley *op. cit.* (1923) 619, Masamune *op. cit.* 642, Kochummen *op. cit.* 307, Moldenke & Moldenke *op. cit.* 315, Beaman & C. Anderson *op. cit.* 456, *Gumira foetida* (Reinw. *ex* Blume) Hassk., Fl. Bot. Zeit. 25, Beibl. (1844) 26, H.J. Lam *op. cit.* 153; *P. cyclophylla* Miq. *op. cit.* (1858) 899, Merrill *op. cit.* (1921) 513, *G. cyclophylla* (Miq.) Kuntze *op. cit.* 507; *P. wrayi* King & Gamble, Bull. Misc. Inform. Kew (1908) 108; *P. kunstleri* King & Gamble *op. cit.* (1908) 109; *P. borneensis* H.J.Lam *op. cit*. 117, H.J. Lam & Bakhuizen *op. cit.* 37, Merrill *op. cit.* (1921) 512, Masamune *op. cit.* 642; *P. macrophylla auct. non* Wallich (1831): H.J. Lam *op. cit.* 148, Merrill *op. cit.* (1921) 513, Masamune *op. cit.* 643; *P. lamii* Moldenke *op. cit.* (1942) 79, Merrill, PEB (1929) 262, Masamune *op. cit.* 642; *P. glandulosa* Merr., Philip. J. Sci. 21 (1922) 532, *nom. illeg. non* Hand.-Maz. 1921, *P. glandulifera* Merr. *op. cit.* (1929) 262, Masamune *op. cit.* 642; *P. woodii* Moldenke, Phytologia 8 (1962) 163. (For further synonyms, *cf.* de Kok, Kew Bull. 65, 4 (2011), in press).

Shrub or small tree, sometimes scandent or creeping, 1–10 m tall, 3–15(–25) cm diameter. **Bark** green to dark or reddish brown or grey, smooth to scaly or fissured. **Sapwood** cream-coloured; heartwood brown. **Twigs** sometimes with conspicuous interpetiolar ridges, hairy when young, becoming more glabrous when older, patches of hairs often remaining on interpetiolar ridges; *bracts absent at base of new shoots*. **Leaves** opposite to subopposite; blades chartaceous to membranaceous, ovate or obovate, (2–)4–21 × (1–)3–16 cm, base cuneate to cordate, margins entire or rarely serrate, apex obtuse to acuminate; *most often glabrous on both surfaces*, *sometimes with hairs on veins* and/or in axils of the midrib with the lateral veins, dull to glossy, crushed leaves with a foetid smell, glands yellow or brown, sessile; often triveined from base; main lateral veins 4–9 pairs; petioles 0.5–7 mm long,

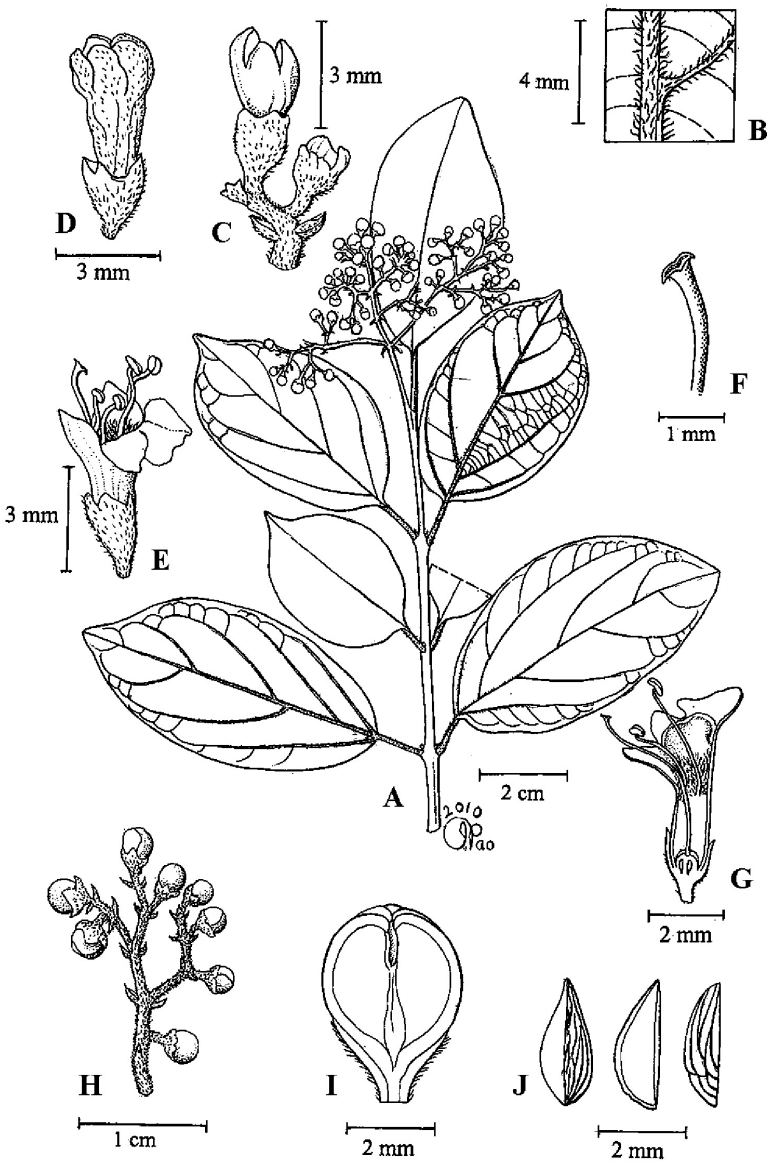

Fig. 6. *Premna serratifolia*. A, fruiting leafy twig; B, indumentum on lower surface at the middle of leaf blade; C, distal part of inflorescence; D, flower bud; E, open flower; F, distal part of style and stigma; G, longitudinal section of open flower; H, distal part of infructescence; I, longitudinal section of fruit showing two pyrenes; J, different view of seeds. (A–B from *SAN 104143*, C–G from *S 51573*, H–J from *SAN 104143*.)

channelled, glabrous except for the hair-filled channel, becoming more glabrous when older. **Inflorescences** 2–20 cm long, glabrous to velutinous; bracteoles linear, to 5 mm long. **Flowers:** *calyx* 1–2 mm long, *5-lobed or unlobed*, clearly to obscurely 2-lipped, outer surface glabrous or sparsely pubescent, green to yellowish white, lobe apices rounded to acute, glands yellow, sessile; corolla (greenish-)white to reddish, slightly 2-lipped to equally lobed, glabrous to sparsely hairy on lobes, inner surface densely covered with white hairs, faintly lemon-scented or without scent, also with sessile yellow glands, tube 1.2–5 mm long, 1–2 mm across, posterior lip orbicular to oblong or spathulate, 0.8–3.5 × 0.5–2 mm, apex rounded, sometimes reflexed, anterior lip with lateral and middle lobes 0.8–1.7 × 0.5–1.5 mm, erect to reflexed, apices rounded; stamens 1–5 mm long, barely exserted from the corolla tube, more or less didynamous, filaments white with long hairs at base, anthers 0.2–0.6 mm long, brown to yellowish green; ovary globose, 0.5–1.3 mm diameter, glabrous, sometimes with a dense patch of glands at apex, style 2–7 mm long, exserted, white, stigma 0.5–1 mm long, apex acute. **Fruits** *4-seeded*, *globose*, 0.3–0.8 cm diameter, glabrous, outer surface sometimes warty, glossy, green turning sometimes white, then black, purple or dark red when mature; endocarp smooth.

Vernacular names. Sabah—*bangkung kayu* (Malay), *buas-buas* or *sarunai* (Brunei); *salung-anak* or *baloh* (East Coast Bajau); *adua* or *lambuas* (Bajau). Sarawak—*singkel* (Malay), *akar tulang* (Kanyah), *akar engkleh* (Iban). C Kalimantan—*laban poetih*.

Distribution. Widely distributed in tropical and subtropical Asia, Africa and Australia. Often grown in gardens and road sides. Widespread in Sabah and Sarawak. In Sabah, recorded from most districts (e.g., *Rimi SPN 7150*, *SAN 70830*, *SAN 94428*, *SAN 104143* and *SAN 135851*) and in Sarawak from Belaga, Bintulu, Kuching, Lundu and Miri districts (e.g., *S 21477*, *S 34652*, *S 39284*, *S 65739*). Also recorded from Brunei (e.g., *Wong WKM 15*, *Kirkup DK 731*, *van Niel 3501* and *Hotta 12299*) and Kalimantan (e.g., *Ambriansyah W 238*, *Arifin AA 1448* and *Kessler PK 1698*).

Ecology. In open vegetation, *kerangas* or swamp forest, common along the coasts, riverbanks, or in urban environments, at 0–350(–700) m altitude. Flowering and fruiting all year round.

Uses. Decoction of boiled roots is used as a cure for stomach-ache and diarrhoea by Kenyah people in Sarawak.

5. **Premna trichostoma** Miq.

(Greek, *tricho-* = hair, *stoma* = mouth: referring to the hairy corolla throat)

Fl. Ind. Bat. 2 (1858) 892; Gamble *op. cit.* 816; Merrill *op. cit.* (1921) 513; H.J. Lam & Bakhuizen *op. cit.* 39; Ridley *op. cit.* (1923) 620; Masamune *op. cit.* 643. **Homotypic synonym:** *Gumira trichostoma* (Miq.) Kuntze, Rev. Gen. Pl. 2 (1891) 508. **Type:** *Horsfield s.n.*, Indonesia, Java, Banjoemas, 1802–1818 (holotype L; isotypes BM, K). **Heterotypic synonyms:** *Premna oblongifolia* Merr., Philipp. Govt. Lab. Bur. Bull. 29 (1905) 48; *P. perakensis* King & Gamble *op. cit.* (1908) 107; *P. ridleyi* King & Gamble *op. cit.* (1908) 109; *P. oblongata* var. *ß subglabra* H.J.Lam *op. cit.* 127, H.J. Lam & Bakhuizen *op. cit.* 38; *P. oblongata* var. *ß subglabra* H.J. Lam forma *α typica* H.J.Lam *op. cit.* 127; *P. oblongifolia* var. *ß major* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 40; *P. oblongifolia* var. *subglabra* (H.J.Lam) Moldenke, Phytologia 5 (1954) 16; *P. oblongifolia* var. *clemensorum* Moldenke, Phytologia 5 (1954) 16; *P. oblongifolia* var. *angustata* Moldenke, Phytologia 43 (1979) 252. (For further synonyms, *cf.* de Kok, Kew Bull. 65, 4 (2011), in press).

Liana, small tree or shrub, 1–20 m tall or when climbing up to 40 m long, sometimes rooting at the nodes, 0.5–15 cm diameter. **Bark** smooth to scaly, blackish or dark green. **Sapwood** white. **Twigs** without interpetiolar ridge, densely hairy when young, becoming more glabrous when older, *a series of bracts present at the base of each new shoot*. **Leaves** opposite to sub-opposite; *blades membranaceous to chartaceous*, pale to dark green, ovate to obovate 3.5–18 × 2–9.5 cm, base cuneate to slightly cordate, margins entire, apex rounded to acuminate; *glabrous on both surfaces when mature*, *sometimes with hairs on veins or hairy when young*, *glands many not sunken*, black to yellow, sessile; venation often triveined from base; main lateral veins 3–9 pairs, *intramarginal veins absent*; petioles 0.5–3.5 cm long, channelled, glabrous to covered with curly hairs, becoming more glabrous when older. **Inflorescences** 3–15 cm long, velutinous to sparsely hairy, whitish green; bracteoles linear, to 5 mm long. **Flowers:** *calyx* 1–1.8 mm long, 1–1.2 mm across, (whitish) green, outer surface glabrous or with few appressed hairs, glands many, sessile, *4-lobed*, weakly 2-lipped, lobes almost equal, 0.1–0.5 mm long, apex rounded to acute; corolla (greenish) white to pale green or grey, equally lobed, glabrous apart from some hairs at apex of lobes, inside with long hairs at mouth, fragrant, tube 2–3 mm long, lobes oblong to spathulate, 1–2 × 1–1.5 mm, apices rounded, reflexed when mature; stamens 2–5 mm long, greatly exceeding tube, not didynamous, white, anthers rounded, 0.2–0.5 mm long, white to bluish grey; ovary globose, 0.25–0.5 mm diameter, glabrous, style 4–5 mm long, white, stigma lobes 0.5–1 mm long. **Fruits** *1-seeded*, *clavoid*, 3–5 mm long, 1–2 mm diameter, glabrous, with sessile glands, *finely ribbed*, white or green turning purple and then black or blue when mature; endocarp smooth.

Vernacular names. Sarawak—*kapapar* (Iban); *akar kinjulabang* (Iban).

Distribution. South Myanmar to Vietnam, southeastwards to New Guinea. Widespread in Borneo. In Sabah recorded from Mt. Kinabalu, Ranau district (e.g., *Clemens 26709*) and Ulu Sg. Brantian, Tawau district (e.g., *SAN 96404*) and in Sarawak from Teng Bukap, Kuching district (e.g., *S 32635*) and Bario and Kelabit Highlands, Marudi districts (e.g., *Beaman 112* and *S 35301*). Also known from SE Kalimantan (e.g., *Motley 243*).

Ecology. In *kerangas*, swamp, mossy and primary forest, often along rivers or in open areas, on clay soil, sometimes over limestone or ultrabasic bedrocks, sometimes epiphytic, sometimes cultivated, at 0–2600 m altitude. Flowering all year round; fruiting from March to October.

EXCLUDED SPECIES

Premna cauliflora Stapf, FMK (1894) 215. **Lectotype** (Bramley 2009)**:** *Haviland 1305*, Borneo, Sabah, Mt. Kinabalu (K; isolectotypes K, SAR) = *Callicarpa stapfii* Moldenke, Phytologia 43 (1979) 222.

DOUBTFUL SPECIES

Premna tomentosa Willd., Sp. Pl. ed. 4, 3, 1 (1800) 314. **Type:** *Klein 1795*, India, Madras (B-Willd.). The correct identity of one specimen (*Cheksum Tawan CST 118*) collected from Tawai FR, Kinabatangan district in Sabah remains to be confirmed.

5. **TEIJSMANNIODENDRON** Koord.

(Johannes Elias Teysmann, 1808–1882, Curator of Botanic Gardens, Buitenzorg (now Bogor), Indonesia)

entabuluh (Iban)

Ann. Jard. Bot. Buitenz. 19 (1904) 19, fig. 2 & 3; Hallier *f.*, Meded. Rijks-Herb. Leiden 37 (1918) 47 & 50; H.J. Lam, Verb. Malay. Archip. (1919) 95; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 29; Merrill, EB (1921) 512, Enum. Philip. Pl. 3 (1923) 398, PEB (1929) 262; Masamune, EPB (1942) 644; Kostermans, Reinwardtia 1 (1951) 75; Backer & Bakhuizen *f.*, FJ 2 (1965) 602; Kochummen, TFM 3 (1978) 308; J.A.R. Anderson, CLTS (1980) 344; Moldenke, Phytologia 46, 7 (1980) 460, *ibid.* 47, 1 (1980) 18; Coode *et al*. (eds.), CLBD (1996) 332; Argent *et al.* (eds.), MNDT-CK (1997) 654; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 195; Beaman & C. Anderson, PMK 5 (2004) 457; de Kok *et al.*, Kew Bull. 64, 4 (2009) 287. **Synonym:** *Xerocarpa* H.J.Lam *op. cit.* 98.

Trees, with or without buttresses. **Twigs** usually terete to tetragonal in cross-section, glabrous to variously pubescent. **Leaves** decussate, *simple*, *unifoliolate or palmately compound with 3–7 leaflets*; when compound middle leaflets largest, others gradually smaller; *blades without conspicuous glands at base*, margins entire; *petioles conspicuously thickened or swollen at both ends*. **Inflorescences** panicles of trichotomous cymes, terminal or axillary; bracts leaf-like; bracteoles ovate, lanceolate to linear, usually less than 1 mm long. **Flowers** *bisexual*; *calyx* persistent, *usually enlarged in fruit*, 5-lobed; *corolla* (4–)5-lobed, *shortly tubular*, *not greatly enlarged at throat*, 2-lipped, upper lip (1–)2-lobed, lower lip 3-lobed, middle lobe the largest, throat villous within; *stamens 4*(*–5*), distinctly didynamous, exserted, inserted in the middle or lower part of the corolla tube, anthers bilocular, dorsifixed, dehiscing by long slits; ovary imperfectly 2-loculed, each locule with 2 ovules, only one ovule developing, the other 3 suppressed, *style terminal*, slender, stigma bifid. **Fruits** *drupaceous*, *dry*; pericarp either thick with scattered schlerenchymatic cells or thin and very brittle. **Seeds** *one per fruit*, pendulous, oblong; testa membranous; germination epigeal; cotyledons emergent, leafy; hypocotyl elongated.

Distribution. From India and the Nicobar Islands (Great Nicobar and Katchal Islands), through Peninsular Thailand and S Vietnam (Birar), across Malesia to the Solomon Islands, with the exception of Java and the Lesser Sunda Islands. The centre of diversity is in Borneo where all 23 currently recognised species are recorded.

Ecology. In various kinds of vegetation from the landward edge of mangrove to submontane forest, but most species are found in primary or secondary lowland rainforest. In primary lowland rainforest, they tend to be more common in open areas such as on ridges or near streams.

Uses. The wood of *Teijsmanniodendron* is used for general purposes such as house construction (rafters and posts), interior work, salt-water piling, telephone poles, framing, moulding, and for making boxes and crates (PROSEA 5, 3 (1998) 548). The fruits of *T. pteropodum* have been used medicinally, both internally and externally for intestinal complaints.

Key to *Teijsmanniodendron* species

Note: *Teijsmanniodendron* specimens are difficult to identify when in flower or sterile. In general, fruit characters are the most important for correct diagnosis. In view of this, users of the key should be aware that it may not be possible to fully identify flowering or sterile material.

1. Leaves 3–7-foliolate……..2
   Leaves unifoliolate……9

2. Petiole winged or with pseudo-stipules at base. Fruits 0.8–4.2 cm long, 0.8–5 cm diameter; pericarp woody and thick (2–3 mm)…….3
   Petiole not winged nor with pseudo-stipules at base. Fruits 1–8 cm long, 0.5–5 cm diameter; pericarp woody or leathery, thick (2–3 mm) or thin (less than 1 mm)…….4

3. Petioles usually 2–7.5 cm long, not winged but with oblong, oblique pseudo-stipules at base……..**6. T. glabrum**
   Petioles usually more than 5 cm long, winged or with round and straight pseudo-stipules at base……**12. T. pteropodum**

4. Petioles less than 2 cm long. Leaflet blades narrowly lanceolate, apex narrowly acuminate……...**14. T. renageorgeae**
   Petioles longer than 2 cm. Leaflet blades obovate, (ob)lanceolate to narrowly elliptic, apex rounded, acute to acuminate……5

5. Clear ridge between petioles (interpetiolar ridge) present. Fruits smooth or only slightly striate, larger (mature fruits more than 2 cm long, more than 2 cm diameter); pericarp woody and thick (2–3 mm)……..**3. T. bogoriense**
   Clear ridge between petioles absent. Fruits smooth or striate, smaller (mature fruits to 2 cm long, to 1.5 cm diameter); pericarp leathery and thin (less than 1 mm)……6

6. Leaflets (3–)5–7, shiny above when dried. Stamens (4–)5. Fruits globose, 1–2 cm diameter, apex rounded, surface smooth when dried……**1. T. ahernianum**
   Leaflets 3(–4), not shiny above when dried. Stamens 4. Fruits ellipsoid, 1–1.5 cm long, 0.5–1.1 cm diameter, apex truncate or depressed, surface striate when dried……..7

7. Adult leaves glabrous, rarely with some soft, to 0.1 mm long hairs……**5. T. coriaceum**
   Adult leaves densely scabrous or sparsely hairy below, hairs hispid, more than 2 mm long……...8

8. Leaflets not bullate. W to C Sarawak……**2. T. bintuluense**
   Leaflets strongly bullate. E Sabah to C Sarawak and Brunei……**4. T. bullatum**

9. Lower leaf surface punctate with tiny pits (10x lens)……10
   Lower leaf surface not punctate with tiny pits (10x lens)……...12

10. Young leaves smooth below; with more than 15 pairs of lateral veins. Mature fruits with a sooty powdery surface……**8. T. hollrungii**
    Young leaves (slightly) rough below, with less than 15 pairs of lateral veins. Mature fruits hispid or with a powdery surface……...11

11. Leaves oblanceolate, 15–28 × 3–10 cm; young leaves green. Fruits hispid, dark purple, not powdery……**11. T. obscurinerve**
Leaves ovate to lanceolate, 11–17 × 4–6 cm; young leaves coppery reddish. Fruits with a powdery surface and only a few hairs at apex……**13. T. punctatum**

12. Young petioles hairy……...13
Young petioles glabrous……14

13. Leaves lanceolate to elliptic, 6–10(–22 cm) long; petioles 0.5–3 cm long with short and long (0.5–2 mm) yellowish hairs. Ovary hairy at apex only…..……**17. T. simplicioides**
Leaves oblong, 20–40 cm long; petioles 1.5–4 cm long with short (less than 1 mm) white to brownish hairs. Whole ovary hairy……..**10. T. latiffii**

14. Young twigs square in cross-section……...15
Young twigs round in cross-section……17

15. Young twigs hairy. Petioles 0.2–6 cm long. Fruits not covered with glaucous layer……..**9. T. holophyllum**
Young twigs glabrous. Petioles less than 3.5 cm long. Fruits sometimes covered with glaucous layer……16

16. Lateral veins of the same colour as the green/brown leaf blade in both dried and fresh material……..**21. T. unifoliolatum**
Lateral veins usually distinctly paler than the green/brown leaf blade in both dried and fresh material……**14. T. sarawakanum**

17. Petioles to 1 cm long; leaf blade thickly coriaceous. Confined to forest on ultramafic substrates in Sabah……..**22. T. zainudinii**
Petioles, 0.8–4 cm long; leaf blade chartaceous to coriaceous. Widespread in many types of habitat……18

18. Leaves with at least one pair of major lateral veins originating at base of leaf blade, all major lateral veins uniformly prominent and arching towards apex (as in the genus *Smilax*)……...**19. T. smilacifolium**
Leaves with no pairs of major lateral veins originating at base, all major lateral veins not uniformly prominent and not arching towards apex……19

19. Fruit apex depressed and with few hairs. Young leaves rough below……
.....**20. T. subspicatum**
Fruit apex round-acute, or notched and glabrous. Young leaves smooth below……20

20. Leaves elliptic, 17–25 × 8–13 cm, strongly bullate in dried specimens; lateral veins (5–)8–10(–20) pairs; petiole pulvinus usually with a distinct black ring…...**18. T. sinclairii**
Leaves elliptic to lanceolate, (5–)7–13(–15) × 2–5(–7) cm, not strongly bullate in dried specimens; lateral veins 3–5 pairs; petiole pulvinus usually without or only occasionally with a distinct black ring……21

21. Leaves elliptic, rusty-coloured in dried specimens; lateral veins 4–5 pairs. Fruits smooth but covered with glands on the surface……**7. T. havilandii**
Leaves lanceolate, light-brown in dried specimens; lateral veins 3(–4) pairs. Fruits smooth with fine longitudinal ridges……...**16. T. simplicifolium**

1. **Teijsmanniodendron ahernianum** (Merr.) Bakh.

