

# TREE FLORA of SABAH AND SARAWAK

Volume Two

edited by  
E. Soepadmo, K.M. Wong and L.G. Saw



ITTO  
International Tropical  
Timber Organization



Government of Malaysia

ODA

Overseas Development  
Administration, U.K.

TREE FLORA  
of  
SABAH AND SARAWAK

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**GOVERNMENT OF MALAYSIA**



**ITTO**

**INTERNATIONAL TROPICAL TIMBER ORGANIZATION**

**ODA**

**OVERSEAS DEVELOPMENT ADMINISTRATION, U.K.**

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*A joint publication of*



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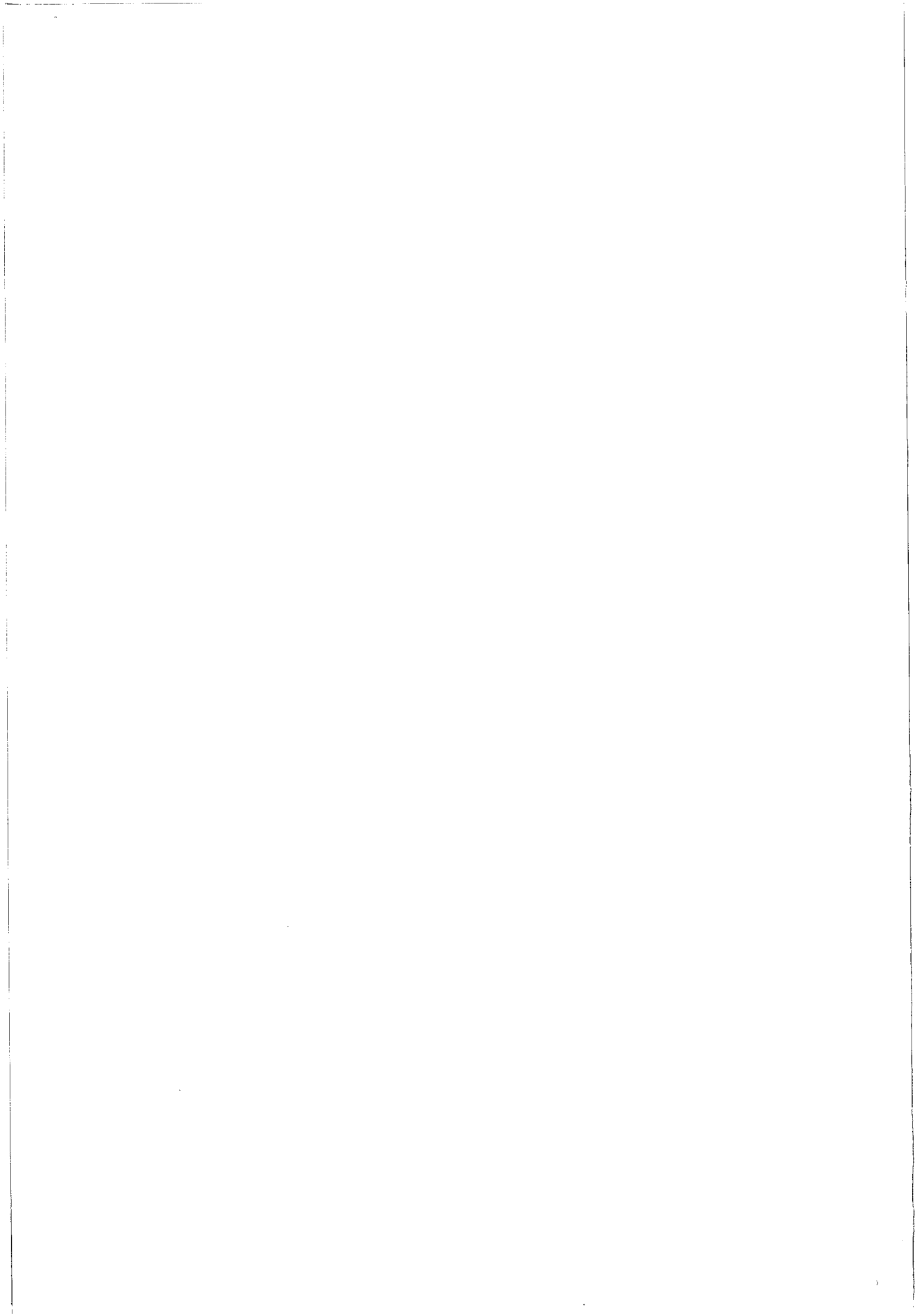
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## FOREWORD

It gives us great pleasure to provide this foreword. The production of the second volume, in just a year after the first, is a noteworthy achievement. This volume, comprising 23 families, covers a range of small and large families. We understand that, as in Volume 1, the revisions are not just mere adaptations from previously revised treatments. This is attested by the discovery of 39 new species during the course of the revisions of the families for this volume. Anacardiaceae (with 19 species) and Loganiaceae (also 19 species) had the most number of new species. Considering that these families have been revised under the Flora Malesiana project, these new discoveries show that continued exploration of the flora of Sabah and Sarawak will reward scientific research. The importance and richness of the flora in Sabah and Sarawak makes it even more important to continue documenting the flora in a systematic fashion.

As we have wished, this volume includes the work of botanists relatively new to taxonomic research. Inasmuch as the project recognises the importance of documenting the tree flora, research and training opportunities are also an integral part of the project. The Overseas Development Administration of the United Kingdom has also continued to support both post-graduate and short-term training, a rather fortunate aspect. Equally important but often not appreciated is the training resulting from the direct interaction between the more senior botanists of the project and the newcomers in producing the revisions.

For a project of such magnitude, funding has always been a major concern to those involved. We are happy to have had the continued financial support of the Malaysian Government through the IRPA (the Intensification of Research by Priority Areas) programme, the Overseas Development Administration (ODA) of United Kingdom, and the International Tropical Timber Organization (ITTO).

We wish to put on record our sincere thanks to these organizations. We also wish to congratulate and thank all contributors of this volume. Finally, our congratulations also to the editors of this volume.

**Dr. Abdul Razak Mohd. Ali**

*Director-General  
Forest Research Institute Malaysia*

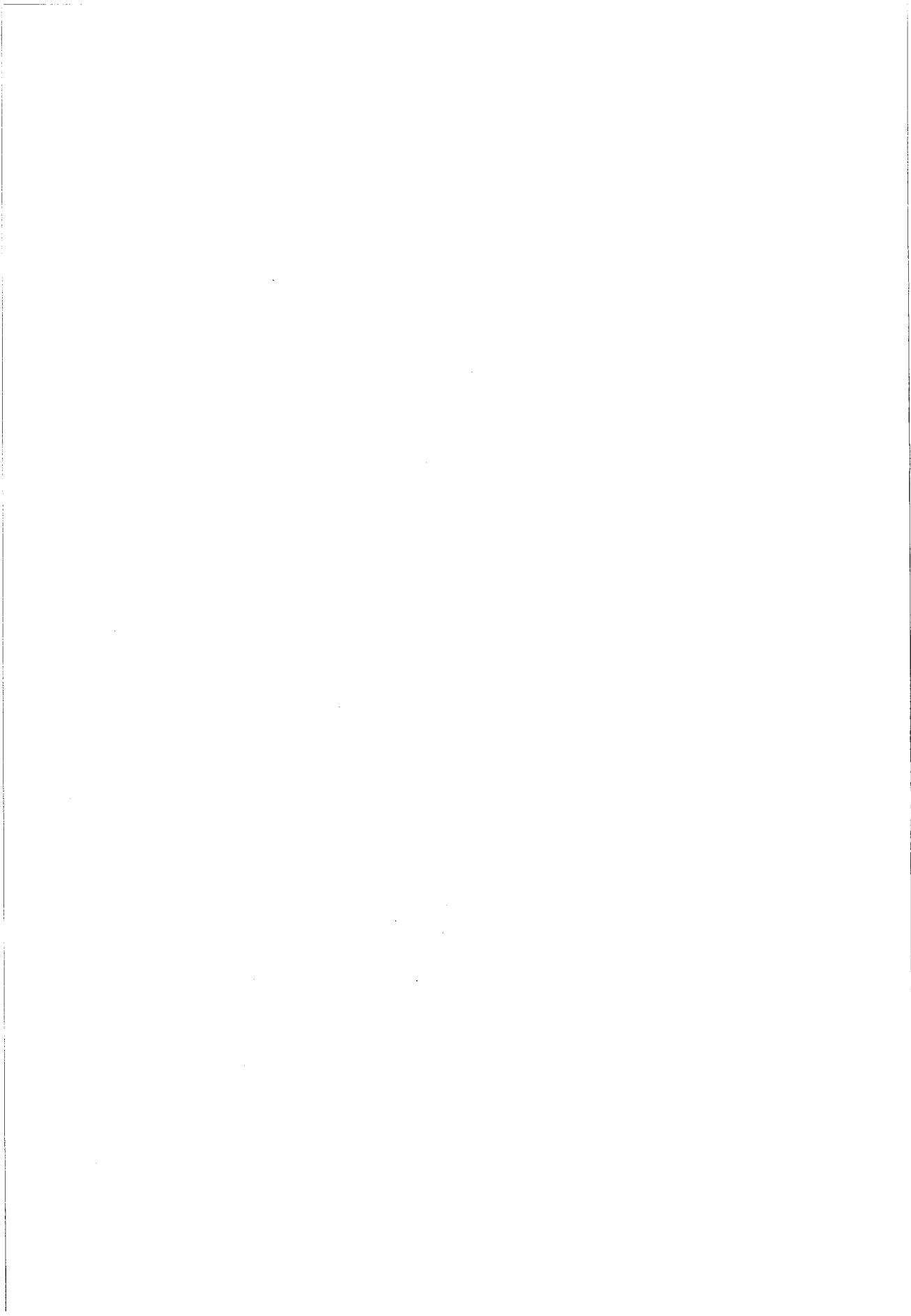
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We would like to record special appreciation of the roles played by Dato' Dr. B.C.Y. Freezailah and Dr. Efransjah (ITTO), as well as Dr. Jeff Burley and Dr. Philip Bacon (Oxford Forestry Institute) in the smooth management of the project. Our collaborating institutions in Malaysia (the Universiti Kebangsaan Malaysia, Universiti Malaya, Universiti Malaysia Sarawak, Universiti Pertanian Malaysia) and overseas (the Royal Botanic Gardens, Kew; the Oxford Forestry Institute; the Rijksherbarium in Leiden; the Herbarium Bogoriense, Indonesia; the Singapore Botanic Garden; the Arnold Arboretum of Harvard University) have continued to give valuable assistance and support.

We have again benefitted from the use of facilities and loans of specimens for study approved by the keepers and curators of the herbaria at the Arnold Arboretum (A), Bogor (BO), the British Museum (BM), Cambridge (CGE), Kew (K), Kepong (KEP), Leiden (L), Sandakan (SAN), Kuching (SAR), Singapore (SING), the Universiti Kebangsaan Malaysia at Bangi (UKMB), the Universiti Malaya (KLU), the Universiti Pertanian Malaysia and the Universiti Malaysia Sarawak. Prof. P.S. Ashton, Prof. C. Kalkman, Dr. J. Dransfield and Dr. T.C. Whitmore kindly gave their time to advise on editorial matters. We are grateful to Prof. Abdul Latiff Mohamad, Prof. Ruth Kiew and Mr. H.S. Lee for their help and cooperation as members of the editorial committee. Many others have provided assistance during visits to their institution by project botanists, including at Kew (Prof. G.T. Prance, its Director; Mr. M.J.E. Coode, Dr. D. Kirkup, Mrs. Diane Bridson, Mr. N. Martland), Leiden (Prof. P. Baas, its Director; Dr. M. Roos, Dr. J.F. Veldkamp, Dr. W.J.J.O. de Wilde, Dr. E.F. de Vogel; Dr. Ding Hou, Dr. P. van Welzen, Dr. M.M.J. van Balgooy, Dr. P. Kessler, Dr. P.W. Leenhouts, Dr. F. Adema, Mrs. Stans Kofman), Harvard (Prof. P.S. Stevens), Oxford (Mr. D. Filer, Prof. D.J. Mabberley), and Singapore (Dr. W.K. Tan, Dr. L. Leong, Dr. S.C. Chin, Mr. E.P. Tay). We are grateful also to the staff of the libraries and photographic units at the British Museum, Kew, Leiden and Singapore for much assistance rendered.

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Illustrators who have assisted in Volume 2 include Ms. Rosemary Wise who has kindly rallied to our help, Ms. Yap Pak Hau, Mr. Mohd. Nizam Isa, Mr. Zainal Mustaffa, Mr. Joseph Pao, Mr. J. Wessendorp and Mr. J.H. van Os. Their work ably accompanies the accounts presented here by the many collaborators who have helped to make this volume possible.

E. Soepadmo  
K.M. Wong  
L.G. Saw

## ANACARDIACEAE

**K.M. Kochummen**

Forest Research Institute Malaysia,  
Kepong, Malaysia

Hooker *f.*, Fl. Br. Ind. 2 (1876) 7; King, J. As. Soc. Beng. 65, 3 (1896) 459; Merrill, EB (1921) 348; Ridley, FMP 1 (1922) 517; Masamune, EPB (1942) 408; Browne, FTSB (1955) 45; Backer & Bakhuizen *f.*, FJ 2 (1965) 146; Smythies, CST (1965) 1; Burgess, TBS (1966) 3; Ding Hou, Blumea 24 (1978) 1, FM 1, 8 (1978) 395; Anderson, CLTS (1980) 134; Wong, DMT (1982) 5; Corner, WSTM 3rd ed. 1 (1988) 106; Kochummen, TFM 4 (1989) 9; Whitmore, Tantra & Sutisna, CLK 1 (1989) 12; Ng, Mal. For. Rec. 34, 1 (1991) 14; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 36.

Trees, erect or scandent shrubs, climbers or very rarely epiphytic shrubs, *usually with acrid, often turpentine smell from crushed living parts*; bole often with buttresses or stilt-roots (in swampy habitats), or without buttresses (*Mangifera*). **Bark** smooth, cracked, fissured, scaly or diphled, *sometimes with blotches of black exudate*; inner bark reddish, pinkish or yellowish, granular or laminated, with black, or white, creamy yellow, pink, brown or colourless watery exudate that soon turns black or brown on drying. **Sapwood** whitish. Twigs slender to stout, glabrous or hairy. *Stipules absent*. **Leaves** simple or imparipinnate, spirally arranged, alternate or opposite (*Bouea*), rarely in pseudowhorls (*Semecarpus* in part), often crowded at the ends of twigs; *leaf or leaflet margins entire; petioles or petiolules often swollen near the base*, sometimes absent or very short. **Inflorescences** terminal, axillary, or extra-axillary panicles; bracts and bracteoles caducous, rarely persistent; pedicels distinct, obscure or absent, *often articulate*. **Flowers** bisexual or unisexual, radially symmetrical, mostly 4- or 5-merous; floral axis between calyx and stamens (torus) often obscure, sometimes distinct and elongated (*Gluta*, *Swintonia*); calyx 5- or 4-lobed, rarely 3-lobed, sometimes calyptriform (hood-like) or splitting irregularly (*Gluta* spp.), caducous or persistent and enlarged in fruit (*Parishia* spp.); petals 5 or 4, imbricate or valvate, rarely contorted in bud, free, sometimes the basal part longitudinally adnate to the floral axis, caducous or persistent and enlarged in fruit (*Gluta* in part, *Swintonia*); *stamens equal or twice the number of calyx lobes or petals*, rarely more to numerous (*Gluta* spp.), inserted on the margin of the disc, or just outside or inside of this margin, or on an enlarged torus (*Gluta* spp.), filaments free or basally connate, glabrous, hairy, or papillose, anthers dorsifixed or basifixed, sometimes dorso-basifixed, longitudinally dehiscent, 2-locular with 4 pollen sacs, usually introrse, connective rarely prolonged, dilated and apically 2-lobed (*Androtium*); *disc usually present and distinct* (obscure or absent in *Gluta* spp.), often fleshy, sometimes thin, round, flat or concave above, pulvinate, rim-like, cup-like or with 5 gland-like lobes (*Swintonia*), rarely cylindrical and stipe-like (some *Mangifera* spp.), often crenulate, emarginate, rarely lobed; ovary free or basally adnate to the disc or receptacle, superior, sometimes partly or wholly immersed in the disc or receptacle and appearing inferior (some species of *Melanochyla*, *Pegia*, and *Semecarpus*), or inferior (*Drimycarpus*), usually sessile, sometimes stipitate (*Gluta*), 1-carpellate and 1-locular, or syncarpous and 2-5(-12)-carpellate and 2-5(-12)-locular, or apocarpous (4-6-carpellate in *Androtium* and *Buchanania*)

or carpels incompletely connate (5-carpellate in *Dracontomelon* and *Koordersiodendron*), usually only one carpel fertile; styles 1-5(-12), distinct or obscure, terminal or eccentric, stigmas 1-5(-12), distinct or obscure; pistillodes small, obscure or absent in male flower; ovule one in each carpel, pendulous. **Fruit** a drupe, sometimes subtended by persistent enlarged calyx lobes (*Parishia*), or enlarged petals (*Gluta* and *Swintonia* spp.), or enlarged fleshy pedicel and receptacle (in *Anacardium* and *Semecarpus*), 1-5(-12)-locular, 1-5(-12)-seeded; epicarp thin, mesocarp usually fleshy and resinous, sometimes waxy and oily, endocarp fibrous, crustaceous, woody or bony. **Seeds** without or with little endosperm, rarely marked with sinuous intricate lines (as in some *Mangifera* spp.); testa membranous or chartaceous, sometimes adnate to the endocarp; embryo straight or curved, cotyledons free, rarely partly or incompletely united (*Gluta* spp.), plano-convex, rarely unequal, radicle short.

**Distribution.** About 70 genera with c. 600 species, distributed mainly in the tropics and subtropics with its highest diversity in the Malesian region. Eighteen genera and 95 species in Sabah and Sarawak.

**Ecology.** Occurring in a variety of habitats, including peat swamp, limestone, riverine, *kerangas*, hill and montane forest, to 2400 m. Most species are found scattered in natural forest. However, certain species, e.g., *Camposperma coriaceum*, are found growing gregariously. The deciduous habit occurs in a number of genera; flowers and new leaves appear together in such species. The flowers possess nectar-bearing organs or discs and are sometimes fragrant. They are evidently pollinated by insects. The fruits are dispersed by animals, water or wind.

**Uses.** Several species belonging to a number of genera are widely cultivated for their edible fruits and nuts. They include the introduced species *Anacardium occidentale* (cashew nut), *Spondias cytherea* (hog-plum), the indigenous *Bouea* spp. (*kundang*) and *Mangifera* spp. (mango).

Important commercial timber trees include species of *Camposperma*, *Dracontomelon*, *Koordersiodendron* and *Swintonia*, the details of which are given under each genus. The heartwood of some species is hard and durable and makes excellent furniture because of the beautiful grain. Some species (although none from Sabah and Sarawak) produce valuable economic products such as lacquers (from the resinous sap of *Gluta laccifera*, *G. usitata* and *Rhus verniciflua*) and tannins (from species of *Schinopsis* and *Rhus*). A number of species are used in traditional medicine.

**Dermatitis.** The sap is irritant in many species and can cause serious allergic contact dermatitis which manifests as redness, swelling, vesiculation and weeping of the affected parts. In most cases, the severe inflammation is controlled by systemic steroids given over a period of a week to 10 days. The intensity of reaction varies with the species and the sensitivity of the individual. The worst irritant exudates are from species of *Drimycarpus*, *Gluta*, *Melanochyla* and *Semecarpus*. In temperate countries poisonous Anacardiaceae are represented by species of *Rhus*, the so-called poison ivies or poison oaks.

**Taxonomy.** Pinnate-leaved members of the Anacardiaceae, i.e. species of *Dracontomelon*, *Koordersiodendron*, *Parishia* and *Pentaspadon*, can be confused with members of the Burseraceae, Meliaceae and Sapindaceae. However, Anacardiaceae species have no stipules

whereas stipules are present in some Burseraceae (*Canarium*, *Garuga*). Technically, Anacardiaceae have a single ovule in each locule of the ovary, whereas Burseraceae have two ovules per locule. From the Meliaceae and Sapindaceae, Anacardiaceae may be distinguished by the resinous nature. Many species of *Aglaia* in the Meliaceae also produce white sap, but in these species stellate hairs are always present on the shoots, a character absent from the Anacardiaceae.

### Key to genera

1. Leaves simple.....2  
Leaves trifoliolate or pinnately compound.....12
2. Leaves opposite.....**2. Bouea**  
Leaves alternate or spirally arranged.....3
3. Carpels free.....4  
Carpels united.....5
4. Anther locules not separate, connective not prolonged.....**3. Buchanania**  
Anther locules separate, connective prolonged and apically bilobed.....**1. Androtium**
5. Ovary inferior. Leaf margin thickened.....**6. Drimycarpus**  
Ovary superior. Leaf margin not thickened.....6
6. Ovary with 3 styles.....**15. Semecarpus**  
Ovary with 1 style.....7
7. Stigmas 3.....8  
Stigma 1.....9
8. Trees. Leaves papillose beneath. Petals velvety hairy inside. Fruits hairy .....  
.....**10. Melanochyla**  
Shrubs. Leaves not papillose beneath. Petals glabrous inside. Fruits glabrous .....  
.....**14. Rhus** (in part)
9. Calyx calyptriform (hood-like) or bursting irregularly at anthesis, without distinct lobes.  
Disc absent. Stamens inserted on the torus (receptacle).....**7. Gluta**  
Calyx not so, with distinct lobes. Disc present. Stamens not inserted on the torus  
.....10
10. Ovary 2-locular. Stamens 6–10, all fertile. Leaves with peltate scales.....  
.....**4. Camptosperma**  
Ovary 1-locular. Stamens 5 (very rarely 10), one to all of them fertile. Leaves without  
peltate scales.....11
11. Petals with glandular ridges inside, caducous. Style often lateral.....**9. Mangifera**  
Petals without glandular ridges inside, persistent in fruit. Style terminal.....**17. Swintonia**

12. Trees or shrubs.....13  
 Woody climbers.....19
13. Inner bark with abundant white sap. Flowers 4-merous. Fruit with long wings.....  
 .....11. **Parishia**  
 Inner bark with scant white latex. Flowers 5-merous. Fruit without wings.....14
14. Stamens or staminodes of the same number as petals.....14. **Rhus** (in part)  
 Stamens or staminodes twice the number of petals.....15
15. Petals valvate.....16. **Solenocarpus** (in part)  
 Petals imbricate at least at the upper parts.....16
16. Ovary 1-locular.....12. **Pentaspadon**  
 Ovary 5-12-locular.....17
17. Leaflets 10-16 pairs, without domatia in the axils of lateral veins.....  
 .....8. **Koordersiodendron**  
 Leaflets usually 3-9 pairs; domatia often present in the axils of lateral veins.....18
18. Leaflet base cuneate, often asymmetric. Ovary 5-12-locular; styles 5-12. Rare trees.....  
 .....13. **Pleiogynium**  
 Leaflet base broadly rounded, symmetric or asymmetric. Ovary 5-locular; styles 5. Very  
 common trees.....5. **Dracontomelon**
19. Stamens of the same number as petals.....14. **Rhus** (in part)  
 Stamens or staminodes twice the number of petals.....20
20. Petals valvate. Leaflets without domatia in the axils of lateral veins.....  
 .....16. **Solenocarpus** (in part)  
 Petals imbricate. Leaflets with domatia in the axils of lateral veins.....  
**Pegia** Colebr.  
 Trans. Linn. Soc. 1, 15 (1827) 364; Ding Hou, FM 1, 8 (1978) 488.  
 Three species; India, Myanmar, Thailand, Laos, Vietnam, China, Borneo.  
 Woody climbers. Leaves alternate, imparipinnate; leaflets 3-4 pairs often with hairy  
 domatia in the axils of lateral veins. Flowers cream; ovary semi-inferior.  
 In Borneo, one species (*P. sarmentosa* (Lecomte) Hand.-Mazz.), recorded from  
 Sabah and Kalimantan only. Lowland to 1500 m.

## 1. ANDROTIIUM Stapf

(Greek, *andros* = male, *otion* = ear-lobe; the stamens furnished with ear-like lobes)

*rengas padang* (Malay)

In Hooker, Icon. Pl. (1903) t. 2763; Merrill, EB (1921) 349; Masamune, EPB (1942) 408; Smythies, CST (1965) 1; Ding Hou, FM 1, 8 (1978) 420; Anderson, CLTS (1980) 134; Kochummen, TFM 4 (1989) 13.

Trees. **Leaves** spirally arranged, simple. **Inflorescences** axillary panicles, hairy. **Flowers** bisexual; calyx 5 (or 4)-lobed; petals 5 (or 4), imbricate, margin sparsely hairy; *stamens* twice the number of petals, anthers basifixed, with 2 separate anther locules, connective prolonged, dilated and apically two-lobed; disc intrastaminal, cup-shaped, crenulate along the margin; ovary superior, subglobose, pilose; carpels 5, free, only one fertile, ovule one per carpel, style obscure, stigma oblique. **Fruit** lentiform.

**Distribution.** Monotypic; Peninsular Malaysia, Borneo.

**Ecology.** Lowland forests including swamps.

### **Androtium astylum** Stapf

Fig. 1.

(Latin, *astylus* = without style; the ovary)

In Hooker *l.c. t.* 2763; Merrill *l.c.* 349; Masamune *l.c.* 408; Ding Hou, FM 1, 8 (1978) 420; Anderson *l.c.* 134; Kochummen *l.c.* 13. **Type:** *Haviland* 2860, Borneo, Sarawak, Kuching (holotype K; isotypes BO, L, SING).

Small tree to 20 m tall, 40 cm diameter. **Bark** chocolate-brown with grey patches, finely cracking; inner bark dark red, laminated. **Sapwood** pinkish. Terminal bud ovoid-ellipsoid, hairy. **Leaves** coriaceous; elliptic, oblong or obovate, 3.5–14 × 2–5.5 cm; base cuneate, margin recurved, apex acute, rarely obtuse or emarginate; midrib raised above, lateral veins 5–13 pairs, visible on both surfaces, intercostal veins reticulate, equally prominent as lateral veins; petioles 0.5–1 cm long. **Flowers** white, in 1–8.5 cm long-hairy panicles. **Fruits** resembling those of *Buchanania*, c. 12 × 15 mm, with slightly depressed apex.

**Distribution.** Peninsular Malaysia, Borneo. Uncommon in Sabah, recorded from Lamag, Pinangah and Sandakan areas; common in Sarawak.

## 2. **BOUEA** Meisn.

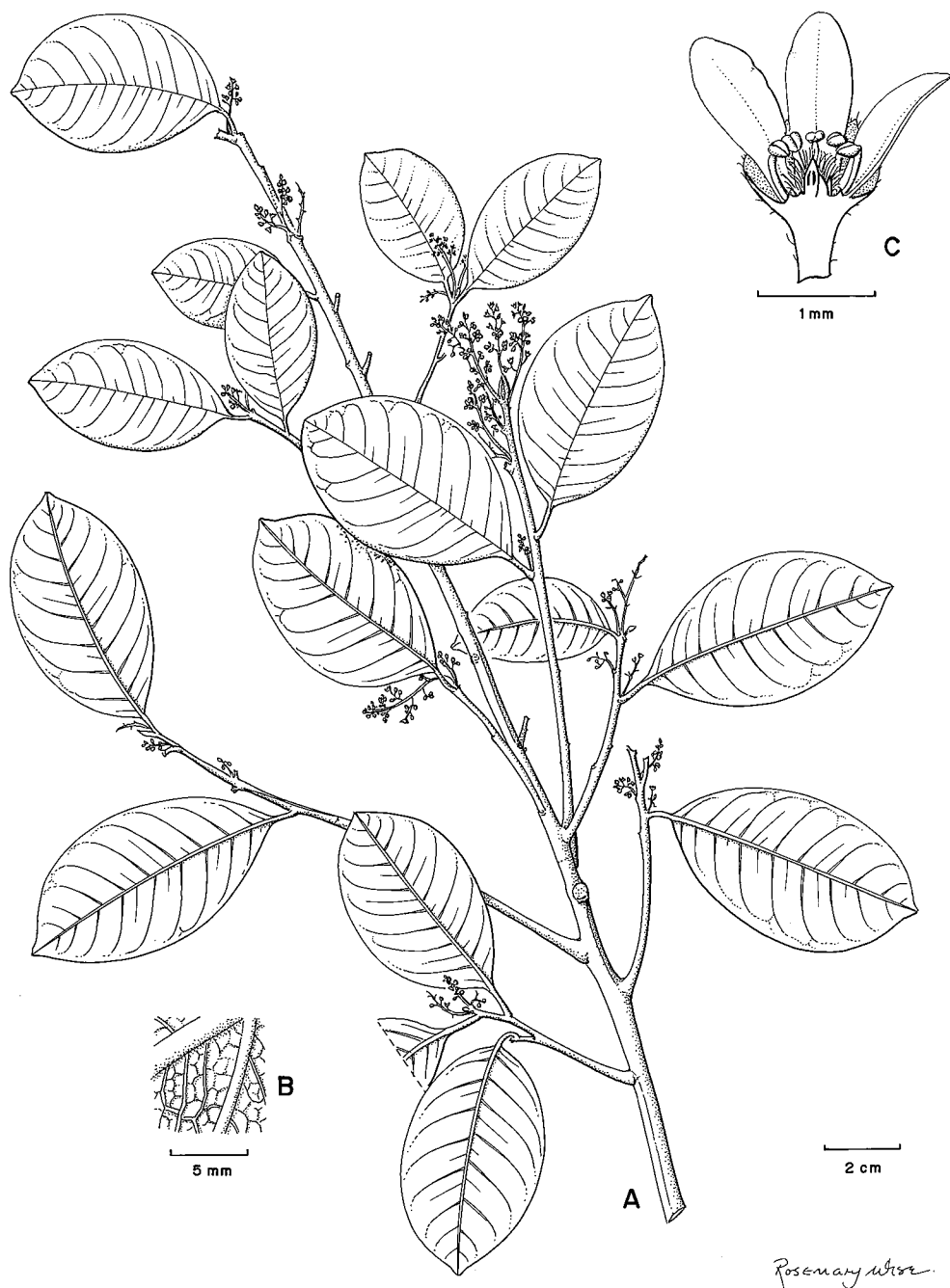
(A. Boue, 1794–1881, German naturalist)

*kundang, kundang rumenia* (Malay)

Pl. Vas. Gen. (1837) Tab. Diagn. 75 & Comment. 55; King, J. As. Soc. Beng. 65, 3 (1896) 465; Merrill, EB (1921) 350; Ridley, FMP 1 (1922) 519; Masamune, EPB (1942) 408; Backer & Backhuizen *f.*, FJ 2 (1965) 150; Ding Hou, Blumea 24 (1978) 4, FM 1, 8 (1978) 466; Anderson, CLTS (1980) 135; Wong, DMT (1982) 112; Corner, WSTM 3rd ed. 1 (1988) 109; Kochummen, TFM 4 (1989) 13; Whitmore, Tantra & Sutisna, CLK 1 (1989) 12; Ng, Mal. For. Rec. 34, 1 (1991) 14; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 37.

Small to medium-sized trees. *Terminal and axillary buds prominent.* **Leaves** opposite-decussate, simple. **Inflorescences** usually axillary panicles. **Flowers** male and bisexual; calyx 3–5-lobed; petals 3–5, imbricate, glabrous, keeled lengthwise; *stamens* 3–5, filaments





**Fig. 1.** *Androtium astylum*. A, flowering leafy twig; B, detail of lower leaf surface; C, flower in longitudinal section. (All from S. 57105.)

subulate, glabrous, anthers basifixed; disc round, flat or slightly concave, glabrous; *ovary superior*; ovoid or subglobose, *1-locular and 1-ovulate*, puberulous or glabrous; style short, stigma rounded and flat; pistillodes minute in male flowers. **Fruits** 1-locular; mesocarp pulpy, edible. **Seeds** with testa adnate to the endocarp; embryo straight, cotyledons free, plano-convex; germination semi-hypogeal.

**Distribution.** Three species; tropical SE Asia and Malesia; one species in Sabah and Sarawak.

**Ecology.** Lowland forest.

**Uses.** The trees have dense bushy crowns and can be recommended for planting as ornamental shade trees. The ripe fruits of *B. oppositifolia* and the cultivated *B. macrophylla* are eaten raw or steamed. The young fruits are sometimes pickled.

**Timber.** The common Malaysian name for the timber is *kundang*. The wood is moderately hard to hard, the sapwood is not differentiated from the heartwood which is light brown with a red tinge or grey-brown, and sometimes a core of dark coloured wood is formed in some trees; the grain is interlocking and texture slightly coarse and even.

**Notes.** In the sterile stage, *Bouea* can be confused with some other genera with opposite leaves such as *Garcinia*, *Mesua* (Clusiaceae) and *Eugenia* (Myrtaceae) but the resinous smell from the crushed fresh leaves distinguishes it.

***Bouea oppositifolia* (Roxb.) Meisn.**

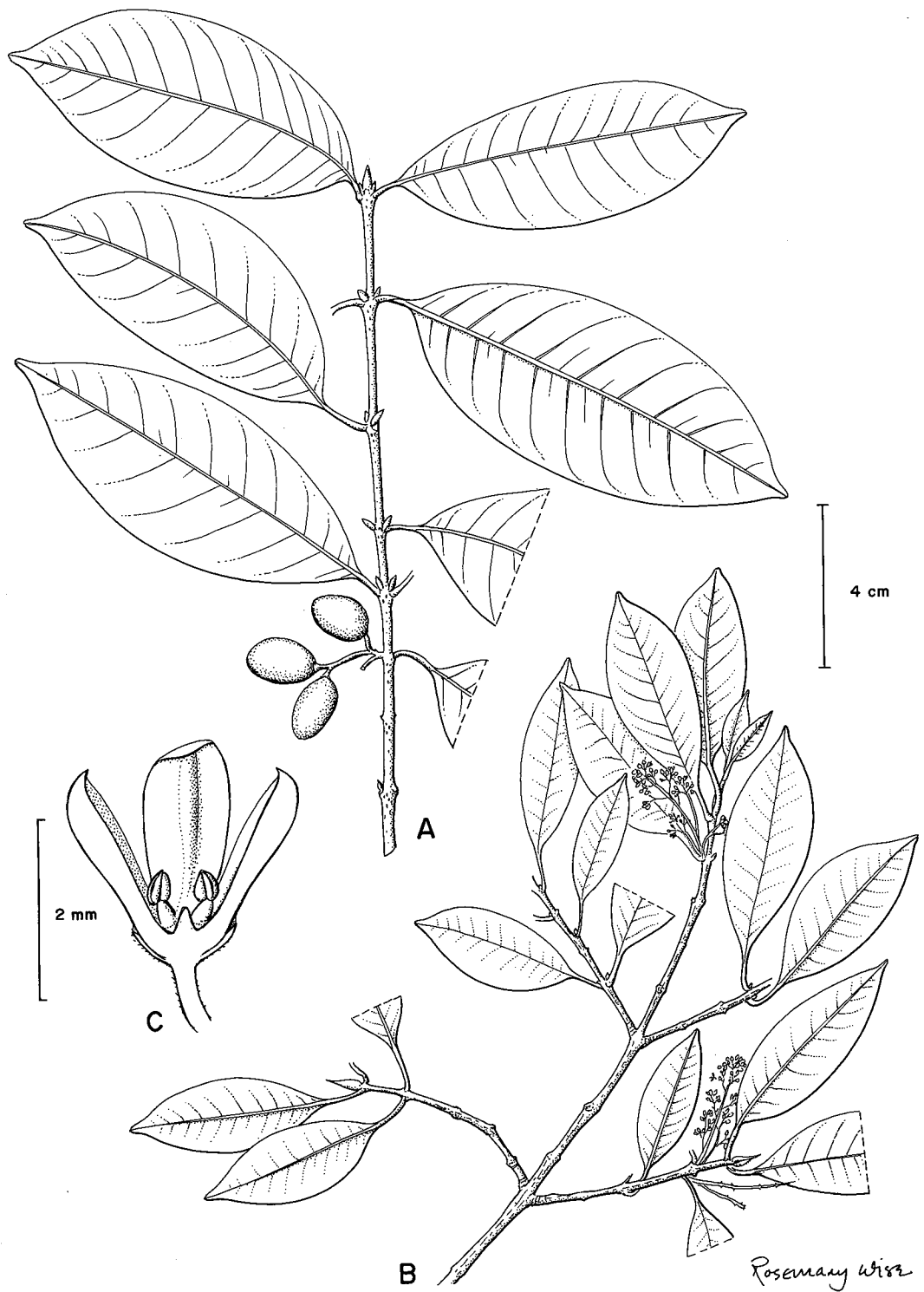
Fig. 2.

(Latin, *oppositus* = opposite, *folius* = leaf; the opposite leaves)

*l.c.* 55; King *l.c.* 465; Ridley *l.c.* 520; Ding Hou, FM 1, 8 (1978) 466; Anderson *l.c.* 135; Corner *l.c.* 110; Kochummen *l.c.* 14; Whitmore, Tantra & Sutisna *l.c.* 12; Kessler & Sidiyasa *l.c.* 37. **Basionym:** *Mangifera oppositifolia* Roxb., Fl. Ind. ed. Wall. 2 (1824) 434. **Type:** Wallich 8490, Burma, Pegu (holotype K). **Synonyms:** *B. angustifolia* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 204, Merrill *l.c.* 350, Masamune *l.c.* 408; *B. microphylla* Griff., J. As. Soc. Beng. 23 (1854) 15, Merrill *l.c.* 350 (as *B. macrophylla*), Masamune *l.c.* 408 (as *B. macrophylla*).

Medium-sized tree to 20 m tall, 30 cm diameter; bole without buttresses. **Bark** dark grey, smooth to cracking to shallowly fissured; *inner bark reddish with dark red latex*. **Sapwood** whitish. Terminal bud ellipsoid, acute. Twigs swollen at the nodes. **Leaves** thick-coriaceous; elliptic to oblong, (1.5–)3.5–10 × (0.8–)1.3–4.4 cm; base broadly cuneate, apex obtuse to rounded; midrib raised above, lateral veins 8–17 pairs, very faint on both surfaces, sometimes impressed beneath, intercostal veins invisible; petioles 0.8–1.7 cm long, narrowly grooved above. **Inflorescences** axillary panicles, 2–6 cm long. **Flowers** white to pale yellow. **Fruits** yellow, red or orange when ripe, broadly ellipsoid, 1.5–1.8 × 0.8–1 cm when dried, stipe *c.* 3 mm long.

**Distribution.** Myanmar, Andaman Islands, Thailand, Laos, Cambodia, Vietnam, S China Peninsular Malaysia, Sumatra, Borneo. In Sabah, recorded from Papar and Tawau districts, while in Sarawak, recorded from Bako National Park and Semengoh Arboretum; also in Brunei and Kalimantan.



**Fig. 2.** *Bouea oppositifolia*. A, fruiting leafy twig; B, flowering leafy twig; C, flower in longitudinal section. (A from SAN 84754, B-C from SAN 78049.)

**Ecology.** Lowland forests including sandy coastal and peat swamp forests. Flowering in February, March and July and fruiting in February and September.

**Uses.** Fruits edible.

### 3. **BUCHANANIA** Spreng.

(F. Buchanan-Hamilton, 1762–1829, Scottish botanist)

*kasat* (Kenyah), *kepala tundang*, *otak udang* (Malay)

In Schrader, J. Bot. 2 (1801) 234; Merrill, EB (1921) 348; Ridley, FMP 1 (1922) 518; Masamune, EPB (1942) 408; Browne, FTSB (1955) 45; Backer & Bakhuizen *f.*, FJ 2 (1965) 147; Burgess, TBS (1966) 4; Ding Hou, Blumea 24 (1978) 4, FM 1, 8 (1978) 412; Anderson, CLTS (1980) 135; Wong, DMT (1982) 5; Corner, WSTM 3rd ed. 1 (1988) 110; Kochummen, TFM 4 (1989) 15; Whitmore, Tantra & Sutisna, CLK 1 (1989) 13; Ng, Mal. For. Rec. 34, 1 (1991) 17; Kessler & Sidiyasa, Trees of Balikpapan-Samarinda Area (1994) 38.

Small to medium-sized trees with dense bushy crowns. **Bark** grey-brown to pale whitish, smooth; inner bark reddish. **Sapwood** pale. **Leaves** *spirally arranged, simple*. **Inflorescences** usually axillary panicles. **Flowers** *bisexual*; calyx usually 5-lobed (rarely 4- or 6-lobed), persistent or caducous; petals usually 5 (rarely 4 or 6), imbricate, glabrous; *stamens twice the number of petals*, anthers basifixed, sagittate (except in *B. splendens*); disc cup-shaped with crenulate upper margin; *ovary superior*, glabrous or hairy, *carpels 4–6, free*, each 1-ovulate, usually only one fertile. **Fruits** 1-locular; endocarp thick, woody or bony. **Seeds** one per fruit; testa free from endocarp; cotyledons free, plano-convex; germination epigeal, cotyledons fleshy, hypocotyle elongate, first two leaves opposite.

**Distribution.** About 25 species; Asia, Malesia, Australia, Micronesia, Melanesia, and Samoa; 4 species in Sabah and Sarawak.

**Ecology.** Mainly in lowland forests including coastal, peat swamp and limestone.

#### Key to *Buchanania* species

1. Leaves sessile or ..... **3. B. sessifolia** (in part)  
Leaves distinctly stalked.....2
2. Pedicels not articulate. Leaf apex usually obtuse or rounded..... **1. B. arborescens**  
Pedicels articulate. Leaf apex acute, acuminate or cuspidate.....3
3. Leaves smaller, 7.5–13 × 2.5–5.5 cm, apex acuminate; lateral veins 8–11 pairs; intercostal veins distinctly reticulate. Petioles 0.5–1.5 cm long. Anthers not sagittate (locules not separate at base)..... **4. B. splendens**  
Leaves larger, (9–)20–35(–45) × (3–)5–8(–10.5) cm, apex acute or cuspidate; lateral veins

- 12 pairs or more; intercostal veins scalariform-reticulate. Petioles absent or 1.5–5.5 cm long. Anthers sagittate (locules separate at base).....4
4. Bud scales inconspicuous. Leaves with short but distinct intermediate veins between lateral veins; lateral veins faint on upper leaf surface; leaf apex cuspidate. Petioles shorter, 1.5–3 cm long, with swollen base. Stamen filament papillose. Fruits obliquely subcordate, with persistent calyx.....**3. B. sessifolia** (in part)  
 Bud scales linear to lanceolate, conspicuous. Leaves without such intermediate veins; lateral veins raised on both surfaces; leaf apex acute. Petioles longer, 2.5–5.5 cm long, without swollen base. Stamen filaments not papillose. Fruits sublentiform (like a doubly convex lens), without persistent calyx.....**2. B. insignis**

**1. *Buchanania arborescens* (Blume) Blume**  
 (Latin, *arbor* = tree; tree-like)

Fig. 3A.

Mus. Bot. Lugd. Bat. 1 (1850) 183; Merrill *l.c.* 348; Masamune *l.c.* 408; Backer & Bakhuizen *f. l.c.* 147; Ding Hou, FM 1, 8 (1978) 415; Burgess *l.c.* 4; Anderson *l.c.* 134; Wong *l.c.* 29; Corner *l.c.* 111; Kochummen *l.c.* 16; Whitmore, Tantra & Sutisna *l.c.* 13; Ng *l.c.* 17. **Basionym:** *Caniogeton arborescens* Blume, Bijdr. Fl. Ned. Ind. (1826) 1156. **Type:** Blume, *s.n.*, Java (holotype L). **Synonyms:** *B. lucida* Blume *l.c.* (1850) 184, Merrill *l.c.* 348, Masamune *l.c.* 409; *B. florida* Schau. var. *lucida* (Blume) Engler in A. DC., Mon. Phan. 4 (1883) 188; *B. glaberrima* Ridl., Kew Bull. (1933) 195, Masamune *l.c.* 409.

Small tree, rarely to 28 m tall, 30 cm diameter. **Bark** grey-brown, smooth; inner bark red or pinkish brown, laminated. **Sapwood** yellowish. **Twigs** dark brown to blackish, with prominent scars of previous flowering. **Bud scales** inconspicuous, lanceolate, glabrous or hairy. **Leaves** generally in clusters, subcoriaceous to coriaceous; elliptic to oblanceolate or obovate, 4–24 × 2–9.5 cm; base cuneate, apex obtuse, rounded, or rarely acute; midrib flattened above, lateral veins 7–12 pairs, faintly visible on both surfaces, intercostal veins reticulate, equally prominent as lateral veins; petioles 1–4 cm long, often flattened. **Flowers** white, glabrous; pedicels not articulate, 2–4 mm long; calyx caducous; stamen filaments glabrous, not papillose, narrowed and whitish towards apex, anthers sagittate. **Fruits** sublentiform, red tinged green, c. 10 mm diameter.

**Distribution.** Myanmar, Andamans, Thailand, Indo-China, China, Formosa, Malesia, Solomon Islands. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 500 m, including beach and limestone forest, often gregarious by riverbanks. Flowering and fruiting throughout the year. When in flower the tree crown is conspicuous with creamy white colour.

**Note.** A very variable species. There are plenty of collections from Sabah with narrowly acute leaves and glabrous inflorescences.

**2. *Buchanania insignis* Blume**  
 (Latin, *insignis* = outstanding, remarkable)

*l.c.* (1850) 184; Merrill *l.c.* 348; Masamune *l.c.* 409; Burgess *l.c.* 5; Ding Hou, FM 1, 8 (1978) 415; Anderson *l.c.* 135; Whitmore, Tantra & Sutisna *l.c.* 13; Kessler & Sidiyasa *l.c.* 38. **Type:** Korthals, *s.n.* (= *L. sheet no.* 897.363–179), Borneo (holotype L; isotype BO).

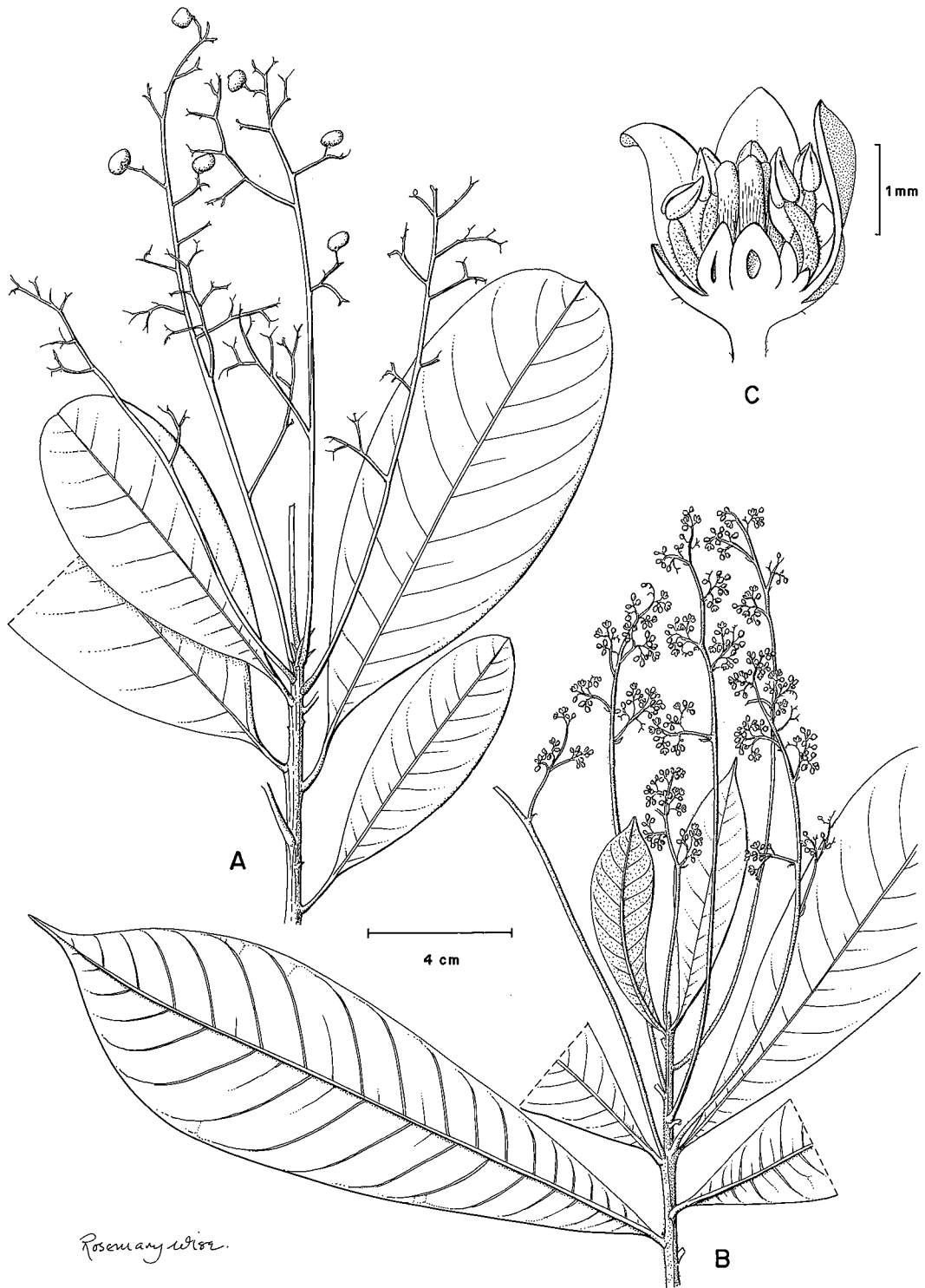


Fig. 3. *Buchanania arborescens* (A); *B. sessifolia* (B–C). A, fruiting leafy twig; B, flowering leafy twig; C, flower in longitudinal section. (A from SAN 93275, B–C from S. 23375.)

Small to medium-sized tree, to 25 m tall, 40 cm diameter. **Bark** grey-white, smooth; inner bark red, laminated. Twigs stout, 8–12 mm thick, angular or irregularly grooved and densely brown short-hairy when young. *Bud scales conspicuous, linear to lanceolate, 10–15 mm long, densely brown-hairy.* **Leaves** slightly hairy on midrib and veins below when young; oblanceolate or narrowly obovate, 24–45 × 5.5–10.5 cm; base attenuate, *apex acute*; midrib raised or flattened above, *lateral veins 20–30 pairs, raised on both surfaces, shorter intermediate lateral veins absent, intercostal veins scalariform-reticulate*, visible on both surfaces; *petioles 2.5–5.5 cm long, without swollen base.* **Inflorescences** 20–36 cm long panicles, with many side branches, yellowish hairy. **Flowers** white; *pedicels distinctly articulate, up to 2 mm long*; calyx lobes broadly ovate with obtuse apices; petals oblong or elliptic; *stamen filaments glabrous, not papillose, upper part narrowed and whitish, anthers sagittate.* **Fruits** sublentiform, *without persistent calyx, 7–10 mm diameter, green with red tinge when ripe.*

**Distribution.** Borneo, Philippines. In Sabah, known from the Lahad Datu, Mostyn and Sandakan districts. Not reported from Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 150 m, including tidal swamps. Flowering in March–May. Young fruits reported in May.

### 3. *Buchanania sessifolia* Blume

Fig. 3B–C.

(Latin, *sessilis* = without stalk, *folium* = leaf; the sessile leaves)

*L.c.* (1850) 184; Merrill *L.c.* (1921) 349, PEB (1929) 166; Ridley *L.c.* 519; Masamune *L.c.* 409; Backer & Bakhuizen *f. L.c.* 48; Burgess *L.c.* 5; Ding Hou, *Blumea* 24 (1978) 5, FM 1, 8 (1978) 418; Anderson *L.c.* 135 (as *B. sessilifolia*); Wong *L.c.* 29; Kochummen *L.c.* 16; Whitmore, Tantra & Sutisna *L.c.* 13; Ng *L.c.* 17; Kessler & Sidiyasa *L.c.* 39. **Lectotype** (Ding Hou, 1978); *Korthals 1034*, Sumatra (L; isolectotype BO).

Small to medium-sized tree, to 20 m tall, 30 cm diameter. **Bark** grey-brown, smooth; inner bark reddish. **Sapwood** pale. Twigs whitish, irregularly grooved, slender, less than 1 cm thick, reddish brown hairy when young. *Bud scales inconspicuous.* **Leaves** glabrous or sparsely reddish brown hairy below; obovate or narrowly oblanceolate, rarely elliptic, very variable in size, 9–35 × 3–10 cm; base attenuate, *apex cuspidate*, acumen *c.* 1 cm long; midrib raised above, lateral veins 12–22 pairs, distinct below, *faint above, with short intermediate veins, intercostal veins scalariform-reticulate*, visible below, faint above; *petioles absent or 1.5–3 cm long, with swollen base.* **Flowers** whitish, hairy; *pedicels articulate; calyx persistent; stamen filaments papillose*, gradually attenuate towards apex, *apical part not whitish, anthers sagittate.* **Fruits** *obliquely subcordate, 10–13 × 8–11 mm, with persistent calyx.*

**Distribution.** Laos, Thailand, Sumatra, Peninsular Malaysia, Borneo. Widely distributed in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 100 m. Flowering from February to November and fruiting from April to December.

**Notes.** Very variable in petiole length and leaf pubescence.

#### 4. *Buchanania splendens* Miq.

(Latin, *splendens* = shining; the leaves)

Fl. Ned. Ind. Suppl. (1861) 524; Ding Hou, FM 1, 8 (1978) 413; Anderson *l.c.* 135; Whitmore, Tantra & Sutisna *l.c.* 13. **Type:** *Teijsmann 3715*, E Sumatra (holotype L; isotype BO). **Synonym:** *B. fragrans* Ridl., Kew Bull. (1933) 195, Masamune *l.c.* 409.

Medium-sized tree to 20 m tall, 25 cm diameter. **Bark** grey-brown, smooth; inner bark reddish. **Sapwood** whitish. **Bud scales inconspicuous**. **Leaves** thick-coriaceous; elliptic or oblong, 7.5–13 × 2.5–5.5 cm; base cuneate, *apex acuminate*; midrib raised above, *lateral veins 8–11 pairs*, raised on both surfaces, *intercostal veins distinctly reticulate*, visible on both surfaces; petioles 0.5–1.5 cm long. **Flowers** white; *pedicels articulate*; calyx caducous, lobes triangular; *anthers not sagittate*. **Fruits** globose, 3–5 mm across.

**Distribution.** Andaman and Nicobar Is., Sumatra, Borneo. Uncommon and of restricted distribution in Sabah and Sarawak, known respectively from the Lahad Datu and Kuching areas only; also in Brunei and Kalimantan.

**Ecology.** Lowland forests. Fruiting in February to May.

#### 4. CAMPNOSPERMA Thwaites

(Greek, *kamptein* = bent, *spermum* = seed; the curved seeds)

*ketang* (Kayan), *nyaletang* (Kenyah), *telatang* (Berawan Murut),  
*terentang* (Malay), *tetang* (Bidayuh)

In Hooker, J. Bot. Kew Misc. 6 (1854) 65; King, J. As. Soc. Beng. 65, 3 (1896) 494; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 533; Masamune, EPB (1942) 409; Browne, FTSB (1955) 46; Smythies, CST (1965) 1; Burgess, TBS (1966) 6; Ding Hou, Blumea 24 (1978) 5, FM 1, 8 (1978) 524; Anderson, CLTS (1980) 135; Wong, DMT 30 (1982) 31; Corner, WSTM 3rd ed. 1 (1988) 111; Kochummen, TFM 4 (1989) 18; Whitmore, Tantra & Sutisna, CLK 1 (1989) 13.

Trees with distinct *Terminalia*-branching; bole either with small buttresses or with stilt-roots and pneumatophores (in swampy habitats). **Leaves spirally arranged, simple**, long- or short-petioled, *usually with minute peltate scales on both surfaces*. **Inflorescences** axillary panicles. **Flowers unisexual** (very rarely bisexual), *calyx 4-lobed*, rarely with 3 or 5 lobes; *petals 4*, rarely 3 or 5, imbricate; *stamens twice the number of petals, epipetalous ones shorter than those alternate with them, all fertile, anthers dorso-basifixed*, sterile in female flowers; disc round and flat in male, cup-like in female flowers; *ovary superior, subglobose, 2-carpellate, style 1, short or obscure, stigma 1*. **Fruits incompletely 2-locular with a vertical, solid or hollow septum**. **Seeds** 1 per fruit; embryo curved, cotyledons free, slightly plano-convex or flat.

**Distribution.** Ten species; South and Central America, Madagascar, Seychelles, SE Asia, Malesia, Micronesia and Melanesia. Three species in Sabah and Sarawak.



**Ecology.** Lowland, including swamp, to lower montane forest to 1100 m. The fruits are eaten by birds. *C. coriaceum* grows gregariously.

**Uses.** The timber is light hardwood, grain shallowly to deeply interlocking, texture fine and even. Sapwood usually not differentiated from heartwood, not durable on contact with ground; susceptible to sapstain and fungal infection. Used for making match boxes and packing cases.

### Key to *Camposperma* species

1. Leaf base without ear-like lobes; petioles 2–5 cm long; midrib sunken above.....  
.....2. ***C. coriaceum***  
Leaf base with distinct ear-like lobes; petioles to 5 mm long; midrib flattened above.....2
2. Leaf apex emarginate.....1. ***C. auriculatum***  
Leaf apex acute or obtuse.....3. ***C. squamatum***

1. ***Camposperma auriculatum*** (Blume) Hook. *f.*  
(Latin, *auriculatus* = with ear-like appendages; the leaf base)

Fig. 4A–B.

Fl. Br. Ind. 1 (1876) 41; King *l.c.* 495; Merrill *l.c.* (1921) 351; Ridley *l.c.* 534 (including var. *wallichii* (King) Ridl.); Masamune *l.c.* 409; Ding Hou, *Blumea* 24 (1978) 5, FM 1, 8 (1978) 529; Smythies *l.c.* 2; Burgess *l.c.* 7; Anderson *l.c.* 235; Wong *l.c.* 31; Corner *l.c.* 112; Kochummen *l.c.* 18; Whitmore, Tantra & Sutisna *l.c.* 13. **Basionym:** *Buchanania auriculata* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 185. **Lectotype** (Ding Hou, 1978); *Korthals* 779, Sumatra (L; isolectotype BO).

Tree to 36 m tall, 100 cm diameter; *crown flat-topped*; bole with spreading buttresses to 3 m tall. **Bark** greyish, shallowly fissured; inner bark pinkish, with creamy exudate. **Sapwood** whitish. Twigs stout, 1–1.5 cm thick, greyish. **Leaves** in close spirals, thick-coriaceous; obovate to oblanceolate, 16–36 × 4.5–14 cm; *base narrowly attenuate with a pair of ear-like lobes (auricles) at the base, apex emarginate; midrib flattened above, lateral veins 18–20 pairs, raised on both surfaces, intercostal veins scalariform-reticulate, faintly visible on both surfaces; petioles obscure or to 5 mm long.* **Flowers** lemon-yellow, in c. 50 cm long panicles. **Fruits** subglobose, 6–8 × 5–6 mm, green when young, becoming dull reddish when ripe.

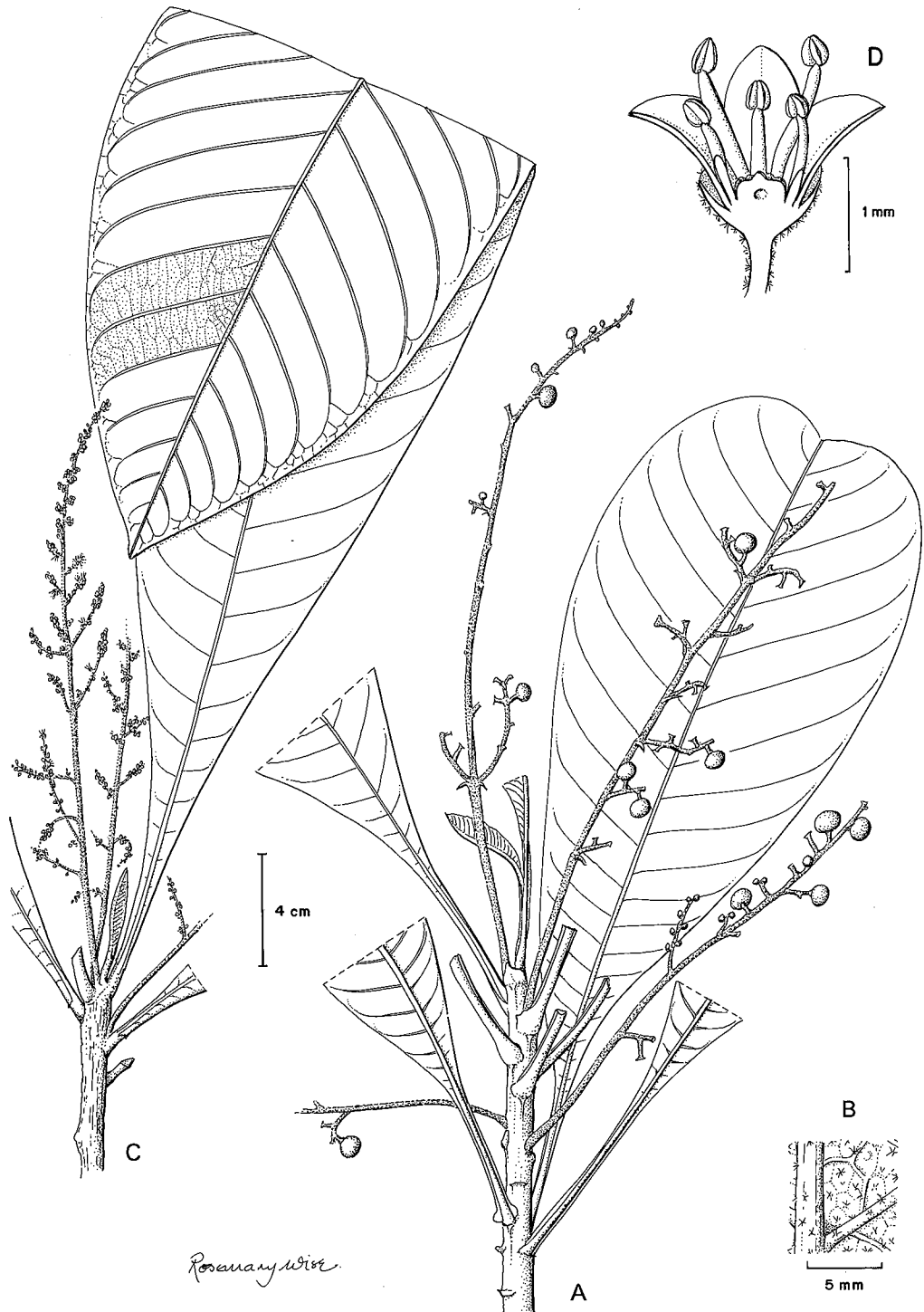
**Vernacular names.** Sabah and Sarawak—*terentang* (Malay).

**Distribution.** Thailand, Sumatra, including Banka island, Peninsular Malaysia, Borneo. Common and widely distributed in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland and hill forests to 1000 m, common near valleys.

2. ***Camposperma coriaceum*** (Jack) Hall. *f. ex* Steenis  
(Latin, *coriaceus* = leathery; the leaf)

Fl. Mal. Bull. 3 (1948) 74; Smythies *l.c.* 3; Burgess *l.c.* 7; Ding Hou, *Blumea* 24 (1978) 5, FM 1, 8 (1978) 530; Anderson *l.c.* 135; Wong *l.c.* 31; Corner *l.c.* 113; Whitmore, Tantra & Sutisna *l.c.* 14; Kochummen *l.c.* 20. **Basionym:** *Coelopyrum coriaceum* Jack, Mal. Misc. 2, 7 (1822) 65. **Type:** *Jack, s.n.*, Sumatra



**Fig. 4.** *Camposperma auriculatum* (A–B); *C. squamatum* (C–D). A, fruiting leafy twig; B, detail of leaf lower surface; C, flowering leafy twig; D, flower in longitudinal section. (A–B from S. 37161, C–D from S. 40511.)

(K). **Synonyms:** *Buchanania macrophylla* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 185; *C. macrophylla* (Blume) Hook. f. *l.c.* 41, Merrill *l.c.* (1921) 351, Masamune *l.c.* 409.

Tree to 36 m tall, 60 cm diameter; *bole with short buttresses, stilt-roots and looped pneumatophores*. **Bark** brown, cracking to fissured and scaly; inner bark reddish. **Sapwood** white. Twigs *c.* 8 mm thick, densely brown short-hairy. **Leaves** densely brown short-hairy below, thick-coriaceous; elliptic, oblong or obovate, 13–36 × 4.5–16 cm; *base attenuate down to petiole, without auricles, apex rounded or emarginate; midrib sunken above, sharply keeled and channelled below, lateral veins 14–32 pairs, raised below, distinct above, intercostal veins scalariform-reticulate, faintly visible on both surfaces; petioles 2–5 cm long, densely yellowish short-hairy*. **Flowers** greenish yellow, in hairy panicles. **Fruits** ovoid, 12–18 × 8–16 mm, shortly pointed, black when ripe.

**Vernacular name.** Sarawak—*terentang paya* (Malay).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Common and widely distributed in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Peat swamp and fresh-water swamp forests, often gregarious.

### 3. *Camnosperma squamatum* Ridl.

Fig. 4C–D.

(Latin, *squamatus* = furnished with scales; the leaf surface)

Kew Bull. (1933) 197; Masamune *l.c.* 409; Smythies *l.c.* 3; Burgess *l.c.* 7; Ding Hou, FM 1, 8 (1978) 532; Anderson *l.c.* 135; Wong *l.c.* 31; Corner *l.c.* 113; Whitmore, Tantra & Sutisna *l.c.* 14; Kochummen *l.c.* 20. **Type:** *Haviland & Hose 3196*, Borneo, Sarawak, Kuching (holotype K; isotype L).

Small to medium-sized tree, to 25 m tall, 55 cm diameter; *bole with short buttresses*. **Bark** yellowish grey, smooth to scaly; inner bark pink with creamy exudate. **Sapwood** whitish. Twigs grey-white. **Leaves** oblanceolate or elliptic, 7–40 × 2–13 cm; *base attenuate and slightly widening towards the end to form ear-like lobes* (sapling leaves very much longer and narrower), *apex acute or obtuse; midrib flattened above, lateral veins 15–25 pairs, hardly distinct from the equally prominent reticulate intercostal veins; petioles to 5 mm long*. **Flowers** greenish yellow, in hairy panicles. **Fruits** subglobose, 12–17 mm diameter, green speckled white when fresh.

**Vernacular name.** Sarawak—*terentang puteh* (Malay).

**Distribution.** Peninsular Malaysia, Borneo. Widely distributed in Sarawak but very uncommon in Sabah, known from two collections, *SAN 51734* from Lamag and *SAN 60174* from the Telupid area; also in Brunei and Kalimantan.

**Ecology.** Lowlands including fresh-water swamp, peat swamp and *kerangas* forests to hill forests to 600 m.

**Notes.** One collection from Sarawak, *S. 24104*, has very large leaves, measuring to 30 cm long and 13.5 cm broad.

## 5. DRACONTOMELON Blume

(Greek, *drakon* = dragon or snake, *melon* = fruit)

*mengkuang, sengkung* (Iban)

Mus. Bot. Lugd. Bat. 1 (1850) 231; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 543; Masamune, EPB (1942) 409; Browne, FTSB (1955) 47; Backer & Bakhuizen *f.*, FJ 2 (1965) 151; Smythies, CST (1965) 5; Burgess, TBS (1966) 9; Ding Hou, Blumea 24 (1978) 6, FM 1, 8 (1978) 468; Anderson, CLTS (1980) 135; Wong, DMT (1982) 51; Corner, WSTM 3rd ed. 1 (1988) 113; Kochummen, TFM 4 (1989) 20; Whitmore, Tantra & Sutisna, CLK 1 (1989) 14; Ng, Mal. For. Rec. 34, 1 (1991) 17; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 39.

Tall trees with spreading buttresses. *Inner bark with scanty white latex. Leaves spirally arranged, pinnately compound with terminal leaflet, lateral leaflets up to 9 pairs; leaflets opposite, subopposite or alternate, often with hairy domatia in the axils of lateral veins, base broadly rounded, symmetric. Inflorescences axillary or terminal panicles. Flowers bisexual; calyx 5-lobed; petals 5, imbricate at the apical parts only, puberulous outside or on both surfaces; stamens 10, those opposite calyx lobes longer, filaments subulate, glabrous, anthers dorsifixed; disc intrastaminal, discoid or cup-shaped, hairy or glabrous; ovary superior, 5-carpellate, 5-locular, hairy to sparsely hairy, carpels free except the basal and apical parts, 1–4 of them abortive, styles 5, connate at the apical part, stigma capitate. Fruits 5-locular or appearing 1-locular due to abortion, each locule with a distinct operculum; endocarp woody, hard. Seeds with testa free from endocarp; embryo straight, cotyledons fleshy, free, plano-convex; germination epigeal.*

**Distribution.** About 8 species, distributed from India to Myanmar, Thailand, Cambodia, China, Malesia, and Fiji. Two species in Sabah and Sarawak.

**Ecology.** Lowland primary and secondary forests, often by streams.

**Uses.** The timber is rather soft and not durable. The coloured heartwood is suitable for making high quality cabinets and other furniture. This is an important export timber from New Guinea. However, the timbers from New Guinea and the Philippines are heavier than those from Sabah and Sarawak. Sometimes *D. dao* is planted for its edible fruits. The rounded bushy crown of *D. dao* is very attractive and so is useful for planting as avenue trees.

### Key to *Dracontomelon* species

Leaflets without domatia; midrib sunken above. Disc glabrous. Fruits globose or broadly ellipsoid, usually 1-locular.....**1. *D. costatum***

Leaflets with hairy domatia; midrib raised above. Disc hairy. Fruits globose, distinctly 5-locular.....**2. *D. dao***

#### 1. *Dracontomelon costatum* Blume

(Latin, *costatus* = ribbed; the strongly veined leaves)

*l.c.* (1850) 232; Merrill *l.c.* (1921) 350, *l.c.* (1929) 168; Masamune *l.c.* 409; Burgess *l.c.* 9; Ding Hou, FM 1, 8 (1978) 473; Whitmore, Tantra & Sutisna *l.c.* 14. **Type:** *Korthals 1836*, Borneo, Martapura (holotype L; isotype BO).

Tree to 30 m tall, 65 cm diameter; bole with tall buttresses. **Bark** cracking. **Leaves** with 4–7 pairs of leaflets. *Leaflets* elliptic to oblong, 7–22 × 4–8 cm, *without domatia*; base almost rounded, apex acute; *midrib sunken above*, lateral veins 7–11 pairs, raised below, faint above, intercostal veins scalariform-reticulate, visible on both surfaces; petiolules to 0.5 cm long. **Flowers** pale yellow, in 70 cm long hairy panicles; *disc glabrous*. **Fruits** ovoid or broadly ellipsoid, c. 2 × 1.5 cm, black when ripe, usually 1-locular.

**Distribution.** Sumatra, Borneo. Widely distributed in Sabah but nowhere abundant, not yet reported from Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forests.

## 2. *Dracontomelon dao* (Blanco) Merr. & Rolfe (from a Philippine plant name – *dao*)

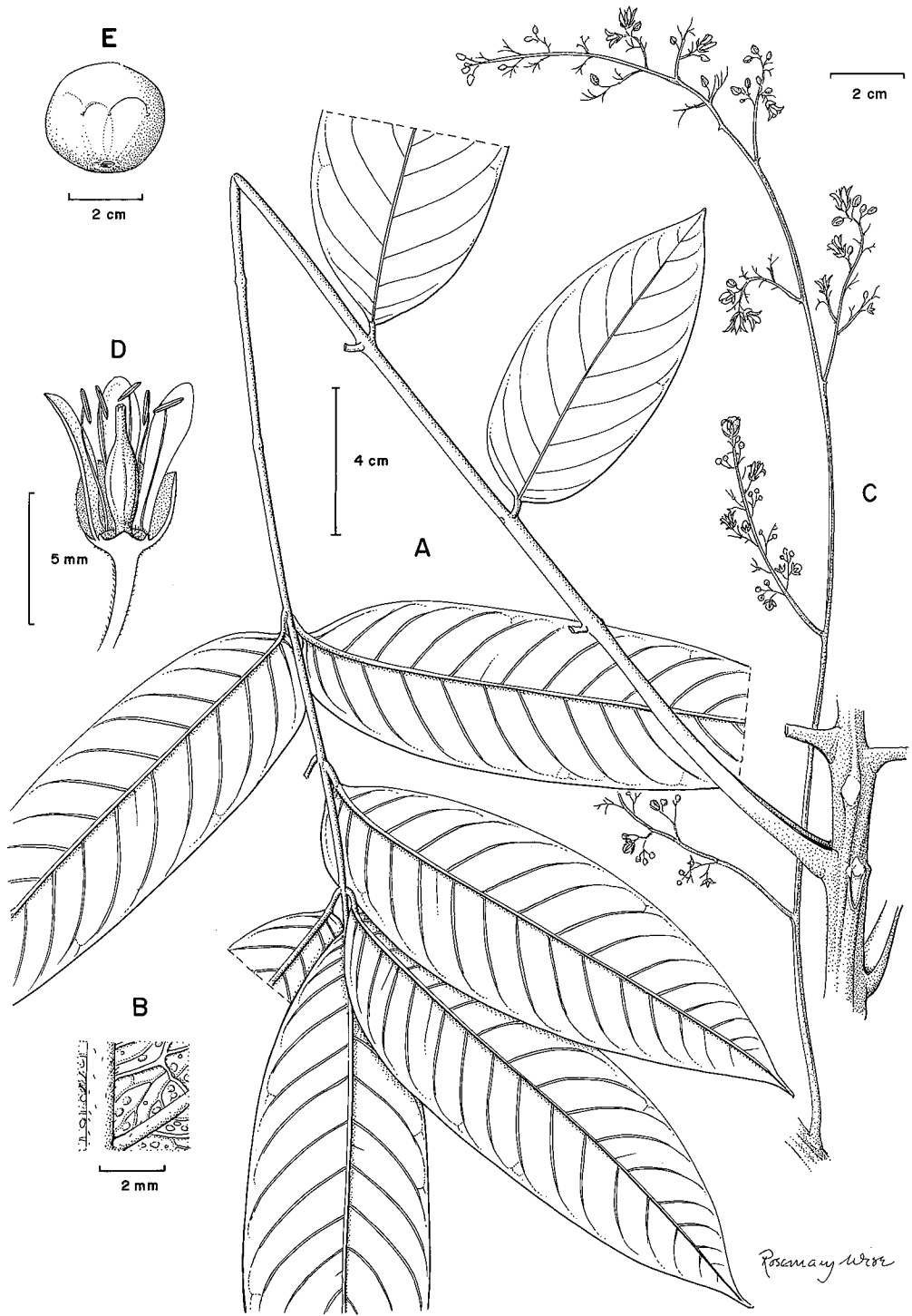
Fig. 5.

Philip. J. Sc. 3 (1908) Bot. 108; Merrill, Spec. Blanc. (1918) 234; Ding Hou, Blumea 24 (1978) 6, FM 1, 8 (1978) 470; Anderson *l.c.* 136; Corner *l.c.* 113; Kochummen *l.c.* 20; Whitmore, Tantra & Sutisna *l.c.* 14; Ng *l.c.* 17; Kessler & Sidiyasa *l.c.* 39. **Basionym:** *Paliurus dao* Blanco, Fl. Filip. (1837) 174. **Type:** Merrill Spec. Blanc. 316, Philippines, Mindanao, Butuan Subprovince (L). **Synonyms:** *Paliurus edulis* Blanco, Fl. Filip. (1837) 173; *D. edulis* (Blanco) Skeels, US Dept. Agric. Bur. Pl. Ind. Bull. 261 (1912) 52, Masamune *l.c.* 410; *D. edule* (Blanco) Merr., Philip. J. Sc. 10 (1915) Bot. 33; *D. mangiferum* Blume *l.c.* (1850) 231, Merrill *l.c.* (1921) 351, Masamune *l.c.* 410; *D. sylvestre* Blume *l.c.* (1850) 231, Merrill *l.c.* (1921) 351, Masamune *l.c.* 410; *D. brachyphyllum* Ridl., Kew Bull. (1933) 202, Masamune *l.c.* 409.

Tree to 40 m tall, 100 cm diameter; bole with steep buttresses to 4 m high. **Bark** grey-brown, smooth to scaly; inner bark pink. **Sapwood** white. Twigs grey-brown or grey-white, 0.5–2.5 cm thick. **Leaves** clustered towards ends of twigs, each with 5–9 pairs of subopposite or alternate leaflets, rachis densely brown short-hairy or glabrous; petioles sometimes flattened or channelled above with sharp edges. *Leaflets* glabrous or sparsely hairy below, *with hairy domatia in the axils of lateral veins*; elliptic, oblong or ovate, 5–22 × 2.5–8 cm; base cuneate or rounded, often unequal, apex acute with distinct tip; *midrib raised above*, lateral veins 6–20 pairs, curving and joining near margin, raised on both surfaces, intercostal veins scalariform-reticulate, visible below, faint above; petiolules 3 mm long. **Flowers** white, in 50 cm long hairy panicles; *disc hairy*. **Fruits** globose, *distinctly 5-locular*, to 3 cm across, smooth or irregularly angular, edible.

**Distribution.** Eastern India, Andamans, Myanmar, Thailand, Cambodia, China, Malesia and Solomon Islands. Common and widely distributed in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowlands to 200 m, common by streams. Seeds germinate within 28–67 days. The first 2 leaves opposite, trifoliate, subsequent leaves pinnately compound, leaflets in early stage with dentate margins.



**Fig. 5.** *Dracontomelon dao*. A, leaf; B, detail of lower leaflet surface; C, inflorescence; D, flower with few sepals, petals and stamens removed; E, fruit. (A, B and E from S. 35022, C-D from SAN 89946.)

## 6. DRIMYCARPUS Hook. f.

(Greek, *drimus* = pungent, *karpos* = fruit)

In Bentham & Hooker, Gen. Pl. 1 (1862) 424; Ding Hou, Blumea 24 (1978) 6, FM 1, 8 (1978) 520; Kochummen, TFM 4 (1989) 21; Whitmore, Tantra & Sutisna, CLK 1 (1989) 14.

Trees. **Leaves** spirally arranged, simple, margins thickened. **Inflorescences** axillary and/or terminal panicles. **Flowers** unisexual (very rarely bisexual); *calyx* 5- or 4-lobed; *petals* 5 or 4, imbricate, glabrous except for the sparsely hairy margins; *stamen* 5 or 4, *anthers* dorsifixed, imperfect or aborted in female flowers; *disc intrastaminal*, slightly concave, 5 or 4-notched; *ovary inferior*, abortive and rudimentary in male flower, 1-locular, 1-ovulate; style short, cylindrical, *stigmas* 3, capitate. **Fruits** 1-locular, crowned by persistent calyx. **Seeds** with testa adnate to the endocarp; cotyledons free, plano-concave.

**Distribution.** Three species; India, Sikkim, Bhutan, Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo; two species in Sabah and Sarawak.

**Ecology.** Lowland and hill forests to 1000 m.

### Key to *Drimycarpus* species

Leaves thin-coriaceous; intercostal veins faintly visible on both surfaces. Twigs terete, slender  
.....1. *D. luridus*

Leaves thick-coriaceous; intercostal veins visible below, very faint to inconspicuous above.  
Twigs angular with sharp edges.....2. *D. maximus*

#### 1. *Drimycarpus luridus* (Hook. f.) Ding Hou

Fig. 6B–E.

(Latin, *luridus* = dingy brown; perhaps referring to the patches on the twigs)

Blumea 24 (1978) 6, FM 1, 8 (1978) 520; Kochummen *l.c.* 21; Whitmore, Tantra & Sutisna *l.c.* 14.  
**Basionym:** *Semecarpus lurida* Hook. f., Fl. Br. Ind. 2 (1876) 34. **Type:** Maingay 495, Malacca (K).  
**Synonym:** *Swintonia lurida* (Hook. f.) King, J. As. Soc. Beng. 65, 3 (1896) 491.

Medium-sized tree to 27 m tall, 40 cm diameter. **Bark** grey-brown, smooth; inner bark brown turning purplish on exposure. **Twigs** terete, slender, dark brown with grey patches. **Leaves** thin-coriaceous; elliptic, oblong or oblanceolate, 8–36.5 × 2–10 cm; base cuneate, sometimes asymmetric, apex acuminate, acumen *c.* 1 cm long; midrib raised above, lateral veins 10–22 pairs, with short intermediate veins, faintly visible on both surfaces, *intercostal veins* reticulate, faintly visible on both surfaces; petioles 1.5–4 cm long, lower half slightly swollen, rugose on drying. **Inflorescences** axillary, 2–11 cm long; male flowers with distinct pedicels, bisexual flowers sessile. **Fruits** transversely oblong, 8–12 × 10–20 mm.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Very uncommon in Sabah, recorded from Kinabatangan, Kudat and Sandakan districts, and of very restricted distribution in Sarawak, known from Anap and Ulu Belaga only; also in Brunei and Kalimantan.

**Ecology.** Lowland to hill forest, at 60–1000 m.



**Fig. 6.** *Drimycarpus luridus* (B–E); *D. maximus* (A). A and B, fruiting leafy twigs; C, flowering leafy twig; D, male flower in longitudinal section; E, female flower in longitudinal section. (A from S. 43483, B from S. 22107, C from SAN 4750, D–E after FM 1, 8 (1978) 519, f. 56 b and e.)



## 2. *Drimycarpus maximus* Kochummen

Fig. 6A.

(Latin, *maximus* = greatest; the large leaves and fruits)

Sandakania 7 (1996) 81. **Type:** *Othman et al. S. 43483*, Borneo, Sarawak, Ulu Sg. Belaga, 7th Division (holotype KEP; isotypes K, L, MO, SAN, SAR).

Medium-sized tree to 23 m tall, 30 cm diameter. **Bark** grey, smooth. *Twigs* brownish, *angular with sharp edges*. **Leaves** *thick-coriaceous*; oblanceolate, 34–35.5 × 8.5–10 cm; base cuneate to attenuate, apex acuminate, acumen *c.* 1 cm long; midrib raised above, strongly keeled below, lateral veins 22–25 pairs, raised below, almost invisible above, with short intermediate veins, *intercostal veins* reticulate, *visible below, very faint to inconspicuous above*; petioles stout, *c.* 3.5 cm long, strongly rugose on drying. **Flowers** unknown. **Infructescens** axillary, 2–3 cm long. **Fruits** transversely oblong, *c.* 2 × 1.2 cm; stalks *c.* 0.7 cm long.

**Distribution.** Endemic to Borneo; so far known only from the type specimen from Sarawak.

**Ecology.** Ridge mixed dipterocarp forest.

## 7. GLUTA L.

(Latin, *gluten* = viscous; the exudate)

*rengas* (Malay)

Mant. 2 (1771) 293; King, J. As. Soc. Beng. 65, 3 (1896) 480; Merrill, EB (1921) 349; Ridley, FMP 1 (1922) 526; Masamune, EPB (1942) 410; Browne, FTSB (1955) 48; Burgess, TBS (1966) 12; Backer & Bakhuizen *f.*, FJ 2 (1965) 150; Ding Hou, Blumea 24 (1978) 8, FM 1, 8 (1978) 446; Anderson, CLTS (1980) 134; Wong, DMT (1982) 70; Corner, WSTM 3rd ed. 1 (1988) 127; Kochummen, TFM 4 (1989) 22; Whitmore, Tantra & Sutisna, CLK 1 (1989) 14; Ng, Mal. For. Rec. 34, 1 (1991) 18; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 40. **Synonym:** *Melanorrhoea* Wall., Pl. As. Rar. 1 (1829) 9, Merrill *l.c.* (1921) 350, Masamune *l.c.* 411, Anderson *l.c.* 137.

Small, medium-sized or large trees, rarely shrubs; bole with buttresses, rarely with stilt-roots (in swampy habitats). **Bark** smooth, cracking, fissured, scaly or flaky, often with *tar-like resinous exudate on the surface; inner bark* pinkish or reddish, *with black sap or with white or colourless sap which turns black on exposure*. **Sapwood** white. **Leaves** *simple, spirally arranged or in pseudowhorls (G. sabahana), margin not thickened*. **Inflorescences** axillary panicles; bracts and bracteoles caducous; pedicels articulate or not. **Flowers** *bisexual; calyx calyptiform (hood-like) or bursting irregularly at anthesis, caducous; floral axis between the calyx and ovary (torus) often elongated and enlarged; petals 5, rarely 4 or 8, caducous or persistent and enlarged in fruit; stamens 5, 10 or many, rarely 4 or 7, inserted on the torus, filaments filiform, glabrous or hairy, anthers dorsifixed; disc absent; ovary superior, with or without stalk, glabrous or hairy, 1-locular, style 1, distinct, terminal or lateral, stigma 1, slightly thicker than style*. **Fruits** stalked or sessile, 1-locular, smooth or rugose, glabrous or hairy, with or without *persistent, enlarged, wing-like petals*. **Seeds** one per fruit; testa adnate to the endocarp; embryo straight, rarely slightly curved, cotyledons free or incompletely fused and partly free on one side only; germination hypogeal, cotyledons non-emergent.

**Distribution.** Thirty species; Madagascar, India, Myanmar, Thailand, Indo-China, and Malesia. Ten species in Sabah and Sarawak.

**Ecology.** Lowland including tidal estuary, fresh-water swamp and peat swamp, to lower montane forest, to 1300 m.

**Uses.** The timber is medium hardwood; grain shallowly interlocking; texture rather fine and even. Sapwood white or straw-coloured, sharply differentiated from the red heartwood. Heartwood bright red with alternating darker coloured layers simulating that of Douglas fir on flat sawn faces, capable of taking a very smooth, highly polished finish; moderately durable, and used for making excellent furnitures. However, the irritant sap discourages its wide use.

### Key to *Gluta* species

(based on vegetative and fruit characters)

1. Leaf apex acute (or rarely obtuse).....2  
    Leaf apex usually rounded or emarginate.....6
2. Leaf midrib sunken above.....10. *G. wallichii*  
    Leaf midrib raised or flattened above.....3
3. Trees of tidal rivers, stilt-rooted. Petioles to 5 mm long.....9. *G. velutina*  
    Trees of inland forests, without stilt-roots. Petioles more than 5 mm long.....4
4. Leaves in pseudowhorls.....7. *G. sabahana*  
    Leaves spirally arranged and well-spaced along the twigs.....5
5. Petioles strongly swollen at base. Fruit without wings.....3. *G. laxiflora*  
    Petioles only slightly swollen at base. Fruits with wings.....4. *G. macrocarpa*
6. Leaves hairy below.....8. *G. speciosa*  
    Leaves glabrous below.....7
7. Leaves larger, 14.5–26.5 × 8–10 cm; lateral veins 15–26 pairs.....6. *G. rugulosa*  
    Leaves smaller, (3–)5–15(–19) × (2–)3–6(–8.5) cm; lateral veins to 12 pairs.....8
8. Leaves usually elliptic or only occasionally obovate.....5. *G. oba*  
    Leaves always obovate.....9
9. Fruits without wings.....1. *G. aptera*  
    Fruits with long wings.....2. *G. beccarii*

### Key to *Gluta* species

(based on flower and fruit characters)

1. Stamens 5 (rarely to 7); calyx bursting irregularly at anthesis.....2  
    Stamens 10 or more; calyx calyptriform (hood-like) at anthesis.....5

- |                                                               |                         |
|---------------------------------------------------------------|-------------------------|
| 2. Pedicels articulate.....                                   | 3                       |
| Pedicels not articulate.....                                  | 4                       |
| 3. Fruits with wings.....                                     | 10. <i>G. wallichii</i> |
| Fruits without wings.....                                     | 9. <i>G. velutina</i>   |
| 4. Leaves in pseudowhorls.....                                | 7. <i>G. sabahana</i>   |
| Leaves spirally arranged and well-spaced along the twigs..... | 3. <i>G. laxiflora</i>  |
| 5. Pedicels articulate.....                                   | 6                       |
| Pedicels not articulate.....                                  | 7                       |
| 6. Stamens 20–28. Petals in fruit only slightly enlarged..... | 4. <i>G. macrocarpa</i> |
| Stamens about 70. Petals in fruit 5–6 cm long.....            | 2. <i>G. beccarii</i>   |
| 7. Stamens 10.....                                            | 5. <i>G. oba</i>        |
| Stamens 40–100.....                                           | 8                       |
| 8. Stamens c. 40. Fruit with enlarged petals (wings).....     | 6. <i>G. rugulosa</i>   |
| Stamens c. 100. Fruit without enlarged petals (wings).....    | 9                       |
| 9. Calyx densely hairy outside.....                           | 8. <i>G. speciosa</i>   |
| Calyx glabrous outside except for tuft of hairs at apex.....  | 1. <i>G. aptera</i>     |

1. *Gluta aptera* (King) Ding Hou

Fig. 7A–B.

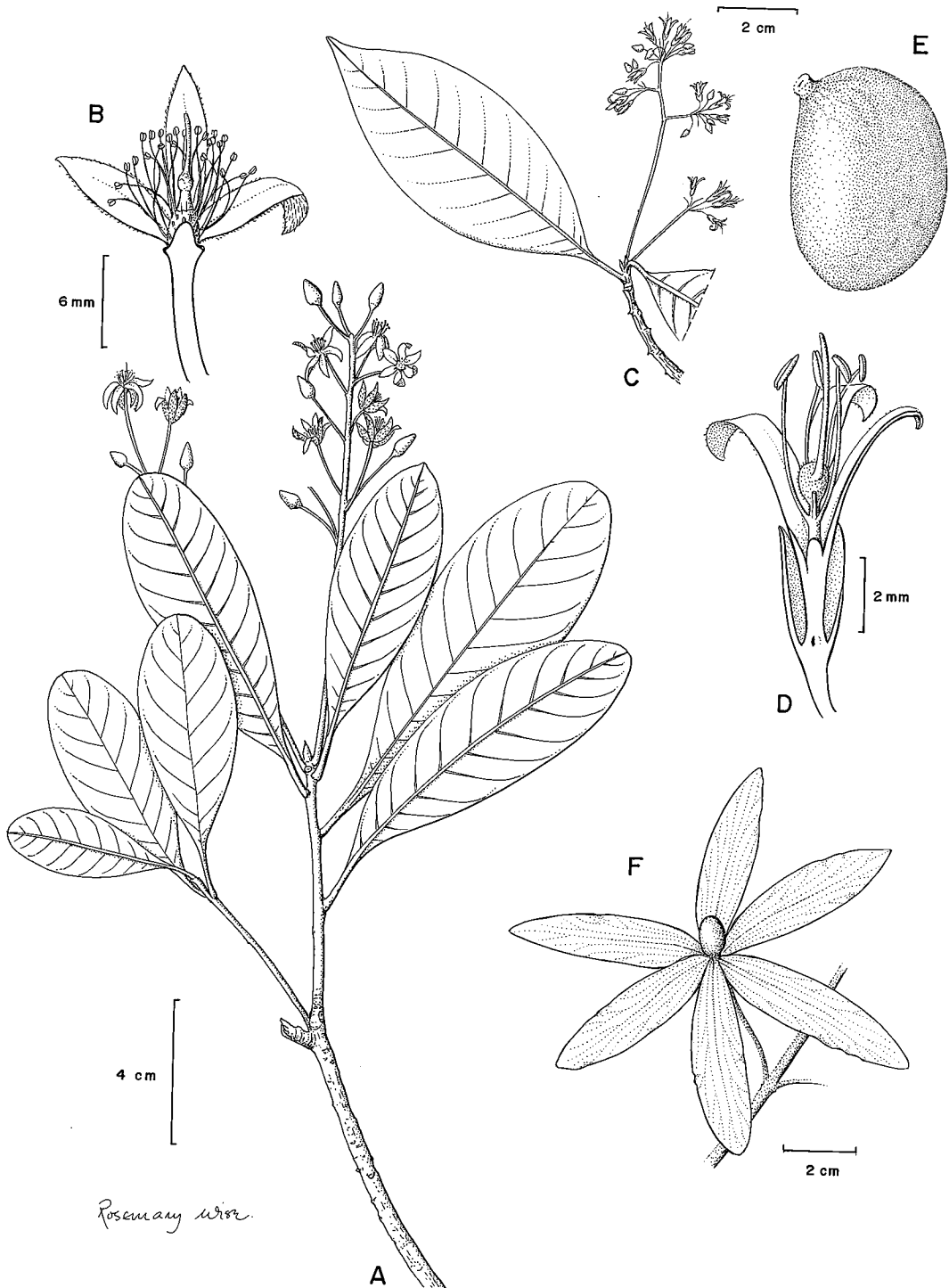
(Greek, *a-* = without, *pteron* = wing; the fruit)

Blumea 24 (1978) 12, FM 1, 8 (1978) 452; Kochummen *l.c.* 24; Whitmore, Tantra & Sutisna *l.c.* 14.  
**Basionym:** *Melanorrhoea aptera* King, J. As. Soc. Beng. 65, 3 (1896) 487. **Syntypes:** King's collector 3485 (BM, K, L), 3727 (K, SING), 7636 (SING), Peninsular Malaysia, Perak; Curtis 1567, Penang (K).  
**Synonym:** *Melanorrhoea tricolor* Ridl., Kew Bull. (1933) 196, Masamune *l.c.* 412.

Medium-sized to large tree to 30 m tall, 70 cm diameter. **Bark** grey-brown, smooth. Twigs brown, youngest ones reddish brown-hairy. **Leaves** spirally arranged and well-spaced, thick-coriaceous, glabrous below; obovate, (3–)4.5–19 × (2–)2.5–8.5 cm; base attenuate, apex rounded or emarginate; midrib flattened (rarely sunken) above, lateral veins 7–10 pairs, faint to distinct above, intercostal veins reticulate, faint to distinct below, faint to invisible above; petioles 1–2 cm long. **Flowers** white; pedicels 10–23 mm long, glabrous, not articulate; calyx calyptriform, glabrous except for tuft of hairs at the apex; petals oblanceolate, 11–16 × 3–5 mm, densely hairy outside; stamens about 100; ovary glabrous; style subterminal. **Fruits** globose to subglobose, 2.5–3.5 cm diameter, brown, smooth, without wings; stalks c. 0.5 cm long.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely distributed in Sarawak, uncommon in Sabah; also in Brunei and Kalimantan.

**Ecology.** Lowland, including peat swamp, to lower montane forest, at 700–1200 m. Flowering in March to October.



**Fig. 7.** *Gluta aptera* (A–B); *G. sabahana* (C–E); *G. wallichii* (F). A and C, flowering leafy twigs; B and D flowers in longitudinal section; E–F, fruits. (A–B from S. 25253, C–D from SAN 60402, E from SAN 110836, F from Ashton BRUN 3309.)

## 2. *Gluta beccarii* (Engl.) Ding Hou

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Blumea 24 (1978) 13, FM 1, 8 (1978) 452; Anderson *l.c.* 137; Kochummen *l.c.* 24; Whitmore, Tantra & Sutisna *l.c.* 15. **Basionym:** *Melanorrhoea beccarii* Engl., Bot. Jahrb. 1 (1880) 45, Merrill *l.c.* (1921) 350, Masamune *l.c.* 411, Anderson *l.c.* 137. **Type:** Beccari PB 1484, Borneo, Sarawak (isotype K).

Small to medium-sized tree to 25 m tall, 45 cm diameter; bole with short buttresses. **Bark** rusty brown, smooth; inner bark pinkish brown. **Sapwood** whitish. Terminal buds pale silky hairy. **Leaves** spirally arranged and well-spaced, thick-coriaceous, glabrous below; obovate, 4.5–9.5 × 2–5 cm; base attenuate, apex emarginate or rounded; midrib flattened above, lateral veins 8–10 pairs, faint on both surfaces, intercostal veins reticulate, faintly visible below, inconspicuous above; petioles 0.5–2 cm long. **Flowers** white turning to pink; pedicels 3–8 mm long, sparsely hairy, articulate; calyx calyptriform, hairy outside; petals hairy outside; stamens c. 70, filaments hairy; ovary glabrous; style terminal. **Fruits** bright purplish red when fresh, subglobose, c. 1.5 cm across; wings 5–6 cm long.

**Distribution.** Peninsular Malaysia, Borneo. Common in Sarawak, uncommon in Sabah; also in Brunei and Kalimantan.

**Ecology.** Fresh-water swamp, peat swamp and ridge forests, to 300 m.

**Note.** This species can be confused with *G. aptera*, but in that species the pedicel is not articulate, the calyx is glabrous and the fruit is without wings.

## 3. *Gluta laxiflora* Ridl.

(Latin, *laxus* = loose, distant, *florum* = flowers; the laxly arranged flowers)

Kew Bull. (1933) 196; Masamune *l.c.* 410; Ding Hou, FM 1, 8 (1978) 456; Anderson *l.c.* 136; Whitmore, Tantra & Sutisna *l.c.* 15. **Type:** Hose 185, Borneo, Sarawak, Baram (holotype K).

Small tree to 20 m tall, 30 cm diameter. **Bark** dark grey, scaly. **Twigs** grey-brown. **Leaves** spirally arranged and well-spaced; elliptic or oblong, 10–19.5 × 3–7 cm; base cuneate, sometimes asymmetric, apex acute; midrib raised above, lateral veins 10–14 pairs, raised below, faint above, intercostal veins finely reticulate, very faint on both surfaces; petioles 1.5–5 cm long, base strongly swollen and cracked. **Flowers** in hairy panicles; pedicels c. 4 cm long, not articulate; calyx bursting irregularly; petals hairy outside; stamens 5, rarely 6; ovary hairy, style lateral. **Fruits** obliquely or broadly ellipsoid, 7.5–9 × 5–6 cm, brown or reddish brown scurfy, without wings; stalks obscure.

**Distribution.** Endemic to Borneo; known only from Sarawak and Brunei.

**Ecology.** Lowland mixed dipterocarp forest.

## 4. *Gluta macrocarpa* (Engl.) Ding Hou

(Greek, *makros* = large, *karpos* = fruit)

Blumea 24 (1978) 14, FM 1, 8 (1978) 454; Kochummen *l.c.* 28; Whitmore, Tantra & Sutisna *l.c.* 15. **Basionym:** *Melanorrhoea macrocarpa* Engl. in A. DC., Mon. Phan. 4 (1883) 236, Merrill *l.c.* (1921) 350, Masamune *l.c.* 412, Anderson *l.c.* 137. **Type:** *Beccari PB 3051*, Borneo, Sarawak (isotype K).

Tree to 36 m tall, 55 cm diameter; bole with steep buttresses to c. 1.5 m high. **Bark** smooth to rough, grey-brown; inner bark reddish, with white latex soon turning black on exposure. **Sapwood** whitish. Young twigs densely rusty brown short-hairy. **Leaves** spirally arranged and well-spaced, glabrous (softly hairy below when young); *oblanceolate or elliptic*, 7.5–2 × 2.5–5 cm, rarely larger to 25 cm × 9.5 cm; base attenuate, *apex acute*; *midrib flattened above*, lateral veins 12–24 pairs, curving and joining near margin, visible on both surfaces, intercostal veins reticulate, faint; *petioles 1–3.5 cm long, slightly swollen at base*. **Flowers** in hairy panicles; *pedicels 1–3.5 cm long, articulate*; *calyx calyptriform*, hairy outside; petals densely hairy outside; *stamens 20, rarely to 28*, with few staminodes, glabrous; *ovary with terminal style*. **Fruits** purplish black, smooth, globose, 2–4 cm diameter, *with a central stalk and short wings*.

**Distribution.** Peninsular Malaysia, Borneo. Of scattered occurrence in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Hill forest at 400–900 m. Flowering in August to September and fruiting in October to February.

#### 5. *Gluta oba* (Merr.) Ding Hou (from the vernacular name – *oba*)

Blumea 24 (1978) 14, FM 1, 8 (1978) 454; Whitmore, Tantra & Sutisna *l.c.* 15. **Basionym:** *Melanorrhoea oba* Merr., J. Str. Br. Roy. As. Soc. 77 (1917) 190, *l.c.* (1921) 350, Masamune *l.c.* 412, Anderson *l.c.* 137. **Type:** *Villamil 316*, North Borneo (isotypes K, SING).

Medium-sized tree to 30 m tall, 35 cm diameter; bole with steep buttresses to 3 m high. **Bark** reddish brown with grey patches, cracking and scaly; inner bark reddish. **Sapwood** whitish. Twigs dark brown, glabrous. **Leaves** spirally arranged and well-spaced, coriaceous, drying chocolate-brown, *glabrous*; *elliptic or occasionally obovate*, 8–15 × 4–6 cm; base cuneate, *apex usually rounded*, very rarely obtuse; *midrib flattened above*, lateral veins 9–12 pairs, very faintly visible on both surfaces, intercostal veins reticulate, faint; *petioles 0.7–1.5 cm long*. **Flowers** in glabrous panicles; *pedicels c. 1 cm long, not articulate*; *calyx calyptriform*, glabrous except the hairy apical part; petals hairy outside; *stamens 10*, filaments hairy; ovary glabrous, style terminal. **Fruits** subglobose, 3–4 cm across, dark brown, smooth, *without wings*; *stalks centrally attached, 1–1.5 cm long*.

**Distribution.** Endemic to Borneo. Common in Sabah and Sarawak, especially on Pulau Sakar in Sabah; also in Brunei and Kalimantan.

**Ecology.** Lowland mixed dipterocarp forest. Flowering in February to March and fruiting in April to June.

#### 6. *Gluta rugulosa* Ding Hou (Latin, *rugulosus* = somewhat wrinkled; the fruits)

Blumea 24 (1978) 16; FM 1, 8 (1978) 452; Whitmore, Tantra & Sutisna *l.c.* 15. **Type:** *Hose 41*, Borneo, Sarawak, Baram (holotype L; isotypes BM, CGE, K).

Tree to 30 m tall, 60 cm diameter; bole with buttresses to 3 m high. **Bark** brown, scaly; inner bark pinkish. **Sapwood** white. **Leaves** spirally arranged and well-spaced, glabrous below; obovate, 14.5–26.5 × 8–10 cm; base attenuate, apex rounded or rarely bluntly acute; midrib flattened (very rarely sunken) above, lateral veins 15–26 pairs, raised below, faint above, curving and joining near margin, intercostal veins scalariform, faintly visible below, invisible above; petioles 1–2 cm long, base swollen. **Flowers** hairy; pedicels not articulate; calyx calyptriform, hairy outside; stamens *c.* 40; ovary scurfy, style terminal. **Fruits** globose, *c.* 3.5 cm across, light brown, scurfy, rugose, sessile; wings 2.5–3 cm long.

**Distribution.** Endemic to Borneo. Uncommon in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forests including *kerangas*.

#### 7. *Gluta sabahana* Ding Hou (of Sabah)

Fig. 7C–E.

Blumea 24 (1978) 16, FM 1, 8 (1978) 455; Whitmore, Tantra & Sutisna *l.c.* 15. **Type:** *Sinanggul SAN 40615*, Borneo, Sabah, Tawau (holotype L; isotype SAN).

Medium-sized tree to 30 m tall, 60 cm diameter. **Bark** dark brown, smooth to scaly. **Leaves** in pseudowhorls, coriaceous, glabrous; oblanceolate or elliptic, 13–23 × 3–8 cm; base cuneate to attenuate, apex acute; midrib raised and prominent above, lateral veins 9–15 pairs, faintly raised on both surfaces, intercostal veins reticulate, faint; petioles 0.5–1.5 cm long, grey-brown and cracked. **Flowers** in hairy panicles; pedicels 3–6 mm long, not articulate; calyx bursting irregularly, hairy outside; petals whitish, hairy outside; stamens 5, rarely 7; ovary hairy, style lateral. **Fruits** broadly ellipsoid, 7.5–9 × 5–6.5 cm, brownish scurfy, without wings; stalks obscure.

**Distribution.** Endemic to Borneo; so far known from Sabah only where it is common.

**Ecology.** Lowland forest below 30 m, including swamp. Flowering in February to September and fruiting in May to December.

#### 8. *Gluta speciosa* (Ridl.) Ding Hou (Latin, *speciosus* = showy; the flowers)

Blumea 24 (1978) 21, FM 1, 8 (1978) 450; Whitmore, Tantra & Sutisna *l.c.* 16. **Basionym:** *Melanorrhoea speciosa* Ridl., Kew Bull. (1933) 197, Masamune *l.c.* 412, Anderson *l.c.* 138. **Type:** *Haviland 3147*, Borneo, Sarawak (holotype K; isotypes L, SING).

Large tree to 40 m tall, 80 cm diameter; bole with buttresses to 1.5 m high. **Bark** dark brown, fissured; inner bark pink. **Sapwood** pale pink. **Leaves** spirally arranged and well-spaced, thick-coriaceous, finely hairy below; oblong to narrowly obovate, 5–17.5 × 3–9 cm; base

cuneate, apex rounded or emarginate; midrib flattened above, lateral veins 10–22 pairs, raised below, visible above, intercostal veins scalariform-reticulate, distinct below, faint above; petioles 1–2 cm long, densely brown short-hairy. **Flowers** in hairy panicles; pedicels 10–22 mm long, not articulate; calyx calyptiform, densely hairy outside; petals white, hairy outside; stamens c. 100; ovary hairy, style terminal. **Fruits** subglobose, 2–3 cm across, smooth, without wings.

**Distribution.** Endemic to Borneo; uncommon in Sabah and Sarawak; in Sabah, known from Ranau districts only from two collections, SAN 22369 and SAN 62741, while in Sarawak, of scattered distribution; also in Brunei and Kalimantan.

**Ecology.** Lowland, including swamp, to hill forests to 600 m.

### 9. *Gluta velutina* Blume

(Latin, *velutinus* = velvety hairy; the inflorescences)

Mus. Bot. Lugd. Bat. 1 (1850) 183; Merrill *l.c.* (1921) 349; Masamune *l.c.* 410; Burgess *l.c.* 12; Ding Hou, FM 1, 8 (1978) 461; Anderson *l.c.* 136; Corner *l.c.* 128; Kochummen *l.c.* 30; Whitmore, Tantra & Sutasna *l.c.* 16. **Type:** *Sine coll., s.n.*, Borneo (L; *n.v.*).

Large shrub or small tree to 7 m tall; bole with stilt-roots. **Bark** brownish, smooth. **Leaves** spirally arranged and well-spaced; oblanceolate or elliptic, 13–19 × 4–7 cm; base cuneate, apex acute; midrib flattened above, lateral veins 15–18 pairs, faintly visible on both surfaces, intercostal veins reticulate, faint; petioles to 5 mm long. **Flowers** in hairy panicles; pedicels short, c. 1 mm long, articulate; calyx bursting irregularly, hairy outside; petals white, glabrous; stamens 5; ovary glabrous, style lateral. **Fruits** subglobose, 4.5–7.5 cm diameter, pale brown, with irregular warty ridges, especially towards the base, without wings.

**Distribution.** Myanmar, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo, Java. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Edges of tidal rivers, standing in water with submerged trunk except at low tides, associated with *Barringtonia conoidea* and *Pandanus helicopus*.

### 10. *Gluta wallichii* (Hook. f.) Ding Hou

Fig. 7F.

(N. Wallich, 1786–1854, Danish botanist at Calcutta)

Blumea 24 (198) 21, FM 1, 8 (1978) 456; Kochummen *l.c.* 30; Whitmore, Tantra & Sutasna, *l.c.* 16; Kessler & Sidiyasa *l.c.* 41. **Basionym:** *Melanorrhoea wallichii* Hook.f., Fl. Br. Ind. 2 (1876) 25, Anderson *l.c.* 138. **Lectotype** (Ding Hou, 1978): Wall. Cat. 980, Singapore (K). **Synonyms:** *Melanorrhoea maingayi* Hook.f. *l.c.* 25, Merrill *l.c.* (1921) 350, Masamune *l.c.* 412; *Swintonia elmeri* Merr., PEB (1929) 167.

Medium-sized to large tree to 36 m tall, 50 cm diameter; bole with short buttresses. **Bark** grey-brown, fissured and scaly; inner bark reddish with watery whitish sap turning black on exposure. **Sapwood** whitish. **Leaves** spirally arranged and well-spaced, glabrous, rarely sparsely brown short-hairy below; oblong, elliptic or narrowly obovate, 8.5–34 × 4–14 cm;



base broadly cuneate to rounded, *apex acute or rarely obtuse*; midrib sunken above, lateral veins 17–20 pairs, raised below, faint above, intercostal veins reticulate, distinct below, faint above; *petioles 2–5 cm long*, glabrous or sparsely brown short-hairy, *distinctly channelled above*. **Flowers** in hairy panicles; *pedicels 2–3 mm long, articulate*; *calyx bursting irregularly*, hairy outside; petals white, *densely hairy on both surfaces*; *stamens 5*; ovary hairy, *style lateral*. **Fruits** ovoid or ellipsoid, *c. 1.5 × 1 cm*, smooth, brownish, *with enlarged bright red wings*; stalks obscure.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Common and widely distributed in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland, including swamp, to hill forest to 500 m. Flowering from March to November and fruiting from March to August.

## 8. KOORDERSIODENDRON Engl.

(S.H. Koorders, 1863–1919, forester and botanist in the former Dutch East Indies Forest Service at Bogor, Java)

*ranggu* (preferred name in ASEAN countries)

In Koorders, *Med. Lands Pl. Tuin* 19 (1898) 410; Merrill, *EB* (1921) 350; Masamune, *EPB* (1942) 410; Smythies, *CST* (1965) 3; Ding Hou, *FM* 1, 8 (1978) 486; Anderson, *CLTS* (1980) 136; Wong, *DMT* (1982) 110; Whitmore, Tantra, & Sutsina, *CLK* 1 (1989) 16.

Trees. *Inner bark with scanty white latex*. **Leaves** spirally arranged, *pinnately compound with terminal leaflet*. *Leaflets opposite or subopposite, 10–16 pairs, without domatia in the axils of lateral veins*. **Inflorescences** axillary, paniculate. **Flowers** *bisexual, 5-merous*; *calyx 5-lobed; petals 5, imbricate*; *stamens 10; disc intrastaminal, round and flat, 10-lobed*; ovary superior, subglobose, *deeply 5-furrowed (carpels incompletely connate), densely hairy, 5-locular*, usually only one fertile, styles 5, short, stigmas small. **Fruits** 1(–3)-locular, *without wings*. **Seeds** with testa free from the endocarp; embryo straight, cotyledons free, plano-convex.

**Distribution.** Monotypic; Borneo, the Philippines, Sulawesi, Maluku, and Irian Jaya.

**Ecology.** Lowland forest.

### **Koordersiodendron pinnatum** (Blanco) Merr.

Fig. 8.

(Latin, *pinnatus* = with parts arranged on each side of a common axis; the compound leaves)

Bull. For. Bur. 1 (1903) 33, Spec. Blanc. (1918) 234, *l.c.* (1921) 350; Masamune *l.c.* 410; Smythies *l.c.* 3; Burgess *l.c.* 16; Ding Hou, *FM* 1, 8 (1978) 486; Anderson *l.c.* 136; Whitmore, Tantra & Sutsina *l.c.* 16. **Basionym:** *Helicteres pinnata* Blanco, *Fl. Filip.* (1837) 384. **Neotype** (Merrill, 1918): *Merrill Spec. Blanc. 744*, Philippines, Luzon, Angat, Bulacan (isoneotype L).

Medium-sized to tall tree to 40 m tall, 90 cm diameter; bole with buttresses to 3 m high. **Bark** dark brown or black, fissured. Twigs brownish, rough, with many small lenticels, 1.5–2 cm



**Fig. 8.** *Koordersiodendron pinnatum*. A, fruiting leafy twig; B, twig with inflorescences; C, flower in longitudinal section. (All from SAN 39031.)

thick. **Leaves** 50–80 cm long, each with 10–16 pairs of leaflets; rachis not swollen at base. Leaflets chartaceous, ovate-oblong, 3–20 × 1.5–5.5 cm; base slightly asymmetric, broadly cuneate to rounded, apex acuminate, acumen c. 1 cm long; midrib raised above, lateral veins 10–24 pairs, distinctly looping, faint on the upper leaflet surface, intercostal veins reticulate, faintly visible on both surfaces; petiolules 3–5 mm long. **Inflorescences** c. 50 cm long, paniculate. **Flowers** whitish. **Fruits** ellipsoid, yellowish when ripe, 2.5–4 × 1.5–2.5 cm. **Seeds** ellipsoid, compressed.

**Distribution.** Borneo, Philippines, Sulawesi, Maluku, Irian Jaya. Common and widely distributed in Sabah (Lahad Datu, Sandakan and Tawau districts); uncommon in Sarawak, recorded only from northeast border with Sabah; also in Brunei and Kalimantan.

**Ecology.** Lowland forest, including swamps.

**Uses.** The timber is moderately hard and moderately heavy with density of 690–915 kg/m<sup>3</sup> air-dried. The sapwood is white to pale pink and is distinct from the heartwood which is pinkish brown or reddish brown; texture is fine and even with straight to interlocking grains. It is suitable for flooring, interior construction, furniture, cabinet making, and door-panels.

## 9. MANGIFERA L.

(Latin, *mango* = latinised local name *mangga*, *ferre* = bearer; *mangga*-bearing trees)

*asam*, *machang* (Malay)

Sp. Pl. (1753) 200, Gen. Pl. ed. 5 (1754) 93; King, J. As. Soc. Beng. 65, 3 (1896) 466; Merrill, EB (1921) 349; Ridley, FMP 1 (1922) 520; Mukherji, Lloydia 12 (1940) 73; Browne, FTSB (1955) 50; Backer & Bakhuizen *f.*, FJ 2 (1965) 148; Burgess, TBS (1966) 19; Ding Hou, Blumea 24 (1978) 21, FM 1, 8 (1978) 423; Anderson, CLTS (1980) 136; Wong, DMT (1982) 128; Corner, WSTM 3rd ed. 1 (1988) 115; Kochummen, TFM 4 (1989) 31; Whitmore, Tantra & Sutisna, CLK 1 (1989) 16; Ng, Mal. For. Rec. 34, 1 (1991) 18; Bompard, PROSEA 2 (1991) 203; Kostermans & Bompard, The mangoes (1993) 1; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 41.

Tall emergent trees; crown dense, rounded; bole usually without buttresses. **Bark** cracking to fissured and scaly; inner bark yellowish to brownish, laminated, with droplets of white creamy or pinkish latex which blackens on drying, often with resinous smell. Twigs terete or strongly angular. **Leaves** simple, spirally arranged, sometimes very close and appear clustered, thick- or thin-coriaceous, glabrous, without peltate scales, margin not thickened; midrib raised above. **Inflorescences** terminal or axillary panicles, glabrous or hairy, often crowded at apex of twigs; pedicels articulate. **Flowers** bisexual or male; 4- or 5-merous; calyx 4–5-lobed; petals free, often with glandular ridges inside, caducous; disc glandular, pulvinate, cup-shaped, cylindrical and stalk-like, or 4- or 5-lobed; stamens 5, rarely 10–12, usually 1–2 fertile, very rarely 3–5 fertile, not inserted on the torus, filaments distinct, anthers 2-locular; staminodes if present very much smaller; ovary superior, one-locular, style 1, usually eccentric; stigma 1. **Fruits** reniform, globose or cylindrical, ripening green, yellow with shades of red, brown or black; pulp (mesocarp) fleshy, juicy, sweet to sour, white to pale to dark yellow, fragrant or stinking, often smelling of turpentine; endocarp hard, fibrous or not. **Seeds** one per fruit; embryo filling

the seed, cotyledons massive, without endosperm; germination hypogeal or semi-hypogeal, in some species lasting 8–151 days, cotyledons mostly non-emergent, the first 2 leaves opposite, subsequent leaves in spirals, produced intermittently in flushes.

**Distribution.** About 70 species; Sri Lanka, India, Myanmar, Thailand, Indo-China, S China, Malesia, Solomon Islands. Sixteen species in Sabah and Sarawak. A number of species, including 2 introduced ones (*M. pentandra* and *M. odorata*), are cultivated for their edible fruits.

**Ecology.** Widely distributed from lowland to lower montane forest, to 1800 m, but nowhere abundant.

**Uses.** *Machang* is the standard Malaysian name for the timber of *Mangifera* species. The timber is a light hardwood with density of 545–610 kg/m<sup>3</sup> air-dried. The sapwood is not clearly defined from the heartwood which is light pink-brown to light brown. In some trees, a streaky corewood is present where the wood is dark brown interspersed with streaks of black colour. Texture moderately fine and even with straight or interlocking grains. The timber is suitable for light construction, planking, flooring, plywood manufacture etc. The streaky corewood is in demand as a decorative timber and is used for high class cabinet work, interior finishing, panelling and partitioning, sliced decorative veneers and also for furniture manufacture. The most important use is the edible fruits produced by a few species, mainly *M. indica* and its cultivars which are cultivated throughout the tropics and subtropics. Young leaves of some species are used as a vegetable. Mango leaves and flowers play a significant role in Hindu religious ceremonies. A few species are used in traditional medicine.

**Taxonomy.** The genus has been divided by Ding Hou (Blumea 24 (1978) 22) into two sections, viz., Section *Mangifera* (characterised by the cup-shaped, papillose disc, which is usually 4- or 5-lobed and completely or partly surrounding the ovary, and free stamen filaments) and Section *Limus* (characterised by the cylindrical or torus-like disc, which is located at the base of the ovary in bisexual flowers and usually neither lobed nor papillose, and stamen filaments which are usually connate at base).

### Key to *Mangifera* species

(based mainly on floral and fruit characters)

(*M. blommesteinii* and *M. subsessilifolia* are not included due to lack of flowers)

1. Disc cup-shaped, pulvinate or obscure. Stamen filaments free.....2  
Disc cylindrical and stalk-like. Stamen filaments connate.....12
2. Disc obscure. Leaves linear, to 4 cm wide.....**8. *M. macrocarpa***  
Disc distinct. Leaves not linear, wider.....3
3. Fertile stamens 3–5.....

***Mangifera pentandra* Hook. f.**

Fl. Br. Ind. 2 (1876) 14; King *l.c.* 472; Ridley *l.c.* 522; Mukherji *l.c.* 81; Ding Hou, Blumea 24 (1978) 28, FM 1, 8 (1978) 426; Corner *l.c.* 120; Kochummen *l.c.* 38; Kostermans & Bompard *l.c.* 36. Lectotype (Ding Hou, 1978): *Maingay 471*, Malacca (K).

Medium-sized tree to 28 m tall, 90 cm diameter. *Leaves spirally arranged, drying greenish, not papillose below, thin-coriaceous; oblong or elliptic, 11–20 × 3.5–9 cm; intercostal veins reticulate, distinctly visible on both surfaces; petioles 1.5–3.5 cm long, swollen at base. Flowers 5-merous; each petal with 5 yellow ridges; stamens 5, fertile stamens 3–5, filaments free; disc distinct, pulvinate; style slightly eccentric. Fruits oblong, 7.5–10 × 5–6.5 cm, green when mature, fragrant; pulp pale orange, sweet.*

Endemic to Peninsular Malaysia. In Sabah, introduced and cultivated for its fruits.

|                                                                                                                              |                             |
|------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Fertile stamen one.....                                                                                                      | 4                           |
| 4. Flowers 5-merous.....                                                                                                     | 5                           |
| Flowers 4-merous.....                                                                                                        | 7                           |
| 5. Inflorescences pyramidal, to 40 cm long.....                                                                              | <b>6. M. indica</b>         |
| Inflorescences not pyramidal, to 15 cm long.....                                                                             | 6                           |
| 6. Leaf midrib pinkish (on drying) beneath; lower leaf surface papillose; petioles 1–2 cm long.....                          | <b>13. M. rufocostata</b>   |
| Leaf midrib not pinkish (on drying) beneath; lower leaf surface not papillose; petioles 4–7 cm long.....                     | <b>15. M. swintonioides</b> |
| 7. Leaf intercostal veins very finely reticulate, visible on the lower leaf surface.....                                     | 8                           |
| Leaf intercostal veins not reticulate, visible or invisible on the lower leaf surface.....                                   | 10                          |
| 8. Leaf apex rounded with short blunt tip; leaf margin thickened.....                                                        | <b>7. M. khoonmengiana</b>  |
| Leaf apex acute; leaf margin not thickened.....                                                                              | 9                           |
| 9. Axillary buds persistent. Leaf margin not recurved.....                                                                   | <b>11. M. parvifolia</b>    |
| Axillary buds caducous. Leaf margin recurved.....                                                                            | <b>16. M. torquenda</b>     |
| 10. Leaves thick-coriaceous, cardboard-like, 5–9 cm wide.....                                                                | <b>9. M. magnifica</b>      |
| Leaves thin-coriaceous, 4–7 cm wide.....                                                                                     | 11                          |
| 11. Inflorescences hairy.....                                                                                                | <b>5. M. griffithii</b>     |
| Inflorescences glabrous.....                                                                                                 | <b>12. M. quadrifida</b>    |
| 12. Fertile stamens 5; petals without ridges.....                                                                            | <b>3. M. decandra</b>       |
| Fertile stamens 1–2; petals with ridges.....                                                                                 | 13                          |
| 13. Petals purplish inside.....                                                                                              | 14                          |
| Petals white to pinkish inside.....                                                                                          | 15                          |
| 14. Petals with 3 ridges each.....                                                                                           | <b>10. M. pajang</b>        |
| Petals with one ridge each.....                                                                                              | <b>2. M. caesia</b>         |
| 15. Peduncles brick-red. Leaves thick-coriaceous, with invisible intercostal veins. Fruits with strong turpentine odour..... | <b>4. M. foetida</b>        |

Peduncles pinkish. Leaves thin-coriaceous, intercostal veins distinct. Fruits strongly fragrant but without turpentine odour.....

**M. odorata** Griff.

Notul. Pl. As. 4 (1854) 417; King, *l.c.* 474; Ridley *l.c.* 524; Masamune *l.c.* 411; Mukherji *l.c.* 122; Backer & Bakhuizen *f. l.c.* 149; Ding Hou, *Blumea* 24 (1978) 26, FM 1, 8 (1978) 437; Anderson *l.c.* 136; Bompard *l.c.* 218; Corner *l.c.* 120; Kochummen *l.c.* 37; Whitmore, Tantra & Sutisna *l.c.* 17; Kostermans & Bompard *l.c.* 168; Kessler & Sidiyasa *l.c.* 42. Type: *Griffith 1098*, Malacca (holotype K; isotype P).

Tree to 30 m tall, 65 cm diameter. *Leaves spirally arranged, drying brownish, thin-coriaceous; oblong-lanceolate, 12–35 × 4–10 cm; intercostal veins reticulate, distinct; petioles 3–7 cm long, swollen at base. Inflorescences pseudoterminal, pyramidal panicles, to 45 cm long; peduncles pinkish. Flowers 5-merous (very rarely 6-merous), fragrant; sepals dark red outside; petals pale pinkish inside towards apex, each with 3–5 ridges; stamens 5, fertile stamen one, filaments connate at base; disc stalk-like; style lateral. Fruits obliquely ovoid, ellipsoid or oblong, 10–13 × 6–9 cm, yellow-green with numerous yellow or brown dots, strongly fragrant; pulp yellow, sweet.*

The species has never been found in the wild. Commonly cultivated in Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and the Philippines. In Sabah and Sarawak, cultivated for the edible fruits, to 1000 m. Vernacular names: Sabah—*huani, kwini, wani* (Malay). Sarawak—*kwini* (Malay).

**Key to *Mangifera* species**

(based on vegetative and flower characters)

1. Leaves drying brownish or chocolate-brown.....2  
Leaves drying greenish, greenish yellow or pale yellow.....10
2. Petioles absent or to 1 cm long only.....**14. M. subsessilifolia**  
Petioles at least 1 cm long.....3
3. Leaves in pseudowhorls on the twigs.....4  
Leaves spirally arranged, sometimes in pseudowhorls at apex of twigs only.....6
4. Leaves smaller, to 8.5 × 3 cm, apex rounded and emarginate; lateral veins faint; petioles less than 2 cm long.....**1. M. blommesteinii**  
Leaves larger, to 38 × 15 cm, apex acute; lateral veins raised on both surfaces; petioles 2–6 cm long.....5
5. Flowers reddish or pinkish; fertile stamens 5.....**3. M. decandra**  
Flowers violet or lilac; fertile stamens 1–2.....**2. M. caesia**
6. Leaf intercostal veins invisible.....7  
Leaf intercostal veins visible to very conspicuous.....8
7. Petioles 2–3.5 cm long, slightly swollen at base.....**4. M. foetida**  
Petioles 3.5–9 cm long, strongly swollen at base.....**10. M. pajang**

8. Leaves very thick, cardboard-like.....**9. M. magnifica**  
 Leaves thinner in texture.....9
9. Leaf intercostal veins very finely reticulate beneath. Leaf margin thickened.....  
 .....**7. M. khoonmengiana**  
 Leaf intercostal veins not so. Leaf margin not thickened.....  
 .....**M. odorata** Griff. (see preceding key)
10. Leaves papillose beneath; midrib pinkish (on drying) beneath.....**13. M. rufocostata**  
 Leaves not papillose beneath; midrib not so.....11
11. Leaves linear, 16–44 × 2–4 cm.....**8. M. macrocarpa**  
 Leaves not linear, wider.....12
12. Leaf intercostal veins invisible or finely reticulate and distinct beneath.....13  
 Leaf intercostal veins visible, not reticulate, distinct or faint beneath.....14
13. Leaf lateral veins 14–20 pairs, raised on both surfaces. Leaf margins recurved.....  
 .....**16. M. torquenda**  
 Leaf lateral veins 8–10 pairs, faint on both surfaces. Leaf margins not recurved.....  
 .....**11. M. parvifolia**
14. Leaf intercostal veins faintly visible beneath. Petioles usually almost half the length of  
 leaf blade.....**15. M. swintonioides**  
 Leaf intercostal veins distinct beneath. Petioles much less than half the length of leaf  
 blade.....15
15. Plants known only through cultivation; fertile stamens 3–5.....  
 .....**M. pentandra** (see preceding key)  
 Plants known in wild and in cultivation; fertile stamen 1.....16
16. Leaves drying greenish, margins often wavy. Flowers 5-merous, petals yellowish to pale  
 green.....**6. M. indica**  
 Leaves drying to pale yellow or yellowish green, margins not wavy. Flowers 4-merous,  
 petals whitish.....17
17. Leaf lateral veins 10–12 pairs. Inflorescences hairy.....**5. M. griffithii**  
 Leaf lateral veins 9–22 pairs. Inflorescences glabrous.....**12. M. quadrifida**

**1. Mangifera blommesteinii** Kosterm.

(L. van Blommestein, a plant collector in Java and Sumatra, c. 1878)

In Kostermans & Bompard *l.c.* 146. **Type:** *G. Mikil SAN 31986*, Borneo, Sabah, Weston Distr. (holotype L; isotype SAN).

Tree to 45 m tall, 110 cm diameter. **Bark** reddish brown, scaly; inner bark laminated, reddish brown. **Sapwood** pale white. Twigs deeply grooved when young. **Leaves** in pseudowhorls,

drying brownish, thick-coriaceous; oblanceolate, 4.5–8.5 × 1.5–3 cm; base attenuate, apex rounded and slightly emarginate; lateral veins 9–12 pairs, faint below, more distinct above, intercostal veins invisible below, faintly visible above; petioles 0.5–1.8 cm long. **Inflorescences** (not fully developed) fascicled racemes, to 20 cm long. **Flowers** unknown. **Fruits** (immature) ellipsoid to subglobose, c. 2 × 1.2 cm, smooth.

**Distribution.** Peninsular Malaysia, Borneo. Very uncommon in Sabah and Sarawak. In Sabah, known from 3 collections, SAN 31986 (type) from Weston, SAN 39172 from Sandakan and SAN 49111 from Semporna districts. In Sarawak, known from one collection, KEP 80068, from Miri.

**Ecology.** Lowlands, including riverbanks and *kerangas*, to 120 m.

## 2. *Mangifera caesia* Jack

(Latin, *caesium* = lavender-blue; the flowers)

In Roxburgh, Fl. Ind. ed. Wall. 2 (1824) 441; King *l.c.* 476; Merrill *l.c.* (1921) 349; Ridley *l.c.* 525; Masamune *l.c.* 410; Mukherji *l.c.* 126; Backer & Bakhuizen *f. l.c.* 15; Kostermans, Reinwardtia 7 (1965) 15; Ding Hou, Blumea 24 (1978) 24, FM 1, 8 (1978) 438; Anderson *l.c.* 136; Corner *l.c.* 117; Kochummen *l.c.* 33; Bompard *l.c.* 207; Whitmore, Tantra & Sutisna *l.c.* 16; Kostermans & Bompard *l.c.* 149. **Type:** Jack, *s.n.*, Sumatra (*n.v.*).

Tree to 45 m high, 90 cm diameter. **Bark** brown, shallowly fissured. Twigs stout, 1 cm thick, with sharp ridges. **Leaves** usually in pseudowhorls, drying chocolate-brown, thick-coriaceous; elliptic to obovate or oblanceolate, 7.5–18 × 2.5–6.5 cm; base attenuate, apex acute or obtuse; lateral veins 10–22 pairs, faintly visible on both surfaces, intercostal veins reticulate, invisible; petioles 2–5 cm long, flattened above. **Inflorescences** pyramidal panicles, to 30 cm long. **Flowers** violet or lilac, 5-merous, petals purplish inside, with 1 ridge each; disc cylindrical and stalk-like, not papillose; stamens 5, one or two fertile, filaments connate; ovary subglobose, style slightly eccentric. **Fruits** pale brown or brownish yellow, ellipsoid or pyriform, 12–19 × 6–10 cm; pulp white or yellowish white, sour to sweet.

**Vernacular names.** Sabah—*beluno* (Malay). Sarawak—*binjai* (Malay), *lanyat* (Iban).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely cultivated in Sabah and Sarawak.

**Ecology.** Lowland forest by streams and in swampy areas.

**Uses.** A well-known fruit tree. The sour fruits are often used as a substitute for tamarind.

## 3. *Mangifera decandra* Ding Hou

(Greek, *deca* = 10, *andros* = male; the flower with 10 stamens)

Reinwardtia 8 (1972) 323, FM 1, 8 (1978) 433; Whitmore, Tantra & Sutisna *l.c.* 16; Kostermans & Bompard *l.c.* 142. **Type:** Singh SAN 60874, Borneo, Sabah (holotype L; isotypes K, SAN).



Medium-sized tree to 30 m tall, 70 cm diameter. **Bark** reddish brown, fissured and scaly; inner bark pinkish to orange-brown. **Sapwood** pale yellow. Twigs stout, to 1.3 cm thick, with sharp ridges. **Leaves** in *pseudowhorls*, drying brownish, coriaceous; elliptic to oblong or obovate, 17–38 × 12–15 cm; base cuneate, apex slightly acute; lateral veins 20–35 pairs, raised on both surfaces, intercostal veins invisible; petioles 2–6 cm long. **Inflorescences** terminal, pyramidal, to 65 cm long, hairy, with stout peduncles. **Flowers** 5-merous, reddish or pinkish; petals without ridges; stamens 10, 5 fertile, filaments connate; disc cylindrical, stalk-like; ovary subglobose, style eccentric. **Fruits** ellipsoid, 9–16 × 8–10.5 cm, irregularly rugose, yellowish to rusty brown when fresh.

**Distribution.** Sumatra, Borneo. Widely distributed in Sabah, uncommon in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest, including swamps, to 340 m.

#### 4. *Mangifera foetida* Lour.

(Latin, *foetidus* = stinking, strong-smelling; the fruits)

Fl. Cochinch. (1790) 160; King *l.c.* 474; Ridley *l.c.* 524; Masamune *l.c.* 410; Burgess *l.c.* 20; Smythies *l.c.* 5; Ding Hou, FM 1, 8 (1978) 435; Anderson *l.c.* 136; Bompard *l.c.* 209; Corner *l.c.* 118; Kochummen *l.c.* 35; Whitmore, Tantra & Sutisna *l.c.* 17; Kostermans & Bompard *l.c.* 159; Kessler & Sidiyasa *l.c.* 42. **Type:** *Rumph. Herb. Amboin.* 1 (1741) t. 28.

Medium-sized tree to 20 m tall, 35 cm diameter. **Bark** grey-brown, fissured and scaly; inner bark reddish with creamy to pinkish latex in droplets. **Sapwood** white. **Leaves** spirally arranged, drying brownish, thick-coriaceous; elliptic, oblong or oblanceolate, 12–28 × 6–10 cm; base cuneate, apex obtuse or rounded; lateral veins 12–20 pairs, with short intermediate veins, raised on both surfaces, intercostal veins very faint to inconspicuous; petioles 2–3.5 cm long, the base slightly swollen and rugose. **Inflorescences** pyramidal, to 30 cm long, peduncles brick-red. **Flowers** fragrant, 5-merous; calyx red; petals whitish inside, each with 3–5 ridges; stamens 5, fertile stamen one, filaments connate at base; disc cylindrical, stalk-like; ovary subglobose. **Fruits** subglobose, slightly oblique, to 14 × 10 cm, greenish grey, with strong turpentine odour; pulp yellow, edible.

**Vernacular names.** Sabah—*pachu* (Malay). Sarawak—*bachang* (Iban), *badut* (Bidayuh), *embang* (Malay), *jabing* (Bidayuh), *kemantan* (Iban), *machang* (Malay), *pangin* (Kayan), *pawuk* (Bidayuh).

**Distribution.** Sumatra, Peninsular Malaysia, Java, Borneo. In Sabah and Sarawak, uncommon in the forest, but often cultivated; also in Brunei and Kalimantan.

**Ecology.** Lowland and hill forests to 1000 m.

**Uses.** The fruits are edible and so the species is extensively cultivated.

#### 5. *Mangifera griffithii* Hook. f.

(W. Griffith, 1810–1845, surgeon at Malacca)

Trans. Linn. Soc. 23 (1860) 168; King *l.c.* 468; Ridley *l.c.* 52; Mukherji *l.c.* 103; Ding Hou, *Blumea* 24 (1978) 25, FM 1, 8 (1978) 430; Anderson *l.c.* 136; Corner *l.c.* 118; Kochummen *l.c.* 35; Whitmore, Tantra & Sutisna *l.c.* 17; Kostermans & Bompard *l.c.* 42. **Type:** *Griffith 1100/1*, Malacca (holotype K; isotypes CAL, L, P). **Synonyms:** *M. sclerophylla* Hook. f., Fl. Br. Ind. 2 (1876) 15, Masamune *l.c.* 411; *M. beccarii* Ridl., Kew Bull. (1933) 194, Masamune *l.c.* 410.

Medium-sized tree to 30 m tall, 60 cm diameter. **Bark** greyish, smooth to cracking. Twigs grey or dark brown, angular. **Leaves** spirally arranged, drying pale yellow or yellowish green, not papillose beneath, thin-coriaceous; elliptic to obovate, 3.5–15.5 × (1.5–)4–7 cm; base cuneate, apex acute or obtuse, rarely finely emarginate; midrib not pinkish on drying beneath, lateral veins 10–12 pairs, visible on both surfaces, intercostal veins reticulate, distinct on both surfaces; petioles 1–3.5 cm long, strongly swollen at base. **Inflorescences** axillary or terminal, hairy. **Flowers** 4-merous; petals whitish, stamens 4, fertile stamen one, filaments free; disc cup-shaped; style lateral. **Fruits** yellow to rose-red, ripening blackish, ellipsoid, 2.5–3.5 × 1.5–2.5 cm; pulp pale orange-yellow.

**Vernacular names.** Sabah—*wahab* (Malay). Sarawak—*asam raba* (Malay).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Uncommon in Sabah and Sarawak, sometimes cultivated; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 360 m, very rarely to 750 m; often in swampy areas.

## 6. *Mangifera indica* L.

(of India)

Sp. Pl. (1753) 200; King *l.c.* 472; Merrill *l.c.* (1921) 349; Ridley *l.c.* 523; Masamune *l.c.* 411; Mukherji *l.c.* 83; Ding Hou, FM 1, 8 (1978) 427; Anderson *l.c.* 136; Bompard *l.c.* 211; Corner *l.c.* 119; Kochummen *l.c.* 36; Whitmore, Tantra & Sutisna *l.c.* 17; Kostermans & Bompard *l.c.* 88. **Type:** *Drawing in Hermann's Herb.* (BM). **Synonyms:** *M. laurina* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 195; *M. longipes* Griff., Notul. Pl. As. 4 (1854) 419, Masamune *l.c.* 411; *M. applanata* Kosterm. in Kostermans & Bompard, The mangoes (1993) 64, *syn. nov.*; *M. bompardii* Kosterm. in Kostermans & Bompard *l.c.* 174, *syn. nov.*; *M. orophila* Kosterm. in Kostermans & Bompard *l.c.* 138, *syn. nov.*; *M. rubropetala* Kosterm. in Kostermans & Bompard *l.c.* 107, *syn. nov.*

Medium-sized tree to 35 m tall, 90 cm diameter. **Bark** greyish, shallowly fissured and scaly. **Leaves** spirally arranged, drying greenish, not papillose beneath; elliptic, oblong or lanceolate, 8–30 × 2–6 cm; base acute, margin entire, often wavy, apex acute; midrib not pinkish on drying beneath, lateral veins 12–30 pairs, visible on both surfaces, intercostal veins reticulate, distinct below, faint to distinct above; petioles 1.5–2 cm long, base swollen. **Inflorescences** pseudoterminal or axillary, pyramidal panicles, to 40 cm long, hairy or glabrous. **Flowers** 5-merous; calyx hairy or glabrous outside; petals pale green to yellowish; stamens 5, fertile stamen one, filaments free; disc cup-shaped; style lateral. **Fruits** very variable in size and shape, subglobose to oblong, to 30 × 10 cm, ripening green to yellowish to greenish red; pulp yellowish to orange.

**Vernacular names.** Sabah—*mempelam* (Malay). Sarawak—*empelam* (Malay).

**Distribution.** India, Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, New Guinea. Of scattered occurrence in Sabah and Sarawak but extensively cultivated; also in Brunei and Kalimantan.

**Ecology.** Lowland to lower montane forest, to 1700 m; cultivated throughout the tropics and subtropics.

**Uses.** Cultivated extensively for its edible fruits which can be eaten either raw, ripe or processed into chutneys, pickles, dried slices, jam, etc. Mango juice is a popular drink.

**Taxonomy.** Ding Hou (*l.c.* 427) considered *M. laurina* as a synonym of *M. indica* while keeping *M. longipes* as a separate species. Kostermans & Bompard (*l.c.* 120) treated *M. laurina* as distinct species with *M. longipes* as its synonym. It is interesting to note that Bompard (*l.c.* 216) recorded the vernacular names "empelam", "mempelam" and "mangga-ayer" for *M. laurina* which are the same vernacular names given to *M. indica*. By studying the descriptions given by Kostermans of his new species and the available collections, I have come to the conclusion that *M. applanata*, *M. bompardii*, *M. rubropetala*, and *M. orophila*, as well as *M. laurina* and *M. longipes*, are just variants of *M. indica*. Accordingly, these species are reduced to synonymy under *M. indica*. With this reduction, the species occurs naturally in the whole Indo-Malesian region and is not confined to parts of India and Myanmar as stated by Kostermans & Bompard (*l.c.* 96).

## 7. *Mangifera khoonmengiana* Kochummen

Fig. 9.

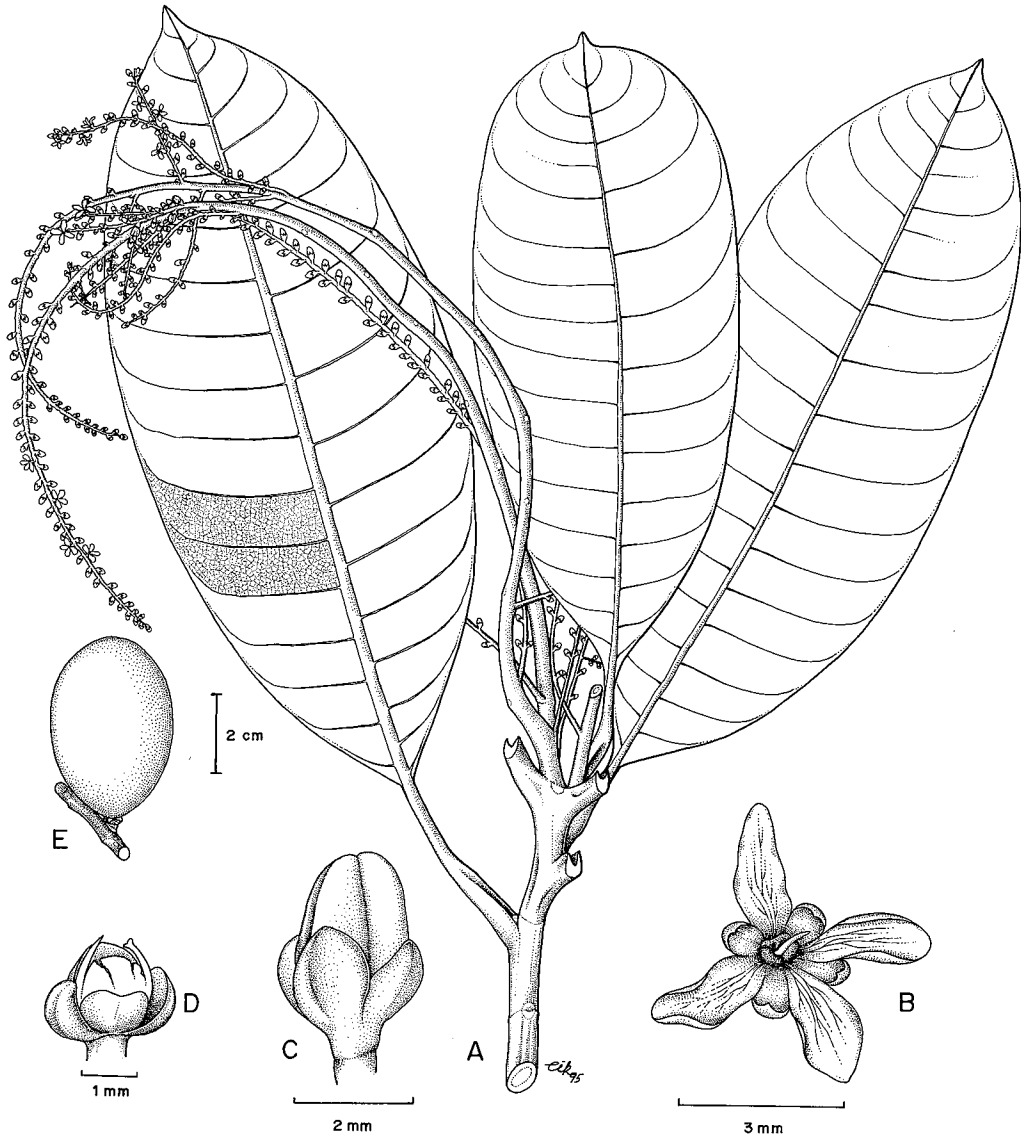
(Wong Khoon Meng, forest botanist at Kepong, Brunei and Sandakan)

Sandakania 7 (1996) 83. **Type:** *K.M. Wong 682*, Brunei (holotype KEP; isotypes BRUN, K).

Medium-sized tree to 30 m tall, 40 cm diameter. **Bark** brownish, smooth to slightly fissured; inner bark bright yellow with creamy latex which turns blackish on exposure. **Sapwood** pale yellow. Twigs brownish or yellowish brown, glossy, slightly angular. **Leaves** spirally arranged, drying brownish, coriaceous; elliptic or oblong, 15–20 × 6–9.5 cm; base cuneate, margin thickened, recurved, apex rounded with short blunt-tip; lateral veins 13–15 pairs, almost at right angles to midrib, faintly raised on both surfaces, intercostal veins finely reticulate, visible on the lower surface, almost invisible above; petioles 1.5–2 cm long, base swollen. **Inflorescences** terminal, racemose panicles, to 30 cm long, glabrous, with few side branches; bracteoles lanceolate. **Flowers** pale green to creamy, 4-merous; pedicels very short, to 1 mm long; sepals 4, ovate, fleshy; petals with circular brown gland-dots, membranous, oblong with rounded apex and base, ridges 4 with a number of branches; disc distinct, cup-shaped; stamens 4, fertile stamen one, filaments free; ovary globose, style slightly eccentric. **Fruits** green when fresh, dark brown on drying, oblong, 2.5–3.5 × 2 cm, with rounded apex and base, sessile.

**Distribution.** Endemic to Borneo. In Sarawak, very uncommon and known from a single collection, S. 36600, from Miri; not yet reported from Sabah.

**Ecology.** Lowland forest. In Brunei growing gregariously in swampy areas.



**Fig. 9.** *Mangifera khoonmengiana*. A, flowering leafy twig; B, open flower viewed from above; C, flower bud; D, flower bud with one sepal removed; E, fruit. (A–D from Wong WKM 882, E from S. 36600.)

## 8. *Mangifera macrocarpa* Blume

(Greek, *makros*=large, *karpos*=fruit)

Bijdr. Fl. Ned. Ind. (1826) 1158; Mukherji *l.c.* 119; Backer & Bakhuizen *f. l.c.* 148; Burgess *l.c.* 20; Ding Hou, *Blumea* 24 (1978) 26, FM 1, 8 (1978) 439; Kochummen *l.c.* 37; Whitmore, Tantra & Sutisna *l.c.* 17; Kostermans & Bompard *l.c.* 157. **Type:** *Blume, s.n.* (= *L. sheet no.* 897. 363–552), Java, Mt. Seribu (holotype L; isotype BO).

Medium-sized to tall tree to 37 m tall, 70 cm diameter. **Bark** grey, fissured; inner bark laminated, yellowish, with white sap. **Sapwood** yellowish. **Leaves** spirally arranged, drying greenish, greenish yellow to pale yellow, not papillose below; linear, 16–44 × 2–4 cm; base cuneate to attenuate, apex acute; midrib not pinkish on drying beneath, lateral veins 25–33 pairs, with short intermediate veins, very faint on both surfaces, intercostal veins reticulate, very faintly visible on both surfaces; petioles 6–10 cm long. **Inflorescences** terminal panicles, pyramidal, to 20 cm long, glabrous. **Flowers** (only male seen) 5-merous; sepals ovate-lanceolate; petals white, linear-oblong, each with 1–3 ridges; stamens 5, 1 fertile, filaments free; disc obscure. **Fruits** obliquely, broadly oblong-globose, 8–12 cm long, with yellow pulp.

**Distribution.** Thailand, Sumatra, Peninsular Malaysia, Java, Borneo. Very uncommon in Sabah, known only from few collections from Beaufort, Kalabakan, Lahad Datu, Tawau, Tenom and Sandakan districts; not yet reported from Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 150 m on hilly areas.

## 9. *Mangifera magnifica* Kochummen

(Latin, *magnus* = large; the tree)

Gard. Bull. Sing. 36 (1983) 189, *l.c.* (1989) 37; Kostermans & Bompard *l.c.* 75. **Type:** *Conservator of Forests, Kedah, KEP 20562*, Peninsular Malaysia, Kedah, G. Jerai (holotype KEP; isotype SING).

Tree to 40 m tall, 130 cm diameter. **Bark** grey-brown, smooth to fissured or scaly; inner bark yellowish brown with white latex which turns to yellow and then black on exposure. **Sapwood** pale yellow. Twigs stout, to 8 mm thick, angular. **Leaves** spirally arranged, sometimes in pseudowhorls at the ends of twigs, drying brownish, very thick-coriaceous (cardboard-like); elliptic to oblong, 13–17.5 × 5–9 cm; base broadly cuneate, apex obtuse, rounded or acute; lateral veins 15–17 pairs, prominently raised below, faint above, intercostal veins reticulate, visible on both surfaces; petioles stout, 2–3 cm long, basal part swollen and rugose. **Inflorescences** terminal and axillary panicles. **Flowers** fragrant, 4-merous; sepals yellowish white or with red tinge when fresh; petals white, each with 3–4 yellow ridges; fertile stamen one, filaments free; disc pulvinate, obscurely lobed; style lateral. **Fruits** ovoid or oblong, 9–12 × 8–10 cm, grey-green, often with brown spots; pulp whitish, with a sweet to acidic taste.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely distributed but uncommon in Sabah and Sarawak.

**Ecology.** Lowland and hill forests, to 500 m.

**10. *Mangifera pajang* Kosterm.**(from the local Kalimantan name—*asem pajang*)

Reinwardtia 7 (1965) 20; Ding Hou, Blumea 24 (1978) 27, FM 1, 8 (1978) 436; Anderson *l.c.* 136; Whitmore, Tantra & Sutisna *l.c.* 18; Bompard *l.c.* 209; Kostermans & Bompard *l.c.* 147. **Type:** *Kostermans 12534*, Borneo, Kalimantan (holotype BO; isotypes K, L, SAN, SING).

Medium-sized tree to 30 m tall, 70 cm diameter. **Bark** dark brown, smooth to shallowly fissured; inner bark brownish with creamy latex. Twigs stout, 1–2 cm thick, angular. **Leaves** usually spirally arranged, sometimes in pseudowhorls, drying brownish, thick-coriaceous; elliptic to oblong or obovate, 15–28 × 5.5–12.5 cm; base cuneate, apex obtuse; midrib usually finely grooved on the under surface, lateral veins 13–25 pairs, raised on both surfaces, intercostal veins invisible on both surfaces; petioles 3.5–9 cm long, strongly swollen at base, upper surface flattened and concave at base, irregularly rugose below. **Inflorescences** terminal or appearing in the axils of upper leaves, to 30 cm long. **Flowers** 5-merous; calyx glabrous, dark purple; petals purplish inside, pinkish white outside, each with 3 ridges; stamens 5, fertile stamens 1–2, filaments free; disc stalk-like; ovary whitish, style eccentric. **Fruits** rugose, brownish, globose to ellipsoid, 10–12 × 8.5–10 cm; epicarp thick, and can be peeled off like a banana skin; pulp deep orange-yellow, sweet.

**Vernacular names.** Sabah—*bambangan*, *embawang* (Malay). Sarawak—*embang* (Malay), *bawang*, *mawang* (Bidayuh).

**Distribution.** Endemic to Borneo. In Sabah and Sarawak, uncommon in the forest, often cultivated for its fruit; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 500 m, often in swampy and riverine habitats.

**Uses.** The fruit is edible and is in great demand.

**Notes.** This species is very similar to *M. foetida* in leaf characters. However, the stouter twigs, generally larger leaves and longer rugose petioles distinguish it from *M. foetida*.

**11. *Mangifera parvifolia* Boerl. & Koord.**(Latin, *parvus* = small, *folium* = leaf)

In Koorders-Schumacher, Syst. Verz. 2 (1910) 31; Mukherji *l.c.* 130; Ding Hou, Blumea 24 (1978) 28, FM 1, 8 (1978) 431; Kostermans & Bompard *l.c.* 39. **Type:** *Koorders 21218*, Sumatra, Sg. Buwatan (BO). **Synonym:** *Mangifera havilandii* Ridl., Kew Bull. (1933) 194, Masamune *l.c.* 411, Anderson *l.c.* 36.

Medium-sized tree to 30 m tall, 40 cm diameter. **Bark** reddish brown, shallowly fissured. Twigs reddish brown, smooth; axillary buds globose, persistent. **Leaves** spirally arranged, well-spaced, coriaceous, drying greenish, not papillose below; elliptic to narrowly obovate or oblong 8.5–12.5 × 4.5–6.5 cm; base cuneate, margin not thickened or recurved, apex acuminate, acumen c. 1 cm long; midrib not pinkish on drying beneath, lateral veins 8–10 pairs, faint on both surfaces, intermediate veins absent or invisible, intercostal veins

*reticulate, very faintly visible below, invisible above; petioles 1.5–4.5 cm long, swollen at base. Inflorescences* axillary or pseudoterminal panicles. **Flowers** 4-merous; petals whitish; *stamens 4, fertile stamen one, filaments free; disc cup-shaped; style lateral. Fruits* cylindrical or ellipsoid, smooth, blue-black, to 6 × 3 cm, with orange pulp.

**Vernacular name.** Sarawak—*raba* (Malay).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sabah and Sarawak, uncommon, mainly in mixed swamp forests to 300 m.

## 12. *Mangifera quadrifida* Jack

(Latin, *quadrifidus* = 4-cleft; the 4-merous flowers)

In Roxburgh, Fl. Ind. ed. Wall. 2 (1824) 440; King *l.c.* 471; Merrill *l.c.* (1921) 349; Ridley *l.c.* 522; Mukherji *l.c.* 112; Ding Hou, Blumea 24 (1978) 28, FM 1, 8 (1978) 429; Anderson *l.c.* 137; Corner *l.c.* 120; Kochummen *l.c.* 38; Whitmore, Tantra & Sutasna *l.c.* 18; Kostermans & Bompard *l.c.* 68. **Type:** Jack, *Herb. Wallich Cat.* 8489, Penang (K).

Large tree to 42 m tall. Twigs reddish brown, angular. **Leaves** *spirally arranged, thin-coriaceous, drying pale yellow or yellowish green, not papillose below*; elliptic to oblong to narrowly obovate, 9.5–30 × 4–7 cm; base cuneate, apex acute, or obtuse to rounded; midrib not pinkish on drying beneath, *lateral veins 9–22 pairs, faintly raised on both surfaces, intercostal veins reticulate, visible on both side; petioles 1.5–5.5 cm long, swollen at base. Inflorescences* terminal and axillary panicles, *glabrous. Flowers* 4-merous; *petals whitish, each with 3 ridges; stamens 4, fertile stamen one, filaments free; disc pulvinate; style eccentric. Fruits* ellipsoid or globose, 6–8 × 5–6 cm, green, ripening black; pulp orange-yellow.

**Vernacular name.** Sarawak—*asam kumbang* (Malay).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, Sulawesi, the Lesser Sunda Islands and Maluku; extremely uncommon in Sabah and Sarawak. In Sabah, known from Kudat, Keningau and Tenom districts, while the only record from Sarawak is from Kuching area; also in Brunei and Kalimantan.

**Ecology.** Lowland forest at very low altitude.

## 13. *Mangifera rufocostata* Kosterm.

(Latin, *rufus* = reddish; *costa* = midrib; the reddish midrib of the leaves)

In Kostermans & Bompard *l.c.* 116. **Type:** *Kostermans 9799*, Borneo, Kalimantan (holotype BO; isotypes BM, L).

Medium-sized to very tall tree to 45 m tall, 120 cm diameter; bole with buttresses to 2.5 m high. **Bark** grey, smooth to fissured and scaly; inner bark yellow. **Sapwood** pale green. Twigs slender, dark brown. **Leaves** *spirally arranged, coriaceous, drying greenish, greenish yellow or pale yellow, papillose and with scattered black dots beneath*; ovate to oblong, 8–17 × 2.5–6 cm; base cuneate, apex obtuse or acute; *midrib pinkish brown on drying beneath, lateral veins*

10–18 pairs, very faint below, visible above, intercostal veins reticulate, very faintly visible on both surfaces; *petioles* 1–2 cm long. **Inflorescences** terminal or subterminal racemes, to 15 cm long, glabrous, pedicels articulate. **Flowers** pale yellow, 5-merous; petals oblong, 4–5 mm long; *stamens* 5, fertile stamen one, filaments free; disc distinct, pulvinate. **Fruits** obliquely globose, 8.5–10 cm, brownish green with numerous brown lenticels; pulp whitish, strongly fibrous.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely distributed in Sabah, not yet reported from Sarawak.

**Ecology.** Lowland to lower montane forest, to 1500 m.

#### 14. *Mangifera subsessilifolia* Kosterm.

(Latin, *subsessilis* = almost without stalk, *folium* = leaf)

In Kostermans & Bompard *l.c.* 180. **Type:** *Kostermans, s.n.*, Singapore, Bt. Timah (holotype L; isotype BO).

Medium-sized tree to 25 m tall. Twigs brown, strongly ridged. **Leaves** in close spirals, appearing as in pseudowhorls, drying brownish, thick-coriaceous; narrowly lanceolate, 25–45 × 2.3–3 cm; base attenuate, margin slightly curled inwards, apex acute with blunt tip; lateral veins more than 40 pairs, curving near margin, very faint below, raised above, intercostal veins reticulate, distinct above, inconspicuous below; *petioles* stout, to 1 cm long. **Inflorescences, flowers and fruits** unknown.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Extremely uncommon in Sabah, known from a single collection (SAN 16792) from Sipitang district, not yet reported from Sarawak.

**Ecology.** Hill forest at about 375 m.

#### 15. *Mangifera swintonioides* Kosterm.

(resembling the genus *Swintonia*)

In Kostermans & Bompard *l.c.* 80. **Type:** *G.H.S. Wood SAN 16489*, Sabah, Tawau (holotype BO; isotypes KEP, SAN, SING).

Tree to 40 m tall, 70 cm diameter. **Bark** grey, cracking and scaly; inner bark yellowish brown. **Sapwood** white. Twigs pale brown, 4 mm thick, slightly angular. **Leaves** spirally arranged, more or less aggregated towards the ends of twigs, thin-coriaceous, drying greenish, not papillose below; oblong or elliptic, 7–15 × 2.5–4 cm; base cuneate, apex acute; midrib not pinkish on drying beneath, lateral veins 13–23 pairs, slightly raised below, very faint above, intercostal veins reticulate, very faintly visible below, almost invisible above; *petioles* 4–7 cm long, strongly swollen at base, swollen part whitish. **Inflorescences** pseudoterminal panicles, glabrous. **Flowers** 5-merous; sepals thin with pale yellow margins; petals whitish, each with 4–6 ridges; fertile stamen one, filaments free; disc pulvinate; style eccentric. **Fruits** oblong, to 11.5 × 10 cm, pale grey-brown, pulp whitish.



**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Uncommon in Sabah, recorded from Kudat, Lahad Datu, Sandakan, Sipitang and Tawau districts; not yet reported from Sarawak.

**Ecology.** Lowland forest.

### 16. *Mangifera torquenda* Kosterm.

(Latin, *torquendus* = cut across and twisted; the manner by which ripe fruit is opened for consumption)

Reinwardtia 7 (1965) 21, in Kostermans & Bompard *l.c.* 60. **Type:** *Kostermans 12533*, Borneo, Kalimantan (holotype BO; isotypes A, BM, K, KEP, L, P, SING).

Tree to 36 m high, 60 cm diameter. **Bark** greyish, shallowly fissured to scaly; inner bark orange with white latex. **Sapwood** pale. Twigs dark brown, slightly angular. **Leaves** spirally arranged, thick-coriaceous, drying greenish, not papillose below; oblong or elliptic, 12.5–23(–32) × 4–8(–11); base broadly cuneate to rounded, margin not thickened but recurved, apex acute; midrib not pinkish on drying beneath, lateral veins 14–20 pairs, raised on both surfaces, intercostal veins finely reticulate, distinctly visible below, faint above; petioles 2–7 cm long, strongly swollen at base. **Inflorescences** pseudoterminal, sparsely hairy at the basal part. **Flowers** 4-merous, sweet scented, pale yellow; each petal with 6 ridges, the central ridges with 3 upright branches ending in tiny globose glands; stamens 4, fertile stamen one, filaments free; disc pulvinate, 4-lobed; style eccentric. **Fruits** globose, c. 7.5 × 6.5 cm, yellowish green with darker dots when fresh; pulp pale yellow, with turpentine smell, with short fibre, tasting sweet to acidic. **Seeds** surface grooved.

**Vernacular names.** Sabah—*buniton*, *bunyitan* (Murut). Sarawak—*kemantan*, *lemantan*, *mantan*, *rade* (Iban).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Uncommon in Sabah and Sarawak. In Sabah, recorded from Kalabakan, Lahad Datu, Sandakan, Tawau and Tenom areas; in Sarawak, collected from Lundu, Serian, and Bintulu areas.

**Ecology.** Lowland and hill forests, to 800 m; also cultivated; also in Kalimantan.

**Uses.** The fruit is edible and is peeled by making a cross-section and twisting the two halves in opposite directions.

**Taxonomy.** Kessler & Sidiyasa (1994), following Ding Hou's treatment (1978), considered *M. torquenda* a synonym of *M. similis* Blume. Kostermans & Bompard (1993), however, have given sufficient reasons to treat these two species as distinct, an opinion accepted in the present account. *M. similis* (which does not occur in Sabah and Sarawak) differs from *M. torquenda* by its conspicuously raised, reticulate intercostal veins on the upper leaf surface, shorter petioles, clustered flowers in subracemose, minutely hairy panicles, minutely hairy flowers, strongly prominent petals ridges topped by larger glands, a compact disc which is not much broader than the ovary, and the seeds without grooves.

## 10. MELANOCHYLA Hook. f.

(Greek, *melanos* = black, *chulos* = sap; the black exudate from bruised parts)

Fl. Br. Ind. 2 (1876) 38; King, J. As. Soc. Beng. 65, 3 (1896) 502; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 541; Masamune, EPB (1942) 411; Smythies, CST (1965) 10; Backer & Bakhuizen *f.*, FJ 2 (1965) 154; Burgess, TBS (1966) 25; Ding Hou, Blumea 24 (1978) 29, FM 1, 8 (1978) 490; Anderson, CLTS (1980) 137; Wong, DMT (1982) 136; Corner, WSTM 3rd ed. 1 (1988) 128; Kochummen, TFM 4 (1989) 40; Whitmore, Tantra & Sutisna, CLK 1 (1989) 18; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 43.

Small to medium-sized trees; bole with short buttresses or stilt-roots (in swampy habitats). **Bark** reddish brown, smooth to cracking; inner bark reddish brown, granular, often with droplets of black sap. **Sapwood** whitish. **Leaves** spirally arranged, simple, usually papillose beneath. **Inflorescences** axillary or terminal panicles, rarely in fascicles, with bracts and bracteoles; *pedicels articulate*. **Flowers** unisexual (plants dioecious), 4–5-merous; *hypanthium* (receptacle) cup-shaped, hairy outside, slightly accrescent in fruit; calyx 5- or 4-lobed; *petals* 5 or 4, imbricate (sometimes only slightly), hairy outside, densely woolly inside; stamens 5 or 4, filaments free or lower part laterally adnate to the petals, densely hairy, anthers dorsifixed, imperfect or aborted in female flowers; *disc intrastaminal*, rim-like, 5- or 4-lobed; *ovary superior*, rarely *semi-inferior* or *inferior*, 1-locular, usually densely hairy, style distinct, *stigmas* 3; ovary in male flowers very small or abortive. **Fruits** hairy outside, mesocarp and endocarp full of black resin. **Seeds** with testa fused to the endocarp; embryo straight, cotyledons free.

**Distribution.** Thirty species; Thailand, Sumatra, Peninsular Malaysia, Java, Borneo; 17 species in Sabah and Sarawak.

**Ecology.** Mainly in the lowland, including swamp, sandstone and limestone forests, rarely in lower montane forest to 1350 m.

**Uses.** The timber is medium hardwood, grain interlocking and slightly wavy, sapwood sharply differentiated from the heartwood which is dark brown with black streaks. In Sabah and Sarawak, the timber has no commercial importance at present.

### Key to *Melanochyla* species

1. Leaves glabrous.....2  
    Leaves hairy, at least on the midrib below.....11
2. Leaves in close clusters, subsessile; leaf base auricled.....2. **M. auriculata**  
    Leaves well-spaced, with well-developed petioles; base not auricled.....3
3. Leaves distinctly glaucous below. Inflorescences axillary panicles to 3 cm long.....  
    .....3. **M. axillaris**  
    Leaves not or only very faintly glaucous below. Inflorescences usually terminal or  
    appearing from the axils of upper leaves, very much longer.....4

4. Twigs stout to 1 cm thick. Leaves thick-coriaceous; petioles thick and stout, 3–4 cm long. Large tree of lower montane forest, at 1370–1800 m.....**13. M. montana**  
 Not this combination of characters.....5
5. Leaf intercostal veins distinctly scalariform.....**14. M. scalarinervis**  
 Leaf intercostal veins reticulate or scalariform-reticulate.....6
6. Leaf base usually almost subcordate or obtuse; papillae in distinct groups on the lower leaf surface. Fruits with spiny processes.....**11. M. fulvinervis** (in part)  
 Leaf base not so; papillae either obscure or uniformly distributed on lower leaf surface. Fruits without spiny processes.....7
7. Lower half of petioles swollen and whitish and often irregularly rugose on drying. Leaves not shiny above.....8  
 Lower half of petioles not swollen. Leaves shiny above.....**7. M. caesia** (in part)
8. Twigs distinctly whitish. Leaves distinctly papillose beneath.....9  
 Twigs grey-brown. Leaves not or only faintly obscurely papillose beneath.....  
 .....**1. M. angustifolia**
9. Leaf base obtuse; lateral veins sunken above, intercostal veins scalariform-reticulate.....**17. M. woodiana**  
 Leaf base cuneate; lateral veins not sunken above; intercostal veins reticulate.....10
10. Leaves drying reddish brown, faintly glaucous and distinctly papillose beneath.....  
 .....**15. M. semecarpoides**  
 Leaves drying yellowish green, not glaucous and faintly papillose beneath.....  
 .....**8. M. castaneifolia**
11. Leaves sparsely hairy below.....12  
 Leaves densely hairy below.....16
12. Leaves not or only faintly papillose beneath; leaf base cuneate.....**12. M. minutiflora**  
 Leaves distinctly papillose beneath; leaf base subcordate, obtuse or rounded, rarely cuneate.....13
13. Leaf base subcordate or obtuse; papillae on the lower leaf surface in groups. Fruit with spiny processes.....**11. M. fulvinervis** (in part)  
 Leaf base cuneate or rounded; papillae on the lower leaf surface uniformly distributed or in groups. Fruit not so.....14
14. Papillae in distinct groups on the lower leaf surface.....**5. M. borneensis**  
 Papillae uniformly distributed on the lower leaf surface.....15
15. Leaves shiny above, glaucous below; intercostal veins scalariform-reticulate.....  
 .....**7. M. caesia** (in part)  
 Leaves not shiny above, not glaucous below; intercostal veins scalariform.....  
 .....**10. M. elmeri**

16. Leaves bullate above; intercostal veins scalariform, distinctly sunken on the upper leaf surface.....**6. M. bullata**  
Leaves not bullate above; intercostal veins scalariform-reticulate or reticulate, usually not sunken on the upper leaf surface.....17
17. Leaves slightly glaucous below.....**4. M. beccariana**  
Leaves not glaucous below.....18
18. Leaves more than 50 cm long; lateral veins 40–44 pairs, sunken on the upper leaf surface. Inflorescences in axillary clusters, 6–7 cm long.....**9. M. condensata**  
Leaves smaller; lateral veins fewer, very faint on the upper leaf surface. Inflorescences terminal or axillary, to 30 cm long.....**16. M. tomentosa**

1. **Melanochyla angustifolia** Hook. *f.*

(Latin, *angustus* = narrow, *folium* = leaf)

Fl. Br. Ind. 2 (1876) 39; King *l.c.* 506; Ridley *l.c.* 541; Ding Hou, FM 1, 8 (1978) 496; Kochummen *l.c.* 41; Whitmore, Tantra & Sutisna *l.c.* 18. **Type:** *Maingay* 492, Malacca (holotype K; isotype L).

