

TREE FLORA of SABAH AND SARAWAK

Volume Two

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



ITTO

International Tropical
Timber Organization



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Overseas Development
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TREE FLORA
of
SABAH AND SARAWAK

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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 Harpullieae : *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, thyrsoid. 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, septicidal, 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, thyrsoid. 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 (<i>Lepisanthes senegalensis</i>) or without petals (<i>Glennia thorellii</i>).....	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 (<i>Litchi chinense</i>), if few small tufts of hairs present then leaves with pseudostipules (<i>Pometia</i>).....	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 · 1.5 cm; if about 1 · 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, dehiscing 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 dehiscing to dehiscing 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, dehiscing 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 Malesia, 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.

(Latin, *glaber* = smooth; the fruits lacking in crests)

Fig. 1.

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*

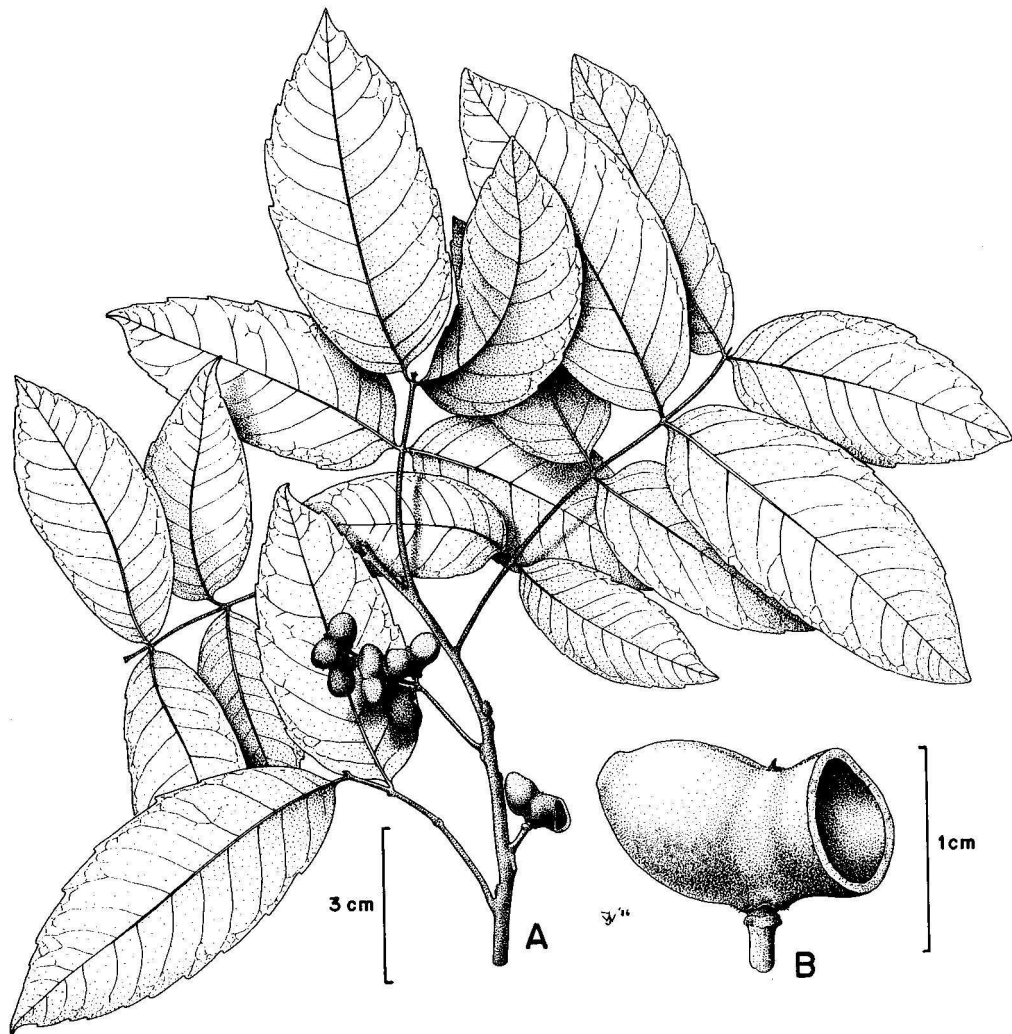


Fig. 1. *Alectryon glaber*. A, fruiting leafy twig; B, fruit. (From Alston 16075.)

chartaceous, glabrous to slightly hairy on the midrib and lateral veins beneath, exceptionally subtomentose; ovate to elliptic, c. 4–14 x 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, 0.9–10 x 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, 2.5–3.5 x 1.5–2.2 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 x 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 x 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).