(George Patrick Ahern, 1859–1942, Lieutenant-Colonel in the U.S. Army and Chief of the Philippines Bureau of Forestry, 1900–1915).

J. Arn. Arb. 16 (1935) 74; Kostermans *op. cit.* (1951) 84; J.A.R. Anderson *op. cit.* 344; Coode *et al.* (eds.) *op. cit.* 332; de Kok *et al. op. cit.* 591. **Basionym:** *Vitex aherniana* Merr., Bur. Govt. Lab., Manila 6 **(**1904) 18, *op. cit.* (1923) 394. **Type:** *Merrill 1007*, the Philippines, Luzon, Principe Prov., Baler, Aug. 1902 (holotype PNH, *n.v.*; isotype K). **Heterotypic synonyms:** *Xerocarpa avicenniaefoliola* H.J.Lam *op. cit.* 99; *Vitex curranii* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 207; *V. bogoriensis* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 60 [non *Teijsmanniodendron bogoriense* Koord.], *nom. inval.*; *V. bankae* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 62; *V. bulusanensis* Elmer, Leafl. Philip. Bot. 10 (1939) 3798.

Tree 9–50 m tall, 10–60 cm diameter; buttresses less than 2 m high, thin. **Bark** smooth, fissured or with small flakes, grey to reddish black; slash light yellow to pale brown. **Sapwood** white to brown; heartwood very hard, blackish brown. **Twigs** terete, *without interpetiolar ridges*, pubescent when young, glabrescent when older, greyish. **Leaves** *3–7-foliolate*; *blades* coriaceous, *obovate*, (7–)25–35 × (*2–*)*8–13 cm* (that of lateral leaflets 5–15 × *2–5 cm*), base cuneate, margin flat, *apex acute*; glabrescent (especially on midrib) to glabrous on both surfaces, *shiny above*; midrib raised on both surfaces; lateral veins 8–15 pairs, slightly looping near margin; intercostal veins reticulate, obscure or invisible; *petioles terete*, *6–12 cm long*, *not winged nor with pseudo-stipules at base*, tomentose, especially basally and distally; petiolules 0.5–5 cm long, equal in all leaflets, furrowed above, tomentose at the base. **Inflorescences** 15–30 cm long; peduncles tomentose, 5–12 cm long; bracteoles ovate, to 1 mm long, persistent. **Flowers:** calyx funnel-shaped, 2.5–3 mm high, 2–5 mm across, outer surface sericeous when young, glabrescent, lobes 0–5, to 0.5 mm long, apex acute to round; corolla white to yellow or pink, sericeous, glabrous at base, with a faint sweet smell, tube 2–3 mm long, glabrous, lobes (4–)5, central lobe of lower lip spathulate, 3–8 × 5–6 mm, apex round to emarginate, margin serrate and undulate, throat villous; other lobes equal 3–5 × 1.5–2 mm, apex round, hairy outside; *stamens* (*4–*)*5*, 2–4 mm long, attached to the upper to lower part of the tube, white, anthers blue or black; ovary globose, 1–1.5 mm diameter, glabrous, style 3–4 mm long, exserted, stigma white or blue. **Fruits** *globose*, *1–2 cm diameter*, *apex rounded*, *smooth when dry*, glabrous, purple to (blue) black; *pericarp thin*, *less than 1 mm*; calyx cup-shaped, 5–8 mm high, 5 mm across, margin entire, outer surface glabrous.

Vernacular name. Sarawak—*entabuluh* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku, Papua New Guinea and the Solomon Islands. In Borneo, rarely collected and so far recorded in Sabah from Weston, Beaufort district (e.g., *SAN 103060*), in Sarawak from Bintulu, Kuching and Simunjan districts (e.g., *S 32062*, *S 35714*, *S 38557* and *S 39411*), and in Brunei (e.g., *BRUN 5110* and *S 2197*).

Ecology. Commonly found growing in primary and secondary forest, sometimes in heath (*kerangas*) or swamp forest, on clay-loam to white sand, ultramafic or iron-rich soils, sometimes over granite, at altitudes to 1000 m.

2. **Teijsmanniodendron bintuluense** Moldenke

(of Bintulu, Sarawak)

Phytologia 26 (1973) 355, *ibid.* 46 (1980) 460; de Kok *et al. op. cit.* 592. **Type:** *Paul P.K. Chai S 31713*, 17 Sep. 1972, Borneo, Sarawak, Bintulu district, Segan FR (holotype SAR; isotypes K, L Barcodes L 0003951 & L 0003952).

Tree 2.5–8.5 m tall, 10–14 cm diameter. **Bark** smooth, light to greyish brown. **Twigs** square in cross-section, densely tomentose when young. **Leaves** *3-foliolate*; *blades* coriaceous, *not bullate*, *narrowly elliptic*, *12–30 × 5–8 cm*, base acute, margin entire, *apex acuminate*; glabrous above, *hispid-pubescent beneath*, surface rough, *not shiny when dried*; midrib prominent and raised beneath; lateral veins 6–8 pairs, intercostal veins reticulate, distinct on both surfaces and slightly raised beneath; *petioles 5–7 cm long*, half-terete, *not winged nor with pseudo-stipules at base*, densely tomentose; petiolules 2–3 cm long, densely tomentose. **Inflorescences** less than 10 cm long, densely tomentose throughout, (dark) purplish (blue); bracteoles narrowly lanceolate, 0.5–0.7 cm, persistent. **Flowers:** calyx 5–5.5 mm high, 1.5–2 mm across, densely tomentose and glandular when young, lobes 2–3 mm long, apex acute to acuminate; corolla purple to pale blue, densely tomentose, tube 3.5–4 mm long, glabrous at base, central lobe of lower lip 3–3.5 × 2–3 mm, spathulate, margin rounded, entire, other lobes 1.5–2 × 1.5–2 mm, apex acute; *stamens 4*, 3–4 mm long, inserted in the lower part of the corolla tube, slightly villous; ovary globose, *c.* 1 mm diameter, apex glabrous, sometimes with a few hairs, style 4–5.5 mm long, light-purple; *c.* 0.5 mm long, apex acute. **Fruits** *ellipsoid*, *1–2 cm long*, *0.5–1 cm diameter*, *apex truncate*, *longitudinally striate when dry*, glabrous, sometimes with a slight bloom, orange to dark purple; *pericarp thin*, *less than 1 mm*; calyx cup-shaped, 8–10 mm diameter, accrescent, lobes prominent erect, glabrous.

Vernacular name. Sarawak—*entabuluh* (Iban).

Distribution. Endemic to Borneo and recorded only from Belaga, Bintulu, Kapit and Kuching districts in W and C Sarawak (e.g., *Hansen 859*, *S 9571*, *S 18014*, *S 23670*, *S 23951*, *S 23975*, *S 43481* and *S 47024*).

Ecology. In primary dipterocarp or *kerangas* forest, often on low hills or ridges, on yellow sandy clay or sandstone-derived soils, at 10–250 m altitude.

3. **Teijsmanniodendron bogoriense** Koord. Fig. 7.

(of Bogor, Java, Indonesia; the type locality of the species)

Ann. Jard. Bot. Buitenz. 19 (1904) 20, fig. 2; Merrill *op. cit.* (1921) 512; H.J. Lam *op. cit.* 97; Bakhuizen, J. Arn. Arb. 10 (1929) 70; Masamune *op. cit.* 644; Kostermans *op. cit.* (1951) 88; Backer & Bakhuizen *f. op. cit.* 602; J.A.R. Anderson *op. cit.* 344; Argent *et al.* (eds.) *op. cit.* 654; de Kok *et al. op. cit.* 593. **Neotype** (de Kok *et al.* 2009)**:** *Kostermans s.n.*, Nov. 1949, Indonesia, Java, Bogor Botanic Gardens, XI.G.82 (L; isoneotypes BO, K). **Heterotypic synonyms:** *Vitex longifolia* Merr., Philip. J. Sci. 5 (1910) 227, *Teijsmanniodendron longifolium* (Merr.) Merr. *op. cit.* (1923) 398; *V. flabelliflora* Hallier*.f. op. cit.* 50; *V. lasiantha* Hallier*.f. op. cit.* 50; *V. merrillii* H.J.Lam *op. cit.* 212; *V. euphlebia* Merr. *ex* H.J.Lam *op. cit.* 212; *T. kostermansii* Moldenke, Phytologia 4 (1952) 57; *T. pendulum* Kosterm., Reinwardtia 5 (1960) 352 & 369; *T. bogoriense* var. *pentaphyllum* Moldenke, Phytologia 14 (1967) 400.

Tree 15–45 m tall, 20–145 cm diameter; buttresses to 2 m high or absent. **Bark** smooth to scaly, lenticellate, greyish brown to light-brown or whitish; slash very hard to brittle, (pale) yellow. **Sapwood** white to yellowish. **Twigs** glabrous to glabrescent, lenticellate, *with distinct transverse interpetiolar ridges*. **Leaves** (*3–*)*5*(*–7*)*-foliolate*; *blades* coriaceous to chartaceous, *lanceolate*, *9–25 × 2–11 cm* (of lateral leaflets 5–15 × 1.5–7 cm), base acute to

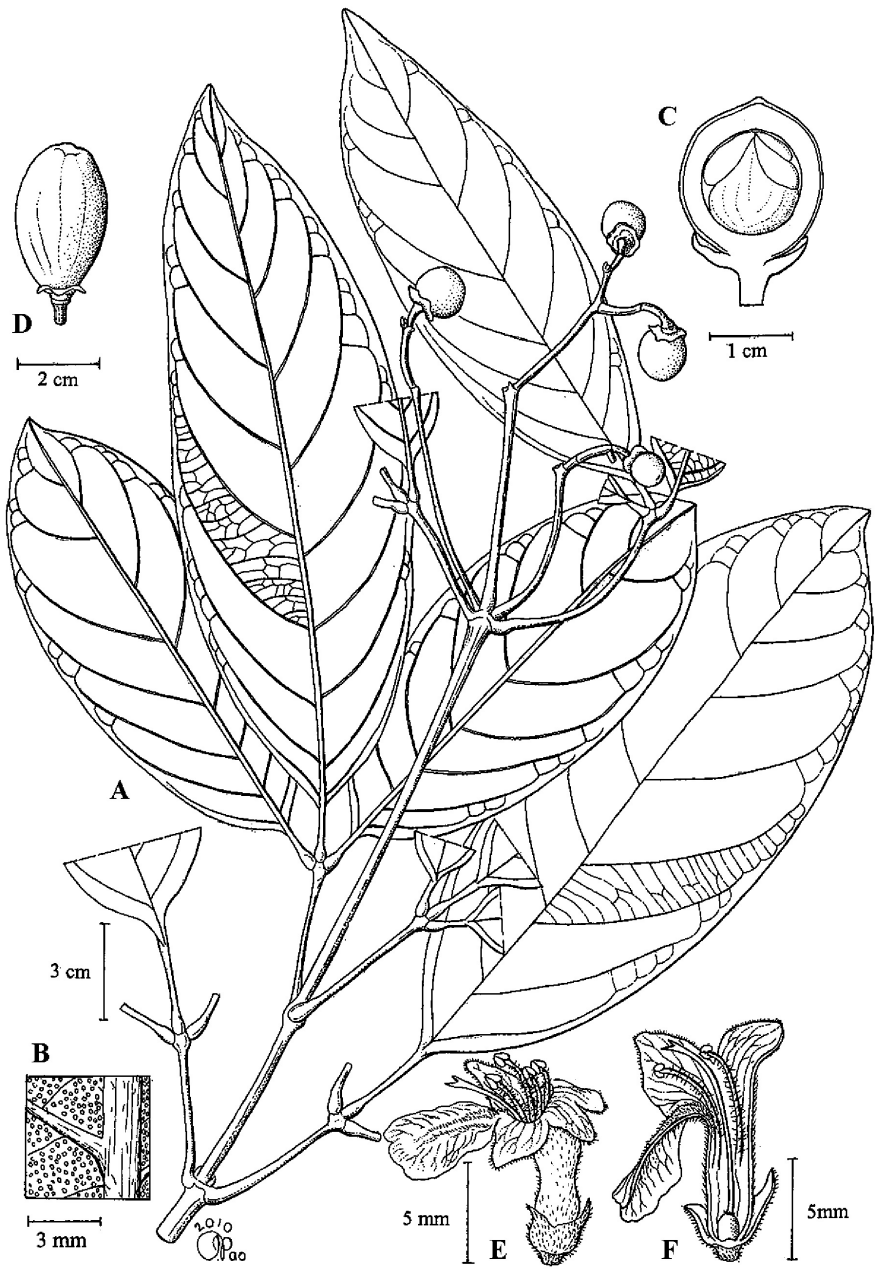

Fig. 7. *Teijsmanniodendron bogoriense*. A, fruiting leafy twig; B, detail of indumentum on lower leaf surface; C, longitudinal section of fruit; D, fruit; E, open flower; F, longitudinal section of open flower. (A–C from *S 36138*, D from *SAN 87629*, E–F from *Zainudin AZ 5626.*)

cuneate, margin slightly recurved, *apex broadly acuminate*; glabrous on both surfaces; midrib prominent and raised on both surfaces; lateral veins 3–12 pairs, looping into an imperfect intramarginal vein near margin; intercostal venation reticulate, prominent on both surfaces; *petioles* subterete, *1–6 cm long*, glabrous; petiolules 0.3–3 cm, subterete, sparsely pubescent to glabrescent. **Inflorescences** to 30 cm long, pubescent when young, glabrescent; bracteoles caducous. **Flowers:** calyx irregularly bell-shaped, 2–2.5 mm high, 2.5–3.5 mm across, lobes 5, pubescent at base, glabrescent near margin, violet; corolla white to blue, fragrant, tube 0.5–2 mm long, white; 4–5 lobed, lobes pubescent, central lobe of lower lip spathulate, 0.3–1.0 × 0.3–0.5 cm, violet with yellow spot at base, densely villous, side lobes of lower lip 1.5–3.5 × 3 mm, apex acute, lobes of upper lip 1–3.5 × 3 mm, apex acute; stamens 3.5–6 mm long, didynamous, exserted, inserted in the middle of corolla-tube, glabrous to hairy at base, anthers deep purple; ovary globose, glabrous, apex densely hairy and glandular, style 4–7 mm long, stigma acute at apex. **Fruits** globose, *2–5 cm diameter*, *smooth when dry*, glabrous, shiny, reddish purple to black; *pericarp woody*, *thick* (*2–3 mm*); calyx shallowly cup-shaped, *c.* 3 cm high, *c.* 1 cm across, margin entire, glabrous.

Vernacular names. Sabah—*buak-buak* (Malay). Sarawak—*entabuluh* or *memaru* (Iban), *pangajen asai* (Kenyah).

Distribution. Southern Thailand, Sumatra, Borneo, the Philippines, Sulawesi, Maluku and Papua New Guinea. In Borneo, widespread throughout Sabah, Sarawak and Kalimantan but has not been collected from Brunei. In Sabah, recorded from most districts (e.g., *Reza RA 534*, *SAN 27456*, *SAN 32581*, *SAN 41572*, *SAN 69154*, *SAN 81517* and *SAN 145660*) and in Sarawak from Belaga, Bintulu, Lubok Antu, Kapit, Marudi and Tatau districts (e.g., *S 19158*, *S 34096*, *S 44106*, *S 52215*, *S 65703* and *S 80965*). In Kalimantan, known from various localities (e.g., *Ambriansyah AA 582*, *Kessler PK 1098*, *Kostermans 6018*, *Kostermans 7577* and *Sidiyasa 685*).

Ecology. Primary and secondary rainforest (occasionally submontane forest), in flood plains or swamps on sandy, black or yellow loam soils over basalt, sandstone or limestone bedrock, at 0–700(–1200) m altitude.

4. **Teijsmanniodendron bullatum** R.Go Fig. 8.

(Latin, *bullatus* = with blistered surface; referring to the leaf-blades)

In de Kok *et al*., Kew. Bull. 64 (2009) 595. **Type:** *Ashton S 19587*, Borneo, Sarawak, Mukah district, Ulu Kenyana, 21 Oct. 1963 (holotype SAR; isotypes K, L).

Tree to 12 m tall, 15–20 cm diameter. **Bark** smooth, grey-brown. **Twigs** *without interpetiolar ridges*. **Leaves** *3-foliolate*; *blades* coriaceous, *strongly bullate*, *not shiny above*, *elliptic*, asymmetric, *8.5–24 × 3.5–8 cm*, base cuneate (that of lateral leaflets distinctly oblique), margin recurved, *apex acute or acuminate*; glabrous above, *densely scabrous below*, greenish brown, young leaves bright yellow-green; midrib prominent, flattened to sunken above, raised below; lateral veins spaced far apart, prominent, 5–7 pairs, looping near margin; intercostal venation prominent beneath and strongly sunken above; *petioles 1–6*(*–8*) *cm long*, subterete, sparsely to densely tomentose; petiolules 0.8–1.3 cm long. **Inflorescences** densely tomentose, purple; bracteoles persistent. **Flowers:** calyx 1.5–3 mm high, 1.5–2 mm across, tomentose, yellow, lobes 0.5–1 mm long, apex acute; corolla tomentose, mauve to purple, tube 2 mm long, glabrous at base, central lobe of lower lip

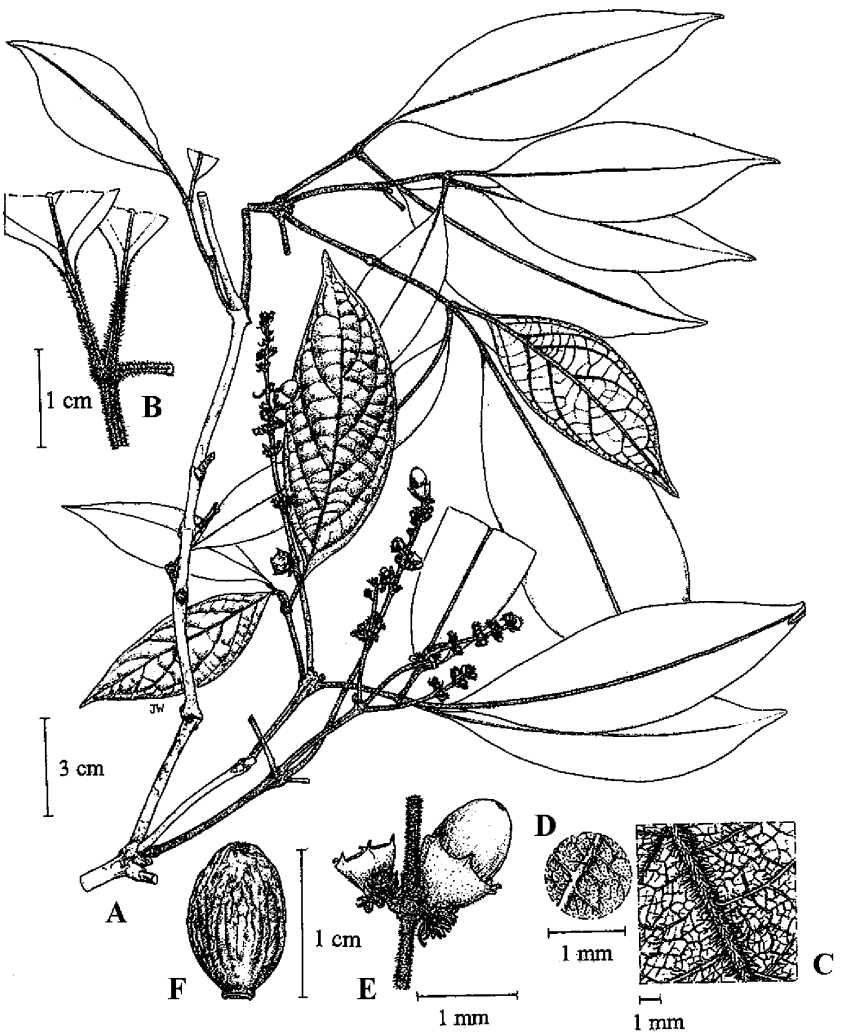

Fig. 8. *Teijsmanniodendron bullatum*. A, flowering and fruiting leafy twig; B, detail of indumentum on petioles; C & D, detail of venation and indumentum on lower leaf surface; E, part of infructescence showing detail of calyx and fruit; F, side view of fruit. (A–F from *Coode 7827*.). Drawn by and reproduced with permission from Juliet Beentje.

oblong, *c.* 3 × 1 mm, apex round and entire, with yellow blotch on throat, villous within, other lobes *c.* 2 × 1 mm, apex acute; *stamens 4*, 3–4 mm long, exserted, inserted in the lower part of corolla tube; anthers black; ovary globose, *c.* 1 mm diameter, glabrous, style *c.* 3 mm long, stigma *c.* 0.5 mm long, apex acute. **Fruits** *globose to ellipsoid*, *1–1.3 cm long*, *0.5–1.1 cm diameter*, *apex truncate*, smooth when fresh, *striate when dried*, glabrous, yellow to pink; *pericarp thin*; calyx about 6–7 mm diameter, shallowly funnel-shaped, glabrous, lobes erect, yellow.