Small to medium-sized tree to 30 m tall, 45 cm diameter; bole with buttresses to 2.5 m high. **Bark** grey-brown to reddish, smooth to cracking; inner bark brownish with white latex, soon becoming black. **Sapwood** whitish. Twigs grey-brown, strongly grooved, glabrous or sparsely hairy. **Leaves** *well-spaced*, thin-coriaceous; *not glaucous below, not shiny above*, glabrous; *papillae obscure*; elliptic to narrowly obovate, 15–27.5 × 3.5–9 cm; *base attenuate and not auricled*, apex acuminate, acumen to 1.5 cm long; midrib raised above with median groove, lateral veins 12–24 pairs, curving and joining near margin, raised below, faint above, *intercostal veins scalariform-reticulate*, visible below, faint to inconspicuous above; *petioles 2–4.5 cm long, often swollen at the lower half, strongly rugose* on drying, glabrous or sparsely hairy. **Inflorescences** terminal hairy panicles, *to 30 cm long*. **Flowers** yellowish, subsessile; calyx lobes triangular; petals oblong, elliptic, lanceolate, or oblanceolate, flat; stamen filaments free; staminodes small; disc 5- or 4-lobed; ovary globose, stigmas minute, capitate; pistillodes replaced by tufts of hairs. **Fruits** ellipsoid, 2–2.5 × 1.5 cm, ripening yellowish, apex rounded, *surface smooth*, sparsely hairy.

**Distribution.** Peninsular Malaysia, Borneo. Uncommon in Sabah and Sarawak. Recorded from Beluran, Kota Merudu, Lamag and Sandakan areas in Sabah, and from Anap, Gunung Gading, Kapit and Tubau areas in Sarawak; also in Kalimantan.

**Ecology.** Lowland to lower montane forest to 1100 m; on ridges and hillsides. Flowering in April to November and fruiting in January.

2. **Melanochyla auriculata** Hook. *f.*

(Latin, *auriculatus* = furnished with ear-like appendage; the leaf base)

*l.c.* 39; King *l.c.* 505; Ridley *l.c.* 540; Ding Hou, FM 1, 8 (1978) 495; Corner *l.c.* 128; Kochummen *l.c.* 41; Whitmore, Tantra & Sutisna *l.c.* 18; Kessler & Sidiyasa *l.c.* 44. **Type:** *Maingay* 1897, Malacca (holotype K).

Tree to 30 m tall, 70 cm diameter; bole with steep buttresses to 2 m tall. **Bark** grey-green, smooth with horizontal rings; inner bark reddish brown with black latex. **Sapwood** whitish. *Twigs stout, 1–2 cm thick, strongly grooved*, young parts densely covered with reddish brown short hairs. **Leaves** in close clusters, *glabrous*; narrowly obovate, 20–46 × 8–10 cm; *base* attenuate, *auricled*, apex acute; midrib raised above, lateral veins 20–25 pairs, raised on both surfaces, *intercostal veins scalariform-reticulate*, visible below, invisible above; *petioles absent or stout and to 5 mm long*. **Inflorescences** terminal panicles, to 6 cm long, axes strongly angular. **Flowers** white, sessile; calyx lobes ovate-oblong; petals oblong, elliptic or lanceolate, slightly longitudinally ridged inside; stamen filaments free; disc 5- or 4-lobed; ovary subglobose, stigma minute, capitate; pistillodes replaced by tufts of hairs. **Fruits** rusty hairy, rugose, 2–3.5 × 2–2.5 cm.

**Distribution.** Peninsular Malaysia, Borneo. Of scattered occurrence in Sabah, not yet reported from Sarawak.

**Ecology.** Lowland, including riverbank, to hill forest, to 400 m. Flowering in May and September, fruiting in May and June.

### 3. *Melanochyla axillaris* Ridl.

(Latin, *axillaris* = growing in an axil; the flowers)

Kew Bull. (1933) 198; Masamune *l.c.* 411; Ding Hou, *Blumea* 24 (1978) 29, FM 1, 8 (1978) 495; Anderson *l.c.* 137. **Lectotype** (Ding Hou, 1978): *Haviland 2211*, Borneo, Sarawak (K; isoelectotypes BM, L, SING).

Medium-sized tree to 24 m tall, 20 cm diameter. Twigs stout, 1.5 cm thick, grey-brown. Bud scales lanceolate, velvety brown-hairy. **Leaves** *well-spaced; distinctly glaucous below, glabrous on both surfaces; papillae distinct on the lower leaf surface*; oblanceolate, 18–67 × 4–16.5 cm; *base* attenuate, *not auricled*, apex obtuse or acute; midrib flattened above, lateral veins 21–37 pairs, *intercostal veins scalariform-reticulate*, visible below, faint to invisible above; *petioles 3–8 cm long*, lower half swollen, rusty velvety hairy and strongly rugose on drying. **Inflorescences** *axillary panicles, 1–3 cm long*; bracts lanceolate, 1.5–2 mm long. **Flowers:** hypanthium 3–4 mm long; calyx lobes triangular or ovate, *c.* 2 mm long; petals oblong or obovate-oblong, 4–5 × 1.2–1.7 mm; lower parts of stamen filaments united with the petals; disc 5-lobed; ovary subglobose, rusty hairy, style short, stigmas minute, capitate. **Fruits** broadly ellipsoid or ovoid, *c.* 3 × 2 cm, rusty hairy, apex acute, *surface smooth*.

**Distribution.** Endemic to Borneo. Reported from Sarawak only with few collections from Kuching and Lundu areas.

**Ecology.** Lowland forest to 450 m. Flowering in April and November and fruiting in January and April.

### 4. *Melanochyla beccariana* Oliv.

Fig. 10A–B.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

In Hooker, *Icon. Pl.* 24 (1894) *t.* 2313; Merrill *l.c.* 351; Masamune *l.c.* 411; Ding Hou, FM 1, 8 (1978)



**Fig. 10.** *Melanochyla beccariana* (A–B); *M. borneensis* (C–E); *M. fulvinervis* (F). A, inflorescence; B, flower in longitudinal section; C, leafy twig; D, detail of lower leaf surface; E–F fruits. (A–B from SAN 21255, C–E from S. 37898, F from FRI 10599.)

497; Anderson *l.c.* 137; Whitmore, Tantra & Sutisna *l.c.* 18. **Syntypes:** *Beccari PB 2546*, Borneo, Sarawak (K); *Haviland 814*, Borneo, Sarawak (K).

Medium-sized tree to 24 m tall, 35 cm diameter. *Twigs densely reddish brown hairy. Leaves well-spaced; velvety reddish brown hairy below and on midrib above, slightly glaucous below; papillae uniformly distributed below; oblong or narrowly obovate, (10-)20-29 × (3-)8.5-12 cm; base cuneate, apex rounded or with very short tip; midrib raised above, lateral veins 17-31 pairs, distinctly raised below, with 1-2 short intermediate veins in between each pair, faint and rarely sunken above, intercostal veins scalariform-reticulate, distinct below, faint above; petioles 0.5-2.5 cm long, densely reddish brown hairy, rugose on drying. Inflorescences terminal and axillary panicles, to 33 cm long, densely short-hairy; bracts linear, to 1.5 cm long. Flowers subsessile; calyx lobes triangular or ovate oblong; petals ovate-oblong or lanceolate; stamen filaments united laterally with the petals; disc 5-lobed; ovary deeply or completely concealed by the receptacle; stigma minute, capitate. Fruits ellipsoid or ovoid, 2.5-4.5 × 1.2-2.2 cm, with blunt or slightly acute apex, rusty velvety hairy, surface smooth.*

**Distribution.** Endemic to Borneo. Uncommon in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland to lower montane forest, to 1500 m. Flowering and fruiting in April and July.

### 5. *Melanochyla borneensis* (Ridl.) Ding Hou (of Borneo)

Fig. 10C-E.

*Blumea* 24 (1978) 31, FM 1, 8 (1978) 497; Anderson *l.c.* 137; Whitmore, Tantra & Sutisna *l.c.* 18. **Basionym:** *Nothopegia borneensis* Ridl., *Kew Bull.* (1933) 197. **Type:** *Beccari PB 241*, Borneo, Sarawak (holotype K; isotypes BO, L, S).

Medium-sized tree to 25 m tall, 30 cm diameter. **Bark** dark grey, smooth. **Leaves** well-spaced, thick-coriaceous; glabrous above except the sparsely hairy midrib, *sparsely hairy below; papillae in prominent horseshoe-shaped groups on the lower leaf surface; elliptic, oblong or obovate, 9-28.5 × 5.5-12 cm; base cuneate to broadly rounded, not auricled, apex cuspidate; midrib prominently raised above, channelled below, lateral veins 18-24 pairs, sunken above, raised below, intercostal veins reticulate, distinct below, obscure above; petioles stout, rugose on drying, 1-3.5 cm long, softly hairy, glabrescent. Inflorescences axillary, to 15 cm long. Flowers sessile, yellowish; calyx lobes triangular; petals ovate, flat; stamen filaments free; disc 4-5-lobed; ovary globose, stigma discoid; pistillodes minute, hairy. Fruits ellipsoid to subglobose, 3-4 × 2-2.5 cm, with rounded or pointed apex, surface soft-hairy, smooth.*

**Distribution.** Endemic to Borneo; so far reported only from the Kuching area (including the Semengoh Arboretum) in Sarawak.

**Ecology.** Lowland forest, to 100 m.

### 6. *Melanochyla bullata* Ding Hou

(Latin, *bullatus* = inflated; the protruding leaf upper surface between veins)

Blumea 24 (1978) 31, FM 1, 8 (1978) 496; Whitmore, Tantra & Sutisna *l.c.* 19; Kessler & Sidiyasa *l.c.* 44. **Type:** *Anderson et al. S. 15436*, Borneo, Sarawak, Lundu (holotype L; isotypes BO, SAR, SING).

Small to medium-sized tree to 30 m tall, 80 cm diameter. **Bark** brown, smooth to scaly. Twigs greyish. **Leaves** *well-spaced, densely hairy below, bullate above*; oblanceolate to narrowly obovate, 13.5–42 × 5–9 cm; *base cuneate, not auricled*, apex rounded with very short tip; midrib flattened above, *lateral veins* 33–38 pairs, *sunken above*, raised below, *intercostal veins scalariform, sunken above*, raised below; *petioles* whitish, 2–3 cm long, *lower half flattened*. **Inflorescences** terminal rusty hairy panicles. **Flowers** (only male seen) yellow, sessile; calyx lobes triangular; petals ovate or ovate-oblong, thickened at the lower two-thirds inside; stamen filaments free; disc obscurely 5-lobed; pistillodes minute, glabrous. **Fruits** ovoid, 3.5–4 × 2–4.5 cm, velvety hairy, apex pointed, *surface smooth*.

**Distribution.** Endemic to Borneo. Uncommon in Sabah and Sarawak. In Sabah, known from Sandakan and Tawau districts and in Sarawak, from Lundu area; also in Kalimantan.

**Ecology.** Lowland forest to 500 m.

## 7. *Melanochyla caesia* (Blume) Ding Hou

(Latin, *caesius* = lavender-blue; the leaf lower surface)

Blumea 24 (1978) 31, FM 1, 8 (1978) 498; Kochummen *l.c.* 42; Whitmore, Tantra & Sutisna *l.c.* 19. **Basionym:** *Semecarpus caesia* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 189. **Lectotype** (Ding Hou, 1978): *Blume, s.n.* (= *L. sheet no. 897. 363–1266*), Java (L; isolectotype BO). **Synonym:** *Semecarpus heterophylla* var. *caesia* (Blume) Engl. in A. DC., Mon. Phan. 4 (1883) 487.

Medium-sized tree to 27 m tall, 30 cm diameter. **Bark** grey-brown, smooth to scaly; inner bark pinkish. **Sapwood** white. Twigs grey-brown, glabrous or rusty brown short-hairy. **Leaves** *well-spaced, thin-coriaceous; glabrous on both surfaces, rarely sparsely hairy beneath, shiny above, faintly glaucous and with uniformly distributed papillae beneath*; oblong or lanceolate, 10–20 × 2.5–4.5 cm; *base cuneate to broadly rounded, not auricled*, apex acute; midrib raised above, lateral veins 18–22 pairs, looping near margin, raised below, faint above, *intercostal veins scalariform-reticulate*, very faint on both surfaces; *petioles* 0.5–2 cm long, whitish, rugose and hairy, *lower half not swollen*. **Inflorescences** *terminal, 10–13 cm long*, rusty hairy panicles, with fewer branches in females. **Flowers** subsessile; calyx lobes triangular; petals white or yellow, oblong, elliptic or ovate-oblong, with longitudinal ridges inside; stamen filaments free; staminodes very small; disc 5-lobed; ovary globose, stigma minute, capitate; pistillodes conical, hairy. **Fruits** oblong or ellipsoid, 3–5 × 2 cm, *smooth*, densely or sparsely rusty hairy, apex emarginate.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Widely distributed in Sabah; uncommon in Sarawak, recorded from Anap and Lawas areas only; also in Kalimantan.

**Ecology.** Lowland and hill forests, including *kerangas*, to 450 m, often by streams.

## 8. *Melanochyla castaneifolia* Ding Hou

(Latin, *castaneus* = chestnut-coloured, *folium* = leaf)



Blumea 24 (1978) 32, FM 1, 8 (1978) 496; Whitmore, Tantra & Sutisna *l.c.* 19. **Type:** *Bunang S. 23016*, Borneo, Sarawak (holotype L; isotypes KEP, SAN, SAR).

Small to medium-sized tree to 24 m tall, 30 cm diameter. *Twigs grey-white*, glabrous. **Leaves well-spaced**, thin-coriaceous; *glabrous, drying to yellowish green*, upper surface not shiny; *papillae uniformly distributed on the lower leaf surface, very faint to obscure*; elliptic, obovate or oblong, 6–14 × 2–5 cm; *base cuneate, not auricled*, apex acute; midrib raised above, flattened below, lateral veins 6–15 pairs, faintly raised on both surfaces, looping near margin, *intercostal veins reticulate*, distinct below, invisible above; *petioles 1–2.5 cm long, lower half thickened and whitish* on drying. **Inflorescences** terminal and axillary panicles, 6–22 cm long, finely hairy. **Flowers** yellow; calyx lobes triangular; petals elliptic, oblong or ovate, longitudinally thickened in the central part inside; stamen filaments free; disc 5-lobed; ovary globose, stigma minute, capitate; pistillodes very small, glabrous. **Fruits** unknown.

**Distribution.** Endemic to Borneo. Uncommon in Sabah and Sarawak; recorded from Lamag and Sandakan districts in Sabah, and from Kuching and 4th Division in Sarawak; also in Kalimantan.

**Ecology.** Lowland forest to 350 m.

### 9. *Melanochyla condensata* Kochummen

(Latin *condensatus* = condensed; the inflorescences)

Sandakania 7 (1996) 83. **Type:** *Ashton S. 18323*, Sarawak, Ulu Sinrok, Similajau Forest Reserve (holotype KEP; isotypes A, BO, FHO, K, L, MEL, P, SAN, SING, SAR).

Small tree to 12 m tall, 8 cm diameter. **Bark** grey-brown, smooth; inner bark pinkish with abundant black sap. Twigs stout, 1–1.5 cm thick, yellowish brown appressed hairy. **Leaves coriaceous**; *densely soft-hairy and not glaucous below*, upper surface not bullate; *papillae uniformly distributed on the lower leaf surface*; oblanceolate, 53–55 × 12–13 cm; *base attenuate, not auricled*, apex rounded or acute; midrib raised above, *lateral veins 40–44 pairs*, raised below, *faintly sunken above*, with short intermediate veins, *intercostal veins scalariform*, raised below, faint to invisible above; petioles 2–7 cm long, softly hairy, lower half swollen, rugose on drying. **Inflorescences** (only male seen) condensed, *arising from leaf axils* and from leafless twigs, 6–7 cm long, hairy; bracts lanceolate, *c.* 2 mm long, hairy; bracteoles ovate, *c.* 1 mm long. **Flowers** (male) sessile; calyx lobes triangular with pointed tip, hairy, *c.* 1 mm long; petals oblong, *c.* 3 mm long, densely hairy inside; stamens free, filaments densely hairy; disc 5-lobed; pistillodes absent. **Infructescences** 4.5–6 cm long. **Fruits** oblong, 1.8–2 × 1.2–1.5 cm, dark brown velvety hairy, apex pointed, *surface smooth*.

**Distribution.** Endemic to Borneo. So far known from the type collection (with fruits) from Sarawak and one flowering collection from Brunei (*Wong WKM 611*).

**Ecology.** Lowland forest. Flowering in January and fruiting in March.

**Taxonomy.** The short axillary inflorescence is a distinct diagnostic feature of *M. condensata*, a character which is present only in *M. axillaris*, but the latter has glabrous leaves which are glaucous underneath.

10. *Melanochyla elmeri* Merr.

(A.D.E. Elmer, 1870–1942, American botanist attached to the Bureau of Sciences, Manila)

PEB (1929) 169; Masamune *l.c.* 411; Ding Hou, FM 1, 8 (1978) 498; Anderson *l.c.* 137; Whitmore, Tantra & Sutisna *l.c.* 19. **Type:** *Elmer 2133*, Borneo, Sabah, Tawau (holotype PNH, destroyed; isotypes BO, K, L, S, SING, NY, UC).

Medium-sized tree to 30 m tall, 40 cm diameter. **Bark** grey-brown, finely fissured; inner bark brownish. Twigs rugose, yellowish hairy, glabrous. **Leaves** thin-coriaceous to coriaceous; *upper surface* glabrous, except for the midrib, *not shiny, lower surface sparsely hairy especially on midrib and lateral veins*, not glaucous; *papillae distinct and uniformly distributed on the lower leaf surface*; narrowly obovate or oblong, 10.5–23 × 3–7.5 cm; *base cuneate, not auricled*, apex cuspidate; midrib raised above, strongly channelled below, lateral veins 27–36 pairs, raised below, very faint to almost sunken above, *intercostal veins scalariform*, raised below, very faint to inconspicuous above; petioles 1.5–4 cm long, glabrous or hairy, channelled to flattened above, rugose at the lower part. **Inflorescences** terminal hairy panicles, *c.* 15 cm long. **Flowers** whitish, subsessile; calyx lobes ovate or ovate-oblong; petals oblong or oblong-lanceolate, longitudinally ridged inside; stamens filaments free, staminodes small; disc 5-lobed; ovary conical, stigma minute, capitate. **Fruits** ellipsoid, 1.5–2.5 × 1–2 cm, rusty hairy, apex pointed, *surface smooth*.

**Distribution.** Endemic to Borneo; uncommon in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest to 150 m.

11. *Melanochyla fulvinervis* (Blume) Ding Hou

Fig. 10E.

(Latin, *fulvus* = yellowish brown, *nervus* = vein)

Blumea 24 (1978) 32, FM 1, 8 (1978) 493; Anderson *l.c.* 137; Kochummen *l.c.* 42; Whitmore, Tantra & Sutisna *l.c.* 19; Kessler & Sidiyasa *l.c.* 44. **Basionym:** *Semecarpus fulvinervis* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 189, Merrill *l.c.* (1921) 35, Masamune *l.c.* 413. **Lectotype** (Ding Hou, 1978): *Korthals, s.n.* (= *L. sheet no. 897. 363–1228*), Borneo, Mt. Parawan (L).

Medium-sized tree to 24 m tall, 50 cm diameter. **Bark** chocolate-brown, smooth. Twigs brownish, hairy. **Leaves** *well-spaced, thin-coriaceous; upper surface shiny, lower surface glabrous or sparsely hairy on midrib and veins*, not glaucous; *papillae in distinct groups*; oblong, elliptic or oblanceolate, 11–29.5 × 4.5–8 cm; *base obtuse to subcordate or rarely cuneate, not auricled*, apex acuminate, acumen *c.* 2 cm long; midrib raised above, distinctly channelled below, lateral veins 15–28 pairs, raised on both surfaces, *intercostal veins scalariform*, distinct below, invisible above; *petioles 0.5–1.5 cm long*, densely short-hairy, channelled above. **Inflorescences** terminal hairy panicles, to 18 cm long. **Flowers** white, subsessile; calyx lobes triangular; petals ovate or lanceolate, flat; stamen filaments free, staminodes in female flowers usually large; disc 5-lobed; ovary conical, stigma discoid; pistillodes small, hairy. **Fruits** ellipsoid or subglobose, 3–4 × 2.5–3 cm, *rusty hairy, with long insect-gall-like processes*.

**Distribution.** Peninsular Malaysia, Borneo. Uncommon in Sabah and Sarawak; also in Kalimantan.

**Ecology.** Lowland to hill forest to 750 m.

**Notes.** *S.* 32352 (in fruit) and *S.* 32752 (male flowers) are different from the rest in having glabrous leaves with cuneate base and 1.5-cm-long petioles.

## 12. *Melanochyla minutiflora* Ding Hou

(Latin, *minutus* = very small, *floris* = flower)

Blumea 24 (1978) 33, FM 1, 8 (1978) 497; Whitmore, Tantra & Sutisna *l.c.* 19. **Type:** *Charington SAN 17810*, Borneo, Sabah (holotype L).

Small tree to 15 m tall, 30 cm diameter. **Bark** grey-brown, scaly; inner bark brown. Twigs densely yellowish brown short-hairy. **Leaves** well-spaced, drying to chocolate-brown; lower surface not papillose, sparsely hairy on midrib and veins; elliptic to oblong, 10.5–16.5 × 3.5–5 cm; base cuneate, not auricled, apex acute; midrib raised above, lateral veins 11–15 pairs, distinct below, faint above, *intercostal veins reticulate*, distinct below, faint to inconspicuous above; *petioles* 0.7–1.3 cm long, densely short-hairy, lower half swollen and greyish white on drying. **Inflorescences** terminal and axillary hairy panicles, 5–6 cm long. **Flowers** (only male seen) yellow, sessile; calyx lobes triangular; petals ovate or ovate-oblong, slightly longitudinally thickened at lower part inside; stamen filaments free; disc 5-lobed; pistillodes absent, replaced by tufts of hair. **Fruits** subglobose, c. 1.2 cm diameter, smooth, thinly velvety yellowish hairy, apex rounded.

**Distribution.** Endemic to Borneo. Uncommon, known from Sabah only from three collections, *SAN 17810* (type), *SAN 36562* from Lamag and *SAN 24997* from Tawau areas.

**Ecology.** Lowland forest to 100 m.

## 13. *Melanochyla montana* Kochummen

(Latin, *montanus* = of mountains)

Sandakania 7 (1996) 86. **Type:** *Mikil SAN 44330*, Borneo, Sabah, Tambunan, Trus Madi FR (holotype SAN; isotype L).

Tree to 45 m tall, 200 cm diameter; bole with buttresses to 2.5 m high. **Bark** dark grey, smooth; inner bark reddish brown with black sap. **Sapwood** reddish brown, with black sap, Sapwood reddish brown. Bud scales stiff, lanceolate. *Twigs stout, 1.2 cm thick. Leaves well-spaced, very thickly-coriaceous; glabrous, faintly glaucous below; papillae uniformly distributed on the lower leaf surface;* oblong to oblanceolate or obovate, 18–32 × 7–18 cm; base cuneate, not auricled, apex rounded or emarginate; midrib prominently raised above, ahannelled below, lateral veins 17–22 pairs, raised on both surfaces, *intercostal veins scalariform-reticulate*, visible below, invisible above; *petioles very stout, 3–4 cm long, lower half strongly swollen and prominently rugose on drying.* **Flowers** and **fruits** unknown.

**Distribution.** Endemic to Borneo. Known only from a few collections from Sabah and Sarawak from lower montane forests where it appears to be one of the tallest trees. In Sabah, recorded from Ranau, Sipitang and Tambunan districts (SAN 44330, SAN 75893, SAN 132820), and in Sarawak, from Kelabit Highlands (S. 20060).

**Ecology.** Lower montane forest at 1370–1800 m.

**Notes.** Although this species is described from sterile material, it is sufficiently distinct.

#### 14. *Melanochyla scalarinervis* Kochummen

(Latin, *scalaris* = ladder-like, *nervus* = veins; the leaf intercostal veins)

Sandakania 7 (1996) 88. **Type:** *Ilias S. 37722*, Borneo, Sarawak, Semengoh Arboretum (holotype SAR; isotypes MO, SAN).

Medium-sized tree to 22 m tall, 15 cm diameter. **Bark** blackish, smooth; inner bark with black sap. Twigs 7 mm thick, grey, with minute lenticels. **Leaves** well-spaced, coriaceous; not glaucous below, *glabrous on both surfaces; papillae uniformly distributed on the lower leaf surface*; oblong, 21–25 × 6.5–7 cm; *base cuneate, not auricled*, apex blunt with short point; midrib raised above, *lateral veins c. 30 pairs, prominent below, faintly raised above, intercostal veins scalariform*, raised below, invisible above; *petioles 1.5–2.5 cm long, whitish, rugose on drying*. **Inflorescences** and **flowers** unknown. **Infructescences** terminal, *c. 30 cm long, velvety hairy, with very short branches, each of which ends in a single fruit*. **Fruits** ellipsoid, 2–2.5 × 1.5–2 cm, densely velvety hairy, *pointed, with a shallow cup-like swelling at the base, surface smooth*.

**Distribution.** Endemic to Borneo; so far known from the type only from the Semengoh Arboretum in Sarawak.

**Ecology.** Lowland forest. Fruiting noted in March.

**Notes.** *M. scalarinervis* appears rather similar to *M. bullata*, but the latter has bullate hairy leaves with sunken lateral and intercostal veins.

#### 15. *Melanochyla semecarpoides* Ding Hou

(Latin, *semecarpoides* = resembling *Semecarpus*)

Blumea 24 (1978) 33, FM 1, 8 (1978) 495; Whitmore, Tantra & Sutisna *l.c.* 19. **Type:** *Sibat S. 21799*, Sarawak, Ulu Mayong, Kakus (holotype L; isotype SAR).

Small tree to 10 m tall, 10 cm diameter. *Twigs whitish, glabrous*. **Leaves** well-spaced, *thin-coriaceous; glabrous, drying reddish brown; upper surface not shiny, lower surface faintly glaucous; papillae distinct and uniformly distributed on the lower leaf surface*; oblong or oblanceolate, 12–25 × 5–10 cm; *base cuneate, not auricled*, apex acute; midrib raised above, *lateral veins 11–16 pairs, distinct below, faint above, intercostal veins reticulate*, distinct below, very faint above; *petioles 1.2–2.5 cm long, lower half swollen, whitish, rugose on*

drying. **Inflorescences** terminal, male to 20 cm long, female shorter, minutely hairy. **Flowers:** females slightly larger than males; calyx lobes triangular; petals triangular, longitudinally ridged inside; stamens free; disc 5-lobed in male flower, entire in female flower; ovary hairy, globose, style c. 1 mm long. **Fruits** ellipsoid, 10–15 × 7 mm, apex pointed, *surface rugose and finely hairy*.

**Distribution.** Endemic to Borneo; known from three collections only (*S. 21799, S. 22541, S. 43854*) from the Kapit district, Sarawak.

**Ecology.** Mixed dipterocarp forest, at 150–200 m.

#### 16. *Melanochyla tomentosa* Hook. f.

(Latin, *tomentosus* = covered with matted hairs; the leaf lower surface and twigs)

Fl. Br. Ind. 2 (1876) 38; King *l.c.* 503; Ridley *l.c.* 539; Ding Hou, FM 1, 8 (1978) 498; Kochummen *l.c.* 43. **Type:** *Maingay 1803*, Malacca (holotype K).

Medium-sized tree to 20 m tall, 37 cm diameter. **Bark** reddish brown, smooth; inner bark reddish with black sap. **Sapwood** white. Young twigs velvety yellowish hairy. **Leaves** coriaceous, not bullate; lower surface not glaucous, densely velvety hairy; papillae distinct and uniformly distributed on the lower leaf surface; elliptic, oblong or obovate, 5.5–19 × 2.5–9 cm; base cuneate, not auricled, apex rounded or acute; midrib raised above, lateral veins 12–22 pairs, raised below, faint above, intercostal veins scalariform-reticulate, raised below, invisible to sunken above; petioles 1–3 cm long, velvety hairy, base swollen. **Inflorescences** terminal, to 30 cm long, hairy. **Flowers** (only male seen) sessile; calyx and petals dark brown to yellowish hairy; calyx lobes triangular; petals elliptic to elliptic-lanceolate, flat; stamen filaments free; disc 5-lobed; pistillodes reduced to tufts of hairs. **Fruits** ellipsoid, globose or ovoid, 1.5–3 cm diameter, velvety hairy, *surface smooth*.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo; very uncommon in Sabah and Sarawak. In Sabah, known from a single collection, *SAN 57370*, from Semporna district; and in Sarawak, recorded from Mulu National Park only (*S. 39356*).

**Ecology.** Lowland mixed dipterocarp forest, at 150–250 m.

#### 17. *Melanochyla woodiana* Kochummen

(G.H.S. Wood, 1927–1957, first forest botanist in Sabah)

Sandakania 7 (1996) 88. **Type:** *G.H.S. Wood SAN 16969*, Borneo, Sabah, Beaufort (holotype SAN; isotypes A, BO, BRI, K, KEP, L, SING).

Medium-sized tree to 20 m tall. Twigs whitish, densely brown short-hairy. **Leaves** well-spaced, coriaceous; glabrous, upper surface not shiny, lower surface not glaucous; papillae distinct and uniformly distributed on the lower leaf surface; elliptic or oblong, 17.5–19 × 9–10 cm; base broadly cuneate to obtuse, not auricled, apex cuspidate; midrib raised above, lateral veins c. 18 pairs, raised below, very faint to sunken above, intercostal veins scalariform-reticulate,

raised below, invisible above; *petioles* 1.5–2.5 cm long, densely short-hairy, *lower half swollen, whitish and rugose* on drying. **Inflorescences** and **flowers** unknown. **Infructescences** *terminal, c. 30 cm long*, with a number of long side-branches, finely brown short-hairy. **Fruits** ovoid or ellipsoid, 1.7–2 × 1–1.2 cm, apex sharp-pointed, *surface rugose and densely brown short-hairy*.

**Distribution.** Endemic to Borneo; so far known from the type only from Sabah.

**Ecology.** Lowland mixed dipterocarp forest, at c. 120 m. Fruiting noted in July.

## 11. PARISHIA Hook. f.

(C.S. Parish, 1822–1897, English botanist  
in British Burma, now Myanmar)

*layang-layang* (Malay), *upi* (Iban)

Trans. Linn. Soc. 23 (1860) 169; Ridley, FMP 1 (1922) 535; Browne, FTSB (1955) 51; Burgess, TBS (1966) 27; Ding Hou, FM 1, 8 (1978) 541; Anderson, CLTS (1980) 38; Wong, DMT (1982) 117; Corner, WSTM 3rd ed. 1 (1988) 121; Kochummen, TFM 4 (1989) 44; Whitmore, Tantra & Sutisna, CLK 1 (1989) 20; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 45.

Medium-sized to tall emergent dioecious trees; bole with tall spreading buttresses. **Bark** smooth to shallowly fissured or scaly; inner bark pink or reddish, *often with pale stripes*, laminated or soft, *with abundant white sap* which darkens on drying. **Sapwood** whitish. **Leaves** spirally arranged, *trifoliolate or pinnately compound with opposite or subopposite leaflets and terminal leaflets*. **Inflorescences** axillary and/or terminal panicles. **Flowers** *unisexual; calyx 4-lobed, enlarged and persistent in fruit; petals 4, imbricate, glabrous or sparsely hairy outside; stamens 4, filaments long, glabrous, anthers dorsifixed or dorso-basifixed, abortive in female flowers; disc intrastaminal, hairy, pulvinate or flat, 4-lobed or 4-grooved; ovary superior, densely hairy, 1-locular, style 3 (rarely 4)-lobed, pistillodes very small*. **Fruits** 1-locular, *densely brown-hairy, with an enlarged persistent calyx with wing-like lobes*. **Seeds** with testa fused to the endocarp; embryo straight, cotyledons free, plano-convex.

**Distribution.** Seven species; Andaman Islands, Myanmar, Thailand, Malesia; 6 species in Sabah and Sarawak.

**Ecology.** Lowland, including swamp, to lower montane forest, to 1500 m. The trees are deciduous and flowers appear before or during the onset of new leaves.

**Uses.** The timber is known in the ASEAN region as *lelayang*. The wood is moderately hard with density of 545–755 kg/m<sup>3</sup> air-dried; the heartwood is red-brown to light brown; and texture is fine and even with interlocking grain. Not durable and susceptible to powder post beetles. It is suitable for light construction, general planking, pallets, packing crates as well as core veneers for plywood manufacture.

### Key to *Parishia* species

1. Leaves trifoliolate; leaflets 10–15 cm wide; intercostal veins strongly reticulate, distinct on both surfaces.....**6. *P. trifoliolata***  
 Leaves pinnately compound; leaflets less than 10 cm wide; intercostal veins weakly reticulate, usually very faint.....2
2. Leaflets concave, reddish-brown hairy below; lateral veins sunken above.....**1. *P. dinghouiana***  
 .....  
 Not this combination of characters.....3
3. Leaflets with asymmetric rounded or subcordate base; petiolules very short, to 2 mm long.....**2. *P. insignis***  
 Leaflets with symmetric cuneate base; petiolules well-developed, much longer.....4
4. Leaves with 2 pairs of leaflets.....**4. *P. paucijuga***  
 Leaves with more than 2 pairs of leaflets.....5
5. Enlarged calyx lobes shorter than the fruits.....**5. *P. sericea***  
 Enlarged calyx lobes very much longer than the fruits.....**3. *P. maingayi***

#### 1. *Parishia dinghouiana* Kochummen

(Ding Hou, b. 1921, botanist at the Rijksherbarium, Leiden)

Sandakania 7 (1996) 91. **Type:** *Jugah & Sibat S. 26300*, Borneo, Sarawak, Kuching (holotype SAR; isotypes A, BO, K, L, SING).

Small tree to 15 m tall, 30 cm diameter. Twigs stout, 1.5–2 cm thick, brown-hairy. **Leaves** pinnately compound; rachis flattened above, hairy. *Leaflets* glabrous above, reddish-brown hairy below, concave; oblong, 10–18.5 × 6–7.5 cm; base broadly cuneate, apex acute; midrib raised above, lateral veins 15–21 pairs, sunken above, raised below, with short intermediate veins, intercostal veins weakly reticulate, faint below, invisible above; petiolules 3 mm long, densely hairy. **Inflorescences** and **flowers** unknown. **Infructescences** terminal, c. 70 cm long, densely hairy, axes stout, 1–1.5 cm thick. **Fruits** (immature) ovoid, c. 7 × 5 mm, velvety hairy; calyx tube c. 2 cm long, 2.5 cm wide, calyx lobes c. 5.5 × 1.5 cm, with distinct reticulate veins.

**Distribution.** Endemic to Borneo; so far known from the type only from Sarawak.

**Ecology.** Lowland forest by streams.

#### 2. *Parishia insignis* Hook. f.

(Latin, *insignis* = remarkable)

Trans. Linn. Soc. 23 (1860) 170; Ridley *l.c.* 536; Burgess *l.c.* 27; Ding Hou, FM 1, 8 (1978) 545; Anderson *l.c.* 138; Corner *l.c.* 121; Kochummen *l.c.* 45; Whitmore, Tantra & Sutisna *l.c.* 20; Kessler & Sidiyasa *l.c.* 45. **Type:** *Griffith 1037*, Burma (holotype K; isotype SING). **Synonym:** *P. borneensis* Ridl.,

Kew Bull. (1933) 20, Masamune *l.c.* 412; *P. lowei* Ridl. *l.c.* (1933) 201, Masamune *l.c.* 412.

Emergent tree to 40 m tall, 60 cm diameter; bole with tall buttresses. **Bark** brownish, cracking; inner bark reddish, laminated. **Sapwood** whitish. Twigs stout, 1.5–1.8 cm thick, with scattered whitish lenticels, youngest ones angular. **Leaves** *pinnately compound*, each with 2–10 pairs of opposite or subopposite leaflets; basal part of rachis flattened above, sparsely hairy to hairy. Leaflets glabrous or sparsely hairy below, coriaceous; oblong or ovate to lanceolate, 6.5–15 × 3.5–6.5 cm; *base obtuse to subcordate, asymmetric, apex acute*; midrib raised above, *lateral veins* 10–17 pairs, raised below, *faint above, intercostal veins weakly reticulate, faint but visible on both surfaces; petiolules very short, to 2 mm long, or leaflets sessile*. **Inflorescences** axillary panicles, to 54 cm long, rusty hairy; bracts triangular, lanceolate or narrowly elliptic, 2–3 mm long, minutely hairy outside, glabrous inside; pedicels 2–5 mm long. **Flowers:** calyx 2.5–4.5 mm long, minutely hairy on both surfaces, lobes triangular, unequal, 2–3 mm long; petals broadly ovate to ovate-oblong or elliptic, 3–5 × 1.5–3 mm; stamens 2.5–4 mm long, anthers ovoid, *c.* 0.75 mm long; staminodes *c.* 1.5 mm long; disc fleshy, flat, round or slightly 4-angular, or shallowly cup-shaped, hairy, 2–2.7 mm diameter; ovary conical, *c.* 1.5 mm diameter, style *c.* 1.5 mm long, stigma capitate. **Fruits** ovoid, 1.5–2 × 0.7–1 cm, velvety hairy, with a distinct beak; calyx lobes, 10–15 × 1–1.5 cm; stalks to 1.5 cm long.

**Vernacular name.** Sarawak—*upi bunga* (preferred name).

**Distribution.** Andaman Is., Myanmar, Thailand, Peninsular Malaysia, Sumatra, Borneo. Uncommon in Sabah and Sarawak; also in Kalimantan.

**Ecology.** Lowland forest, including swamp forest.

### 3. *Parishia maingayi* Hook. *f*

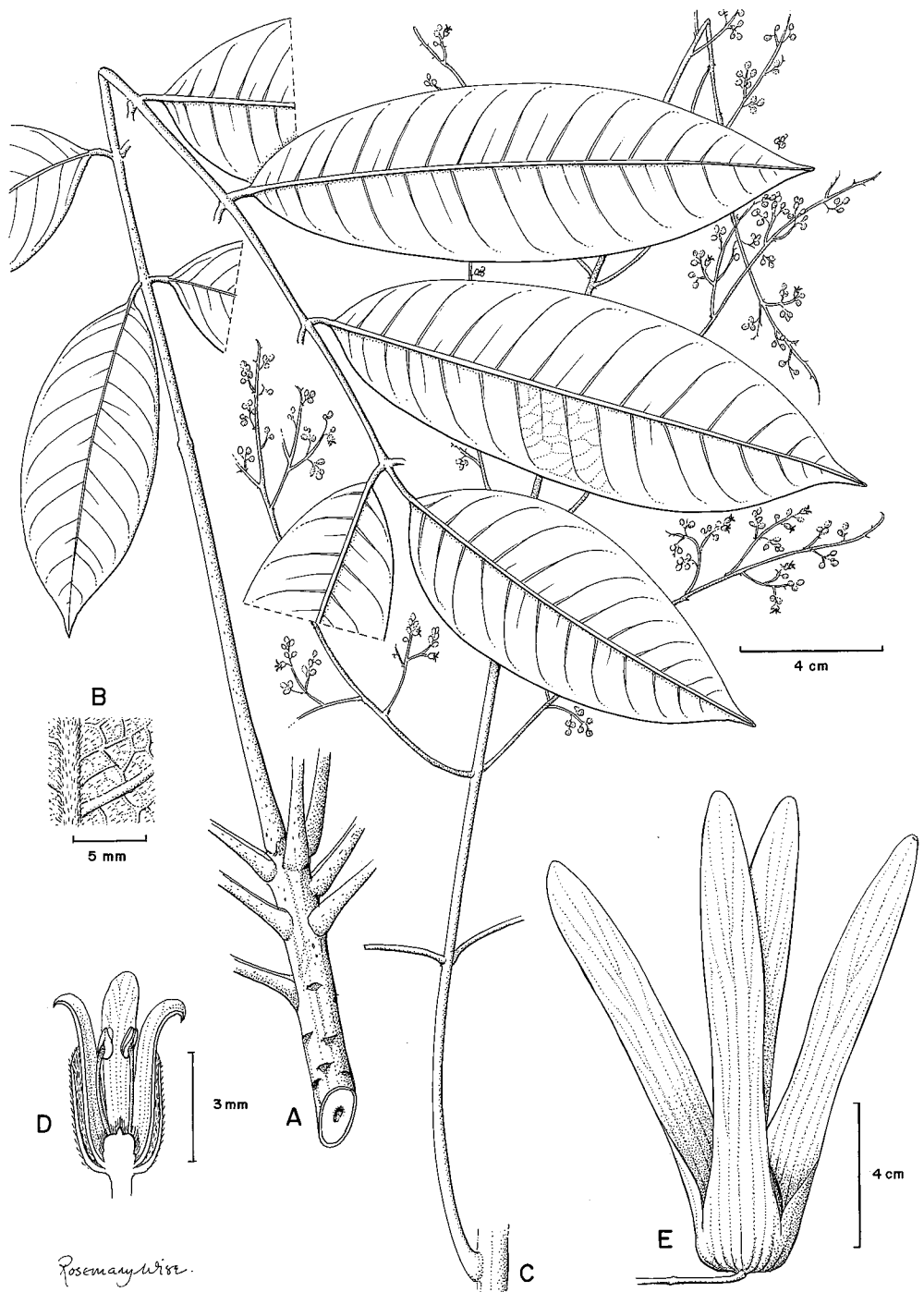
Fig. 11.

(A.C. Maingay, 1836–1869; 1862–1868 magistrate in charge of the jail in Malacca)

Fl. Br. Ind. 2 (1876) 30; King *l.c.* 493; Ridley *l.c.* 535; Burgess *l.c.* 27; Ding Hou, FM 1, 8 (1978) 543; Anderson *l.c.* 138; Corner *l.c.* 122; Kochummen *l.c.* 44; Whitmore, Tantra & Sutisna *l.c.* 20. **Type:** *Maingay* 488, Malacca (holotype K; isotype L).

Medium-sized to emergent tree to 36 m tall, 95 cm diameter; bole with steep buttresses to 1.5 m tall, or with stilt-roots in swampy habitats. **Bark** dark brown, shallowly fissured to scaly; inner bark reddish, with abundant white latex. **Sapwood** whitish. Twigs slender to very thick, 0.5–2 cm thick, glabrous, often lenticellate. **Leaves** *pinnately compound*, each with 4–8 pairs of leaflets; rachis slightly swollen at base. Leaflets coriaceous, often shiny above, very rarely sparsely reddish-brown hairy below; elliptic, ovate, or oblong, 4–16.5 × 1.8–6 cm; *base cuneate to rounded, symmetrical, apex acute, rarely rounded or obtuse and emarginate*; midrib raised above and prominent beneath, rarely flattened and faint above, *lateral veins* 10–12 pairs, *usually very faint to almost invisible on both surfaces, intercostal veins weakly reticulate, very faint* and hardly distinguishable from the lateral veins; *petiolules* 4–8 mm long, rugose on drying, sometimes faintly channelled above. **Inflorescences** axillary or terminal panicles, hairy, to 50 cm long, with many long branches, sometimes smaller ones with few short branches; axes occasionally very thick, almost as thick as the twig; bracts ovate, 2–3.5 mm long, minutely hairy outside; pedicels 1.5–3 mm long. **Flowers** white; calyx 2–6 mm long, densely appressed hairy on both surfaces, lobes triangular, unequal, 0.6–1 mm long; petals





**Fig. 11.** *Parishia maingayi*. A, leafy twig; B, detail of lower leaflet surface; C, inflorescence; D, flower in longitudinal section; E, fruit. (A–B from SAN 15031, C–D from Ladi BRUN 5108, E from SAN 16328.)

oblanceolate or narrowly oblong,  $5-8 \times 1-2$  mm, sparsely hairy outside; stamens 3–4 mm, inserted in the grooves at the lower half of the disc, anthers ovoid, *c.* 1 mm long, staminodes *c.* 2 mm long; disc pulvinate and 4-grooved, *c.* 1.2 mm diameter in male flowers, fleshy and shallowly cup-shaped, *c.* 2.5 mm diameter in female flowers; ovary conical, *c.* 1.5 mm diameter, style *c.* 1 mm long, stigmas capitate. **Fruits** ovoid or broadly ellipsoid,  $1.5-2.5 \times 1-1.5$  cm, velvety hairy, gradually narrowed into a beak; enlarged calyx lobes hairy on both surfaces, red when fresh, oblong,  $6-13.5 \times 1-1.8$  cm.

**Vernacular name.** Sarawak—*upi paya* (preferred name).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo and the Philippines. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland, including swamp and *kerangas*, to lower montane forest, to 1450 m. Flowering in February to June and fruiting in March to June.

**Taxonomy.** There is considerable variation in the shape, texture and pubescence of leaflets, the thickness of the twigs, and branching as well as thickness of axes of the inflorescences. Two varieties are recognised.

#### Key to varieties

Leaflet apex acute, not emarginate; midrib prominently raised above.....

var. **maingayi**

Synonyms: *P. elmeri* Merr., PEB (1929) 168, Masamune *l.c.* 412; *P. polycarpa* Ridl., Kew Bull. (1933) 200, Masamune *l.c.* 412.

Distribution: as for the species.

Leaflet apex obtuse or rounded-emarginate; midrib not prominent, flattened above.....

var. **minor** (Ridl.) Kochummen

Sandakan 7 (1996) 94. Basionym: *Parishia minor* Ridl. *l.c.* (1933) 201, Masamune *l.c.* 412.

Known from the Kuching area in Sarawak.

#### 4. *Parishia paucijuga* Engl.

(Latin, *pauci* = few, *jugum* = pair; the few pairs of leaflets)

In A. DC., Mon. Phan. 4 (1883) 309; Ridley *l.c.* (1922) 536; Ding Hou, FM 1, 8 (1978) 544; Anderson *l.c.* 138; Corner *l.c.* 122; Kochummen *l.c.* 46; Whitmore, Tantra & Sutisna *l.c.* 20. **Type:** *Maingay* 496, Malacca (holotype K).

Medium-sized tree to 30 m tall, 20 cm diameter. **Leaves** *pinnately compound*, each with two pairs of leaflets; rachis finely hairy, flattened above at the base. Leaflets coriaceous; oblong,  $10-15 \times 5-7$  cm; base *cuneate*, *symmetric*, apex rounded with short point; midrib raised above, lateral veins *c.* 20 pairs, faint above, intercostal veins weakly reticulate, very faintly visible above; petiolules to 7 mm long, finely hairy, rugose on drying. **Inflorescences** to 35 cm long, hairy, with many branches; bracts triangular, 2–5 mm long, usually densely hairy outside; pedicels absent or *c.* 0.6 mm long. **Flowers** white; calyx 3–4.5 mm long, densely hairy on both

surfaces, lobes triangular, 2–3 mm long; petals obovate-oblong or oblong,  $3-6 \times 1.5-2$  mm, sparsely hairy outside; stamens inserted at the base of the disc, 3–3.5 mm long, anthers oblong, 0.7–1 mm long; staminodes *c.* 2 mm long; disc pulvinate, 4-grooved and 1.5–2 mm diameter in male flowers, shallowly cup-shaped and 2.5–3 mm diameter in female flowers; ovary conical, *c.* 2 mm diameter, style *c.* 1.7 mm long, stigmas capitate. **Fruits** ellipsoid,  $4-6 \times 2$  cm, apex acute; *calyx lobes* hairy on both surfaces, *shorter than the fruit*.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sarawak, so far known only from two collections (*S.* 404 and *S.* 15508) from Lundu area, not yet reported from Sabah; also in Brunei and Kalimantan.

**Ecology.** Lowland forest.

**Notes.** *S.* 15508 from Sarawak has young fruits with the calyx lobes longer than the fruits.

### 5. *Parishia sericea* Ridl.

(Latin, *sericeous* = with silky long appressed hairs)

*l.c.* (1933) 201; Masamune *l.c.* 412; Burgess *l.c.* 27; Ding Hou, FM 1, 8 (1978) 544; Whitmore, Tantra & Sutisna *l.c.* 20. **Type:** *Haviland 2273*, Borneo, Sarawak Kuching (holotype K).

Tree to 25 m tall, 40 cm diameter; bole with short buttresses. Bark scaly. Leaves *pinnately compound*, each with 4–7 pairs of leaflets; rachis minutely hairy. Leaflets coriaceous, shiny above, faintly hairy below; ovate-oblong to lanceolate,  $6.5-17 \times 3-6.5$  cm; base *cuneate to rounded*, symmetric, apex obtuse or acute; *lateral veins* 14–20 pairs, raised and prominent below, *visible or obscure above*, *intercostal veins weakly reticulate*, faintly visible on both surfaces; *petiolules to 1 cm long*. **Inflorescences** to 44 cm long, hairy, with long branches; bracts ovate to lanceolate, *c.* 2 mm long, densely minute-hairy outside; pedicels absent or to 0.7 mm long. **Flowers** (only male seen): calyx *c.* 3 mm long, hairy on both surfaces, lobes triangular, *c.* 1.5 mm long; petals oblanceolate, glabrous,  $5 \times 1-1.5$  mm; stamens *c.* 3 mm long, inserted at the base of the disc, anthers ovoid, *c.* 0.7 mm long; disc pulvinate, 4-grooved, 1.5–1.7 mm diameter. **Fruits** ellipsoid,  $5-5.7 \times 1.7$  cm; calyx tube *c.* 0.7 cm long; *calyx lobes* oblong or lanceolate,  $2-3 \times 0.5-1$  cm, *shorter than the fruit*, brown to dark brown hairy on both surfaces.

**Distribution.** Endemic to Borneo. Locally common, recorded from Lahad Datu and Ranau districts in Sabah, and Bintulu and Kuching areas in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland and hill forests to 750 m.

### 6. *Parishia trifoliolata* Kochummen

(Latin, *tri* = three, *foliolum* = leaflet; leaf with three leaflets)

Sandakania 7 (1996) 91. **Type:** *Yii S. 42974*, Borneo, Sarawak, Samunsam Wildlife Sanctuary (holotype KEP; isotypes K, L, SAN, SAR).

Small tree 12 m tall, 10 cm diameter. Twigs brown, *c.* 8 mm thick. **Leaves** *trifoliolate*; rachis

glabrous, with many close grooves. Leaflets thick-coriaceous, drying to yellowish green; oblong, 17–21 × 10–15 cm; base rounded, apex rounded with a very short tip; midrib sunken above at least along the upper half, lateral veins 14–16 pairs, faintly visible on both surfaces, intercostal veins strongly reticulate, distinct on both surfaces; petiolules 1–1.5 cm long, rugose. **Inflorescences** and **flowers** unknown. **Infructescences** terminal, more than 40 cm long, with long branches. **Fruits** (immature) ovoid, c. 7 × 6 mm, velvety hairy; calyx tube c. 1 cm long; calyx lobes dark red when fresh, dark brown velvety hairy on both surfaces, c. 3 cm long.

**Distribution.** Endemic to Borneo; so far known only from the type specimen from the Samunsam Wildlife Sanctuary in Sarawak.

**Ecology.** Lowland *kerangas* forest.

**Taxonomy.** This species differs from the other species of the genus by its trifoliolate leaves, large leaflets with distinct reticulate intercostal veins and the dark brown velvety hairy calyx lobes.

## 12. PENTASPADON Hook. f.

(Greek, *penta* = five, *spadon* = eunuch;  
the presence of five sterile stamens in the flowers)

*pelajau* (Iban), *pelong* (Malay)

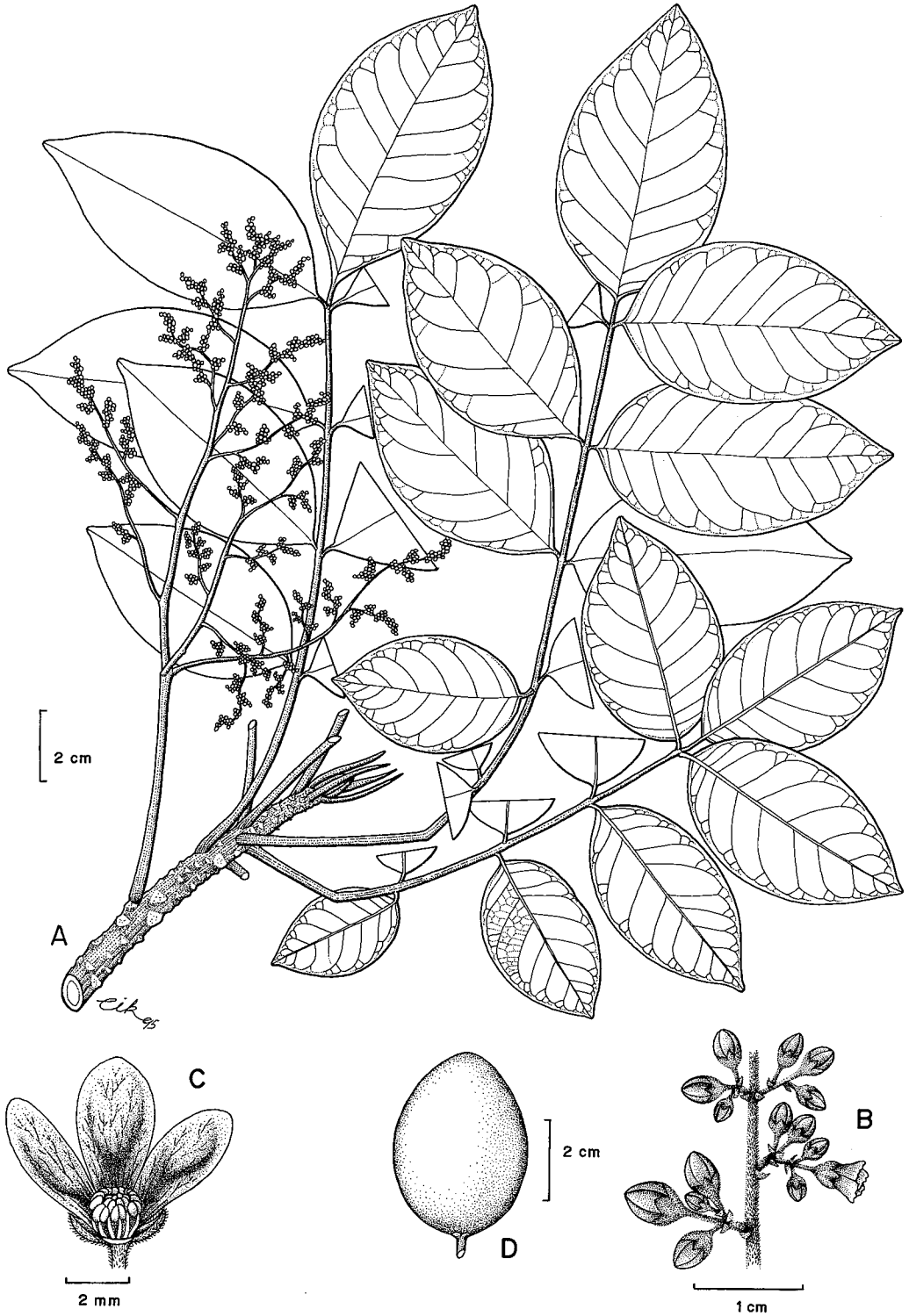
Trans. Linn. Soc. 23 (1860) 168; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 537; Masamune, EPB (1942) 413; Browne, FTSB (1955) 52; Ding Hou, FM 1, 8 (1978) 520; Anderson, CLTS (1980) 138; Wong, DMT (1982) 177; Corner, WSTM 3rd ed. 1 (1988) 122; Kochummen, TFM 4 (1989) 46; Whitmore, Tantra & Sutisna, CLK 1 (1989) 20; Ng, Mal. For. Rec. 34, 1 (1991) 18.

Large deciduous trees. **Leaves** spirally arranged, clustered at the ends of twigs, *pinnately compound with terminal leaflet, with hairy domatia in the axils of lateral veins*. **Inflorescences** axillary, paniculate. **Flowers** *bisexual*, calyx 5-lobed; *petals 5, imbricate*; fertile stamens 5, *sterile stamens 5*, inserted outside the disc, anthers basifixed or dorsifixed; disc cup-shaped, grooved or wavy outside; ovary superior, 1-locular, style short, stigma subglobose or 2-lobed. **Fruits** 1-locular, ovoid. **Seeds** one per fruit; testa free from endocarp; germination epigeal, in *P. motleyi* seeds germinate within 12–30 days, cotyledons emergent, fleshy; the first two leaves opposite and divided into 3–5 leaflets with dentate margins.

**Distribution.** Six species; Thailand, Vietnam, Sumatra, Peninsular Malaysia, Borneo, Maluku, New Guinea and Solomon Islands; one species in Sabah and Sarawak.

**Ecology.** Lowland and hill forests.

**Uses.** The timber, known by the ASEAN standard name as *pelajau*, is suitable for interior finishing, panelling, partitioning, moulding, flooring, etc. It has been successfully used as a peeler-log for plywood manufacture. It is fairly hard and fairly heavy with density of 480–835



**Fig. 12.** *Pentaspadon motleyi*. A, flowering leafy twig; B, part of inflorescence; C, flower with 1 sepal and 2 petals removed; D, fruit. (A from SAN 27312, B–C from Hamid FMS 13252, D from SAN 25959.)

kg/m<sup>3</sup> air-dried, easy to saw and cross-cut, and moderately durable under exposed conditions; the sapwood is not clearly differentiated from the heartwood. The oil obtained from *P. motleyi* is used to cure certain skin diseases; and the fruits are edible after boiling.

**Pentaspadon motleyi** Hook. f.

Fig. 12.

(J. Motley, civil engineer and plant collector in Labuan and Banjarmasin in the 1850s)

*l.c.* 168; Merrill *l.c.* (1921) 351; Ridley *l.c.* (1922) 538; Masamune *l.c.* 413; Burgess, TBS (1966) 30; Ding Hou, FM 1, 8 (1978) 524; Anderson *l.c.* 138; Corner *l.c.* 122; Kochummen *l.c.* 47; Whitmore, Tantra & Sutisna *l.c.* 20; Ng *l.c.* 18. **Type:** *Motley, s.n.*, Borneo (holotype K).

Medium-sized tree to 30 m tall, 60 cm diameter; bole with spreading buttresses. **Bark** grey-brown, smooth to scaly; inner bark pink, laminated, with droplets of white sap which turns to brown resin after a few days. **Sapwood** white. Twigs grey-brown. **Leaves** each with 4–5 pairs of subopposite leaflets and a terminal leaflet, *the basal pair always smaller*. **Leaflets** thin-coriaceous, glabrous, *lower surfaces often with hairy domatia in the axils of lateral veins*; elliptic-oblong or ovate, 4.5–13 × 3–5.5 cm; base obtuse, apex acute; midrib raised above, lateral veins 8–10 pairs, raised below, faint above, with short intermediate veins; leaflets of seedlings with dentate margins; petiolules 1–2 mm long. **Inflorescences** to 30 cm long. **Flowers** white; calyx lobes broadly ovate; petals obovate to oblong; anthers bent towards the centre. **Fruits** ovoid, sharply pointed, green with brown spots when fresh, 2.5–4 × 1.8–2.5 cm; edible.

**Vernacular names.** Sarawak—*buah pusit* (Penan), *emplangau* (Iban), *japing* (Kenyah), *lakacho* (Murut), *pelasih* (Berawan), *pelajau* (Iban), *perajau* (Bidayuh), *umit* (Iban), *uping* (Kayan).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, Maluku, New Guinea, Solomon Islands. Widely distributed in Sabah and Sarawak, but less common in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest, usually by rivers, to 300 m. Flowering twice a year along with new foliage.

### 13. PLEIOGYNIUM Engl.

(Greek, *pleio* = more than usual, *gyne* = female organs; the number of carpels and styles)

In A. DC., Mon. Phan. 4 (1883) 255; Ding Hou, FM 1, 8 (1978) 474; Whitmore, Tantra & Sutisna, CLK 1 (1989) 20.

Dioecious trees. **Leaves** spirally arranged, *pinnately compound, usually with terminal leaflet*. Leaflets opposite, entire. **Inflorescences** axillary panicles. **Flowers** *unisexual*; calyx 5 (rarely 4 or 6)-lobed; petals 5 (rarely 4 or 6), imbricate; stamens 10 (rarely 8–12), twice the number of petals, anthers abortive or imperfect in female flowers; disc annular, pulvinate; ovary 5–12-

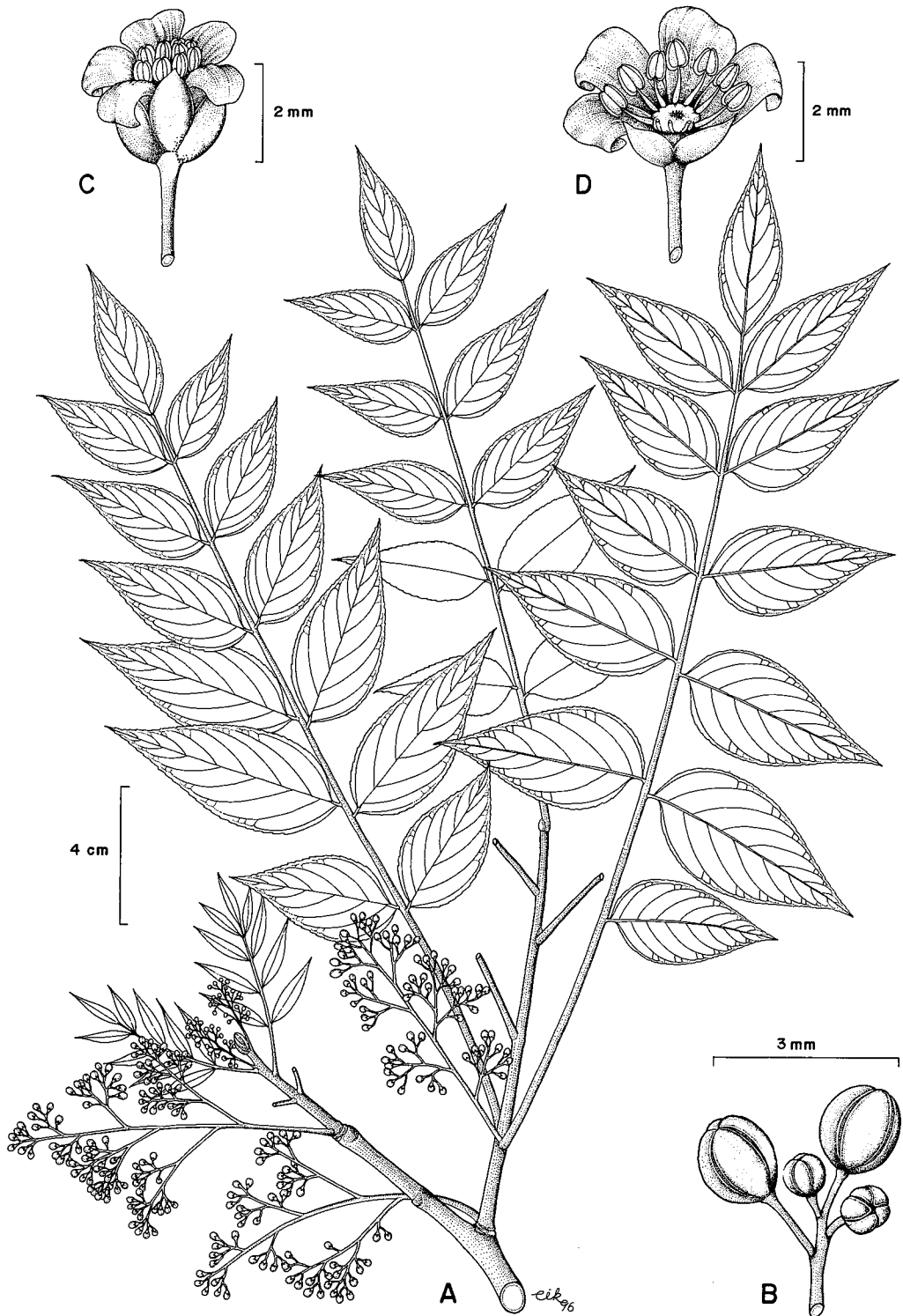


Fig. 13. *Pleio gynium timorense*. A, flowering leafy twig; B flower buds; C-D, flowers. (All from Kostermans 28246.)

locular, style 5–12, stigmas spatulate. **Fruits** 5–12-locular, with 5–12 seeds; endocarp hard, woody. **Seeds** with testa free from the endocarp; embryo slightly curved, cotyledons free, plano-convex.

**Distribution.** Two to three species; Malesia, Australia, Pacific islands; one species in Sabah.

**Ecology.** Lowland and hill forests.

**Pleiogynium timorense** (DC.) Leenh.  
(of Timor island)

Fig. 13.

Blumea 7 (1952) 159; Ding Hou, FM 1, 8 (1978) 474; Whitmore, Tantra & Sutisna *l.c.* 21. **Basionym:** *Icica timorensis* DC., Prod. 2 (1825) 78. **Type:** *Sine coll., s.n., Timor (G, n.v.)*.

Tree to 36 m tall, 75 cm diameter; bole with buttresses to 2.5 m high. **Bark** dark grey to grey-brown, fissured or scaly. **Leaves** each with 3–6 pairs of leaflets. Leaflets glabrous or sparsely hairy, *lower surface with hairy domatia in the axils of lateral veins*; elliptic to oblong or lanceolate, rarely ovate or obovate, 3.5–13.5 × 2–6 cm; *base asymmetric*, cuneate, apex acute; lateral veins 8–11 pairs, faint on both surfaces, intercostal veins reticulate; petiolules 0.5–1 cm long. **Inflorescences:** males to 30 cm long, with branches to 8.5 cm long, females usually to 3.5 cm long. **Flowers** greenish yellow; calyx lobes suborbicular, 0.5–0.7 mm long; petals ovate-oblong, 1.5–3 × 1–2.5 mm; stamens 2–3 mm long, those opposite calyx lobes usually longer than those opposite petals, anthers 0.5–0.6 mm across; staminodes 0.6–1 mm long; disc 1.5–1.7 mm diameter; ovary subglobose, *c.* 1 mm diameter, glabrous, styles *c.* 0.5 mm long; pistillodes 0.6–1 mm across. **Fruits** broadly ovoid, 1.5–1.7 × 1.5–2 cm, red to dark brown when ripe, with distinct scars of styles near the apex.

**Distribution.** Borneo, Lesser Sunda Islands, Philippines, Maluku, New Guinea, Australia, Fiji, Solomon Islands, and Pacific Islands. In Borneo, known only from a single collection (*NBFD 9227*) from Sabah.

**Ecology.** Lowland forest.

## 14. RHUS L.

(Greek, *rhous* = an old plant-name for *Rhus coriaria* L.)

Gen. Pl. ed 5 (1754) 129; Engler, Bot. Jahrb. 1 (1881) 378; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 538; Brizicky, J. Arn. Arb. 44 (1963) 62; Backer & Bakhuizen *f.*, FJ 2 (1965) 153; Ding Hou, Blumea 24 (1978) 34, FM 1, 8 (1978) 534; Kochummen, TFM 4 (1989) 48.

Small trees, scandent shrubs or woody climbers. **Leaves** spirally arranged, *pinnately compound*, each with 1–21 leaflets, or very rarely simple (*R. borneensis*); lateral leaflets in compound leaves opposite. **Inflorescences** terminal or axillary panicles or racemes. **Flowers** *unisexual or bisexual*; *calyx 5-lobed*; *petals 5*, imbricate; *stamens 5*, anthers dorsifixed,



imperfect or sterile in female flowers; disc intrastaminal, shallowly cup-shaped, cup-shaped or round and flat; ovary 1-locular, superior, abortive in male flowers, style short, distinct or obscure, stigmas 3, free or united, capitate or obscure. **Fruits** 1-locular, *without wings*. **Seeds** with testa adherent to or free from the endocarp; embryo straight, cotyledons free, flat.

**Distribution.** About 200 species; widely distributed in temperate zones of both hemispheres with a few species extending to the tropics and subtropics. Two species are recorded from Sabah and Sarawak, one of which is endemic to Borneo.

**Ecology.** From sea-level to 2400 m.

**Uses.** There are no recorded local uses of the indigenous species. However, the galls of *R. chinensis*, a native of China, are medicinal and imported to Malaysia. *R. verniciflua* is cultivated in China and Japan for its lacquer.

### Key to *Rhus* species

Leaves simple. Shrub.....

**R. borneensis** Stapf

FMK (1894) 142; Merrill *l.c.* (1921) 35; Masamune *l.c.* 413; Ding Hou, FM 1, 8 (1978) 541.

Synonym: *Toxicodendron borneense* (Stapf) Gillis, *Rhodora* 73 (1971) 164.

Shrub or small tree to 3 m high. Inflorescences axillary, paniculate. Fruits (young) subglobose, 5–7 mm diameter.

Endemic to Borneo; uncommon, recorded from Sabah and Sarawak. Montane forest, at 1200–2300 m.

Leaves pinnately compound; scandent shrub or woody climber, rarely small tree.....**R. nodosa**

**Rhus nodosa** Blume

Fig. 14.

(Latin, *nodosus* = knotty; probably referring to the twigs)

Bijdr. Fl. Ned. Ind. (1826) 1164; Backer & Bakhuizen *f. l.c.* 153; Ding Hou, FM 1, 8 (1978) 539. **Type:** Blume, *s.n.*, Java, Mount Salak (holotype L). **Synonyms:** *R. perakensis* Scort. *ex* King, J. As. Soc. Beng. 65, 3 (1896) 500, Masamune *l.c.* 413; *Toxicodendron nodosum* (Blume) Gillis *l.c.* 168.

Scandent shrub or woody climber, rarely small tree to 9 m tall. *Twigs strongly lenticellate*. **Leaves** copper-red when young, each with (1–)2–3(–5) pairs of leaflets; rachis 4–10 cm long. Leaflets thin-coriaceous; lower surface minutely hairy, early glabrescent, *domatia present in the axils of lateral veins*; ovate, elliptic or elliptic-lanceolate, 4–15 × 2–6 cm; base cuneate, attenuate or obtuse, margin entire, apex attenuate-acuminate; lateral veins 12–23 pairs, intercostal veins reticulate and rather faint on both surfaces; petiolules absent or to 0.7 cm long, of terminal leaflets absent to 2.3 cm long. **Inflorescences** axillary or pseudoterminal, to 40 cm long. **Flowers** creamy or yellowish; calyx lobes triangular, 0.5–0.7 mm long; petals ovate-elliptic, 2–3 × 1–1.5 mm, glabrous; stamens 1.5–2 mm long, anthers ovoid, *c.* 1 mm long; disc shallowly cup-shaped, *c.* 1 mm diameter; ovary subglobose, *c.* 1 mm diameter. **Fruits** subglobose, 5–7 × 5–8 mm.

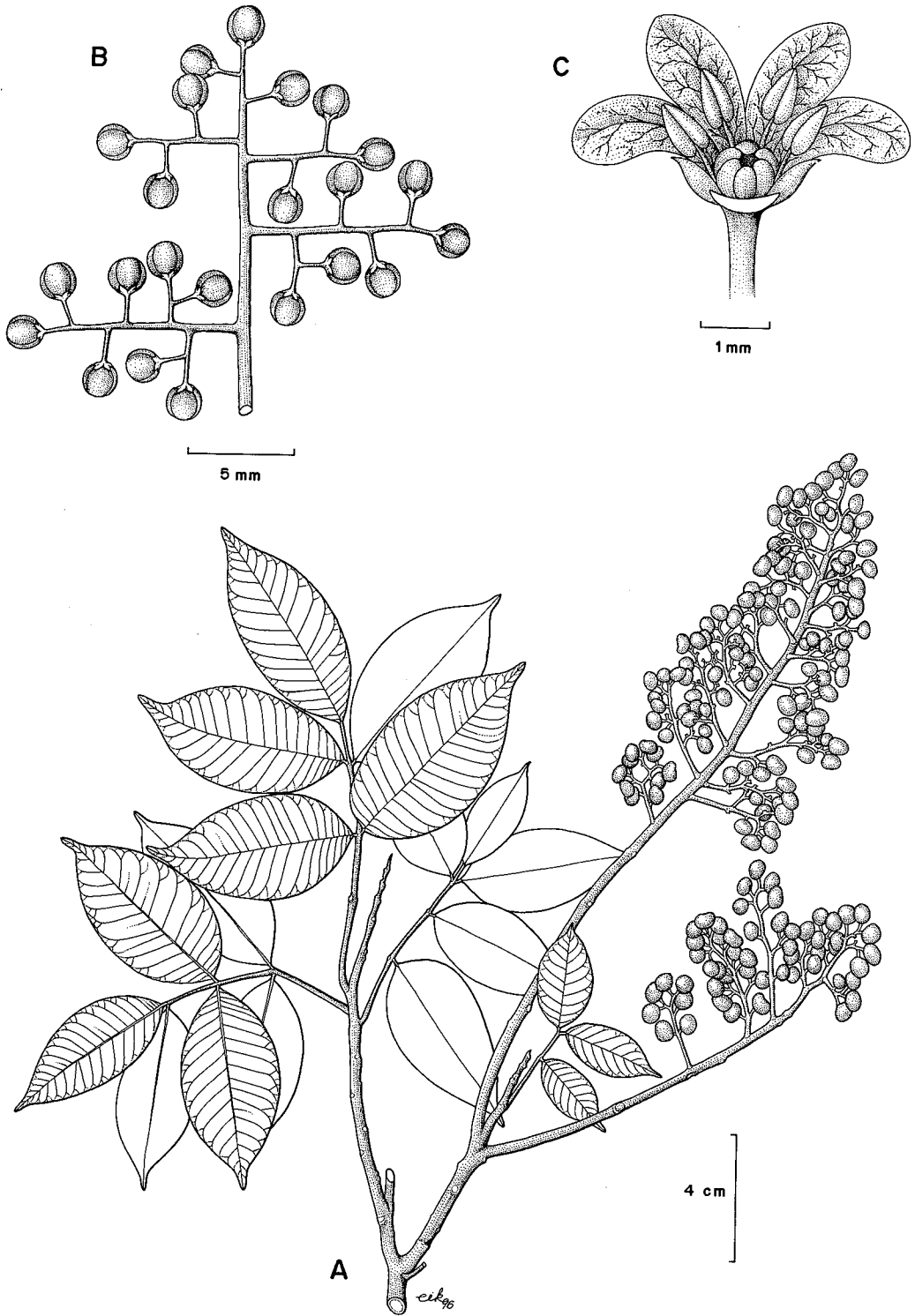


Fig. 14. *Rhus nodosa*. A, fruiting leafy twig; B, part of inflorescence; C, flower with one sepal and one petal removed. (A–B from S. 43015, C from S. 16547.)

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sarawak, uncommon, so far recorded only from Baram, Bau, Kelabit Highlands, the Kuching area and the Hose Mountains; not yet reported from Sabah.

**Ecology.** Lowland to lower montane forest, to 1350 m.

## 15. SEMECARPUS L. f.

(Greek, *sema* = mark, *karpos* = fruit; named after the marking nut-tree, *Semecarpus anacardium*)

*rengas* (Malay)

Suppl. Pl. (1782) 25; Hooker f., Fl. Br. Ind. 2 (1876) 30; Merrill, EB (1921) 351; Ridley, FMP 1 (1922) 54; Masamune, EPB (1942) 413; Ding Hou, Blumea 24 (1978) 35, FM 1, 8 (1978) 499; Anderson, CLTS (1980) 138; Corner, WSTM 3rd ed. 1 (1988) 131; Kochummen, TFM 4 (1989) 50; Whitmore, Tantra & Sutisna, CLK 1 (1989) 21. **Synonym:** *Melanocomia* Ridl., Kew Bull. (1933) 198, Masamune *l.c.* 411.

Small trees or shrubs, sometimes unbranched, often spiny when young with irritant creamy or black sap. **Leaves** simple, spirally arranged and well-spaced, in close spirals or in pseudowhorls, often papillose beneath, margin not thickened. **Inflorescences** paniculate or racemose, terminal, extra-axillary or axillary, rarely borne on leafless stems (not in Borneo), pedicels articulate. **Flowers** unisexual (plants dioecious), rarely bisexual; female flowers usually larger than males; calyx 5- or 4-lobed, petals 5 or 4, imbricate or valvate; stamens 5 or 4, filaments subulate, glabrous, anthers dorsifixed, stamens in female flowers shorter, sterile; disc intrastaminal, often 5- or 4-notched, round, flat, dish-shaped, cup-shaped or funnel-shaped; ovary superior, rarely semi-inferior, 1-carpellate, 1-locular, usually densely hairy, styles 3, often hairy near the base, stigmas transversely oblong or subreniform; pistillodes minute or absent or replaced by a tuft of hairs. **Fruits** 1-locular, often laterally compressed, seated on a distinct fleshy hypocarp (formed by calyx and floral axis). **Seeds** with testa free from the endocarp; cotyledons free, plano-convex.

**Distribution.** About 75 species; India, Sri Lanka, Myanmar, Thailand, Indo-China, Formosa, Malesia, Australia, Micronesia, Solomon Islands, New Caledonia and Fiji; 19 species in Sabah and Sarawak.

**Ecology.** Lowland to montane forest, to 1950 m, including swampy and limestone habitats.

**Uses.** No reported use in Sabah and Sarawak. The pericarp is filled with black irritant resin, but the fleshy fruit of certain species such as *S. anacardium* can be eaten after roasting. The black sap of *S. anacardium*, when mixed with lime water or alum, is used for a water-resistant marking-ink.

### Key to *Semecarpus* species

1. Leaves glabrous (sometimes only very sparsely hairy below).....2  
Leaves distinctly hairy (at least below).....17

2. Leaf midrib sunken above.....3  
 Leaf midrib raised or flattened above.....6
3. Leaf lateral veins more than 20 pairs; leaf margin recurved; midrib below and petiole pale yellow on drying.....**14. S. minutipetalus**  
 Leaf lateral veins less than 20 pairs; leaf margin not recurved; midrib and petiole not pale yellow on drying.....4
4. Leaves distinctly glaucous below.....**9. S. glaucus** (in part)  
 Leaves not or only slightly glaucous below.....5
5. Leaf lateral veins faint on the lower surface.....**8. S. euodiifolius**  
 Leaf lateral veins raised on the lower surface.....**6. S. cuneiformis** (in part)
6. Papillae distinct and in groups on the lower leaf surface.....**18. S. sandakanus**  
 Papillae obscure or distinct but uniformly distributed on the lower leaf surface.....7
7. Leaves spirally arranged, well-spaced.....8  
 Leaves in pseudowhorls or in close spirals.....10
8. Leaf apex rounded; lateral veins to 10 pairs.....**15. S. paucinervius**  
 Leaf apex acute or obtuse; lateral veins more than 10 pairs.....9
9. Young stem not spiny. Hypocarp disc-like.....**10. S. heterophyllus**  
 Young stem spiny. Hypocarp not disc-like.....**4. S. bunburyanus** (in part)
10. Leaves narrow, the length more than 4 times the width.....11  
 Leaves broader, the length less than 4 times the width.....13
11. Petioles short, to 1 cm long; leaf base obtuse.....**2. S. angustifolius**  
 Petioles longer; leaf base attenuate.....12
12. Leaves to 2 cm wide; petioles to 1.5 cm long, base slightly swollen.....**13. S. lineatus**  
 Leaves wider than 3.5 cm; petioles 4.5–6 cm long, base prominently swollen.....  
 .....**16. S. pulvinatus**
13. Leaves sessile.....**4. S. bunburyanus** (in part)  
 Leaves with distinct petioles.....14
14. Inflorescences or infructescences extra-axillary. Leaf intercostal veins finely reticulate. Trees of limestone habitats.....**5. S. calcicolus**  
 Inflorescences or infructescences axillary or terminal. Leaf intercostal veins laxly reticulate. Trees of non-limestone habitats.....15
15. Leaf margin wavy. Inflorescence axes angular.....**1. S. angulatus**  
 Leaf margin entire. Inflorescence axes not angular (or not known).....16
16. Leaves glaucous below. Hypocarp cup-shaped, enclosing more than three-quarters of the fruit .....**7. S. cupularis**  
 Leaves not or only rarely glaucous below. Hypocarp not cup-shaped, usually not

- enclosing the fruit.....**4. S. bunburyanus** (in part)
17. Leaf margin wavy, recurved.....**19. S. trengganuensis**  
 Leaf margin plane.....18
18. Leaf midrib sunken above.....19  
 Leaf midrib raised or flattened above.....22
19. Leaves in close spirals, 43–85 cm long, sessile or with very short petioles.....  
 .....**11. S. impressicostatus**  
 Leaves well-spaced, shorter, petioles well-developed.....20
20. Leaves velvety hairy below, margin pale whitish on drying.....**17. S. rufovelutinus**  
 Leaves sparsely hairy below, margin not so.....21
21. Leaves glaucous below.....**9. S. glaucus** (in part)  
 Leaves not glaucous below.....**6. S. cuneiformis** (in part)
22. Leaves well-spaced. Inflorescences axillary.....**3. S. borneensis**  
 Leaves in pseudowhorls. Inflorescences terminal.....23
23. Leaves densely tomentose below, margin whitish. Fruit with cup-shaped hypocarp.....  
 .....**12. S. kinabaluensis**  
 Leaves sparsely, often rough-hairy below, margin not whitish. Fruit without cup-shaped  
 hypocarp.....**4. S. bunburyanus** (in part)

### 1. *Semecarpus angulatus* Kochummen

(Latin, *angulatus* = angular; the inflorescence axes)

Sandakania 7 (1996) 94. **Type:** *Fedilis & Sumbing SAN 91435*, Borneo, Sabah, Kalabakan (holotype SAN).

Small tree to 6 m tall, 5 cm diameter. Twigs stout, *c.* 1.7 cm thick, grey-brown, rugose. **Leaves** in close spirals, coriaceous; faintly glaucous and sparsely hairy below; papillae dense, distinct and uniformly distributed on the lower leaf surface; lanceolate, 28–31.5 × 10.5–12.5 cm, the length less than 4 times the width; base attenuate, slightly asymmetric, margin wavy, apex acute; midrib raised above, lateral veins 11–15 pairs, raised below, faint above, intercostal veins laxly reticulate, raised below, faint above; petioles 8–9 cm long, basal part swollen, concave above and rugose on drying. **Inflorescences** terminal, in clusters, 15–19 cm long, with few short branches, finely hairy, axes angular. **Flowers** (only female seen) sessile; bracteoles triangular, hairy, *c.* 1 mm long; calyx lobes deltoid, *c.* 1 mm high, *c.* 2 mm broad, hairy outside; petals imbricate, elliptic, *c.* 5 × 2.5 mm, glabrous, with a number of black veins inside, apex blunt; disc prominent, *c.* 0.5 mm high, saucer-shaped with entire rim, glabrous; staminodes very small; ovary broadly conical, *c.* 3 × 2 mm, densely hairy, styles *c.* 1 mm long, hairy, stigmas peltate. **Fruits** unknown.

**Distribution.** Endemic to Borneo; so far known only from the type from Sabah.

**Ecology.** Lowland forest.

## 2. *Semecarpus angustifolius* Kochummen

(Latin, *angustus* = narrow, *folium* = leaf)

Sandakania 7 (1996) 94. **Type:** *Zainudin 5060*, Sabah, Telupid, Bukit Tawai Forest Reserve (holotype SAN).

Small tree; *stem spiny*. Twigs *c.* 1 cm thick, brown, shallowly fissured, glabrous. **Leaves** *in pseudowhorls, glabrous, faintly glaucous below; papillae distinct, uniformly distributed on lower leaf surface; narrowly oblong, 52–64 × 3.8–4.4 cm, the length more than 4 times the width; base obtuse, apex acute; midrib raised above, lateral veins 32–36 pairs, curving and joining near margin, visible on both surfaces, intercostal veins reticulate, visible below, faint to invisible above; petioles to 1 cm long, rugose. Inflorescences and flowers unknown. Fruits ellipsoid, c. 1 × 0.5 cm, glabrous, apex obtuse; hypocarp glabrous or sparsely scaly, funnel-shaped, c. 3 mm long; fruit stalks c. 2 mm long.*

**Distribution.** Endemic to Borneo; so far known only from the type specimen from Sabah.

**Ecology.** Lowland forest, at *c.* 200 m.

## 3. *Semecarpus borneensis* Merr.

(of Borneo)

J. Str. Br. Roy. As. Soc. 86 (1922) 323; Masamune *l.c.* 413; Ding Hou, *Blumea* 24 (1978) 35, FM 1, 8 (1978) 507. **Type:** *Agama 1061*, Borneo, Sabah, Kudat, Rosop (holotype PNH, destroyed; isotype A).

Small tree to 12 m tall, 15 cm diameter. Young twigs tomentose. **Leaves** *in well-spaced spirals, glabrous above except the midrib, hairy below; papillae distinct, uniformly distributed on the lower leaf surface, and veins; elliptic, oblong or oblanceolate, 7–20 × 1.5–8 cm, the length usually less than 4 times the width; base broadly rounded to cuneate, margin plane, apex acute; midrib flattened above, lateral veins 10–16 pairs, raised below, faint above, intercostal veins reticulate, distinct below, faint above; petioles 1–2.5 cm long, lower part swollen and rugose on drying. Inflorescences axillary panicles, to 20 cm long, hairy; bracts linear, 2–3 mm long. Flowers (only male seen) subsessile; buds subglobose; calyx lobes triangular; petals hairy outside. Fruits (young) broadly ellipsoid, c. 7 × 6 mm, with obtuse apex, hypocarp obconical.*

**Distribution.** Endemic to Borneo. Common in the Ranau district, with a few collections from Beluran (Labuk Sugut district), Lamag (Kinabatangan district) and Marudi area in Sabah; not yet reported from Sarawak.

**Ecology.** Hill to lower montane forest, including riverbanks, at 600–1500 m.

**Notes.** SAN 69337 and SAN 92476, collected from riverbanks, have narrowly linear leaves, 1.5–2 cm wide.

## 4. *Semecarpus bunburyanus* Gibbs

(Mr. Bunbury, probably an officer of the British North Borneo administration)

J. Linn. Soc. Bot. 42 (1914) 67; Merrill *l.c.* (1921) 351; Masamune *l.c.* 413; Ding Hou, FM 1, 8 (1978) 512. **Type:** *Gibbs 3964*, N Borneo, Sabah, Mt. Kinabalu (holotype BM). **Synonym:** *S. scaberulus* Merr., PEB (1929) 169, Masamune *l.c.* 414.

Small tree to 15 m tall, 20 cm diameter, often a treelet, sometimes unbranched; *young stem spiny*. Twigs very stout to 2 cm thick or slender to 0.5 cm thick. **Leaves** in *pseudowhorls* or in *well-spaced spirals*; *upper surface glabrous, lower surface glabrous, sparsely rough-hairy or densely tomentose*, only sometimes glaucous; *papillae distinct to obscure, uniformly distributed on the lower leaf surface*; obovate, oblong or oblanceolate, 15–100 × 3.5–22 cm, *the length less than 4 times the width*; base attenuate, *margin plane, not whitish, apex acute or obtuse*; *midrib raised above, lateral veins 10–35 pairs*, raised on both surfaces, *intercostal veins reticulate*, distinct below, visible above; *petioles absent or to 8 cm long*. **Inflorescences** *terminal or axillary panicles*, to 35 cm long, with many side branches, sparsely hairy, *axes not angular*; bracts and bracteoles of variable length and shape; pedicels very short to 1.5 mm long. **Flowers** whitish, buds oblong; calyx lobes triangular, sparsely hairy outside; petals valvate, elliptic or oblong, usually glabrous outside with several longitudinal veins which are more distinct on the inner surface; stamens *c.* 2.5 mm long, anthers ovoid-oblong, 1–1.5 mm long, staminodes slightly smaller; disc in male flowers flat and often glabrous, in female flowers cup-shaped, glabrous; ovary conical, hairy, styles to 1 mm long. **Fruits** subglobose, 0.7–2 × 0.6–1.5 cm, glabrous or sparsely hairy, apex rounded; *hypocarp funnel-shaped or obconical or cylindrical*.

**Distribution.** Borneo and the Philippines. Common and widely distributed in Sabah, very uncommon in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland to lower montane forest, to 1500 m.

**Notes.** There is extremely wide variation in twig thickness, leaf arrangement, leaf size, pubescence and petiole length. Even though there are a large number of collections of this species from Sabah, mature fruits are lacking and only very few collections have female flowers.

##### 5. *Semecarpus calcicolus* Kochummen

(Latin, *calx* = chalk or lime, *colus* = dweller; the limestone habitat)

Sandakania 7 (1996) 97. **Type:** *Dewol & Rahman SAN 90206*, Borneo, Sabah, Kota Belud, Mantanani Besar Island (holotype SAN).

Small tree to 15 m tall, 20 cm diameter. **Bark** grey-white; inner bark pale. **Sapwood** white. *Twigs stout, c.* 1.5 cm thick, lenticellate, *hollow*. **Leaves** in *close spirals, glabrous on both surfaces; papillae obscure on the lower leaf surface*; oblanceolate, 26–34 × 7–8.5 cm, *the length less than 4 times the width*; base attenuate, apex attenuate-acuminate; *midrib raised above, lateral veins 28–30 pairs, distinct below, faint above, intercostal veins finely reticulate*, visible on both surfaces; *petioles c. 1 cm long, drying black and rugose*. **Inflorescences** and **flowers** unknown. **Infructescences** *extra axillary, c.* 12 cm long. **Fruits** broadly oblong, 2.1–2.5 × 2–2.2 cm, glabrous, green when fresh, apex blunt and slightly depressed in the middle; *hypocarp obconical, c.* 0.7 cm high.

**Distribution.** Endemic to Borneo; so far known only from the type from Mantanani Besar Island in Sabah.

**Ecology.** On limestone.

### 6. *Semecarpus cuneiformis* Blanco

(Latin, *cuneiformis* = wedge-shaped; the leaf base)

Fl. Filip. (1837) 220; Merrill, Spec. Blanc. (1918) 235; Ding Hou, FM 1, 8 (1978). **Neotype** (Merrill, 1918): *Merrill Spec. Blanc.* 283, Philippines, Luzon, Manila (L). **Synonym:** *S. lanceolatus* Ridl., Kew Bull. (1933) 199, Masamune *l.c.* 413.

Small tree to 15 m tall, 20 cm diameter. **Leaves** spirally arranged, well-spaced; *lower surface distinctly or sparsely hairy to almost glabrous, not glaucous*; papillae distinct and uniformly distributed on lower leaf surface; oblong or oblanceolate, 9.5–28 × 2–8.5 cm, *the length less than 4 times the width*; base cuneate, *margin plane, not whitish on drying, not recurved*, apex acute or obtuse or emarginate; *midrib sunken above, not pale yellow on drying, lateral veins 15–18 pairs, raised below, very faint to invisible above*, intercostal veins reticulate, distinct below, very faint above; petioles 0.5–2.5 cm long, not pale yellow on drying. **Inflorescences** usually terminal, to 30 cm long, hairy. **Flowers:** buds subglobose; calyx lobes triangular; petals hairy outside with distinct longitudinal veins; ovary densely hairy. **Fruits** subglobose, c. 7 mm diameter; hypocarp funnel-shaped.

**Distribution.** Borneo, Philippines, Sulawesi, Lesser Sunda Islands, Formosa. In Borneo, recorded from the eastern and southern parts of Sabah; not yet reported from Sarawak; also in Brunei and Kalimantan.

**Ecology.** Lowland forest below 100 m.

### 7. *Semecarpus cupularis* Kochummen

(Latin, *cupularis* = cup-shaped; the hypanthium of the fruit)

Sandakania 7 (1996) 97. **Type:** *Ilias S. 41671*, Borneo, Sarawak, Kapit (holotype SAR; isotypes K, L, SAN).

Small tree to 10 m tall, 10 cm diameter; *stem with scattered spines*. Twigs glabrous, stout, 1–2.2 cm thick, yellowish grey, shallowly fissured. **Leaves** in close spirals; *glabrous*, drying to greenish grey above, *glaucous below*; *papillae uniformly distributed on the lower leaf surface*; obovate, 28–52 × 8–19 cm, *the length less than 4 times the width*; base attenuate, *margin plane*, apex acute; *midrib raised above*, lateral veins c. 30 pairs, curving and joining near margin, raised on both surfaces, *intercostal veins laxly reticulate*, visible on both surfaces; *petioles c. 1.5 cm long*, flattened above, yellowish on drying. **Inflorescences** and **flowers** unknown. **Infructescences** *terminal*, more than 20 cm long, axes stout, glabrous. **Fruits** green, ripening to orange, transversely oblong, 1.4–2 × 1.2–1.4 cm, glabrous, apex blunt with shallow depression in the middle; *hypocarp cup-shaped, enclosing more than three-quarters of the fruit*.



**Distribution.** Endemic to Borneo. Very uncommon, known from two collections, *S. 41671*, the type, and *S. 37203*, from Kapit District, Sarawak.

**Ecology.** Lowland forest, at about 250 m.

#### 8. *Semecarpus euodiifolius* Kochummen

(Latin, *Euodia* = a genus in the Rutaceae, *folium* = leaf; leaves resembling that of *Euodia*)

Sandakania 7 (1996) 100. **Type:** *Mikil SAN 28100*, Borneo, Sabah, Beaufort (holotype KEP; isotype SAN).

Medium-sized tree to 23 m tall, 20 cm diameter. **Bark** brownish, smooth; inner bark pale yellow. Twigs pale whitish, glabrous, 2–3 mm thick. **Leaves** spirally arranged, well-spaced, thin-coriaceous; glabrous, slightly glaucous below; papillae uniformly distributed on the lower leaf surface; elliptic-oblong, 7.5–19.5 × 3.5–6.5 cm; base attenuate, margin not recurved, apex acute with sharp tip; midrib sunken above, not pale yellow on drying, lateral veins 11–14 pairs, looping and joining near margin, faint on both surfaces, intercostal veins reticulate, visible on both surfaces; petioles 1.2–5 cm long, swollen near the base, not pale yellow on drying. **Inflorescences** in terminal panicles or in clusters, 9–16 cm long, densely hairy; sometimes male and female flowers on the same inflorescence; bracts linear-lanceolate, c. 1.5 mm long. **Flowers:** hypanthium funnel-shaped in male flower, cup-shaped and longer and 4–6 mm wide in female flower, densely hairy outside; calyx lobes triangular, c. 0.5 mm long; petals oblong, glabrous, c. 2.5 × 1 mm, with 8–10 distinct black veins, apex acute; stamens c. 1.5 mm long; pistillodes densely hairy; staminodes present; ovary conical, densely hairy. **Fruits** globose, 1.2–1.5 × 1.2–1.4 cm, densely hairy, apex slightly depressed; *hypocarp* cup-shaped, enclosing almost half of the fruit.

**Distribution.** Endemic to Borneo. Uncommon, recorded only from Beaufort and Kuala Penyu districts in Sabah (*SAN 28072*, *SAN 28100* (type), *SAN 58436*, and *SAN 102258*).

**Ecology.** Lowland forest. Flowering from February to May, fruiting in February.

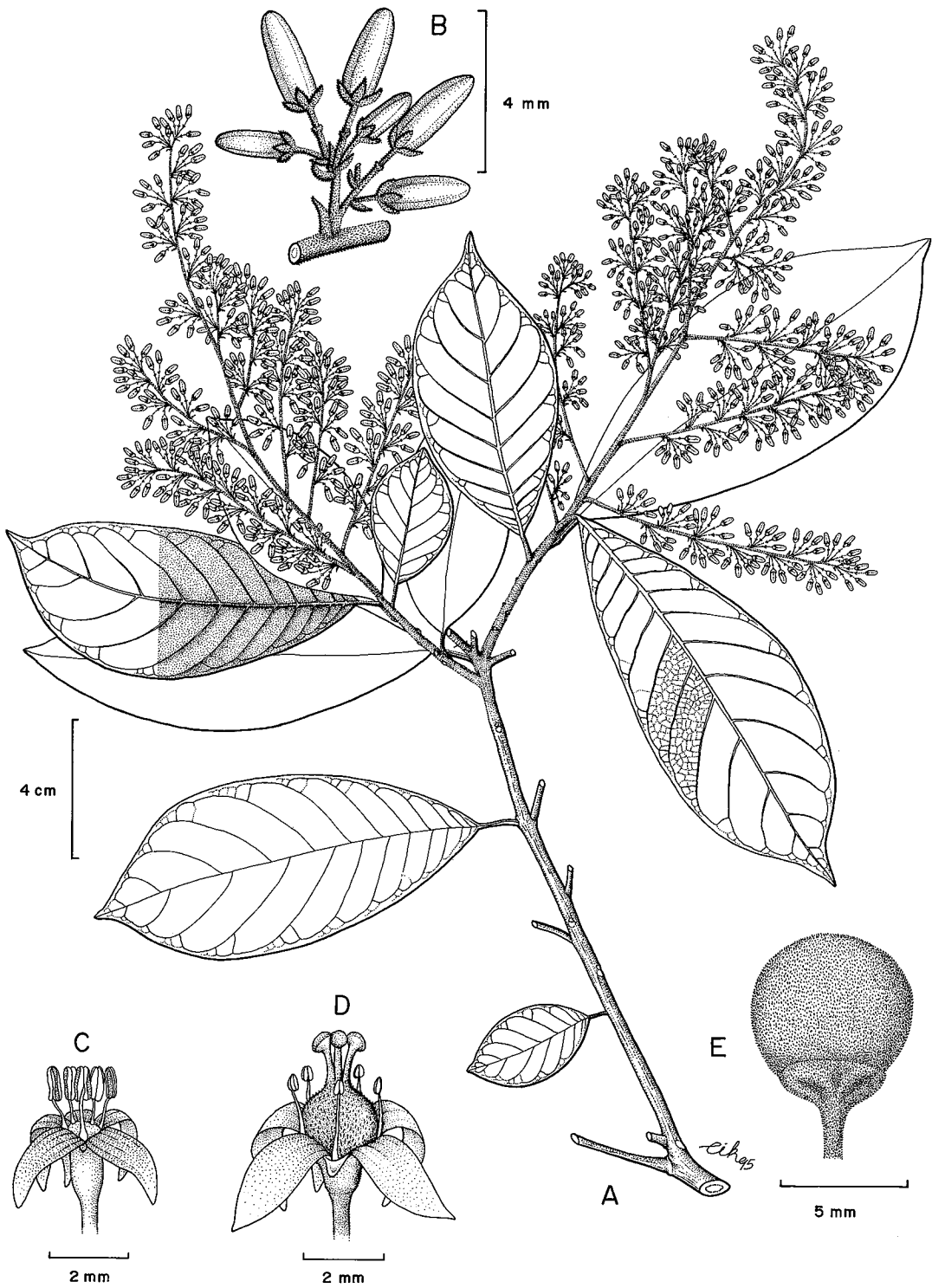
#### 9. *Semecarpus glaucus* Engl.

Fig. 15.

(Latin, *glaucus* = with a pale bloom; the lower leaf surface)

In A. DC., *Mon. Phan.* 4 (1883) 478; Merrill *l.c.* (1921) 352; Masamune *l.c.* 413; Ding Hou, *FM* 1, 8 (1978) 513; Anderson *l.c.* 138; Whitmore, Tantra & Sutisna *l.c.* 21. **Syntypes:** *Beccari PB 2875 & 3318*, Borneo, Sarawak (FI).

Small to medium-sized tree to 25 m tall, 20 cm diameter. **Bark** grey-brown, smooth. Twigs grey or grey-brown, densely brown short-hairy when young. **Leaves** spirally arranged, well-spaced; lower surface distinctly or slightly glaucous, uniformly covered with distinct papillae, upper surface glabrous, except for the midrib and lateral veins which are tomentose; elliptic to oblong or oblanceolate, 7–26.5 × 2.5–13 cm, the length less than 4 times the width; base cuneate, margin plane, not recurved, not pale whitish, apex acute; midrib usually sunken above, not pale yellow on drying, lateral veins 7–17 pairs, looping and joining near margin, raised below, visible above, intercostal veins reticulate, visible on both surfaces; petioles



**Fig. 15.** *Semecarpus glaucus*. A, flowering leafy twig; B, part of inflorescence; C, male flower; D, female flower; E, fruit. (A–B from *S.* 41896, C–D from *FM* 1, 8 (1978) 500, f. 47 c and d, E from *S.* 34664.)

0.5–4.8 cm long, not pale yellow on drying. **Inflorescences** terminal panicles, 11–35 cm long, hairy; bracts linear, 1.5–3 mm long. **Flowers:** buds oblong or ellipsoid; pedicels to 2.5 mm long; calyx lobes triangular; petals white, hairy outside with several longitudinal veins; ovary velvety hairy. **Fruits** (young) broadly ellipsoid, c. 1 × 0.7 cm, hairy, glabrescent, with almost rounded apex; hypocarp discoid.

**Distribution.** Endemic to Borneo. Widely distributed in Sabah and Sarawak but nowhere abundant; also in Kalimantan.

**Ecology.** Lowland forest to 450 m, in a variety of habitats including peat swamp, fresh-water swamp, and limestone.

**Note.** Very close to *S. rufovelutinus* from which it can be distinguished by the reddish brown leaves which are sparsely hairy and glaucous below.

#### 10. *Semecarpus heterophyllus* Blume

(Greek, *hetero* = different, *phullon* = leaves; the different shapes of the leaf)

Mus. Bot. Lugd. Bat. 1 (1850) 187; Ridley, FMP 5 (1925) 302; Backer & Bakhuizen *f. l.c.* 154; Ding Hou, FM 1, 8 (1978) 512; Anderson *l.c.* 139; Whitmore, Tantra & Sutisna *l.c.* 21. **Type:** Blume, *s.n.*, Java (holotype L).

Medium-sized tree to 22 m tall, 60 cm diameter; *young stem not spiny*. **Bark** grey-brown, smooth. **Leaves** spirally arranged, well-spaced, variable in shape, coriaceous; glabrous, slightly glaucous below; *papillae distinct and uniformly distributed on the lower leaf surface*; elliptic, obovate or oblanceolate, 11–22 × 5–8 cm; base broadly attenuate, *apex acute*; *midrib raised above, lateral veins 10–20 pairs*, raised on both surfaces, intercostal veins reticulate, raised below, visible above; petioles 0.5–6 cm long. **Inflorescences** terminal panicles, rarely in the axils of upper leaves. **Flowers** sessile; calyx lobes triangular; petals imbricate, hairy outside, with 9 distinct veins. **Fruits** subglobose, 1.7–2 × 1.5–2 cm, glaucous, apex rounded; hypocarp discoid.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, Java, Lesser Sunda Islands. In Sabah, recorded only from Mt. Kinabalu (*RSNB 4264* and *RSNB 7095*); not yet reported from Sarawak; also in Kalimantan.

**Ecology.** Lower montane forest, at 1350–1800 m.

#### 11. *Semecarpus impressicostatus* Kochummen

(Latin, *impressus* = sunken, *costus* = vein; the sunken midrib on the upper leaf surface)

Sandakania 7 (1996) 102. **Type:** Kulip & Goh SAN 137045, Borneo, Sabah, Tongod (holotype SAN).

Small unbranched tree to 20 m tall, 10 cm diameter. Twigs very stout, c. 2 cm thick, rugose. **Leaves** in close spirals, coriaceous; glabrous above, *rough hairy below*; *papillae uniformly distributed on the lower leaf surface*; oblanceolate, 43–85 × 11–22 cm, the length less than 4 times the width; base attenuate, *margin plane*, pale white on drying, apex rounded, bluntly pointed or emarginate; *midrib sunken above, prominent below, to 8 mm broad*, lateral veins

30–50 pairs, raised below, faint above, looping and joining near margin, intercostal veins reticulate, raised below, visible above; *petioles absent or to 5 mm long*. **Inflorescences** terminal, 75–92 cm long, axes stout, to 7 mm thick, rusty brown-hairy; bracts lanceolate, c. 1.5 mm long, woolly; bracteoles lanceolate, woolly, c. 0.5 mm long. **Flowers** (only male seen): pedicels c. 1 mm long, pale yellow in bud, densely hairy; calyx lobes c. 0.5 mm long, triangular with blunt apex; petals oblong, c. 2 × 1 mm, glabrous on both surfaces, with distinct black veins inside; stamen filaments c. 2 mm long; *disc densely hairy*; pistillodes absent. **Fruits** obliquely oblong, c. 1.7 × 1.5 cm, with blunt apex, sparsely hairy; hypocarp c. 5 mm long, slightly obconical.

**Distribution.** Endemic to Borneo. In Sabah, known only from Beluran (Pensiangan district), Sandakan district and Tongod (Kinabatangan district) (SAN 137045, SAN 79352, SAN 131008); not yet recorded in Sarawak.

**Ecology.** Lowland forest.

## 12. *Semecarpus kinabaluensis* Kochummen

(of Mt. Kinabalu)

Sandakania 7 (1996) 102. **Type:** *Aban & Saikeh* SAN 74108, Borneo, Sabah, Kinabalu Park (holotype SAN; isotypes K, L).

Small tree to about 10 m tall; *stem spiny*. Twigs 0.5–1 cm thick, grey-brown, shallowly fissured, glabrous. **Leaves** in *pseudowhorls*; glabrous above, *densely tomentose below*; *papillae distinct and uniformly distributed on the lower leaf surface*; obovate, 22–37.5 × 8.5–15.5 cm, *the length less than 4 times the width*; base attenuate, *margin plane, pale whitish*, apex attenuate and sharp-pointed; *midrib raised above*, lateral veins 18–28 pairs, raised below, visible above, intercostal veins reticulate, raised below, visible above; petioles 0.5–3.5 cm long, rugose on drying, swollen at base. **Inflorescences** *terminal panicles*, to 33 cm long, with many side-branches, hairy; bracts broadly triangular, c. 1 × 1 mm, hairy; bracteoles lanceolate, c. 1.5 mm long, hairy. **Flowers** (only male seen) sessile; calyx lobes triangular, c. 0.5 mm long; petals yellow when fresh, imbricate, glabrous, outer surface rugose, oblong, c. 2 × 0.5 mm; stamens c. 2 mm long, anthers oblong, c. 1 mm long; disc 5-lobed, glabrous; pistillodes absent. **Fruits** subglobose, c. 1.2 × 1.3 cm, glabrous, apex with short point; *hypocarp cup-shaped*, 3–4 mm high.

**Distribution.** Endemic to Borneo. So far recorded only from the Kinabalu Park in Sabah, where it appears to be common.

**Ecology.** Lower montane forest, at 1200–1800 m.

**Notes.** In addition to the type, the following collections belong to this species: SAN 56516, SAN 76483; RSNB 4167, RSNB 4339, and *Kokawa & Hotta* 4392.

## 13. *Semecarpus lineatus* Kosterm.

(Latin, *lineatus* = marked with fine lines; the twigs)

Blumea 33 (1988) 348. **Type:** *Binideh SAN 55161*, Borneo, Sabah, Lahad Datu (holotype L; isotype SAN).

Small tree to 5 m tall, 10 cm diameter. *Twigs slender, shallowly longitudinally furrowed. Leaves in pseudowhorls, glabrous; papillae obscure; linear, 20–43 × 1–2 cm, the length more than 4 times the width; base attenuate, apex acuminate; midrib raised above, lateral veins 20–23 pairs, with short intermediate veins, intercostal veins reticulate, lax; petioles 1–1.5 cm long, base slightly swollen. Inflorescences* panicles, terminal or in the axils of upper leaves, 15–20 cm long. **Flowers** light green; sepals triangular, 0.25–0.5 mm long; petals *c.* 2.5 mm long. **Fruits** unknown.

**Distribution.** Endemic to Borneo; so far known only from Mt. Silam in Lahad Datu area, Sabah.

**Ecology.** Hill forest at about 700 m.

#### 14. *Semecarpus minutipetalus* Kochummen

(Latin, *minutus* = very small, *petalus* = petal)

Sandakania 7 (1996) 105. **Type:** *Ilias S. 39169*, Borneo, Sarawak, Miri (holotype KEP; isotypes K, L, SAN, SAR).

Small tree to 12 m tall, 12 cm diameter. *Twigs pale whitish, glabrous. Leaves spirally arranged, well-spaced; glabrous, faintly glaucous below; papillae distinct on the lower leaf surface except on the midribs and veins; narrowly obovate to oblong, 18.5–31.5 × 5.5–10 cm; base attenuate, margin pale whitish, recurved, apex acute; midrib sunken above, on drying pale yellow below, lateral veins 20–25 pairs, looping and joining near margin, distinct below, faint to invisible above, intercostal veins reticulate, faintly visible on both surfaces; petioles 3.5–6 cm long, pale yellow on drying, swollen at base, narrowly grooved above. Inflorescences* short panicles, arising from the axils of upper leaves, to 8 cm long, densely hairy; bracts linear-lanceolate, *c.* 1 cm long, densely hairy; bracteoles to 2 mm long. **Flowers** (only immature male flowers seen): calyx lobes *c.* 2 mm long, oblong, hairy outside with glabrous margins and with 3 black ridges inside; *petals* narrowly oblong, apex obtuse, *very much smaller than calyx lobes, c.* 0.2 mm long, with a single ridge on the inside; stamens 5; pistillodes absent. **Fruits** unknown.

**Distribution.** Endemic to Borneo; so far recorded only from the type specimen from Miri in Sarawak.

**Ecology.** Lowland forest, at about 120 m.

#### 15. *Semecarpus paucinervius* Merr.

(Latin, *pauci* = few; *nervis* = veins; the leaf)

Philip. J. Sc. 7 (1912) Bot. 286; Ding Hou, Blumea 24 (1978) 36, FM 1, 8 (1978) 510; Whitmore, Tantra & Sutisna *l.c.* 21. **Type:** *Foxworthy Bur. Sci. 750*, Borneo, Sabah, Tawau (isotype BO).

Small tree to 20 m tall, 60 cm diameter. Twigs grey-brown, glabrous. **Leaves** *well-spaced, spirally arranged, coriaceous, glabrous; papillae uniformly distributed on the lower leaf surface*; obovate or oblong, 5–12.5 × 2–5.5 cm; base attenuate, *apex rounded; midrib flattened above, lateral veins 5–10 pairs, raised below, faint above, intercostal veins reticulate, distinct below, faint above*; petioles 0.5–1.7 cm long. **Inflorescences** panicles, often terminal; bracts lanceolate. **Flowers**: buds globose; calyx lobes triangular; petals sparsely hairy outside, with several distinct veins; ovary hairy. **Fruits** maturing red, subglobose, *c.* 8 mm diameter, apex rounded; hypocarp funnel-shaped.

**Distribution.** Borneo, the Philippines. In Borneo, recorded only from Kota Belud and Kudat districts in Sabah.

**Ecology.** Lowlands including seashores and riverbanks.

#### 16. *Semecarpus pulvinatus* Kochummen

(Latin, *pulvinatus* = cushion-shaped; the swollen petiole base)

Sandakania 7 (1996) 105. **Type:** *Dewol SAN 124556*, Borneo, Sabah, Kota Kinabatangan (holotype SAN).

Small tree to 8 m tall, 20 cm diameter. **Bark** grey, smooth. Twigs *c.* 7 mm thick, brownish, shallowly fissured. **Leaves** *in pseudowhorls; glabrous on both surfaces, faintly glaucous below; papillae obscure on the lower leaf surface*; narrowly elliptic to oblanceolate, 20–30 × 3.5–6.5 cm, *the length more than 4 times the width; base attenuate, apex acute; midrib raised above, lateral veins c. 35 pairs, looping and joining near margin, raised below, visible above, intercostal veins reticulate, faintly visible on both surfaces; petioles 4.5–6 cm long, lower 1–1.5 cm prominently swollen.* **Inflorescences** terminal panicles, *c.* 45 cm long, with many side branches, sparsely hairy; bracts lanceolate, *c.* 0.5 mm long, hairy. **Flowers** (only male seen) sessile; calyx lobes triangular, *c.* 0.5 mm long, hairy outside; petals valvate, glabrous on both surfaces, oblong, *c.* 3 × 1.5 mm, with acute apex and 6–7 distinct veins; stamen filaments *c.* 2 mm long, anthers oblong, *c.* 1.5 mm long; disc pulvinate, glabrous; pistillodes absent. **Fruits** globose, 1.5–2 × 1–1.2 cm, glabrous apex emarginate; hypocarp saucer-shaped.

**Distribution.** Endemic to Borneo; known only from 2 collections from Kinabatangan and Tawau districts in Sabah (*SAN 89703*, and *SAN 124556* respectively).

**Ecology.** Lowland forest. Flowering in February and fruiting in September.

#### 17. *Semecarpus rufovelutinus* Ridl.

(Latin, *rufus* = reddish, *velutinus* = velvety; indumentum on the lower leaf surface)

Kew. Bull. (1933) 199; Masamune *l.c.* 414; Ding Hou, FM 1, 8 (1978) 513; Anderson *l.c.* 139; Whitmore, Tantra & Sutisna *l.c.* 22. **Type:** *Hose 654*, Borneo, Sarawak, Miri (holotype K; isotypes BM, L). **Synonym:** *Melanocommia borneensis* Ridl. *l.c.* (1933) 198, Masamune *l.c.* 411.

Small tree to 10 m tall, 10 cm diameter. **Bark** grey, smooth; inner bark brownish. **Sapwood** whitish. Twigs grey-brown, soft-hairy when young. **Leaves** in spirals, well-spaced; glabrous above, reddish velvety hairy below, drying to grey-brown; papillae distinct, uniformly distributed on the lower leaf surface; elliptic, oblong or obovate, 10–32 × 6–11 cm, the length less than 4 times the width; base attenuate, margin plane, pale whitish on drying, apex acute; midrib sunken above, lateral veins 10–12 pairs, raised below, visible above, intercostal veins reticulate, raised below, faintly visible above; petioles 0.5–3.5 cm long, hairy. **Inflorescences** often terminal panicles, to 34 cm long, velvety hairy; bracts lanceolate, 1–4 mm long. **Flowers:** buds oblong; pedicels to 1 mm long; calyx lobes triangular; petals hairy outside, with distinct longitudinal veins; ovary subglobose, velvety. **Fruits** subglobose, 1–1.5 × 1.5–1.7 cm, velvety hairy, apex rounded; hypocarp discoid or cupular.

**Distribution.** Peninsular Malaysia, Borneo. Common and widely distributed in Sabah, uncommon in Sarawak; also in Kalimantan.

**Ecology.** Lowland and hill forests, including limestone, to 500 m.

**Notes.** Often confused with *S. glaucus* but it is easily distinguished by the reddish velvety hairy leaves which are not glaucous below.

#### 18. *Semecarpus sandakanus* Kochummen

(of Sandakan in Sabah)

Sandakania 7 (1996) 108. **Type:** *Saikeh SAN 87801*, Borneo, Sabah, Sandakan (holotype KEP; isotype SAN).

Small tree to 5 m tall. Twigs slender, grey, glabrous. **Leaves** in close spirals, thin-coriaceous; glabrous, glaucous below; papillae distinct and in groups on the lower leaf surface; elliptic, 26–30.5 × 8–10 cm; base attenuate, apex acuminate, acumen 2–2.5 cm long; midrib raised above, lateral veins 20–25 pairs, looping near margin, distinct below, faintly raised above, intercostal veins reticulate, faintly visible below, invisible above; petioles 2–3 cm long, channelled above, yellowish on drying, not swollen at base. **Inflorescences** slender terminal panicles, to 10 cm long, with few side-branches, sparsely hairy; bracts linear, c. 4 mm long, hairy; bracteoles linear-lanceolate, c. 1.5 mm long, hairy. **Flowers** (only male seen): calyx lobes triangular; petals imbricate, oblong, c. 2.5 × 1 mm, glabrous, with distinct veins; stamens c. 1 mm long; disc pulvinate, c. 1 mm diameter; pistillodes absent. **Fruits** unknown.

**Distribution.** Endemic to Borneo; so far known only from the type from Sandakan in Sabah.

**Ecology.** Lowland forest.

#### 19. *Semecarpus trengganuensis* Kochummen

(of Trengganu, a state in Peninsular Malaysia)

Gard. Bull. Sing. 36 (1984) 196, l.c. (1989) 52. **Type:** *Chan FRI 16876*, Peninsular Malaysia, Bukit Bauk FR, Trengganu (holotype KEP; isotypes A, K, L, SING).

long. **Fruits** globose, smooth, 3–4 mm diameter, ripening yellow or orange; pericarp thin; endocarp breaking up at maturity into 4 separate single-seeded parts; persistent calyx much shorter than the fruit.

**Distribution.** Myanmar to Australia. In Sabah, known from Ranau district. No record from Sarawak.

**Ecology.** Mixed dipterocarp forest.

#### 4. PTELEOCARPA Oliv.

(Greek, *Ptelea* = a rutaceous genus, *karpos* = fruit; having fruits resembling that of *Ptelea*)

Trans. Linn. Soc. London 28 (1873) 518; Merrill, EB (1921) 510; Masamune, EPB (1942) 637; Anderson, CLTS (1980) 154; Cockburn, TS 2 (1980) 22; Whitmore & Tantra, CLS (1986) 154; Ng, TFM 4 (1989) 64; Whitmore, Tantra & Sutisna, CLK 1 (1989) 33.

Trees. **Leaves** spirally arranged, stalked. **Inflorescences** terminal, many-flowered panicles. **Flowers:** calyx tubular, deeply 5-lobed; corolla tube short, 5-lobed; stamens 5, exserted from the corolla throat; ovary thick-stalked, 2-locular, style divided into 2 almost from its base, ovules 1 per locule. **Fruit** a samara.

**Distribution.** A monotypic genus, distributed in Thailand, Peninsular Malaysia, Sumatra and Borneo (Sabah, Sarawak, Brunei and Kalimantan).

**Uses.** In Sabah and Sarawak, no recorded use, but in Sumatra, the timber which is fairly hard and durable is used for construction works inside the house (Burkill *l.c.* 1855).

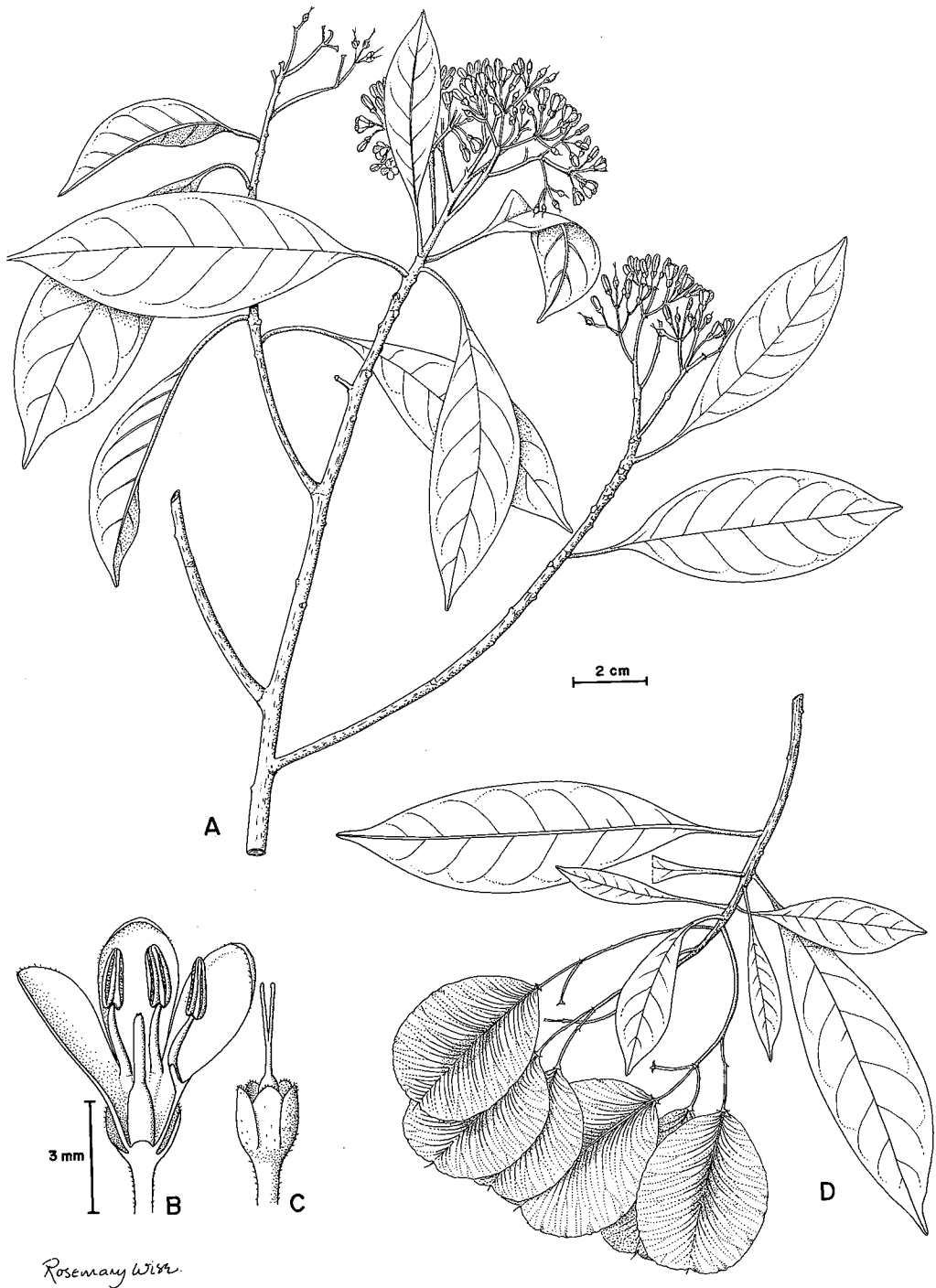
**Pteleocarpa lamponga** (Miq.) Bakhuizen *ex* Heyne  
(of Lampong, Sumatra)

Fig. 4.

Nut. Pl. Ned. Ind., 2nd ed. (1927) 1309; Anderson *l.c.* 154; Whitmore & Tantra *l.c.* 154; Ng *l.c.* 64; Whitmore, Tantra & Sutisna *l.c.* 33. **Basionym:** *Dodonaea ?lamponga* Miq., Fl. Ind. Bat., Suppl. (1855) 511. **Type:** *Teijsmann, s.n.*, Sumatra, Lampong Prov. (holotype L; isotype BO). **Synonyms:** *P. malaccensis* Oliv. *l.c.* 518, Cockburn *l.c.* 22; *P. longistyla* Becc., Malesia 1 (1877) 130, Merrill *l.c.* 510, Masamune *l.c.* 637.

Tree to 37 m tall, 50 cm diameter; crown bushy; bole straight. **Bark** smooth to shallowly fissured; inner bark pale brown or pale orange, laminated. **Sapwood** pale yellow-brown. **Leaves** membranous to thin-coriaceous, glabrous, withering yellow before shedding; obovate-elliptic, 3–14 × 1–6 cm; base attenuate, margin entire, apex acuminate; midrib prominent on both sides of the leaf, lateral veins 4–7 pairs, fine, fading toward the margin, intercostal veins finely reticulate. **Inflorescences** terminal, many-branched, many-flowered, to 7 cm long. **Flowers** bright yellow; pedicels *c.* 5 mm long; sepals 5, *c.* 2 mm long, imbricate; corolla tube *c.* 2 mm long, corolla lobes 5, 3–6 mm long; stamens 5, exserted from the mouth of corolla



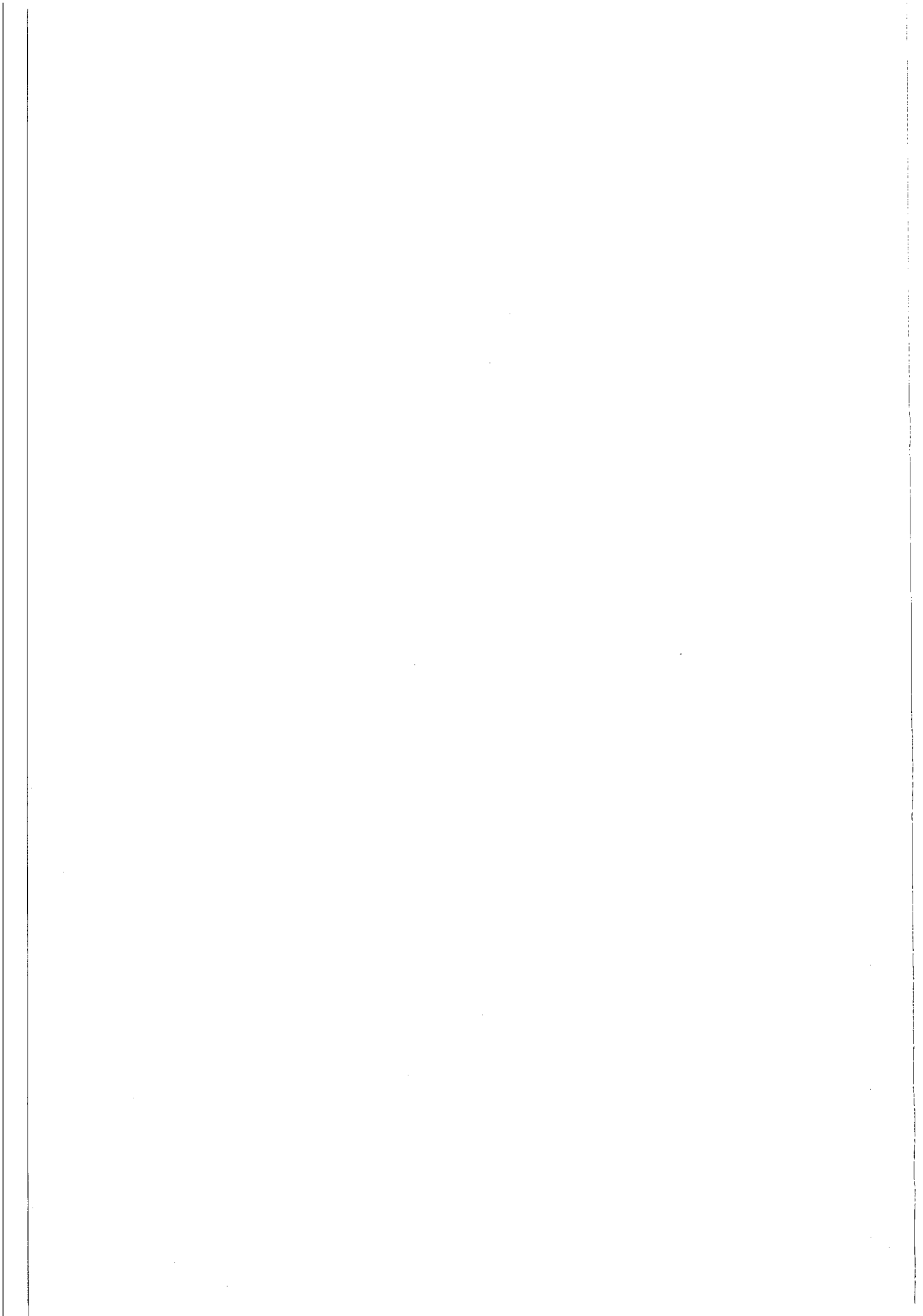


**Fig. 4.** *Pteleocarpa lamponga*. A, flowering leafy twig; B–C, flowers; D, fruiting leafy twig. (A–C from living trees cultivated at the FRIM arboretum; D from *Enggoh FDNB 10558*.)

tube; ovary *c.* 3 mm long, stipe *c.* 1 mm, styles 2, *c.* 0.5–1 mm long; ovules 1 per locule. **Fruits** flat, winged, broadly elliptic to orbicular, *c.* 5.5 × 5 cm, pale green or yellowish, ripening pink to light red. **Seed** 1 per fruit, elongate.

**Distribution.** As for the genus. In Sabah, known from Beaufort, Ranau and Kudat (Banggi Island) districts. In Sarawak, recorded from Balai Ringin and Matang FR. Also in Brunei and Kalimantan.

**Ecology.** In mixed dipterocarp and *kerangas* forests, to 600 m. The winged fruits are dispersed by wind.



## CAPRIFOLIACEAE

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Kuala Lumpur, Malaysia

King & Gamble, J. As. Soc. Beng. 72, 2 (1903) 112; Merrill, EB (1921) 582; Ridley, FMP 2 (1923) 1; Masamune, EPB (1942) 719; Backer & Bakhuizen *f.*, FJ 2 (1965) 357; Kern & van Steenis, FM 1, 4 (1951) 175, *l.c.* 1, 6 (1972) 928; Anderson, CLTS (1980) 158; Corner, WSTM 3rd ed. 1 (1988) 204; Wong & Saw, TFM 4 (1989) 66; Whitmore, Tantra & Sutisna, CLK 1 (1989) 40.

Shrubs, small trees, sometimes lianas or perennial herbs; twigs terete. **Leaves** *simple* or rarely compound, *opposite or alternate*, sometimes with stipules. **Inflorescences** terminal, corymbose cymes, panicles or umbellate corymbs. **Flowers** *bisexual or unisexual, radially or bilaterally symmetrical, 4–5-merous*; calyx (4–)5-lobed or toothed, the lobes usually small, calyx tube fused to the ovary; corolla (3–)5-lobed or sometimes 2-limbed, lobes imbricate in bud, corolla tube variable from very short to long and narrow; stamens inserted on the corolla tube, usually as many as corolla lobes, anthers dorsifixed or basifixed, usually introrse, rarely extrorse, 2-locular, the locules parallel, opening by longitudinal slits; *ovary inferior, 2–5(–8)-locular*; style simple with capitate or lobed stigma; ovules 1 to numerous, *pendulous, anatropous, placentation axile*. **Fruit** *usually a fleshy berry or a drupe*, sometimes an achene or a capsule. **Seeds** one to several per fruit; testa bony, rarely membranous.

**Distribution.** Fifteen genera with about 400 species, cosmopolitan, mostly in the temperate regions of N America and E Asia and montane tropical areas. In Sabah and Sarawak, represented by 2 genera with 8 species.

**Ecology.** Growing along streams and on hill slopes in secondary forest, and primary montane forest. Flowers of most species are pollinated by insects such as bees, flies and beetles, although self-pollination may also occur.

**Uses.** Many genera are of horticultural value as ornamental flowering shrubs and most species treated here are used for such purposes. The family produces no important commercial timbers.

**Taxonomy.** Kern and van Steenis (1951) are of the opinion that Caprifoliaceae is closely related to Valerianaceae, an opinion shared by Thorne (Nord. J. Bot. 3 (1983) 85–117) and Cronquist (Integr. Syst. Class. Fl. Pl. 1981) who placed the two families in the order Dipsacales. Dahlgren (Nord. J. Bot. 3 (1983) 119–149), on the other hand, excluded Caprifoliaceae from the order Dipsacales and split the family into three smaller families, the Caprifoliaceae *s.s.*, Sambucaceae and Viburnaceae, and placed these families in the order Cornales. Takhtajan (Syst. Magnol. 1987) agreed with Dahlgren in splitting the Caprifoliaceae into three smaller families but included them in the order Dipsacales. In the present account,

a broader concept of the family as proposed by Kern & van Steenis (*l.c.*), Cronquist (*l.c.*) and Thorne (*l.c.*) is followed.

### Key to genera

Leaves simple. Flowers in umbellate corymbs or few-flowered paniculate inflorescences. Fruit a drupe.....**Viburnum**

Leaves pinnately or bipinnately compound. Flowers in compound, corymbose cymes or many-flowered paniculate inflorescences. Fruit a 3–5-seeded berry.....

#### **Sambucus L.**

Sp. Pl. (1753) 269; Kern & van Steenis *l.c.* (1951) 190; Backer & Bakhuizen *f. l.c.* 357; Corner *l.c.* 205; Wong & Saw *l.c.* 66.

About 25 species, distributed in subtropical and temperate regions worldwide.

Small trees or shrubs, rarely perennial herbs. Leaves opposite or alternate; leaflet margins serrate or narrowly lobed; stipules present or absent. Flowers radially symmetrical, bisexual or unisexual, with flowers of both sexes usually in the same inflorescence; calyx tube ovoid or turbinate, limb 3–5-toothed; corolla rotate, 3–5-lobed, lobes imbricate or rarely valvate in bud; stamens 5, inserted at the base of corolla tube, filaments filiform, anthers oblong; ovary 3–5-locular, ovule 1 in each locule, style short, stigmas 3 or 5.

In Sabah, represented by one introduced and naturalised species, *S. javanicus*, commonly found in secondary hill and lower montane forest, at 600–1500m.

## VIBURNUM L.

(an old Latin plant-name)

Sp. Pl. (1753) 267; King & Gamble, J. As. Soc. Beng. 72, 2 (1903) 112; Merrill, EB (1921) 582; Ridley, FMP 2 (1923) 1; Masamune, EPB (1942) 719; Kern, Reinwardtia 1 (1951) 111; Kern & van Steenis, FM 1, 4 (1951) 180; Backer & Bakhuizen *f.*, FJ 2 (1965) 358; Anderson, CLTS (1980) 158; Corner, WSTM 3rd ed. 1 (1988) 183; Wong & Saw, TFM 4 (1989) 67; Whitmore, Tantra & Sutisna, CLK 1 (1989) 40.

Trees, shrubs or treelets. **Leaves** *simple, opposite*, pinnately or palmately (non-Bornean taxa) veined, *without stipules*. **Inflorescence** a terminal, umbellate corymb or a few-flowered panicle; bracts and bracteoles usually small, caducous. **Flowers** *bisexual, radially symmetrical*; calyx tube turbinate or cylindrical, limb 5-toothed; corolla white, pink or yellowish, rotate, bell-shaped or tubular, 5-lobed; stamens 5, exerted, anthers basifixed or dorsifixed; ovary 1-locular, style short, conical, stigmas 3, *ovules anatropous, pendulous, solitary*. **Fruit** *a drupe*, crowned by persistent calyx and style. **Seeds** oblong; testa horny or stony; endosperm often hard and copiously folded.

**Distribution.** About 225 species; north temperate regions, South America, Madagascar and tropical Asia. In Sabah and Sarawak, 7 species are known.

**Ecology.** In primary and secondary forests to 1800 m.

**Uses.** None of the species found in Sabah and Sarawak is known to be of economic importance.

### Key to *Viburnum* species

1. Leaf margin coarsely crenate-serrate to serrulate along the upper two-thirds, and entire or faintly denticulate at the lower third.....**5. V. lutescens**  
Leaf margin entire throughout.....2
2. Leaves narrowly elliptic-oblong, apex acute to acuminate. Fruits not compressed and more or less rounded in cross-section.....**3. V. clemensae**  
Leaves obovate, elliptic-orbicular, elliptic-oblong, or broadly elliptic, apex cuspidate, rounded, truncate or emarginate, rarely acute-acuminate. Fruit compressed, bilobate, biconvex or somewhat unequally 4-angular in cross-section.....3
3. Leaves obovate or elliptic-orbicular, thick-coriaceous.....4  
Leaves elliptic-oblong to broadly elliptic, thin-coriaceous.....5
4. Leaves obovate, upper surface shiny; apex rounded, truncate, emarginate, or very rarely abruptly cuspidate; midrib angular on lower surface, distinct glands present at the base on both sides. Fruits *c.* 5 × 4 mm.....**7. V. vernicosum**  
Leaves elliptic-orbicular, upper surface not shiny; apex cuspidate; midrib flat on lower surface, both sides without distinct glands. Fruits 10–11 × 8–10 mm.....**2. V. beccarii**
5. Leaves elliptic-oblong, both surface densely punctate, lower surface hispidulous; midrib raised and angular on the lower surface. Fruits biconvex in cross-section.....**4. V. hispidulum**  
Leaves broadly elliptic, glabrous to minutely papillose; midrib raised and rounded on the lower surface. Fruits bilobed or somewhat unequally 4-angular in cross-section.....6
6. Peduncles more than 12 cm long. Fruits *c.* 16 × 3 mm, bilobed in cross section .....**1. V. amplificatum**  
Peduncles to 3 cm long. Fruits *c.* 7 × 6 mm, somewhat unequally 4-angular in cross-section.....**6. V. sambucinum**

#### 1. *Viburnum amplificatum* Kern

(Latin, *amplificatio* = enlargement; the large leaves and fruits)

*L.c.* 150; Kern & van Steenis *L.c.* 188, Sar. Mus. J. 9 (1960) 679, *L.c.* (1972) 929; Whitmore, Tantra & Sutisna *L.c.* 40. **Type:** *Elmer 21741*, North Borneo, Tawao, Elphinstone Prov. (holotype G; isotypes L, S).

Small treelet to 6 m tall. **Sapwood** white. **Bark** smooth, greyish brown; inner bark pale cream. *Young parts sparsely hairy to almost glabrous. Leaves thin-coriaceous, glabrous; broadly elliptic to rarely elliptic-obovate, 7.7–19.8 × 4.6–8.1 cm; base cuneate to acute, margins entire, apex cuspidate; midrib flat and slightly sunken above, raised and rounded beneath; lateral*

veins 5–8 pairs, visible but not prominent on both surfaces; intercostal veins visible but not prominent on both surfaces; petioles 1.3–2.9 cm long. **Inflorescence** a terminal corymb; *peduncles to 12 cm*; primary rays to 7. **Flower** buds ovoid to subglobose; calyx tube c. 1.5 mm long, lobes 5, narrowly ellipsoid; corolla bell-shaped; stamens c. 1 mm long, anthers basifixed; ovary slightly oblong, style less than 1 mm long, tubular, stigmas fused. **Fruits** greenish, *narrowly oblong to ellipsoid, grooved, c. 16 × 3 mm, bilobed in cross-section*. **Seeds** oblong, almost black, with rough surface.

**Distribution.** Endemic to Borneo. Known from a few collections from Lahad Datu, Tawau and Ranau districts in Sabah. Not yet reported from Sarawak; also known from Kalimantan.

**Ecology.** Along streams or on hillsides in primary forest to 360 m.

## 2. *Viburnum beccarii* Gamble

Fig. 1.

(Odoardo Beccari, 1843–1920, Italian botanist and explorer)

In King & Gamble *l.c.* 114; Ridley *l.c.* 2; Kern *l.c.* 120; Kern & van Steenis *l.c.* (1951) 183; Wong & Saw *l.c.* 67. **Type:** *Scortechini 375b*, Peninsular Malaysia (*n.v.*).

Shrub or treelet to 5 m tall. **Bark** smooth; inner bark light brown. Twigs terete, glabrous. Young parts densely covered with minute, short, stiff hairs. **Leaves** *thick-coriaceous*, densely punctate on both surfaces, *not shiny above; elliptic-orbicular, 7.3–9.8 × 5.6–7.5 cm*; base rounded, *margins entire, apex cuspidate; midrib flat beneath, at base on both sides without distinct glands*; lateral veins 5–6 pairs, obscure above, prominent beneath; intercostal veins visible beneath, obscure above; petioles, 1.7–2.3 cm long. **Inflorescence** a terminal corymb; peduncles 4–8 cm long. **Flowers** with clavate calyx tube, to 0.3 cm long; *petals white*, tubular, lobes 5, acute; stamens about 4 mm long, attached to the base of corolla tube; ovary glabrous, cylindrical, style less than 1 mm long, stigmas capitate. **Fruits** ovoid to globose, grooved, green with reddish base when young, ripening blackish red, *10–11 × 8–10 mm, somewhat unequally 4-angular in cross-section*. **Seeds** ovoid, dark brown to almost black, smooth.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sarawak, uncommon, known only from Mt. Murud, Lawas; not yet recorded in Sabah.

**Ecology.** Along river banks, on rocky areas or sandstone cliffs in lower montane forest at 1400–1800 m.

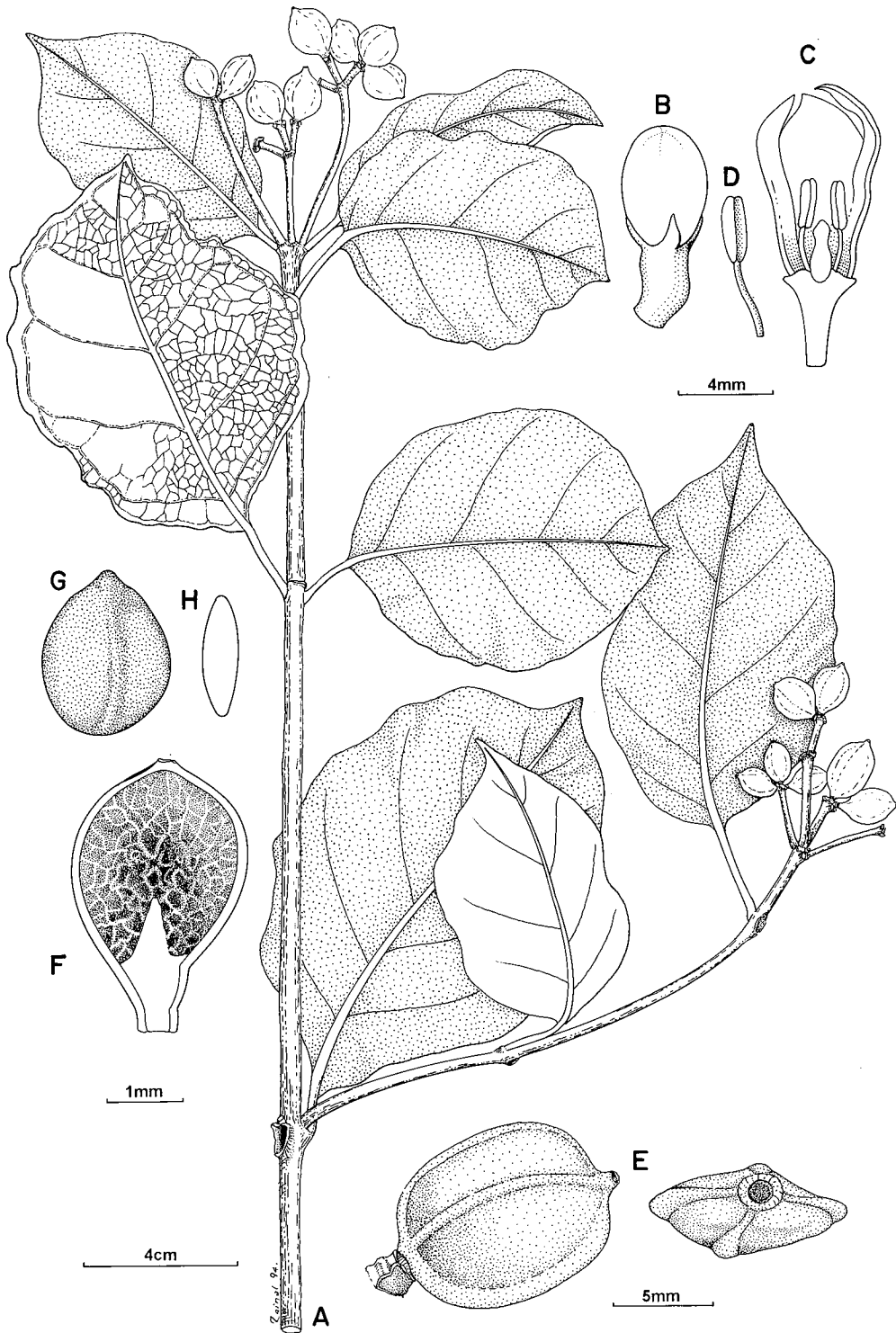
## 3. *Viburnum clemensae* Kern

Fig. 2.

(Mary Strong Clemens, who collected plants on Mt. Kinabalu in 1915, 1916, 1917 and 1931–33)

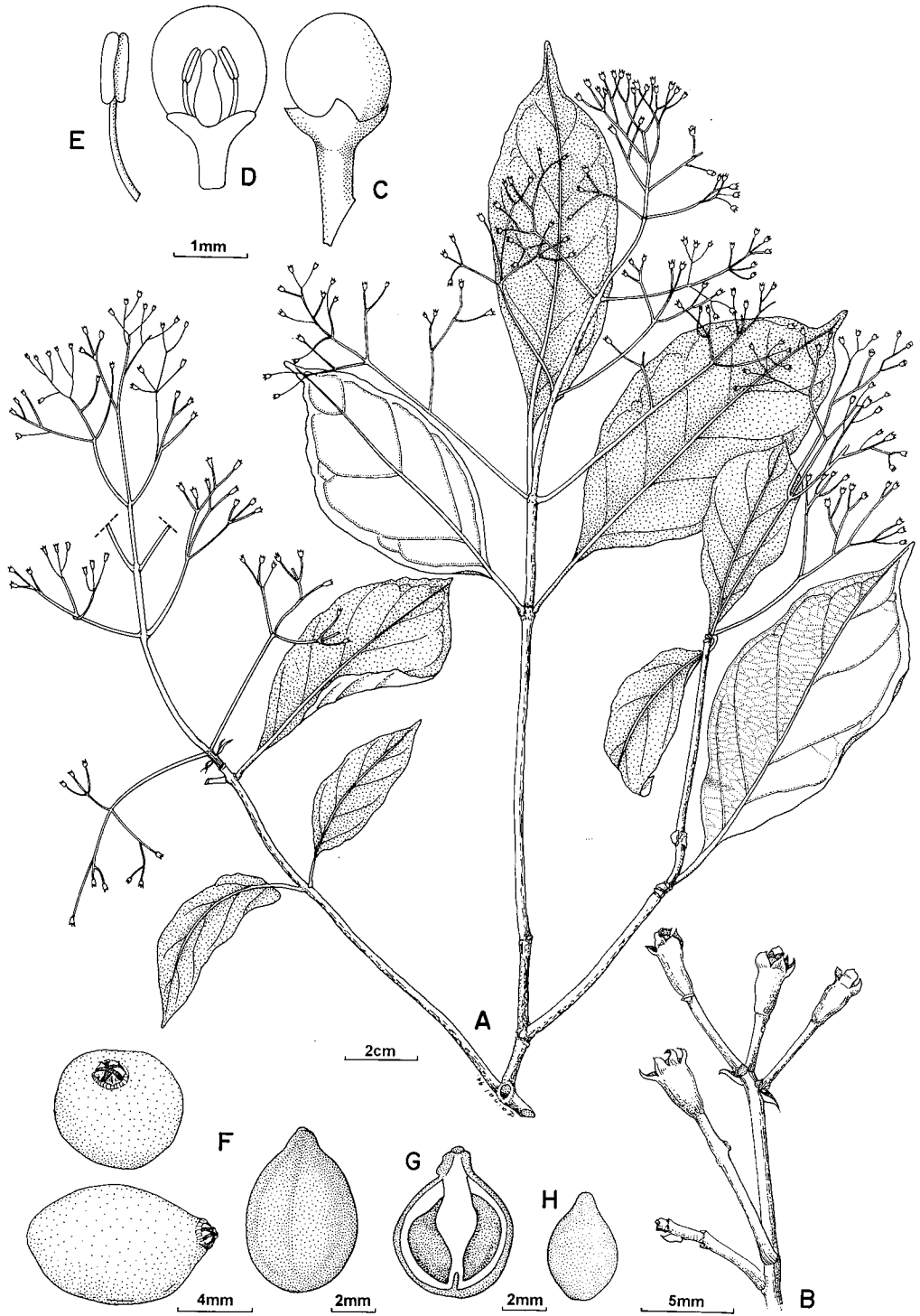
*l.c.* (1951) 157; Kern & van Steenis *l.c.* (1951) 189; Whitmore, Tantra & Sutisna *l.c.* 40. **Type:** *Clemens 29978*, North Borneo, Mt. Kinabalu, Tenompok (A).

Small tree to 13 m tall. **Bark** brown; inner bark yellow to brown. Young parts sparsely hairy. **Leaves** *thin-coriaceous, densely papillose on both surfaces; elliptic-oblongate, 4.9–12.5 × 2–5.5 cm*; base cuneate, *margins entire, apex acute to acuminate*; midrib slightly sunken



**Fig. 1.** *Viburnum beccarii*. A, fruiting leafy twig; B, flower bud; C, flower in longitudinal section; D, stamen; E, fruits; F, fruit in longitudinal section; G, seed; H, side view of seed. (A–H from S. 32934.)





**Fig. 2.** *Viburnum clemensae*. A, flowering leafy twig; B, part of inflorescence; C, flower bud; D, flower bud in longitudinal section; E, stamen; F, fruits; G, fruit in longitudinal section; H, seed. (A-H from SAN 48000.)

above, *raised and rounded beneath, glands distinct at base on both sides*; lateral veins 5–6 pairs, visible but not prominent beneath, obscure above; intercostal veins visible but not prominent on both surfaces; petioles 1–3 cm. **Inflorescences** terminal panicles; *peduncles to 8.5 cm long*; bracts and bracteoles minute. **Flower** buds subglobose; calyx tube 1.5–2 mm long, lobes 5, triangular; petals white; anthers basifixed; ovary ovoid-oblong, style less than 1 mm long, stigma surface rounded. **Fruits** *ovoid-ellipsoid to obovoid, 13 × 6–7 mm*, subtended by remains of calyx lobes, *not compressed and more-or-less rounded in cross-section*. **Seeds** black.

**Distribution.** Endemic to Borneo. In Sabah, known from Kota Belud, Tambunan, Tawau, Kundasang and Ranau areas; in Sarawak, not yet recorded; also occurs in Kalimantan.

**Ecology.** In primary and secondary lower montane forests on ridge tops or hill slopes at 1300–1800 m.

#### 4. *Viburnum hispidulum* Kern

Fig. 3.

(Latin, *hispidulus* = with minute, coarse, erect hairs; the young parts and lower leaf surface)

*L.c.* 1 (1951) 136; Kern & van Steenis *L.c.* (1951) 187; Anderson *L.c.* 158; Whitmore, Tantra & Sutisna *L.c.* 41 (cited as *V. hispidum* Kern). **Type:** *Clemens 31902*, North Borneo, Mt. Kinabalu, Upper Kinataki River (holotype B; isotype L).

Tree to 30 m tall. **Bark** fissured; inner bark orange. **Sapwood** cream-yellow. Young parts sparsely hispidulous. **Leaves** *thin-coriaceous, densely punctate on both surfaces, lower surface hispidulous*, especially on midrib and lateral veins; *elliptic-oblong, 6.6–17 × 2.8–7.8 cm*; base cuneate to slightly rounded, *margins entire, apex cuspidate; midrib raised and angular beneath*, lateral veins 6–9 pairs, visible but not prominent beneath, obscure above, intercostal veins visible but not prominent beneath, obscure above; petioles 1.3–6 cm long. **Inflorescence** a terminal, umbellate corymb; peduncles 6.7–9 cm long; primary rays to 6; bracteoles present. **Flower** buds globose, rotate-cupular when open; calyx tube *c.* 2 mm long, lobes 5, triangular; petals white, with a strong sweet scent; stamens exerted, anthers dorsifixed, yellowish, thick; ovary cylindrical, style *c.* 1 mm long, stigmas capitate. **Fruits** *ellipsoid to obovoid, c. 10 × 5–6 mm*, green, ripening black, *biconvex in cross-section*. **Seeds** oblong-ellipsoid, dark brown to black with rough surface.

**Distribution.** Endemic to Borneo. In Sabah, recorded from Ranau, Sg. Inarat, Mt. Kinabalu, Mt. Trus Madi areas; and in Sarawak, from Bario, Limbang, Kapit, Kelabit Highlands, Lawas, and Mt. Serapi; also occurs in Kalimantan.

**Ecology.** In primary lower montane forest at 1600–1800 m.

#### 5. *Viburnum lutescens* Blume

(Latin, *lutescens* = becoming pale yellow; the lower surface of dried leaves)

Bijdr. Fl. Ned. Ind. 13 (1826) 655; King & Gamble *L.c.* 114; Merrill *L.c.* 582; Ridley *L.c.* 2; Masamune *L.c.* 719; Kern *L.c.* 142; Kern & van Steenis *L.c.* (1951) 188; Backer & Bakhuizen *f. L.c.* 360; Corner *L.c.* 206; Whitmore, Tantra & Sutisna *L.c.* 41; Wong & Saw *L.c.* 67. **Type:** *Blume, s.n.*, Java (holotype L).

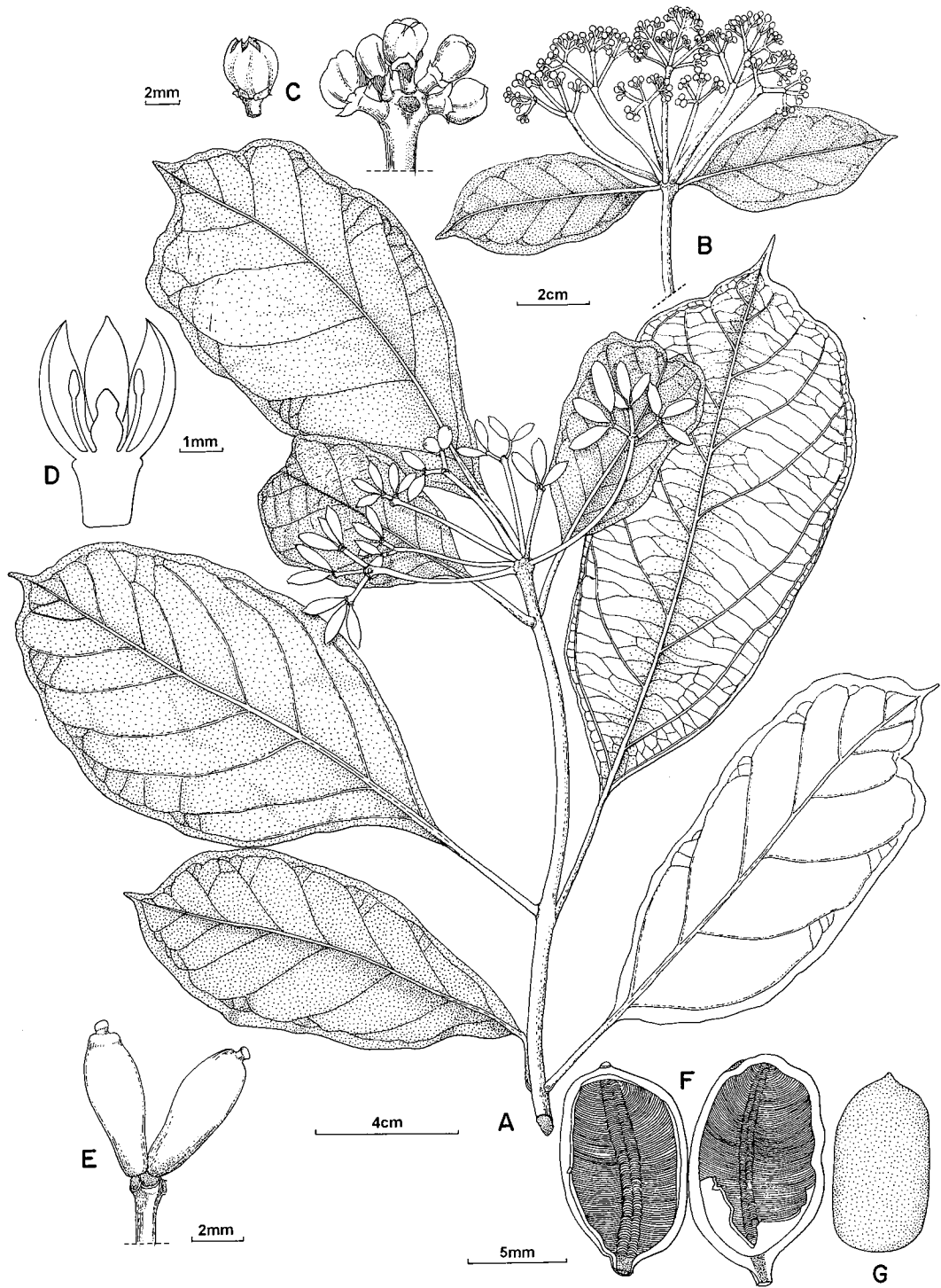


Fig. 3. *Viburnum hispidulum*. A, fruiting leafy twig; B, flowering leafy twig; C, flower buds; D, flower bud in longitudinal section; E, young fruits; F, fruits in longitudinal sections; G, seed. (A-G from S. 50970.)

Shrub or treelet to 9 m tall. Twigs terete. *Young parts stellate hairy*. **Leaves** thin-coriaceous, usually glabrous; ovate-elliptic to oblong-elliptic, 9.5–11.6 × 4.2–5.5 cm; base cuneate to slightly rounded, *margin entire or faintly denticulate to about one-third from the base, upper two-thirds coarsely crenate-serrate to serrulate*, apex acuminate; midrib flattened to slightly rounded beneath, lateral veins 6–8 pairs, *prominent beneath*, obscure above, *intercostal veins prominent beneath*; petioles 1.2–2 cm long. **Inflorescence** a terminal, sometimes axillary, panicle; peduncles 2.5–3.4 cm long; bracts and bracteoles present, hairy. **Flowers** fragrant, cream-white; buds ovoid to subglobose; calyx tube c. 1 mm long, lobes 5, ovate-triangular; corolla rotate-campanulate, lobes 5, stamens shortly exerted, c. 1 mm long, anthers basifixed; ovary cylindrical, style less than 1 mm long, stigmas united. **Fruits** oblong-ellipsoid, slightly flattened, grooved, 8–12 × 6 mm, ripening black. **Seed** dark brown.

**Distribution.** Peninsular Malaysia, Java, Borneo, and Lesser Sunda Islands. In Sabah, uncommon, known only from a few collections from Tambunan district; not yet recorded from Sarawak; also occurs in Kalimantan.

**Ecology.** Lowland to lower montane forest at 750–1200 m.

## 6. *Viburnum sambucinum* Blume

(resembling *Sambucus*)

*l.c.* (1826) 656; Miquel, *Fl. Ind. Bat.* 2 (1856) 120; King & Gamble *l.c.* 113; Merrill *l.c.* 582; Ridley *l.c.* 1; Masamune *l.c.* 719; Kern *l.c.* 129; Kern & van Steenis *l.c.* (1951) 186; Backer & Bakhuizen *f. l.c.* 359; Corner *l.c.* 205; Wong & Saw *l.c.* 67; Whitmore, Tantra & Sutisna *l.c.* 41. **Type:** *Blume, s.n.*, Java (L).

Shrub or treelet to 10 m tall. Young parts hairy. **Bark** greyish brown, smooth. **Leaves** thin-coriaceous, glabrous except for the sparsely hairy veins beneath; *broadly elliptic* to oblong-lanceolate, 10.7–14 × 5–7 cm; base cuneate, *margins entire*, apex cuspidate; *midrib slightly rounded beneath, glands indistinct*, lateral veins visible but not prominent on both surfaces, 4–6 pairs, intercostal veins visible but not prominent beneath; petioles 1.4–3 cm long. **Inflorescence** a terminal umbellate corymb; *peduncles to 3 cm long*. **Flowers** cream-white, fragrant; bud globose; calyx tube cylindrical, lobes 5, ovate-triangular; corolla rotate, lobes 5; stamens 5, 2–3 mm long, exerted; ovary cylindrical, more or less hairy, style short, stigmas united. **Fruits** dark purple, *ovoid to globose, c. 7 × 6 mm, somewhat unequally 4-angular in cross-section*. **Seeds** dark brown to black.

**Distribution.** Sumatra, Peninsular Malaysia, Java, Borneo, Sulawesi, and Lesser Sunda Islands. In Sabah and Sarawak, uncommon.

**Ecology.** Lowland to lower montane forest to 1200 m.

## 7. *Viburnum vernicosum* Gibbs

(Latin, *vernicosum* = varnished, shiny; the upper leaf surface)

Fig. 4.

*J. Linn. Soc. Bot.* 42 (1914) 86; Merrill *l.c.* 582; Masamune *l.c.* 720; Kern *l.c.* 139; Kern & van Steenis *l.c.* 187; Whitmore, Tantra & Sutisna *l.c.* 41. **Type:** *Gibbs 3990*, North Borneo, Mt. Kinabalu, Kiau (BM).

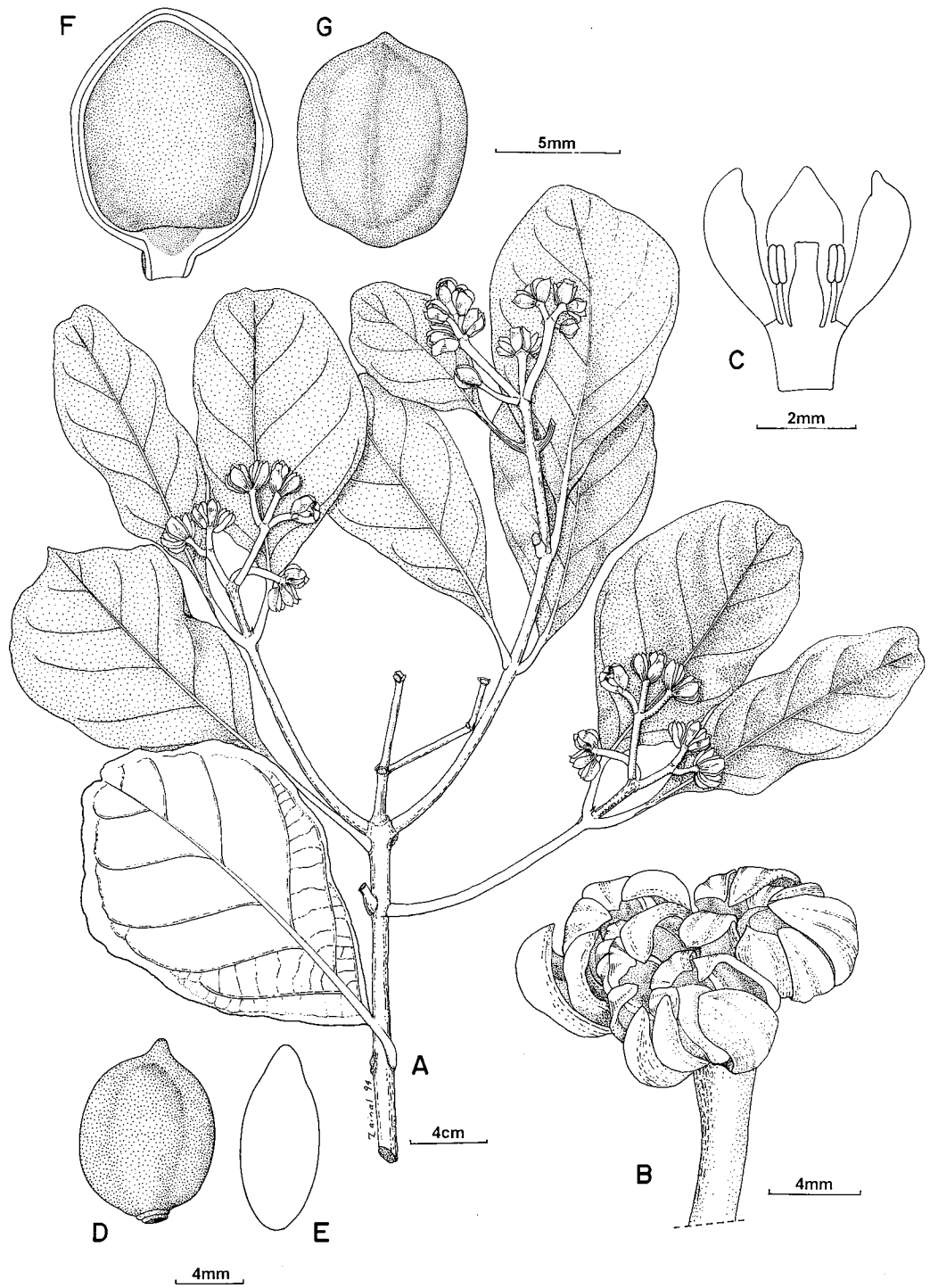


Fig. 4. *Viburnum vernicosum*. A, flowering leafy twig; B, part of an inflorescence; C, flower in longitudinal section; D, fruit; E, fruit in side view; F, fruit in longitudinal section; G, seed. (A-G from RSNB 4410.)