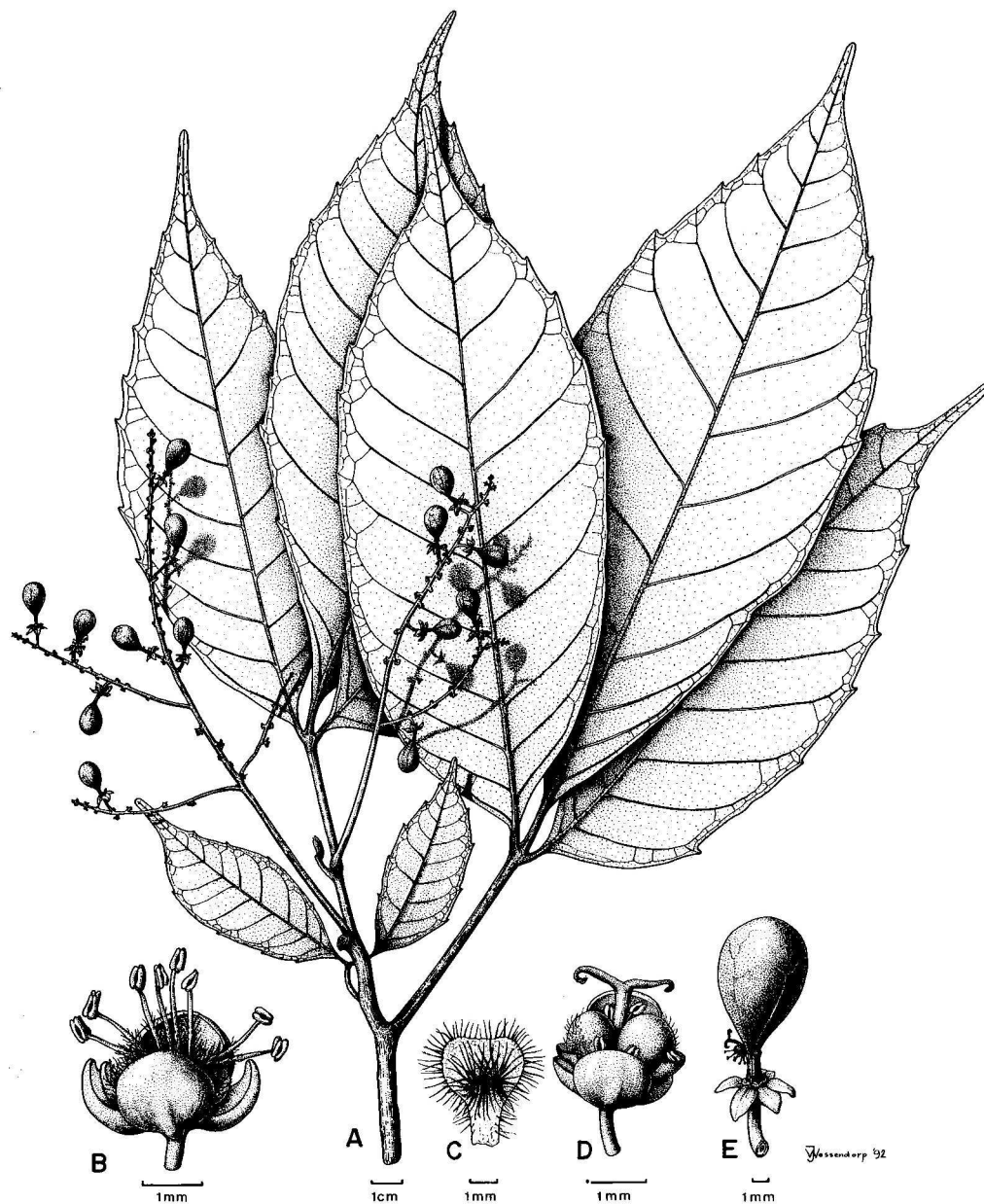


Fig. 2. *Allophylus cobbe*. A, fructing leafy twig; B, male flower; C, petal from inside; D, female flower; E, fruit. (A and E from Forbes 2557, B–D from Maxwell 77-375.)