Vernacular names. Sarawak—*entabuluh* (Iban). Brunei—*maratubu* (Iban).

Distribution. Endemic to Borneo; known only from a few collections from Nabawan district in Sabah (e.g., *SAN 129935*), Bintulu, Miri and Mukah districts in C and E Sarawak (e.g., *S 16450*, *S 19587* and *S 59564*) and Brunei (e.g., *BRUN 256*, *BRUN 17471*, *Dransfield JD 6828*, *Coode 7827*, *Hotta 12726* and *Kirkup 253*).

Ecology. Primary and secondary dipterocarp and heath (*kerangas*) forest, on yellow sandy or sandy clay soils, sometimes over sandstone bedrock, at 15–250 m altitude.

5. **Teijsmanniodendron coriaceum** (C.B.Clarke) Kosterm.

(Latin, *coriaceus* = leathery; referring to the texture of the leaves)

Reinwardtia 1 (1951) 80; Kochummen *op. cit.* 308; Moldenke *op. cit.* (1980) 480; J.A.R. Anderson *op. cit.* 344; Coode *et al.* (eds.) *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 596. **Basionym:** *Vitex coriacea* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 586, Gamble *op. cit.* 846, H.J. Lam & Bakhuizen *op. cit.* 58, Ridley *op. cit.* (1923) 632, Corner, WSTM 4th. edition 2 (1997) 753. **Lectotype** (de Kok *et al.* 2009)**:** *Griffith 6065*, Peninsular Malaysia, Malacca (K; isolectotype SING). **Heterotypic synonym:** *Vitex venosa* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 61, Kostermans *op. cit.* (1951) 80.

Tree 4–30 m, 6–100 cm diameter. **Bark** smooth, slightly scaly to fissured, grey to pale-brown or brown; slash dull blackish or pale brown. **Sapwood** orange-ochre. **Twigs** glabrous *without interpetiolar ridges*. **Leaves** *3*(*–4*)*-foliolate*; *blades coriaceous*, smooth to strongly bullate, *oblanceolate*, *5–18*(*–20*) × (*2–*)*3–5*(*–7*) *cm*, base acute, (that of lateral leaflets sometimes oblique), *apex acute to obtuse*; *not shiny above when dried*, *glabrous on both surfaces*, sometimes hairy beneath in young leaflets; midrib prominent and raised beneath; lateral veins 5–8 pairs, curving and joined near margin to form an imperfect intramaginal vein, conspicuous above, prominent and raised beneath; intercostal venation reticulate, distinct and raised beneath; *petioles 2–5 cm long*, glabrous to slightly hairy, sub-terete in cross-section, *not winged nor with pseudo-stipules at base*. **Inflorescences** 4–15 cm long, slightly pubescent; bracteoles linear to oblong, 0.2–0.4 cm long, persistent, pubescent. **Flowers:** calyx broadly funnel-shaped, *c.* 1.5 cm long, sparsely pubescent, lobes 0.5–1 mm long, apex acute to obtuse; corolla white, violet to dark violet, pubescent, slightly fragrant, tube 5–6 mm long, lower lip of central lobe spathulate, 4.5–5 × 3.5–4 mm, apex round, throat villous inside, violet with a yellow patch at base, side lobes of lower lip *c.* 2 × 1.5 mm, apex round, lobes of upper lip *c.* 1.5 × 2 mm, apex round to acute; *stamens 4*, 4–5 mm long, distinctly didynamous, exserted, inserted in the lower part of the corolla tube, sparsely pubescent, anthers globose; ovary glabrous, cream-coloured, style purple, long-exserted, stigma pale purple. **Fruits** *ellipsoid*, *1–1.5 cm long*, *0.5–0.8 cm diameter*, *apex truncate*, *striate when dry*, glabrous, deep blue or black; *pericarp thin*; calyx accrescent, shallowly cupuliform, margin entire.

Vernacular names. Sarawak—*entabuluh* or *madang* (Iban). Kalimantan—*mahuwi kuning* (Samarinda), *kaju gading* or *kaju krasak* (Dayak).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, and Borneo. In Sabah, recorded from Kinabatangan, Labuk Sugut, Ranau, Sandakan and Tawau districts (e.g., *FRI 41291*, *SAN 43828*, *SAN 53314*, *SAN 77292*, *SAN 89106* and *SAN 136243*) and in Sarawak from Bintulu, Kapit, Limbang, Marudi, Miri and Tatau districts (e.g., *S 16618*, *S 23988*, *S 32258*, *S 41401*, *S 59882* and *S 76957*). Also reported from Brunei (e.g., *Bygrave PCB 22*, *BRUN 3379* and *Dransfield JD 7422*) and Kalimantan (e.g., *Ambriansyah AA 564*, *Kostermans 6388*, *Kostermans 7962*, *Kostermans 8924* and *Kostermans 10181*).

Ecology. In primary or secondary forests, on sandy, sandy-clay or clay soils, sometimes over sandstone or granite bedrock, at 100–1200 m altitude.

6. **Teijsmanniodendron glabrum** Merr.

(Latin, *glabrus* = non-hairy; referring to the lack of hairs on the leaves)

PEB (1929) 263; Masamune *op. cit.* 644; J.A.R. Anderson *op. cit.* 344; Coode *et al.* (eds.) *op. cit.* 332; de Kok *et al. op. cit.* 599. **Homotypic synonym:** *Teijsmanniodendron bogoriensis* var. *glabrum* (Merr.) Bakh. *ex* Moldenke, Résum. Verben. Supl. 15 (1967) 23, *nom. in syn*. **Lectotype** (de Kok *et al.* 2009)**:** *Elmer 21320*, Oct. 1922–March 1923, Borneo, Sabah, near Tawau (K; isolectotypes A, BO, BM, L Barcode L 0003957, NY). **Heterotypic synonyms:** *Teijsmanniodendron pteropodum* (Miq.) Bakh. var. *auriculatum* Bakh. *ex* Kosterm. *op. cit.* (1951) 94; *T. pteropodum* (Miq.) Bakh. forma juv. *auriculatum* (Bakh. *ex* Kosterm.) Moldenke, Phytologia 47 (1980) 27.

Tree, rarely shrub, 4–33 m tall, 6–50 cm diameter; buttresses to 1 m high. **Bark** smooth to slightly scaly, whitish, greyish to (greenish) brown; slash brittle, whitish, yellowish to yellowish brown. **Sapwood** white to yellow or brownish. **Twigs** glabrous, with raised interpetiolar ridges. **Leaves** *3-foliolate*; blades oblong or elliptic, 9–15 × 4–7 cm, base subequal, apex acuminate with tip slightly to strongly curved; glabrous on both surfaces; slightly shiny above; midrib prominent, raised on both surfaces; lateral veins 6–11 pairs, arching towards the margin, conspicuous beneath; intercostal venation reticulate; *petioles 2–5*(*–7.5*) *cm long*, terete, glabrous, *with basal*, *obtusely oblong pseudo-stipular appendages*; petiolules 1–3 cm long. **Inflorescences** to 20 cm long, younger parts sparsely pubescent, older parts glabrous; bracteoles lanceolate, less than 0.3 cm long, glabrous to glabrescent, caducous. **Flowers:** calyx 2–3 mm high, bell-shaped, glabrous to glabrescent outside, white-green to purple, 5-lobed, lobes triangular-ovate, *c.* 0.5 mm long, apex acute to rounded; corolla white, pubescent, fragrant, tube 3–5 mm long, central lobe of lower lip 3–4.5 × 2–3 mm, apex rounded to truncate, other lobes 2–3 × 1.5–2 mm; stamens *c*. 5 mm long, distinctly didynamous when mature, exserted, inserted in the lower part of corolla tube, villous, white, anthers blue; ovary glabrous, slightly villous at apex, style 3–5 mm long, stigmas blue or violet. **Fruits** ellipsoid or ovoid-ellipsoid, *0.8–3.5 cm long*, *0.8–4.5 cm diameter*, apex obtuse, smooth when dry, glabrous, shiny, pale grey to brown; *pericarp woody*, *thick* (*2–3 mm*); calyx saucer-shaped, lobed, *c.* 1.5 cm diameter, *c.* 0.5 cm high, glabrous.

Vernacular names. Sabah—*salunapid* (Dusun), *ragas* (Orang Sungei), *buak-buak* (Malay). Kalimantan—*kaju gédang* (Dayak).

Distribution. Sumatra and Borneo. In Sabah, common and widespread in Sandakan and Tawau districts (e.g., *SAN 22548*, *SAN 34311*, *SAN 42157*, *SAN 70269* and *SAN 142164*, but

in Sarawak so far only collected twice from Miri district (i.e., *Richards 2570* and *S 38458*). Also recorded from Brunei (e.g., *Wong WKM s.n.*) and Kalimantan (e.g., *bb 14752*, *Kostermans 9027*, *Kostermans 9056* and *Kostermans 21397*).

Ecology. Primary and secondary forests on sandy loam or blackish soils, sometimes over limestone or sandstone bedrock, at 0–120 m altitude.

7. **Teijsmanniodendron havilandii** (Ridl.) R.Go

(George Darby Haviland, 1857–1901, surgeon and naturalist, Director of the Raffles Museum Singapore, Medical officer of Sarawak Government and Curator of Government Museum, Kuching).

In de Kok *et al*., Kew Bull. 64 (2009) 600. **Basionym:** *Vitex havilandii* Ridl., Bull. Misc. Inform. Kew (1929) 262. **Lectotype** (de Kok *et al.* 2009)**:** *Haviland 861*, Borneo, Sarawak, Simunjan district, Sadong Hill (K; isolectotypes K, SAR).

Tree 8–15 m tall, 13–25 cm diameter. **Bark** smooth, grey; slash yellowish. **Sapwood** pale yellow. **Twigs** *terete*, *glabrous*, whitish. **Leaves** *unifoliolate*; *blades coriaceous*, *elliptic*, (*5–*)*7–10*(*–15*) × *2–5*(*–7*) *cm*, base acute to rounded, apex acuminate; glabrous on both surfaces, *not punctate beneath*, *young leaves smooth beneath*, *mature leaves rusty-coloured when dry*; midrib prominent and raised beneath; *main lateral veins 4–5 pairs*, *none originating at the leaf base*, *not arching towards apex*, prominently raised beneath, some forming incomplete intramarginal veins; intercostal venation reticulate, obscure beneath; *petioles 1–1.5 cm long*, subterete, *glabrous*, *pulvinus without a distinct black ring*. **Inflorescences** *slightly puberulous*; bracteoles narrowly lanceolate, *c.* 1 mm long, persistent. **Flowers:** calyx 2–3 mm high, 1.8–3 mm across, with a few hairs, dark reddish, lobes to 1 mm long, broadly acute; corolla purple to pale blue, pubescent, tube 3.5–5 mm long, central lobe of lower lip oblong to orbicular, 4–5 × 2.5–4 mm, apex round, side lobes of lower lip 2–2.3 mm long, apex acute, lobes of upper lip 1.5–2 mm long, apex round; stamens 3–5 mm long, didynamous, exserted, inserted in the middle part of corolla tube; ovary *c.* 1 mm diameter, apex villous, style *c*. 5 mm long, purple, stigma black. **Fruits** ellipsoid, 1.2–1.5 cm long, 0.8–0.9 cm diameter, *smooth when dry*, *glabrous* except for few hairs at the round apex, *glandular*, dark brown; pericarp thin; calyx cup-shaped, 7–8 mm high, 7–12 mm across, accrescent, glabrous, irregularly lobed.

Distribution. Endemic to Borneo and confined to Semengoh FR in Kuching district and Sadong Hill in Simunjan district in Sarawak (e.g., *S 12574*, *S 14768*, *S 26242*, *S 35766* and *S 62607*).

Ecology. In mixed dipterocarp forest on ridges on yellow sandy clay soils, at altitude to 50 m.

8. **Teijsmanniodendron hollrungii** (Warb.) Kosterm.

(Udo Max Hollrung, 1858–1937; Professor in Halle, Germany, collected between 1885–1888 in New Guinea, Australia and Java)

Reinwardtia 1 (1951) 103; Kochummen *op. cit.* 309; Moldenke *op. cit.* (1980) 486; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 603. **Basionym:** *Vitex hollrungii* Warb., Bot. Jahrb. Syst. 18 (1894) 208, Hallier *f. op. cit.* 51, Merrill *op.*

cit. (1921) 514, H.J. Lam *op. cit.* 179, H.J. Lam & Bakhuizen *op. cit.* 31 & 52, Masamune *op. cit.* 645. **Type:** *Hollrung 377*, Papua New Guinea, Hatzfeldhafen (holotype B; isotypes BO, K Barcode K 000223745). **Heterotypic synonyms:** *Vitex punctata* Schauer *in* A. de Candolle, Prodr. 11 (1847) 687; *V. clarkeana* King & Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 845, H.J. Lam *op. cit.* 178; *V. simplicifolia* C.B.Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 586; *Teijsmanniodendron monophyllum* Kurata, Bull. Tokyo Univ. Forest. 35 (1947) 203.

Tree (seldom shrub) 2–25 m tall, 2–45 cm diameter; buttresses to 0.8 m high. **Bark** smooth to slightly flaky, soft, white to whitish grey; slash yellowish to pale red or brown. **Sapwood** white or greyish to yellow; heartwood hard. **Twigs** stout, terete, variously pubescent, nodes swollen. **Leaves** *unifoliolate*; blades coriaceous, lanceolate, 15–35 × 5–13 cm, base acute to narrowly rounded, margin straight, apex long-acuminate; glabrous on both surfaces, somewhat glossy above; *young leaves smooth and densely punctate beneath*; midrib slender, flat or slightly impressed above, slightly rounded and raised beneath; *lateral veins 13–20 pairs*, arching towards the margin and sometimes joined; intercostal venation reticulate, distinct beneath; petioles slender, to 0.5 cm long, smooth, terete. **Inflorescences** to 40 cm long; bracteoles linear, 3–5 mm long, inconspicuous, puberulent, caducous; peduncles sharply tetragonal in cross-section, densely rusty-pubescent. **Flowers:** calyx bell-shaped, 3.5–4 mm high, 3–3.5 mm across, hairy, lobes *c.* 1 mm long, apex acute; corolla white, cream-yellow to purple, fragrant, velvety, tube funnel-shaped, 5–7 mm long, central lobe of lower lip oblong to spathulate, 4–5 × 3–5 mm, apex rounded, sparsely hairy to glabrous above, with lilac to purple, yellow spot at base, side lobes of lower lip 3–4 × 2–2.5 mm, apex acute, white, lobes of upper lip 4–4.5 × 2–2.5, apex rounded to acute, white; stamens 7–10 mm long, distinctly didynamous, villous at base, pale purple to yellow or white, anthers *c.* 1 mm long, white; ovary globose, 1–1.5 mm diameter, apex flattened, pubescent, style 10–15 mm long, purple, stigma yellowish white. **Fruits** globose to clavate, 1.5–2 cm long, 1.5–2 cm diameter, apex round, smooth, glabrous except for few hairs at apex, somewhat fleshy, *covered with sooty yellowish or greenish brown powder which forms a cracked layer when dry*, olive-green to (greyish) black; pericarp thin; calyx much accrescent, shallowly cup-shaped, 10–18 mm diameter, unevenly truncate.

Vernacular names. Sabah—*renggas* (Kedayan), *kapur-kapur* (Brunei). Brunei—*putat* (Binuni). Sarawak—*entabuluh* (Iban), *ladip* (Malay), *rengas* (Kuching), *senumpol* (Binatang). Kalimantan—*lihampit*, *kaju kolok ampit* (Dayak).

Distribution. Peninsular Malaysia, Borneo, Sulawesi, Maluku to New Guinea and the Solomon Islands. In Sabah, recorded from Beaufort, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Papar and Sandakan districts (e.g., *SAN 22620*, *SAN 55970*, *SAN 67302*, *SAN 80369* and *SAN 84578*), and in Sarawak from Betong, Bintulu, Dalat, Daro, Kapit, Kuching, Lundu, Marudi, Serian and Sibu districts (e.g., *Haviland 3551*, *S 14055*, *S 18868*, *S 40528*, *S 62459*, *S 100423* and *SFN 36085*). Also known in Brunei from Belait and Tutong districts (e.g., *Dransfield JD 6797*, *van Niel 4186*, *van Niel 4563* and *van Niel 4644*) and in Kalimantan (e.g., *Ambriansyah AA 834*, *Endert 1431*, *Kostermans 4810*, *Kostermans 6131* and *Murata et al. B 129*).

Ecology. In primary or secondary forests, usually along rivers, tidal creeks, peat swamps or mangroves, at 0–50(–100) m altitude.

Uses. Used in Sarawak for treating scabies: the ash from the leaves is added to coconut oil and applied to the head.

9. **Teijsmanniodendron holophyllum** (Baker) Kosterm.

(Greek, *holos* = entire or not lobed, *phyllum* = leaf; referring to the entire leaf margin)

Reinwardtia 1 (1951) 97; Kochummen *op. cit.* 308; Moldenke *op. cit.* (1980) 492; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 601. **Basionym:** *Vitex holophylla* Baker, Bull. Misc. Inform. Kew (1896) 25, Gamble *op. cit.* 844, Merrill *op. cit.* (1921) 514, Ridley *op. cit.* (1923) 631, Masamune *op. cit.* 644. **Type:** *Creagh [Hugh Low] s.n.*, April 1895, Borneo, Sabah, Sandakan (holotype K Barcode K 000498353). **Heterotypic synonym:** *Teijsmanniodendron subspicatum* (Hallier *f.*) Kosterm. var. *acutifolium* Moldenke, Phytologia 49 (1981) 431.

Tree to 30 m tall, to 40 cm diameter. **Bark** smooth to slightly scaly, whitish, greyish to brown; slash greenish yellow to pale brownish. **Sapwood** white to pale yellow or yellow. **Twigs** *soft-pubescent and square in cross-section when young*, becoming glabrous when older. **Leaves** *unifoliolate*; blades slightly bullate, coriaceous, elliptic-lanceolate or lanceolate, 12–20 × 4–7(–10) cm, base rounded to slightly cordate, apex acuminate; glabrous on both surfaces, but slightly tomentose *and not punctate* when young; midrib prominent and raised beneath; lateral veins 6–10 pairs, prominent and raised beneath; intercostal venation reticulate, conspicuous above, distinct and raised beneath; *petioles 0.2–6 cm long*, subterete, *glabrous*, distal pulvinus sometimes with distinct black ring. **Inflorescences** to 50 cm long, *sparsely hirsute*; bracteoles lanceolate to elliptic-lanceolate, 2–5 mm long, caducous. **Flowers:** calyx bell-shaped, 2–2.5 mm high, 1.5–2 mm across, tomentose and glandular when young; corolla deep-purple or white, velvety, tube 3–4 mm long, central lobe of lower lip oblong, 3–4 × 2–3 mm, apex rounded, throat villous inside, other lobes 1.5–2 × 1.2–2 mm, apex acute to rounded; stamens 4–5 mm long, exserted, inserted in the middle or lower part of corolla tube, filaments slightly villous, anthers *c.* 0.5 mm long; ovary *c.* 1 mm diameter, villous at the top, style 6–7 mm long. **Fruits** subglobose, 2–2.2 cm long, 0.9–1.2 cm diameter, apex depressed to acute, smooth with very faint longitudinal stripes, glabrous except few hairs at apex, *dark brown to bluish*, *shiny*; pericarp thin; calyx bell-shaped, 12–16 mm in diameter, glabrous when older.

Vernacular names. Sabah—*kemuning* (Lahad Datu area). Sarawak—*entabuluh* (Iban), *kenjau* (Penan). Brunei—*mertubu* or *martubu* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. Records of one specimen from South Vietnam and one from the Indonesian New Guinea are doubtful. In Borneo, widespread in Sabah (e.g., *SAN 32184*, *SAN 55158*, *SAN 72297*, *SAN 83897* and *SAN 143627*) and Sarawak (e.g., *S 34719*, *S 44959*, *S 54313*, *S 64546* and *S 110128*). Also recorded from Brunei (e.g., *Niga NN 46*, *Forman LLF 869*, *BRUN 15117* and *BRUN 16522*) and Kalimantan (e.g., *Tukirin NGS 846*, *Kessler 1597* and *bb 35258*).

Ecology. In primary or secondary forests, on hillsides or ridge-tops, along riverbanks, on sandy, dark-brown or black soils, sometimes ultramafic and stony soil, at 60–265 m altitude.

10. **Teijsmanniodendron latiffii** R.Go Fig. 9.

(A. Latiff Mohamed, 1948–, Professor of Botany and Curator of UKMB Herbarium, Universiti Kebangsaan Malaysia, Bangi, Malaysia)

In de Kok *et al.* Kew. Bull. 64 (2009) 604. **Type:** *Sibat ak Luang S 22819*, 1 May 1965, Borneo, Sarawak, Marudi district, Sg. Mentagai (holotype SAR; isotypes K, L, KEP Barcode KEP 107539).