Shrub or treelet to 5 m tall. **Bark** dark brown. Twigs glabrous, terete. Young parts glabrous. **Leaves** *thick-coriaceous*, densely punctate on both surfaces, *shiny above*, *glands distinct at base on both sides of midrib*; *obovate* to ovate-elliptic, 6.5–7.5 × 4–5.2 cm; base rounded to cuneate, margins entire, *apex rounded, truncate, emarginate*, or rarely abruptly cuspidate; *midrib angular beneath*, lateral veins 4–5 pairs, visible on both surfaces but more prominent beneath, intercostal veins visible beneath, obscure above; petioles 8–11 mm long. **Inflorescence** a terminal, umbellate corymb; peduncles to 5.4 cm long; bracteoles present. **Flowers** ovoid to obovoid in bud; calyx green, narrowly triangular; *petals cream-white*, ovate triangular; stamens exserted, filaments thick, attached to the base of corolla; ovary cylindrical to narrowly ellipsoid, style less than 1 mm long, stigmatic surface flat. **Fruits** ovoid, grooved, *c. 5 × 4 mm, somewhat unequally 4-angular in cross-section*. **Seeds** ovoid-globose, black, surface rough.

**Distribution.** Endemic to Borneo. In Sabah, known from Mt. Kinabalu; in Sarawak, from Lawas. Also occurs in Kalimantan.

**Ecology.** Lowland forest on ridges and lower montane forest, at 960–1800 m.



## CASUARINACEAE

### Runi S. Punga

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Ridley, FMP 3 (1924) 371; Mitchell, MF 27 (1964) 118; Backer & Bakhuizen. *f.*, FJ 2 (1965) 8; Smythies, CST (1965) 33; Burgess, TBS (1966) 70; Johnson, Nuytsia 1 (1972) 261, Telopea 2 (1980) 83, *l.c.* 3, 2 (1988) 113, J. Adelaide Bot. Gard. 6, 1 (1982) 73; Keng, OFMSP (1978) 128; Ng, TFM 3 (1978) 45; Anderson, CLTS (1980) 159; Cockburn, TS 2 (1980) 23; Corner, WSTM 3rd ed. 1 (1988) 207; Whitmore, Tantra & Sutisna, CLK 1 (1989) 41; Wilson & Johnson, Fl. Austral. 3 (1989) 100.

Dioecious or less commonly monoecious trees or shrubs; bole straight, cylindrical, sometimes fluted; short buttresses sometimes present. **Bark** greyish to reddish brown, rough, fissured and shedding off into narrow, elongate flakes. **Twigs** of two kinds, woody and persistent, and non-woody and caducous; the latter modified into green needle-shaped structures, branched or unbranched, superficially resembling those of pine trees, internodes rounded or quadrangular in cross-section, usually with longitudinal grooves or furrows, nodes swollen. **Leaves** in whorls of 4–18, tiny, scale-like, apex rounded-acute to narrowly acute. **Male inflorescences** usually terminal, simple or compound, erect, spike-like structures; each male flower of one or two scale-like perianth lobes (falling at anthesis) and a single stamen with basifixed anther. **Female inflorescence** a globose cone, terminal or subterminal on woody persistent twigs or on green needle-shaped twigs; each female flower of one-carpellate ovary with 2-branched, divergent stigmas, subtended by a bract and two bracteoles. **Fruit cone** (infructescence) a woody structure developed from a whole female inflorescence, with several alternating woody bracts, each subtending a pair of woody bracteoles, bracteole-pairs gaping open at maturity. **Fruitlet** a samara with membranous wing. **Seed** solitary in each samara, often with more than one embryo, each with two large cotyledons.

**Distribution.** Four genera with about 100 species; from SE Asia to Australia and Polynesia. Three genera with 4 species in Sabah and Sarawak.

**Ecology.** Often growing gregariously in sandy beach vegetation (*Casuarina equisetifolia*) and in *kerangas*, hill, and montane forest on ultramafic soils and limestone outcrops (*Ceuthostoma* and *Gymnostoma* spp.), from sea level to 2000 m.

**Uses.** In the past, timbers of *Casuarina equisetifolia* were used for shingles and other construction work, but they are now of little commercial importance. The timber is hard and heavy, excellent for firewood and for making charcoal and matches.

**Taxonomy.** Prior to Johnson's taxonomic work (*l.c.* 1980, 1982, 1988), the family was considered monogeneric having *Casuarina* as the only genus. Johnson, however, reclassified *Casuarina s.l.* into 4 smaller genera, namely *Allocasuarina*, *Casuarina s. str.*, *Ceuthostoma*,



and *Gymnostoma*, based on the number of scale-leaves per node, branching pattern, the cross-sectional outline and position and arrangement of stomata in the grooves of the needle-shaped twigs, the structure of the infructescence, the form of the bracts and bracteoles, and chromosome numbers. In the present account, we follow Johnson's scheme but note that it is difficult to distinguish *Ceuthostoma* from *Gymnostoma* using only sterile specimens and without the help of a scanning electron microscope.

### Key to genera

1. Needle-shaped twigs rounded in cross-section; scale-leaves 5–18 per node.....**1. Casuarina**  
Needle-shaped twigs quadrangular in cross-section; scale-leaves 4 per node.....2
2. Furrows of internodes deep and narrow, concealing the stomata. Fruit cones terminal, c. 1 cm diameter, with 1–6 fertile fruitlets; bracts thin and inconspicuous; bracteoles inserted at an oblique angle with the fruit cone axis, apex acute.....**2. Ceuthostoma**  
Furrows of internodes shallow and open, exposing the stomata. Fruit cones terminal or subterminal, 2.2–5 cm diameter, with 20–35 fertile fruitlets; bracts broad, well-developed; bracteoles inserted perpendicularly to the fruit cone axis, apex acute or rounded.....**3. Gymnostoma**

## 1. CASUARINA L.

(resembling the plumage of the Cassowary; the needle-twigs)

*rhu laut* (Malay)

Amoen. Acad. 4 (1759) 143; Ridley, FMP 3 (1924) 371; Mitchell, MF 27 (1964) 118; Backer & Bakhuizen *f.*, FJ 2 (1965) 9; Smythies, CTS (1965) 33; Hutchinson, Gen. Fl. Pl. 2 (1967) 143; Johnson, Nuytsia 1 (1972) 261, J. Adelaide Bot. Gard. 6, 1 (1982) 79; Keng, OFMSP (1978) 128; Ng, TFM 3 (1978) 45; Anderson, CLTS (1980) 159; Cockburn, TS 2 (1980) 23; Corner, WSTM 3rd ed. 1 (1988) 209; Whitmore, Tantra & Sutisna, CLK 1 (1989) 41; Wilson & Johnson, Fl. Austral. 3 (1989) 100.

Dioecious or monoecious trees; bole cylindrical, straight; *crown narrow, branches ascending, with a rather untidy appearance*. **Bark** greyish to reddish brown, ridged, fissured and peeling off into oblong flakes. **Needle-shaped twigs** mostly unbranched; *internodes 0.5–1.5 cm long, rounded in cross-section, furrows of internodes deep and closed*. **Scale-leaves 5–18 per node, narrowly acute**. **Male inflorescences** simple, elongated spikes, at the end of long needle-shaped twigs. **Female inflorescences** *lateral on woody persistent twigs*. **Fruit cones globose or ovoid-cylindrical**; bracts thin at the exposed portions, distally not expanded; bracteoles protruding slightly from the cone surface, not greatly thickened. **Samaras** glabrous, dull grey or pale yellow-brown.

**Distribution.** About 17 species; from the Bay of Bengal to Malesia, Melanesia, Polynesia, New Caledonia and Australia. Only *C. equisetifolia* is found in Borneo (Sabah, Sarawak, Brunei and Kalimantan).

**Ecology.** Found on infertile, sandy or acidic soils along the coasts (*C. equisetifolia*) and elsewhere (other species) on mountains.

### **Casuarina equisetifolia L.**

Fig. 1.

(Latin, *folius* = leaf; with "foliage" resembling that of horsetails, *Equisetum*)

Amoen. Acad. 4 (1759) 143; Ridley *l.c.* 372; Mitchell *l.c.* 119; Backer & Bakhuizen *f. l.c.* 10; Smythies *l.c.* 119; Ng *l.c.* 45; Anderson *l.c.* 159; Cockburn *l.c.* 23; Johnson *l.c.* (1980) 84, *l.c.* (1982) 79; Corner *l.c.* 210; Whitmore, Tantra & Sutisna *l.c.* 41; Wilson & Johnson *l.c.* 100. **Type:** *Rumphius, Herbarium Amboniense* 3 (1743) t. 57.

Monoecious trees to 40 m tall, 100 cm diameter; bole straight, cylindrical, usually fluted towards the base; *crown conical when young*, becoming untidy at maturity. **Bark** greyish brown, ridged, fissured, and flaking into oblong pieces. **Needle-shaped twigs** to 30 cm long, mostly unbranched, greenish yellow, green stripes distinct; internodes 0.5–1.2 cm long, 0.5–1 mm thick, furrows usually densely hairy. **Scale-leaves** (7–)8(–9) per node, apex narrowly acute. **Male inflorescences** simple elongated spikes, terminal on needle-shaped twigs; stamens with basifixed anthers. **Female inflorescences** on lateral woody persistent twigs, c. 0.5 cm long; style red, 0.3–0.5 cm long. **Fruit cones** ovoid-cylindrical, c. 2.5 × 2.2 cm, sparsely hairy; peduncles 0.3–1.3 cm long; bracts woody but rather thin in the exposed portion; bracteoles acute, slightly protruding, more or less of equal size. **Samara** 0.6–0.8 cm long.

**Distribution.** As for the genus; in Sabah and Sarawak, the species is found only along sandy beaches.

**Ecology.** Naturally common in sandy soils near the sea but also grows rather well when planted far inland.

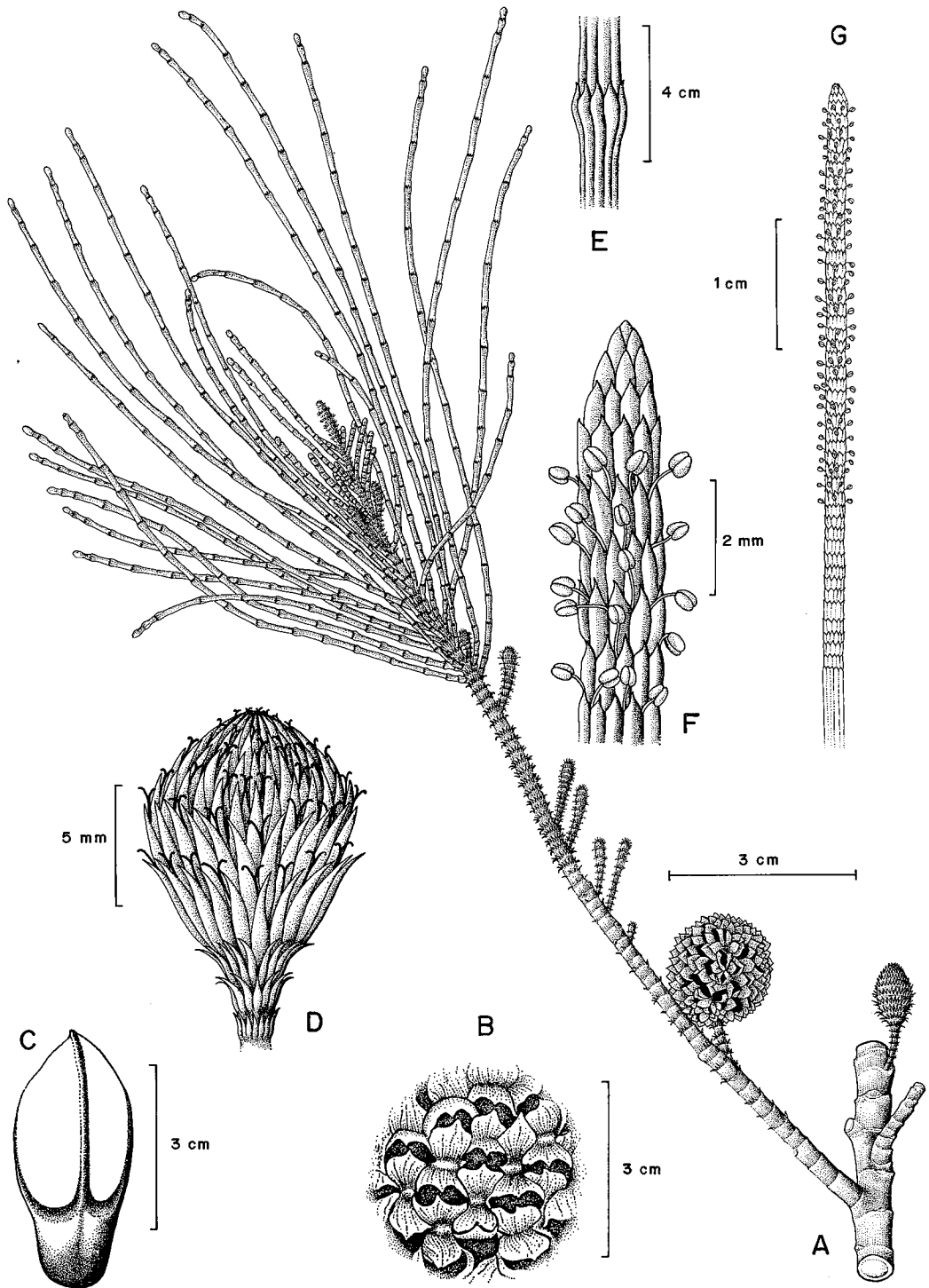
**Uses.** The wood is suitable for light construction, piling and fuel. In Peninsular Malaysia, the Malays use a decoction of the twigs as a lotion to soothe swelling. The powdered bark is used to treat pimples. The species is protected in Sarawak due to its importance in controlling coastal erosion. The tree is frequently planted as a wind-break along major roads.

## 2. CEUTHOSTOMA L.A.S. Johnson

(Greek, *keuthos* = hidden, *stoma* = minute opening;  
the concealed stomata in the furrows of needle-twigs)

*Telopea* 3, 2 (1988) 133.

Dioecious trees. **Needle-shaped twigs** 4-ribbed, furrows deep and almost closed, concealing the rows of stomata, mostly branched. **Leaf-scales** 4 per node. **Female flowers** in globose, terminal cone-like structures. **Fruit cones** longer than broad; bracts somewhat expanded distally; bracteoles strongly protruding and inserted at an oblique angle with the cone axis, not strongly woody, convex dorsally, with prominent dorsal eccentric rib, neither ridged nor with protuberances. **Samara** dull pale brown.



**Fig. 1.** *Casuarina equisetifolia*. A, fruiting twig; B, detailed arrangement of bracts and bracteoles in fruit cone; C, samara or fruitlet; D, female inflorescence; E, nodal portion of needle-shaped twig; F-G, male inflorescences. (A-B and D-E from S. 13733, C from S. 42032, F-G from SAN 87058.)

**Distribution.** Two species; Palawan Is., Borneo, Maluku, and New Guinea. Only *C. terminale* is found in Borneo (Sabah).

**Ecology.** In hill and lower montane forests on ultramafic soils, to c. 1500 m.

### **Ceuthostoma terminale** L.A.S. Johnson

Fig. 2.

(Latin, *terminalis* = apical; the position of fruit cones)

*l.c.* (1988) 135; Wilson & Johnson in Crane & Blackmore, *Evol. Syst. & Foss. Hist. Ham.* 2 (1989) 182.

**Type:** *Clemens 30757*, North Borneo, Mt. Kinabalu, 1200–1500 m (holotype K; isotypes A, BO, L, NSW).

Tree to 30 m tall, 30 cm diameter. **Bark** rough, scaly or flaky, peeling off into long broad strips. **Needle-shaped twigs** rounded-quadrangular in cross-section, little-branched, longest unbranched ones exceeding 10 cm long; internodes 0.5–1 cm long, occasionally set with white hairs on the furrows. **Scale-leaves** narrowly deltoid, 0.7–1 mm long. **Male flowers** in simple terminal spikes. **Female inflorescences** cone-like, terminal on moderately elongated needle-shaped twigs. **Fruit cones** c. 1 cm across, with 1–4 whorls of fertile fruitlets; bracts woody, 2–2.5 mm high and broad, not markedly ridged; bracteoles strongly protruding, to 5–7 mm long, with a prominent dorsal eccentric rib, tips sharply acute. **Samaras** c. 6 mm long, with transparent wing.

**Distribution.** Borneo, Philippines (Palawan Is.), Maluku (Halmahera), and Irian Jaya. In Borneo, so far known from Mt. Kinabalu and Mt. Tawai in Sabah.

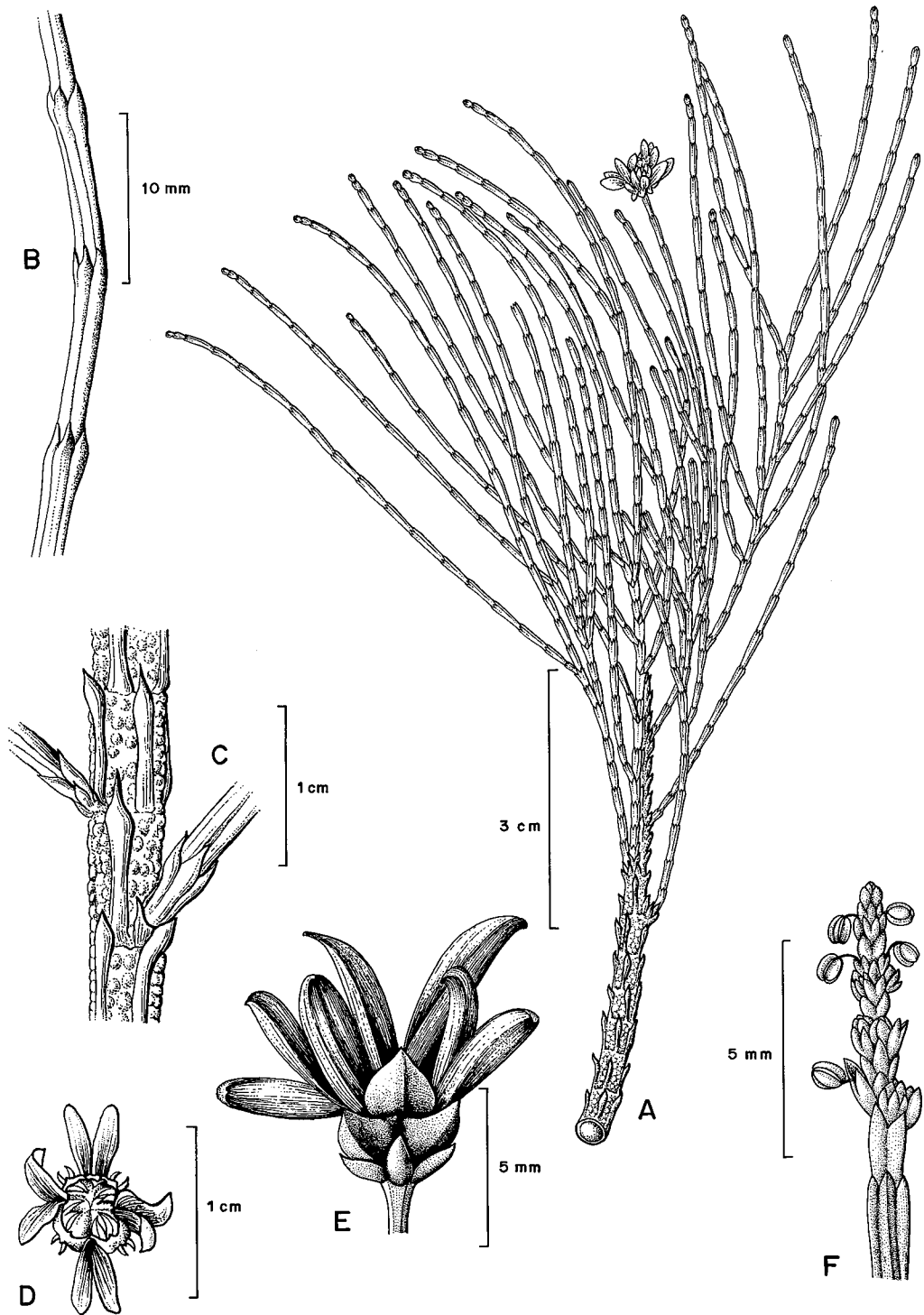
**Ecology.** In primary and secondary forests on ultramafic soils, at 100–1500 m.

## 3. GYMNOSTOMA L.A.S. Johnson

(Greek, *gymnos* = exposed, *stoma* = minute opening;  
the position of stomata in the grooves of needle-twigs)

*Telopea* 2, 1 (1980) 83, *J. Adelaide Bot. Gard.* 6, 1 (1982) 83; Wilson & Johnson, *Fl. Austral.* 3 (1989) 103.

Trees or tall shrubs, dioecious or monoecious. **Needle-shaped twigs** mostly branched, internodes 4-ribbed, furrows shallow and open, exposing the stomata, quadrangular in cross-section, ridges rounded to somewhat sharp-edged. **Scale-leaves** in whorls of 4, apex rounded-acute to narrowly acute. **Male flowers** in simple or compound spikes at the ends of needle-shaped twigs. **Female flowers** in terminal or subterminal globose cones-like structures on woody persistent twigs or on elongated branches of needle-shaped twigs. **Fruit cones** globose or cylindrical; bracts woody, much expanded distally, with the abaxial surface below the apex broader than high; bracteoles prominently protruding and inserted perpendicularly to the fruit cone axis, convex, dorsally neither split nor furnished with protuberances. **Samaras** grey to pale brown.



**Fig. 2.** *Ceuthostoma terminale*. A, fruiting twig; B, part of needle-shaped twig showing the arrangement of scale-leaves; C, a portion of woody twig; D-E, fruit cones; F, male inflorescence. (A and D from RSNB 4490, B-C from RSNB 4963, E from SFN 26398, F from SMHI 1573.)

**Distribution.** About 17 species; Malesia, Solomons Is., tropical NE Australia, Fiji, and New Caledonia; 2 species in Sabah and Sarawak.

**Ecology.** In open and closed lowland to montane habitats on shallow soils, stream banks, and peaty or sandy substrates. Often found in shrubby plant communities on ultramafic soils.

**Uses.** The timber is used mainly as firewood and for piling work.

### Key to *Gymnostoma* species

Needle-shaped twigs 1–1.5 mm thick, internodes 0.5–1 cm long; lateral branches long, with less or no secondary branches, mostly exceeding 10 cm. Fruit cones globose, to 2.2 cm across.....1. *G. nobile*

Needle-shaped twigs c. 0.5 mm thick, internodes 0.2–0.3 cm long; lateral branches short, with many secondary branches, not exceeding 10 cm long. Fruit cones ellipsoid, c. 2.5 × 4.5 cm. ....2. *G. sumatranum*

#### 1. *Gymnostoma nobile* (Whitmore) L.A.S. Johnson (Latin, *nobilis* = noble, excellent; its graceful growth habit)

*l.c.* (1982) 84. **Basionym:** *Casuarina nobilis* Whitmore, *Tropical Rain Forests of the Far East* (1975) 134, Ng *l.c.* 46, Anderson *l.c.* 159, Cockburn *l.c.* 25. **Type:** A. Cuadra SAN A3292, Sabah, Sipitang Distr., Seungau (holotype K; isotypes A, KEP, L, NSW, US).

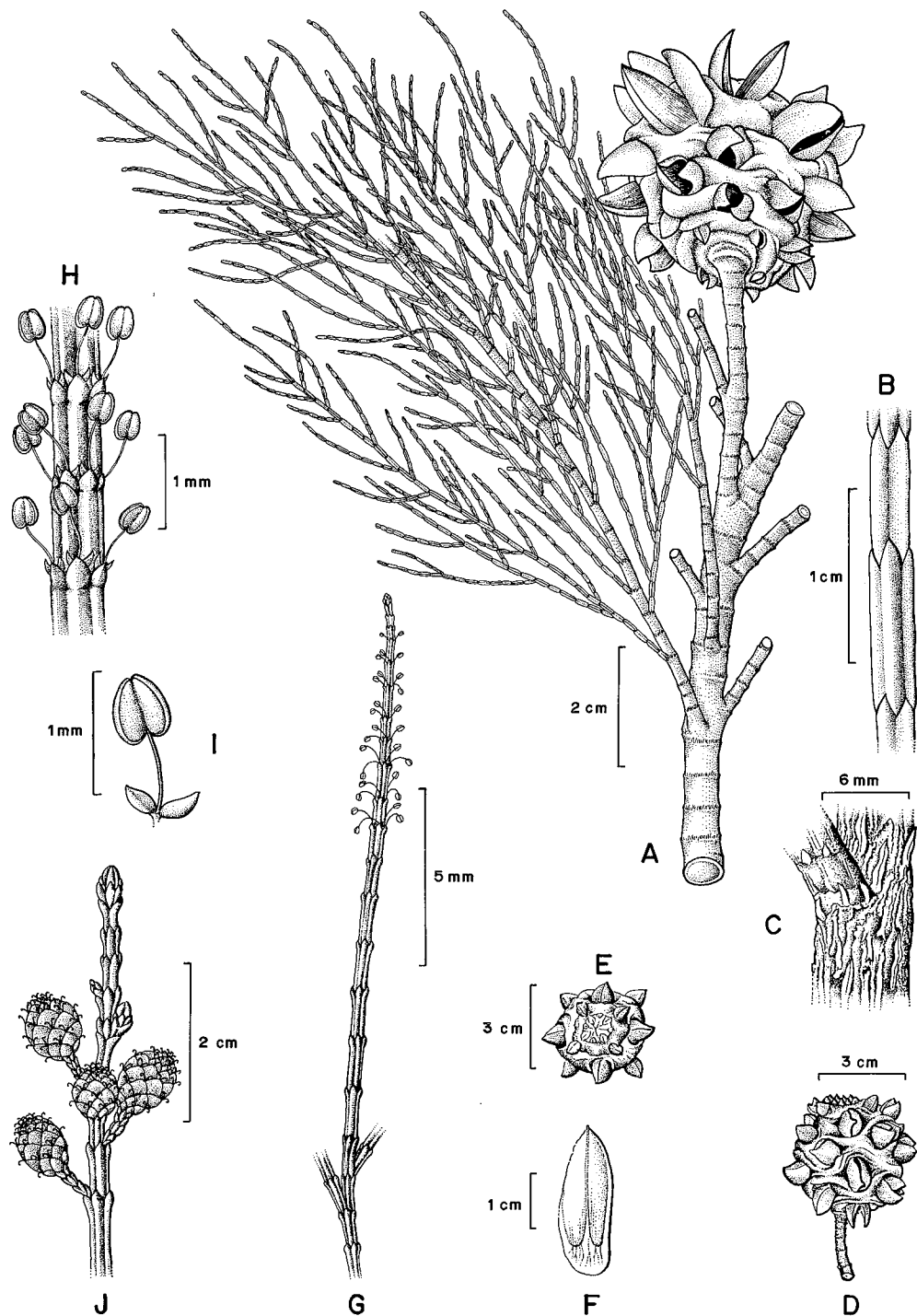
Tree to 40 m tall, 50 cm diameter; bole cylindrical, short buttresses often present; *crown bushy conical, becoming umbrella-shaped*. **Bark** greyish to reddish brown, fissured and scaly. **Wood** hard, inner part reddish brown, occasionally with black streaks and often with a wavy figure. **Needle-shaped twigs** with a few lateral branches, the longest unbranched ones *mostly exceeding 10 cm long, 1–1.5 mm thick; internodes 0.5–1 cm long*. **Scale-leaves** with rounded-acute apex. **Male flowers** in compound, cone-like structures. **Female flowers** in terminal or subterminal capitate inflorescences. **Fruit cones** globose, c. 2.2 cm across, usually 1 or more cones terminal or subterminal on lateral, woody persistent twigs or needle-shaped twigs; each cone with 20–30 fertile fruitlets, and whorls of sterile, undeveloped fruitlets at its upper and basal parts; bracteoles slightly projecting, rounded-acute at the tips.

**Vernacular name.** Sarawak—*rhu ronang* (Iban, Malay).

**Distribution.** Palawan Is., Borneo (Sabah, Sarawak, Brunei, and Kalimantan).

**Ecology.** Lowland and hill *kerangas* forest to 1000 m, on sandstone and ultramafic rocks. Occasional in forest on impoverished sandy infertile soils in coastal areas and near the central zone of peat swamp forests.

**Uses.** Commonly planted at roadsides and in gardens. Its wood is useful for construction and fuel.



**Fig. 3.** *Gymnostoma sumatranum*. A, fruiting twig; B, detail of nodes of a needle-shaped twig; C, detailed surface of woody twig; D-E, fruit cones; F, samara; G-H, male inflorescences; I, male flower; J, female inflorescence. (A-D and from Chew CWL 1389, E from Anderson S. 8431, G-I from SAN 37835, J from KEP 65596.)

2. **Gymnostoma sumatranum** (Jungh. ex de Vriese) L.A.S. Johnson Fig. 3.  
(of Sumatra)

*l.c.* (1982) 86. **Basionym:** *Casuarina sumatrana* Jungh. ex de Vriese, Tijdschr. Natuur. Gesch. Physiol. 11 (1844) 115, Mitchell *l.c.* 119, Backer & Bakhuizen f. *l.c.* 9, Smythies *l.c.* 34, Anderson *l.c.* 159, Cockburn *l.c.* 24. **Type:** *Junghuhn, s.n.*, Sumatra, Toba Plateau (holotype L; isotype U).

Tree to 20 m tall, 60 cm diameter; bole cylindrical, often twisted or fluted, sometimes with short buttresses; *crown spreading with its main branches ascending and topped by softly bushy needle-shaped twigs*. **Bark** greyish brown, sometimes marked with white patches, rough and fissured. **Needle-shaped twigs** *c. 0.5 mm thick, with many short lateral branches, bushy, the longest unbranched ones seldom exceeding 10 cm long; internodes short, 0.2–0.3 cm long*. **Scale-leaves** with rounded-acute apex. **Male flowers** in simple, terminal spikes, anthers basifixed. **Female flowers** in terminal capitate structures. **Fruit cones ellipsoid, c. 2.5 × 4.5 cm, usually solitary on the apex of woody persistent twigs, each with 20–35 fruitlets; bracteoles strongly protruding, with acute tips.**

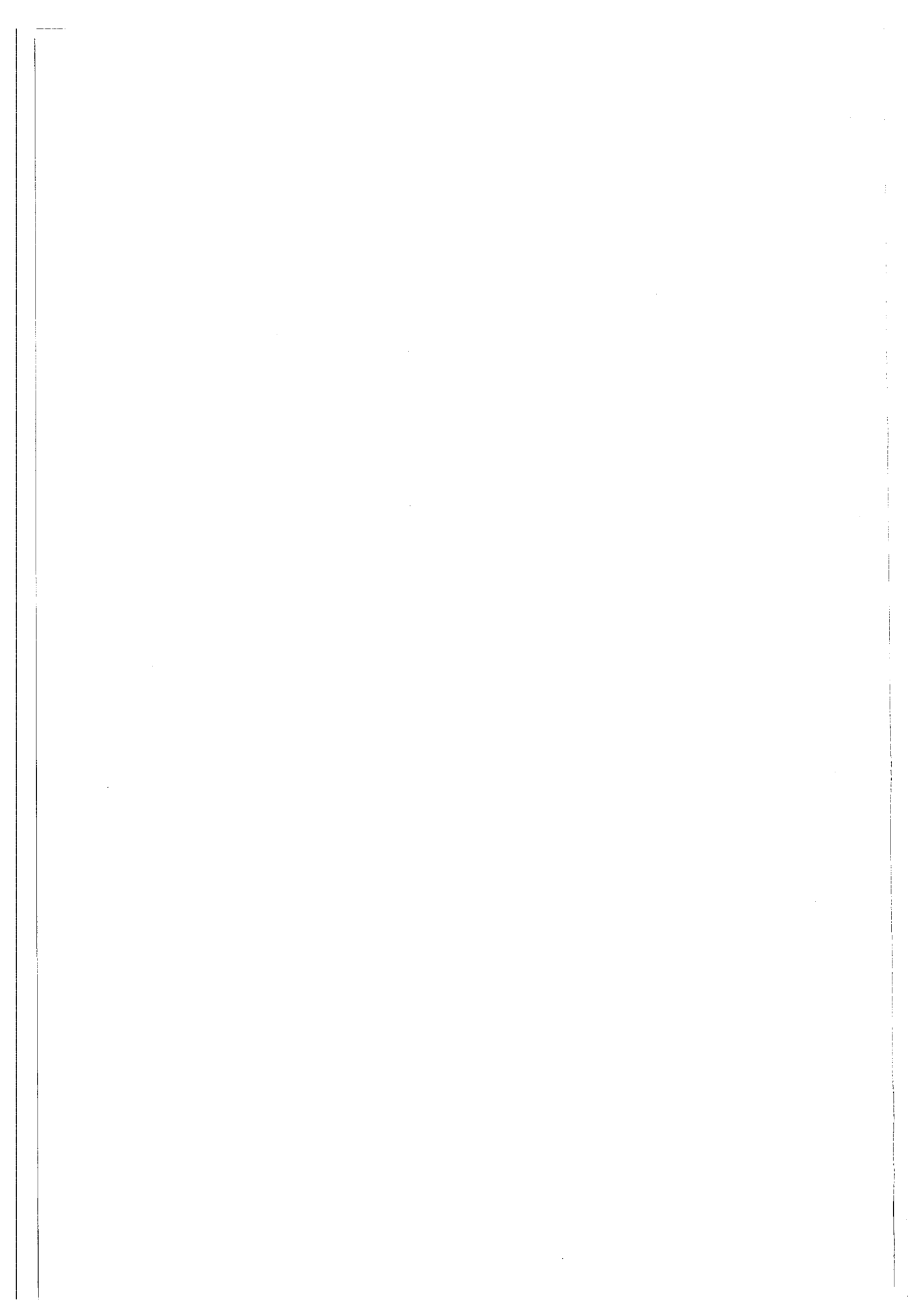
**Vernacular name.** Sabah and Sarawak—*rhu bukit* (Malay).

**Distribution.** Sumatra and Borneo. In Sabah, the species is known from the Tawau Hills, Batanga near Sipitang, Mt. Tawai and Melinau River, and Mt. Silam, whereas in Sarawak it occurs in many localities.

**Ecology.** Apparently confined to hill, ridge and lower montane forests on ultramafic soils and in *kerapah* vegetation on sandstone, shale or acidic soils, at 600–1800 m. Grows well when planted in fertile soil.

**Uses.** Attractive ornamental tree suitable for road sides and gardens.





## CHLORANTHACEAE

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Merrill, EB (1921) 209, PEB (1929) 41; Masamune, EPB (1942) 231; Anderson, CLTS (1980) 162; Verdcourt, FM 1, 10 (1986) 123; Whitmore, Tantra & Sutisna, CLK 1 (1989) 45.

Monoecious or dioecious herbs, shrubs or trees; *tissues typically aromatic. Nodes of stem and branch typically conspicuously swollen. Leaves simple, decussate or sometimes clustered together in pseudowhorls*; blade pinnately veined, serrate or dentate, the teeth often thickened at the tips; petioles often connected by an interpetiolar ridge at the base or joined into a distinct sheath. **Inflorescences** spicate, paniculate, or capitate, axillary or terminal, unisexual or bisexual. **Flowers** *without sepals and petals*; male flowers with or without bract, *stamens 1–3 or numerous (Hedyosmum) and organised in a cone-like structure*; female flowers *exposed or enclosed by a cup-shaped bract*, with a perianth-like structure attached to the ovary, *ovary usually inferior, 1-locular, ovules solitary, orthotropous, pendulous*, with two-layered integuments and thick nucellus, style short or absent, stigmas truncate, 2-lipped, depressed subcapitate, or rarely linear or clavate; *bisexual flowers with an anther-bearing structure attached to one side of the ovary. Fruit a fleshy drupe*, ovoid, obovoid or globose to ellipsoid, small, free or in a cluster enclosed by the bract; endocarp hardened and crustaceous. **Seeds** subglobose, *without aril*; embryo minute, cotyledons variable or scarcely developed; *endosperm copious, oily or not.*

**Distribution.** Four genera with about 80 species, distributed mainly in the tropics but extending south to New Zealand (*Ascarina*) and north to Japan, China, Korea and E Russia (*Chloranthus* and *Sarcandra*). In Sabah and Sarawak, four genera with four species, of which only *Ascarina philippinensis* reaches tree-size.

**Ecology.** Mostly found in moist habitats, some ascending to about 2650 m (in upper montane forest on Mt. Kinabalu in Sabah). Flowers are pollinated by wind or insects; fruits and seeds are dispersed by birds.

**Taxonomy.** The Chloranthaceae was placed in the Piperales by Lindley (1821) who first described the family. Although this has been widely accepted and followed, Smith (1972) assigned the Chloranthaceae to its own order, Chloranthales. It is considered one of the most primitive of extant Angiosperm families, with a fossil pollen record going back as far as the early Cretaceous.

## Key to genera

1. Petioles joined at the base to form a conspicuous membranous interpetiolar sheath. Inflorescence with many conspicuous ovate to leaf-like bracts, 0.5–1 cm long. Flowers unisexual.....

**Hedyosmum** Swartz

Prod. Veg. Ind. Occ. (1788) 84; Swamy, J. Arn. Arb. 34 (1953) 402; Endress, Bot. Jahrb. 91 (1971) 39; Verdcourt, FM 1, 10 (1986) 143.

About 30 species, largely distributed in the New World from Mexico to Peru, Brazil, and the W Indies.

Monoecious or dioecious herbs, shrubs or treelets; stems smelling of ginger-root when crushed; stipules forming an interpetiolar sheath with comb-like margin. Leaves decussate, chartaceous. Inflorescences unisexual or bisexual, axillary or terminal, sometimes united with the stem near the base. Male flowers in cone-like, solitary or paniculate structures, filaments very short or absent, anthers numerous, 2-locular, locules parallel, opening lengthwise. Female flowers in capitate or paniculate clusters; perianth tube joined to the ovary, limb very short, 3-toothed; style very short or absent, stigmatic at apex, stigmas truncate, rarely linear or clavate, often caducous. Fruits free or in a cluster enclosed by the bracts, ellipsoid, globose or ovoid, often 3-angular, sometimes crowned with persistent perianth-like lobes; pericarp juicy, endocarp hard. Seeds 3-angular, pale yellow.

One species (*H. orientale*) occurs in E Asia extending from S China to Malesia (Sumatra, Borneo, and Sulawesi). Uncommon in Sarawak, not yet recorded in Sabah. In Sarawak, in hill and ridge forests in the Hose mountains, Bt. Kajang, Bt. Sarpandai, Bt. Kenawang, and the Usun Apau plateau.

Petioles not joined to form any sheath (at most connected by an interpetiolar ridge or a low coriaceous sheath). Inflorescence with tiny inconspicuous bracts, less than 0.5 cm long. Flowers unisexual or bisexual.....2

2. Leaf apex acute to shortly cuspidate; leaf margin recurved when dry; lateral veins close together (not more than 10 mm apart). Inflorescences to 1.5–2 cm long. Flowers unisexual.....

**Ascarina**

Leaf apex acuminate-caudate; leaf margin not recurved when dry; lateral veins well-spaced (mostly more than 10 mm apart). Inflorescences longer than 2 cm. Flowers bisexual, with a male part (the anther-bearing organ) attached to the ovary.....3

3. Leaves finely pustulate all over the lower surface, margins typically finely serrate. Infructescence branches very fine (less than 0.5 mm thick), distal parts not zig-zag. Male part with a 3-lobed organ bearing 4 anthers.....

**Chloranthus** Swartz

Phil. Trans. Roy. Soc. 77 (1787) 359; Merrill, EB (1921) 209, PEB (1929) 41; Masamune EPB (1942) 231; Swamy, J. Arn. Arb. 34 (1953) 375; Verdcourt, FM 1, 10 (1986) 129.

About 200 species, distributed from Japan, China, E Russia to India, Sri Lanka and Malesia.

Shrubs or treelets. Leaves decussate or sometimes clustered together in pseudowhorls; stipules minute, subulate. Inflorescence a compound spike with opposite branches; bracts tiny, boat-shaped. Flowers: male parts basally attached to

the ovary or enveloping it, anthers introrse, without filaments, variously arranged; female parts exposed, stigma truncate. Fruits fleshy, usually white; endocarp thin, fibrous. Seeds subglobose, narrowed at base, minutely apiculate.

In Borneo, one species (*C. erectus*). In Sabah and Sarawak, scattered in the lowland, hill and montane forests, to 2500 m. Also in Brunei and Kalimantan.

Leaves not pustulate on the lower surface, margins typically set with coarse teeth. Infructescence branches coarse (1–1.5 mm thick), distal parts noticeably zig-zag. Male part a narrow clavate structure bearing 2 anthers.....

**Sarcandra** Gardner

Calc. J. Nat. Hist. 6 (1846) 348; Swamy & Bailey, J. Arn. Arb. 3 1(1950) 127; Verdcourt, Kew Bull. 39 (1984) 66, FM 1, 10 (1986) 123.

Two species, distributed from India and Sri Lanka to Myanmar, Indo-China, China, Japan and Malesia.

Monoecious shrubs or treelets; stems and branches without vessels. Leaves decussate or sometimes clustered in pseudowhorls; stipules minute, subulate, attached to the inconspicuous interpetiolar sheath. Inflorescence a spike-like panicle, terminal or axillary; bracts boat-shaped, inconspicuous. Flowers: male parts attached to one side of the ovary at about a third from the top, anthers introrse, opening lengthwise; ovary ovoid, style absent, stigma depressed subcapitate. Fruits with succulent pericarp. Seeds ellipsoid, testa membranous.

Only one species (*S. glabra* subsp. *brachystachys* var. *brachystachys*) in Borneo (Sabah). In Sabah, mostly found in damp habitats, at 1000–1500 m.

## ASCARINA J. R. Forst. & G. Forst.

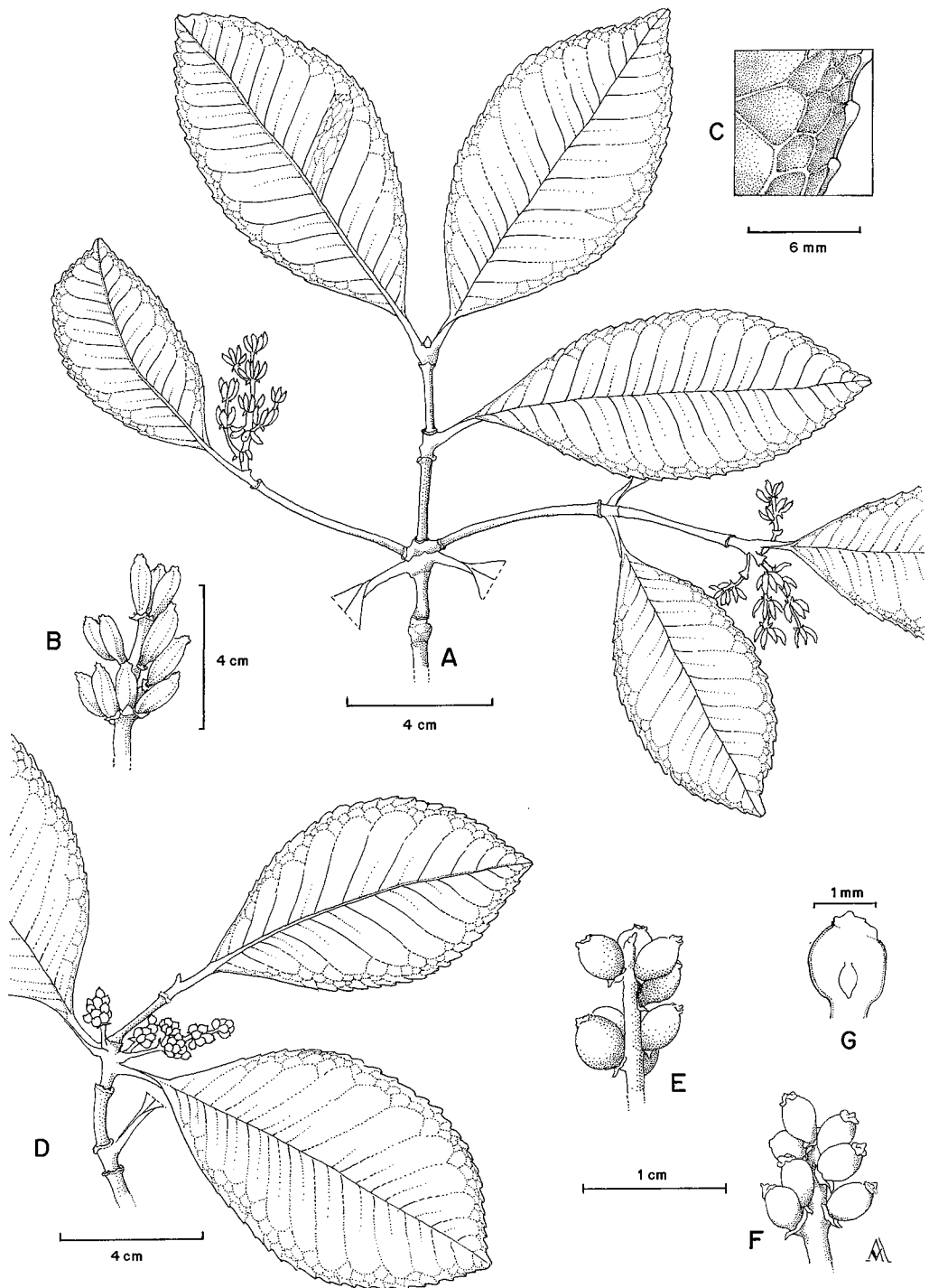
(Greek, *askaris* = intestinal worm; the anther shape)

Char. Gen. (1775) 59, *l.c.* ed. 2 (1776) 117; Anderson, CLTS (1980) 162; Verdcourt, FM 1, 10 (1986) 137; Whitmore, Tantra & Sutisna, CLK 1 (1989) 45.

Small to medium-sized trees, monoecious or dioecious; all parts glabrous. Stipules very small. **Leaves** decussate, mostly elliptic to obovate; margins frequently serrate or crenate, teeth often gland-tipped; lateral veins close together (not more than 10 mm apart) and subparallel for the most part. **Inflorescences** compound spikes with several spreading branches, bracteate. **Flowers:** males bracteate, reduced to 1–5 subsessile or sessile anthers, each with 2 parallel linear locules, opening lengthwise; females consisting of an exposed sessile ovoid-globose ovary, without outer bracts or with 2 often caducous inner bracts (and if the flowers are paired then also with bracteoles), stigmas sessile, truncate or 2-lipped or horseshoe-shaped. Infructescence branches coarse (1–1.5 cm thick). **Fruits** ovoid or obovoid, with thin succulent pericarp; epidermis without stomata. **Seeds** ovoid, flattened, with smooth testa.

**Distribution.** About 12 species, distributed from Madagascar to the Pacific Islands, New Caledonia and New Zealand. In Malesia (Borneo, Philippines, Sulawesi and New Guinea), 4 species. In Sabah and Sarawak, one species.

**Ecology.** In lower montane or more often in upper montane rain forest at 1500–3300 m, sometimes in lowland and hill forest.



**Fig. 1.** *Ascarina philippinensis*. A, flowering (male) leafy twig; B, a portion of male inflorescence; C, leaf margin showing the thickened, gland-tipped teeth; D, fruiting leafy twig; E, infructescence; F, older female inflorescence; G, ovary in longitudinal section. (A–C from SAN 134198, D–G from Kokawa & Hotta 5989.)

**Ascarina philippinensis** C. B. Robinson  
(of the Philippines)

Fig. 1.

Philip. J. Sc. 4 (1909) Bot. 70; Merrill, En. Philip. 2 (1923) 22; Smith, J. Arn. Arb. 57 (1976) 409; Anderson *l.c.* 162; Verdcourt *l.c.* (1986) 139; Whitmore, Tantra & Sutasna *l.c.* 45. **Type:** *Williams 2541*, Philippines, Mindanao, Mt. Apo (holotype PNH, destroyed; isotypes K, NY). **Synonym:** *A. reticulata* Merr., Philip. J. Sc. 12 (1917) Bot. 263, *l.c.* (1923) 22.

Small to medium-sized tree, to 18 m tall, *c.* 35 cm diameter. **Bark** rough, flaky to slightly to distinctly fissured, white to dark reddish brown. Twigs easily broken. Stipules linear to ovate-boat-shaped, 1–2.5 mm long, often caducous; leafless internodes often present, with sheaths to 6.5 mm long. **Leaves** coriaceous, glossy on the upper side, somewhat paler on the lower side; 4–11 × 2–6 cm; base cuneate, margin crenate with thickened teeth, apex acute to shortly cuspidate; midrib prominent, finely longitudinally ridged, lateral veins 12–14 pairs, subparallel for the most part, fine and slightly raised on both sides; petioles 0.5–2 cm long. **Inflorescences** 1.5–2 cm long; bracts ovate, inconspicuous, 1.5–3 × 1–2 mm. **Flowers:** males whitish or pale greenish yellow, with 2 collateral stamens, anthers 2.5–4 × 1–1.5 mm, the projecting connective subacuminate; females congested, usually separated by not more than 2 mm; ovary green. **Fruits** obovoid, 2–3 × 1.5–2 mm, with spicy aroma, turning purple-black when ripe; endocarp pale yellow. **Seeds** 1.5–2 mm long.

**Distribution.** Borneo, Philippines, Sulawesi and New Guinea. In Sabah and Sarawak, principally in the mountains; also in Kalimantan.

**Ecology.** Lower montane to upper montane rain forest, common at 1500–2650 m on Mt. Kinabalu. Flowering in June, July and September; fruits ripen in June–August.



## CRYPTERONIACEAE

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Merrill, EB (1921) 452; Masamune, EPB (1942) 545; Backer & Bakhuizen *f.*, FJ 1 (1965) 257; van Beusekom-Osinga & van Beusekom, Blumea 22 (1975) 255; Shea in Cockburn, TS 1 (1976) 72; van Beusekom-Osinga, FM 1, 8 (1977) 187; Anderson, CLTS (1980) 164; Keating, Ann. Missouri Bot. Gard. 71, 3 (1984) 801; van Vliet & Baas, Ann. Missouri Bot. Gard. 71, 3 (1984) 783; Patel *et al.*, Ann. Missouri Bot. Gard. 71, 3 (1984) 858; Corner, WSTM 3rd ed. 1 (1988) 222; Ng, TFM 4 (1989) 78; Whitmore, Tantra & Sutisna CLK 2, 1 (1990) 50; Mentink & Baas, Blumea 37 (1992) 189.

Trees. Twigs with swollen nodes marked by a transverse line, internodes finely ridged or winged. Leaves simple, opposite, pinnately veined; stipules absent (except in saplings). Inflorescences terminal and axillary panicles, few- to many-branched. Flowers bisexual or unisexual (plant dioecious), radially symmetrical, 4–5-merous; sepals valvate, triangular, persistent or caducous; petals present or absent (in *Crypteronia*), if present, valvate or rarely imbricate, alternate with the sepals, in bud hood-shaped and enveloping the stamens, caducous; stamens inflexed in bud, persistent or caducous, in one or two epipetalous whorls, filaments sometimes very short, connective broadly to narrowly divergent, conduplicate or not, sometimes with a dorsal tubercle or a large outgrowth, anthers adnate, linear to suborbicular, lengthwise dehiscent, introrse; ovary superior or inferior, 2–4(–5)-carpellate, 1–6-locular, septa not or rarely only partly connate, style terminal, terete, mostly persistent, stigmas capitate to punctate, ovules inserted horizontally or vertically on the septum, 1 to many per locule, anatropous, placentation parietal, septal or basal. Fruit a chartaceous to woody capsule, subglobose to ellipsoid, impressed at the septum, loculicidally dehiscent into 2–6 valves, sometimes with persistent style and stigma at the apex (*Crypteronia*). Seeds 1 to many, compressed-ellipsoid, located basally, apically, centrally or laterally within its membranous wing; raphe running freely within the wing; embryo straight.

**Distribution.** Three genera with about 12 species, distributed in tropical SE Asia and Malesia. In Sabah and Sarawak, three genera with 10 species.

**Ecology.** Frequent in lowland to lower montane forest, up to about 1500 m. The monotypic *Dactylocladus* is confined to peat swamp forest.

**Taxonomy.** The definition, delimitation and systematic position of Crypteroniaceae in the order Myrtales is controversial. In the earlier system of classification (Bentham & Hooker *f.*, Gen. Pl. 1 (1862) 782), the genus *Crypteronia* on which the family was founded, was originally placed under Lythraceae. A. De Candolle (Prodr. 16 (1868) 677), assigned this genus to its own family, the Crypteroniaceae, a decision accepted by Hutchinson (Fam. Fl. Pl. 1



(1959) 167; Gen. Fl. Pl. 2 (1967) 33), and also by Cronquist (Int. Syst. Class. Fl. Pl. (1981) 633). Niedenzu (in Engler & Prantl, Nat. Pfl. Fam. 3, 7 (1898), however, placed *Crypteronia* in the tribe Crypteronioideae of the Blattiaceae (= Sonneratiaceae).

Van Beusekom-Osinga & van Beusekom (*l.c.*), and van Beusekom-Osinga (*l.c.*), recognized 5 genera in the family, namely *Alzatea* (confined to Peru and Bolivia), *Axinandra*, *Crypteronia* and *Dactylocladus* (in tropical SE Asia and Malesia), and *Rhynchocalyx* (restricted to tropical S Africa). Van Vliet (Blumea 27 (1981) 395) and Thorne (in Young & Seigler (eds.), Phytochemistry and angiosperm phylogeny (1981) 227) proposed the inclusion of Crypteroniaceae as a subfamily in the Melastomataceae, a suggestion not accepted by Mentink & Baas (Blumea 37 (1992) 216). Johnson & Briggs (Ann. Missouri Bot. Gard. 71, 3 (1985) 732) excluded *Rhynchocalyx* from the Crypteroniaceae and assigned it to its own family, the Rhynchocalycaceae. Concurrently, Graham (Ann. Missouri Bot. Gard. 73, 3 (1985) 775) segregated *Alzatea* from Crypteroniaceae and placed it in its own family, the Alzateaceae.

Brummitt (Vasc. Pl. Fam. & Gen. (1992) 549), in agreeing with the concepts of Graham and Johnson & Briggs, recognized Crypteroniaceae as a well-defined family comprising *Axinandra*, *Crypteronia*, and *Dactylocladus*. In the present account, Brummitt's delimitation of the Crypteroniaceae is followed.

### Key to genera

1. Leaf apex typically obtuse, rarely acute; intercostal veins almost invisible on both surfaces. Functional stamens very short, 0.5–1 mm long. Plants typically of peat swamp forest.....**3. Dactylocladus**
- Leaf apex acute, acuminate to caudate or cuspidate; intercostal veins typically prominent on one or both sides of the leaf. Functional stamens longer, 1.5–4 mm long. Plants of other habitats.....**2**
2. Flower subtended by 1 bract; petals absent; stamens or staminodes as many as sepals, persistent; ovary superior, 2–4-locular, ovules many per locule. Fruits small, chartaceous, typically with persistent style and stigma. Seeds many.....**2. Crypteronia**
- Flower subtended by 3 bracts, the two lateral ones often tiny; petals present; stamens twice as many as sepals or petals, non persistent; ovary inferior, (4–)6-locular, ovules 1 or 2 per locule. Fruits large, woody, style and stigma caducous. Seeds few.....**1. Axinandra**

## 1. AXINANDRA Thwaite

(Greek, *axine* = axe, *andros* = male; the hatchet-shaped stamens)

In Hooker, J. Bot. 6 (1854) 66; Ridley, FMP 1 (1922) 821; van Beusekom-Osinga & van Beusekom, Blumea 22 (1975) 262; van Beusekom-Osinga, FM 1, 8 (1977) 187; Ng, TFM 4 (1989) 78; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 50. **Synonyms:** *Axinandra* sect. *Naxinandra* Baill., Adansonia 12 (1876) 85; *Naxinandra* (Baill.) Krasser in Engler & Prantl, Nat. Pfl. Fam. 3, 7 (1893) 197.

Trees. **Leaves:** apex acuminate to caudate or cuspidate; midrib flattened above, prominent beneath; lateral veins ascending and joining to form looped marginal veins, *intercostal veins*

*prominent on one or both sides*, glabrous. **Inflorescences** terminal or axillary, erect, few-branched; axes more or less angular; *bracts triangular; bracteoles 3 per flower, the two lateral ones often tiny*. **Flowers** bisexual, receptacle pubescent in flower, glabrous in fruit; sepals (4–)5, caducous in fruit; petals, (4–)5, flimsy, *valvate-connate or imbricate-conduplicate* or imbricate-contorted, more or less connate or coherent and dropping simultaneously as a unit; stamens (8–)10, 1.5–3.5 mm long, caducous, filaments terete to more or less flattened, connective divergent, with distinct dorsal tubercle, anthers broadly linear at apex; *ovary inferior*, (2–)3-carpellate, (4–)6-locular, glabrous, *ovules 1 or 2 per locule, inserted basally to the septum*, style (subulate-)terete, sometimes protruding from mature buds, glabrous, caducous in fruit, stigmas punctate. **Fruits** large, woody, globose to ellipsoid, splitting into 2–6 valves in the apical part that protrudes from the enlarged receptacle; receptacle with distinct encircling rim; valves triangular, coarse, glabrous. **Seeds** few, depressed-ellipsoid, located basally and obliquely in the narrowly oblong wing; raphe running along the embryo.

**Distribution.** Four species, distributed from Sri Lanka to Peninsular Malaysia and Borneo. In Sabah, only *A. coriacea* is recorded, whereas in Sarawak, *A. alata* and *A. beccariana* are known.

**Ecology.** Lowland to lower montane forest to 1200 m.

### Key to *Axinandra* species

1. Internodes winged. Leaves oblong; lateral veins 12–14 pairs. Bracteoles of median flowers 1–1.5 mm long.....**1. *A. alata***  
Internodes not winged. Leaves elliptic, ovate-elliptic to ovate; lateral veins 6–12 pairs. Bracteoles of median flowers, 0.25–1 mm long.....**2**
2. Leaves coriaceous to subcoriaceous; acumen obtuse; intercostal veins prominent and distinctly reticulate on both sides. Inflorescences 2.5–5 cm long; ultimate branches 1.5–4 cm long; main axis 1–2 mm thick; bracts 0.25–1 mm long.....**3. *A. coriacea***  
Leaves chartaceous; acumen acute; intercostal veins obscure and faintly reticulate on both sides. Inflorescences 5–20 cm long; ultimate branches 4.5–7 cm long; main axis 0.3–0.5 mm thick; bracts 1–4 mm long.....**2. *A. beccariana***

#### 1. *Axinandra alata* Baill.

(Latin, *alatus* = furnished with wing-like extensions; the internodes)

*Adansonia* 12 (1876) 86; Merrill, EB (1921) 452; Masamune, EPB (1942) 545; van Beusekom-Osinga & van Beusekom *l.c.* 263; van Beusekom-Osinga *l.c.* 187. **Type:** *Beccari PB 3651*, Borneo, Sarawak (holotype FI; isotypes K, P).

Tree. Twigs glabrous; *internodes* terete at base, *becoming acutely quadrangular upwards with 4 gradually widening wings towards the nodes*; wings 1–3 mm wide, ending in acute, often upward-curved processes. **Leaves** drying brown-green above, brown below, chartaceous; *oblong*, 5–10 × 3–5 cm; base rounded, apex cuspidate, acumen 0.3–0.7 cm long; midrib flattened on the upper leaf surface, raised on the lower surface, *lateral veins 12–14 pairs*,

distinctly looping towards the margin, flattened above, raised below, intercostal veins prominent on both surfaces, distinctly reticulate, glabrous; petioles 3–5 mm long, 1–2 mm thick, glabrous. **Inflorescences** axillary, 8–15 cm long, main axes 1–1.2 mm thick, ultimate branches 5–7 cm long, rachis pubescent; bracts *c.* 1 mm long, sparsely pubescent, caducous; *bracteoles of median flowers 1–1.5 mm long*, narrowly triangular, densely hairy, persistent; pedicels 1–2 mm long, *c.* 0.5 mm thick, pubescent. **Flowers:** sepals 0.5–0.8 × 1–1.5 mm, triangular, glabrous inside, pubescent outside; petals 3.5–4 × 1–1.5 mm; filaments 1.5–2 mm long; styles 3–5 mm long, protruding from mature buds. **Fruits** not seen.

**Distribution.** Endemic to Borneo (Sarawak only), very uncommon and only known from the type.

## 2. *Axinandra beccariana* Baill.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

*l.c.* 85; Merrill *l.c.* 452; Ridley *l.c.* 826; Masamune *l.c.* 545; van Beusekom-Osinga & van Beusekom *l.c.* 263; van Beusekom-Osinga *l.c.* 187; Ng *l.c.* 78. **Type:** *Beccari PB 3458*, Borneo, Sarawak (holotype FI; isotypes K, P). **Synonyms:** *A. maingayi* C.B. Clarke in Hooker *f.*, Fl. Br. Ind. 2 (1879) 581; *A. borneensis* Bakhuizen *f.*, Rec. Trav. Bot. Neerl. 40 (1943) preprint 332.

Tree. Twigs glabrous to minutely pubescent; *internodes not winged*. **Leaves** glabrous, drying green-brown on both surfaces, *chartaceous*; *elliptic to ovate*, 5–10 × 2–5 cm; base cuneate, apex acuminate to acute, acumen 0.3–0.5 cm long, *tip acute*; midrib flattened on the upper leaf surface, raised on the lower leaf surface, *lateral veins 8–12 pairs*, looping towards the margin, flattened above, slightly raised below, *intercostal veins obscure and faintly reticulate on both sides*, glabrous; petioles 5–8 mm long, 1–2 mm thick. **Inflorescences** axillary to terminal, 5–20 cm long, *main axes 0.3–0.5 mm thick*, *ultimate branches 4.5–7 cm long*, rachis sparsely pubescent to glabrous; *bracts 1–4 mm long*, subglabrous, persistent, *bracteoles of median flowers 0.5–1 mm long*, narrowly triangular to triangular; pedicels 1–2.5 mm long, *c.* 0.5 mm thick. **Flowers:** sepals *c.* 0.5 × 1 mm, triangular, glabrous inside, subglabrous to glabrous outside; petals *c.* 3 × 1 mm; filaments 1–1.5 mm long; styles *c.* 2 mm long, hardly or not protruding from mature buds. **Fruits** 1.5–2 × 1–1.5 cm; valves *c.* 0.8 cm long. **Seeds** not seen.

**Distribution.** Peninsular Malaysia (one collection, *Maingay 65412*, from Melaka) and Borneo (known from Sarawak only).

**Ecology.** Lowland forest.

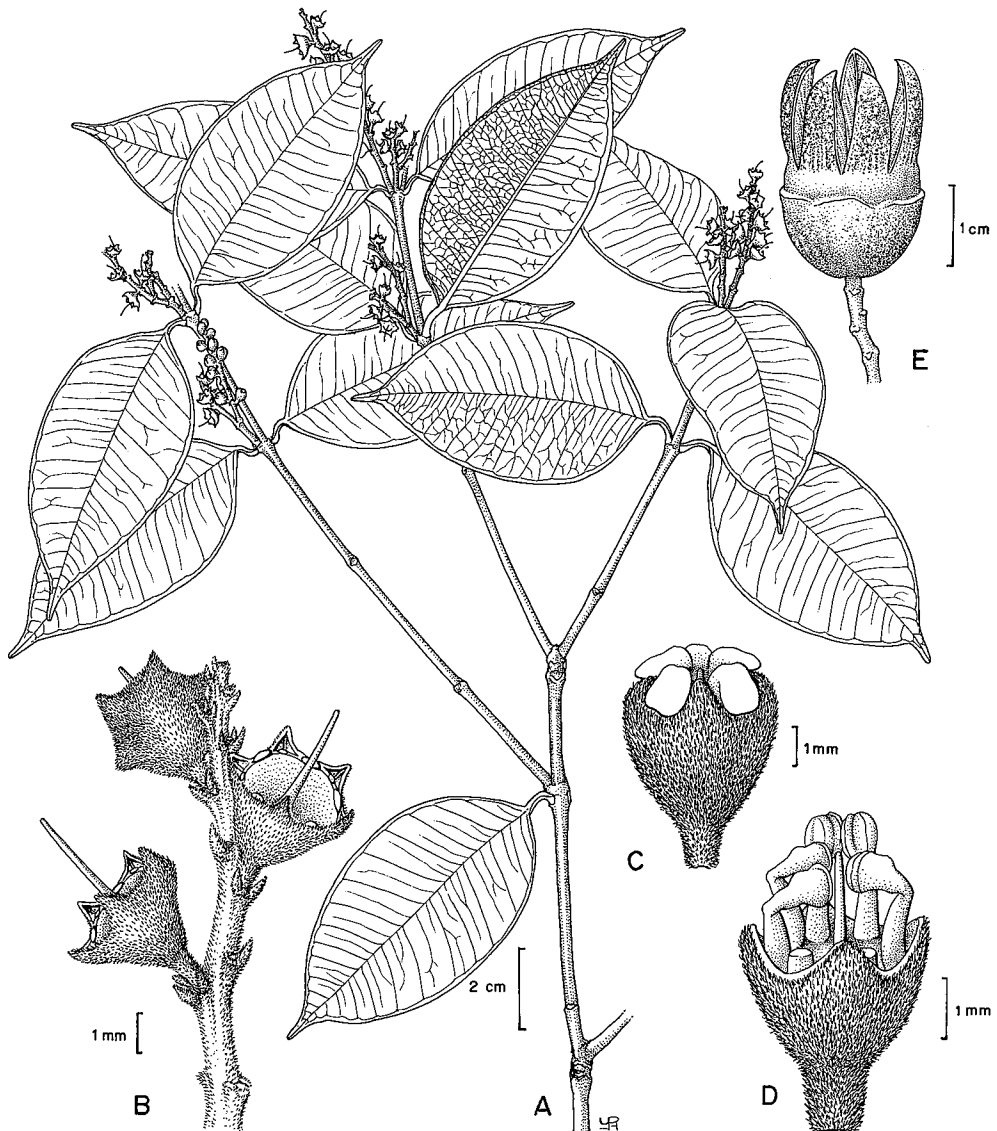
## 3. *Axinandra coriacea* Baill.

Fig. 1.

(Latin, *coriaceous* = leathery; the leaves)

*l.c.* 85; Merrill *l.c.* 452; van Beusekom-Osinga & van Beusekom *l.c.* 264; van Beusekom-Osinga *l.c.* 187. **Lectotype** (van Beusekom-Osinga & van Beusekom, 1975): *Beccari PB 2622* Borneo, Sarawak (FI; isolectotypes K, P).

Tree to 55 m tall, 90 cm diameter; buttresses to 2 m tall and 0.5 m wide. **Bark** grey-brown, smooth to flaky; inner bark pale brown to red-brown. **Sapwood** whitish to brown. Twigs



**Fig. 1.** *Axinandra coriacea*. A, flowering leafy twig; B, old flowers with petals and stamens fallen off; C, mature flower bud with style protruding; D, mature open flower with petals fallen off, showing style and stamens; E, fruit. (A–B from *S.* 39235, C–D after FM 1, 8 (1977) 187, fig. 11, E from *S.* 37302.)

glabrous to sparsely hairy; *internodes not winged*. **Leaves** drying greenish to dark brown above, brown below, *coriaceous to subcoriaceous*, glabrous above, sparsely hairy to glabrous below; elliptic to ovate-elliptic, 5–15 × 1.5–7 cm; base cuneate to rounded, apex acuminate to caudate, acumen 0.5–1 cm long, *tip obtuse*; midrib flattened on the upper leaf surface, raised on the lower leaf surface, *lateral veins 6–12 pairs*, looping towards the margin, flattened above, slightly raised below, *intercostal veins prominent and distinctly reticulate on both sides*; petioles 3–7 mm long, 1–2 mm thick, glabrous or sparsely hairy. **Inflorescences** axillary to terminal, 2.5–5 cm long, *main axes 1–2 mm thick*, angular, *ultimate branches 1.5–4 cm long*, rachis densely pubescent; *bracts 0.25–1 mm long*, subglabrous, *bracteoles of median flowers 0.25–1 mm long*, triangular; pedicels 1–2 mm long, *c.* 1 mm thick. **Flowers**: sepals 0.5–1 × 1–1.5 mm, triangular, glabrous inside, densely to sparsely pubescent outside; petals *c.* 6 × 1.5 mm; filaments 1.5–2 mm long; styles 3–5 mm long, protruding from mature buds. **Fruits** 1.2–4 × 1–3 cm; valves 5–6, 0.5–1.7 × 0.3–0.7 cm. **Seeds**: wings broadly obtuse at apex.

**Distribution.** Endemic to Borneo (Sabah, Sarawak and Kalimantan).

**Ecology.** In lowland to lower montane forest up to 1200 m. In Sabah, it is recorded mainly in forest on ultramafic soil (Mt. Silam, Bidu-Bidu Hills, Bukit Kiabau, etc.), whereas in Sarawak it is found in mixed dipterocarp and *kerangas* forests, up to 1200 m.

## 2. CRYPTERONIA Blume

(Greek, *kruptos* = hidden, *eros* = love; probably alluding to the small flowers)

Bijdr. Fl. Ned. Ind. (1826) 1151; Ridley, FMP 1 (1922) 821; Keng, OFMSP (1969) 151; van Beusekom-Osinga & van Beusekom, Blumea 22 (1975) 258; Shea in Cockburn, TS 1 (1976) 73; van Beusekom-Osinga, FM 1, 8 (1977) 191; Anderson, CLTS (1980) 164; Corner, WSTM 3rd ed. 1 (1988) 222; Whitmore, Tantra & Sutisna, CLK 1 (1989) 51; Ng, TFM 4 (1989) 79; Pereira & Wong, Sandakania 6 (1995) 41. **Synonyms**: *Henslowia* (*non* Blume) Wall., Pl. As. Rar. 3 (1831) 13, t. 221; *Quilamum* Blanco, Fl. Filip. 1 (1837) 851.

Medium-sized to large trees; buttresses sometimes present. Twigs with nodes somewhat swollen, glabrous to pubescent. *Stipules absent or very small*. **Leaves** coriaceous, subcoriaceous to chartaceous, *apex acute, acuminate to caudate*; midrib flattened or sunken above, lateral veins distinctly to vaguely looping, *intercostal veins prominent on one or both sides*, glabrous to pubescent. **Inflorescences** terminal and/or axillary panicles, branching 1–3 orders, many-flowered; *bracts 1 per flower*. **Flowers** *bisexual or unisexual* (only in *C. paniculata*); sepals persistent even in fruit; *petals absent*; stamens or staminodes 5, as many as sepals, persistent, *functional stamens 1.5–4 mm long*, glabrous, filaments flattened, connective tissue divergent, anthers apically or laterally attached to the connective; *ovary superior, 2–4-locular, ovules many per locule*, inserted horizontally or vertically (basally) to the septum, style terete, glabrous to hairy, stigmas capitate to punctate. **Fruits** *small*, hardly larger than the flowers, *chartaceous, typically with persistent styles and stigmas*, subglobose to ovoid-ellipsoid, impressed at the septa, *splitting loculicidally into 2–4 valves, styles and stigmas adhering at apex*. **Seeds** *many*, tiny, ovoid-ellipsoid, inserted on the septum or at the base of the septum; wing membranous, acute to obtuse at base or apex; raphe running closely along the embryo.

**Distribution.** Seven species with 2 varieties, distributed in tropical and subtropical SE Asia from Assam to Bengal, Myanmar, Thailand, Indo-China and Malesia. In Sabah and Sarawak, six species are recorded.

**Ecology.** Lowland to lower montane forest, up to about 1500 m.

### Key to *Crypteronia* species

1. Leaf intercostal veins obscure on both sides. Flowers unisexual (plants dioecious); ovary 2-locular. Seeds inserted on the septum, the membranous wing with a broadly rectangular base and a tapered or acute apex.....**6. *C. paniculata* (var. *paniculata*)**  
 Leaf intercostal veins prominent on one or both sides. Flowers bisexual; ovary 3–4-locular. Seeds inserted at the base of the septum; the membranous seed wing with a tapered or acute to narrowly rectangular or obtuse base and a broadly obtuse to acute apex.....2
2. Midrib distinctly sunken on the upper leaf surface. Inflorescence bracts 2.5–9 mm long.....**1. *C. borneensis***  
 Midrib flat on the upper leaf surface. Inflorescence bracts 0.5–1.5 mm long.....3
3. Leaves oblong to ovate-oblong; lateral veins 10–20 pairs. Inflorescences branching to the 3rd order, rarely to only the 2nd order; main axis 3–5 mm thick.....**5. *C. macrophylla***  
 Leaves narrowly elliptic, elliptic to ovate-elliptic; lateral veins typically not more than 10 pairs. Inflorescences branching to the 1st or 2nd order (typically to the 1st order); main axis 1–3 mm thick.....4
4. Leaf apex acuminate to caudate, acumen 0.5–1.8 cm long; leaf base distinctly cuneate; intercostal veins distinctly reticulate to tessellate. Petioles slender, only 1–1.5 mm thick. Ovary glabrous. Fruits ellipsoid.....**2. *C. elegans***  
 Leaf apex shortly acute, acumen if present shorter, 0.1–0.4 cm long; leaf base cordate to rounded; intercostal veins sparsely reticulate. Petioles thicker, 2–7 mm thick. Ovary sparsely to densely minutely papillose to pubescent. Fruits subglobose to ovoid.....5
5. Inflorescences with ultimate branches (15–)20–40 cm long; main axis 2–3 mm thick; pedicels 0.1–0.5 mm long, densely pubescent. Sepals broadly spread open in the mature flower, sparsely to densely pubescent outside. Styles sparsely pubescent at base, glabrous at upper part. Seed wing tapered at apex.....**4. *C. griffithii***  
 Inflorescences with ultimate branches not more than 20 cm long; main axis slender, 1–2 mm thick; pedicels 1–1.5 mm long, glabrous. Sepals connate, forming a dome-shaped structure even in the mature flower, glabrous outside. Styles glabrous throughout. Seed wing broadly obtuse at apex.....**3. *C. glabriflora***

#### 1. *Crypteronia borneensis* J.T. Pereira & Wong (of Borneo)

Sandakan 6 (1995) 45. **Type:** *Tarmiji & Talib SAN 90941*, Borneo, Sabah, Beaufort (holotype SAN; isotype K).

Medium-sized tree to 25 m tall, 45 cm diameter. **Bark** greyish brown, smooth; inner bark brown to greyish. **Sapwood** yellowish white to brown. Twigs glabrous. **Leaves** drying dark brown to green-brown on both sides, coriaceous to subcoriaceous; broadly ovate, ovate-elliptic to elliptic, 10–26 × 4–20 cm; base cordate, rounded to cuneate, apex acute to acuminate, acumen 0.5–1.0 cm long; *midrib distinctly sunken on the upper surface*, distinctly raised on the lower leaf surface, lateral veins 8–15 pairs, distinctly looping towards the margin, sunken to flattened above, distinctly raised below, *intercostal veins obscure above, prominent below*, laxly reticulate, glabrous; petioles 0.5–2 cm long, 2–5 mm thick, glabrous. **Inflorescences** terminal or in the axils of fallen leaves on older branches, 14–25 cm long, branching to the 2nd or 3rd order, main axis 2–4 mm thick, ultimate branches 5–15 cm long, rachis pubescent; *bracts 2.5–9 mm long*, triangular, subglabrous, persistent. **Flowers** *bisexual*, bracteoles (0.5–) 1–2 mm long, narrowly triangular to subulate, sparsely hairy, persistent; pedicels 0.5–2 mm long, *c.* 0.5 mm thick, minutely papillose or pubescent; sepals triangular, densely tomentose inside, minutely papillose or tomentose outside, 0.5–1.5 × 0.5–1.5 mm; stamens 1.5–2.5 mm long, filaments 1–2 mm long, anthers 0.25–0.5 × 0.2–0.8 mm; *ovary 3(–4)-locular*, 1–2 mm across, styles 1–3.5 mm long, minutely densely papillose or tomentose, stigmas capitate. **Fruits** subglobose, papillose to densely tomentose. **Seeds** *inserted at the base of the septum; wing broadly obtuse at apex, tapered or acute at base.*

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

**Distribution.** Endemic to Borneo (Sabah, Sarawak and Brunei).

**Ecology.** In lowland primary mixed dipterocarp forest, on clay-rich, well-drained alluvium and sandy soils, to *c.* 600 m. Frequently near river banks.

## 2. *Crypteronia elegans* J.T. Pereira & Wong

(Latin, *elegans* = elegant; the inflorescences)

Sandakan 6 (1995) 48. **Type:** *Paie S. 36393*, Borneo Sarawak, 7th Division, Kapit, Bukit Bakar (holotype SAN; isotypes K, KEP, L, MO, SAR).

Medium-sized tree to 27 m tall, 75 cm diameter; buttresses to 1.5 m tall and 1.5 m wide. **Bark** reddish brown to blackish, flaky; inner bark red with deep yellow. **Sapwood** orange- straw-coloured. Twigs glabrous. **Leaves** drying dark brown to brown on both sides, subcoriaceous; *narrowly elliptic*, 7–12 × 2–5 cm; *base cuneate, apex acuminate to caudate, acumen 0.5–1.8 cm long; midrib flattened on the upper leaf surface*, raised on the lower leaf surface, *lateral veins 8–10 pairs*, looping towards the margin, flattened at both sides, *intercostal veins prominent and distinctly reticulate or tessellate on both sides*, glabrous; petioles 1–2 cm long, 1–1.5 mm thick. **Inflorescences** terminal and axillary, up to 24 cm long, *branching to the 1st or 2nd order, main axis 1–2 mm thick*, ultimate branches 7–18 cm long, rachis puberulose; bracts 0.5–1 mm long, early caducous. **Flowers** *bisexual*; bracteoles 0.5–1.5 mm, narrowly triangular, usually caducous; pedicels 0.5–1.5 mm long, *c.* 0.5 mm thick, puberulose; sepals triangular, sparsely puberulose outside, densely puberulose inside, 0.5–1 × 0.75–1 mm; stamens 1.5–2.5 mm long, filaments 1–2 mm long, anthers *c.* 0.5 mm across; *ovary 3-locular*, 1.5–2 mm across, styles 1–3 mm long, *glabrous*, stigmas punctate. **Fruits** *ellipsoid*, glabrous to subglabrous. **Seeds** *inserted at the base of the septum; wing tapered at base and apex.*

**Distribution.** Endemic to Borneo (Sarawak and Brunei); not yet recorded for Sabah. In Sarawak, recorded at Kelabit Highlands and Bukit Bakar, Kapit, while in Brunei, it is found in the Temburong District.

**Ecology.** In lowland mixed dipterocarp forest and secondary forest, to 1100 m, mainly on low hills and ridges.

3. **Crypteronia glabriflora** J.T. Pereira & Wong  
(Latin, *glaber* = without hair, *florus* = flowers)

Fig. 2.

Sandakania 6 (1995) 50. **Type:** *Dransfield JD 7225*, Brunei, Temburong, Bukit Belalong (holotype SAN; isotypes BRUN, K, KEP).

Tree to 20 m tall, 40 cm diameter. **Bark** reddish brown, cracking; inner bark reddish. **Sapwood** pale yellowish brown. Twigs glabrous. **Leaves** drying dark brown to brown above, pale brown below, coriaceous; *ovate-elliptic to elliptic*, 7–20 × 3–8 cm; *base cordate to rounded, apex shortly acute, acumen 0.1–0.4 cm long; midrib flattened on the upper leaf surface, slightly raised on the lower leaf surface, lateral veins 8–10 pairs, looping towards the margin, flattened above, flattened to slightly raised below, intercostal veins prominent and laxly reticulate on both sides*, glabrous; petioles 0.4–1 cm long, 2–3 mm thick, glabrous. **Inflorescences** terminal and in the axils of fallen leaves on older branches, 12–20 cm long, *branching to the 1st or 2nd order, main axis 1–2 mm thick, ultimate branches 5–20 cm long, rachis puberulose; bracts 0.5–1 mm long, triangular, glabrous, caducous. Flowers bisexual; bracteoles 0.5–1 mm long, narrowly triangular, pubescent, persistent; pedicels 1–1.5 mm long, c. 0.5 mm thick, glabrous; sepals triangular, connate, forming a dome-like structure even in the mature flower, glabrous on both sides, slightly hairy at margin below, 1–1.5 × 1–1.5 mm; stamens 3–4 mm long, filaments 2.5–3.5 mm long, anthers c. 0.5 mm across; ovary 3-locular, 1–1.5 mm across, densely minutely papillose, styles 2–4.5 mm long, glabrous, stigmas punctate. Fruits subglobose, minutely papillose. Seeds inserted at the base of the septum; wing broadly obtuse at apex, narrowly obtuse at base.*

**Distribution.** Endemic to Borneo (Sarawak and Brunei only); not yet recorded in Sabah. In Sarawak, it occurs on Mt. Pagon, Limbang and in Brunei in the Temburong District.

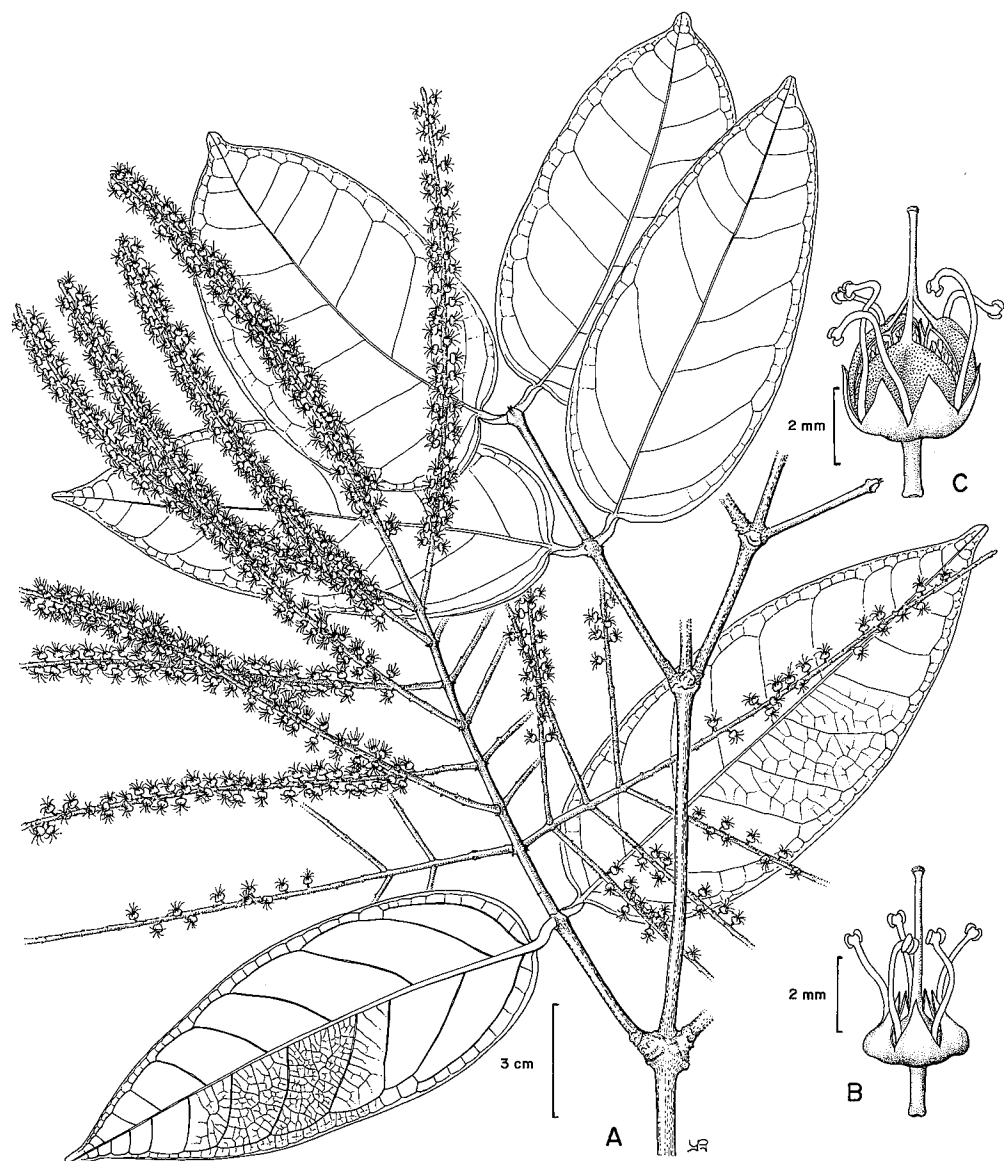
**Ecology.** Mixed dipterocarp forest to 820 m, on clay soil overlying sandstone.

4. **Crypteronia griffithii** C.B. Clarke  
(W. Griffith, 1810–1845, physician and botanist in India and Malaya)

In Hooker *f.*, *Fl. Br. Ind.* 2 (1879) 574; Ridley *l.c.* 822; van Beusekom-Osinga & van Beusekom *l.c.* 260; van Beusekom-Osinga *l.c.* 196; Corner *l.c.* 222; Ng *l.c.* 80; Whitmore, Tantra & Sutisna *l.c.* 51. **Type:** *Griffith 2513*, Malacca (holotype K; isotype L).

Medium-sized to large tree to 40 m tall, 70 cm diameter; buttresses to 0.6 m tall and 0.6 m wide. **Bark** brownish to grey, smooth to fissured or flaky; inner bark brown to red. **Sapwood** white to yellow or pale brown. Twigs glabrous. **Leaves** drying green-brown to brown or dark brown on both sides, coriaceous; *elliptic to ovate-elliptic*, 9–40 × 4–15 cm; *base cordate to*





**Fig. 2.** *Crypteronia glabriflora*. A, flowering leafy twig; B, mature open flower; C, young fruit with the stamens still persistent. (All from *Dranfield JD 7225*.)

rounded, apex shortly acute, acumen 0.1–0.4 cm long; midrib flattened on the upper leaf surface, raised on the lower leaf surface, lateral veins 8–10(–14) pairs, flattened above, raised below, looping towards the margin, intercostal veins prominent and laxly reticulate beneath, glabrous; petioles 0.5–1.5 cm long, 3–7 mm thick, glabrous. **Inflorescences** in the axils of fallen leaves on older branches, 20–45 cm long, branching to the 1st or 2nd order, main axis 2–3 mm thick, ultimate branches (15–)20–40 cm long, rachis densely pubescent; bracts 0.5–1 mm long, triangular, hairy, persistent to caducous. **Flowers** bisexual; bracteoles 0.5–1 mm long, triangular with slender tip; pedicels 0.1–0.5 mm long, 0.5–1 mm thick, densely pubescent; sepals triangular, broadly spread open in the mature flower, densely to sparsely pubescent on both sides, 1–2 × 1–1.5 mm; stamens 2–3.5 mm long, filaments 1.5–3 mm long, anthers c. 0.5 mm across; ovary 3-locular, 1.5–2 mm across, sparsely pubescent, styles (2–)3–4 mm long, sparsely pubescent at base, glabrous at upper part, stigmas punctate. **Fruits** subglobose, sparsely pubescent. **Seeds** inserted at the base of the septum; wing tapered or acute at apex, narrowly rectangular at base.

**Vernacular names.** Sabah—*rambai-rambai* (Bajau). Sarawak—*ubah semut* (Iban).

**Distribution.** Myanmar, C Sumatra, Peninsular Malaysia and Borneo. In Sabah and Sarawak, common in most districts; also in Kalimantan.

**Ecology.** Scattered in primary forest, up to 600 m; often on yellow to brown-blackish sandy soil, sometimes on clayey soil. In Peninsular Malaysia and Borneo, the species often forms an association with *Cladomyrma maschwitzii* ants.

**Uses.** The wood has been reported to be durable and used in house-building.

### 5. *Crypteronia macrophylla* Beus.-Osinga

(Greek, *makros* = large, *phullon* = leaves)

Blumea 22 (1975) 261; van Beusekom-Osinga *l.c.* 198; Whitmore, Tantra & Sutasna *l.c.* 51. **Type:** Ashton S. 19372, Borneo, Sarawak, Anap, Ulu Muput Kanan, Bt. Naoung (holotype L; isotypes K, SAN, SAR).

Medium-sized tree to 25 m tall, 60 cm diameter. **Bark** greyish to pale yellowish brown, smooth to flaky; inner bark orange. Twigs glabrous. **Leaves** drying greenish brown above, brown below, coriaceous; *oblong to ovate-oblong*, 18–45 × 8–15 cm; base cordate to slightly rounded, apex acute, acumen c. 0.5 mm long; midrib flattened on the upper leaf surface, distinctly raised on the lower leaf surface, lateral veins 10–20 pairs, flattened above, raised below, distinctly to vaguely looping towards the margin, intercostal veins prominent and distinctly reticulate to tessellate on both sides, glabrous; petioles 1–1.5 cm long, 2–5 mm thick, glabrous. **Inflorescences** in the axils of leaves on older nodes, 30–40 cm long, branching to the 2nd or 3rd order, main axis 3–5 mm thick, rachis pubescent; bracts 0.5–1 mm long, triangular, short-hairy, caducous. **Flowers** bisexual; bracteoles 0.5–1 mm long, narrowly triangular; pedicels 1.5–2 mm long, c. 0.5 mm thick, densely thinly pubescent; sepals triangular, 0.5–1 mm across, pubescent on both surfaces; stamens 1.5–3 mm long, filaments 1–2.5 mm long, anthers 0.5–1 × 0.5–1 mm; ovary (3–)4-locular, 1–2.5 mm across, densely pubescent to thinly tomentose, styles 0.2–3 mm long, densely pubescent, stigmas punctate. **Fruits** subglobose, pubescent. **Seeds** inserted at the base of the septum; wing acute at base and apex.

**Vernacular names.** Sarawak—*bedulang semut, ubah semut, ubah samak* (Iban); *teletang* (Kelabit).

**Distribution.** Endemic to Borneo (Sarawak and Kalimantan only). In Sarawak, known from Anap, Rejang, Kapit, Ulu Melinau, Balleh, Baram and Kuching areas; in Kalimantan, recorded from West Kutei, Pontianak and Sg. Kahayan.

**Ecology.** Primary lowland to hill forest, on clay, igneous, sandstone to basalt soils, to 1200 m, sometimes near river banks. Young branches are often inhabited by ants.

## 6. *Crypteronia paniculata* Blume

(Latin, *paniculatus* = panicle; the inflorescence)

*l.c.* 1151; Ridley *l.c.* 821; van Beusekom-Osinga & van Beusekom *l.c.* 259; van Beusekom-Osinga *l.c.* 194; Anderson *l.c.* 165; Corner *l.c.* 224; Whitmore, Tantra & Sutisna *l.c.* 51; Ng *l.c.* 80. **Type:** *Blume, s.n.*, Java (holotype L).

### var. *paniculata*

Tree to 36 m tall, 105 m diameter; buttresses to 1.5 m tall, 1.2 m wide. **Bark** brown to grey-brown, finely fissured to scaly; inner bark brown. **Sapwood** light brown to yellowish white. Twigs glabrous. **Leaves** drying deep brown to brown-green above and greenish-brown below, chartaceous; ovate-elliptic to elliptic, 6–21 × 3–10(–12) cm; base cuneate to sometimes rounded, apex shortly to narrowly acuminate, acumen 0.2–1.5 cm long; midrib flattened on the upper leaf surface, raised on the lower leaf surface, lateral veins 7–10 pairs, flattened, vaguely looping towards the apex, *intercostal veins obscure on both sides*, laxly reticulate, glabrous; petioles 0.2–0.8 cm long, 1–2 mm thick, glabrous. **Inflorescences** axillary and/or terminal, 9–30 cm long, branches to the 1st or 2nd order, main axis 1–1.5 mm thick, ultimate branches 10–20 cm long, rachis puberulose; bracts *c.* 0.5 mm long, triangular, glabrous, caducous. **Flowers** *unisexual* (plants dioecious); bracteoles (0.5–)1–1.5 mm long, narrowly triangular to subulate, glabrous; pedicels 1–1.5 mm long, *c.* 0.5 mm thick, glabrous; sepals triangular, densely to sparsely puberulose inside, papillose to subglabrous outside, 0.5–1.5 × 0.5–1 mm; males: stamens 2–4 mm long, filaments 1.5–3.5 mm long, anthers *c.* 0.5 × 0.5–1.5 mm; pistillodes 0.5–1 mm long; females: staminodes 0.5–1 mm long; *ovary 2-locular*, 0.5–1.5 mm across, papillose to puberulose, styles (0.8–)1–1.5 mm long, papillose, stigmas capitate. **Fruits** subglobose, slightly impressed at the septum, minutely papillose to puberulose. **Seeds** *inserted on the septum; wing acute or tapered at apex, broadly rectangular at base.*

**Vernacular names.** Sabah—*kinkidon mantok* (Dusun Kadazan). Sarawak—*ubah semut* (Iban).

**Distribution.** Continental SE Asia; from E Bengal to Assam, Andaman Islands, Myanmar, Peninsular Malaysia, Borneo (Sabah, Sarawak, Kalimantan), Sumatra, Java, Lesser Sunda Islands, and the Philippines. In Sabah, more common in the west coast; in Sarawak, recorded in the 1st, 2nd and 7th Divisions. In Kalimantan, documented for W Kutei.

**Ecology.** Frequent in primary and secondary hill forests, on sandy clay soil, to *c.* 1500 m.

**Uses.** The timber is claimed to be hard and durable and is utilized in house-building in W Java and S Sumatra. It is also used in making cart-wheels and also for fuel. In the Philippines, the bark has been used to treat blisters. In Java, the young shoots are eaten as salad.

### 3. DACTYLOCLADUS Oliv.

(Greek, *daktulos* = finger, *klados* = twigs; the branching mode of the twigs)

*jongkong* (Malay)

In Hooker, *IC Pl.* (1895) *t.* 2351; Merrill, *EB* (1921) 452; Masamune, *EPB* (1942) 547; Brown, *FTSB* (1955) 261; Smythies, *CST* (1965) 89; Burgess, *TBS* (1966) 391; van Beusekom-Osinga & van Beusekom, *Blumea* 22 (1975) 261; van Beusekom-Osinga, *FM* 1, 8 (1977) 199; Anderson, *CLTS* (1980) 165; Whitmore, *Tantra & Sutisna*, *CLK* 1 (1989) 51.

Large trees; without buttresses. Twigs quadrangular, swollen at the nodes. **Leaves** coriaceous, *apex typically obtuse, rarely acute*; midrib thick, flattened on the upper leaf surface, raised on the lower leaf surface, lateral veins vague and flattened on both sides, looping towards the margin, *intercostal veins almost invisible on both surfaces*, glabrous. **Inflorescences** terminal and/or axillary, erect, poorly branched; bracts and bracteoles caducous, minute; pedicels short. **Flowers** *bisexual*; sepals triangular, persistent; petals unguiculate, blades irregularly lobed, suborbicular, pubescent on the margin, enclosing stamens in bud, caducous; *functional stamens 0.5–1 mm long*, persistent, glabrous, anthers oblong to broad-linear, filaments terete; *ovary half-inferior*, lower part adnate to the receptacle, puberulose, (3–)4–5-locular, ovules 3 per locule, basally inserted in between the septa, septa not connate, styles pubescent, persistent, stigmas capitate. **Fruits** broad-ellipsoid, small, pubescent, (3–)4–5-valved. **Seeds** narrow-ellipsoid, flat, situated centrally to the membranous wing, apex obtuse to irregularly shaped, broader than the base; raphe running close to the embryo.

**Distribution.** Monotypic, so far known with certainty from Borneo only. A doubtful record has been reported from Irian Jaya (*cf.* van Beusekom-Osinga *l.c.* 201).

**Ecology.** Common in lowland peat swamp forest.

#### **Dactylocladus stenostachys** Oliv.

Fig. 3.

(Greek, *stenos* = narrow, small, *stachys* = spike; the inflorescence)

In Hooker *l.c.* *t.* 2351; Merrill *l.c.* 452; Masamune *l.c.* 457; Brown *l.c.* 261; Smythies *l.c.* 89; Burgess *l.c.* 391; van Beusekom-Osinga & van Beusekom *l.c.* 262; van Beusekom-Osinga *l.c.* 200; Anderson *l.c.* 165; Whitmore, *Tantra & Sutisna l.c.* 51. **Lectotype** (van Beusekom-Osinga & Beusekom, 1975): *Haviland 2916*, Borneo, Sarawak (K; isolectotype L).

Large tree to 40 m tall, 150 cm diameter; trunk base of big trees developing masses of small adventitious roots; pneumatophores (sharp-pointed aerial roots) yellowish, appearing at the base or around the tree. **Bark** brown to grey, smooth in immature tree, reddish brown, fissured to scaly in mature tree; inner bark yellowish to brown. **Sapwood** yellow to white, with small

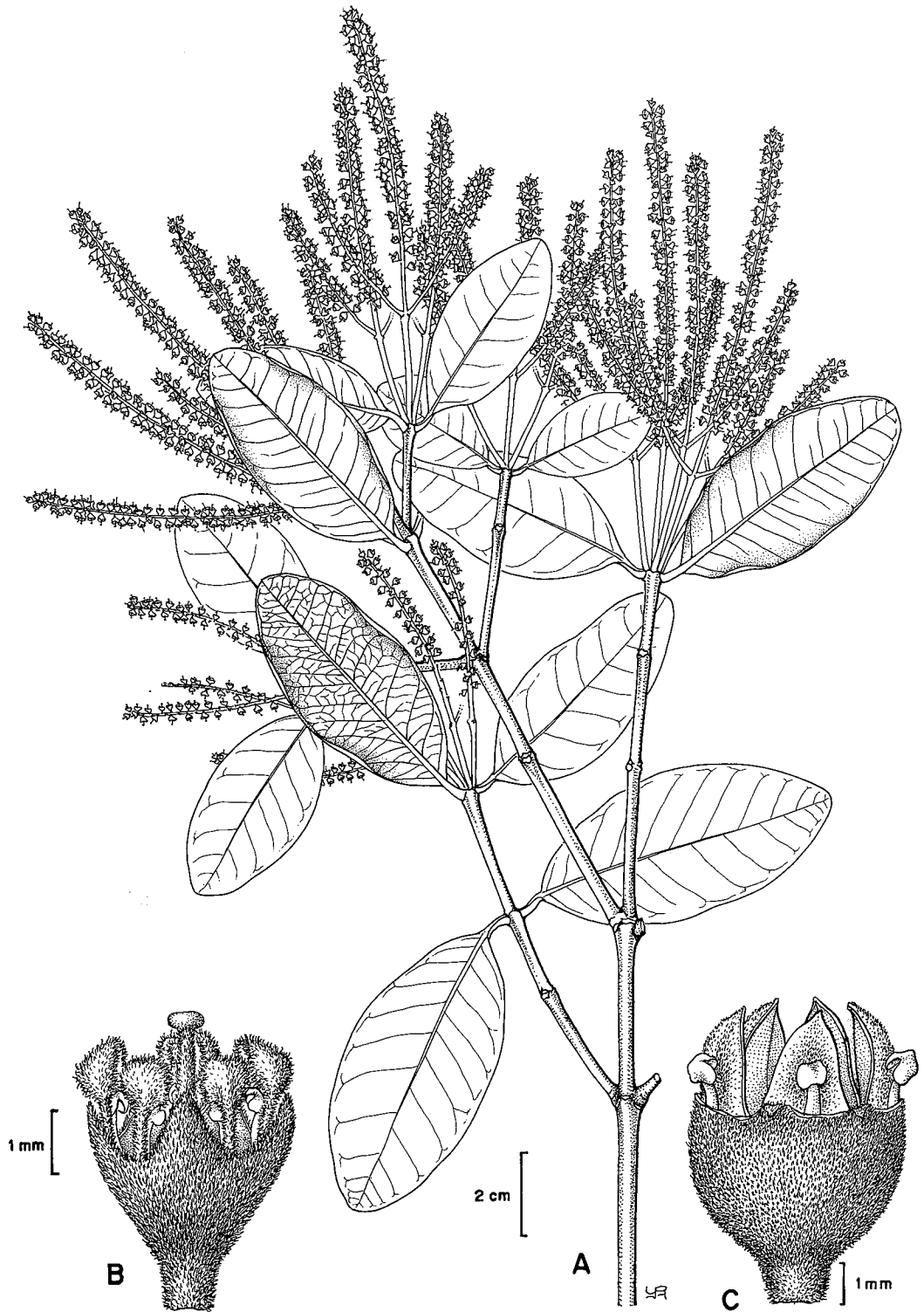


Fig. 3. *Dactylocladus stenostachys*. A, flowering leafy twig; B, flower; C, fruit. (A–B from SAN 50096, C from SAN 73145.)

canal-like perforations. Twigs glabrous. **Leaves** drying greenish above, brown to greenish below; elliptic, ovate, obovate to spatulate, 3.5–10(–15) × 2–7 cm; base cuneate to slightly rounded; lateral veins 10–15 pairs; petioles 0.1–0.7 cm long, 0.1–0.3 mm thick, glabrous. **Inflorescences** 6–16 cm long, branching to the 1st order, rachis pubescent; bracteoles persistent, triangular, *c.* 0.5 mm long; pedicels 0.25–1 mm long, densely puberulose. **Flowers:** sepals puberulose on both surfaces, *c.* 0.5 × 0.5–1 mm; stamens 0.5–1 mm long, filaments 0.25–0.5 mm long, anthers 0.5–0.8 × 0.5 mm; ovary *c.* 1 mm across, styles 0.5–2 mm long, stigmas capitate. **Fruits** 3–4 mm across; valves 1–2 × 1–1.5 mm. **Seeds** 2–3 mm long, inserted at the base of the septum.

**Vernacular names.** Sabah—*jongkong* (Malay), *medang miang* (Kedayan), *medang tabak* (Brunei Malay), *tanjiong awan* (Malay). Sarawak—*gatal* (Murut), *jongkong* (Malay), *medang jongkong* (Murut), *merebong* (Iban).

**Distribution.** Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan).

**Ecology.** Common in all types of peat swamp and mixed swamp forests. Occasionally in *kerangas* forest. In the peat swamp forest, it is common and dominant constituent of the “*padang keruntum*” phasic communities. Flowering and fruiting throughout the year, particularly from May to August.

**Uses.** The timber is moderately hard and moderately heavy, with density ranging from 495 to 610 kg/m<sup>3</sup> air dry. The heartwood is not differentiated from the sapwood and is light brown when fresh and darkening to pink-brown or red-brown. Texture is fine and even, with straight or slightly interlocking grains. The timber is easy to work and produces a smooth and lustrous surface. It is not durable when exposed to weather or in contact with the ground, but suitable for weather-boarding, flooring, partitioning, utility furniture, concrete shuttering, and for veneers in plywood manufacture (Burgess *l.c.*; Wong, DMT (1982) 82).



## CTENOLOPHONACEAE

Runi S. Pungga

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Exell & Mendonça, *Consp. Fl. Angol.* 1, 2 (1951) 248; Hutchinson, *Fam. Fl. Pl.* (1959) 265; van Hooren & Nootboom, *Blumea* 29 (1984) 559, *FM* 1, 10 (1988) 629; Brummitt, *Vasc. Pl. Fam. & Gen.* (1992) 550.

A monogeneric family closely allied to the Ixonanthaceae and Linaceae. Ctenolophonaceae differ from the Ixonanthaceae in having indumentum of stellately tufted hairs, opposite leaves, interpetiolar stipules, hypogynous flowers with twisted, caducous, extrastaminal disc, a 2-forked style with each fork topped by a capitate stigma, and a soft-hairy arillode. From the Linaceae, Ctenolophonaceae differ in their indumentum, interpetiolar stipules, extrastaminal disc, free filaments, 2-forked style and well-developed soft-hairy arillode.

### CTENOLOPHON Oliv.

(Greek, *ctenos* = comb, *lophorus* = crested; the crested arillode)

*Trans. Linn. Soc.* 28 (1873) 516; Beccari, *Malesiana* 1 (1877) 119; King, *J. As. Soc. Beng.* 64, 2 (1895) 105; Merrill, *EB* (1921) 313; Ridley, *FMP* 1 (1922) 423; Masamune, *EPB* (1942) 356; Cockburn, *TFM* 1 (1972) 306, *TS* 1 (1976) 204; Anderson, *CLTS* (1980) 239; van Hooren & Nootboom, *Blumea* 29 (1984) 560, *FM* 1, 10 (1988) 629; Whitmore, *Tantra & Sutisna, CLK* 2, 1 (1990) 208; Brummitt, *Vasc. Pl. Fam. & Gen.* (1992) 550.

Trees. *Indumentum of stellately tufted and simple hairs. Stipules interpetiolar*, boat-shaped, caducous. **Leaves** simple, *opposite*, entire, coriaceous. **Inflorescences** terminal panicles or lateral racemes. **Flowers** *bisexual, hypogynous*; sepals 5, thick, persistent; petals 5, thick, linear, *twisted in bud, caducous; disc extrastaminal*; stamens 10, *filaments free*, short and long, inserted halfway on the inner side of the disc; ovary 2-locular, with 2 ovules in each locule; *style apically 2-forked, each fork topped by a capitate stigma*. **Fruit** a woody capsule, splitting irregularly down one side. **Seeds** solitary, pendulous, *with soft-hairy arillode*.

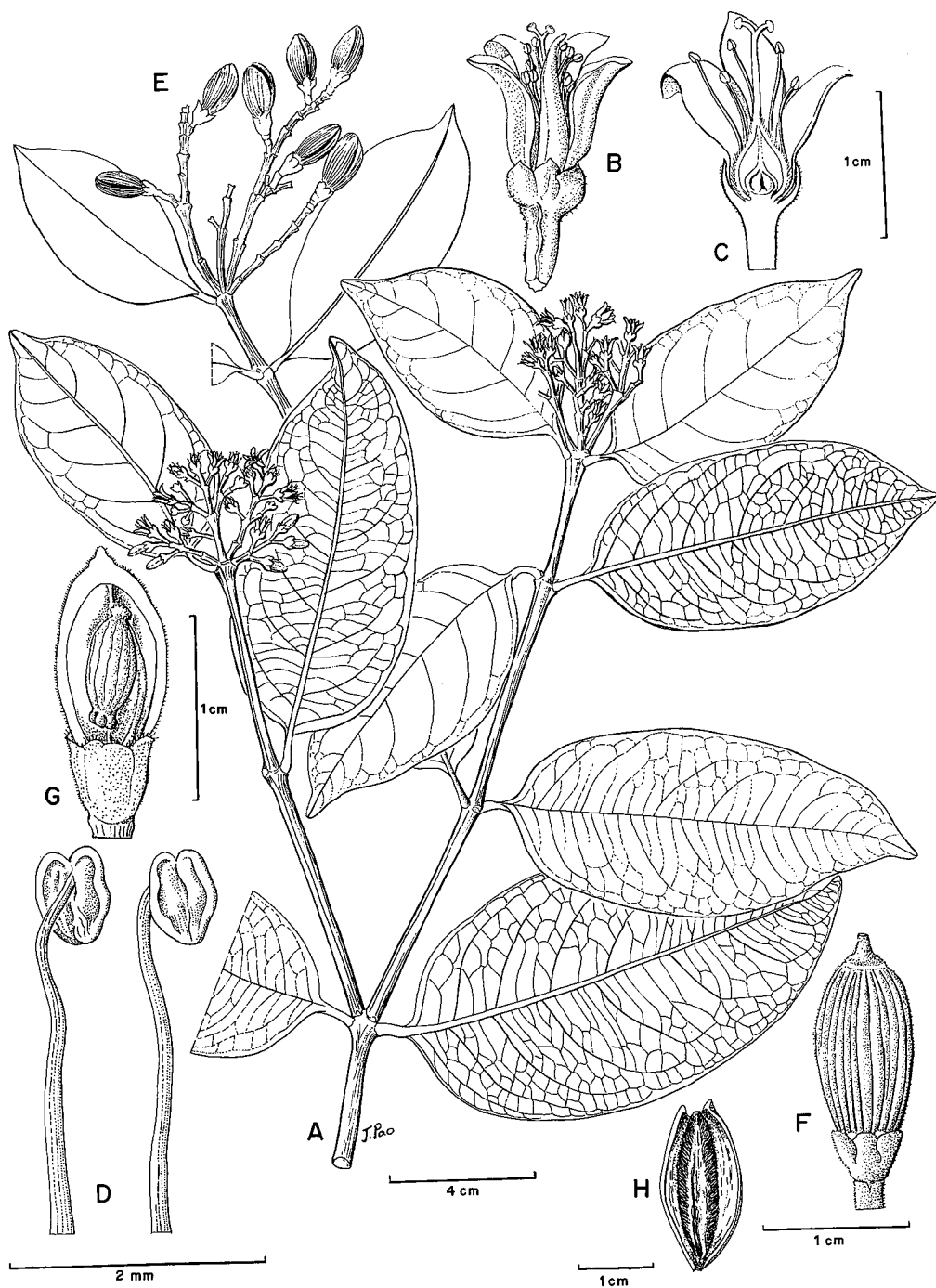
**Distribution.** Two species, distributed from W Africa to Malesia (Peninsular Malaysia, Sumatra, Borneo, Philippines and New Guinea). One species in Sabah and Sarawak.

**Ctenolophon parvifolius** Oliv.

(Latin, *parvus* = small, *folium* = leaf)

Fig. 1.





**Fig. 1.** *Ctenolophon parvifolius*. A, flowering leafy twig; B, open flower; C, flower in longitudinal section; D, stamens; E, fruiting leafy twig; F, fruit; G, longitudinal section of fruit; H, seed. (A–D from S. 29917, E–H from S. 14777.)

*L.c.* 516, *t.* 43, *f.* 1–7; Beccari *L.c.* 120; King *L.c.* 106; Merrill *L.c.* 313; Ridley *L.c.* 423; Masamune *L.c.* 356; Cockburn, Gard. Bull. Sing. 24 (1969) 4, *L.c.* (1972) 306, *L.c.* (1976) 205; Anderson *L.c.* 239; van Hooren & Nootboom *L.c.* (1988) 631; Whitmore, Tantra & Sutisna *L.c.* 208. **Type:** *Maingay KD 382*, Malaya (holotype K; isotype L). **Synonym:** *C. grandifolius* Oliv. *L.c.* 517, *t.* 43, *f.* 8–10, Beccari *L.c.* 119, King *L.c.* 106, Merrill *L.c.* 313, Ridley *L.c.* 403, Masamune *L.c.* 356.

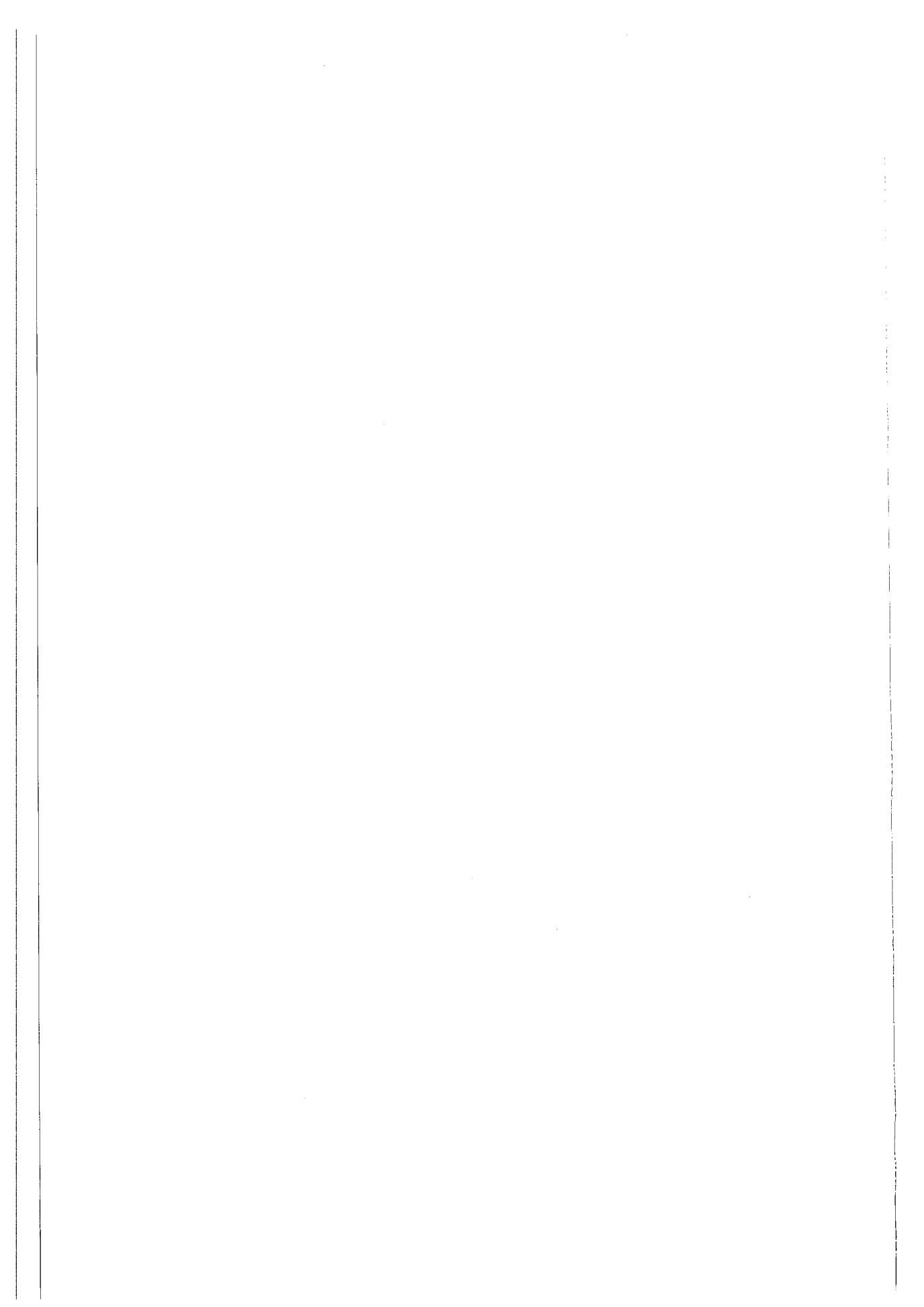
Tree to 35 m tall, 40 cm diameter; buttresses steep and sharp. **Bark** grey to grey-brown, finely cracked or scaly, hard and lenticellate. **Leaves** thick-coriaceous, drying grey-brown; elliptic to elliptic-ovate, 5–9 × 2–6 cm; base rounded to broadly cuneate, apex broadly acute to obtusely acuminate; midrib slightly sunken on the upper leaf surface, raised on the lower leaf surface, lateral veins looping and joining at the margin without forming a distinct marginal vein, intercostal veins reticulate and slightly raised on the lower leaf surface. **Inflorescences** dense panicles, terminal or in the axils of upper leaves. **Flowers:** sepals ovate, whitish hairy; petals linear-oblong, 5–9 mm long; filaments 3.5–6 mm long; ovary ovoid, hairy, style 5.5–6.5 mm long. **Fruits** ellipsoid, 15–25 × 5–10 mm, hairy, apex whitish hairy, sharply acute, with persistent clavate swollen stalk and sepals. **Seeds** ellipsoid, to 1.8 cm long, brown, shiny, surrounded by crest-like arillode.

**Vernacular names.** Sabah—*besi-besi*, *obah* (Dusun). Sarawak—*krian*, *litoh* (Iban).

**Distribution.** Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak), the Philippines and New Guinea.

**Ecology.** Found in swamp forest and on hills, on rather poor soils over sandstone and ultramafic rocks. Common in peat swamp forest.

**Uses.** The timber is hard and very durable, and good for house construction and general purpose timber.



## DAPHNIPHYLLACEAE

### Balu Perumal

World Wide Fund for Nature (WWF),  
Kuala Lumpur, Malaysia

Backer & Bakhuizen *f.*, FJ 1 (1963) 505; Huang, Taiwania 11 (1965) 57, *l.c.* 12 (1966) 137; Hsuan Keng, OFMSP (1969) 415; Whitmore, TFM 1 (1972) 181; Anderson, CLTS (1980) 165.

A monogeneric family comprising about 9 species, widely distributed in E Asia and Malesia extending from India to C China, Japan, and Malesia. In Sabah and Sarawak, represented by 2 species.

**Taxonomy.** The genus *Daphniphyllum* was formerly considered to be a member of the Euphorbiaceae, but now it is placed in a family (Daphniphyllaceae) and an order (Daphniphyllales) of its own. The relationship of this small family is thought to be with the Hamamelidaceae or perhaps with the Magnoliaceae. Embryological, palynological and wood anatomical studies confirmed its exclusion from the Euphorbiaceae and its alliance with the Hamamelidaceae. Chemically, the family is known to produce iridoid glycosides and the daphniphylline series of alkaloids. So far this alkaloid seems to be restricted to the family.

## DAPHNIPHYLLUM Blume

(Greek, *daphne* = laurel, *phullon* = leaf;  
having leaves resembling those of *Daphne*, Thymelaeaceae)

Bijdr. Fl. Ned. Ind. 17 (1826) 1153; Merrill, EB (1921) 336; Ridley, FMP 3 (1924) 234; Masamune, EPB (1942) 395; Backer & Bakhuizen *f.* *l.c.* 505; Huang *l.c.* (1965) 57, *l.c.* (1966) 137; Whitmore *l.c.* 181; Anderson *l.c.* 165.

*Dioecious trees or shrubs. Leaves spirally arranged, simple, entire, pinnately veined; without stipules. Inflorescences* axillary racemes; bracts basal, caducous. **Flowers unisexual**; calyx 2–6-lobed, lobes imbricate in bud, basally united; petals absent. **Flowers:** males with 5–12 stamens, radially arranged, anthers introrse or extrorse, dehiscent through longitudinal slits; female: *ovary superior*, incompletely 2(–3–4) locular, styles short, united basally, stigmas thick, recurved, ovules 2 per locule, subapical, pendulous, anatropous; staminodes sometimes present. **Fruit** a drupe. **Seed** 1; endosperm thick, oily; embryo tiny, apical.

**Ecology.** In a wide variety of habitats, from the lowlands to mountain summits; in *kerangas*, limestone and montane forests, in both secondary and primary forests.

**Uses.** Some species, e.g., *Daphniphyllum laurinum*, are known to be poisonous due to the presence of the alkaloid daphniphylline, found in the bark and seeds. In Banka (Sumatra, Indonesia), a decoction of the root has been reported as a medicine for diarrhoea and thrush (Heyne, Nutt. Pl. Ned. Ind. 3 (1917) 80).

### Key to *Daphniphyllum* species

Tree to 15 m tall, restricted to montane forest. Leaves usually coriaceous, margin recurved. Calyx in female flower not persistent. Anthers usually oblong or ellipsoid, extrorse, filaments usually long. Fruit with prominent recurved styles.....**D. glaucescens**

Shrub or treelet to 3 m tall, restricted to lowland forest. Leaves usually chartaceous, margin slightly undulating. Calyx in female flower persistent. Anthers crescent-shaped, introrse, filaments short. Fruit with minute styles.....

**D. laurinum** (Benth.) Baill.

Étud. Gen. Euph. (1858) 565; Merrill *l.c.* 336; Ridley *l.c.* 234; Masamune *l.c.* 395; Huang *l.c.* (1966) 139; Whitmore *l.c.* 181; Anderson *l.c.* 165. Basionym: *Gouphia laurina* Benth. in Hooker, Kew Jour. 6 (1854) 9. Type: *Wallich 1836*, Singapore (holotype K; isotypes BM, E). Synonym: *Daphniphyllum bancanum* Kurz, Tijdschr. Ned. Ind. 27 (1864) 188, Ridley *l.c.* 234, Masamune *l.c.* 395.

Leaves alternate or often spirally clustered towards the ends of twigs; blades 11–28 × 3.5–12 cm; *intercostal veins faintly scalariform*. Flowers: males with the calyx 3–4-lobed, pistillodes rarely present; females with a bell-shaped, 4-lobed calyx, style very short, spreading, staminodes rarely present. Fruits 7–12 × 5–7 mm, surface finely warty.

W Malesia; widely distributed in Sumatra, Peninsular Malaysia, and Borneo; also cultivated in Java. In Sabah and Sarawak, common in forest on sandy soils or on sandstone rocks by the seashore, as well as inland on limestone at 500–900 m.

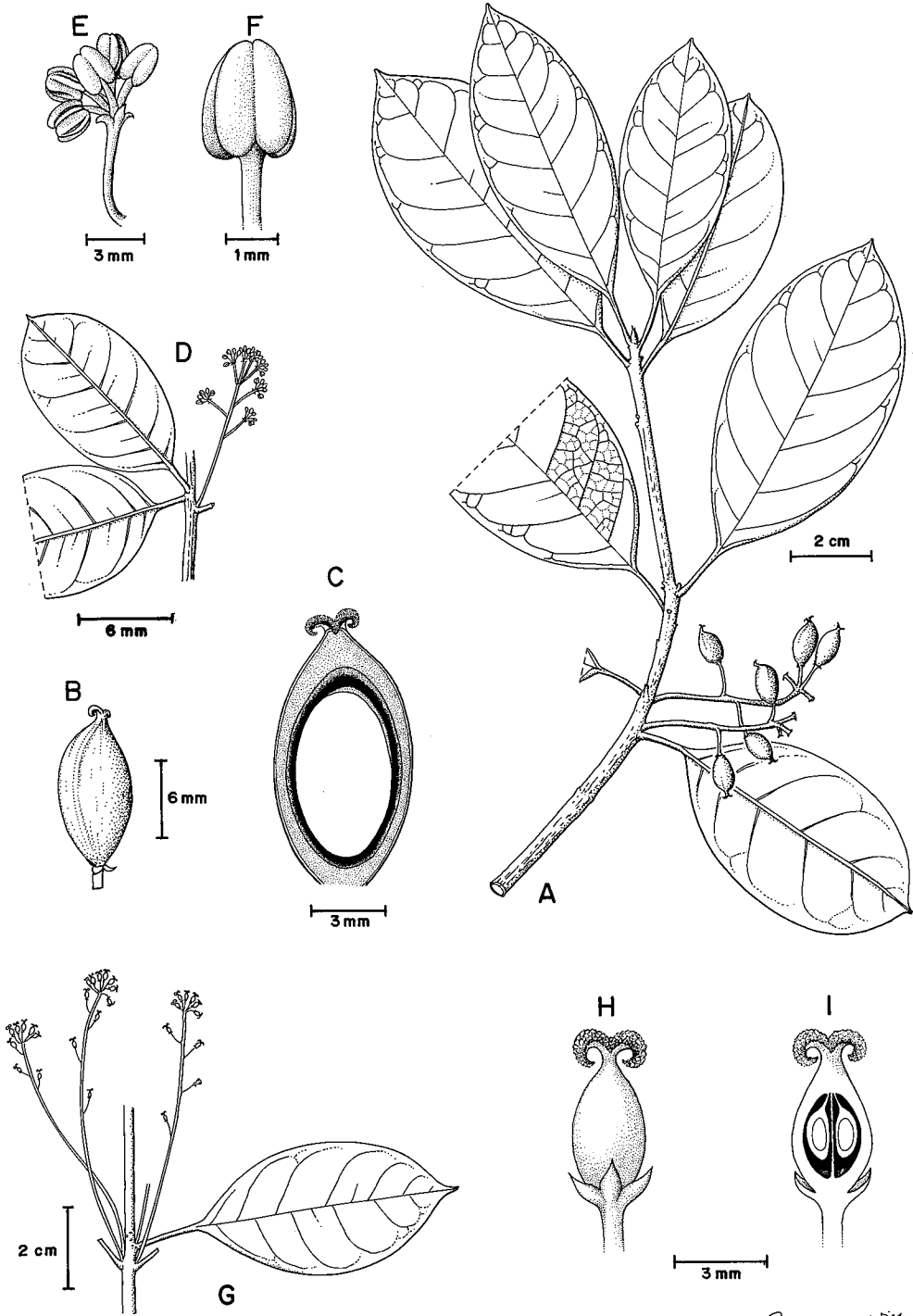
### *Daphniphyllum glaucescens* Blume

Fig. 1.

(Greek, *glaukos* = covered with whitish or pale bloom; the lower leaf surface)

*l.c.* 1153; Merrill *l.c.* 336; Masamune *l.c.* 395; Huang *l.c.* (1966) 161; Whitmore *l.c.* 181; Anderson *l.c.* 165. **Type:** *Blume 1908*, Java, Mt. Salak (holotype L; isotypes NY, US).

Tree to 15 m tall, 30 cm diameter. Twigs terete, brown, marked with many triangular leaf scars. **Leaves** occasionally clustered towards the ends of twigs; *blades usually coriaceous*, rarely chartaceous, dark green above, greyish brown, glaucous and papillose below; narrowly elliptic, elliptic, elliptic-oblong, or rarely lanceolate, 8–16 × 3–5 cm; base acute, cuneate or rounded, *margin recurved*; midrib prominent below, somewhat impressed above, lateral veins 7–12 pairs, intercostal veins reticulate; petioles narrowly triangular in cross-section, 1–4.5 cm long, *c.* 0.7 mm thick. **Inflorescences:** males slender racemes, 3–8 cm long; females racemose, 3–6 cm long, pedicels terete, 6–16 mm long, *c.* 0.2 mm thick. **Flowers:** males purple, calyx bell-shaped, 4–5-lobed, filaments 0.2–0.6 mm long, *anthers usually oblong or ellipsoid*, 0.6–1.5 × 0.2–0.5 mm, *extrorse*; females: *calyx not persistent*, styles spread out upwards or coiled, as long as the ovary, staminodes present. **Fruits** ellipsoid, obovoid or ovoid, 6–14 ×



**Fig. 1.** *Daphniphyllum glaucescens* subsp. *borneense*. A, fructing leafy twig; B, fruit; C, longitudinal section of fruit; D, leafy twig with a male inflorescence; E, male flower; F, stamen; G, leafy twig with female inflorescences; H, ovary; I, ovary in longitudinal section. (A–C from SAN 56346, D–F from SAN 54275, G–I from SAN 21965.)

5–10 mm, ripening blackish purple, surface uneven with a few tiny knobs; *persistent styles prominent and recurved*.

**Key to subspecies**

Leaves narrowly elliptic, length 2.6–3.8 times the width; apex acute-acuminate. Fruits obovoid or ovoid, 6–8 × 5–7 mm.....

subsp. **dichotomum** Huang

*l.c.* (1966) 190. Lectotype (Huang, 1966): *Clemens, s.n.*, Borneo, Sabah, Ranau, Mt. Kinabalu (UC; isolectotypes A, BO, L, NY).

Endemic to Borneo. In Sabah, known from a few collections from Mt. Kinabalu (*Clemens 10946, 30912, 32385; SAN 79578*); and in Sarawak, from Mt. Api, Ulu Melinau, Baram Distr. (*S. 30884*). Also known in Kalimantan. In lower montane and limestone hill forest, at 1000–1500.

Leaves elliptic to elliptic-oblong, length 1.5–2.7 times the width; apex rounded, cuspidate or abruptly acuminate. Fruits ellipsoid 10–12 × 8–10 mm.....

subsp. **borneense** (Stapf) Huang

Fig. 1.

*l.c.* (1966) 192. Basionym: *Daphniphyllum borneense* Stapf, FMK (1894) 224, Merrill *l.c.* 336, Anderson *l.c.* 165. Type: *Haviland 1070*, Borneo, Sabah, Mt. Kinabalu (holotype K; isotypes BM, L, UC).

Endemic to Borneo. In Sabah, common in the lower and upper montane forest on Mt. Kinabalu, at 1,500–4000 m; in Sarawak, known only from Mt. Murud, the Hose mountains and Usun Apau plateau, at 2300–2600 m. Also reported from Kalimantan.

**Vernacular name.** Sarawak—*teradam bukit* (Iban).

**Distribution.** E Asia extending from Sri Lanka to Japan and Malesia.

**Ecology.** In Sabah and Sarawak, common on mountain ridges or slopes of lower and upper montane forest (usually associated with *Magnolia* and *Symplocos*) and subalpine vegetation, at 1000–4000 m. Flowering from February to July.

## EPACRIDACEAE

**S.P. Lim**

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Hooker *f.*, Fl. Br. Ind. 3 (1882) 477; Merrill, EB (1921) 467; Masamune, EPB (1942) 577; Sleumer, FM 1, 6 (1964) 422; Whitmore, TFM 2 (1972) 32.

Small trees or shrubs. **Leaves** spirally arranged, simple, stiff and coriaceous, with several longitudinal main veins; stipules none. **Inflorescence** an axillary and/or terminal raceme, with very short-stalked flowers, each flower subtended by small bracts. **Flowers** bisexual or unisexual (plants dioecious), radially symmetrical, 4–5-merous, often fragrant; *sepals free*, coriaceous, imbricate and persistent; *corolla tube present*, lobes valvate or imbricate; stamens 4–5, rarely 2, free, inserted in the corolla tube, alternate with the corolla lobes, included or exserted, *anthers 1-locular, dehiscing by a longitudinal slit, becoming inverted during development*; disc entire or 5-lobed; ovary superior, 1–10-locular, ovules one per locule, placentation axile. **Fruit** with a single hard stone (pyrene) containing several locules, or with several 1-locular stones. **Seeds** small; embryo straight; endosperm fleshy.

**Distribution.** About 31 genera and 400 species, extending from Myanmar and Thailand, Indo-China, Malesia to the Pacific islands, Australia, New Zealand, Hawaii and the SW part of South America; Australia and Tasmania have the most species. In Malesia, 3 genera with 18 species, 4 of which are known also from outside Malesia. In Sabah and Sarawak, 2 genera with 4 species are known.

**Ecology.** In open coastal vegetation on white sands, *kerangas* forest and forest on ultramafic soils; in the lowlands and on mountains up to 4000 m. In Australia, the Epacridaceae assume the importance of the Ericaceae in other continents, although in Malesia, they can be found growing with Ericaceae.

**Taxonomy.** Epacridaceae is distinguishable from Ericaceae in having free sepals (those in Ericaceae generally connate), 4–5 stamens rather than 10, with unilocular anthers splitting longitudinally rather than bilocular anthers opening by pores.

### Key to genera

Leaves without distinct stalk or with a short stalk up to 1 mm long; veins rather inconspicuous on the lower surface, either very faint and numerous, or 1–3 unbranched veins parallel for the most part and running to the apex with other branched veins diverging toward the margins. Fruit containing a single hard stone, with (2–)5(–10) locules (chambers) each with a seed.....

.....1. **Styphelia**



Leaves with distinct stalk longer than 1 mm; veins very conspicuous on the lower leaf surface, with 1–3 unbranched veins running to the apex, only the central one straight, the other veins curved and almost parallel to the leaf margins. Fruit containing 8–10 separable stones, each equivalent to an ovary locule with one seed.....**2. Trochocarpa**

## 1. STYPHELIA Sm.

(Greek, *stuphelos* = set closely together; the leaves)

Sp. Bot. New Holl. (1793) 45; Hooker *f.*, Fl. Br. Ind. 3 (1882) 477; Merrill, EB (1921) 467; Masamune, EPB (1942) 577; Sleumer, Blumea 12 (1963) 145, FM 1, 6 (1964) 424; Whitmore, TFM 2 (1972) 32.

Shrubs or small trees, monoecious (with bisexual flowers) or dioecious; young branches minutely puberulent, becoming glabrous and fissured in older parts. **Leaves** without a distinct stalk or only a short stalk not more than 1 mm long; venation inconspicuous on the lower side, the veins either very faint and numerous or 3 parallel veins running straight to the apex, the other veins branched and diverging toward the margins. **Inflorescence** a short raceme or a solitary flower terminating a short peduncle; bracteoles 2, opposite, ovate, keeled dorsally, margin ciliate. **Flowers** 5-merous; sepals with ciliate margin; corolla lobes valvate, recurved in open flower, inner side hairy on the upper half, outside glabrous; stamens 5, attached at or near the top of the corolla tube, filaments short, filiform; ovary (2–)5(–10)-locular, style attenuate, stigma a slight swelling. **Fruit** globose to ellipsoid with a hard stone, containing (2–)5(–10) locules, base covered with persistent sepals (in Bornean taxa). **Seed** one in each locule.

**Distribution.** About 130 species. Eight species in Malesia (one species widespread, also in Indo-China, Myanmar and Thailand), one species in Marianas, six species throughout the Pacific area, 13 species in New Caledonia, eight species in New Zealand and the majority in Australia. Three species are found in Sabah, while only a single species has been documented for Sarawak.

**Ecology.** On seashores, and acidic and peaty soil in montane forest up to alpine elevation. Often gregarious.

**Uses.** Some fruits are edible, while leaves and roots of some species are used as medicine.

### Key to *Styphelia* species

1. Leaves generally large, (15–)25–55(–85) mm long, (2–)5–10(–11) mm wide. Veins very fine and hardly visible..... **2. S. malayana**  
Leaves much smaller, typically up to 14 mm long, 3 mm wide. Veins visible, with 1–3 main veins running straight to the apex, the other veins branched and diverging toward the margins.....**2**
2. Leaves with a short distinct stalk not more than 1 mm long, glaucous on the lower surface; leaf apex acute without a stiff point. Racemes 3–6 mm long, with 4–9(–13) flowers each. Flowers unisexual.....**3. S. suaveolens**

Leaves sessile, not or very slightly glaucous on the lower surface; leaf apex acuminate with a stiff sharp slender point. Racemes 1–3 mm long, with only 1–2 flowers each. Flowers bisexual.....**1. S. abnormis**

**1. *Styphelia abnormis* (Sond.) J. J. Sm.**

Fig. 1.

(Latin, *abnormis* = abnormal or unusual)

Ic. Bog. 4 (1910) 82; Merrill *l.c.* 467; Masamune *l.c.* 577; Holthuis & Lam, *Blumea* 5 (1942) 224; Sleumer *l.c.* (1963) 151, *l.c.* (1964) 433. **Basionym:** *Leucopogon abnormis* Sond. in Lehm., *Pl. Preiss.* 1 (1845) 325. **Type:** *D'Urville & Lesson, s.n. 1825*, New Guinea (holotype P). **Synonyms:** *Leucopogon acuminatus* (non R. Br.) Duperrey, *Voy. Coquille Bot. Atlas* (1826) t. 53; *Leucopogon lancifolius* Hook. f., *Ic. Pl.* (1852) t. 898; *Leucopogon moluccanus* Scheff., *Nat. Tijds. Ned. Ind.* 32 (1873) 419; *Leucopogon malayanus* Jack var. *moluccanus* (Scheff.) Kurz, *J. As. Soc. Beng.* 46, 2 (1877) 217; *Styphelia lancifolia* (Hook. f.) J.J. Sm. *l.c.* (1910) 82; *Styphelia moluccana* (Scheff.) J.J. Sm. *l.c.* 82.

Shrub or small tree. **Leaves** sessile, upper surface waxy and glabrous, lower surface not or only very slightly glaucous, glabrous; narrowly elliptic, lanceolate or oblanceolate, (6–)10–14(–16) × (1–)2–3(–4) mm; base narrow and truncate, subglabrous, margin finely serrulate-ciliate, apex acuminate with a conspicuous stiff sharp slender point; 1–3 unbranched veins running to the apex, the other (outer) veins on each side branched and diverging towards the margins. **Inflorescences** axillary, minutely puberulent, 1–3(–4) mm long, with 1–2, rarely 3 flowers; bracteoles 2, opposite, ovate, 1.3–2 × 1–1.5 mm, keeled dorsally ending in a short mucro, margin ciliate, glabrous on surface. **Flowers** bisexual; sepals ovate, 2–3 × 1.2–1.5 mm, glabrous on both surfaces; corolla tube c. 2 mm long, tube hidden by sepals, corolla lobes 1.5–2 × 0.6–0.8 mm, inner surface densely covered with pale long soft hairs; stamens with filament 0.5 mm long, anthers oblong, 0.6–0.7 mm long, slightly exerted; ovary globose, c. 1 mm across, glabrous, styles 1.2–1.5 mm long, glabrous. **Fruits** broadly ellipsoid with truncate apex, to 3 × 1.5–2 mm, tipped with a persistent style, glabrous; stone with 4–5 locules.

**Distribution.** Confined to Malesia: Borneo, SE Sulawesi, Maluku and New Guinea. In Borneo, it occurs only in Sabah, recorded for Balambangan Island, Gaya Island, Menggatal and Bukit Padang in Kota Kinabalu.

**Ecology.** On sandy beaches (Balambangan Island), among rocks (Gaya Island), and on sand and degraded sandstone (Menggatal and Bukit Padang, Kota Kinabalu). Flowering and fruiting throughout the year.

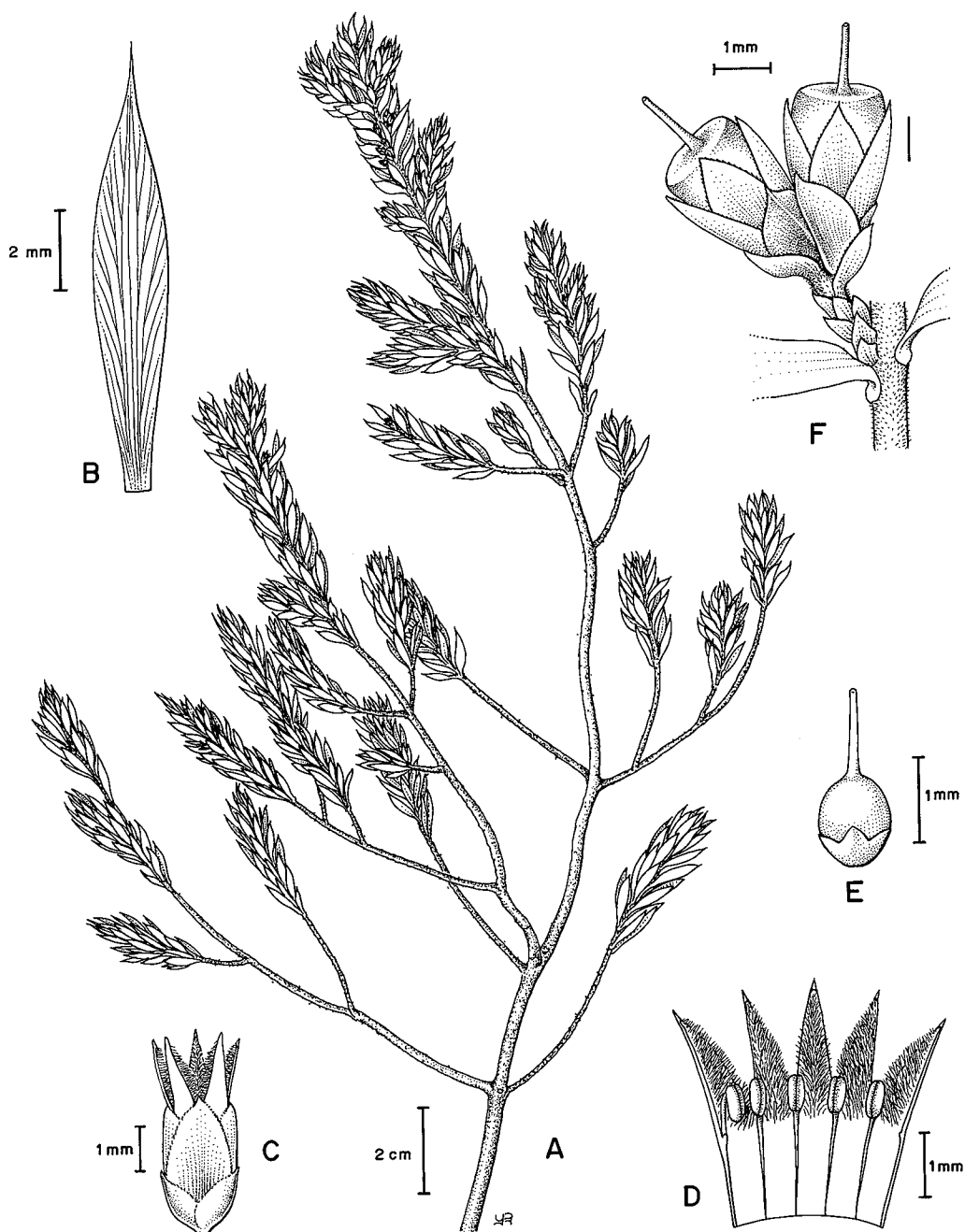
**2. *Styphelia malayana* (Jack) Spreng.**

(of Malaya)

*Syst. Veg.* 4 (1827) *Cur. Post.* 67 (as “*malaica*”); Hooker *f. l.c.* 477; Merrill *l.c.* 467; Masamune *l.c.* 577; Lam, *Blumea* 5 (1945) 572; Sleumer *l.c.* (1963) 147, *l.c.* (1964) 426; Whitmore *l.c.* 32. **Basionym:** *Leucopogon malayanus* Jack, *Mal. Misc.* 1, 5 (1820) 20. **Type:** *Jack, s.n.*, Singapore (not preserved).

var. **malayana**

Sleumer *l.c.* (1963) 147, *l.c.* (1964) 426.



**Fig. 1.** *Styphelia abnormis*. A, flowering leafy twigs; B, detail of leaf venation; C, flower; D, corolla slit open to show stamens; E, ovary with style and stigma; F, infructescence with two fruits. (A–B from Mohd. Shah & Kadim MS 946, C–F from SAN 85553.)

Shrub or small tree. **Leaves** *sessile*, upper surface waxy and glabrous or with minute appressed stiff hairs along the middle, lower surface glaucous, glabrous to puberulent; narrowly elliptic to lanceolate,  $(15-25-55(-85)) \times (2-5-10(-11))$  mm; base narrow and truncate, covered in tiny hairs, margin glabrous to ciliate especially towards the base and apex, apex acute or acuminate with a conspicuous stiff sharp slender point, glabrous or minutely puberulent; *veins numerous, very fine and without distinct midrib, hardly visible*. **Inflorescences** axillary, densely long-hairy, up to 15 mm long with up to 10 flowers; bracteoles 2, opposite, ovate,  $1.5-2 \times 2-2.5$  mm, keeled dorsally, apex mucronulate, margin ciliate, glabrous or subglabrous on the surface. **Flowers** bisexual; sepals ovate to lanceolate,  $3-4.5 \times 1.5-2.5$  mm, glabrous or with appressed fine hairs along the middle on the inner surface, glabrous or subglabrous on the outer surface; corolla tube c. 3 mm long, hidden by or slightly exerted from the sepals, *corolla lobes*  $2 \times 1.5$  mm, *inner surface covered with rusty tomentose indumentum*; stamens with filament 0.6–1 mm long, anthers oblong, 0.2–0.8 mm long, slightly exerted; ovary globose to ellipsoid, c. 1 mm across, glabrous, styles 1–2.5 mm long, glabrous or covered with dense flexuous hairs especially at the base. **Fruits** globose to ellipsoid,  $3-5 \times 2-4$  mm, tipped with a persistent hairy or glabrous style, glabrous; stone with 5 locules.

**Vernacular names.** Sarawak—*chuchur atap* (Malay), *maki china* (Malay), *melamut* (Iban), *rusak* (Bidayah). Brunei—*ambok gobang* (Brunei Dusun), *ludang-ludang* (Tutong), *terindak ati* (Brunei Malay, Kedayan).

**Distribution.** Myanmar, Thailand, Indo-China, Peninsular Malaysia, Sumatra (including Banka, Billiton, and Riouw), Anambas Is. and Borneo. In Sabah, it is confined to the northwest parts (Mt. Kinabalu, Mt. Tambuyukon and Labuan). In Sarawak, recorded only from the 1st Division (Mt. Santubung, Bako National Park and Bungoh Hill) and 4th Division (Lambir Hill, Murud Hill and Mt Dulit) but generally present throughout. In Brunei, it has been documented from the Tutong and Belait districts and the Berakas Forest Reserve in Muara district. Also in Kalimantan.

**Ecology.** On nutrient-poor dry sandy soils (0–150 m), in montane *kerangas* forest on sandstone (400–2400 m) and ultramafic soils (1600–2750 m). Flowering and fruiting throughout the year but mainly in July and August.

**Uses.** Leaves and roots are used to prepare a concoction drunk for stomach ache and for administration after childbirth. Fruits are edible.

### 3. *Styphelia suaveolens* (Hook. f.) Warb.

(Latin, *suaveolens* = sweet-smelling; the flower)

In Sarasin, *Reisen* 2 (1905) 329; Merrill *l.c.* 468; Masamune *l.c.* 577; Lam *l.c.* 571; Sleumer *l.c.* (1963) 148, *l.c.* (1964) 428. **Basionym:** *Leucopogon suaveolens* Hook. f., *l.c.* Pl. (1852) t. 898. **Type:** *Low, s.n.*, Sabah, Mt Kinabalu (holotype K). **Synonyms:** *Styphelia philippinensis* Merr., *Philip. J. Sc.* 20 (1922) 419; *Leucopogon philippinensis* (Merr.) Hosokawa, *Trans. Nat. Hist. Soc. Formosa* 30 (1940) 336.

Shrub or small tree. **Leaves** glabrous and waxy on the upper surface, glaucous, glabrous to slightly hairy on the lower surface; narrowly elliptic to oblanceolate,  $(4-8-14(-16)) \times (1-2-3)$  mm; base cuneate, margin glabrous and sometimes ciliate toward the apex, *apex acute without a stiff sharp slender point; 1-3 unbranched veins parallel for the most part and running to the*

apex, and 1 or 2 outer veins on each side branched towards the margin, obscure on the upper leaf surface; *petioles shorter than 1 mm*, subglabrous or minutely puberulent up to the leaf base. **Inflorescences** terminal, minutely puberulent, 1–3 in a leaf axil, 3–6(–9) mm long, each with 4–9(–13) flowers; bracteoles 2, opposite, ovate to triangular, 1–1.5 × 1.2–1.8 mm, keeled dorsally, margin ciliate, surface minutely puberulent or with tiny glistening hairs. **Flowers unisexual** (plant dioecious); sepals triangular 2–2.5 × 2–1.5 mm, both surfaces glabrous or with tiny glistening hairs all over the outer surface; corolla tube *c.* 2 mm long, hidden by sepals, *corolla lobes* 1.5–2 × 1 mm, *inner surface densely covered with pale long curly hairs*; in male flowers, filaments of stamens *c.* 1 mm long, anthers oblong, 1–1.5 mm, exerted, reduced pistil columnar, *c.* 2 mm long; in female flower, filaments of stamens *c.* 0.5 mm long, anthers reduced, *c.* 0.3 mm long, less exerted compared to those in the male flower, ovary globose, *c.* 0.8 mm across, glabrous, styles 0.5–1 mm long, glabrous. **Fruits** subglobose, 2.5 × 2 mm, tipped with a persistent style, glabrous; stone with 2–5 locules.

**Distribution.** Borneo, Philippines, Sulawesi, Timor, New Guinea, Solomon Islands, Australia and New Zealand. In Borneo, it is restricted to Mt. Kinabalu, Sabah.

**Ecology.** In montane forest at 1800–4000 m, on ultramafic rock, granite and sandstone. Flowering throughout the year.

## 2. TROCHOCARPA R. Br.

(Greek, *trocho* = wheel-like, *karpos* = fruit)

Prod. (1810) 548; Sleumer *l.c.* (1963) 163, *l.c.* (1964) 436.

Shrubs or small trees. **Leaves** distinctly stalked; veins conspicuous on the lower surface, with 1–3 unbranched veins running to the apex, only the central one straight, the others curved and almost parallel to the leaf margins. **Inflorescence** a raceme, terminal or axillary or both. **Flower** bisexual, 5-merous; bracts below the flowers 2 (opposite) or 7–10, margin ciliate; corolla lobes valvate, plane to recurved, inner surface hairy, outer surface glabrous; stamens 5, attached at or near the top of the corolla tube, filaments short, filiform; ovary (8–)10(–11)-locular, styles columnar, stigmas obtuse or capitate. **Fruits** globose, with 8–10 separable stones, each developed from an ovary locule. **Seed** one in each locule.

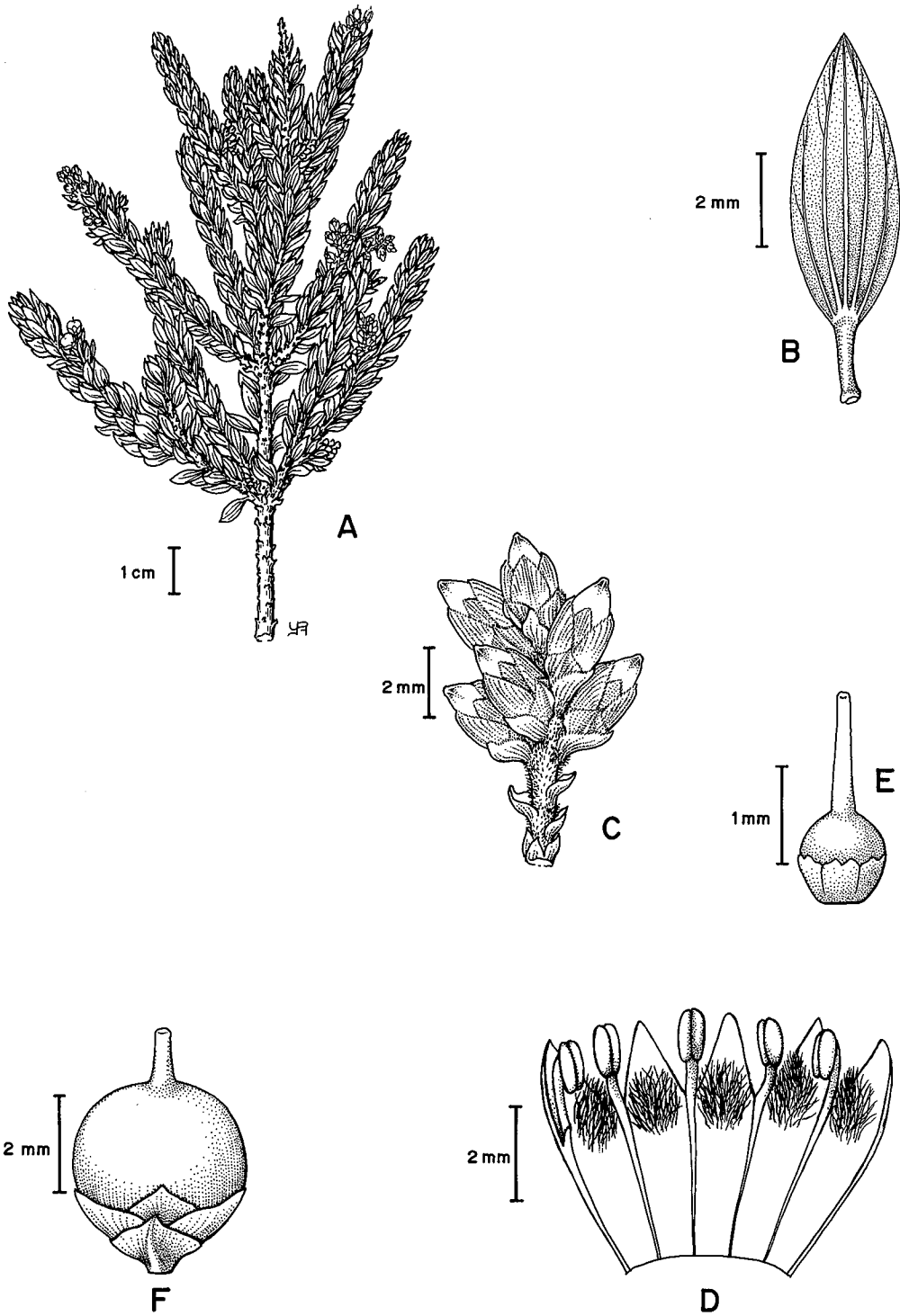
**Distribution.** About 12 species. A single species in Borneo, one species in Sulawesi, 6 species in New Guinea and 6 species in Australia with one in both Australia and New Guinea.

**Ecology.** In open places, up to 600 m in Australia, and NW New Guinea and between 3000–4000 m in Sabah, Central Sulawesi and the main range of New Guinea.

**Trochocarpa celebica** (J. J. Sm.) Steen.  
(of Celebes = Sulawesi)

Fig. 2.

In Lam *l.c.* 573; Merrill *l.c.* 467; Masamune *l.c.* 577; Lam *l.c.* 573; Sleumer *l.c.* (1963) 166, *l.c.* (1964) 439. **Basionym:** *Styphelia celebica* J. J. Sm., Ic. Bog. 4 (1910) 81. **Type:** Abendanon, *s.n.*, 1909, Central



**Fig. 2.** *Trochocarpa celebica*. A, flowering and fruiting leafy twigs; B, detail of leaf venation; C, inflorescence; D, corolla slit open to show stamens; E, ovary with style and stigma; F, fruit. (A–B from SAN 54715, C–F from SAN 82977.)

Celebes (holotype BO). **Synonyms:** *Styphelia learmonthiana* Gibbs, J. Linn. Soc. Bot. 42 (1914); *Trochocarpa learmonthiana* (Gibbs) H.J. Lam, l.c. 574.

Low shrub or tree; young branches minutely puberulent, becoming glabrous and fissured in older parts. **Leaves** waxy and glabrous to slightly hairy on the upper surface, not glaucous, glabrous on the lower surface; elliptic to ovate, (3-)5-7(-9) × (1-)2-3(-4) mm; base cuneate, glabrous or subglabrous on the upper surface, margin glabrous to ciliate at the acute leaf apex; *venation conspicuous, with 1-3 unbranched veins running to the apex*, only the central one straight, the other (outer) veins on each side curved and almost parallel to the leaf margins, branched toward the margin; *petioles 1-2 mm long*, glabrous or subglabrous. **Inflorescences** axillary and terminal, densely puberulent, up to 8 mm long, with up to 12 flowers; bracteoles 2, opposite, c. 1.5 × 2 mm, ovate, dorsally keeled, ending in short mucro, imbricate, margin ciliate, surface glabrous. **Flowers:** sepals ovate to triangular, 2-2.5 × 1.3-1.8 mm, glabrous, margin ciliate; corolla tube c. 3 mm long, exerted from the sepals; *corolla lobes 2 × 1-1.5 mm*, inner surface with dense long coarse hairs at the base; stamens with filament c. 2 mm long, anthers linear, 0.8-1 mm long, very exerted; disc 5-lobed; ovary globose, c. 1 mm across, glabrous, styles 1.3-1.7 mm long, columnar, ridged, glabrous. **Fruits** globose to ovoid, 2-4 × 3-5 mm, tipped with persistent style, glabrous, containing 10 separable stones; base covered by persistent sepals.

**Distribution.** Borneo and Sulawesi. In Borneo, it is confined to Mt. Kinabalu, Sabah.

**Ecology.** In montane *kerangas* or open summit vegetation and in rock crevices. On Mt. Kinabalu, it occurs between 3000 m and 4000 m. Flowering throughout the year.

## ERYTHROXYLACEAE

**R.C.K. Chung**

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Kepong, Malaysia

King, J. As. Soc. Beng. 62, 4 (1893) 190 (as Order Lineae, in part); Koorders, Exk. Fl. Java (1912) 415; Merrill, EB (1921) 313; Ridley, FMP 1 (1922) 324 (as Order Lineae, in part); Masamune, EPB (1942) 357; Payens, FM 1, 5 (1958) 543; Backer & Bakhuizen *f.*, FJ 1 (1963) 440; Hutchinson, Fam. Fl. Pl. 1 (1959) 263, Gen. Fl. Pl. 2 (1967) 605; Cockburn, TFM 1 (1972) 194, TS 1 (1976) 82; Keng, OFMSP (1978) 175; Anderson, CLTS (1980) 171; Ashton, MNDTS 2 (1988) 238; Corner, WSTM 3rd ed. 1 (1988) 254; Whitmore, Tantra & Sutisna, CLK 1 (1989) 108.

Shrubs or trees. *Stipules intrapetiolar, rarely extrapetiolar, completely fused or rarely bifid, often caducous. Leaves alternate (distichous) or rarely opposite (Aneulophus), simple, entire. Flowers axillary, solitary or in clusters, bisexual, heterostylous (with short- and long-styled forms), 5-merous, radially symmetrical; calyx campanulate, lobes 5, imbricate or valvate, persistent; petals 5, free, caducous, imbricate or involute in bud, usually with a ligular appendage near the base on the inner side; stamens 10, in two whorls of 5, filaments connate at least at the base, anthers basifixed, 2-locular, dehiscent longitudinally; disc absent; ovary superior, mostly 3-carpellate, 3-locular with 2 of the locules usually sterile, fertile locule 1- or 2-ovulate; styles 3, erect, free or partly connate, stigmas capitate (often oblique) or clavate; ovules pendulous, anatropous. Fruit a drupe; endocarp hard. Seeds with or seldom without endosperm; embryo straight.*

**Distribution.** Four genera with about 270 species; *Aneulophus* (2 species), *Nectaropetalum* (6 species) and *Pinacopodium* (2 species) are restricted to Africa, while *Erythroxylum* (c. 250 species) is a genus centered mainly in the Andes and the Amazon basin in tropical and subtropical S America. In Sabah and Sarawak, 4 species of *Erythroxylum* are known.

**Ecology.** In primary and secondary forests, to c. 1600 m, especially on slopes of low hills.

**Taxonomy.** In the past the genus *Erythroxylum* has been incorporated in different families, *viz.* the Malpighiaceae (de Jussieu, Gen. Pl. (1789) 281), Linaceae (Bentham & Hooker, Gen. Pl. 1 (1862) 244, and Ridley *l.c.* 323), and Erythroxylaceae (Payens *l.c.*, Hutchinson *l.c.*, Keng *l.c.*, and others). In recent classifications, it is widely accepted that the Erythroxylaceae differ from the Malpighiaceae in their fruits which are not winged and at maturity do not split into 3 nut-like parts, and from the Linaceae in their ligulate petals and 3-locular ovary with only one locule fully developing.



## ERYTHROXYLUM P. Browne

(Greek, *erythros* = red, *xylon* = wood)

Civ. Nat. Hist. Jam. 1 (1756) 278; Linnaeus, Syst. Nat. ed. 10, 2 (1759) 1035 (*Erythroxyton*); King, J. As. Soc. Beng. 62, 4 (1893) 190; O. E. Schulz, Pflanzenr. 29 (1907); Koorders, Exk. Fl. Jav. (1912) 416; Merrill, EB (1921) 313; Ridley, FMP 1 (1922) 324; Masamune, EPB (1942) 357; Payens, FM 1, 5 (1958) 543; Backer & Bakhuizen *f.*, FJ 1 (1963) 441; Burkill, EPMP (1966) 966; Plowman, Taxon 25 (1976) 141; Ashton, MNDTS 2 (1988) 238; Corner, WSTM 3rd ed. 1 (1988) 254; Whitmore, Tantra & Sutisna, CLK 1 (1989) 108; Ng, MFFSS 1 (1991) 66; Chung, Sandakania 7 (1996) 67.

Shrubs or trees. *Young twigs flattened*, usually becoming terete when older; small distichous bracts (ramenta) often found at the base of lateral twigs and between the leaves. *Stipules* small, *entire*, rarely two-lobed, often 2-keeled below, sometimes emarginate or 2-dentate at apex, *caducous and leaving a distinct scar*. **Leaves** *alternate (distichous)*, involute in bud, *pinnately veined*; midrib often sunken above, prominent below, *lateral veins* numerous, fine, *joining and forming marginal loops and anastomosing irregularly with the intermediate lateral, intercostal, and intramarginal veins to form a distinctive reticulate venation*; petioles articulate at the base. **Flowers** appearing as the leaves mature, subtended by bracts; pedicels thickened under the calyx, mostly angular, with 2 bracteoles at the base; *calyx lobes imbricate in bud, persistent*; *petals* alternating with the calyx lobes, *with a 3-lobed, ligule-like appendage inserted on the apex of the claw*; stamens 10, arranged in 2 whorls of 5, persistent, *filaments connate into a persistent staminal tube at base*, outermost alternate with the petals, arising directly from the staminal tube, innermost sometimes ventral to the obtuse or dentate rim of the staminal tube, anthers ellipsoid, basifixed, cordate at the base; ovary (1-)3-locular, only one locule fertile, with 1 ovule; styles 3, erect, free or partly connate, stigmas capitate (often oblique) or clavate, rounded or rarely acute. **Fruit** *a drupe*, 3-locular, with one containing a seed, the other two empty but enlarged; mesocarp pulpy; endocarp hard and connate into a 3-locular pyrene. **Seeds** flattened; with or without endosperm; testa thin-coriaceous; embryo oblong, straight, erect, cotyledons flat to plano-convex, radicle distinct, pointing towards the fruit apex.

**Distribution.** A pantropical genus with about 250 species, with the centre of distribution in S America; 6 species are known in the Malesian region, of which 4 are documented in Sabah and Sarawak.

**Ecology.** Primary and secondary forests, from sea level to 500 m, especially on slopes of low hills.

**Uses.** The family includes the important cocaine-producing plants, *Erythroxyton coca* (Bolivian coca) and *E. novogranatense* (Peruvian coca), whose leaves yield the important alkaloid cocaine, a narcotic widely used in modern medicine. In the past, *E. novogranatense* was cultivated in Sri Lanka, Java and Thailand to produce cocaine, used as a local anaesthetic and in the prescription of some medicines. The timber of some species is hard, strong, and durable and used locally in tropical America and Africa for construction purposes. In SE Asia, however, due to its small size, the timber is of minor importance.

Key to *Erythroxylum* species

1. Shrub or treelet to 1.5 m tall. Flowers solitary; pedicels 16–19 mm long.....  
***E. iwahigense* forma *calcicola*** R.C.K. Chung Fig. 2H–J.  
*l.c.* 74. Type: *Paul Chai S. 39898*, Borneo, Sarawak, 4th Div., Mt. Mulu National Park, Mt. Buda (holotype SAR; isotypes K, KEP, L, MO, SAN).  
 Leaves *thick-coriaceous*; elliptic or obovate, (1.6–)2.4–4(–4.3) × (1.1–)1.3–1.8(–2) cm; base cuneate, apex acute with rounded or emarginate tip, rarely obtuse with rounded tip; *lateral veins* (12–)14–20 pairs, 1–2(–2.5) mm apart, intercostal veins distinct, prominent to faint on both surfaces. *Flowers solitary, pedicels 16–19 mm long.*  
 Endemic to Sarawak. Very uncommon, known only from the type collection. Limestone hills to 1000 m. The typical form, *E. iwahigense* forma *iwahigense* from Palawan Is., differs from the present form by its thin-coriaceous leaves and broader spacing between lateral veins, (3–)4–8(–10) mm.
- Treelet or tree, 5–40 m tall. Flowers in clusters of 2–8, or rarely solitary but never exclusively so; pedicels 3–10 mm long.....2
2. Staminal tube longer than calyx lobes.....1. ***E. cuneatum***  
 Staminal tube shorter than or at most as long as calyx lobes.....3
3. Leaves thin-coriaceous or chartaceous, apex acute with rounded or pointed tip, or cuspidate, or rarely obtuse with rounded or emarginate tip. Calyx lobes 1–1.2 mm long. Fruits broadly ellipsoid, 4.5–8 mm diameter.....2. ***E. latifolium***  
 Leaves thick-coriaceous, apex obtuse-emarginate. Calyx lobes 1.4–1.8 mm long. Fruits ellipsoid, to 4 mm diameter.....3. ***E. sarawakanum***

1. ***Erythroxylum cuneatum*** (Miq.) Kurz  
 (Latin, *cuneatus* = wedge-shaped; the leaf base)

Fig. 1A–G.

J. As. Soc. Beng. 43, 2 (1847) 135; O.E. Schulz *l.c.* 146; Payens *l.c.* 548; Merrill, Philip. J. Sci. Bot. (1908) 232, EPP (1923) 325; Cockburn *l.c.* (1976) 84; Anderson *l.c.* 171; Ashton *l.c.* 238; Corner *l.c.* 255; Whitmore, Tantra & Sutisna *l.c.* 108; Chung *l.c.* 69. **Basionyms:** *Ficus cuneata* Wall., Cat. (1828) no. 4534, *nom. nud.*; *Urostigma ?cuneatum* Miq. in Hooker, Lond. J. Bot. 6 (1847) 585. **Type:** *Wallich, Cat. no. 4534, "India Orientalis"* (holotype K).