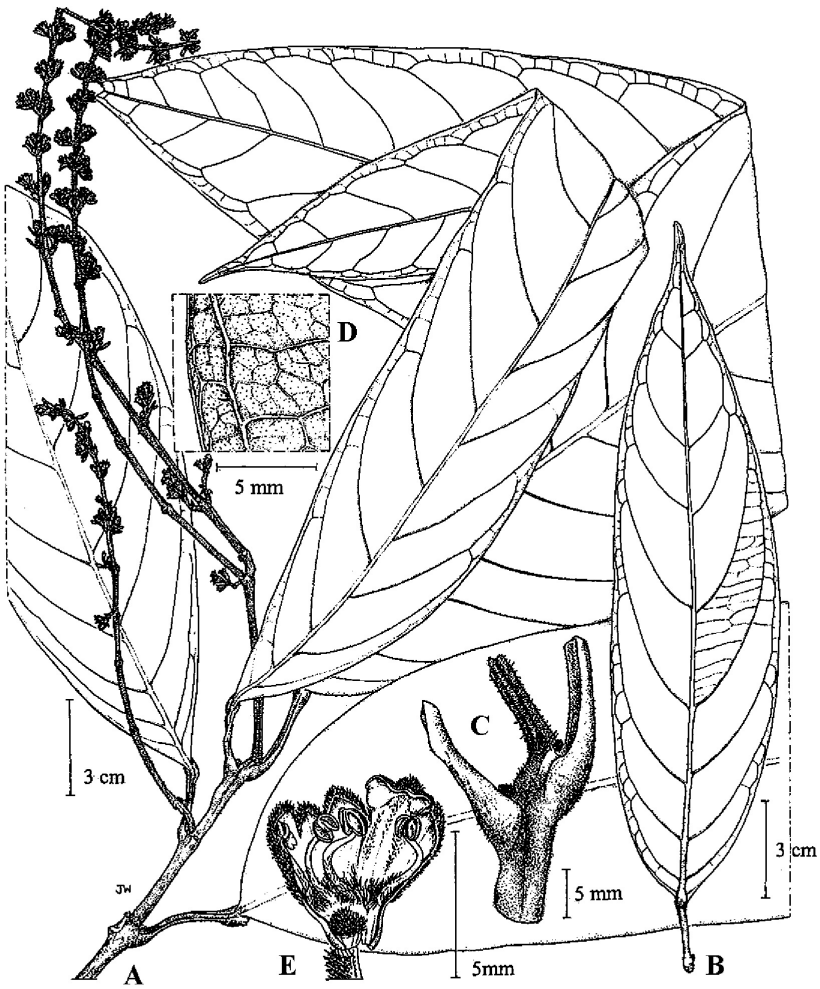

Fig. 9. *Teijsmanniodendron latiffii*. A, flowering leafy twig; B, lower leaf surface; C, indumentum detail at node; D, detail of lower leaf surface; E, flower with the corolla opened to show ovary and stamens. (A–E from *S 22819*.). Drawn by and reproduced with permission from Juliet Beentje.

Tree 5–15 m tall, 10–20 cm diameter. **Bark** pale brown to greyish, flaky. **Twigs** *densely pubescent when young*, terete. **Leaves** *unifoliolate*; *blades* coriaceous, slightly bullate, *oblong*, *20–40* × 5–10 cm, base acute, margin straight to strongly recurved, apex acuminate; glabrous on both surfaces, shiny above, *slightly rough and not punctate beneath*, dark to dull green; midrib raised with a sharp ridge above and beneath; lateral veins 8–12 pairs, sunken above, raised beneath; intercostal venation scalariform; *petioles 1.5–4 cm long*, subterete, *densely to sparsely short-hairy*. **Inflorescences** *densely pubescent*; bracteoles lanceolate, less than 5 mm long, green to violet. **Flowers:** calyx campanulate, 3–4 mm high, 1.5–2 mm across, densely hirsute outside, lobes *c.* 1 mm long, apex acute; corolla white to violet, golden pubescent, tube *c.* 2.5 mm long, central lobe of lower lip spathulate, *c.* 1.5 × 3 mm, apex round, white to violet with yellow patch at the base of the lip, villous at throat, other lobes 1–1.5 × 1–1.2 mm, apex acute; stamens 2.5–3 mm long, slightly didynamous, villous at base, anthers black; ovary globose, *c.* 1 mm diameter, *villous*, more densely so at apex, style *c.* 5 mm long. **Fruits** globose, 0.5–1 cm diameter, sparsely tomentose, more densely so at apex, purple; calyx funnel-shaped, much accrescent, 5-lobed, lobes broadly connate, apex acute, densely hirsute outside.

Distribution. Endemic to Borneo; in Sarawak known only by the type collection (*S 22819*), and in Kalimantan recorded from Sg. Mentaya, Kotawaringin, C Kalimantan (e.g., *Ambriansyah AA 1961*, *Veldkamp 8584* and *Argent 93135*). Not known in Brunei and Sabah.

Ecology. In primary mixed dipterocarp forest on ridges, at 50–100 m altitude.

11. **Teijsmanniodendron obscurinerve** R.Go

(Latin, *obscurus* = unclear, *nervus* = vein; referring to the obscure intercostal venation of the leaf)

In de Kok *et al.*, Kew Bull. 64 (2009) 605. **Type:** *Matin Pikkoh SAN 67646*, 24 Sept. 1984, Borneo, Sabah, Labuk Sugut district, Kuala Sg. Sasau (holotype SAN; isotypes K, KEP).

Tree to 15 m tall, to 40 cm diameter. **Bark** smooth, whitish; slash yellowish. **Sapwood** yellow. **Twigs** smooth, distinctly square in cross-section, glabrous. **Leaves** *unifoliolate*; *blades* coriaceous, *oblanceolate* to elliptic, *15–28* × 3–10 cm, base rounded to cordate, margin thickened and slightly recurved, apex acuminate; glabrous on both surfaces, glossy above, *punctate beneath*; *young leaves green*, *rough beneath*; midrib prominent and raised on both surfaces, whitish beneath when dry; *lateral veins 8–14 pairs*, obscure above, slightly raised beneath, arching and looping near the margin forming an intramarginal vein; intercostal venation reticulate, obscure on both surfaces; petioles 1.2–2.5 cm long, glabrous, subterete **Inflorescence** to 20 cm long, sparsely to densely hairy; bracteoles ovate, 2–2.2 × 0.5–1 mm, apex acute, caducous. **Flowers** purple-blue to purple; calyx bell-shaped, 1–2 mm high, 1.5–2 mm across, densely appressed tomentose, lobes deltoid, *c.* 0.5 mm long, apex acute; corolla funnel-shaped, densely pubescent, throat villous inside; stamens distinctly didynamous, exserted, inserted in the middle part of corolla tube; ovary obtuse and villous at apex. **Fruits** ellipsoid, 1.5–2 cm long, 0.7–1.5 cm diameter, apex round, smooth, *hispid especially at apex*, *dark purple*, *surface not powdery*; pericarp thin (less than 0.1 mm).

Vernacular name. Sabah—*buak-buak pulas* (Malay).

Distribution. Endemic to Borneo; confined to Sabah and so far recorded only from Beluran and Labuk Sugut districts (e.g., *SAN 33190*, *SAN 67646* (type), *SAN 99689*, *SAN 136546* and *SAN 151108*).

Ecology. In lowland mixed dipterocarp forest, usually on riverbanks, at altitudes to 150 m.

12. **Teijsmanniodendron pteropodum** (Miq.) Bakh. Plate 3B.

(Greek, *pteron* = wing, *podos* = foot; referring to the winged petioles)

In H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 29; Merrill *op. cit.* (1923) 398; Masamune *op. cit.* 644; Kostermans *op. cit.* (1951) 92; Kochummen *op. cit.* 309; J.A.R. Anderson *op. cit.* 345; Moldenke *op. cit.* (1980) 21; Coode *et al.* (eds.) *op. cit.* 332; Argent *et al.* (eds.) *l.c.* 655; de Kok *et al. op. cit.* 605. **Basionym:** *Vitex pteropoda* Miq., Fl. Ind. Bat., Suppl. (1861) 242 & 567, Gamble *op. cit.* 851, H.J. Lam *op. cit.* 170, Ridley *op. cit.* (1923) 633. **Type:** *Teijsmann s.n.*, Sumatra, Palembang, Dangku Lematang (holotype L; isotypes BO, K). **Heterotypic synonyms:** *Vitex philippinensis* Merr., Bull. Bot. Forest Philip. Islands 1 (1903) 52; *V. peralata* Miq. *op. cit.* (1861) 242 & 567, King *in* King & Gamble, Bull. Misc. Inform. Kew (1908) 112, *Teijsmanniodendron peralatum* ["*peralata*"] (King) Balakrishnan, Bull. Bot. Surv. India 22 (1980) 176, *nom. inval.*; *V. koordersii* H.J.Lam *in* H.J. Lam & Bakhuizen *op. cit.* 64; *T. pteropodum* forma *cristatum* Moldenke, Phytologia 44 (1979) 473.

Tree 6–40 m tall, 12–60 cm diameter; buttresses less than 4 m high. **Bark** smooth to flaky, lenticellate, whitish, yellowish to black; slash yellow to purplish mottled. **Sapwood** yellow. **Twigs** glabrous, pale brown. **Leaves** *3–7-foliolate*; blades coriaceous, lanceolate, obovate to ovate, central ones 10–55 × 3–19 cm, base attenuate to cuneate, margin slightly to strongly recurved, apex obtuse to acuminate; shiny or glossy, bright- or dark-green above, lighter beneath, glabrous on both surfaces; midrib and lateral veins sunken above, prominent and raised beneath; lateral veins (5–)12–16 pairs; intercostal venation reticulate, conspicuous; *petioles 7–30 cm long*, triangular in cross-section, glabrous, *narrowly to broadly winged*, usually throughout the length; petiolules 0–5 cm long, broadly grooved above. **Inflorescences** 20–100 cm long, reddish brown or pale purplish red; bracteoles lanceolate to ovate, 2–10 × 3–7 mm, persistent, apex abruptly acute, glabrescent on both surfaces, whitish or pale greenish to purple. **Flowers:** calyx bell-shaped, 2–2.5 mm high, 1.5–2 mm across, sparsely pubescent outside, glabrous inside, lobes 1.5–3.5 × 2–2.5 mm, purple to rose-coloured; corolla violet to pale blue violet, pubescent, tube 4–7 mm long, central lobe of lower lip spathulate, 3.5–4 × 3.8–5 mm, apex rounded, throat brown-striate, side lobes of lower lip 2–2.5 × 2–3 mm, apex rounded, lobes of upper lip 1.5–2 × 2 mm, apex acute, reflexed; stamens distinctly didynamous, exserted, inserted above or at middle part of corolla tube, filaments 2–6.5 mm long, white to pale violet, slightly villous at base, anthers dark violet or dark purple, glabrous; ovary globose, apex depressed and villous, style 8–10 mm long, exserted, glabrous, stigmas shortly bifid. **Fruits** ellipsoid, sometimes lobed when dry, *1.5–4.5 cm long*, *2–5 cm diameter*, smooth, irregularly wrinkled when young, glabrous, brown; *pericarp woody*, *thick* (2–3 mm); calyx salver-shaped, 1.7–5 cm high, 3–4.5 cm across, greatly spreading, margin undulating, glabrous, brownish.

Vernacular names. Sabah—*buak-buak* or *tapak itik* (Malay). Sarawak—*entabuluh* (Iban). Brunei—*mengkulat* or *merkulat* (Iban). Kalimantan—*miang* (Dayak, *miang* means can cause itchiness and therefore the wood is not cut).

Distribution. India, Nicobar Islands, S Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo widespread; recorded in Sabah from Beaufort, Keningau,

Kinabatangan, Labuk Sugut, Lahad Datu, Papar, Sandakan, Semporna, Tawau and Tongod districts (e.g., *SAN 31702*, *SAN 55156*, *SAN 79925*, *SAN 88384*, *SAN 102740* and *SAN 132230*), and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Marudi, Mukah, Miri and Tatau districts (e.g., *S 16477*, *S 39319*, *S 48193*, *S 53426*, *S 86828* and *S 91682*). Also known in Brunei (e.g., *Niga NN 288*, *Kirkup DK 783*, *Dransfield JD 6796*, *SAN 17286* and *FMS 35696*) and Kalimantan (e.g., *Mogea 3761*, *Noteboom 4763*, *Kostermans 6149* and *Kostermans 13366*).

Ecology. In primary and secondary forests, including *kerangas* forest, often along riverbanks or in freshwater swamps, on clay or sandy soils, sometimes over basalt, sandstone or limestone bedrock, at 0–960 m altitude.

13. **Teijsmanniodendron punctatum** R.Go Fig. 10.

(Latin, *punctatus* = punctate, dotted; referring to the many tiny gland-pits on the lower leaf surface)

In de Kok *et al.*, Kew Bull. 64 (2009) 609. **Type:** *Othman Ismawi S 40040*, 14 July 1979, Borneo, Sarawak, Kuching, Semengoh FR (holotype SAR; isotypes K, KEP Barcode KEP 107861).

Tree 4–8 m tall, 10–30 cm diameter. **Bark** greyish. **Twigs** square in cross-section, scabrous. **Leaves** *unifoliolate*; *blades* coriaceous, *ovate to lanceolate*, *11–17 × 4–6 cm*, base round to acute, margin flat, apex acuminate; glabrous on both surfaces, *punctate with gland-pits and rough beneath*; *young leaves coppery reddish*; midrib prominent and raised on both surfaces; *lateral veins 6–11 pairs*, prominent and raised beneath, arching towards margin and looping into imperfect intramarginal vein; intercostal venation obscure above, visible beneath, subscalariform to reticulate; petioles 1–2 cm long, terete, sparsely tomentose. **Inflorescences** 3–4 cm long, densely tomentose; bracteoles narrowly lanceolate, densely pubescent. **Flowers:** calyx bell-shaped, 2–2.5 mm high, 1.5–2.2 mm across, densely pubescent and whitish at base, lobes 0.8–1 mm long; corolla purple, tube 3–3.5 mm long, densely pubescent, central lobe of lower lip spathulate, 2.5–3.5 × 1.5–2.5 mm, apex rounded, undulate, pinkish violet with yellow streak inside the throat, side lobes of lower lip 2–3 × 1–1.5 mm, apex acute, lobes of upper lip 2–2.5 × 1.5–2 mm, apex acute; stamens 3–4 mm long, distinctly didynamous, exserted, inserted in lower part of corolla tube, white, anthers ellipsoid, brown; ovary globose, *c*. 1 mm diameter, apex slightly villous, style *c.* 5.5 mm long, stigmas *c*. 0.5 mm long, blue to white. **Fruits** globose, 1–1.5 cm (immature) diameter, apex round, smooth, *surface powdery*, *apex with a few hairs*; pericarp thin; calyx shallowlly funnel-shaped, irregularly lobed, densely pubescent.

Vernacular name. Sarawak—*entabuluh* (Iban).

Distribution. Endemic to Borneo; so far known only in Sarawak from the Semengoh Arboretum, Kuching district (e.g., *S 9388*, *S 14828*, *S 32467*, *S 32549* and *S 66077*).

Ecology. Understorey trees of primary mixed dipterocarp forest on yellow sandy clay soil, at altitudes to 150 m.

14. **Teijsmanniodendron renageorgeae** R.Go Fig. 11.

(Rena George, 1956–1994, Assistant Forest Botanist of the Sarawak Forest Department)

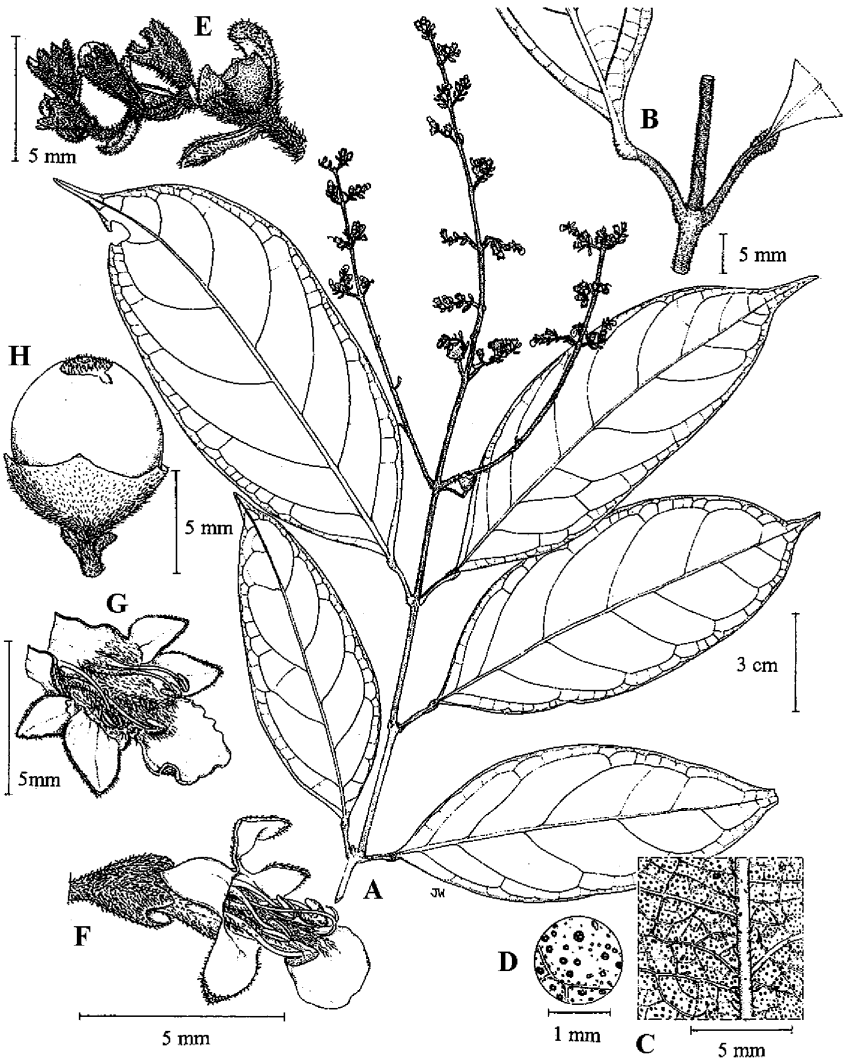

Fig. 10. *Teijsmanniodendron punctatum*. A, flowering leafy twig; B, detail of node and petioles; C, detail of leaf lower surface; D, finer detail of lower leaf surface; E, distal part of inflorescence; F, side view of open flower; G, front view of open flower; H, side view of fruit. (A–E from *S 32549*, F–G from *S 66077*, H from *S 40040*.). Drawn by and reproduced with permission from Juliet Beentje.

In de Kok *et al.*, Kew Bull. 64 (2009) 611. **Type:** *Rena George S 43074*, 21 Sept. 1980, Borneo, Sarawak, Limbang district, Ulu Medamit, Sg. Ensungai, Tg. Long Amok (holotype SAR; isotypes K, KEP Barcode KEP 107860, L, SAN).

Tree 4–13 m tall, 15–20 cm diameter. **Bark** smooth, greyish brown. **Twigs** terete, slightly scabrous when young, glabrescent when older, greyish brown. **Leaves** *3-foliolate*; *blades coriaceous*, *narrowly lanceolate*, 8–10 × 2–3 cm, base symmetric (lateral leaflets have distinctly oblique base), margin strongly recurved, *apex narrowly acuminate*; glabrous on both surfaces, coriaceous, shiny above, glaucous beneath; midrib sunken above, prominent and slightly raised beneath; lateral veins 5–6 pairs, obscure above, prominent beneath; intercostal venation obscure on both surfaces; *petioles not winged*, subterete, grooved above, less than 2 cm long, scabrous; petiolules 1–1.3 cm long. **Inflorescences** 9–14.5 cm long, glabrous to sparsely hairy; bracteoles narrowly lanceolate, pubescent. **Flowers:** calyx bell-shaped, 2–2.5 mm high, 1–1.5 mm across, slightly scabrous, dark green, lobes 1–1.5 mm long, apex acute; corolla violet with yellow spot on the lip, pubescent, tube *c.* 3 mm long, central lobe of lower lip seen only when damaged, side lobes of lower lip *c.* 2 × 1 mm, apex rounded, upper lip seen only when damaged; stamens didynamous, anthers black; ovary *c.* 1 mm diameter, glabrous with few hairs at apex. **Fruits** when dried *c. 2.5 cm long*, *c. 3.5 cm diameter*; pericarp woody or leathery, thick or thin; young fruit globose, smooth with a few hairs at apex; calyx *c.* 3.5 mm high, *c.* 4 mm across, fleshier than flowering calyx.

Distribution. Endemic to Borneo; known only from two localities: Ulu Medamit, Limbang district in Sarawak (the type) and Batu Melintang Hot Spring in Brunei (*Kessler et al. 410*).

Ecology. An understorey tree in mixed dipterocarp forest on loamy soil, at 0–150 m altitude.

15. **Teijsmanniodendron sarawakanum** (H.H.W.Pearson) Kosterm.
(of Sarawak, Borneo)

Reinwardtia 1 (1951) 100; Moldenke *op. cit.* (1980) 29; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 332; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 613. **Basionym:** *Vitex sarawakana* H.H.W.Pearson, Bull. Misc. Inform. Kew (1907) 60, Merrill *op. cit.* (1921) 514, H.J. Lam *op. cit.* 175, H.J. Lam & Bakhuizen *op. cit.* 52, Masamune *op. cit.* 645. **Lectotype** (de Kok *et al.* 2009)**:** *Beccari 2280*, 1865–1868, Borneo, Sarawak (K). **Heterotypic synonym:** *Vitex tetragona* Hallier*.f. op. cit.* 53, Merrill *op. cit.* (1921) 515, H.J. Lam *op. cit.* 202, H.J. Lam & Bakhuizen *op. cit.* 59, Masamune *op. cit.* 645.

Tree (2–)7–40 m tall, 10–50(–165) cm diameter; buttresses 0.5 m out. Bark smooth to slightly scaly to flaky, white, grey to black. **Sapwood** hard or soft, yellowish or light brown to white. **Twigs** *glabrous*, *square in cross-section distally*. **Leaves** *unifoliolate*; *blades* chartaceous, strongly bullate or not, elliptic to oblanceolate or lanceolate, 8.5–30 × 2–11 cm, base acute to rounded, margin strongly recurved to subrecurved, apex acuminate; glabrous on both surfaces, shiny above, *not punctate beneath*; midrib prominent and raised; *lateral veins* 5–12 pairs, arching and looping near the margin, prominent and slightly sunken above, raised beneath, *distinctly paler than blade*; intercostal venation scalariform-reticulate, distinct, raised and whitish beneath; *petioles 1–3.5 cm long*, subterete, *glabrous*. **Inflorescences** to 25 cm long, glabrous, sometimes hairy at base, purplish; bracteoles

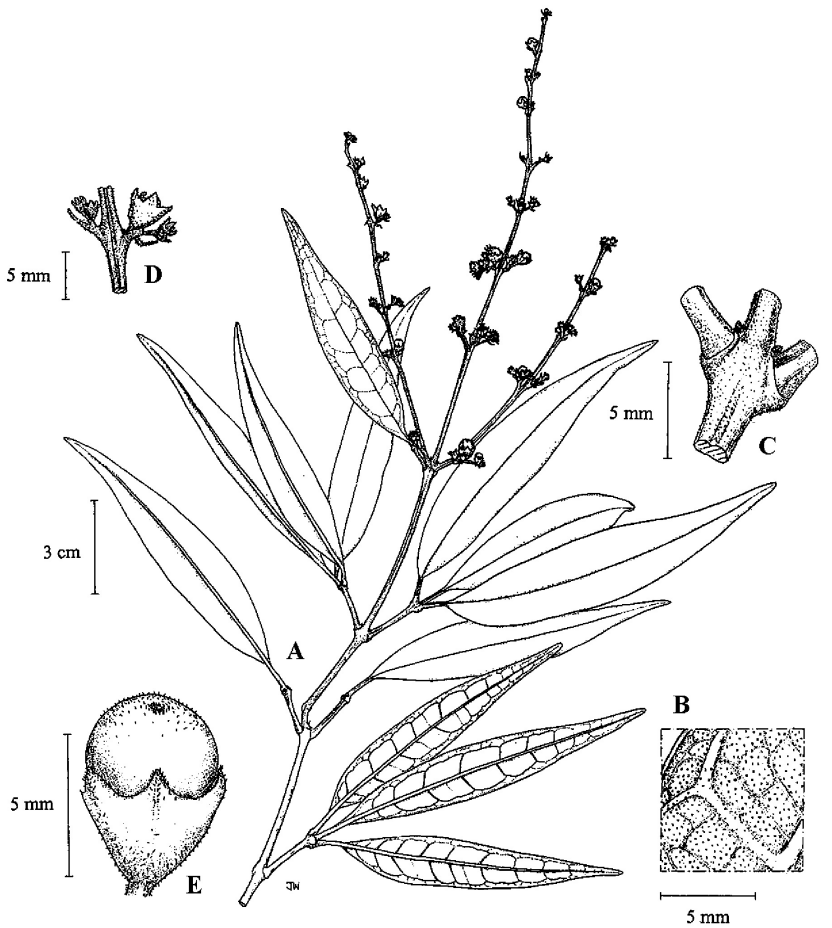

Fig. 11. *Teijsmanniodendron renageorgeae*. A, flowering leafy twig; B, details of lower leaf surface; C, details of node and petioles; D, part of inflorescence; E, fruit. (A–E from *S 32547*.). Drawn by and reproduced with permission from Juliet Beentje.

persistent, densely appressed-puberulous, caducous. **Flowers:** calyx bell-shaped, 1.5–2.5 mm high, 1.5–2 mm across, purple, densely minutely pubescent, lobes *c*. 1 mm long, apex acute; corolla white or white-purple to pale pinkish mauve or blue, velvety, pubescent, tube 3–3.5 mm long, violet, central lobe of lower lip spathulate, 2.5–3 × 2.5–3 mm, apex rounded, white to purple with yellow or purple markings at base, with erect hairs at base, side lobes of lower lip 1.5–2 × 1–2 mm, apex acute, white-violet to yellow, lobes of upper lip 1.5–2 × 1–2 mm, apex acute, white-violet to yellow; stamens 3–4 mm long, slightly didynamous, exserted, inserted halfway on corolla tube, hairy at base, white to yellow, anther *c.* 0.5 mm long, black; ovary globose, glabrous with velutinous upper half, style 3–8 mm long, stigma 0.5 mm long, apex acute. **Fruits** globose, 1–2.5 cm diameter, smooth when dry, apex rounded to depressed, surface glabrous with velutinous apex or *covered by a dark bluish green powder*, dark grey to orange, later black; pericarp thin; calyx shallowly cup-shaped, 5–8 mm high, 10–12 mm across, irregularly lobed.

Vernacular names. Sarawak—*entabuluh* (Iban). Brunei—*mertuboh* (Iban).

Distribution. Endemic to Borneo. Widespread throughout Sabah and Sarawak. In Sabah, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Tawau districts (e.g., *Beaman et al. 10298*, *SAN 39981*, *SAN 57264*, *SAN 88993* and *SAN 129440*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lubok Antu, Lundu, Serian and Sri Aman districts (e.g., *S 18915*, *S 35173*, *S 46309* and *S 68798*). Also known in Brunei (e.g., *BRUN 22*, *S 7890*, *BRUN 16556* and *Wong WKM 1981*) and Kalimantan (e.g., *Burley NGS 714*, *Burley et al. 3187*, *Koyama et al. 3460* and *Tuke P13 605*).

Ecology. In primary and secondary, or sometimes *kerangas* forests on clay to (sandy) loam soils, sometimes over shale, sandstone, limestone or ultramafic bedrock, at 35–900 m altitude.

16. **Teijsmanniodendron simplicifolium** Merr.

(Latin, *simplex* = simple, *folium* = leaf; referring to the unifoliolate leaves that have been described by Merrill as simple leaves)

PEB (1929) 263; Masamune *op. cit.* 644; Kostermans *op. cit.* (1951) 96; Kochummen *op. cit.* 309; Moldenke *op. cit.* (1980) 32; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 655; Beaman & C. Anderson *op. cit.* 457; de Kok *et al. op. cit.* 614. **Type:** *Elmer 21837*, Oct. 1922 – March 1923, Borneo, Sabah, Tawau district (holotype PNH; isotypes A, BM, BO, K Barcode K 000498441, L Barcode L 0003965, NY, SING). **Synonym:** *Teijsmanniodendron simplicifolium* var. *cordifolium* Moldenke, Phytologia 43 (1979) 252.

Tree 5–32 m tall, 12–60 cm diameter; buttresses to 2 m high, *c.* 0.5 m out. **Bark** smooth to slightly scaly or fissured, white to whitish green or brownish. **Sapwood** hard, heavy, yellowish to brownish. **Twigs** *terete*, glabrous. **Leaves** *unifoliolate*; *blades coriaceous*, not bullate, *lanceolate*, *7–13 × 2–5 cm*, base acute to rounded (cordate), margin entire, apex acuminate; glabrous on both surfaces, *light brown when dried*, *not punctate beneath*; midrib prominent; *lateral veins 3*(*–4*) *pairs*, curving and ascending, *arching towards the margin*, very conspicuous beneath; intercostal venation densely reticulate, distinct beneath; *petioles 0.8–1.2 cm long*, subterete, grooved above, *glabrous*, sometimes with short hairs on the swollen articulations, distal pulvinus sometimes with distinct black ring. **Inflorescences** slender, to 15 cm long, glabrous; bracteoles small, lanceolate to elliptic lanceolate, caducous. **Flowers:** calyx bell-shaped, 1–2 mm high, 1–2 mm across, glabrous, yellow or whitish, lobes to 0.5 mm long, apex acute; corolla glabrous outside, pale yellow or white,

fragrant, tube 3–4 mm long, with blue-purple longitudinal stripes, central lobe of lower lip spathulate, 2–2.5 × 2–2.5 mm, apex rounded, with dark yellow spot at the base, side lobes of lower lip 1.5–2.5 × 1–1.5 mm, apex acute, lobes of upper lip 1–2.5 × 1–1.5 mm, apex acute to rounded; stamens 3–4 mm long, didynamous, exserted, inserted in the lower part of corolla tube, anthers dark purple; ovary globose, *c.* 1 mm diameter, apex glabrous, covered with glands, style 3–5 mm long, stigma 0.1 mm long. **Fruits** ovoid, 1.3–2 cm long, 1.1–1.5 cm diameter, *apex notched*, *smooth with fine longitudinal ridges*, *glabrous*; pericarp thin; calyx broadly funnel-shaped, 7–10 mm high, 3–8 mm across, irregularly lobed, glabrous.

Vernacular names. Sabah—*buak-buak* (Malay). Sarawak—*ubah sireh* or *entabuluh* (Iban) *esak* (Kayan). Kalimantan—*kaju gadang* or *kemuning* (Dayak).

Distribution. Sumatra, Peninsular Malaysia and Borneo. Widespread throughout Sabah and Sarawak. In Sabah recorded from most districts (e.g., *Wong WKM 2348*, *SAN 29798*, *SAN 50503*, *SAN 75051* and *SAN 114020*) and in Sarawak from Bintulu, Kapit, Limbang, Miri and Tatau districts (e.g., *S 19243*, *S 21404*, *S 22208* and *S 42866*). Also known in Brunei (e.g., *BRUN 611*) and Kalimantan (e.g., *Church et al. 1687*, *Endert 3625*, *Kostermans 12732* and *bb 28654*).

Ecology. In primary and secondary forests on sandy clay or yellow sandy clay soils, sometimes over sandstone, basalt, shale or ultramafic substrates, at 0–1200 m altitude.

Uses. The wood is used in Sabah and said to be durable against insect attack. In Sarawak the wood is used for canoes and the bark for roofing.

17. **Teijsmanniodendron simplicioides** Kosterm.

(Latin, *simplicioides* = resembling *T. simplicifolium*)

Reinwardtia 6 (1962) 303 & 325; de Kok *et al. op. cit.* 616. **Synonym:** *Teijsmanniodendron simplicifolium* var. *kostermansii* Moldenke, Phytologia 4 (1952) 57. **Type:** *van der Zwaan 1074* (= *bb 19034*), 28 May 1934, Borneo, SE Kalimantan, Berau Betemuan (holotype BO; isotypes A, BO, L Barcode L 0003966, NY).

Tree 5–60 m tall, 25–120 cm diameter, bole fluted or with steep buttresses. **Bark** whitish, pale yellow to greyish brown, smooth; inner bark yellowish. **Sapwood** yellowish, hard. **Young twigs** densely golden pubescent, terete. **Leaves** *unifoliolate*, sometimes pseudo-whorled; *blades* coriaceous, *lanceolate*, *6–10*(*–22*) × 3–8 cm, base rounded to broadly acute, margin flat, apex acuminate; glabrous on both surfaces, , *not punctate beneath*; midrib prominent above, prominent and slightly raised below; lateral veins 4–10 pairs, sunken above, raised below, arcuating towards margin, not looping but becoming faint near margin towards apex; intercostal venation prominent; *petioles 0.5–3 cm long*, *densely pubescent when young*, sometimes glabrous when old. **Inflorescences** densely pubescent to at least densely hairy at base; bracteoles 1–5 mm long, caducous. **Flowers:** calyx bell-shaped, 1.5–2 mm high, 2–3 mm across, margin undulating and uneven, glabrous; corolla yellowish white to (bluish) yellow or purple, tube 4.5–5 mm long, central lobe of lower lip spathulate, 3–4 × 3–5 mm, apex rounded, throat villous inside, side lobes of lower lip 2–2.5 × 1.8–2 mm, apex rounded, lobes of upper lip 2–2.5 × 2–3 mm, apex round; stamens 3–4 mm long, didynamous, yellow, anther *c.* 0.5 mm long, round; *ovary* globose, *villous at apex*, style 3–4 mm long, stigma 0.1 mm long. **Fruits** ellipsoid, 1–2.2 cm long, 0.6–1.2 cm diameter,

smooth, apex round, glabrous with a few glands; pericarp thin; calyx 0.7–1 cm diameter, erect, margin undulating and uneven, glabrous.

Vernacular names. Sabah—*buak-buak* (Malay); *kilons* (Dusun – Papar).

Distribution. Peninsular Malaysia and Borneo. In Sabah recorded from Lahad Datu, Papar, Sandakan, Tawau and Tongod districts (e.g., *SAN 28830*, *SAN 32196*, *SAN 36086*, *SAN 37072* and *SAN 56881*) and in Sarawak by a single collection from Bt. Merubang, Tebedu, Serian district (*S 49256*). Also known from Kalimantan (e.g., *bb 11204*, *bb 19034* and *bb 26430*) but not yet recorded from Brunei.

Ecology. In primary and secondary forests often on ridges, on sandy, clay or clay loam soils, sometimes over sandstone or ultramafic bedrock, at 60–150 m altitude.

18. **Teijsmanniodendron sinclairii** Kosterm.

(James Sinclair, 1913–1968, botanist at the Singapore Botanic Gardens)

Gard. Bull. Sing. 17 (1958) 6; Kochummen *op. cit.* 309; Moldenke *op. cit.* (1980) 36; J.A.R. Anderson *op. cit.* 345; de Kok *et al. op. cit.* 617. **Type:** *Sinclair & Kiah SFN 40877*, 18 Sept. 1955, Peninsular Malaysia, Terengganu, Kuala Terengganu, Besut Road, Sg. Nerus riverbank (holotype SING; isotypes BO, K, L Barcode L 0003967).

Tree to 20 m tall, to 45 cm diameter. **Bark** smooth, grey. **Sapwood** white to pale yellowish brown. **Twigs** stout; *young twigs terete*, minutely scabrous, older ones glabrous. **Leaves** *unifoliolate*; *blades distinctly bullate*, *coriaceous*, *elliptic*, *17–25 × 8–13 cm*, base acute, margin strongly recurved, apex acuminate; glabrous on both surfaces, shiny above, rough beneath; *young leaves not punctate below*; midrib sunken above, raised beneath; *lateral veins* (*5–*)*8–10*(*–20*) *pairs*, sunken above, prominent and raised beneath, *arching towards the margin*; intercostal venation densely reticulate, impressed above, distinct and raised beneath; *petioles 2–4 cm long*, terete, *glabrous*, *distal pulvinus with distinct black ring*. **Inflorescences** to 30 cm long, sparsely scabrous; bracteoles persistent, narrowly ovate to elliptic-lanceolate, *c.* 3 × 8 mm, apex acute. **Flowers:** calyx bell-shaped, 2–3 mm high, 2–3 mm across, sparsely hairy, lobes *c.* 0.5 mm long, apex broadly acute, erect; corolla funnel-shaped, blue, dark violet or purple, pubescent, tube 2–4 mm long, *c.* 2 mm across, central lobe of lower lip oblong to rounded, 3.5–3.8 × 2–3 mm, apex rounded, with yellow-brown patch at base, throat villous at base, side lobes of lower lip 2–2.2 × 1.5–2 mm, apex rounded, lobes of upper lip 1.5–2 × 1–1.2 mm, apex rounded; stamens 5–7 mm long, didynamous, exserted, inserted in the middle part of corolla tube, white, anthers black; ovary globose, *c.* 1 mm diameter, pubescent at apex, style 6.5–7 mm long, stigma blue. **Fruits** ellipsoid, 1.5–1.7 cm long, 1–1.2 cm diameter, *apex acute and with a dimple*, *smooth with faint longitudinal groove*, *glabrous*, dark green; pericarp thin; calyx shallowly cup-shaped, 1–1.2 cm high, 0.5–0.7 cm across, rim irregularly lobed, minutely pubescent.

Vernacular name. Sarawak—*entabuluh* (Iban).

Distribution. Peninsular Malaysia and Borneo. In Sabah known by a single collection from G. Silam, Lahad Datu district (*SAN 57450*) and in Sarawak by two collections from Bintulu and Kapit districts (*S 20939* and *S 21756*). Also recorded from W and E Kalimantan (e.g., *Ambriansyah Berau 1070* and *Church et al. 1433*). Not known in Brunei.

Ecology. In primary and secondary forests, often along riverbanks, on alluvium soils, sometimes over sandstone or basalt bedrock, at 0–500 m altitude.

19. **Teijsmanniodendron smilacifolium** (H.H.W.Pearson) Kosterm.

(Latin, *smilacifolium* = with leaves having a similar type of venation as that of *Smilax*, Smilacaceae)

Reinwardtia 1 (1951) 95; Moldenke *op. cit.* (1980) 37; Coode *et al.* (eds.) *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 618. **Basionym:** *Vitex smilacifolia* H.H.W.Pearson, Bull. Misc. Inform. Kew (1907) 59, H.J. Lam *op. cit.* 175, H.J. Lam & Bakhuizen *op. cit.* 48 & 51, Merrill *op. cit.* (1921) 514, Masamune *op. cit.* 645. **Lectotype** (de Kok *et al.* 2009)**:** *Beccari 1097*, 1865–68, Borneo, Sarawak (K; isolectotypes BM, NY).

Tree 4–30 m tall, 10–55 cm diameter; buttresses present. **Bark** smooth, powdery to scaly, whitish grey to yellow or black; slash yellow, grey to pale brown. **Sapwood** white to yellowish brown, soft. **Twigs** *terete*, glabrous. **Leaves** *unifoliolate*; blades *coriaceous*, oblanceolate, 12–20 × 4–8 cm, base broadly acute to rounded, margin slightly recurved, apex acute or broadly acuminate; glabrous on both surfaces, shiny above, *not punctate below*; midrib prominent above and below; *lateral veins 3–4 pairs*, *ascending from below the middle of the blade and joined at the apex*; intercostal venation finely reticulate, obscure above, prominent beneath; *petioles 1–2 cm long*, subterete, *glabrous*. **Inflorescences** 25–30 cm long, glabrous; bracteoles small or minute, caducous. **Flowers:** calyx bell-shaped, 1–2 mm high, 1–2 mm across, sparsely and minutely glandular, lobes *c.* 0.5 mm long, apex acute; corolla dull dark glaucous, pale purple or blue to white, pale mauve, white (yellow), tube funnel-shaped, upper part marked with glands outside, central lobe of lower lip darkish violet near the villous throat, with a distal pale yellow spot, cream, side lobes of lower lip cream, lobes of upper lip cream; stamens 4, distinctly didynamous, slightly exserted, inserted below the middle part of corolla tube, filaments dark purplish to faintly violet, basally dilated and villous, anthers dark purplish or black; ovary globose, *c.* 1 mm diameter, glabrous, densely glandular-dotted, style *c.* 6 mm long, white. **Fruits** subglobose, 1.2–1.8 cm long, 0.8–1.2 cm diameter, apex round to acute, finely ribbed when dry, glabrous, black; pericarp thin; calyx cup-shaped, 6–9 mm across, accrescent, irregularly lobed, glabrous.

Distribution. Endemic to Borneo. In Sabah, recorded from Beaufort, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 20724*, *SAN 44587*, *SAN 54063*, *SAN 75369* and *SAN 100643*) and in Sarawak from Bintulu, Kapit, Kuching, Lubok Antu and Miri districts (e.g., *Native Collector 1830*, *S 15620*, *S 19580*, *S 20724* and *S 22298*). Also recorded from W and C Kalimantan (e.g., *Jarvie & Ruskandi 5803*, *Ridsdale PBU 22*, *Hallier B 219* and *Laman et al. TL 334*). Not known in Brunei.

Ecology. In primary or secondary forests on clay or black stony soil, sometimes over shale bedrock, at 0–1000 m altitude.

20. **Teijsmanniodendron subspicatum** (Hallier *f.*) Kosterm.

(Latin, *sub* = somewhat, *spicatus* = gathered in spikes; referring to the inflorescence which resembles a bundle of spike-like branches).

Reinwardtia 1 (1951) 99; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 655; de Kok *et al. op. cit.* 619. **Basionym:** *Vitex subspicata* Hallier *f.*, Meded. Rijks-

Herb. Leiden (1918) 52, H.J. Lam *op. cit.* 117, Merrill *op. cit.* (1921) 514, Masamune *op. cit.* 645. **Lectotype** (de Kok *et al.* 2009)**:** *Forbes 3204*, 1880, Sumatra (L; isolectotypes BM, BO, L, SING).

Tree to 20 m tall, 6–40 cm diameter; buttresses to 1 m high. **Bark** smooth to flaky cracked, yellowish to grey; slash white or light greenish, yellowish, yellow or orange, granular, soft. **Sapwood** pale brown to yellowish. **Twigs** white or pale ochraceous, stout, *terete*, glabrous. **Leaves** *unifoliolate*; *blades coriaceous*, somewhat bullate, lanceolate, (8–)15–30(–38) × (3–)10–14(–16) cm, base broadly acute to rounded, margin recurved, apex acuminate; shiny and glabrous on both surfaces, *texture rough*, *not punctate beneath*; midrib prominent, impressed above, raised beneath; *lateral veins* 7–10 pairs, *arching towards the margin and sometimes forming an* (*imperfect*) *intramarginal vein*, prominent and raised beneath; intercostal venation reticulate, faint and slightly raised beneath; *petioles 1–3 cm long*, subterete, *glabrous*, distal pulvinus sometimes with distinct black ring. **Inflorescences** to 25 cm long, dark purplish red, very minutely puberulent; bracteoles minute, linear, persistent. **Flowers:** calyx bell-shaped, 1.5–2 mm high, 2–2.2 mm across, puberulent, green to dark red-purple, lobes to 0.3 mm long, apex broadly acute; corolla lilac to purple, pubescent, tube 2.5–3.5 mm long, pale yellow or white to pale-dark purple, central lobe of lower lip rounded to spathulate, 2–4 × 1.5–2 mm long, band of white hairs along length of lip, lilac-blue with yellow blotch at base, side lobes of lower lip 1.5–2.8 × 0.8–1 mm, apex rounded to acute, dark violet, lobes of upper lip 1–1.2 × 0.8–1 mm, apex round, dark violet; stamens 3–5 mm long, distinctly didynamous, exserted, inserted in the lower part of corolla tube, white, basally pale blue, villous, anthers black, *c.* 0.5 mm long; ovary globose, *c.* 1 mm diameter, villous at apex, style 5–7 mm long, exserted, white to pale blue. **Fruits** ellipsoid, 0.9–2 cm long, 0.8–1.5 cm diameter, *apex depressed*, surface smooth, glabrous but *with few hairs at apex*, black; pericarp thin; calyx shallowly funnel-shaped, 6–8 mm high, 10–18 mm across, much accrescent, irregularly dentate, dirty brownish-yellow.