Shrub or small to large tree to 40 m tall, 65 cm diameter. **Bark** grey to reddish brown, smooth to finely fissured and sometimes scaly, lenticellate, brittle; inner bark orange-brown to reddish brown. **Sapwood** pale yellow; heartwood dark reddish brown. Twigs drying brown to black. *Stipules triangular to lanceolate*, as long as petiole. **Leaves** chartaceous to thin-coriaceous, glabrous; elliptic to elliptic-lanceolate or obovate, 1.9–12 × 0.9–5.8 cm; base cuneate, acute to obtuse, apex obtuse to acute, with emarginate, rounded or rarely pointed tip; midrib sunken above, lateral veins 8–15 pairs, 2–13 mm apart, intercostal veins slightly raised to faint on both surfaces; *petioles 2–9 mm long, 0.5–1 mm thick, glabrous.* **Flowers** in clusters of 2–6(–8), or rarely solitary but never exclusively so; *pedicels 3–10 mm long, 0.2–0.7 mm thick, glabrous; calyx lobes 0.5–1.2 mm high, triangular to lanceolate; petals white, greenish white to light*

green, 3–4 × 1.5–2 mm, claw distinctly narrowing towards the base, about a third as long as the petal; filaments in short-styled form *c.* 2–3.5 mm long (for equal stamens) and *c.* 1.5–4.5 mm long (for unequal stamens), in long-styled form *c.* 2–4 mm long (for equal stamens) and 0.5–1.5 mm long (for unequal stamens), *staminal tube longer than calyx lobes*, 1.5–2 mm high, anthers 0.3–0.5 mm across; ovary ellipsoid or ovoid, longer than staminal tube, 3-locular, styles in short-styled form 1–2 mm long, shortly connate at base, in long-styled form 2–5 mm long, connate to a third to a half of their length, stigma in short-styled form oblong-ovoid or clavate, in long-styled form capitate, in both forms broader than the style. **Fruits** ripening bright red, ellipsoid, 8–12 × 2.5–4.5 mm, *curved*, glabrous, apex acute, triangular with curved sides in cross section; locules arranged in a triangular position, with the fertile one nearly of the same size as the 2 sterile locules. **Seeds** 6–10 × 1.5–3 mm; endosperm present.

**Vernacular name.** Sabah—*perepat burong* (Malay).

### Key to forms

Leaf apex obtuse with rounded or emarginate tip.....

forma **cuneatum**

Fig. 1A–F.

Synonyms: *E. burmanicum* Griff., Posth. Papers, Not. Pl. As. 4 (1854) 468, *t.* 581, fig. 3; *E. longistipulatum* Burck, Ann. Jard. Bot. Btzig. 11 (1893) 193; *E. bancanum* Burck *l.c.* 192, *t.* 16; *E. cuneatum* (Miq.) Kurz var. *bancanum* (Burck) O.E. Schulz. *l.c.* 148; *E. platyphyllum* Merr. *l.c.* (1908) 232.

Shrub or small tree to 5 m tall, 5 cm diameter. *Stipules lanceolate*, (2.5–)4–6(–7.5) mm long. Leaves obovate or elliptic to elliptic-lanceolate, (1.9–)3.5–9.5(–12) × (0.9–)1.9–4.5(–5.8) cm; *base cuneate, apex obtuse with emarginate or rounded tip*; lateral veins 8–12 pairs, (2–)3–9(–13) mm apart; petioles (2–)3–7(–9) mm long. Calyx lobes 0.5–1(–1.2) mm high, triangular. Fruits 8–10 × 2.5–4.5 mm. Seeds 6–8 × 1.5–3 mm.

Myanmar, Thailand, Indo-China, Sumatra (Banka and Riouw Islands), Peninsular Malaysia, Singapore, Anambas and Natuna Islands, Java (western part, Kangean), Borneo (Sabah only), Philippines, Lesser Sunda Islands (Sumbawa) and Maluku. Seasonal monsoon forest, lowland mixed dipterocarp forest, beaches; also (rarely) on mountain peaks and limestone. In Sabah, uncommon, found along beaches and on islands. No record from Sarawak, Brunei and Kalimantan.

Leaf apex acute with rounded or emarginate or rarely pointed tip.....

forma **sumatranum** (Miq.) R.C.K. Chung

Fig. 1G.

*l.c.* 71. Basionym: *E. sumatranum* Miq., Fl. Ned. Ind., Suppl. (1862) 200, 512. Type: *Teijsmann, s.n.* (= *L. sheet no.* 908.125–2056), Sumatra, Palembang, Ogan Ulu (holotype L; isotype BO). Synonyms: *E. densinerve* O.E. Schulz *l.c.* 142, Merrill *l.c.* (1921) 313, Masamune *l.c.* 357; *E. borneense* Merr., PEB (1929) 112, Masamune *l.c.* 357.

Trees to 40 m tall, 65 cm diameter. *Stipules triangular*, (2–)2.5–4(–5) mm long. Leaves elliptic to narrowly elliptic, lanceolate or rarely obovate, (2.8–)4.2–7.7(–10.2) × (0.9–)1.7–2.8(–3.2) cm; *base acute to obtuse, apex acute with rounded or emarginate or rarely acute tip*; lateral veins 8–15 pairs, (2–)3–7(–9) mm apart; petioles (2–)3–5(–7) mm long. Calyx lobes 0.5–1.2 mm high, triangular to lanceolate. Fruits 9–12 × 2.5–4 mm. Seeds 8–10 × 1.5–2.5 mm.

Sumatra, Borneo and the Philippines. In Borneo, found in mixed dipterocarp forest to

150 m; rather common in Sabah, but uncommon in Sarawak; also known in Kalimantan.

## 2. *Erythroxylum latifolium* Burck

Fig. 1H.

(Latin, *latus* = broad, *folium* = leaf)

*l.c.* 192; Merrill *l.c.* (1921) 313; Masamune *l.c.* 357; Chung *l.c.* 77. **Type:** *Teijsmann, s.n.*, Sumatra, Lingga (holotype BO). **Synonyms:** *E. latifolium* Burck var. *angustatum* O.E. Schulz *l.c.* 144; *E. latifolium* Burck var. *longipetiolatum* Boerl. & Koord., *l.c.* Bog. 1 (1897) t. 6; *E. cuneatum* (non (Miq.) Kurz) Payens *l.c.* 549, *p.p.*, *quoad syn. E. latifolium, incl. var. angustatum* O.E. Schulz *et var. longipetiolatum* Boerl. & Koord.

Shrub or small tree to 6 m tall. Twigs brown to grey-brown. *Stipules triangular*, (2.5–)3–3.5(–4) mm long. **Leaves chartaceous or thin-coriaceous**; elliptic or rarely obovate, (5.5–)6.2–13(–17) × (2.5–)2.8–5.7(–6.4) cm; base cuneate to acute, *apex acute with rounded or pointed tip, sometimes cuspidate or rarely obtuse with rounded or emarginate tip*; midrib sunken above, lateral veins 9–14 pairs, (3–)5–13(–16) mm apart, intercostal veins distinct, slightly prominent below, faint above; *petioles (3–)4–8(–10) mm long, 0.8–1.5 mm thick, glabrous*. **Flowers in clusters of 2–4**; pedicels 5–6 mm long, 0.8–1 mm thick, glabrous; *calyx lobes 1–1.2 mm high, triangular*; petals 5; stamens 10, *staminal tube shorter than or at most as long as the calyx lobes*. **Fruits broadly obovoid, 9–12 × 4.5–8 mm, not curved, glabrous, apex acute, triangular with curved sides in cross-section; locules arranged in a triangle, with the fertile one nearly of the same size as the 2 sterile locules.** **Seeds 7–9 × 3–5 mm; endosperm present.**

**Distribution.** Sumatra (including Banka, Billiton, and Lingga), Anambas and Natuna Islands, and Borneo. In Sarawak, known from Baram, Marudi FR, Lambir Hills NP and Sg. Dalam FR in the 4th Div. and from the Lassa Protected Forest in the 6th Div. Not yet recorded from Sabah; also found in Brunei.

**Ecology.** Lowland mixed dipterocarp, *kerangas* and peat swamp forests, to 20 m.

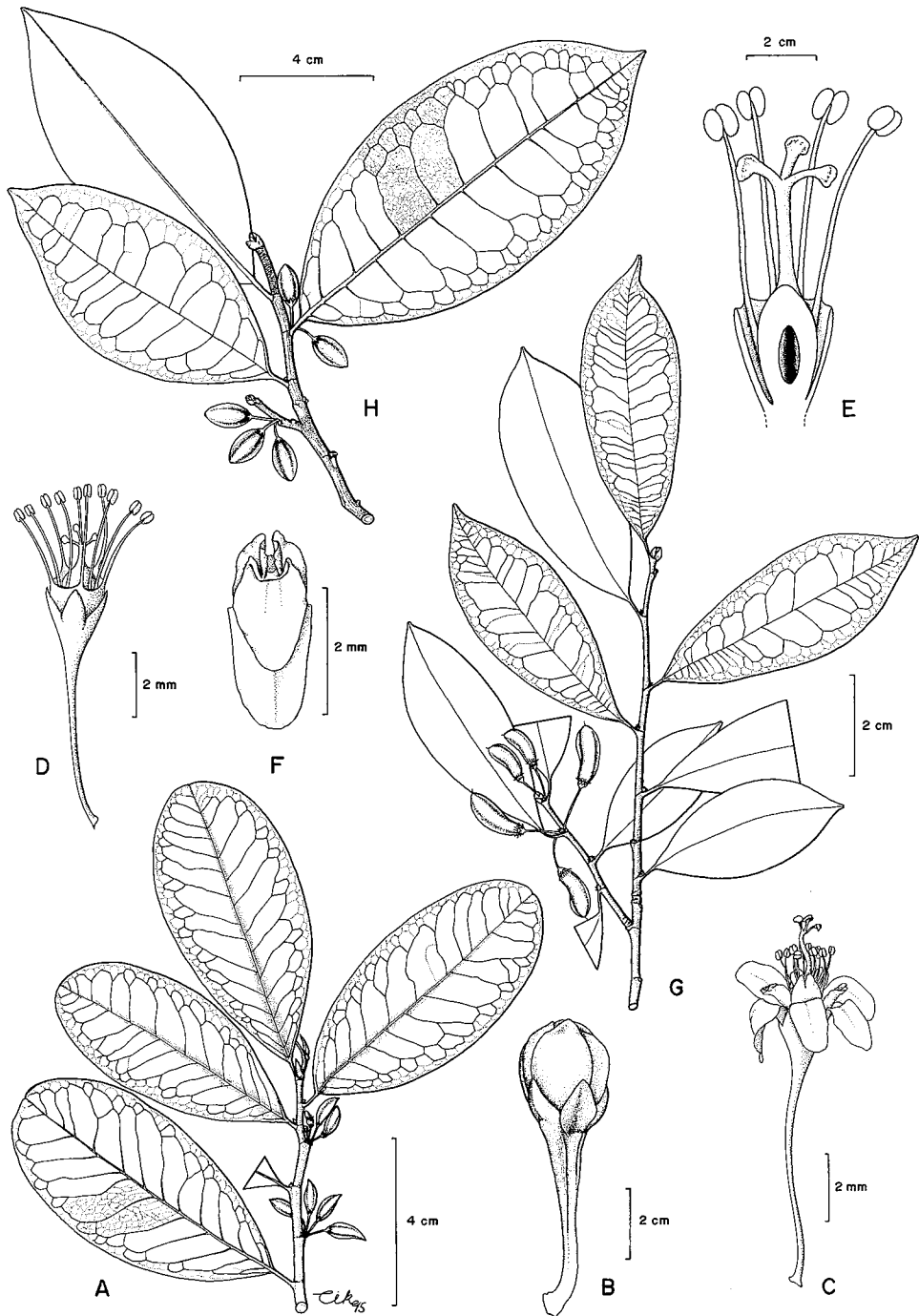
## 3. *Erythroxylum sarawakanum* R.C.K. Chung

Fig. 2A–G.

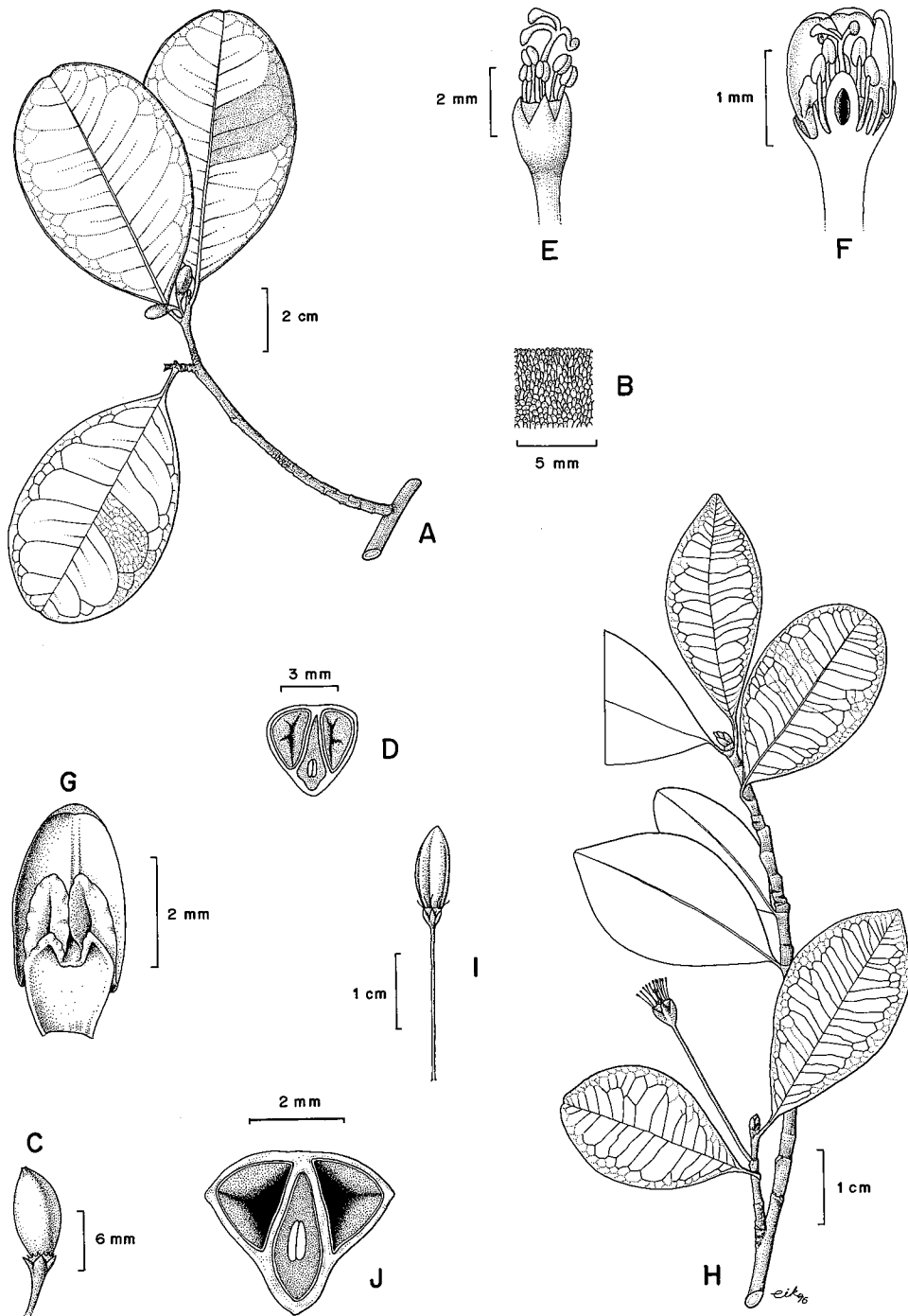
(of Sarawak)

*l.c.* 78. **Type:** *Ilias S. 17894*, Borneo, Sarawak, Bako National Park (holotype SAR; isotypes A, BO, K, L, SAN, SING).

Shrub or treelet to *c.* 5 m tall, 4 cm diameter. Twigs grey-brown. *Stipules triangular, 2–2.5 mm long*. **Leaves thick-coriaceous**, drying brown and glabrous above, *pruinose below*; obovate or elliptic, (4.3–)5.5–9(–10.5) × (2.2–)2.8–5(–5.5) cm; base broadly cuneate to acute, *apex obtuse with emarginate tip*; midrib sunken above, lateral veins (6–)8–12 pairs, (4–)7–12(–13) mm apart, intercostal veins distinctly prominent above, faint below; *petioles (6–)7–10(–12) mm long, 1–2 mm thick, glabrous*. **Flowers in clusters of 2–4**; pedicels 4–5 mm long, *c.* 0.5 mm thick, glabrous; *calyx lobes 1.4–1.8 mm high, triangular*; petals 5; stamens 10, *staminal tube shorter than or at most as long as the calyx lobes*. **Fruits ellipsoid, 9 × 3.5–4 mm, glabrous, with a rounded top, triangular with curved sides in cross-section; locules arranged in a triangle,**



**Fig. 1.** *Erythroxylum cuneatum* forma *cuneatum* (A–C, F), forma *sumatranum* (D–E, G); *E. latifolium* (H). A, fructing leafy twig; B, flower bud; C, long-styled flower with equal stamens; D, short-styled flower with equal stamens, petals removed; E, longitudinal section through flower, with petals removed; F, posterior clawed petal with 3-lobed ligule-like appendage; G–H, fructing leafy twig. (A from SAN 107458, B from S. 12753, C and F from KKSS 417, D–E and G from SAN 30377, H from S. 25076.)



**Fig. 2.** *Erythroxylum sarawakanum* (A–G); *E. iwahigense* forma *calcicola* (H–J). A, fruiting leafy twig; B, detail of lower leaf surface; C, fruit; D, fruit in cross-section; E, mature flower bud with petals removed; F, flower bud in longitudinal section; G, posterior clawed petal with 3-lobed ligule-like appendage; H, flowering leafy twig; I, fruit; J, fruit in cross-section. (A–D from *S.* 17894, E–G from *S.* 73603, H–J from *S.* 39898.)

with 2 sterile ones as large as the fertile one, *seldom curved*. **Seeds** 6–8 × 2.5–3 mm; endosperm present.

**Distribution.** Endemic to Sarawak. So far known only from a few collections from Bako National Park (*S. 17894*, *S. 10324*, *S. 73601*), Mt. Matang (*Clemens 22354*) and Mt. Santubong (*S. 37668* and *S. 73603*).

**Ecology.** Lowland to hill forest, to c. 700 m.

**Notes.** *E. sarawakanum* differs from *E. latifolium* in its thick-coriaceous leaves, which are obovate or elliptic, obtuse at the apex and with a emarginate tip; longer calyx lobes (1.4–1.8 mm long), and ellipsoid fruits (up to 4 mm wide).

## IXONANTHACEAE

**Runi S. Punga**

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Exell & Mendonça, Bol. Soc. Brot. 25 (1951) 105; Forman, Kew Bull. 19 (1965) 521; Hutchinson, Gen. Fl. Pl. 2 (1967) 592; Anderson, CLTS (1980) 219; van Hooren & Nootboom, Blumea 29 (1984) 550; Kool, FM 1, 10 (1988) 621; Brummitt, Vasc. Pl. Fam. & Gen. (1992) 589.

Trees or shrubs. *Indumentum* of simple hairs. **Stipules** lateral, minute, scale-like, caducous. **Leaves** simple, pinnately veined, alternate or spirally arranged. **Inflorescences** axillary, dichasially corymbose cymes, lax or fascicled racemes, or panicles of racemes; bracts small, caducous; pedicels articulate at the base or to the middle. **Flower** perigynous, bisexual, 5-merous, radially symmetrical; sepals 5, shortly connate at base, lobes imbricate in bud; petals 5, free, imbricate or contorted in bud, *persistent in fruit*; stamens 10 or (15–)25, filaments inserted outside and against the disc, irregularly coiled in bud, anthers basifixed or dorsifixed, 2-locular; ovary 2–5-locular, ovules 2 or 1 in each locule; style 1, *simple*. **Fruit** a septicidal coriaceous capsule, 5-locular, valves often spuriously septate, either with or mostly without a central axis, occasionally apically bifid. **Seeds** 1 or 2 per locule, *with a wing or with a suprahilar arillode*; endosperm fleshy or spongy.

**Distribution.** Three (or possibly five) genera, distributed in the tropical and subtropical regions of the Old World, Australia and the Pacific Islands. In Sabah and Sarawak, one genus (*Ixonanthes*).

**Taxonomy.** The family is closely allied to the Ctenolophonaceae and the Linaceae. It differs from the Ctenolophonaceae in its indumentum consisting of simple hairs, lateral stipules, spirally arranged leaves, perigynous flowers, persistent petals in fruits, intrastaminal disc, simple style, and seeds that have a prominent basal wing or suprahilar arillode. From the Linaceae, it differs in its perigynous flowers, persistent petals in fruits, free filaments inserted outside the disc, single style, capsular fruit, and seeds with a basal wing or suprahilar arillode. Forman (*l.c.*) described *Allantospermum* from Borneo and assigned it to the Ixonanthaceae. Nootboom (*Adansonia* 2, 7 (1967) 161; FM 1, 6 (1972) 970) and Kool (*l.c.*), however, excluded the genus from the Ixonanthaceae and included it in the Simaroubaceae, and recognised three genera, *viz.* *Cyrillopsis* (from S America), *Ochthocosmus* (from tropical America and Africa) and *Ixonanthes* (from Indo-Malesia), in the family. Their decision is followed in the present account.



## IXONANTHES Jack

(Greek, *ixos* = birdlime, *anthos* = flower; the sticky flowers)

Mal. Misc. 2, 7 (1822) 51; Merrill, EB (1921) 313; Ridley, FMP 1 (1922) 324; Hallier, Beih. Bot. Centralbl. 39 (1923) 6; Masamune, EPB (1942) 356; Burgess, TBS (1966) 247; Cockburn, TFM 1 (1972) 307, TS 1 (1972) 205; Anderson, CLST (1980) 219; Kool, Blumea 26 (1980) 191, FM 1, 10 (1988) 622; Corner, WSTM 3rd ed. 1 (1988) 255; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990).

Trees or treelets growing monopodially in flushes, often with steep and sharp buttresses; branches ascending. **Bark** grey-brown, smooth or finely fissured and lenticellate; inner bark dark reddish brown, fibrous. **Sapwood** cream to pale yellow; heartwood dark purplish brown. **Leaves** spirally arranged, thin- to thick-coriaceous; base cuneate, *margin entire or remotely serrate*, apex obtuse or often emarginate, drying dark-brown; midrib sunken on the upper surface, raised on the lower surface; lateral veins faint or distinctly raised on both surfaces; *intercostal veins finely and irregularly reticulate*; petioles swollen at the base, grooved on the adaxial side, drying blackish. **Flowers** in long-stalked, dichasially corymbose cymes; young buds often sticky or resinous; stamens 10 or (15–)20 in one whorl, subpersistent in fruit; disc annular or cup-shaped, *intrastaminal*; ovary 5-locular; ovules 2 in each locule, placentation axile; stigmas discoid. **Fruits** ellipsoid, apiculate, thinly woody, smooth. **Seeds** with a firm testa; endosperm spongy, oily; embryo straight.

**Vernacular names.** Sarawak—*inggir burung* (Malay, Iban), *kayo mupa* (Berawan), *kayu mup* (Penan Tutoh), *meridian* (Bidayuh), *pagar anak* (Malay).

**Distribution.** Three species in continental SE Asia and Malesia (except Java and Lesser Sunda Islands); 2 species in Borneo.

**Ecology.** In primary and secondary forests on hillsides, ridges and slopes, also in *kerangas* forest, from sea level to 800 m.

**Taxonomy.** The genus has been divided (Hallier *l.c.*, Kool *l.c.*) into two sections, *viz.* section *Brewstera* represented by *I. icosandra* which does not occur in Borneo, and section *Ixonanthes* represented by *I. petiolaris* and *I. reticulata*. Section *Brewstera* differs from section *Ixonanthes* in its shorter petioles (2–3 mm), slightly glandular, serrate leaf margins, sub-4-whorled branching of the peduncles, each flower with (15–)20 stamens, and seeds with suprahilar arillode.

### Key to *Ixonanthes* species

Leaves thin-coriaceous; lateral and intercostal veins faint on the lower leaf surface. Inflorescences dense. Styles 1.5–2.5 mm long. Fruits 1.3–2 cm long; valves ultimately apically bifid. Seeds 10–13 × 3–4 mm.....**1. *I. petiolaris***

Leaves thick-coriaceous; lateral and intercostal veins prominent on the lower leaf surface. Inflorescences lax. Styles 15–20 mm long. Fruits 2–4.5 cm long; valves never apically bifid. Seeds 18–20 × 4–9 mm.....**2. *I. reticulata***

**1. *Ixonanthes petiolaris* Blume**

Fig. 1.

(Latin, *petiolaris* = with a well-developed stalk; the leaves)

Mus. Bot. Lugd. Bat. 1 (1852) 396; Cockburn *l.c.* (1976) 207; Kool *l.c.* (1980) 199, *l.c.* (1988) 626; Whitmore, Tantra & Sutisna *l.c.* 209. **Type:** *Praetorius*, *s.n.* (= *L. sheet no. 908. 126–1336*) (L). **Synonyms:** *I. multiflora* Stapf ex Ridl., Kew Bull. (1930) 75, Masamune *l.c.* 356, Anderson *l.c.* 220; *I. philippinensis* Elmer, Leafl. Philip. Bot. 10 (1930) 3758.

Tree to 45 m tall, 50 cm diameter; bole deeply fluted. **Bark** smooth, with numerous lenticels, pale brown to yellowish brown or black, flaky and minutely ridged. **Leaves** *thin-coriaceous*, elliptic to obovate, 6–15 × 3–7.5 cm; base acute, apex slightly obtuse; *lateral and intercostal veins rather faint on lower leaf surface*; petioles 14–20 mm long. **Inflorescences** *dense*; peduncles 3.5–7 cm long; pedicels *c.* 5 mm long. **Flowers** at anthesis 1.5–3 × 1–2.5 mm; sepals elliptic to orbicular, 1–1.5 × 1–1.5 mm (in fruit fleshy and enlarging to 1.5–2 mm), thickened at base, margins with a *c.* 1.5-mm-wide transparent band, apex rounded; petals elliptic-orbicular, 2–2.5 × 1–1.5 mm (in fruit chartaceous and enlarging to 2.5–3 × 1.5–2 mm), thickened at base, margins with a narrow transparent band, apex rounded; stamens 10, filaments to 15 mm long; ovary depressed globose, *style 1.5–2.5 mm long*. **Fruits** ellipsoid, 1.3(–2) × 0.8(–1.2) cm; *valves apically bifid*. **Seeds** 10–13 × 3–4 mm, with basal wing.

**Vernacular name.** Sabah—*pagar anak* (Malay).

**Distribution.** Thailand, Sumatra, Peninsular Malaysia, Borneo, Philippines and Sulawesi. In Sabah and Sarawak, fairly common; also in Kalimantan.

**Ecology.** In primary and secondary forests on slopes and ridges; from sea level to 800 m.

**Uses.** The timber is used in minor construction.

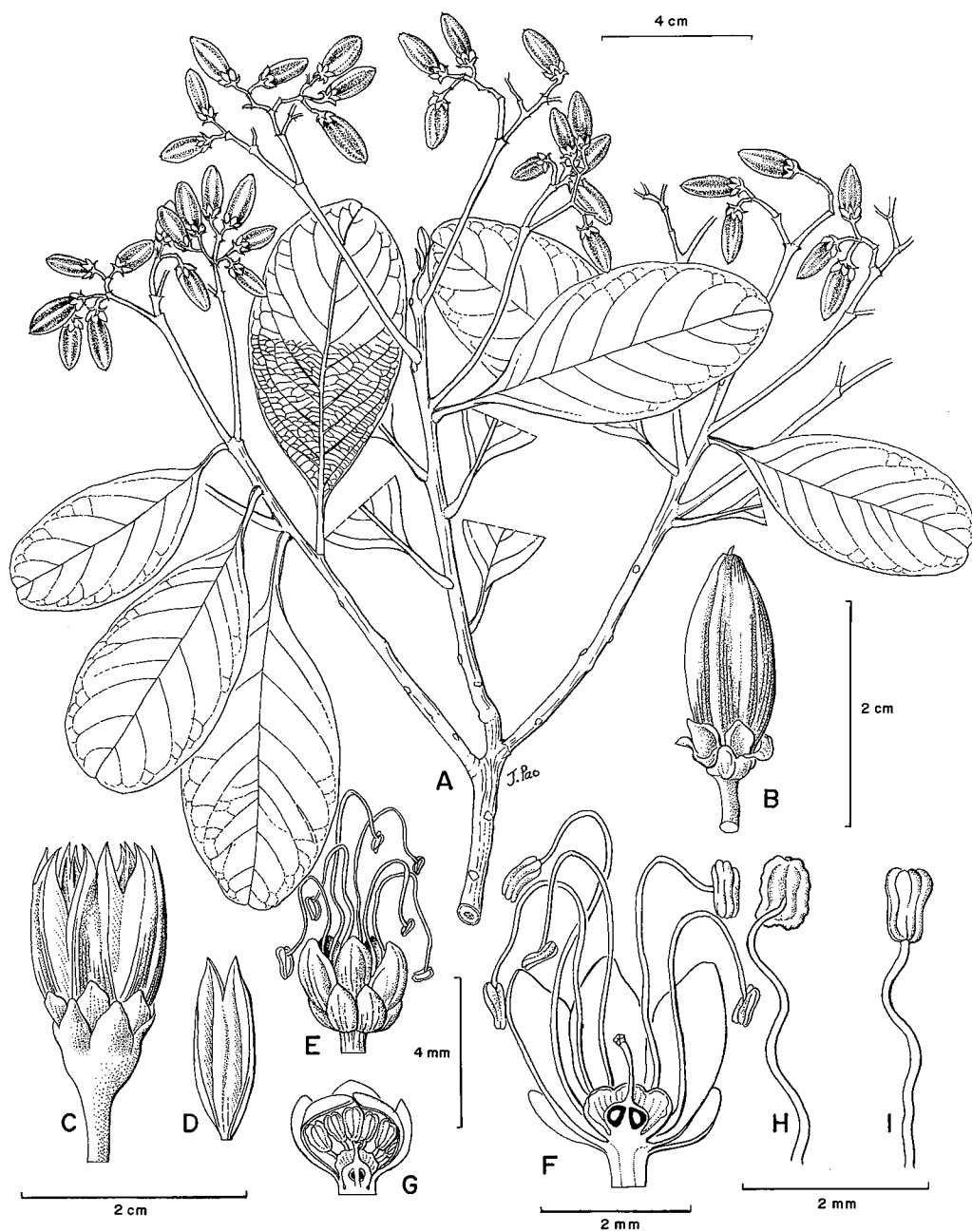
**2. *Ixonanthes reticulata* Jack**

Fig. 2.

(Latin, *reticulatus* = net-like; the leaf intercostal veins)

*l.c.* 51; Ridley *l.c.* (1922) 326; Hallier *l.c.* 9; Masamune *l.c.* 357; Browne, FTSB (1955) 175; Cockburn *l.c.* (1972) 307, *l.c.* (1976) 206; Kool *l.c.* (1980) 200, *l.c.* (1988) 626; Corner *l.c.* 256; Whitmore, Tantra & Sutisna *l.c.* 209. **Type:** *Jack, s.n.*, Sumatra, Tapanuli (L). **Synonyms:** *I. grandiflora* Hochr., Pl. Bog. Exsicc. (1904) 39, Merrill *l.c.* 313, Masamune *l.c.* 356; *I. beccarii* Hallier *l.c.* 10, Anderson *l.c.* 220; *I. crassifolia* Hallier *l.c.* 10, Cockburn *l.c.* (1976) 206; *I. grandifolia* Ridl. *l.c.* (1930) 74, Masamune *l.c.* 356.

Tree to 35 m tall, 30 cm diameter; bole straight and fluted; buttresses narrow, small. **Bark** smooth, slightly fissured, scaly or cracked, pink, yellowish brown, fawn or grey to blackish. **Wood** white, hard. **Leaves** *thick-coriaceous*, elliptic to obovate, 5.5–14 × 3–10 cm; base cuneate, apex obtuse or emarginate; *lateral and intercostal veins raised and prominent on both surfaces, intercostal veins distinctly reticulate*; petioles 10–20 mm long. **Inflorescences** *lax*; peduncles 2.5–14 cm long; pedicels 0.5–1.5 cm long; sepals elliptic to linear-elliptic, 4–8 × 3–4 mm; petals elliptic-orbicular, 4–10 × 3–6 mm; stamens 10, filaments to 20 mm long; ovary globose, *style 20–25 mm long*. **Fruits** ellipsoid, 2–4.5 cm long, *valves not apically bifid*, septa after fruit-dehiscence persistently connate with the adjacent one. **Seeds** 18–20 × 4–9 mm, with basal wing.



**Fig. 1.** *Ixonanthes petiolaris*. A, fruiting leafy twig; B, fruit; C, open fruit; D, fruit valve; E, flower; F, longitudinal section of flower; H and I, stamens. (A–B from SAN 50411, C–D from SAN 44751, E–I from SAN 40370.)

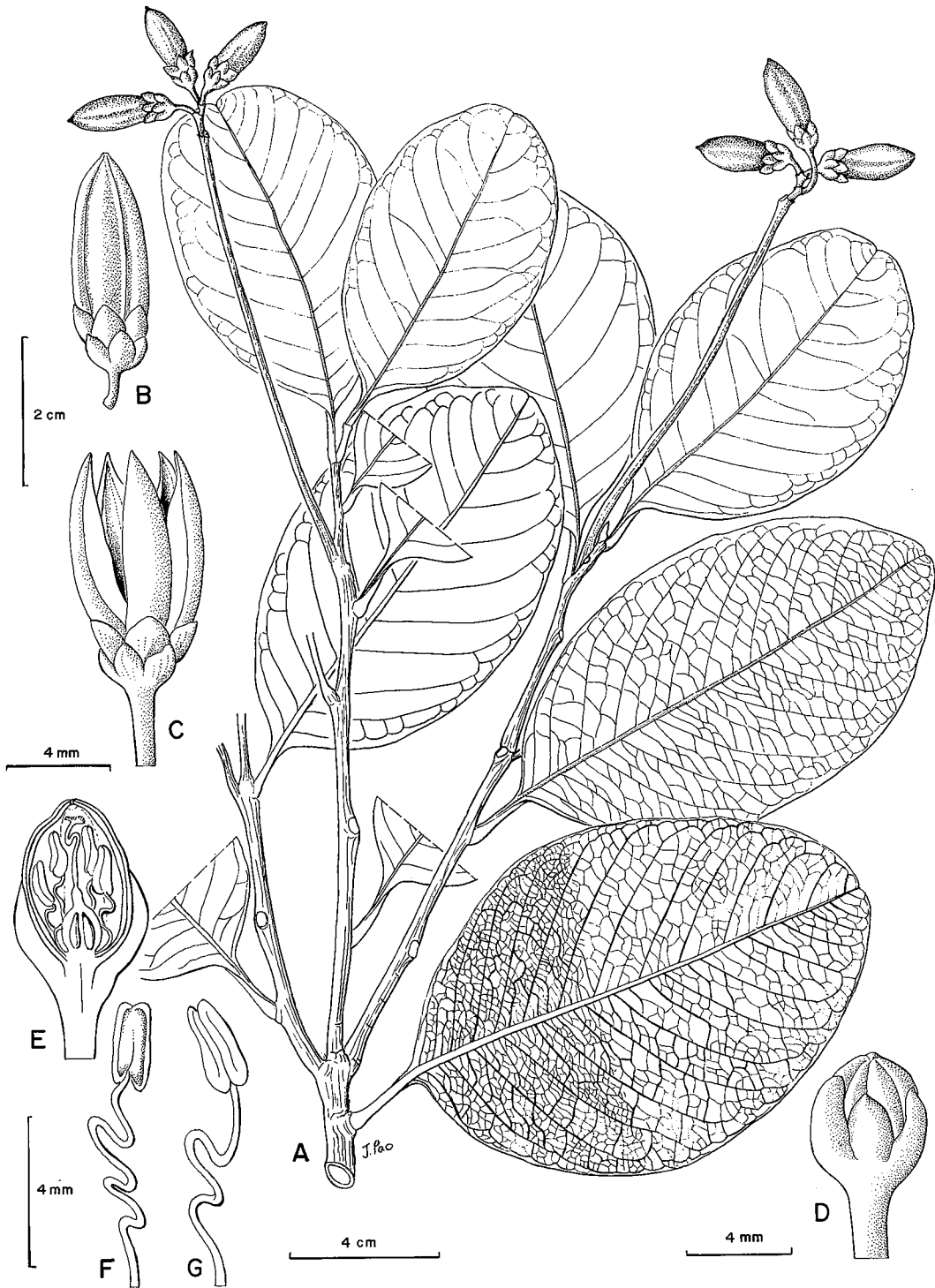


Fig. 2. *Ixonanthes reticulata*. A, fruiting leafy twig; B, fruit; C, open fruit; D, flower bud; E, flower bud in longitudinal section; F-G, stamens. (A from S. 34367, B from SAN 73585, C from SAN 39762, D-G from S. 13482.)

**Vernacular name.** Sabah and Sarawak—*inggir burung* (Malay, Iban).

**Distribution.** India, Myanmar, Vietnam, S China, Hong Kong, Sumatra, Peninsular Malaysia, Borneo, Philippines, Sulawesi, and New Guinea. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary forests on hillsides and ridges; also in *kerangas* and swamp forests, from sea level to 2400 m.

**Uses.** The timber is utilised for minor construction and firewood.

## LEEACEAE

### A. Latiff

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Dumort., Anal. Fam. Pl. (1829) 27; Ridsdale, Blumea 22 (1974) 57, FM 1, 7 (1976) 755.

A monogeneric family closely allied to the Vitaceae in the order Rhamnales, separated because of the development of a complex staminodial tube joined to the corolla, the ovary locules that each have a single ovule, and pollen morphology (Ridsdale *l.c.* 1974).

### LEEA van Royen *ex L.*, *nom. cons.*

(James Lee, 1715–1795, a Scottish gardener)

*mali-mali* (Malay)

Syst. Nat. ed. 12, 2 (1767) 627; Merrill, EB (1921) 368; Ridley, FMP 1 (1922) 483; Masamune, EPB (1942) 439; Suessenguth in Engler & Prantl, Nat. Pfl. Fam. 2, 20d (1953) 382; Backer & Bakhuizen *f.*, FJ 2 (1965) 93; Ridsdale *l.c.* (1974) 74, *l.c.* (1976) 755; Anderson, CLTS (1980) 134; Corner, WSTM 3rd ed. 2 (1988) 757; Latiff, TFM 4 (1989) 480.

Trees, erect or creeping shrubs, scramblers, or herbaceous plants with woody base; stems with spines or unarmed. **Leaves** *compound*, 1–3-foliolate or 1–4-pinnate, usually imperfectly pinnate with terminal leaflets; *petioles expanded to form a stipular structure surrounding the stem apex*; stipules narrowly sheathing and subpersistent or large and caducous; leaflets glabrous or pubescent, *lower surface often with pearl-glands, margin serrate or crenate*. **Inflorescence** a cyme, lax or condensed, axillary or seemingly terminal, distinctly stalked. **Flowers** *bisexual, radially symmetrical, 4–5-merous*; calyx bell-shaped, lobes triangular; corolla lobes valvate in bud, *apical part of each lobe joined into a keel*, reflexed at maturity, *basal part joined to each other and to the androecium*; *staminodial tube consisting of thickened parts representing the filaments and thin parts or sinuses between the filaments, the tube joined to the corolla above the base, but free above and below this point*, anthers introrse; ovary discoid, *4–10-locular, each locule with one ovule*, style short, entire, stigma slightly thickened. **Fruit** a berry, depressed subglobose. **Seeds** triangular-ovoid in cross-section; *endosperm simply ruminant*; embryo linear.

**Distribution.** About 32 species; from Africa and Madagascar to SE Asia, Malesia, Micronesia, Melanesia and Australia. In Sabah and Sarawak, represented by 7 species, of which only 5 reach tree-size.

**Ecology.** Quite common in a variety of habitats from beach vegetation to montane forest, but mostly found in lowland secondary vegetation. The flowers are pollinated by flies, while the fruits are dispersed by birds.

**Uses.** Members of the genus do not reach timber size. Locally, some species are used in traditional medicine. Some Dusun groups in Sabah utilise leaves of *Leea* for scaring off evil spirits from entering the house.

### Key to *Leea* species

1. Stems and main branches spiny.....2  
    Stems and main branches not spiny.....3
2. Plant single-stemmed. Leaves 1-pinnate. Inflorescences glabrous. Fruits 10–15 mm in diameter.....**1. *L. aculeata***  
    Plant many-stemmed. Leaves 2- or 3–4-pinnate. Inflorescences pubescent. Fruits 7–10 mm in diameter.....**3. *L. angulata***
3. Leaves 1-pinnate.....  
    ***Leea amabilis* Veitch ex Masters**  
    Gard. Chron. 27 (1882) 492; Masamune *l.c.* 439; Suessenguth *l.c.* 385; Ridsdale *l.c.* (1976) 765.  
    Treelet to 2 m tall. Flowers 5-merous, white. Fruits deeply grooved between segments, 18–20 mm in diameter.  
    Uncommon and endemic to Sarawak.  
    Leaves 2- to 4-pinnate.....4
4. Stipules resembling narrow wings, subpersistent, scars long and thin. Leaflets without pearl-glands. Flowers red.....  
    ***Leea rubra* Blume ex Spreng.**  
    Syst. Veg. 1 (1824) 670; Merrill *l.c.* (1921) 396; Ridley *l.c.* 485; Burkill, EPMP (1935) 1327; Masamune *l.c.* 439; Suessenguth *l.c.* 383; Ridsdale *l.c.* (1976) 776; Latiff *l.c.* 482; Corner *l.c.* 757.  
    Shrub to 3 m tall. Leaves 2–4-pinnate. Inflorescences rusty pubescent. Flowers 5-merous, bright red. Fruits dark red, *c.* 8 mm diameter.  
    India, Bangladesh, Myanmar, Thailand, Cambodia, Laos, Vietnam, throughout Malesia and Australia. In Borneo, known only from Sabah.  
    Stipules obovate, caducous, leaving broad-triangular scars. Leaflets with pearl-glands. Flowers reddish orange or greenish white.....5
5. Young twigs and stipules densely pubescent. Inflorescence and leaflets with large, conspicuous, light brown pearl-glands.....**2. *L. aequata***  
    Young twigs and stipules glabrous or only sparsely pubescent. Inflorescences and leaflets with small, inconspicuous, caducous pearl-glands.....6
6. Leaves 2-pinnate; leaflet margin wavy to finely serrate. Flowers reddish orange.....  
    .....**4. *L. guineensis***

Leaves 3-pinnate; leaflet margin crenate or coarsely serrate to shallowly dentate. Flowers greenish white.....**5. *L. indica***

**1. *Leea aculeata* Blume ex Spreng.**

Fig. 1.

(Latin, *aculeatus* = prickly; the stems and branches)

*l.c.* 670; Merrill *l.c.* (1921) 368, PEB (1929) 183; Masamune *l.c.* 439; Suessenguth *l.c.* 383; Backer & Bakhuizen *f. l.c.* 93; Ridsdale *l.c.* (1976) 773; Anderson *l.c.* 134. **Type:** *Blume, s.n.*, Java, Mt. Salak (L). **Synonym:** *L. sandakanensis* Ridl., Kew Bull. (1931) 499, Masamune *l.c.* 439, Suessenguth *l.c.* 386.

*Single-stemmed shrub or small tree to 10 m tall; trunk and main branches with spines. Stipules forming very narrow wings, c. 2 × 0.5 cm, scars of similar length. Leaves 1-pinnate; rachis 8–15 cm long; petioles 2–6 cm long. Leaflets 5–9, glabrous, thin-coriaceous, pearl-glands globose, black; elliptic to elliptic-oblong, occasionally ovate to ovate-oblong, 10–18 × 4–7 cm; base rounded to cuneate, margin infrequently serrulate, apex long-acuminate; lateral veins 6–12 pairs; petiolules to 2 cm long. Inflorescences 8–16 cm long, broad and many-branched, glabrous; bracts triangular, to c. 3 × 2 mm; peduncles 2–8 cm long. Flowers 5-merous, greenish white; calyx enclosing the corolla, c. 3 × 3 mm, glabrous, lobes c. 2 × 1 mm; corolla tube and staminodial lobes c. 4 mm long; corolla lobes c. 3 × 2 mm; staminodial tube c. 3.5 mm long, upper free part c. 1.5 mm long, lobes slightly cleft, sinuses shallow, lower free part 1.5–2 mm long, extending downwards to the ovary; free part of filaments c. 1 mm long, anthers c. 1 mm across; ovary 4–6-locular, style c. 2 mm long. Fruits 10–15 mm diameter, shallowly grooved, blue-black. Seeds usually 6, c. 8 × 4 mm.*

**Vernacular names.** Sabah—*togunumali* (Dusun Kinabatangan). Sarawak—*kamali, kemali* (Iban), *mali-mali* (Malay), *teloyang* (Berawan).

**Distribution.** Sumatra, W Java, Borneo, Philippines, Sulawesi, Maluku and Irian Jaya. Common throughout Sabah, less common in Sarawak.

**Ecology.** Widespread in secondary vegetation, particularly in riverine areas.

**Notes.** In Sabah and Sarawak, there are two species with spines. Unlike *L. angulata*, the spines in this species are found only on the trunk and main branches.

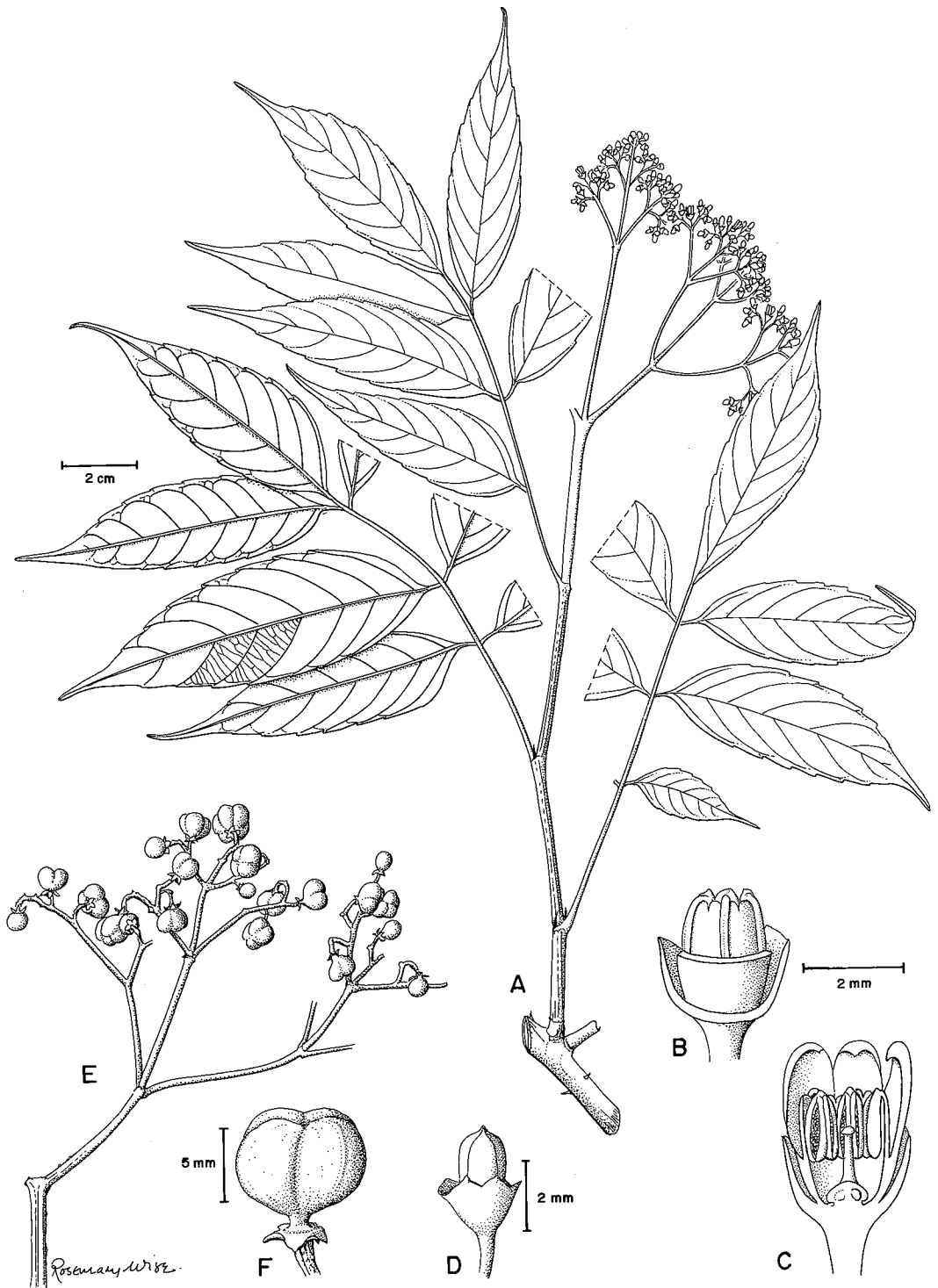
**2. *Leea aequata* L.**

(Latin, *aequatus* = watery; the soft fruits)

Syst. Nat. ed. 12, 2 (1767) 627; King, J. As. Soc. Beng. 65, 2 (1896) 419; Winkler, Bot. Jahrb. 44 (1910) 537; Merrill *l.c.* (1921) 368; Ridley *l.c.* (1922) 486; Masamune *l.c.* 429; Corner *l.c.* 757; Suessenguth *l.c.* 388; Backer & Bakhuizen *f. l.c.* 94; Ridsdale *l.c.* (1976) 775; Anderson *l.c.* 134; Latiff *l.c.* 481. **Type:** *Herb. Linn. 1118: 1* (LINN).

Shrub, treelet or less frequently small tree to 8 m; *stems and main branches not spiny; young twigs usually densely pubescent. Stipules obovate, c. 4 × 3 cm, sparsely to densely pubescent, caducous, scars broad-triangular, 2–3 cm long. Leaves 2–3-pinnate; rachis 7–20 cm long, petioles 8–14 cm long, usually pubescent. Leaflets 5 to numerous, chartaceous, glabrous to*





**Fig. 1.** *Leea aculeata*. A, flowering leafy twig; B, cut flower bud showing the staminodial tube; C, longitudinal section of flower; D, young fruit; E, infructescence; F, fruit. (A–C from S. 45409, D–F from SAN 113617.)

pubescent on the veins above, sparsely to densely pubescent beneath, *pearl-glands rounded to disc-shaped, light brown, large and conspicuous*; ovate to ovate-lanceolate or elliptic to elliptic-lanceolate, 10–20 × 4–6 cm; base cuneate to truncate, sometimes subcordate or asymmetric, margins serrate, apex acuminate to long-acuminate; lateral veins 8–12 pairs, usually densely pubescent; petiolules 5–15 mm long, hairy. **Inflorescences** 6–15 cm long, rusty pubescent, *covered with large, conspicuous, light brown pearl-glands*; bracts ovate, c. 6 × 5 mm, conspicuous; peduncles 2–4 cm long, lateral and ultimate branches rather short, sometimes condensed. **Flowers** 5-merous, *greenish white*; calyx c. 4 × 4 mm, glabrous to densely pubescent, usually with pearl-glands, lobes c. 1 × 2 mm; corolla tube and staminodial lobes c. 2 mm long; corolla lobes c. 2 × 1 mm; staminodial tube 1.5–2 mm long, upper free part c. 1.5 mm long, lobes deeply emarginate, sinuses shallow, to 0.5 mm deep, lower free part 0.2–0.4 mm long; free part of filaments c. 1 mm long, anthers c. 1 mm across; ovary 4–7-locular, style 1, c. 0.5 mm long. **Fruits** 9–12 mm diameter, red. **Seeds** 6, 4–6 mm across.

**Distribution.** India, Bhutan, Nepal, Bangladesh, Andaman Is., Myanmar, Thailand, Cambodia, Laos, Vietnam, throughout Malesia except New Guinea; uncommon in Sabah and Sarawak.

**Ecology.** In secondary vegetation.

### 3. *Leea angulata* Korth. ex Miq.

(Latin, *angulatus* = angular; the branches and twigs)

Ann. Mus. Bot. Lugd. Bat. 1 (1863) 97; King *l.c.* 414; Ridley *l.c.* (1922) 485; Corner *l.c.* 757; Backer & Bakhuizen *f. l.c.* 94; Ridsdale *l.c.* (1976) 772; Latiff *l.c.* 481. **Type:** *Korthals, s.n.*, Java, Kerawang (L).

Weak straggler, bushy shrub, or tree to 10 m tall, frequently *many-stemmed* and suckering; *trunk, main and ultimate branches with whitish triangular spines*. **Bark** smooth, inner bark pale. *Stipules forming narrow wings, c. 2 × 2 cm, usually extending the whole length of the petioles, scars narrow*. **Leaves** 2- or 3–4-pinnate; rachis 14–18 cm long; petioles c. 4–6 cm long. Leaflets numerous, glabrous, pearl-glands rounded, caducous; elliptic to elliptic-lanceolate or ovate to ovate-lanceolate, c. 10 × 4 cm; base rounded to cuneate, margin crenate, less frequently shallowly serrate, apex acuminate; lateral veins 4–8 pairs, often with pubescent domatia, rarely sparsely pubescent along the whole length; petiolules to 8 mm long. **Inflorescences** to 20 cm long, broad, many-branched, *pubescent*; bracts triangular to narrowly triangular, to c. 3 × 2 mm; peduncles 4–7 cm long, main branches long, ultimate branches lax. **Flowers** 5-merous, greenish white; calyx c. 2 × 2 mm, pubescent, lobes c. 1 mm long; corolla tube and staminodial lobes c. 4 mm long; corolla lobes c. 2 × 1 mm; staminodial tube c. 2 mm long, upper free part 1.2–1.5 mm long, lobes obtuse, sinuses shallow, lower free part c. 0.5 mm long; free part of filaments c. 1.5 mm long, anthers c. 1.5 mm across; ovary 6-locular, style c. 2 mm long. **Fruits** 7–10 mm diameter, greyish blue. **Seeds** usually 6, c. 5 × 3 mm.

**Vernacular name.** Sabah—*mali-mali* (Malay).

**Distribution.** Nicobar Is., Thailand and Malesia. In Sabah, it has been recorded from the Tawau, Semporna and Sandakan districts.

**Ecology.** Uncommon in secondary vegetation in the east coast of Sabah, especially in logged-over forest.

#### 4. *Leea guineensis* G. Don

(of Guinea)

Gen. Hist. 1 (1831) 712; Ridsdale *l.c.* (1974) 92, *l.c.* (1976) 777; Latiff *l.c.* 481. **Type:** *G. Don, s.n.* (BM). **Synonym:** *L. javanica* (non Blume) Miq., Ann. Mus. Bot. Lugd. Bat. 1 (1863) 100, Merrill *l.c.* (1921) 369, Masamune *l.c.* 439; *L. robusta* Ridl. *l.c.* (1922) 486.

Shrub with soft branches, to 5 m tall; *stems and main branches not spiny*. *Young twigs glabrous, rarely sparsely pubescent*. *Stipules obovate*, c. 12 mm broad, *caducous, glabrous, scars broad-triangular*. **Leaves** 2-pinnate; rachis to 50 cm long; *petioles 10–14 cm long*. Leaflets numerous, glabrous above, scabrous beneath, *pearl-glands small, inconspicuous*; elliptic-lanceolate to broadly elliptic, 8.3–19 × 4.5–10.8 cm; base obtuse, *margin wavy to finely serrate*, apex caudate; lateral veins 10–16 pairs. **Inflorescences** 3-forked cymes, c. 15 cm long, very dense, rusty pubescent, glabrescent, *covered with small, inconspicuous, caducous pearl-glands*; peduncles c. 3.5 cm long. **Flowers** 5-merous, *reddish orange*; calyx c. 3 × 2 mm, glabrous, lobes c. 1 × 1 mm; corolla tube and staminodial lobes 3–5 mm long; corolla lobes c. 3 × 2 mm; staminodial tube 2–3 mm long, upper free part 1–2.5 mm long, lobes shallowly retuse, notched or cleft, sinuses shallow; free part of filaments c. 1 mm long, anthers c. 1.5 mm across; ovary (4–)6(–8)-locular, style 1–2.5 mm long. **Fruits** 6-seeded, c. 10 mm diameter. **Seeds** c. 6 × 5 mm.

**Distribution.** Tropical Africa, India, Andaman Is., Myanmar, Thailand, Cambodia, Laos, Taiwan, Peninsular Malaysia, Sumatra, Java, Lesser Sunda Isl., Borneo, Sulawesi, New Guinea and Micronesia. In Borneo, known from Kalimantan and Sabah. In Sabah, it is confined to the Kota Marudu area.

**Ecology.** In secondary vegetation.

#### 5. *Leea indica* (Burm. f.) Merr.

(of India)

Philip. J. Sci. 14 (1919) 245, *l.c.* (1921) 368; Craib, Fl. Siam En. 1 (1926) 318; Masamune *l.c.* 439; Corner *l.c.* 758; Merrill & Perry, J. Arn. Arb. 22 (1941) 380; Ridsdale *l.c.* (1976) 779; Anderson *l.c.* 134; Latiff *l.c.* 482. **Basionym:** *Staphylea indica* Burm. f., Fl. Ind. (1786) 75, t. 23, f. 2. **Type:** *Burmans f.* (1986) t. 23, fig. 2, *description*. **Synonym:** *L. sundaica* Miq., Fl. Ind. Bat. 1, 2 (1859) 610, Merrill *l.c.* (1921) 369, Ridley *l.c.* (1922) 485, Masamune *l.c.* 439, Backer & Bakhuizen *f. l.c.* 94

Shrub or small tree, to 10 m tall, many- or single-stemmed, frequently stilt-rooted; *stems and main branches not spiny*; *young twigs glabrous*, rarely woolly or rough-hairy or pustulate or papillose. *Stipules obovate*, to 6 × 4 cm, *caducous, usually glabrous or sparsely pubescent*, rarely densely soft or bristly pubescent, *scars broadly triangular*, c. 4 cm long. **Leaves** 3-pinnate; rachis 15–30 cm long, glabrous to pubescent, rarely soft or bristly pubescent, or papillose; *petioles 8–20 cm long*. Leaflets glabrous to pubescent, rarely densely so or woolly, chartaceous to thin-coriaceous, *pearl-glands small, inconspicuous, caducous*, angular to

subglobose; broadly ovate, ovate-oblong to ovate-lanceolate, 8-30 × 3-16; base cuneate, rounded to subcordate, *margin crenate, serrate to shallowly dentate*, apex acute to acuminate; lateral veins 8-16 pairs; petiolules to 25 mm long, glabrous to pubescent. **Inflorescences** 10-40 cm long, usually broad and lax, rarely condensed, glabrous to pubescent, rarely soft or bristly pubescent or papillose, *pearl-glands small, inconspicuous, caducous*; bracts triangular to linear, to 8 mm long; peduncles to 15 cm long, lateral and ultimate branches numerous and spreading, rarely condensed. **Flowers** 5-merous, *greenish white*; calyx *c.* 3 × 2 mm, glabrous to pubescent, lobes *c.* 2 × 1 mm; corolla tube and staminodial lobes *c.* 3 mm long; corolla lobes *c.* 3 × 2 mm, staminodial tube 1.5-2.5 mm long, upper free part 1-2 mm long, lobes shallowly retuse, notched or cleft, sinuses shallow to 0.4 mm deep, rarely to 1 mm deep, lower free part *c.* 0.5 mm long; free part of filaments *c.* 1.5 mm long, anthers *c.* 1 mm across; ovary 4-8-locular, style *c.* 2 mm long. **Fruits** 6-10 mm across, purple-black. **Seeds** 6, *c.* 5 × 4 mm.

**Vernacular names.** Sabah—*mali-mali* (Malay), *pantan pantan* (Dusun Tuaran), *togimamalid* (Dusun Kiau). Sarawak—*kayu kenupan* (Penan), *kemali* (Iban).

**Distribution.** India, Sri Lanka, Nepal, Bangladesh, Andaman and Nicobar Is., Myanmar, Thailand, Cambodia, Laos, Vietnam, Hainan, China, throughout Malesia, Australia to Pacific islands. Widespread in Sabah and Sarawak; also in Brunei.

**Ecology.** Common in primary and secondary forests, from sea level to mountains, up to 1700 m.



## LOGANIACEAE

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Merrill, EB (1921) 490; Masamune, EPB (1942) 613; Leenhouts, Bull. Jard. Bot. Brux. 32 (1962) 417, FM 1, 6 (1962) 293, Blumea 14 (1966) 230, Blumea 29 (1984) 423; Burgess, TBS (1966) 385; Cockburn, TS 1 (1976) 207; Anderson, CLTS (1980) 239; Ashton, MNDTS 2 (1988) 307.

Trees, shrubs, woody climbers, stranglers, epiphytes or herbs. **Leaves** *opposite, simple, entire*; stipules absent but *petiole bases expanded on the margins and joining between leaves to form an ochrea around the node (Mitrasacme, Mitreola and Norrisia), or developing transverse scale-like appendages just above the leaf axil ("axillary scales") that resemble truncate rims* which are separate between leaves (*Fagraea*) or joined between leaves to form a cup-shaped ochrea tightly encircling the node (*Fagraea, Geniostoma*), or *these appendages absent and the nodes with a transverse line or thickening between petiole bases (Gelsemium, Norrisia, Strychnos)*. **Inflorescence** terminal or axillary, a cyme, raceme, thyrse or a solitary flower. **Flower** *nearly always bisexual, radially symmetrical, (4-)5-merous*; sepals united or free, valvate or imbricate; *petals fused and forming a tube*, lobes (4-)5, valvate, imbricate or contorted in bud; *stamens inserted on the corolla tube*, alternate with corolla lobes, *anthers basifixed or rarely dorsifixed, dehiscing lengthwise*; disc sometimes present, *ovary superior, usually 2-locular, rarely 1- or 4-locular, ovule 1-many per locule*, amphitropous or anatropous, placentation axile; style usually one, stigma knob-like or club-shaped or faintly or deeply bifid. **Fruit** a berry, capsule or drupe. **Seeds** 1-many, with copious endosperm; embryo minute, straight.

**Distribution.** About 28 genera with some 600 species have been placed in this family, taken in its wider taxonomic sense. Chiefly pantropical, a few genera extending to warm-temperate regions, mainly towards the south. In Malesia, 10 genera with *c.* 100 species; 7 genera in Sabah and Sarawak of which *Fagraea* is the main genus.

**Uses.** Strychnine is obtained from *Strychnos* and other poisonous alkaloids are also known from *Mostuea* and *Gelsemium* spp. Only a few species of *Fagraea* are taken for timber. *Fagraea* and *Gelsemium* yield various species of ornamental importance or potential.

**Taxonomy.** *Buddleja*, commonly included in the Loganiaceae in the past is now generally accepted as representing a separate family, Buddlejaceae (in the Scrophulariales), chiefly on account of the occurrence of intraxylary phloem in its wood, pollen characters that resemble those of the Scrophulariaceae and a number of characters (e.g., possession of stellate hairs and glandular-capitate hairs) that are absent in most of the Loganiaceae.

Recent work appears to indicate that the Loganiaceae as here circumscribed, mainly following the concept of Solereder (in Engler & Prantl, Nat. Pfl. Fam. 4, 2 (1892–95) 19), is still a heterogenous assemblage of distinct families belonging to the Gentianales. It has been suggested that the Loganiaceae *sensu stricto* should comprise just *Logania*, *Mitrasacme* and *Mitreola*; *Gelsemium* and *Geniostoma* should be the bases of distinct families; *Strychnos* and *Norrisia* might be placed together within the Strychnaceae; and *Fagraea* belongs properly to the Gentianaceae (Struwe *et al.*, Cladistics 10 (1994) 175).

The concept for grouping the genera used here is therefore only one of convenience, as we await more detailed studies that corroborate the newly proposed classification. Of importance in our flora are the genera *Fagraea*, *Geniostoma* and *Norrisia*.

### Key to genera

1. Small herbs.....2  
 Shrubs, trees, climbers, stranglers or epiphytes.....3
  
2. Flowers 4-merous. Leaves small (less than 2 cm long), petioles inconspicuous.....  
**Mitrasacme** Labill.  
 Nov. Holl. Pl. Spec. 1 (1804) 35; Merrill, EB (1921) 490; Masamune, EPB (1942) 615; Leenhouts, Bull. Jard. Bot. Brux. 32 (1962) 440, FM 1, 6 (1962) 378.  
 About 40 species, mainly Australian, also in Tasmania, New Zealand, New Caledonia, Malesia, the Carolines, and in Asia from the Deccan and Sri Lanka to Central Japan and Korea.  
 Wiry, low, usually clump-forming herbs. Leaves often with only the midrib distinct. In Sabah, one species (*M. neglecta*) recorded from Balambangan Is., and in Sarawak, one species (*M. pygmaea*) recorded from Mt. Santubong.
  
- Flowers 5-merous. Leaves larger (at least several cm long), with distinct petioles.....  
**Mitreola** L.  
 Gen. Pl. ed. 1 (1737) 377. Synonym: *Cynoctonum* Gmel., Syst. (1791) 443; Leenhouts, FM 1, 6 (1962) 375.  
 Seven species; Madagascar, SE Asia, Malesia, and N and W Australia. In Sabah and E Kalimantan, one species.  
 Low herb, less than 0.5 m high. Inflorescence axillary, dichasial with long cincinnate branches.
  
3. Leaves with 3–5 main veins from the leaf base. Tendrils often present in leaf axils.....  
**Strychnos** L.  
 Sp. Pl. 1 (1753) 189; Gen. Pl. ed. 5 (1754) 86; A. W. Hill, Kew Bull. (1917) 121; Merrill, EB (1921) 490; Masamune, EPB (1942) 616; Leenhouts, FM 1, 6 (1962) 374.  
 About 150–200 species, in tropics and subtropics. In Sabah and Sarawak, c. 11 species.  
 Woody climbers or rarely shrubs or treelets; usually with axillary, simple or double tendrils. Petioles often inserted on swellings (“leaf-cushions”) at the nodes.
  
- Leaves pinnately nerved. Tendrils absent.....4

4. Petiole bases developing conspicuous wings or axillary scales or forming a distinct cup-like ochrea around the node.....5  
 Petiole bases not forming any special structures, the nodes at most marked by a transverse line or thickening, or the ochrea very low and not more than 1 mm high, inconspicuous.....6
5. Fruit a dehiscent capsule. Inflorescence strictly axillary. Corolla campanulate to rotate  
 Leaves chartaceous to thin-coriaceous, with strongly recurved margin when dry.....  
 .....2. **Geniostoma**  
 Fruit a berry, not dehiscent. Inflorescence terminal or axillary. Corolla salverform, infundibular (funnel-shaped) or tubular. Leaves thin- to thick-coriaceous, the margins recurved only in some thick-coriaceous leaves.....1. **Fagraea**
6. Leaf apex rounded to acute or slightly acuminate. Style knob-like or slightly 2-lobed.....3. **Norrisia**  
 Leaf apex long-caudate. Style twice forked.....

**Gelsemium** Juss.

Gen. Pl. (1789) 150; Merrill, EB (1921) 490; Masamune, EPB (1942) 615; Leenhouts, FM 1, 6 (1962) 343.

Three species; SE Asia, SE North America, Mexico and Guatemala. In Sabah and Sarawak, one species (*G. elegans*).

Liana or straggling shrub. Leaves pinnately nerved. Flower 5-merous; corolla lobes imbricate. Fruit a dry capsule, 2-valved. Seeds winged.

**1. FAGRAEA** Thunb.

(J.T. Fagraeus, 1729–47, Swedish naturalist)

Merrill, EB (1921) 491; Masamune, EPB (1942) 613; Leenhouts, Bull. Jard. Bot. Brux. 32 (1962) 417, FM 1, 6 (1962) 293, Blumea 14 (1966) 230, 29 (1984) 423; Burgess *l.c.* 385; Cockburn *l.c.* 207; Anderson *l.c.* 239; Ashton *l.c.* 307; Wong & Sugau, Sandakania 8 (1996) 1.

*Trees, shrubs, woody climbers, stranglers or epiphytes*; buttresses absent or very small. **Leaves** strap-shaped, elliptic, lanceolate, oblanceolate, obovate to broadly ovate, *pinnately nerved*, thin- to thick-coriaceous, margin mostly entire or crenulate (*F. crenulata*), mostly glabrous; *petioles* indistinct to distinct, *developing axillary scales above the base that loosely clasp the node* (section *Fagraea*) *or at the very base and tightly clasping the node* (sections *Cyrtophyllum* and *Racemosae*), the petiole base with or without auricles developed. **Inflorescences** *terminal or rarely axillary*, either without any branches (with only a solitary flower) or cyme-like, with well-developed primary branches that rebranch 1–6 times (sections *Fagraea* and *Cyrtophyllum*), or branches typically very condensed and grouped as distinct tiers along the main axis (section *Racemosae*); bracts small and scale-like, bracteoles subtending flowers 2–3 pairs, small or in some species very large and forming an involucre around the flower. **Flowers** small to very large, *5-merous*; calyx with a firm cup-like basal part, lobes imbricate; *corolla* mostly creamy-white, either *tubular, salverform or narrowly to widely infundibular*, lobes contorted, shorter than to as long as the tube; stamens included or exsert; *ovary one-ocular, ovules many*, in 2 parietal placentas; style as long as corolla tube or



distinctly longer, stigma capitate, slightly 2-lobed. **Fruit** a berry, apex with persistent remains of style. **Seeds** many, irregularly angular (sections *Cyrtophyllum* and *Racemosae*) or ellipsoid-rounded (section *Fagraea*).

**Distribution.** About 60–70 species; Sri Lanka, India, Indo-China, China, Hainan, Taiwan, throughout Malesia, to northern Australia and the Pacific. 42 species in Borneo; in Sabah and Sarawak 40 species, with *F. crenulata* and *F. kalimantanensis* as yet known only from Kalimantan.

**Ecology.** In primary or secondary forest, in open places, riverbanks and forest edges; sea-level to about 3000 m.

**Uses.** Some species of the genus have timber value but many have potential in ornamental horticulture.

**Taxonomy.** Three sections of the genus are recognised (Wong & Sugau *l.c.*). Section *Fagraea* has axillary scales that develop above the petiole base and loosely clasp the stem; inflorescences of either a solitary flower or that are cyme-like with the primary branches rebranching 1–3 times; fruits that are typically large at maturity (always more than 25 mm across), with the epidermis detaching from the pericarp on drying; and ellipsoid-rounded seeds. Section *Cyrtophyllum* has axillary scales that develop at the very base of the petiole and tightly clasp the stem; cyme-like inflorescences with primary branches that rebranch 3–6 times; smaller fruits (less than 20 mm across) with the epidermis not detaching from the pericarp on drying and angular seeds. Section *Racemosae* has axillary scales, fruits and seeds similar to that in section *Cyrtophyllum* but the inflorescence typically has all its branches very condensed and grouped in distinct tiers along the main axis; in addition it appears to be characterised by stamens and styles that are not or only slightly exsert in the open flower in comparison to the conspicuously exsert stamens and styles in flowers of section *Cyrtophyllum*.

Recent studies (Struwe, pers. comm.) support the isolation of a few species of *Fagraea s.l.* from New Guinea, Maluku, Australia, Polynesia and Malesia as a distinct genus, but the present review of *Fagraea* in Borneo (Wong & Sugau *l.c.*) reveals insufficient evidence to treat the sections as separate genera.

Leenhouts' delimitation of the species has not been adhered to in most cases, notably in his concept of *F. auriculata*, *F. blumei*, *F. elliptica*, *F. fragrans*, *F. gardenioides* and *F. racemosa*. *F. ceilanica* is here considered absent in Malesia and is an artificial assemblage of a large number of species (see Wong & Sugau *l.c.*).

### Key to *Fagraea* species

1. Fruits typically large at maturity (always more than 25 mm across), the epidermis detaching from the pericarp on drying. Inflorescence either without any branching (with only a solitary flower) or with well-developed primary branches (which resemble the lower internodes of the main axis in length) that rebranch typically only once but exceptionally (in *F. floribunda*) to 3 orders. Axillary scales developing above the petiole base and loosely clasping the node.....2

- Fruits always smaller (less than 20 mm across), the epidermis not detaching from the pericarp on drying (sometimes the pericarp wrinkled). Inflorescence either pendulous or with all branches very condensed and grouped as distinct tiers along the main axis, or with well-developed primary branches that rebranch 3–6 orders. Axillary scales developing at the very base of the leaf stalk and slightly clasping the node.....28
2. Petiole bases typically developing distinct, rim-like auricles or large lobe-like auricles that are usually reflexed.....3  
 Petiole bases without auricles, or these auricles very indistinct and easily overlooked (*F. resinosa*).....8
3. Leaf blade decurrent along the petiole, forming distinct wings several mm wide all along the petiole, and continuing into the petiole base auricle (Flowers not known).....  
**Fagraea sp. A**  
 Wong & Sugau, Sandakania 8 (1996) 92.  
 Epiphytic shrub. Leaves large, base attenuate to decurrent. Flowers not known.  
 Borneo (Sarawak). Riverside forest, 100–200 m.
- Leaf blade not decurrent along the petiole, or only very slightly so and never more than 1 mm wide, distinct from the petiole base auricle.....4
4. Lateral veins on the lower leaf surface distinct and prominent. Flower subtended by an involucre of large bracts. Corolla tube inside pale floccose (with loose long hairs) at the middle part.....  
**F. macroscypha** Baker  
 Kew Bull. (1896) 65; Merrill *l.c.* (1921) 492; Masamune *l.c.* 614; Cockburn *l.c.* 210; Wong & Sugau *l.c.* 77. Synonym: *F. involucrata* Merr. var. *longipetiolata* Merr., PEB (1929) 25, Masamune *l.c.* 614.  
 Epiphytic shrub or climber, possibly a strangler. Leaves oblong-lanceolate, 12–27 × 3.5–9.5 cm, thick-coriaceous. Flower terminal, solitary, corolla tubular, slightly widened upwards, creamy white with broad green stripes on the outside, tube 12–14 cm long.  
 Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). Mixed dipterocarp forest, to 200 m.
- Lateral veins on the lower surface obscure or only very slightly distinct. Flowers not subtended by any involucre or (in *F. involucrata*) with such an involucre. Corolla tube inside completely glabrous or (in *F. involucrata*) pale floccose (with loose long hairs) at the middle part.....5
5. Leaf apex obtuse, rounded or with only an inconspicuous tip.....6  
 Leaf apex acute, caudate or distinctly cuspidate.....7
6. Flowers solitary. Corolla tube 13–14 cm long. Calyx lobes 3.5–4 cm long. Leaf blades typically very large, 28–29 × 12–13 cm.....  
**F. megalantha** Wong & Sugau  
 Sandakania 8 (1996) 77.  
 Climber. Leaves oblanceolate, thick coriaceous. Flower large, corolla funnel-shaped.  
 Borneo (Sarawak); known only from the type. Peat swamp forests.

Flowers 3–5 in a cyme. Corolla tube 6–9 cm long. Calyx lobes 2.5–3 cm long. Leaf blades typically smaller, 12–19 × 6–10 cm.....

**F. auriculata** Jack

Mal. Misc. 2, 7 (1822) 82; Wong & Sugau *l.c.* 51; *sensu* Leenhouts, FM 1, 6 (1962) 326, *pro parte*.

Climbing or terrestrial shrub or epiphyte. Leaves broad obovate, 10–20 × 5–8 cm, thick-coriaceous. Flowers large, corolla infundibular, corolla tube 6–9 cm long, 1–1.5 cm wide, corolla lobes ovate, 4–5 cm long, 2.5–3 cm wide.

Indo-China, Peninsular Malaysia, Java and Borneo (Sarawak and Kalimantan). Lowlands and mountains, to 1930 m.

7. Flowers solitary, subtended by an involucre of bracts. Corolla tube inside pale floccose at the middle part. Inflated upper part of corolla tube bell-shaped. Petiole base auricles large and conspicuous, resembling lobes.....

**F. involucrata** Merr.

J. Str. Br. R. As. Soc. 77 (1917) 233, *l.c.* (1921) 492, PEB (1929) 251 (excl. var. *longipetiolata* Merr.); Masamune *l.c.* 614 (excl. var. *longipetiolata* Merr.); Cockburn *l.c.* 210; Wong & Sugau *l.c.* 68. Synonyms: *F. macrocypha sensu* Heine, Pfl. Clemens Kinabalu (1953) 91, *non* Baker (1896); *F. uniflora* Heine *l.c.* 92, *non* Merr. (1917).

Epiphytic shrub or liana, possibly a strangler. Leaves oblong to oblanceolate, 9.5–10 × 3–6 cm, coriaceous. Flower terminal, solitary, corolla infundibular, 14–15 cm long, greenish white.

Endemic to Borneo (Sabah, Sarawak and Kalimantan). Montane forests to 1800 m.

Flowers 3–5 in a cyme, without any involucre. Corolla tube inside completely glabrous. Inflated upper part of corolla tube trumpet-shaped. Petiole base auricles 1–2 mm wide only, resembling rims.....**3. F. borneensis** (typically)

8. Lateral veins on lower leaf surface distinct and prominent on drying.....9  
Lateral veins on lower leaf surface indistinct, or sunken on drying.....12

9. Cyme subsessile, the flowers individually subtended by bracts 1–1.5 cm long forming a loose involucre.....

**F. iliasii** Wong & Sugau

Sandakania 8 (1996) 66.

Epiphytic shrub. Leaves thin-chartaceous. Inflorescence a 3-flowered cyme; pedicels indistinct (hidden by bracteoles).

Endemic to Borneo (Sarawak); known only from the type. On yellow sandy soil, river bank at 280 m.

Cyme distinctly pedunculate, the flowers not subtended by any unusually large bracts.....10

10. Inflorescence a laxly branched cyme 14–16 cm long, the primary branches rebranching to 3 orders.....**9. F. floribunda**  
Inflorescence with condensed branches or laxly branched but never exceeding 10 cm long, the primary branches rebranching only once.....11

11. Leaves thick-coriaceous, the petioles massive (5–8 mm thick). Inflorescence with condensed branches. Calyx lobes in flower 10–12 mm long.....
- F. ridleyi** King & Gamble  
 J. As. Soc. Beng. 74, 2 (1908) 612, *non* Gandoger (1924); Wong & Sugau *l.c.* 87.  
 Liana or big straggling shrub, twigs massive. Leaves broadly obovate to suborbicular. Peninsular Malaysia, Lingga and Borneo (Sarawak and Brunei). Lowland primary forest, in *kerangas* forest, sea-level to 300 m.
- Leaves thin-coriaceous, the petioles slender (2–3 mm thick). Inflorescence with distinct elongate branches. Calyx lobes in flower 5–8 mm long.....
- F. renae** Wong & Sugau  
 Sandakania 8 (1996) 82. Synonym: *F. blumei sensu* Cockburn *l.c.* 211, Anderson *l.c.* 239, Ashton *l.c.* 312, *pro parte, non* G. Don (1837).  
 Strangling or epiphytic shrub. Leaves broadly elliptic to broadly oblanceolate, lateral veins 3–6 pairs, lower side prominent.  
 Peninsular Malaysia and Borneo (Sabah and Sarawak). Primary and secondary forests, also on limestone; lowlands up to 1200 m in mossy forest.
12. Flowers subtended by an involucre of enlarged bracts.....13  
 Flowers without any involucre at their base.....15
13. Calyx and most of the involucre bracts elliptic with rounded apices. Petiole bases developing small, inconspicuous auricles.....**15. F. resinosa**  
 Calyx and most of the involucre bracts with acute-pointed apices. Petiole bases clearly without auricles.....14
14. Leaf blades narrowly elliptic, the apex acute-caudate. Petioles longer, 2.2–4 cm long. Flowers 1–3, each on a short but distinct and thick pedicel; involucre bracts typically keeled.....
- F. kuminii** Wong & Sugau  
 Sandakania 8 (1996) 71.  
 Epiphytic shrub or woody climber. Leaves narrowly obovate to oblanceolate. Bracteoles in 2–3 decussate pairs, enclosing the lower part of the calyx, the inner or innermost pairs larger than the outer ones.  
 Borneo (Sabah). On undulating land, river banks in disturbed forest on ultramafic soil.
- Leaf blades obovate, the apex cuspidate. Petioles shorter, 0.5–2 cm long. Flowers solitary, the pedicels hidden by the bracts and inconspicuous; involucre bracts without distinct keels.....
- F. acutibracteata** Wong & Sugau  
 Sandakania 8 (1996) 49.  
 Woody climber. Bracteoles with acute-acuminate apex; corolla unknown.  
 Borneo (Sarawak), so far known only from the type. On sandstone rocks at 550 m.
15. Flowers solitary.....16  
 Flowers (2–)several in a cyme.....19

16. Corolla tubular to narrowly infundibular (funnel-shaped), the tube 8.5–15 cm long.....  
**F. carnosa** Jack  
 Malay Misc. 2, 7 (1822) 81; Wong & Sugau *l.c.* 57. Synonym: *F. uniflora* Merr., J. Str. Br. R. As. Soc. 77 (1917) 235, *l.c.* (1921) 493, Masamune *l.c.* 615.  
 Woody climber or epiphyte. Leaves broadly elliptic to obovate, thick-coriaceous.  
 Lower Burma, Sumatra, Peninsular Malaysia and Borneo (Sarawak). On sandstone soils in mixed dipterocarp forest, sea-level to 200 m.

Corolla short-infundibular, the tube 3–4.5 cm long.....17

17. Corolla lobes larger, 3.5–4 cm long, 2–2.5 cm broad. Petioles 1.2–3 cm and leaves elliptic.....  
**F. stonei** Wong & Sugau  
 Sandakania 8 (1996) 88.  
 Woody climber or epiphytic shrub. Leaves broadly elliptic to lanceolate, thick-coriaceous. Flower solitary.  
 Borneo (Sabah and Sarawak). In *kerangas* forest on white sand podsols, also on basalt ridges.

Corolla lobes smaller, 1.8–3 cm long, 1.3–2.5 cm broad. Petioles less than 1 cm long if leaves elliptic (*F. kinabaluensis*), or when longer (1–2.2 cm) then leaves distinctly obovate.....18

18. Leaves obovate, the petioles 1–2.2 cm long. Upper part of corolla tube at most 1 cm across at the mouth.....**7. F. dulitensis**  
 Leaves elliptic or only very slightly obovate, the petioles less than 1 cm long. Upper part of corolla tube more flared, 2–2.5 cm across at the mouth.....**12. F. kinabaluensis**
19. Inflorescence a tight cluster of many flowers, the branches condensed and hidden by the flowers themselves (in fruit the axes visible but still short, supporting many fruits).....

**F. splendens** Blume

Mus. Bot. Lugd. Bat. 1 (1850) 168; Wong & Sugau *l.c.* 87. Synonyms: *F. heterophylla* Blume, *l.c.* (1850) 168; *F. acuminatissima* Merr., J. Str. Br. R. As. Soc. 77 (1917) 232, *l.c.* (1921) 491, Masamune *l.c.* 613, Cockburn *l.c.* 211, Anderson *l.c.* 239, Ashton *l.c.* 311; *F. rostrata sensu* Merrill *l.c.* (1921) 493, Masamune *l.c.* 615, *non* Blume (1836); *F. ceilanica sensu* Leenhouts, FM 1, 6 (1962) 315, *pro parte, non* Thunb. (1782).

Climber or epiphyte, rarely a small tree to 6 m tall. Leaves oblanceolate or obovate, 11–25.5 × 4.5–9.5 cm, coriaceous. Inflorescence a 3–8(–10)-flowered sessile cyme, corolla tubular, 4–4.5 cm long, lobes 1.5–2 cm long.

Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak and Brunei). On various types of soils, including in swamp forest, and especially *kerangas* forest, from sea-level to 1333 m.

Inflorescence a few-flowered cyme or, if many-flowered, the branches distinct and not hidden by the flowers.....20

20. Leaf apex obtuse-rounded. Leaves drying black or dark brown.....

**F. tuyukii** Wong & Sugau

Sandakania 8 (1996) 90.

Probably epiphytic shrub to small tree. Leaves elliptic to obovate, 4–8 × 4–7 cm, stiff-coriaceous. Flower unknown. Infructescence terminal, of a few fruits in a cyme. Fruit ellipsoid, mucronate apically, 2.5–3 cm long, 2.5–2.7 cm wide.

Endemic to Borneo (Sabah); known only from the type. Mixed dipterocarp forests, 700–800 m.

Leaf apex acute or cuspidate or caudate. Leaves drying pale to dark greenish brown.....21

21. Corolla tube more than 10 cm long.....**3. F. borneensis** (in part)  
Corolla tube less than 8 cm long.....22

22. Corolla tubular, the tube more than twice as long as the lobes.....

**F. havilandii** Wong & Sugau

Sandakania 8 (1996) 64. Synonym: *F. gardenioides* ssp. *borneensis* Leenhouts, Bull. Jard. Bot. Brux. 32 (1962) 425.

Probably shrub or epiphyte. Leaves obovate, 8–11 × 3–6 cm, coriaceous. Flowers 2–5 in a cyme, corolla tubular, tube 5.5 cm long, lobes 1–1.8 cm long.

Borneo (Sarawak, near Kuching).

Corolla infundibular, the tube less than twice as long as the lobes.....23

23. Corolla throat 5–8 mm across.....24  
Corolla throat 10–20 mm across.....26

24. Leaf blades decurrent to the base of their petioles, which are broadly winged. Ultimate branches developing broadened, somewhat corky and very short internodes that form a series of coarse cicatrices (bands) along the branches .....

**F. oreophila** Wong & Sugau

Sandakania 8 (1996) 78. Synonym: *F. ceilanica sensu* Leenhouts, FM 1, 6 (1962) 315, Cockburn *l.c.* 211, *pro parte, non* Thunb. (1782).

Epiphyte, possibly also a small tree. Leaves obovate, 7–9 × 2.5–4 cm, coriaceous. Inflorescence terminal, 3-flowered; corolla pale yellow or white, tube *c.* 2.5 cm long, lobes *c.* 1.5–1.8 cm long.

Sabah (on Mt. Kinabalu) and Sarawak (Mt. Murud). Mossy montane forest.

Leaf blades not completely decurrent along their petioles, which are always distinctly slender. Ultimate branches not so, such nodal cicatrices if developing always far apart.....25

25. Leaves small, to 9 × 2.5 cm, the apex caudate. Corolla tube 18–20 mm long.....

**F. rarissima** Wong & Sugau

Sandakania 8 (1996) 82. Synonym: *F. ceilanica sensu* Leenhouts, FM 1, 6 (1962) 315, *pro parte, non* Thunb. (1782).

Shrub. Leaves narrowly elliptic, 4–8.5 × 1.5–2.5 cm, coriaceous. Inflorescence a 2–3-flowered cyme; corolla salverform, white, tube 2–2.5 cm long, lobes 1.5–1.7 cm long.

Borneo (Sarawak and Brunei). On yellow podsols in mixed dipterocarp forests.

Leaves typically larger, 8–15 × 3–6.5 cm, the apex acute to cuspidate. Corolla tube 20–30 mm long.....**2. F. blumei**

26. Corolla tube with a base 5–7 mm across, gradually flared upwards. Leaves smaller typically, at most 3 cm wide.....  
**F. longipetiolata** Wong & Sugau  
 Sandakania 8 (1996) 75.  
 Climbing shrub. Leaves elliptic to narrowly obovate, margin slightly recurved when dry.  
 Borneo (Sarawak and Brunei). Primary mixed dipterocarp forest.
- Corolla tube with a base only 1–2 mm across, abruptly flared upwards. Leaves larger typically, 3–10 cm wide.....27
27. Flower calyx lobes small, 2–4 mm long. Leaves narrowly obovate-elliptic to oblong. Upper leaf surface parchment-like when dry.....  
**F. oblonga** King & Gamble  
 J. As. Soc. Beng. 74, 2 (1908) 612; Wong & Sugau *l.c.* 78.  
 Climbing shrub. Leaves with slightly recurved margin, apex obtuse.  
 Peninsular Malaysia, Sumatra and Borneo (Sarawak). Lowlands to mountains, also on limestone.
- Flower calyx lobes larger, 7–8 mm long. Leaves broadly ovate to elliptic. Upper leaf surface coarsely shagreen when dry.....  
**F. littoralis** Blume  
 Bijdr. Fl. Ned. Ind. (1826) 1021, Merrill *l.c.* (1921) 492, Masamune *l.c.* 614, Wong & Sugau *l.c.* 73.  
 Climbing shrub. Leaf base rounded; midrib prominent, sharp-ridged.  
 Borneo, all territories. Mostly near river and lakes.  
 The variety in Borneo is var. *borneensis* Wong & Sugau, *l.c.* 73, wrongly attributed by both Merrill and Masamune to Miquel's var. *forstenii* (a synonym of var. *amboinensis* Blume) from Sulawesi.
28. Inflorescence pendulous or typically with all branches very condensed and grouped in distinct tiers along the main axis. Stigma capitate but at maturity developing an expanded rim that gives it a peltate structure. Stamens and style not or only slightly exsert in the open flower.....29  
 Inflorescence rigid and erect, with well-developed primary branches (as long as the lower internodes of the main axis) that rebranch 3–6 orders. Stigma capitate throughout, an expanded rim not developing. Stamens and style long-exsert in the open flower.....35
29. Narrowed basal tubular part of corolla very short, much less than a third the length of the corolla tube, and mostly hidden by the calyx in the open flower.....**6. F. cuspidata**  
 Narrowed basal tubular part of the corolla longer, more than a third or half the corolla tube, and clearly extending beyond the calyx in the open flower.....30
30. Corolla lobes in the open flower relatively short, at most up to about a third the length of the expanded upper part of the corolla tube. Leaves sessile.....**17. F. spicata**  
 Corolla lobes in the open flower relatively longer, about half or more the length of the expanded upper part of the corolla tube. Leaves with distinct petioles.....31
31. Corolla of open flowers relatively narrow (the uppermost part of the tube only 6–8 mm wide).....32

- Corolla of open flowers wider (the uppermost part of the tube 10 mm or wider).....33
32. Corolla of open flowers 20–27 mm long (the narrowed basal tubular part 8–10 mm long, the inflated upper part 10–11 mm long). Anthers 2–2.5 mm long. Leaves linear, 12–27 cm long, with 7–14 pairs of lateral veins faintly visible. (Rheophytic plants of the lowlands).....**18. F. stenophylla**  
Corolla of open flowers 18–20 mm long (the narrowed basal tubular part 7–8 mm long, the inflated upper part 5–6 mm long). Anthers *c.* 1 mm long. Leaves elliptic-obovate, 3.5–13.5 cm long, with 4–5 pairs of lateral veins faintly visible. (Montane plants) .....**13. F. montana**
33. Mature flowers with calyx 4–6 mm long; inflated upper part of the corolla tube 7–10 mm long, shorter than or about as long as the basal tubular part.....**20. F. volubilis**  
Mature flowers with calyx 7–9 mm long; inflated upper part of corolla tube 12–16 mm long, much longer than the basal tubular part.....34
34. Uppermost part of the corolla tube only 10–12 mm wide; corolla lobes 7–8 mm long. Anthers *c.* 1.5 mm long. (Leaves typically smallish, the length at least 3 times the width.).....**19. F. teysmannii**  
Uppermost part of the corolla tube 20–22 mm wide; corolla lobes 10–12 mm long. Anthers 3.5–4 mm long. (Leaves typically large, sometimes small, the length typically less than 3 times the width.).....**14. F. philippinensis**
35. Inflorescences exclusively axillary.....36  
Inflorescences terminal.....38
36. Inflorescence a 3-branched cyme, or (sometimes) reduced unbranched inflorescence, (1–)3-flowered. Corolla tube 10–12 mm long. Leaves coriaceous, the margins never wavy, with lateral veins 3–6 pairs.....**4. F. caudata**  
Inflorescence a many-branched, many-flowered cyme. Corolla tube 6–8 mm long. Leaves chartaceous with wavy margins, or leaves (sub)coriaceous with lateral veins 9–12 pairs.....37
37. Inflorescence peduncle 4–6 cm long. Open flowers with calyx diameter 2–2.5 mm, corolla lobes (5–)6–7 mm long and 3–4 mm wide, and styles exsert for 8–10 mm. Leaves with 9–12 pairs of lateral veins which are flat on the upper surface, and plane margins when fresh.....**10. F. fragrans**  
Inflorescence peduncle 2–3.5 cm long. Open flowers with calyx diameter 1.5–2 mm, corolla lobes 4–5 mm long and 2.5–3 mm wide, and styles exsert for 14–16 mm. Leaves with 3–8 pairs of lateral veins which are often depressed on the upper surface, and wavy margins when fresh.....**11. F. gigantea**
38. Cymes with main axis branching 4–6 orders. Corolla lobes ovate, 2.5–3 mm long. Leaf apex typically obtuse-rounded to emarginate. Tree mostly of lowland secondary forest and open sites, and forest gaps.....**1. F. belukar**  
Cymes with main axis typically branching only 3–4 orders (very exceptionally an occasional 5th order of branching present). Corolla lobes lanceolate, *c.* 3.5 mm long or more. Leaf apex acuminate to cuspidate-caudate. Tree typically of primary forest in the lowlands or mountains.....39



39. Calyx in flower 3–4 mm long. Corolla lobes 5–8 mm long. Stamen filaments in open flowers 15–18 mm long. Mature fruits (6–)9–10 mm across. Leaf surfaces drying very coarsely wrinkled and very coarse to the touch.....**16. F. rugulosa**  
 Calyx in flower 2–3 mm long. Corolla lobes 3.5–6 mm long. Stamen filaments in open flowers 7–11 mm long. Mature fruits smaller, only 3.5–5(–6) mm across. Leaf surfaces drying smooth.....40
40. Flowers sessile to subsessile, the pedicels (if developed) to 1 mm long. Leaf apex acuminate. Leaf lateral veins obscure to only very faintly visible, never elevated on the lower side. (Leaves coriaceous. Corolla tube 6–7 mm long).....**5. F. collina**  
 Flowers with distinct pedicels 1–3 mm long. Leaf apex cuspidate to caudate. Leaf lateral veins distinct and raised on the lower side. (Leaves chartaceous to coriaceous. Corolla tube 6–11 mm long).....**8. F. elliptica**

1. **Fagraea belukar** Wong & Sugau

Fig. 1.

(Malay, *belukar* = secondary forest; the usual habitat)

Sandakan 8 (1996) 15. **Type:** *Saikeh SAN 72151*, Sabah, Beaufort, Beaufort Hill (holotype SAN).  
**Synonym:** *F. elliptica sensu* Leenhouts, FM 1, 6 (1962) 303, Cockburn *l.c.* 210, Ashton *l.c.* 314, Anderson *l.c.* 239, *pro parte, non* Roxb. (1824).

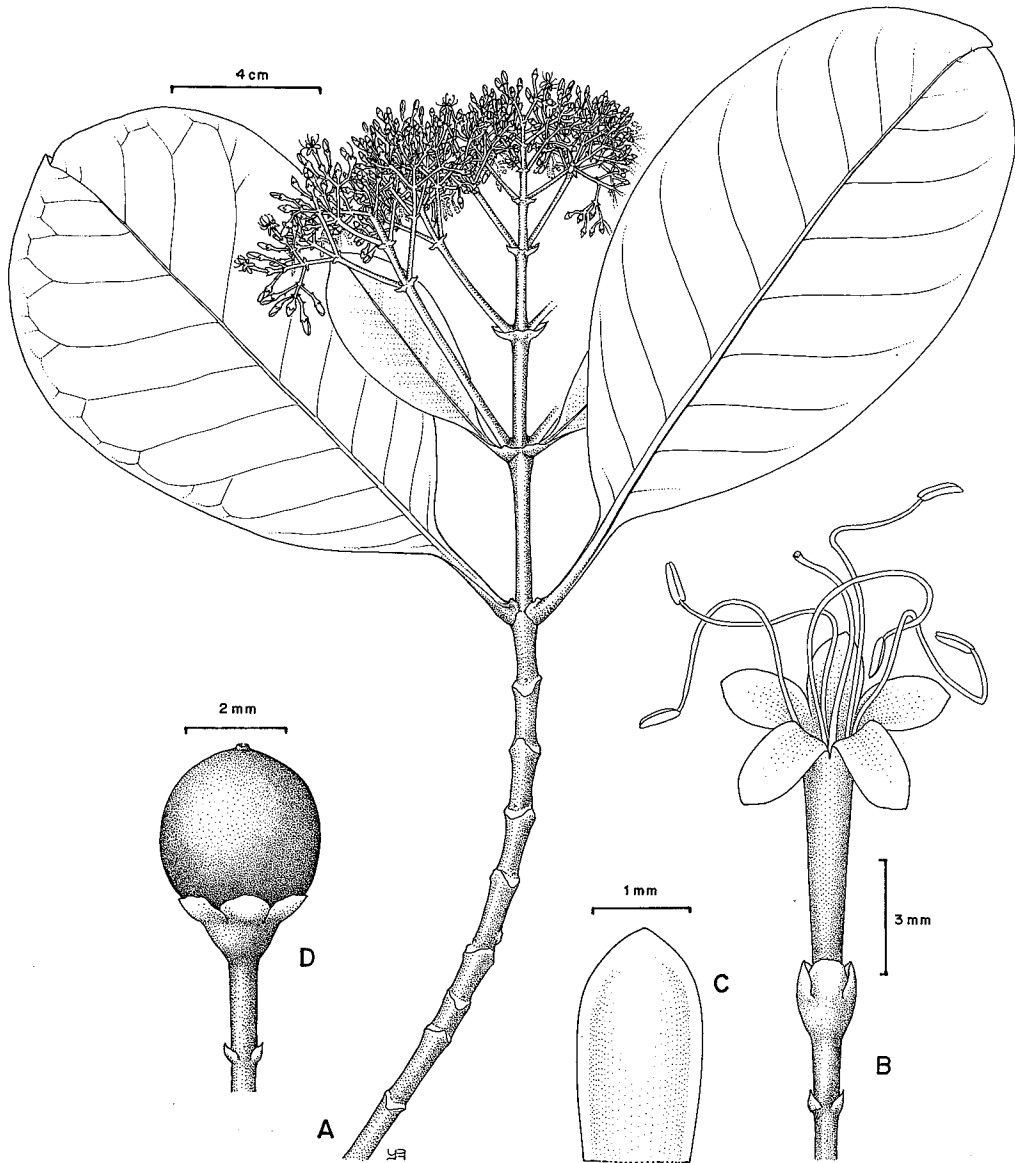
Tree to 30 m tall and 60 cm diameter or more, trunk base fluted-cylindric. **Bark** fissured, greyish black; inner bark reddish-yellow. **Sapwood** yellowish white. **Leaves** coriaceous, upper and lower surfaces finely shagreen or smooth; obovate to broad-elliptic, 7–22 × 4–13 cm; base cuneate, margin plane to recurved, apex obtuse-rounded to emarginate; midrib prominent on lower side, lateral veins 10–12 pairs, faintly visible and immersed (never raised) on the lower side, faintly visible, flat, immersed or slightly sunken on the upper side, intercostal veins obscure; petioles 3–4.5 cm long, stout, the base with axillary scales forming a cup-shaped ochrea tightly clasping the node. **Inflorescence** terminal, a many-flowered branched cyme, 13 cm long, 15–19 cm wide, main axis branching 4–6 orders; peduncles 2–3.5 cm long. **Flowers** with pedicels 3–4 mm long; calyx campanulate, 1–2 mm long, 1–2 mm diameter, divided to the middle; corolla salverform, tube 7–10.5 mm long, 1–1.5 mm wide, lobes ovate, 2.5–3 mm long, 1.5 mm wide; stamens 8–10 mm long, filaments 6–8 mm long, inserted at the mouth of corolla, exserted for 8–9 mm, anthers oblong, c. 1 mm long; style exsert for 4–9 mm, stigma small, capitate, very obscurely 2-lobed. **Fruits** globose, 3.5–5 mm across, tipped with a minute circular scar of the fallen style; fruit calyx 1–1.5 mm long, 1–1.5 mm wide. **Seeds** c. 1 mm diameter, angular, brownish black.

**Vernacular names.** Sabah—*tamasuk hutan* (Brunei Malay), *tembusu bukit* (Malay), *tembusu tagai* (Malay).

**Distribution.** Borneo, in all districts including Sabah and Sarawak, and Banka island. Very common throughout Sabah and Sarawak.

**Ecology.** Lowland secondary forests, open sites and forest gaps.

**Uses.** Apparently a durable wood for house and bridge construction.



**Fig. 1.** *Fagraea belukar*. A, flowering leafy twig; B, flower; C, corolla lobe; D, fruit. (A–C from SAN 72151, D from SAN 72256.)

## 2. *Fagraea blumei* G. Don

(C.L. Blume, 1796–1862, Dutch Botanist)

Gard. Dict. 4 (1837) 69; Leenhouts, FM 1, 6 (1962) 320, Cockburn *l.c.* 210, Anderson *l.c.* 239, Ashton *l.c.* 312, *pro parte*; Wong & Sugau *l.c.* 54. **Type:** *Blume, s.n.* (= *Leiden sheet no. 908. 127-758*) (L), Java. **Synonyms:** *F. obovata sensu* Blume, *l.c.* (1826) 1021, *nom. illeg., non* Wall. (1824), Masamune *l.c.* 614; *F. obovato-javana* Blume, Rumphia 2 (1838) 29, *t.* 75, incl. var. *bebeak* Blume; *F. vaginata* King & Gamble, J. As. Soc. Beng. 74, 2 (1908) 610, *pro parte*; *F. obovata sensu* Bakh. *f.* in Backer, Bekn. Fl. Java 7 (1948) fam. 170: 11, incl. var. *brevicalyx* Bakh. *f.*, Blumea 6 (1950) 382.

Tree to 20 m tall, 20 cm diameter, sometimes a climbing shrub or epiphyte. **Leaves** coriaceous, upper and lower surfaces shagreen, smooth; elliptic, obovate to oblanceolate, 8–15 × 3–6.5 cm; base cuneate to attenuate, margin plane, *apex acute to cuspidate*; midrib prominent on lower side, *lateral veins* 2–3 pairs, *obscure to only rather faintly visible on the lower side*, obscure on the upper side, intercostal veins obscure; *petioles* 1–3 cm long, base with conspicuous axillary scales loosely clasping the node. **Inflorescence** terminal, *a few-flowered cyme*, 4–7 cm long; peduncle nil to 2 cm long, smooth or lenticellate. **Flowers** with pedicels 0.5–2 cm long; bracteoles small, 1–3 mm long, attached halfway on the pedicel; calyx 1.2–2.9 cm long, 0.8–1 cm wide; *corolla* narrowly to widely *infundibular*, 4.5–6.5 cm long, divided to about halfway down or slightly deeper, *tube* 2–3 cm long, *lobes* 3–3.4 cm long; stamens *c.* 2 cm long, anthers oblong, 5–7 mm long; style 2.5–3 cm long, stigma capitate, 1–5 mm diameter. **Fruits** ellipsoid, *c.* 4 cm wide, fruit calyx 1.3–3 cm long, 1.4–2 cm wide, lobes patent. **Seeds** ellipsoid-rounded.

**Distribution.** Sumatra, Peninsular Malaysia, Java and Borneo (Sabah and Sarawak). In Sabah, recorded from the Tambunan, Kota Belud and Ranau districts; in Sarawak, documented from the Miri district but probably more common.

**Ecology.** Primary forest, mostly in highlands.

## 3. *Fagraea borneensis* Scheff.

(of Borneo)

In Hasskarl, Flora 52 (1869) 309; Merrill *l.c.* (1921) 491; Masamune *l.c.* 613; Wong & Sugau *l.c.* 55. **Type:** *Lobb, s.n.*, Sarawak (K). **Synonyms:** *F. auriculata ssp. borneensis* (Scheff.) Leenh., FM 1, 6 (1962) 328, Cockburn *l.c.* 210, *pro parte*; *F. nonok* Elm., Leaflet. Philip. Bot. 3 (1910) 858; *F. resinosa sensu* Leenhouts, FM 1, 6 (1962) 331, *pro parte*.

Epiphytic shrub or tree, to *c.* 13.5 m tall, *c.* 30 cm diameter. **Bark** smooth, grey; inner bark green. **Wood** whitish. **Leaves** thick-coriaceous, upper and lower surfaces shagreen, rough; oblanceolate, elliptic to broad obovate, 8–25 × 4–10 cm; base attenuate to cuneate, margin plane to slightly recurved when dry, *apex acute to acuminate*; midrib prominent on lower side, *lateral veins* 6–8(–11) pairs, *indistinct to slightly distinct (not prominent) on both sides*, intercostal veins obscure; *petioles* 2–3(–4) cm long, base with conspicuous axillary scales loosely clasping the node, *auricles indistinct or 1–2 mm wide*. **Inflorescence** terminal, *a 3–5-flowered cyme*, sessile. **Flowers** with pedicels 1.5–2 cm long; bracteoles 1 pair, *c.* 0.5 cm long, attached to calyx cup base; calyx 3–3.5 cm long, 1.5–2 cm diameter; *corolla* slender, *infundibular*, *tube* 9–11 cm long, 0.8–3.5 cm diameter, *glabrous inside, upper inflated part*

*trumpet-shaped*, lobes ovate, 2–3.5 cm long, 1–2 cm wide; stamen filaments 5–5.5 cm long, inserted *c.* 4–4.5 cm down from the corolla mouth, anthers *c.* 0.5 cm long; style 11–11.5 cm long, stigma peltate, *c.* 3 mm diameter. **Fruits** ellipsoid, 5–5.5(–7) cm long, 2–2.5 cm wide; fruit calyx lobes 2–2.5 cm long, 1–1.5 cm wide, patent. **Seeds** ellipsoid-rounded.

**Distribution.** Borneo (Sabah, Sarawak, Brunei and Kalimantan) and the Philippines.

**Ecology.** Lowland and montane forest, also in swampy areas and on limestone. Once recorded from seaside rocks.

#### 4. *Fagraea caudata* Ridl.

(Latin, *caudatus* = caudate; the attenuate leaf apex)

J. Str. Br. R. As. Soc. 79 (1918) 97; Merrill *l.c.* (1921) 491; Masamune *l.c.* 613; Wong & Sugau *l.c.* 8. **Type:** *Lobb, s.n.*, (1858), “Borneo” (Sarawak) (K). **Synonym:** *F. fragrans sensu* Leenhouts, FM 1, 6 (1962) 304, Ashton *l.c.* 310, *pro parte, non* Roxb. (1824).

Small tree, to 6 m tall, 4.5 cm diameter. **Bark** fissured and flaky, dark brown; inner bark orange. **Wood** pale brown. **Leaves** *coriaceous*, upper and lower side smooth; elliptic to obovate, 1.5–4 × 6–12 cm; base acute, decurrent, *margin plane*, apex caudate; midrib prominent on lower side, *lateral veins 3–6 pairs*, prominent on lower side, obscure or faint and impressed on upper side, intercostal veins obscure; petioles 0.7–1.5 cm long, base with axillary scales adnate to and tightly clasping the node. **Inflorescence** *axillary, a (1–)3-flowered branched cyme, or (sometimes) a reduced unbranched inflorescence*, 6–9 cm long; peduncle 2.5–5 cm long, branches (when present) 1.8–3 cm long. **Flowers** with pedicels 5–10 mm long; calyx cylindrical, 4–4.5 mm long, divided to halfway, 2.5–3 mm diameter; *corolla* salverform, *tube 10–12 mm long*, 4–5 mm wide, lobes 6.5–8 mm long, 4–5 mm wide, ovate; stamen filaments 10–13 mm long, inserted just above the middle of the corolla tube, anthers brownish green; style exsert for 8–12 mm, stigma capitate. **Fruits** broadly ellipsoid, 8–10 mm long, 5–6 mm wide; fruit calyx 3.5–4 mm long, 3.5–4 mm wide. **Seeds** angular.

**Distribution.** Endemic to Borneo (Sarawak and Brunei). In Sarawak, recorded only from the Kuching and Miri districts and in Brunei, documented for the Batu Patam area in Belait district.

**Ecology.** Mixed dipterocarp forest, sea-level to 285 m.

#### 5. *Fagraea collina* Wong & Sugau

(Latin, *collinus* = pertaining to hills; the typical habitat)

Sandakan 8 (1996) 19. **Type:** *Aban SAN 50747*, Sabah, Ranau, copper mining area (holotype SAN). **Synonym:** *F. elliptica sensu* Leenhouts, FM 1, 6 (1962) 303, Cockburn *l.c.* 210, Ashton *l.c.* 314, Anderson *l.c.* 239, *pro parte, non* Roxb. (1824).

Shrub to medium-sized tree, to 15(–20) m tall, 10(–25) cm diameter. **Bark** fissured, dark brown to black. **Sapwood** yellowish. **Leaves** *coriaceous*, upper and lower *surfaces smooth*; elliptic, oblanceolate-obovate, 4–15 × 2–7 cm; base cuneate, margin plane to slightly recurved, *apex acuminate*; midrib prominent on lower side, *lateral veins 7–9 pairs, faint to obscure on*

*both sides*, intercostal veins obscure; petioles 1.5–2 cm long, base with axillary scales adnate to the twig and forming a nodal ochrea. **Inflorescence** terminal, a many-flowered cyme, 11–18 cm long, main axis branching to 3–4 orders; peduncle 1–3.5 cm long, first branch 2.5–7 cm long. **Flowers** with pedicels 0–1 mm long; calyx campanulate, 2–3 mm long, 1.5–2 mm diameter, divided to almost halfway or more; corolla salverform, tube 6–7 mm long, 1–1.5 mm wide, lobes ovate to lanceolate, 3.5–4 mm long, 1–1.5 mm wide; stamen filaments 8–11 mm long, inserted at the corolla mouth, anthers c. 1 mm long, exsert for 6–7 mm; style exsert for 5–7 mm, stigma capitate. **Fruits** globose, 3.5–5 mm across. **Seeds** angular, c. 1 mm diameter, brownish black.

**Distribution.** Borneo, so far known only from Sabah (around Ranau and on Gaya Island on the west coast) and Sarawak (Kuching, Sibul, Bintulu and Kapit districts).

**Ecology.** Mostly in montane forest to 1700 m, sometimes lowland (Gaya island, Sabah).

## 6. *Fagraea cuspidata* Blume

(Latin, *cuspidatus* = with an abrupt, short point; the leaf apex)

Mus. Bot. Lugd. Bat. 1(1850) 170; Merrill *l.c.* (1921) 491; Masamune *l.c.* 614; Wong & Sugau *l.c.* 28. **Type:** *Blume, s.n.* (Leiden sheets no. 908.127-738, 908.127-740 & 944.202-211), Borneo, Tanjong Java (isotype L). **Synonyms:** *F. robusta* Blume, *l.c.* (1850) 170; *F. crassipes* Benth., J. Linn. Soc. Bot 1 (1856) 99; *F. cymosa* Merr., J. Str. Br. R. As. Soc. 77 (1917) 234, *l.c.* (1921) 492, Masamune *l.c.* 614; *F. pendula* Merr. *l.c.* (1929) 251, Masamune *l.c.* 615; *F. racemosa sensu* Merrill *l.c.* (1921) 493, Masamune *l.c.* 615, Leenhouts, FM 1, 6 (1962) 311, Anderson *l.c.* 240, Ashton *l.c.* 314, *pro parte, non* Jack *ex* Wall. (1824).

Small tree to 18 m tall, 12 cm diameter. **Bark** smooth to slightly fissured, dark grey. **Leaves** coriaceous, upper and lower surfaces smooth; ovate-elliptic, 8–40 × 4.5–16 cm; base cuneate-rounded to cordate, margin plane, apex abruptly short-caudate; midrib prominent on lower side, lateral veins 6–9 pairs, prominent on the lower side, faint to obscure on the upper side, intercostal veins obscure to prominent; petioles 0.5–2 cm, base with axillary scales fused to form a nodal ochrea. **Inflorescence** terminal, 5.5–34 cm long, with clusters of condensed branches in distinct tiers along the main axis, peduncle 2.5–22 cm long. **Flowers** with pedicels 7–35 mm long; calyx 7–9 mm long, 7–8 mm wide, lobes 4–5 mm long; corolla narrowly funnel-shaped, 34–59 mm long, narrowed basal part 5–6 mm long, expanded upper part 22–24 mm long, 11–18 mm wide, lobes semi-orbicular to ovate, 7–11 mm long, 6.5–9 mm wide; stamen filaments exsert for 2–3 mm, anthers 5–6 mm long; style exsert for 8–10 mm, stigma capitate. **Fruits** ovoid-ellipsoid, 13–18 mm long, 9–14 mm wide; fruit calyx lobes clasping the fruit base. **Seeds** angular.

**Vernacular names.** Sabah—*todopon puak* (Dusun). Sarawak—*sukang ranyai* (Iban), *sukong ganyai* (Iban), *tembusu gajah* (Malay), *tinggirang pirak* (Kedayan).

**Distribution.** Known only from Borneo (all districts) and the Philippines (Balabac island). Very common.

**Ecology.** Mixed dipterocarp forest, in gaps and clearings, also secondary forests and forest fringes. Lowlands to 1500 m.

### 7. *Fagraea dulitensis* Wong & Sugau

(of Mt. Dulit, Sarawak)

Sandakania 8 (1996) 59. **Type:** *Tong S. 34870*, Sarawak, 4th Div., Marudi, Ulu Sg. Tinjar, Dulit Range, near Koyan (holotype SAN, isotypes K, KEP, L, MO, SAR).

Tree, to 5 m tall, 5 cm diameter. **Bark** brown. **Leaves** thin-coriaceous, upper and lower surfaces smooth; *obovate*, 5–1.5 × 2–4.5 cm; base attenuate to cuneate, margin plane, apex acute or shortly acute-acuminate; midrib prominent on lower side, *lateral veins obscure on both sides*, intercostal veins obscure; *petioles 1–2.2 cm long*, base with conspicuous axillary scales loosely clasping the node. **Inflorescence** a solitary flower. **Flowers** subsessile or with pedicels to 0.5 cm long; bracteoles 1–2 decussate pairs, tiny (only up to 5 mm long); calyx 2 cm long, 1–1.3 cm diameter, divided more than halfway down (in bud), lobes ovate, c. 1.4 cm long; *corolla* greenish-yellow, *short-infundibular*, tube to 4.5 cm long, the upper part to 10 mm wide, lobes white, to 1.8 cm long, 1.5 cm wide; anthers brown; pistil light green. **Fruit** unknown.

**Vernacular name.** Sarawak—*jatem* (Kenyah).

**Distribution.** Borneo, known only from the type specimen from Sarawak.

**Ecology.** Recorded in old secondary forest, at c. 113 m.

### 8. *Fagraea elliptica* Roxb.

(Latin, *ellipticus* = elliptic; the leaf shape)

Fl. Ind. ed. Wall. 2 (1824) 32; Leenhouts, FM 1, 6 (1962) 303, Cockburn *l.c.* 210, Anderson *l.c.* 239, Ashton *l.c.* 314, *pro parte*; Wong & Sugau *l.c.* 21. **Type:** not designated (see Wong & Sugau *l.c.*). **Synonyms:** *Picrophloeus javanensis* Blume, *l.c.* (1826) 1020, *nom. nud.*; *Cyrtophyllum speciosum* Blume, *l.c.* (1826) 1022; *Willughbeia elliptica* (Roxb.) Spreng., Syst. Veg. 4 (1827) Cur. Post. 71; *F. speciosa* (Blume) Blume, Rumphia 2 (1838) 35, t. 81, Mus. Bot 1 (1850) 172, Merrill *l.c.* (1921) 493, Masamune *l.c.* 615; *F. picrophloea* Blume, *l.c.* (1838) 36, *nom. illeg.*, Merrill *l.c.* (1921) 492, Masamune *l.c.* 615; *F. kimangu* Blume, *l.c.* (1850) 173; *F. valida* Miq., Fl. Ind. Bat. 2 (1857) 376; *F. sumatrana* Miq. *l.c.* 377; *F. aurantiodora* S. Moore, J. Bot. 66 (1928) 105; *F. pseudoelliptica* Kanehira & Hatusima, Bot. Mag. Tokyo 56 (1942) 161, f. 5; *F. javensis* (Blume) Bakh. f. in Backer, Bekn. Fl. Java 7 (1948) fam. 170, 12, *nom. illeg.*; *F. pusilliflora* Bakh. f. in Backer *l.c.* 13, *nom. nud.*

Shrub to tree, to 25 m tall, 32 cm diameter or more, sometimes with buttresses to 45 cm high. **Bark** fissured, pale brown to dark grey-brown; inner bark cream. **Leaves** chartaceous to coriaceous, upper and lower surfaces smooth when dry; elliptic, oblanceolate-obovate, 6–15 × 3–8 cm; base cuneate, margin plane to slightly recurved, apex *cuspidate-caudate*; midrib prominent on lower side, *lateral veins* 8–12 pairs, *distinct and raised on the lower side*, flattened and indistinct to slightly raised on the upper side, intercostal veins obscure; petioles 1.5–4 cm long, base with axillary scales adnate to the twig and fused to form a nodal ochrea. **Inflorescence** terminal, a many-flowered branched cyme, 9–12 cm long, 6–21 cm wide, main axis branching 3–4 orders (occasionally to 5 orders); peduncle 3–6.5 cm long. **Flowers** with pedicels 1–3 mm long; calyx campanulate, 2–3 mm long, divided to about halfway, 2–2.5 mm diameter; *corolla* salverform, whitish, tube 6–11 mm long, 1–1.5 mm wide, lobes lanceolate,

3.5–6 mm long, 1–2 mm wide; stamen filaments 7–10 mm long, inserted at corolla mouth, anthers oblong, c. 1 mm long; style exsert for 4–6 mm, stigma small, capitate. **Fruits** globose, 3.5–6 mm across, orange to brick-red, fruit calyx lobes 1–2 mm long. **Seeds** angular.

**Distribution.** Sumatra, Java, Borneo, Sulawesi, Maluku and New Guinea. In Borneo, in all territories. In Sabah, documented for the Ranau and Penampang districts, in Sarawak, for the Miri and Kapit districts. Uncommon.

**Ecology.** Lowland primary forest, occasionally montane forest to 1600 m (on Mt. Kinabalu).

### 9. *Fagraea floribunda* Wong & Sugau

Fig. 2.

(Latin, *floribundus* = profusely flowering)

Sandakania 8 (1996) 62. **Type:** Ashton S. 16743, Sarawak, Ulu Anap, Bt. Mersing (holotype SAN, isotypes BO, K, KEP, L, MEL, SAR, SING). **Synonym:** *F. blumei sensu* Leenhouts, FM 1, 6 (1962) 320, *pro parte*, non G. Don (1837).

Tree, to 23 m tall, 60 cm diameter, sometimes with stilt-roots. **Bark** smooth, with white hoop marks. **Leaves** subcoriaceous, lower surface shagreen, upper surface smooth; broadly oblanceolate, 5–13.5 × 3–6 cm; base cuneate-attenuate, margins plane, apex broadly acute; midrib prominent on lower side, *lateral veins* 4–5 pairs, *prominent on lower side*; impressed or sunken on upper side, intercostal veins obscure; *petioles* 2–3 cm long, *base with conspicuous axillary scales loosely clasping the node*. **Inflorescence** terminal, a compound cyme, *laxly branched, short-pedunculate, 14–16 cm long, primary branches rebranching to 3 orders*. **Flowers** with pedicels 0.8–1 cm long, 3–4 mm thick; bracts subtending inflorescence branches 5–6 mm long; bracteoles 1 pair, small, 1–2 mm long, attached halfway on the pedicel; calyx campanulate, 0.9–1.2 cm long, lobes rounded, 0.3–0.5 cm across; corolla creamy yellow, c. 2.7 cm long, lobes 1–1.4 cm long, 3–4 mm wide; stamen filaments 1–1.5 cm long, anthers 3–4 mm long; style 0.9–1 cm long, stigma capitate. **Fruits** oblong, to 5 × 4 cm. **Seeds** ellipsoid.

**Distribution.** Borneo (Sarawak, documented only for the Bintulu and Mukah districts).

**Ecology.** Mixed dipterocarp forest and *kerangas* forest, also on basalt boulders, up to 700 m.

### 10. *Fagraea fragrans* Roxb.

(Latin, *fragrans* = fragrant; the flowers)

Fl. Ind. ed. Wall., 2 (1824) 32; Merrill *l.c.* (1921) 492; Masamune *l.c.* 614; Cockburn *l.c.* 211; Leenhouts, FM 1, 6 (1962) 304, Anderson *l.c.* 240, Ashton *l.c.* 310, *pro parte*; Wong & Sugau *l.c.* 11. **Type:** Hunter, *s.n.* (= Wallich, *Cat. no. 1597E*), "Pullo Penang" (K). **Synonyms:** *Cyrtophyllum peregrinum* Reinw., Syll. Pl. Nov. Soc. Bot. Ratisb. 2 (1826) 9, Blume, Bijdr. Fl. Ned. Ind. (1826) 1022; *F. peregrina* Blume, Rumphia 2 (1838) 34, t. 80, Mus. Bot. Lugd. Bat. 1 (1850) 172; *F. cochinchinensis* A. Chevalier, Cat. Pl. Jard. Bot. Saigon (1919) 65, *pro specim.*, excl. basionyms.

Medium-sized to big tree, to 35 m tall, 1.2 m diameter. **Bark** irregularly fissured, dark brown to greyish to black; inner bark yellowish, fibrous. **Wood** pale yellow. **Leaves** subcoriaceous,



**Fig. 2.** *Fagraea floribunda*. A, flowering leafy twig; B, flower; C, fruit. (A, B from S. 16743; C from S. 19455.)



upper and lower surface smooth; elliptic, 4–14 × 1.5–5 cm; base acute, decurrent on the petiole, *margin plane*, apex cuspidate; midrib prominent on the lower side, *lateral veins 9–12 pairs*, distinct, flat to only slightly prominent on the lower side, *flat and indistinct to obscure on the upper side*, intercostal veins obscure; petioles 0.5–1.8 cm long, base with axillary scales adnate to the twig and fused to form a nodal ochrea. **Inflorescence** axillary, a many-flowered cyme, 6.5–12 cm long, 4–7 cm wide, main axis branching 2–3 orders; *peduncle 4–6 cm long*. **Flowers** with pedicels 5–7 mm long; *calyx* campanulate, 2–2.5 mm long, 2–2.5 mm diameter; *corolla* infundibular, pale yellow, fragrant, tube 6–8 mm long, 1.5–2 mm wide, *lobes* ovate, (5–)6–7 mm long, 3–4 mm wide; stamens exsert, filaments 14–17 mm long, inserted just above the middle of the tube, anthers oblong-linear, c. 1.5 mm long; *style exsert for 8–10 mm*, stigma faintly 2-lobed. **Fruits** ovoid-globose, 5–6 mm long, 5–6 mm wide, orange then scarlet; fruit calyx 2–2.5 mm long, 2.5–3 mm wide. **Seeds** minute, angular.

**Vernacular names.** Sabah—*banati* (Keningau Murut), *ombinaton* (Dusun), *tambiaton*, *tambinaton* (Dusun), *temasuk*, *temasuk laut*, *temasuk pasir* (Brunei Malay). Sarawak—*tembusu* (Malay).

**Distribution.** Bengal, Myanmar, Thailand, Indo-China, Andamans, Sumatra, Java, Peninsular Malaysia, Mindoro, Balabac, Palawan, Borneo and Sulawesi. In Borneo, in all territories. In Sabah and Sarawak common only in the west coast districts, elsewhere mostly planted.

**Ecology.** Lowland forests, especially secondary or disturbed forest, sometimes in coastal or beach forest, or *kerangas* forest. Sea-level to c. 800 m.

**Uses.** Often planted along roadsides as an ornamental and shade tree. The timber is hard and very durable.

### 11. *Fagraea gigantea* Ridl.

(Latin, *giganteus* = very big; the tree)

J. Str. Br. R. As. Soc. 79 (1918) 98; Cockburn *l.c.* 211; Wong & Sugau *l.c.* 11. **Lectotype** (Wong & Sugau *l.c.*): *Ridley 5818*, Singapore, Gardens Jungle (SING). **Synonyms:** *F. speciosa sensu* Ridley, J. Str. Br. R. As. Soc. 50 (1908) 122, *non* Blume (1838); *F. sororia* J.J. Smith *ex* Cammerl., Bull. Jard. Bot. Btzg. 3, 5 (1923) 319, pl. 5; *F. fragrans sensu* Leenhouts, FM 1, 6 (1962) 304, Anderson *l.c.* 240, Ashton *l.c.* 310, *pro parte*, *non* Roxb. (1824).

Small to very large tree, to 45 m tall, 1.2 m diameter, trunk sometimes fluted, buttresses short, to 1 m high. **Bark** deeply fissured, dark brown. **Wood** orange to pale yellow. **Leaves** chartaceous to subcoriaceous, upper and lower side smooth; elliptic-obovate, 4–14 × 1.5–5.5 cm; base acute, *margin wavy*, apex caudate; midrib prominent on lower side, *lateral veins 3–8 pairs*, prominent to faint on the lower side, *often depressed on the upper side*, intercostal veins obscure; petioles 1.5–2.5 cm long, base with axillary scales adnate to the twig and fused to form a nodal ochrea. **Inflorescence** axillary, a many-flowered branched cyme, 2.5–5.5 cm long, 3–5 cm wide, main axis branching 2–3 orders; *peduncle 2–3.5 cm long*. **Flowers** with pedicels 4–7 mm long; *calyx* 3–3.5 mm long, 1.5–2 mm diameter; *corolla* salverform, tube 6–8 mm long, 1.5 mm wide, *lobes* elliptic, 4–5 mm long, 2.5–3 mm wide; stamen filaments 12–15 mm long, inserted just above the middle of the tube, anthers c. 1 mm long; *style exsert for 14–16 mm*, stigma capitate. **Fruits** globose, 3–5 mm across, yellowish, fruit calyx 3–3.5 mm long, 3–3.5 mm wide. **Seeds** minute, angular, dark brown.

**Vernacular names.** Sabah—*temasuk, temasuk hutan* (Brunçi Malay).

**Distribution.** Sumatra, Peninsular Malaysia and Borneo (all territories). In Sabah, documented for the Keningau, Sandakan and Tawau districts; in Sarawak, known in the Kuching, Baram and Limbang districts.

**Ecology.** Mixed dipterocarp forests, lowlands and hills up to 450 m.

**Uses.** The timber is hard and sometimes used for construction.

12. ***Fagraea kinabaluensis*** Wong & Sugau  
(of Mt. Kinabalu)

Fig. 3.

Sandakania 8 (1996) 69. **Type:** *Aban & Meijer SAN 93260*, Sabah, Keningau, Crocker Range FR, mile 16 (holotype SAN; isotype L). **Synonym:** *F. ceilanica sensu* Leenhouts, FM 1, 6 (1962) 315, Cockburn *l.c.* 211, *pro parte, non* Thunb. (1782).

Shrub or tree to 6 m tall, sometimes a climber or epiphyte, possibly also a strangler. **Leaves** thin-coriaceous, upper and lower surfaces shagreen; *narrowly elliptic to slightly obovate*, 5–11 × 2–3.5 cm; base acute to attenuate, margin slightly recurved when dry, apex acuminate to caudate; midrib prominent on lower side, *lateral veins obscure on both sides*, intercostal veins obscure; *petioles less than 1 cm long*, base with inconspicuous axillary scales. **Inflorescence** a solitary terminal flower. **Flowers** with pedicels 2–3 mm long; bracteoles two pairs, small, 2–3 mm long; calyx cup-shaped, 2.2–2.6 cm long, 1.2–1.3 cm diameter, divided to its middle, lobes 1.7–1.8 cm long; *corolla short-infundibular*, divided more than halfway down, *tube 3–4 cm long, upper part 2–2.5 cm across, lobes 2.5–3 cm long, 1.5–2.5 cm wide*. **Fruits** ellipsoid, mucronate, 3–3.5 cm long, 2.5–2.7 cm across; fruit calyx lobes patent. **Seeds** rounded, brown.

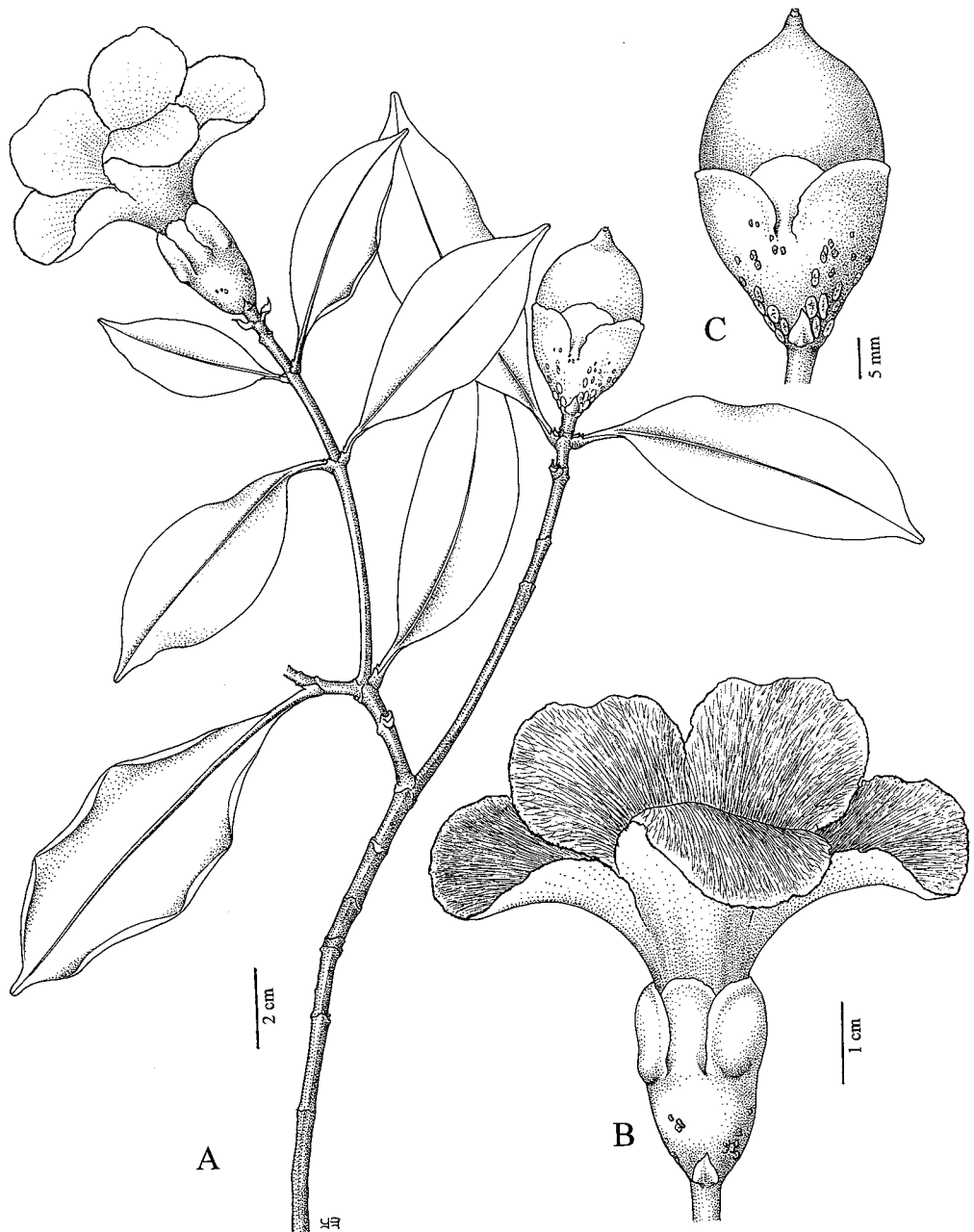
**Distribution.** Endemic to Borneo (Sabah). In Sabah, documented only on the Crocker Range (including Mt. Kinabalu) and its foothills, and Mt. Silam on the east coast.

**Ecology.** Montane forests.

13. ***Fagraea montana*** Wong & Sugau  
(Latin, *montanus* = of mountains; the typical habitat)

Sandakania 8 (1996) 31. **Type:** *Aban SAN 50722*, Sabah, Ranau, copper mining area (holotype SAN, isotypes K, L). **Synonyms:** *F. minor sensu* Merrill *l.c.* (1921) 492, Masamune *l.c.* 614, *non* Reinw. *ex* Blume (1826); *F. racemosa sensu* Leenhouts, FM 1, 6 (1962) 311, Cockburn *l.c.* 210, *pro parte, non* Jack *ex* Wall. (1824).

Tree to 40 m tall, 90 cm diameter, buttresses to 1.3 m high. **Bark** fissured to scaly, brown; inner bark fibrous, laminated, yellow to reddish. **Wood** pale yellow. **Leaves** coriaceous, upper and lower surface smooth; *elliptic-obovate*, 3.5–13.5 × 1.5–5.5 cm; base cuneate, margin plane to slightly recurved, apex abruptly caudate; midrib prominent on lower side, *lateral veins 4–5 pairs, faint to obscure on both sides*, intercostal veins obscure; *petioles 0.7–2 cm long*, base with axillary scales fused to form a nodal ochrea. **Inflorescence** terminal, 4.5–14 cm long,



**Fig. 3.** *Fagraea kinabaluensis*. A, flowering leafy twig; B, detail of flower; C, fruit. (All from SAN 93260.)

with clusters of condensed branches in distinct tiers along the main axis; peduncle 1.5–5.5 cm long. **Flowers** with pedicels 6–12 mm long; calyx 4–4.5 mm long, 4–6.5 wide, lobes 2.5–3 mm long; *corolla* funnel-shaped, 18–20 mm long, narrowed basal part 7–8 mm long, expanded upper part 5–6 mm long, 6–7.5 mm wide, lobes ovate, 4.5–5 mm long, 3–3.5 mm wide; stamens inserted at the base of the inflated part of the corolla, *anthers* 1 mm long, included or just visible at the throat; style exerted for 4–5 mm, stigma capitate. **Fruits** ovoid-globose, 9–15 mm long, 8–11 mm wide; fruit calyx lobes patent to clasping the fruit base. **Seeds** angular.

**Vernacular name.** Sarawak—*bira parak* (Kelabit).

**Distribution.** Endemic to Borneo (Sabah and Sarawak). In Sabah, known only in the Crocker Range (including Mt. Kinabalu) and its foothills; in Sarawak, documented for the Baram and Kapit districts.

**Ecology.** Montane forests, usually 1000–1600 m.

#### 14. *Fagraea philippinensis* Wong & Sugau

(of the Philippines)

Sandakania 8 (1996) 35. **Type:** *Ahern's Coll., For. Bur. 3270*, Philippines, Luzon, Rizal (holotype K).

**Synonym:** *F. racemosa sensu* Leenhouts, FM 1, 6 (1962) 311, Anderson *l.c.* 240, Ashton *l.c.* 314 (as "Form 4"), *pro parte, non* Jack *ex* Wall. (1824).

Small tree, 3–10 m tall, to 13 cm diameter. **Bark** fissured, grey. **Leaves** coriaceous, upper and lower surfaces smooth; elliptic-oblong, 8–23 × 3.5–10.5 cm; base cuneate rounded or cordate, margin plane to recurved, apex acuminate-short caudate; midrib prominent on lower side, lateral veins 4–8 pairs, slightly prominent on the lower side, faint to obscure on the upper side, intercostal veins obscure; petioles 0.6–1.5 cm long, the base with axillary scales forming a nodal ochrea. **Inflorescence** terminal, 4.5–19 cm long, with clusters of condensed branches in distinct tiers along the main axis; peduncle 2.5–8.5 cm long. **Flowers** with pedicels 2–6 mm long; *calyx* 7–9 mm long, 5–8 mm wide, lobes 4–6 mm long; *corolla* salverform, 34–46 mm long, narrowed basal part 7–12 mm long, expanded upper part 12–16 mm long, 20–22 mm wide, lobes ovate, 10–12 mm long, 9–10 mm wide; stamen filaments inserted at the base of the inflated part, *anthers* included, 3.5–4 mm long; style exert for 5–7 mm. **Fruits** ellipsoid, 9–11 mm long, 7–9 mm wide; fruit calyx lobes clasping the fruit base. **Seeds** angular.

**Distribution.** Philippines, Borneo (Sarawak and Kalimantan). In Sarawak, documented for the Kuching and Limbang districts.

**Ecology.** Mixed dipterocarp forest and *kerangas* forest, to 600 m.

#### 15. *Fagraea resinosa* Leenh.

(Latin, *resinosus* = resinous; the shoot tips and flower buds)

Bull. Jard. Bot. Brux. 32 (1962) 429; Wong & Sugau *l.c.* 86. **Type:** *Hallier 3162*, Amai Ambit (holotype L; isotype BO).

Tree to 25 m tall, 80 cm diameter, also recorded as an epiphyte or climber. **Bark** smooth, sometimes covered with big lenticels, whitish brown; inner bark pale yellow. **Leaves** thick coriaceous, upper surface slightly coarse, lower surface shagreen; broadly obovate, 10–18 × 4–8 cm; base cuneate, margin slightly recurved when dry, apex acute with short acumen; midrib prominent on the lower side, *lateral veins* 7–8(–11) pairs, *faint to sunken on both sides*, intercostal veins obscure; *petioles* 1–2.5 cm long, *base with conspicuous axillary scales loosely clasping the node, auricles indistinct or absent*. **Inflorescence** terminal, with a solitary or a pair of flowers, rarely a sessile 3-flowered cyme. **Flowers** with pedicels 2.5–3 cm long; *bracteoles large, 2–3 pairs, with rounded apices, attached to calyx cup base and forming an involucre*; calyx 2.5–3 cm long, *c. 1.5 cm diameter*; corolla tubular, white, fragrant, tube 8–9 cm long, contracted lower part *c. 0.6 cm diameter*, expanded upper part *c. 2 cm wide*, lobes ovate, *c. 3 cm long, 2.5 cm wide*; anthers broadly oblong, *c. 6 mm long*; stigma dish-shaped, *c. 2.5 mm diameter*. **Fruits** ellipsoid, 5.5–6 cm long, 3.5–4 cm wide, fruit calyx 4–4.5 cm long, 2.5–3 cm wide. **Seeds** ellipsoid-rounded.

**Vernacular name.** Sarawak—*terongau paya* (Kelabit).

**Distribution.** Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, documented only for the Ranau district; in Sarawak, recorded for the Kuching, Kapit, Miri and Limbang districts.

**Ecology.** Montane forest, up to 1500 m; also recorded at *c. 1000 m* on limestone on Mt. Api in Sarawak.

#### 16. *Fagraea rugulosa* Wong & Sugau

Fig. 4.

(Latin, *rugulosus* = wrinkled; the coarse leaf surface)

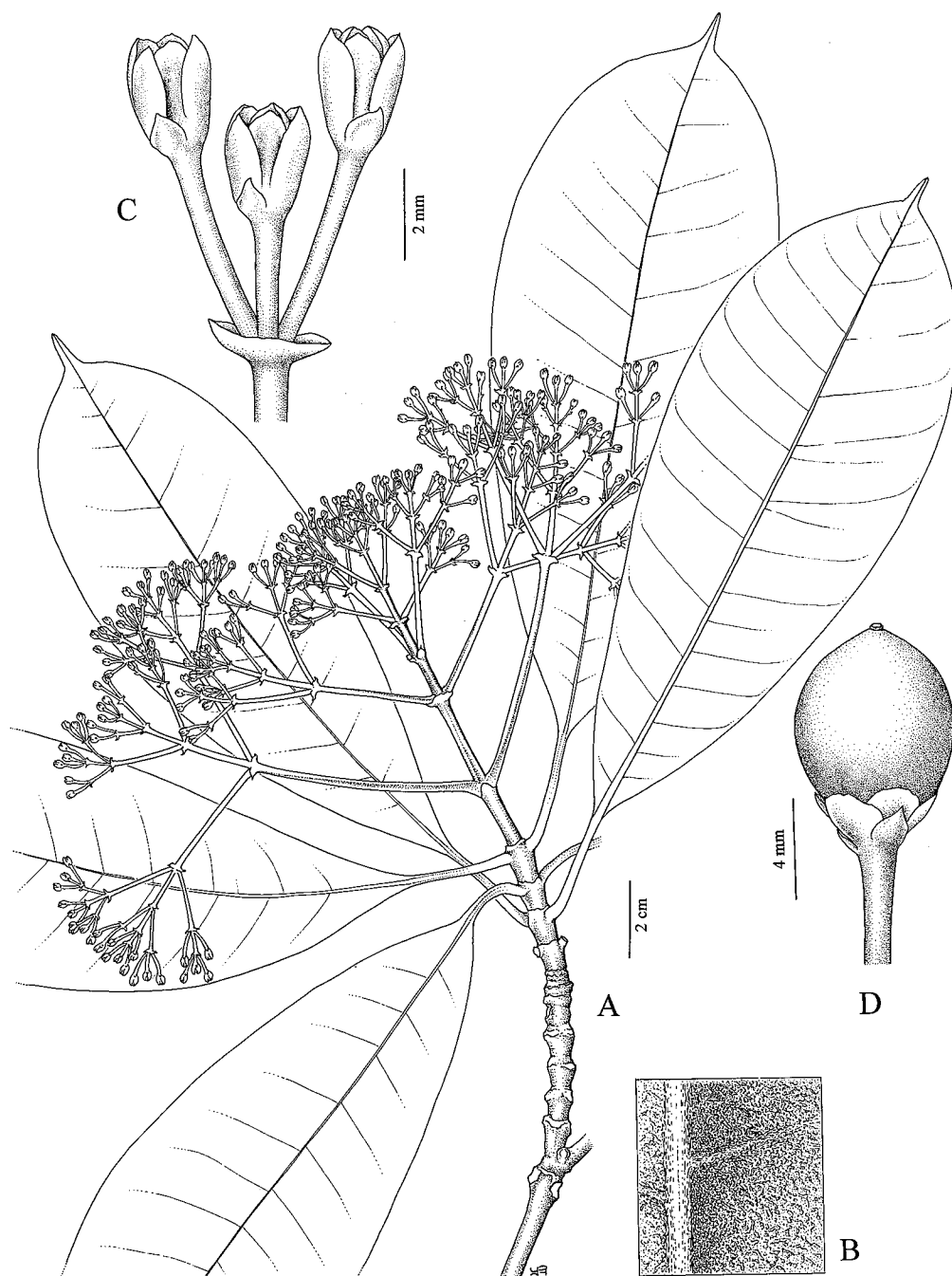
Sandakan 8 (1996) 22. **Type:** *Chai & Illias S. 27929*, Sarawak, 5th Div., Ulu Lawas, near Sg. Telau, Kota FR (holotype SAN; isotypes A, BO, K, KEP, L, SING). **Synonym:** *F. elliptica sensu* Leenhouts FM 1, 6 (1962) 303, Ashton *l.c.* 314, Anderson *l.c.* 239, *pro parte, non* Roxb. (1824).

Tree to 15 m tall, 25 cm diameter. **Bark** lightly fissured, dark brown; inner bark dark brown. **Leaves** coriaceous, upper and lower *surfaces very coarsely shagreen and rough*; elliptic-obovate, 11–21 × 5–9 cm; base cuneate, margin recurved when dry, *apex cuspidate*; midrib prominent on lower side, *lateral veins* 9–12 pairs, *faint to obscure on both sides*, intercostal veins obscure; *petioles* 2–3.5 cm long, *base with axillary scales adnate to the twig and fused to form a nodal ochrea*. **Inflorescence** *terminal, a many-flowered branched cyme, c. 6 cm long, c. 15 cm wide, main axis branching 3–4 orders*, first branch 2.5–6 cm long; peduncle 1–2 cm long. **Flowers** with pedicels 2–3 mm long; *calyx* campanulate, *3–4 mm long, 2–3.5 mm diameter*, divided almost to its base; *corolla* salverform, tube 10–11 mm long, 1–1.5 mm wide, *lobes lanceolate, 5–8 mm long, 2–2.5 mm wide*; *stamen filaments 15–18 mm long*, inserted at corolla mouth, anthers *c. 1 mm long*; style exsert for 10–11 mm; stigma capitate. **Fruits** globose, *(6–)9–10 mm across*; fruit calyx 2–3 mm long, 2–3 cm wide. **Seeds** angular, *c. 1 mm diameter*.

**Vernacular name.** Sabah—*tamasuk jantan* (Brunei Malay).

**Distribution.** Borneo: SW Sabah, Sarawak (Lawas and Baram area only) and Brunei.

**Ecology.** Mixed dipterocarp and *kerangas* forests, up to 450 m.



**Fig. 4.** *Fagraea rugulosa*. A, flowering leafy twig; B, detail of rough lower leaf surface; C, ultimate cyme-like unit of the inflorescence, in bud; D, fruit. All from S. 27929, except D from S. 16603.)

17. *Fagraea spicata* Baker

(Latin, *spicatus* = spike-like; the inflorescence)

Kew Bull. (1896) 25; Merrill *l.c.* (1921) 493; Masamune *l.c.* 615; Wong & Sugau *l.c.* 38. **Type:** *Creagh, s.n.*, British North Borneo, East Coast (holotype K). **Synonyms:** *F. congestiflora* Elmer, *Leaf. Philip. Bot.* 8 (1915) 2741; *F. racemosa sensu* Leenhouts, *FM* 1, 6 (1962) 311, *Cockburn l.c.* 210, *Anderson l.c.* 240, *Ashton l.c.* 314, *pro parte, non Jack ex Wall.* (1824).

Tree, to 17 m tall and 30 cm diameter or more. **Bark** smooth to fissured, brown. **Leaves** chartaceous to thin coriaceous, upper and lower surfaces smooth; ovate-elliptic, 10–30 × 5–14 cm; *base cordate*, margin plane, apex acuminate-short caudate, midrib prominent on lower side, lateral veins 9–15 pairs, prominent on lower side, faint to obscure on upper side, intercostal veins obscure; *petioles indistinct*, 0.2–0.5 cm long, base with axillary scales fused to form a nodal ochrea. **Inflorescence** terminal, 4–13 cm long, with clusters of condensed branches in distinct tiers along the main axis; peduncle 1–3 cm long. **Flowers** with pedicels 2–7 mm long; *calyx* campanulate, 5–6 mm long, 3.5–5.5 mm wide, lobes 1.5–2.5 mm long; *corolla* infundibular, 32–41 mm long, narrowed basal part 11–12 mm long, expanded upper part 20–28 mm long, 12–17 mm wide, lobes ovate, 5.5–7 mm long, 5–6.5 mm wide; stamen filaments short, inserted at base of the inflated part, anthers included, 2.5–4 mm long; style 3–3.5 cm long, included or barely exsert, stigma capitate. **Fruits** ovoid-globose, 8–12 cm long, 8–10 mm wide, *fruit calyx lobes patent*. **Seeds** angular.

**Vernacular names.** Sabah—*todopon puak* (Dusun). Sarawak—*sira* (Kelabit).

**Distribution.** Borneo (Sabah, Sarawak, Brunei and Kalimantan) and the Philippines. In Sabah, documented only for the east coast districts, but probably more widespread; in Sarawak known for the Bintulu, Kapit and Miri districts.

**Ecology.** Lowlands to montane forest (to *c.* 3200 m), frequently in gaps and also secondary forests.

18. *Fagraea stenophylla* Becc. *ex* Merr.

(Greek, *stenos* = narrow, *phullon* = leaf)

*J. Str. Br. R. As. Soc.* 77 (1917) 236, *l.c.* (1921) 493; Masamune *l.c.* 615; Wong & Sugau *l.c.* 38. **Type:** *Native coll., Bur. Sci.* 2828, Sarawak, Upper Baram, Selongo (holotype PNH, destroyed; isotypes A, UC). **Synonyms:** *F. eucalyptifolia* Cammerl., *Bull. Jard. Bot. Btzig.* 3, 5 (1923) 312, f. 2; *F. racemosa sensu* Leenhouts, *FM* 1, 6 (1962) 311, *Cockburn l.c.* 210, *Anderson l.c.* 240, *Ashton l.c.* 314 (as “Form 5”), *pro parte, non Jack ex Wall.* (1824).

Small tree to 4 m tall. **Bark** smooth. **Leaves** coriaceous, upper and lower surfaces smooth; *linear*, 12–27 × 0.7–2.7 cm; base cuneate, margin recurved when dry, apex acuminate to caudate; midrib prominent on lower side, *lateral veins 7–14 pairs, faint to obscure on both sides*, intercostal veins obscure; *petioles* 1.3–2.2 cm long, base with axillary scales fused to form a nodal ochrea. **Inflorescence** terminal, 3.5–15 long, with clusters of condensed branches in distinct tiers along the main axis; peduncle 1.5–5.5 cm long. **Flowers** with pedicels 3–6 mm long; *calyx* campanulate, 5–6 mm long, 5–6 mm wide, lobes 3–4 mm long; *corolla* funnel-shaped, 20–27 mm long, narrowed basal part 8–10 mm long, expanded upper part 10–11 mm

long, 7–8 mm wide, lobes semi-orbicular, 7–9 mm long, 4.5–5 mm wide; stamen filaments short, inserted at the base of the inflated part of the corolla tube, *anthers* included, 2–2.5 mm long; style included, stigma capitate. **Fruits** ellipsoid, 10–14 mm long, 6–9 mm wide, fruit calyx lobes clasping the fruit base to patent. **Seeds** angular.

**Distribution.** Endemic to Borneo (Sarawak, Kalimantan, Sabah and Brunei). In Sabah, documented for the Sipitang, Penampang and Keningau districts in the SW; in Sarawak, recorded for the Kapit, Miri and Limbang districts.

**Ecology.** A rheophyte, on banks of swift-running streams in the lowlands to 180 m.

### 19. *Fagraea teysmannii* Cammerl.

(J.E. Teysmann, 1808–1882, Curator of the Bogor Botanic Gardens)

Bull. Jard. Bot. Btsg. 3, 5 (1923) 314. f. 3; Wong & Sugau *l.c.* 40. **Lectotype** (Wong & Sugau *l.c.*): *Teymann, s.n.*, Karimata, Soengei Tajan (L). **Synonym:** *F. racemosa sensu* Leenhouts, FM 1, 6 (1962) 311, Anderson *l.c.* 240, Ashton *l.c.* 314 (as “Form 5”), *pro parte, non* Jack *ex* Wall. (1824).

Tree, to 10 m tall, *c.* 20 cm diameter. **Bark** smooth, brown. **Leaves** coriaceous, upper and lower surfaces smooth; elliptic, oblong, 4.5–16 × 1.5–6 cm; base cuneate to rounded, margin recurved when dry, apex acuminate; midrib prominent to flattened on the lower side, lateral veins 4–7 pairs, faint to obscure on both sides, intercostal veins obscure; petioles 0.6–1.7 cm long, base with axillary scales adnate to the twig and fused to form a nodal ochrea. **Inflorescence** terminal, 2–10 cm long, with clusters of condensed branches in distinct tiers along the main axis; peduncle 1–5 cm long. **Flowers** with pedicels 2–7 mm long; *calyx* 7–8 mm long, 5–6 mm wide, lobes 3–4 mm long; *corolla* infundibular, 26–39 mm long, narrowed basal part 6–7 mm long, expanded upper part 13–14 mm long, 10–12 mm wide, lobes semi-orbicular, 7–8 mm long, 5–6 mm wide; stamen filaments short, inserted at the base of the inflated part of the corolla tube, *anthers* included, *c.* 1.5 mm long; style included or barely exsert, 2.5–3 cm long, stigma capitate. **Fruits** ovoid-ellipsoid, 7–8 mm long, 5–7 mm wide, fruit calyx clasping the fruit base. **Seeds** angular.

**Vernacular names.** Sarawak—*kapan, uchip bali* (Kenyah).

**Distribution.** Endemic to Borneo (Sabah, Sarawak and Kalimantan). In Sabah, documented for the Tambunan district, in Sarawak for the Kapit district.

**Ecology.** In montane forests, to 1250 m.

### 20. *Fagraea volubilis* Wall.

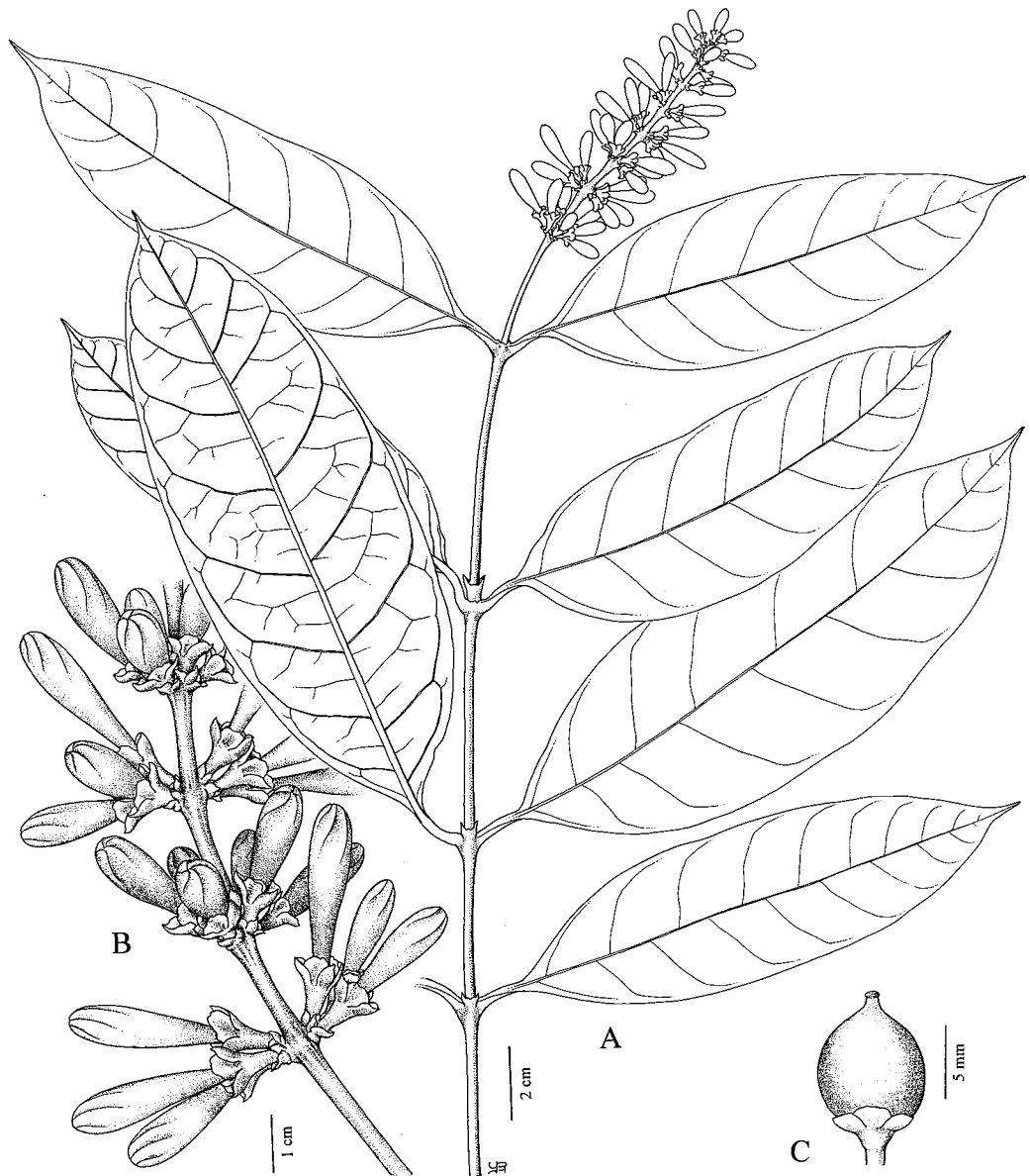
Fig. 5

(Latin, *volubilis* = twining; a habit wrongly attributed to this species)

In Roxb., Fl. Ind. 2 (1824) 36; Wong & Sugau *l.c.* 40. **Type:** *Jack, s.n.*, E Bencoolen (holotype K, sheet marked “1600 E. Bencoolen” on bottom left).

Tree to 14 m tall, 20 cm diameter or more. **Bark** fissured or cracking, dark brown; inner bark pale brown. **Sapwood** yellowish. **Leaves** coriaceous, upper and lower surfaces smooth; ovate, elliptic to oblong, 9–24 × 4–15 cm; base cuneate, rounded to subcordate, margin plane, apex





**Fig. 5.** *Fagraea volubilis* var. *microcalyx*. A, flowering leafy twig; B, detail of part of inflorescence; C, fruit. (All from S. 35683.)

acuminate to short caudate; midrib prominent on lower side, lateral veins 5–11 pairs, prominent on the lower side, faint to obscure on the upper side, intercostal veins obscure; petioles 1–2 cm long, stout, base with axillary scales fused to form a nodal ochrea. **Inflorescence** terminal, 2–30 cm long, with clusters of branches in distinct well-spaced tiers along the main axis, these branches typically condensed but rarely elongate; peduncle 2.5–17 cm long. **Flowers** with pedicels 3–13 mm long; calyx 4–6 mm long, 3.5–6 mm wide, lobes 1.5–3.5 mm long; corolla broadly infundibular, 26–34 mm long, narrowed basal part 10–12 mm long, expanded upper part 8–10 mm long, 13–15 mm wide, lobes semi-orbicular to ovate, 7–12 mm long, 7.5–9 mm wide; stamen filaments inserted at the base of the inflated part of the corolla tube, anthers included, 2.5–3 mm long; style barely exsert for 2–3 mm, stigma capitate. **Fruits** ovoid to ellipsoid, 11–16 mm long, 8–12 mm wide, tipped with persistent style base; fruit calyx lobes patent. **Seeds** tiny, angular, black.

### Key to varieties

Calyx lobes 3–3.5 mm long.....

#### var. **volubilis**

Synonyms: *F. morindaefolia* Blume, Rumphia 2 (1838) 32, t. 73 f. 2, t. 79; *F. coarctata* Blume l.c. (1838) 33, Merrill l.c. (1921) 491, Masamune l.c. 613; *F. scholaris* Blanco, Fl. Filip. ed. 2 (1845) 93, ed. 3, 1 (1877) 171; *F. appendiculata* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 169; *F. subreticulata* Blume l.c. (1850) 171; *F. latifolia* Miq., Fl. Ind. Bat. 2 (1857) 369; *F. rodatzii* Laut. & Schum., Fl. Schutzgeb. (1900) 499; *F. grandifolia* Merr., J. Str. Br. R. As. Soc. 77 (1917) 231, l.c. (1921) 492, Masamune l.c. 614; *F. racemosa* var. *pauciflora* King & Gamble, J. As. Soc. Beng. 74, 2 (1908) 609; *F. pauciflora* (King & Gamble) Ridl., FMP 2 (1923) 419, f. 110; *F. racemosa sensu* Leenhouts, FM 1,6 (1962) 311, Cockburn l.c. 210, Anderson l.c. 240, Ashton l.c. 314 (as "Form 5"), *pro parte, non* Jack ex Wall. (1824).

The Andaman and Nicobar islands, Sumatra, Peninsular Malaysia, Java, Borneo (Sabah, Sarawak, and Kalimantan), the Philippines, Sulawesi, Maluku and New Guinea. In Sabah, known from the Sipitang, Beaufort, Papar, Tenom, Keningau, Kota Belud, Labuk Sugut and Sandakan districts; in Sarawak, from the Kuching and Miri districts. Lowland rain forest, including secondary forest and forest fringes, up to 1100 m, also in *kerangas* and peat swamp.

Calyx lobes 1.5–2.5 mm long.....

#### var **microcalyx** Wong & Sugau

l.c. 43. Synonyms: *F. ligustrina* Blume, Rumphia 2 (1838) 33 (including var. *disparifolia* Blume), Merrill l.c. (1921) 492, Masamune l.c. 614; *F. cordifolia* Blume, l.c. (1838) 33, Merrill l.c. (1921) 491, Masamune l.c. 613; *F. gracilis* Cammerl., Bull. Jard. Bot. Btzg. 3, 5 (1923) 316; *F. racemosa sensu* Leenhouts, FM 1, 6 (1962) 311, Anderson l.c. 240, Ashton l.c. 314 (as "Form 3"), *pro parte, non* Jack ex Wall. (1824).

Borneo (Sarawak, Brunei and Kalimantan) and Maluku. In Sarawak, documented for the Kuching, Sibiu and Bintulu districts. Lowlands; peat swamps, mixed dipterocarp forest and *kerangas* forest.

**Vernacular names.** Sabah—*todopon puok* (Dusun). Sarawak—*sokong ranyai* (Iban), *tembusu* (Malay).

## 2. GENIOSTOMA J.R. Forst. & G. Forst.

(Greek, *geneion* = bearded, *stoma* = mouth; the hairy corolla throat)

Char. Gen. Pl. 12 (1776) t. 12; Valetton, Bull. Inst. Bot. Btzg. 12 (1902) 1; Leenhouts, FM 1, 6 (1962) 369; A.C. Smith & Stone, Contrib. U.S. Nat. Herb. 37 (1962) 1; Conn, Blumea 26 (1980) 245.

*Shrubs or treelets. Leaves pinnately nerved; petioles distinct or very short, the base expanded to form a distinct cup-like ochrea. Inflorescence axillary*, sometimes at leafless nodes, a cyme or sometimes a solitary flower; minute bracteoles often present. **Flowers** (4-)5-merous, gynodioecious (with female and bisexual flowers together); sepals fused at the very base, margin ciliate; *corolla campanulate to rotate*, greenish white, lobes imbricate or contorted in bud, outside glabrous or short-hairy, inside glabrous or densely woolly, especially at the throat; stamens inserted in the throat, exsert, filaments usually short, anthers 2-locular; ovary 2-locular, ovules many, style often very short, stigma club-shaped or ellipsoid to globular, about as large as the ovary. **Fruit a capsule**, splitting into 2 parts. **Seeds** numerous, ellipsoid to subglobular, intruded on the hilar side, minutely warty, embedded in a juicy pulp.

**Distribution.** About 20–40 species, mainly in the Pacific region, extending to S Japan (Kyushu) and to Australia, Lord Howe Island, New Zealand, New Caledonia and the Society Islands in the east. Four species occur in Malesia, 3 of which are restricted to New Guinea; 1 species in Sabah.

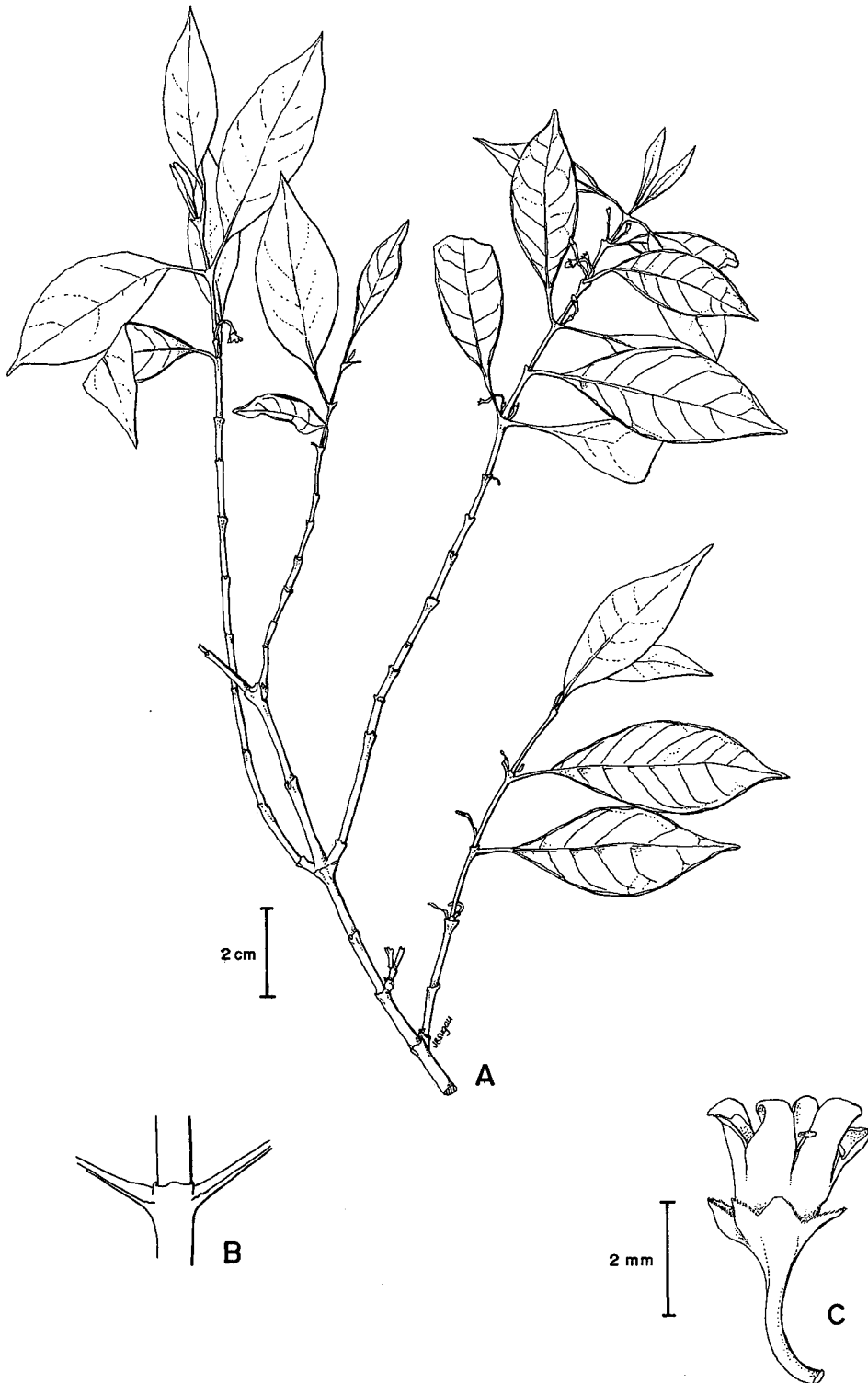
### **Geniostoma rupestre** J.R. Forst. & G. Forst.