Vernacular names. Sabah—*kedaras* (Dusun). Brunei—*mertubu* (Iban-Brunei). Sarawak—*selumpo*, *medang sisit*, *entabuluh* (Iban), *ubah putih* (Malay).

Distribution. Sumatra and Borneo. In Borneo, recorded in Sabah from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Tenom and Tongod districts (e.g., *SAN 31476*, *SAN 49460*, *SAN 52816*, *SAN 99716* and *SAN 113207*) and in Sarawak from Bintulu, Kapit, Kuching, Miri and Samarahan districts (e.g., *Hewitt 806*, *S 23856*, *S 38589*, and *S 38737*). Also known in Brunei (e.g., *Wong WKM 177*, *Atkins 529*, *Hotta 12525* and *BRUN 17399*) and in W, C and E Kalimantan (e.g., *Kessler Berau 755*, *Endert 2529*, *Kostermans 12755* and *Argents 94117*).

Ecology. In primary and secondary forests, sometimes swamp or *kerangas* forest or along riverbanks, on white sandy to sandy clay or loamy, sometimes on acid or limestone-derived soils, at 10–400(–1000) m altitude.

21. **Teijsmanniodendron unifoliolatum** (Merr.) Moldenke

(Latin, *unus* = one, *foliolum* = leaflet; referring to the leaves)

Phytologia 4 (1952) 58; J.A.R. Anderson *op. cit.* 345; Coode *et al.* (eds.) *op. cit.* 333; de Kok *et al. op. cit.* 621. **Basionym:** *Vitex unifoliolata* Merr., Philip. J. Sci. 20 (1922) 438. **Type:** *Ramos & Edano 37048*, Oct.–Nov. 1919, the Philippines, Mindanao, Zamboanga District, Melangas (holotype PNH; isotype K).

Tree to 26 m tall, 10–35(–100) cm diameter; bole sometimes fluted. **Bark** smooth to flaky, whitish to greyish green or brown. **Sapwood** soft, white to pale yellow; heartwood brown, hard. **Twigs** *square* in cross-section, *glabrous*, smooth. **Leaves** *unifoliolate*; blades slightly bullate, coriaceous, narrowly elliptic to lanceolate, 12–40 × 4–11 cm, base acute to rounded, margin flat to recurved, apex acuminate; glabrous on both surfaces, shiny above, *not punctate beneath*; young leaves rough beneath; midrib prominent and raised on both surfaces; lateral veins 6–12 pairs, *concolorous with the blade*, arching towards the margin, sometimes forming intramarginal veins, prominent and raised beneath; intercostal venation laxly reticulate, distinct and slightly raised beneath, obscure above; *petioles 1–3 cm long*, subterete, *glabrous*. **Inflorescences** to 40 cm long; peduncles about 6 cm long, glabrescent, violet; bracteoles lanceolate to elliptic-lanceolate, caducous. **Flowers:** calyx bell-shaped, 1.8–3 mm high, 1–2 mm across, green to (dark) purple, pubescent, lobes *c.* 0.5 mm long, apex acute to obtuse; corolla blue to violet or (white) purple, velvety, scented, tube 3–5 mm long, purple to violet, central lobe of lower lip orbicular to spathulate, 2.5–4 × 2–3 mm, apex rounded, with erect hairs and a yellow spot at base, side lobes of lower lip 2.5–3 mm, apex acute, blue, lobes of upper lip 1.5–3 mm, apex acute, blue; stamens 2–5.5 mm long, distinctly didynamous, greatly to shortly exserted, inserted in the middle or lower part of corolla tube, villous at base, white to faintly violet, anther black; ovary globose, *c.* 1 mm diameter, villous at apex, style *c.* 6 mm long, white; stigma *c.* 0.5 mm. **Fruits** globose, 0.7–2 cm diameter, smooth, apex round to depressed, glabrous except for a few hairs at apex, sometime *covered with a glaucous layer that forms cracks when dry*, pale purple to black; pericarp thin with pithy layer inside; calyx cup-shaped, 0.7–1.2 cm across, erect, lobed to entire, glabrous to pubescent.

Vernacular names. Sarawak—*entabuluh* (Iban). Kalimantan—*kayu sanaman* (Dayak).

Distribution. Borneo and the Philippines. In Sabah recorded from Kinabatangan district (e.g., *SAN 81759* and *SAN 91068*) and in Sarawak from Bintulu, Kapit, Kuching, Marudi, Song and Sri Aman districts (e.g., *Pearce ITTO/BB 585*, *Jacobs 5391*, *S 16476*, *S 39632*, *S 68689* and *SFN 36053*). Also known in Brunei (e.g., *BRUN 863* and *Forman LLF 939*) and Kalimantan (e.g., *Kato & Wiriadinata B 5369*, *Nooteboom 4544*, *Kostermans 13649*, *Kostermans 13710* and *Kostermans 13845*).

Ecology. In primary and secondary, sometimes in *kerangas* forest or along rivers or in seasonally inundated forest, on sandy, clay or sandy loam or shale-derived soils, sometime over basalt, sandstone or limestone bedrock, at 0–800 m altitude.

22. **Teijsmanniodendron zainudinii** R.Go Fig. 12.

(Ahmed Zainudin Ibrahim (1949–), Plant Collector at the Herbarium, Universiti Kebangsaan Malaysia, Bangi (UKMB) and collector of the type specimen)

In de Kok *et al.*, Kew Bull. 64 (2009) 622. **Type:** *Zainudin AZ 5009*, 11 April 1994, Borneo, Sabah, Kinabatangan district, Bukit Tawai FR (holotype UKMB; isotypes KEP Barcode KEP 107580, SAN). **Heterotypic synonym:** *Teijsmanniodendron subspicatum* (Hallier *f.*) Kosterm. var. *parvifolium* Moldenke, Phytologia 43 (1979) 252.

Tree 2–10(–25) m tall, 3–20 cm diameter. **Bark** smooth, pale green to whitish. **Sapwood** yellow to yellowish ochre; sap yellowish ochre turning brown on exposure. **Twigs** greyish brown, glabrous, *terete*. **Leaves** *unifoliolate*; *blade thickly coriaceous*, elliptic to lanceolate, 7–9 × 3–5 cm, base round to slightly cordate, margin flat or recurved, apex acuminate to

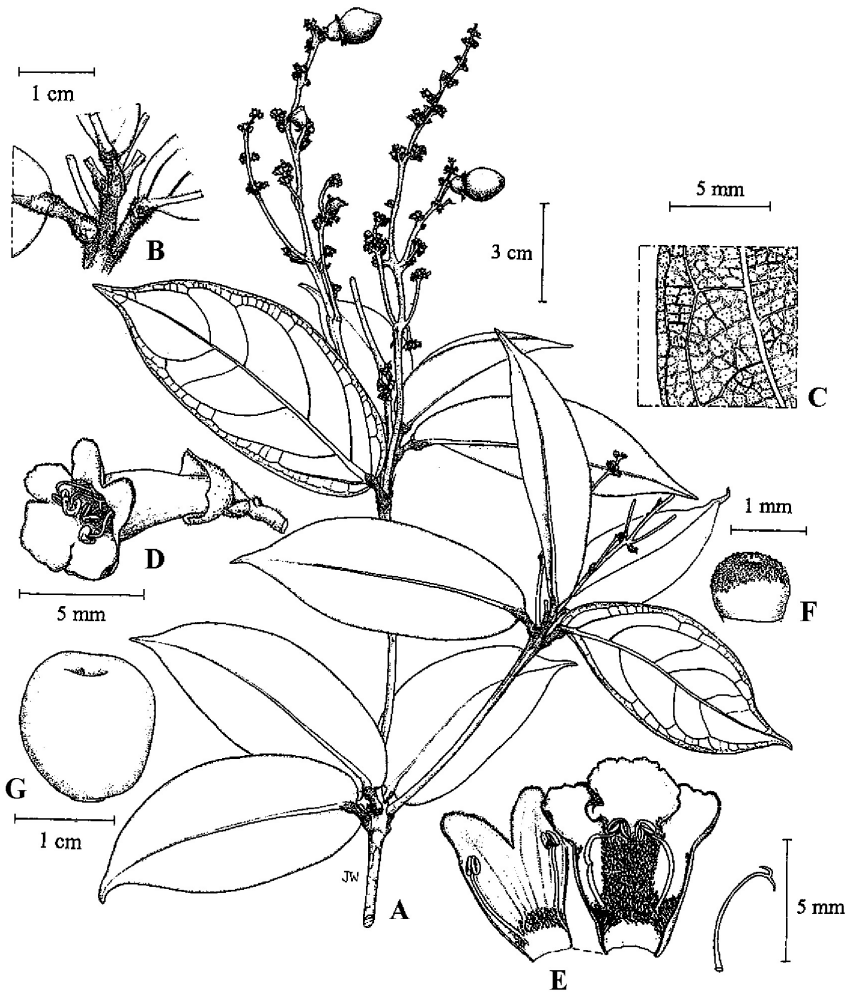

Fig. 12. *Teijsmanniodendron zainudinii*. A, flowering and fruiting leafy twig; B, detail of nodes and petioles; C, detail of lower leaf surface; D, side view of open flower; E, opened corolla showing stamens and style; F, young fruit; G, mature fruit. (A–C from *SAN 131966*, D–E from *SAN 24184*, F–G from *SAN 107787*.). Drawn by and reproduced with permission from Juliet Beentje.

acute; glabrous above, *not punctate beneath*; midrib prominent, flat to slightly raised above, raised beneath; lateral veins 5–7 pairs, faint above, subprominent beneath but not raised, arching towards margin and looping into a faint intramarginal vein; intercostal venation invisible above, fairly faint beneath, finely reticulate; *petioles to 1 cm long*, subterete, *glabrous*. **Inflorescences** comprising panicles of subsessile branched cymes, violet; bracteoles narrowly lanceolate, less than 3 mm long, caducous. **Flowers:** calyx funnel-shaped, 1–2 mm high, 1.5–2 mm across, glabrous, reddish purple, lobes to 0.5 mm long, apex acute, glabrous; corolla purple to violet or white with sparse yellow hairs, tube 4–5.5 mm long, central lobe of lower lip spathulate, 2–2.5 × 3–3.5 mm, apex rounded or emarginate, reflexed, throat villous inside, side lobes of lower lip 2–3 × 2–2.5 mm, apex rounded, lobes of upper lip 2–3 × 1.5–2 mm, apex rounded; stamens 4–6 mm long, didynamous, exserted, inserted in the lower part of corolla tube; ovary globose, 1–2 mm diameter, glabrous, apex covered with glands, style 3–5 mm long. **Fruits** ellipsoid, 1.4–1.7 cm long, 1–1.2 cm diameter, apex acute with slight notch, smooth, glabrous; pericarp thin; calyx cup-shaped, 12–14 mm high, 4–5 mm across, lobes irregular, glabrous, greyish dark brown.

Distribution. Endemic to Borneo and so far known only in Sabah by a few collections from Kinabatangan, Labuk Sugut, Ranau and Sandakan districts (e.g., *Mat-Salleh KMS 3331*, *SAN 24184*, *SAN 39328*, *SAN 92990*, *SAN 107787*, *SAN 131966*, *SAN 142192* and *FRI 41327*).

Ecology. In lowland and hill dipterocarp forests and *kerangas* forest on clay soils over ultramafic substrates, at 150–850 m altitude.

6. **VITEX** L.

(Latin name for the plant *Vitex agnus-castus* L. from Southern Europe)

leban (Iban, Malay)

Sp. Pl. 2 (1753) 638; Blume, Bijdr. Fl. Ned. Ind. 14 (1826) 812; Schauer *in* A. de Candolle, Prodr. 11 (1847) 682; Miquel, Fl. Ind. Bat. 2 (1858) 858; Bentham & Hooker *f.*, Gen. Pl. 2, 2 (1876) 1154; C.B. Clarke *in* Hooker *f.*, Fl. Brit. Ind. 4 (1885) 583; Gamble, J. As. Soc. Beng. 74, Extra No. (1909) 841; H.J. Lam, Verb. Malay. Arch. (1919) 164; H.J. Lam & Bakhuizen, Bull. Jard. Bot. Buitenz. 3, 3 (1921) 47; Merrill, EB (1921) 513, Enum. Philip. Pl. 3 (1923) 394; Ridley, FMP 2 (1923) 630, *p.p.*; Masamune, EPB (1942) 644; Backer & Bakhuizen *f.*, FJ 2 (1965) 604; Kochummen, TFM 3 (1978) 310; J.A.R. Anderson, CLTS (1980) 345; Moldenke & Moldenke, Rev. Handb. Fl. Ceylon 4 (1983) 348; Munir, J. Adelaide Bot. Gard. 10, 1 (1987) 31; Coode *et al.* (eds.), CLBD (1996) 333; Corner, WSTM 4th. edition 2 (1997) 751; Argent *et al.* (eds.), MNDT-CK 2 (1997) 657; Kessler, Secondary Forest Trees Kalimantan (2000) 197; Beaman & C. Anderson, PMK 5 (2004) 458; Harley *et al. in* Kadereit (ed.), Fam. Gen. Vasc. Pl. 7 (2004) 195; de Kok, Kew Bull. 62 (2007) 587, *ibid.* 63 (2008) 17 (*cf.* for full synonymy).

Trees, *shrubs*, rarely lianas. **Leaves** *palmately compound*, (1–)3–5(–6)-foliolate, decussate; leaflets (when fresh) herbaceous; *blade without conspicuous glands at base*; venation pinnate, usually prominent below and sunken above, short-stalked glands present on both surfaces, *hairs simple*, multicellular; *petioles* round to laterally flattened in cross-section, *not swollen or thickened at either end*. **Inflorescences** terminal or axillary, cymose or paniculate, axis round to flattened in cross-section; bracts leaf-like, persistent; bracteoles triangular, elliptic-linear, often not persistent. **Flowers** bisexual, bilaterally symmetrical;

calyx (0–)4–5-lobed, bell-shaped, rarely 2-lipped, *usually enlarged* (*accrescent*) *in fruit*; *corolla* (4–)5-lobed, *strongly to weakly 2-lipped*, upper lip (1–)2-lobed, lower lip 3-lobed, central lobe the largest, or the lobes more or less equal, apex emarginate to rounded to acute, hairs concentrated at corolla mouth and along centre of lip, usually glabrous inside, *tube funnel-shaped or tubular*, glabrous at base, *not greatly enlarged at throat*; *stamens 4*, *all fertile*, usually equal, exserted, glabrous but usually with hairs at base, inserted at the middle to lower half of corolla tube, anthers with dorsifixed, divergent thecae; ovary globose, apex usually rounded, usually glabrous, sometimes wholly or only the apex covered with glands, *style terminal*, usually straight, seldom with hooked apex, glabrous, stigma bifid, apex acute to acuminate. **Fruits** *drupaceous*, *usually somewhat fleshly*, globose, *not lobed*. **Seeds** 4 (or less by abortion) per fruit.

Distribution. Approximately 250 species, in the Old and New World tropics, few in temperate regions. Seven species occur in Borneo, of which six are recorded in Sabah and Sarawak.

Ecology. In primary or secondary forest and in disturbed areas such as roadsides.

Uses. The wood of *Vitex* species occurring in Borneo is not of commmercial importance because the trees usually do not reach timber size. Locally, however, the timber of *V. pinnata*, *V. quinata* and *V. vestita* is commonly used for construction, making boats and household tools as well as agricultural implements. Other species (e.g., *V. negundo*, *V. pinnata* and *V. trifolia* subsp. *trifolia*) are planted as ornamentals or for their traditional medicinal values (PROSEA 5, 2 (1995) 502; 12, 1 (1999) 479).

Key to *Vitex* species

1. Inflorescences cymose……..2
   Inflorescences paniculate……..3

2. Bracteoles more than 5 mm long, often persistent at least in flowering stage. Leaves glabrous…….**1. V. flava**
   Bracteoles less than 2 mm long, seldom persistent. Leaves glabrous to hairy……...
   ……**4. V. vestita**

3. Second and higher order bracteoles leaf-like and clavate, more than 6 mm long (in some old or poor collections, bracteoles may be absent). Hairs on leaves yellowish when dry……**2. V. pinnata**
   Second and higher order bracteoles scale-like, triangular to linear, less than 5 mm long. Hairs on leaves when present whitish when dry……...4

4. Fruiting calyx flattened, not enclosing the fruit. Trees or treelets (4–)7–30 m tall. Lower leaf surface glabrous with the veins usually covered with appressed hairs……
   ……..**3. V. quinata**
   Fruiting calyx partly enclosing fruit. Treelets or shrubs 1–4(–8) m tall. Lower leaf surface velutinous……5
5. Fruit spherical with a rounded apex and only covered for about half or less by the calyx; glands present on calyx surface. Leaves always with entire margins. Inflorescences paniculate consisting of side cymes in lax clusters…….
   V. trifolia L.

(Latin, *tri* = three, *folia* = leaves; referring to the 3-foliolate leaves)

Sp. Pl. 2 (1753) 638; Schauer *op. cit.* 683; Miquel *op. cit.* (1858) 859; C.B. Clarke *in* Hooker *f. op. cit.* 583; Gamble *op. cit.* 842; H.J. Lam *op. cit.* 180; H.J. Lam & Bakhuizen *op. cit.* 52; Merrill *op. cit.* (1921) 515, *op. cit.* (1923) 397; Ridley *op. cit.* (1923) 630; Masamune *op. cit.* 645; Corner, Gard. Bull. Str. Settl. 10 (1940) 257; Backer & Bakhuizen *f. op. cit.* 604; Kochummen *op. cit.* 311; Moldenke & Moldenke *op. cit.* 378; Munir *op. cit.* (1987) 65; Corner *op. cit.* (1997) 755; de Kok *op. cit.* (2007) 596, *op. cit.* (2008) 32.

Upright treelet or shrub to 4 m tall (elsewhere to 8 m) or prostrate or small erect shrub to 0.6 m tall, sometimes forming dense mats of several meters wide and rooting at the nodes. Leaves 1–3(–6)-foliolate, aromatic when bruised; blades rounded to oblong-elliptic to obovate or obovate-spathulate, central blades 1–12 × 1–4.5 cm, lateral ones 2.4–4.5 × 1–1.5 cm; glabrous above or with only hairs on the veins, velutinous below; lateral veins 9–14 pairs, slightly raised, visible on both surfaces; petioles 0.3–4.5 cm long, round in cross-section, covered with minute curly hairs; petiolules 0–5 cm long. Inflorescences terminal, paniculate, consisting of side cymes in lax clusters, 4–25 cm long, densely covered with appressed hairs; bracts usually leaf-like; bracteoles scale-like, triangular to linear, to 4 mm long, velutinous, usually persistent. Flowers: calyx 2–4 mm diameter, erect, 5-lobed (sometimes not obviously so), clearly to weakly 5-ribbed, accrescent in fruit (sometimes only slightly so), lobes to 1.5 mm long, persistent, velutinous, glands few to many; corolla pale purplish to blue to white, covered outside with appressed hairs, base glabrous, sometimes with sweet smell, tube funnel-shaped, 5.5–8 mm long, white to mauve, 5-lobed, 2-lipped, central lobe of lower lip spathulate, 4.5–7 × 3–4.5 mm, reflexed, (dark) purple to mauve, side lobes 2–4.2 × 2–3 mm, erect, mauve, lobes of upper lip 1.2–2.2 × 1–2 mm, reflexed or erect; stamens inserted halfway on the corolla tube, clearly exceeding the corolla tube and grouped together above the upper part of corolla mouth, filaments 3–10 mm long, equal, glabrous, except for tuft of erect simple multicellular hairs at base, white, anthers *c.* 1 mm long, fawn to black; ovary globose, 1–1.5 mm diameter, glabrous, apex covered with glands, style 7–12 mm long, glabrous, purple, stigma 2-lobed, lobes *c.* 1 mm long, acuminate with a whitish appendices at each lobe. **Fruits**, when dry, broadly obovoid to globose, 3–7 mm diameter, glabrous, smooth, turning first yellow to pink or purplish, then blue-black or dark brown when mature, glaucous; calyx 3.5–6 mm diameter, erect, covering about half of the fruit, glandular.

Two subspecies are recognised which can be distinguished as follows:

Leaves usually with three or more leaflets; lateral veins more than 9 pairs. Upright treelet or shrub to 4 m tall (elsewhere to 8 m tall)……..

V. trifolia L. subsp. **trifolia**

Sp. Pl. 2 (1753) 638; de Kok *op. cit.* (2007) 597, *op. cit.* (2008) 32. Type: *Herb. Linn. 811/7*, India (lectotype LINN). Heterotypic synonyms: *Vitex bicolor* Willd., Enum. Hort. Berol. 2 (1809) 660, Schauer *op. cit.* 683, Miquel *op. cit.* (1858) 830, Hallier *f. op. cit.* 42, *V. trifolia* L. var. *bicolor* (Willd.) Moldenke, Known Geogr. Distrib. Verbenac. edition 2 (1942) 79, Moldenke & Moldenke *op. cit.* 386, *V. negundo* L. var. *bicolor* (Willd.) H.J.Lam *op. cit.* 91, H.J. Lam & Bakhuizen *op. cit.* (1921) 56, Merrill *op. cit.* (1923) 394, Corner *op. cit.* (1940) 258; *V. trifolia* L. var. *trifoliolata* Schauer *op. cit.* 683, H.J. Lam *op. cit.* 182, H.J. Lam & Bakhuizen *op. cit.* 53, *V. agnus-castus* L. var. *trifolia* (L.) Kurz, For Fl. Burma (1877) 270; *V. agnus-castus* L. var. *javanica* Kuntze, Rev. Gen. Pl. (1891) 510; *V. negundo* var. *philippinensis* Moldenke, Phytologia 38 (1978) 308. (For further synonyms, *cf.* de Kok *op. cit.* 2008).

Widespread from tropical E Africa and Afghanistan to India, Bangladesh, Sri Lanka, Myanmar to Thailand, Indo-China, China, Japan, Malaysia, Indonesia,

the Philippines, New Guinea, northern Australia, New Caledonia, Fiji, Polynesia and the Hawaiian Islands. Because of its local use as an ornamental and a medicinal plant, it is also widely cultivated in and outside its natural geographical range. In Sabah and Sarawak widespread and recorded from beach vegetation, inland edge of mangrove swamp and in secondary vegetation, often near stream, at 0–150 m altitude (e.g., *Wong WKM 2586*, *SAN 114988*, *SAN 126807*, *SAN 126977*, *SAN 145653*, *S 17812*, *S 38523* and *S 48714*).

Most leaves with only one leaflet; lateral veins fewer than 9 pairs. Prostrate or small shrub to 0.6 m high……

V. trifolia L. subsp. **litoralis** Steenis

Blumea 8 (1957) 514; de Kok *op. cit.* (2007) 599, *op. cit.* (2008) 32. Type: *Bloembergen 3894*, 22 April 1939, Indonesia, Lesser Sunda Is., Kisar, E of Wonreli (holotype L). Heterotypic synonyms: *Vitex rotundifolia* L. *f.*, Suppl. Pl. (1782) 294, Munir *op. cit.* (1987) 52, Chen & Gilbert, Fl. China 17 (1994) 30; *V. ovata* Thunb. *in* Murray, Syst. Veg. ed. 14 (1784) 578, Corner *op. cit.* (1940) 258, Backer & Bakhuizen *f. op. cit.* 604, *V. agnus-castus* L. var. *ovata* (Thunb.) Kuntze, Rev. Gen. Pl. 2 (1891) 511, *V. trifolia* L. var. *ovata* (Thunb.) Makino, Bot. Mag. Tokyo 17 (1903) 92, Merrill *op. cit.* (1918) 332, *op. cit.* (1921) 515, *op. cit.* (1923) 397, Masamune *op. cit.* 646; *V. trifolia* var. *simplicifolia* Cham., Linnaea 7 (1832) 107, H.J. Lam *op. cit.* 182, Moldenke & Moldenke *op. cit.* 382; *V. repens* Blanco, Fl. Filip. (1837) 513, Merrill *op. cit.* (1918) 332; *V. trifolia* L. var. *ß unifoliolata* Schauer *op. cit.* 683, H.J. Lam *op. cit.* 182, H.J. Lam & Bakhuizen *op. cit.* 53; *V. trifolia* L. var. *repens* Ridl. *op. cit.* (1923) 631.

Widespread and confined to sandy beaches, costal dunes and estuarine sandbars in Sri Lanka, Nicobar Islands, Thailand, Indo-China, SE China, Malaysia, Indonesia, the Philippines, Papua New Guinea, northern Australia and Samoa. In Sabah and Sarawak also widespread but very rarely collected. Recorded in Sabah from Sandakan district (e.g., *SAN 68413* and *SAN 74293*) and in Sarawak from Baram and Kuching districts (e.g., *Beccari PB 1773* and *Hose 267*).

Fruit ellipsoid with truncate apex and almost completely covered by the calyx; glands absent or few on calyx surface. Leaves sometimes with toothed margin. Inflorescences paniculate consisting of side cymes in dense clusters……

V. negundo L.

(Latin version of the Sanskrit word *negundi*, the vernacular name of the species in India)

Sp. Pl. 2 (1753) 638; Miquel *op. cit.* (1858) 860; C.B. Clarke *in* Hooker *f. op. cit.* 583; Gamble *op. cit.* 843; H.J. Lam *op. cit.* 189; H.J. Lam & Bakhuizen *op. cit.* 55; Merrill *op. cit.* (1921) 514, *op. cit.* (1923) 394; Ridley *op. cit.* (1923) 631; Corner *op. cit.* (1940) 257; Masamune *op. cit.* 645; Backer & Bakhuizen *f. op. cit.* 605; Kochummen *op. cit.* 311; J.A.R. Anderson *op. cit.* 345; Moldenke & Moldenke *op. cit.* 373; Corner *op. cit.* (1997) 753; de Kok *op. cit.* (2008) 25. Type: *Linnaeus 811/8*, India (holotype LINN). Heterotypic synonyms: *Vitex chinensis* Mill., Gard. Dict. ed. 8 (1768) 5; *V. incisa* Lam., Encycl. 2 (1786) 612, *V. negundo* var. *incisa* (Lam.) C.B.Clarke *op. cit.* 584; *V. negundo* forma *intermedia* C.P'ei, Mem. Sci. Soc. China 1 (1932) 105, *V. negundo* var. *intermedia* (C.P'ei) Moldenke, Revist. Sudam. Bot. 5 (1937) 2; *V. elmeri* Moldenke, Phytologia 38 (1978) 307. (For further synonymy *cf.* de Kok *op. cit.* 2008).

Treelet or shrub to 4 m high. Leaves 3(–6)-foliolate, aromatic when crushed; blade of central leaflet oblong-elliptic to narrowly elliptic, 3.4–7 × 1.2–1.6 cm, that of lateral leaflets 2.3–5 × 0.8–1.4 cm, base cuneate, margin entire to dentate, apex acuminate; glabrous above or with hairs on the veins only, whitish velutinous below; lateral veins 7–12 pairs; petioles 2.2–3.2 cm long, round in cross-section, covered with minute curly hairs; petiolules 0–6 cm long. Inflorescences paniculate,

terminal, 6–25 cm long, axis angular in cross-section; bracteoles scale-like, linear, to 3 mm long, velutinous, usually persistent. Flowers in dense side clusters on peduncles to 8 mm long, hairs dense, appressed; calyx 1–1.5 mm diameter, erect, clearly 5-ribbed, 5-lobed, lobes 0.5–1 cm long, persistent, velutinous, glands absent to few; corolla white or purple to blue-violet, covered with appressed hairs, also with a few white glands, tube funnel-shaped, 2–3.5 mm long, 5-lobed, 2-lipped, central lobe of lower lip oblong, 1.8–3 × 1.9–2.1 mm, apex rounded and reflexed, margin entire, two well-developed ridges at corolla mouth, blue, side lobes 1.2–1.5 × 1–2 mm, apex round, patent, blue, lobes of upper lip 1.2–1.5 × 1–1.2 mm, fused to about one tenth of their length, apex rounded, reflexed to erect, blue; stamens inserted halfway on the corolla tube, filaments 1.5–4 mm long, slightly to strongly didynamous, pale purple, anthers *c*. 0.8 mm long, pale brown to violet; ovary globose, 0.5–0.8 mm across, glabrous, style 2.5–3 mm long, stigma lobes 0.1–0.5 mm long. Fruits (when dried) ellipsoid, 2.5–4 mm long, 1.8–2 mm diameter, apex truncate, glabrous, smooth; calyx 2–2.5 mm diameter, erect, completely covering the mature fruit.

From eastern tropical Africa and Madagascar (Melagasi) to Iran, Afghanistan, Pakistan, India, Sri Lanka, Myanmar, Thailand, Indo-China, China, Japan, Taiwan, Malaysia, Indonesia and the Philippines. For its traditional medicinal uses, the species has been introduced and become naturalised in at least parts of this range. In Borneo, widespread but rarely collected; known so far by a few collections from secondary forest, along roadsides and villages in Sabah (e.g., *Ranis Kungkai 93*), Sarawak (e.g., *S 59961*, *S 62840*, *S 62885*, *S 63296* and *S 64473*), and Kalimantan (e.g., *Prawiroatmodjo 256*).

Most specimens from Borneo have only a few indentations in the leaves. This is unlike most specimens from mainland Asia (especially China), which can have frequent and substantial indentations in the leaves. These latter forms are sometimes cultivated in botanical gardens and other institutions and are often recognised as *Vitex negundo* var. *incisa* (Lam.) C.B.Clarke.

1. **Vitex flava** Ridl.

(Latin, *flavus* = yellow; referring to the bright yellow corolla)

Bull. Misc. Inform. Kew (1929) 261; de Kok *op. cit.* (2008) 20. **Type:** *Haviland 2025*, 20 Dec. 1892, Borneo, Sarawak, path to Tegora (holotype K Barcode K 000183027; isotype SAR).

Small tree, 5–12 m tall, 30–50 cm diameter. **Bark** smooth, pale brown to dark grey. **Leaves** 3-foliolate; young leaves reddish; blades of central leaflet elliptic, 13.5–17 × 7–10 cm, that of side leaflets 9–14 × 4–7 cm, base cuneate, sometimes oblique, apex acute to acuminate; *glabrous except on the veins*; lateral veins 8–10 pairs, with many glands; petioles 6.5–8 cm long, round to laterally flattened in cross-section, hairs few, brown, erect; petiolules 3–4.2 cm long. **Inflorescences** *axillary cymes*; axis 1.4–2 cm long, flattened in cross-section, hairs few to moderate, appressed, glands many; *bracteoles* elliptic-lanceolate, *to 10 mm long*, glabrous, *often persistent*. **Flowers:** calyx 5-lobed, accrescent in fruit, (pale) green, sparsely hairy, also with many glands, lobes 2.5–4 × 2–2.2 mm, apex acute, erect; *corolla* (bright) *yellow*, covered outside with glands, tube *c*. 5 mm long, 5-lobed, *lobes almost equal*, *c*. 2 × 1.5 mm, apex rounded to acute; stamens inserted in the lower half of corolla tube, filaments *c*. 3 mm long, yellow, anthers *c*. 1.5 mm long, pale yellow to brown; ovary globose, *c*. 1.5 mm diameter, apex rounded, glabrous, covered with glands, style *c*. 5.5 mm long, yellow to white, apex hooked, stigma *c*. 0.8 mm long, apex acuminate with whitish tip. **Fruits** bright

yellow when fresh, when dried globose, 0.7–1.3 cm diameter, apex flattened; calyx lobes *c*. 2.5 mm long, patent.

Vernacular names. Sarawak—*kepapar* or *serang kampong* (Iban).

Distribution. Endemic to Borneo; known only by a few collections from Kapit, Kuching, Lubok Antu and Miri districts in Sarawak (e.g., *S 39425*, *S 40335*, *S 40611*, *S 41338* and *S 78125*).

Ecology. Growing along paths and on ridges in forest at *c*. 500 m altitude, on rich humus or sandy clay soils.

2. **Vitex pinnata** L. Fig. 13, Plate 3C.

(Latin, *pinnatus* = resembling a feather; referring to the "pinnately compound" leaves, as erroneously intepreted by Linnaeus; *cf*. Moldenke & Moldenke *op. cit.* 364)

Sp. Pl. 2 (1753) 638; Kochummen *op. cit.* 311; Moldenke & Moldenke *op. cit.* 361; Coode *et al*. (eds.) *op. cit.* 333; Argent *et al.* (eds.) *op. cit.* 657; Kessler (ed.) *op. cit.* 198; Beaman & C. Anderson *op. cit.* 458; de Kok *op. cit.* (2008) 28. **Homotypic synonyms:** *Vitex pubescens* L. *ex* Vahl, Symb. Bot. 3 (1794) 85, Blume *op. cit.* (1826) 812, Schauer *op. cit.* 685, Miquel *op. cit.* (1858) 861, C.B. Clarke *in* Hooker *f. op. cit.* 585, Gamble *op. cit.* 848, Gibbs, J. Linn. Soc. Bot. 12 (1914) 123, H.J. Lam *op. cit.* 183, H.J. Lam & Bakhuizen *op. cit.* 53, Merrill *op. cit.* (1921) 514, *op. cit.* (1923) 396, Ridley *op. cit.* (1923) 632, Merrill *op. cit.* (1929) 264, Masamune *op. cit.* 645, Backer & Bakhuizen *f. op. cit.* 606, J.A.R. Anderson *op. cit.* 345, Corner *op. cit.* (1997) 754; *V. puberula* Miq., Fl. Ind. Bat., Suppl. 1 (1861) 242, *V. heterophylla* Blume *ex* Miq. var. *β puberula* (Miq.) H.J.Lam *op. cit.* 189, H.J. Lam & Bakhuizen *op. cit.* 55, *V. quinata* (Lour.) F.N.Williams var. *puberula* (H.J.Lam) Moldenke, Phytologia 3 (1951) 489, *V. turczaninowii* Merr. forma *puberula* (H.J.Lam) Moldenke, Phytologia 51 (1982) 163 (*cf.* de Kok *op. cit.* 2008, for further synonyms). **Type:** *Hermanni s.n.*, Sri Lanka 'the Pistacio-vitex' [vol 1: 16, no: 415] (holotype BM). **Heterotypic synonyms:** *Vitex pubescens* Vahl var. *genuina* Hochr., Candollea 5 (1925) 191; *V. pubescens* Vahl *α lilacina* Kuntze *op. cit.* 511; *V. pubescens* Vahl *β bicolor* Kuntze *op. cit.* 511; *V. heterophylla* Blume *ex* Miq. var. *velutina* Koord. & Valeton, Bijdr. Booms. Java 7 (1900) 207, *V. velutina* (Koord. & Valeton) Koord., Exkursionsfl. Java 3 (1912) 137; *V. pubescens* Vahl var. *pantjarensis* Hochr. *op. cit.* 191; *V. pinnata* L. forma *glabrescens* Moldenke, Phytologia 33 (1976) 375. (For further synonyms, *cf.* de Kok *op. cit.* 2008).

Tree to 15(–25) m tall, 10–45 cm diameter; bole to 5 m tall, sometimes fluted. **Bark** white to greyish or light brown, smooth to flaky; slash brownish to pale yellow, becoming green on exposure. **Sapwood** orange-yellow. **Leaves** (1–)3(–5)-foliolate; blades of central leaflet elliptic to narrowly elliptic, (3.5–)8.2–24 × 3–9 cm, that of lateral leaflets 6–15 × 3.4–8.5 cm, base cuneate to oblique, apex emarginate, rounded to acuminate; *hirsute hairs yellow*; lateral veins 10–20 pairs; petioles 0–10 cm long, channelled to rounded in cross-section, hirsute; petiolules 0–4 mm long, channelled. **Inflorescences** *paniculate*, axis 8–20 cm long, square to round in cross-section, hirsute, purple to greyish or brown; *bracteoles leaf-like or club-shaped*, *7–15 × 6–7 mm*, persistent. **Flowers:** calyx 5-lobed, *c*. 4 mm diameter, lobes erect, yellowish to brownish green, hairs appressed, glands few, orange; corolla (pale) violet to (lavender) white or greenish yellow, fragrant, with many orange glands, tube funnel-shaped, 5–6 mm long, 5-lobed, 2-lipped, central lobe of lower lip 4–8 × 4–6.5 mm, apex round, margin entire, patent, deep red to blue or (pale) violet, white, side lobes 2.5–5 × 2.5–4 mm, apex rounded to acute, patent to reflexed, white, violet to pale blue, lobes of upper lip 2.5–3.5 × 2.5–3 mm, fused to *c*. half of its length, apex acute to oblique, erect, white, violet to pale blue; stamens inserted in the lower half of corolla tube, filaments 8–11 mm long,

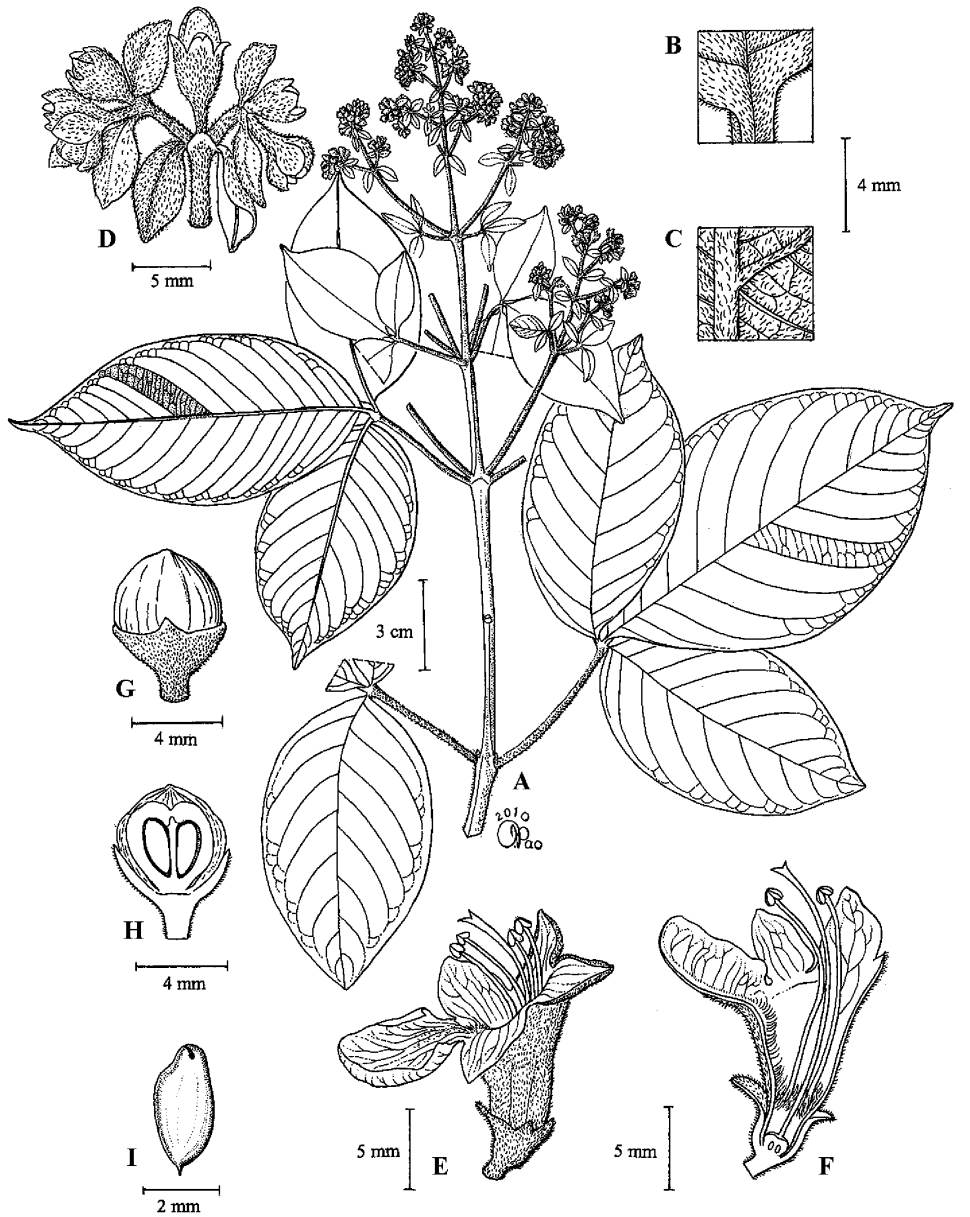

Fig. 13. *Vitex pinnata*. A, flowering leafy twig; B, detail of indumentum of upper leaf surface of leaf base; C, detail of indumentum on lower leaf surface; D, distal part of inflorescence; E, open flowers; F, longitudinal section of open flower; G, fruit; H, longitudinal section of fruit; I, seed. (A–D from *Matus AA 24*, E–F from *Argent et al. S 56664*, G–I from *S 57318*.)

pale green to white, anthers *c.* 1 mm long, violet to black; ovary globose, 1.2–1.5 mm diameter, glabrous, style 11–16 mm long, straight, white, stigma lobes *c*. 1 mm long, pale green to white. **Fruits** globose, when fresh 5–8 cm diameter, smooth, glabrous, purple to black, shiny, juice purple; when dry 4.5–7.5 mm diameter; calyx 7–9 mm diameter, erect to patent.

Vernacular name. Malaysia—*bunyak laban* (Malay).

Distribution. Widespread from India and Sri Lanka to Myanmar, Thailand, Indo-China, Malaysia, Indonesia, Brunei and the Philippines. In Borneo, common and widespread, recorded from various localities in Sabah (e.g., *SAN 26150*, *SAN 88650*, *SAN 131642*, *SAN 138254* and *SAN 148882*), Sarawak (e.g., *S 18944*, *S 24531*, *S 43864*, *S 52954* and *S 74582*), Brunei (e.g., *Niga NN 375*, *Atkins SA 522*, *BRUN 706*, *Simpson DAS 2627* and *Coode MC 7355*) and Kalimantan (e.g., *Sidiyasa PBU 207*, *Burley NGS 494*, *Arifin AA 1032* and *Wilkie 94137*).

Ecology. In primary and secondary forests (including *kerangas*, coastal vegetation and peat swamp forest), on white sandy to clay soils over sandstone, limestone or basalt substrates, at 0–300(–1700) m altitude.

Uses. In Sarawak, the bark is soaked in warm water in order to make a tea for the relief of stomach ache and juice from the leaves is used to treat eyes.

3. **Vitex quinata** (Lour.) F.N.Williams

(Latin, *quinatus* = consisting of 5 parts; referring to the 5-lobed corolla)

Bull. Herb. Boiss. Ser. 2. 5 (1905) 431; Merrill *op. cit.* (1923) 396, Philip. J. Sci. 29 (1926) 395; Masamune *op. cit.* 645; Backer & Bakhuizen *f. op. cit.* 606; Kochummen *op. cit.* 311; Corner *op. cit.* (1997) 755; Argent *et al*. (eds.) *op. cit.* 657; Beaman & C. Anderson *op. cit.* 458; de Kok *op. cit.* (2007) 30, *op. cit.* (2008) 594. **Basionym:** *Cornutia quinata* Lour., Fl. Cochin. (1790) 387. **Type:** *Loureiro s.n.*, [China, Canton] Canto Sinar (holotype P; isotype K Barcode K 000223708). **Heterotypic synonyms:** *Vitex sumatrana* Miq. *op. cit.* (1861) 567; *V. urceolata* C.B.Clarke *in* Hooker *f. op. cit.* 585; *V. heterophylla* Roxb. var. *undulata* C.B.Clarke *in* Hooker *f. op. cit.* 585; *V. celebica* Koord., Meded. Lands Plantent. 19 (1898) 645; *V. padangensis* Hallier *f. op. cit.* 46; *V. heterophylla* Roxb. var. *α genuina* H.J.Lam & Bakhuizen *op. cit.* 55; *V. buddingii* Moldenke, Phytologia 4 (1952) 59; *V. secundiflora* Hallier *f.* var. *longipes* Moldenke, Phytologia 43 (1979) 252. (For further synonyms, *cf.* de Kok *op. cit.* 2007 & *op. cit.* 2008).