Fig. 6.

(Latin, *rupestris* = rock-dwelling)

Char. Gen. Pl. 12 (1776) t. 12; Valetton *l.c.* 12, 17, f. 1. **Lectotype** (A. C. Smith & Stone *l.c.*): *J. R. & G. Forster 30, s. dat.*, Tanna, New Herbrides (BM; *J. R. & G. Forster, s.n., s. dat.*, Tanna, New Herbrides at K is believed to be the isoelectotype). **Synonyms:** *G. micranthum* DC., Prod. 9 (1845) 27; *G. montanum* Zoll. & Moritz in Moritz, Syst. Verz. (1846) 58; *G. lasiostemon* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 239; *G. cumingianum* Benth., J. Linn. Soc. Bot. 1 (1856) 97, Merr., En. Philip. 3 (1923) 310; *G. avene* Valetton, Bull. Inst. Bot. Btzg. 12 (1902) 23 & 16; *G. celebicum* Valetton *l.c.* 19 & 15, f. 7 & 13; *G. miquelianum* Koord. & Valetton ex Valetton *l.c.* 22 & 14, f. 11, 12 & 16; *G. moluccanum* Valetton, *l.c.* (1902) 19 & 15, f. 4, Cammerl., Bull. Jard. Bot. Btzg III, 5 (1923) 297; *G. oblongifolium* Koord. & Valetton ex Valetton *l.c.* (1902) 20 & 15, f. 5 6 & 14; *G. philippinensis* Merr., Philip. J. Sc. 3 (1908) Bot. 259; *G. batanense* Merr., *ibid.* 3 (1909) Bot. 427, *l.c.* (1923) 309; *G. stenophyllum* Merr., Philip. J. Sc. 7 (1912) Bot. 329, non Gilg. & Bened. (1916); *G. brevipes* Merr., Philip. J. Sc. 9 (1914) Bot. 384; *G. laxa* Elm., Leafl. Philip. Bot. 8 (1915) 2746; *G. mindanaense* Elm., Leafl. Philip. Bot. 8 (1915) 2747; *G. longipes* Merr., Philip. J. Sc. 12 (1917) Bot. 296; *G. pachyphyllum* Merr., Philip. J. Sc. 14 (1919) 448; *G. lancilimbus* Merr., Philip. J. Sc. 17 (1921) 304; *G. ramosii* Merr., Philip. J. Sc. 17 (1921) 304; *G. fasciculata* Quis. & Merr., Philip. J. Sc. 37 (1928) 190.

Shrub or small tree, to 4(–10) m tall. Branches terete, rarely quadrangular, glabrous or the young twigs shortly yellowish brown hairy. **Leaves chartaceous to thin-coriaceous**, glabrous, ovate to elliptic, 4–6 × 1.5–2.5 cm; base cuneate, apex gradually tapering to acuminate, *margins strongly recurved when dry*; midrib prominent, lateral veins 6–7 pairs, intercostal veins loosely reticulate and flat to slightly prominent on both surfaces; *petioles* 0.5–1.5 cm long, *the expanded bases forming a distinct cup-like ochrea 1–2 mm high around the node*. **Inflorescence** several-flowered, 0.5–1.5 cm long, glabrous; bracteoles small. **Flowers** with



**Fig. 6.** *Geniostoma rupestre*. A, flowering leafy twigs; B, detail of node, showing cup-shaped ochrea; C, flower. (All from RSNB 4708.)

pedicels 1–5 mm long; calyx 0.5–2 mm long, lobes ovate to triangular, acute, outside glabrous, margin ciliate; corolla white, 1.5–4.5 mm long, outside glabrous or rarely fairly densely papillose-hairy, inside densely to sparsely hairy at the throat, lobes 0.5–2.5 mm long, blunt to acute; stamens with filaments 0.5–1 mm long, glabrous or hairy, anthers 0.7–1.2 mm long; ovary glabrous to densely shortly hairy, style very short (less than 0.2 mm). **Fruits** somewhat flattened-globose, rarely ellipsoid, ovoid, or obovoid 4–8(–12) × 4–6(–9) mm, black when ripe. **Seeds** ellipsoid, dark brown.

**Distribution.** Widely distributed in Malesia (except in Peninsular Malaysia), E Queensland and the W Pacific. In Borneo, so far recorded only from Sabah, at about 2000 m on Mt. Kinabalu.

**Ecology.** The species has a wide ecological amplitude, recorded from sea-level to 2800 m elevation, in both forest as well as exposed sites. It is, however, apparently uncommon in Borneo.

### 3. NORRISIA Gardner

(William Norris, 1793–1859, a British judge in colonial SE Asia)

In Hooker, J. Bot. Kew Misc. 1 (1849) 326; Merrill, EB (1921) 490; Masamune, EPB (1942) 616; Leenhouts, FM 1, 6 (1962) 293; Cockburn, TS 1 (1976) 207; Anderson, CLTS (1980) 240; Ashton, MNDTS 2 (1988) 317.

*Trees.* Twigs often terete, covered with brown hairs when young. **Leaves** elliptic to oblong, base attenuate to cuneate, apex rounded to acute or acuminate; *pinnately veined; petiole bases connected by a ridge-like thickening or forming a low inconspicuous ochrea not more than 1 mm high.* **Inflorescence** terminal, densely brown-hairy, a dichasially-branched to compound cyme, many-flowered; bracts narrowly triangular. **Flowers** fragrant, subsessile, with two pairs of decussate bracteoles at the base; calyx cupular, tube very short, lobes broadly rounded, densely hairy outside, glabrous inside; corolla salver-shaped, creamy to yellowish, densely hairy outside, lobes valvate in bud; stamens inserted between the corolla lobes; ovary obovoid, densely short-hairy, 2-locular, ovules many, style terete, *stigma knob-like and slightly bilobed.* **Fruits** capsular, *splitting down the septa into 2 parts.* **Seeds** few to many, small, spindle-shaped, glabrous, smooth; endosperm fleshy.

**Distribution.** Two closely related species, distributed from Sumatra, Peninsular Malaysia, Borneo to the Philippines. Both species in Sabah and Sarawak.

#### Key to *Norrisia* species

Leaf lateral veins not looping except for the distal-most 2–3 pairs, which arch and join close to the margin; midrib on upper side distinctly short-hairy (×10 magnification). Mouth of the corolla villous-hairy. Anthers suborbicular, c. 0.5 mm across. Fruits larger, 4–10 mm long.....  
 .....1. *N. maior*

Leaf lateral veins distinctly arched and joined at some distance from the margin; midrib on upper side glabrous. Mouth of the corolla only sparsely hairy to glabrous. Anthers oblong, *c.* 0.8 mm long. Fruits smaller, 2–3.5 mm long.....2. *N. malaccensis*

### 1. *Norrisia maior* Soler.

(Latin, *maior* = bigger; the fruit compared with *N. malaccensis*)

In Engl. & Prantl, Nat. Pfl. Fam. 4, 2 (1892) 37; Cockburn *l.c.* 212; Anderson *l.c.* 240; Ashton *l.c.* 317. **Type:** *s. coll., s.n.*, Malacca (K). **Synonyms:** *N. malaccensis sensu Merr., l.c.* (1921) 490, *non* Gardner (1849); *N. malaccensis* var. *major* Ridl., FMP 2 (1923) 414.

Tree to 50 m tall, 75 cm diameter; buttresses to 3.2 m high. **Bark** smooth to slightly fissured, dark brown; inner bark pale brown. **Sapwood** pale yellow to white. **Leaves** thin-coriaceous, elliptic, 2.5–4.5 × 2.5–9.5 cm; base attenuate to cuneate, apex acuminate, acute or rounded; *midrib* prominent and glabrous to hairy on lower side, flat to slightly channelled and distinctly *short-hairy on upper side, lateral veins* 6–10 pairs, *the distalmost 2–3 pairs arching and joining close to the margin*, intercostal veins subreticulate; petioles 0.3–0.5 cm long. **Inflorescence** 5.5–10.5 cm long, peduncle 4–5 cm long; bracts to 2 mm long. **Flowers** yellowish green, calyx 0.5–1 cm high, divided to halfway down, densely hairy; corolla 6–8 mm long, inside *villous-hairy at the mouth*, outside minutely hairy, lobes 1–2 mm long, inside glabrous; stamens 4–5 mm long, *anthers suborbicular, c. 0.5 mm diameter*; ovary *c.* 1.5 mm long; style 7–8 mm long. **Fruits** obovoid, 4–10 × 2–4 mm. **Seeds** *c.* 5–20 per locule, *c.* 4 mm long.

**Vernacular names.** Sabah—*simpapait* (Putatan Dusun). Sarawak—*bannang* (Padawan Bidayuh), *belet* (Kenyah), *bi'is* (Bau Bidayuh), *empaling* (Iban), *gunnong* (Sadong Bidayuh), *mepa* (Berawan, Tutoh Punan), *nyvang* (Kayan).

**Distribution.** Sumatra (Palembang), Banka, Riouw, Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded for all W coast districts and the Kota Belud, Keningau, Telupid, Sandakan and Kinabatangan districts. In Sarawak, common throughout.

**Ecology.** Primary and secondary forest, often along river banks, also in swamp forest, to 450 m. Flowering recorded in January and June to August, fruiting in February and September.

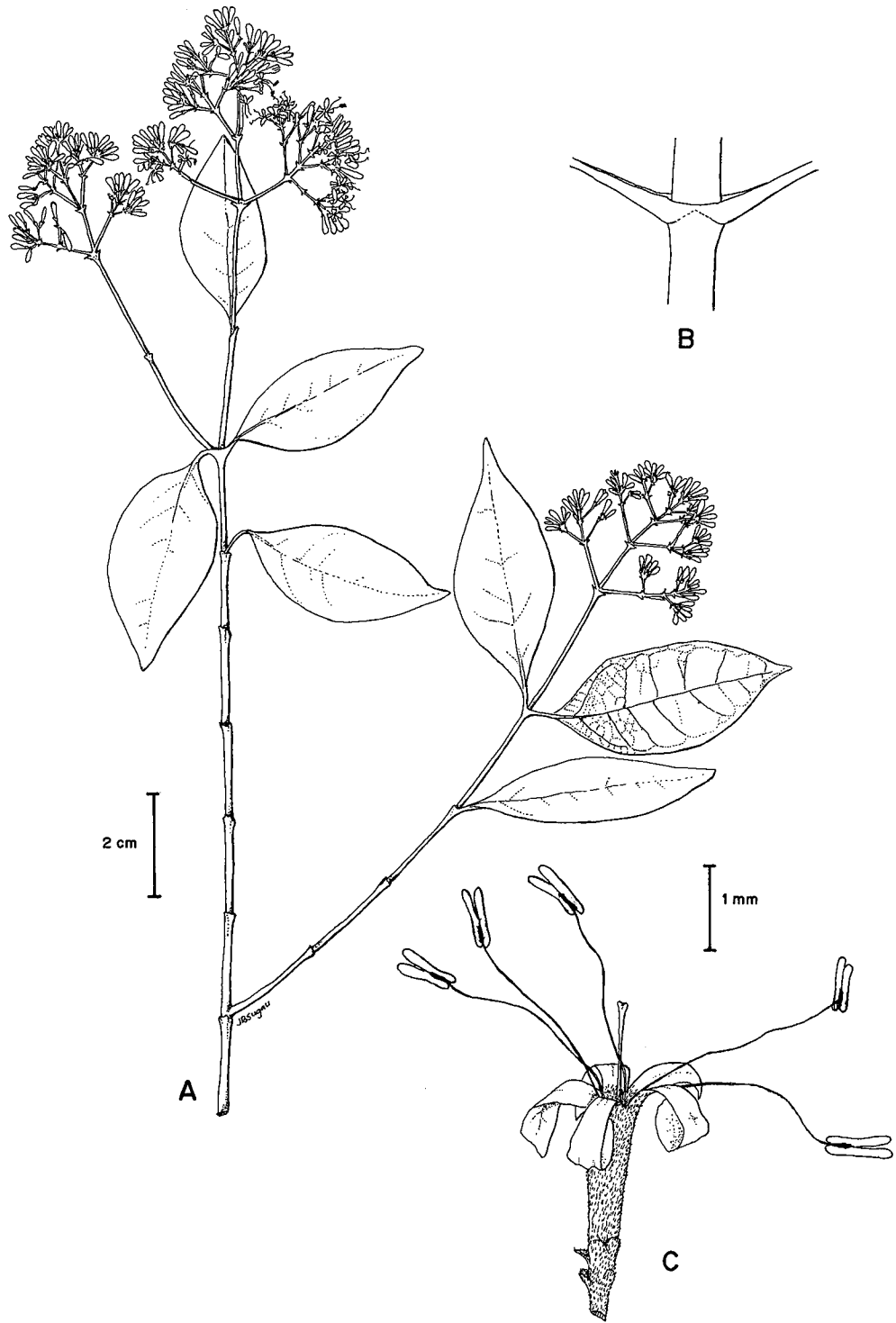
**Uses.** The timber is locally used for construction in Peninsular Malaysia.

### 2. *Norrisia malaccensis* Gardner (of Malacca)

Fig. 7.

In Hooker, J. Bot. Kew Misc. 1 (1849) 327. **Type:** *Griffith, s.n.*, Malacca (K). **Synonyms:** *Antonia griffithii* Wight, Ill. Ind. Bot. 2 (1858) 172, *t.* 156b; *N. philippinensis* Elm. Leaflet. Philip. Bot. 4 (1912) 1482.

Tree to 30 m tall, 50 cm diameter. **Bark** smooth, dark grey; inner bark pale brown. **Sapwood** yellowish. **Leaves** thin-coriaceous, elliptic to oblong, 4–6 × 1.8–2.6 cm; base attenuate to cuneate, apex acute to acuminate; *midrib* prominent and glabrous to sparsely hairy on lower



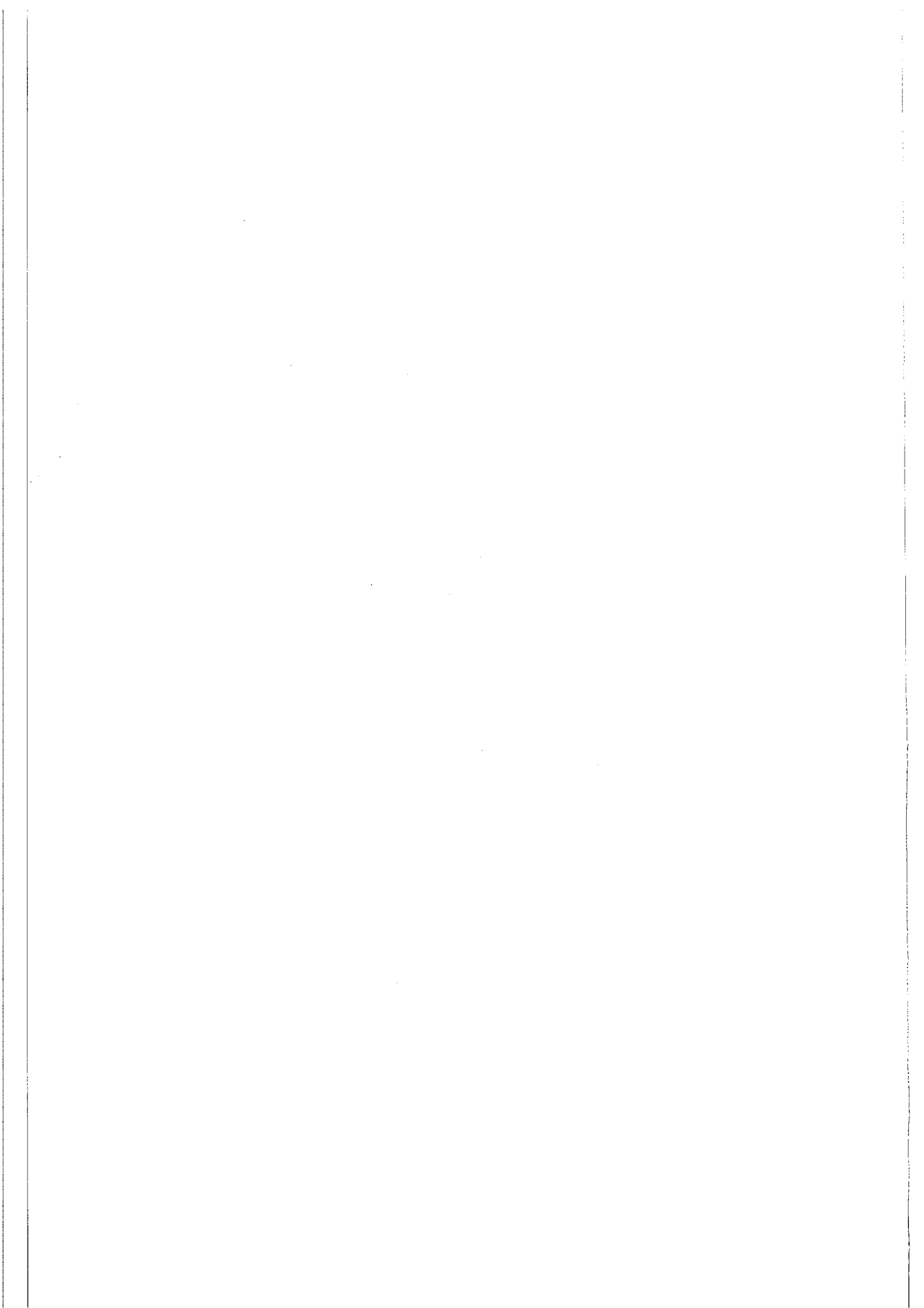
**Fig. 7.** *Norrisia malaccensis*. A, flowering leafy twigs; B, detail of expanded petiole bases joining to form an ochrea; C, flower. (All from SAN 131857.)

side, flat to slightly channelled and *glabrous on upper side*, *lateral veins* 6–8 pairs, *distinctly arching and joining at some distance from the margin*, intercostal veins reticulate; petioles slender, 0.4–1 cm long. **Inflorescence** 4–4.5 cm long; peduncle 1.8–2 cm long; bracts to 2.5 mm long. **Flowers** pale yellow; calyx 0.5–1 mm long, divided nearly to the base, densely short-hairy; corolla 2–4 mm long, *inside sparsely hairy to glabrous*, outside usually sparsely hairy, lobes 1.5–2 mm long, inside glabrous; stamens 4–5 mm long, *anthers oblong*, *c. 0.8 mm long*; ovary *c. 1 mm long*, style 6–7.5 mm long. **Fruits** obovoid,  $2\text{--}3.5 \times c. 1.9\text{ mm}$ . **Seeds** few, *c. 2 mm long*.

**Distribution.** Sumatra (W coast), Peninsular Malaysia, the Philippines (Sibuyan and Mindanao) and Borneo (Sabah only, here newly recorded with *SAN 92976* and *SAN 131857* from Bukit Tangkunan in Beluran).

**Ecology.** Recorded in mixed dipterocarp forest at about 400 m.





## LYTHRACEAE

P.C. Yii

Sarawak Forestry Department,  
Kuching, Malaysia

Hooker *f.*, Fl. Br. Ind. 2 (1879) 565; King, J. As. Soc. Beng. 67, 1 (1898) 345; Merrill, EB (1921) 417; Ridley, FMP 1 (1922) 819; Masamune, EPB (1942) 512; Backer & Bakhuizen *f.*, FJ 1 (1963) 251; Keng, OFMSP (1969) 153; Everett & Whitmore, TFM 2 (1973) 276; Shea in Cockburn, TS 1 (1976) 212; Anderson, CLTS (1980) 240; Corner, WSTM 3rd ed. 1 (1988) 470; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 211.

Herbs, shrubs or trees, occasionally scrambling shrubs or vines (not in Borneo). *Young twigs usually quadrangular, gradually becoming terete, smooth or sometimes spiny. Leaves simple, entire, mostly opposite-decussate and crowded at the ends of twigs; stipules minute or absent. Inflorescences axillary or terminal racemes or panicles. Flowers bisexual, radially or rarely bilaterally symmetrical; calyx bell-shaped or tubular, smooth or ridged, free from ovary, persistent in fruit, calyx lobes 3–6, valvate; petals as many as calyx lobes, crinkled and usually caducous or absent (Ammannia, Peplis & Rotala, not in Borneo); stamens twice as many as petals or numerous, inserted on the inside of receptacle, filaments equal or unequal, anthers 2-locular; ovary superior or semi-superior, 2–6-locular, style one, stigma capitate; ovules numerous. Fruit a loculicidal capsule, adnate to the base of the persistent calyx. Seeds numerous, straight and small, with or without wings; endosperm absent.*

**Distribution.** About 25 genera and 550 species, chiefly tropical. In Sabah and Sarawak, represented by 3 genera and 7 species.

**Taxonomy.** The Lythraceae are closely related to the Crypteroniaceae and Sonneratiaceae. The Crypteroniaceae are segregated from the Lythraceae in their tiny apetalous flowers with a 2–3-carpellate ovary. The Sonneratiaceae are distinct in their partially united carpels containing numerous ovules that are inserted on the septa.

### Key to genera

1. Stems and branches usually twisted. Leaves fleshy, with indistinct veins. Flowers axillary.....**2. Pemphis**  
Stems and branches not so. Leaves coriaceous, with distinct veins. Flowers in terminal panicles.....2
2. Flower 4-merous, stamens usually 8 or fewer. Fruit an indehiscent capsule. Seeds not winged.....

**Lawsonia** L.

Sp. Pl. (1753) 349; Hooker *f. l.c.* 573; Merrill *l.c.* 418; Masamune *l.c.* 512; Backer & Bakhuizen *f. l.c.* 256; Corner *l.c.* 475.

A monotypic genus (*L. inermis*), distributed from the east coast of Africa to SW Asia and widely cultivated throughout tropical SE Asia.

Shrubs or treelets. *Twigs usually spiny or rarely without spines. Leaves short-stalked. Flowers white, intensely fragrant, in axillary and terminal leafy panicles; calyx obconical, deeply lobed, lobes 4; petals 4; stamens 8, rarely 4, alternate with petals; ovary 4-carpellate, styles filiform, stigmas small and capitate; ovules numerous. Fruit an indehiscent capsule, globose or depressed globose, subtended by a shallow persistent calyx tube.*

In Sabah and Sarawak, the species is widely cultivated for its red dye.

Flower 6-merous or more, stamens numerous. Fruit a dehiscent capsule. Seeds winged.....

.....1. **Lagerstroemia**

## 1. LAGERSTROEMIA L.

(M. Lagerstroem, 1691–1759, Swedish patron of science)

*bungor* (Malay)

Arn. Acad. 4 (1759) 137; Hooker *f.*, Fl. Br. Ind. 2 (1879) 575; King, J. As. Soc. Beng. 67, 1 (1898) 350; Merrill, EB (1921) 417; Ridley, FMP 1 (1922) 822; Masamune, EPB (1942) 512; Backer & Bakhuizen *f.*, FJ 1 (1963) 255; Furtado & Montien, Gard. Bull. Sing. 24 (1969) 186; Everett & Whitmore, TFM 2 (1963) 277; Shea in Cockburn, TS 1 (1976) 214; Anderson, CLTS (1980) 240; Corner, WSTM 3rd ed. 1 (1988) 472; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 211.

Deciduous or semi-deciduous trees or shrubs; crown usually bushy and spreading; bole often fluted; buttresses small or absent. **Bark** smooth, papery, grey to light fawn-brown mottled, flaking; inner bark fibrous or laminated, grey fawn, staining purple. **Sapwood** white to pale yellowish brown. Axillary buds conspicuous, elongated and pointed. **Leaves** opposite, entire, coriaceous, often withering orange or red before falling. **Inflorescence** a large panicle, terminal or in the axils of upper leaves. **Flowers** large, showy, pink-mauve, fading white, scentless; calyx funnel- or bell-shaped, coriaceous, smooth or ridged, lobes acute or acuminate, valvate; *petals 6 or more, delicate, crinkled; stamens numerous*, in few rows, filaments slender, anthers minute; ovary globose or ellipsoid, fused to the base of calyx cup. **Fruit** a large woody capsule, splitting longitudinally into 6 parts at the apical end. **Seeds** numerous, elongated, with apical wing.

**Distribution.** About 55 species, chiefly in tropical and subtropical parts of Madagascar, Asia, New Guinea and Australia. In Borneo, represented by 6 species, of which only 3 species are native to Sabah and Sarawak. *Lagerstroemia borneensis* occurs only in Kalimantan, while *L. indica* and *L. floridunda* have been introduced as ornamental plants.

**Ecology.** *Lagerstroemia* species prefer seasonally dry parts of continental SE Asia; in Sabah and Sarawak, they occur from coastal forest within reach of sea-spray to lowland forest farther inland.

**Uses.** Rarely reaching timber size and, therefore, only occasionally used for domestic purposes. Three species, namely *L. floribunda*, *L. indica* and *L. speciosa* are widely cultivated as ornamentals throughout the country.

### Key to *Lagerstroemia* species

1. Shrub. Leaves sessile or almost so.....
  - L. indica** L.  
*l.c.* 137; Hooker *f.l.c.* 575; Backer & Bakhuizen *f.l.c.* 256; Furtado & Montien *l.c.* 190; Corner *l.c.* 474.  
 Shrubs. Leaves chartaceous, obovate or ovate, 3–10 × 2–4 cm. Inflorescences to 20 cm long, 7–20 cm across. Flower buds subglobose, 5–6 mm across, shortly tipped at the apex, ridges 5–6, superficial and soon disappearing in the upper half; calyx 4–6-lobed, lobes erect, triangular; petals suborbicular, wavy and curled at the margins; stamens numerous, only 4–6 are stouter and longer, others unequal; ovary subglobose, glabrous, with a long slender style. Capsules globose, *c.* 10 × 8 mm, 4–6-valved; persistent calyx funnel-shaped or cup-shaped.  
 Native to the Himalayan region, China, Indo-China and Japan; widely cultivated in parks and roadsides throughout Sabah and Sarawak.
  - Tree. Leaves distinctly stalked.....2
2. Lower leaf surface glabrous.....3  
 Lower leaf surface hairy on the veins.....4
3. Leaves and calyces often pustulate. Persistent calyx lobes in fruit spreading.....**2. L. pustulata**  
 Leaves and calyces not so. Persistent calyx lobes in fruit recurved.....**3. L. speciosa**
4. Upper leaf surface glabrous, lower leaf surface minutely hairy. Inflorescences minutely velvety hairy.....**1. L. piriformis**  
 Both leaf surfaces and inflorescences rusty stellate-tomentose.....  
**L. floribunda** Jack  
*Mal. Misc.* 1 (1820–22) 38; Hooker *f.l.c.* 577; King *l.c.* 345; Ridley *l.c.* 823; Backer & Bakhuizen *f.l.c.* 256; Furtado & Montien *l.c.* 329; Everett & Whitmore *l.c.* 279; Shea in Cockburn *l.c.* 216; Corner *l.c.* 474.  
 Tree to 13 m tall. Leaves oblong-elliptic, 6–23 × 4–10 cm; young leaves with stellate hairs above and along veins beneath, late glabrescent; base broadly cuneate or somewhat rounded, apex obtuse or rarely acute; petioles 3–7 mm long. Inflorescences 20–40 cm long, rusty stellate-tomentose. Flower buds turbinate, 10–12-ridged; calyx, 6-lobed; petals oblong, gradually cuneate towards the base, margin wavy; stamens numerous, unequal; ovary subglobose, densely brown-tomentose. Capsules ellipsoid-oblong, 12–16 × 7–11 mm, sparsely tomentose all over; persistent calyx cup-shaped, lobes oblique or recurved.  
 Native to subtropical and tropical SE Asia, from S China to Mynmar, Thailand, Cambodia, Indo-China and Peninsular Malaysia. In Sabah and Sarawak, widely cultivated as ornamental trees.

1. **Lagerstroemia piriformis** Koehne

(Latin, *piriformis* = pear-shaped; the fruit)

In Engler, Bot. Jahrb. 4 (1883) 23; Furtado & Montien *l.c.* 248; Shea in Cockburn *l.c.* 216. **Type:** *Cuming 1675*, Philippines (*n.v.*). **Synonym:** *L. crassifolia* Furtado & Montien *l.c.* 232.

Tree to 15 m tall, 30 cm diameter. **Leaves** coriaceous, greyish green and glabrous above, brownish green and *minutely hairy along the veins beneath*; elliptic or ovate, 5–8 × 3–4.2 cm; base asymmetric or rarely symmetric and cuneate, shortly decurrent, apex acute or acuminate; lateral veins 6–8 pairs; *petioles 3–6 mm long*. **Inflorescences** 7–20 cm long, 7–15 cm across, *minutely velvety hairy*. **Flower** buds 9–12 × 5 mm, obscurely apiculate at the apex, ridges 6, superficial, straight in the developing buds, slightly angular in the lower parts, slightly thickened along the suture at the top, finely furrowed; calyx *c.* 8 × 5 mm, lobes *c.* 3 mm long; petals obovate, *c.* 6 × 4 mm, margins frilly or wavy; stamens numerous, only 6 thicker and longer ones with filaments; ovary ovoid, glabrous, style *c.* 1.5 mm long. **Fruits** broadly ellipsoid, *c.* 15 × 11 mm, conspicuously beaked; persistent calyx *c.* 10 × 10 mm, abruptly narrowed at the base, slightly ridged at the lower half of the tube, lobes *c.* 4 × 3 mm, recurved.

**Distribution.** Borneo, Philippines, New Guinea and Melanesia. In Borneo, known from Sabah from two collections (*SAN 47262* and *SAN 51859*) from primary forest at Gomantong, Sungei Lambah, Sandakan district and from Lamag, Kinabatangan district, respectively.

**Ecology.** Low-lying primary forest on limestone or black volcanic soils.

2. **Lagerstroemia pustulata** Furtado & Montien

Fig. 1.

(Latin, *pustulatus* = blistered; the leaf surface)

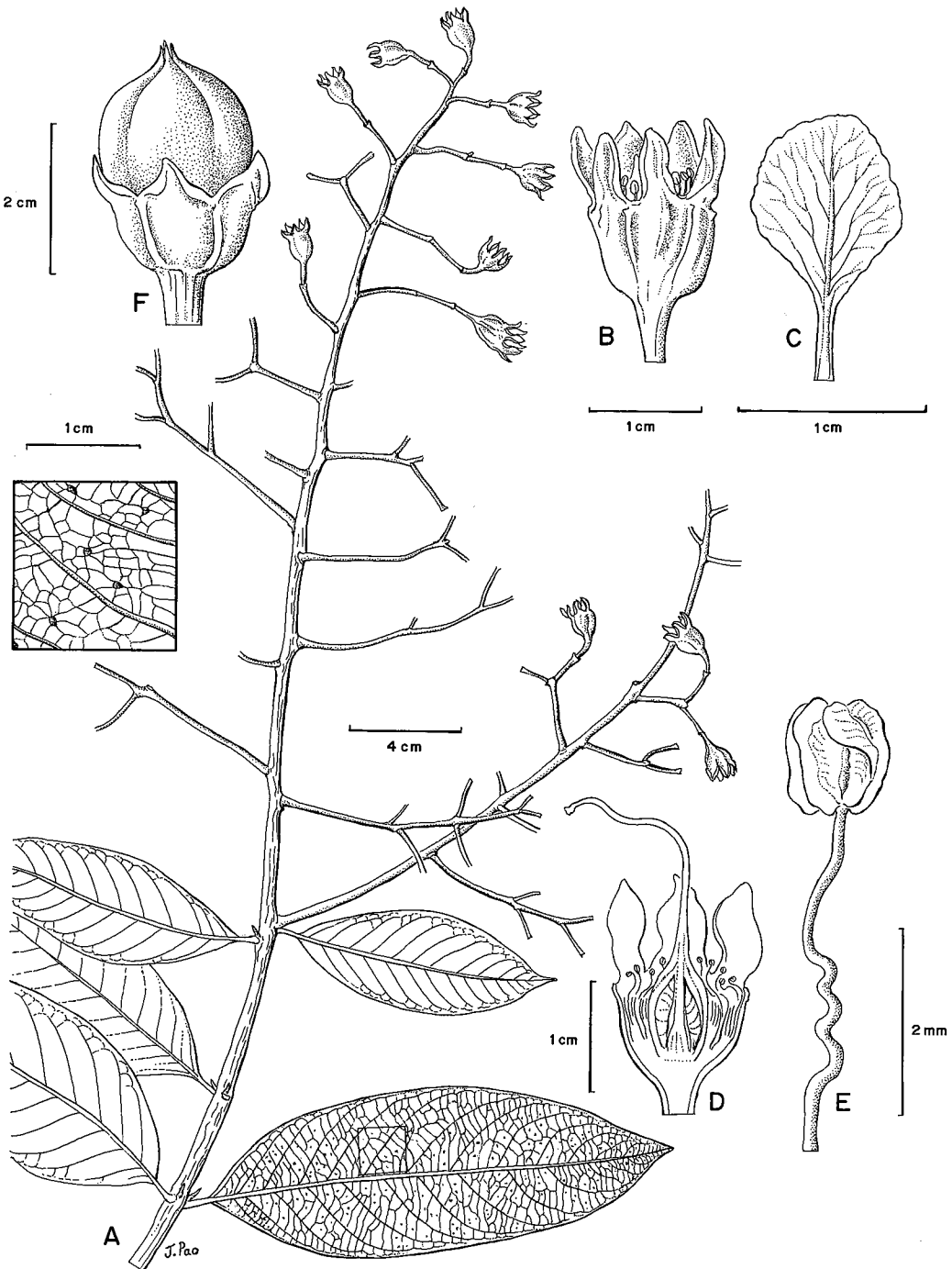
*l.c.* 222; Shea in Cockburn *l.c.* 216; Whitmore, Tantra & Sutisna *l.c.* 212. **Type:** *Muin Chai SAN 26006*, Borneo, Sabah, Lahad Datu, Segam Sarai (holotype SING; isotype SAN, SAR).

Tree to 17 m tall, 60 cm diameter. **Leaves** oblong-elliptic 10–17 × 4–6 cm; base cuneate, margin slightly recurved, apex acuminate; *glabrous with distinct pustules on both surfaces*; lateral veins 10–12 pairs; *petioles 5–10 mm long*. **Inflorescences** to 32 cm long, greyish hairy. **Flowers:** calyx pustulate and hairy, 10–12 mm deep (including 4–6 mm obconical base), ribs 6, distinct, lobes *c.* 5 × 2 mm, distinctly recurved; petals 6, suborbicular or obovate, *c.* 15 mm long (including 5-mm claw); stamens numerous, erect, inserted at the bottom of the calyx tube; ovary glabrous, ovoid, gradually narrowed into a conical apex, style long. **Fruits** oblong, *c.* 25 × 20–22 mm, abruptly apiculate at the apex; persistent calyx hard, abruptly narrowed into 8–12 mm long obconical base, *c.* 5 mm deep, *lobes spreading*, slightly thicker at the margins.

**Vernacular name.** Sabah—*perlimpong hutan* (Dusun).

**Distribution.** Only known from the type collection from Segam Sarai, Lahad Datu district, Sabah.

**Ecology.** Lowland forest along river at *c.* 70 m.



**Fig. 1.** *Lagerstroemia pustulata*. A, flowering leafy twig; B, flower with petals removed; C, petal; D, longitudinal section of flower; E, stamen; F, mature fruit. (All from SAN 26006.)

### 3. *Lagerstroemia speciosa* (L.) Pers.

(Latin, *speciosus* = showy; the flowers)

Synops. 2 (1807) 72; Merrill *l.c.* 417; Masamune *l.c.* 512; Furtado & Montien *l.c.* 264; Everett & Whitmore *l.c.* 280; Shea in Cockburn *l.c.* 216; Anderson *l.c.* 240; Corner *l.c.* 474; Whitmore, Tantra & Sutisna *l.c.* 212. **Basionym:** *Munchausia speciosa* L. in Munchausen, Hausvater 5, 1 (1770) 357, t. 2. **Type:** *Katou-Adamboe* Rheede, Hort. Mal. 4 (1683) 45, t. 22, p.p. **Synonym:** *L. flos-reginae* Retz., Obs. 5 (1789) 25, Hooker *f. l.c.* 577, King *l.c.* 352, Ridley *l.c.* 823, Corner, Gard. Bull. Str. Settl. 10 (1939) 272, Backer & Bakhuizen *f. l.c.* 256, Whitmore, Tantra & Sutisna *l.c.* 212.

Tree to 10 m tall, 30 cm diameter. **Leaves** elliptic-oblong, 5–19 × 4–8 cm; base cuneate or almost rounded, apex acute or obtuse; *glabrous*, greyish green above and brown beneath; lateral veins 8–15 pairs, distinctly looped and joined to the next pair; *petioles* 4–9 mm long. **Inflorescences** 15–40 cm long, 10–20 cm across, covered with caducous, ashy or rusty hairs; pedicels *c.* 1.5 mm long. **Flower** buds subglobose or pyriform, 10–15 × 6–10 mm, shortly apiculate at the apex, 12–14-ridged, ridges of the same length; calyx ashy or rusty hairy, lobes recurved; petals 6, suborbicular, 15–30 × 10–20 mm, tapering towards the slender claw; stamens numerous, subequal; ovary globose, *glabrous* or slightly scaly, style filiform, stigma capitate. **Fruits** woody, globose, *glabrous*, *c.* 22 mm across; persistent calyx *glabrous* or slightly hairy, *lobes recurved*.

**Vernacular names.** Sabah—*tibabah* (Dusun Banggi). Sarawak—*bongor biru* (Malay).

**Distribution.** China, Indo-China, Peninsular Malaysia, Sumatra, Borneo and the Philippines. Some doubt has been expressed as to whether *L. speciosa* is native to Sabah and Sarawak, since most of the collections are from towns or forest close to habitation. However, they are common in some places beside large rivers, such as the Kinabatangan in Sabah, and appear to grow wild there.

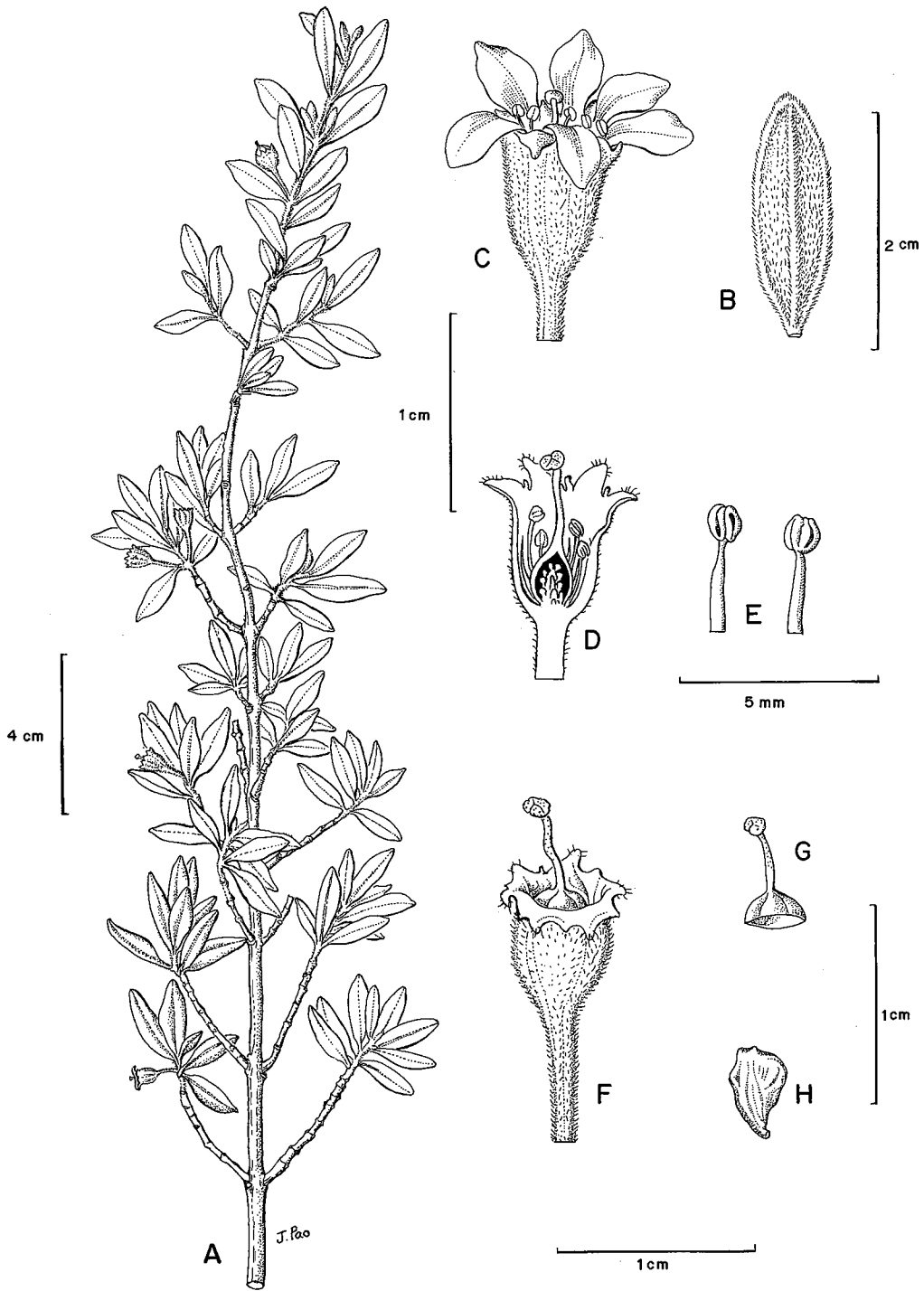
**Ecology.** Lowland secondary forest on sandy soil.

## 2. PEMPHIS J. R. Forst. & G. Forst.

(Greek word for bladder; the shape of the fruit stalk)

Char. Gen. (1776) 68, t. 34; Hooker *f.*, Fl. Br. Ind. 2 (1879) 572; King, J. As. Soc. Beng. 67, 1 (1898) 348; Merrill, EB (1921) 418; Ridley, FMP 1 (1922) 821; Masamune, EPB (1942) 512; Backer & Bakhuizen *f.*, FJ 1 (1963) 255; Burkill, EPMP (1966) 1716; Everett & Whitmore, TFM 2 (1963) 276; Shea in Cockburn, TS 1 (1976) 214; Anderson, CLTS (1980) 240; Corner, WSTM 3rd ed. 1 (1988) 475.

Shrubs or rarely trees; *stems and branches usually twisted*. **Leaves** *decussate, succulent, subsessile*. **Flowers** *axillary*, solitary or rarely in pairs, short-stalked, *radially symmetrical, 6-merous*; calyx bell-shaped or tubular with broadly triangular lobes; *stamens 12–18, with shorter and longer ones alternating, longer ones opposite the sepals*, anthers dorsifixed; ovary sessile, globose, 1-locular, style filiform, stigma small, capitate, ovules numerous. **Fruits** obovoid or ellipsoid capsules, inserted inside the calyx tube, splitting transversely, the upper half falling as a lid. **Seeds** cuneate and slightly flattened, with thick, almost corky marginal wings.



**Fig. 2.** *Pemphis acidula*. A, flowering leafy twig; B, detail of leaf; C, flower; D, longitudinal section of flower; E, stamens; F, fruit; G, fruit cap; H, seed. (All from S. 21437.)



**Distribution.** A monotypic genus, distributed from the Zanzibar coast to the W Pacific.

**Ecology.** Confined to exposed rocky coasts or limestone cliffs where coral abounds.

**Pemphis acidula** J.R. Forst. & G. Forst.

Fig. 2.

(Latin, *acidulus* = rather sour; the taste of the fruits)

*l.c.* 68 t. 34; Hooker *f. l.c.* 572; King *l.c.* 348; Merrill *l.c.* 418; Ridley *l.c.* 821; Masamune *l.c.* 512; Backer & Bakhuizen *f. l.c.* 255; Everett & Whitmore *l.c.* 276; Shea in Cockburn *l.c.* 214; Anderson *l.c.* 240; Corner *l.c.* 475.

Shrub or tree to 10 m tall, 30 cm diameter; *stem usually short and stocky*. **Bark** dark grey-brown, finely fissured; inner bark light reddish, laminated. *Twigs pale-colored, nodes prominent*. **Leaves** thick and fleshy; *elliptic-oblong, 1–3.2 × 0.3–0.5 cm, densely and finely hairy; base acute, margin entire, apex acute, rarely obtuse*. **Flower** erect, scentless; pedicels 5–10 mm long; calyx *c.* 7 mm deep; petals 6–7 × 3–4 mm, white, elliptic and crinkled. **Fruits** *c.* 1.5 × 1 cm, reddish green and ripening brown.

**Vernacular name.** Sarawak—*mentigi* (Malay).

**Distribution.** As for the genus. In Sabah, known from from the Selingan, Balambangan and Malawali islands and in Sarawak from Sampadi island and Teluk Bandung on Santubong Peninsula.

## MALVACEAE

### Balu Perumal

World Wide Fund for Nature (WWF),  
Kuala Lumpur, Malaysia

Merrill, EB (1921) 374; Ridley, FMP 1 (1922) 253; Masamune, EPB (1942) 452; Backer & Bakhuizen f., FJ 1 (1963); van Borssum Waalkes, Blumea 14 (1966) 23; Hsuan Keng, OFMSP (1969) 161; Kochummen, TFM 1 (1972) 309; Anderson, CLTS (1980) 242; Corner, WSTM 3rd ed. 2 (1988) 479.

Annual or perennial herbs, shrubs or trees. **Bark** usually very fibrous, with slime canals. **Indumentum** nearly always of stellate hairs or scales and simple hairs, sometimes of simple or stalked glandular hairs. **Leaves** spirally arranged, simple, entire to deeply lobed, mostly palmately veined, nectaries commonly found on the veins below; stipules present. **Flowers** radially symmetrical, bisexual, 5-merous, solitary and axillary, or in terminal and/or axillary racemes or panicles, often in condensed clusters or solitary by reduction of the inflorescence; **epicalyx** usually present, usually persistent, with 3 to many free or connate leafy segments; **calyx** connate at base, lobes valvate, persistent; disc none, but nectariferous tissue present at the base of calyx; corolla contortate (especially in bud), adnate at base to the staminal tube and falling off with it; **stamens** many, connate into a long tube, developing centrifugally, anthers dorsifixed, 1-locular, pollen grains spiny, very large (visible to unaided eye); **ovary** superior, (3-)5-many-locular, ovules 1-many per locule, placentation axile; styles as many as or twice the number of ovary locules, mostly united to various degrees, stigmas as many as styles, on distinct style-arms or almost united. **Fruit** a schizocarp or a capsule, breaking into separate parts, loculicidally dehiscent, or indehiscent. **Seeds** usually hairy; endosperm usually oily; embryo mostly curved; cotyledons usually folded.

**Distribution.** About 116 genera and 1550 species, distributed throughout the world, but mainly found in the tropics and subtropics. In Sabah and Sarawak, represented by 7 genera comprising 13 species and a hybrid (*Hibiscus xarcheri* W. Watson). *Pavonia rigida*, although recorded for Kalimantan, has not been collected from Sabah or Sarawak.

**Ecology.** Generally sun-loving (or heliophilous) and weedy plants, commonly found near coastal areas and in lowland forest.

**Uses.** The most important economic product of the family is cotton, produced by *Gossypium*. The bark of certain species of *Hibiscus* yields valuable fibres that are used for cordage or manufactured into textiles. Oil is obtained from the seed of several species and the residue is made into oil-cakes for stock feed. Several shrubs are cultivated for their showy flowers; of these the *bunga raya*, *Hibiscus rosa-sinensis*, is widely grown throughout the tropics. Though the possible origin of the species is Tanganyika, *bunga raya* has been designated the national flower of Malaysia. Some species are cultivated for vegetables, e.g., the Ladies' Fingers, *Abelmoschus esculentus*. A few others are medicinal, e.g., species of *Sida*. The timber is not of economic importance but that of a few species is used locally.

**Taxonomy.** The Malvaceae are very closely related to the Bombacaceae. Spiny pollen grains, 1-locular anthers and a well-developed staminal tube are the main characters distinguishing the Malvaceae. Moll & Janssonius (quoted in Desch, Malay. For. Rec. 15, (1954) 572) have also described differences in the wood characters.

### Key to genera

1. Apex of staminal tube 5-toothed, filaments projecting from its whole surface or from a greater part of it; epicalyx present.....2  
 Apex of staminal tube without teeth, but splitting into numerous filaments; epicalyx absent.....6

2. Styles twice as many as carpels; always 10. Fruit a schizocarp.....

**Urena L.**

Gen. Pl. ed. 5 (1754) 764; Merrill *l.c.* 374; Ridley *l.c.* 256; Masamune *l.c.* 453; Backer & Bakhuizen *f. l.c.* 428; van Borssum Waalkes *l.c.* 137.

A monotypic genus (*U. lobata*) with pantropical distribution.

Annual or perennial low shrubs. Leaves palmately lobed and veined, often twice divided or undivided, with extrafloral nectaries on the veins beneath. Flowers axillary, solitary or in clusters; calyx bell-shaped or tubular; staminal tube bearing anthers on the upper half; ovary 5-locular, each locule with one ovule. Fruit breaking-up into 5 dehiscent or indehiscent, 1-seeded mericarps at maturity.

In Sabah and Sarawak, common on roadsides, waste ground, fallow fields, plantations, and secondary vegetation, from sea level to *c.* 2000 m.

- Style 1, stigmatic arms as many as carpels, usually 5. Fruit a capsule.....3

3. Style divided at apex into 5-ribbed or lobed stigmas. Calyx rim minutely toothed to 5-lobed.....4  
 Style not divided at apex into ribbed or lobed stigmas. Calyx rim entire or only minutely toothed.....5

4. Calyx 5-lobed, not splitting on one side during anthesis, free from corolla, persistent after flowering.....**1. Hibiscus**  
 Calyx minutely 5-toothed, splitting on one side during anthesis, joined to corolla and falling with it after flowering.....

**Abelmoschus Medic.**

Malv. (1787) 46; Merrill *l.c.* 375; Masamune *l.c.* 452; Backer & Bakhuizen *f. l.c.* 434; van Borssum Waalkes *l.c.* 89; Kochummen *l.c.* 310.

Six species in S and SE Asia and Australia.

Herbs or low shrubs. Leaves palmately lobed and veined. Flowers in axillary or terminal racemes; calyx at anthesis spathaceous and falling together with the corolla; staminal tube bearing anthers almost throughout; ovary 5(6-9)-locular, each locule with many ovules. Fruit a loculicidal capsule.

Two species in Sabah and Sarawak, *viz.* *A. moschatus* and *A. esculentus*. *A. moschatus* is common in open places, especially on waste ground, roadsides, and secondary vegetation, to 1000 m. *A. esculentus* is cultivated as a vegetable.

5. Epicalyx with 3–8 segments, small and narrow, mostly caducous. Seed coat glabrous or short-hairy. Ovary and fruit 5–merous.....**2. Thespesia**  
Epicalyx with 3 segments, large and leaf-like, cordate, persistent. Seed coat densely long-hairy or woolly. Ovary and capsule 3–5-merous.....

**Gossypium L.**

Gen. Pl. ed. 5 (1754) 764; Merrill *l.c.* 375; Masamune *l.c.* 452; Backer & Bakhuizen *f. l.c.* 436; van Borssum Waalkes *l.c.* 119.

About 20–70 species; pantropical.

Straggling shrubs. Leaves mostly palmately lobed or divided. Flowers solitary or in 2–4-flowered racemes, terminal or axillary; calyx cup-shaped; staminal tube bearing anthers throughout; ovary 3–5-locular, each locule with many ovules. Capsule loculicidally dehiscent into 3–5 valves.

In Sabah and Sarawak, one species, *G. barbadense* L. var. *acuminatum* (Roxb.) Mast. is occasionally cultivated in gardens.

6. Seeds 1 per mericarp; mericarp wall enveloping the seeds to form a globose to flat-rounded fruit (schizocarp). Flowers less than 2.5 cm across.....

**Sida L.**

Gen. Pl. ed. 5 (1754); Merrill *l.c.* 374; Ridley *l.c.* 254; Masamune *l.c.* 453; Backer & Bakhuizen *f. l.c.* 426; van Borssum Waalkes *l.c.* 177.

About 150 species, distributed in the tropics and subtropics of the world.

Annual or perennial herbs or low shrubs. Leaves simple, rarely divided or lobed, pinnately or palmately veined, without extrafloral nectaries. Flowers axillary, solitary or clustered; epicalyx lacking or present; calyx bell-shaped; corolla rotate; staminal column usually shorter than the petals; carpels 5–14, each with one ovule. Fruits globose or flat-rounded; mericarps often more or less 3-angular, indehiscent or dehiscent at apex only, in falling leaving a blunt slender columella. Seeds closely enveloped by the wall of the mericarps.

Two species in Sabah and Sarawak; *S. rhombifolia* L. with subsp. *rhombifolia* and subsp. *retusa* (L.) Borss., and *S. acuta* Burm. *f.* subsp. *acuta*. Common in open places, especially in the lowlands.

Seeds 2 or more per mericarp; mericarp arranged in a longitudinal series without constriction to form a globose to cylindrical fruit (schizocarp). Flowers at least about 2.5 cm across.....

**Abutilon Mill.**

Gard. Dict. ed. 4, 1 (1754); Merrill *l.c.* 374; Masamune *l.c.* 452; Backer & Bakhuizen *f. l.c.* 422; van Borssum Waalkes *l.c.* 159.

About 150 species; in the tropics and subtropics.

Annual or perennial herbs or low shrubs. Leaves divided or undivided, mostly cordate at base, palmately veined, without extrafloral nectaries. Flowers axillary, solitary or in paniculate clusters; epicalyx absent; calyx usually bell-shaped; corolla rotate, bell-shaped or rarely tubular; staminal column usually much shorter than the petals; carpels 5–40, each with 2–9 ovules. Fruits globose or cylindrical, rarely discoid; mericarps 5–40, follicular, dehiscent, in falling leaving a blunt, slender columella. Seeds 2–9 per mericarp, reniform.

One species in Sabah and Sarawak, *A. indicum* (subsp. *indicum*). Common on waste ground.

## 1. **HIBISCUS L., *nom. cons.***

(a Greek plant-name, possibly referring to the hollyhock)

Gen. Pl. 5 (1754) 310; Merrill, EB (1921) 374; Ridley, FMP 1 (1922) 257; Masamune, EPB (1942) 452; Backer & Bakhuizen *f.*, FJ 1 (1963) 429; van Borssum Waalkes, Blumea 14 (1966) 25; Kochummen, TFM 1 (1972) 311; Anderson, CLTS (1980) 242; Corner, WSTM 3rd ed. 2 (1988) 480.

Herbs, shrubs or trees. *Indumentum of stellate hairs and/or scales.* **Leaves** simple, lobed or entire, spirally arranged, often with extrafloral nectaries. **Flowers** axillary, solitary, often in racemes or panicles; *pedicels mostly articulate, at apex rarely thickened into an obconical or discoid hypanthium; epicalyx usually persistent in fruit, 3–many-lobed*, lobes free or shortly connate at base; calyx bell-shaped, *distinctly 5-lobed*, rarely splitting on one side, mostly with distinct venation, sometimes with nectaries, *persistent*; corolla mostly large and showy, of various colours, often yellow with a dark purple centre; *stamens connate into a tube that adnates to the base of corolla*, mostly as long as or shorter than the petals, rarely longer, *bearing anthers throughout or only in the upper half*; ovary mostly 5-locular, rarely 10-locular as a result of 5 false dissepiments, *style 1, distally 5-branched*, stigma discoid, capitate or obscure, ovules 3 to many per locule. **Fruit** a capsule, *splitting loculicidally into 5–10 valves.* **Seeds** 3 to many per locule, globose or reniform; testa glabrous or hairy.

**Distribution.** At least 250 species; in the tropics and subtropics of the Old and New World; only 2 or 3 species in the temperate zone. Five species and 1 hybrid in Sabah and Sarawak, of which *H. borneensis*, *H. macrophyllus*, *H. surattensis* and *H. tiliaceus* are indigenous.

**Ecology.** Most species are sun-loving and prefer lower altitudes. Herbaceous and shrub species occur particularly on waste ground, along roadsides or planted as ornamentals in the gardens. Tree species occur especially in secondary forest. Flowers are known to be pollinated by birds.

### Key to *Hibiscus* species

1. Scrambling spiny shrub. Leaves lobed.....2  
Tree, not spiny. Leaves not lobed.....3
2. Epicalyx segments long-spathulate, their apices broadened.....

#### ***H. surattensis* L.**

Sp. Pl. (1753) 696; Merrill *l.c.* 375; Masamune *l.c.* 453; van Borssum Waalkes *l.c.* 57.

Herb or low scrambling shrub, to 2 m tall, often rooting at the nodes; stems slender, with long internodes, densely covered with recurved prickles, often tinged red. Leaves palmately 3–5-lobed, base 5–7-veined, shallowly cordate or obtuse, lobes coarsely toothed; extrafloral nectaries absent; veins prickly beneath; stipules broad and leafy, at base auricled. Flowers axillary, solitary; epicalyx segments 9–12, spreading; calyx bell-shaped, accrescent; corolla yellow and mostly with a dark purple centre; staminal column much shorter than the petals, bearing anthers throughout; ovary conical, densely hairy; stigmas discoid, hairy. Capsule ovoid to globose, outside densely covered with stiff, simple hairs. Seeds many, reniform.

Throughout the tropics of the Old World. In Sabah and Sarawak, common in young secondary forest, occasionally on waste ground near houses or villages, from the lowlands to 1200 m.

Epicalyx segments linear, their apices not broadened.....

**H. radiatus** Cav.

Diss. 3 (1987) 150, *t.* 54, fig. 2; van Borssum Waalkes *l.c.* 60.

Herb or low scrambling shrub, to 1 m high. Stems slender, typically with recurved prickles. Leaves palmately 3–5-lobed, base 5–7-veined, shallowly heart-shaped or truncate, lobes coarsely toothed; extrafloral nectaries absent; veins prickly beneath; stipules linear. Flowers axillary, solitary; epicalyx segments 10, spreading; calyx bell-shaped, accrescent; corolla yellow with a dark purple centre; staminal column much shorter than petals, bearing anthers throughout; ovary globose, densely hairy, stigmas capitate. Capsules ovoid to globose, outside with dense long appressed bristles. Seeds *c.* 4 per locule, trigonous.

S and SE Asia; in Malesia sometimes planted, also a weed. In Sabah, recorded in the Kinabatangan and Tongod areas.

3. Twigs and leaf stalks with dense coarse shiny stellate hairs (hair arms to 8–10 mm long).....**2. H. macrophyllus**  
Twigs and leaf stalks glabrous or with short-tomentose hairs (hairs fine, at most 2–3 mm long).....4
4. Leaves glaucous on the lower surface, with extrafloral nectaries in the axils of inner veins beneath. Ovary and fruit 10-locular (5 true and 5 false dissepiments). Staminal tube shorter than the petals. Rocky and sandy coasts (cultivated inland).....**3. H. tiliaceus**  
Leaves not glaucous on the lower surface, without extrafloral nectaries. Ovary and fruit 5-locular, without false dissepiments. Staminal tube as long as the petals. Inland forest.....**1. H. borneensis**

**1. Hibiscus borneensis** Airy Shaw  
(of Borneo)

In Hooker, *l.c.* Pl. 34 (1939) *t.* 3377; Van Borssum Waalkes *l.c.* 49. **Type:** *Native Collector* (Oxford Univ. Exp.) 1541, Borneo, Sarawak, Dulit Trail (holotype K; isotypes GH, L, SING).

Tree to 30 m tall, *c.* 80 cm diameter, with small buttresses; crown narrow, appearing cylindrical, low-branched. **Bark** smooth to minutely fissured, tough and fibrous. Twig somewhat angular, covered with lenticels and minute stellate hairs. Stipules large, 8–10 × 10 mm, orbicular to reniform, auricled, stellate-hairy. **Leaves** coriaceous, *not glaucous beneath*, on both surfaces with scattered minute stellate hairs, early glabrescent; ovate to orbicular, 10–22 × 8–16 cm; base cordate or truncate, rarely acute, margins coarsely, often doubly crenate, apex acute to acuminate; at base 5–7-veined, with the veins and intercostal veins forming a cobweb-like pattern; *without extrafloral nectaries*; petioles 5–13 cm long. **Flowers** in axillary, few-flowered racemes or panicles, the lower ones occasionally solitary; primary peduncles 10–28 cm long, secondary peduncles 4–13 cm long; pedicels 2–5 cm long; epicalyx 7–9-lobed, segments coriaceous; calyx widely bell-shaped, 1.5–2 cm high, *c.* 1.5 cm wide, coriaceous, segments usually recurved, triangular, 6–7 mm wide and long, stellate-tomentose outside, at base with a ring of fairly stiff stellate hairs inside; corolla white or pinkish, base pale yellow, shiny, petals obovate, 4–6.5 × 2–2.5 cm, apex rounded, somewhat rough by coarse minute stellate hairs and short glandular hairs outside, at base with minute stellate hairs inside;

*staminal tube as long as petals*, 3.5–5.5 cm long, at base downy by slender stellate hairs, for the rest glabrous, bearing anthers almost throughout, filaments 1–2 mm long, anthers 1–1.5 mm long; *ovary* conical, *c.* 7 × 4 mm, hirsute, *5-locular*, *without false dissepiments*, styles 4–5 mm long, soft-hairy, stigmas capitate, 1.5–2 mm wide. **Fruits** *c.* 20 × 17 mm, globose to obovoid, covered with fairly long, simple hairs and minute stellate hairs. **Seeds** *c.* 7 per locule, reniform, covered with long red-brown or yellowish woolly hairs.

**Distribution.** Endemic to Borneo (Sarawak and Kalimantan).

**Ecology.** Primary forest, mostly in damp places near rivers, to 300 m.

**Taxonomy.** The species is closely related to *H. decaspermus* from S and E Malesia and to *H. floccosus* from Peninsular Malaysia. It differs from both species in its stellate-hairy epicalyx, instead of densely scaly epicalyx.

## 2. *Hibiscus macrophyllus* Roxb. *ex* Hornem.

(Greek, *makros* = large; *phullon* = leaf)

Hort. Hafn., Suppl. (1819) 149; Merrill, Philip. J. Sc. 14 (1919) 245; Ridley, FMP 1 (1922) 258; Backer & Bakhuizen *f. l.c.* 430; van Borssum Waalkes *l.c.* 47; Kochummen *l.c.* 31; Corner *l.c.* 481. **Type:** *Wallich, s.n.*, Pakistan, Chittagong (holotype CAL).

Tree to 15–25 m tall, *c.* 20 cm diameter. **Bark** finely fissured, corky, grey. *Twigs* with annular stipular scars, *densely covered* with minute, brown stellate hairs and *coarse, shiny, brown stellate hairs with long arms 8–10 mm long*. Stipules 8–15 × 2–4 cm, initially cohering along the margins and enclosing the terminal buds, subsequently spreading and falling off, oblong, densely stellate-tomentose outside, sericeous inside. **Leaves** chartaceous, densely stellate hairy on both surfaces, lower surface on the midrib and 2–6 basal veins with nectaries; more or less orbicular (5–)25–50 cm across; based 7–9-veined, cordate, margin entire or crenulate, apex cuspidate; inner 2–6 veins with extra floral nectaries; petioles stout, 4–40 cm long, *densely covered with coarse, shiny stellate hairs with long arms to 8–10 mm long*. **Flowers** axillary, solitary or in few-flowered, terminal raceme-like clusters; pedicels stout, 1–2 cm long, stellate-hairy; epicalyx cup-shaped, usually shorter than the calyx, 10–14-lobed; calyx bell-shaped, 5-lobed, 2.5–3 cm deep, *c.* 3 cm wide, segments triangular, acute, 15–18 × 6–7 mm, outside with stellate hairs, inside sericeous, without nectaries; corolla large and showy, yellow with maroon eye, often turning red before falling, petals obovate, apex rounded, 6–7 × 4–5 cm, outside stellate hairy, inside with scattered glandular hairs; staminal tube *c.* 4 cm long, glabrous, bearing anthers throughout, filaments 3–8 mm long, anthers *c.* 1.5 mm long; ovary conical *c.* 7 × 5 mm, covered with stellate-sericeous hairs, 5-locular, style 5–6 mm long, pilose, stigmas capitate, *c.* 1.5 mm across. **Fruit** 22–35 × 17–23 mm, ovoid to obovoid, acuminate, with a beak *c.* 5 mm long, densely hirsute by simple and stellate hairs. **Seeds** many, reniform, brownish black, dorsally densely covered with 3–4 mm long, ferruginous, partly spirally twisted hairs, otherwise glabrous.

**Vernacular name.** Sabah—*randog* (Dusun Ranau).

**Distribution.** Peninsular India, E Pakistan, Assam, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, and Java. Cultivated as an ornamental in Palawan and the Hawaiian

islands. In Sabah, known from Kota Belud (SAN 76302), Kota Merudu (SAN 99493), and Ranau (SAN 61997 and SAN 123132) districts.

**Ecology.** Secondary forest, from lowland to 1400 m.

### 3. *Hibiscus tiliaceus* L.

Fig. 1.

(Latin, *tiliaceus* = resembling the lime tree, *Tilia*, of northern temperate forests)

Sp. Pl. (1753) 694; Merrill *l.c.* 375; Ridley *l.c.* 259; Masamune *l.c.* 453; Backer & Bakhuizen *f. l.c.* 429; van Borssum Waalkes *l.c.* 29; Kochummen *l.c.* 312; Anderson *l.c.* 242; Corner *l.c.* 482. **Type:** *Herb. Hermann no. 258*, vol. 3, fol. 51 (holotype BM).

#### subsp. *tiliaceus*

Tree to 30 m tall, *c.* 40 cm diameter, without buttresses; crown low, spreading and appearing much-branched; trunk fairly smooth, with a tough fibrous bark. Twigs terete, covered with lenticels, usually glabrous but sometimes stellate-hairy, with ring-like stipular scars. Stipules 1–3.5 × 0.5–1 mm, ultimately spreading, ovate to oblong, stellate-hairy outside, usually simple-sericeous inside. **Leaves** 5–9-veined at base, chartaceous to coriaceous, sparsely stellate-hairy or glabrous above, glaucous and densely stellate-hairy beneath; usually orbicular, 7.5–15 cm across; base cordate, margin entire, crenulate, or undulate, apex cuspidate, rarely rounded or obtuse; *inner 1–5 veins with extrafloral nectaries*; petioles stout, 3.5–10 cm long, white hairy towards the junction with the blade. **Flowers** axillary, solitary or in few-flowered, terminal raceme-like clusters; pedicels short, stout, stellate-hairy; epicalyx cup-shaped, usually shorter than the calyx, spreading and often splitting into 8–11 lobes; calyx bell-shaped, 5-lobed, after anthesis widening and often splitting, with nectaries on the veins and stellate-hairs outside, stellate-velutinous along the margins, for the rest simple-sericeous inside; corolla large and showy, bright yellow with maroon eye, fading dull pink after falling, petals fleshy, obovate, 5–7 × 4–5.5 cm, base rounded, apex rounded, stellate-hairy outside, scattered glandular-hairy inside; staminal tube 2.5–3 cm long, glabrous, yellow, bearing anthers throughout; ovary globose to ovoid, 5-angular, densely sericeous, *10-locular (5 true and 5 false dissepiments)*, style with 5 glandular hairy arms, purple, stigmas capitate, dark purple. **Fruits** globose to obovoid, *c.* 18 mm across, surrounded by a calyx cup, simple-sericeous or covered with stellate and simple hairs. **Seeds** 5–7 per locule, upper surface dotted with minute warts, glabrous or more or less densely stellate-hairy, brownish black.

**Vernacular names.** Sabah—*kali bang-bang* (Dusun Sungai). Sarawak—*langkubing, menoa* (Kelabit). Brunei—*baru-baru* (Malay).

**Distribution.** Widespread in the tropics and subtropics of the Old World and the Pacific Islands. Throughout the coasts of Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Very common along sandy seashores and tidal creeks, a common constituent of the *Barringtonia*-formation, rarely in higher places in mangrove, also extending upriver to their brackish reaches; often planted far inland.

**Uses.** The fibre of the bark is used by fishermen for string and cordage in making nets and as tow for caulking boats. Grows well from cuttings and makes an excellent living fence.



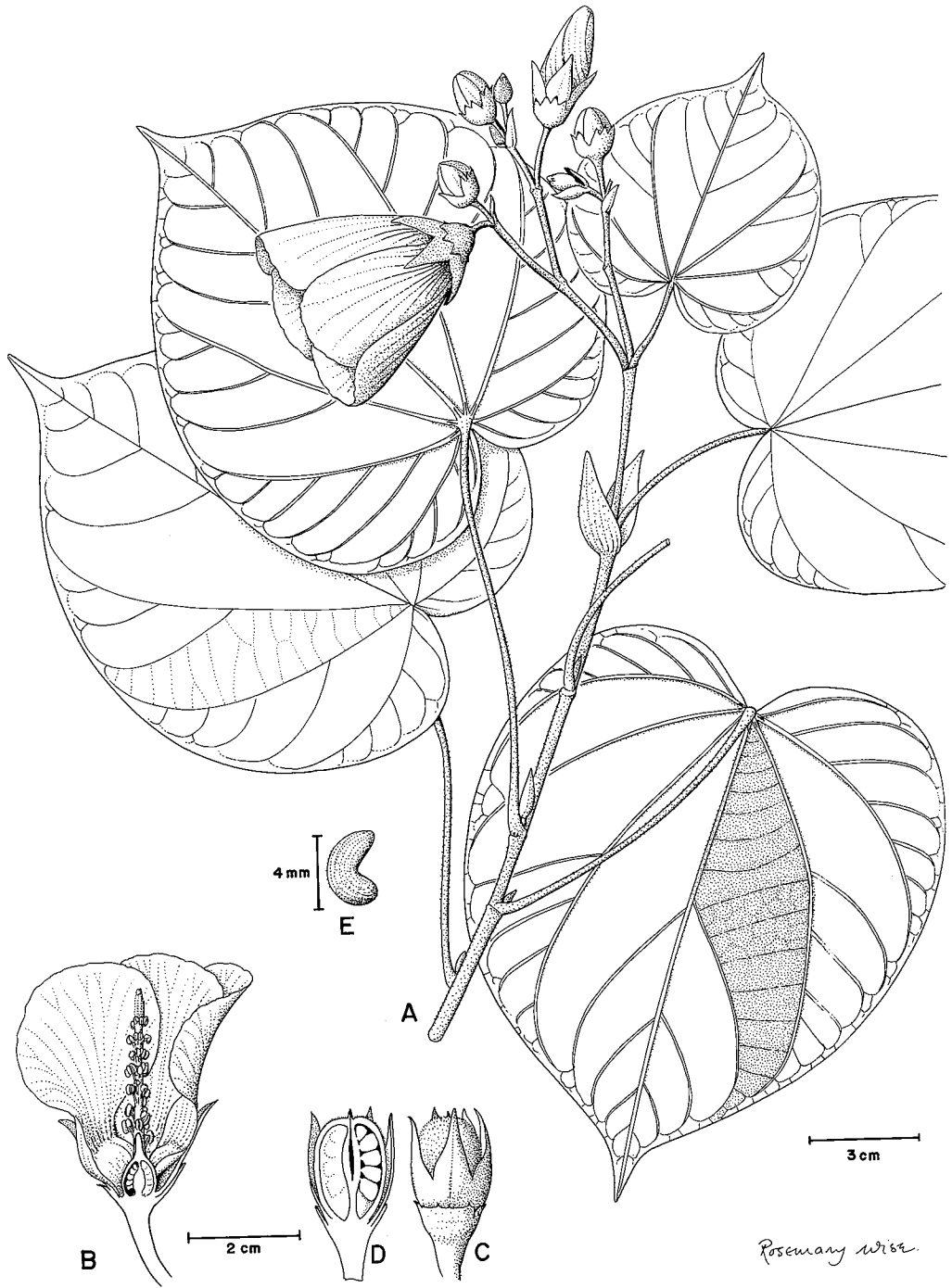


Fig. 1. *Hibiscus tiliaceus*. A, flowering leafy twig; B, flower in longitudinal section; C, fruit; D, fruit in longitudinal section; E, seed. (A–B from S. 24529, C–E from *Balu Perumal* 100.)

## 2. THESPESIA Sol. ex Corrêa, *nom. cons.*

(Greek, *thespesios* = divinely beautiful plant)

Ann. Mus. Herb. Paris 9 (1807) 290; Merrill, EB (1921) 375; Ridley, FMP 1 (1922) 259; Masamune, EPB (1942) 453; Backer & Bakhuizen *f.*, FJ 1 (1963) 435; van Borssum Waalkes, Blumea 14 (1966) 105; Kochummen, TFM 1 (1972) 313; Corner, WSTM 3rd ed. 2 (1988) 483.

Trees or shrubs. *Indumentum of scales or stellate hairs.* **Leaves** spirally arranged, occasionally clustered towards the ends of twigs, entire or palmately lobed, palmately veined, often with extrafloral nectaries. **Flowers** solitary, axillary, often in raceme-like clusters; *pedicels mostly not articulate*, at apex thickened into a hypanthium; *epicalyx 3–8-lobed*, lobes free, small, caducous; calyx usually woody, *cup-shaped, rim entire or with 5 minute teeth*, persistent in fruit; corolla large and showy, mostly yellow with a dark purple centre; staminal tube much shorter than the petals, bearing anthers throughout; ovary 5-locular or as a result of 5 false dissepiments becoming 10-locular; *style 1*, short, *stigmas clavate, 5-grooved* or very rarely 5-lobed. **Fruit** a capsule, indehiscent or loculicidally dehiscent, 5–10-locular; fruit wall woody. **Seeds** 3–many per locule, obovoid; *seed coat glabrous or short hairy*.

**Distribution.** About 15 species, distributed throughout the tropics; 1 species in Sabah and Sarawak.

### *Thespesia populnea* (L.) Sol. ex Corrêa

Fig. 2.

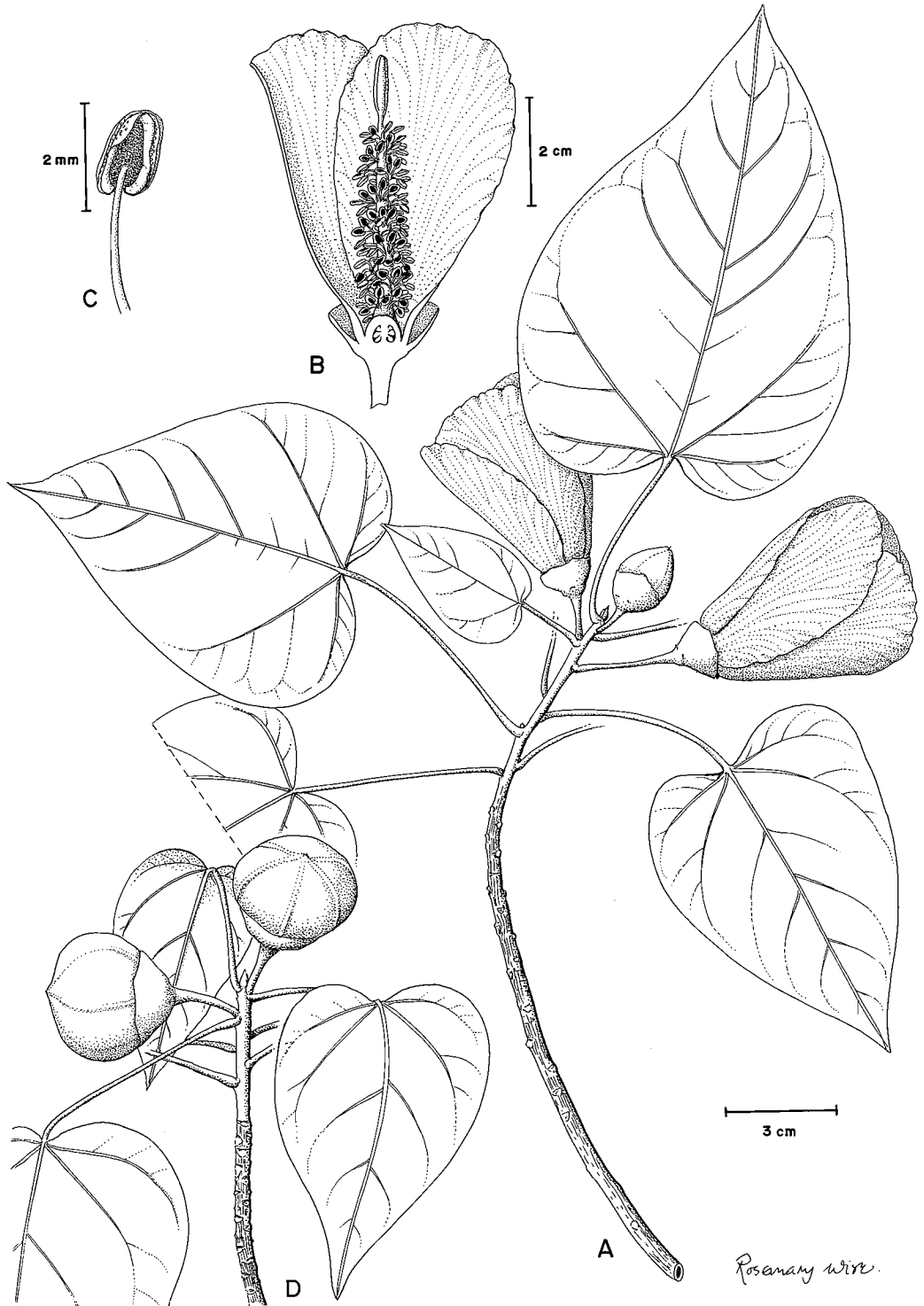
(Latin, *populneus* = resembling the poplar tree, *Populus*, of northern temperate forests)

*l.c.* 290; Merrill *l.c.* 375; Ridley *l.c.* 260; Masamune *l.c.* 453; Backer & Bakhuizen *f. l.c.* 435; van Borssum Waalkes *l.c.* 106; Kochummen *l.c.* 313; Anderson *l.c.* 242; Corner *l.c.* 483. **Basionym:** *Hibiscus populneus* L., Sp. Pl. (1753) 694. **Lectotype** (van Borssum Waalkes, 1966): *Linn. n.* 258, Ceylon (BM).

Shrub or small tree to 20 m tall, with rather dense crown. **Bark** light grey, smooth, becoming rugged with deep fissures. Twigs terete, densely covered with brown to silvery minute scales, early glabrescent. Stipules lanceolate to subulate, acute, 3–10 mm long, scaly. **Leaves** coriaceous, densely covered with bronze-green minute scales, early glabrescent; ovate or oblong, triangular to cordate when young, 7–23 × 5–16 cm; base deeply cordate, 7-veined, margin entire, apex acute, acuminate, or long-attenuate; axils of the basal veins mostly with small, saccate, extrafloral nectaries beneath; petioles 5–16 cm long, scaly. **Flowers** axillary, solitary, large; pedicels 2.5–8 cm long, scaly; epicalyx segments 3, caducous; calyx cup-shaped, almost entire; corolla bell-shaped, pale yellow with a maroon eye, fading pink on the tree and lasting several days, petals obliquely obovate, 6–7 × 4.5–6 cm, apex rounded; staminal tube pale yellow, bearing anthers throughout, filaments *c.* 4 mm long, anthers *c.* 1.5 mm across; ovary globose to ovoid, *c.* 8–10 mm diameter, scaly, 10-locular, style short *c.* 4 mm long, stigma clavate, 5-grooved, *c.* 5 × 3 mm, yellow. **Fruits** depressed subglobose, not splitting, faintly 5-angular, 2–4.5 cm diameter, containing bright yellow gum, subtended by persistent disc-like calyx. **Seeds** 4 per locule, obovoid, densely rusty short-hairy or glabrous.

**Vernacular names.** Sabah—*baru* (Malay), *pangiz* (Dusun).

**Distribution.** Widely distributed in the Old World tropics. Also planted as a shade tree. In Sabah and Sarawak, occasional in coastal areas, though not as common as *H. tiliaceus*.

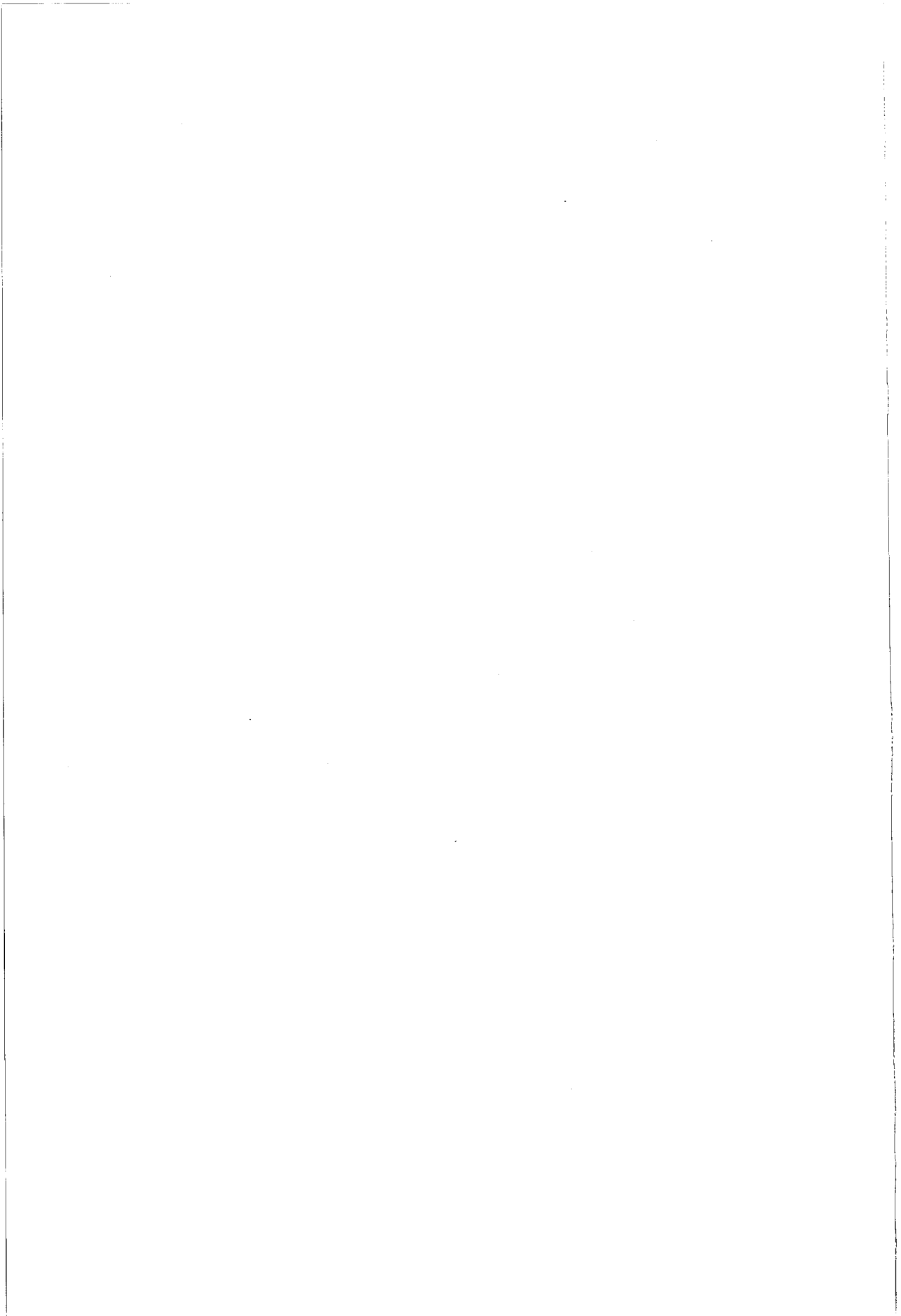


**Fig. 2.** *Thespesia populnea*. A, flowering leafy twig; B, flower in longitudinal section; C, stamen; D, fruiting leafy twig. (A–C from KEP 7574, D from Balu Perumal 101.)

**Ecology.** Sandy sea shores, confined to the *Barringtonia*-formation.

**Uses.** Commonly planted as a roadside tree in some tropical countries.

**Notes.** Easily confused with *Hibiscus tiliaceus*, but the entire calyx and non-splitting gummy fruit which is not enclosed in the calyx are obvious differences.



## MYRICACEAE

### A. Noorsiha

Forest Research Institute Malaysia,  
Kepong, Malaysia

Merrill, EB (1921) 210; Ridley, FMP 3 (1924) 370; Masamune, EPB (1942) 231; Backer, FM 1, 4 (1951) 277; Hutchinson, Fam. Fl. Pl. 1 (1959) 189, Gen. Fl. Pl. 2 (1967) 120; Backer & Bakhuizen *f.*, FJ 2 (1965) 1; Keng, OFMSP (1969) 129; Whitmore, TFM 2 (1973) 295; Anderson, CLTS (1980) 263; Ashton, MNDTS 2 (1988) 322; Corner, WSTM 3rd ed. 2 (1988) 558; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 261.

A monogeneric family (or with 2–4 genera according to some botanists) with about 50 species, distributed in temperate, subtropical, and tropical regions worldwide, except in Australia.

**Ecology.** Often gregarious in open scrublands, marshy places, and mountainous regions. A number of species have been shown to form nitrogen-fixing root nodules (Bond, Ann. Rev. Pl. Phys. 18 (1967) 108; Torrey, Bio Science 28 (1978) 586). This seems to correlate with the occurrence of *Myrica* in characteristically nitrogen-deficient sites with well-drained or swampy acidic soils where available mineral nutrients are usually also in short supply. The fully developed male spikes readily emit clouds of pollen when tapped, indicating that the flowers are wind-pollinated. The fruits are dispersed mainly by birds and squirrels.

**Uses.** The small, aromatic and decorative trees or shrubs merit planting in avenues, gardens, and courtyards.

**Taxonomy.** Myricaceae has been placed in different orders, *viz.* Juglandales (Melchior in Engler's Syll. Pflanzenfam. ed. 12, 2 (1964) 39), Rutales (Thorne, Nordic J. Bot. 3 (1983) 85), and Myricales (Hutchinson *l.c.*; Cronquist, Integr. Syst. Class. Fl. Pl. (1981) 59; Dahlgren, Nordic J. Bot. 3 (1983) 119; Takhtajan, Syst. Magnol. (1987) 95).

## MYRICA L.

(Greek, *murike* = name of an aromatic shrub)

Sp. Pl. (1753) 1024; Merrill, EB (1921) 210; Ridley, FMP 3 (1924) 370; Masamune, EPB (1942) 231; Backer, FM 1, 4 (1951) 277; Backer & Bakhuizen *f.*, FJ 2 (1965) 2; Hutchinson, Gen. Fl. Pl. 2 (1967) 120; Whitmore, TFM 2 (1973) 295; Anderson, CLTS (1980) 263; Ashton, MNDTS 2 (1988) 322; Whitmore, Tantra & Sutisna, CLK 2,1 (1990) 261. **Synonym:** *Morella* Lour., Fl. Coch. (1790) 548.

Monoecious or dioecious trees or shrubs, *often strongly aromatic; young parts often covered with yellow, peltate, scale-like glands.* **Leaves** spirally arranged, alternate, or sometimes

crowded at the ends of twigs, *simple* or *sometimes deeply pinnately lobed*, pinnately veined; *stipules absent* or rarely present. **Inflorescences** axillary, simple or branched paniculate spikes, unisexual (or bisexual, where the male flowers are located on the lower part of the rachis; rare in Sabah and Sarawak). **Flowers** *unisexual or rarely bisexual* (New Caledonian taxa); *perianth absent*, or the female flower with 2–few sepaloïd, whorled bracteoles; male flowers subtended by a tiny, solitary bracteole, stamens 2–many, usually 2–8, filaments short, free or united at base, anthers basifixed, 2-locular, dehiscing longitudinally, pistillodes absent or rarely present; female flowers in clusters of 3–8, subtended by a bract, staminodes absent, *ovary 1-locular*, inferior to rarely superior (non-Malesian taxa), style short, 2-branched, stigmatose on inner side, stigmas 2, ovate-triangular, subulate or filiform, *ovules one in each locule, erect, basal, orthotropous*, or pendulous-anatropous. **Fruit** a *drupe*; pericarp often warty, warts waxy; mesocarp thin, pulpy; endocarp hard. **Seed** 1; testa membranous; endosperm scanty to absent; embryo straight, cotyledons flat-convex, radicle short.

**Distribution.** As in the family. In Sabah and Sarawak, 2 species.

**Ecology.** Coastal areas to mountain tops, to 3300 m.

### Key to *Myrica* species

Twigs usually densely hairy. Leaves of mature trees lanceolate or narrowly oblong-obovate, thin-coriaceous; base acute to narrowly rounded, margin subentire or distantly serrulate, apex acuminate to rounded-acute or rarely obtuse; midrib densely hairy on both sides; lateral veins thinly hairy, arching and looping near the margin; petioles densely tomentose or sometimes glabrous. Stigmatic arms filiform or subulate.....**1. *M. esculenta***

Twigs usually glabrous. Leaves of mature trees obovate or oblong-obovate, thick-coriaceous; base acute, margin serrate or crenate, apex rounded or slightly emarginate; midrib glabrous on both sides; lateral veins glabrous, not arcuating nor looping but ending in marginal toothlets; petioles glabrous. Stigmatic arms ovate-triangular.....**2. *M. javanica***

#### 1. *Myrica esculenta* Buch.-Ham.

(Latin, *esculentus* = edible and nourishing; the fruit)

In D. Don, Prod. Fl. Nep. (1825) 56; Gamble, J. As. Soc. Beng. 75, 4 (1915) 404; Merrill *l.c.* 210; van Steenis, Bull. Jard. Bot. Btzg. 3, 13 (1936) 229; Masamune *l.c.* (1942) 231; Backer *l.c.* 278; Backer & Bakhuizen *f. l.c.* 2; Keng *l.c.* 133; Whitmore *l.c.* 295; Anderson *l.c.* 263; Ashton *l.c.* 322; Whitmore, Tantra & Sutisna *l.c.* 261. **Type:** *Hamilton, s.n.*, Nepal (K). **Synonyms:** *Myrica sapida* Wall., Tent. Fl. Nep. (1826) 59; *M. esculenta* Buch.-Ham. var. *sapida* (Wall.) A. Chev., Mon. Myric. (1901) 122, Merrill *l.c.* 210, Masamune *l.c.* 231; *M. farquhariana* Wall. *l.c.* 61; *M. esculenta* Buch.-Ham. var. *farquhariana* (Wall.) A. Chev. *l.c.* 125, Merrill *l.c.* 210, Masamune *l.c.* 231; *M. missionis* Wall., Cat. (1832) No. 7297; *M. esculenta* Buch.-Ham. var. *missionis* (Wall.) A. Chev. *l.c.* 126, Merrill *l.c.* 210, Masamune *l.c.* 231; *M. lobbii* Teijsm. & Binn. ex Miq., Fl. Ind. Bat. 1 (1858) 872; *M. esculenta* Buch.-Ham. var. *lobbii* (Teijsm. & Binn. ex Miq.) A. Chev. *l.c.* 127, Merrill *l.c.* 210, Masamune *l.c.* 231.

Monoecious small bushy tree, treelet or shrub to 15 m tall, 15 cm diameter; crown uneven or oblong; *bole often twisted and crooked*. **Bark** fissured or smooth, blackish grey. *Twigs and*

*terminal buds densely clothed with long, thin hairs and scattered yellow, peltate glands; stipules present in young plants. Leaves* spirally arranged or sometimes crowded at the ends of twigs; *thin-coriaceous*, dark green and shiny above, sparsely hairy or glabrous and sparsely glandular on both surfaces, sometimes pitted; *lanceolate to narrowly oblong-obovate*, 3–11 × 1.5–4 cm; *base acute or narrowly rounded, margin subentire or distantly serrulate, apex acuminate, rounded-acute or obtuse*; midrib flat or slightly depressed above, thick and prominent below, *densely hairy on both sides*; lateral veins 5–12 pairs, reddish brown, slender, *thinly hairy, arching and looping near the margin*, prominent below; intercoastal veins reticulate, reddish brown, conspicuous on both surfaces; *petioles* stout, 0.2–1.2 cm long, *densely tomentose*, sometimes glabrous. **Inflorescences:** males 1–6.5 cm long, patent, branched, rather laxly flowered at the lower part, bracts ovate-triangular, 1.5–2.5 × 1–1.5 mm, densely hairy, bracteoles ovate-triangular, c. 1.5 × 1 mm, long-hairy outside; females to 5 cm long, erect, unbranched, densely flowered on the upper part, laxly flowered on the lower part, bracts ovate-triangular, 1.75–3 × 1–2 mm, hairy and glandular outside, bracteoles 2, ovate-triangular, to 1.5 × 1 mm, hairy and glandular outside. **Flowers:** males yellowish red, turning to brown on drying, stamens 2–4, filaments 0.25–0.5 mm long, united at base, pistillodes absent; females c. 2 mm across, pale green, in clusters of 3–6(–10), ovary densely hairy when young, styles reflexed, *stigmatic arms filiform or subulate*, c. 2.5 mm long. **Fruits** ellipsoid-globose, 1–2 × 1 cm, slightly flattened, dark bright red when mature; pericarp warty, yellow, pulpy with a sweet-sourish taste when fresh.

**Vernacular names.** Sarawak—*merbuta gunung, telur cicak* (Malay).

**Distribution.** S and E Asia, stretching from India to Nepal, China, Myanmar, Thailand, Indo-China, and Malesia (Sumatra, Peninsular Malaysia, Java, Borneo, Phillipines, Sulawesi and Lesser Sunda Islands). In Sabah and Sarawak, recorded from many areas.

**Ecology.** Uncommon in primary forest, occasional in *kerangas* forest, often locally abundant in secondary forest and open scrublands on well-drained stony laterite soils, rocky beach, sand-dunes, sandstone pavements, cliffs and screes, from lowlands to 1500 m. Flowering and fruiting throughout the year.

**Uses.** Occasionally cultivated for its edible fruits, used in drinks and desserts. The bark has been reported as a source of tanning material and dyes; its decoction is used in traditional medicine. The waxy substance of the fruit pulp is used for making candles and soap.

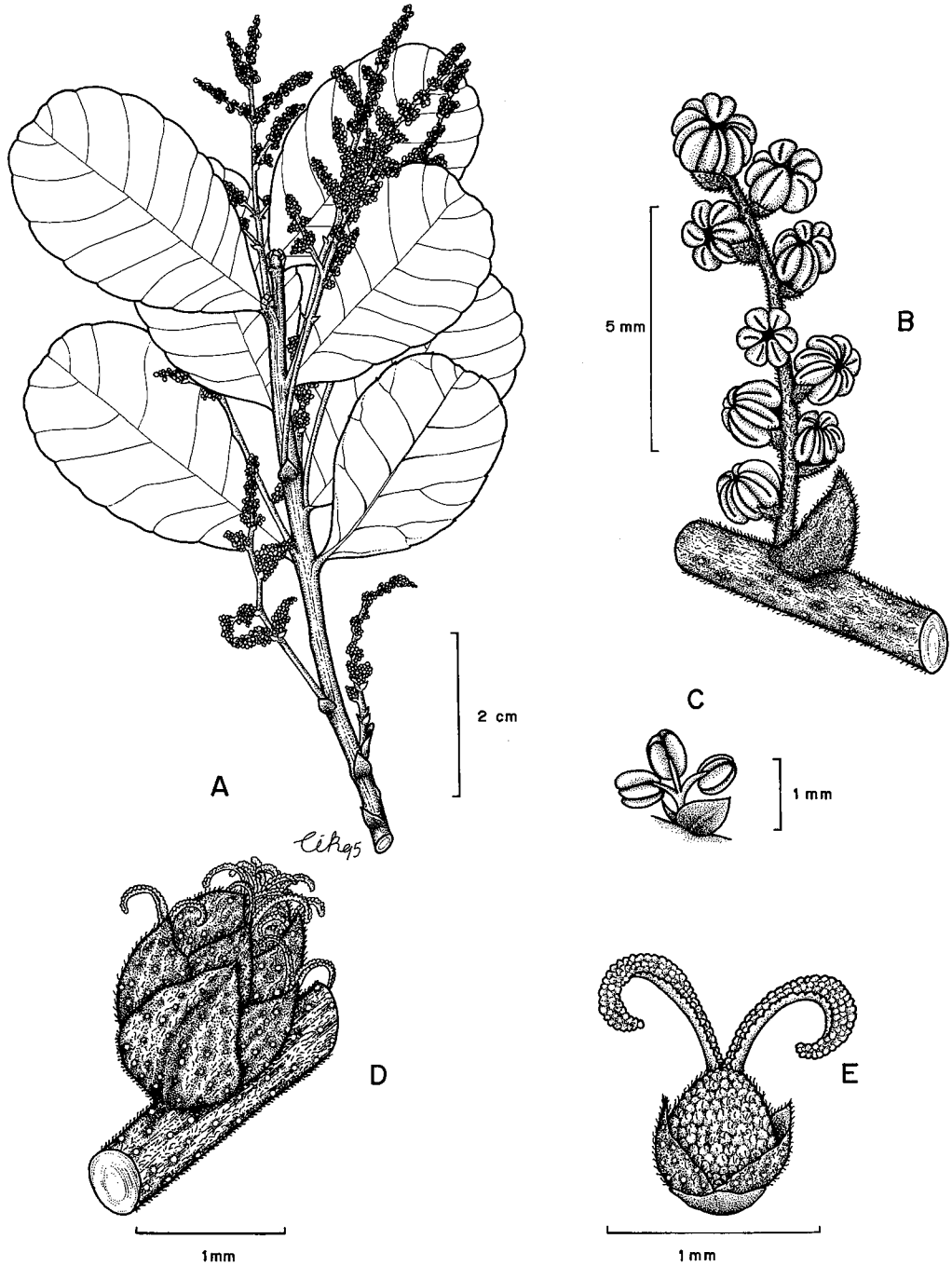
**Notes.** Leaves of saplings and seedlings are very different from those of mature trees: blades 19–23 × 3.5–5 cm, margins deeply, pinnately incised; lateral veins to 15 pairs; stipules ovate-lanceolate, 0.5–0.75 cm long, caducous.

## 2. *Myrica javanica* Blume (of Java)

Fig. 1.

Bijdr. Fl. Ned. Ind. (1825) 517; Stapf, FMK (1894) 231; Merrill *l.c.* 210; van Steenis, Bull. Jard. Bot. Btzg. 3, 13 (1936) 229, *l.c.* 3, 17 (1948) 389; Masamune *l.c.* 231; Backer *l.c.* 277; Backer & Bakhuizen *f. l.c.* 2; Anderson *l.c.* 263; Ashton *l.c.* 324; Whitmore, Tantra & Sutisna *l.c.* 261. **Type:** Reinwardt, *s.n.*, West Java, Mt. Gede (holotype L).





**Fig. 1.** *Myrica javanica*. A, flowering (male) leafy twig; B, side-branch of a male inflorescence; C, male flower; D, a cluster of female flowers; E, female flower. (A–C from K. M. Wong s.n., 4 June 1993, D–E from Kostermans c.s. (UNESCO) 262.)

Monoecious small bushy tree or erect shrub, 2–12(–20) m tall, 10–16 cm diameter; crown dense; bole straight or crooked. **Bark** brown; inner bark red; sapwood white. *Twigs reddish brown, glabrous*, sparsely glandular. **Leaves** *thick-coriaceous*, glabrous, sometimes darker below, densely glandular on both surfaces, sometimes shallowly pitted; *obovate to obovate-oblong*, 3–8.5 × 1.5–4 cm; *base acute, margin serrate or crenate, apex rounded or slightly emarginate*; *midrib* slightly flat above, prominent below, *glabrous on both sides*; *lateral veins* 5–8 pairs, slender, reddish brown, sunken above, rather prominent below, *glabrous on both sides, ending in marginal minute teeth, often forked*; intercoastal veins densely reticulate, distinct below; petioles stout, 2–10 mm long, *glabrous*, sparsely glandular. **Inflorescences:** males branched, rachis angular, widely patent, to 6.5 cm long, pinkish brown, bracts ovate-pointed, 1–2 mm long, shortly hairy, glandular; females 3–7 cm long, erect, hardly branched, rather remotely flowered, bracts ovate-triangular, 1–2 mm long, acute, hairy and glandular, bracteoles 2, adhered to the ovary, ovate, long-hairy along the margin, glandular. **Flowers:** males yellow turning to red, stamens 3–4, filaments 1–1.5 mm long, most part united into a short, thick staminal column, densely tomentose and yellowish glandular, pistillodes absent; females in clusters of 5–8, ovary ovoid-ellipsoid, 0.5–2 mm, hairy, style spreading, *stigmatic arms ovate-triangular*, *c.* 1.3 mm long. **Fruits** red-brown to black, ovoid-globose or broadly ellipsoid, *c.* 0.5 cm diameter, slightly flattened, minutely warty, glabrous, glandular; pericarp thin, yellow, pulpy; *sap purplish*, of acid taste.

**Distribution.** Sumatra, Java, Borneo, Philippines, Sulawesi, Lesser Sunda Islands, and New Guinea. In Sabah, recorded mainly from Mt. Kinabalu; in Sarawak, known from Mt. Murut, Mt. Api, Mt. Kanyi, Mt. Mulu, Mt. Dulit and Bt. Batanga; also in Brunei and Kalimantan.

**Ecology.** In lower montane to open mossy montane forest and shrubby subalpine vegetation, at 1000–3300 m. Often found on precipitous ridge crests, limestone hills, volcanic and granite rocks, and in open grassy thickets on peaty substratum. Flowering and fruiting throughout the year.

**Uses.** The timber has been used mainly for making charcoal and as firewood. Ripe fruits are consumed fresh. In Java, cultivated as roadside trees or planted in the reforestation of degraded lands in the mountains.



## NYCTAGINACEAE

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Ridley, FMP 3 (1924) 1; Stemmerik, FM 1, 6 (1964) 450; Hsuan Keng, OFMSP (1969) 111; Whitmore, TFM 2 (1973) 297; Anderson, CLTS (1980) 382; Corner, WSTM 3rd ed. 2 (1988) 598.

Trees, shrubs, herbs, or climbers; wood (in *Pisonia*) with included phloem. **Leaves** *opposite, alternate or rarely in whorls, simple, without stipules*. **Inflorescences** cymose, often thyrsoid, corymbose or umbellate, terminal, axillary or sometimes borne on the stems; bracts and bracteoles present. **Flowers** *radially symmetrical, bisexual or unisexual*, pedicellate, sometimes enclosed by bracts; the bracts often brightly coloured or resembling perianth lobes; perianth tubular, bell-shaped, funnel-shaped or urceolate, shortly 5–10-lobed, sometimes adnate to the pedicel, the basal part persistent, enclosing the receptacle, clavate or funnel-shaped, the apices partly plaited or valvate in bud, green or variously coloured; *stamens* 1–40, *in 1–2 whorls, connate at base, free from the perianth; anthers* 2-locular, *latrorse, basifixed; ovary subsessile, superior, 1-locular, ovule anatropous*, style terminal, *stigma capitate or frilled to shortly lobed*. **Fruits** *indehiscent*, enclosed by basal persistent part of the perianth lobes, smooth, or *with viscid ribs and glands*, sometimes the glands accrescent into prickles; pericarp thin. **Seeds** 1 per fruit; embryo straight or folded; endosperm abundant.

**Distribution.** About 26 genera and *c.* 300 species, mostly American, particularly in South America. In Malesia, 4 genera and 19 species; only *Pisonia* comprises small native trees. In Sabah and Sarawak, the family is represented by 4 genera and probably 9 species, of which only two are small trees, the rest being either shrubs, climbers or herbs.

**Ecology.** Occurring in lowland to montane forest, to *c.* 2000 m, on various types of soil. *Boerhavia* is a genus of pantropical weeds; *Mirabilis* is naturalised and weedy, and often cultivated as an ornamental; *Bougainvillea* is widely grown as an ornamental and *Pisonia* is a genus of trees or treelets in various forest types especially in coastal areas.

**Uses.** *Bougainvillea* is the best known member of the family in Malesia as well as in Sabah and Sarawak; many cultivars are very commonly cultivated for their colourful bracts. *Pisonia grandis* is also cultivated for its foliage.

### Key to genera

1. Herbs, unarmed. Flowers bisexual, in cymes of 2–10.....2  
Woody plants, sometimes thorny. Flowers bisexual or unisexual, in dense flower-clusters.....3

2. Leaves in a pair typically unequal in size. Inflorescence without involucre. Fruit with 5–10 prominent ribs and viscid glands.....

**Boerhavia** L.

Gen. Pl. ed. 5 (1754) 4; Stemmerik, FM 1, 6 (1964) 452.

Three variable species, namely *B. diffusa*, *B. chinensis*, and *B. erecta*; pantropical.

Annual herbs, erect, ascending or creeping, covered with minute hairs or clavate glands or hairs. Stem often red-tinged, nodes swollen, becoming constricted on drying. Inflorescences axillary. Flowers bisexual. Seeds with longitudinally folded embryos.

In Sabah and Sarawak, these are introduced and have become weeds of open places.

Leaves in a pair of equal size. Inflorescence with involucre. Fruits with faint ribs, without viscid glands.....

**Mirabilis** L.

Gen. Pl. ed. 5 (1754) 82; Masamune, EPB (1942) 272; Stemmerik, FM 1, 6 (1964) 451.

About 60 species, mostly American.

Erect herb, c. 60 cm tall. Leaves oblong to slightly 3-angular; petioles c. 2.5 cm long. Inflorescence a terminal corymb, 1–many-flowered, each flower subtended by a persistent involucre which is divided halfway into 5 oblong, acute lobes. Flowers bisexual, ephemeral, trumpet-shaped. Seeds with recurved cotyledons; endosperm mealy.

One species from the Himalayas and SW China, *M. jalapa*, has been introduced to Sabah and Sarawak as an ornamental.

3. Each pedicel bearing one sessile coloured bract, 3–6 cm long. Shrubs or coarse climbers...

**Bougainvillea** Comm. ex Juss.

Gen. (1789) 91; Stemmerik, FM 1, 6 (1964) 455.

About 14 species, native of Central and Tropical South America.

Coarse climbers with supra-axillary spines. Leaves opposite, ovate to elliptic-oblong. Inflorescence supra-axillary, peduncle bearing a single apical cluster of 3 flowers; perianths tubular, limb 4–5-lobed, tube with 4–5 ribs. Fruits spindle-shaped, coriaceous, 5-ribbed, not viscid. Embryo longitudinally coiled.

Three species, with many hybrids and cultivars are cultivated as ornamentals in Malesia, including Sabah and Sarawak; particularly common are *B. glabra* and *B. spectabilis*.

Each pedicel bearing 1–3 small, greenish bracteoles. Small trees, rarely climbers...**Pisonia**

**PISONIA** Plum. ex L.

(W. Piso, b. 1611, a Dutch physician)

Gen. Pl. ed. 5 (1754) 451; Ridley, FMP 3 (1924) 2; Heimerl in Engler & Prantl, Pflz. Fam. ed. 2, 16c (1934) 126; Burkill, EPMP 1 (1935) 1755; Stemmerik, Blumea 12 (1964) 275, FM 1, 6 (1964) 457; Whitmore *l.c.* 298; Anderson *l.c.* 282; Corner *l.c.* 599.

Trees to 30 m tall, unarmed, or thorny climbers (*P. aculeata*). Branches sympodial. **Bark** soft and spongy, brittle, pale cream. **Leaves** opposite, entire, dull, drying chartaceous and black to

dark brown; midrib flat above. **Inflorescences** axillary or terminal cymes (rarely borne on leafless stems or branches), 2–8-times umbellately branched, each ultimate branch bearing 1–3 flowers; *pedicels with 1–3, small, caducous bracteoles*. **Flowers** bisexual or unisexual, small, greenish white; perianths fleshy, valvate in bud, bell-shaped, tubular, urceolate, or funnel-shaped, 5- or rarely 10-lobed, basal part tubular, coriaceous, persistent, accrescent and elongating after anthesis, apical part coloured, often circumscissile; stamens 2–40, in 1–2 whorls, mostly exerted and sterile; ovary, elongated, smooth, style longer than the ovary, stigma capitate, lobes frilled, radiating or unilateral. **Fruits** coriaceous, often crowned by a perianth limb, smooth or with 5 ribs, viscid due to the presence of longitudinal rows of glands, which sometimes developing into prickles; sometimes a rostrum also developed. **Seeds** oblong; *embryo straight, deeply longitudinally furrowed*; cotyledons recurved and surrounding the perisperm, the latter sometimes reduced to a gelatinous mass.

**Distribution.** About 35 species, with 20 in the Americas, only one in East Africa, and two others in the Madagascar area, few in continental SE Asia; eight native in Malesia, including three in Sabah and Sarawak.

**Ecology.** In primary rain forest, especially near the coast.

### Key to *Pisonia* species

1. Spiny climber. Perianth limb with 5 large lobes, alternating with 5 smaller ones. Fruit 5-ribbed, each rib with a row of biseriate glandular appendages.....

***P. aculeata* L.**

Sp. Pl. (1953) 1026; Ridley *l.c.* 3; Stemmerik, FM 1, 6 (1964) 467; Whitmore *l.c.* 298.

Scandent climber *c.* 20 m high, with mostly recurved thorns. Leaves elliptic 4–10 × 1.2–5 cm. Flowers unisexual, in dense, axillary cymes. Fruits clavate, *c.* 15 × 2 mm, sericeous.

Tropical and subtropical America, Africa, Madagascar, Mauritius, Seychelles, Sri Lanka, India, the Andaman islands, Myanmar, Indo-China, throughout Malesia, Australia, and New Caledonia. In Borneo, very rare on the northern coast of Sabah.

Tree or erect shrub, unarmed. Perianth limb with 5 rows of black glands or short brown hairs. Fruit 5-ribbed, each rib bearing uniseriate prickles or a row of viscid glands.....2

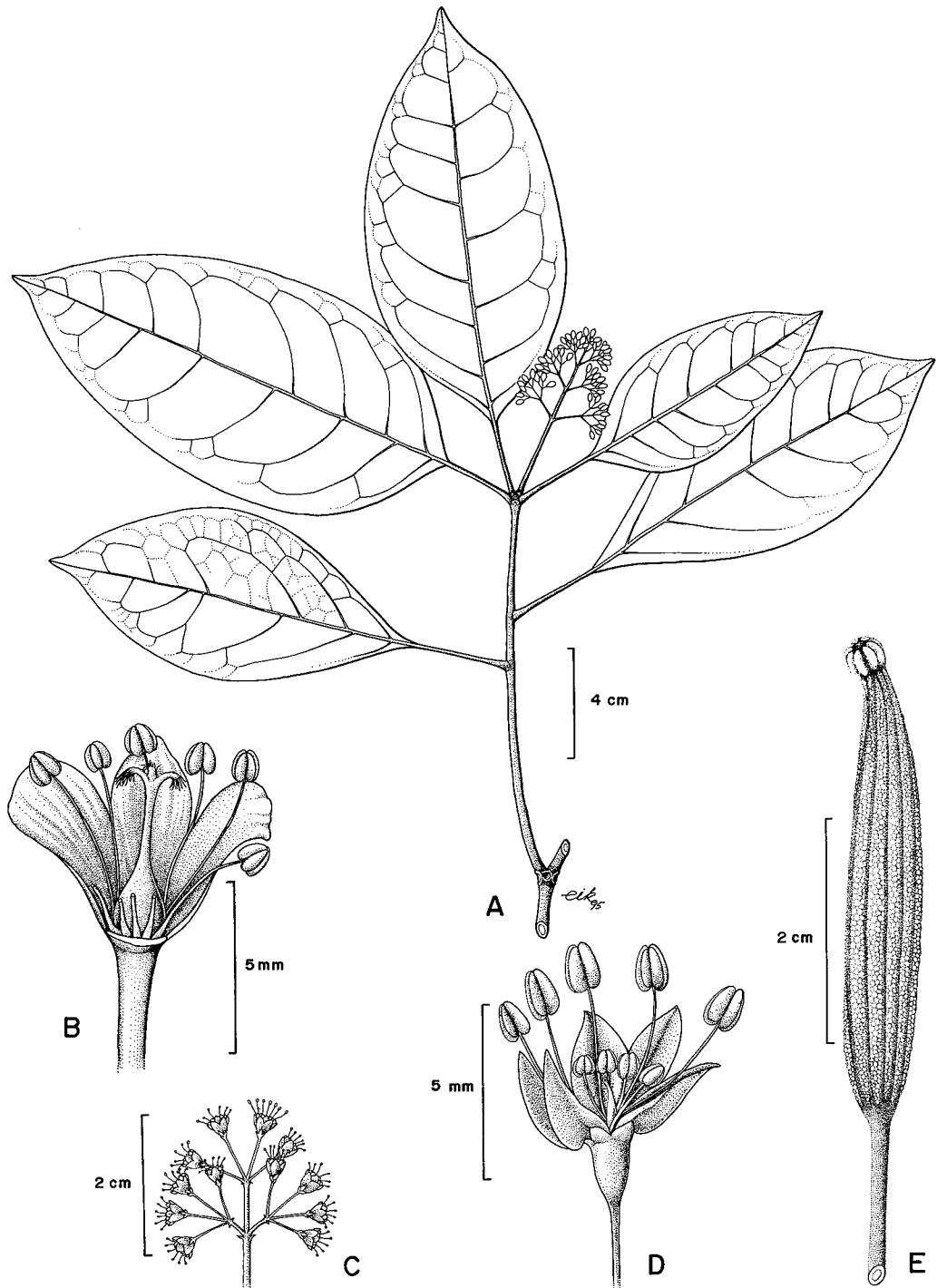
2. Leaves with distinct dark veins contrasting with lighter coloured intercostal veins; lateral veins and intercostal veins hairy beneath. Perianth limb glandular. Fruit, with 5 rows of uniseriate prickles.....**1. *P. grandis***  
 Leaves without distinctly contrasting dark veins, glabrous on lower surface. Perianth limb not glandular. Fruits with rows of viscid glands.....**2. *P. umbellifera***

**1. *Pisonia grandis* R. Br.**

(Latin; *grandis* = large; the leaves)

Prod. Fl. Nov. Holl. 1 (1810) 422; Ridley, J. Str. Br. Roy. As. Soc. 45 (1905) 215; Backer & Bakhuizen *f.*, FJ 1 (1963) 272; Stemmerik *l.c.* (1964) 464; Whitmore *l.c.* 298; Corner *l.c.* 599. **Type:** *R. Brown, s.n.*, north coast of Australia (BM). **Synonym:** *P. alba* Span., Linnaea 15 (1841) 342, Corner *l.c.* 599.

Shrub or tree to 30 m high, *c.* 100 cm diameter, usually much smaller, with large exposed



**Fig. 1.** *Pisonia umbellifera*. A, flowering leafy twig; B, bisexual flower with some sepals, petals and stamens removed; C, a portion of male inflorescence; D, male flower; E, fruit. (A–B from Podzorski SMHI 985, C–D from Leonardo Co 3410, E from Saw et al. FRI 40010.)

roots; wood soft and light. Twigs light-coloured, when dry with conspicuous furrows and large leaf scars. **Leaves** membranous; elliptic, oblong or ovate, 10–20 × 6–10 cm; base cuneate, rounded or cordate, mostly asymmetric, apex acuminate; *with red or dark coloured veins*, sericeous, early glabrescent, tardily so on the veins beneath; petioles 1–6 cm long. **Inflorescence** a terminal, cymose, 1.7–3.5 × 3–4.5 cm; peduncles c. 1.5 cm long, light-brown hairy; pedicels 1–2.5 mm long, at the upper or lower part with 2–4 oblong bracteoles. **Flowers** bisexual; perianth white, funnel-shaped, c. 4 mm long, 5-lobed, *limbs with 5 rows of black glands*; stamens 6–10, exserted for 2 mm long; stigma frilled, not exserted. **Fruits** cylindrical to clavate, c. 12 × 2.5 mm, *with 5 ribs, each bearing a row of viscid uniseriate prickles of c. 1 mm long*, hairy between the ribs; stalks 1–1.5 cm long. **Seeds** 9–10 × 1.5–2 mm.

**Distribution.** From Madagascar through Malesia to Australia and the Pacific. In Sabah, known only from Pulau Sibun, Lahad Datu district.

**Ecology.** Wild on the northern coast of Sabah; presently widely cultivated as an ornamental in urban areas for its beautiful yellowish green foliage.

**2. *Pisonia umbellifera* (J. R. Forst.) v. Seemen**  
(Latin, *umbelliferus* = umbel-bearing; the inflorescences)

Fig. 1.

Bonplandia 10 (1862) 154; Kurz, For. Fl. Burm. 2 (1877) 279; Stemmerik *l.c.* (1964) 460; Whitmore *l.c.* 298; Anderson *l.c.* 282. **Basionym:** *Ceodes umbellifera* J. R. Forst., Char. Gen. Pl. (1776) 71. **Type:** Forster, *s.n.*, Tanna (BM). **Synonym:** *P. excelsa* Blume, Bijdr. Fl. Ned Ind. 14 (1826) 735.

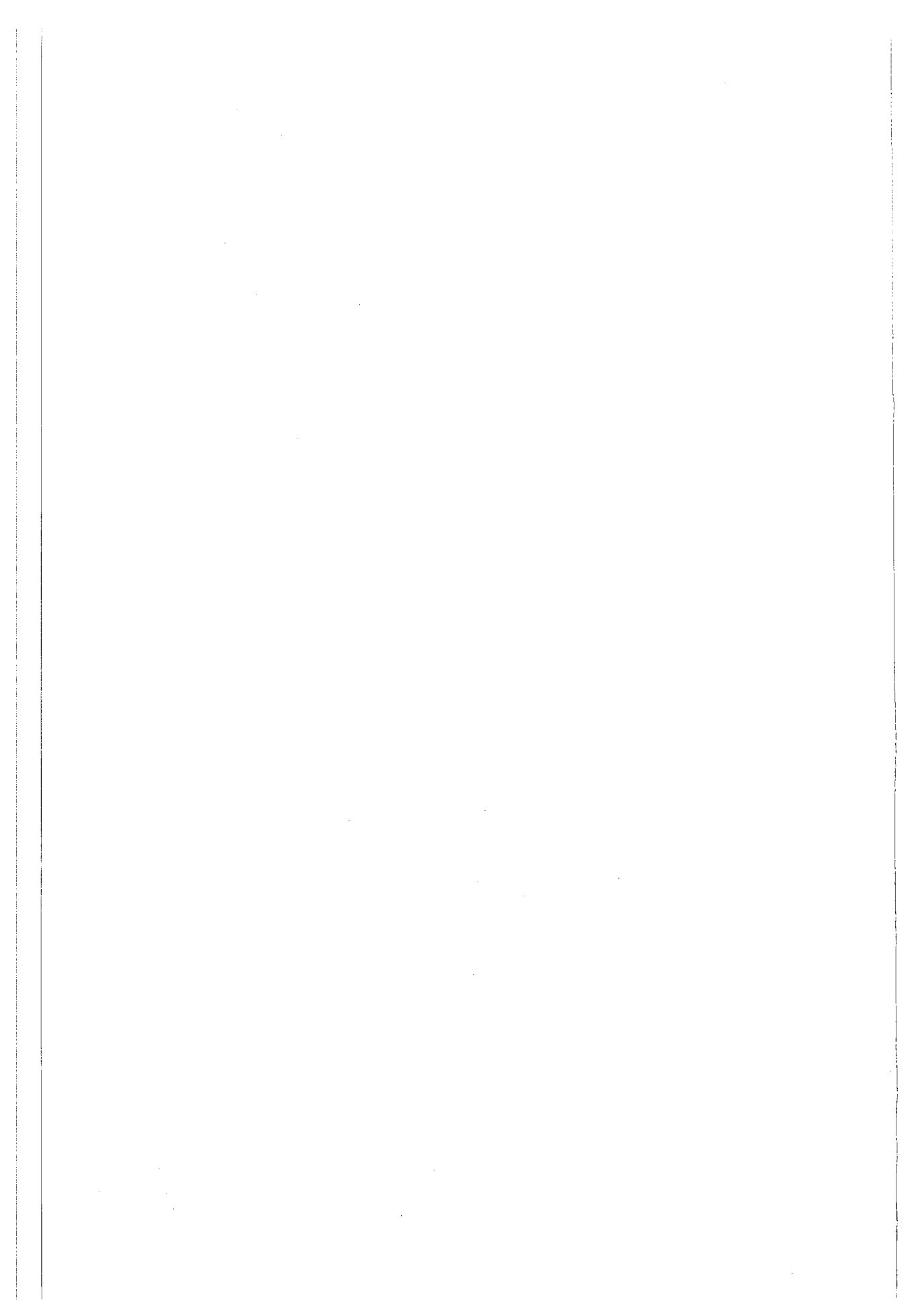
Shrub or tree to 28 m high, unarmed. **Bark** smooth, greyish; inner bark pale green; sapwood soft, cream. **Leaves** sometimes crowded at the ends of twigs, *glabrous beneath*; ovate to elliptic-oblong, 9–23 × 4–11 cm; base cuneate to rounded, apex acute to rounded; *without contrasting dark veins*; petioles 0.5–4 cm long. **Inflorescence** a terminal, branched, many-flowered compound umbel, 3–9 cm across, sericeous or glabrous; peduncles 3.5–6 mm long; pedicels 1.5–6 mm long, with 1–3 small bracteoles at the base or higher. **Flowers** bisexual or unisexual, yellow; perianth 2.5–7 mm long, bell-shaped, *limbs with short brown hairs*; stamens 6–14, exserted to 4 mm; stigma frilled, exserted for c. 1 mm in unisexual flowers and c. 1.5 mm in bisexual flowers. **Fruits** cylindrical, black, 2–4 × 0.3 cm, *5-ribbed, each rib with a row of viscid glands*; stalks 0.7–1.5 cm long. **Seeds** 17–20 × 2 mm.

**Vernacular names.** Sabah—*tintotobokon, tutubokon* (Dusun).

**Distribution.** South Africa, Madagascar, Indo-Malesia, Australia and the Pacific. Common throughout Sabah but less common in Sarawak.

**Ecology.** In Sabah, it is found in various habitats, from coastal forest as on Banggi Is., limestone at Madai Caves, to higher elevation on the Crocker Range. However, in Sarawak, it has only been collected on limestone at Niah, although it also occurs in coastal vegetation on Talang-talang island.





## SANTALACEAE

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Kepong, Malaysia

Bentham, Fl. Austral. 6 (1873) 211; Hooker *f.*, Fl. Br. Ind. 5 (1890) 228; King, J. As. Soc. Beng. 75, 2 (1912) 269; Merrill, EB (1921) 241; Ridley, FMP 3 (1924) 166; Danser, Nova Guinea N.S. 4 (1940) 133; Masamune, EPB (1942) 257; Backer & Bakhuizen *f.*, FJ 2 (1965) 76; Stauffer, Vierteljahrsschrift Naturf. Ges. Zurich 114 (1969) 49; Whitmore, TFM 2 (1972) 341; Anderson, CLTS (1980) 310; Hewson & George, Fl. Austral. 22 (1984) 29.

Small to medium-sized trees or *hemiparasitic, climbing or epiphytic shrubs*. **Leaves** simple, alternate or spirally arranged, rarely opposite, *often reduced to minute scales*, persistent or caducous; *stipules absent*. **Inflorescence** a raceme, spike, panicle or corymb, rarely a solitary flower, axillary or terminal, usually bracteate. **Flowers** small, *radially symmetrical, unisexual or bisexual; perianth in one series*, 3–5-lobed, lobes valvate in bud, inserted on a shallow, cup-like receptacle, perigynous or epigynous; *disc present*, often thickened and lobed at margin, rarely absent; stamens 3–5, opposite perianth lobes, anthers basifixed or almost so, 2-locular, dehiscing longitudinally; *ovary superior or inferior*, 1- or incompletely 5–12-locular, with 1–5 *pendulous ovules, placentation free*; style very short or none; stigma entire or 2–5-lobed. **Fruit** a *drupe or pyrene*; pericarp often fleshy; endocarp usually hard; *receptacle often enlarged, fleshy and coloured*. **Seeds** 1 to several per fruit, entire or lobed, without testa; endosperm copious.

**Distribution.** Worldwide, with 37 genera and about 1400 species. In Sabah and Sarawak, represented by 5 genera and 6 (–9) species, of which only 2 genera with 2 species are trees.

**Ecology.** Occurring in a wide variety of habitats on nutrient-poor soils such as white sands, in swamps, on limestone, and in mossy forest, from lowland to 3000 m.

**Uses.** The most well-known product of the family is sandalwood, derived principally from *Santalum album*, native to India, Myanmar, East Java, Lesser Sunda Islands, and northern Australia. Its aromatic heartwood or the oil distilled from it has important cosmetic and ceremonial uses in Asia. The indigenous species have no commercial value.

**Taxonomy.** Santalaceae are closely related to the Olacaceae, Opiliaceae and Loranthaceae in the order Santalales.

### Key to genera

1. Small to medium-sized trees.....2
- Climbers or hemiparasitic shrubs, sometimes epiphytic.....3

2. Trees with spiny bole. Ovary inferior. Fruit without swollen receptacle.....**2. Scleropyrum**  
Trees without spiny bole. Ovary superior. Fruit with swollen receptacle.....**1. Exocarpos**

3. Leaves minute, scale-like, caducous. Flowers sessile.....

**Phacellaria** Benth.

Gen. Pl. 3, 1 (1880) 229; Danser, *Blumea* 3 (1940) 222.

Seven species; SE China, Indo-China, Myanmar, Thailand, Peninsular Malaysia, Borneo.

Branches without haustoria. Male flowers with 3–6, 3-angular perianth lobes; anthers cordate. Female flowers with 4–8 perianth lobes; stigma lobed; ovary inferior, obovoid to cylindrical. Fruit a drupe, crowned by persistent perianth lobes and disc. Seed 1, 5-grooved; endosperm copious; embryo small, basal.

In Sabah, 1 species (*P. malayana*); uncommon, known from only a single collection (SAN 27605) from Obar Ridge, south of Sugut in Sandakan district.

Leaves large and well-developed, persistent or reduced to minute scales. Flowers stalked.....4

4. Woody climbers; stems not twining. Seeds several per fruit, many-lobed.....

**Dendrotrophe** Miq.

Fl. Ind. Bat. 1 (1855) 779; Backer & Bakhuizen *f. l.c.* 76; Stauffer *l.c.* 53; George in Hewson & George *l.c.* 59. Synonym: *Henslowia* Blume, Mus. Bot. Lugd. Bat. 1 (1850) 242, Merrill *l.c.* 241, Masamune *l.c.* 257.

About 30 species; Himalayas eastwards to Malesia.

Dioecious or monoecious plants. Leaves spirally arranged. Inflorescences umbellate; flowers unisexual or bisexual, perianth lobes 5; ovary inferior with several to many incomplete septa, style short, stigmas 5. Fruit a pyrene with 8–12 longitudinal rows of warts.

In Sabah and Sarawak, 2–5 species, widespread.

Hemiparasitic shrubs; stems twining. Seed one per fruit, entire.....

**Dendromyza** Danser

Nova Guinea N. S. 4 (1940) 133; Backer & Bakhuizen *f. l.c.* 76; Stauffer *l.c.* 59; George in Hewson & George *l.c.* 60.

Five species; Sumatra, Java, Borneo, the Philippines, New Guinea, Australia and Solomon Islands.

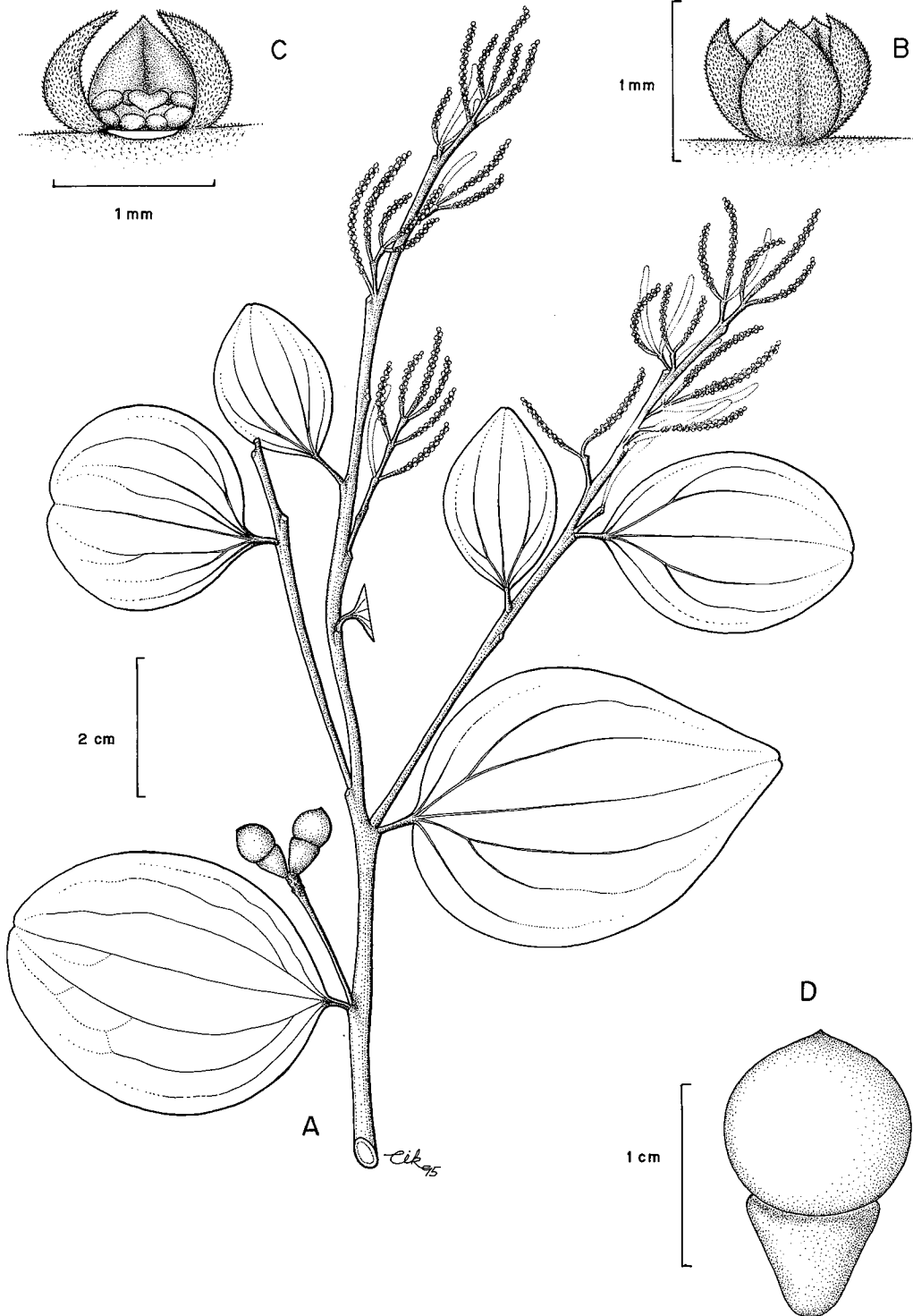
Dioecious plants. Branches either leafy or with haustoria and minute scales. Perianth lobes 4–5, triangular, persistent; ovary 1-locular, style short, stigmas 5. Fruit a pyrene, smooth, 1-locular, easily splitting into 4 or 5 parts.

One species (*D. reinwardtiana*) in Sabah, known from Ranau, Kinabatangan and Sandakan districts (*Chew, Corner & Stainton* 830, SAN 37869, SAN 95107, SAN 38577).

## 1. EXOCARPOS Labill.

(Greek, *exo* = outside, *karpos* = fruit; fruit borne on a swollen receptacle)

Voy. 1 (1798) 155, *t.* 14; Blume, Mus. Bot. Lugd. Bat. 1 (1850) 180; Bentham, Fl. Austral. 6 (1873) 228; Heyne, Nutt. Pl. Ned. Ind. (1950) 589; George in Hewson & George, Fl. Austral. 22 (1984) 34.



**Fig. 1.** *Exocarpos latifolius*. A, flowering and fruiting leafy twig; B, flower; C, flower with two perianth lobes removed; D, fruit. (All from SAN 134615.)

Small trees or erect shrubs; *bole without spine*. **Leaves** alternate, rarely opposite, sometimes reduced to minute scales. **Inflorescences** an axillary spike or sometimes reduced to a sessile cluster of flowers. **Flowers** unisexual or bisexual; perianth 4–5-lobed; disc glandular; stamens 4–5, filament short, broad; *ovary superior*, stigma blunt, sessile, ovule 1, anatropous. Fruit a drupe; *receptacle swollen*, fleshy.

**Distribution.** About 26 species; Malesia to Australia, New Caledonia, New Zealand and the Hawaiian Islands. In Malesia, known from Java, Borneo, the Philippines, and New Guinea. In Sabah, one species, not recorded from Sarawak or Brunei.

### **Exocarpos latifolius** R. Br.

Fig. 1.

(Latin, *latifolius* = broad-leaved)

Prodr. (1810) 356; Bentham *l.c.* 228; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 114; Heyne *l.c.* 589; Backer & Bakhuizen *f. l.c.* 76; George in Hewson & George *l.c.* 36. **Type:** *R. Brown, s.n.*, 6 November 1802, Australia, Queensland, Coen River (BM, BRI).

Tree to 10 m tall, 20 cm diameter. **Leaves** thick-coriaceous, orbicular to ovate, 3–8.5 × 2–7 cm; base broadly attenuate to rounded, *margin recurved*, *apex rounded to emarginate*, *3-veined at the base*; veins raised on both surfaces, *intercostal veins indistinct*; petioles 0.3–0.9 cm long. **Inflorescences** an axillary spike, 0.5–2.5 cm long, often branched, tomentose. **Flowers** tiny; perianth lobes 5, broadly triangular-ovate, hairy. **Fruit** globose, scurfy, *c.* 0.8 × 0.7 cm; receptacle obovoid, 0.4–0.7 cm long.

**Distribution.** Malesia to Australia, New Caledonia, New Zealand and the Hawaiian Islands. In Malesia, known from Java, Borneo, the Philippines, and New Guinea. In Sabah, known only from a few collections (e.g., *Berhaman & Madani SAN 134615*) from Pulau Manukan and Pulau Gaya on the west coast.

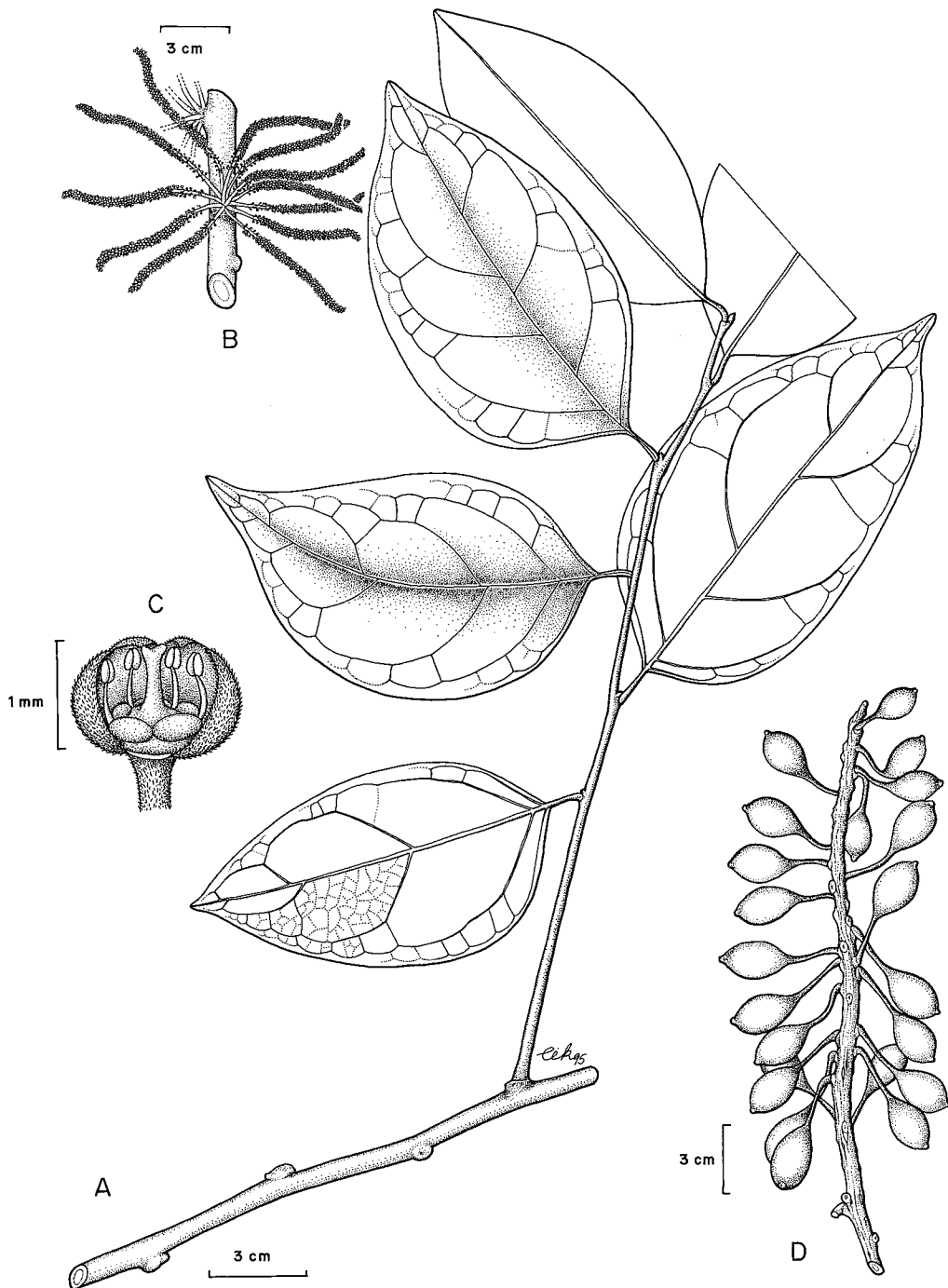
**Ecology.** In Sabah, known from sandstone and shale ridges fringed by coastal *kerangas* vegetation.

## 2. SCLEROPYRUM Arn.

(Greek, *skleros* = hard, *pyrus* = pear; hard, pear-shaped fruit)

Jard. Mag. Zool. & Bot. 2 (1838) 549; Hooker *f.*, Fl. Br. Ind. 5 (1890) 234; King, J. As. Soc. Beng. 75, 2 (1912) 275; Lecomte, Fl. Indo-Chine 5 (1915) 220; Merrill, EB (1921) 242; Ridley, FMP 3 (1924) 171; Danser, Nova Guinea N. S. 4 (1940) 133; Masamune, EPB (1942) 258; Whitmore, TFM 2 (1972) 343; Anderson, CLTS (1980) 310.

Small to medium-sized trees; *bole spiny*. **Leaves** spiral. **Inflorescence** an *erect or hanging spike* at leafless nodes on twigs or on the bole. **Perianth** 5-lobed; *disc annular*; stamens 5, inserted at the base of perianth lobes, filaments short; *ovary inferior*, *ovules 3*, style short and thick, stigma peltate. **Fruit** a drupe, ovoid or pear-shaped, stony, *without swollen receptacle*.



**Fig. 2.** *Scleropyrum wallichianum*. A, leafy twig; B, inflorescences; C, flower with one perianth lobe removed; D, infructescence. (A–C from SAN 50943, D from SAN 122235.)

**Distribution.** Six species; India, Sri Lanka, Myanmar, Thailand, Indo-China and W Malesia (Peninsular Malaysia, Borneo, the Philippines). In Sabah and Sarawak, one species.

**Ecology.** Widespread on a variety of soils, in the lowland to lower montane forest, sometimes in swamp, *kerangas* and limestone forest.

***Scleropyrum wallichianum*** (Wight & Arn.) Arn.

Fig. 2.

(N. Wallich, 1786–1854, superintendent of the East India Company's Botanic Garden at Calcutta)

*l.c.* 550; Hooker *f. l.c.* 234; Lecomte *l.c.* 221; Merrill *l.c.* 242; Hansen & Larsen, *Stud. Fl. Thailand* 50 (1969) 23; Anderson *l.c.* 310; Whitmore *l.c.* 343. **Basionym:** *Sphaerocarya wallichianum* Wight & Arn., *Edinb. Phil. J.* 15 (1832) 180. **Type:** *Wight Cat. no. 948* (GH, M). **Synonym:** *S. maingayi* Hook. *f. l.c.* 235, King *l.c.* 276, Ridley *l.c.* 171, Merrill *l.c.* 242, Masamune *l.c.* 258.

Small tree to 15 m tall, 10 cm diameter; *spines on bole to 8 cm long*. **Bark** greyish brown, smooth to finely fissured; inner bark brown. **Sapwood** yellow to white, hard. **Leaves** spirally arranged to alternate, often drying green, coriaceous; oblong-ovate to broadly elliptic, 9–26 × 4–13 cm; base broadly rounded or cuneate, margin recurved when dry, apex acute; *midrib sunken on the upper surface*, lateral veins 3–5 pairs, very distant, looping away from the margin, intercostal veins forming an open network, raised on both surfaces, more prominent on the lower surface; petioles to 1 cm long. **Inflorescences** 0.5–8 cm long, covered with appressed velvety hairs; bracts triangular. **Flowers:** perianth lobes hairy outside; disc 5-lobed. **Infructescence** axis 15–30 cm long, stout, on drying finely grooved, scarred by fallen flower stalks. **Fruit** a drupe, ovoid, 1.5–3 × 0.8–2 cm; stalk stout, *c.* 2.5 cm long; perianth lobes sometimes persistent.

**Vernacular names.** Sarawak—*limau antu* (Iban), *sabong ambok* (around Limbang).

**Distribution.** India, Sri Lanka, Thailand, Indo-China, Peninsular Malaysia, Borneo and the Philippines. In Sabah and Sarawak, widespread; also in Brunei.

**Ecology.** Common on a variety of soils, from lowland to 1000 m, sometimes in swamp, *kerangas* and limestone forest.

## SAPINDACEAE

F. Adema, P.W. Leenhouts & P.C. van Welzen

With contributions by M. Davids (*Paranephelium*), J. van Dijk (*Dictyoneura*),  
B. Etman (*Rhysotoechia*), R.W.J.M. van der Ham (*Mischocarpus*),  
H. Turner (*Arytera*), and M. Vente (*Harpullia*)

Rijksherbarium/Hortus Botanicus,  
Leiden, The Netherlands

Jussieu, Gen. Pl. (1789) 246 ("Sapindi"); King, J. As. Soc. Beng. 65, 3 (1896) 419; Merrill, EB (1921) 357; Ridley, FMP 1 (1922) 487; Radlkofer in Engler, Pflanzenr. 98 (1931–1934) 1; Masamune, EPB (1942) 424; Backer & Bakhuizen f., FJ 2 (1965) 130; Anderson, CLST (1980) 310; Whitmore & Tantra, CLS (1986) 212; Corner, WSTM 3rd ed. 2 (1988) 673; Yap, TFM 4 (1989) 434; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 310; Adema *et al.*, FM 1, 11 (1994) 419.

Trees, shrubs, or lianas, or rarely herbaceous climbers; monoecious, rarely dioecious or polygamous. *Indumentum* usually of solitary simple hairs, sometimes also of two-branched hairs or stellate bundles of hairs, in several genera scale-hairs present (then the young parts, buds and inflorescences viscid). **Leaves** spirally arranged, rarely opposite or whorled, simple, biternate, digitate, pinnate or bipinnate; true stipules usually absent, pseudostipules (reduced leaflets at the base of the leaf stalk) sometimes present. Leaflets alternate to opposite, symmetric to distinctly asymmetric, entire or dentate to serrate or crenate. **Inflorescences** axillary, pseudoterminal, terminal or borne on leafless branches, corymbose, paniculate, racemose, thyrsoid, or umbellate; bracts and bracteoles present. **Flowers** usually unisexual, rarely bisexual, radially or bilaterally symmetrical; sepals 4 or 5, rarely more, free or almost totally connate, equal to distinctly unequal, and then the outer 1 or 2 much smaller than the inner three, herbaceous to petaloid, imbricate, valvate or apert (fringing or enclosing a narrow calyx opening); petals absent or 2–6, free, usually clawed, often with 1 or 2 scales or auricles (inrolled margins), scales crested or not; disc complete or interrupted, lobed or annular to subannular, rarely with appendages or an erect (tubular) rim; stamens 5–10(–74), usually 8, inserted within the disc, often exerted in male flowers, filaments glabrous or hairy, anthers basifixed or rarely dorsifixed, introrse or latero-introrse, in female flowers present as staminodes with non-opening anthers; ovary superior, 1–3(–8)-locular, lobed or not, style usually apical, rarely inserted between the lobes, stigma entire with 1–3 lines or grooves of stigmatic papillae, or 1–3-lobed, in male flowers rudimentary; ovules 1 or 2 per locule, ascending, anatropous, campylotropous or amphitropous. **Fruits** capsular or drupaceous, or consisting of 2 or 3 samaras, when capsular usually loculicidal, rarely septicidal or septifragal (dehiscing with the valve surface separating from the septa or locule partitions). **Seeds** globose to obovoid, sometimes compressed, often with an arillode or a sarcotesta; endosperm absent; embryo usually thick, straight, sometimes sigmoid or convolute, cotyledons above each other to laterally beside each other.



**Distribution.** About 150 genera with c. 2000 species, widespread in tropical and subtropical regions of the world, especially well represented in South America. In Sabah and Sarawak, 23 genera with 62 species, most of which are trees or shrubs.

**Ecology.** Primary or secondary rain forest, forest edges, shrublands, coastal vegetation, often along rivers or road sides; in everwet or seasonal climates; mainly lowlands, but also mountains to 3600 m; on all kinds of soil.

**Uses.** The wood of several species is used for timber (Klaassen, FM 1, 11 (1994) 425). Various species are used in medicine, as vegetables, as soap or fish poison. However, Sapindaceae are more important as a source of edible fruits and seeds. The juicy arillode or sarcotesta is particularly appreciated. Of economic importance, and hence widely cultivated, are *Dimocarpus longan* (longan), *Litchi chinensis* (litchi, lychee) and *Nephelium lappaceum* (*rambutan*) (PROSEA 2 (1992) 146, 191, 233; van Welzen, Lamb & Wong, Nature Malaysiana 13 (1988) 10).

**Taxonomy.** The last survey of the family as a whole was made by Muller & Leenhouts (in Ferguson & Muller (eds.), The evolutionary significance of the exine (1976) 407). The system adopted there follows mostly the system developed by Radlkofer (*l.c.*). Important changes made by Muller & Leenhouts are: (1) combination of tribes Aphanieae and Lepisantheae; (2) discarding the division of the Eusapindaceae into Nomophyllae and Anomophyllae by proposing a more informal grouping of three groups A, B and C; and (3) the Dodonaeoideae (formerly Dyssapindaceae) are considered an assemblage of relicts, and the Sapindoideae (formerly Eusapindaceae) as more homogenous and derived. An enumeration of the subfamilies, tribes and genera occurring in Sabah and Sarawak is given below.

**Subfam. Dodonaeoideae**

- Tribe Dodonaeae : *Dodonaea*  
 Tribe Doratoxyleae : *Ganophyllum*  
 Tribe Harpulliae : *Harpullia*  
 (Tribes not represented : Cossinieae, Koelreuterieae)

**Subfam. Sapindoideae**

Group A

- Tribe Lepisantheae : *Glennia, Lepisanthes, Zollingeria*  
 Tribe Melicocceae : *Tristiropsis*  
 (Tribe not represented : Sapindeae)

Group B

- Tribe Cupanieae : *Arytera, Dictyoneura, Guioa, Mischocarpus, Paranephelium, Rhysotoechia, Trigonachras*  
 Tribe Nephelieae : *Alectryon, Cubilia, Dimocarpus, Litchi, Nephelium, Pometia, Xerospermum*  
 (Tribe not represented : Schleichereae)

Group C

- Tribe Paullinieae : *Cardiospermum*  
 Tribe Thouinieae : *Allophylus*

**Key to genera**

(based on flowering material and vegetative characters)

1. Herbaceous or woody climbers. Leaves biternate. Inflorescences with basal tendrils.....  
**Cardiospermum** L.  
 Sp. Pl. (1753) 366; Radlkofer in Engler, Pflanzenr. 98 (1932) 370; Leenhouts, FM 1, 11 (1994) 483.  
 Inflorescences axillary, thyrsoïd. Flowers unisexual, obliquely bilaterally symmetrical; sepals 4, free, imbricate, outer 2 smaller; petals 4; disc a gland at the base of every petal; ovary 3-locular, with a short style and a 3-lobed stigma; ovule 1 per locule. Fruits capsular, 3-lobed, inflated, 3-locular, septicial, papyraceous. Seeds with a cordate hilum.  
 Twelve species, tropical and subtropical America, one species extending to Africa; one species in Sabah and Sarawak (*C. halicacabum*), which is a worldwide tropical and subtropical weed.
- Trees or shrubs. Leaves simple, unifoliolate, pinnate, bipinnate or digitate. Inflorescences without basal tendrils.....2
2. Leaves bipinnate.....**19. Tristiropsis**  
 Leaves simple, unifoliolate, paripinnate, imparipinnate, or digitate.....3
3. Leaves imparipinnate.....4  
 Leaves simple, unifoliolate, paripinnate or digitate.....5
4. Pseudostipules present. Petals shorter than the sepals.....**11. Lepisanthes** (in part)  
 Pseudostipules absent. Petals longer than the sepals.....**15. Paranephelium**
5. Scale-hairs present (rarely only visible in inflorescences), often also with solitary simple hairs. Young parts viscid (inflorescence of *Lepisanthes fruticosa*, race "*glandulosa*" may be sticky). Petals absent.....6  
 Hairs simple, solitary, or two-branched (T-hairs in *Litchi chinensis*), or in stellate tufts ("stellate hairs"). Young parts not viscid. Petals absent or present.....8
6. Leaves simple. Ovules 2 per locule.....  
**Dodonaea** Miller  
 Gard. Dict. ed. 4, 1 (1754); King *l.c.* 450; Merrill *l.c.* (1921) 362; Ridley *l.c.* (1922) 509; Radlkofer in Engler, Pflanzenr. 98 (1933) 1350; Masamune *l.c.* 426; Backer & Bakhuizen *f. l.c.* 141; Anderson *l.c.* 310; Corner *l.c.* 678; Yap *l.c.* 440; Leenhouts *l.c.* (1994) 522.  
 Sixty five species, mainly in Australia, three in Malesia.  
 Inflorescences axillary and terminal, thyrsoïd. Flowers bisexual or unisexual, radially symmetrical; sepals 4 or 5, free, valvate, all equal; petals absent; disc absent in male flowers, in the form of a slight swelling around the gynophore in female and bisexual flowers; stamens 5–15; ovary 2–3-locular, style and stigma longer than the ovary, hardly to deeply divided at apex; ovules 2 per locule. Fruit a septifragal capsule, with 3 wings. Seeds subglobose, attached to a swollen funicle.  
 One species, a pantropical shrub (*D. viscosa*), present in Sabah and Sarawak; in coastal vegetation, along the beach or on limestone.

- Leaves paripinnate. Ovules 1 or 2 per locule.....7
7. Leaflets subentire to crenate. Sepals free, petaloid. Stigma grooved. Ovules 1 per locule.....**5. Dictyoneura**  
 Leaflets entire. Sepals connate up to halfway, not petaloid. Stigma lobed. Ovules 2 per locule.....**7. Ganophyllum**
8. Leaves digitate, 1–5-foliolate. Flowers bilaterally symmetrical, with 4 petals.....**2. Allophylus**  
 Leaves paripinnate, if unifoliolate then flowers radially symmetrical, usually with 5 petals (*Lepisanthes senegalensis*) or without petals (*Glennia thorellii*).....9
9. Lower side of leaflets with exposed glands.....10  
 Lower side of leaflets without exposed glands.....14
10. Leaves with pseudostipules.....**16. Pometia** (in part)  
 Leaves without pseudostipules.....11
11. Sepals almost totally connate, apert. Stamens 5, filaments glabrous or with few hairs.....**4. Cubilia** (in part)  
 Sepals free or basally connate, usually slightly imbricate. Stamens usually (6–)8(–10), filaments mostly hairy.....12
12. Ovary 3-locular, smooth.....**18. Trigonachras** (in part)  
 Ovary 2-, rarely 3-locular, warty.....13
13. Leaf with 1–2 pairs of leaflets, exceptionally unifoliolate or with 3 pairs of leaflets. Hairs if present mainly in stellate tufts. Petals absent or present. Disc hairy.....**6. Dimocarpus** (in part)  
 Leaf with 1–7 pairs of leaflets. Hairs if present solitary, simple. Petals present. Disc glabrous or (exceptionally) hairy.....**20. Xerospermum** (in part)
14. Hairs often mainly in stellate tufts, mixed with solitary simple ones.....15  
 Hairs solitary, simple, exceptionally two-branched (*Litchi chinense*), if few small tufts of hairs present then leaves with pseudostipules (*Pometia*).....17
15. Sepals free. Petals always 5.....**10. Harpullia**  
 Sepals connate at base. Petals absent or 1–5(–6).....16
16. Sepals imbricate in bud. Petals absent or present. Stamens (6–)8(–10), filaments usually hairy. Ovary tuberculate.....**6. Dimocarpus** (in part)  
 Sepals valvate to slightly imbricate in bud. Petals absent. Stamens 6 or 7, filaments glabrous. Ovary smooth.....**8. Glennia**
17. Leaves with pseudostipules.....18  
 Leaves without pseudostipules.....19
18. Sepals free, imbricate in bud, outer 1 or 2 distinctly smaller than inner 3. Stamens (4–) 8 (–10).....**11. Lepisanthes** (in part)

- Sepals connate up to halfway, valvate in bud, slightly unequal. Stamens 5 (or 6).....**16. Pometia** (in part)
19. Sepals free, imbricate in bud, outer 1 or 2 distinctly smaller than the inner three.....20  
 Sepals free or to almost completely connate, apert, valvate or slightly imbricate in bud,  
 usually all equal, rarely slightly unequal.....22
20. Leaflets concolorous, yellowish green (or green) when dry. Petal scales absent.....**17. Rhysotoechia**  
 Leaflets usually discoloured, brown or greyish (green) when dry, rarely concolorous,  
 yellowish green (*Lepisanthes falcata* subsp. *borneensis*). Petal scales or auricles  
 present.....21
21. Petals with 2 scales. Stigma pyramidal, grooved.....**9. Guioa**  
 Petals with 1 scale, or with auricles, rarely with a hairy ridge. Stigma usually capitate,  
 globose or dome-shaped, rarely elongated, grooved.....**11. Lepisanthes** (in part)
22. Petals usually absent, rarely up to 3.....23  
 Petals present, usually 5, sometimes reduced.....26
23. Ovary smooth, 3-locular, not lobed, rather long-stalked.....**13. Mischocarpus** (in part)  
 Ovary warty or smooth, 1–2(rarely 3)-locular, lobed, sessile or short-stalked.....24
24. Two-branched hairs often present. Leaflets mostly opposite or subopposite. Sepals  
 connate, apert.....**12. Litchi**  
 All hairs simple. Leaflets alternate to opposite. Sepals free or connate, valvate or slightly  
 imbricate in bud.....25
25. Leaflets opposite to rarely alternate. Ovary smooth.....**1. Alectryon**  
 Leaflets alternate to rarely opposite. Ovary warty.....**14. Nephelium** (in part)
26. Petals without scales or auricles. Ovary warty.....27  
 Petals with scales or auricles. Ovary smooth or warty.....29
27. Sepals almost totally connate, calyx urceolate with a narrow mouth and minute lobes.  
 Stamens 5.....**4. Cubilia** (in part)  
 Sepals free or connate to halfway, calyx flat or cup-shaped with a wide mouth and distinct  
 lobes. Stamens 4–10.....28
28. Leaflets opposite, lower surface not glaucous, with flat orbicular glands, without domatia.  
 Stamens 8, exceptionally 7 or 9. Stigma grooved.....**20. Xerospermum** (in part)  
 Leaflets alternate to rarely opposite, lower surface mostly glaucous, without glands, with  
 domatia. Stamens 4–10. Stigma lobed.....**14. Nephelium** (in part)
29. Petals with 1 large, sometimes deeply cleft scale. Ovary warty.....**14. Nephelium** (in part)  
 Petals with 2 scales or auricles. Ovary smooth.....30
30. Twigs white or silvery grey. Ovary 1-locular, septa incomplete.....**21. Zollingeria**  
 Twigs light to dark brown or grey to black. Ovary 2–5-locular, septa complete.....31

31. Intercostal veins rather densely reticulate. Petals usually with auricles. Ovary short- to long-stalked. Stigma distinctly lobed.....**13. Mischocarpus** (in part)  
 Intercostal veins more-or-less laxly reticulate. Petals with 2 scales. Ovary sessile. Stigma grooved or slightly lobed.....32
32. Lower surface of leaflets without small, round glands, but with domatia. Petals shorter than, rarely as long as, the sepals; petal scales shorter than the petals. Ovary 2(-3)-locular.....**3. Arytera**  
 Lower surface of leaflets with small, round glands, without domatia. Petals as long as to longer than the sepals; petal scales nearly as long as the petals. Ovary 3-locular.....  
 .....**18. Trigonachras** (in part)

### Key to genera

(based on fruiting material and vegetative characters)

1. Herbaceous or woody climbers. Leaves biternate. Inflorescences with basal tendrils.....  
 .....**Cardiospermum** (see notes in previous key)  
 Trees, shrubs, or occasionally woody climbers. Leaves simple, unifoliolate, digitate, pinnate, or bipinnate. Inflorescence without tendrils.....2
2. Leaves bipinnate.....**19. Tristiropsis**  
 Leaves simple, unifoliolate, digitate or pinnate.....3
3. Leaves all simple, unifoliolate, digitate, or imparipinnate.....4  
 Leaves paripinnate or pseudo-imparipinnate (with one of the final two leaflets reduced and vestigial); occasionally also some leaves unifoliolate.....7
4. Fruits winged. Leaves simple.....**Dodonaea** (see notes in previous key)  
 Fruits not winged. Leaves unifoliolate, digitate or imparipinnate.....5
5. Leaves (1-)3(-5)-digitate; rachis not winged. Fruits globose to obovoid, coriaceous, at most 0.4-1.3 x 0.3-0.8 cm.....**2. Allophylus**  
 Leaves unifoliolate or imparipinnate. Fruits either slightly lobed and coriaceous, or subglobose and very woody, larger than 1 x 1.5 cm; if about 1 x 1.5 cm then rachis winged  
 .....6
6. Pseudostipules present or absent; rachis winged or not. Fruits slightly lobed, smooth, coriaceous; fruit wall glabrous inside.....**11. Lepisanthes** (in part)  
 Pseudostipules absent; rachis not winged. Fruits subglobose, spiny to warty, woody; fruit wall pilose inside.....**15. Paranephelium** (in part)
7. Fruits winged.....**21. Zollingeria**  
 Fruits without wings.....8
8. Fruits warty to densely spiny or densely scaly.....9  
 Fruits smooth to rugose when dry.....14

9. Fruit wall hairy inside. Seeds without sarcotesta or arillode....**15. Paranephelium** (in part)  
Fruit wall glabrous inside. Seeds with sarcotesta or arillode.....10
10. Seeds with sarcotesta.....11  
Seeds with arillode.....12
11. Leaf with 1–5(–18) pairs of leaflets, usually papillose below (dull), often minutely sericeous; without glands, often with domatia. Sepals free to connate more than halfway. Spines and other forms of appendages on fruit usually longer than broad.....  
.....**14. Nephelium** (in part)  
Leaf with 1–2(–3) pairs of leaflets, smooth below (more or less shiny), glabrous or at most hairy on midrib and lateral veins, not sericeous; with scattered glands, without domatia. Sepals free or only basally connate. Spines and other forms of appendages on fruit broader than long.....**20. Xerospermum**
12. Arillode covering the lower half of seed only. Fruit dehiscent. Indumentum of simple hairs only.....**4. Cubilia**  
Arillode almost completely covering the seed. Fruit indehiscent. Indumentum of tufted, 2-branched or simple hairs.....13
13. Indumentum often partly or mainly of dense stellately tufted hairs. Glands present on lower side of leaflets near axils of lateral veins (seldom absent in all leaflets). Seeds about as long as broad.....**6. Dimocarpus** (in part)  
Indumentum of solitary, simple or 2-branched hairs. Glands absent. Seeds longer than broad.....**12. Litchi**
14. Seeds without sarcotesta or arillode. Placenta neither thickened nor cup-shaped.....15  
Seeds with sarcotesta (sometimes as a narrow basal ring around hilum) and/or arillode. Placenta thickened and cup-shaped.....20
15. Leaves with hairs and glandular scales (distinct under the microscope)....**7. Ganophyllum**  
Leaves without glandular scales, at most with hairs only.....16
16. Fruit wall hairy inside.....17  
Fruit wall glabrous inside.....19
17. Fruits stalked, obovoid, dehiscent loculicidally into 3 equal valves; 3-locular; fruit wall thick, fleshy; hilum covering less than lower one-third of the seed.....**18. Trigonachras**  
Fruits sessile, ellipsoid, shortly obovoid to subglobose, not dehiscent to dehiscent into 3 or 4 usually unequal valves or tearing apart at random; 2- or 3-locular; either fruit wall thick and hilum covering up to lower three-quarters of the seed, or fruit wall thin and hilum covering less than lower one-third of the seed.....18
18. Indumentum at most of short hairs. Leaflets entire to serrate. Fruits capsular; fruit wall 2.5–12 mm thick; hilum covering up to lower three-quarters of the seed.....  
.....**15. Paranephelium** (in part)  
Indumentum often of hairs of more than 5 mm long. Leaflets entire. Fruits drupaceous; fruit wall less than 2 mm thick; hilum covering less than lower one fifth of the seed.....  
.....**11. Lepisanthes** (in part)

19. Leaf with 1 to more than 40 pairs of leaflets; pseudostipules present or absent; rachis winged or not. Outer 1 or 2 sepals smaller than inner ones. Fruits 2–3(–4)-locular, glabrous or pilose, less than 5 cm long; fruit wall usually thin, sometimes thick and fleshy.....**11. Lepisanthes** (in part)  
 Leaf with 1–6 pairs of leaflets; pseudostipules absent; rachis not winged. Sepals all equal. Fruits 2-locular, glabrous, either less than 2 cm long and fruit wall rather thin or more than 6 cm long and fruit wall very thick and fleshy.....**8. Glenniea**
20. Indumentum of stellately tufted hairs besides solitary hairs.....21  
 Indumentum of solitary hairs or plant glabrous.....22
21. Fruits lobed, loculicidally dehiscent into valves; hilum small, covering less than one sixth of the seed.....**10. Harpullia**  
 Fruits not lobed, breaking up irregularly; hilum very large, covering up to half of the seed.....**6. Dimocarpus** (in part)
22. Pseudostipules present (sometimes reduced or early caducous, but then leaving scars). Fruits lobed, but seemingly 1-locular and not lobed by abortion; exocarp thin, hard, mesocarp thick, juicy when fresh.....**16. Pometia**  
 Pseudostipules absent. Fruits lobed or not; carpels usually thin to thick, coriaceous to woody.....23
23. Fruit wall completely hairy or papillose inside, or only hairy along the suture.....24  
 Fruit wall glabrous inside except sometimes for the lower part of the axis.....27
24. Fruit lobes each dehiscent by an irregular transverse break.....**1. Alectryon**  
 Fruits dehiscent loculicidally.....25
25. Fruit wall only hairy along the suture inside.....**3. Arytera**  
 Fruit wall nearly completely hairy or papillose inside.....26
26. Fruit on a slender stalk, inside without an extra fleshy layer. Aril with pseudofunicle .....  
 .....**13. Mischocarpus** (in part)  
 Fruit hardly stalked, inside with an extra fleshy layer. Aril without pseudofunicle.....  
 .....**5. Dictyoneura**
27. Placenta thickened below the seed, more-or-less cup-shaped. Seeds not covered with sarcotesta or arillode.....**17. Rhysotoechia**  
 Placenta seldom thickened below the seed. Seeds (partly) covered with sarcotesta and/or arillode.....28
28. Fruits 1-locular. Seeds partly to completely covered with a sarcotesta.....  
 .....**14. Nephelium** (in part)  
 Fruits 3-locular. Seeds partly to completely covered with an arillode.....29
29. Fruits lobed. Stigma a pyramidal remnant without recurved lobes on top of the fruit. Sepals dimorphous, free.....**9. Guioa**  
 Fruits not lobed. Stigma with recurved lobes. Sepals all equal, usually connate at the base  
 .....**13. Mischocarpus** (in part)

# 1. ALECTRYON Gaertn.

(Greek, *alektruon* = rooster; the crested fruits)

**P.W. Leenhouts**

Fruct. Sem. Pl. 1 (1788) 216, pl. 46; Radlkofer in Engler, Pflanzenr. 98 (1933) 983; Backer & Bakhuizen f., FJ 2 (1965) 139; Leenhouts, FM 1, 11 (1994) 450.