Tree 7–30 m tall, 10–50 cm diameter; buttresses, if present, to 1.5 m high and to 1 m out. **Bark** flaky, light to grey-brown; slash straw to cream-yellow. **Sapwood** pale ochre; heartwood yellow to light brown; exudates colourless or ochre, scanty. **Leaves** (1–)3–5-foliolate; blades of central leaflets elliptic to narrowly elliptic, 7–15 × 3–5.6 cm, that of side leaflets 3.8–9 × 1.7–3.7 cm, base cuneate to oblique, margin entire, apex acuminate; *both surfaces glabrous except for the veins*, *which are covered with whitish appressed hairs*, lower surface covered with many orange glands; lateral veins 5–14 pairs, prominent beneath, sunken above; petioles 2–11 cm long, round to laterally flattened in cross-section, glabrous to covered with minute curly hairs; petiolules 1–3 cm long. **Inflorescences** terminal, *paniculate*, 15–27 cm long, axis angular in cross-section, with dense to moderate indumentum of appressed, simple hairs; *bracteoles scale-like*, *triangular to linear*, *to 4 mm long*, velutinous, usually persistent. **Flowers:** calyx 2–3 mm wide, erect, 5-lobed, persistent, accrescent, lobes to 0.8 mm long, outer surface with dense appressed, simple hairs, also

with many orange glands; corolla violet to white, outer surface with appressed hairs, base glabrous, also with a few orange to mauve glands, tube funnel-shaped, 5–6 mm long, 5-lobed, 2-lipped, central lobe of lower lip pale blue with faint nectar guide, spathulate, 2–6 × 2.5–4 mm, patent, apex rounded to acute, margin crenulate, hairs appressed, side lobes 2–3 × 1–3 mm, patent, apex rounded to acute, lobes of upper lip 2–3 × 1.5–2.5 mm, erect, fused to half of its length, apex rounded to oblique; stamens inserted halfway on corolla tube, slightly to clearly exceeding the corolla tube, filaments 4–6 mm long, slightly didynamous, glabrous except for tuft of erect simple or multicellular hairs at base, anthers *c*. 1 mm long; ovary globose, 1–1.2 mm diameter, glabrous, glands absent to few, style 4.5–11 mm long, glabrous, stigma 2-lobed, lobes *c*. 0.1 mm long, apex acuminate. **Fruits**, when dried, obovoid, 6–8 mm long, 4.5–6 mm diameter, smooth, deep purple to black; *calyx* 4.5–6 mm wide, *flattened*, *not enclosing the fruit*.

Vernacular names. Malaysia—*leban tandok* or *leban merbok* (Malay).

Distribution. Widespread ranging from India to Myanmar, Thailand, Indo-China, S China, Malaysia, Indonesia, the Philippines, Papua New Guinea and New Britain. In Borneo, common in Sabah and recorded from most districts (e.g., *SAN 16219*, *SAN 23494*, *SAN 44403*, *SAN 55812*, *SAN 85430* and *SAN 117306*) and in Sarawak from Bau, Belaga, Marudi, Miri and Sibu districts (e.g., *S 2644*, *S 35397*, *S 39830* and *S 91998*). Also recorded from Kalimantan (e.g., *Giesen 95*, *Jacobs 5144*, *bb 10722*, *Kostermans 10566* and *Kostermans 13770*). Not known in Brunei.

Ecology. In primary to secondary forest or more rarely in submontane forest, often in swamps or periodically inundated forest, on stony to sandy or loamy clay soils, sometimes over limestone substrate, at 10–470(–1000) m altitude.

4. **Vitex vestita** Wall. *ex* Walp. Plate 3D.

(Latin, *vestitus* = hidden; referring to the densely hairy veins of the leaf)

Rep. Bot. Syst. 4 (1845) 85; Schauer *op. cit.* 692; Miquel *op. cit.* (1858) 864, *op. cit.* (1861) 568; C.B. Clarke *in* Hooker *f. op. cit.* 587; Gamble *op. cit.* 854; H.J. Lam *op. cit.* 205; H.J. Lam & Bakhuizen *op. cit.* 60; Merrill *op. cit.* (1921) 515; Ridley *op. cit.* (1923) 635; Masamune *op. cit.* 646; Backer & Bakhuizen *f. op. cit.* 605; Kochummen *op. cit.* 313; J.A.R. Anderson *op. cit.* 346; Coode *et al.* (eds.) *op. cit.* 333; Corner *op. cit.* (1997) 756; Argent *et al.* (eds.) *op. cit.* 657; Kessler (ed.) *op. cit.* 198; Beaman & C. Anderson *op. cit.* 458; de Kok *op. cit.* (2008) 33. **Lectotype** (de Kok *op. cit.* 2008)**:** *Wallich Cat*. *1750*, East India, Toong-Dong Avae (K Barcode K 000182557; isolectotype K-W). **Heterotypic synonyms:** *Vitex vestita* forma *winkleri* Moldenke, Phytologia 3 (1951) 489; *V. vestita* forma *glabrescens* Moldenke *op. cit.* (1951) 489.

Small tree or shrub, (2.5–)8–15 m tall, 3–15(–40) cm diameter; rarely a liana. **Bark** smooth to scaly or cracked, (dark) grey to (light) brown; slash light yellowish to (pale) brown, darkening rapidly when cut. **Sapwood** pale white to pale brown. **Leaves** 3-foliolate; young leaves pink; blades of central leaflet elliptic to narrowly elliptic, 8–16.5 × 3.5–6.5 cm, that of side leaflets 3–7(–11) × 1.3–3.2 cm, base rounded to cuneate, margin rarely serrate, apex acuminate; *upper surface glabrous except on the veins*, *lower surface glabrous except for the venation which is hairy*, *sometimes densely so*, the hairs erect, also with many glands on both surfaces; lateral veins 5–10 pairs; petioles 4–7.5 mm long, round in cross-section, velutinous; petiolules 1.5–3.5 cm long. **Inflorescences** *axillary cymes*; axis 0.8–2.2 cm long, flattened in cross-section, hairs few to dense, appressed, glands few; *bracteoles* triangular to linear, *less than 2 mm long*, moderately ciliate, *seldom persistent*. **Flowers:**

calyx bell-shaped, (light) green, 5-lobed, lobes 2.5–5 mm long, apex acute, erect, hairs sparse to dense, erect, glands few; corolla whitish pink to olive-yellow, yellow, or cream at the mouth, outer surface with glands, tube 2.5–6.5 mm long, white, 5-lobed, lobes *c.* 1 × 0.8–1 mm, almost equal, apex acute; stamens inserted in the upper half of corolla tube, filaments 1–3 mm long, yellow, anthers white to grey; ovary globose, 1–1.2 mm diameter, apex acute, glabrous, glands many (sometimes covering the whole apex), style 3.5–6.5 mm long, white, stigma *c*. 2 mm long, pale yellow or white. **Fruits**, when fresh, yellowish green turning to orange or purple and finally black when dry shiny, ellipsoid, 5–6 mm long, 3–4 mm diameter, apex rounded to acute; calyx 3–4 mm diameter, flattened, not enclosing the fruit.

Distribution. From Myanmar, Thailand and Vietnam to Sumatra, Peninsular Malaysia and Borneo. In Sabah common and widespread and recorded from most districts (e.g., *Chew RSNB 524*, *SAN 25003*, *Clemens 29999*, *SAN 31436*, *SAN 50519*, *SAN 67544*, *SAN 96183* and *SAN 124095*) and in Sarawak known from Belaga, Kapit, Kuching, Lawas, Lundu, Marudi, Miri and Tatau districts (e.g., *S 21522*, *S 25177*, *S 34160*, *S 43996* and *S 91370*). Also reported from Brunei (e.g., *BRUN 14*, *SANDS MS 5760*, *Coode MC 6794*, *Prance GTP 30557* and *Wong WKM 1588*) and Kalimantan (e.g., *Hansen 1234*, *Murata B3040*, *Veldkamp 8602*, *Argent 9354* and *Wilkie 94185*).

Ecology. In primary or secondary forest and *kerangas* forest on clay soil overlying sandstone, granite or volcanic bedrock, at 50–500(–3000) m altitude. Sometimes occurring in water-logged areas.

PLATES

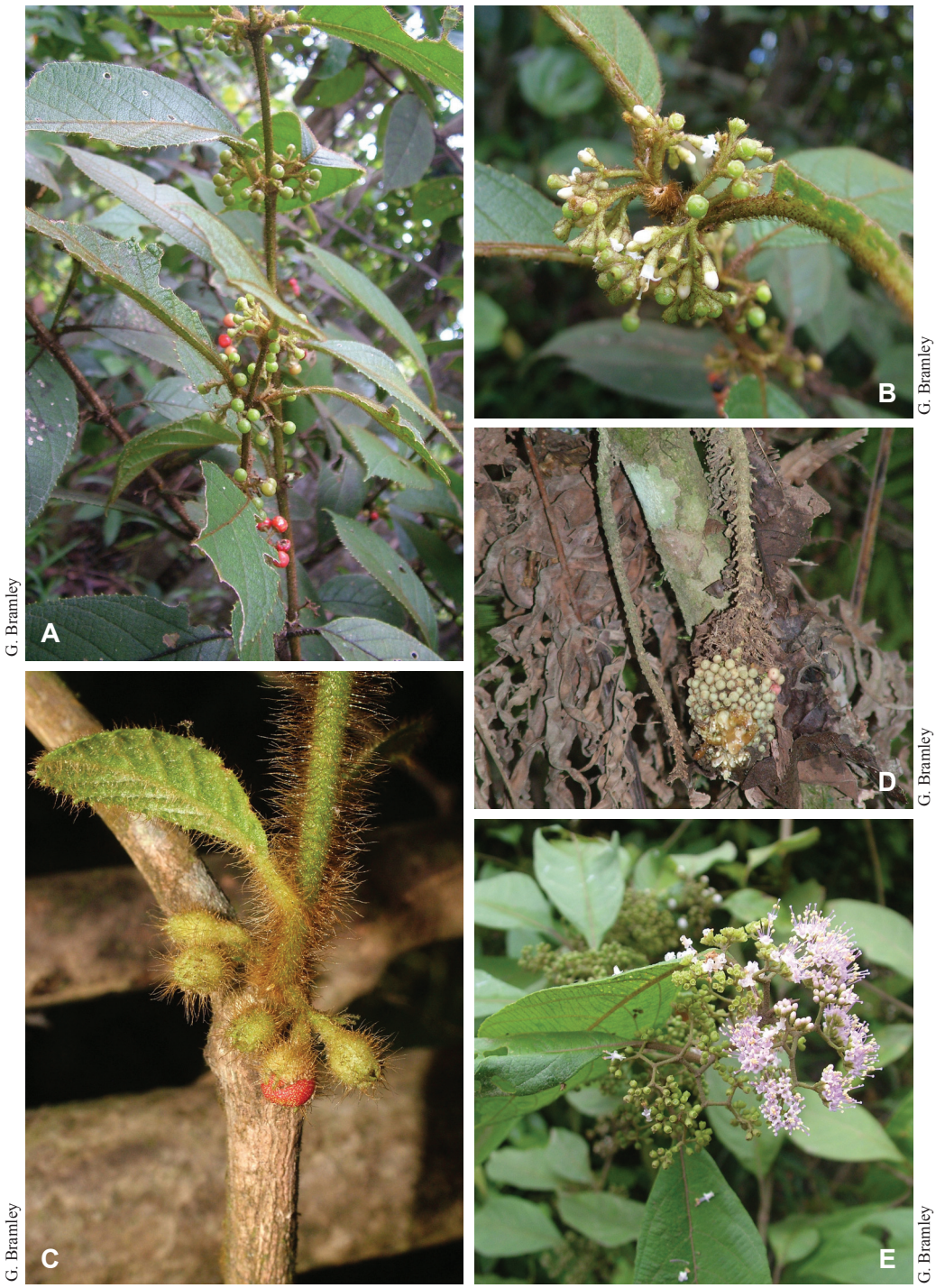

Plate 1. Lamiaceae. A–B, *Callicarpa havilandii*: A leafy twig with young (green) and mature (red) fruits, B leafy twig with open flowers and young fruits; C, *Callicarpa hispida*: hispid hairs on young twig, leaf and flower buds; D, *Callicarpa involucrata*: long-stalked pendent inflorescence; E, *Callicarpa longifolia*: leafy twig with inflorescences bearing flower buds and open flowers.

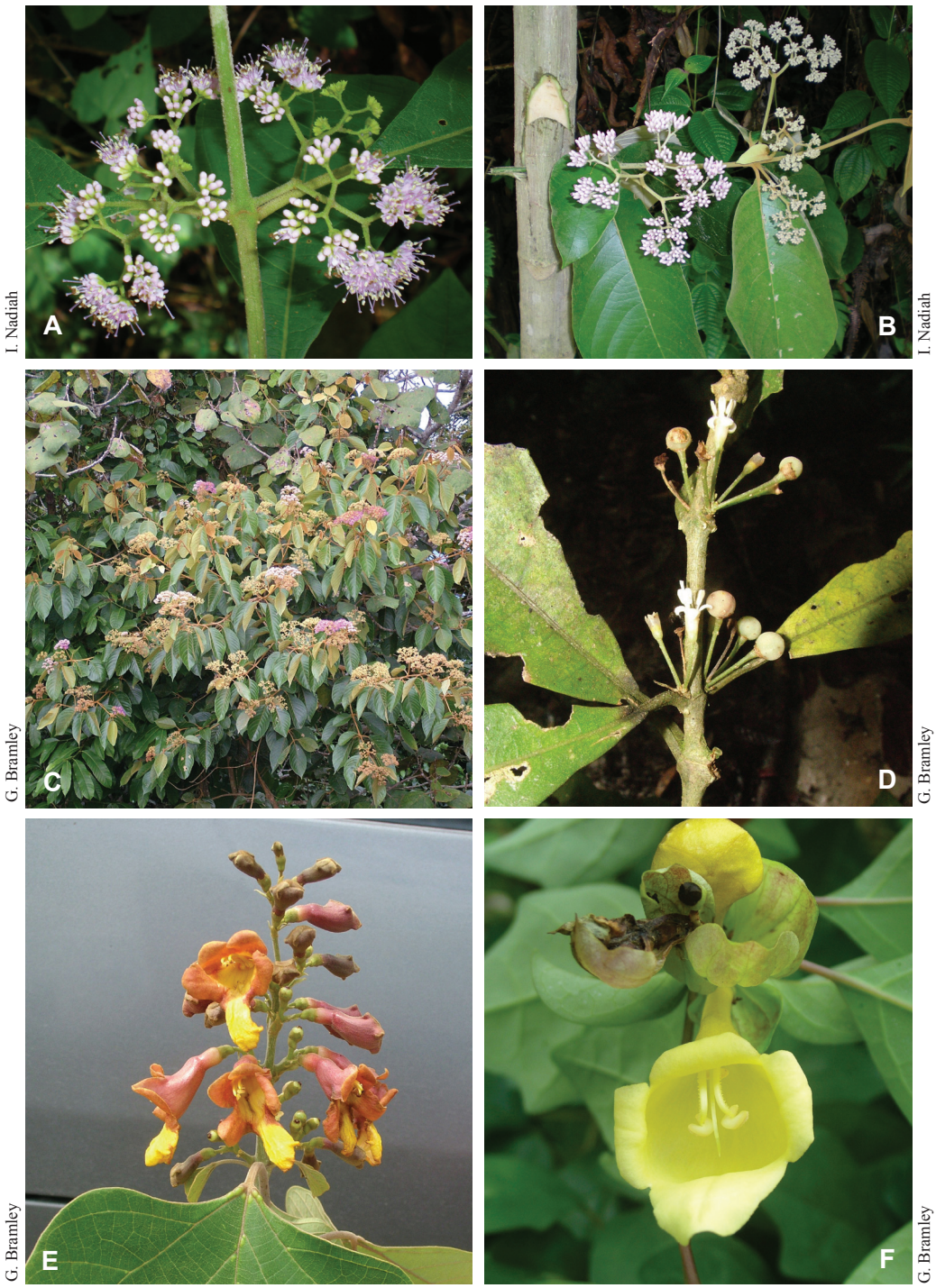

Plate 2. Lamiaceae. A, *Callicarpa longifolia*: inflorescences bearing mature flower buds and open flowers; B–C, *Callicarpa pentandra*: B leafy twig with inflorescences bearing flower buds and open flowers, C habit; D, *Callicarpa stapfii*: leafy twig with axillary open flowers and young fruits; E, *Gmelina arborea*: terminal inflorescence with flower buds and open flowers; F, *Gmelina philippinensis*: frontal view of open flower and fruits.

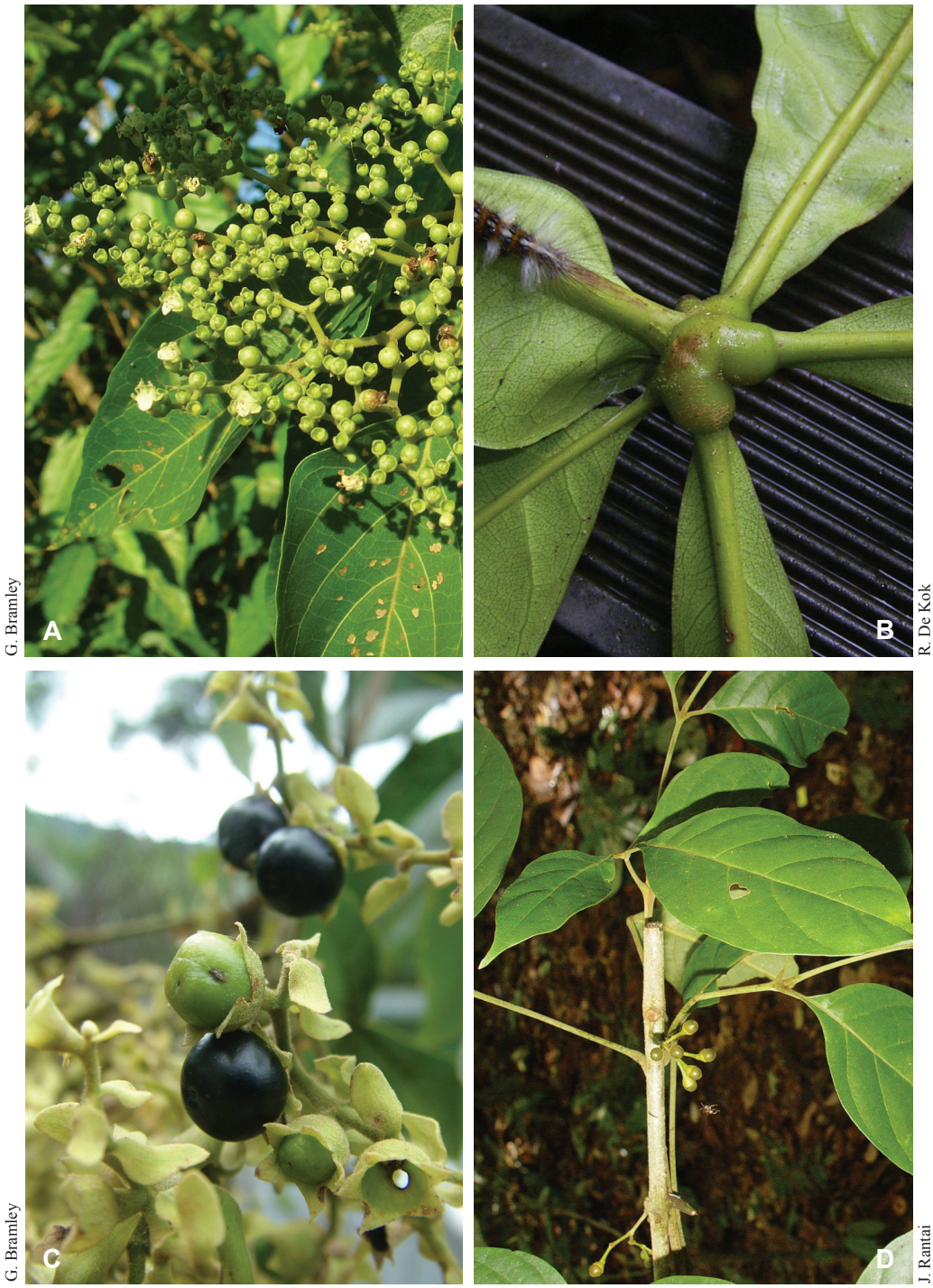

Plate 3. Lamiaceae. A, *Premna serratifolia*: much-branched terminal inflorescence with flower buds and open flowers; B, *Teijsmanniodendron pteropodum*: swollen bases of petiolules; C, *Vitex pinnata*: young (green) and ripe (black) fruits substended by accrescent calyx; D, *Vitex vestita*: leafy twig with axillary cymose infructescence.

The Tree Flora of Sabah and Sarawak is an account of the families of trees that occur in these two botanically rich Malaysian states situated in the island of Borneo. The Flora provides identification keys, illustrations and plates for all families treated and descriptions of all species that grow to significant size, usually taken as at least 10 cm diameter or 5 m high, although in many cases will be found a complete treatment of all species in a group.

The Project is an endeavour jointly undertaken by the Forest Research Institute Malaysia, the Sabah Forestry Department, and the Sarawak Forestry Department.
At least eight volumes are planned to cover the rich Tree Flora of Sabah and Sarawak

ISBN 978-967-5221-44-6
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