Trees or shrubs, *dioecious* or sometimes *monoecious*. *Indumentum of solitary simple hairs only*. **Leaves** *paripinnate*, each with 1–8 pairs of leaflets; *petiole and rachis not winged*; *true stipules absent*, lowermost pair of leaflets sometimes stipule-like. Leaflets variably hairy to glabrous, lower surface not papillose; base often oblique, margin entire or serrate, dentate or crenate; lateral veins ending free or the upper ones looping and joining near the margin. **Inflorescences** axillary, pseudoterminal, or borne on leafless branches, thyrses, panicles or racemes. **Flowers** *unisexual or sometimes bisexual, radially symmetrical*; sepals 4, 5 (or 6), about *halfway to nearly completely connate, all equal*, hardly or not petaloid; *petals absent or 4 or 5*, about as long as or shorter than the sepals, *short-clawed*, with 2 scales, without a crest; *disc complete*, annular or more-or-less lobed, without appendages, glabrous; stamens (5–)8, exerted in male flowers, *anthers basifixed, the base usually deeply cleft*, latrorse or latero-introrse; ovary sessile or short-stalked, (1–)2–4(–5)-*locular*, style apical, columnar, mostly shorter than the ovary, stigma grooved or with reflexed lobes; *ovules 1 per locule*. **Fruits** *sessile or short-stalked, 1(or more)-lobed, capsular, dehiscent by an irregular transverse break on each lobe or along the septum*; fruit wall smooth or slightly warty, hairy or late glabrescent outside, glabrous or hairy inside. **Seeds** black, *partly covered with a red sarcotesta*.

**Distribution.** About 25 species; in Malasia, Australia, New Zealand, New Caledonia, the New Hebrides, the Solomon Is., Fiji, Samoa, and the Sandwich Is. One species in Sabah.

**Ecology.** Often at forest edges, on river banks, in coastal vegetation, on limestone; in the lowlands but sometimes also on mountains. The seeds, with contrasting light yellowish greenish capsules, red sarcotesta, and shiny black testa, are probably mainly dispersed by birds.

**Uses.** Some species are sources of good timber.

**Alectryon glaber** (Blume) Radlk.

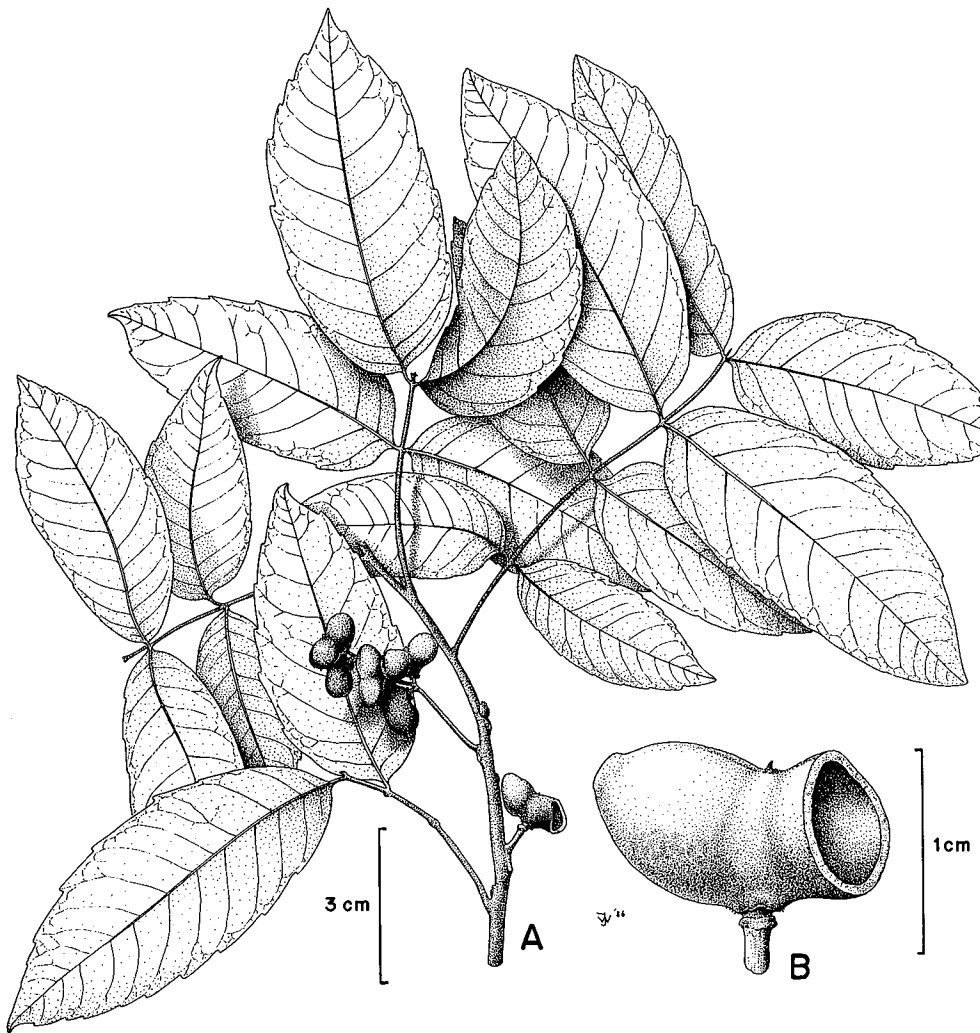
Fig. 1.

(Latin, *glaber* = smooth; the fruits lacking in crests)

Sapind. Holl.-Ind. (1879) 14, in Engler *l.c.* (1933) 993; Leenhouts *l.c.* (1994) Sapind. Holl.-Ind. (1879) 14, in Engler *l.c.* (1933) 993; Leenhouts *l.c.* (1994) 456, fig. 5f. **Basionym:** *Spanogheaglabra* Blume *l.c.* (1847) 174. Type: *Spanoghe 52*, Lesser Sunda Is. (L).

Shrub or small tree to 30 cm diameter; stem slightly fluted, with rather inconspicuous thick buttresses. Bark smooth, pale brown to ash-grey. Leaves each with 2–5(–7) pairs of leaflets; petioles 1–8.5 cm long, (0.5–)1–2 mm thick. *Leaflets opposite to alternate, parchment-like to*





**Fig. 1.** *Alectryon glaber*. A, fruiting leafy twig; B, fruit. (From Alston 16075.)

chartaceous, glabrous to slightly hairy on the midrib and lateral veins beneath, exceptionally subtomentose; ovate to elliptic, *c.* 4–14 × 1–5.5 cm; base symmetric to asymmetric, acute to rounded, somewhat attenuate, *margin slightly serrate, dentate, or crenate in the upper half, or rarely entire*, apex rounded to acute; midrib slightly raised above, lateral veins 0.5–2 cm apart, ending free or in marginal teeth, or looping and joining near the margin, slightly raised on both sides or flat above, intercostal veins and veinlets laxly to minutely reticulate, slightly raised on both sides, or indistinct beneath; petiolules 1–8 mm long. **Inflorescences** to 9 cm long; unbranched or with branches to 4 cm long, few-flowered, hairy; peduncles 0.75–2.5 cm long; pedicels 1–1.5 mm long. **Flowers:** sepals *c.* 1 mm high, *slightly connate*, hairy inside; *petals absent*; stamen filaments short, anthers *c.* 1.2 mm long; ovary 2(–3)-locular with a lobed stigma. **Fruits** 2-lobed and then often cordate (or only 1 lobe developed), *keeled and shouldered to slightly grooved*, densely to sparsely fulvous or ferruginous tomentose or tomentulose, the lobes almost globose, 0.9–1 × 0.75–0.9 cm; fruit wall 0.5–1 mm thick.

**Distribution.** E Java, the Lesser Sunda Is., N Borneo (Sabah, one specimen), the Philippines, Sulawesi, Ceram, and the Kai Is.

**Notes.** In Sabah, once recorded (*Berhaman AB21*) on coral limestone on Balambangan Is.

## 2. ALLOPHYLUS L.

(Greek, *allos* = another, *phulon* = tribe; its distinction from other known tribes)

### P.W. Leenhouts

Sp. Pl. (1753) 348; Merrill, EB (1921) 357; Ridley, FMP 1 (1922) 488; Radlkofer in Engler, Pflanzenr. 98 (1932) 455; Masamune, EPB (1942) 424; Backer & Bakhuizen *f.*, FJ 2 (1965) 133; Leenhouts, Blumea 15 (1968) 301, FM 1, 11 (1994) 459; Anderson, CLST (1980) 310; Corner, WSTM 3rd ed. 2 (1988) 670; Yap, TFM 4 (1989) 436.

Shrubs, small trees, or sometimes woody climbers, *monoecious* or *dioecious*. *Indumentum sometimes of stellately tufted hairs*. **Leaves** *digitate, (1–)3(–5)-foliolate*. **Inflorescences** *axillary*, usually either simple or composed of a few long and slender, racemose thyrses, sometimes paniculate. **Flowers** *unisexual, obliquely bilaterally symmetrical*; *sepals 4, free, imbricate in bud, outer 2 distinctly narrower than the inner ones*; *petals 4, nail-shaped to spatulate, inside above the claw with a 2-lobed, usually bearded scale*; *disc more-or-less interrupted abaxially, mostly lobed or modified into glands in front of the petals, in female flowers sometimes saucer-shaped*; stamens 8 (rarely fewer), all of about the same length, exerted in male flowers; *ovary deeply 2(–3)-lobed, 2(–3)-locular, ovule 1 per locule, style 1, inserted between the lobes, more or less deeply 2(–3)-branched, the branches exceptionally also forked at the apex*. **Fruits** *drupaceous, mostly of 1 mericarp only, globose to obovoid, thin-walled, mostly almost glabrous when ripe*. **Seeds** *without arillode*.

**Distribution.** Probably monotypic, though up to 250 “species” may be accepted. Circumtropical, in some regions penetrating into the subtropics.

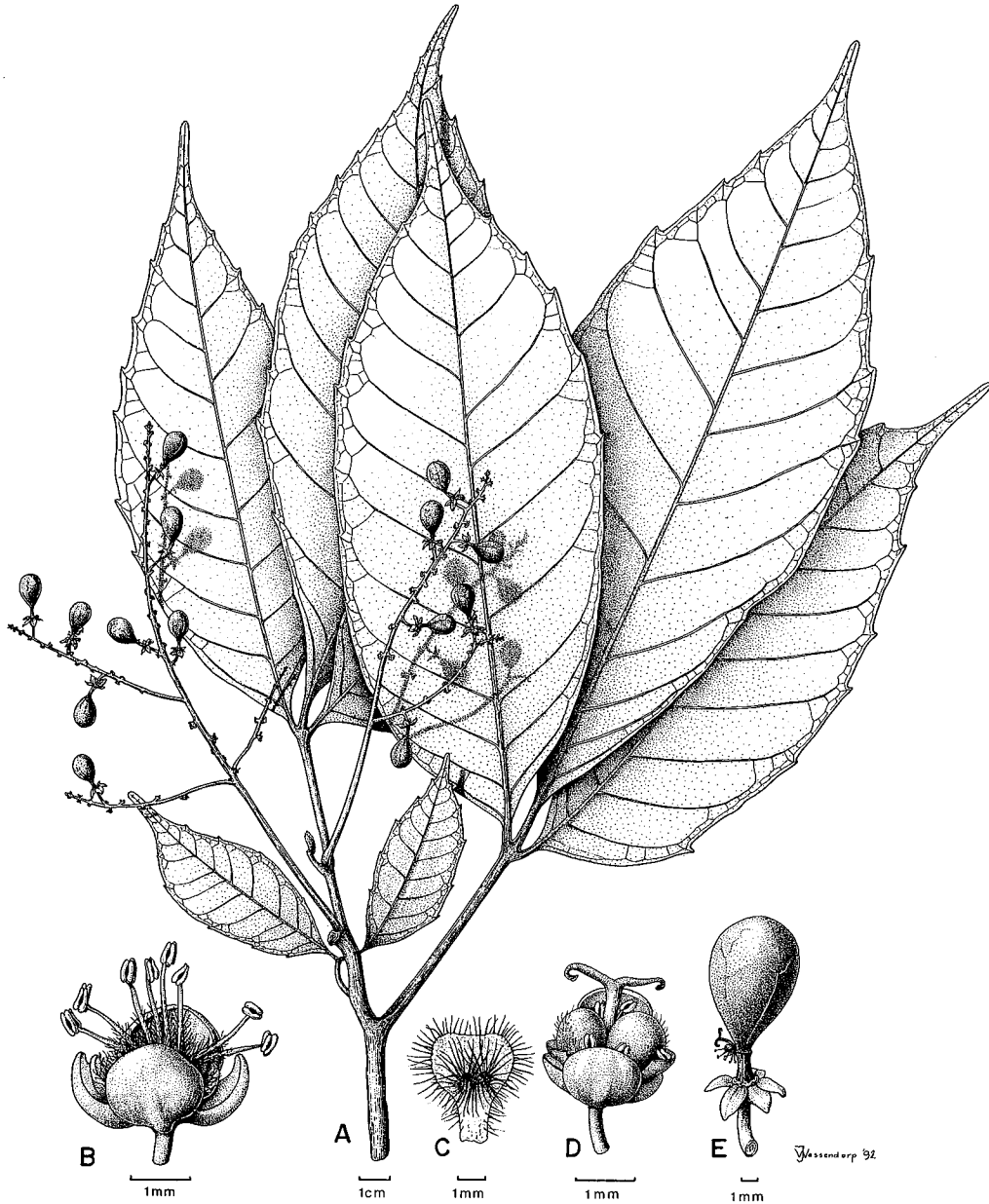
**Allophylus cobbe** (L.) Raeuschel  
(after the Sri Lankan plant-name *kobbae*)

Fig. 2.

Nomencl. ed. 3 (1779) 108; Merrill *l.c.* (1921) 357; Radlkofer in Engler *l.c.* (1932) 594; Masamune *l.c.* 424, 425; Anderson *l.c.* 310; Corner *l.c.* 677; Backer & Bakhuizen *f. l.c.* 133. **Basionym:** *Rhus cobbe* L., Sp. Pl. (1753) 267. **Type:** *Herb. Hermann vol. 2, fol. 46* ("Kobbae"), Sri Lanka (BM). **Synonyms:** *A. javensis* (Blume) Blume *l.c.* (1847) 126, Merrill *l.c.* (1921) 357, Masamune *l.c.* 424; *A. sumatranus* Blume *l.c.* (1847) 132, Merrill *l.c.* (1921) 357, Masamune *l.c.* 425; *A. timorensis* (DC.) Blume *l.c.* (1847) 130, Merrill *l.c.* (1921) 357, Masamune *l.c.* 425; *A. scandens* Ridl., J. Str. Br. Roy. As. Soc. 75 (1917) 26, Merrill *l.c.* (1921) 357, Masamune *l.c.* 425; *A. obliquus* Radlk. in Merrill, PEB (1929) 173, Masamune *l.c.* 424; *A. glaber* (Roxb.) Radlk. in Engler *l.c.* (1932) 566, Masamune *l.c.* 424; *A. racemosus* (L.) Radlk. in Engler & Prantl, Nat. Pflz. Fam. 3, 5 (1895) 312, in Engler *l.c.* (1932) 568, Merrill *l.c.* (1921) 357, Masamune *l.c.* 425; *A. ternatus* (Forst.) Radlk. in Engler *l.c.* (1932) 572, Masamune *l.c.* 425.

Shrub or treelet, rarely a tree to 25 m high, 30 cm diameter, or a climber (not in Sabah and Sarawak). Twigs glabrous except for the sparsely appressed hairy terminal bud or more or less persistently thinly to densely covered with often stellately tufted, appressed to patent, short, fulvous hairs. **Leaves:** petioles terete, rarely quadrangular, mostly flattened to grooved above especially at apex and base, 4.5–20 cm long, indumentum usually similar to that of the twig at earlier stage. Leaflets membranous, fleshy or coriaceous, on drying greenish to greyish or dark-brown and dull to shiny above, light green to reddish brown and dull (sometimes even glaucous) to shiny beneath, glabrous (often with a distinct gland) to densely velvety (especially beneath) and often bearded in the axils of lateral veins and sometimes also of the intercostal veins; *elliptic or oblong, rarely lanceolate, lateral ones often ovate, terminal ones sometimes obovate, 2.5–35 × 1.5–22 cm* (terminal ones slightly to distinctly larger than the lateral ones); base cuneate to rounded, often slightly decurrent, *margin entire to serrate, crenate or dentate*, apex more or less attenuate-acuminate; midrib hardly prominent to keeled above, *lateral veins 6–15 per side, looping and joining near the margin or not*, intercostal veins usually rather inconspicuous above, hardly conspicuous to prominent beneath; petiolules absent to 25 mm long, indumentum like that of petioles. **Inflorescences** to 40 cm long, *few- to many-flowered, with umbel-like dichasia or sometimes comb-like cincinni, glabrous to densely pubescent*; peduncles usually about one third to one fifth the length of rachis, laxly to densely flowered; pedicels absent or short; bracts mostly minute, sometimes longer than the pedicels, subulate. **Flowers** often solitary in the upper part of an inflorescence; *sepals 1–2.5 × 0.8–2 mm, green to whitish, entire to denticulate, mostly ciliate, glabrous to sparsely appressed short-hairy (mainly in the central part) outside; petals 1–2.2 mm long, white, almost glabrous to densely woolly along the entire margin, blade entire to bilobed, claw about two third of the petal length, scale very small to nearly equalling the blade, glabrous to densely woolly along the entire margin, often bearded; disc 0.2–0.8 mm high, glabrous or puberulous, orange; anthers c. 0.5 mm long; ovary smooth or rough, glabrous or minutely stellately tufted-hairy, or sparsely to densely pilose by appressed, long, stiff hairs, style 1–1.5 mm long, glabrous or pilose up to the stigmatic lobes.* **Fruits** globose (smaller ones) to obovoid and narrowed at the base (larger ones), 4.5–12.5 × 3.5–8 mm, smooth to slightly rugose, red turning to brown or black when dry, somewhat pulpy and almost glabrous when ripe.

**Vernacular names.** Sabah—*bonbongan* (Murut), *embuakat*, *gamperut* (Dusun), *kalasi* (Bajau), *kerimbau* (Murut), *mambahino*, *sasah* (Bajau East Coast), *sisipen pelandok* (Dusun), *tukil-tukil* (Brunei Malay). Sarawak—*balaro* (Kayan), *buah penancang* (Malay), *ising* (Iban, Paloh), *kelampu* (Iban).



**Fig. 2.** *Allophylus cobbe*. A, fruiting leafy twig; B, male flower; C, petal from inside; D, female flower; E, fruit. (A and E from *Forbes* 2557, B–D from *Maxwell* 77-375.)

**Distribution.** Throughout the range of the genus. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In different types of primary and secondary forests, from lowland to c. 1300 m (Mt. Kinabalu), on various soil types. Flowering and fruiting throughout the year. The flowers are visited by bees; the fruits are dispersed by birds (Docters van Leeuwen, Trop. Natuur 21 (1932) 142).

**Uses.** The wood is reported to be very hard, but not very durable. It is mainly used for temporary and indoor structures, for making canes, hilts, and as firewood. The pulped leaves, or an extraction or decoction of them, as well as a decoction of the roots and bark, are used in medicine against stomach-ache and fever. The fruits, though a bit sour, are edible.

**Taxonomy.** *A. cobbe* is a very variable species, with wide distribution and broad ecological amplitude. The species probably comprises a large number of local races. Leenhouts (*l.c.* 1967, 1994) concluded that all Malesian specimens examined belong to a single species. However, on a local scale it may be possible to distinguish the more important races (varieties or forms). For Borneo, and especially Sabah and Sarawak, no attempt has been made to subdivide the species into infraspecific taxa.

### 3. ARYTERA Blume

(Greek, *aruter* = ladle; the shape of the fruit-lobes)

#### H. Turner

Rumphia 3 (1847) 169; Merrill, EB (1921) 361; Ridley, FMP 1 (1922) 507; Radlkofer in Engler, Pflanzenr. 98 (1933) 1268; Masamune, EPB (1942) 425; Backer & Bakhuizen *f.*, FJ 2 (1965) 140; van der Ham, Blumea 23 (1977) 289; Anderson, CLTS (1980) 310; Reynolds, Austrobaileya 2 (1985) 158; Yap, TFM 4 (1989) 438; Turner, Blumea 38 (1993) 144, FM 1, 11 (1994) 467.

Trees, rarely shrubs. *Indumentum of solitary, simple hairs.* Leaves *paripinnate; petioles subterete, pulvinate; rachis subterete.* Leaflets *subopposite;* petiolules usually consisting of pulvinus only, usually 1-grooved; *domatia usually present.* Inflorescences axillary to pseudoterminal or borne on leafless twigs, thyrsoïd; bracts and bracteoles triangular, hairy outside, usually glabrous inside; pedicels hairy. **Flowers seemingly hermaphrodite; calyx 5-dentate to 5-partite, teeth all equal to slightly unequal, apert to narrowly imbricate, margin entire; petals (2-)5(-6), slightly longer or shorter than the calyx, scales present or rarely absent, free to basally adnate to the margins, not crested; disc complete;** stamens (6-)8(-10), filaments at least basally pilose, anthers pilose or glabrous; *ovary sessile, 2-3-locular, smooth, hairy, ovule 1 per locule, stigmas apical, with 2 or 3 stigmatic lines, or with 2 or 3 lobes, the lobes distinctly recurved in fruit.* **Fruits with 1-3 well-developed lobes, loculicidal, short- or long-stalked, lobes laterally not or slightly flattened; endocarp hairy at least on sutures of carpels. Seeds partly covered by an arillode, consisting of 1 or 2 layers, the outer or only one soft, yellow, the inner one firm, dark brown when dry.**

**Distribution.** About 28 species, from NE India and SE Asia, throughout Malesia, to Australia, the Solomon Islands and the Pacific Islands. In Sabah and Sarawak, one species.

### **Arytera litoralis** Blume

Fig. 3.

(Latin, *litoris* = coastal region; its natural habitat)

*L.c.* (1847) 170; Merrill *L.c.* (1921) 361; Ridley *L.c.* (1922) 507; Masamune *L.c.* 425; Backer & Bakhuizen *f. L.c.* 140; Anderson *L.c.* 310; Turner *L.c.* (1994) 473. **Lectotype** (Turner, 1993): *Blume 1314*, Java, Nusa Kambangan (L).

Tree, rarely shrub, to 40 m tall, 90 cm diameter. **Bark** smooth, greyish green to reddish to almost black. **Leaves** each with 1–4 pairs of leaflets; petioles 1.3–9.5 cm long; rachis 0.8–11.5 cm long. Leaflets thin-coriaceous to chartaceous, not to densely punctate; *ovate to elliptic or obovate*, 4–31 × 1.5–12 cm; base symmetrical or asymmetrical, rounded to slightly attenuate, apex acuminate to cuspidate, rarely retuse or rounded, acumen retuse, obtuse to rounded; *glabrous above, glabrous to hairy especially on major veins beneath, domatia often pustular, in the form of large to small pockets or sacs, opening in front (on top)*; midrib slightly raised above, concolorous with lamina to reddish brown or yellowish, lateral veins raised below, indistinctly looping near margin, intercostal veins scalariform to almost reticulate, obscure; petiolules 2–14 mm long. **Inflorescences** *basally branched or unbranched*; rachis terete to slightly flattened, 1.5–17 cm long, hairy when young; first-order branches to 10 cm long; cymules dichasial or sometimes monochasial, 1–7-flowered; bracts 0.3–1.2 mm long; bracteoles 0.1–0.6 mm long; pedicels 1–5 mm long, hairy. **Flowers** 1–3.5 mm diameter; *calyx 0.8–2 mm high, deeply incised, hairy outside, glabrous inside, apex acute to acuminate; petals triangular to rhomboidal to obovate, 0.5–2.2 × 0.3–1.9 mm, usually gradually decurrent into the claw, margin entire, subpilose, apex obtuse to acute to acuminate, glabrous to pilose outside, subglabrous to subpilose inside, claw 0.1–0.4 mm long, scales 0.2–1.2 mm long, apex irregularly broadened, slightly to densely pilose; disc glabrous to hairy; stamens 6–8(–10), filaments 2–4 mm long, pilose, anthers 0.7–1.1 mm long, straight, pilose, connective not protruding; ovary 2(–3)-locular, style and stigma elongating up to 3 mm in fruit, not to slightly 2(–3)-lobed. Fruits 1–2(–3)-lobed, 7–36 × 5–23 mm, smooth to slightly rugose to verrucose, glabrous to sparsely hairy, lobes 8–23 × 5–21 mm, dorsally rounded to slightly angular; stalk absent or to 3 mm long, slender to broadly cuneate. **Seeds** *ellipsoid to orbicular, not to slightly flattened laterally, 6–24 × 5–19 mm; arillode covering the seed halfway to completely, dentate to lobed, not to slightly folded towards the base inside, thick towards the base, coriaceous, 2-layered*; cotyledons obliquely superposed to almost collateral, equal to slightly unequal, upper or lower one larger; hypocotyl and radicle 0.5–3 mm long, glabrous.*

**Vernacular names.** Sabah—*ampungit* (Murut), *anging manuk* (Kadazan), *nunuk-nunuk, petinag* (Sungei Kinabatangan).

**Distribution.** From NE India (Bay of Bengal) to SE Asia, S China (Hainan), Malesia, and the Solomon Islands. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary forests on all kinds of soil, lowland to 1500 m. Flowering and fruiting throughout the year.

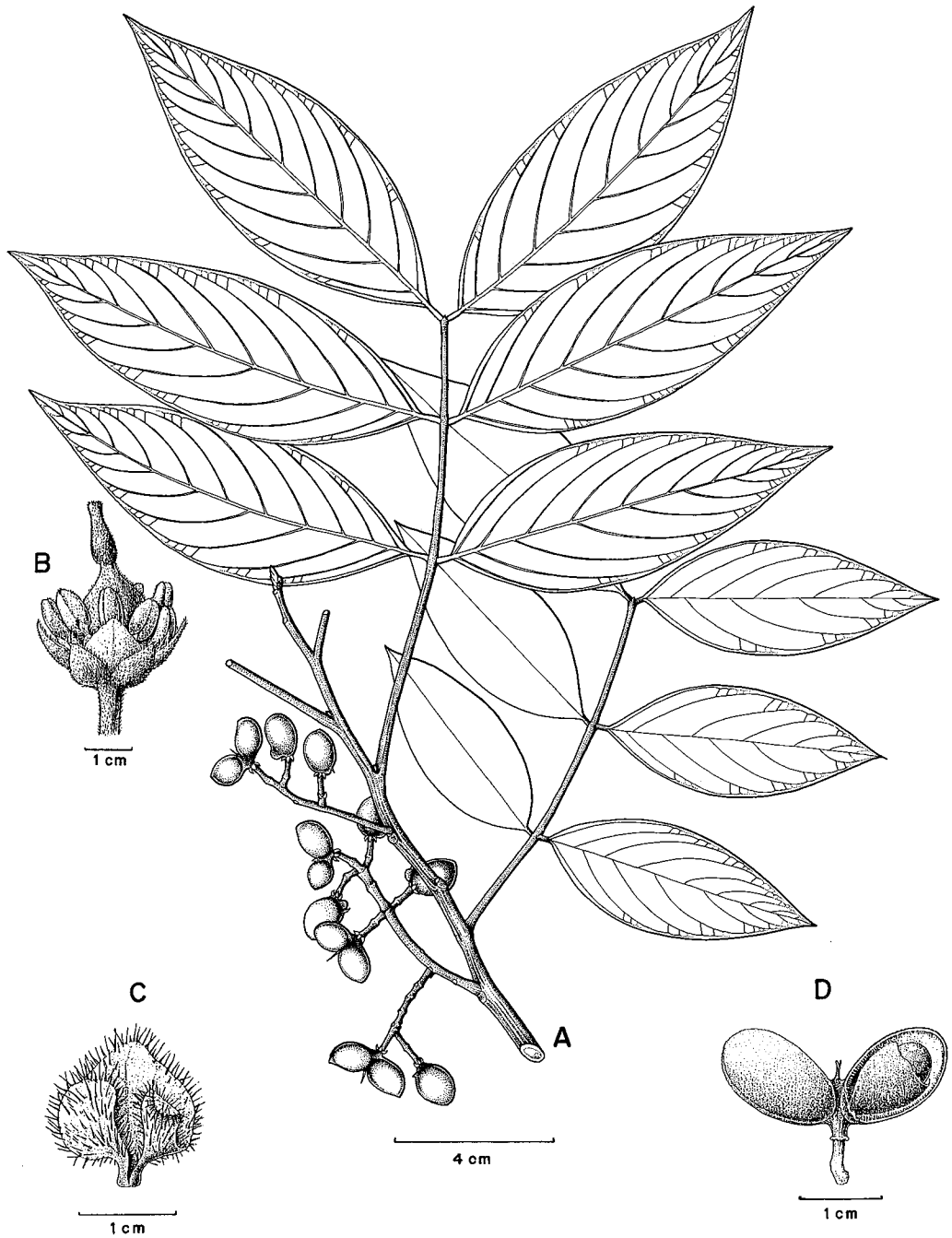


Fig. 3. *Arytera litoralis*. A, fruiting twig; B, female flower; C, petal from inside; D, fruits. (A from SAN 95571, B-C from Gibbs 2664, D from van Balgooy 6099.)

## 4. CUBILIA Blume

(from the Philippine plant-name *kubili*)

### P.W. Leenhouts

Rumphia 3 (1847) 100; Radlkofer in Engler, Pflanzenr. 98 (1932) 921; Backer & Bakhuizen *f.*, FJ 2 (1965) 143; Leenhouts, Blumea 24 (1978) 297, 298, FM 1, 11 (1994) 490; Whitmore & Tantra, CLS (1986) 212; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 310.

Medium-sized, *monoecious trees*. *Indumentum of solitary, simple hairs*. **Leaves** *paripinnate*. Leaflets opposite to alternate, base equal-sided to oblique, margin entire; venation mainly open but somewhat irregular. **Inflorescences** terminal or pseudoterminal, thyrsoid or corymbose; cymules many-flowered; bracts inconspicuous. **Flowers** *unisexual, radially symmetrical; calyx urceolate, the narrow mouth surrounded by 5 minute lobes, densely tomentulose on both surfaces, not petaloid; petals 5, included in the calyx, hardly clawed, margin sometimes slightly inflexed just above the base but without a clear scale; disc annular, broad, adnate to the receptacle, glabrous; stamens 5 (or 6), hardly exerted, filaments flattened, glabrous or with a few hairs, anthers adnate, glabrous, introrse; ovary sessile, 2-locular, divided to near the base, warty and densely hairy, stigma sessile, 2-lobed, inserted between the ovary lobes, ovules 1 per locule, attached at the base*. **Fruits** *2-parted, the parts obovoid, loculicidal, glabrous, densely aculeate*; fruit wall coriaceous, glabrous inside. **Seeds** *basally attached, up to about halfway enveloped by a thin-fleshy, more-or-less entire arillode, hilum large, nearly orbicular*.

**Distribution.** Monotypic; Borneo (Sabah, Sarawak, E Kalimantan), the Philippines, Sulawesi, and the western Maluku.

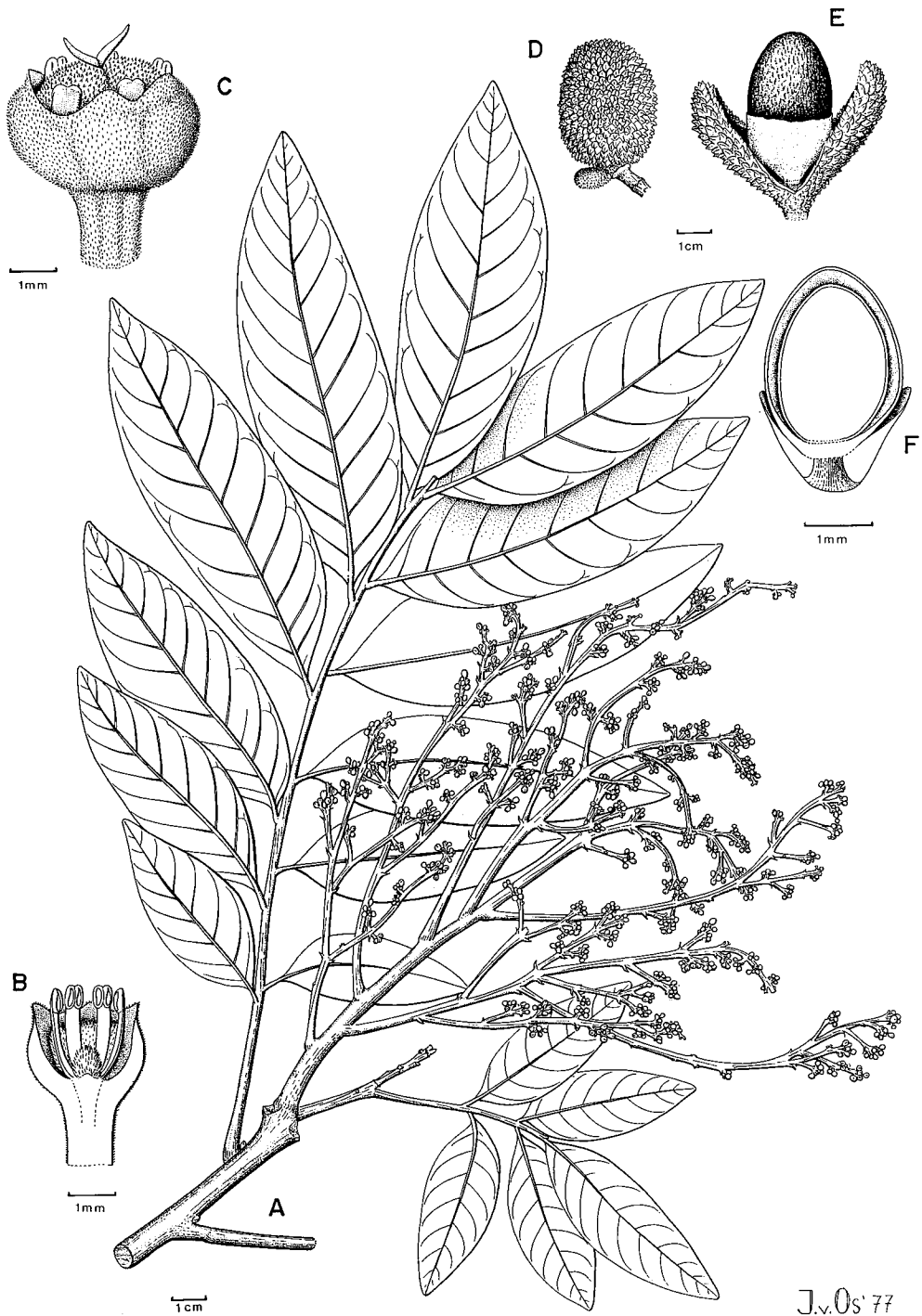
### *Cubilia cubili* (Blanco) Adelbert

Fig. 4.

Blumea 6 (1948) 325; Backer & Bakhuizen *f. l.c.* 143; Leenhouts *l.c.* (1978) 397, *l.c.* (1994) 491. **Basionym:** *Euphoria cubili* Blanco, Fl. Philip. (1837) 287, *nom. illeg.* **Neotype** (Leenhouts, 1978): *Merrill Spec. Blanc. 705*, Philippines, Luzon (L; isoneotypes BO, P).

Tree to 25(–50) m tall, 75 cm diameter; buttresses to 6 m high. **Bark** usually smooth and reddish, sometimes greyish brown. **Leaves** *each with 3–5(–7) pairs of leaflets; petioles terete or sometimes slightly flattened above, smooth or thicker ones canaliculate, strongly swollen at base, 5–25 cm long, 1.5–3 mm thick; rachis slightly flattened above, otherwise terete, sometimes carinate above towards the apex. Leaflets elliptic to ovate, (5–)10–15(–40) × (2.5–)3–5(–10) cm, the upper ones often slightly falcate, chartaceous, often with an exposed gland in or above the axils of some lateral veins beneath; base rounded and attenuate to acute, apex obtuse- to acute-acuminate, mucronate or not; midrib slender, slightly raised to sunken above, mostly sharp-triangular, sometimes more or less rounded beneath, lateral veins 1–2(–4) cm apart, sometimes a few looping and joining towards the margin, slightly raised above, more so beneath; intercostal veins mostly feeble, reticulate, mostly faint above, slightly raised beneath; petiolules 3–7.5 mm long*. **Inflorescences** to 30 cm long, densely and minutely appressed brown-hairy, the branches sparsely branched; *cymules to 25-flowered; peduncles to 1 cm long; pedicels slender, 3–4 mm long, slightly thickened towards the apex; bracts triangular and hardly 0.5 mm long to subulate and 3 mm long*. **Flowers** *copper-coloured; calyx*





**Fig. 4.** *Cubilia cubili*. A, flowering leafy twig; B, male flower in longitudinal section; C, female flower; D, fruit; E, open fruit with seed; F, seed in longitudinal section. (A from *FB* 1996, B–C from *PNH* 22872, D from *NIFS* Cel. V/236 = *Waturandang* 221, E from *Radlkofer* in *Engler, Pflanzenr.* (1932–1933) f. 22, F from *Kostermans* 7011.)

in male flowers *c.* 3 × 2 mm, opening *c.* 1 mm diameter, lobes minute; in female flowers 1.5–2 × 3–4 mm, opening wider than in male, lobes broad-triangular, *c.* 0.8 mm high; petals in male flowers elliptic, *c.* 1 × 0.7 mm, in female flower subovate, *c.* 1.5 × 1.5 mm; stamen filaments *c.* 1 × 0.2 mm, anthers *c.* 0.3 mm long, in female flowers hardly reduced; ovary *c.* 1.5 mm high, stigma lobes triangular, dorsoventrally flattened, *c.* 1 mm long. **Fruit** parts 3–4(–5) × 2–2.5 cm, green to brown, warty with the warts pyramidal to triangular, to 2 mm long; fruit wall *c.* 0.8 mm thick; endocarp smooth, white. **Seeds** ovoid-ellipsoid, *c.* 2.5 × 1.7 cm; testa smooth, shiny dark brown; arillode to 6–10 mm high.

**Distribution.** As the genus. Uncommon in Sabah and Sarawak.

**Ecology.** Primary and secondary forests, apparently mostly on poorly aerated, often basic soil, often along rivers; mostly at low altitudes, to 600 m. Flowering and fruiting throughout the year.

**Uses.** The whitish to light reddish brown timber is used in the Philippines for indoor construction. The arillode is edible; the seeds, when cooked or roasted, are said to be comparable with, but more delicious, than chestnuts.

## 5. DICTYONEURA Blume

(Greek, *dictyon* = net, *neuron* = nerve; the leaflet venation)

### J. van Dijk

Rumphia 3 (1847) 163; Merrill, EB (1921) 361; Radlkofer in Engler, Pflanzenr. 98 (1933) 1219; Masamune, EPB (1942) 426; Reynolds, Austrobaileya 2 (1985) 153; J. van Dijk, Blumea 31 (1986) 437, FM 1, 11 (1994) 507.

Shrubs to medium-sized trees, *monoecious*. *Indumentum* of simple, solitary hairs and small, round scales. **Leaves** *paripinnate*. Leaflets alternate to opposite, variably hairy or scaly, *domatia* absent or pocket-like. **Inflorescences** axillary, often pseudoterminal, simple and raceme-like or more-or-less strongly branched; cymules 1–few-flowered; bracts and bracteoles densely hairy, mostly caducous. **Flowers** *unisexual*, *radially symmetrical*; *sepals* 5( or 6), *imbricate* in bud, *slightly connate* at the base, *about equal* or the inner- and/or outermost one *distinctly smaller*, persistent in fruit; *petals* absent; *disc* entire, swollen, tomentose; *stamens* (4–)5(–6), *exserted* in male flowers, filaments usually patently long-hairy in the basal half, anthers basifixed to halfway dorsifixed; *ovary* *sessile*, 2(–3)-*locular*, *more-or-less hairy*, *sparsely* to *densely scaly*, *style* apical, *shorter* to a little longer than the ovary, with 2 ( or 3) *stigmatic* lines, *ovules* 1 per *locule*, axillary. **Infructescences** with thickened axes. **Fruits** *capsular*, *sessile*, *loculicidal*; *fruit wall* granular, *inner side* more or less fleshy with a thicker fleshy layer in a narrow to broad strip along the dissepiment and covering the inside of the valves for 30–100%. **Seeds** ovoid to ellipsoid, 1–2(–3) per fruit; testa parchment-like or a more-or-less hard shell; *sarcotesta* *cupular* on the ventral side and covering 25–100% of the seed, *dorsally* interrupted by a very narrow to very broad *cuneate cleft*; embryo straight, cotyledons superposed, the upper slightly to very much larger than the lower one.

**Distribution.** Two to three species; Borneo, Philippines, Sulawesi, Maluku and New Guinea. In Sabah and Sarawak, one species, represented by one of its two subspecies.

**Dictyoneura acuminata** Blume

Fig. 5.

(Latin, *acuminatus* = gradually attenuated; the leaflet apex)

*l.c.* (1847) 163; Merrill *l.c.* (1921) 361; Radlkofer in Engler *l.c.* (1933) 1221; Masamune *l.c.* 426; J. van Dijk *l.c.* (1986) 441, *l.c.* (1994) 508. **Lectotype** (J. van Dijk, 1986): *Muller, s.n.*, Borneo (L).

subsp. **acuminata**

Tree, sometimes treelet or shrub to 12(-15) m tall, 20(-30) cm diameter. **Bark** greenish or greyish, smooth; inner bark pale brown. **Wood** white. **Leaves** each with 2-7(-11) pairs of leaflets; petioles 1.5-7.5 cm long; rachis 4-18 cm long, terete to marginate. Leaflets slightly oblique, parchment-like, sometimes coriaceous, glabrous or rarely very sparsely hairy above, hairy beneath; *narrowly ovate or elliptic*, (2.5-)3.5-10.5(-18) × (1-)2-4(-5) cm; base attenuate-acute, margin entire at base, distantly serrate towards apex, apex acute or acuminate, acumen obtuse or slightly retuse; lateral veins 5-8 on each side, 5-16(-22) mm apart; *domatia mostly absent*. **Inflorescences** *mostly much-branched, sometimes unbranched*; bracts and bracteoles to 3 mm long; pedicels to 2 mm long. **Flowers** *greenish, whitish or yellowish brown, c. 5 mm diameter*; *sepals suborbicular to subelliptic*, 1.5-2.5 × 1-2 mm, glabrous or sparsely to sometimes densely hairy outside, subglabrous inside; disc (1.2-)1.5-1.8 mm diameter; stamen filaments with long patent hairs, in male flowers (2.5-)3.2-3.5 mm long, in female flowers (0.5-)1.5-2 mm long, anthers narrowly cordate to ovate, 0.6-0.8 × 0.4-0.7 mm, glabrous or sometimes sparsely hairy; ovary ellipsoid, 2-locular, (1.5-)1.8-2 × (1-)1.3-1.5 mm, sparsely hairy, often densely hairy along the sutures, *mostly densely scaly*, style 1-1.2(-1.5) mm long; pistillodes 0.5-1.2 mm long. **Fruits** *brownish, obovoid to globose, rarely transversely ellipsoid, 1(-2)-seeded, 9-14(-20) × 8-14(-20) mm; fruit wall 1-1.5(-3) mm thick*, sparsely to densely hairy or more or less densely scaly outside, densely hairy inside. **Seeds** subellipsoid, 8-12 × 5.5-8 mm; *sarcotesta covering (25-)45-60% of the seed, dorsally interrupted by a wide cuneate cleft*; testa parchment-like.

**Distribution.** Borneo, Philippines, Sulawesi, Maluku, New Guinea. In Sabah, very uncommon, known only from Silumpat Is. in the Lahad Datu district; not recorded from Sarawak.

**Ecology.** Primary and secondary forests, often at forest edges, along rivers, on the banks of lakes, on ridges, or in open vegetation; mostly in well-drained, sometimes in swampy habitat; on limestone rock, sandy, or loamy soil; to 1700 m.

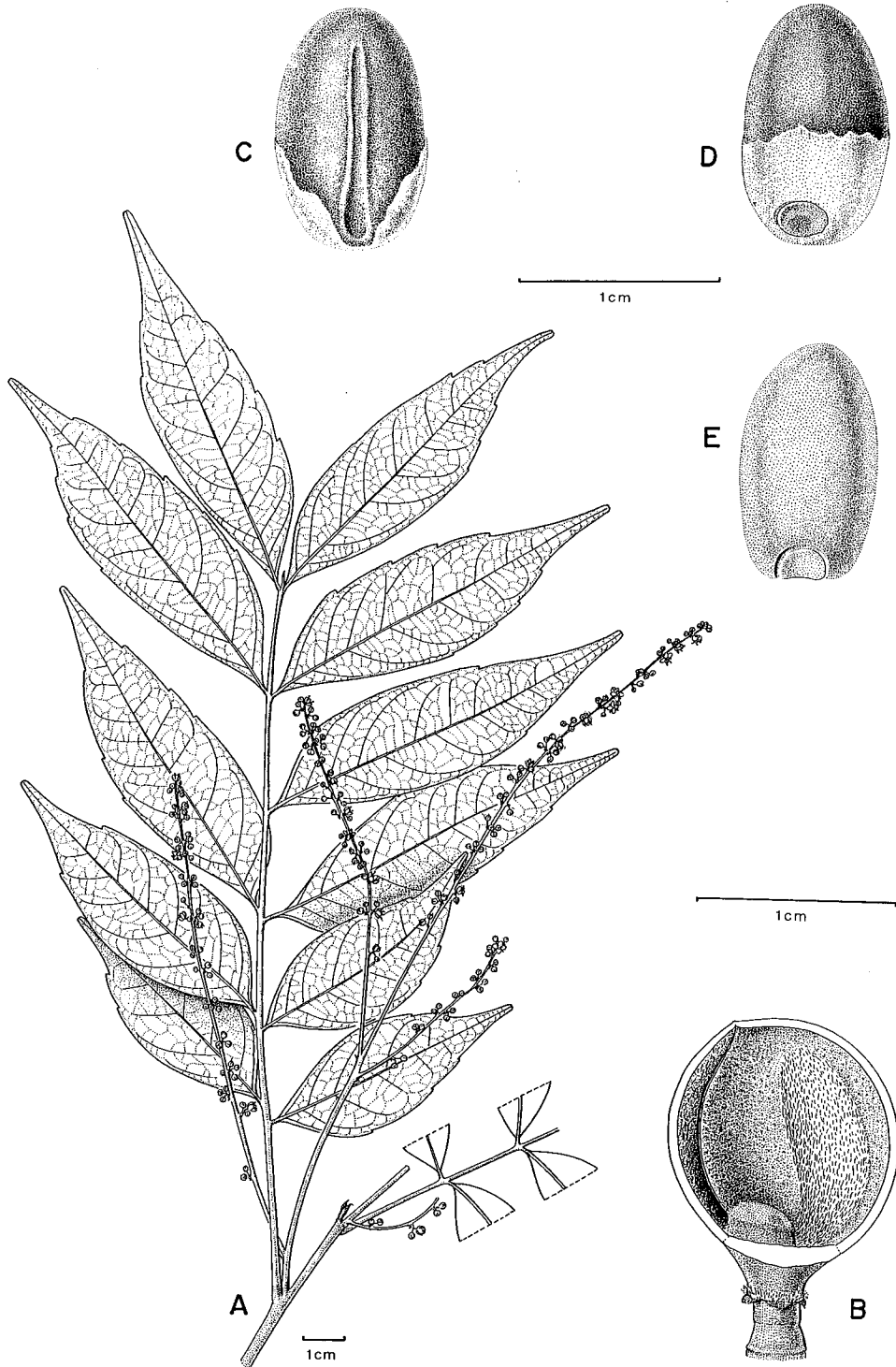
## 6. DIMOCARPUS Lour.

(Greek, *didumos* = double, *karpos* = fruit; the deeply 2-lobed fruits)

### P.W. Leenhouts

Fl. Coch. (1790) 233; Leenhouts, *Blumea* 19 (1971) 113, FM 1, 11 (1994) 511; Anderson, CLTS (1980) 310; Whitmore & Tantra, CLS (1986) 213; Yap, TFM 4 (1989) 438; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 310.

Trees or shrubs, *mostly monoecious. Indumentum often partly or mainly of dense tufts of hairs. Leaves paripinnate*, rarely unifoliolate. Leaflets opposite or alternate, not or hardly papillose



**Fig. 5.** *Dictyoneura acuminata* subsp. *acuminata*. A, flowering leafy twig; B, fruit valve from inside; C, seed, ventral view; D, seed, dorsal view; E, embryo. (A from SAN 37193), B-E from *Kostermans* 6892.)

and often with exposed glands beneath, margin entire to dentate. **Inflorescence** a panicle, terminal and sometimes in the axils of upper leaves. **Flowers** unisexual, radially symmetrical; sepals 5–6, confluent at base, imbricate, equal, not petaloid, densely tomentose outside, short-hairy at least in the upper part inside, not ciliate, entire; petals absent or 5–6, mostly longer than sepals, more-or-less oblanceolate, without scales; disc entire, 5-lobed, hairy; stamens (6–)8(–10), equal or more-or-less distinctly alternately long and short, exerted or not, filaments usually hairy, often tufted, anthers glabrous; ovary sessile, 2–3-carpellate, broadly cordate, tuberculate, hairy, usually each wart crowned by a hair-tuft, style slender, slightly shorter to longer than the ovary, variably hairy at least in the lower half, hairs mostly tufted, stigma with spreading lobes, ovules 1 per locule, axillary near the base; pistillodes small, densely pilose. **Infructescences** with thickened and sometimes elongated pedicels; persistent calyx slightly or not accrescent. **Fruits** nearly always with only 1 lobe developing, globose or broad-ellipsoid, indehiscent or sometimes loculicidal; fruit wall warty, sometimes smooth, rarely spiny, mostly glabrescent outside, smooth and glabrous inside. **Seeds** more or less globose; hilum subbasal, suborbicular, large; testa shiny, blackish brown; arillode thin, translucent-white, fleshy.

**Distribution.** Six species; in S and SE Asia from Sri Lanka and India to eastern Malesia and Australia. In Sabah and Sarawak, three species.

### Key to *Dimocarpus* species

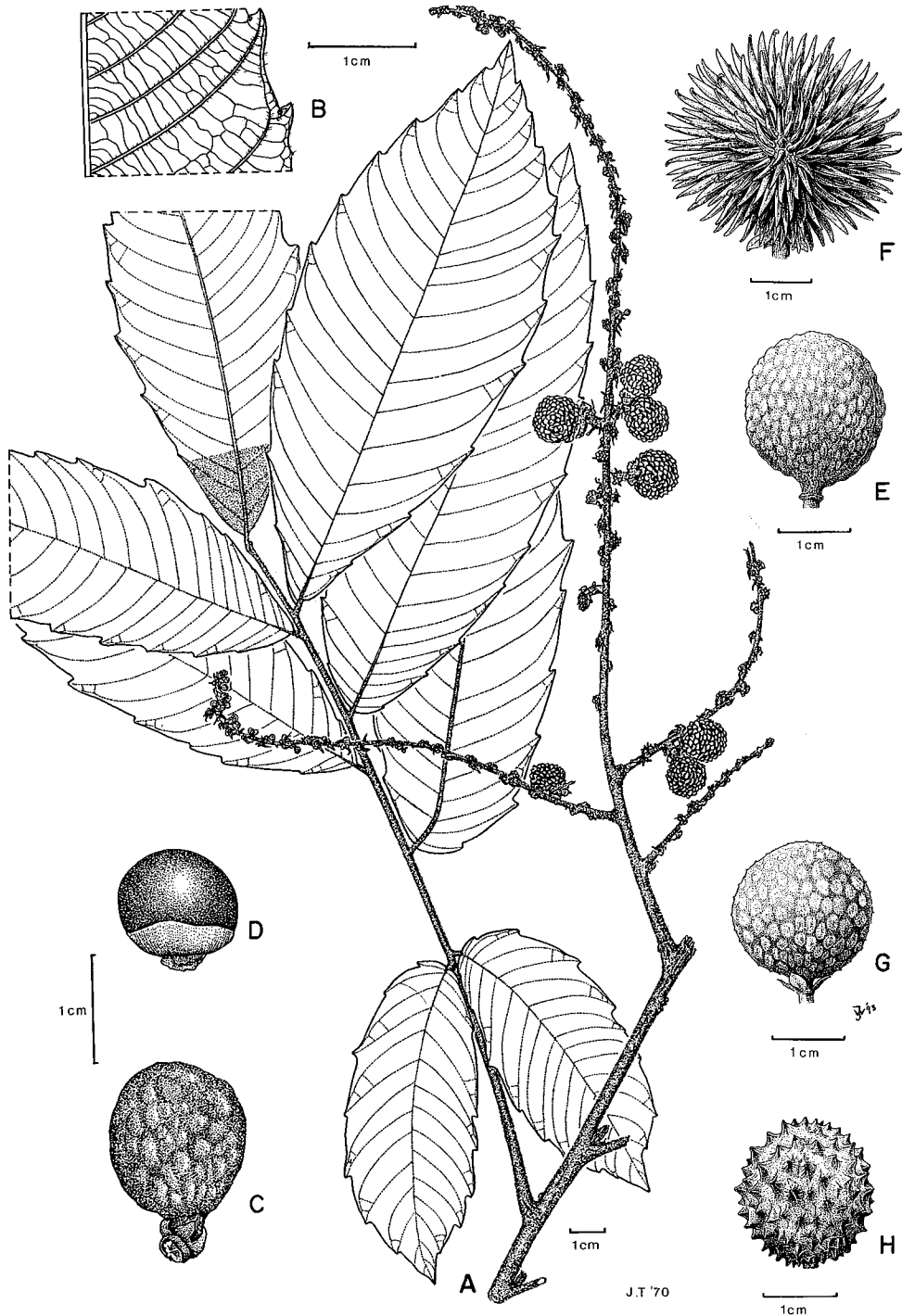
1. Leaflet margin serrate-dentate. Leaf with 4–7 pairs of leaflets.....**1. D. dentatus**  
 Leaflet margin entire or repand, rarely sinuous or distantly dentate. Leaf with 1–4(–6) pairs of leaflets.....2
2. Glands on lower surface of leaflets present in the axils of lateral veins and elsewhere, often near or along the margin. Petals absent or 1, reduced. Disc woolly.....**2. D. fumatus**  
 Glands on lower surface of leaflets usually only present in the axils of lateral veins, sometimes absent. Petals 5. Disc velutinous.....**3. D. longan**

**1. *Dimocarpus dentatus* Meyer ex Leenh.**  
 (Latin, *dentatus* = toothed; the leaflet margin)

Fig. 6A–D.

*l.c.* (1971) 116, *l.c.* (1994) 513. **Type:** *Ambulah SAN 37193*, Borneo, Sabah (holotype L; isotype K).

Tree to 15(–24) m tall, 40 cm diameter, sometimes with buttresses. **Leaves** each with 4–7 pairs of leaflets; petiole and rachis densely hairy; petioles 6–18 cm long. Leaflets thin-coriaceous to stiff-chartaceous, hairy on midrib and lateral veins above, glabrescent, rather densely to sparsely tufted-hairy on midrib and lateral veins beneath, in between lateral veins often with scattered tufted, paired or solitary hairs, with exposed glands in the axils of lateral veins and along the margin; oblong-obovate to lanceolate, 5.5–24 × 3.2–9 cm; base acute and symmetric or slightly asymmetric and cordate in the lower leaflets, margin distantly serrate or dentate, apex acute to rounded, sometimes attenuate-acuminate; midrib flat above, lateral veins 8–15 mm apart, alternately ending in and between the marginal teeth, sunken above, intercostal veins scalariform, rather dense, hardly visible above, raised beneath; petiolules 1–2 mm long.



**Fig. 6.** *Dimocarpus dentatus* (A–D); *D. fumatus* (E); *D. longan* var. *echinatus* (F); *D. longan* var. *longan* (G); *D. longan* var. *malesianus* (H). A, fruiting leafy twig; B, detail of lower leaflet surface; C, fruit; D, young seed with partly developed arillode; E–H, fruits. (A–B from SAN 37193, C–D from *Kostermans* 12654, E from *Kostermans* 13245, F from SAN 61671, G from *Tilley, s.n.*, H from *S. 32681*.)

**Inflorescences** 25–55 cm long, densely ferruginous-tomentose, hairs tufted; branches few, erecto-patent, to 20 cm long, bearing rather numerous sessile, few-flowered, glomerulous cymules; pedicels to 1.5 mm long; bracts narrowly triangular, to 4 mm long, patent to recurved; sepals 2.5–3 × 1.8–2 mm, sparsely hairy in the upper part inside; *petals* 5, *oblanceolate*, 3.5–4.2 × 1 mm, sericeous outside except at the base and sometimes in the upper half, densely long-hairy along the margin and inside except at the base; *disc velutinous*; stamen filaments 2.2–4 mm long, patently tufted-hairy mainly towards the apex, anthers to 0.8 mm long. **Fruit** lobes subglobose, *c.* 16 × 15 mm; fruit wall with rather large, hardly raised, flat warts, granular, glabrous.

**Vernacular name.** Sabah—*rambutan kunyit* (Kedayan).

**Distribution.** Endemic to Borneo. In Sabah, locally common; so far no record from Sarawak; also in E Kalimantan.

**Ecology.** Primary, sometimes secondary, forest, in well-drained as well as in periodically inundated or marshy localities, on various types of soil, from sea level to 750 m. Flowering in May, July, October to November; fruiting in July to August.

**Uses.** Arillode sweet, edible.

**2. *Dimocarpus fumatus* (Blume) Leenh.**  
(Latin, *fumatus* = smoke-coloured; the twigs)

Fig. 6E.

*l.c.* (1971) 119, *l.c.* (1994) 515; Anderson *l.c.* 310; Yap *l.c.* 439. **Basionym:** *Nephelium fumatum* Blume, *Rumphia* 3 (1847) 111. **Type:** *Korthals, s.n.* (or *Müller s.n.?*), SE Borneo (L). **Synonym:** *Pseudonephelium fumatum* (Blume) Radlk., *Sapind. Holl.-Ind.* (1879) 71, in Engler, *Pflanzenr.* 98 (1932) 329, Merrill *l.c.* 359, Masamune *l.c.* 432.

subsp. ***fumatus***

Tree, rarely shrub, to 27 m tall, 1 m diameter, sometimes with buttresses. **Leaves** each with (2–)3(–4) pairs of leaflets; petiole and rachis thin-hairy, mostly early glabrescent; petioles 1.5–12 cm long, flat to sometimes slightly hollowed above, exceptionally terete. *Leaflets alternate to subopposite*, thin-coriaceous to sometimes chartaceous, glabrous and minutely punctate above, glabrous to sparsely hairy on midrib, vein axils and veins beneath; *exposed glands present in the axils of lateral veins and along or in the incisions of the margin beneath; elliptic to oblong*, 6.5–28 × 2.5–10.5 cm; base symmetric to asymmetric, cuneate to rounded, decurrent or not, *margin repand to sinuous (mainly in the apical part) or distantly dentate, sometimes entire*, apex attenuate to abruptly acuminate; midrib slightly raised to hardly sunken above, lateral veins 1–2.8 cm apart, not joined, slightly raised or rarely grooved above, intercostal veins and veinlets finely tessellate-reticulate, mostly inconspicuous above, distinct beneath; petiolules 2.5–15 mm long, grooved above, often with a median rib. **Inflorescences** lax, to 50 cm long, with a few branches; cymules sessile, mostly many-flowered, sparsely hairy; pedicels 2–4 mm long, slender; bracts subulate, to 3 mm long. **Flowers:** sepals connate to one third of their length, 2–3 × 1.5–2.5 mm, hairy inside; *petals absent or rarely 1, much reduced; disc woolly*; stamen filaments 1.5–2.5 mm long, glabrous or nearly so, anthers 0.6–0.8 mm long. **Fruit** lobes 2–3.5 cm diameter, hardly warty to short-spiny, granular, glabrous; dehiscent by valves.

**Vernacular names.** Sabah—*mambuakat* (Dusun Kinabatangan). Sarawak—*marakiang*, *ribau balabau* (Iban).

**Distribution.** Peninsular Thailand, Peninsular Malaysia and Borneo. Common in Sabah, uncommon but widespread in Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary mixed dipterocarp forest, on flat country, slopes, hill tops, or along riverbanks, mainly on yellow/red sandy loam soils, from lowlands to 1350 m. Flowering in April to July, September, November; fruiting in July, September, December.

### 3. *Dimocarpus longan* Lour.

Fig. 6F–H.

(from the Chinese fruit-name *long-yen* = dragon's eye; the dark seed subtended by a pale arilode)

Fl. Coch. (1790) 233; Leenhouts *l.c.* (1971) 122, *l.c.* (1994) 517; Anderson *l.c.* 310; Yap *l.c.* 439; Wong & Ketso, PROSEA 2 (1991) 146. **Neotype** (Leenhouts, 1971): *Liao & Kuo 1598*, Taiwan (L; isoneotype TAI). **Synonyms:** *Nephelium longan* (Lour.) Hook., Curtis Bot. Mag (1844) t. 4096; *N. long-yan* Blume, Rumphia 3 (1849) 108.

Tree, very rarely shrub, to 30(–40) m tall, 30(–80) cm diameter; buttresses to 2 m high. **Leaves** each with 2–4(–6) pairs of leaflets; rachis mostly densely hairy; petioles 3–20 cm long, terete to flattened above. Leaflets stiff-chartaceous to coriaceous, with or without exposed glands or hair-tufts in the axils of lateral veins beneath, often hairy in the basal part of the midrib above; elliptic to ovate, 3–45 × 1.8–20 cm; base symmetric to asymmetric, acute to rounded, rarely decurrent, margin entire, apex mostly attenuate-acute to obtuse-acuminate, sometimes obtuse to acute; midrib sunken or rarely flat to raised above, lateral veins 0.4–3 cm apart, at least in the lower half of leaflet not joined, slightly raised to faintly grooved above, intercostal veins mostly more-or-less scalariform, rather dense, often inconspicuous above, more-or-less raised beneath; petiolules 0.2–35 mm long, mostly grooved above. **Inflorescences** 8–40 cm long, densely tufted tomentose; branches few to several; cymules subsessile to distinctly stalked, (1)–3–5-flowered; pedicels 1–3 mm long, rather slender; bracts patent, oblong-ovate to narrowly lanceolate, 1.5–5 × 0.6–1.5 mm. **Flowers:** sepals 2–5 × 1–3 mm, partly short-hairy inside; petals 5, broadly to narrowly spathulate, 1.5–6 × 0.8–2 mm, for the greater part densely woolly (large ones) to subglabrous (small ones) on both sides, apex woolly or with sessile glands inside; disc velutinous; stamen filaments 1–6 mm long, mostly woolly (hairs often tufted) except at the base and less often at the apex, anthers 0.6–1.5 mm long. **Fruit** lobes broad-ellipsoid to globose, 1–3 × 1–3 cm; fruit wall smooth to warty or with spines to 1 cm long, sometimes granular, glabrescent.

**Vernacular names.** Sabah—*bambo* (Idahan), *mabo* (Dusun), *mahau* (Kedayan), *mambu* (Tenggara), *mumboh* (Dusun Kinabatangan), *rafag* (Banggi), *sabon-sabon* (Bajau). Sarawak—*apong keliau* (Berawan), *buah keregan* (Punan Tutoh), *chiru* (Malay-Lundu), *enkiong*, *gurin* (Iban), *kayo bilong* (Kayan), *kayu soman* (Kenyah), *mata kucing* (Malay), *merkiang* (Iban).

**Distribution.** Continental Asia from Sri Lanka and India to S China, Hainan, and Taiwan, and Malesia (in Java and New Guinea probably only naturalized; not seen from the Lesser Sunda Islands). In Sabah and Sarawak, 2 subspecies with 3 varieties are recognised.



**Key to subspecies and varieties**

1. Leaves mostly distinctly asymmetric at base; midrib and lateral veins nearly always flat or slightly raised above; petiolules rarely grooved.....

subsp. **longan** var. **longan**

Synonyms: *Sapindus longifolius* Vahl, Symb. 3 (1794) 53; *Nephelium bengalense* G. Don, Gen. Hist. 1 (1831) 670; *N. pupillum* Wight, Illustr. 1 (1840) 141; *Euphoria echinulata* Radlk., Pflanzenr. 98 (1932) 903; *N. echinulatum* (Radlk.) Ridl., FMP 1 (1922) 503.

Leaves each with (2-)4-5 pairs of leaflets; petioles 3-8 cm long. Leaflets usually opposite, stiff-chartaceous, mostly glabrous above, subglabrous beneath; domatia rare and never hairy; oblong-ovate to oblanceolate, 3-19 × 1.8-6.5 cm; base at least in the upper leaflets distinctly asymmetric, acute, apex obtuse to shortly, broadly, and obtusely acuminate; midrib flat to slightly raised above, lateral veins 0.5-1.5 cm apart, usually slightly raised on both sides; petiolules 2-10 mm long. Inflorescences with distinctly stalked, 1-3-flowered cymules, Fruit subglobose, c. 1.2 cm across, mostly finely pustulate, granular or nearly smooth.

Continental S and SE Asia and Malesia (probably indigenous only in Peninsular Malaysia, and naturalized in some parts of Java, Borneo, Philippines and New Guinea). In Sabah, uncommon and of uncertain origin.

- Leaves nearly always symmetric at base; midrib and lateral veins nearly always sunken above; petiolules often grooved.....2

2. Fruits densely covered with 0.8-1 cm long, flattened spines.....

subsp. **malesianus** var. **echinatus** Leenh.

*l.c.* (1971) 128, *l.c.* (1994) 519. Based on *Euphoria nephelioides* Radlk., Philip. J. Sc. 8 (1914) Bot. 457. Type: *Kleme EB 15218*, Philippines, Basilan (M).

Leaves each with 1-4 pairs of leaflets; petioles 6-9 cm long. Leaflets 4-22 × 1.5-9 cm, hairy or not; domatia present or absent; base more-or-less symmetric, apex acuminate; lateral veins 1-1.8 cm apart, intercostal veins slightly sunken beneath, invisible above; petiolules 3-15 mm long.

Borneo (Sabah and Kalimantan) and the Philippines (Mindanao and Basilan).

- Fruits smooth to warty.....

subsp. **malesianus** var. **malesianus** Leenh.

*l.c.* (1971) 126, *l.c.* (1994) 519. Based on *Sapindus cinereus* Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 402. Neotype (Leenhouts 1971): *Cuming 1131*, Philippines, Luzon (isoneotypes BM, FI, K, L). Synonyms: *Nephelium malaiensis* Griff., Notul. 4 (1854) 549, Masamune *l.c.* 428; *Euphoria cinerea* Radlk., Pflanzenr. 98 (1932) 905; *E. malaiensis* (Griff.) Radlk. *l.c.* (1932) 909; *Sapindus stellatus* Turz. *l.c.* 403; *E. stellata* (Turz.) Radl. *l.c.* (1932) 908, Merrill *l.c.* (1921) 359, Masamune *l.c.* 426, Anderson *l.c.* 311; *E. elongata* Radlk., Sapind. Holl.-Ind. (1879) 7, 25, Merrill *l.c.* (1921) 359, Masamune *l.c.* 426; *E. sclerocarpa* Radlk. in Merrill, PEB (1929) 174, Masamune *l.c.* 426; *E. succulenta* Radlk. in Merrill *l.c.* (1929) 174, Masamune *l.c.* 426; *E. microcarpa* Radlk. *l.c.* (1932) 907, Anderson *l.c.* 311.

Leaves each with 2-4(-6) pairs of leaflets; petioles (3-)6-10(-20) cm long. Leaflets opposite to alternate, mostly slightly hairy, often with hairy domatia; base mostly symmetric, apex often acuminate. Inflorescences often with subsessile cymules.

Myanmar, Laos, Cambodia, S Vietnam and Malesia (Sumatra, Peninsular Malaysia, Borneo, Philippines, Sulawesi and Maluku). Common in Sabah and Sarawak; also in Brunei.

## 7. GANOPHYLLUM Blume

(Greek, *ganos* = shiny, *phullon* = leaves)

### P.W. Leenhouts

Mus. Bot. Lugd. Bat. 1 (1850) 230; Radlkofer in Engler, Pflanzent. 98 (1933) 1423; Backer & Bakhuizen f., FJ 2 (1965) 141; Whitmore & Tantra, CLS (1986) 213; Yap, TFM 4 (1989) 440; Leenhouts, FM 1, 11 (1994) 538.

Tall trees, possibly *monoecious*. *Indumentum* of only simple, solitary hairs on the inflorescences; glandular scales common on twigs, leaves, inflorescences, and on outside of sepals; young parts sticky resinous. **Leaves** paripinnate, each with 4–10 pairs of leaflets; pseudostipules absent; neither petiole nor rachis winged. Leaflets herbaceous to stiffly parchment-like; base slightly to strongly asymmetric, margin entire. **Inflorescences** axillary thyrses, flowers solitary or in small cymules on racemose branches; bracts caducous. **Flowers** unisexual, radially symmetrical; sepals 4–6, nearly free to about halfway connate, valvate, all about equal, not petaloid, entire; petals absent; disc complete, consisting of short-hairy or glabrous lobes opposite the sepals; stamens 5–7, alternating with the disc lobes, in male flowers far exserted, glabrous, anthers basifixed, laterally dehiscent; ovary 2(–3)-locular, sessile, sparsely short-hairy, style apical, about as long as the ovary, stigma indistinctly lobed, ovules 2 per locule, one above the other, pendulous. **Fruit** a sessile drupe, not winged, smooth, glabrous, with 1 or 2 locules. **Seed** 1 per locule; arillode absent; embryo curved, radicle in a pocket of the testa, directed towards the hilum, outer cotyledon more or less enveloping the smaller inner one; germination epigeal, seedling leaves from the start paripinnate, first leaves with the petiole and rachis marginate.

**Distribution.** Two species, one in W and C Africa, the other from the Andamans and Nicobars to NE Australia and the Solomon Is. One species in Sabah.

**Ecology.** Canopy tree of evergreen and deciduous forest.

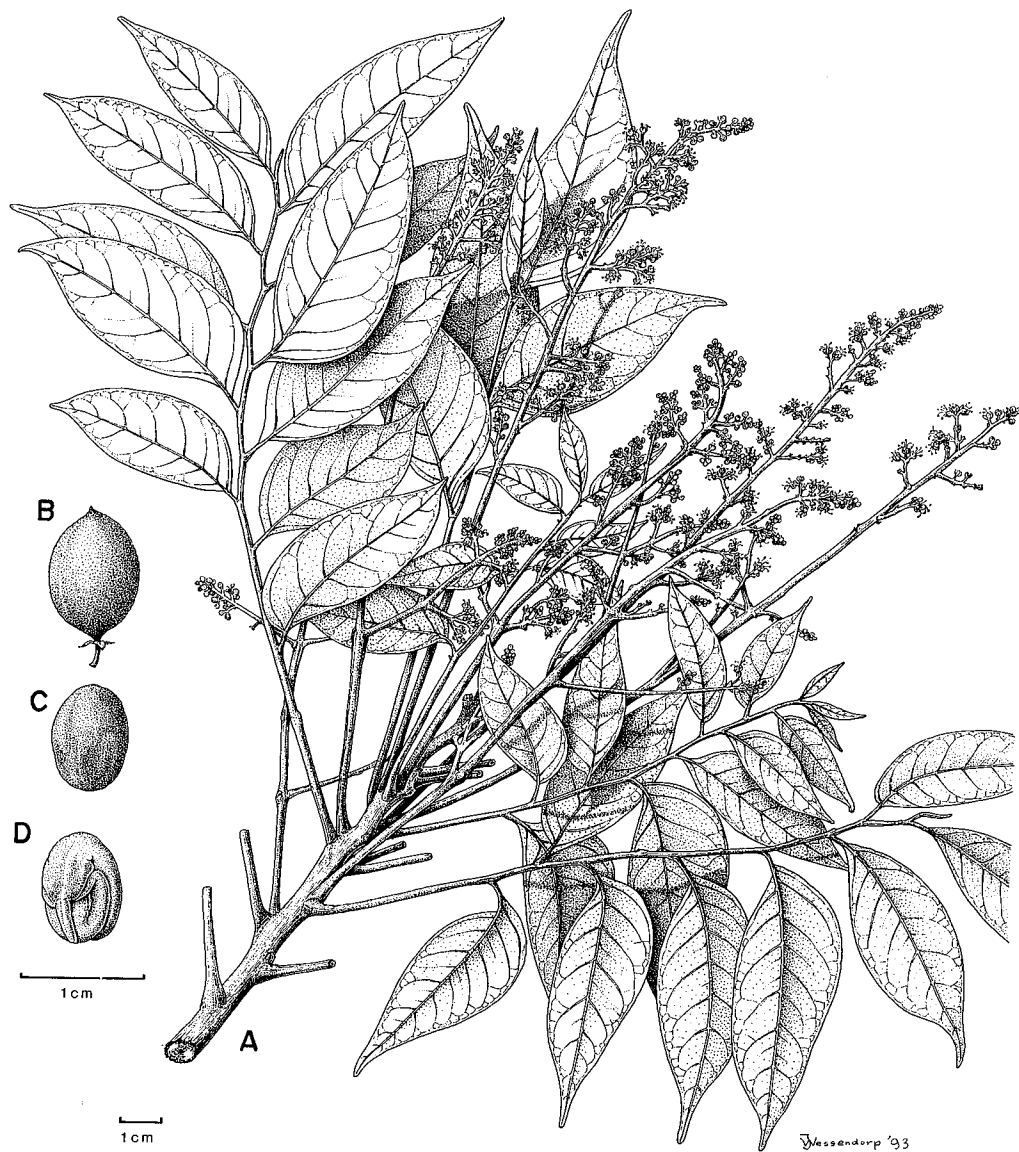
### *Ganophyllum falcatum* Blume

Fig. 7.

(Latin, *falcatus* = sickle-shaped; the leaflets)

*l.c.* (1850) 230; Radlkofer in Engler *l.c.* 1424; Backer & Bakhuizen *f. l.c.* 142; Whitmore & Tantra *l.c.* 213; Yap *l.c.* 440; Leenhouts *l.c.* 538. **Type:** *Sine coll.*, *s.n.* (= *L. sheet no.* 902.35–69), New Guinea (L).

Tree to 42 m tall, 150 cm diameter, with buttresses. **Bark** dark to grey-brown, peeling off as papery flakes. **Leaves** each with (4–)5–8(–10) pairs of leaflets; petioles 3.6–9 cm long, subterete with an upwards widening groove above, grading into the rachis. Leaflets: petiolules 2–5 mm long, lowermost leaflets ovate, *c.* 2.5 × 1 cm, base strongly asymmetric; upper leaflets elliptic, often more or less sickle-shaped, to 23 × 8 cm, base hardly asymmetric; apex hardly to distinctly acuminate, acumen short, broad, and rounded; midrib flat to slightly raised above, distinct below, lateral veins rather distant, oblique-patent, mostly looping and joining near the margin, intercostal veins and veinlets many, distinct, reticulations rather lax, in thick leaflets indistinct above. **Inflorescences** to 20 cm long, widely and (especially in the female ones) sparsely branched; bracts and bracteoles broad-triangular scales; pedicels *c.* 2 mm long.



**Fig. 7.** *Ganophyllum falcatum*. A, flowering leafy twig; B, fruit; C, seed; D, embryo. (A from Brass 2440, B-D from SAN 64306.)

**Flowers:** sepals 1.25–1.5 mm long, green, hairy inside; disc orange, short-hairy; stamen filaments 3–4 mm long, white, anthers *c.* 0.75 mm long, yellow, staminodes in female flowers strongly reduced; ovary *c.* 2.25 mm high, yellow-green, ellipsoid, tapering into a columnar style, pistillodes in male flowers well-developed. **Fruits** ovoid to subglobose, 10–20 × 7–10 mm, red; persistent calyx reflexed.

**Vernacular name.** Sabah—*panapok ayer* (Dusun).

**Distribution.** Andaman and Nicobar Is. to Australia (Western parts, the Northern Territory, and Queensland) and the Solomon Is. In Borneo, uncommon, so far reported from Sabah only (Tenom and Tambunan districts).

**Ecology.** Primary and secondary forests; along forest edges, on riverbanks, inner edge of mangroves, on well-drained or periodically inundated level lands, on slopes, clay, and limestone, to 1200 m. Flowering mainly in August–November; fruiting in November–March. The fruits are eaten and dispersed by different kinds of birds (Japing & Oey Djoen Sen, Tectona 29 (1936) 421, fig. 29; Meyer Drees, Commun. Forest. Res. Inst. 33 (1951), 109).

**Uses.** The timber is of a good quality; also used for making matches and match-boxes. The bark is used in preparing soap and as a fish poison (Japing & Oey Djoeng Sen, Tectona, 29 (1936) 421, fig. 29; Quisumbing, Philip. J. Sci. 77 (1948) 161; Brown, Useful Pl. Philipp. 2 (1950) 361, fig. 176).

## 8. GLENNIEA Hook. f.

(Probably after Lady Glennie)

### P.W. Leenhouts

In Bentham & Hooker *f.*, Gen. Pl. 1 (1862) 404; Radlkofer in Engler, Pflanzenr. 98 (1932) 858; Leenhouts, Blumea 22 (1975) 411, FM 1, 11 (1994) 540; Whitmore & Tantra, CLS (1986) 213; Yap, TFM 4 (1989) 440; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 311. **Synonyms:** *Crossonephelis* Baill., Adansonia 11 (1874) 245; *Hedyachras* Radlk., Bot. Jahrb. 56 (1920) 258.

Trees, *monoecious* or *dioecious*. *Indumentum* mainly of solitary hairs or small tufts of hairs. **Leaves** spirally arranged or partly decussate, unifoliolate or paripinnate, each with 1–6 pairs of leaflets, without pseudostipules, neither petiole nor rachis winged. Leaflets opposite to alternate, smooth, glabrous or variably hairy beneath; ovate to elliptic; base symmetric or slightly oblique, margin subentire, apex rounded-acuminate, acumen rounded; lateral veins looping and joining in the upper part only, intercostal veins and veinlets finely reticulate, slightly raised on both sides. **Inflorescences** terminal or in the axils of upper leaves, thyrsoïd or paniculate, with few spreading branches. **Flowers** radially symmetrical, unisexual, if plant monoecious the male and female flowers in the same inflorescence; *sepals* 4 or 5, connate at base, valvate to narrowly imbricate in bud, spreading during anthesis, persistent and recoiled

after anthesis, equal, deltoid, not petaloid, densely hairy outside, variably hairy inside; *petals absent*; disc for the greater part adnate to the base of the calyx, complete, broad and flat, more or less distinctly lobed, purplish black when dry, glabrous or rarely variably hairy; stamens 6 or 7, equal, exerted, glabrous, filaments filiform, anthers basifixed, dehiscing lengthwise, latrorse to introrse, connective broad; staminodes short; ovary sessile, 2-locular, hairy, style apical, conical, with 2 stigmatic lobes or grooves, ovules 1 per locule; pistillodes small, white woolly. **Fruits** indehiscent; pericarp thick, endocarp membranous to thin-crustaceous, wings absent. **Seeds** without arillode; testa thin-crustaceous, closely adhering to the endocarp.

**Distribution.** Eight species, three occurring in tropical Africa, one in Madagascar, one in Sri Lanka, and three in Malesia (of which two are found in Borneo).

**Ecology.** In lowland rain forest.

### Key to *Glenniea* species

Fruits 6 cm long or more. Inflorescences densely hairy, bearing densely arranged, many-flowered cymules.....1. ***G. philippinensis***

Fruits less than 2 cm long. Inflorescences sparsely hairy, with scattered, few-flowered cymules or solitary flowers.....2. ***G. thorelii***

#### 1. *Glenniea philippinensis* (Radlk.) Leenh. (of the Philippines)

*l.c.* (1975) 412, *l.c.* (1994) 542. **Basionym:** *Hedyachras philippinensis* Radlk., Bot. Jahrb. 56 (1920) 258. **Type:** Villamil FB 20635, Philippines (holotype M; isotypes BM, K, L). **Synonym:** *Crossonephelis philippinensis* Leenh., Blumea 21 (1973) 100.

Monococious tree to 18 m tall, 30 cm diameter. *Hairs mainly solitary.* **Leaves** spirally arranged, each with (1-)4-6 pairs of leaflets; petioles 3-9 cm long, flat to grooved at base, with marginal ribs, more or less flattened at the upper part. Leaflets opposite to alternate, stiff-chartaceous, with hairy domatia in the axils of lateral veins beneath; 5-22 × 2.75-9 cm; base more or less symmetric, rounded in the lower, acute and attenuate in the upper leaflets, apex obtuse to broadly and obtusely acuminate; midrib slightly raised above, lateral veins 1-3.5 cm apart, slightly to distinctly curved, those in the upper half of the leaflets more or less distinctly looping and joining at some distance from the margin, slightly raised above, more so beneath, intercostal veins more-or-less strongly developed; petiolules 2-10 mm long, with a broad and flat to narrow and deep groove above. **Inflorescences** thyrsoid, 20-25 cm long, *fulvous-velutinous*; *cymules crowded*, sessile, glomerulous, *many-flowered*; pedicels 1.5-2 mm long; bracts and bracteoles lanceolate, 2-2.5 mm long. **Flowers:** sepals 4, valvate to narrowly imbricate, 2-3 × 1.5-2.5 mm, hairy inside; disc glabrous; stamens 6 or 7, filaments *c.* 5 mm long, anthers broadly ellipsoid, *c.* 1 mm long, introrse; ovary obcordate, style very short, stigma grooved. **Fruits** pear-shaped, 6-7 × 4.5-6 cm, yellow when fresh, glabrous; pericarp

thick, fleshy, endocarp tough. **Seeds** more or less ovoid,  $3\text{--}3.5 \times 1.75\text{--}2.25$  cm; testa brown, smooth, glabrous.

**Distribution.** SE Thailand, Vietnam, Borneo, Philippines. Very uncommon in Sabah (Tenom district); no record from Sarawak.

**Ecology.** In thickets and forests along streams at low altitude. Flowering in June, October; fruiting in May–December.

**Use.** The fruits are edible (Madulid, Nat. Mus. Papers 2, 1 (1991) 56).

## 2. *Glenniea thorelii* (Pierre) Leenh.

Fig. 8.

(C. Thorel, 1833–1911, French physician, botanist, and plant collector)

*l.c.* (1975) 412, *l.c.* (1994) 544; Whitmore & Tantra *l.c.* 213; Whitmore, Tantra & Sutisna *l.c.* 311. **Basionym:** *Cnemidiscus thorelii* Pierre, Fl. Coch. (1894) t. 320a, text. **Type:** *Pierre 4089*, S Vietnam (P). **Synonyms:** *Crossonephelis thorelii* (Pierre) Leenh. *l.c.* (1973) 101; *Lepisanthes palawanica* Radlk. in Elmer, Leaflet. Philip. Bot. 5 (1913) 1604; *Crossonephelis palawanicus* (Radlk.) Leenh. *l.c.* (1973) 97.

Tree to 30 m tall, 50 cm diameter, buttressed; probably dioecious. *Indumentum mainly of small stellate tufts of hairs.* **Leaves** spirally arranged to subdecussate, each with 1–2 pairs of leaflets; petioles 2.5–10 cm long, 3-angular to terete. Leaflets subopposite, chartaceous, glabrous except for occasional hair-tufts in the axils of some lateral veins beneath;  $6\text{--}26 \times 3\text{--}13.5$  cm; base symmetric to slightly asymmetric, cuneate to rounded, attenuate, apex obtuse or gradually to abruptly, broadly, and obtusely acuminate; midrib slightly raised above, sometimes sunken towards the base, lateral veins 1.25–6 cm apart, usually strongly curved, about equally slightly raised on both sides, intercostal veins faintly to sometimes strongly developed; petiolules 0.3–1.5 cm long, with a shallow broad groove above. **Inflorescences** thyrsoid to paniculate, to 25 cm long, *slightly hairy; cymules sometimes distant, few-flowered or flowers solitary;* pedicels to 5 mm long; bracts and bracteoles 3-angular, to 1 mm long. **Flowers:** sepals 4 or 5, valvate,  $2\text{--}2.5 \times 1.5\text{--}2.5$  mm, tomentose, with glabrous longitudinal strips inside; disc glabrous to velutinous; stamens 6 or 7, filaments *c.* 5 mm long, anthers ovoid, *c.* 1 mm long, latero-introrse; ovary slightly 2-lobed, style short, stigma 2-lobed with short, thick lobes curved outwards, to knobby. **Fruits** 2-lobed, *c.*  $1.25 \times 2 \times 1$  cm, often 1 lobe suppressed, then transversely ovoid and *c.*  $1.25 \times 1.5 \times 1.25$  cm, smooth and glabrous; pericarp thin, fleshy. **Seeds:** testa closely adhered to the endocarp, thin-coriaceous.

**Distribution.** S Vietnam, Sumatra, Borneo, Philippines, and New Guinea. Uncommon in Sabah; also in Kalimantan.

**Ecology.** Primary forest on alluvial plains, slopes, or ridges, also on riverbanks, to 200 m. Flowering April, October, December; fruiting March, September.

**Uses.** Produces a good quality timber (Desch, Mal. For. Rec. 15, (1954) 529). The bark is easily inflammable and is used for kindling fire.

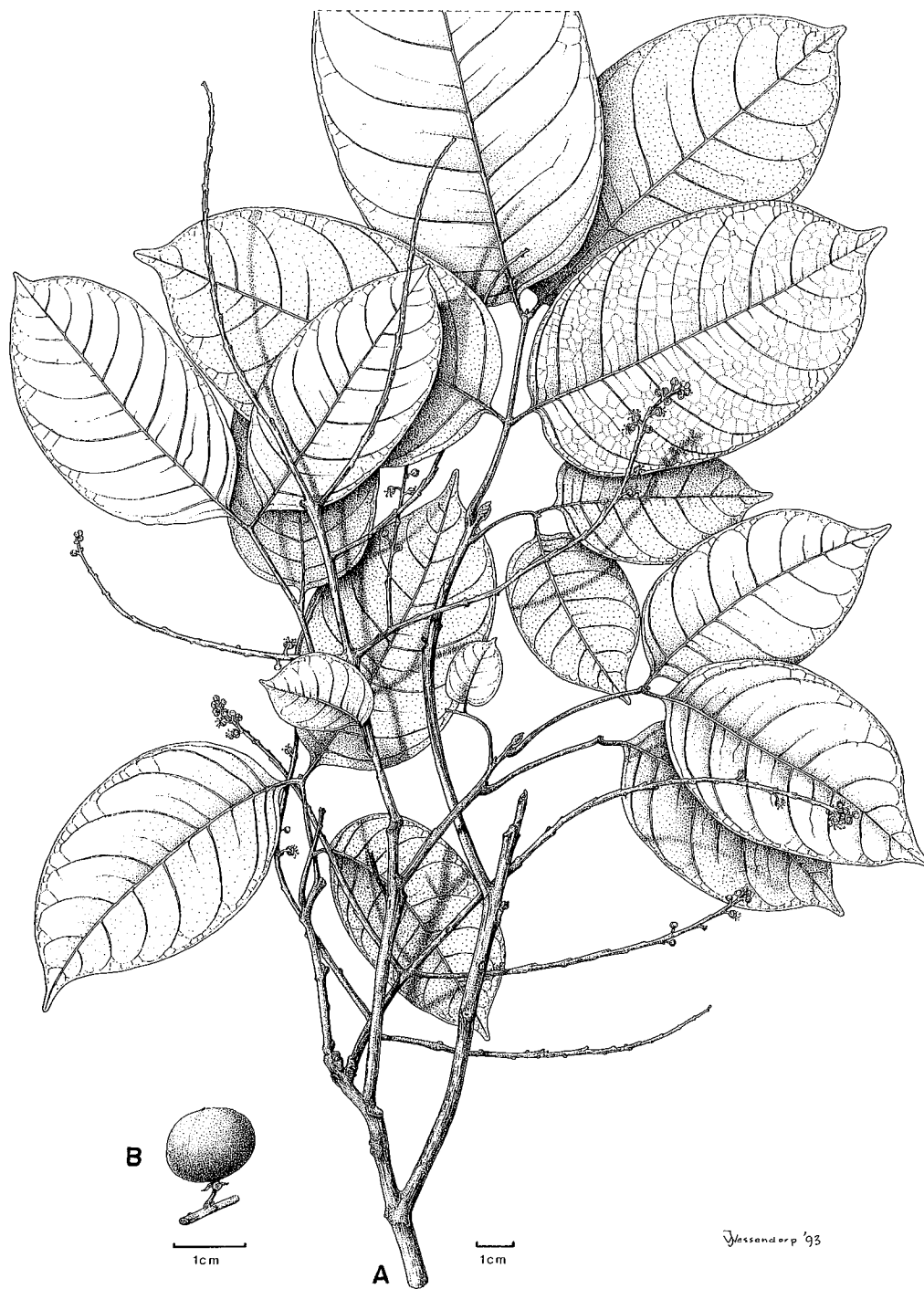


Fig. 8. *Glenniea thorelii*. A, flowering leafy twig; B, fruit. (A from *Lambach 1336*, B from *Boschproefstation T. 973*.)

## 9. GUIOA Cav.

(J. Guio, Spanish botanical artist)

*lokud-lokud* (Dusun, Sabah)

### P.C. van Welzen

Icon. 4 (1798) 49, t. 373; Merrill, EB (1921) 361; Radlkofer in Engler, Pflanzenr. 98 (1933) 1157; Masamune, EPB (1942) 426; Backer & Bakhuizen f., FJ 2 (1965) 139; Anderson, CLST (1980) 311; Corner, WSTM 3rd ed. 2 (1988) 680; Yap, TFM 4 (1989) 441; van Welzen, Leiden Bot. Ser. 12 (1989) 146, FM 1, 11 (1994) 548.

Shrubs or trees. *Indumentum of simple solitary hairs and indistinct glandular hairs. Leaves paripinnate, each with 1–9 pairs of leaflets, without pseudostipules; petioles pulvinate; rachis terete to distinctly winged. Leaflets opposite to alternate, often punctate; glandular hairs indistinct, white; lower surface smooth to whitish papillose, domatia usually present as sacs or pockets; petiolules very short, pulvinate. Inflorescence a thyrses, axillary, pseudoterminal or borne on leafless twigs, usually few-flowered; cymes in cincinnate to dichasial clusters; pedicels articulate. Flowers bilaterally symmetrical, structurally hermaphrodite, but presumably functionally unisexual; sepals 5, margin usually with glands, inner 3 sepals with a petaloid margin; petals 5, clawed, scales present and usually crested, petals between two adjacent large sepals usually with reduced blade and scales; disc interrupted or complete, lobed, smooth, glabrous; stamens 8, anthers basifixed in cleft, latrorse; ovary 3-lobed, 3-locular, smooth, ovules 1 per locule, stigma sessile, pyramidal, longitudinally grooved, style elongating in fruit. Fruit a subcordate loculicidal capsule with 3 lobes, of which one to all develop, red; stalk narrow and high to broadly obconical and indistinguishable; lobes laterally flattened. Seeds globose to obovoid, black, in open fruits dangling from the pseudofunicle; arillode completely enveloping the seed, apically open and lobed, at base with a rim from which a pseudofunicle is attached to the basal corner of the seed; hilum ovoid; cotyledons superposed to subcollateral, usually unequal, with the upper one larger.*

**Distribution.** About 65 species, in SE Asia (Thailand to S Vietnam as the northern limit), throughout Malesia (43 species) to E Australia and into the Pacific up to Samoa and New Caledonia. In Sabah and Sarawak, 6 species.

**Ecology.** In secondary and primary forests, often locally common; along road sides, riverbanks, forest edges, beaches, plantation edges. Several species are partly confined to ultramafic soil; from sea level to 1800 m.

### Key to *Guioa* species

1. Rachis of leaves slightly to distinctly winged.....2  
    Rachis of leaves not winged.....4
2. Leaves each with 1–4 pairs of leaflets; upper leaflets elliptic; lower surface of leaflets smooth to somewhat papillose, rather shiny; domatia absent or a single small sac.....  
    .....1. *G. bijuga* (in part)



- Leaves each with (1-)2-7 pairs of leaflets; upper leaflets elliptic to obovate; lower surface of leaflets densely greyish papillose, dull; domatia many.....3
3. Wings of rachis narrow, to 3 mm broad. Leaflet apex obtuse, abruptly acuminate to cuspidate; midrib convex and raised below; domatia pocket- to sac-shaped.....**4. G. pleuropteris** (in part)  
 Wings of rachis to 4 mm broad. Leaflet apex gradually acuminate to cuspidate; midrib hardly raised or flattish below; domatia sac-shaped.....**5. G. pterorhachis**
4. Domatia absent or a single sac.....5  
 Domatia of two to many sacs or pockets.....8
5. Petal scales very much broadened at apex; crest usually absent. Fruit lobes usually broader than high, glabrous.....**2. G. diplopetala** (in part)  
 Petal scales hardly broadened at apex; crest always present. Fruit lobes broader than high and sparsely sericeous or about as broad as high and glabrous.....6
6. Leaves each with 1-4 pairs of leaflets. Leaflets elliptic, usually symmetric, apex abruptly acuminate to cuspidate, acumen usually obtuse to acute, not mucronulate.....**1. G. bijuga** (in part)  
 Leaves each with 1-6 pairs of leaflets. Leaflets ovate to elliptic, asymmetric, apex usually gradually acuminate to caudate, acumen acute to usually mucronulate.....7
7. Leaflets smooth, shiny, glabrous below. Ovary subhirsute. Fruits glabrous.....**3. G. koelreuteria** (in part)  
 Leaflets papillose, dull, and slightly short-sericeous below. Ovary densely hirsute. Fruits sparsely sericeous, glabrescent.....**6. G. pubescens** (in part)
8. Petal scales very much broadened at apex; crest usually absent.....**2. G. diplopetala** (in part)  
 Petal scales not to hardly broadened at apex; crest present.....9
9. Lower leaflet surface smooth, glabrous; ovary subhirsute.....**3. G. koelreuteria** (in part)  
 Lower leaflet surface slightly short-sericeous to silky or rough hairy. Ovary densely hirsute or slightly rough-hairy.....10
10. Upper leaflets elliptic to obovate, apex obtuse, abruptly acuminate to cuspidate; lower surface somewhat silky hairy to rough-hairy, domatia pocket- or sac-shaped. Ovary slightly rough-hairy. Fruits glabrous.....**4. G. pleuropteris** (in part)  
 Upper leaflets ovate to elliptic; apex gradually acuminate to cuspidate; lower surface slightly short-sericeous, domatia sac-shaped. Ovary densely hirsute. Fruits sparsely sericeous, glabrescent.....**6. G. pubescens** (in part)

### 1. *Guioa bijuga* (Hiern) Radlk.

(Latin, *bijugus* = with two pairs of leaflets; the leaf)

Sapind. Holl.-Ind. (1879) 38; Anderson *l.c.* 311; Corner *l.c.* 680; Yap, *l.c.* 441; van Welzen *l.c.* (1989) 183, *l.c.* (1994) 567. **Basionym:** *Cupania pleuropteris* Blume var. *bijuga* Hiern in Hooker *f.*, Fl. Br. Ind. 1 (1875) 677. **Type:** Wallich *KD 8094*, Malaya (holotype K; isotypes BM, K). **Synonyms:** *Guioa pleuropteris* (Blume) Radlk. var. *bijuga* (Hiern) King, J. As. Soc. Beng. 65, 2 (1896) 444; *Guioa rubrofusca* Radlk. ex Merr., EPB (1929) 175, *nom. nud.*, Masamune *l.c.* 427.

Tree to 30 m tall, 35 cm diameter. **Bark** smooth to somewhat finely fissured, usually hard, whitish to dark grey with dark patches, or red-brown; inner bark yellow to red to brown, fibrous; cambium white to yellow to red. **Sapwood** white to brown; heartwood pinkish brown. **Leaves** each with 1–4 pairs of leaflets; rachis 0.8–16.8 cm long, winged or not, wings to 2 mm broad; petioles 0.7–11 cm long. *Leaflets usually symmetric, thin- to thick- coriaceous, punctate; upper surface glabrous to slightly sericeous*, lower surface duller, smooth to slightly papillose, glabrous to sparsely sericeous especially on the midrib; *domatia absent or in the form of a single small sac; elliptic*, 2.1–20 × 1.1–8.4 cm; base sharply attenuate, margin entire, flat to revolute, *apex abruptly acuminate to cuspidate, acumen obtuse to acute*; lateral veins 0.3–4.2 cm apart, marginally looped and joined, less so in lower third of leaflets, intercostal veins laxly reticulate, indistinct. **Inflorescences** axillary to pseudoterminal, unbranched to basally branched; rachis 0.7–16.5 cm long, terete to flattened, glabrous to pilose; first-order branches to 7.4 cm long; cymules cincinnate, 1–3(–6)-flowered; bracts and bracteoles deltate to triangular, bracts 0.5–1.9 mm long, bracteoles 0.2–1 mm long; pedicels 2.2–10 mm long. **Flowers** 3.5–4.2 mm diameter; sepals 5, ovate, 2 outer smaller ones 1–2.8 × 1–2.3 mm, 3 inner larger ones 1.4–3.4 × 1.2–3.8 mm, margin petaloid; petals 5, white to yellow, slightly hairy, obovate, 1.8–3.8 × 0.7–1.7 mm, blade obovate, subglabrous, gradually decurrent into the 0.4–1.2 mm high claw, margin pilose, apex emarginate to acute, *scales* (0.8–)1.2–2 mm long, *not to hardly broadened at apex*, crest a pilose flat part of the bifid scale apex; disc interrupted; stamens 8, filaments 1.6–5 mm long, anthers 0.2–0.4 mm long; ovary 0.3–1.8 mm high, sparsely hirsute, style and stigma 0.2–2.5 mm long. **Fruits** 1.2–2.3 × 1.3–2.6 cm, *glabrous*; stalks 2–5 mm long; *lobes 8.5–14 × 8–16 mm*. **Seeds** globose to obovoid, 8–10 × 7–8 mm; embryo 7–9 × 5–7 mm.

**Vernacular names.** Sabah—*buah sungket* (Kedayan), *lapak lapak* (Murut), *rupag* (Sungei Kinabatangan), *tinggal asam* (Murut Tenom). Sarawak—*ilat* (Iban).

**Distribution.** Thailand, Peninsular Malaysia, Sumatra, Borneo, Philippines. In Sabah and Sarawak, locally common; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary *kerangas*, mixed dipterocarp and mixed peat swamp forests, along road sides, riverbanks, edges of forest, mangroves, and sometimes in cultivated fields; on different types of soil, including sandstone, podsolized white sand, ultramafic and red-yellow loam. From sea level to 1500 m. Flowering mainly in November to April, less so in August to September; fruiting mainly in March to June, less so in September and October.

**Notes.** In Borneo, it is often difficult to distinguish *G. bijuga* from *G. pubescens*. In most cases, *G. bijuga* has elliptic leaflets which are smooth and glabrous below, and glabrous fruits. *G. pubescens*, on the other hand, usually has ovate leaflets, which are papillose and sericeous below and glabrescent fruit. In specimens collected from Sarawak and Mt. Kinabalu, leaflets of *G. bijuga* may be papillose and subsericeous, while those of *G. pubescens* are subelliptic and more glabrous. In these specimens the more ovate leaflets and the few hairs remaining on the fruit are suggestive of *G. pubescens*, and the flattened to winged rachis are reminiscent of *G. bijuga*. Notwithstanding these somewhat overlapping characters, there are, in addition to those shown in the key, additional features which can be used to separate *G. bijuga* from *G. pubescens*, viz., the former always has secretory idioblasts in the leaf tissue, whereas the latter is without them.

**2. *Guioa diplopetala* (Hassk.) Radlk.**

Fig. 9.

(Greek, *diplos* = double, *petalon* = petal; the broad scales on the inside of the petals)

Sapind. Holl.-Ind. (1879) 88, in Engler *l.c.* (1933) 1162; Masamune *l.c.* 426; Backer & Bakhuizen *f. l.c.* 140; van Welzen *l.c.* (1989) 197, fig. 76, 77, *l.c.* (1994) 570. **Basionym:** *Cupania diplopetala* Hassk., Flora 25, 2, Beibl. (1842) 39. **Type:** (Not indicated, probably Hasskarl's collection from Java; BO). **Synonyms:** *Guioa regularis* (Blume) Radlk. *l.c.* (1879) 12, 41, Masamune *l.c.* 427; *Guioa diplopetala* (Hassk.) Radlk. forma *borneensis* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 610; *Guioa diplopetala* (Hassk.) Radlk. var. *borneensis* (Radlk.) Radlk., Bot. Jahrb. 49 (1913) 370; *Guioa bullata* Radlk., in Fedd. Repert. 18 (1922) 342, in Engler *l.c.* (1933) 1164, Masamune *l.c.* 426, Anderson *l.c.* 311.

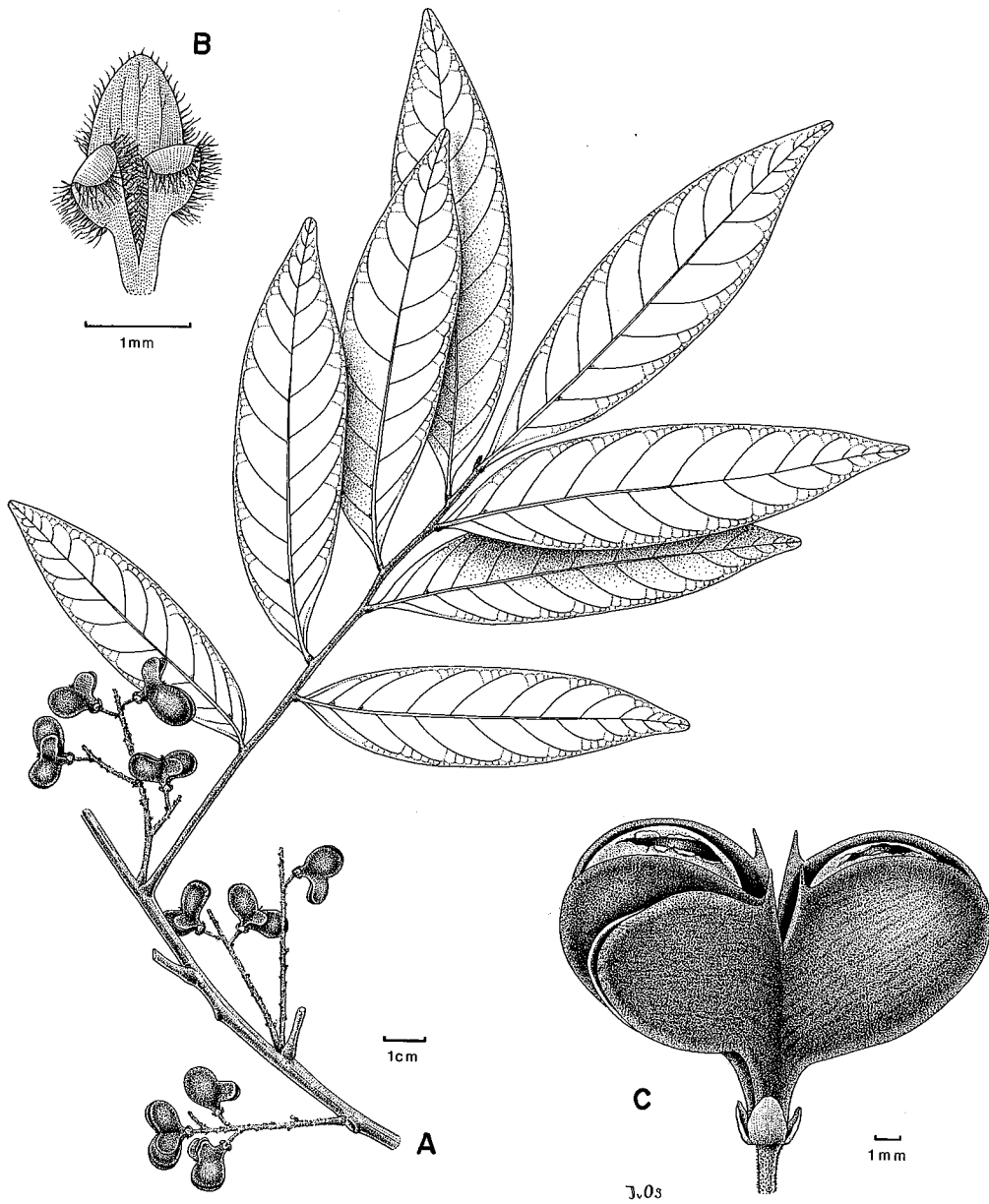
Shrub or tree to 20 m tall, 45 cm diameter. **Bark** smooth, grey-brown to grey-white, inner bark pink to pale brown. **Sapwood** white to light yellow. **Leaves** each with 1–9 pairs of leaflets; *rachis* 2.3–33.5 cm long, *not winged*; petioles 1.4–13.5 cm long. Leaflets coriaceous, usually punctate; *ovate to elliptic*, 2.3–24.3 × 0.8–7.8 cm; base attenuate, slightly asymmetric, margin entire, flat to revolute, apex obtuse to caudate, usually not mucronulate; upper surface usually glabrous to slightly sericeous, *lower surface smooth to papillose, glabrous to slightly sericeous or subvillose, domatia absent or in the form of 1 to many small sacs (or pockets)*; lateral veins 0.2–3.7 cm apart, marginally looped and joined (less distinctly so in lower part of leaflets), intercostal veins laxly reticulate, usually indistinct; petiolules absent to 0.9 cm long. **Inflorescences** borne on leafless twigs, or axillary to pseudoterminal, unbranched to basally branched; *rachis* 0.4–18 cm long, terete to slightly flattened, subsericeous to subhirsute; first-order branches to 9 cm long; cymules in cincinnate or dichasial clusters, 2–6-flowered; bracts and bracteoles triangular, bracts 0.5–2 mm long, bracteoles 0.2–0.9 mm long; pedicels 1.8–7.3 mm long. **Flowers** 3–4.5 mm diameter, without scent; sepals 5, ovate, 2 outer smaller ones 0.9–2.8 × 0.8–2.1 mm, 3 inner larger ones 1.4–3.4 × 1.2–3.6 mm, margin petaloid, white; *petals* 5, *elliptic to obovate*, 0.5–4 × 0.3–2.2 mm, white, claw 0.2–1 mm high, margin pilose, subglabrous inside, apex rounded to acute, *scales* 0.3–2 mm long, *very much broadened at apex, crest usually absent* or present as a hairy flat part of the bifid scale apex; *disc complete*, yellow; stamens 8, filaments 1.2–5 mm long, white, anthers 0.3–0.8 mm long, pink; ovary 0.2–2 mm long, subhirsute, light green to white, style and stigma 0.1–2 mm long. **Fruits** 0.7–1.5 × 0.7–1.8 cm, *glabrous*; stalks 2–5 mm long; *lobes* 5–10 × 4–9.5 mm. **Seeds** obovoid, 5–9 × 4.1–7.3 mm; embryo 4–7.8 × 3–6 mm.

**Vernacular names.** Sabah—*belimbing talun* (Bajau), *gulambir ayam, kayu lulus* (Tidong).

**Distribution.** Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia, Sumatra, Java, Borneo, Sulawesi. Rather common in Sabah and Sarawak; also in Kalimantan.

**Ecology.** In primary and secondary *kerangas*, mixed dipterocarp, and lower montane forests, edges of forest, along riverbanks, road sides, and seashore, in deserted cultivated fields; on different soil types including granitic sand, basalt, clay, loam on sandstone, limestone, and water-logged sand. From sea level to 1700 m. Flowering in September to April; fruiting in December to April.

**Notes.** Two forms of *G. diplopetala* are found in Borneo. In Sabah and northern parts of Sarawak the leaflets are slender, rather symmetric, and glabrous; in southern parts of Sarawak (Kuching area) the leaflets are very broad, asymmetric, bullate and are slightly villose below. Both forms are united by transitional forms found in Peninsular Malaysia, Sumatra, and Java, and therefore cannot be designated as two separate infraspecific taxa.



**Fig. 9.** *Guioa diplopetala*. A, fruiting leafy twig; B, petal; C, fruit. (A and C from *Rahayu & Maskura* 540, B from *Beumée* A 765.)

3. **Guioa koelreuteria** (Blanco) Merr.

(J.G. Koelreuter, 1733–1806, German botanist)

Sp. Blanc. (1918) 241; Radlkofer in Engler *l.c.* (1933) 1172 (footnote); van Welzen *l.c.* (1989) 219, fig. 7b, 86, *l.c.* (1994) 376. **Basionym:** *Sapindus koelreuteria* Blanco, Fl. Filip. (1837) 289 ('*kolreuteria*'). **Neotype** (Merrill, 1918): *Merrill Spec. Blanc.* 644, Philippines, Luzon, Rizal Province (PNH, destroyed; isoneotypes BM, F, K, L, NY, P, W).

Shrub or tree to 16 m tall, 20 cm diameter. **Bark** brown to dark grey, smooth to rough; inner bark pink to red-brown, fibrous. **Sapwood** white to brownish, rings slightly visible. **Leaves** each with 1–6 pairs of leaflets; rachis 2.4–20.5 cm long, not winged; petioles 1–8 cm long. Leaflets usually asymmetric, thick-coriaceous, usually punctate, upper surface glabrous, lower surface smooth, glabrous; domatia absent to many in the form of small sacs or pockets; ovate, 2.8–17.8 × 0.9–5.4 cm; base attenuate, margin entire, flat to revolute, apex usually gradually acuminate to caudate, acumen acute to mucronulate; lateral veins 0.2–2.5 cm apart, marginally looped and joined; intercostal veins laxly reticulate, usually distinct; petiolules absent to 0.7 cm long. **Inflorescences** axillary to pseudoterminal, unbranched to basally branched; rachis 0.8–20.5 cm long, slightly flattened, brown-subsericeous; first-order branches to 9.8 cm long; cymules cincinnate, 2–5(–8)-flowered; bracts and bracteoles triangular, bracts 0.5–1.5 mm long, bracteoles 0.2–1 mm long; pedicels 1.4–7 mm long. **Flowers** 3.2–4 mm diameter; sepals 5, ovate, pink, 2 outer smaller ones 1–3.1 × 1–3.3 mm, 3 inner larger ones 1.5–3.8 × 1.2–4 mm, margin petaloid; petals 5, elliptic to obovate, 1.8–3.8 × 1–2.5 mm, creamy white to reddish, gradually decurrent into the 0.4–1.3-mm-high claw, pilose along margin and outside, subglabrous inside, apex obtuse to acute, scales 0.9–2.1 mm long, not to hardly broadened at apex, crest present as a hairy, flat part of the bifid scale apex; disc interrupted; stamens 8 (or 9), filaments 1.2–5 mm long, anthers 0.3–0.6 mm long; ovary 0.2–2.4 mm long, subhirsute, style and stigma 0.1–2.7 mm long. **Fruits** 1–2.2 × 1–2.3 cm, glabrous; stalks 2–5.5 mm long; lobes 6.5–13 × 7–12 mm. **Seeds** globose to obovoid, 5.3–8.5 × 5–7.5 mm; arillode edible; embryo 5–7.8 × 3.8–6 mm.

**Vernacular names.** Sabah—*saasa*, *saksah*, *sasah* (east-coast Bajau).

**Distribution.** Borneo and the Philippines. Common on the islands northeast of Sabah.

**Ecology.** In primary and especially in secondary forest, ridge forest, in *kerangas* forest, along the seashore, road sides, streams, edges of plantations. Soil: sand, gravel, limestone, ultramafic. From sea level to 1350 m. Flowering in August to March; fruiting in March to October.

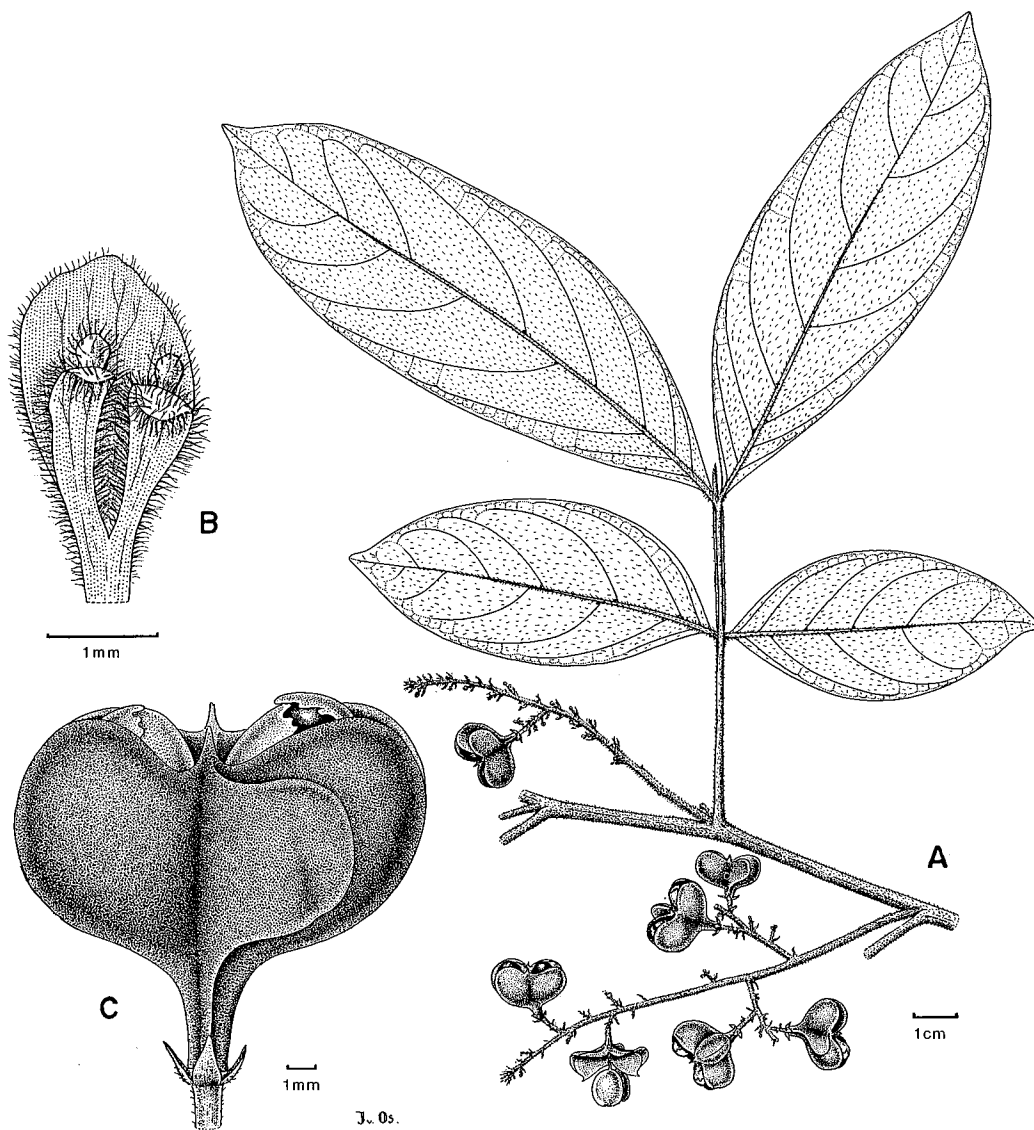
**Uses.** The wood is used for agricultural implements and tool handles (Reyes in Desch, Mal. For. Rec. 15 (1954) 526). Oil extracted from the seeds can be used to cure certain skin diseases (Guerrero in Brown, Useful Pl. Philip. 2 (1950) 363).

4. **Guioa pleuropteris** (Blume) Radlk.

Fig. 10.

(Greek, *pleuron* = lateral outgrowth, *pteron* = wing; the winged petioles)

*l.c.* (1879) 10, in Engler *l.c.* (1933) 1164; Merrill *l.c.* (1921) 361, *l.c.* (1929) 175; Masamune *l.c.* 426; Anderson *l.c.* 311; Corner *l.c.* 680; Yap *l.c.* 442; van Welzen *l.c.* (1989) 257, fig. 109, 110, *l.c.* (1994) 584. **Basionym:** *Cupania pleuropteris* Blume, Rumphia 3 (1847) 158. **Type:** *Korthals, s.n.*, Borneo (holotype L; isotypes L, W).



**Fig. 10.** *Guioa pleuropteris*. A, fruiting leafy twig; B, petal; C, fruit. (A and C from Davidson 1325; B from Maxwell 81-34.)

Shrub or tree to 30 m, 20–70 cm diameter, without buttresses. **Bark** smooth to sometimes irregularly fluted, usually dark brown, often mottled with white or grey spots; inner bark white to dark brown, finely fibrous; cambium yellow to brown. **Sapwood** finely granular, soft to hard, white to yellow, without odour or sap. **Leaves** each with (1–)2–5(–7) pairs of leaflets; rachis 0.8–25.3 cm long, usually slightly winged, wings to 3 mm broad; petioles 0.6–9.3 cm long. Leaflets asymmetric at base and apex, subcoriaceous, usually punctate; upper surface glabrous to subsericeous or hirsute, lower surface dull, papillose, subsericeous to usually hirsute, domatia many, in the form of pockets or sacs; ovate (lower ones) to elliptic or obovate (upper ones), 0.9–18.7 × 0.5–8.3 cm; base acute, cuneate to attenuate, margin entire, flat to revolute, apex obtuse to abruptly acuminate or cuspidate, often mucronulate; midrib convex and raised below; lateral veins 0.2–4.9 cm apart, marginally looped and joined, less distinctly so in the lower half of leaflets; intercostal veins laxly reticulate, usually distinct. **Inflorescences** axillary to pseudoterminal, unbranched to basally branched; rachis 0.5–21.6 cm long, terete, usually brown hirsute, first-order branches to 13.8 cm long; cymules cincinnate, 2–5-flowered; bracts and bracteoles triangular, bracts 0.7–3.8 mm long, bracteoles 0.2–1.5 mm long; pedicels 1.1–7 mm long. **Flowers** 3–4.2 mm diameter, fragrant; sepals 5, ovate, green to tinged reddish or whitish, 2 outer smaller ones 0.7–2.8 × 0.6–2 mm, 3 inner larger ones 1.5–3.5 × 0.9–3.3 mm, margin petaloid; petals 5, elliptic to obovate, 1.3–3.5 × 0.7–2.2 mm, white, gradually decurrent into the 0.2–1 mm high claw, pilose at the margin and outside, glabrous inside, apex rounded to acute, scales 0.8–2.2 mm long, apex not to hardly broadened, crest yellow, usually developed as a pilose flat part of the bifid scale apex; disc complete to interrupted by small gaps; stamens 8, filaments 1.3–5.1 mm long, white, anthers 0.2–0.7 mm long, pink; ovary green, 0.3–2.8 mm long, slightly rough-hairy, style and stigma 0.1–2.2 mm long. **Fruits** 1–1.9 × 1–2.5 cm, glabrous; stalks 2–5 mm long; lobes 7.5–13 × 6.5–13 mm. **Seeds** globose to obovoid, 5.5–9.7 × 5–8 mm; arillode yellow to orange, edible, sour; embryo 3.3–9 × 3.3–7 mm.

**Vernacular names.** Sabah—*andipatan*, *gulambir ayam* (Dusun), *gurujod*, *kanawit* (Dusun Kinabatangan), *kangi runok* (Dusun Tambunan), *kejangan* (Dusun Kundasan), *mata pait* (Dusun Banggi), *munggulan ayam* (Dusun), *pengkul* (Dusun Kinabatangan), *piri manok*, *saasa* (Bajau), *tanggianuk*, *tanjsanuk* (Dusun Kinarut), *tangking manok* (Dusun), *tingir manok* (Bajau), *tongianum* (Dusun Kinarut).

**Distribution.** Myanmar, Cambodia, Vietnam, Thailand, east coast of Peninsular Malaysia, Sumatra, Borneo, Philippines. Uncommon to rather common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary mixed dipterocarp forest; edges of forests and plantations; in open landscapes like cultivated land and belukar; in mossy forest; along riverbanks, road sides, and on seashores; on different types of soil, including sandstone, yellow sandy loam, black sand, ultramafic, and alluvial deposit. From sea level to 1800 m. Flowering in August to May; fruiting throughout the year, but mainly in February to April.

**Uses.** The wood is used for torches (Radlkofer, 1913). The timber is durable and elastic, but thin and in Indonesia, it is used for making handles of axes and shafts of wagons and plows (Heyne, Nutt. Pl. ed. 2, 1, 1927, 1000). A decoction of the roots is used medicinally in NE Pahang (Peninsular Malaysia) against fever and stomach ache. The Malay name *pokok seriawan burung* probably refers to its medicinal use against sprue (Burkill, EPMP, ed. 2, 1, 1966, 1134). Also used to exterminate intestinal worms. The arillode is edible, but due to its thinness offers no real food value.

### 5. *Guioa pterorhachis* Welzen

(Greek, *pteron* = wing, *rhachis* = main leaf axis)

Blumea 33 (1988) 419, pl. 12a, b, *l.c.* (1989) 269, fig. 114, *l.c.* (1994) 590. **Type:** *Elmer 20268*, Borneo, Sabah (holotype L; isotypes BM, F, K, M, NSW, P, U).

Shrub or tree to 16 m tall, 10–15 cm diameter. **Bark** smooth, flaky, white to brown, soft; inner bark fibrous, pink to brown; cambium yellow. **Sapwood** white to brown. **Leaves** each with 3–7 pairs of leaflets; rachis winged, wings to 4 mm broad; petioles 1.1–12.2 cm long. Leaflets subcoriaceous, punctate; upper surface glabrous to puberulous on the midrib and veins, lower surface dull, papillose, sparsely short-serriceous, domatia many, in the form of sunken sacs; elliptic to obovate, 2.4–14.6 × 1–4.6 cm; base often slightly asymmetric, acute to attenuate or cuneate, margin entire, flat, apex gradually acuminate to cuspidate, sometimes mucronulate; midrib hardly raised below, lateral veins 0.2–3.6 cm apart, marginally looped and joined, less so in the lower half of leaflets, intercostal veins laxly reticulate, rather indistinct. **Inflorescences** axillary to pseudoterminal, unbranched to basally branched; rachis 1–20.8 cm long, terete, subsericeous, first-order branches to 11.5 cm long; cymules cincinnate, 2–5-flowered; bracts and bracteoles triangular, bracts 0.7–1.2 mm long; bracteoles 0.3–0.8 mm long; pedicels 2–7 mm long. **Flowers** 3.5–4 mm diameter; sepals 5, ovate, 2 outer smaller ones 1–1.9 × 0.8–1.5 mm, 3 inner larger ones 1.7–3 × 1.2–2.7 mm, margin petaloid; petals 5, elliptic to obovate, 1.1–2.8 × 0.8–1.6 mm, white, claw 0.2–0.5 mm high, margin pilose, glabrous on both sides, apex more or less acute, scales 1.1–2 mm long, crest present as a pilose flat part of bifid scale apex; disc interrupted to complete; stamens 8, filaments 2–5 mm long, anthers c. 0.3 mm long; ovary 0.3–1 mm long, sparsely rough-hairy, style and stigma 0.1–1 mm long. **Fruits** 1.4–1.9 × 1.2–2.2 cm, glabrous; stalks 4–7 mm long; lobes 8.5–11 × 8–12 mm. **Seeds** obovoid, 7.5–10.5 × 6–9 mm; arillode edible, with yellow exudate; embryo 6.8–9.2 × 5–7.5 mm.

**Vernacular names.** Sabah—*angil manuk* (Malay), *galid* (Dusun Kinabatangan), *garong* (Sungei), *guruyod* (Dusun Kinabatangan), *lipang lipang* (Sungei), *sikip sikip* (Dusun Kinabatangan), *tanggianggi*, *tengaranuk* (Dusun Kinarut), *tingir manuk* (Bajau).

**Distribution.** Endemic to E Sabah (Sandakan and Tawau districts).

**Ecology.** In primary and secondary forests, along rivers and road sides, and on flat to undulating country, on different soil types, from sea level to 500 m. Flowering in July to November to January; fruiting in November to May.

**Uses.** Firewood.

### 6. *Guioa pubescens* (Zoll. & Moritzi) Radlk.

(Latin, *pubescens* = soft-hairy; the fruits)

*l.c.* (1878) 302, in Engler *l.c.* (1933) 1169; Merrill *l.c.* (1921) 361; Masamune *l.c.* 427; Backer & Bakhuizen *f. l.c.* 140; Anderson *l.c.* 311; Corner *l.c.* 681; Yap *l.c.* 442; van Welzen *l.c.* (1989) 272, fig. 115, 116, *l.c.* (1994) 591. **Basionym:** *Sapindus pubescens* Zoll. & Moritzi in Moritzi, Syst. Verz. (1846) 22, *p.p.* **Type:** *Zollinger 1105*, Java (holotype L; isotypes A, BM, FI, P).



Tree to 25 m tall, 30 cm diameter; without buttresses. **Bark** smooth, hard, sometimes deeply fissured to flaky, greyish white or greyish brown to dark brown; inner bark yellowish white to reddish brown; cambium white. **Sapwood** soft to hard, white to ochre; heartwood red. **Leaves** each with (1-)2-6 pairs of leaflets; rachis 2.1-29.5 cm long, not winged; petioles 1.4-10.8 cm long. *Leaflets* coriaceous, not punctate; upper surface glabrous to sparsely short-sericeous, lower surface dull, papillose, slightly short-sericeous, domatia absent or present as 1-many small sacs; ovate to elliptic, often slightly sickle-shaped, 2.9-19.2 × 0.8-7.2 cm; base asymmetric, attenuate, margin entire, flat to revolute, apex gradually acuminate to cuspidate or caudate, usually mucronulate; lateral veins 0.3-3.3 cm apart, marginally looped and joined (less so in the lower third of leaflets), intercostal veins laxly reticulate, rather indistinct; petiolules to 1 cm long. **Inflorescences** axillary to pseudoterminal, unbranched to basally branched; rachis 1.4-24.2 cm long, terete, brown-sericeous; first-order branches to 9.3 cm long; cymules cincinnate, 2-4-flowered; bracts and bracteoles triangular, bracts 0.6-1.8 mm long, bracteoles 0.2-1.2 mm long; pedicels 1.8-8 mm long, sericeous. **Flowers** 3.5-4.5 mm diameter; sepals 5, ovate, 2 outer smaller ones 1-2.8 × 0.8-2.1 mm, 3 inner larger ones 1.4-3.3 × 1.3-3.1 mm, margin petaloid; petals 5, obovate, 1.9-3.4 × 0.7-1.8 mm, white to yellow, gradually decurrent into the 0.3-1.2 mm-long claw, pilose at the margin and outside, glabrous inside, rounded to acute at apex, scales 1.1-2 mm long, apex not to hardly broadened, crest present as a pilose flat part of the bifid scale apex; disc interrupted; stamens 8, filaments 1.9-5.2 mm long, white, anthers 0.2-0.4 mm long, pink; ovary 0.3-2 mm long, densely rough-hairy, yellowish green, style and stigma 0.1-2.5 mm long. **Fruits** 1-1.5 × 1-1.9 cm, sparsely sericeous, glabrescent; stalks 1.5-5 mm long; lobes 7-10 × 6.5-10 mm. **Seeds** globose to obovoid, 6.8-10 × 5.8-7.5 mm; embryo 5.9-8.3 × 4.9-6 mm.

**Vernacular names.** Sabah—*angir manuk* (Kedayan), *geronok* (Dusun Tambunan), *saasa, saksah* (Bajau). Sarawak—*rutan berangat* (Kelabit).

**Distribution.** Peninsular Malaysia, Singapore, Sumatra (including Banka), W Java, Karimunjawa Is., Borneo (above equator), Philippines (Palawan). Uncommon to rather common in Sabah and Sarawak; also in Brunei.

**Ecology.** In primary and secondary mixed dipterocarp forests, *kerangas*, peat swamp forests, beach forest, on different soil types including sand, sandy loam, sandstone, limestone, ultramafic, and well-drained peat; from sea level to 1800 m. Flowering in August to February; fruiting in January to April.

**Uses.** The wood is used as a construction timber, although it is brittle and the stem diameter is too small for planks (Heyne, Nutt. Pl. Ned. Indie ed. 2 (1927) 1001).

## 10. HARPULLIA Roxb.

(Latin form of the Bengal plant-name *harpulli*)

**P.W. Leenhouts & M. Vente**

Fl. Ind. 2 (1824) 441; Merrill, EB (1921) 362; Radlkofer in Engler, Pflanzenr. 98 (1933-1934) 1433; Masamune, EPB (1942) 427; Backer & Bakhuizen f., FJ 2 (1965) 142; Anderson, CLST (1980) 311;

Leenhouts & Vente, *Blumea* 28 (1982) 1, FM 1, 11 (1994) 598; Whitmore & Tantra, *CLS* (1986) 214; Yap, *TFM* 4 (1989) 443; Whitmore, Tantra & Sutisna, *CLK* 2, 1 (1990) 311.

Shrubs or medium-sized trees, *dioecious*. *Indumentum* of solitary and stellate tufts of simple hairs and glandular hairs; glandular scales absent. **Leaves** *paripinnate*, each with 1–9 pairs of leaflets, without *pseudostipules*; *petiole* and *rachis* winged. Leaflets alternate or opposite, not papillose beneath; margin entire (Malesian species). **Inflorescences** usually thyrses, *axillary*, *pseudoterminal*, or *terminal*, solitary or borne in tufts on leafless twigs or stems; bracts and bracteoles usually caducous. **Flowers** *unisexual*, *radially symmetrical*; *sepals* 5, *free*, imbricate, equal or the outer two sometimes slightly smaller, not petaloid, not ciliate, glandular hairs mainly present along the entire margin; *petals* 5, longer than the sepals, distinctly clawed with a pair of auricles above the claw, or sessile with a broad or narrow base and without auricles and scales, entire; *disc complete to divided into 5 lobes*, without appendages; *stamens* 5–8, in male flowers exerted, filaments glabrous, anthers basifixed, base cleft for up to one-fifth the length, latero-introrse; ovary 2–3(–4)-locular, sessile or short-stalked, hairy, *ovules* 1 or 2 *per locule*, style apical, shorter to much longer than the ovary, slender, often hooked and twisted at the upper part, lower part hairy, stigmatic lines usually extended to slightly above the base. **Fruits** *loculicidal capsules*, usually short-stalked, not winged, 2–3-lobed, the lobes erect to spreading, inflated, rounded; fruit wall parchment-like to woody. **Seeds** with a thin-crustaceous testa; *arillode entire and without appendages, restricted to a narrow annular sarcotesta around the hilum*, or composed of a basal sarcotestal part covering half the seed, and an upper free arillodal part, reaching to near the apex; hilum covering less than one-sixth of the seed; embryo straight; cotyledons superposed, about equal.

**Distribution.** About 26 species; from Sri Lanka and India through SE China and Malesia to Australia, New Caledonia, and Tonga (Avé in van Balgooy, *Pacific Plant Areas* 4 (1984) 238, 239). Two species are known from Sabah and Sarawak.

**Ecology.** In primary and sometimes secondary rain forests, sometimes growing in low or open forest and in coastal shrubby vegetation; from sea level to 2000 m. The seeds are probably mainly dispersed by birds, possibly also by mammals and lizards.

### Key to *Harpullia* species

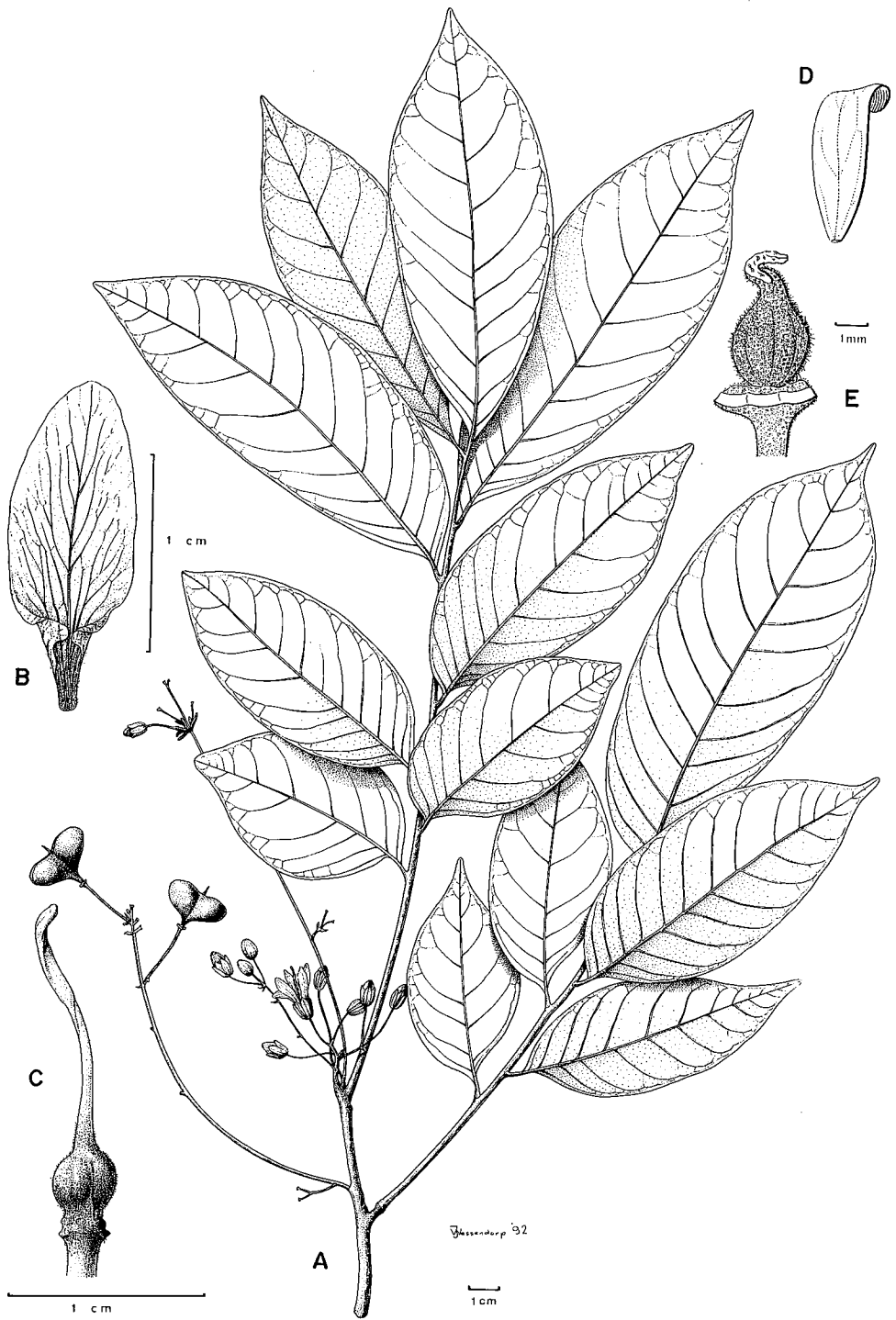
Petals clawed and auricled, membranous. Arillode restricted to a sarcotesta ring around the hilum.....1. ***H. arborea***

Petals not clawed, without auricle, thin-fleshy. Arillode completely or nearly completely enveloping the seed.....2. ***H. cupanioides***

1. ***Harpullia arborea*** (Blanco) Radlk.  
(Latin, *arbor* = tree)

Fig. 11A–C.

Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16 (1887) 404, in Engler, *Pflanzenr.* 98 (1934) 1456; Merrill, *Sp. Blanc.* (1918) 243, *l.c.* (1921) 362; Masamune *l.c.* 427; Backer & Bakhuizen *f. l.c.* 142; Anderson *l.c.* 311; Leenhouts & Vente *l.c.* (1982) 11, *l.c.* (1994) 601, fig. 45, 46a–f.; Whitmore



**Fig. 11.** *Harpullia arborea* (A–C); *H. cupanioides* (D–E). A, flowering and fruiting leafy twig; B, petal; C, ovary; D, petal; E, ovary. (A from PNH 12482, B–C from van Beusekom et al. 2862, D–E from Waterhouse 36 B.)

& Tantra *l.c.* 214; Yap *l.c.* 444; Whitmore, Tantra & Sutisna *l.c.* 311. **Basionym:** *Ptelea arborea* Blanco, Fl. Filip. (1837) 63. **Neotype** (Merrill, 1918): *Merrill Sp. Blanc.* 339, Philippines, Luzon, Bulacan Province, Angat (A; isoneotypes BM, BO, K, L, NSW, P, US, W). **Synonym:** *Harpullia tomentosa* Ridley, Kew Bull. (1933) 192, Masamune *l.c.* 427.

Shrub or tree to 33 m tall, 60 cm diameter, but usually much smaller. Young parts more or less densely hirsute. **Leaves** each with 2–6 pairs of leaflets; petioles 4.5–15 cm long; all axes hairy, glabrescent. Leaflets herbaceous, glabrous except for the midrib above, glabrous or sparsely hairy on midrib and lateral veins beneath; ovate to elliptic, 5.5–30 × 2–10 cm, base asymmetric with the upper half cordate or both sides acute, or symmetric and acute to rounded, apex acute to rounded or acuminate, acumen usually short, acute; midrib flat to slightly raised above, lateral veins 0.75–2.25 cm apart, flat above, intercostal veins inconspicuous; petiolules 3–8 mm long. **Inflorescences** axillary or borne on leafless twigs or stems, hairy, to 17 cm long and branched only near the base into several axes of about the same length, or to 35 cm (in fruit to 60 cm) long with short branches. **Flowers:** sepals all equal, ovate to obovate, 5–10.5 × 3–5 mm, sparsely glandular hairy especially along the margin; *petals membranous, clawed*, obovate-oblong, 8–17 × 3–10 mm, white, glabrous outside or sparsely hairy on the claw and central lower half of the blade, margin often ciliate mainly in the basal part, often sparsely hairy inside, claw 3–7 mm long; disc sparsely to densely hairy; stamens 5(–7), filaments 10–17 mm long, anthers 2–2.5 mm long; ovary 2(–4)-locular, style 14–17 mm long. **Fruits** 9–31 × 27–65 mm; stalks to 4.5(–7) mm long; lobes spreading, slender ellipsoid to globose; fruit wall thin, chartaceous to woody, prominently veined to smooth, red, fairly densely to sparsely hairy outside, reddish, sparsely hairy to glabrous inside. **Seeds** 1 or 2 per locule, black, mahogany-brown, or dark purple; *arillode restricted to a ring around the hilum*, to 2.5 mm wide, orange.

**Vernacular names.** Sabah—*bambuakat, tambuakat* (Dusun, Kinabatangan). Sarawak—*apoh* (Iban), *arip, ensiru* (Bidayuh), *sakubong* (Melanau).

**Distribution.** Sri Lanka, SE India, Assam, Thailand, Vietnam, Malesia, the Solomon Is., Samoa, Tonga and N Queensland. In Sabah and Sarawak, locally common; also in Brunei and Kalimantan.

**Ecology.** Usually in well-drained primary and secondary lowland and hill mixed dipterocarp forest and lower montane forest, from sea level to 1200 m. On various types of soil, including clay, loam, sand, limestone and volcanic. Flowering and fruiting throughout the year.

**Uses.** The bark is used as a fish poison. A watery exudate of the bark and sometimes the fruits is used for washing, to keep away leeches, or is drunk to allay pain. The timber is of good quality. The oil pressed out of the seeds is used as an anti-rheumatic (Brown, Useful Pl. Philip. 2 (1950) 363; Desch, Malayan Forest Rec. 15 (1954) 528).

## 2. *Harpullia cupanioides* Roxb.

(Greek, *cupanioides* = resembling *Cupania*)

Fig. 11D–E.

Fl. Ind. 2 (1824) 442; Merrill *l.c.* (1921) 362; Radlkofer in Engler *l.c.* (1934) 1444; Masamune *l.c.* 427; Backer & Bakhuizen *f. l.c.* 142; Leenhouts & Vente *l.c.* (1982) 26, *l.c.* (1994) 606; Whitmore & Tantra *l.c.* 214; Yap *l.c.* 444; Whitmore, Tantra & Sutisna *l.c.* 311. **Type:** *Roxburgh, s.n.*, 1813, Bangladesh (holotype K; isotypes A, BO). **Synonym:** *Harpullia confusa* Blume, Rumphia 3 (1847) 176, Masamune *l.c.* 427.

Shrub or tree to 20(–40) m tall, 40 (–100) cm diameter; buttresses to 2 m high and 2 m wide. Young parts densely appressed short-hairy, glabrescent. **Leaves** each with (1–)3–6(–7) pairs of leaflets; petioles to 20 cm long; rachis glabrous or sparsely puberulous. Leaflets herbaceous to chartaceous, glabrous or very sparsely hairy on midrib and on lateral veins below; ovate (lower ones) or elliptic to obovate (upper ones), 5–36 × 2–15 cm; base symmetric to asymmetric, acute or the broader half (rarely both halves) rounded, not or only slightly decurrent, apex acute, rounded or gradually to abruptly acuminate, acumen short to rather long, rounded, obtuse or acute; midrib usually slightly raised or sunken, lateral veins 0.75–3 cm apart, slightly sunken above, intercostal veins feeble or absent; petiolules 2–12 mm long. **Inflorescences** axillary, pseudoterminal or terminal, erect or pendulous, 5–85 cm long, unbranched or variously branched, often few-flowered, usually tardily hairy on the upper parts; bracts small, solitary or in clusters of threes. **Flowers** fragrant; sepals elliptic to suborbicular, 3–6 × 2.5–4.5 mm, persistent in fruit; *petals not clawed, thin-fleshy*, oblong-obovate to oblanceolate, 5–10 × 2–3 mm, white to creamy, yellow, greenish, pink, glabrous; disc complete, low, short-velvety; stamens 5 (or 6), filaments 2.5–3.5 mm long, white, anthers 1.5–3.5 mm long, yellowish white, greyish yellow or dark mauve; ovary 2-locular, light green, yellow or reddish brown, style 1.75–6.5 mm long, light green, stigma whitish. **Fruits** subreniform, transversely ellipsoid, broadly ovoid, obovoid, or globose, 12–20 × 12–32.5 mm; base rounded to truncate to slightly concave, apex slightly concave to obtuse-angular, apiculate; fruit wall coriaceous to woody, red, variably hairy outside, early to late glabrescent, glabrous to laxly long-hairy or glandular hairy inside; stalks 1–3 mm long. **Seeds** shiny brown to black; arillode bright glossy red, *completely or nearly completely enveloping the seed.*

**Vernacular names.** Sabah—*lokud* (Dusun Ranau), *mampongoh* (Murut).

**Distribution.** S China, Assam, the Andaman Is., Bangladesh, Myanmar, Thailand, Indo-China, throughout Malesia, and the Northern Territory of Australia. Locally common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary mixed dipterocarp forest, tidal forest, scrubland, and open places; from sea level to 1800 m. On different types of soil, including rocky, sandy, clay, loam, limestone, and volcanic. Flowering in (January–)April–July(–December); fruiting in (January–)April–October(–December).

**Uses.** The wood is used for making charcoal and as firewood; the bark is reportedly used as a fish poison.

## 11. LEPISANTHES Blume

(Greek, *lepis* = scale, *anthos* = flower;  
the presence of scales on the petals)

**P.W. Leenhouts**

Bijdr. Fl. Ned. Ind. (1825) 237; Merrill, EB (1921) 358; Ridley, FMP 1 (1922) 492; Radlkofer in Engler, Pflanzenr. 98 (1932) 726; Masamune, EPB (1942) 427; Backer & Bakhuizen *f.*, FJ 2 (1965) 134; Leenhouts, Blumea 17 (1969) 33, FM 1, 11 (1994) 627; Anderson, CLTS (1980) 311; Whitmore &

Tantra, CLS (1986) 214; Yap, TFM 4 (1989) 444; Whitmore, Tantra & Sutasna, CLK 2, 1 (1990) 312. **Synonyms:** *Erioglossum* Blume l.c. (1825) 229, Merrill l.c. (1921) 358, Ridley l.c. 491, Radlkofer in Engler l.c. (1932) 692, Masamune l.c. 429, Corner, WSTM 3rd ed. 2 (1988) 679; *Aphania* Blume l.c. (1825) 236, Merrill l.c. (1921) 358, Ridley l.c. 492, Radlkofer in Engler l.c. (1932) 699, Masamune l.c. 425, Backer & Bakhuizen f. l.c. 134; *Otophora* Blume, Rumphia 3 (1847) 142, Merrill l.c. (1921) 358, Ridley l.c. 492, Radlkofer in Engler l.c. (1932) 753, Masamune l.c. 429.

Trees or shrubs, mostly monoecious. *Indumentum* of solitary, simple hairs. **Leaves** pari- or imparipinnate, sometimes simple, with 1 to more than 40 pairs of leaflets; *petiole and/or rachis winged or not; with or without pseudostipules*. Leaflets opposite or alternate, not papillose beneath, margin entire. **Inflorescences** terminal, axillary, or borne on leafless twigs or stems. **Flowers** unisexual, radially symmetrical; *sepals 4 or 5 (rarely 3 or 6), free, imbricate, outer 2 (or 1) mostly distinctly smaller, mostly at least inner ones partly petaloid, entire or partly denticulate; petals 4 or 5 (rarely 3, 6, or 7), shorter to longer than sepals, mostly distinctly clawed, scale mostly well-developed, sometimes only represented by a hairy rim or a pair of small auricles, crested or not; disc interrupted or not, mostly slightly lobed; stamens (4-)8(-18), in male flowers not to distinctly exserted, filaments nearly always hairy except for the base or the apex, anthers hairy or glabrous; ovary sessile to short-stalked, lobed or not, 2-3(-4)-locular, style apical, about as long as the ovary or stigma sessile, stigma globose or dome-shaped, slightly lobed, ovules 1 per locule, sub-basal to median, placenta with an obturator. Fruits sessile to short-stalked, not to distinctly lobed, drupaceous, smooth or slightly warty outside, hairy to glabrous; fruit wall thin- or thick- fleshy, hairy or glabrous inside; septa mostly complete, sometimes interrupted or represented merely by a rib. Seeds with a shiny brown to black, glabrous or sometimes hairy testa; without arillode or sarcotesta.*

**Distribution.** Twenty four species; tropical Africa, Madagascar, S and SE Asia from Sri Lanka to Hainan, Malesia, and NW Australia. In Sabah and Sarawak, 11 species.

**Ecology.** In Borneo, most species are found in primary and secondary forests, especially in open places, escarpments, steep slopes, riverbanks, forest edges, clearings, and other types of open secondary vegetation; from sea level to c. 2000 m. The aggregated and sweet-scented flowers are probably pollinated by insects. The fruits, of at least those species with a fleshy fruit wall, are dispersed by animals.

**Taxonomy.** Leenhouts (1969) combined several genera were into *Lepisanthes*. He subdivided the genus as follows:

Subgenus **Lepisanthes**

Section *Lepisanthes* (*L. tetraphylla*)

Section *Hebecoccus* (*L. falcata* subsp. *borneensis*)

Subgenus **Otophora**

Section *Otophora* (*L. amoena, divaricata, kinabaluensis, multijuga*)

Section *Pseudotophora* (*L. fruticosa*)

Section *Anomotophora* (*L. alata, ramiflora*)

Subgenus **Erioglossum** (*L. rubiginosa*)

Subgenus **Aphania** (*L. senegalensis*)

**Uses.** A few species have some value as ornamental trees. The wood of several species is used, but only a few reach a sufficient size to have some value as timber trees. Different parts of

several species are of medicinal value. The fruits of some species are edible, but only *L. fruticosa* and *L. alata* are planted for their fruits.

### Key to *Lepisanthes* species

1. Pseudostipules (a pair of leaflets attached at the base of the petiole) absent.....2  
Pseudostipules present.....5
2. Leaf venation closed (lateral veins distinctly looping and joining). Sepals subglabrous, as long as the petals. Petals usually dark red. Fruits glabrous, lobed.....**10. L. senegalensis**  
Leaf venation open (lateral veins not looping and joining) (if fruits subglabrous) or open to closed (if fruits densely hairy). Sepals sericeous, shorter than the petals. Petals greenish white to yellowish or pink. Fruits densely hairy or subglabrous, not or slightly (rarely distinctly) lobed.....3
3. Leaf venation open. Fruits dark purple to black, distinctly lobed, lobes spreading, subglabrous.....**9. L. rubiginosa**  
Leaf venation open to closed. Fruits bright orange, yellowish or greyish pink, not or only slightly lobed, or if distinctly lobed then the lobes erect and densely hairy.....4
4. Leaflets mostly with glandular-pitted warts. Petal scales not crested. Dry fruit coarsely rugose.....**4. L. falcata**  
Leaflets without glandular-pitted warts. Petal scales mostly crested. Dry fruit smooth.....**11. L. tetraphylla**
5. Petiole and rachis winged.....6  
Petiole not winged, rachis very rarely winged.....7
6. Twigs glabrous. Leaflets glabrous, mostly lanceolate, smaller and narrower rarely more than 20 × 4 cm, base acute or sometimes rounded. Ovary 3(–4)-locular. Fruits 3-locular, trigonous-obovoid.....**1. L. alata**  
Twigs sparsely hairy. Leaflets sparsely hairy, oblong or sometimes slightly obovate, larger and broader to 33 × 10.5 cm, base cordate. Ovary 2-locular. Fruits incompletely 2-locular, transversely ellipsoid.....**8. L. ramiflora**
7. Fruits distinctly lobed, lobes spreading.....8  
Fruits not or slightly lobed, if distinctly lobed then the lobes more or less erect.....9
8. Leaves each with 7–14 pairs of leaflets. Twigs up to 1 cm diameter, tomentose.....**6. L. kinabaluensis**  
Leaves each with (15–)30–40 pairs of leaflets. Twigs 1.5–2 cm diameter, glabrous.....**7. L. multijuga**
9. Leaves paripinnate or with a reduced terminal leaflet, each with 1–8(–14) pairs of leaflets. Leaflets densely finely-pitted underneath. Inflorescences rarely terminal.....**5. L. fruticosa**  
Leaves mostly imparipinnate, each with (3–)7–42 pairs of leaflets. Leaflets with pitted warts resembling small white scales. Inflorescences terminal and axillary.....10

10. Leaf venation open.....**2. L. amoena**  
 Leaf venation closed.....**3. L. divaricata**

**1. *Lepisanthes alata* (Blume) Leenh.**

Fig. 12G.

(Latin, *alatus* = winged; the petiole and rachis)

*l.c.* (1969) 80, *l.c.* (1994) 646; Anderson *l.c.* 311. **Basionym:** *Otophora alata* Blume *l.c.* (1847) 145, Merrill *l.c.* (1921) 358, Radlkofer in Engler *l.c.* (1932) 768, Masamune *l.c.* 429, Backer & Bakhuizen *f. l.c.* 135. **Lectotype** (Leenhouts, 1969): *Korthals, s.n.*, S Borneo (L). **Synonym:** *Otophora edulis* C. E. C. Fischer, Kew Bull. (1932) 178, Radlkofer in Engler *l.c.* (1934) 1493, Masamune *l.c.* 430.

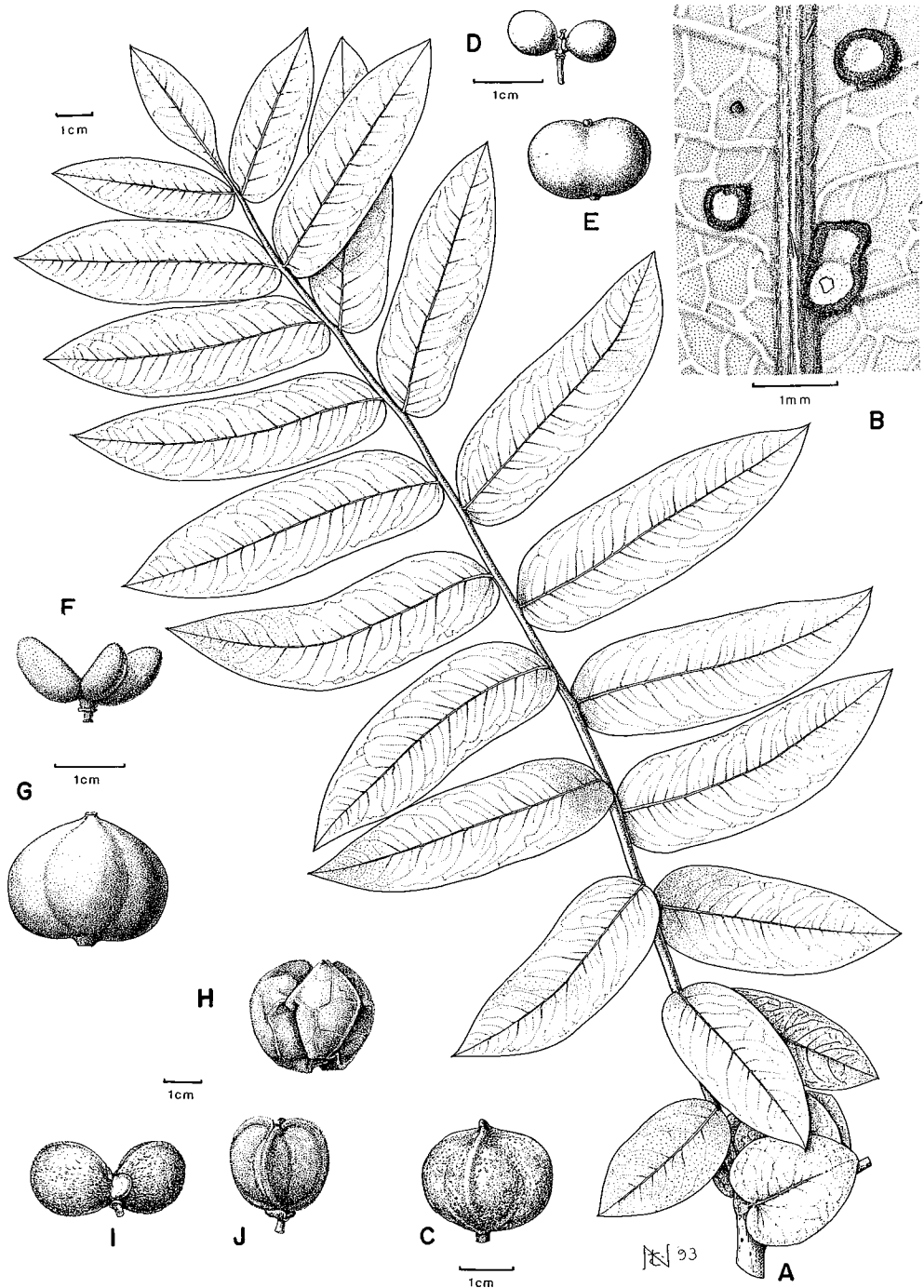
Tree or shrub to 15 tall m, 30 cm diameter. *Twigs 0.8–1.2(–1.5) cm diameter, glabrous. Leaves paripinnate*, each with 3–5(–13) pairs of leaflets; petioles 1.5–7.5(–25) cm long; *petiole and rachis winged, wings 3–8 mm wide; pseudostipules oblique-ovate*, 1–3(–8.5) × 0.8–2.2(–5) cm, base deeply cordate, apex obtuse, sometimes acuminate, pinnately veined. *Leaflets opposite to alternate, sessile or petiolules to 2 mm long, glabrous*, thin-chartaceous, greyish to blackish brown above, brown to greyish green beneath; lanceolate (exceptionally linear-lanceolate or oblong to obovate-oblong, lower ones sometimes ovate-lanceolate), 10–20(–45) × 1.8–4(–8) cm; base mostly hardly asymmetric, acute and sometimes attenuate, in asymmetric leaflets one half or both halves rounded, apex attenuate long-acuminate, acute; midrib mostly sharply raised beneath; lateral veins 1–1.5(–2) cm apart, curved, at least those in the upper half of the leaflet looping and joining near the margin. **Inflorescences** often drooping, purple to reddish brown, apparently mostly unisexual; *male inflorescences usually axillary, narrowly thyrsoid, unbranched, 20–25(–40) cm long; flowers in scattered, sessile fascicles of 3–5(–7) along the rachis; pedicels 2–7 mm long; female inflorescences axillary in the axils of lower leaves or on leafless twigs or stems, strongly branched at least near the base of the rachis, to 45 cm long; flowers scattered, and mostly solitary along the rachis; pedicels 6–13 mm long. Flowers dark wine-red to purple; sepals sparsely glandular-ciliolate, obovate-orbicular, 2.5–4 × 2–3 mm, outer sepals slightly smaller than inner ones, the inner sepals partly petaloid with crenulate margin; petals sessile or with a claw of c. 0.5 mm, sparsely, partly glandular, ciliolate, glabrous, or rarely the basal half sparsely appressed short-hairy outside, blade suborbicular, 2–4 × 2.5–3 mm, scale erect, slightly hood-shaped, 0.2–0.3 × as long as the blade, glabrous or densely ciliolate; disc glabrous, pink; stamens 8, anthers c. 1.8 mm long, subglabrous, yellow; ovary ellipsoid, 3(–4)-locular, pale mauve, style very short, stigma dome-shaped to flat, slightly 3-lobed, white. Fruits shortly stalked, trigonous-obovoid, 2.5–4 × 2.2–3 cm, apiculate, dark brownish purple to nearly black when ripe; pulp rather thick, fleshy, white; pedicels patent, slender, to 2 cm long. Seeds ellipsoid, to 2.5 × 1.5 cm; hilum rhomboid, c. 6 × 5 mm.*

**Vernacular names.** Sabah—*sintatanod* (Dusun Kinabatangan). Sarawak—*enkelili* (Iban), *peraju* (Bidayuh Bau), *sipaju* (Bidayuh Padawan), *sokungu* (Bidayuh Sadang).

**Distribution.** Peninsular Malaysia, Java (probably only naturalized), and Borneo. Uncommon in Sabah and Sarawak; also in Brunei.

**Ecology.** In lowland mixed dipterocarp forest, on riverbanks on clay soil, to 450 m. Flowering in August to May; fruiting in August to April. Ants may live under the stipules.





**Fig. 12.** *Lepisanthes amoena* (A–C); *L. senegalensis* (D); *L. fruticosa* (E); *L. rubiginosa* (F); *L. alata* (G); *L. falcata* subsp. *borneensis* (H); *L. multijuga* (I); *L. tetraphylla* (J). A, leaf; B, detail of lower surface of leaflet; C–J, fruits. (A–B from Danser 5474, C from Wirawan 63, D from Kostermans 60, E from Nooteboom 1323, F from Kartawinata 683, G from S. 40142, H from Podzorski SMHI 618, I from Kokawa & Hotta 2329, J from SAN 25591.)

**Uses.** The fruits and possibly also the seeds are edible. In Sumatra, Java, and Borneo sometimes grown as a fruit tree (Heyne, Nutt. Pl. Ned.-Indië, ed. 2 (1927) 990; Jansen *et al.* PROSEA 2 (1991) 343).

**Notes.** *L. alata* is on the whole a rather uniform species. Only a few specimens from Borneo show some characters which deviate considerably from the mean. Among these are *Ender* 1702 and *Jaheri* 1693 from Kalimantan, characterized by their rather large (15–23 × 5–7.5 cm), relatively wide (length *c.* 3 times the width), and distinctly obovate leaflets that have rather distant lateral veins (1.5–2 cm apart); *Hotta* 12660 from Brunei, has a leaf with 13 pairs of very long and narrow leaflets (33 × 2.2 cm, length *c.* 14 times the width), a petiole and rachis that is rounded or flat above, and very large stipules (8.5 × 5 cm); and *Orolfo* 1319 from Sabah, (type of *Otophora edulis*), which has rather narrow leaflets (length 8 times the width) with nearly perpendicular lateral veins, distinctly clawed petals which are hairy on the outside of the scale, thick ovary wall, and large fruits (*c.* 4 × 3 cm) with a thick, fleshy pulp.

**2. *Lepisanthes amoena* (Hassk.) Leenh.**  
(Latin, *amoenus* = lovely, charming; the habit)

Fig. 12A–C.

*L.c.* (1969) 71, *L.c.* (1994) 636; Anderson *L.c.* 311; Whitmore & Tantra *L.c.* 214; Yap *L.c.* 444; Whitmore, Tantra & Sutisna *L.c.* 312. **Basionym:** *Melicoccus amoenus* Hassk., Flora 25, 2 (1842) Beibl. 39. **Type:** Reinwardt, *s.n.*, Java (L). **Synonyms:** *Otophora amoena* (Hassk.) Blume *L.c.* (1847) 142, Merrill *L.c.* (1921) 358, Radlkofer in Engler *L.c.* (1932) 771, Masamune *L.c.* 429, Backer & Bakhuizen *f. L.c.* 135; *Otophora spectabilis* Blume *L.c.* (1847) 142, Merrill *L.c.* (1921) 359, Masamune *L.c.* 431; *Otophora imbricata* Blume *L.c.* (1847) 144, Merrill *L.c.* (1921) 358, Ridley *L.c.* 495, Radlkofer in Engler *L.c.* (1932) 773, Masamune *L.c.* 430; *Otophora pubescens* Blume *L.c.* (1847) 145, Merrill *L.c.* (1921) 359, Radlkofer in Engler *L.c.* (1932) 770, Masamune *L.c.* 430; *Otophora cordigera* Radlk., Sapind. Holl.-Ind. (1879) 85, Merrill *L.c.* (1921) 358, Radlkofer in Engler *L.c.* (1932) 770, Masamune *L.c.* 430.

Tree to 10 m tall, 15 cm diameter, or shrub to 6 m. *Twigs* 0.8–1(–1.2) cm diameter, sparsely to rather densely, fulvous short-hairy when young, mostly early glabrescent. **Leaves** imparipinnate, each with 7–42 pairs of leaflets, axial parts usually glabrous to thinly tomentose or sometimes densely fulvous-tomentose or rarely hirsute, glabrescent; flush white over pink to salmon or coral-red; *petioles* 1–9 cm long; *pseudostipules* orbicular, ovate, or transversely elliptic, usually asymmetric, 1–6 × 0.8–6 cm, base truncate to deeply cordate, apex rounded, obtuse, acute, or shortly and broadly acuminate, in extremely asymmetric ones sometimes with an additional lateral apex, pinnately or reticulately veined, usually connected with the normal leaflets by a series of intermediates. *Leaflets* opposite to alternate, subsessile, thin-chartaceous or parchment-like, greenish grey to dark brown above, yellowish to red-brown beneath; glabrous or the midrib densely fulvous- to ferruginous-tomentose above, sparsely hirsute or, rarely thinly hairy beneath, *both surfaces or the upper surface only often with scattered, minute, glandular-pitted warts*; linear or sometimes ovate-lanceolate, 7–22.5 × 1.2–5 cm; base oblique or not, obtuse to subcordate, apex obtuse to attenuate-acuminate, acumen short to long, obtuse to acute; lateral veins 0.5–2 cm apart, curved, only the upper ones looping and joining at some distance from the margin. **Inflorescences** terminal and axillary, pyramidal, up to 60 cm long, sparsely to densely fulvous short-hairy; axial parts often reddish; rachis and main branches sharply triangular; branches nearly transverse to ascending, to 30 cm long, the lower ones often with some short, spreading branches; cymes sessile to short-stalked, 1–several-flowered; pedicels 2–4 mm long. **Flowers** mostly white, sometimes creamy to yellow

or pink to red, not scented; *sepals* red, outer two ovate to oblong, 1.5–3.5 × 1.2–2 mm, inner 3 more or less orbicular, 2.5–4 × 2–3.5 mm; thinly appressed short-hairy to glabrous outside, glabrous to sparsely appressed short-hairy in the basal half inside, towards the base usually sparsely partly glandular ciliolate; petals white or red, sparsely to densely appressed long-hairy outside, variably hairy inside, blade subdeltoid to suborbicular, to 1.5 × 1.2 mm, densely to very sparsely ciliate at base, with 2 incurved, more or less joined basal lobes, claws to c. 0.6 mm long, densely to very sparsely ciliate; disc glabrous, orange or yellow; stamens 7–9, filaments white or reddish, anthers 1.5–1.8 mm, densely hairy, yellowish; ovary 3-locular, densely velvety to nearly glabrous, cream to reddish, style 1.5 mm long. **Fruits** slightly 3-lobed, widest in or above the middle, 2–2.5 × 2.2–2.8 cm (fresh c. 2.5 × 3 cm), apiculate by the style base, scurfy or sometimes hardly scurfy, thinly short-hairy to glabrous, light green to spotted brown when unripe, brownish or purple when ripe; pulp yellowish to white. **Seeds** obliquely ellipsoid, hilum orbicular to lanceolate, small.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo, W Java, Timor (one collection). Common in Sabah, less so in Sarawak.

**Ecology.** In primary and secondary mixed dipterocarp forests, scrub- or bamboo-forest, often along rivers, in well-drained as well as in swampy or periodically inundated localities; on acid, basic loam, clay, or sandy soils; from sea level to 1650 m. Flowering and fruiting throughout the year. The often large pseudostipules, appressed to the twigs, are often used as shelter by ants.

**Uses.** In Java, sometimes planted as an ornamental tree. The bark as well as the young leaves contain saponin and are applied as a poultice for treating ulcers (Borneo). The wood is reported to be very hard and has been used for making hooks to catch crocodiles. The fruit pulp is sweet and edible (Heyne, Nutt. Pl. Ned.-Indië, ed. 2, 1927, 990; Burkill, EPMP (1935) 1613; Jansen *et al.*, PROSEA 2 (1991) 343).

**Taxonomy.** *L. amoena* is a variable species but, apart from one race in the east coast of Sumatra, no clearly delimited infraspecific taxa can be distinguished. In Borneo, three rather distinct “forms” or “races” can be distinguished, but outside Borneo, the differences often become less clear. These “races” are:

“*amoena*” – leaves with rather many pairs of leaflets; leaflets not very narrow, linear, often greyish green above, reddish brown beneath. Throughout the area of distribution.

“*imbricata*” – leaves with a few pairs of leaflets; leaflets large, relatively wide, brown, margin not parallel, base obtuse. The presence of a series of intermediates between pseudostipules and leaflets in this “race” is unique. E Borneo and Java.

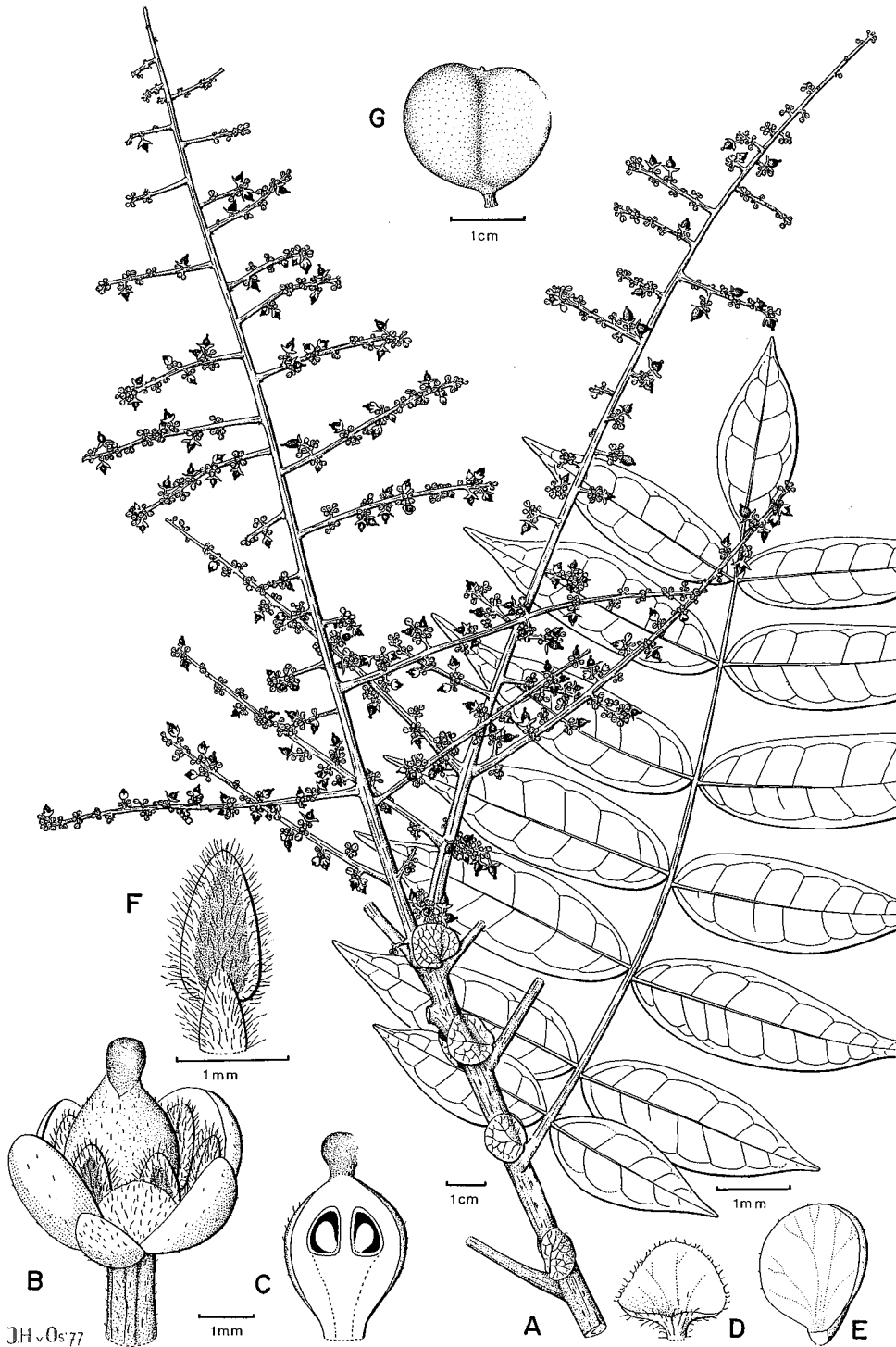
“*pubescens*” – leaves with many pairs of leaflets; leaflets small, narrow-linear, leaflet base cordate, mostly dark brown above, midrib usually hirsute beneath. W Borneo and Sumatra.

### 3. *Lepisanthes divaricata* (Radlk.) Leenh.

Fig. 13.

(Latin, *divaricatus* = spreading; the inflorescence branches)

*L.c.* (1969) 72, *L.c.* (1994) 638; Anderson *L.c.* 312; Whitmore, Tantra & Sutisna *L.c.* 312. **Basionym:** *Otophora divaricata* Radlk., Fedd. Repert. 18 (1922) 338, in Engler *L.c.* (1932) 758, Masamune *L.c.* 430.



**Fig. 13.** *Lepsanthes divaricata* forma *divaricata*. A, flowering leafy twig; B, female flower; C, ovary in longitudinal section; D, petal from inside, E, sepal from inside; F, staminode from outside; G, fruit. (A–F from *S. 17527*, G from *Rehal 13015*.)

**Type:** *Anon.*, s.n., Borneo, Sarawak (holotype M; isotype SAR). **Synonym:** *Otophora pyramidalis* Radlk. l.c. (1922) 338, in Engler l.c. (1932) 759, Masamune l.c. 431.

Small tree to 7 m tall, or shrub. *Twigs* 3–13 mm diameter, glabrous to rather densely ferruginous short-hairy. **Leaves** *pari- or imparipinnate*, each with (3–)7–11(–16) pairs of leaflets, 25–40 cm long; axial parts ferruginous or fulvous short-hairy, glabrescent; petioles 2–6(–17) cm long; *pseudostipules* *suborbicular to elliptic, often slightly asymmetric*, (0.4–)1–1.8 × (0.3–)1.2–2.2 cm, base cordate to cuneate, apex rounded to acute, reticulately, palmately, or pinnately veined. *Leaflets* opposite to alternate, sessile or with petiolules up to 2 mm long, stiff-chartaceous, mostly greenish grey to blackish above, light to dark brown beneath, glabrous or ferruginous-tomentose on the midrib on both sides, *with pitted warts beneath*; elliptic to lanceolate, 7–20 × 2–7 cm; base slightly cordate or rounded to cuneate, asymmetric, long-attenuate in terminal leaflet, apex attenuate, acuminate, acute to obtuse; lateral veins 1–2.2 cm apart, nearly straight, distinctly looping and joining at some distance from the margin. **Inflorescences** terminal or in the axils of upper leaves, pyramidal, to more than 40 cm long, glabrous to fulvous short-hairy, repeatedly branched, main branches patent, up to 25 cm long; cymes short-stalked to sessile, few- to many-flowered; pedicels slender, 1–1.2 mm long. **Flowers** *orange-yellow*; sepals sparsely (outer) to densely (inner) partly glandular ciliate, outer two broad-ovate to obovate, 1.8–2.2 × 1.2 mm, inner ones suborbicular to ovate, 1.8–3.5 × 1.8–2.2 mm; petals distinctly clawed, long-hairy, blade transversely subelliptic, 0.7–1.5 × 1.2–2 mm, *auricled at base*; disc glabrous or fairly densely short-hairy; stamens 5–8, anthers c. 1 mm long, rather densely woolly; *ovary* 2–3-locular, *glabrous to thinly appressed hairy*; *stigma sessile or on a short style*. **Fruits** *slightly 2–3-lobed*, 2–3 × 2–3 cm, hardly pointed, smooth and glabrous; *yellow to pale brown*. **Seeds** obovoid, hilum elliptic, c. 3 mm long.

**Distribution.** Endemic to Sarawak and W Kalimantan.

**Ecology.** Disturbed *kerangas* or swamp forest behind the mangrove, to 400 m. Flowering in October to July; fruiting in October to January.

### Key to forms

Leaves imparipinnate, each with 6 or more pairs of leaflets. Pseudostipules orbicular, never pinnately veined, at least 8 × 8 mm, sessile; base rounded to cordate. Leaflets sessile, the length 3–4 times the width, to 4 cm wide; margins parallel. Ovary 2-locular.....

forma **divaricata**

Synonym: *Otophora macrocarpa* Ridl., Kew Bull. (1933) 190, Radlkofer in Engler l.c. (1934) 1494, Masamune l.c. 430.

Known from a few collections from Kuching and Samarahan areas.

Leaves paripinnate, each with up to 6 pairs of leaflets. Pseudostipules elliptic, mostly pinnately veined, up to 8 × 4 mm, subsessile; base cuneate to subcordate. Leaflets short-stalked, the length 2.5–3 times the width, to 7 cm wide; margins not parallel. Ovary 3-locular.....

forma **lunduensis** (Radlk.) Leenh.

l.c. (1969) 72, l.c. (1994) 639. Basionym: *Otophora lunduensis* Radlk. l.c. (1922) 339, in Engler l.c. (1932) 769, Masamune l.c. 430. Type: *Foxworthy 17*, Borneo Sarawak (holotype M).

Known from 3 collections from Lundu area, 1st Div., Sarawak.

**Notes.** A few specimens, including *Native collector 375* (Type of *Otophora pyramidalis* Radlk.), collected from Kuching and its surrounding area are intermediate between forma *divaricata* and forma *lunduensis*.

**4. *Lepisanthes falcata* (Radlk.) Leenh.**  
(Latin, *falcatus* = sickle-shaped; the leaflets)

Fig. 12H.

*L.c.* (1969) 69, *L.c.* (1994) 633; Whitmore, Tantra & Sutisna *L.c.* 312. **Basionym:** *Hebecoccus falcatus* Radlk., Philipp. J. Sc. 8 (1914) Bot. 453, in Engler *L.c.* (1932) 721. **Lectotype** (Leenhouts, 1969): *Rosenbluth FB 12631*, Philippines, Leyte (M; isolectotype L).

subsp. **borneensis** (Leenh.) Leenh.

Blumea 18 (1970) 429, *L.c.* (1994) 634. **Basionym:** *Lepisanthes borneensis* Leenh. *L.c.* (1969) 68, Anderson *L.c.* 311. **Type:** Chew, Corner & Stainton *RSNB 2936*, Borneo, Sabah (holotype L; isotypes BO, SAR).

Tree to 22 m tall, 40 cm diameter. Twigs 1–1.5 cm diameter, when young sparsely yellowish brown tomentose to glabrous. **Leaves** each with 4–10 leaflets; petioles swollen at base, 7–25 cm long, light yellowish green. **Leaflets** subopposite to alternate, thin- to stiff-chartaceous, shiny bright green above, dull green with scattered, *glandular-pitted warts beneath*; elliptic to ovate or oblong to lanceolate, 14–28 × 4–10 cm, not or slightly sickle-shaped; base symmetric to asymmetric, acute to rounded and attenuate or subcordate, apex acute to attenuate-acuminate; lateral veins c. 15 per side, 1.5–3 cm apart, spreading, slightly to strongly curved, some intermediate lateral veins sometimes as strongly developed as the lateral veins, *venation mostly open, only the lateral veins in the upper one third to one fourth distinctly looping and joining at several mm from the margin*; petiolules swollen, 4–15 mm long. **Inflorescences** 20–70 cm long, minutely brown-tomentose, branches up to 40 cm long, patent to oblique-erect; cymes condensed, several-flowered, stalks c. 5 mm long; pedicels c. 1 mm long; bracts narrowly triangular, c. 3 mm long. **Flowers:** sepals ovate to obovate to suborbicular, 3–4.5 × 2–4.5 mm; petals 4–7 mm long, blade elliptic to suborbicular, 2.3–5 mm long, base glabrous or sericeous, basal one fifth densely long-ciliate, glabrous inside, claw 0.75–2.5 mm long, sparsely hairy inside, glabrous or sericeous outside, densely long-ciliate, *scales short and broad, entire, bilobed, or 3-dentate, densely bearded*; stamen filaments 2–3 mm long, anthers ovoid, 1–1.5 mm long. **Fruits** slightly 3-lobed, often only 1 lobe developed, with the sterile ones not visible, 1.8–2.5 × 1.8–3.5 cm, densely brown short-velvety and corrugated outside. **Seeds** obovoid-globose, 15 × 8–10 mm, hilum basal, circular, small.

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

**Distribution.** Borneo and the Philippines (Palawan). Probably not uncommon in Sabah, uncommon in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Primary lowland to lower montane forest, on rocky banks of streams, at 60–1500 m. Flowering in March, June, September, November; fruiting in March, May.

**Taxonomy.** Two other subspecies are found in Sulawesi (subsp. *celebica* (Radlk.) Leenh.) and the Philippines (subsp. *falcata*). They differ mainly in the venation of the leaflets: closed in

subsp. *celebica* and subsp. *falcata*; mostly open or closed in the upper one-third to one-fourth only in subsp. *borneensis*.

### 5. *Lepisanthes fruticosa* (Roxb.) Leenh.

Fig. 12E.

(Latin, *fruticosus* = shrubby)

*l.c.* (1969) 76, *l.c.* (1994) 643; Anderson *l.c.* 312; Yap *l.c.* 446; Whitmore, Tantra & Sutisna *l.c.* 312. **Basionym:** *Sapindus fruticosa* Roxb., Fl. Ind. ed. 2, 2 (1832) 283. **Type:** Roxburgh, *s.n.*, Hort. Bot. Calcutta (introduced from the Moluccas) (CAL, *n.v.*). **Synonyms:** *Otophora fruticosa* (Roxb.) Blume *l.c.* (1847) 142, Merrill *l.c.* (1921) 358, Radlkofer in Engler *l.c.* (1932) 759, Masamune *l.c.* 430, Backer & Bakhuizen *f. l.c.* 135; *Otophora pulchella* (Ridley) Merr. *l.c.* (1921) 359, Masamune *l.c.* 431; *Otophora bijuga* Radlk. in Engler *l.c.* (1932) 765, Masamune *l.c.* 429; *Otophora glandulosa* Radlk. in Engler *l.c.* (1932) 763, Masamune *l.c.* 430; *Otophora latifolia* Ridl., Kew Bull. (1933) 190, *nom. illeg.*, Radlkofer in Engler *l.c.* (1934) 1494, Masamune *l.c.* 430.

Shrub or tree 1.5–10(–15) m tall, 2–15 cm diameter. *Twigs* 2.5–20 mm diameter, smooth or lenticellate, glabrous or sometimes variably fulvous hairy, glabrescent. **Leaves** without or sometimes with a rather strongly reduced terminal leaflet, each with 1–8(–14) pairs of leaflets, mostly glabrous; petioles 0.5–32 cm long; *rachis terete to laterally flattened, often marginate to exceptionally narrowly winged in the upper part; pseudostipules very rarely absent, mostly persistent, ovate, obovate, elliptic, or orbicular, sometimes very oblique*, 0.2–10 × 0.1–10 cm, base cordate to obtuse, apex obtuse to rounded or exceptionally furcate, reticulately or palmately, rarely pinnately veined. *Leaflets* opposite to alternate, thin-chartaceous to coriaceous, often greyish above, brown beneath, *with scattered sunken glands above, sparsely to densely finely pitted beneath, or exceptionally with minute pitted warts on both surfaces*, glabrous or sometimes hairy on the midrib beneath; ovate- to obovate-oblong to narrowly lanceolate, 9–40 × 2–12 cm; base asymmetric or symmetric, subcordate to acute, mostly attenuate, in asymmetric leaflets sometimes rounded at the lower half and cuneate at the upper half, apex obtuse to acuminate, rarely acute, acumen short, broad and obtuse to long, slender and acute, sometimes mucronate; midrib sharply raised to rounded beneath; lateral veins 0.8–5 cm apart, straight to curved, none to all looping and joining; petiolules absent to 3 cm long. **Inflorescences** terminal, axillary or borne on leafless twigs or stems, solitary or sometimes clustered, unbranched or if branched either with a few to several ascending long-branches appearing from near the base, or from all over and pyramidal, to 75 cm long, glabrous; cymes subsessile, rarely with a stalk up to 1 cm long, few- to several-flowered, in the upper part flowers often solitary, sometimes sticky (race “*glandulosa*”); pedicels filiform, 0.3–1(–1.5) cm long. **Flowers** scentless; sepals 4–5, glabrous or very sparsely glandular-ciliolate, outer 2 sometimes smaller, elliptic, orbicular, or obovate, 2–4 × 1.5–3 mm, *dark red, rarely yellow to white*, margins, especially of the inner ones, petaloid, crenulate to fimbriate-ciliolate; petals 4–5, blade broadly ovate or elliptic to obovate, 1.5–3 × 1–2 mm, *dark red, rarely yellow to white*, glabrous, claw short, ciliate or rarely hairy outside, *either with 2 auricles or with a small auricle and a reflexed scale*, scales and auricles ciliate; stamens 5–8, anthers 1.2–2.2 mm, yellow to white, glabrous or hairy; ovary 2–3(–4)-locular, glabrous, stigma subsessile, slightly lobed. **Fruits** ovoid, ellipsoid, subglobose, or transversely ellipsoid, rarely distinctly lobed, 1–3 × 0.6–2 × 0.5–2 cm (fresh fruit to 4 cm diameter), white when young, dark red to blackish when ripe; fruit wall thin, fleshy when fresh; *septum usually interrupted, mostly reduced to a rib all around*; pedicels patent, slender, to 1.5 cm long. **Seeds** mostly 2, subglobose to subellipsoid, flattened on the axial side, 8–23 × 6–18 mm, 4–18 mm thick, hilum orbicular to lanceolate, to 6 × 3–4 mm.

**Vernacular names.** Sabah—*belingasan* (Kedayan), *indulus* (Dusun Sungei), *kelinga* (Dusun Banggi), *lulupitan* (Murut), *tamud tamud* (Dusun West Coast).

**Distribution.** Lower Myanmar, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, Java, Philippines, Sulawesi, Lesser Sunda Is., and Maluku. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary and secondary mixed dipterocarp forests, on ridges, along rivers, in swamps, behind beaches, and in abandoned plantations; on various types of well-drained or periodically inundated, nutrient-rich or nutrient-poor soil, including clay, sands, acid and basic soil; from sea level to 1400 m. Flowering and fruiting mainly in December to May. Fruits sweet, eaten and dispersed by birds, wild pigs and deer.

**Uses.** In Peninsular Malaysia, the roots are used in traditional medicine. The wood is hard, durable, and heavy and has been used for house-building in Melaka. Sometimes cultivated for its edible fruits (Burkill, EPMP (1935) 1614; Jansen *et al.* PROSEA 2 (1991) 343).

**Taxonomy.** In Borneo there are 3 main races, "*acuminata*", "*fruticosa*", and "*glandulosa*", the last one with 2 ecotypes. Race "*acuminata*" is characterized by its acute leaflets, inflorescences borne on leafless twigs or stems, 5-merous flowers, and completely 3-locular fruits; it is restricted to the Kapuas basin in Kalimantan. Race "*fruticosa*" has obtuse leaflets, axillary or sometimes terminal inflorescences, 4-merous flowers, and incompletely 2-locular fruits; it is apparently restricted to N Borneo. Race "*glandulosa*" is characterized by its obtuse leaflets, axillary inflorescences (or borne on leafless twigs or stems), 5-merous flowers, densely short-hairy anthers, and incompletely 2-locular fruits; its lowland ecotype is rather wide-spread, but its mountain ecotype is restricted to Mt Kinabalu. The mountain ecotype differs from the lowland ecotype in its more slender petiole and rachis, smaller pseudostipules that are earlier caducous, narrower leaflets with a longer attenuate apex, and the midrib which is more rounded beneath.

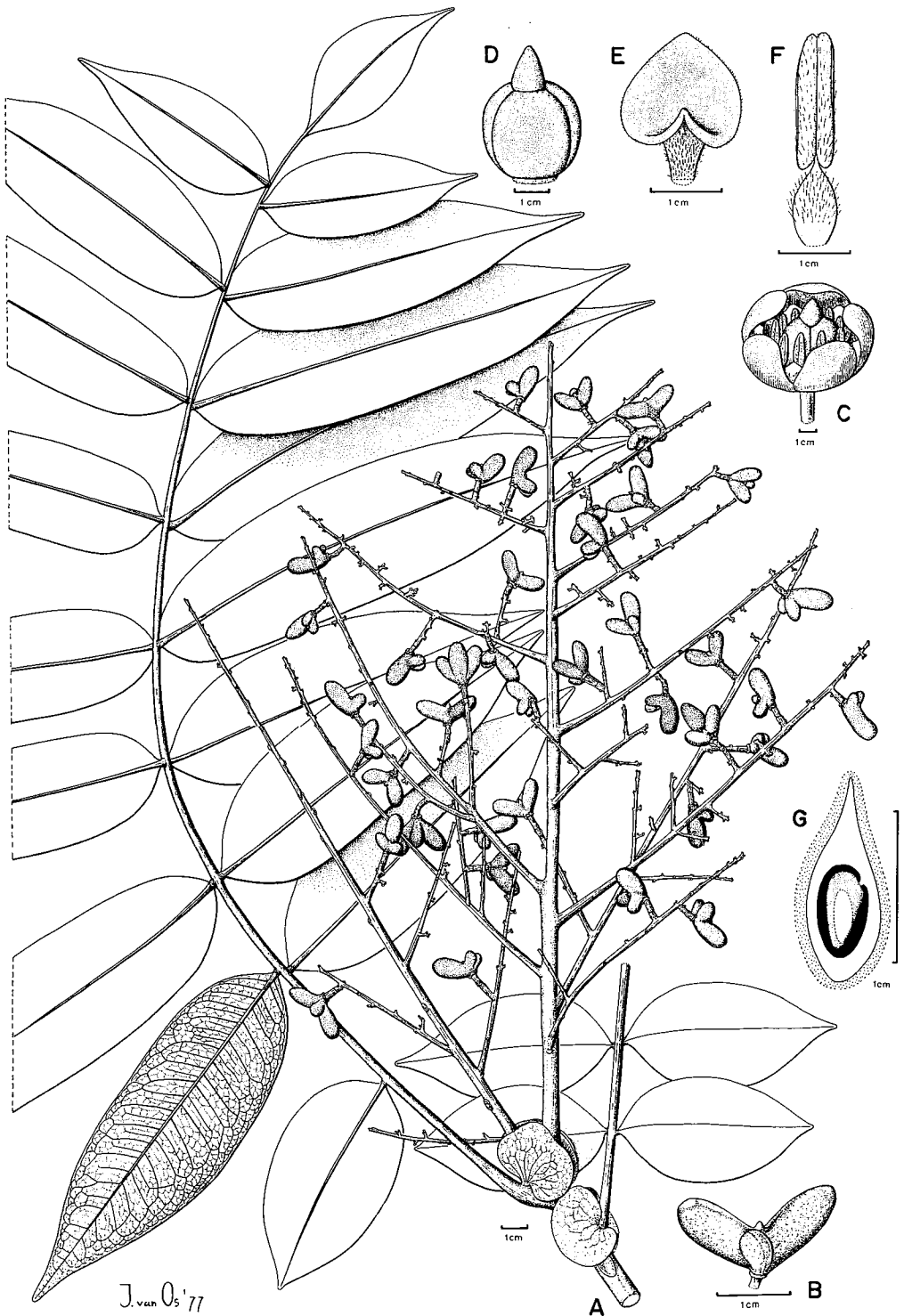
6. *Lepisanthes kinabaluensis* Leenh.  
(of Mt. Kinabalu)

Fig. 14.

*L.c.* (1969) 73, *L.c.* (1994) 639; Whitmore, Tantra & Sutisna 312. **Type:** Chew & Corner RSNB 4998, Borneo, Sabah, Mt. Kinabalu, Mesilau river (holotype K; isotype L).

Tree to 10 m tall, or shrub. *Twigs* 0.8–1 cm diameter, densely fulvous short-tomentose, glabrescent. **Leaves** *imparipinnate*, each with 7–14 pairs of leaflets; axial parts hairy; petioles 5–13 cm long; *pseudostipules* *orbicular to broadly ovate*, 2–5 × 2.5–4 cm, base deeply cordate, apex rounded or obtuse to short-acuminate, pinnately to reticulately veined, distant from the normal leaflets. *Leaflets* more-or-less opposite, parchment-like, mostly greyish green above, greenish beneath, glabrous or the midrib fulvous short-tomentose above, with scattered, glandular-pitted warts on both surfaces; lanceolate to oblong, parallel-sided, 12–20 × 3.5–5 cm; base asymmetric to symmetric, cuneate or lower half rounded, apex attenuate-acuminate, acumen long, pointed or obtuse; lateral veins 1–2 cm apart, straight to slightly curved, more or less distinctly looping and joining near or at some distance from the margin. **Inflorescences** terminal, pyramidal, c. 25 cm long, red, densely short-hairy to subglabrous; branches patent; cymes short-stalked to sessile, several-flowered; pedicels to 5 mm long. **Flowers:** *sepals* *deep*





**Fig. 14.** *Lepisanthes kinabaluensis*. A, fruiting leafy twig; B, fruit; C, female flower; D, ovary; E, petal from inside; F, stamen; G, seed in longitudinal section. (A–B from RSNB 4998, C–G from RSNB 4944.)

*rose-red*, sparsely ciliolate in the apical part, outer 2 ovate, 3.5–5 × 2.5–3 mm, inner 3 elliptic to rounded, 4–5 × 2.5–5 mm, rather thin, the greater part petaloid, sometimes grading to petals; petals 4, *pink outside, darker towards the base, whitish inside*, claw *c.* 0.5 mm, ciliolate, blade widely rhomboid, *c.* 2.5 × 3.5 mm, ciliolate at base, sparsely ciliolate at the upper part, elsewhere glabrous or appressed hairy outside, *scale bilobed or the lateral parts reflexed, the central part erect and hood-shaped, c. 0.4× as long as the blade*; disc glabrous or short-hairy; stamens 7–10, anthers *c.* 2 mm long; ovary 3-locular, 3-angular, obovoid, 3-lobed, glabrous, stigma sessile, dome-shaped. **Fruits** 3-lobed, often 1 or 2 lobes not developed and style nearly basal, lobes spreading, ellipsoid, *c.* 3.2 × 2.2 cm, scurfy, glabrous, brown, yellow, orange, or purplish red when ripe.

**Distribution.** Uncommon and endemic to Sabah (Mt. Kinabalu, Crocker Range).

**Ecology.** In montane forest, at 1200–2000 m. Flowering in March to April; fruiting in January, March to April, June.

### 7. *Lepisanthes multijuga* (Hook. f.) Leenh.

Fig. 12I.

(Latin, *multus* = many, *jugum* = leaflet pair)

*L.c.* (1969) 73, *L.c.* (1994) 642; Whitmore, Tantra & Sutisna *L.c.* 312. **Basionym:** *Nephelium multijuga* Hook. f., Trans. Linn. Soc. 23 (1860) 164. **Type:** Motley 328, Borneo, Labuan (K). **Synonyms:** *Otophora multijuga* (Hook. f.) Merr. *L.c.* (1921) 358, Radlkofer in Engler *L.c.* (1932) 774, Masamune *L.c.* 430; *Otophora tricocca* Radlk. in Merrill, PEB (1929) 174, *nom. nud.*, Masamune *L.c.* 431.

Tree or shrub to 12 m tall, 10 cm diameter. *Twigs 1.5–2 cm diameter, glabrous. Leaves imparipinnate*, each with (15–)30–40 pairs of leaflets; axial parts fulvous tomentose, glabrescent; petioles 3–6(–8) cm long; *pseudostipules 1 or 2 pairs, ovate to suborbicular, 2.5–7.5 × 2.5–5 cm, base cordate, apex acute, pinnately to reticulately veined, more or less intergrading with the normal leaflets by intermediates. Leaflets opposite to alternate, subsessile, chartaceous, blackish brown to greenish grey above, medium- to dark-brown beneath; densely covered with glandular-pitted warts above, sparsely so beneath; linear-lanceolate, to 18 × 3 cm; base rounded to subcordate, asymmetric, apex attenuate-acuminate, obtuse to acute; midrib densely fulvous tomentose above, very sparsely hairy to glabrous beneath, lateral veins 1–1.5 cm apart, slightly curved, obscurely looping and joining at a distance from the margin. Inflorescences terminal, broadly thyrsoid, 25–30 cm long, subglabrous, sparsely branched; branches obliquely patent, to 45(–60) cm long, narrowly thyrsoid with scattered, short-stalked to sessile, condensed, few-flowered cymes; pedicels 0.5–4 mm long. Flowers red; sepals sparsely appressed short-hairy to glabrous outside, sparsely glandular ciliolate, outer 2 elliptic to ovate, 2.5–3 × 1.8–2.5 mm, inner 3 orbicular, with a broad petaloid margin, 3–4 × 2.5–4 mm; petals rather densely long-ciliate, sparsely hairy at the base or glabrous outside, blade broadly ovate, slightly subtruncate at base, *c.* 2 × 2.5 mm, claw *c.* 0.5 mm, *scale slightly bilobed, about 0.3× as high as the blade, slightly recurved, ciliate*; disc glabrous; stamens (6–)8, anthers 1.5–1.8 mm long, long-ciliate to completely woolly; ovary 3-locular, deeply grooved, glabrous, style conical. **Fruits** deeply 3-lobed (if only 1 lobe is developed, style located near the base above the scars of fallen sterile lobes), *lobes spreading*, oblique-ellipsoid, *c.* 22 × 13 mm, scabrous, glabrous, chocolate-coloured or yellow or orange when fresh. **Seeds** hazelnut-shaped, *c.* 12 × 9 mm.*

**Distribution.** Endemic to Sabah (also on Labuan Is.), Sarawak (one collection, from the Kelabit Highlands), and Brunei.

**Ecology.** In primary and secondary forests, up to 1000 m. Flowering in July, September, November; fruiting in January, September, November, December.

### 8. *Lepisanthes ramiflora* (Radlk.) Leenh.

(Latin, *ramus* = twig, *flos* = flower; flowering on leafless twigs)

*L.c.* (1969) 81, *L.c.* (1994) 647; Anderson *L.c.* 312. **Basionym:** *Otophora ramiflora* Radlk., Sapind. Holl.-Ind. (1879) 32, 85, in Engler *L.c.* (1932) 758, Merrill *L.c.* (1921) 359, Masamune *L.c.* 431. **Lectotype** (Leenhouts, 1969): *Beccari PB 364*, Borneo, Sarawak (FI).

Small tree or shrub to 22 m tall, 20 cm diameter. *Twigs 5–7 mm diameter*, densely pustular lenticellate, *sparsely hirsute*, early glabrescent. **Leaves** *pari- or rarely imparipinnate*, each with (3–)4–6 pairs of leaflets, 40–50 cm long; petiole and rachis sparsely hairy to subglabrous, *wings to 5 mm wide*; petioles 6–18 cm long; *pseudostipules ovate*, 0.8–3.5 × 0.5–2 cm, base cordate, apex acute to rounded, pinnately veined. *Leaflets* subopposite, sessile, chartaceous, sometimes slightly bullate, grey or brown above, brown to greenish beneath; *oblong or sometimes slightly obovate*, to 33 × 10.5 cm; base asymmetric, narrowed, cordate, apex attenuate-acuminate, acute; midrib rounded beneath, sparsely hirsute at least near the base, lateral veins 1–2.5 cm apart, more or less curved, at least those in the upper half distinctly looping and joining at some distance from the margin. **Inflorescences** *several to many fascicles borne on knobs of leafless twigs and stems, unbranched or hardly branched, racemose*, c. 1.5 cm long, few-flowered; pedicels patent, slender, 1.5–5 mm long. **Flowers** 4-merous; *sepals pale pink*, outer 2 elliptic, c. 2.5 × 2 mm, with petaloid margin, inner ones broadly ovate, c. 3 × 2 mm, for the greater part petaloid; *petals white*, sparsely long-ciliate near the base, blade semi-transversely elliptic, c. 1 × 1.8 mm, claw c. 0.4 mm long, *scale broad, rounded to bilobed*, about 0.3–0.5× as high as the blade, slightly hairy; disc pale yellow, glabrous; stamens 5–7, anthers c. 1 mm long, glabrous, cream-coloured; ovary suborbicular, flattened, *2-locular*, pale yellowish, style short, stigma dome-shaped, slightly bilobed, white. **Fruits** *transversely ellipsoid, slightly bilobed*, c. 1 × 1.5 cm, crimson to dark purple, *incompletely 2-locular*. **Seeds** ellipsoid.

**Distribution.** Endemic to Sarawak (around Kuching).

**Ecology.** In primary and secondary forests on sandstone, from sea level to 100 m. Flowering in January to February, July to September, November; fruiting in January, October, November.

**Uses.** The fruits are edible.

### 9. *Lepisanthes rubiginosa* (Roxb.) Leenh.

Fig. 12F.

(Latin, *rubiginosus* = rust-coloured; the indumentum)

*L.c.* (1969) 82, *L.c.* (1994) 648; Yap *L.c.* 446; Whitmore, Tantra & Sutisna *L.c.* 313. **Basionym:** *Sapindus rubiginosa* Roxb., Pl. Corom. 1 (1796) 44, t. 62. **Type:** *Roxb. Pl. Corom. 1 (1796) t. 62*. **Synonyms:** *Erioglossum rubiginosum* (Roxb.) Blume *L.c.* (1847) 118, Merrill *L.c.* (1921) 358, Radlkofer in Engler *L.c.*

(1932) 693, Masamune *l.c.* 426, Backer & Bakhuizen *f. l.c.* 134, Corner, WSTM 3rd ed. 2 (1988) 679, pl. 209.

Shrub or small tree to 16 m tall, 28 cm diameter. *Indumentum ferrugineous to fulvous*, sometimes silvery grey. *Twigs c. 5(-15) mm diameter*, densely short-hairy when young. **Leaves** each with (2-)3-6(-9) pairs of leaflets, often with a pseudoterminal leaflet, velvety when young; petioles, 7.5-12(-20) cm long, densely short-hairy, late glabrescent. Leaflets stiff-chartaceous, greyish green to grey above, yellowish green to reddish brown beneath, densely short-hairy on midrib and lateral veins on both sides, sparsely hairy on the blade beneath (velvety to the touch), glabrescent; elliptic to lanceolate, (4.5-)6.5-18(-25) × (2-)3.5-8.5(-11) cm; base rounded to broadly cuneate, apex obtuse to acute or acuminate, often mucronulate; midrib prominent above, rather strongly raised and rounded beneath, lateral veins 8-12(-16) on either side, nearly straight to slightly curved, bent at the margin, except for few upper ones, not distinctly joining, hardly prominent above, slightly prominent beneath, intercostal veins and veinlets inconspicuous above, densely reticulate-scalariform and faintly raised beneath; petiolules to 5(-10) mm long. **Inflorescences** 25-35(-50) cm long, densely ferrugineous tomentose, branches often long, ascending, spicate; cymes nearly sessile to short-stalked, glomerulous to distinctly branched, few- to several-flowered; bracts and bracteoles small, subulate; pedicels 1-2(-5) mm long. **Flowers** sweet-scented; sepals orbicular-ovate, slightly concave, margin sometimes petaloid, ciliate, glabrous or with a few hairs inside, outer two 1.2-2.2 × 1.2-2 mm, ciliate, inner three 1.8-2.8 × 2-3 mm, obtuse; petals 4 (or 5), blade 2-4 × 1.5-2.2 mm, crenulate in the upper half, white to yellowish, sparsely long-ciliate in the narrowed lower part, sparsely hairy at base outside, abaxial petals shorter and narrower than the adaxial ones, and with a shorter scale, claw 0.5-1 mm long, long-ciliate in the upper part, *scale 1.5-3 mm long, quadrangular to more or less bilobed, slightly narrowed from base to apex, bearded, the appendage deeply bilobed, the lobes sometimes also bilobed*, hairy; abaxial stamens longer than the adaxial ones, stamen filaments flattened, white long-hairy, in male flowers (1.5-)3-5 mm long, in female flowers *c.* 1.5 mm long, anthers oblong-ovoid, *c.* 0.8 mm long, glabrous; ovary 3-lobed, 1.2-1.8 × 2-2.2 mm, densely appressed hairy, style cylindric, *c.* 2.2 mm long, bent near the obscurely 3-lobed apex, sparsely appressed hairy in the lower two third; pistillodes in male flowers *c.* 0.8 mm high, long-hairy. **Fruits** 1-3-lobed, lobes spreading, 8-13 × 7-8 mm, faintly keeled, dark purple to nearly black when ripe, subglabrous; endocarp thin but hard and tough, glabrous. **Seeds** oblong-ellipsoid, 9-11 × 4 × 4 mm, hilum basal, small.

**Vernacular names.** Sabah—*borobogan* (Dusun Bundu), *damai* (Bajau), *lipupdsu* (Dusun), *suang rason* (Bajau Laut).

**Distribution.** Continental SE Asia from northern India to Indo-China and SE China, Malesia and NW Australia. In Sabah, rather common; also in Brunei and Kalimantan.

**Ecology.** In young secondary forest, shrub growth, forest edges, road sides, riverbanks, and inner mangroves; up to 1200 m; on well-drained or periodically inundated, nutrient-rich or nutrient-deficient soils, including heavy clay, sand, and limestone. Flowering and fruiting throughout the year. Flowers much visited by *Xylocopa* bees.

**Uses.** In India, where the trees seem to be bigger, the timber is said to be valuable, but in Malesia it is used only for firewood and sometimes (in Java) for rice-pounders and tool-

handles. A decoction of the roots and leaves, sometimes also of fruits and seeds, is used medicinally against fever. The young leaves are eaten as a vegetable, and the astringent but sweet fruits are relished as a titbit, mainly by children (Burkill, EPMP (1935) 938; Heyne, Nutt. Pl. Ned. Indië, ed. 2 (1927) 989; Ochse & Bakhuizen, Ind. Groenten (1931) 648, f. 396).

10. *Lepisanthes senegalensis* (Juss. ex Poir.) Leenh.  
(of Senegal)

Fig. 12D

*L.c.* (1969) 85, *L.c.* (1994) 651; Anderson *L.c.* 312; Whitmore, Tantra & Sutasna *L.c.* 313. **Basionym:** *Sapindus senegalensis* Juss. ex Poir., Encycl. 6 (1805) 666. **Type:** Adanson & Geoffroi f., s.n., Herb. Jussieu 11386, Senegal (P). **Synonym:** *Aphania dasypetala* Radlk., Fedd. Repert. 18 (1922) 333, in Engler *L.c.* (1932) 714, Masamune *L.c.* 425.

Treelike, shrub, or tree to 24 m tall, 44 cm diameter. Young parts densely to sparsely appressed fulvous to ferruginous short-hairy. *Twigs* 2–6 mm diameter, smooth to verruculose by many small, orbicular lenticels. **Leaves** sometimes with a pseudoterminal leaflet, with 1–4(–6) pairs of leaflets or sometimes simple; lower pair of leaflets sometimes attached near or at the base, smaller and more caducous than the other ones; petioles absent to 14 cm long, often strongly swollen at base; *rachis terete to keeled above. Leaflets* chartaceous to subcoriaceous, greyish green (rarely olive or brown) above, *greyish or yellowish green to light brown beneath, densely to sparsely set with minute pellucid dots*; elliptic to lanceolate, 7–35 × 2–15 cm (simple leaves to 60 × 18 cm); base acute to obtuse, more or less attenuate (in sessile simple leaves subcordate, symmetric or asymmetric), apex obtuse to acuminate, mucronulate, acumen to 5 cm long, blunt to acute; midrib faint to slightly raised above, prominent and rounded beneath, lateral veins 7–20 per side, 1–3(–4 in the large simple leaves) cm apart, straight to curved, looping and joining at some distance from the margin, slightly raised on both surfaces, shorter intermediate veins strongly developed between two lateral veins, intercostal veins rather densely reticulate, slightly raised on both surfaces, especially beneath; petiolules swollen, 2–15 cm long. **Inflorescences** hairy to subglabrous, in fascicles of a few to several, unbranched or sparsely slender-branched racemes to 40 cm long, or unbranched or widely sparsely branched thyrses to 60 cm long with a strong peduncle and rachis; cyme-like parts distant, short-stalked, 3-flowered; pedicels 1–4(–8) mm long. **Flowers** slightly fragrant, female ones apparently developing first; sepals 5, rarely 4, *mostly dark red*, concave, outer 2 oblong-ovate to orbicular, apex rounded, 1–3 × 0.8–1.2 mm, sometimes with a narrow, petaloid, crenulate margin, sparsely ciliolate, inner ones 3–4 × 3 mm, mostly with a broad, petaloid, crenulate to fimbriate, ciliolate margin; petals 5, rarely 4, *creamish or greenish white*, imbricate, short-clawed to sessile, blade elliptic to oblong, widest below to about the middle, 2.5–4.5 × 1–2 mm, entire, rounded, membranous but often thickened towards the centre and the base, ciliate at least near the base, other parts mostly glabrous, sometimes subsericeous outside, *scale minute to two-fifths the length of the blade, simple to deeply bilobed, rarely divided into two minute auricles*, sparsely ciliate to long-hairy (exceptionally glabrous); disc entire (more or less interrupted if one of the petals is suppressed), annular to saucer-shaped; stamens 5–7(–9), filaments flattened or terete, narrowed from base to apex, 1–3.5 mm long, white, woolly in the lower two third, rarely subglabrous, anthers ellipsoid to ovoid, 1–1.8 mm long, light yellow when young, purplish brown when old, connective mostly apiculate; *ovary* 2(–3)-lobed, 1.5–3 mm across, subsessile or with a stalk to 1.5 mm long, mostly with some stiff hairs at the style base, style cylindrical, 1–2 mm long, straight to slightly curved, stigma sometimes decurrent halfway down the style, purple; pistillode often long-pilose in the apical

part. **Fruits** 2-lobed (often only 1 lobe developed), sessile or with a stalk to 2 mm long, lobes short-ellipsoid to globose, 8–15 × 5–15 mm, smooth, dark red to black when ripe; endocarp eggshell-like, light brown. **Seeds** ovoid to globose, more-or-less attenuate towards the hilum, 7–8 × 6–7 mm; testa shiny brown to black, hilum circular.

**Vernacular names.** Sabah—*kelinga gaba* (Dusun Banggi). Sarawak—*melingkat* (Iban).

**Distribution.** Tropical Africa, Madagascar, Sri Lanka and the SW Deccan Peninsula, NE India, E Pakistan, Myanmar to Indo-China and Hainan, the Andamans and Nicobars, and Malesia (all regions except the Lesser Sunda Islands). Common in Sabah, less so in Sarawak; also in Brunei.

**Ecology.** In mixed dipterocarp forest and secondary forest, from sea level to 1400 m; on well-drained as well as marshy, fertile to infertile, acid to basic soils, including clay, sand, marl and coral limestone rocks. Flowering mainly in July to November; fruiting mainly in January to April.

**Uses.** The wood is hard, heavy, and durable, and is used, in Peninsular Malaysia, for house-posts. The fruits are edible (Burkill, EPMP (1935) 190).

**Notes.** Two races ("*montana*" and "*dasyptala*") occur in Borneo. The latter differs from the former in its flowers with 4 petals that are rather densely sericeous outside, ovary with a longer stalk, leaflets with an inconspicuous venation and lateral veins that are more distinctly looping and joining at a slightly greater distance from the margin.

#### 11. *Lepisanthes tetraphylla* (Vahl) Radlk.

Fig. 12J.

(Greek, *tetra* = four, *phullon* = leaf; leaf of four leaflets)

Sitzungsber. Math. Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 8 (1878) 276, in Engler *l.c.* (1932) 743, f. 15; Ridley FMP 5 (1925) 301; Leenhouts *l.c.* (1969) 39, 63, *l.c.* (1994) 630; Anderson *l.c.* 312; Yap *l.c.* 447; Whitmore, Tantra & Sutisna *l.c.* 313. **Basionym:** *Sapindus tetraphylla* Vahl, Symb. 3 (1794) 54. **Type:** Koenig, *s.n.*, Herb. Vahl, India (C). **Synonyms:** *L. heterolepis* Blume *l.c.* (1847) 153, Merrill *l.c.* (1921) 358, Radlkofer in Engler *l.c.* (1932) 734, Masamune *l.c.* 427; *L. petiolaris* Radlk., Fedd. Repert. 18 (1922) 334, in Engler *l.c.* (1932) 733, Masamune *l.c.* 427.

Mostly shrub or treelet, sometimes tree to 23 m tall, 20 cm diameter. *Twigs to 2.5 cm diameter*, glabrous or variably fulvous to ferruginous hairy, mostly early glabrescent, mostly conspicuously lenticellate. **Leaves** with 2–10 pairs of leaflets; axial parts glabrous or variably hairy; petioles 5–50 cm long. Leaflets chartaceous to parchment-like, glabrous or variably hairy; lanceolate to elliptic, ovate to obovate, 7–55 × 2–10(–20) cm; base slightly (or strongly) asymmetric to symmetric, acute to rounded or subcordate, apex tapering to abruptly acuminate, acumen short to long, obtuse to acute, lateral veins variable, at least the upper ones (rarely all) looping and joining or exceptionally connected by an intramarginal vein, slightly raised or sometimes sunken above, slightly raised to prominent beneath, intercostal veins and veinlets finely reticulate; petiolules 2–25 mm long. **Inflorescences** 2–70 cm long, mostly densely short-hairy; peduncles very short to long; main branches often racemose; cymes patent, sessile or with a stalk to 0.5 cm long, to 7-flowered; pedicels to 6 mm long; bracts ovate-lanceolate to subulate, to 5 mm long, rarely ovate and to 7 × 6 mm. **Flowers** white,

*sometimes greenish white, cream, or pink*, sweet-scented; outer two sepals ovate to suborbicular, 1.2–7 × 1.2–6 mm, densely (sometimes partly glandular) ciliolate, glabrous to sparsely hairy inside, inner 3 sepals elliptic to orbicular, ovate to obovate, 2.2–6.2 × 1.8–6 mm, margins mostly narrowly to broadly petaloid, glabrous outside, crenulate to fimbriate-denticulate, indumentum otherwise like that of outer sepals; petals 2.2–10 mm long, claw 0.5–2(–4) mm long, sparsely hairy inside, blade elliptic to oblong to ovate, 1.2–4 mm wide, more-or-less dentate in the upper part, mostly up to two-thirds sericeous outside, rarely subglabrous, margin glabrous or sparsely to densely woolly ciliate below the insertion of scale, rarely rest of the blade (partly glandular) ciliate outside, glabrous inside or the base rarely sparsely hairy, *scale mostly well-developed (rarely represented by a hairy rim only), entire to deeply 2–4-lobed, glabrous, ciliate or sparsely to densely woolly inside, without or more often with a crest varying in shape from a small wart to a deeply bilobed duplication of the scale or 2 brushes*; stamen filaments 1.5–6.5 mm long, sparsely to densely woolly in the upper half, or rarely also in the lower half, anthers broadly ellipsoid to oblong, ovoid to obovoid, 0.8–2.5 mm long, connective broad and obtuse or rarely narrow and pointed, woolly to glabrous; ovary and lower part of style densely hairy to subglabrous. **Fruits** turning to yellowish, grey, or greyish pink on ripening, *flattened ellipsoid, shortly obovoid, or subglobose, slightly lobed, the lobes rarely keeled*, 1.5–5 cm diameter. **Seeds** brown; testa papery, probably partly fleshy when fresh.

**Vernacular names.** Sabah—*arit-arit* (Dusun), *bansisi* (Dusun Labuk). Sarawak—*jung* (Iban).

**Distribution.** SE Asia, from Sri Lanka and the Deccan Peninsula to Hainan, Sumatra, Peninsular Malaysia, Java, Timor, Borneo, Philippines, N Sulawesi (one collection), and New Guinea. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** In primary mixed dipterocarp and secondary forests, in forest edges, on riverbanks, and in open country; on well-drained or swampy or periodically inundated localities, on all kinds of soil; to 1200 m. Flowering throughout the year; fruiting in November to July.

**Uses.** The wood of some forms is heavy, hard, and close-grained, and good for furniture (Burkill, EPMP (1935) 1332, under *L. kunstleri*).

## 12. LITCHI Sonn.

(after the Chinese plant-name *li-tchi*)

### P.W. Leenhouts

Voy. Ind. Or. Chine 2 (1782) 230, *t.* 129; Radlkofer in Engler, Pflanzenr. 98 (1932) 914; Backer & Bakhuizen *f.*, FJ 2 (1965) 137; Leenhouts, Blumea 24 (1978) 398, FM 1, 11 (1994) 653; Yap, TFM 4 (1989) 447.

*Monoecious trees. Indumentum of solitary, simple or 2-branched hairs. Leaves* spirally arranged or sometimes partly, especially towards the inflorescence, nearly opposite, *paripinnate*, each with 1–4(–5) pairs of leaflets, *without pseudostipules; petiole and rachis not winged*. Leaflets mostly subopposite, dull beneath, margin entire to undulate in the upper part.

**Inflorescences** terminal and axillary, thyrsoid; bracts triangular. **Flowers** radially symmetrical, unisexual; calyx 4–5-lobed, densely appressed short-hairy on both sides, tube cupular, lobes to 0.3–0.5× the length of the tube, apert in bud, equal, not petaloid; petals absent; disc annular, small, without appendages; stamens 6–11, far exserted in male flowers, short in female and in seemingly bisexual but functionally male flowers, filaments variably hairy, anthers glabrous; ovary short-stalked, 2(–3?)-locular, style terminal, shorter than the ovary, stigma consisting of 2(–3?) long, spreading to recoiled lobes; ovules 1 per locule, basal. **Fruits** nearly always with only 1 locule developed, hardly stalked, ellipsoid, ovoid, or globose, not winged, indehiscent, glabrous, spiny to scaly; pericarp thin, coriaceous to rather hard; endocarp glabrous. **Seeds** glabrous, partly or completely enveloped by an entire, translucent, juicy arillode; embryo straight, cotyledons thick, superposed, radicle basal.

**Distribution.** Monotypic. SE China, Peninsular Malaysia, Borneo, Philippines, SE New Guinea; cultivated elsewhere.

**Litchi chinensis** Sonn.  
(of China)

Fig. 15.

*l.c.* 230, *t.* 129; Radlkofer in Engler *l.c.* (1932) 917, *f.* 21; Backer & Bakhuizen *f. l.c.* 137; Poilane, *J. Agr. Trop. Bot. Appl.* 12 (1967) 541; Leenhouts *l.c.* (1978) 398, *l.c.* (1994) 654; Yap *l.c.* 447. **Type:** *Sonnerat* 1062, China (G, P).

subsp. **chinensis**

Tree to *c.* 35 m high, *c.* 1 m diameter. Twigs 2.5–3.5 mm diameter, appressed brown-hairy when young, early glabrescent. **Leaves** with 2–4(–5) pairs of leaflets; petioles swollen and slightly hollowed at base, 1.2–7 cm long, early glabrescent to glabrous, often pustular lenticellate; rachis flat or grooved with a fine central rib (lower part) or keeled (upper part) above, rounded beneath. *Leaflets chartaceous to coriaceous*, mostly rather stiff, smooth, shiny above, glabrous to fairly densely appressed minute-hairy beneath; elliptic or obovate, (3–)8–11(–16) × 1.8–4 cm; base acute, more or less attenuate, symmetric to sometimes asymmetric, margin slightly recurved, apex gradually or abruptly tapering acuminate, acumen obtuse to acute or sometimes rounded to slightly emarginate; midrib narrowly grooved above, prominent and rounded, lateral veins 0.5–1 cm apart, inconspicuous on both sides, intercostal veins coarsely reticulate, veinlets minutely tessellate, distinct; domatia absent; petiolules 3–8 mm long, narrowly and deeply grooved above, swollen toward the base. **Inflorescences** ferruginous-strigose, 15–30 cm long, few-branched; cymules lax, 5–12-flowered, stalks to 5 mm long; pedicels slender, 2–3(–4) mm long; bracts 0.5–2 mm long. **Flowers** greenish white or yellowish, fragrant; calyx 4(–5)-lobed, *c.* 1.5 × 2 mm; disc variably hairy to glabrous; stamens 6(–10), filaments filiform, to 2.5 mm long, rather densely hairy all over, anthers ellipsoid, apiculate to emarginate at apex, *c.* 1 mm long; ovary *c.* 2 × 5 mm, with spreading lobes, densely warty, stalk 1–1.5 mm long, style terete, *c.* 1 mm long. **Fruits** *c.* 3.5 × 3 cm, bright red to purplish when ripe, nearly smooth, scaly, or densely set with flat, pyramidal, acute warts of up to 1 mm high. **Seeds** ellipsoid, *c.* 2 × 1.5 cm; testa shiny blackish brown; hilum basal, circular, 6–7 mm diameter; arillode bluish white or light yellow to pinkish, to 5 mm thick when fresh.

**Vernacular names.** *Lychee* (popular local name). Sarawak—*pareh* (Iban).





**Fig. 15.** *Litchi chinensis*. A, fruiting leafy twig; B, female flower; C, immature male flower; D, mature male flower. (A from FRI 36409, B–D from FRI 27888.)

**Distribution.** Probably originating from the northern parts of Indo-China or from SE China; widely cultivated mainly in subtropical regions. In Malesia, possibly indigenous in Peninsular Malaysia, Borneo and the Philippines, and rarely cultivated or naturalized and apparently hardly ever fruiting. Rarely cultivated in Sabah, Sarawak and Brunei; apparently not indigenous.

**Ecology.** Prefers a hot and wet climate with at least a short cool dry season, but no frost. It seems to favour compact, moist, and fertile soils, and is mostly grown at low altitudes on riverbanks, along dykes, between ditches or ponds, etc. The “mountain lychee”, which has smaller and more prickly fruits and may represent the original form, however, is grown on well-drained land in the hills. The fruits are dispersed by bats and parrots.

**Uses.** Cultivated for its fruits mainly in SE China, Florida, Hawaii, Madagascar and South Africa, from where they are exported fresh, dried, or canned. The wood is also highly prized, reported to be hard, durable, and taking a fine polish (Groff, Ding & Groff, *Lingn. Agr. Rev.* 2 (1924) 34; Burkill, *EPMP* (1935) 1546; Menzel *l.c.* 191).

**Notes.** Although probably one of the best-known genera in the family, to the taxonomist *Litchi* remains full of mystery regarding its history, phylogeography, and taxonomy (for more detailed discussion on its origin and morphological variation, see Leenhouts *l.c.* 1994).

### 13. MISCHOCARPUS Blume, *nom. cons.*

(Greek, *mischos* = stalk, *karpos* = fruit; the stalked fruits)

**R.W. J. M. van der Ham**

*Bijdr. Fl. Ned. Ind.* (1825) 238, *Rumphia* 3 (1849) 166; King, *J. As. Soc. Beng.* 65, 3 (1896) 447; Merrill, *EB* (1921) 362; Ridley, *FMP* 1 (1922) 507; Radlkofer in Engler, *Pflanzenr.* 98 (1933) 1288; Masamune, *EPB* (1942) 427; Backer & Bakhuizen *f.*, *FJ* 2 (1965) 140; van der Ham, *Blumea* 23 (1977) 251, *FM* 1, 11 (1994) 658; Corner, *WSTM* 3rd ed. 2 (1988) 681; Yap, *TFM* 4 (1989) 449; Whitmore, *Tantra & Sutisna*, *CLK* 2, 1 (1990) 313.

Shrubs or large trees, *monoecious or dioecious*. *Indumentum of mostly appressed, single hairs only*. **Leaves** *paripinnate*, each with 1–6 pairs of leaflets; upper leaflets larger; *pseudostipules and wings absent*; petioles subterete to dorsiventrally flattened. *Leaflets alternate to subopposite*; base symmetric to slightly asymmetric, margin entire, flat to revolute, apex emarginate, rounded to acuminate, often mucronulate; lower surface not papillose, red glands absent, domatia often present in the axils of lateral veins; lateral veins looping and joining in the upper part to indistinctly so in the lower half to three-quarters, intermediate lateral veins present, intercostal veins forming a very regular, dense reticulate pattern, more or less prominent on both surfaces; petiolules present. **Inflorescences** *thyrses, pseudoterminal, axillary, or borne on leafless twigs*, nearly always branching; cymules 1–7(–10)-flowered; pedicels 1–3(–5) mm long; bracts triangular to lanceolate. **Flowers** *unisexual*; calyx spreading or cup-shaped, 5(–6)-lobed, lobes connate for up to two-thirds, persistent in fruit, lobes subequal, slightly imbricate at base; *petals absent or up to 5*, minute to slightly longer than the calyx, apert, clawed or not, blade basally usually with 2 auricles or scales, without crest; *disc*

*uninterrupted or interrupted*, annular or cup-shaped; *stamens* (5-)8(-9), exerted, filaments filiform, anthers basifixed, latrorse or latero-introrse, connective with a lighter coloured wart at the top; *ovary* (2-)3(-4)-*locular*, stalked or sessile, style apical, the upper part split into 3 more or less recurved stigmatic lobes, *ovules one per locule*. **Fruit** a *loculicidal capsule*, nearly always stalked, *not lobed, not winged*, red, smooth; the locules about equally developed but the seeds abortive in 1 or 2 locules; stalk hollow; valves thin to almost woody, usually shrivelled after dehiscence; pericarp slightly fleshy; endocarp glabrous or variably hairy, sclerenchymatic, complete and lining the valves and distal parts of septa, or incomplete and present along the sutures only. **Seeds** *hanging by the pseudofunicle*; testa shiny, chestnut-brown, nearly completely covered by a thin-fleshy, translucent arillode, with an abaxial pseudofunicle descending into the stalk; cotyledons superposed.

**Distribution.** About 15 species; from SE Asia, throughout Malesia to Australia; two species in Sabah and Sarawak.

**Ecology.** In primary and sometimes secondary forests, from sea level (rocky sea coasts; salt water creeks) to 3000 m. The fruits may be attractive to animals because of the showy, slightly fleshy arillode.

### Key to *Mischocarpus* species

Leaflets (1-)2-6 per side; intercostal veins usually coarsely reticulate. Calyx lobes hardly connate. Petals 5 or reduced in number. Filaments usually puberulous; anthers more or less hairy.....**1. *M. pentapetalus***

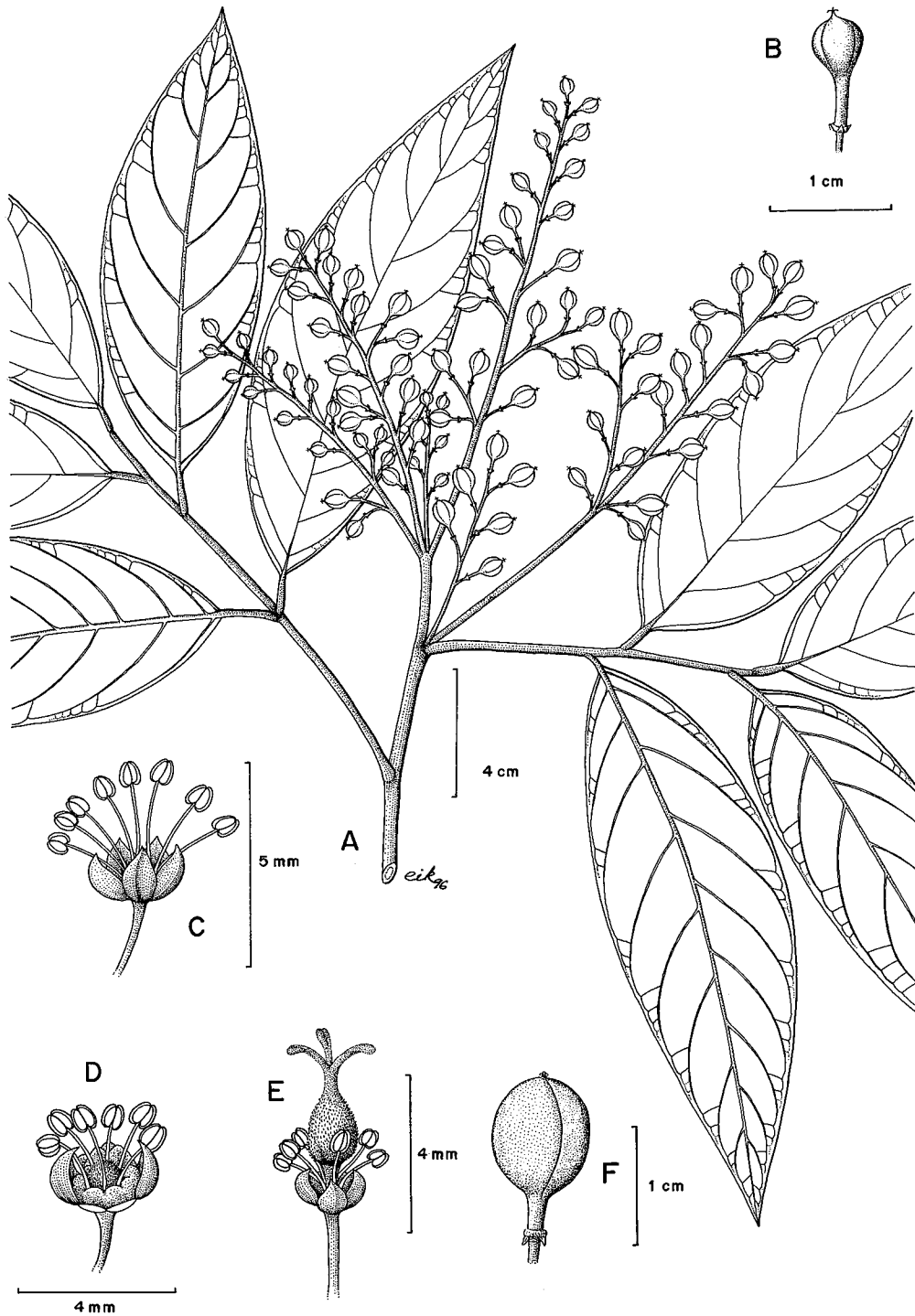
Leaflets 1-3(-4) per side; intercostal veins densely and finely reticulate. Calyx connate for one-fourth to one-third its length. Petals absent. Filaments and anthers glabrous.....**2. *M. sundaicus***

**1. *Mischocarpus pentapetalus* (Roxb.) Radlk.**  
(Greek, *penta* = five, *petalon* = petals; the flower)

Fig. 16F.

Sapind. Holl.-Ind. (1879) 43, in Engler *l.c.* (1933) 1293; van der Ham *l.c.* (1977) 271, *l.c.* (1994) 662; Whitmore, Tantra *l.c.* 215; Yap *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 313. **Basionym:** *Schleichera pentapetala* Roxb., Fl. Ind. ed. 2 (1832) 275. **Type:** *M.R. Smith (3041?)*, 1811, India (holotype BM). **Synonyms:** *M. sumatranus* Blume *l.c.* (1847) 168, King *l.c.* 448, Merrill *l.c.* (1921) 362, Ridley *l.c.* (1922) 508, Masamuné *l.c.* 427, Anderson *l.c.* 312, Corner *l.c.* 681; *Mischocarpus fuscescens* Blume *l.c.* (1847) 169, King *l.c.* 447, Merrill *l.c.* (1921) 362, Masamuné *l.c.* 427, Backer & Bakhuizen *f. l.c.* 141.

Shrub or tree to 15(-25) m tall; all young parts puberulous, partly glabrescent. **Leaves** *each with (1-)2-5(-6) pairs of leaflets*; petioles 3-25 cm long. Leaflets parchment-like to coriaceous; ovate to elliptic, (5-)7-20(-40) × (1-)2-6(-15) cm; base rounded or angular; domatia usually present in the axils of lateral veins below; midrib prominent above, angular to rounded in the basal part, or in larger leaflets completely so or rather flat and broad, lateral veins (6-)9-20(-25) per side, at least prominent on the lower surface, hardly distinct from intercostal veins, *intercostal veins usually coarsely reticulate*, hardly or not prominent above, prominent beneath; petiolules 3-12 mm long. **Inflorescences** axillary and pseudoterminal;



**Fig. 16.** *Mischocarpus sundaicus* (A–E); *M. pentapetalus* (F). A, fruiting leafy twig; B, fruit; C, male flower; D, male flower with two sepals removed; E, bisexual flower; F, fruit. (A–B from SAN 50950, C–D from SAN 116099, E from SAN 121647, F from PNH 34128.)

main axis to 40 cm long, secondary axes 1–20 cm long; cymules to 11 mm long; bracts triangular, 6–8 × 1.5–4 mm, those of the secondary axes caducous. **Flowers:** *calyx lobes hardly connate* to one-fourth its length, triangular to ovate, 0.75–2 × 1–2 mm, subcoriaceous to slightly fleshy, 1(–3)-veined, upper part puberulous to pubescent outside, or rarely very sparsely so in the upper part, puberulous inside; *petals 5 or less*, usually unequal, ovate to elliptic, to 2 × 1 mm, glabrous or pubescent at the base, not clawed, usually auriculate; disc annular, (1–)1.5–2(–3) mm diameter, sometimes irregularly lobed, rarely with lobes protruding between the stamens, puberulous or glabrous; stamens 7 or 8, 3–4 mm long, *filaments usually puberulous, rarely glabrous, anthers papillose, sparsely pubescent or rarely glabrous*; ovary puberulous. **Fruits** (0.8–)1–2(–3) cm long, glabrous; stalk 2–11 × 1–2 mm; seed-bearing locules globose to ellipsoid to obovoid, 3-angular or triquetrous in cross section, 0.4–1.4 cm diameter, glabrous or completely rather densely hairy inside; endocarp incomplete (2 mm thick at either side of the suture) to complete, usually less so in the fertile than in the sterile locules. **Seeds** to 8(–12) mm long, ellipsoid to globose; cotyledons subcollateral, both or only the lower one folded, lower one usually smaller.

**Distribution.** From India, Myanmar, SW China, throughout SE Asia, to W Malesia. Relatively frequent in Sabah and Sarawak; also in Kalimantan and possibly in Brunei.

**Ecology.** In primary and secondary forests, at (300–)800–2000 m. In Sabah and Sarawak, mainly found on fertile clay loam soil. Flowering and fruiting throughout the year, but the main periods differ from region to region.

## 2. *Mischocarpus sundaicus* Blume (of the Sunda islands)

Fig. 16A–E.

*l.c.* (1825) 238; King *l.c.* 447; Merrill, *En. Philip.* 2 (1923) 513; Radlkofer in Engler *l.c.* (1933) 1299; Masamune *l.c.* 428; Backer & Bakhuizen *f. l.c.* 141; van der Ham *l.c.* (1977) 281, *l.c.* (1994) 667; Anderson *l.c.* 312; Whitmore & Tantra *l.c.* 215; Corner *l.c.* 681; Yap *l.c.* 449; Whitmore, Tantra & Sutisna *l.c.* 312. **Lectotype** (van der Ham 1977): *Anonymous, s.n.* (= *L. sheet no. 908.269–749*), Java, Nusa Kambangan (L).

Shrub or tree to 10(–30) m tall; young parts and inflorescences puberulous. **Leaves** each with 1–3(–4) pairs of leaflets or simple; petioles 1–11 cm long. Leaflets parchment-like to subcoriaceous; ovate to elliptic, 4–17(–26) × 1.5–7(–10) cm; base rounded or angular, margin slightly revolute, domatia usually present in the axils of lateral veins below; midrib prominent above, broad to rather narrow, rounded or often locally to completely angular beneath, lateral veins 8–15 per side, moderately curved, prominent beneath; *intercostal veins densely and finely reticulate*, slightly raised to flat above, more prominent toward the margin beneath; petiolules 3–8 mm long. **Inflorescences** axillary and pseudoterminal, 1.5–25 cm long, branched; cymules short-stalked; pedicels 1–3 mm long; bracts triangular, to 6 × 2 mm, usually caducous. **Flowers:** *calyx connate for one-fourth to one-third its length*, triangular, 0.65–2 × 0.5–1 mm, subcoriaceous, puberulous to pubescent in the lower half or rarely in the upper half, glabrous to sparsely hairy inside; *petals absent* or to 3 (in Peninsular Malaysia); disc annular, 1–2 mm diameter, glabrous or sparsely puberulous; stamens (6–)8(–9), to 4 mm long, *filaments glabrous, anthers not papillose, glabrous*; ovary puberulous. **Fruits** 7–17(–20) mm long, glabrous or very sparsely puberulous; stalk 2–14 × 1–1.5 mm; seed-bearing lobes globose to ellipsoid, round to faintly triangular in cross section, glabrous to hairy along the

sutures inside; endocarp completely sclerenchymatic. **Seeds** globose to ellipsoid, to 7 mm long; cotyledons superposed, about equal.

**Distribution.** India, S China, throughout SE Asia and Malesia. Relatively common in Sabah and Sarawak; also in Kalimantan and possibly in Brunei.

**Ecology.** In primary and secondary lowland, hill, and lower montane forests, from sea level to 1600 m. Flowering mostly in January–August; fruiting mostly in May–December.

## 14. NEPHELIUM L.

(Greek, *nephelion* = a little cloud)

*rambutan* (Malay)

**P.W. Leenhouts**

Mant. Pl. (1767) 18; King, J. As. Soc. Beng. 65, 3 (1896) 432; Merrill, EB (1921) 359; Ridley, FMP 1 (1922) 498; Radlkofer in Engler, Pflanzenr. 98 (1932/33) 950; Masamune, EPB (1942) 428; Brown, FTSB (1955) 317; Backer & Bakhuizen f., FJ 2 (1965) 138; Anderson, CLTS (1980) 312; Leenhouts, Blumea 31 (1986) 373, FM 1, 11 (1994) 669; Whitmore & Tantra, CLS (1986) 215; Corner, WSTM 3rd ed. 2 (1988) 682; Yap, TFM 4 (1989) 450; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 313.

Medium-sized to tall trees or rarely shrubs, *dioecious or sometimes monoecious*. *Indumentum of solitary simple hairs*. **Leaves** spirally arranged, *paripinnate*, 1-foliolate or each with 1–5(–18) pairs of leaflets, *without pseudostipules; neither petiole nor rachis winged*. *Leaflets* alternate to more rarely opposite, *mostly distinctly glaucous and finely papillate beneath*, domatia often present; margin entire or rarely repand; venation open (except in *N. subfalcatum*). **Inflorescences** axillary, pseudoterminal, terminal, or borne on leafless twigs and stems (*N. cuspidatum*). **Flowers** *unisexual, radially symmetrical; sepals (4–)5(–6), free to connate for more than halfway, valvate or sometimes slightly imbricate, all equal, not petaloid*, entire, hairy inside, sparsely short-hairy outside, not ciliate, without glands; *petals 5(–6) or 1–4 reduced, or often absent*, if present shorter than the calyx, *clawed, well-developed, with a bilobed scale without appendages*, hairy on both sides, entire; *disc entire*, often slightly lobed, without appendage; *stamens 4–10*, exerted in male flowers, filaments rather densely long-hairy at least in the basal part, anthers nearly always with at least a few hairs; ovary short-stalked, *(1–)2(–4)-locular; mostly warty, densely hairy, style usually well-developed, stigmas fairly long, spreading to finally recurved; ovules 1 per locule, half enveloped by an outgrowth of the placenta*. **Fruits** *1(–2)-lobed*; stalk short to inconspicuous; *lobes ellipsoid to subglobose, warty to spiny, or exceptionally nearly smooth*; fruit wall thin- to thick-coriaceous or rarely corky to nearly woody, glabrous inside, indehiscent or apparently often dehiscing irregularly at the upper part or splitting into two or more or less equal valves. **Seeds:** hilum nearly basal; micropylar wart apical or mostly subapical; *sarcotesta covering the whole seed, except for the micropylar region or at least perforated in front of the micropyle, sometimes with a collar-like outgrowth around the hilum*; endotesta tough or exceptionally rather hard; embryo erect with the plumule at the micropylar end, equal cotyledons, straight suture and fully included plumule and radicle or transverse with lateral plumule, often very unequal cotyledons (the hilar one larger), curved to sigmoid suture, and exposed radicle.

**Distribution.** Twenty two species; SE Asia from Yunnan and Assam to Hainan, Peninsular Malaysia, Sumatra, Jawa, Borneo, Philippines, Sulawesi, and Maluku; 15 species in Sabah and Sarawak.

**Ecology.** Midstorey trees of rain forest at low to medium altitudes; outside Borneo sometimes also in deciduous or savannah forest. The fruits are mainly dispersed by monkeys and fruit-bats, though in some species dispersal by water has been reported.

**Uses.** The sarcotesta of a few species is edible, but only *N. lappaceum* and *N. ramboutan-ake* are commonly cultivated for their commercially important fruits. The timber is hardly of any commercial importance.

**Taxonomy.** Identification is hardly possible without more or less mature fruits. Therefore, under many species notes have been given regarding differences with other comparable species from the same area.

### Key to *Nephelium* species

1. Ovary 1-locular.....**8. N. maingayi**  
     Ovary 2(-4)-locular, very rarely 1-locular.....2
2. Fruit wall hard, corky, 3-6 mm thick.....**2. N. compressum**  
     Fruit wall coriaceous or eggshell-like, rarely more than 1(-7) mm thick.....3
3. Fruits warty, knobby or spiny.....4  
     Fruits with filiform, strap-shaped, tongue-shaped or spine-like appendages.....6
4. Fruits glabrous. Leaflets ovate to elliptic.....**1. N. aculeatum**  
     At least the upper half of the fruit-appendages densely puberulous. Leaflets elliptic to obovate.....5
5. Leaf axes densely tomentulose, sometimes glabrescent. Leaflets hairy above, except (sometimes only) for the midrib, early glabrescent; midrib and lateral veins densely tomentose beneath. Calyx to 3 mm high.....**4. N. daedaleum**  
     Leaf axes sparsely puberulous to glabrous. Leaflets glabrous above, sparsely sericeous beneath, sometimes glabrescent. Calyx to 1.75 mm high.....**10. N. melanomiscum**
6. Fruit appendages distinctly puberulous all over.....7  
     Fruits subglabrous or exceptionally with a hair-tuft on top of the appendages.....9
7. Petiolules not grooved above. Leaflets slightly falcate.....**7. N. macrophyllum**  
     Petiolules grooved above. Leaflets symmetrical.....8
8. Intercostal veins and veinlets densely reticulate, faintly conspicuous above, inconspicuous beneath. Leaflets drying brown.....**9. N. meduseum**  
     Intercostal veins and veinlets more or less laxly reticulate and conspicuous on both sides. Leaflets drying green.....**13. N. reticulatum** (in part)

9. Domatia present.....10  
 Domatia absent.....14
10. Reticulation dense on the upper side of leaflets.....11  
 Reticulation lax on the upper side of leaflets.....12
11. Fruits to 2.5 × 1.5 cm; fruit wall to 1 mm thick; appendages to 10 mm long. Intercostal veins reticulate.....**5. N. havilandii**  
 Fruits to 6 × 3.5 cm; fruit wall to 2.5 mm thick, appendages usually more than 10 mm long. Intercostal veins often tending to be scalariform.....**6. N. lappaceum** (in part)
12. Inflorescences axillary or pseudoterminal, ending in a vegetative bud; infructescences thus lateral. Fruits with bulbous-based spines, or sometimes warty. Leaflets when dried often curled or rolled-up.....**12. N. ramboutan-ake** (in part)  
 Inflorescences usually truly terminal, not ending in a vegetative bud; infructescences thus also terminal. Fruit appendages subfiliform or sometimes more or less tongue-shaped. Leaflets when dried mostly flat.....13
13. Leaflets parchment-like, apex not mucronate; midrib raised above; intermediate lateral veins well-developed; intercostal veins reticulate. Fruits to 3 × 2.25 cm; appendages sparse and short, to 7.5 mm long.....**15. N. uncinatum**  
 Leaflets coriaceous, apex usually mucronate; midrib usually sunken above, intermediate lateral veins mostly inconspicuous; intercostal veins tending to be scalariform. Fruits to 6 × 3.5 cm; appendages dense, to 2 cm long.....**9. N. lappaceum** (in part)
14. Fruit appendages of long spines. Leaflets when dried often curled or rolled-up.....  
 .....**12. N. ramboutan-ake** (in part)  
 Fruit appendages mostly filiform. Leaflets mostly flat when dried.....15
15. Leaflets, at least on the midrib, nearly always hairy below.....16  
 Leaflets glabrous below or at most with a few minute hairs along the midrib.....17
16. Twigs and leaves usually densely hairy, rarely glabrous. Inflorescences axillary and/or pseudoterminal.....**3. N. cuspidatum**  
 Twigs and leaves sparsely hairy to glabrous. Inflorescences mostly truly terminal.....  
 .....**6. N. lappaceum** (in part)
17. Apical part of fruit appendages nipple-like, 1–2 mm long. Leaflets hardly short- and broad-acuminate.....**11. N. papillatum**  
 Apical part of fruit appendages thread- or hair-like, to 15 mm long. Leaflets rather abruptly caudate-acuminate.....18
18. Reticulation of intercostal veins and veinlets dense and not elongatedly parallel to the lateral veins. Apical part of fruit appendages to 10 mm long, slightly hairy.....  
 .....**13. N. reticulatum** (in part)  
 Reticulation of intercostal veins and veinlets lax and elongatedly parallel to the lateral veins. Apical part of fruit appendages to 15 mm long, glabrous.....**14. N. subfalcatum**



### 1. *Nephelium aculeatum* Leenh.

(Latin, *aculeatus* = with spine-like appendages; the fruit)

*L.c.* (1986) 382, *L.c.* (1994) 672. **Type:** *Meijer SAN 48559*, Borneo, Sabah (holotype L; isotypes K, SAN).

Medium-sized tree. **Leaves** each with 4 pairs of leaflets; petioles 8–10 cm long, 2 mm thick, terete; rachis tomentulose to subglabrous. Leaflets stiff parchment-like, glabrous above, puberulous on midrib and lateral veins beneath, in between veins fairly densely sericeous; *domatia* absent; *ovate to elliptic*, 9–19 × 4.5–5.5 cm; base rounded to obtuse, slightly attenuate, usually parallel-sided in the lower two third, apex gradually acuminate, acumen rather long and broad; midrib grooved above, lateral veins 0.75–1 cm apart, hardly raised above, intermediate lateral veins absent, *intercostal veins fairly densely scalariform*, slightly raised on both sides, veinlets finely reticulate, slightly raised above, only partly visible beneath; petiolules 5–8 mm long, narrowly deeply grooved, without a rib above. **Inflorescences** probably axillary. Flowers unknown. **Fruits** 1–2-lobed, oblique-ellipsoid, *c.* 3 × 2 × 1.75 cm, *glabrous; appendages fairly dense, spine-like, c. 2 mm long.*

**Distribution.** Endemic to Borneo; In Sabah, uncommon.

**Ecology.** Secondary forest. Fruiting in August.

**Uses.** Fruits edible.

### 2. *Nephelium compressum* Radlk.

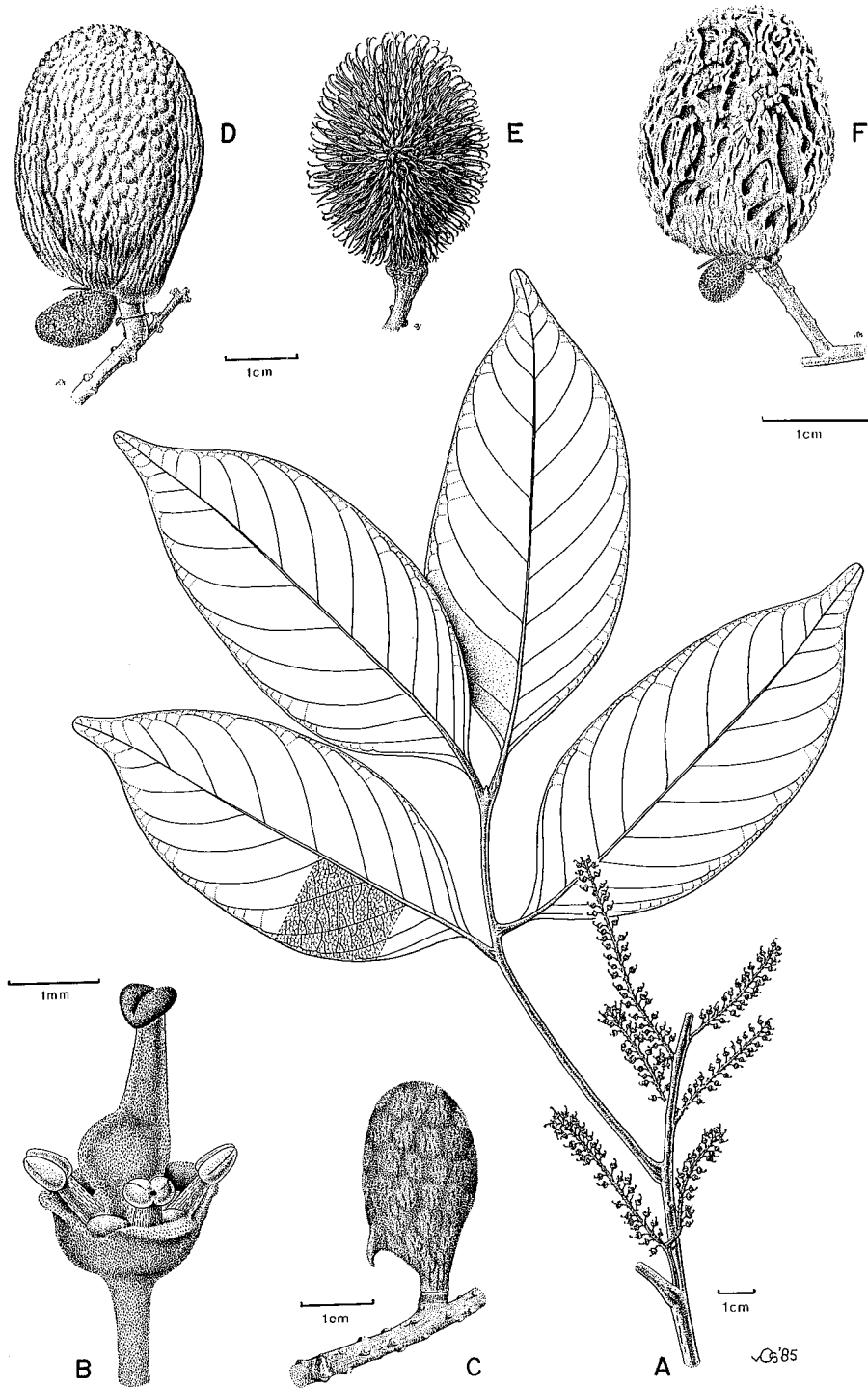
Fig. 17D.

(Latin, *compressus* = laterally flattened; the fruit)

Sapind. Holl.-Ind. (1879) 9, 28; Merrill *L.c.* (1921) 360; Radlkofer in Engler *L.c.* (1933) 980; Masamune *L.c.* 428; Anderson *L.c.* 317; Leenhouts *L.c.* (1986) 382, *L.c.* (1994) 672; Whitmore, Tantra & Sutsina *L.c.* 313. **Type:** *Beccari PB 1268*, Borneo, Sarawak (holotype M; isotypes BO, FI, K, NY).

Tree. **Leaves** each with 3–5-pairs of leaflets; petioles 4.5–12 cm long, 2–4 mm thick, grooved or subterete towards the apex above; rachis tomentose, glabrescent. Leaflets stiff-coriaceous, tomentose on the midrib above, soon glabrescent, densely tomentose on the midrib, lateral veins and intermediate lateral veins beneath, thinly in between; *domatia* absent; *elliptic to obovate*, 4.5–18 × 2.75–7.5 cm; base rounded (upper leaflets), obtuse or acute, sides curved, *margin repand*, apex apiculate or with a short, broad, acute to rounded acumen; midrib slightly raised above, *lateral veins 0.5–1.25 cm apart, sunken above*, intermediate lateral veins well-developed; *intercostal veins densely scalariform, slightly sunken or flat above*, visible beneath, veinlets minutely reticulate, visible above, obscure beneath; petiolules 2–5 mm long, broadly and shallowly grooved with a strong median rib above. **Inflorescence** a widely branched terminal or pseudoterminal thyrses. **Flower:** *sepals free or nearly so*, 2–2.2 mm long; petals 5, 1.25–1.8 × 1.1–1.4 mm, white, blade woolly outside, base sometimes woolly inside, claw 0.3–0.4 mm long, woolly outside, scale 0.2–0.25 mm high, consisting of 2 connate, reflexed, rounded lobes; disc glabrous; stamens 7 or 8; *ovary 2-locular*. **Fruits** flattened ellipsoid, 4–4.5 × 2.5 × 1.25–1.75 cm, tomentulose, partly glabrescent, *rugose-warty; fruit wall hard, corky, 3–6 mm thick.*

**Distribution.** Endemic to Sarawak, near Kuching, uncommon.



**Fig. 17.** *Nephelium maingayi* (A–C); *N. compressum* (D); *N. cuspidatum* (E); *N. daedaleum* (F). A, flowering leafy twig; B, female flower; C–F, fruits. (A–B from SAN 65365, C from SAN 38799, D from Beccari PB 1268, E from S. 27687, F from SAN 50490.)

**Ecology.** Flowering in March; fruiting in December. This species is characterized by its peculiar fruits which appear to be dispersed by water rather than by animals at least as judged from the thick corky fruit wall and the thin sarcotesta.

**Taxonomy.** Vegetatively, the species is closely related to *N. cuspidatum* var. *eriopetalum*. The best characters to distinguish these two taxa are: the slightly bullate leaflets with sunken lateral veins and usually slightly sunken intercostal veins on the upper surface in *N. compressum*, against the hardly bullate leaflets with narrowly grooved lateral veins and usually slightly raised intercostal veins in *N. cuspidatum* var. *eriopetalum*. In flowering specimens, *N. compressum* differs from *N. cuspidatum* var. *eriopetalum* by its rather large and widely branched, thyrsoïd, terminal or pseudoterminal inflorescences, the nearly free and slightly imbricate sepals, and the well-developed corolla. In *N. cuspidatum* var. *eriopetalum*, the inflorescences are mainly axillary or sometimes even borne on leafless twigs and stems, and composed of a few spike-like branches; the sepals are more connate and valvate; and the petals are few and reduced in size or absent.

### 3. *Nephelium cuspidatum* Blume

Fig. 17E.

(Latin, *cuspidatus* = tapering gradually; the leaflet apex)

Rumphia 3 (1847) 110; Merrill *l.c.* (1921) 360; Radlkofer in Engler *l.c.* (1933) 977; Masamune *l.c.* 428; Anderson *l.c.* 312; Leenhouts *l.c.* (1986) 385, *l.c.* (1994) 674; Yap *l.c.* 451; Whitmore, Tantra & Sutisna *l.c.* 215. **Type:** *Korthals, s.n.* (= *L. sheet no. 908. 269-1369, 1389, 1470 and 1490*), Borneo (L). **Synonyms:** *N. dasyneurum* Radlk., Rec. Bot. Surv. India 3 (1907) 354, in Engler, *Planzentr.* 98 (1933) 978; *N. obliquinerve* Radlk. *l.c.* (1907) 354, in Engler *l.c.* (1933) 978.

Tree to 40 m tall, 80 cm diameter, sometimes with small buttresses, rarely a shrub. **Leaves** each with (1-)2-9(-13) pairs of leaflets; petioles 2.5-21 cm long, 1-6 mm thick, terete or subterete with a longitudinal groove above; rachis mostly persistently hairy. Leaflets coriaceous or chartaceous, glabrous to variably hairy along the midrib and on the lower lateral veins or rarely hairy all over above, variably hairy all over beneath, between lateral veins often minutely sericeous, *domatia absent*; *elliptic to linear*, 6-35 × 1.75-12.5 cm; base acute to broadly rounded, exceptionally subcordate, mostly variably attenuate, sides curved to straight and parallel, apex rounded to acute, mostly acuminate, acumen to 2.5 cm long, slender to sometimes broad, acute to sometimes obtuse; midrib sunken to slightly raised above, lateral veins 0.5-2 cm apart, slightly raised to slightly grooved above, intermediate lateral veins variably developed, *intercostal veins and veinlets either together closely or sometimes laxly reticulate, or the former more or less clearly scalariform*, at least the veinlets often hardly visible beneath; petiolules 2-7.5(-15) mm long, variably grooved or sometimes flat above, with or without a median rib. **Inflorescences** mostly pseudoterminal in the axils of upper leaves, sometimes terminal, or borne on leafless twigs or stems, often long pendulous racemes or spikes. **Flower:** *sepals hardly to halfway connate*, 1.1-2.5 mm long; *petals mostly absent, if present often reduced in number*; disc hairy or glabrous; stamens (4-)7-8(-9); *ovary 2-locular*. **Fruits** ellipsoid to sometimes globose, 2-4 × 2-3 cm, glabrous or sometimes slightly hairy at the tip of the appendages; *appendages dense, filiform to narrowly strap-shaped, up to 2 cm long, or sometimes ligulate and 5-6 mm long, straight or often curved or curled, globose at base, pyramidal, or triangular and in the latter case often connate; fruit wall thin-coriaceous*.

**Vernacular names.** Sabah—*kalambuko* (Murut), *lemag* (Dusun Kinabatangan), *manggalum* (Kadazan), *mengalim* (Dusun Kinabatangan), *rambutan* (Malay). Sarawak—*buah kebuau* (Iban), *buah mersilat* (Punan), *buah sibau* (Iban), *kapusong* (Kayan, Land Dayak).

**Distribution.** Myanmar, Thailand, Cambodia, Vietnam, Peninsular Malaysia, Sumatra, W Java, Borneo, and Palawan. Common in Sabah and Sarawak.

**Ecology.** Usually an understorey tree of primary or sometimes secondary mixed dipterocarp forest on well-drained land, mainly on ridges and slopes, rarely on plains or river banks; preferably on fertile clay loam derived from igneous rocks, rarely on sandstone or limestone; from sea level to 800 m. Flowering mainly in November to March; fruiting mainly in May to September.

**Uses.** Locally cultivated as a fruit tree. The wood is sometimes used for construction but is not of a very good quality (Burkill, EPMP (1935) 1544, 1548; Heyne, Nutt. Pl. Ned.-Indië, ed. 2 (1927) 997).

In Sabah and Sarawak, five varieties with two subvarieties are recognized.

### Key to varieties and subvarieties

1. Intercostal veins laxly reticulate, prominent on both sides of leaflets. Inflorescences terminal.....
  - var. **robustum** (Radlk.) Leenh.  
*L.c.* (1986) 391, *L.c.* (1994) 677. Basionym: *N. robustum* Radlk., Leaflet. Philip. Bot. 5(1913) 1607, in Engler *L.c.* (1933) 966. Type: *Elmer 12934*, Philippines, Palawan, Puerto Princesa, Mt. Pulgar (holotype M; isotypes BO, FI, L, NY, U).  
 Leaflets *c.* 35 × 5–10 cm, margins straight and parallel to slightly curved; midrib flat to sunken above, lateral veins slightly raised to sunken above, intermediate lateral veins only slightly developed; petiolules 7–15 mm long. Flowers: sepals 25–50% connate, 1.3–1.8 mm long; petals absent. Fruit appendages dense, narrowly strap-shaped to filiform, gradually thickened and broadened toward the base, curled, *c.* 1.5 cm long.  
 Palawan (one collection) and Borneo. Common in Sabah; also in Brunei and Kalimantan.
- Intercostal veins finely reticulate, often inconspicuous to hardly visible on the upper side of leaflets. Inflorescences pseudoterminal or axillary.....2
2. Leaflet lower surface in between lateral veins glabrous or sparsely appressed-hairy (the venation visible). Sepals 20–40% connate.....3
  - Leaflet lower surface in between lateral veins minutely sericeous or more-or-less hairy (the venation obscure). Sepals hardly to slightly connate.....4
3. Leaf rachis hairy. Largest leaflets 20–35 cm long, lateral veins not conspicuously dense, those in the central part of leaflets to 2 mm apart. Fruit appendages 10–20 mm long.....
  - var. **eripetalum** (Miq.) Leenh.  
*L.c.* (1986) 389, *L.c.* (1994) 676; Yap *L.c.* 451. Basionym: *N. eripetalum* Miq., Fl. Ned. Ind.,

Suppl. (1861) 508, Ridley *l.c.* (1922) 502, Radlkofer in Engler *l.c.* (1933) 979, Anderson *l.c.* 312, Corner *l.c.* 684. Lectotype (Leenhouts, 1986): *Junghuhn, s.n.* (= *L. sheet no. 908. 269-1390*), Sumatra (L).

Leaflets 3–12.5 cm broad, margin nearly straight and parallel to mostly slightly curved; midrib slightly raised to slightly sunken above, lateral veins finely grooved or flat above, intermediate lateral veins often many and well-developed; petiolules 2–10 mm long. Flowers: sepals 1.8–2.5 mm long; petals absent to 5 and reduced in size. Fruit appendages dense, strap-shaped to sometimes filiform, straight to sometimes curled, base swollen, pyramidal or broadened.

Peninsular Malaysia, Sumatra, Borneo, W Java. Common in Sabah, uncommon in Sarawak; also in Brunei.

Leaf rachis early glabrescent. Largest leaflets to 17 cm long; lateral veins dense, those in the central parts of leaflets to 0.75 mm apart. Fruit appendages to 8 mm long.....

var. **multinerve** (Radlk.) Leenh.

*l.c.* (1986) 389, *l.c.* (1994) 676. Basionym: *N. multinerve* Radlk., Sapind. Holl.-Ind. (1879) 9, 27, in Engler, *l.c.* (1933) 979, Merrill *l.c.* (1921) 360, Masamune *l.c.* 429. Type: *Beccari PB 2820*, Borneo, Sarawak (FI).

Leaflets 6–8.5 broad, margins curved; midrib almost glabrous, narrowly grooved above, lateral veins almost glabrous, slightly raised above, intermediate lateral veins hardly developed; petiolules 5–12.5 mm long. Flowers: sepals *c.* 1.75 mm long; petals not seen (present according to Radlkofer *l.c.*, 1933). Fruit appendages very dense, arranged in longitudinal rows, narrowly triangular to strap-shaped.

4. Leaflets linear, margins parallel, glabrous or early glabrescent beneath; petiolules narrowly shallowly grooved above, sometimes with a faint median rib. Twigs early glabrescent. Inflorescences pseudoterminal. Fruit appendages ligulate-triangular.....

var. **cuspidatum** subvar. **cuspidatum**

Leaflets 1.75–5 cm broad, apex acuminate, acumen long and slender; midrib sunken above, lateral veins flat to slightly grooved above, intermediate lateral veins often well-developed, petiolules 4–7.5 mm long. Flowers: sepals 1.1–1.2 mm long; petals absent, or one and reduced in size. Fruit appendages dense, 5–6 mm long, slightly curved.

Endemic to Borneo; uncommon in Sabah.

Leaflets elliptic, margins gradually curved, more-or-less sericeous beneath; petiolules broadly grooved with a strong median rib above. Twigs densely hairy. Inflorescences axillary. Fruit appendages narrowly strap-shaped with bulbous base.....

var. **ophioides** (Radlk.) Leenh. subvar. **beccarianum** (Radlk.) Leenh.

*l.c.* (1986) 390, *l.c.* (1994) 677. Basionyms: *N. ophelioides* Radlk. *l.c.* (1879) 77, 78, Ridley *l.c.* (1922) 502, Corner *l.c.* 686. Type: *Maingay KD 543, p.p.*, Malacca (holotype B, destroyed; isotype K); *N. beccarianum* Radlk. *l.c.* (1879) 9, 27, in Engler *l.c.* (1933) 978, Merrill *l.c.* (1921) 359, Masamune *l.c.* 428, Anderson *l.c.* 312. Lectotype (Leenhouts, 1986): *Beccari PB 2279*, Borneo, Sarawak, Mt. Matang (FI).

Leaflets 2–5 cm broad, midrib slightly raised to slightly sunken above, lateral veins flat to slightly grooved above, intermediate lateral veins often rather strongly developed; petiolules 2–7 mm long. Flowers: sepals *c.* 1.8 mm long; petals absent (present according to Radlkofer *l.c.*, 1933). Fruit appendages to 1 cm long.

Endemic to Borneo; common in Sabah and Sarawak.

**4. *Nephelium daedaleum* Radlk.**

Fig. 17F.

(Latin, *daedaleus* = with sinuous, irregularly plaited or jagged lines; the fruit wall)

Sapind. Holl.-Ind. (1879) 9, 27, in Engler *l.c.* (1933) 980; Merrill *l.c.* (1921) 360; Masamune *l.c.* 429; Leenhouts *l.c.* (1986) 391, *l.c.* (1994) 677. **Type:** *Beccari PB 2818*, Borneo, Sarawak (holotype FI; isotype K).

Tree to 33 m tall, 70 cm diameter, sometimes with buttresses. **Leaves** each with 1–3(–5) pairs of leaflets; petioles 2–9.5 cm long, 1–2 mm thick, terete to subterete; rachis tomentulose, sometimes glabrescent. *Leaflets* parchment-like, hairy all over above, early glabrescent except the midrib, tomentose on midrib and lateral veins beneath, densely sericeous in between lateral veins, *domatia absent; elliptic*, 6.5–18 × 2.5–7 cm; base acute to rounded, margins curved, apex not to abruptly acuminate, acumen short and broad to long and slender, obtuse; midrib slightly raised above, lateral veins 0.5–1.25 cm apart, slightly grooved above, intermediate lateral veins often well-developed, *intercostal veins finely reticulate, inconspicuous above*, invisible or sometimes slightly raised and somewhat scalariform beneath; petiolules 5–9 mm long, variably grooved, and mostly with a median rib above. **Inflorescences** terminal. **Flowers:** *sepals almost free*, c. 3 mm long; *petals 4 or 5*, 1.75–2 × 1.5–2 mm, blade auricled to funnel-shaped, densely woolly outside, claw to 1 mm long, densely woolly outside; disc glabrous; stamens 8 or fewer; *ovary 2-locular*. **Fruits** flattened-ellipsoid, base bulging at the abaxial side, c. 4 × 2.25 cm, c. 1.5 cm thick, densely short-hairy, *fairly densely set with pyramidal warts of c. 1.5 mm high*, deeply irregularly fissured; *fruit wall coriaceous, 2–2.5 mm thick*.

**Vernacular names.** Sabah—*rambutan* (Malay). Sarawak—*kalas* (Iban).

**Distribution.** Endemic to Borneo; common in Sabah, uncommon in Sarawak.

**Ecology.** Primary lowland *kerangas* or mixed dipterocarp forest on slopes or ridges; on sandstone, sandy clay, or loam soils; up to 570 m. Flowering in May, September; fruiting in June, August, September, November.

**Uses.** Sometimes cultivated for its edible fruit.

**5. *Nephelium havilandii* Leenh.**

(G. D. Haviland, 1857–1901, first Sarawak Medical Officer)

*l.c.* (1986) 394, *l.c.* (1994) 678. **Type:** *Haviland 2241*, Borneo, Sarawak (holotype K; isotypes L, SING).

Tree c. 8 m tall. **Leaves** each with 1–2 pairs of leaflets; petioles 2.25–5 cm long, 1–1.5 mm thick, slightly hollowed above; rachis subglabrous. *Leaflets* coriaceous, glabrous above, thinly minutely sericeous beneath, *domatia absent or present as exposed glands or covered by a tuft of hairs; elliptic*, 6–9 × 3–4.25 cm; base slightly asymmetric, acute, attenuate, margins curved, apex narrowly rounded, short-acuminate or not; midrib slender and slightly raised above, lateral veins 0.5–1.5 cm apart, slightly raised above, intermediate lateral veins well-developed or sometimes absent, *intercostal veins reticulate, moderately coarse and slightly raised above, inconspicuous beneath*; petiolules 3–5 mm long, broadly rather deeply grooved and often with a faint median rib above. **Inflorescences** axillary. **Flowers:** *sepals free*, 1.5–2.5 mm long; *petals 5*, elliptic, 0.8–1.4 mm long, with a short claw, without a scale, either glabrous outside

and woolly in the lower half inside, or woolly mainly in the lower half on both sides; disc woolly; stamens *c.* 7; ovary 2-locular. **Fruits** ellipsoid, *c.* 2–2.5 × 1.25 cm, glabrous, appendages dense, 8–10 mm long, base bulbous, apical part triangular in cross section, curved; fruit wall coriaceous, *c.* 0.5 mm thick.

**Distribution.** Endemic to Borneo; Sarawak, near Kuching, uncommon; also very uncommon in W Kalimantan.

**Ecology.** Flowering in October; fruiting in February, November.

## 6. *Nephelium lappaceum* L.

(Latin, *lappaceus* = bur-like; the fruit appendages)

Mant. Pl. 1 (1767) 125; Ridley *l.c.* (1922) 499; Radlkofer in Engler *l.c.* (1932) 957, fig. 24; Backer & Bakhuizen *f. l.c.* (1965) 138; Anderson *l.c.* 312; Leenhouts *l.c.* (1986) 398, *l.c.* (1994) 680; Whitmore & Tantra *l.c.* 215; Corner *l.c.* 684; Yap *l.c.* 453; Whitmore, Tantra & Sutisna *l.c.* 314. **Neotype** (Leenhouts, 1986): Bogor Botanic Garden III.H.10 (= Carocci-Buzi 190, Nedi 12, Sutrisno 71) (L; isoneotypes BO, M, NY, U).

Tree or sometimes shrub. **Leaves** 1-foliolate or each with up to 8 pairs of leaflets; petioles 1.5–16 cm long, 1–3.5 mm thick, terete, subterete, or sometimes grooved above; rachis variably hairy, early to late glabrescent. **Leaflets** coriaceous, glabrous or sometimes slightly hairy on the midrib above, variably hairy beneath, *domatia* common to absent; ovate to obovate, 5–28 × 2–10.5 cm; base acute to rounded, attenuate or not, margins strongly curved to nearly straight and parallel, apex acute to truncate; midrib slightly raised to slightly sunken above, lateral veins 0.5–2 cm apart, slightly raised to slightly sunken above, intermediate lateral veins mostly inconspicuous, *intercostal veins* finely or coarsely reticulate, the veinlets often tending to be scalariform, often raised above; petiolules 5–12 mm long, broadly and shallowly grooved with or without median or lateral rib or narrowly grooved or flat without rib above. **Inflorescences** axillary, pseudoterminal, or sometimes terminal. **Flowers:** *sepals* almost free to more than halfway connate, 0.7–2.1 mm long; *petals* mostly absent, sometimes up to 4, reduced in size, claw *c.* 1.1 mm long, blade *c.* 0.5 × 0.5 mm, margin infolded and connate towards the base, glabrous or with a few long hairs outside, margin long-ciliate, woolly inside; disc hairy or glabrous; stamens (4–)5–8(–9); ovary 2(–3)-locular. **Fruits** hardly stalked, ellipsoid to subglobose, to 6 × 3.5 cm, glabrous; fruit wall coriaceous, to 2.5 mm thick; appendages sparse or dense, base bulbous or broad, tapering towards the strap-shaped or filiform, more or less curved, 0.5–2-cm-long upper parts.

**Vernacular names.** Preferred name—*rambutan* (Malay). Sabah—*rangalau* (Dusun Ranau). Sarawak—*buah abong* (Kenyah), *buah maha* (Punan Tutoh), *lung bipuyoh* (Berawan), *sangan* (Bidayuh Sadong), *situgog* (Bidayuh).

**Distribution.** Yunnan, Hainan, Indo-China, Peninsular Malaysia, Sumatra, Java, Borneo, Philippines, and Sulawesi. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Taxonomy.** The only constant morphological difference between *N. lappaceum* and *N. ramboutan-ake* is in the fruit appendages. In *N. lappaceum*, the basal part of fruit appendage is small and inconspicuous and the upper part is thread-like and long; in *N. ramboutan-ake*, on the other hand, the basal part of fruit appendage is relatively large, triangular to ovoid, and

tapering towards the short and broad, often thick and stiff apical part. In Sabah and Sarawak, 3 varieties are recognised.

### Key to varieties

1. Leaflets hardly glaucous beneath, mostly widest above the middle, margins strongly curved, apex rarely acuminate; lateral veins widely spreading and strongly curved.....

var. **lappaceum**

Yap *l.c.* 453; Leenhouts *l.c.* (1994) 682. Synonyms: *N. glabrum* Reinw. *ex* Blume, *Cat.* (1923) 111, *nom. nud.*, Masamune *l.c.* 428; *N. subferrugineum* Radlk. *l.c.* (1879) 9, 77, in Engler *l.c.* (1933) 956, Masamune *l.c.* 428, Anderson *l.c.* 313; *N. obovatum* Ridl., *Kew Bull.* (1933) 191, Radlkofer in Engler *l.c.* (1934) 1500, Masamune *l.c.* 429, Anderson *l.c.* 313.

Tree or shrub to 27 m tall, 70 cm diameter; buttresses to 1.5 m high. Leaves 1-foliolate or each with up to 5 pairs of leaflets; petioles 1.5–12 cm long; rachis variably hairy, glabrescent. Leaflets 5–22 × 2.5–10.5 cm, glabrous above, sparsely hairy on the midrib and lateral veins beneath, in between lateral veins mostly glabrous, sometimes sparsely or densely appressed-hairy, domatia present; base obtuse or rounded, apex obtuse or rounded, sometimes truncate to slightly emarginate, apiculate or slightly acuminate, rarely tapering into a cuneate and acute acumen; lateral veins 0.75–2 cm apart, intercostal veins and veinlets coarsely to finely reticulate; petiolules 2–10 mm long. Flowers: sepals 4–5(–7), mostly slightly connate, 1.1–2.1 mm long, mostly thinly to densely appressed short-hairy outside, mostly appressed long-hairy to woolly inside; stamens 5–8. Fruits large; fruit wall thin.

Thailand, Peninsular Malaysia, Sumatra, Borneo, W and C Java, Philippines, and possibly Ceram. Commonly cultivated for its fruits, also in other parts of the tropics, and doubtless not rarely escaped and become naturalized. In Sabah and Sarawak common; also in Brunei and Kalimantan.

Leaflets usually distinctly glaucous beneath, mostly widest about or below the middle, margins often nearly straight and parallel, apex usually acuminate; lateral veins fairly steep and only slightly curved.....2

2. Leaflets mostly to only 4 cm wide; midrib often glabrous beneath, intercostal veins and veinlets reticulate, with the veins often tending to be scalariform.....

var. **pallens** (Hiern) Leenh.

*l.c.* (1986) 402, *l.c.* (1994) 683. Basionym: *N. mutabile* Blume var. *pallens* Hiern in Hooker *f.*, *Fl. Br. Ind.* 1 (1875) 687. Lectotype (Leenhouts, 1986): *Maingay 1527 = KD 454, p.p.*, Malacca (K). Synonym: *N. chryseum* Blume *l.c.* (1847) 105, Merrill *l.c.* (1921) 360, Radlkofer in Engler *l.c.* (1933) 962, Masamune *l.c.* 428, Anderson *l.c.* 312.

Tree or shrub to 44 m tall, 125 cm diameter; buttresses to 4 m tall. Leaves each with (1–)3–5(–8) pairs of leaflets; petioles 2.5–12 cm long; rachis densely short-hairy to glabrous. Leaflets 5.5–12(–20) × (2–)3–4(–7) cm, sometimes slightly sickle-shaped, upper surface glabrous or sometimes slightly puberulous on the midrib, lower surface mostly minutely sericeous, domatia common to absent; base acute to sometimes obtuse or rounded, apex narrowly rounded to acute or tapering into rounded or acute acumen; lateral veins 0.5–1(–2) cm apart; petiolules (1.5–)3–8 mm long. Flowers: sepals 4–5, rarely 6, up to halfway connate, 1–2 mm long, sparsely to densely appressed, short-hairy outside, densely velutinous inside; stamens (4–)5–8(–9). Fruits



to 5 × 3.5 cm; stamens (4–)5–8(–9). Fruits to 5 × 3.5 cm; fruit wall 1.5–2.5 mm thick. China, Thailand, Indo-China, Peninsular Malaysia, Sumatra, Borneo, Philippines and Sulawesi. Common in Sabah, uncommon in Sarawak; also in Brunei and Kalimantan.

Leaflets to 10 cm wide; midrib densely tomentulose, intercostal veins mostly distinctly scalariform, sometimes tending to be coarsely reticulate, veinlets reticulate.....

var. **xanthioides** (Radlk.) Leenh.

*l.c.* (1986) 403, *l.c.* (1994) 683. Basionym: *N. xanthioides* Radlk. *l.c.* (1879) 9, 77, in Engler *l.c.* (1933) 966, Beccari, For. Born. (1902) 601, Merrill *l.c.* (1921) 360, Masamune *l.c.* 429. Type: *Beccari PB 2849*, Borneo, Sarawak (FI).

Tree to 30 m tall, 60 cm diameter; buttresses to 2 m high. Leaves each with 2–5 pairs of leaflets; petioles 10–16 cm long; rachis tomentulose. Leaflets 9–28 × 3–10 cm, upper surface glabrous or sometimes sparsely puberulous on the basal half of the midrib, lower surface densely tomentulose on the midrib or sparsely to densely appressed short-hairy on the midrib and lateral veins or sparsely minute-hairy, domatia rare; base obtuse to rounded, apex tapering into a slender, rounded or acute acumen; lateral veins 0.6–1.75 cm apart; petiolules 5–12 mm long. Flowers: sepals 4–5, to halfway connate, 0.7–1.6 mm long, densely hairy on both sides; stamens 5–6. Fruits *c.* 3 × 2 cm; fruit wall *c.* 1 mm thick.

Endemic to Borneo. Uncommon in Sabah and Sarawak; also in Kalimantan.

## 7. **Nephelium macrophyllum** Radlk.

(Greek, *makros* = large; *phullon* = leaf)

Sapind. Holl.-Ind. (1879) 9, 27, in Engler *l.c.* (1933) 973; Merrill *l.c.* (1921) 360; Masamune *l.c.* 428; Anderson *l.c.* 313; Leenhouts *l.c.* (1986) 406, *l.c.* (1994) 684. **Type:** *Beccari PB 2500*, Borneo, Sarawak (holotype FI; isotypes M, NY).

Tree to 24 m tall, 40 cm diameter. **Leaves** each with 1–2 pairs of leaflets; petioles 4–7 cm long, 1–2.5 mm thick, subterete to obtuse-angular above; rachis glabrous or sometimes very sparsely minutely puberulous. **Leaflets** thick-coriaceous, glabrous above, sparsely puberulous on midrib and lateral veins beneath, in between lateral veins densely minute-sericeous, *domatia present; elliptic*, 10–22.5 × 5–10 cm; base acute to rounded, slightly attenuate, margin curved, apex tapering into short acute acumen; midrib slightly raised above, lateral veins 1–3 cm apart, slightly sunken above, few intermediate lateral veins well-developed, *intercostal veins tending to be scalariform*, slightly raised or hardly visible above, slightly raised beneath, *veinlets finely reticulate*, slightly raised to hardly visible above, hardly visible beneath; petiolules 1.5–7 mm long, slightly bulging above. **Inflorescences** pseudoterminal. **Flowers** known only from remains under the fruit; *sepals probably only slightly connate, c. 2 mm long; petals present (?); disc glabrous; ovary 2- rarely 3-locular.* **Fruits** ellipsoid, *c. 3.5 × 2 cm, appendages dense, c. 7.5 mm long, base bulbous, upper part tongue-shaped, slightly curved*, densely ferruginous-puberulous; fruit wall coriaceous, *c. 2 mm thick.*

**Distribution.** Endemic to Borneo; Sarawak, from the Baram valley to Kuching, uncommon; also in Brunei.

**Ecology.** In primary mixed dipterocarp forest, on sandy clay and clay loam soils, to 1000 m. Fruiting in September.

**Taxonomy.** The gross morphology of fruits of the present species may superficially resemble that of *N. ramboutan-ake*. However, in the latter species the fruits are glabrous and the leaflets much thinner. *N. macrophyllum* sometimes shows some vegetative characters similar to those of *N. melanomiscum*. However, the former is characterized by asymmetric, slightly sickle-shaped leaflets, whereas the latter has symmetric leaflets. The fruits of both species are distinctly different.

### 8. *Nephelium maingayi* Hiern

Fig. 17A–C.

(A.C. Maingay, 1836–1869, botanist of the East India Company)

In Hooker *f.*, Fl. Br. Ind. 1 (1875) 688; Radlkofer in Engler *l.c.* (1933) 964; Anderson *l.c.* 313; Leenhouts *l.c.* (1986) 407, *l.c.* (1994) 685; Yap *l.c.* 454. **Syntypes:** *Maingay 1120, 1120A, 1524A*, Malaya (K).

Tree to 40 m tall, 90 cm diameter; sometimes buttresses to 1.4 m high. **Leaves** 1-foliolate or each with up to 3(–5) pairs of leaflets; petioles 1–10 cm long, 1–3 mm thick, terete to subterete; rachis early glabrescent or sometimes glabrous. **Leaflets** parchment-like, glabrous or sometimes very sparsely hairy on midrib and lateral veins beneath, *domatia absent*; *elliptic to obovate*, 5.75–22 × 2.75–9 cm; base rounded to acute, mostly attenuate, margin curved, apex without or with an obtuse to acute acumen; midrib sunken to slightly raised above, lateral veins 0.5–2.5 cm apart, slightly grooved to slightly raised above, intermediate lateral veins absent, *intercostal veins and veinlets coarsely reticulate*, slightly raised on both sides; petiolules 4–17.5 mm long, grooved, and without rib above. **Inflorescences** axillary to terminal. **Flowers:** *sepals from less than halfway to nearly completely connate*, 1–1.3 mm long; *petals absent*; disc hairy or glabrous; stamens 4–6; *ovary 1-locular*; *style lateral, with 1 stigma*. **Fruits** more-or-less flattened-ellipsoid, 2–2.75 × 1.25–1.75 cm, × 1–1.25 cm thick; stalk 2–3 mm long; remnant of style present in the form of a small point or hook just above the fruit stalk; *surface variably warty*, slightly puberulous around and especially beneath the style remnant, otherwise glabrous; fruit wall coriaceous, 1–1.5 mm thick.

**Vernacular names.** Sabah—*buah sungkit* (Kedayan), *kolomundui* (Kadazan). Sarawak—*mujau* (Iban), *serait* (Malay).

**Distribution.** Peninsular Malaysia, Sumatra, Borneo. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

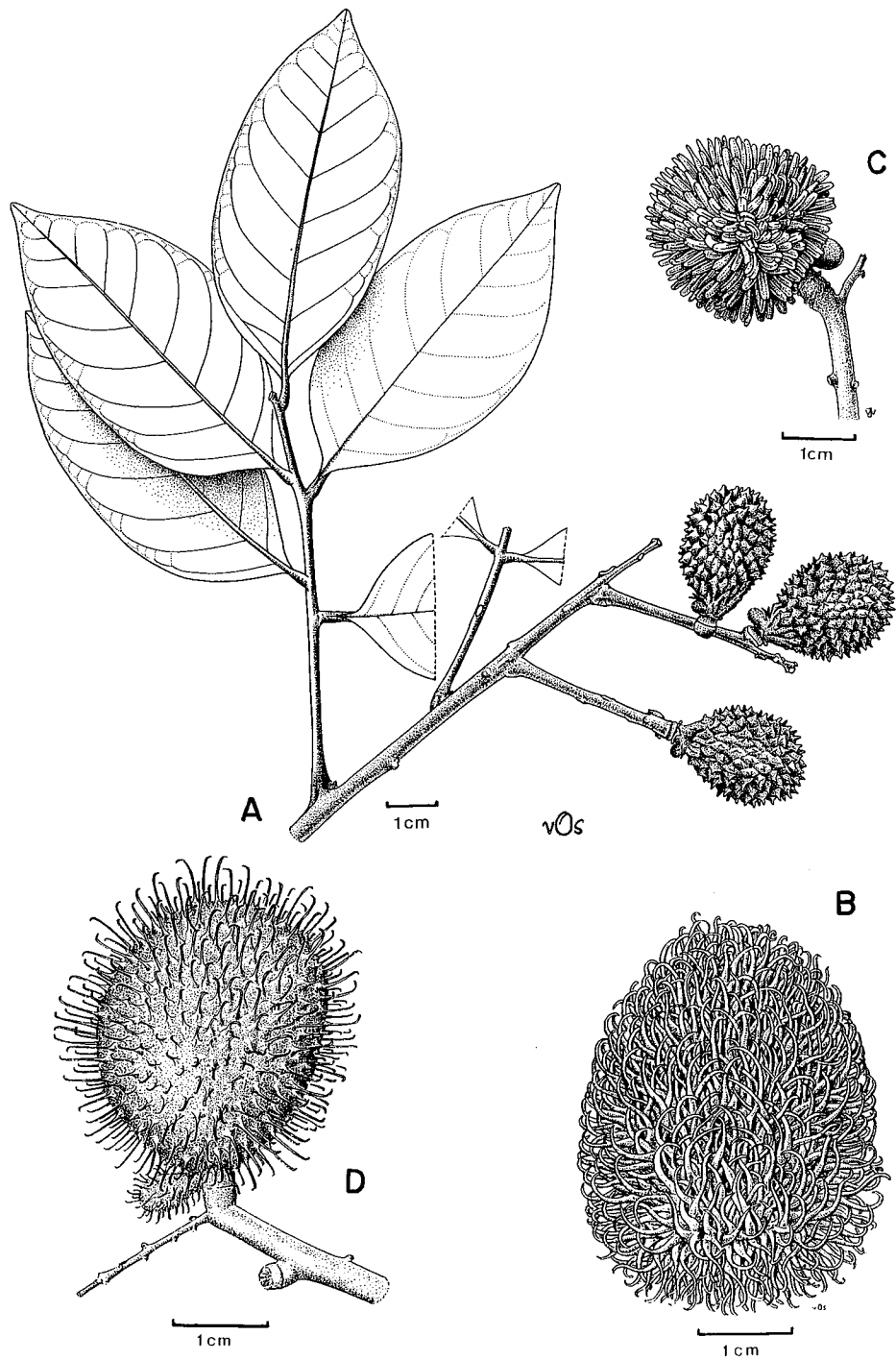
**Ecology.** In primary mixed dipterocarp and secondary forest on flat land (often in peat swamps and periodically flooded riverbanks), slopes, and ridges; on peat, sandy or low-nutrient clay soils, mostly at low to medium altitudes, exceptionally up to 1000–1600 m. Flowering mainly in January–April, July–October; fruiting in January–April, August–November.

**Uses.** The timber is of a good quality and is used for many purposes; the sarcotesta is edible but of no economic importance (Heyne, Nutt. Pl. Ned.-Indië, ed. 2 (1927) 998; Burkill, EPMP (1935) 1544, cited as *N. glabrum*).

### 9. *Nephelium meduseum* Leenh.

Fig. 18B.

(Latin, *medusa* = one of the three Gorgons, whose head bears serpents; the curled fruit appendages)



**Fig. 18.** *Nephelium papillatum* (A); *N. meduseum* (B); *N. ramboutan-ake* (C); *N. uncinatum* (D). A, fruiting leafy twig; B–D, fruits. (A from SAN 41845, B from S. 32399, C from FRI 10648, D from Hotta 12984.)

*l.c.* (1986) 409, *l.c.* (1994) 686. **Type:** *Yii S. 41142*, Borneo, Sarawak, 1st Div., G. Gaharu, Sabal FR (holotype K; isotypes KEP, L, MO, SAN, SAR).

Tree to 27 m tall, 50 cm diameter; buttresses to 1.2 m high. **Leaves** each with 2–5 pairs of leaflets; petioles 2–7 cm long, 1.5–2 mm thick, subterete; rachis puberulous, glabrescent. *Leaflets* thin-coriaceous to stiff parchment-like, upper surface puberulous along the midrib, mostly early glabrescent, lower surface glabrescent or glabrous except for the long-hairy midrib and lateral veins, *domatia absent; elliptic*, 5–12.5 × 2.5–5 cm; base acute to obtuse, slightly attenuate, margin curved, apex attenuate-acuminate with a fairly long, broad and obtuse acumen, or acutely apiculate, or not acuminate; midrib slender and slightly raised above, lateral veins 0.75–1 cm apart, slightly sunken above, intermediate lateral veins mostly well-developed though usually only a few per leaflet, *intercostal veins and veinlets finely reticulate and slightly raised above*, veins coarsely reticulate to scalariform beneath, veinlets reticulate and slightly raised to inconspicuous beneath; petiolules 3–12 mm long, broadly shallowly grooved, mostly with a broad but not very strong median rib. **Inflorescences** terminal. **Flowers** (only known from old ones and the remains under the fruit): *sepals hardly connate; petals at least 3, c. 1.6 mm long, claw slender, c. 1 mm long, blade ovate, c. 0.7 mm wide, margin incurved at the basal half, sparsely woolly (except the apex) outside, glabrous inside; disc glabrous; ovary 2-locular.* **Fruits** ellipsoid to subglobose, 3.25–4 × 2.5–3 cm, densely fulvous puberulous; *appendages dense, filiform, curled, c. 15 mm long, swollen at base; fruit wall coriaceous, c. 1 mm thick.*

**Vernacular name.** Sarawak—*rambutan hutan* (Malay).

**Distribution.** Endemic to Borneo; in Sarawak uncommon; also in Brunei and Kalimantan.

**Ecology.** In primary mixed dipterocarp forest on hills, ridges, and slopes, on yellow sandy clay, to 450 m. Fruiting in January and October.

**Uses.** The sarcotesta is edible.

## 10. *Nephelium melanomiscum* Radlk.

(Greek, *melanos* = black, *miskos* = stalk; the leaf rachis)

*l.c.* (1879) 74, in Engler *l.c.* (1933) 972; Merrill *l.c.* (1921) 360; Masamune *l.c.* 429; Anderson *l.c.* 313; Leenhouts *l.c.* (1986) 410, *l.c.* (1994) 687. **Type:** *Beccari PB 3918*, Borneo, Sarawak, Rejang river (FI). **Synonym:** *Nephelium xerospermoides* Radlk., *Leafl. Philipp. Bot.* 5 (1913) 1608, in Engler *l.c.* (1933) 976, Anderson *l.c.* 313.

Tree to 25 m tall, 45 cm diameter; buttresses to 1.2 m high. **Leaves** 1-foliolate or each with up to 5 pairs of leaflets; petioles 1–6 cm long, 1–2 mm thick, terete to subterete, sometimes grooved above; rachis sparsely puberulous to glabrous. *Leaflets* parchment-like, glabrous or puberulous on the base of the midrib above, sparsely minute-sericeous beneath, sometimes glabrescent, *domatia absent or present; elliptic to obovate*, 3.5–14 × 1.5–6 cm; base acute to rounded, slightly attenuate, margin curved, apex rounded, emarginate, or tapering into a short to long, narrow to broad, acute to rounded acumen; midrib slightly raised to sunken above, lateral veins 0.75–1.5 cm apart, slightly raised to grooved above, intermediate lateral veins mostly well-developed, *intercostal veins and veinlets mostly well-differentiated, especially*

beneath, more or less finely reticulate, often more prominent above than beneath; petiolules 3–8 mm long, broadly to narrowly deeply grooved above, with or without a median rib. **Inflorescences** terminal, or sometimes pseudoterminal. **Flowers:** *sepals less than 30–65% connate*, 1.3–1.75 mm long; petals (according to Radlkofer) 2 or 3, reduced in size; disc glabrous; stamens 6; *ovary 2–3-locular*. **Fruits** ellipsoid, c. 3.75 × 2.5 cm, densely fulvous puberulous at least in the upper half of the appendages; *appendages dense, 1.5–2 mm high, not differentiated into a basal and an apical part, those at the base of the fruit appear as longitudinal ribs, those in the central part as triangles, and those towards the upper part as pyramidal warts*; fruit wall fairly hard, c. 0.75 mm thick.

**Vernacular name.** Sabah—*harut* (Kedayan).

**Distribution.** Borneo, Philippines (Mindanao); uncommon in Sabah and Sarawak; also in Brunei.

**Ecology.** Primary and old secondary forests on slopes, riverbanks, and hill tops on clay-rich soil, and on fertile alluvial soil in mixed dipterocarp forest; to 1350 m. Flowering in October; fruiting in January.

**Uses.** The sarcotesta is edible.

### 11. *Nephelium papillatum* Leenh.

Fig. 18A.

(Latin, *papillatus* = having papillae; the fruit wall)

*l.c.* (1986) 413, *l.c.* (1994) 688. **Type:** *Mikil SAN 41845*, Borneo, Sabah, Tambunan Dist., Mt. Trus Madi (holotype L; isotype SAN).

Tree to 36 m tall, 85 cm diameter; buttresses to 2 m high. **Leaves** each with 1–3 pairs of leaflets; petioles 2–5 cm long, 1–1.5 mm thick, subterete; rachis glabrous. *Leaflets* stiff parchment-like, glabrous, *domatia absent; elliptic*, 4.5–10.5 × 2.5–4.5 cm; base acute to obtuse, attenuate, margin curved, apex hardly obtuse-acuminate; midrib slightly sunken to flat above, lateral veins 0.5–1.25 cm apart, slightly raised above, intermediate lateral veins well-developed, making the venation more or less irregular, *intercostal veins and veinlets rather coarsely reticulate*, slightly more prominent above than beneath; petiolules 5–8 mm long, narrowly deeply grooved without a median rib above. **Inflorescences** axillary, or somewhat pseudoterminal. **Flowers** (known only from remains under the fruit): sepals 5, at least sparsely puberulous outside; disc glabrous; stamens 7; *ovary 2-locular*. **Fruits** ellipsoid, c. 2.25 × 1.75 cm, glabrous; *appendages fairly dense, c. 3 mm long, pyramidal, apical part nipple-like, to 2 mm long*; fruit wall rather woody, c. 1 mm thick.

**Distribution.** Endemic to Borneo; uncommon in Sabah.

**Ecology.** Primary lower montane to montane forest, at 1350–1950 m. Fruiting in November.

### 12. *Nephelium ramboutan-ake* (Labill.) Leenh.

Fig. 18C.

(after a local name, *rambutan ake*)

*l.c.* (1986) 415, *l.c.* (1994) 689; Yap *l.c.* 454. **Basionym:** *Litchi ramboutan-ake* Labill. in DC., Bull. Soc. Phil. Math. Paris 2 (1801) 161 ('*Litsea*'). **Type:** *Herb. Jussieu 11382* (P). **Synonym:** *Nephelium mutabile* Blume *l.c.* (1847) 104, Merrill *l.c.* (1921) 360, Ridley *l.c.* (1922) 501 (excl. var. *pallens*), Radlkofer in

Engler *l.c.* (1933) 967, Masamune *l.c.* 429, Backer & Bakhuizen *f. l.c.* 138, Anderson *l.c.* 313, Corner *l.c.* 686.

Tree mostly less than 10 m, sometimes to 40 m tall, 80 cm diameter; buttresses to 2.4 m high. **Leaves** 1-foliolate or each with 1–7 pairs of leaflets; petioles 0.75–11.5 cm long, 0.75–2.5 mm thick, terete to subterete; rachis densely hairy to glabrous. *Leaflets* thin parchment-like to thin-coriaceous, upper surface puberulous on the midrib to glabrous, lower surface sparsely puberulous on the base of the midrib, densely minute-sericeous all over, to sometimes glabrous, *domatia* mostly common, sometimes scarce or absent; narrowly elliptic, 4–20 × 1.75–11 cm; base acute or in lower leaflets obtuse to rounded, attenuate, margin mostly curved, sometimes nearly straight, apex mostly acuminate, the acumen usually short, broad, obtuse; midrib slightly raised or rarely slightly sunken above, usually appearing as a slender rib, lateral veins 0.5–2 cm apart, slightly sunken to sometimes slightly raised above, intermediate lateral veins variable, *intercostal veins* mostly reticulate, tending to be somewhat scalariform or sometimes conspicuously so, slightly raised above, hardly visible beneath; petiolules 3–8 mm long, mostly narrowly and deeply grooved without or with only a faint median rib, or sometimes broadly and shallowly grooved with a stronger rib. **Inflorescences** axillary or pseudoterminal. **Flowers:** *sepals* slightly or up to halfway connate, 1–2.75 mm long; *petals* absent; disc glabrous; stamens 5–8; *ovary* 2(–3)-locular. **Fruits** ellipsoid to subglobose, 4–6.5 × 2.5–5 cm, glabrous; pericarp coriaceous, to 7 mm thick, *coarsely spiny* with the spines up to 1.5 cm long, bulbous and often confluent at base, or covered with short tongue-shaped knobs.

**Vernacular names.** Sabah—*longitam* (Dusun), *meritam* (Kedayan, Malay), *rambutan hutan* (Malay). Sarawak—*buah mua, ma, melenjau, mujau, pudun* (Iban).

**Distribution.** Assam, Myanmar, Peninsular Malaysia, Sumatra, Java (doubtful), Borneo, Philippines, Maluku. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Primary mixed dipterocarp or sometimes secondary forest on flat lands, slopes, riverbanks, rarely in swamps; usually on clay, loam, more rarely on rocky soil, particularly shale, basalt, or limestone; from sea level to 1950 m. Flowering mainly in February to April and July to September; fruiting in May to July and October to December.

**Uses.** Cultivated as a fruit tree; the timber is also used for construction (Seibert, PROSEA 2 (1991) 233).

**Taxonomy.** This species is a rather variable one. The typical “form” found in Peninsular Malaysia, Sumatra, Java, and Borneo, is characterized by its thin parchment-like leaflets which, unlike those of most other species of *Nephelium*, are commonly rolled up in the herbarium specimens, drying reddish brown above and glaucous beneath. The midrib is slightly raised and slender above; the lateral veins are distinctly curved and rather steeply ascending; *domatia* are common; and the reticulations are fairly lax and usually visible above.

The most distinct “form” restricted to Borneo is characterized by its leaves, each with 1–3 pairs of leaflets; the leaflets are relatively large, thin-coriaceous, glabrous above and often so beneath, and lacking in *domatia*. The midrib is hardly raised to slightly sunken and more rounded above; the lateral veins are dense, steeply ascending and nearly straight; the

intercostal veins and veinlets are clearly different from one another, with the former being mostly rather densely scalariform and raised on both sides, and the latter being more faintly and laxly reticulate. This "form" resembles *N. lappaceum* var. *xanthioides* but the latter differs in its leaflets having midrib which is densely hairy beneath and at the base slightly sunken above; and by its terminal inflorescences and infructescences.

*N. ramboutan-ake* may easily be confused with *Dimocarpus longan* var. *echinatus* because these two taxa possess a strong resemblance in leaf and fruit characters. The main differences are that in the former, the indumentum consists of solitary hairs and the twigs are brownish, whereas in the latter, the indumentum is of stellate hair-tufts, and the twigs are white. The fruits of *N. ramboutan-ake* may also resemble those of *N. macrophyllum*; for differences between the two species see there.

*N. ramboutan-ake* is also closely allied to *N. lappaceum* var. *pallens*. However, the latter can be distinguished by its midrib which is flat to sunken above, instead of mostly raised; intercostal veins and veinlets which are slightly raised above, instead of inconspicuous; and the rather dense instead of lax reticulations.

### 13. *Nephelium reticulatum* Radlk.

(Latin, *reticulatus* = net-like; the leaflet intercostal veins and veinlets)

*l.c.* (1879) 9, 27, in Engler *l.c.* (1932) 955; Beccari, For. Born. (1902) 600, 601; Merrill *l.c.* (1921) 360; Masamune *l.c.* 429; Leenhouts *l.c.* (1986) 419, *l.c.* (1994) 691. **Type:** *Beccari PB 2819*, Borneo, Sarawak (FI).

Tree to 25 m tall, 70 cm diameter, sometimes with small buttresses. **Leaves** each with 4(–7) pairs of leaflets; petioles 6–18.5 cm long, 1.5–3 mm thick, terete to slightly hollowed above; rachis thinly puberulous, glabrescent. **Leaflets** parchment-like, glabrous or sometimes sparsely puberulous on the midrib and sparsely appressed minute-hairy all over beneath, *domatia* absent; narrowly elliptic to ovate, 6.5–20 × 2.5–5.5 cm; base rounded to acute, attenuate, margin slightly curved, apex abruptly to gradually acuminate, acumen short to fairly long, cuneate, acute; midrib appearing as a slightly sunken fine rib above, lateral veins 0.75–1.25(–1.5) cm apart, slightly raised above, intermediate lateral veins variably developed, *intercostal veins and veinlets coarsely to minutely reticulate, slightly raised on both sides*; petiolules 2–10 mm long, narrowly and deeply to broadly and shallowly grooved, without rib or with 3 ribs. **Inflorescences** terminal and axillary. **Flowers** often male and female in the same inflorescence; *sepals nearly free or up to c. 40% connate, 1–1.2 mm long; petal absent or 5 to 1.8 mm long, claw c. 1 mm, blade c. 1.5 mm wide, sparsely hairy outside, densely hairy on the lower half inside; disc glabrous; stamens 5–8; ovary 2-locular*. **Fruits** ellipsoid, c. 4 × 2.5 cm; *appendages dense, narrowly strap-shaped, bulbous to triangular at base, curved, to c. 1 cm long, thinly puberulous, glabrescent; fruit wall coriaceous, c. 1 mm thick*.

**Distribution.** Endemic to Borneo; uncommon in Sabah, more common in Sarawak; also in Kalimantan.

**Ecology.** Primary forest on flat or hilly country; to 400 m. Flowering in April, May, July, August, October; fruiting in January.

**Uses.** Occasionally locally cultivated for its fruits.

**14. *Nephelium subfalcatum* Radlk.**(Latin, *sub* = somewhat, *falcatus* = sickle-shaped; the leaflets)

Rec. Bot. Surv. India 3 (1907) 353, in Engler *l.c.* (1933) 973; Leenhouts *l.c.* (1986) 420, *l.c.* (1994) 692; Yap *l.c.* 455. **Type:** *Forbes 3092*, Sumatra, Palembang, Rawas river (holotype M; isotypes K, L, SING).

Tree to 35 m tall, 60 cm diameter; buttresses to 2 m high. **Leaves** *1-foliolate or each with up to 5 pairs of leaflets*; petioles 1.5–7 cm long, 0.75–1.5 mm thick, terete to subterete; rachis sparsely puberulous, mostly glabrescent, or glabrous from the beginning. *Leaflets* thinly parchment-like to coriaceous, glabrous or sometimes sparsely appressed minute-hairy along the midrib beneath, *domatia absent*; *narrowly ovate to elliptic*, 4–15 × 1.5–5 cm; base acute to rounded, attenuate, margins slightly to sometimes strongly curved, sometimes nearly parallel, apex obtuse or rounded or attenuate-acuminate, acumen short, broad and rounded to long, slender and acute; midrib sunken to sometimes slightly raised above, lateral veins 0.5–1.5 cm apart, slightly raised above, more or less distinctly looping and joining near the margin, venation rather irregular because of the often great number of variably developed intermediate lateral veins, intercostal veins clearly differentiated from veinlets, coarsely reticulate, slightly raised on both sides; petiolules 3–10 mm long, narrowly and deeply or sometimes slightly grooved above, without a median rib, mostly with swollen lateral ribs. **Inflorescences** axillary, pseudoterminal, or terminal. **Flowers:** *sepals variably connate*, 1–2 mm long; *petals absent*; disc glabrous; stamens (6–)8; *ovary 2-locular*. **Fruits** ellipsoid, 3.25–3.75 × 2.5 cm, glabrous; *appendages more-or-less dense, strap-shaped to filiform, curved, to c. 15 mm long, base bulbous to triangular, confluent or not*; fruit wall hard, coriaceous, to 3 mm thick.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. Uncommon in Sabah, more common in Sarawak; also in Brunei.

**Ecology.** Primary mixed dipterocarp forest on slopes and ridges, on sandy and loamy soils mainly below 500 m, exceptionally to 975 m. Flowering in August; fruiting in December to February.

**Taxonomy.** Compared to most specimens from Peninsular Malaysia and Sumatra, the Bornean material is less hairy, the margin of the petiolules is not swollen, the apex of the leaflets is long, slender acute-acuminate, and the fruit appendages are somewhat longer. But these differences are not sharp, they do not hold for all specimens, and so a subdivision into infra-specific taxa seems unwarranted.

**15. *Nephelium uncinatum* Radlk. ex Leenh.**

Fig. 18D.

(Latin, *uncinatus* = hook-like; the fruit appendages)

*l.c.* (1986) 421, *l.c.* (1994) 692; Yap *l.c.* 455. **Type:** *Elmer 21708*, Borneo, Sabah, Tawau (holotype M; isotypes BO, L, NY, SING, U).

Tree to 25(–40?) m tall, 45 cm in diameter; buttresses to 1.5 m high. **Leaves** *1-foliolate or each with up to 3–7(–18) pairs of leaflets*; petioles 3–9 cm long, 1–1.5 mm thick, terete; rachis densely minute-hairy, rarely glabrescent. *Leaflets* parchment-like, puberulous in the basal part of the midrib to subglabrous above, sparsely hairy on the midrib and lateral veins beneath, in between lateral veins minutely sericeous, *domatia present*; *narrowly elliptic to obovate*,



sometimes slightly falcate, 4.75–11 × 1.5–3.5 cm; base acute, decurrent, margin slightly curved, apex tapering to fairly abruptly acuminate, acumen short to long, broad, obtuse to acute; midrib raised above; lateral veins 3–8 mm apart, nearly patent, slightly raised above, intermediate lateral veins well-developed, *intercostal veins and veinlets clearly different, coarsely reticulate*, slightly raised but rather inconspicuous on both sides; petiolules (1–)2–4 mm long, broadly shallowly grooved with a strong median rib above. **Inflorescences** terminal, pseudoterminal, or axillary in the upper leaves. **Flowers:** *sepals c. 25–50% connate*, in male flowers 1–1.1 mm, in female ones 1.4–1.5 mm long; *petals absent*; disc in male flowers fairly strongly developed, with the lobes protruding between the stamens, in female flowers less conspicuous, glabrous or sparsely hairy; stamens 5 or 6; *ovary 2-locular, sometimes in the same specimen also 1-locular*. **Fruits** ellipsoid to subglobose, 2.75–3 × 2–2.25 cm, glabrous, *sparsely warty; warts thick, tapering into or more abruptly terminated by filiform, curved appendage of up to 7.5 mm long*; fruit wall coriaceous, 1–2 mm thick.

**Distribution.** Peninsular Malaysia, Sumatra, Borneo. Common in Sabah, uncommon in Sarawak; also in Brunei and Kalimantan.

**Ecology.** Primary and sometimes old secondary forests, mainly on hill slopes and ridges on well-drained soils, rarely in swamp; mostly on sandy soils, to 330 m. Flowering mainly in April to June, sometimes August to October and December; fruiting in December, March.

**Uses.** In Kalimantan, sometimes cultivated for its fruits.

## 15. PARANEPHELIUM Miq.

(Greek, *para* = resembling; near to the genus *Nephelium*)

### M. Davids

Fl. Ned. Ind. Suppl. (1861) 509; Merrill, PEB (1929) 176; Radlkofer in Engler, Pflanzenr. 98 (1933) 1321; Masamune, EPB (1942) 431; Anderson, CLST (1980) 313; Davids, Blumea 29 (1984) 425, FM 1, 11 (1994) 693; Whitmore & Tantra, CLS (1986) 216; Corner, WSTM 3rd ed. 2 (1988) 686; Yap, TFM 4 (1989) 456; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 314.

Trees or sometimes shrubs, *monoecious* or *very rarely dioecious*. *Indumentum of solitary simple hairs only*. **Leaves** *imparipinnate* or *paripinnate*, each with 1–6 pairs of leaflets; *pseudostipules absent*; petiole and rachis terete, not winged. Leaflets smooth beneath; margin entire to dentate; venation open, if margin dentate then each second lateral vein ending in a tooth. **Inflorescences** *borne on leafless twigs, axillary or terminal*. **Flowers** *unisexual* or *very rarely bisexual, radially symmetrical*; *sepals (4–)5(–7), slightly connate to free*, all equal to very unequal, *not petaloid*, white to dark yellow hairy outside, white sericeous inside, margin entire, ciliate, glands absent; *petals (4–)5(–7)*, longer than the sepals, distinctly clawed to broadly truncate at base, usually glabrous to laxly woolly outside, glabrous inside, blade variably developed to nearly completely reduced, scale usually larger than the blade, emarginate to divided into two lobes, orange woolly especially at the upper margin on both sides, crest absent; *disc composed of a flat ring adnate to the torus* except for the margin, thinly fleshy, glabrous, margin with an erect rim to tubular collar up to 1 mm high; *stamens*

5–8(–9), distinctly exerted in male flowers, glabrous, latrorse; ovary sessile, densely tuberculate, each tubercle bearing a stiff erect hair, elsewhere glabrous to minute-hairy, (1–) 3(–4)-locular, ovules 1 per locule, style apical, longer than the ovary, laxly to densely short-strigose, stigma flat or with recurved lobes to 1.5 mm long. **Fruits** *loculicidal capsules*, subglobose, sessile, not winged, smooth, rough, ribbed, or warty to densely spiny, *dehiscing into 3–4 mostly unequal valves or tearing apart at random*; fruit wall thick, fibrous-woody, hairy inside. **Seeds** usually 1 per fruit, subglobose to slightly 2–3-lobed; *arillode absent*; white hilar spot covering up to 75% of the seed; membranous remains of the septa and the undeveloped ovules tightly pressed against the seed.

**Distribution.** Four species; in SE Asia from Yunnan and Myanmar to Hainan, Vietnam, and Thailand, Sumatra, Peninsular Malaysia, Borneo, and the Philippines. In Sabah and Sarawak, 2 species.

**Ecology.** Mainly medium-sized trees in the lower storeys of various kinds of lowland forest. The seeds are said to be dispersed by monkeys.

**Uses.** Of slight importance, only the seeds are edible; oil pressed from the seeds was formerly used for lamp-oil.

### Key to *Paranephelium* species

Leaflet lateral veins straight, abruptly curving near the margin; intercostal veins densely scalariform (lax if leaflets large and petiolules at least 4 mm diameter).....**1. P. joannis**

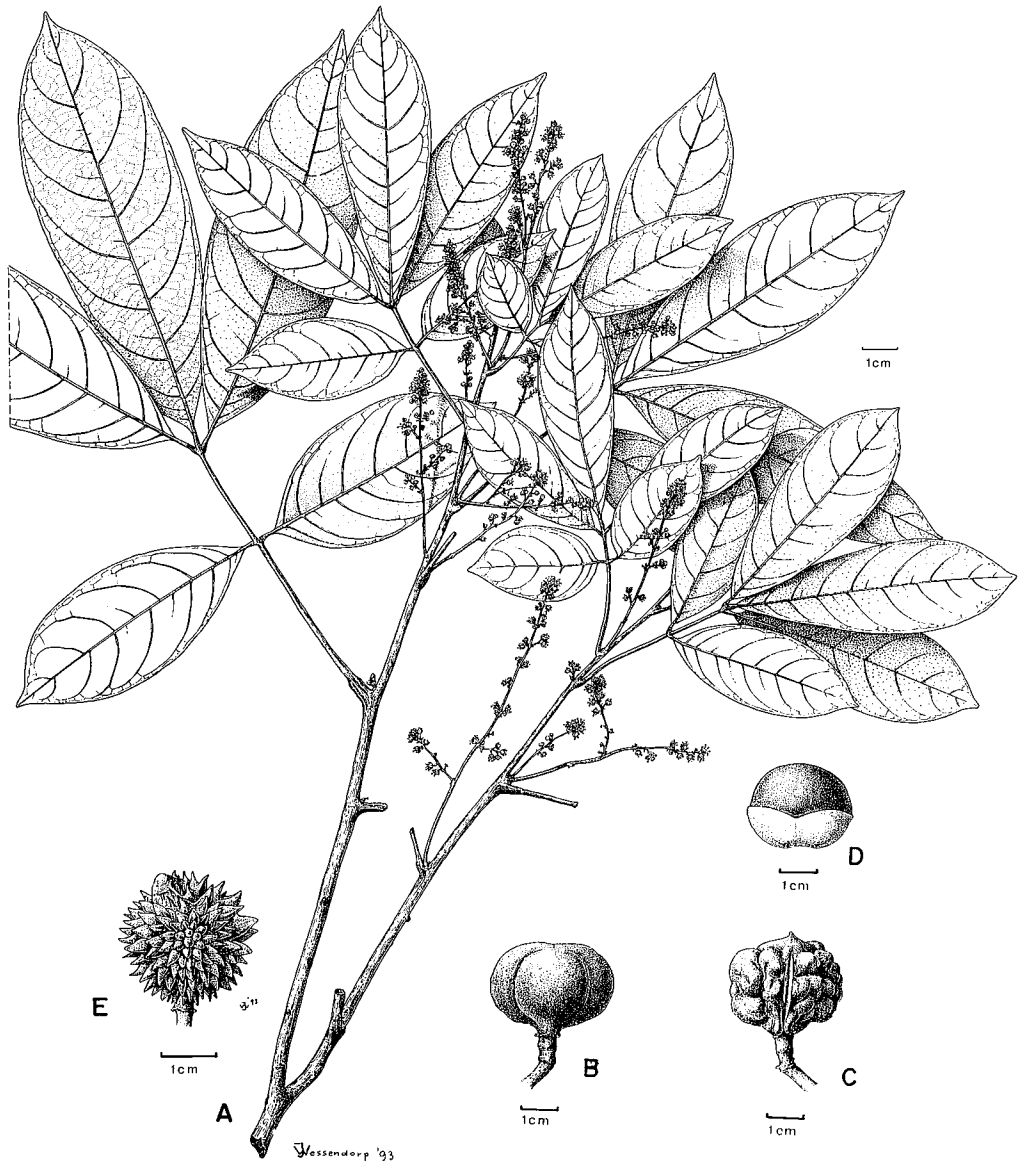
Leaflet lateral veins curving gradually; intercostal veins laxly reticulate (sometimes laxly scalariform if leaflets large, but petiolules at most 4 mm diameter).....**2. P. xestophyllum**

**1. *Paranephelium joannis* Davids**  
(Joannes A.G. Davids, father of M. Davids)

Fig. 19E.

*L.c.* (1984) 434, fig. 2, 3a, *L.c.* (1994) 695, fig. 64a; Whitmore, Tantra & Sutisna *L.c.* 314. **Type:** *Endert 3460*, Central E Borneo, W Kutei, near Petah (holotype L).

Shrub or tree to 24 m tall, 10–40(–60) cm diameter; buttresses to 1.5 m high or with stilt-roots. **Leaves** each with 2–3 pairs of leaflets, sparsely tomentose, glabrescent; petioles 8–25 cm long, 3–7 mm thick. Leaflets coriaceous, tomentose on midrib above and on midrib, lateral veins, intercostal veins and veinlets beneath; elliptic to obovate, 10–50 × 4–22 cm; base symmetric or asymmetric, acute, margin entire, apex emarginate, acute or cuspidate; midrib more or less raised in a groove above; *lateral veins straight, abruptly curving near margin*, sunken to slightly raised, *intercostal veins densely to laxly scalariform*; petiolules 7–22 mm long, 1–8 mm thick. **Inflorescences** *axillary or terminal*, stout and often clustered, 20–38 cm long, densely yellow-tomentose or strigose. **Flowers** sweetly fragrant, white; sepals 5(–6), connate at base, deltoid to ovate, 0.2–2.3 × 0.6–1.8 mm, acute to mucronate; petals 5, blade small to absent (but mind the scale!), narrowly spatulate, 0–1.7 × 0–1 mm, glabrous to pilose outside, scale lobed, 1.5–2.1 × 0.9–2 mm; disc to 1 mm high, 2.5–3.5 mm diameter; stamens



**Fig. 19.** *Paranephelium xestophyllum* (A–D); *P. joannis* (E). A, flowering leafy twig; B–C, fruits; D, seed; E, fruit. (A from Whitmore & Kade 3311, B from SAN 79936, C from Kostermans 13238, D from Boerlage, s.n., E from Kostermans 12670.)

7–8, filaments 2–4.5 mm long; ovary 3-locular. **Fruits** 2.5–4 × 3.5–4.5 cm, yellowish or brownish or red to black, *laxly to densely spiny*, glabrous to densely short-strigose.

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

**Distribution.** Endemic to Borneo; uncommon in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Primary forest, often on riverbanks, sometimes on slopes; on clay or sandy soil, sandstone or limestone; from sea level to 450 m. Flowering in March–April and August–September, November; fruiting in July–November and January–February.

**Uses.** The seeds are edible when cooked.

## 2. *Paranephelium xestophyllum* Miq.

Fig. 19A–D.

(Greek, *xestos* = smooth, *phullon* = leaves)

*l.c.* (1861) 198, 509; Merrill, Enum. Philipp. Fl. Pl. 2 (1923) 514; Radlkofer in Engler *l.c.* (1933) 1324; Davids *l.c.* (1984) 437, fig. 1, 3b–i, *l.c.* (1994) 696, fig. 646–d, 65; Yap *l.c.* 457; Whitmore & Tantra *l.c.* 216; Whitmore, Tantra & Sutisna *l.c.* 314. **Lectotype** (Davids, 1984): *Teijsmann HB 4218*, Sumatra, Lampong Province, G. Batin (L; isolectotype K). **Synonym:** *Paranephelium nitidum* King, J. As. Soc. Beng. 65, 3 (1896) 450, Merrill *l.c.* (1929) 176, Masamune *l.c.* 431, Anderson *l.c.* 313.

Shrub or tree to 20(–40) m tall, 10–45(–75) cm diameter, often with stilt-roots to 60 cm, or with buttresses to 70 cm high. **Leaves** each with 1–6 pairs of leaflets; rachis more or less densely minute-hairy; petioles 0.8–17 cm long, 1–4 mm thick. Leaflets thick-chartaceous; elliptic (or in the lowermost pair ovate), 3–42 × 1.1–14 cm; base symmetric (or strongly asymmetric in the lowermost pair), narrowly cuneate to obtuse, attenuate or not, margin entire, more or less undulate, apex acute to rounded, acuminate or not; midrib more or less raised in a furrow to slightly prominent above, minute-hairy on both sides (especially at base), *lateral veins gradually curving*, sunken or flat to slightly raised in a groove and hairy beneath, *intercostal veins more or less laxly reticulate or scalariform*; petiolules 1–20 mm long, 0.8–4 mm thick. **Inflorescences** usually borne on leafless twigs, occasionally axillary or terminal, delicate and clustered, 2–30 cm long, laxly to densely velutinous and hispid. **Flowers** fragrant, white to greenish white to yellowish; sepals (4–)5(–6), free or connate at base, equal to very unequal, narrowly triangular to broadly ovate or linear, acute to acuminate, 2-tipped, 0.8–2 × 0.5–1.8 mm; petals (4–)5(–7), 1–2.5 × 0.7–2.7 mm, glabrous to woolly outside, scale emarginate to divided into 2 lobes, 1.1–2.2 × 1.2–3 mm; disc 0.7–1.5 mm high, 1–2.8 mm diameter, at base with a few hair-tufts alternating with petals; stamens 5–8 (or 9), filaments to 4 mm long; ovary (2–)3(–4)-locular. **Fruits** to 7 cm diameter, more or less 2–3-lobed or globose, brown, yellow or grey, *smooth, laxly to densely more-or-less irregularly gibbose, warty or spiny*, glabrous.

**Vernacular names.** Sabah—*ambuakat*, *ampungot*, *bambakat*, *tombuakat* (Dusun Kinabatangan).

**Distribution.** China (Yunnan), Myanmar, Thailand, Indo-China, Peninsular Malaysia, Sumatra, Borneo, and the Philippines. Relatively common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Understorey trees of various kinds of forest, often along rivers, on hill-slopes, rarely in seasonal swamps and on well-drained ridges or summits, on clay, podsol, sand over igneous rock, sandstone or limestone; most typically in mixed dipterocarp forest on leached clay-rich soils; from sea level to 1100 m. Flowering mainly in February–July, fruiting in May–September.

**Uses.** Good firewood but rarely used for timber. Seeds are edible when baked or boiled; lamp-oil can be obtained from the pressed seeds.

## 16. POMETIA J.R. Forst. & G. Forst.

(P. Pomet, 1658–1699, a French writer)

*kasai* (Malay)

Based on the work by the late

**M. Jacobs**

Char. Gen. Pl. (1775) 55, t. 55; King, J. As. Soc. Beng. 65, 3 (1896) 440; Merrill, EB (1921) 360; Ridley, FMP 1 (1922) 503; Radlkofer in Engler, Pflanzenr. 98 (1932) 924; Masamune, EPB (1942) 431; Jacobs, Reinwardtia 6 (1962) 109, FM 1, 11 (1994) 698; Backer & Bakhuizen *f.*, FJ 2 (1965) 138; Anderson, CLTS (1980) 313; Whitmore & Tantra, CLS (1986) 216; Corner, WSTM 3rd ed. 2 (1988) 687; Yap, TFM 4 (1989) 457; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 314. **Synonyms:** *Irina* Blume, Bijdr. Fl. Ned. Ind. (1825) 229.

Medium-sized to large *monoecious trees*; often buttressed, with a red exudate when cut. *Indumentum* mainly of solitary hairs, sometimes mixed with some small tufts of hairs. **Leaves** spirally arranged, *paripinnate*; basal leaflets stipule-like, often strongly reduced and caducous; petioles pulvinate; young leaves crimson, very conspicuous; leaves at the base of inflorescences often reduced to pseudostipules. *Leaflets opposite to alternate*, lower ones always smaller; *lower surface often with large orbicular glands at least on both sides near the base, or in the axils of some lateral veins, or sometimes scattered all over the surface, or exceptionally on the marginal incisions*; petiolules broadly attached, nearly always with 2 lateral grooves, or with a broad flat groove, or narrowly winged above. **Inflorescences** terminal and sometimes in the axils of upper leaves, *thyrsoid*; branches mostly long and racemose; cymules short, of about the same length, patent or nearly so, once-dichasial, branches bostrycoid (ringlet-like), condensed, axes usually partly connate, distal cymules reduced to 2 seemingly collateral, bracteate flowers; uppermost flowers solitary; bracts narrowly triangular to filiform; bracteoles absent; pedicels terete, slender, articulate, lengthened and swollen in fruit. **Flowers** *unisexual, radially symmetrical*; *sepals 5, slightly to more than halfway connate, valvate in bud, 2 outer ones usually slightly smaller, not petaloid, entire, persistent in fruit*; *petals 5 (rarely absent), much shorter to distinctly longer than the calyx, not or hardly clawed, nearly entire, without appendages; disc annular, pulvinate, not lobed, more or less wavy*; *stamens 5 (6), in male flowers long-exserted, filaments filiform, hairy mainly in the lower half or glabrous, anthers densely minutely papillose; ovary sessile, cordate, 2(-3)-locular, style about as long as or longer than the ovary, ovules 1 per locule*. **Fruits** *sessile, mostly only 1 locule developed, indehiscent, smooth, glabrous, red to black*

when ripe; exocarp hard, rather thin; mesocarp rather thick and very juicy, white, semitransparent, tasting sweet, in the dried fruit irregularly split into two fibrous or corky layers, one inside the pericarp, the other covering the seed. **Seeds** oblique ovoid, red-brown, *completely enveloped by a thin fleshy arillode*, hilum orbicular, *c.* 5 mm diameter.

**Distribution.** Two species; Sri Lanka, Andaman and Nicobar Is., Indo-China, Taiwan, throughout Malesia and the Pacific to Fiji, Samoa, and Tonga.

**Ecology.** Lower storey and canopy trees of tropical rain forest, primary as well as secondary, at low to medium altitudes. Dispersal probably mainly by fruit-bats and by birds (Lane-Poole, For. Res., 1925, 109; Sody, Indon. J. Nat. Sc. 111 (1955) 195), possibly also to some extent by water as at least some forms of *P. pinnata* are common along river banks and as the fruits are buoyant for a few days (Guppy, Observ. Natur. Pacific 2 (1906) 532). In both species, witches' broom is a common and conspicuous pathological feature; they represent mostly repeatedly dissected leaves, but sometimes also (parts of) inflorescences; the origin is unknown.

**Taxonomy.** *Pometia* seems to be closely allied to *Dimocarpus* with which it shares characters such as the orbicular glands on the lower side of the leaflets and, when the leaflets are incised, the typical venation. They also have similarities in floral structure, the free arillode, and the tendency to develop pseudostipules.

### Key to *Pometia* species

Leaflets acicular to coarsely dentate; lateral veins sunken above, venation hardly or not prominent.....**1. *P. pinnata***

Leaflets entire; lateral veins slightly raised above, venation prominent on both sides.....**2. *P. ridleyi***

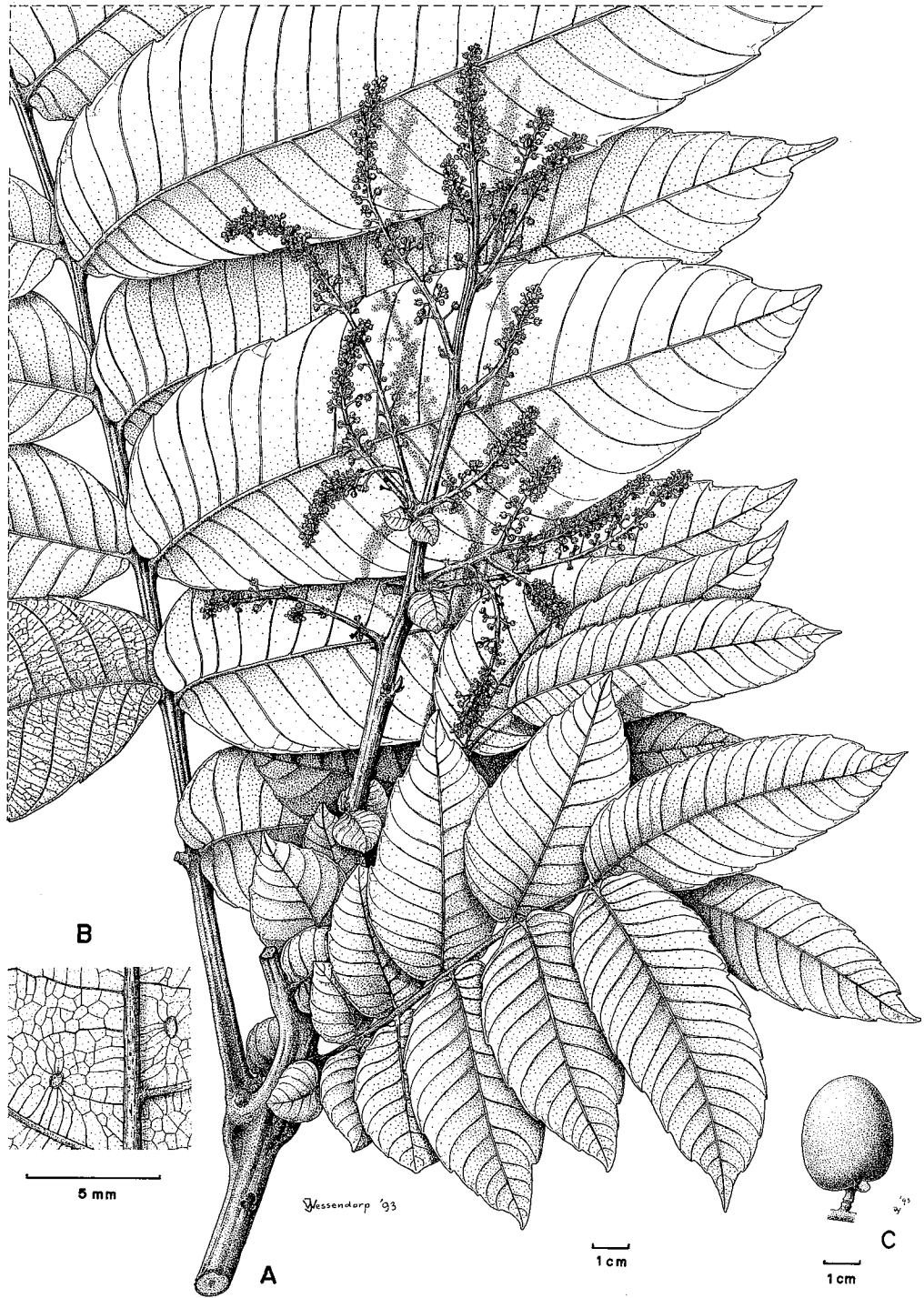
#### 1. *Pometia pinnata* J.R. Forst. & G. Forst.

Fig. 20.

(Latin, *pinnatus* = with 2 rows of leaflets; the leaf)

*l.c.* 55, *t.* 55; King *l.c.* 441; Merrill *l.c.* (1921) 375; Ridley *l.c.* (1922) 504; Radlkofer in Engler *l.c.* (1932) 929; Masamune *l.c.* 431; Desch, Mal. For. Rec. 15 (1954) 534, *t.* 107, *f.* 2; Brown, FTSB (1955) 318; Jacobs *l.c.* (1962) 120, *l.c.* (1994) 701; Backer & Bakhuizen *f. l.c.* 139; Burgess, TBS (1966) 443, *f.* 52; Anderson *l.c.* 313; Whitmore & Tantra *l.c.* 216; Corner *l.c.* 688; Yap *l.c.* 457; Whitmore, Tantra & Sutisna *l.c.* 314. **Type:** *Forster, s.n.*, New Hebrides, Namoka (holotype BM; isotype W). **Synonyms:** *Irina tomentosa* Blume *l.c.* (1825) 230; *Pometia tomentosa* (Blume) Teijsm. & Binnen., Cat. Hort. Bogor. (1866) 214, Radlkofer in Engler *l.c.* (1932) 934, Masamune *l.c.* 413; *Irina alnifolia* Blume, Rumphia 3 (1847) 117; *Pometia alnifolia* (Blume) King *l.c.* 442, Ridley *l.c.* (1922) 504, Radlkofer in Engler *l.c.* (1932) 928, Masamune *l.c.* 431, Corner *l.c.* 688; *Nephelium acuminatum* Hook.f., Trans. Linn. Soc. 23 (1860) 164; *Pometia acuminata* (Hook. f.) Radlk., Sapind. Holl.-Ind (1879) 9, Merrill *l.c.* (1921) 175, Radlkofer in Engler *l.c.* (1932) 933, Masamune *l.c.* 431, Anderson *l.c.* 313.

Tree to 50 m tall, 1.4 m diameter; buttresses to 5 m high, spreading to 3 m wide, to 15 cm thick. Young parts very early to late glabrescent. **Leaves** to more than 1 m long, *each with 4–13 pairs of leaflets*; petiole and rachis glabrous to densely hairy; pseudostipules elliptic to ovate, 0.4–3



**Fig. 20.** *Pometia pinnata*. A, flowering leafy twig; B, detail of gland on lower surface of leaflet; C, fruit. (A from Hoogland 5048, B from King's coll., s.n., C from Clemens 5329.)

× 0.25–5 cm, straight to strongly falcate. *Leaflets* parchment-like to coriaceous, glabrous or variably hairy, variably glandular; *ovate to obovate, slightly to distinctly falcate*, 6–32 × 2–13 cm; *margin acicular or coarsely dentate*, apex acute to abruptly or gradually acuminate, acumen to 2 cm long, broad to slender, mostly mucronate, *lateral veins sunken above, 1.5–2.5 cm apart, every 2nd vein ending in or protruding from a marginal tooth, those in between gradually curving towards the margin and becoming feebler, intercostal veins hardly or not prominent*; petiolules 1.5–4 mm long, **Inflorescences** erect to drooping, 15–70 cm long, mostly hairy; pedicels 1–4 mm long, slender to filiform, articulate in the lower one fifth; bracts usually absent apart from those of the primary flowers of the cymules. **Flowers:** calyx 1–2.5 mm diameter, sepals variably connate, lobes 0.5–1.5 × 0.3–1.2 mm, variably hairy outside, hairy or glabrous inside; petals shorter or longer than calyx, 0.4–1.3 × 0.3–1.6 mm, hairy or sometimes glabrous outside; stamen filaments 2–6 mm long, glabrous to completely hairy, anthers 0.5–1 mm long; ovary 0.8–1.2 × 2.5 mm, style 2–5.5 mm long. **Fruits** 1.5–5 × 1–3 cm; fruit wall in the lower part c. 1 mm, in the upper part to at least 7 mm thick. **Seeds** to 2.5 × 1.5 cm.

**Vernacular names.** Sabah—*datanut* (Dusun), *dipangah* (Dusun Banggi). Sarawak—*enselan* (Iban Selayar), *kasai*, *kasai daun besar* (Malay), *merabong* (Malay, Pusa), *rapanah*, *selan* (Melanau), *silak* (Iban).

**Distribution.** As for the genus.

**Ecology.** Primary and secondary forests; well-drained land, swamps, or temporarily inundated habitats; slopes, ridges and plains, in some regions especially common on riverbanks; on various soils; from sea level to 1700 m. Flowering and fruiting throughout the year, mainly seasonally.

**Uses.** Throughout its area, the wood is used for several purposes, the fruits are eaten, and according to a few reports a decoction of the bark can be used medicinally. In Sarawak, the Selayar Iban use this tree for curing chickenpox: the patient is bathed in water in which small pieces of or powder from the bark is boiled (Heyne, Nutt. Pl. Ned.-Indië ed. 2 (1927) 999; Burkill, EPMP (1935) 1797).

## 2. *Pometia ridleyi* King *ex* Radlk.

(H.N. Ridley, 1855–1956, botanist and former Director of Singapore Botanic Gardens)

In Engler *l.c.* (1932) 927; Jacobs, *l.c.* (1962) 119, *l.c.* (1994) 703; Whitmore & Tantra *l.c.* 216; Corner *l.c.* 688; Yap *l.c.* 458; Whitmore, Tantra & Sutisna *l.c.* 314. **Type:** *Goodenough 1099*, Malaya (holotype CAL; isotypes K, M, SING).

Tree to 40 m tall, 1.5 m diameter; buttresses steep, to 3 m high. Young parts very early glabrescent. **Leaves** each with 6–8 pairs of leaflets; petiole and rachis subglabrous; pseudostipules more or less elliptic, 0.6–1 × 0.2–0.5 cm, strongly falcate. *Leaflets* chartaceous, glabrous except for a few scattered hairs on the midrib beneath, without gland or exceptionally with a gland in the axils of 1 or 2 lateral veins; *more or less elliptic*, 7.5–15 × 2.8–5.5 cm, middle ones hardly to distinctly falcate, *margin entire*, apex gradually to rather abruptly acuminate, acumen acute, to 1 cm long; *lateral veins 0.5–1 cm apart, all alike, gradually bending towards the margin and more or less distinctly looped and joined*, slightly raised



above, *intercostal veins prominent on both surfaces*; petiolules 1.5–2 mm long. **Inflorescences** erect, 17–25 cm long, subglabrous; pedicels *c.* 2 mm long, rather slender, articulate up to one fourth to one third above the base; bracts present under all flowers. **Flowers:** calyx *c.* 2.5 mm diameter, sepals connate for 15–20%, lobes *c.* 1.5 × 0.75 mm, glabrous on both sides; petals shorter than the calyx, 0.65 × 0.8–1 mm, glabrous outside; stamen filaments *c.* 2.2 mm long, very sparsely hairy at base, anthers *c.* 0.75 mm long; style *c.* 3.5 mm long. **Fruits** *c.* 2 × 2 cm.

**Distribution.** Sumatra, Peninsular Malaysia, Borneo. In Sabah, uncommon.

**Ecology.** Primary lowland mixed dipterocarp; outside Borneo also in bamboo forests; to 200 m. Flowering in July, September.

## 17. RHYSOTOECHIA Radlk.

(Greek, *rhusos* = wrinkled, *toichos* = wall; the inner side of the fruit wall)

### B. Etman

Sapind. Holl.-Ind. (1879) 61, 62, in Engler, Pflanzenr. 98 (1933) 1209; Merrill, EB (1921) 361; Masamune, EPB (1942) 432; Etman, Blumea 39 (1994) 41, FM 1,11 (1994) 704.

Small to medium-sized trees or shrubs. *Indumentum*, if present, *mostly of simple, appressed hairs*. **Leaves** *imparipinnate*; petiole and rachis terete, slightly winged or not; petioles pulvinate. *Leaflets opposite to alternate*; base symmetric to slightly asymmetric, margin entire; lower surface with domed cells, *domatia absent*; petiolules pulvinate, sometimes absent. **Inflorescences** *axillary, subterminal or borne on leafless twigs, paniculate or thyrsoïd*; bracts and bracteoles usually not persistent in fruit. **Flowers** *radially symmetrical, seemingly bisexual*; *sepals 5, subsistent in fruit, outer 2 slightly to distinctly smaller than inner 3, inner ones with a petaloid margin*; petals 5, distinctly clawed, *scales absent to well-developed, crest absent*; *disc entire, slightly lobed, glabrous*; stamens (7–)8, filaments especially towards the base pilose or velutinous, anthers often with a few hairs; *ovary 2(–3) locular, sericeous, ovule one per locule*, style usually glabrous, elongating in fruit. **Fruits** subcordate to reniform, with one to all lobes developing, *loculicidal*; fruit wall rugose to ribbed and often laxly hairy outside, *densely papillose inside*; stalk absent to very distinct. **Seeds** obovoid to globose; *arillode (or sarcotesta) cup-shaped, covering the seed except at the apex*; hilum round; pseudohilum round to reniform; cotyledons secondarily collateral, about equal in size.

**Distribution.** Fourteen species; Borneo, the Philippines, Sulawesi, Maluku, New Guinea, and Australia. In Sabah, 1 species, not yet reported from Sarawak.

**Ecology.** In lowland rain forest (often coastal) to montane forest.

### **Rhysotoechia koordersii** Radlk.

Fig. 21.

(S.H. Koorders, 1863–1919, Forest Officer of the Dutch East Indies at Bogor)

In Engler & Prantl, Nat. Pfl. Fam. 3 (1907) 206, in Engler *l.c.* (1933) 1213; Etman, Blumea 39 (1994) 63, FM 1, 11 (1994) 708. **Type:** *Koorders 18844*, Celebes, Menado (holotype M; isotypes BO, K, L).



Fig. 21. *Rhysotoechia koordersii*. A, fruiting leafy twig; B, fruit. (From SAN 92985.)

Tree to 20 m tall, 25 cm diameter. **Bark** smooth, dark green to blackish brown, inner bark yellowish to ochre, thin. **Leaves** each with 1–4 pairs of leaflets; petioles 2–11 cm long, slightly angular to terete, sometimes slightly winged below the lowermost pair of leaflets, slightly ribbed, glabrous; rachis 2.5–20 cm long, angular, slightly winged below pairs of leaflets, ribbed, glabrous. **Leaflets** usually subopposite, sometimes opposite, coriaceous; glabrous on both surfaces; *obovate to elliptic*, 6–23 × 1–11 cm; base sometimes very slightly asymmetric but never distinctly so, acute to attenuate, margin not to slightly recurved, *apex obtuse to abruptly narrowing and distinctly acuminate*; midrib prominent, smooth to angular, lateral veins 0.5–3 cm apart, upper ones distinctly looped, intermediate lateral veins curved towards the base, intercostal veins laxly reticulate, slightly raised above; petiolules usually of pulvinus only, *to 10 mm long*, glabrous. **Inflorescences** *axillary*, thyrsoïd, branching at the base, to 19 cm long, sparsely puberulous; cymules 1-flowered; bracts and bracteoles 0.5–1 mm long; pedicels 4–9 mm long. **Flowers** *c.* 7 mm diameter; sepals glabrous on both sides, ciliate, outer ones broadly ovate, 2.5–3 × 2.5 mm, inner ones orbicular, 3–3.5 × 3 mm; petals broadly obovate, *c.* 2.5 × 2 mm, pilose outside, sparsely so inside, margins coarsely lobed, slightly thickened towards the base, densely pilose, apex rounded, claw *c.* 0.8 mm high, pilose on both sides, scales absent; disc glabrous; stamens 8, filaments *c.* 3 mm long, velutinous towards the base, anthers *c.* 0.5 mm long, puberulous; ovary *c.* 1 mm high, densely sericeous, style *c.* 2 mm high, sparsely puberulous. **Fruits** obcordate, attenuate at base, 1.5–1.7 × 1.3–1.5 cm, rugose and very sparsely puberulous outside, smooth inside; stalk slender, 5–7 mm long; lobes 1–3, well-developed, 0.8–1 × 0.6–0.7 cm; style *c.* 0.5 mm long.

**Distribution.** Borneo (Sabah: Kota Belud and Beluran districts), Sulawesi. Also known from Kalimantan.

**Ecology.** In lowland and hill forests, from sea level to 700 m. Flowering in April; fruiting in May.

## 18. TRIGONACHRAS Radlk.

(Greek, *trigonos* = triangular, *achras* = pear-shaped; the fruit)

### P.W. Leenhouts

Sapind. Holl.-Ind. (1879) 46, in Engler, Pflanzenr. 98 (1933) 1243; King, J. As. Soc. Beng. 65, 3 (1896) 445; Ridley, FMP 1 (1922) 507; Corner, WSTM 3rd ed. 2 (1988) 689; Leenhouts, Blumea 33 (1988) 204, FM 1, 11 (1994) 734; Yap, TFM 4 (1989) 459.

Trees, *monoecious*. *Indumentum of solitary simple hairs only*. **Leaves** *paripinnate*, each with 1–9 pairs of leaflets; *pseudostipules absent*; neither petiole nor rachis winged. Leaflets opposite to alternate, parchment-like; margin entire; upper surface without wax, below sometimes with brownish glands in the axils of lateral veins. **Inflorescences** *axillary or pseudoterminal, thyrsoïd*, hairy, more or less glabrescent; cymes lax, 1–few-flowered. **Flowers** *radially symmetrical, unisexual*; *sepals 5, free*, slightly imbricate, all about equal or sometimes the outer two slightly smaller, sometimes thinner towards the entire margin, without glands; petals 5, longer than the calyx, distinctly clawed, claw densely ciliate, blade entire, scales 1(–2), erect, nearly as long as the blade, densely woolly, not crested; *disc*

*uninterrupted*, annular, rather thick, glabrous; stamens (7–)8(–9), in male flowers long exerted, filaments filiform, broadened toward the base, anthers obovoid, latero-introrse to latrorse; ovary sessile, densely hairy, *3-locular*, *ovule 1 per locule*, septa complete, style apical, about as long as the ovary, stigma grooved or slightly lobed. **Fruits** distinctly stalked, *loculicidal capsules*, dehiscing into 3 equal valves, *not winged*, smooth, minute-hairy or glabrous outside, usually densely woolly inside; fruit wall hard-fleshy. **Seeds** ellipsoid; testa smooth, shiny, black to brown; hilum nearly basal, elliptic, fairly big, covering less than one third of the seed; *arillode absent*.

**Distribution.** Eight species; Peninsular Malaysia, Sumatra, Borneo, the Philippines, Sulawesi, and New Guinea. In Sabah and Sarawak, three species, including two undescribed ones.

**Ecology.** Lowland primary as well as secondary forests, often in marshy habitats.

### Key to *Trigonachras* species

1. Mature fruits hairy.....**1. T. acuta**  
Mature fruits glabrous.....2
2. Leaves each with 3–5 pairs of leaflets; leaflets elliptic, apex acute.....**2. Trigonachras sp. A**  
Leaves each with 7 pairs of leaflets; leaflets ovate, apex tapering into an acute acumen.....**3. Trigonachras sp. B**

#### 1. *Trigonachras acuta* (Hiern) Radlk. (Latin, *acutus* = pointed; the leaflet apex)

Fig. 22.

*l.c.* (1879) 46, in Engler *l.c.* (1933) 1245; King *l.c.* 445; Ridley *l.c.* (1922) 507; Corner, *l.c.* 689; Leenhouts *l.c.* (1988) 206, *l.c.* (1994) 735, fig. 79; Yap *l.c.* 459. **Basionym:** *Cupania acuta* Hiern in Hooker, *f.*, Fl. Br. Ind. 1 (1875) 677. **Types:** *Maingay KD 445*, Malay Peninsula (holotype K; isotypes CGE, L).

Tree to 25 m tall, 50 cm diameter, with buttresses. **Leaves** each with 3–8 pairs of leaflets; petioles 1.5–6 cm long, 1–2 mm thick. Leaflets opposite to alternate, slightly falcate, thin to rather stiff parchment-like; glabrous or with some appressed hairs on the lower side of the midrib, with small glands in the axils of lateral veins beneath; ovate to elliptic, 4.5–12 × 1.5–4 cm; base symmetric to asymmetric, obtuse, acute or rounded, slightly attenuate, apex usually tapering into an acute acumen, or acute to obtuse; lateral veins 0.5–1.5 cm apart, spreading, strongly curved, ending free, intercostal veins fairly coarsely reticulate, equally raised on both sides; petiolules subterete to grooved above, 3–6 mm long. **Inflorescences** pseudoterminal and terminal, 10–20 cm long, without or with a few long branches, usually few-flowered, fulvous-puberulous. **Flowers:** sepals broadly ovate, 1.3–1.75 × 1.25–1.75 mm, fairly densely short-sericeous on both sides to rather sparsely so inside, margin ciliate; petals 2–3 × 1.6–2.5 mm, claw with a few hairs outside, orbicular, glabrous, scales 2, slightly more than half as long as the petal; stamens 7 or 8, filaments to 5.5 mm long, fairly densely patently long-hairy except for the upper part, anthers *c.* 1 mm long, glabrous; ovary 3(–4)-locular, shortly brown-hairy,



Fig. 22. *Trigonachras acuta*. A, flowering leafy twig; B, fruit. (From SAN 40845.)

slightly 3-angular, tapering into the at least equally long style, stigma grooved. **Fruits** more-or-less triangular-clavate, apiculate,  $4.5\text{--}5 \times 2.25\text{--}3$  cm, *brown-tomentulose*, red when fresh; fruit wall *c.* 1 mm thick, hard, thick and fleshy when fresh; endocarp rugose, sparsely to densely woolly. **Seeds** *c.*  $1.5 \times 1$  cm, black and shiny; hilum basal, transversely elliptic, *c.*  $7 \times 5$  mm.

**Distribution.** Sumatra, Peninsular Malaysia, and Borneo (Sabah, uncommon).

**Ecology.** In primary and secondary forests, often in swamps, along riverbanks, along road sides, on slopes and ridges, often on sandy soils; from sea level to 225 m. Flowering in April–June; fruiting in February, July–September, November.

## 2. *Trigonachras* sp. A

Leenhouts *l.c.* (1988) 207, *l.c.* (1994) 739.

Tree to 30 m tall, 35 cm diameter. **Leaves** each with 3–5 pairs of leaflets; petioles 3.5–4 cm long, 1.5–2 mm thick. **Leaflets** opposite, stiff parchment-like, glabrous, without glands; *elliptic*,  $5\text{--}10 \times 1.75\text{--}4$  cm, slightly falcate; base hardly to distinctly asymmetric, acute, strongly attenuate, *apex acute*; lateral veins 1–1.5 cm apart, spreading, straight, ending free, intercostal veins coarsely reticulate, slightly raised on both sides. **Inflorescences** pseudoterminal, 12–15 cm long, in fruit sparsely branched, fairly densely puberulous. **Flowers** (only known from remains under the fruit): sepals sparsely hairy outside, densely hairy inside. **Fruits** (probably young) triangular-obovoid, *c.*  $2.75 \times 1.5$  cm, narrowed toward the base, apiculate, *glabrous*; fruit wall somewhat fleshy, at least 1 mm thick; endocarp densely woolly.

**Distribution.** Borneo: Sabah, 1 collection, SAN 75360, Sandakan Distr. (L, SAN).

**Ecology.** Low hill at *c.* 180 m. Young fruits collected in July.

## 3. *Trigonachras* sp. B

Leenhouts *l.c.* (1988) 209, *l.c.* (1994) 739.

Tree *c.* 25 m tall, *c.* 65 cm diameter; with buttresses. **Leaves** each with 7 pairs of leaflets; petioles *c.* 5 cm long, 2 mm thick. **Leaflets** subopposite, membranous (young?), glabrous above, tomentulose on the midrib beneath, small glands present in the axils of lower lateral veins; *ovate*,  $7.5\text{--}11.5 \times 3\text{--}4$  cm, slightly falcate; base asymmetric, *apex tapering into an acute acumen*; lateral veins *c.* 1 cm apart, straight to slightly curved, ending free, intercostal veins densely reticulate above, coarsely reticulate beneath, slightly raised on both sides; petiolules slightly grooved above, 3–5 mm long. **Fruits** triangular ellipsoid, *c.*  $3 \times 2$  cm, stalked, apiculate, rugose, *glabrous*.

**Distribution.** Borneo: Sarawak, one collection, S. 28037 (L, SAR).

**Ecology.** On limestone slope, grey sandy soil; at *c.* 250 m. Fruiting noted in September.

**Taxonomy.** Possibly related to another unnamed species from Mindanao, the Philippines.

## 19. TRISTIOPSIS Radlk.

(Greek, *opsis* = resembling; closely allied to *Tristira*)

### P.W. Leenhouts

In Durand, Ind. Gen. Phan. (1888) 76; in Engler, Pflanzenr. 98 (1932) 861; Anderson, CLST (1980) 314; Leenhouts, FM 1, 11 (1994) 742; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315.

Trees, *monoecious*. *Indumentum of solitary, simple hairs only*. **Leaves** *bipinnate* or the upper ones at least forked, with several leaflets per branch; *pseudostipules absent*; petiole and rachis not winged; petioles pulvinate, more or less flattened above. Leaflets alternate to subopposite, chartaceous, base oblique, margin entire. **Inflorescences** *thyrses, axillary* towards the end of the branches; peduncles pulvinate, branches few, spreading, bearing few to many, short- to long-stalked, few- to many-flowered (in the upper parts reduced to a solitary flower) cymes; pedicels articulate at base. **Flowers:** *sepals 5, free*, imbricate, concave, the two outer ones slightly or hardly smaller, fleshy, margin petaloid or not, ciliate, densely appressed short-tomentose outside; *petals absent or 5*, slightly shorter than the sepals, clawed or not, sericeous towards the base outside, margin ciliate, scale solitary, somewhat bifid, hairy, not crested; *disc uninterrupted*; stamens 8(-13), hardly or not exerted, filaments filiform, anthers latrorse, ovate-oblong, basifixed, cleft at base for a third at most, apex of connective usually rounded-apiculate by a gland which is dark when dry; ovary densely appressed fulvous-hairy, conical-ovoid, faintly 3(-5)-angular, *3(-5)-locular*, tapering into a short style with a 3-grooved stigma; *ovules 1 per locule*. **Fruits** *subdrupaceous*, (1-)3(-5)-locular, shortly attenuate to short-stalked at base, shortly apiculate at apex, densely minutely tomentose, subglabrescent, variably hairy inside; fruit wall thin; epicarp fibrous; endocarp woody. **Seeds** brown; hilum basal, orbicular; *arillode absent*.

**Distribution.** Three species; from the Philippines and Borneo eastwards to the Marianas, Christmas Is., Queensland, and the Solomon Is. (Leenhouts & van Balgooy, *Blumea* Suppl. 5 (1966) 198, map 109). One species in Sabah and Sarawak.

**Ecology.** Canopy trees of primary and secondary forests at low to medium altitudes.

### **Tristiopsis ferruginea** Leenh.

Fig. 23.

(Latin, *ferrugineus* = rusty brown; the indumentum)

*Blumea* 13 (1966) 395, *l.c.* (1994) 746, fig. 82a-c. **Type:** *Carr SF 27276*, Borneo (holotype SING).

Tree to 30 m tall, 40 cm diameter. **Leaves:** petioles 6-10 cm long; ultimate parts of rachis flattened to keeled above. Leaflets alternate, bearded in the axils of lateral veins, glabrous or thinly tomentose on the midrib and on the lateral veins beneath; ovate, 5-10 × 1.8-3 cm; base acute to obtuse, decurrent, apex attenuate-acuminate, acumen acute; midrib slender and slightly raised above, lateral veins 0.5-1 cm apart, curved to straight, only the upper ones looped and joined near the margin, slightly raised on both sides, but more strongly so beneath, intermediate lateral veins more or less well-developed, parallel to the lateral veins; petiolules to 2 mm long, keeled above, pulvinate. **Inflorescence** a thyrse, to 17 cm long, densely tomentulose; peduncles 2-5 cm long; cymes with 1-2-mm-long stalks; pedicels 1-2 mm long.



**Fig. 23.** *Tristiropsis ferruginea*. A, fruiting leafy twig; B, petal from inside; C, ovary. (A from Kostermans 21330, B-C from Anderson 4626.)



**Flowers:** sepals dark purple, hardly or not persistent in fruit, outer 2 broadly ovate, inner ones broadly obovate, *c.* 2.5 × 2–2.2 mm, rather densely appressed hairy inside, margin entire, not petaloid; petal blade transversely half-elliptic, *c.* 1 × 1.5 mm, margin at below the insertion of the scale densely woolly, upper part crenulate and densely ciliate, woolly inside, claw *c.* 1.25 mm long, densely woolly, scale about half the length of blade, slightly bilobed, completely woolly; disc 5-lobed, the lobes in the centre deeply hollowed, hence each lobe more or less annular, the parts towards the centre of the flower densely hairy, elsewhere glabrous; stamens 8, filaments 1–2 mm long, rather densely woolly in the lower part, anthers *c.* 0.8 mm long, glabrous. **Fruits** subglobose, *c.* 22 × 17 mm, at base contracted into a *c.* 1-mm-long stalk, densely ferruginous tomentulose, (1–)2(–3)-locular, densely ferruginous velvety inside.

**Distribution.** Endemic to Borneo. In Sabah and Sarawak uncommon; also in Kalimantan.

**Ecology.** Primary forest on limestone; up to 500 m. Flowering in May, July; fruiting in August, October.

## 20. XEROSPERMUM Blume

(Greek, *xeros* = dry, *spermum* = seed; the seed without arillode)

**P.W. Leenhouts**

Rumphia 3 (1847) 99; King, J. As. Soc. Beng. 65, 3 (1896) 431; Merrill, EB (1921) 359; Ridley, FMP 1 (1922) 496; Radlkofer in Engler, Pflanzenr. 98 (1932) 936; Masamune, EPB (1942) 432; Backer & Bakhuizen *f.*, FJ 2 (1965) 137; Anderson, CLTS (1980) 314; Leenhouts, Blumea 28 (1983) 389, FM 1, 11 (1994) 746; Whitmore & Tantra, CLS (1986) 216; Corner, WSTM 3rd ed. 2 (1988) 690; Yap, TFM 4 (1989) 460; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 315.

Medium-sized trees or shrubs, *androdioecious*. *Indumentum of solitary simple hairs only*. **Wood** reddish brown. **Leaves** *paripinnate, unifoliolate or each with 3 pairs of leaflets; pseudostipules absent*; petioles slightly swollen at base, hollowed above; petiole and rachis not winged. Leaflets opposite, neither papillose, nor glaucous beneath, usually with a few to several *orbicular flat glands in the axils of lateral veins or glands scattered all over the surface mainly in the basal half, domatia absent*; base somewhat symmetric, margin entire. **Inflorescences** usually solitary in the lower leaf axils and tufted in the upper leaf axils; bracts usually caducous. **Flowers** *radially symmetrical, 4- or 5-merous, effectively unisexual; sepals free or slightly connate*, either all about equal or the outer two slightly smaller, the outer ones usually with a narrow, the inner ones with a broad membranous margin to nearly completely membranous; petals about equal to slightly shorter than the sepals, sessile to variably clawed, without a scale, woolly ciliate; *disc uninterrupted or interrupted*, not lobed, in female flowers inconspicuous; stamens (7–)8(–9), in male flowers hardly to distinctly exerted, *anthers dorsifixed*, latrorse, in female flowers with indehiscent anthers bearing functional pollen; ovary 2(–3)-locular, deeply lobed, warty, style apical, columnar, broadened towards the apex, stigma arched, elliptic with a longitudinal groove, deeply cleft in fruit, ovules 1 per locule, nearly basally attached. **Fruits** with 1(–2) lobes developed, in the latter case lobes widely spreading, not winged; lobes ellipsoid to subglobose, indehiscent; fruit wall early glabrescent, spiny, warty, colliculate or granular outside, smooth or slightly colliculate and glabrous inside;

spines broader than high. **Seeds** ellipsoid to subglobose, *completely covered by a thin sarcotesta* except for the basal hilum; inside of testa with a pocket in which the radicle fits; embryo transverse, plumule lateral with a relatively big radicle pointing downwards.

**Distribution.** Two species; Bangladesh, Assam, Myanmar, Indo-China, Peninsular Malaysia, Sumatra, Java, and Borneo.

**Ecology.** Often common in the middle and lower storeys of lowland and lower montane rain forests. The fruits are said to be eaten and dispersed by birds, monkeys, and fruit-bats.

**Uses.** The thin yellow to orange sarcotesta is edible, but is not of economic importance. The opinions on the timber quality are rather divergent: fire wood, inferior timber, or a good, tough, and durable timber (Heyne, Nutt. Pl. ed. 3 (1950) 997; Burkill, EPMP 2 (1966) 2313).

### Key to *Xerospermum* species

Flowers 5-merous. Pedicels in fruit not much swollen, 1.5–2.5(–3.5) mm thick.....**1. X. laevigatum**

Flowers 4-merous. Pedicels in fruit distinctly swollen, (3.5–)5–7 mm thick.....**2. X. noronhianum**

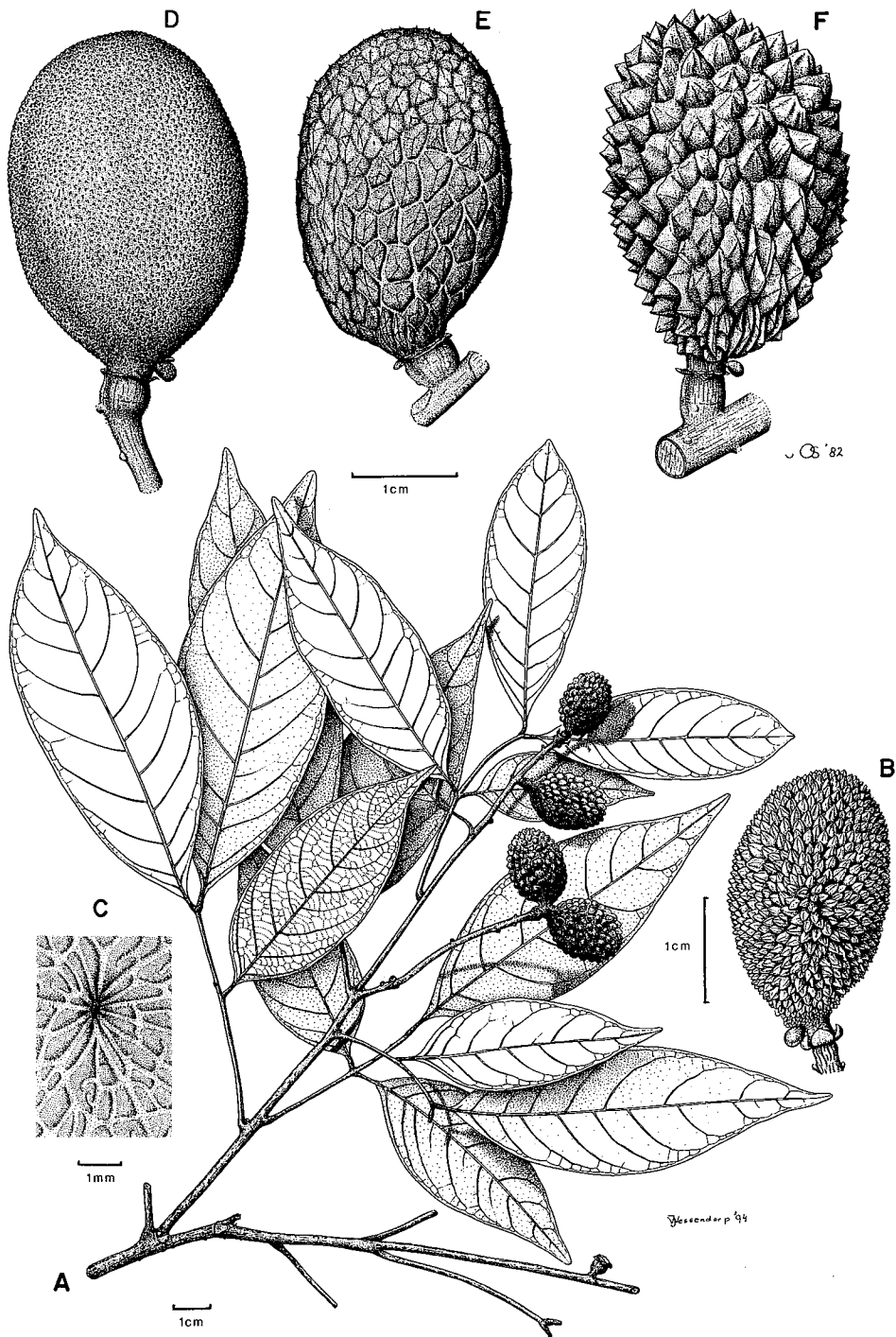
#### 1. *Xerospermum laevigatum* Radlk.

Fig. 24A, B.

(Latin, *laevigatus*= smooth and polished; the leaves)

Sapind Holl.-Ind. (1879) 23, 25; in Engler *l.c.* (1932) 949; King *l.c.* 431; Ridley *l.c.* 497; Burkill, EPMP 2 (1935) 2272; Anderson *l.c.* 314; Leenhouts *l.c.* (1983) 391, *l.c.* (1994) 748; Whitmore & Tantra *l.c.* 216; Yap *l.c.* 461. **Type:** *Griffith KD 1006/1*, Burma (holotype K).

Shrub or tree to 36 m tall, 1 m diameter. **Leaves:** petioles 0.4–7 cm long; petiole and rachis glabrous. Leaflets coriaceous, glabrous, without or with a few to several glands; elliptic, 4.5–18 × 1.75–10 cm; base acute to rounded, decurrent, apex rounded to acute or variably acuminate; upper lateral veins more or less distinctly joined, intermediate lateral veins variable, intercostal veinlets rather finely reticulate, slightly raised on both sides, sometimes more so beneath than above; petiolules 0.3–1.5 cm long. **Inflorescences** to 20 cm long if solitary, to 5 cm long if tufted; well-developed axes with scattered, patent and short or erecto-patent and long side-branches; branches and upper part of main axis bearing several lax and often several-flowered cymes; lower cymes long-stalked, consisting of a central flower and two sometimes long and many-flowered monochasial branches; upper cymes sessile and monochasial, often (if the axis is short) forming a dense cluster of branches and flowers; bracts deltoid to lanceolate, to 1.5 mm long, sparsely hairy; pedicels 1.5–5 mm long. **Flowers** 5-merous; sepals free, about equal and ovate to obovate, or the outer two distinctly smaller and concave, 1.6–2.8 × 1.4–2.5 mm, ciliate to woolly ciliate, glabrous or nearly so; petals obovate to spatulate, 1–3 × 0.5–1.2 mm, larger in male than in female flowers, whitish, variably woolly; disc uninterrupted or interrupted, yellow; stamens (7–)8, filaments 2–5 mm long, woolly in the lower half to all over except for the apex, anthers 0.6–0.9 mm long, glabrous: **Fruit** lobes globose to oblong-ellipsoid, 2.5–3.75 × 1.5–2.5 cm, densely spiny, orange to pinkish; fruit wall coriaceous, *c.* 0.5 mm thick; *pedicels only slightly swollen, 1.5–2.5(–3.5) mm thick.*



**Fig. 24.** *Xerospermum laevigatum* subsp. *laevigatum* (A); *X. laevigatum* subsp. *acuminatum* (B); *X. noronhianum* (C–F). A, fruiting leafy twig; B, fruit; C, gland on lower leaflet surface; D–F different sculptures of fruits. (A from *de Wilde & de Wilde-Duyffes* 18907, B from *SAN* 27301, C from *Ja* 6185, D from *FRI* 10748, E from *Stone & Sidek* 12523, F from *KEP* 29472.)

**Distribution.** Myanmar (Mergui Arch.), Peninsular Malaysia, Sumatra, and Borneo. Two subspecies are recognised.

### Key to subspecies

Disc in female flowers nearly always interrupted, in male flowers sometimes interrupted. Leaflets broad-elliptic, distinctly acuminate.....

subsp. **acuminatum** (Radlk.) Leenh.

*l.c.* (1983) 393, *l.c.* (1994) 749. Basionym: *Xerospermum acuminatum* Radlk. *l.c.* (1879) 25, Merrill *l.c.* 359, Masamune *l.c.* 432, Anderson *l.c.* 314 (as *X. acuminatissimum*). Type: *Beccari PB 3468*, W Borneo (holotype FI; isotypes K, P).

Shrub or tree to 20 m tall, 24 cm diameter, with slight buttresses or with stilt-roots. Leaves: petioles to 7 cm long; rachis to 7 cm long. Leaflets fairly strongly dorsiventrally curved, acumen usually cuneate and acute, to 3 cm long. Inflorescences if axillary 2 cm long or longer, glabrous or rarely sparsely hairy. Flowers: outer sepals distinctly smaller than inner ones, glabrous except the margin, fleshy or the inner ones partly petaloid; petals to  $3 \times 1.2$  mm.

Endemic to Borneo. In Sabah and Sarawak, relatively common; also in Brunei and Kalimantan. In peat swamp, *kerangas* and mixed dipterocarp forests, on sandy humic yellow soils; to 30 m.

Disc interrupted. Leaflets usually oblong to elliptic, not or slightly acuminate.....

subsp. **laevigatum**

Leenhouts *l.c.* (1983) 392, *l.c.* (1994) 749; Yap *l.c.* 461. Synonym: *Xerospermum unijugum* Radlk., *Rec. Bot. Surv. Ind.* 3 (1907) 351, in Engler *l.c.* (1932) 948, Ridley *l.c.* (1922) 497.

Shrub or tree to 36 m tall, 1 m diameter; buttresses to 2.5 m high, 2.3 m wide, thick, branching. Leaves: petioles to 4.5 cm long; rachis 2–3 cm long. Leaflets flat to slightly dorsiventrally curved. Inflorescences to 12 cm long, slightly thin-puberulous, glabrescent. Flowers: sepals nearly equal, usually thin and petaloid; petals to  $2 \times 0.8$  mm.

Distribution as for the species; common in Sabah and Sarawak; also in Kalimantan. In primary and sometimes secondary mixed dipterocarp forest, on well-drained land; to 700 m.

## 2. *Xerospermum noronhianum* (Blume) Blume (Fernando Noronha, Spanish biologist in the 18th century)

Fig. 24C–F.

*l.c.* (1847) 100; Radlkofer in Engler *l.c.* (1932) 946; Backer & Bakhuizen *f. l.c.* 137; Leenhouts, *l.c.* (1983) 394, fig. 2a–c, e, *l.c.* (1994) 750, fig. 84b–e; Whitmore & Tantra *l.c.* 217; Yap *l.c.* 461. **Basionym:** *Euphoria noronhiana* Blume, *Bijdr. Fl. Ned. Ind.* (1825) 234. **Lectotype** (Leenhouts, 1983): *Blume, s.n.* (=L. sheet no. 908.272–748), Java (L). **Synonyms:** *Xerospermum lanceolatum* Radlk. *l.c.* (1879) 7, 25, Merrill *l.c.* 359, Masamune *l.c.* 432; *X. muricatum* Radlk. in Engler & Prantl *l.c.* (1895) 331, fig. 168, Anderson *l.c.* 314; *X. echinulatum* Radlk. *l.c.* (1907) 350, Anderson *l.c.* 314; *X. intermedium* Radlk. *l.c.* (1907) 348, Anderson *l.c.* 314.

Tree to 25(–30) m tall, 30(–75) cm diameter, with buttresses. **Leaves:** petioles 1–7 cm long; petiole and rachis glabrous or thinly to densely brownish or fulvous-puberulous, glabrescent. Leaflets parchment-like to coriaceous; glands few to many; more-or-less elliptic, to  $50 \times 30$  cm; base obtuse to acute, apex rounded to variably acuminate, lateral veins ending free except

for a few uppermost ones, intermediate lateral veins not conspicuous, intercostal veins and veinlets finely to laxly reticulate, about equally raised on both sides to smooth or slightly sunken on the upper side; petiolules 1–12 mm long. **Inflorescences** male or female; male inflorescences to 25 cm long if solitary, or much shorter if tufted; female inflorescences tufted; axes simple or with some short patent branches in the lower part; cymes few to many, sessile or subsessile, very condensed, few- to several-flowered; distal flowers solitary; bracts deltoid to lanceolate, to 1.5 mm long, sparsely hairy; pedicels c. 2 mm long. **Flowers** 4-merous; sepals free or slightly connate, outer two usually slightly smaller than inner ones, ovate to obovate, 1–2(–3) × 1–2.4 mm, glabrous on both sides or at base hairy inside, ciliate; petals obovate to broadly spatulate, 1–2.8 × 0.5–1.7 mm, short- to long-clawed, blade ovate to transversely elliptic, variably woolly except the base outside, sparsely hairy to glabrous inside; disc uninterrupted; stamens 8(–9), filaments 1.5–2.5 mm long, woolly except at base and apex, to woolly or glabrous in the upper half, anthers 0.3–0.8 mm long, glabrous or with a few hairs (ciliate). **Fruit** lobes ellipsoid to subglobose or obovoid, 1.75–5 × 1.25–5 cm, aculeate, tuberculate, colliculate to granulate, red or dark brown; fruit wall coriaceous, corky or woody, 0.65–2.5 mm thick; *pedicels strongly swollen, (3.5–)5–7 mm thick.*

**Vernacular names.** Sabah—*resat* (Dusun Kinabatangan). Sarawak—*ilat, kalas* (Iban), *tundun biawak* (Malay).

**Distribution.** As for the genus. Common in Sabah and Sarawak; also in Brunei and Kalimantan.

**Ecology.** Primary and secondary rain forests, sometimes in peat swamp and *kerangas* forests, on plains, slopes and crests; in well-drained places but also on riverbanks, marshy habitats, and periodically flooded localities; on different kinds of soil including sandy, sandy-clay, fertile volcanic loam, peat, subsoil granite, sandstone, and moist limestone; from sea level to 1500 m. Flowering throughout the year but mainly in January–April and August–December; fruiting mainly in January–August. The fruits are eaten and dispersed by birds and monkeys.

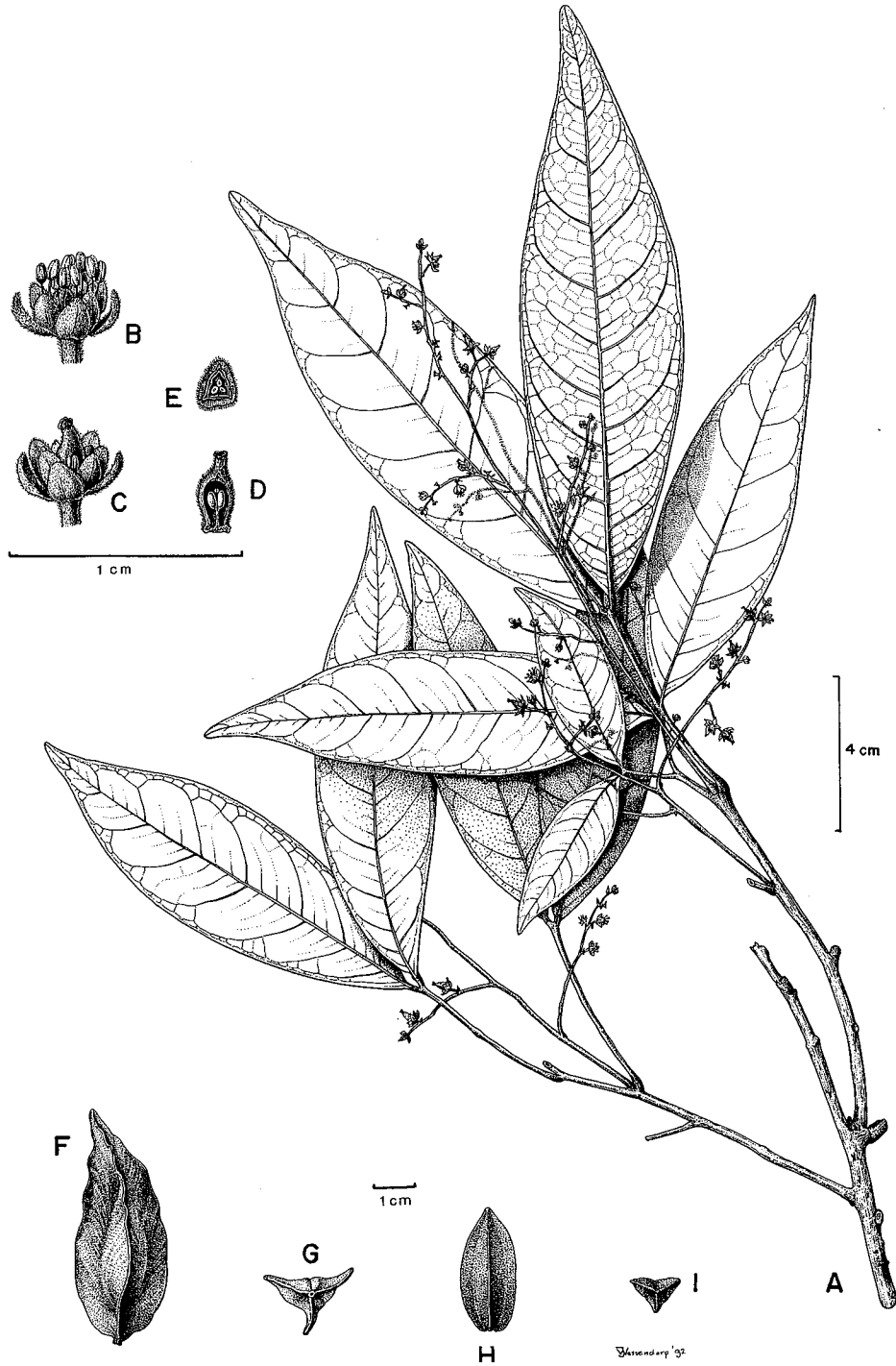
## 21. ZOLLINGERIA Kurz, *nom. cons.*

(H. Zollinger, 1818–1859, Swiss school teacher and plant collector)

### F. Adema

J. As. Soc. Beng. 41, 2 (1872) 303; Radlkofer in Engler, Pflanzenr. 98 (1933) 724; Adema, Blumea 37 (1992) 73, FM 1, 11 (1994) 752.

Trees, *monoecious*. *Indumentum of solitary simple hairs; glands absent. Leaves* spirally arranged, *paripinnate*, each with 1–8 pairs of leaflets; *pseudostipules absent*; petiole and rachis winged. *Leaflets opposite to alternate, margin entire. Inflorescences axillary, thyrsoid, branched. Flowers unisexual*, radially or rarely bilaterally symmetrical; *sepals 5, free, slightly to distinctly unequal, imbricate or valvate*, not petaloid, hairy or glabrous outside; *petals 5 or occasionally 4*, shorter or longer than the sepals, *with or without scales or auricles; disc entire or interrupted, glabrous; stamens 8, slightly exerted in male flowers, filaments hairy, anthers glabrous; ovary 3-locular at base, higher up 1-locular, ovule 1 per locule, style 3-lined or 3-lobed. Fruits 1-locular, 3-winged, indehiscent. Seeds 1 per fruit, without arillode or sarcotesta.*



**Fig. 25.** *Zollingeria borneensis*. A, flowering leafy twig; B, male flower; C, female flower; D, ovary in longitudinal section; E, ovary in cross-section; F, fruit; G, fruit, bottom view; H, seed; I, seed, bottom view. (A–E from SAN 90057, F–I from *Elmer* 20888.)

**Distribution.** Three or four species in Myanmar, Laos, Thailand and Borneo; one species in Sabah.

**Zollingeria borneensis** Adema  
(of Borneo)

Fig. 25.

Blumea 37 (1992) 75, *l.c.* (1994) 754. **Type:** *Elmer 20888*, Borneo, Sabah, Tawau (holotype L; isotypes A, F, U).

Tree *c.* 60 m tall, clear bole 30 m high, to 70 cm in diameter. **Bark** whitish, inner bark pale yellow, *c.* 0.7 cm thick. **Sapwood** white. Indumentum ferruginous tomentulose. **Twigs** silvery-grey. **Leaves** each with (1-)2-3 pairs of leaflets; petioles 1-6.5 cm long, pulvinate; rachis 1-10.5 cm long; petiole and rachis subterete, finely grooved, patently short-hairy. **Leaflets** chartaceous, glabrous; more or less elliptic, 9.5-20 × 2-6 cm; base slightly asymmetric, broadly cuneate, apex acuminate, acumen rounded; midrib and lateral veins sparsely to densely short-hairy, midrib prominent above, lateral veins 9-12 per side, 8-28 mm apart; petiolules reduced to pulvinus, 1-4 mm long, subterete, short-hairy. **Inflorescences** pseudoterminal, 6-14 cm long; cymes several-flowered; bracts and bracteoles acicular, 0.6-12 × 0.1-0.4 mm, hairy on both sides; pedicels 1.5-2.5 mm long, articulate near the base, angular, hairy. **Flowers** yellowish to green; male ones somewhat smaller than the female ones; sepals triangular to spatulate, valvate, thinned towards the margin especially at the apex, *slightly unequal*, 1.7-2.6 × 1.2-1.6 mm, apex rounded to retuse, appressed hairy on both sides; petals cuneate to spatulate, distinctly clawed, 1.4-2.4 × 1.2-1.6 mm, ciliate, claw 0.4-0.7 mm long, hairy on both surfaces, *auricles ciliate*; disc entire, annular or saucer-shaped; stamen filaments *c.* 1.5 mm long, anthers *c.* 0.4 mm long, in female flowers respectively 1.2-1.6 mm long, 0.5-0.6 mm long; ovary hairy outside, glabrous inside, style *c.* 1 mm long, stigma more or less capitate, 3-lobed; pistillode *c.* 3 × 1.9 mm. **Fruits** *prismatoid*, *sharply deltoid in cross section*, 6-7 × 2.5-5 cm; fruit wall thin-coriaceous, striate and densely velutinous outside, glabrous inside. **Seeds** *prismatoid*, *c.* 33 × 14 mm.

**Distribution.** Endemic to Sabah; uncommon.

**Ecology.** Primary forest, at *c.* 15 m. Flowering noted in February.

## SCYPHOSTEGIACEAE

**E.J.F. Campbell-Gasis**

Taman Fajar, Lahad Datu,  
Sabah, Malaysia

Hutchinson, *Fam. Fl. Pl.* 2nd ed. (1964) 326, *f.* 187a & b; Metcalfe, *Reinwardtia* 4 (1956) 99; van Steenis, *FM* 1, 5 (1957) 297; van Heel, *Blumea* 15 (1967) 107; Anderson, *CLTS* (1980) 323.

A monogeneric family with one species endemic to Borneo.

**Taxonomy.** The systematic position of the family has been controversial. Stapf (FMK (1894) 217) assigned the only genus, *Scyphostegia*, to the Monimiaceae, but Hutchinson (*l.c.*) placed it in a separate family, the Scyphostegiaceae, closely related to Moraceae. van Steenis (*l.c.*), Metcalfe (*l.c.*), and van Heel (*l.c.*), on the other hand, though in agreement with Hutchinson, considered the family as closely allied to the Flacourtiaceae. The interpretation of the inflorescence structure used here differs from that of van Steenis *l.c.* and was kindly provided by Dr. K. M. Wong.

## SCYPHOSTEGIA Stapf

(Greek, *scyphos* = cup, *stege* = shelter; the cup-like floral bracts)

FMK (1894) 217, *t.* 17 (under Monimiaceae); Hutchinson *l.c.* (1964) 326, *f.* 187a & b; Baehni, *Soc. Phys. Hist. Nat. Geneva* 54 (1937) 91, *Ber. Schweiz. Bot. Ges.* 48 (1938) 22, *f.* 1–3; Swamy, *Proc. Nat. Inst. Sc. India* 19 (1953) 127, *f.* 1–38; Metcalfe *l.c.* 99; van Steenis *l.c.* 297; van Heel *l.c.* 107; Anderson *l.c.* 323.

Dioecious shrubs or trees, without exudate. *Twigs often strongly 3–4-angular*, slender, *more or less zig-zag*, brown, *nodes swollen*. Stipules free, triangular, caducous. **Leaves simple, alternate**, pinnately veined. **Inflorescence** basic units of short-peduncled racemes, bearing 1–12 (in male) or 1–2 (in female) serially imbricate, tubular, obtuse bracts, with each bract subtending a single flower; the tubular-bracteate raceme units solitary in the distal leaf axils or arranged on a slender flowering main stalk terminal to a leafy branch. **Flowers unisexual, radially symmetrical, developing one at time from the base upwards on each raceme-like unit; pedicel flattened, persistent**; perianth 6-lobed (3 outer and 3 inner tepals), imbricate in bud, orbicular, petaloid, connate, fleshy; male flowers: pedicels thin, dry and membranous, lengthwise 2-veined; perianth lobes shorter than the tube, inner ones shorter than and alternate with the outer ones, distinctly thickened at apex; *stamens* 3, connate into in a column with common apical connective produced above the anthers, anthers 4-locular, extrorse, dehiscing lengthwise; disc-glands 3, oblong, fleshy, opposite the stamens; female flowers: pedicels shorter than in males; *perianth lobes* longer than the tube, equal, *more or less persistent*,



*recurved in fruit*; disc present, disc-glands absent; *ovary superior, 1-locular*, globose, style discoid with a narrow central aperture, stigmatic lobes 9–12, fleshy, largely fused to form a thick plate-like stigma with recurved margin; ovules numerous, crowded on the slightly convex base of the ovary, surrounded at base by a fleshy, collar-like aril, placentation parietal. **Fruits** fleshy, dehiscent capsules, *crowned by persistent styles and stigmas, 9–12-ribbed*, at maturity breaking up at the mouth into 9–12 segments. **Seeds** numerous, dry, densely packed, funiculate, shortly erect-patent hairy over whole surface, their needle-like bases surrounded and partly joined with spongy tissue from the base.

**Scyphostegia borneensis** Stapf  
(of Borneo)

Fig. 1.

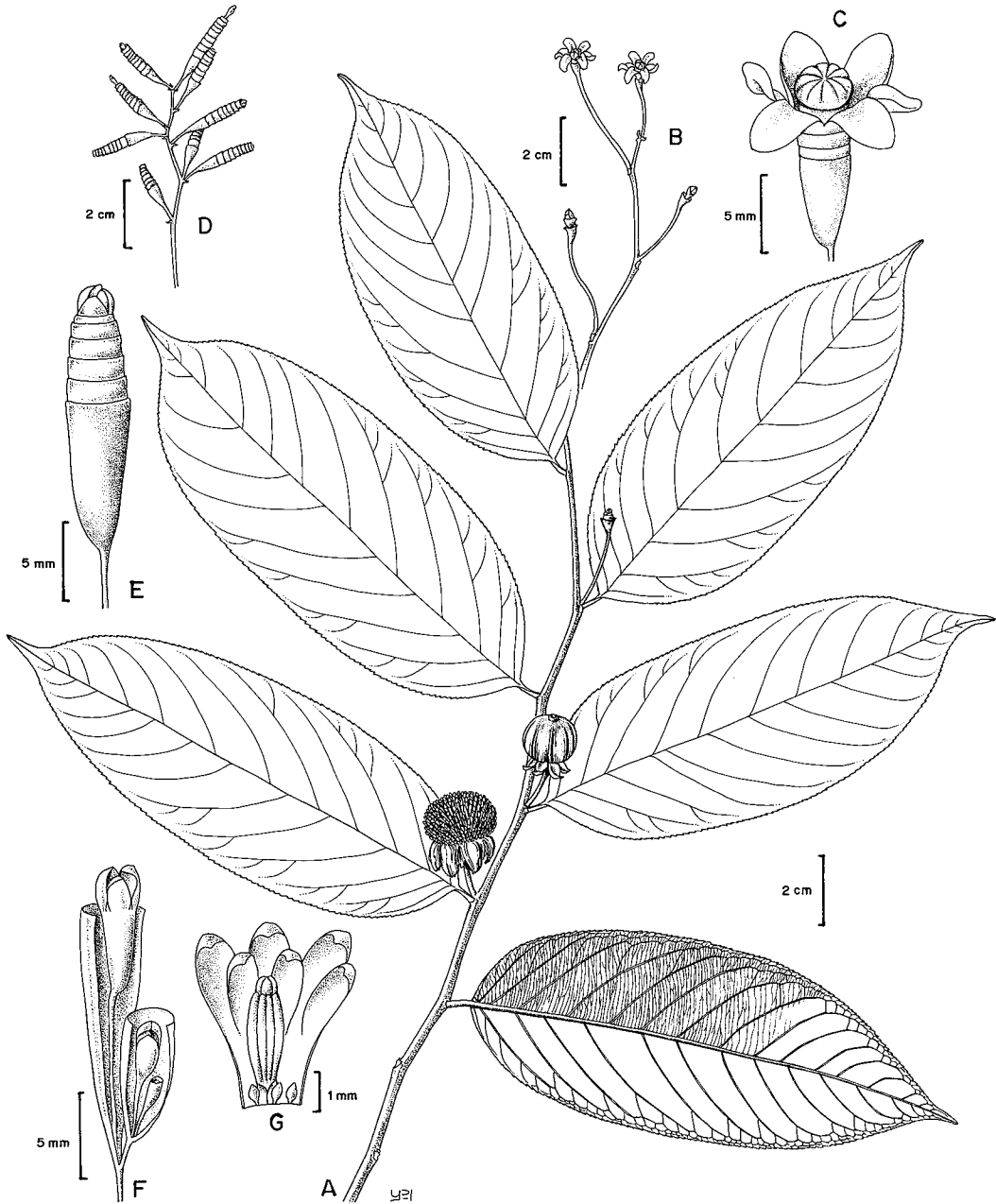
*l.c.* 218, *t.* 17; Merrill, EB (1921) 272; Baehni *l.c.* (1937) 91; Masamune, EPB (1942) 305; Metcalfe *l.c.* 99; van Steenis *l.c.* 297; van Heel *l.c.* 107; Anderson, *l.c.* 323. **Type:** *Haviland 1377*, Borneo, Sabah, Mt. Kinabalu, near Koung (holotype K).

Shrub or tree to 20 m tall, 40 cm diameter, *low branching; crown spreading*. **Bark** dark green to dark brown or blackish, smooth, thin, sometimes lenticellate; inner bark yellow to brown or grey. **Wood** white or slightly yellowish. Twigs sometimes lenticellate, with knob-like stipule scars; stipules 1–2 × 1 mm. **Leaves** drying chartaceous; narrow-oblong to obovate-oblong, 7–18(–24) × 2.5–6.8 (–8.5) cm; base rounded, often decurrent down the petiole, margin serrulate, the teeth with thickened tips, apex acute to acuminate, acumen to *c.* 13 mm long; lateral veins 6–11 pairs, spreading at a narrow angle from the midrib, arching in the lower half and joining in faint loops 1–2 mm from the margin, flat or sunken above; intercostal veins scalariform, more or less parallel to the midrib; petioles 2–5(–6) mm long, 1(–3) mm thick, furrowed above. **Inflorescences:** males 6.5–30 cm long, raceme units 1–2 cm long, peduncles 2.5–20 mm long, bracts 5–10 mm long, 2–3 mm wide, pedicels 4–6 mm long, *c.* 1 mm thick; females 5–8.5 cm long, raceme units 5–8 mm long, peduncles 12–35 mm long, bracts 1–4 × 2–3 mm, pedicels shorter than in the males. **Flower:** males: perianth tube 4–5 mm long, the outer lobes orbicular-oblong or spatulate, *c.* 3 × 2 mm, the inner ones *c.* 2 × 1.5 mm, disc-glands *c.* 0.75 × 0.4 mm, staminal column 2–3 mm long, anthers *c.* 2 mm long; females: perianth tube *c.* 2 mm long, lobes *c.* 6 × 4 mm, ovary *c.* 4 mm. **Fruits** *c.* 18 × 15 mm. **Seeds** 5–6 × 0.8–1 mm, funicle *c.* 3 mm long.

**Vernacular names.** Sabah—*kata manok* (Dusun), *sangkurat* (Kedayan), *tarukakang* (Dusun), *tulau* (Idahan). Sarawak—*delako* (Kelabit), *rukam hantu* (Iban).

**Distribution.** In Sabah, known from the Crocker Range through the interior to the east coast and southwards from Sapulut to Tawau; also in Kudat at the northern most tip of Sabah. In Sarawak, on the Rejang river from Kapit to Belaga and headwaters of the rivers to the north; also on the Balleh river south of Kapit and on the Baram river near Lobang Garam. Also known in Kalimantan.

**Ecology.** In Sabah, found in primary rain forest from flat and sloping ridge areas to steep-sided riverbanks, streams and gorges, and also in logged and disturbed forests. In Sarawak, often growing along banks of swift-flowing rivers, at 20–1700 m. Flowering and fruiting all the year around with local variation.



**Fig. 1.** *Scyphostegia borneensis*. A, fruiting leafy twig; B, female inflorescence; C, young female inflorescence, detail; D, male inflorescence; E, young male inflorescence; F, detail of apical part of male inflorescence, with tubular bracts slit to show flowers; G, male flower, longitudinally slit open. (A–C from SAN 91836, D–G after FM 1, 5 (1957) 298, fig. 1.)

**Uses.** In Sarawak, the leaves are pounded together with *tuba* roots and used as fish-poison.

**Notes.** This species can be mistaken for *Flacourtia rukam* (Flacourtiaceae) from the structure of the tree and the similarity of the leaves. However, the 4-angular, zig-zag twigs, the serrulate leaf margin, and the fruit being a dehiscent fleshy capsule rather than an indehiscent drupe clearly distinguish *S. borneensis* from *F. rukam*.

## TETRAMERISTACEAE

John B. Sugau

Forest Research Centre,  
Sabah Forestry Department,  
Sandakan, Malaysia

Hutchinson, *Fam. Fl. Pl.* (1959) 277; Merrill, *EB* (1921) 392 (as part of Theaceae); Ridley, *FMP* 1 (1922) 367 (as part of Ochnaceae); Masamune, *EPB* (1942) 474 (as part of "Camelliaceae"); Browne, *FTSB* (1955) 259 (under Marcgraviaceae); Smythies, *CST* (1965) 134; Burgess, *TBS* (1966) 468; Cockburn, *TS* 2 (1980) 105 (as part of Theaceae); Anderson, *CLTS* (1980) 329; Keng, *TFM* 4 (1989) 470.

Trees. **Leaves** spirally arranged, simple, entire, coriaceous, punctate with black glands below; stipules none. **Inflorescence** axillary, a panicle with umbel-like clusters of flowers, pedunculate, with conspicuous bracts. **Flowers** small, bisexual, 2-bracteolate; sepals 4 or 5, free, imbricate, persistent; petals 4 or 5, free, imbricate; stamens 4 or 5, free, alternate with petals, filaments flattened and slightly fused at the base, anthers basifixed, oblong-sagittate, locules 2, separate, glandular at the base, opening longitudinally; ovary superior, locules 4 or 5, style one, stigma apically lobed or toothed; ovules one in each locule, basal, anatropous. **Fruit** a globose to ellipsoid berry; exocarp leathery, mesocarp fleshy. **Seeds** 4 or 5, oblong; endosperm copious; embryo straight.

**Distribution.** Two genera, one (*Tetramerista*) in W Malesia, the other (*Pentamerista*) in the Guayana Highlands of S America.

**Taxonomy.** The Tetrameristaceae were formerly placed in various classifications under either the Ochnaceae, Marcgraviaceae or Theaceae. They were treated as a separate family by Hutchinson *l.c.* and other more recent systems of classification. The Marcgraviaceae are distinct by having many ovules in its basically 1-locular ovary, and seeds with little or no endosperm. The Ochnaceae and Theaceae are still regarded by many authors as being heterogeneous and typically differ from the Tetrameristaceae by their numerous stamens and axile placentation. In addition, Ochnaceae anthers dehisce mostly by terminal pores and Theaceae seeds have little or no endosperm.

## TETRAMERISTA Miq.

(Greek, *tetra* = four, *meris* = part; the 4-partite flower)

*amat* (Brunei Malay, Sabah), *entuyut* (Iban, Sarawak), *tuyut* (Dusun, Sabah)

*Fl. Ind. Bat. Suppl.* 534 (1861); Merrill *l.c.* 392; Ridley *l.c.* 367; Masamune *l.c.* 474; Smythies *l.c.* 134; Burgess *l.c.* 468; Cockburn *l.c.* 105; Anderson *l.c.* 329; Keng *l.c.* 470.

Trees. Leaves large, spirally arranged, coriaceous. **Inflorescence** an axillary panicle with umbel-like clusters of flowers, peduncle long. **Flower** 4-merous, small, radially symmetrical; sepals 4, imbricate, persistent, the 2 outer ones larger; petals 4, persistent; ovary 4-angled, 4-locular, septa thin; style one, stigma with 4 triangular lobes. **Fruit** at the base with persistent petals, sepals and bracteoles. **Seeds** 4, oblong.

**Distribution.** Three species, confined to W Malesia. *T. glabra* is the only species found in Sabah and Sarawak.

**Taxonomy.** The 4-merous flowers of *Tetramerista* distinguish it from *Pentamerista*, which is a more recently discovered genus (in 1972) with 5-merous flowers.

**Tetramerista glabra** Miq.

Fig. 1.

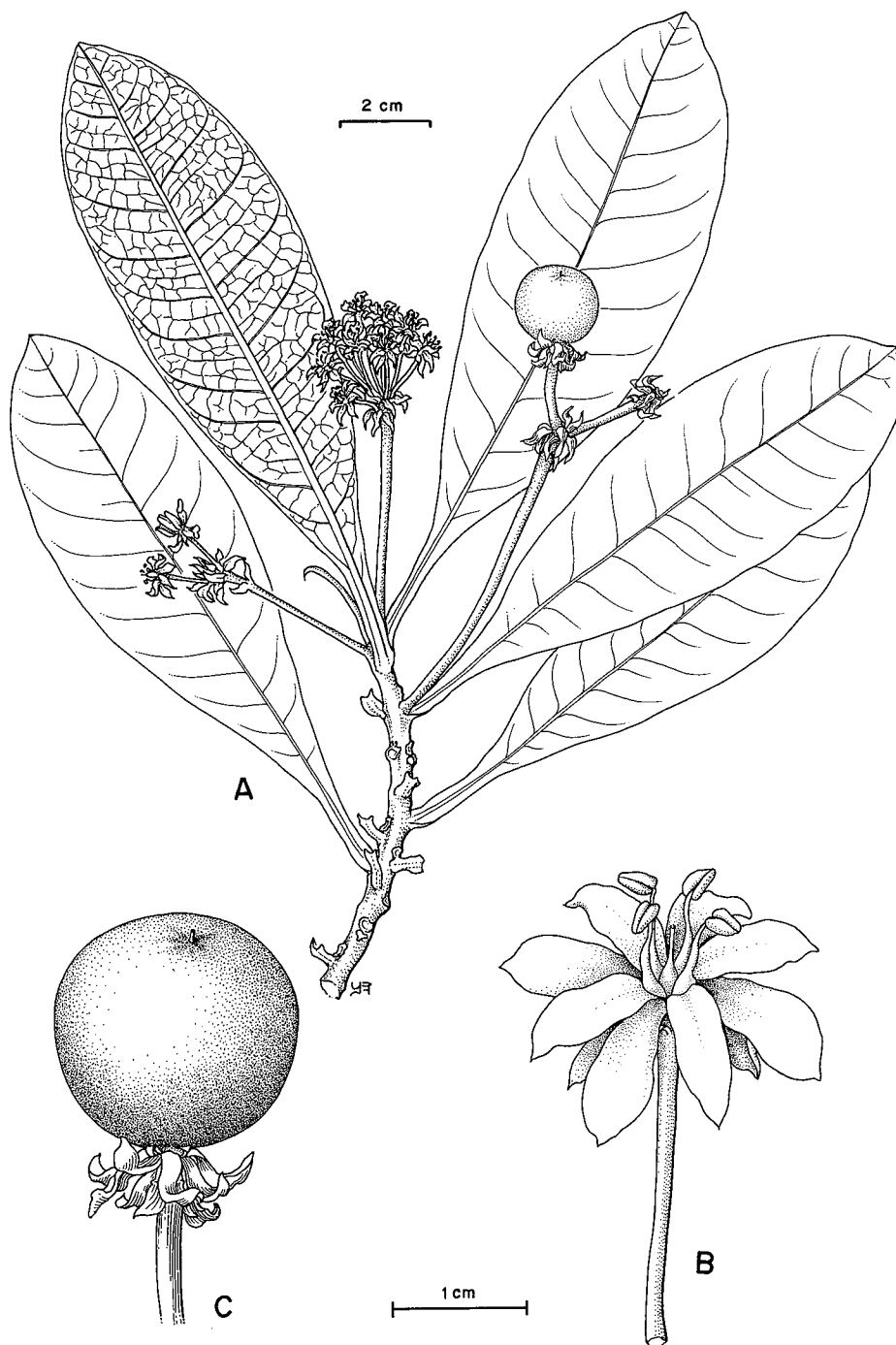
(Latin, *glaber* = without hairs; referring to most parts of the plant)

*l.c.* 534; Ridley *l.c.* 367; Masamune *l.c.* 474 (as "*Tetramerista glabra*"); Smythies *l.c.* 134; Anderson *l.c.* 329; Keng *l.c.* 470; PROSEA 5 (1) (1994) 453. **Type:** *Teysmann, s.n.*, W Sumatra, Sibolga district (BO). **Synonyms:** *Tetramerista crassifolia* Hallier f. in Beih. Bot. Centralbl. 34, 2 (1916) 38, Merrill *l.c.* 392 (as "*Tetramerista crassifolia*"), Masamune *l.c.* 474 (as "*Tetramerista crassifolia*"); *Tetramerista montana* Hallier f. *l.c.* 39, Merrill *l.c.* 392 (as "*Tetramerista montana*"), Masamune *l.c.* 474 (as "*Tetramerista montana*").

Tree to 35 m tall, 110 cm diameter, *fluted near the base*; buttresses small and steep, pneumatophores and stilt roots sometimes present. **Bark** fissured to flaky, rough, corky, dark brown; inner bark thick, soft, fibrous, red to pinkish. **Wood** pale yellow, darkening on exposure. **Leaves** mostly clustered at the distal portions of twigs, *coriaceous*, glabrous and sometimes shiny on the upper surface, punctate with black glands below; *oblanceolate*, 8–22 × 4–8 cm; base attenuate, running down to the leaf-stalk base and forming narrow wings, *margin with small dark pit-glands*, slightly recurved when dry, apex acute or rounded to notched; midrib prominent and drying purple-brown on the lower side, flattened and drying medium brown on the upper side, lateral veins 11–15 pairs, flattened on upper side, slightly prominent on the lower side, reticulations faint or invisible; *petioles* 2–3.5 cm long, *winged*. **Inflorescence** a little- to much-branched panicle, peduncle 3.5–10.5 cm long, 3–4 mm thick, rather stiffly erect, glabrous. **Flowers** 2–2.5 cm across, with 2 persistent bracteoles at the base of the pedicel; pedicels 1–1.8 cm long; sepals oblong, 6–10 × 2–4 mm, glabrous; petals oblong to lanceolate, 5–6 × 2–2.5 mm, glabrous; stamens 5–6.5 mm long, filaments 4–5 mm long; anthers 1–1.5 mm long, glandular at the base; ovary broad-ellipsoid to cylindrical, 3–4 × 1.5–2 mm, style 2–2.5 mm long. **Fruits** 1.5–3 cm across; fruit wall 2–3 mm thick. **Seeds** long-ovoid, 10–15 × 5–8 mm, brown; germination epigeal.

**Vernacular names.** Sabah—*amat* (Brunei Malay), *punah* (Malay), *samundu* (Brunei Malay), *suyut* (Dusun), *tuyot*, *tuyut* (Brunei Malay, Dusun, Kedayan). Sarawak—*antuyut*, *entuyut* (Iban), *kayu chelega* (Punan Tutoh), *kayu hujan* (Malay), *kayu tangiran* (Berawan), *punah* (Malay). Brunei—*amat* (Brunei Malay), *terepit* (Brunei Malay).

**Distribution.** Peninsular Malaysia, Sumatra and Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, found in the Sipitang, Weston, Kuala Penyu, Membakut, Beaufort, Papar, Keningau and Tawau districts; in Sarawak, recorded for the Kuching, Sibul, Belaga, Bintulu, Binatang, Miri and Baram districts.



**Fig. 1.** *Tetramerista glabra*. A, flowering and fruiting leafy twig; B, flower; C, fruit. (All from SAN 103272.)

**Ecology.** Lowland forests, usually in peat swamp forests, but occasionally also in *kerangas* forest on white sands; lowlands up to 200 m. Occurrence of big trees is usually scattered but in some peat swamp sites it may be more common. Young trees coppice freely (Browne *l.c.*).

**Uses.** Medium to heavy hardwood, suitable for indoor construction. The fresh logs sink in water. Wong (DMT) gives a review of the timber characteristics.

## ULMACEAE

**E. Soepadmo & Z. Edi Hamli**

Forest Research Institute Malaysia,  
Kepong, Malaysia

Merrill, EB (1921) 216; Masamune, EPB (1942) 237; Backer & Bakhuizen *f.*, FJ 2 (1965) 10; Soepadmo, TFM 2 (1973) 413, FM 1, 8 (1977) 31; Anderson, CLTS (1980) 340; Corner, WSTM 3rd ed. 2 (1988) 735; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 361; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 230.

Monoecious, unarmed shrubs or trees, *without milky sap, mucilage cells or canals often present. Indumentum of simple, bulbous-based, unicellular hairs and/or multicellular glandular hairs.* Stipules extrapetiolar or intrapetiolar (*Parasponia*, not in Borneo), caducous or rarely persistent, basally or peltately (several species of *Celtis*) attached at the nodes. **Leaves simple, alternate, pinnately veined or 3-veined at base.** **Inflorescences** male, female, or mixed (bearing functionally male and female or bisexual flowers), 1–many-flowered, lax or condensed panicles, racemes, or thyrses, axillary, subterminal, or borne on leafless older twigs, or on short, lateral leafless new shoots; bracts caducous or rarely persistent. **Flowers unisexual, bisexual, or functionally unisexual;** male flowers solitary or in condensed cymose clusters along the main axes, sessile or short-stalked, perianth (4–)5(–7)-lobed, lobes free or variously connate, *imbricate or induplicate-valvate in bud, stamens erect in bud*, as many as and opposite perianth lobes, anthers dorsifixed or subdorsifixed, dehiscing lengthwise, introrse or extrorse, pistillodes if present either well-developed or rudimentary, densely whitish to silvery soft- or hirsute-pubescent; female and bisexual flowers sessile or stalked, solitary in the axils of upper new leaves or arranged in various types of inflorescences, perianth herbaceous or thin-coriaceous, (4–)5(–7)-lobed, lobes imbricate, connate at base, caducous or persistent, staminodes or stamens as many as perianth lobes or absent, *ovary superior, 2-carpellate, 1-locular*, sessile, style 1, tubular or absent, stigmatic arms 2, slender, often bifid to deeply lobed at the tip, stigmas papillose, ovule 1, *anatropous or hemi-anatropous, subapical and pendulous.* **Fruit a samara (*Ulmus*, not in Borneo) or drupe**, rounded, angular or compressed and lens-shaped in cross-section. **Seeds with scanty or copious or mostly without endosperm;** embryo large, curved or straight (not in Borneo), cotyledons plano-convex, fleshy, variously curved or folded; germination epigeal.

**Distribution.** Fifteen genera with about 200 species, distributed in the tropics, subtropics, and temperate regions of Europe, Africa, continental Asia, Malesia, Australia, Pacific Is., and N, C and S America. In Sabah and Sarawak, 4 genera with 10 species.

**Ecology.** In primary and secondary forests, on various types of soil, from sea level to 2000 m.

**Taxonomy.** In most recent classifications, it is widely accepted that Ulmaceae, together with Moraceae, Urticaceae, and several other smaller related families, belong to the order Urticales.



The Ulmaceae differ from the Moraceae by the lack of lactiferous ducts, non-fleshy receptacle, erect stamens in bud, and drupaceous or samara-type fruits; and from the Urticaceae by their pendulous anatropous or hemi-anatropous ovules, erect stamens in bud, and the lack of stinging hairs/glands.

### Key to genera

1. Leaves exclusively pinnately veined; stipules leaving circular scars around the nodes after falling. Perianth lobes of male flowers imbricate in bud, anthers subdorsifixed. Fruits compressed and lens-shaped in cross-section; seeds without endosperm.....**3. Gironniera**  
Leaves 3-veined at base, or if pinnately veined then the stipules not leaving circular scars around the nodes after falling. Perianth lobes of male flowers induplicate-valvate in bud, or if imbricate, anthers dorsifixed. Fruits 3-5-angular or rounded in cross-section or if compressed and lens-shaped, the seed with scanty or copious endosperm.....2
2. Leaf margins serrate throughout. Perianth lobes of male flowers induplicate-valvate in bud. Fruits compressed, lens-shaped in cross-section.....**4. Trema**  
Leaf margins entire and undulate or crenate throughout, or entire and recurved or rarely distantly serrulate in the upper half. Perianth lobes of male flowers imbricate. Fruits rounded or 3-5-angular in cross-section.....3
3. Leaf base exclusively 3-veined. Male flowers always with pistillodes; anthers extrorse. Staminoles always present in female flowers. Cotyledons foliaceous, broad, variously folded or curved.....**2. Celtis**  
Leaf base not 3-veined (Bornean taxa). Male flowers without pistillodes; anthers introrse. Staminoles absent in female flowers. Cotyledons narrow, involute.....**1. Aphananthe**

### 1. APHANANTHE Planch., *nom. cons.*

(Greek, *aphanes* = concealed, invisible, *anthe* = flower; small flowers)

Ann. Sc. Nat. 3, 10 (1848) 265, *non* Link, 1821; Soepadmo, FM 1, 8 (1977) 66; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 361. **Synonyms:** *Homoioceltis* Blume, Mus. Bot. Lugd. Bat. 2 (1856) 64; *Galumpita* Blume l.c. 73; *Gironniera* subgenus *Galumpita* (Blume) Hook. f. in Bentham & Hooker, Gen. Pl. 3 (1880) 356.

Deciduous or semi-deciduous trees, often buttressed. *Stipules basally attached, not leaving circular scars after falling. Leaves* glabrous, coriaceous, 3-veined at base or pinnately veined. **Inflorescences** axillary; bracts caducous; *male inflorescence a condensed, many-flowered raceme*, borne on the lower parts of new shoots; mixed inflorescence 2-3-flowered. **Flowers:** males 4-5-merous, perianth lobes membranous, *imbricate in bud*, filaments subulate, *anthers dorsifixed*, ovoid-subreniform, non-apiculate, *introrse, pistillodes absent*, replaced by a cluster of whitish to silvery, erect, soft, simple hairs; *females solitary in the axils of upper leaves of new shoot, or in clusters of 2-3*, perianth lobes 4-5, persistent, *staminodes absent*, ovary sessile, ovoid-ellipsoid, rounded to angular in cross-section, stigmatic arms tubular, *ovule anatropous*. **Fruit** a drupe, ovoid-globose, *faintly 3-5-angular or almost rounded in cross-section*; endocarp hard and persistent. **Seeds** with scanty endosperm; testa membranous, several-celled thick; *cotyledons* narrow, more or less equal, *involute*.

**Distribution.** About 4–5 species, distributed in Mexico, Madagascar, Sri Lanka, India, Myanmar, China, Korea, Japan, Taiwan, Hong Kong, Indo-China, Thailand, Andamans, Malasia, Australia (Queensland and New South Wales) and the Solomons. In Borneo, 1 species, so far known from Sabah only.

**Aphananthe cuspidata** (Blume) Planch.

Fig. 1.

(Latin, *cuspidatus* = with a sharp, rigid point; the leaf apex)

In A. DC., Prod. 17 (1873) 209; Soepadmo *l.c.* (1977) 69; Whitmore, Tantra & Sutisna *l.c.* 361. **Basionym:** *Cyclostemon cuspidatum* Blume, Bijdr. Fl. Ned. Ind. (1825) 599. **Type:** Blume, *s.n.*, Java, Mt. Parang (holotype L). **Synonyms:** *Galumpita cuspidata* (Blume) Blume *l.c.* (1856) 73; *Girroniera nitida* Benth., Fl. Hongk. (1861) 324; *Girroniera reticulata* Thwaite, En. Pl. Zeyl. 1 (1861) 268; *Girroniera lucida* Kurz, For. Fl. Burma 2 (1877) 470; *Girroniera cuspidata* (Blume) Kurz *l.c.* 470; *Girroniera curranii* Merr., Philip. J. Sc. 4 (1909) Bot. 251.

Tree to 30 m tall, 60 cm diameter; buttresses to 1 m high, and 2 m wide. **Bark** surface rough, grey-brown, often flaky. Young twigs sparsely, minutely appressed-pubescent, glabrescent; older twigs sparsely lenticellate. Stipules narrow, ovate-acute, 2–3 × 1 mm. **Leaves** *pinnately veined*; ovate-elliptic to elliptic-oblong, (5–)10–14(–20) × (2–)3–6(–8) cm; base rounded, subcordate or attenuate, symmetric or occasionally slightly asymmetric, margin entire, recurved, or rarely distantly serrulate in the upper half, *apex cuspidate* or acuminate, acumen to 2 cm long, pointed; midrib strongly raised beneath, impressed to flattish above, lateral veins (5–)7–8(–10) pairs, slightly raised beneath, flattish above, subparallel, arching and forming an angle of more than 60° with the midrib, weakly joining near the margin, intercostal veins finely reticulate to subscalariform, indistinct on both surfaces; petioles glabrous, (5–)8–12(–15) mm long, 1–2 mm thick, grooved on the upper side. **Inflorescences** male or mixed; male inflorescences to 4 cm long, 10–30-flowered; mixed inflorescences 2–3-flowered; bracts ovate-acute, 0.25–0.5 × 0.25 mm. **Flowers:** males globose, 1.5–2 mm diameter, short-stalked or rarely sessile, perianth lobes obovate-lanceolate, *c.* 2 × 1 mm, anthers *c.* 1 mm diameter; females solitary or 2–3 together, ovoid-ellipsoid, *c.* 2 × 1 mm, perianth lobes coriaceous, ovate-acute, *c.* 2 × 1 mm; ovary sessile, ovoid, glabrous, *c.* 1.5 × 1 mm, stigmatic arms 2–3 mm long. **Fruits** fleshy, ovoid, glabrous, including the beak 13–20 × 6–12 mm; stalk to 3 cm long, *c.* 1 mm thick.

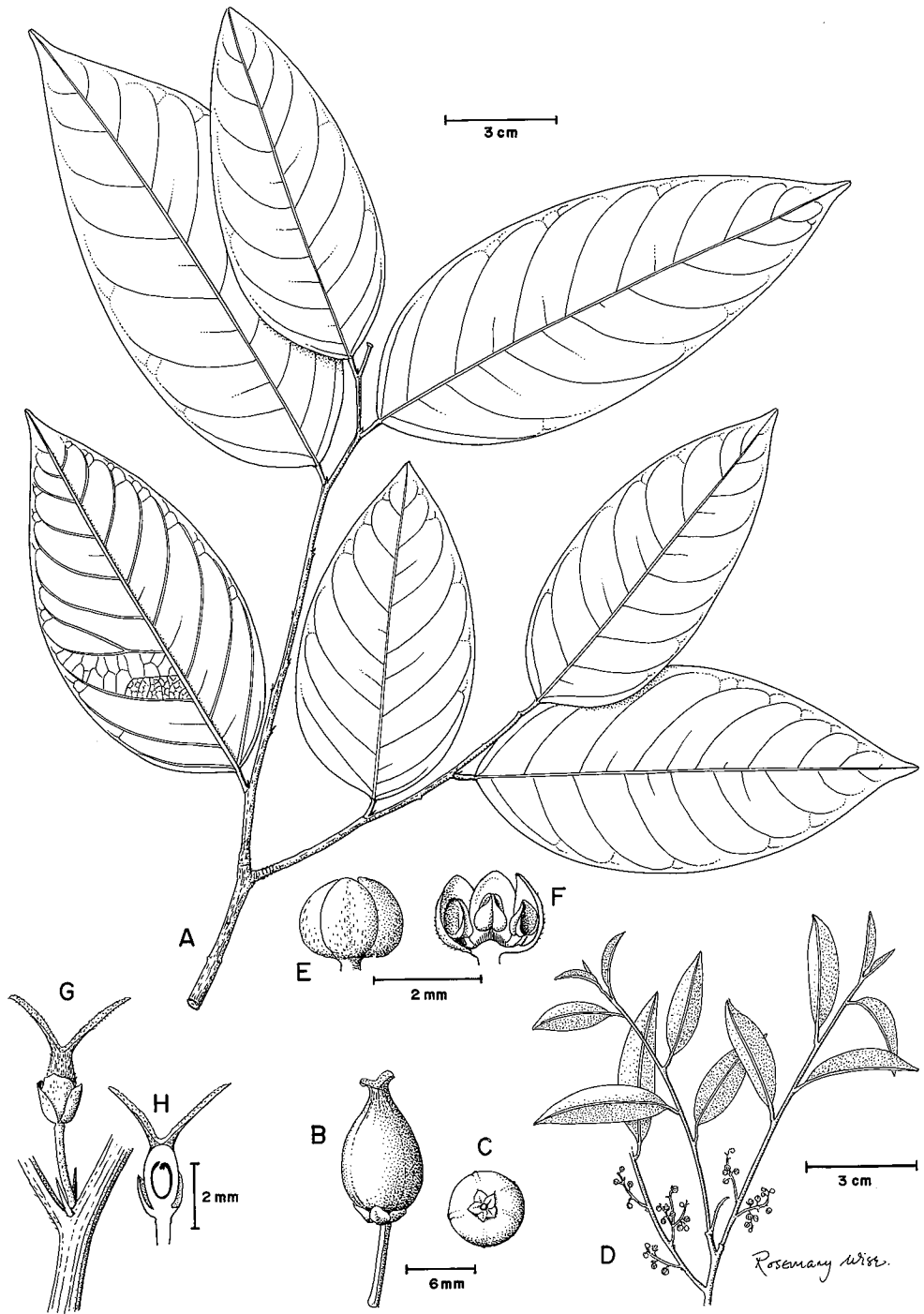
**Distribution.** India, Sri Lanka, Myanmar, Andamans, Hong Kong, Indo-China, Thailand, NE Sumatra, Borneo (Sabah), Java, Lesser Sunda Islands, Philippines (Mindanao, Palawan), and Sulawesi.

**Ecology.** In Sabah, *Aphananthe cuspidata*, is extremely uncommon and so far recorded from a single collection (*SAN 64311*) from the Ranau district. The deciduous or semideciduous habit, episodic growth, structure, size, colour of the inflorescence and flowers suggest that pollination is effected by wind. The drupes which turn to deep red when ripe are possibly dispersed by frugivorous birds.

## 2. CELTIS L.

(an old Latin plant-name)

Gen. Pl. ed. 5 (1754) 467; Ridley, FMP 3 (1924) 321; Backer & Bakhuizen *f.*, FJ 2 (1965) 11; Soepadmo,



**Fig. 1.** *Aphananthe cuspidata*. A, leafy twig; B-C, fruits; D, flowering leafy twig; E, male flower bud; F, male flower bud in longitudinal section; G, female flower; H, female flower in longitudinal section. (A-C from SAN 64311, D-F from Koorders 30071b, G-H from Koorders 27583b.)

TFM 2 (1973) 414, FM 1, 8 (1977) 55; Anderson, CLTS (1980) 340; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 361. **Synonym:** *Solenostigma* Endl., Prod. Fl. Norf. (1833) 41.

Small to large, monoecious or polygamo-monoecious trees; often buttressed. **Bark** smooth or finely fissured, often conspicuously warty lenticellate. Twigs initially densely yellow-brown or rufous-hairy, glabrescent. Buds enclosed by the overlapping stipules or exposed. Stipules thick and tough, *peltately or basally attached at the nodes*, caducous or permanent (not in Borneo). **Leaves** 3-veined at base. **Inflorescences** male, female, or mixed, branched racemes or panicles, few- to many-flowered, axillary or subterminal on new shoots. **Flowers:** males globular, stalked or sessile, *perianth lobes* (4–)5, *imbricate in bud*, membranous, boat-shaped, at anthesis recurved, caducous, stamens inserted on the densely pilose receptacle, filaments subulate, incurved in bud and then spreading, exerted at anthesis, anthers ovoid to subreniform, *dorsifixed, extrorse, pistillodes always present*; functionally female and bisexual flowers ovoid, stalked, *perianth lobes* (4–)5, *imbricate in bud*, connate at base, membranous, sparsely pubescent outside, boat-shaped, at anthesis recurved, caducous, stamens or staminodes well-developed and functional or rarely rudimentary, other characters as in male flowers, ovary ovoid-ellipsoid, sessile, style short or absent, stigmatic arms elongate, divergent, the tips entire to deeply bifid, *ovule anatropous*. **Fruit** a drupe, fleshy, ovoid, ellipsoid or globose, *3–5-angular to almost rounded in cross-section*; exocarp thick and firm; mesocarp thin and fleshy, containing slimy substances; endocarp hard and persistent, smooth or variously ridged or pitted. **Seeds:** testa membranous, chalazal area broad, dark-coloured and close to the minute hilum; *endosperm scanty*, oily or gelatinous; cotyledons broad, foliaceous, equal or unequal in thickness, flat or conduplicate, variously folded.

**Distribution.** About 50–60 species, widely distributed in the tropical and temperate regions of the world, with the majority in the Old and New World tropics. In the Malesian region, 9 species are known, 2 from Sabah and Sarawak.

**Ecology.** In primary and secondary lowland and hill forests, up to about 900 m, including exposed and stunted forest stands on rocky shores and limestone hills. Pollination may be effected by wind or insects, and fruit dispersal by frugivorous birds or sea current.

### Key to *Celtis* species

Leaves thin-coriaceous, brittle on drying, ovate-elliptic, base strongly asymmetric, margins crenate at least in the upper half, lateral veins 2(–3) pairs, basal pair running up to half to three-quarters the length of the blade. Stipules basally attached. Fruit more-or-less 4-angular in cross-section.....**2. *C. timorensis***

Leaves thick-coriaceous, tough and not brittle on drying, elliptic-oblong, lanceolate-oblong, to ovate-suborbicular, base mostly symmetric, margin entire and undulate, lateral veins 1 (to rarely 2) pairs, the basal veins running throughout the length of the blade or very rarely running up to about three-quarters the length of the blade. Stipules peltately attached. Fruits more-or-less rounded in cross-section.....**1. *C. philippensis***

#### 1. *Celtis philippensis* Blanco (of the Philippines)

Fig. 2A–D.

Fl. Filip. (1837) 197; Merrill, Spec. Blanc. (1918) 122; Soepadmo *l.c.* (1973) 416, *l.c.* (1977) 62;

Anderson *l.c.* 340; Whitmore, Tantra & Sutsna *l.c.* 361. **Type:** *Merrill Spec. Blanc.* 52, Philippines, Luzon, Rizal Prov., Dec. 1912 (A, L). **Synonyms:** *Celtis wightii* Planch., *Ann. Sc. Nat.* 3, 10 (1848) 307, Backer & Bahkuizen *f. l.c.* 11; *Solenostigma "philippinensis"* (Blanco) Miq., *Fl. Ned. Ind.* 1, 2 (1859) 220; *Solenostigma wightii* (Planch.) Miq. *l.c.* 220; *Celtis mindanaensis* Elmer, *Leafl. Philip. Bot.* 8 (1915) 2842; *Celtis collinsae* Craib, *Kew Bull.* (1918) 370; Ridley *l.c.* (1924) 322.

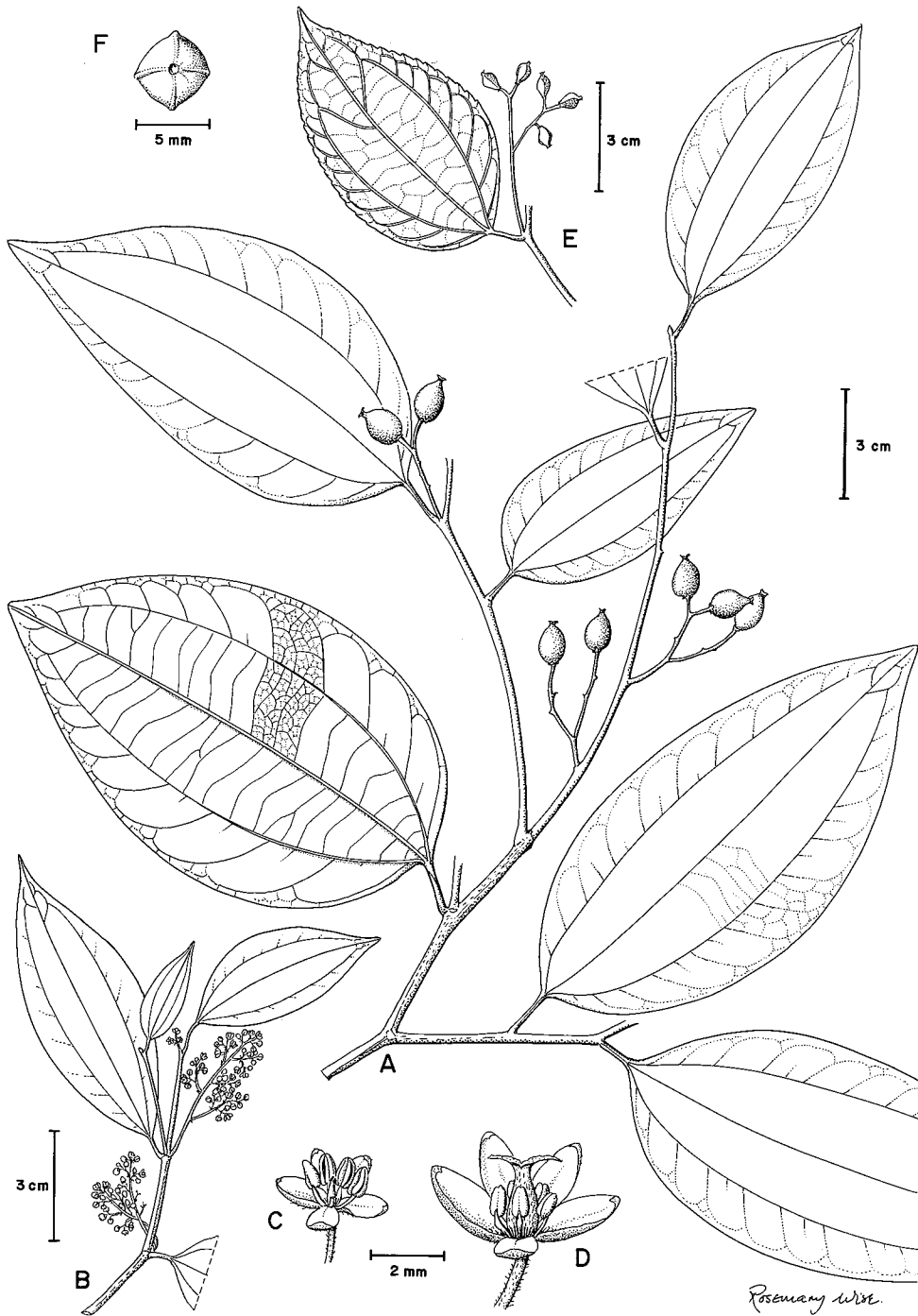
Low stunted shrub or treelet to large tree to 40 m tall, 80 cm diameter; buttresses, if present, to 4.5 m tall. **Bark** smooth to finely fissured, pale grey to grey-brown. Twigs sparsely lenticellate, subsulcate, glabrous or sparsely appressed-hairy. *Stipules thick and tough, peltately attached*, ovate-acute, 3–6 × 1–3 mm, overlapping, completely enclosing the bud, sparsely appressed-hairy or glabrous. **Leaves** *thick-coriaceous, tough and not brittle on drying*, glabrous, grey to dark brown; *elliptic-oblong, lanceolate-oblong to ovate-suborbicular*, (6–)8–14(–16) × 3–9 cm; base rounded or attenuate-rounded, rarely truncate, mostly symmetric, margin entire and slightly undulate, apex rounded to acute; midrib and lateral veins raised beneath, impressed to flattish above, *lateral veins 1(–2) pairs, basal veins ascending, arching and running throughout the length of the blade or rarely to about three-quarters the length of the blade*, intercostal veins finely and densely reticulate or subscalariform or tessellate, usually distinct beneath; petioles (3–)5–13(–17) mm long, (1–)2–3(–4) mm thick, somewhat grooved on the adaxial side, glabrous or sparsely appressed-hairy. **Inflorescences** male or mixed, much-branched panicles, many-flowered, including the bracts densely yellow-brown to rufous soft-hairy; bracts ovate-acute, *c.* 3 × 1 mm; male inflorescences borne on the lower parts of new shoots, 2–4 cm long, to 40-flowered; mixed inflorescences borne on the upper parts of new shoots, to 5 cm long, to 50-flowered, with the bisexual flowers on the distal parts of the rachis. **Flowers:** males *c.* 2 mm across, perianth lobes ovate-elliptic, 1.5–2 × 1 mm, filaments 1–1.5 mm long, anthers subreniform, 0.5–1 × 0.5 mm, pistillodes ovoid-cylindrical, compressed, 1–1.5 × 0.5 mm; functionally female and bisexual flowers *c.* 2–2.5 × 2 mm, perianth lobes ovate-elliptic, *c.* 2–2.5 × 1 mm, filaments 1–2 mm long, anthers 0.5–1 mm diameter, ovary ovoid-cylindrical, 2–3(–4) × (1–)1.5–2 mm, glabrous except at the base, stigmatic arms spreading, *c.* 1–1.5 mm long, bilobed to bifid at the tip. **Fruits** ovoid-ellipsoid, *more-or-less rounded in cross section*, only beaked when young, 8–13(–15) × 5–10 mm, glabrous; exocarp less than 1 mm thick, sometimes lenticellate, turning orange to red when ripe; endocarp more or less smooth. **Seeds** with unequal cotyledons.

**Distribution.** Tropical Africa to Madagascar, islands of the Indian Ocean (Reunion, Mauritius), India, Myanmar, SE China, Hong Kong, Taiwan, Indo-China, Thailand, throughout Malesia, NE Australia and the Solomons. In Sabah, scattered in coastal hill forests in the Semporna (including Sipadan island), Sandakan, Lahad Datu (including Timbun Mata island) and Tawau districts in the east coast and in Beaufort district (including Pulau Tiga) in the west coast. In Sarawak, twice collected from Mt. Subis, Niah Caves, Miri (*S. 16035* and *S. 16041*). Also known in Brunei.

**Ecology.** Understorey or main storey trees in primary and secondary forests, on various types of soil, from sea level to about 700 m.

**Uses.** The timber, though not durable, is locally used in house-building.

**Taxonomy.** A rather variable species in terms of leaf and fruit size. Specimens collected from limestone and rocky shores usually have smaller and narrower leaves and smaller fruits than those from more inland coastal hills.



**Fig. 2.** *Celtis philippensis* (A–D); *Celtis timorensis* (E–F). A, fruiting leafy twig; B, flowering leafy twig; C, functionally male flower; D, functionally female flower; E, fruiting leafy twig; F, fruit seen from the base. (A from SAN 66966, B–D from SAN 16496, E–F from Clemens 30351.)

## 2. *Celtis timorensis* Span. (of Timor Island)

Fig. 2E-F.

Linnaea 15 (1841) 343; Soepadmo *l.c.* (1977) 65; Whitmore, Tantra & Sutisna *l.c.* 362. **Type:** *Spanoghe, s.n.*, Timor (L; n.v.). **Synonyms:** *Celtis cinnamomea* Lindl. *ex* Planch. *l.c.* 303; *Celtis reticulosa* Miq., Pl. Jungh. (1851) 69; *Celtis hamata* Blume *l.c.* (1856) 72; *Celtis waitzii* Blume *l.c.* (1856) 71; *Celtis crenatoserrata* Merr., Philip. J. Sc. 5 (1910) Bot. 174.

Tree to 25 m tall, 30 cm diameter. **Bark** smooth, brownish grey, lenticellate; inner bark pale brown, fibrous. Twigs initially rather densely rufous-pubescent, glabrescent; older twigs glabrous, rather densely lenticellate. *Stipules basally attached, free and scarious, linear-lanceolate, 5–10 × 1–2 mm.* **Leaves** *thin-coriaceous, brittle on drying*, except for the midrib and lateral veins glabrous, upper surface dull grey to dark brown, lower surface chocolate-brown; ovate-elliptic, (6–)10–12(–17) × (2–)4–5(–8) cm; base rounded to subcordate, *asymmetric, margin undulate and distantly crenate at least in the upper half*, apex acute to acuminate, acumen to 2 cm long; midrib and lateral veins flattish to impressed above, raised beneath, lateral veins 2(–3) pairs, arching and ascending, the basal pair running to half to three-quarters the length of the blade, joining along the margin, intercostal veins subscalariform, sparse, rather distinct beneath; petioles 5–15 mm long, 1–2 mm thick, adaxially grooved. **Inflorescences** male or mixed, racemose, lax; axes slender, always longer than the petioles, including the bracts sparsely rufous-hairy; bracts narrowly ovate-acute, *c.* 3–5 × 1–2 mm; male inflorescences borne on the lower leafless parts of new shoots, much-branched, 10–20-flowered, to 3 cm long; mixed inflorescences borne in the axils of new leaves, 4–7-flowered, to 2–3 cm long. **Flowers:** males *c.* 2 mm diameter, perianth lobes 1.5–2 × 1 mm, filaments 1–1.5 mm long, anthers reniform, *c.* 1 × 0.5 mm, pistillodes present but strongly reduced in size; bisexual flowers (functionally female) 2–3 mm diameter, perianth lobes 1.5–2 × 1 mm, filaments 0.5–1 mm long, anthers subreniform, 0.5–0.75 × 0.5 mm, ovary ovoid-ellipsoid, *c.* 2 × 1 mm, stigmatic arms 1–1.5 mm long, spreading. **Fruits** ovoid, more-or-less 4-angular in cross-section, strongly beaked, (4–)5–8(–10) × 3–6 mm, glabrous. **Seeds** with equal cotyledons.

**Distribution.** India, Bangladesh, Sri Lanka, Myanmar, Thailand, Indo-China, C Sumatra, Java, Borneo, Philippines, and Lesser Sunda Islands (Flores, Timor). In Borneo, uncommon and known from 6 specimens collected from the Mt. Kinabalu area, in Ranau district (*Chew & Corner RSNB 5772, Clemens 30351, SAN 56520, SAN 92527, SAN 116594*) and from Apin near Laing Caves in Keningau district (*SAN 44568*), and a few others from Kalimantan; so far no record from Sarawak and Brunei.

**Ecology.** In hilly mixed dipterocarp forest and lower montane forest, at 600–1500 m.

## 3. *GIRONNIERA* Gaudich.

(Proust de la Gironnier, prominent French citizen of Manila, *c.* 1840)

*entabuloh, untoh bulu* (Iban), *medang kasap* (Malay)

Voy. Bonite (1844) t. 85; Merrill, EB (1921) 216; Ridley, FMP 3 (1924) 317; Masamune, EPB (1942) 237; Brown, FTSB (1955) 356; Phuphathanaphong, Thai For. Bull. 6 (1972) 49; Backer & Bakhuizen *f.*, FJ 2 (1965) 12; Soepadmo, TFM 2 (1973) 417, FM1, 8 (1977) 70; Anderson, CLTS (1980) 340; Corner,

WSTM 3rd ed. 2 (1988) 735; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 362. **Synonyms:** *Nemostigma* Planch., Ann. Sc. Nat. 3, 10 (1848) 265; *Helminthospermum* Thwaite in Hooker, J. Bot. Kew Misc. 6 (1854) 301.

Shrubs to large trees, very rarely buttressed. **Bark** smooth to finely fissured, grey-brown, often rugose with pustular lenticels; inner bark usually pinkish, fibrous inwards, granular outwards. **Sapwood** hard, pale fawn. Young parts densely or sparsely covered with golden yellow or yellowish brown indumentum. *Stipules basally attached, overlapping and completely enclosing the ellipsoid-cylindrical terminal buds, after falling leaving distinct circular scars around the nodes.* **Leaves** pinnately veined, lateral veins parallel and regularly spaced. **Inflorescences** male or female, very rarely mixed, axillary or borne on older, leafless twigs, 1-many-flowered, paniculate, racemose or thyrsoid; bracts caducous in male inflorescences, rather persistent in female and mixed inflorescences. **Flowers:** males globular, sessile or short-stalked, *perianth lobes 4-6, imbricate in buds*, stamens (4-)5(-6), glabrous or hairy, filaments subulate, inflexed, *anthers introrse*, ovoid-reniform, apiculate, *sub-dorsifixed*, *pistillodes present*, rather well-developed or strongly rudimentary, densely covered with long whitish or silky erect hairs; females ovoid-ellipsoid, compressed, perianth lobes 4-5, usually unequal in size, persistent, *staminodes absent*, ovary ovoid-ellipsoid, *strongly compressed*, sessile, densely or sparsely appressed-hairy, glabrescent, stigmatic arms to 1.5 cm long, curled in bud, later spreading, rather persistent; *ovules anatropous*. **Fruit** a drupe, *compressed ovoid-globose, lens-shaped in cross-section*, subtended by persistent perianth lobes; exocarp thin, strongly adnate to the hard and persistent endocarp. **Seeds** mostly sterile; testa membranous, several-celled thick; *endosperm absent; cotyledons fleshy, narrow, equal, curved*.

**Distribution.** Five species, distributed in E and SE Asia extending from Sri Lanka to Andaman Is., Thailand, Indo-China, China, Malesia, Micronesia, Melanesia, and Polynesia. In Malesia, throughout the region except for the eastern parts of Java, Lesser Sunda Islands, and SE Maluku. In Sabah and Sarawak, represented by 3 species.

**Ecology.** In primary and secondary forests, from sea level to 1600 m, on different types of soil, including those derived from limestone. Flowering and fruiting throughout the year. Pollination is most likely by wind. The drupes which turn bright yellow or orange when ripe are mostly sterile, and dispersed by frugivorous birds.

### Key to *Gironniera* species

1. Leaves densely covered with yellowish brown, soft, slender hairs beneath; lateral veins (10-)12-16(-18) pairs, adjacent veins 5-8 mm apart, straight and parallel, not joining near the margin. Male inflorescence a much-branched panicle; male flowers in condensed cyme-like clusters of 5-10..... **1. *G. nervosa***  
Leaves glabrous or only sparsely covered with yellowish-brown, appressed short-hairs on the midrib and lateral veins beneath; lateral veins (5-)6-8(-10) pairs, adjacent veins (7-)10-15 mm apart, joining near the margin. Male inflorescence an unbranched or little-branched raceme or panicle; male flowers solitary or in clusters of 3-5 on short, condensed secondary branches of the inflorescence.....2
2. Leaves thick-coriaceous, sparsely covered with yellowish brown, short hairs beneath, especially on the midrib and lateral veins; length 2-2.5 times the width, base more-or-less



asymmetric; intercostal veins laxly subscalariform. Male inflorescences little-branched panicles, 40–100-flowered. Female inflorescences (2–)5–10(–15)-flowered. Mature fruits 10–12 × 8–9 mm, 5–6 mm thick.....**3. G. subaequalis**  
 Leaves chartaceous to thin-coriaceous, glabrous on both surfaces; length 3–3.5 times the width, base more-or-less symmetric; intercostal veins densely, finely tessellate. Male inflorescences unbranched racemes, 15–30-flowered. Female inflorescences 1–3-flowered. Mature fruits 7–8 × 5–6 mm, 3–4 mm thick.....**2. G. parvifolia**

### 1. *Girroniera nervosa* Planch.

(Latin, *nervosus* = conspicuously veined; the leaves)

*l.c.* 338; Merrill, EB (1921) 216; Ridley *l.c.* 320; Masamune *l.c.* 237; Soepadmo *l.c.* (1973) 419, *l.c.* (1977) 74; Corner *l.c.* 736. **Type:** *Porter ex Wallich Cat. 7289*, Penang (K). **Synonyms:** *Girroniera penangiana* Gandog., Bull. Soc. Bot. Fr. 66 (1919) 289; *Girroniera sponioides* Gandog. *l.c.* 289; *Girroniera hirta* Ridl., J. Str. Br. Roy. As. Soc. 82 (1920) 194, *l.c.* (1924) 321, Soepadmo *l.c.* (1973) 417, *l.c.* (1977) 74, *syn. nov.*

Medium-sized to large tree to 40 m tall, 60 cm diameter; buttresses sometimes present. **Bark** smooth or finely fissured, grey-green to dark grey-brown, often hoop-marked and lenticellate; inner bark pale yellow. Young twigs, stipules, terminal buds, petioles, inflorescences and fruits densely covered with long or short silky, soft, erect or appressed, yellowish-brown hairs. Terminal buds ovoid-ellipsoid or conical 1–3 × 0.2–0.6 cm. Stipules 1.5–3.5 × 0.25–0.5 cm. **Leaves** thick-coriaceous, rigid, upper surface glabrous except for the midrib and lateral veins, lower surface densely covered with long, yellowish brown, soft, silky, slender hairs; elliptic-lanceolate to elliptic-oblong, (6–)10–20(–29) × (2.5–)4–10(–13) cm, broadest at the middle, length 2–3 times the width; base rounded, subcordate, or attenuate, often asymmetric, margin entire and recurved or rarely distantly serrulate in the upper half, apex rounded-acute or acuminate; midrib and lateral veins strongly raised beneath, flattish or impressed above, lateral veins (10–)12–16(–18) pairs, adjacent veins 5–8 mm apart, straight and parallel for the most part, arching but not joining near the margin, intercostal veins densely scalariform or subscalariform, distinctly raised beneath, obscure to faintly visible above; petioles (3–)5–10(–15) mm long, 1–2(–3) mm thick, terete, subterete or flat on the upper side near the base. **Inflorescences** male or female, axillary, borne on separate twigs; bracts ovate-acute, 1–2 × 0.5–1 mm; male inflorescences slender, lax, pendent, much-branched panicles of 5–10-flowered, condensed cyme-like clusters, 7–8 cm long, up to 100-flowered; female inflorescences unbranched or branched panicles, 2.5–6 cm long, (2–)5–20(–25)-flowered. **Flowers:** males 1–2 mm diameter, sessile or short-stalked, perianth lobes broadly ovate-acute, (1–)1.5–2 × 1–1.5 mm, densely short, appressed-hairy outside, stamens (4–)5(–6), sparsely covered with short, appressed hairs, filaments 1–1.5 mm long, anthers ovoid-reniform, 0.5–1 mm diameter, glabrous or hairy, pistillodes strongly rudimentary; females sessile or short-stalked, 2–3 × 1.5–2 mm, perianth lobes narrowly ovate-acute, 1.5–2 × 1 mm, densely appressed short-hairy outside, ovary densely appressed-hairy, 1.5–3 × 1–2 mm, stigmatic arms 5–10 mm long. **Fruits** subglobose or ovoid, dull orange, 5–10 × 3–6 mm, 3–5 mm thick, short-beaked.

**Vernacular names.** Sabah—*hugot hugot* (Dusun), *kiga* (Dusun Sungei), *luazon* (Kadazan), *sosopon bonging* (Dusun Putatan). Sarawak—*medang kasap* (Malay), *puloh* (Iban).

**Distribution.** Thailand, Sumatra, Peninsular Malaysia, Borneo, Maluku, and New Guinea. Common in Sabah and Sarawak; also known for Brunei and Kalimantan.

**Ecology.** In primary and secondary forests, from sea level to 1400 m, mostly below 700 m; often locally common as understory trees in lowland mixed dipterocarps forest and hill and lower montane forest or in forest on ultramafic soil.

**Uses.** The timber is locally used in house-building.

**Taxonomy.** In previous accounts, Soepadmo (*l.c.* 1973 & 1977), based on a limited number of specimens, recognised *G. hirta* Ridl. as a species distinct from *G. nervosa*. However, recent collections from Sabah and Sarawak indicate that these two species should be combined, due to the presence of intermediate specimens integrating morphological characters of the two species.

## 2. *Gironniera parvifolia* Planch.

(Latin, *parvum* = small, *folium* = leaf)

*l.c.* 338; Ridley *l.c.* (1924) 321; Soepadmo *l.c.* (1973) 419, *l.c.* (1977) 75; Corner *l.c.* 689. **Type:** Griffith, *s.n.* (= *Herb. Lemann*), Malacca (K). **Synonyms:** *Gironniera subaequalis* var. *ceylanica* Planch *l.c.* (1848) 339; *Helminthospermum scabridum* Thwaite in Hooker, *J. Bot. Kew Misc.* 6 (1854) 303, t. 9c; *Gironniera paucinervia* Merr., *J. Str. Br. R. As. Soc.* 77 (1917) 189, *l.c.* (1921) 217, Masamune *l.c.* 238; *Gironniera zeylanica* Gandog., *Bull. Soc. Bot. Fr.* 66 (1919) 288; *Gironniera scabrida* (Thwaite) Alston in Trimen, *Fl. Ceyl.* 6 (1931) 267.

Small to medium-sized tree to 20 m tall, 20 cm diameter. **Bark** smooth to finely fissured, lenticellate, grey-green or grey-brown; inner bark pale yellow or pinkish. Terminal buds (5–)8–15(–18) × 1–3 mm. Stipules linear-acute, (6–)8–20(–23) × 2–5 mm. **Leaves** chartaceous to thin-coriaceous, glabrous or rarely sparsely appressed-hairy; elliptic-lanceolate, very rarely elliptic-obovate, (4–)7–15(–19) × (1.5–)3–5(–6) cm, length 3–3.5 times the width, broadest at or above the middle; base attenuate or rounded, more or less symmetric, margin entire or sometimes minutely and distantly serrulate in the upper half especially in young specimens, apex attenuate-acute or rounded-acuminate, acumen to 2.5 cm; midrib and lateral veins slightly raised beneath, flattish above, lateral veins (4–)6–8(–10) pairs, adjacent veins 7–10 mm apart, subparallel for the most part and forming an angle of up to 60° with the midrib, arching and joining along the margin, intercostal veins densely finely tessellate, visible beneath, obscure above; petioles (4–)5–7(–10) mm long, 1–3 mm thick, adaxially grooved, sparsely appressed-pubescent, glabrescent. **Inflorescences** male or female, axillary, borne on separate twigs, including bracts sparsely appressed-pubescent, glabrescent; bracts ovate-acute, membranous, c. 1 × 0.5 mm; male inflorescence a slender, pendulous, unbranched or little-branched raceme, 10–30-flowered, axes 5–8 cm long, 0.3–0.7 mm thick; female inflorescence a slender, 1–3(–5)-flowered raceme, 4–10 cm long, axes 0.2–0.3 mm thick. **Flowers:** males solitary or in clusters of 3–5 along the axes, short-stalked or sessile, 1–3 mm diameter, perianth lobes broadly ovate, 1–2.5 × 1–2 mm, stamens (4–)5(–6), filaments 1–1.5 mm long, anthers ovoid-reniform, 0.7–1 mm diameter, glabrous, pistillodes strongly rudimentary or cylindrical, to 0.5 mm across, densely covered with long, yellowish white wavy hairs; females 2–3 × 2 mm, short-stalked, perianth lobes mostly 4, 1.5–2.5 × 1–2 mm, ovary sparsely appressed-pubescent, 2–3 × 2 mm, stigmatic arms to 1.5 mm long. **Fruits** 7–8

× 5–6 mm, 3–4 mm thick, ripening orange, sparsely appressed-pubescent, glabrescent; beak 5–10 mm long.

**Vernacular names.** Sabah—*ampas tebu, hampas tebu, medang kasap* (Malay), *rozan, ruazon* (Dusun Kinabatangan). Sarawak—*belian landak* (Iban), *tepada* (Kelabit).

**Distribution.** Sri Lanka, Sumatra, Peninsular Malaysia, Borneo. In Sabah, rather common in the western districts (Kota Merudu, Tuaran, Kota Kinabalu, Penampang, Ranau, Papar, Tambunan, Beaufort and Sipitang); but in Sarawak, very rare and so far known from a single collection from the Kelabit Highlands (S. 35414).

**Ecology.** In primary as well as secondary forest, from sea level to 1600 m, mostly below 1000 m. Occasionally in *kerangas* forest.

**Uses.** The timber is heavier and more compact than that of *G. nervosa* but not durable. It is locally used in house-building.

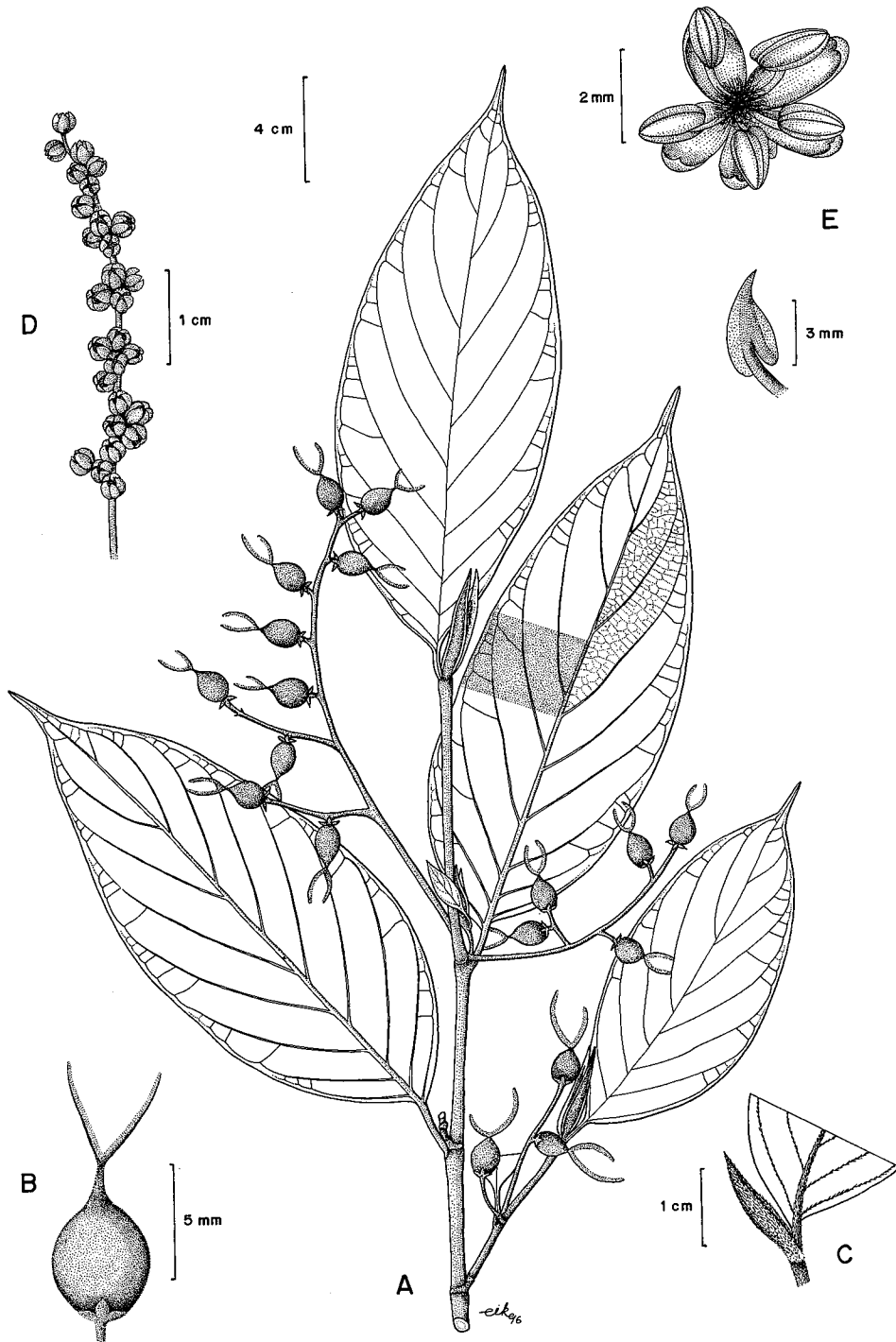
### 3. *Gironniera subaequalis* Planch.

Fig. 3.

(Latin, *subaequalis* = not completely equal; the asymmetric leaf base)

*l.c.* (1848) 339, *p.p.*, excl. var. *ceylanica*; Merrill *l.c.* (1921) 217; Ridley *l.c.* (1924) 320; Masamune *l.c.* 238; Backer & Bakhuizen *f. l.c.* 12; Soepadmo *l.c.* (1973) 419, *l.c.* (1977) 75; Corner *l.c.* 690. **Type:** *Spanoghe, s.n.* (= *Herb. Hooker*), Java (K). **Synonym:** *Gironniera nervosa* var. *subaequalis* (Planch.) Kurz, For. Fl. Burma 2 (1877) 470.

Small to large tree to 40 m tall, 60 cm diameter; buttresses up to 1.5 m high. **Bark** smooth to finely fissured, pustular or lenticellate, grey brown; inner bark granular outwards, fibrous inwards, yellow-brown. **Sapwood** pale yellow. Young twigs, stipules, petioles, and inflorescences sparsely appressed-hairy, glabrescent. Terminal buds ellipsoid, 2–3 × 0.25–0.5 cm, densely appressed, yellowish pubescent. Stipules linear-lanceolate, 1.5–2.5 × 0.25–0.5 cm. **Leaves** *thick-coriaceous, except for midrib and lateral veins glabrous*; broadly ovate-elliptic to elliptic-oblong, (6–)10–20(–27) × (3–)5–9(–13) cm, *length 2–2.5 times the width*, broadest below or at the middle; base attenuate or rounded, *more or less asymmetric*, margin entire or occasionally (especially when young) distantly serrulate in the upper half, apex rounded or attenuate-acute; midrib and lateral veins prominent beneath, flattish above, sparsely yellowish-brown, appressed short-hairy or glabrous beneath, *lateral veins (5–)6–8(–10) pairs, adjacent veins 10–15 mm apart, arching and joining along the margin, intercostal veins laxly subscalariform*, clearly visible beneath, flattish and faintly visible or obscure above; petioles (5–)10–15(–26) mm long, 1–3(–5) mm thick, terete or adaxially flat near the base. **Inflorescences** male or female, axillary, borne on separate or rarely on the same twigs, including bracts sparsely to densely yellowish-brown, appressed short-hairy, glabrescent; bracts ovate-acute, 1–2 × 0.5–1 mm; *male inflorescences pendent, little-branched panicles, 40–100-flowered, axes 3–8 cm long, 0.5–1 mm thick; female inflorescences racemose or more commonly paniculate (branched), axes 3–6 cm long, 1–1.5 mm thick, (2–)5–10(–15)-flowered*. **Flowers:** males 1.5–2.5 mm diameter, sessile or short-stalked, *solitary along the axes or in clusters of 3–5 on short, condensed secondary branches of the panicle*, perianth lobes sparsely appressed short-hairy, glabrescent, broadly ovate-rounded, 2–2.5 × 1–2 mm, stamens 5, filaments 1–2 mm long, anthers ovoid-subreniform, *c.* 1 mm long,



**Fig. 3.** *Gironniera subaequalis*. A, fruiting leafy twig; B, young fruit; C, stipules; D, male inflorescence; E, male flower and dorsal view of a stamen. (A–C from SAN 117970, D from SAN 92016, E from FRI 19281.)

glabrous, pistillodes cylindrical, to 1 mm long, or strongly rudimentary, densely covered with long, yellowish, wavy or erect hairs; females solitary and short-stalked along the axes, 2–4 × 2 mm, perianth lobes broadly ovate-acute, 1.5–2 × 1–1.5 mm, sparsely appressed-pubescent outside, ovary 2–3 × 2 mm, densely appressed-pubescent, glabrescent, stigmatic arms to 2 cm long. **Fruits** 10–12 × 8–9 mm, 5–6 mm thick, sparsely appressed-pubescent, glabrescent; beak 2–5 mm long; ripening yellow-orange.

**Vernacular names.** Sabah—*kuayun*, *ruwayon* (Dusun), *luazon*, *russen* (Dusun Kinabatangan). Sarawak—*medang kasap* (Malay), *untoh bulu* (Iban).

**Distribution.** A rather variable species, widely distributed in the Andaman Is., Myanmar, China, Hong Kong, Indo-China, Thailand, and Malesia (except the Lesser Sunda Is.). Common in Sabah and Sarawak; also known in Brunei and Kalimantan.

**Ecology.** Understorey or main canopy trees in primary and secondary forests, from sea level to 1600 m, on various types of soil; more common in the lowlands between 100 and 1000 m. Flowering and fruiting throughout the year.

**Uses.** The timber, which is heavier and darker than that of *G. nervosa*, is locally used in house-building, flooring and making planks.

#### 4. TREMA Lour.

(Latinized Greek word, *trema* = hole, gap, pit; the pitted endocarp of the fruit)

*halindagong*, *randagong* (Dusun, Sabah); *kereneong* (Iban, Sarawak); *marong* (Malay, Sarawak); *towi* (Bidayuh, Sarawak)

Fl. Coch. 2 (1790) 562; Merrill, EB (1921) 217, PEB (1929) 45; Ridley, FMP 3 (1924) 319; Masamune, EPB (1942) 238; Brown, FTSB (1955) 359; Backer & Bakhuizen *f.*, FJ 2 (1965) 11; Elias, J. Arn. Arb. 51 (1970) 37; Soepadmo, TFM 2 (1973) 420, FM 1, 8 (1977) 47; Anderson, CLTS (1980) 341; Wong, DMT (1982) 247; Corner, WSTM 3rd ed. 2 (1988) 738; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 362; Kessler & Sidiyasa, Trees of the Balikpapan-Samarinda Area (1994) 231. **Synonym:** *Sponia* Commers. *ex* Lamk, Dict. 4 (1795) 138.

Trees or shrubs, often buttressed and with spreading and drooping branches. *Stipules basally attached, overlapping but free*, caducous. **Leaves** *pinnately veined and 3-veined at base*. **Inflorescences** axillary, paniculate or thyrsoid, many-flowered, condensed or lax, male, female or mixed (with structurally bisexual but functionally male and female flowers in the same inflorescence), variously densely pubescent; bracts caducous. **Flowers:** males globose, *perianth lobes (4–)5, induplicate-valvate in bud*, anthers *dorsifixed, introrse, pistillodes present*, hirsute; females ovoid, *perianth lobes (4–)5*, glabrous or sparsely short-hairy, *staminodes rarely present*, ovary ovoid, glabrous, slightly compressed, sessile, style short, *ovules anatropous or hemi-anatropous*. **Fruit** a drupe, *compressed, lens-shaped in cross-section*; exocarp fleshy and fibrous; endocarp stony and very hard, pitted. **Seeds** *with scanty or copious endosperm; cotyledons equal, curved*.

**Distribution.** About 10–15 species, widely distributed throughout the tropics and subtropics. In Asia (6–7 species), ranging from the warmer parts of the Himalayas, extending northeastwards to China, S Japan and southeastwards through India, Myanmar, Thailand, Indo-China, and Malesia to the tropical and subtropical parts of Australia and Pacific Islands as far east as Tahiti. In Africa (3–4 species), it occurs south of the Sahara to S Africa and Madagascar. In America (4–5 species), known from C and S Florida and Mexico, extending southeastwards through Central America, Bermuda, and the Bahamas, to the Greater Antilles and southwards to South America as far south as the northern parts of Argentina. In Sabah and Sarawak, 4 species are known.

**Ecology.** Throughout its range of distribution, the genus seems to thrive and often grow gregariously in newly cleared areas on various types of soil ranging from heavy laterite to limestone and soils derived from volcanic ash, from sea level to 2000 m. Flowering and fruiting prolifically throughout the year. Pollination is by wind or insects. The fruits, which turn orange, red or black when ripe, are dispersed by frugivorous birds, especially bulbuls.

**Uses.** The timber of *Trema orientalis* and *T. tomentosa* is soft and light, with density ranging from 415–465 kg/m<sup>3</sup> air dry. The sapwood is straw-coloured and is sharply differentiated from the heart-wood, which is light brown with a grey tinge. The wood is very easy to saw and to work, but not durable; it has been used locally for making tea-chests, matches, and wooden clogs, and according to Brown (*l.c.*) has the potential for use as pulp-wood. The fibrous inner bark is locally used as rough cordage.

### Key to *Trema* species

1. Lower leaf surface densely rough tomentose with short, matted, rufous or glaucous, simple hairs and multicellular glandular hairs. Petioles (2–)3–6(–8) mm long. Mature fruits subglobose, 1.5–2 mm across.....**1. T. angustifolia**  
Lower leaf surface glabrous or sparsely appressed hairy, or densely velvety tomentose with silvery or glaucous, long simple hairs or combination of long simple hairs and short multicellular glandular hairs. Petioles (7–)10–15(–25) mm long. Mature fruits ovoid, (2–)3–4(–5) × 2–3(–4) mm.....2
2. Leaves chartaceous to thin-coriaceous, smaller, (3–)5–10(–13) × (1.5–)2–4(–5.5) cm, lower surface glabrous or rarely sparsely short-pubescent; base rounded to attenuate, mostly symmetric, lateral veins (2–)3–4(–5) pairs. Inflorescences axes slender, less than 1 mm thick. Fruits smaller, 2–3 × 2 mm.....**2. T. cannabina**  
Leaves mostly thick-coriaceous, larger, (5–)10–15(–19) × (2–)3–7(–10) cm, lower surface densely velvety tomentose with long simple hairs or densely tomentose with long simple hairs and short, multicellular glandular hairs; base cordate, subcordate or rounded, mostly asymmetric; lateral veins 5–8 pairs. Inflorescence axes stout, thicker than 1 mm. Fruits larger, (2–)3–5 × 2–4 mm.....3
3. Lower leaf surface densely tomentose with combination of silvery, long, appressed hairs and short glandular hairs (lamina surface hidden, even under high magnification). Fruits larger, 3–5 × 2–4 mm.....**3. T. orientalis**

Lower leaf surface densely or sparsely velvety tomentose with glaucous, erect, simple hairs (lamina surface clearly visible between the hairs even under low magnification).  
Fruits smaller, 2–3 × 2 mm.....**4. T. tomentosa**

**1. *Trema angustifolia* (Planch.) Blume**

(Latin, *angustus* = narrow, *folium* = leaf)

Mus. Bot. Lugd. Bat. 2 (1856) 58; Merrill *l.c.* (1921) 217; Ridley *l.c.* (1924) 219; Masamune *l.c.* 238; Soepadmo *l.c.* (1973) 421, *l.c.* (1977) 54; Whitmore, Tantra & Sutisna *l.c.* 362. **Basionym:** *Sponia angustifolia* Planch., Ann. Sc. Nat. 3, 10 (1848) 326. **Type:** *Wallich 3691*, Penang (holotype K; isotype CGE). **Synonyms:** *Sponia acuminatissima* Miq., Fl. Ned. Ind. Suppl. (1873) 410; *Trema acuminatissima* (Miq.) Boerl., Handl. 3 (1900) 358; *Trema orientalis* var. *bicolor* De Wit, Bull. Bot. Gard. Btzg. 3, 18 (1949) 190.

Small tree to 7 m tall, 15 cm diameter. **Bark** smooth, grey-brown; inner bark greenish. Twigs slender, spreading and drooping, densely covered with rufous, multicellular glandular hairs and glaucous short and matted simple hairs, subglabrescent. Stipules linear-lanceolate, 1–2(–3) × 1 mm. **Leaves** chartaceous to thin-coriaceous, discolorous, upper surface strongly scabrate, dark chocolate-brown to blackish-brown, lower surface densely rough tomentose with short, matted, rufous to glaucous simple and multicellular glandular hairs; narrowly ovate-lanceolate to lanceolate, (3–)4–6(–8) × (1–)2–3(–4) cm, length 3–3.5 times the width, broadest below or at the middle; base symmetric, rounded to attenuate, margin finely serrate throughout, apex acute to acuminate; midrib and lateral veins slightly raised beneath, impressed above, lateral veins 3–5 pairs, straight, ascending, intercostal veins fine, subscalariform to tessellate, obscure above, faintly visible beneath; petioles (2–)3–6(–8) long, 0.5–1 mm thick, densely short-hairy. **Inflorescences** male or mixed, rufous tomentose, much-branched, (5–)10–15(–30)-flowered, axillary, very condensed, shorter than or as long as the petioles; bracts narrowly ovate-acute, 0.5–1 × 0.25–0.5 mm. **Flowers:** males 1–2 mm diameter, perianth lobes 5, subelliptic, (0.75–)1–1.5 × 1 mm, filaments to 1 mm long, pistillodes obovoid-ellipsoid, 0.75–1 × 0.5 mm, strongly compressed; females *c.* 2 × 1 mm, perianth lobes 5, narrowly lanceolate, acute, 0.5–1 × 0.25–0.5 mm, staminodes absent, ovary 1–2 × 1 mm, stigmatic arms *c.* 0.5–1 mm long, incurved or spreading. **Fruits** subglobose, 1.5–2 mm across, turning to orange or red when ripe. **Seeds** with copious endosperm.

**Vernacular name.** Sabah—*randagong* (Dusun Ranau).

**Distribution.** China, Thailand, Indo-China, Sumatra, Peninsular Malaysia, Borneo, and Sulawesi. In Sabah and Sarawak, apparently little-collected, known only from 3 collections (*SAN 99290* from Beluran in Sabah, and *Native collector E. 284* and *Haviland s.n.* from Mt. Matang, Sarawak).

**Ecology.** Occasional in secondary forest and newly cleared areas in the lowlands and lower montane areas, from sea level to 1200 m.

**2. *Trema cannabina* Lour.**

(Latinized Greek word, *kannabinos* = resembling the hemp or cannabis plant)

Fl. Coch. 2 (1790) 563; Backer & Bakhuizen *f. l.c.* 12; Soepadmo *l.c.* (1973) 421, *l.c.* (1977) 50; Anderson *l.c.* 341; Corner *l.c.* 738; Whitmore, Tantra & Sutisna *l.c.* 363. **Type:** *Loureiro, s.n.*, Indo-China (BM). **Synonyms:** *Celtis amboinensis* Willd., Sp. Pl. 4, 2 (1805) 997; *Sponia amboinensis* (Willd.) Decne, Nouv. Ann. Mus. Hist. Nat. 3, 3 (1834) 498; *Trema amboinensis* (Willd.) Blume *l.c.* (1856) 61, Merrill *l.c.* (1921) 217, *l.c.* (1929) 45, Ridley *l.c.* (1924) 319; *Trema orientalis* var. *amboinensis* (Willd.) Kurz, For. Fl. Burma 2 (1877) 469; *Sponia virgata* Planch. *l.c.* 316; *Trema virgata* (Planch.) Blume *l.c.* (1856) 59, Ridley *l.c.* (1924) 319.

Shrub or much-branched treelet to 6 m tall, 10 cm diameter. **Bark** smooth, grey-brown, lenticellate. Twigs slender, spreading, often drooping, sparsely covered with short, appressed silvery hairs, glabrescent. Stipules linear-lanceolate, 5–7 × 1–2 mm. **Leaves** chartaceous to thin-coriaceous, upper surface glabrous and scabrate, lower surface glabrous or occasionally sparsely appressed hairy on the midrib and veins; narrowly to broadly ovate or elliptic-lanceolate, (3–)5–10(–13) × (1.5–)2–4(–5.5) cm, length 2–3(–4) times the width, broadest below or at the middle; base rounded to attenuate, very rarely subcordate, mostly symmetric, margin serrulate to denticulate for its entire length, apex acute to caudate with a sharp tip; midrib and lateral veins slightly raised beneath, impressed above, lateral veins (2–)3–4(–5) pairs, subparallel for the most part and arching towards margin, intercostal veins fine, subscalariform, obscure to visible beneath; petioles (7–)8–12(–15) long, 1–2 mm thick, glabrescent. **Inflorescences** male or mixed; axes slender, less than 1 mm thick, (5–)10–15(–20)-flowered, at anthesis lax, 1–2.5 cm long, sparsely greyish appressed-hairy; bracts ovate-acute, 2–3 × 1 mm. **Flowers:** males 1–2 mm diameter, sparsely hairy outside, glabrescent, perianth lobes (4–)5, membranous, oblong-lanceolate, c. 1–1.5 × 0.5–1 mm, filaments c. 1 mm long, anthers c. 0.5–1 × 0.5 mm, pistillodes obovoid, compressed, 0.5–1 × 0.5 mm; females 1.5–2 × 1–1.5 mm, perianth lobes mostly 5, membranous, glabrous, ovate-acute, 1–1.5 × 0.5 mm, staminodes absent, ovary 0.5–1 × 0.5 mm, stigmatic arms spreading or incurved. **Fruits** ovoid, 2–3 × 2 mm, turning to deep-orange or red when ripe. **Seeds** with copious endosperm.

**Vernacular names.** Sabah—*randagong* (Dusun Ranau). Sarawak—*kereneong* (Iban).

**Distribution.** Myanmar, China, Indo-China, Thailand, throughout Malesia to Australia, Melanesia, W Polynesia, and Micronesia. Common in Sabah and Sarawak; also known for Brunei and Kalimantan.

**Ecology.** Common as a pioneer plant in newly cleared areas along road sides, edges of forests, hillsides, thickets, and in young secondary vegetation, from sea level to 1500 mm.

**Uses.** In Sabah and Sarawak, the roots or leaves are boiled and the water is taken as a drink or used to bathe for curing rheumatism and measles.

### 3. *Trema orientalis* (L.) Blume

(Latin, *orientalis* = from the East)

Mus. Bot. Lugd. Bat. 2 (1856) 62; Bentham, Fl. Austr. 6 (1873) 158; Backer & Bakhuizen *f. l.c.* 12; Soepadmo *l.c.* (1973) 421, *l.c.* (1977) 51; Corner *l.c.* 739; Whitmore, Tantra & Sutisna *l.c.* 363. **Basionym:** *Celtis orientalis* L., Sp. Pl. 2 (1753) 1044. **Type:** *Herb. Hermann*, Ceylon (BM). **Synonyms:** *Celtis rigida* Blume, Bijdr. Fl. Ned. Ind. (1825) 486; *Sponia rigida* (Blume) Decne, Nouv. Ann. Mus.



Hist. Nat. 3, 3 (1834) 498; *Trema rigida* (Blume) Blume *l.c.* (1856) 61, Merrill *l.c.* (1921) 217, Masamune *l.c.* 238; *Trema orientalis* var. *rigida* (Blume) Lauterb, Bot. Jahrb. 50 (1913) 320; *Trema orientalis* var. *bicornis* De Wit, Bull. Bot. Gard. Btzig. 3, 18 (1949) 189.

Small to large tree to 36 m tall, 90 cm diameter; buttresses, if present, to 2 m high. **Bark** smooth to finely fissured, lenticellate, grey-brown or whitish grey; inner bark greenish to reddish-brown. Twigs, stipules, petioles, and inflorescences densely tomentose with appressed and matted or erect silvery simple hairs and short multicellular glandular hairs. Stipules linear-lanceolate to ovate-acute, 2–6 × 1–2 mm. **Leaves** *thick-coriaceous*, or rarely thin-coriaceous, often rigid and brittle, *usually discolorous*, upper surface dull grey-brown or grey-green (in dried specimens), scabrate and sparsely covered with bulbous-based simple hairs, *lower surface densely tomentose with a combination of silvery, glaucous or grey-brown, long appressed simple hairs and shorter crowded multicellular glandular or crisped hairs which completely cover the lamina surface*; ovate, ovate-lanceolate to narrowly elliptic-lanceolate, (6–)10–15(–20) × (1.5–)4–7(–10) cm, length (2–)3–4(–5.5) times the width, broadest at or mostly below the middle; *base cordate, rounded* or sometimes truncate, *mostly asymmetric*, margin serrate to denticulate for its entire length, apex acute-acuminate; midrib and lateral veins strongly raised beneath, impressed above, *lateral veins 5–8 pairs*, intercostal veins subscalariform to tessellate, sometimes strongly raised and distinct beneath; petioles (7–)10–15(–20) mm long, 1–2 mm thick, densely short-pubescent. **Inflorescences** male and female on separate twigs, much-branched panicles or thyrses, lax or condensed at anthesis, *axes stout, 1–2 mm thick*; bracts ovate-acute, 2–3 × 1 mm; male inflorescences 3–5 cm long, 20–100-flowered; female inflorescences to 4 cm long, (3–)5–15(–20)-flowered. **Flowers**: males 1.5–2 mm diameter, perianth lobes ciliate, 1.5–2 × 1 mm, filaments 1–1.5 mm, anthers *c.* 1 × 0.5 mm, pistillodes obovoid-conical, compressed, 0.5–1 × 0.5 mm; females 2–3 × 1–2 mm, perianth lobes ovate-acute, 1–1.5 × 0.5 mm, ciliate and densely short-pubescent, glabrescent, *staminodes absent*, ovary ovoid-conical, *c.* 2 × 1 mm, stigmatic arms slender, 1–1.5 mm long, spreading. **Fruits** *ovoid, 3–5 × 2–4 mm*, turning to deep purple or black when ripe, glabrous; stalks to 3 mm long. **Seeds** *with scanty to copious endosperm.*

**Vernacular names.** Sabah—*halindagong, randagong* (Dusun Ranau).

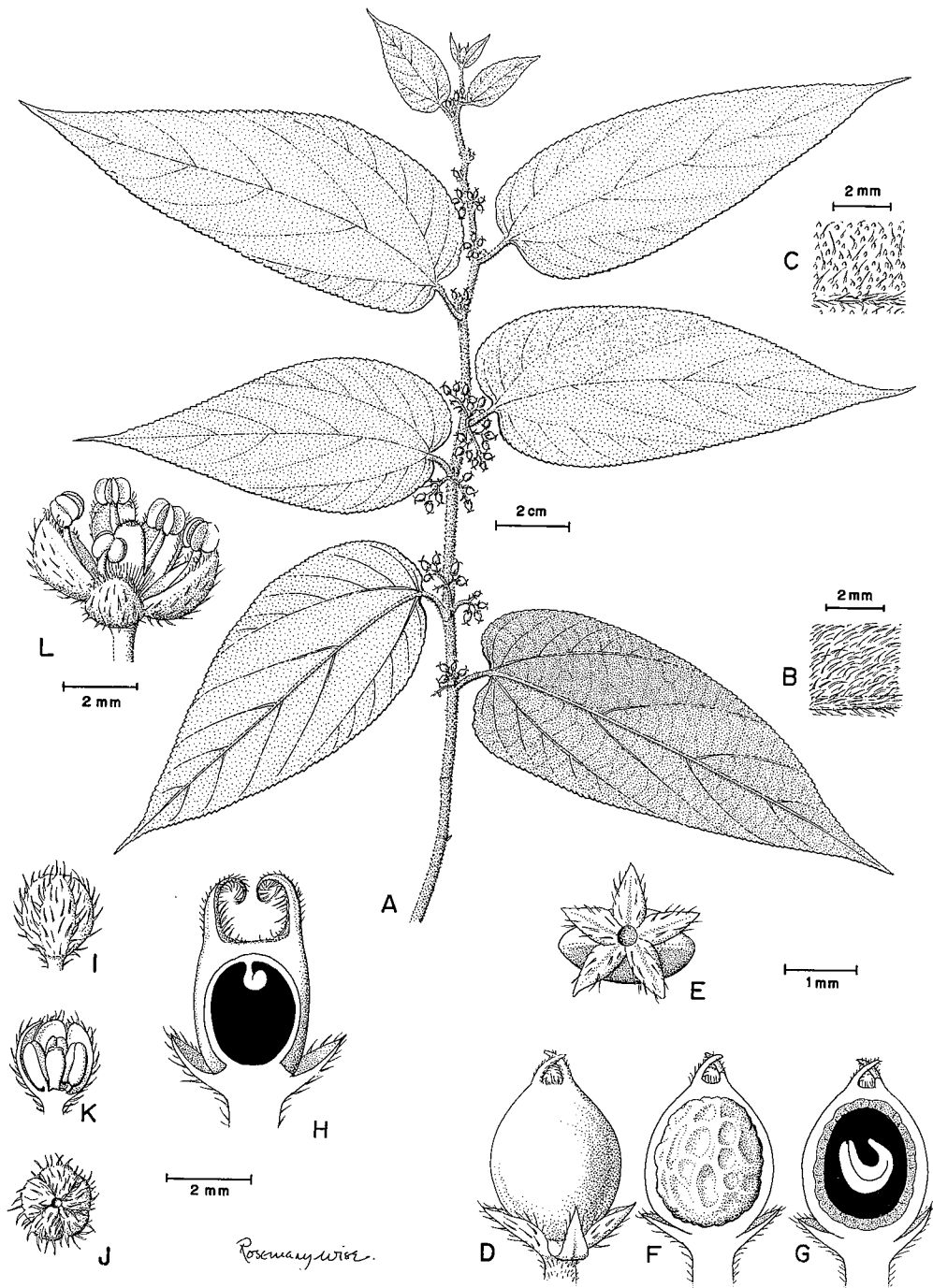
**Distribution.** Widely distributed from India (W Himalayas to Bombay and Malabar) to Myanmar, Thailand, Indo-China, China, S Japan, through Malesia to Queensland, Melanesia, Micronesia, and Polynesia. In Malesia, the species is found in Sumatra, Peninsular Malaysia, Java, Borneo, Philippines, Sulawesi, Maluku, Lesser Sunda Islands, and New Guinea. In Borneo, so far known from a few collections from Keningau (*SAN 85756*), Kunak (*SAN 89965*), Ranau (Mt. Kinabalu, *Chew, Corner & Stainton RSNB 2586; SAN 116596*), Sandakan (*Kadir A. 932*), and Tambunan (*SAN 59469*) districts, in Sabah.

**Ecology.** In Sabah, scattered in secondary forest, road sides, and other newly cleared areas in the hills and lower montane areas, from sea level to 1500 m.

#### 4. *Trema tomentosa* (Roxb.) Hara

(Latin, *tomentosus* = covered with matted woolly or short hairs; the young parts of the plants, inflorescences and fruits)

Fig. 4.



**Fig. 4.** *Trema tomentosa*. A, fruiting leafy twig; B, lower leaf surface; C, upper leaf surface; D, mature fruit; E, basal view of mature fruit; F, mature fruit with the pericarp halfway removed to show the endocarp; G, mature fruit in longitudinal section; H, female flower in longitudinal section; I–K, male flower buds; L, open male flower. (A–G from SAN 35146, H from Cuadra A 259, I–L from SAN 107230.)

Fl. E. Himal. 2 (1971) 19; Soepadmo *l.c.* (1973) 423, *l.c.* (1977) 53; Corner *l.c.* 739; Whitmore, Tantra & Sutisna *l.c.* 363; Kessler & Sidiyasa *l.c.* 231. **Basionym:** *Celtis tomentosa* Roxb., Fl. Ind. ed. Carey 2 (1832) 66. **Type:** Roxburgh, *s.n.*, "Native to Chittagong" (*n.v.*; no drawing at BM or K). **Synonyms:** *Sponia tomentosa* (Roxb.) Planch. *l.c.* 336; *Sponia velutina* Planch. *l.c.* 327, *p.p.*, *excl. specim. Cuming 1232 ex Luzon*; *Trema velutina* (Planch.) Blume *l.c.* (1856) 58.

Shrub to medium-sized tree, (3-)5-15(-24) m tall, (5-)10-30(-50) cm diameter. **Bark** grey-brown, smooth to finely fissured, lenticellate; inner bark yellowish green. Young parts, inflorescences, petioles, and stipules densely and thickly tomentose with grey-brown, erect, velvety simple hairs. Stipules linear-lanceolate, 2-6 × 1-1.5 mm. **Leaves** *thick-coriaceous*, rarely thin-coriaceous, *more or less concolorous*, drying dark-chocolate brown to blackish brown, upper surface strongly scabrate, *lower surface densely velvety tomentose with grey-brown to glaucous simple hairs* (lamina surface between hairs visible even under low magnification); broadly ovate to ovate-elliptic, (5-)8-15(-20) × (2-)4-7(-9) cm, length 2.5-3 times the width, broadest mostly below the middle; *base cordate, subcordate*, rarely rounded or truncate, *mostly strongly asymmetric*, rarely symmetric, margin serrate throughout, apex acute to acuminate-caudate, acumen sharp, 0.5-3 cm long; midrib and lateral veins strongly raised beneath, impressed above, *lateral veins 5-6 pairs*, subparallel, ascending, intercostal veins subscalariform to tessellate, often rather distinct beneath; *petioles 10-15 mm long, 1-2 mm thick*. **Inflorescences** male, female, or mixed, *axes 1-2 mm thick*; bracts ovate-acute, *c.* 1 × 0.5 mm; male and mixed inflorescences 3-4.5 (-6) cm long, lax, 10-100-flowered; female inflorescences to 5 cm long, *axes stout, 1-2 mm thick, 5-15-flowered*. **Flowers:** males 1-2 mm diameter, perianth lobes mostly 5, elliptic, *c.* 1.5 × 1 mm, filaments *c.* 1 mm long, flat, glabrous, anthers *c.* 1 × 0.5 mm, pistillodes obovoid-ellipsoid, compressed, 1-1.5 × 0.5 mm; females *c.* 2 × 1 mm, perianth lobes 4-5, ovate-acute, *c.* 1 × 0.5 mm, *staminodes absent or strongly rudimentary*, ovary *c.* 1.5 × 0.5-1 mm, stigmatic arms slender, *c.* 1 mm long, spreading. **Fruits** *ovoid, c. 3 × 2 mm*, turning to black when ripe, glabrous. **Seeds** *with copious endosperm*.

**Vernacular names.** Sabah—*bintanong* (Murut), *balik-balik angin* (Bajau Tuaran), *lindagong* (Malay), *lundagong* (Dusun), *nasi-nasi* (Malay), *ondogon* (Dusun Kimanis), *randagong* (Dusun Kinabatangan, Dusun Labuk, Dusun Ranau), *rondongon* (Dusun Kinabatangan), *rondogong* (Dusun Bundu Tuhan), *tikam* (Dusun Sungei). Sarawak—*kereneong* (Iban), *lindagong* (Kedayan), *marong* (Malay), *murieng* (Bidayuh), *tuku baroh* (Bidayuh).

**Distribution.** East tropical Africa, Madagascar, Pakistan, India, Bangladesh, Myanmar, Thailand, Indo-China, China, Ryu Kyu Is., throughout Malesia to Queensland, New Caledonia, Micronesia, and Polynesia. Common in Sabah and Sarawak; also known for Brunei and Kalimantan.

**Ecology.** Common pioneer shrubs or trees in the lowlands and hills, from sea level to 1000 m, in newly cleared areas on all types of soil, including limestone.

**Taxonomy.** In the past, this species has been wrongly identified and described as *T. orientalis* (Merrill *l.c.*, 1921, *l.c.*, 1929; Masamune *l.c.*; Brown *l.c.*; Anderson *l.c.*). However, though *T. tomentosa* and *T. orientalis* are closely allied, they can be distinguished easily by the characters given in the key.

## WINTERACEAE

**K.M. Wong**

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A.C. Smith, J. Arn. Arb. 24 (1943) 1, 119; Vink, Blumea 18 (1970) 225; Anderson, CLTS (1980) 346, excl. *Illicium*.

Shrubs and trees, rarely epiphytes. **Wood** without true xylem vessels. **Leaves** simple, entire, spirally arranged, typically with pale translucent dots on the lower side, often with aromatic tissue; stipules none. **Inflorescence** axillary or terminal, of a solitary flower or several flowers spirally and closely arranged on a very short flowering shoot, or a condensed shoot with 1–2 orders of very short branches bearing the flowers; developing in the axil of a scale-like bract or leaf. **Flowers** bisexual, unisexual (and then plants dioecious), or unisexual and bisexual together (plants polygamo-dioecious); sepals 2–6, valvate to spirally inserted, overlapping and slightly twisted, or basally fused and cup-like or nearly completely fused and hood-like and rupturing into 2 or more parts; petals none, or 2–many, in whorls of (2–)3 or in spirals, free; *stamens* 5–numerous (more than 100) in 1–several whorls, filaments club-shaped and slightly flattened or tapering, anthers opening by slits; *ovary superior*, of 1–many carpels in 1 whorl, carpels free or fused or sometimes initially connate and later separating, each a conduplicate (lengthwise folded) structure with 2 stigmatic crests forming a ventral pair of ridges or a completely closed structure with a terminal style and stigma; ovules 1 or several to many (and then in 2 rows (“laminar placentation”) within the carpel), anatropous. **Fruit** berry-like or a cluster of follicles developed from free carpels, or a multilocular capsule or syncarp developed from fused carpels. **Seeds** with copious endosperm; embryo minute.

**Distribution.** About 5 genera, c. 60 species, Old and New World but principally southern hemisphere. *Drimys* (represented by section *Drimys*) is the only genus extending to the New World (S Mexico to Cape Horn) and *Takhtajania* is a monotypic genus of Madagascar. Borneo, the Philippines, Flores, Sulawesi, Maluku, New Guinea, the Solomons, New Caledonia; also eastern Australia, Tasmania and New Zealand. In Borneo (all territories), *Drimys* is the sole genus.

**Taxonomy.** In some older classifications, the Winteraceae (often together with *Illicium*) were regarded as a part of the Magnoliaceae, but differ in having oil-glands in the leaf tissue, its comparatively small floral axis and the lack of stipules. *Illicium* is now removed to its own family, Illiciaceae (Volume 1), on account of, among others, its differing wood structure, nodal anatomy, carpellary structure and cytology (Smith *l.c.*). Notwithstanding, the Winteraceae, Annonaceae, Degeneriaceae, Magnoliaceae and Myristicaceae are generally accepted as a closely related alliance of families that—along with other families such as the Illiciaceae and Schisandraceae—retain some of the most primitive (often also termed “ranalean”)

characteristics among flowering plants. The lack of xylem vessels in the wood and presence of conduplicate carpels among members of the Winteraceae make this family one of the most primitive in this sense. Indeed, Bailey & Swamy (Amer. J. Bot. 38 (1951) 373) have remarked that "the least modified [= advanced] form of surviving carpel" occurs in species of *Drimys*, including *D. piperita*.

## DRIMYS J.R. Forst. & G. Forst.

(Greek, *drimus* = acrid; the bitter taste of the bark)

Char. Gen. 42 (1776) 83; Merrill, EB (1921) 252 (as part of Magnoliaceae); Masamune, EPB (1942) 277 (as part of Magnoliaceae); A.C. Smith *l.c.* 122; Vink *l.c.* 302; Anderson *l.c.* 346. **Synonym:** *Tasmannia* R. Br. ex DC., Syst. 1 (1817) 445.

Shrubs, trees or rarely epiphytes. **Leaves** glabrous. **Inflorescence** axillary, with (in section *Drimys*) or without distinct peduncles, with 1–many flowers. **Flowers** usually unisexual, very rarely bisexual and then together with unisexual flowers on the same plant, or (in section *Drimys*) always bisexual; *calyx a hood-like structure* enclosing the flower bud, rupturing and falling as the flower opens; petals none or 2–25, free; stamens 7–numerous (more than 100), filaments thick and tapering; ovary of 1–24 carpels, *carpels free*, globular to ovoid, slightly laterally flattened, sessile or short-stalked, *each a conduplicate structure with 2 stigmatic crests forming a ventral pair of ridges along the carpel length*; ovules several to many, in 2 rows within the carpel. **Fruit** berry-like or a cluster of follicles developed from free carpels. **Seeds** straight to strongly curved.

**Distribution.** Nine species, of which four (in section *Drimys*) in S America and five (in section *Tasmannia*) in Malesia, Australia, New Zealand and the SW Pacific. In Borneo (including Sabah and Sarawak), one species.

**Uses.** The most famous product of the genus is Winter's bark, from the S American *D. winteri*, used in 1578 by Capt. William Winter against scurvy and as a spice. In Brazil, bark of this species is used as an astringent and a stimulant. No recorded uses in Sabah and Sarawak.

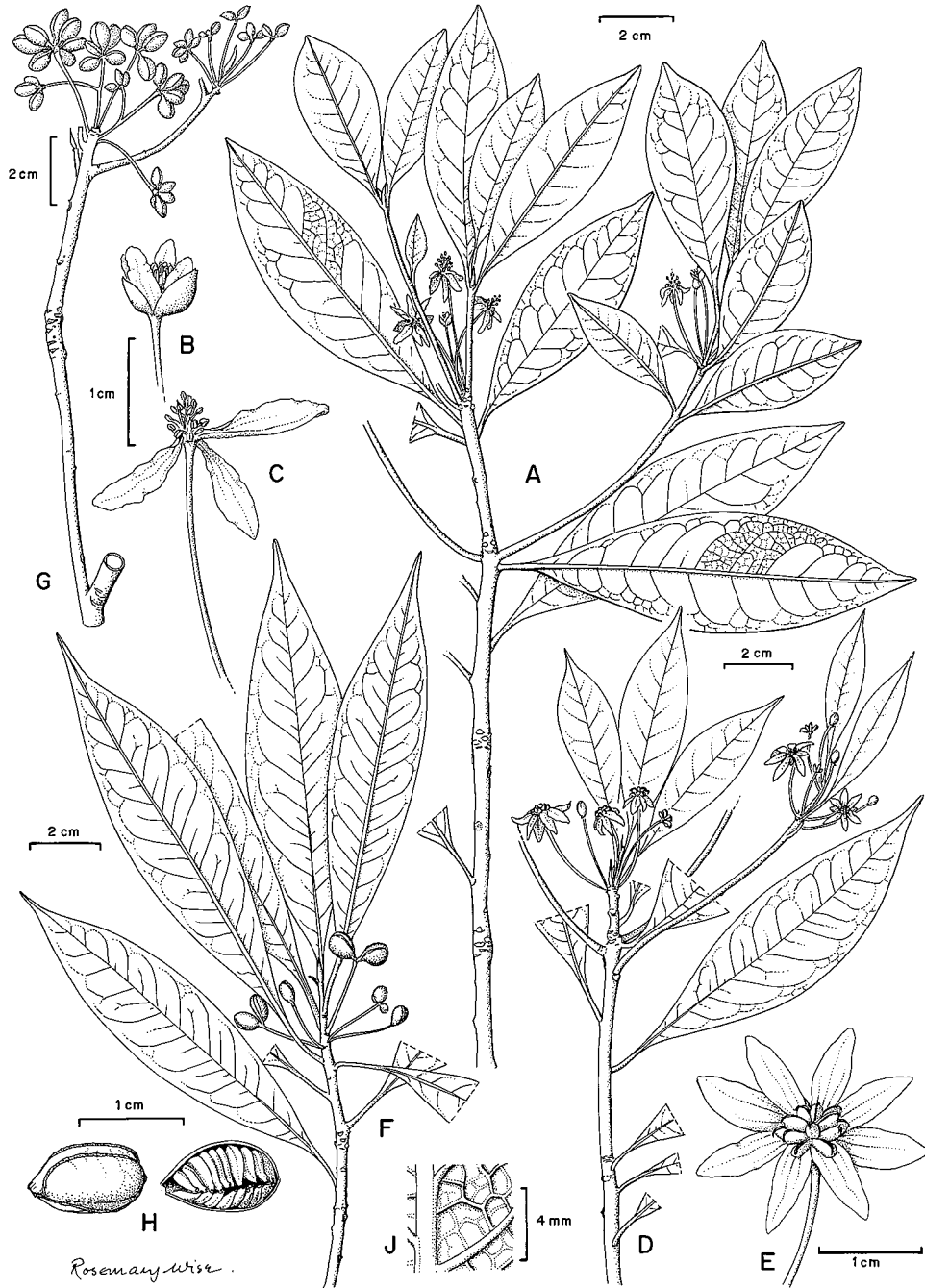
**Taxonomy.** Only two sections are recognised for the genus. Section *Drimys* (S American) has distinct inflorescence peduncles, bisexual flowers and a base chromosomal number of 43, whereas section *Tasmannia* (Old World) has indistinct peduncles, typically unisexual flowers and a base chromosomal number of 13. Very many species recognised by A.C. Smith *l.c.* 122, especially from New Guinea, have been reduced to synonymy under *D. piperita* by Vink *l.c.*, who considers the species as a widespread Malesian-Australasian species with at least 39 local "entities" often without any sharply defined taxonomic boundaries.

### *Drimys piperita* Hook. f.

Fig. 1

(Latin, *piperita* = pepper-flavoured; the aromatic bark and leaf tissue)

Icon. Pl. 9 (1852) pl. 896; Beccari, Malesia 1 (1877) 185; Stapf, FMK (1894) 128; Merrill *l.c.* 252; Masamune *l.c.* 277; A.C. Smith *l.c.* 137; Vink *l.c.* 314; Anderson *l.c.* 346. **Type:** *Low, s.n.*, Borneo, Mt.



**Fig. 1.** *Drimys piperita*. A, leafy twig with male flowers; B, young male flower; C, mature male flower; D, leafy twig with female flowers; E, mature female flower; F, leafy twig with fruits; G, twig with mature fruits; H, lateral view of fruit (left) and section through carpel showing seeds; J, detail of lower leaf surface. (A, B & J from Chew *et al.* 1056, C from Ding Hou 249, D & E from SAN 29058, F from SAN 57540, G from SAN 123345, H from SAN 41271.)

Kinabalu (holotype K; isotype UC). **Synonym:** *Tasmannia piperita* (Hook. f.) Miers, Ann. Mag. Nat. Hist. 3, 2 (1858) 110.

Shrub less than 1 m high or tree to 12 m high and 25 cm diameter, usually a small tree 2–4 m high, rarely an epiphyte. **Bark** smooth, dark brown; inner bark pale brown, thin, aromatic when bruised. **Sapwood** pale yellow to white. **Leaves** reddish when young, chartaceous to coriaceous; glabrous on both sides; occasionally very slightly to conspicuously glaucous, with scattered dark glands on the lower side; *aromatic when crushed*; lanceolate to elliptic or obovate, 2–15 × 1–4.5 cm, base usually cuneate and slightly decurrent on the petiole to obtuse, apex acute to acuminate; midrib slightly grooved to flat or slightly prominent on the upper side, prominent on the lower side, often reddish in fresh specimens, lateral veins (6–)10–14 pairs, immersed in the blade in fresh material, flat to slightly prominent on both sides in dried specimens, branching conspicuously towards the margin, sometimes reddish in fresh material, intercostal veins loosely to densely reticulate, immersed in the blade in fresh material, slightly prominent on both sides in dried specimens; petiole (3–)7–25 mm long, shallowly grooved on the upper side; **Inflorescence** of 1–3(–5) flowers on a very short inconspicuous axis and *resembling a fascicle of flowers, in the axils of reduced leaves ("scale-leaves") at the proximal part of a new episode of shoot extension or a new axillary shoot*, very rarely in the axils of normal leaves, scale-leaves triangular to ovate, papery, 3–12 × 1–6 mm, caducous. **Flowers** unisexual, very rarely bisexual and then occurring with other unisexual flowers; pedicels (5–)10–40(–60) mm long; calyx hood-like, 2–12 mm long, rupturing into 2 (sometimes more) parts as the flower opens, pale green with reddish apex, caducous; petals (2–)5–12(–15), narrowly blunt-elliptic to oblanceolate, 4–18 × 1.5–6 mm, white, spreading to strongly folded back in the open flower; *stamens in male flower (7–)25–60 or more* in several series, filaments slightly flattened, tapering, 1–5 mm long, white and pink-tinged, anthers 0.5–1 mm long, yellow (in female flowers: stamens none); *carpels in female flowers (2–)3–12(–15)*, obovoid, 2–2.5 mm long, short-stalked, pale green, *stigmatic crest pale brown and extending nearly the entire carpel length* (in male flowers: carpels none or 1–3 and sterile, 1.5–2 mm long); ovules (2–)12–30(–46) in fertile carpels, none or degenerate in sterile carpels. **Fruit** of (1–)3–12(–15) *follicles*; follicles globular to blunt-ellipsoid to obovoid, 5–15 × 3–8 mm, each marked by a dark brown longitudinal thickening (the remains of the stigmatic crest), short-stalked, pale green *ripening reddish and then purple-black*. **Seeds** many per follicle, narrowly blunt-ellipsoid, slightly curved, 2–4 × 1–3 mm, dark brown to black.

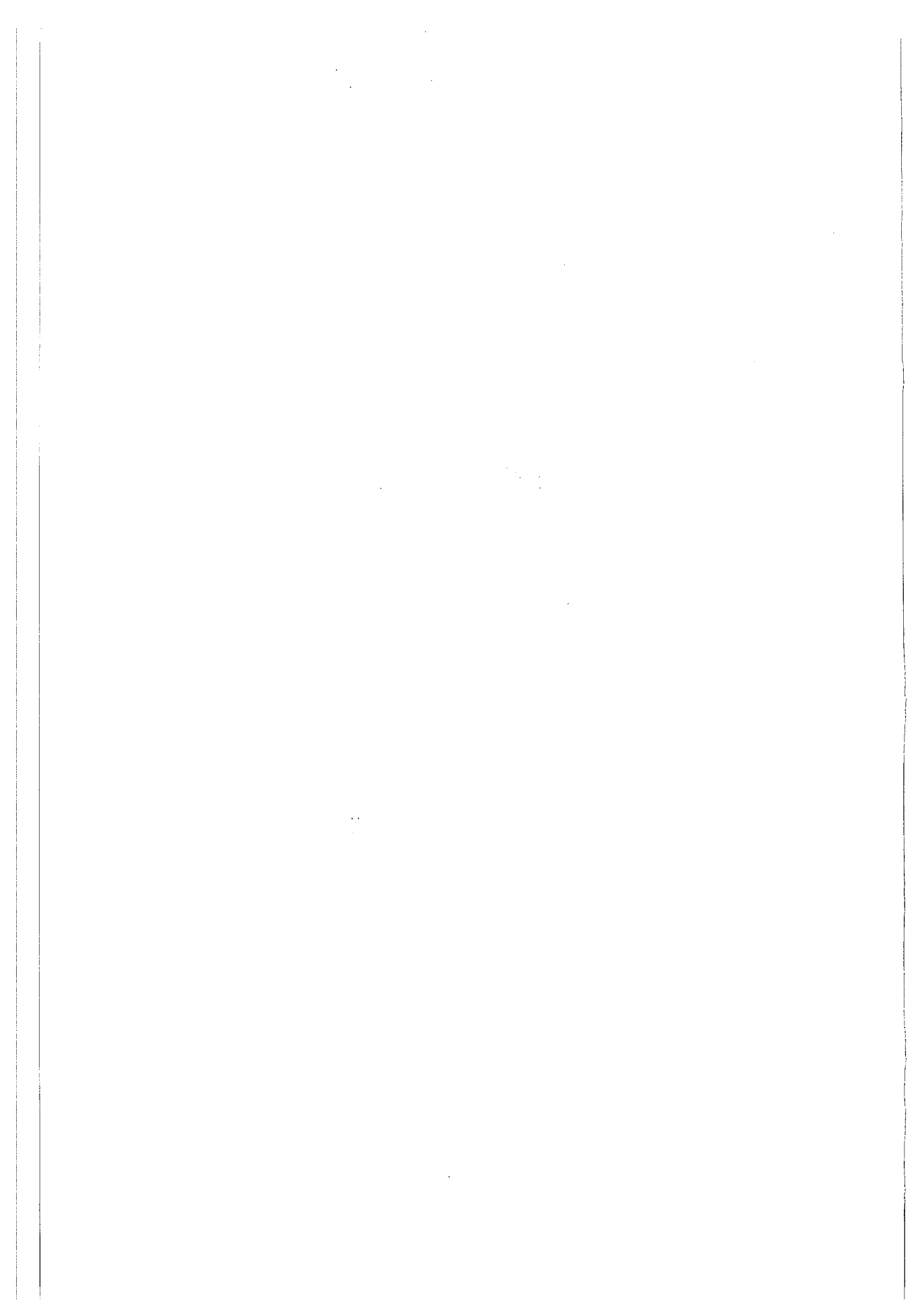
**Distribution.** Philippines, Borneo, Flores, Sulawesi, Maluku, New Guinea, eastern Australia. In Borneo in all territories (Sabah, Sarawak, Brunei, Kalimantan). This is the only Asiatic species of the genus known outside of New Guinea and Australia.

**Ecology.** Montane forests, mostly at 1000–3000 m, from around 700 m on coastal mountains (e.g., Mt. Silam in Sabah) and up to 3800 m on Mt. Kinabalu in Sabah; locally frequent, also on exposed ridges. Occurring on sandstone, granite, ultramafic rocks (in Sabah), dacite and limestone (in Sarawak).

**Notes.** The inflorescences are produced in the axils of reduced (scale) leaves that mark the beginning of each new episode of stem elongation or a new axillary branch shoot; these scale leaves are arranged closely together and contrast with the normal leaves produced higher up together with internodal elongation, which are more distantly spaced. It is not known whether each episode of new shoot growth corresponds to a definite growth season during a year, but

the presence of some exceedingly short leafy sections on some stems, and the occurrence of both flowering and non-flowering individuals in most populations seen at various times of the year, suggest that both episodic shoot growth and flowering occur intermittently throughout the year in Borneo.





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FTSB

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TBS

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EPMP

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TS

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WSTM

**Flora Malesiana**  
FM

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TNB

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OFMSP

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EB
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PEB
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DMT

## COMMONLY USED ABBREVIATIONS FOR LOCALITIES

| English        |              | Malay   |              |
|----------------|--------------|---------|--------------|
| Word           | Abbreviation | Word    | Abbreviation |
| Central        | C            | Bukit   | Bt.          |
| Division       | Div.         | Gunung  | G.           |
| East           | E            | Kampung | Kg.          |
| Forest Reserve | FR           | Sungai  | Sg.          |
| Island         | Is.          | Tanjung | Tg.          |
| Mount          | Mt.          |         |              |
| National Park  | NP           |         |              |
| North-East     | NE           |         |              |
| North-West     | NW           |         |              |
| River          | R.           |         |              |
| South          | S            |         |              |
| South-East     | SE           |         |              |
| South-West     | SW           |         |              |
| West           | W            |         |              |



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(compiled by R.C.K. Chung)

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(compiled by R.C.K. Chung)

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