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, thyrsoid; 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 x 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 x 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 x 5–23 mm, smooth to slightly rugose to verrucose, glabrous to sparsely hairy, lobes 8–23 x 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 x 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.

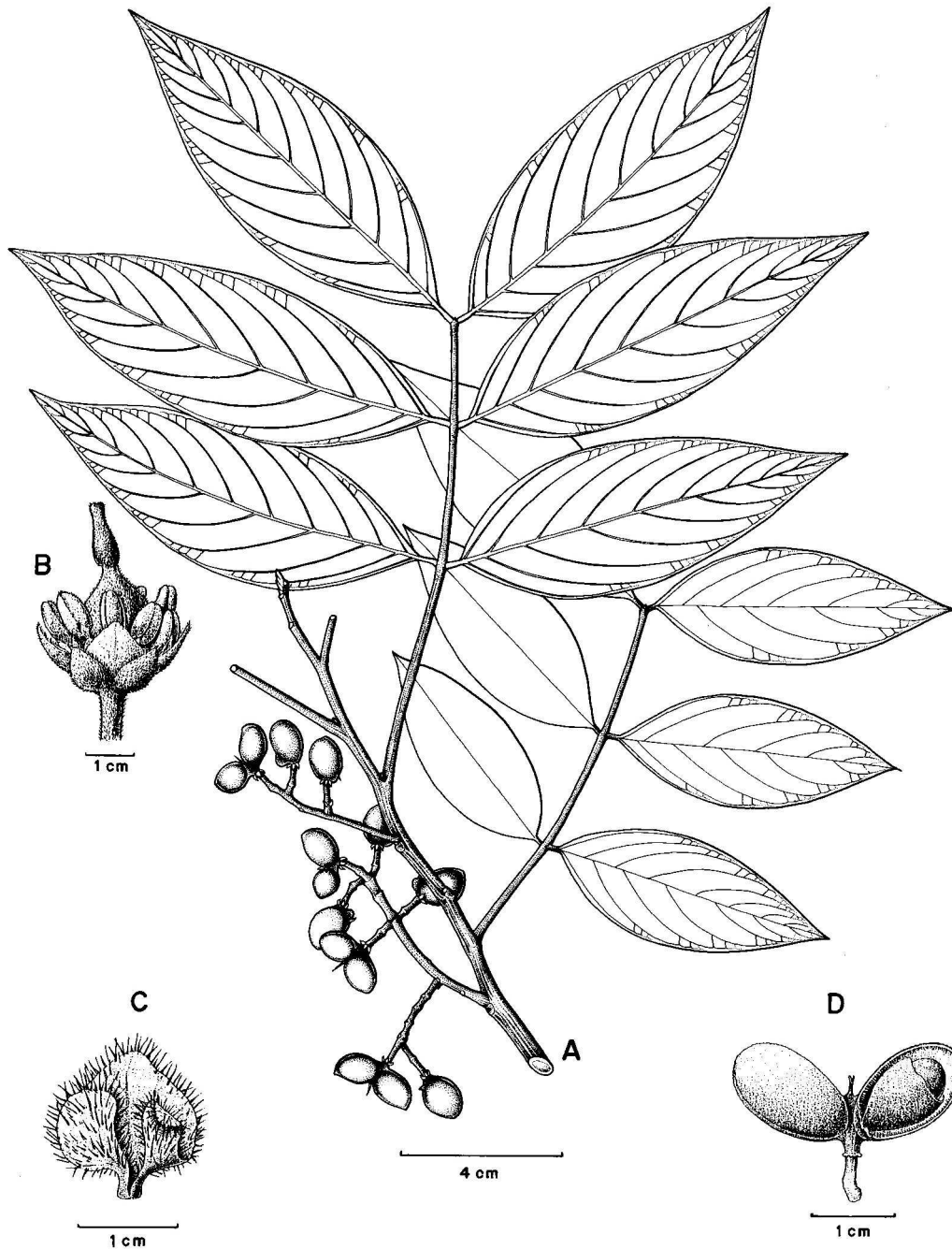


Fig. 3. *Arytera litoralis*. A, fruiting twig; B, female flower; C, petal from inside; D, fruits. (A from SAN 95571, B–C from Gibbs 2664, D from van Balgooy 6099.)

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) x (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;*

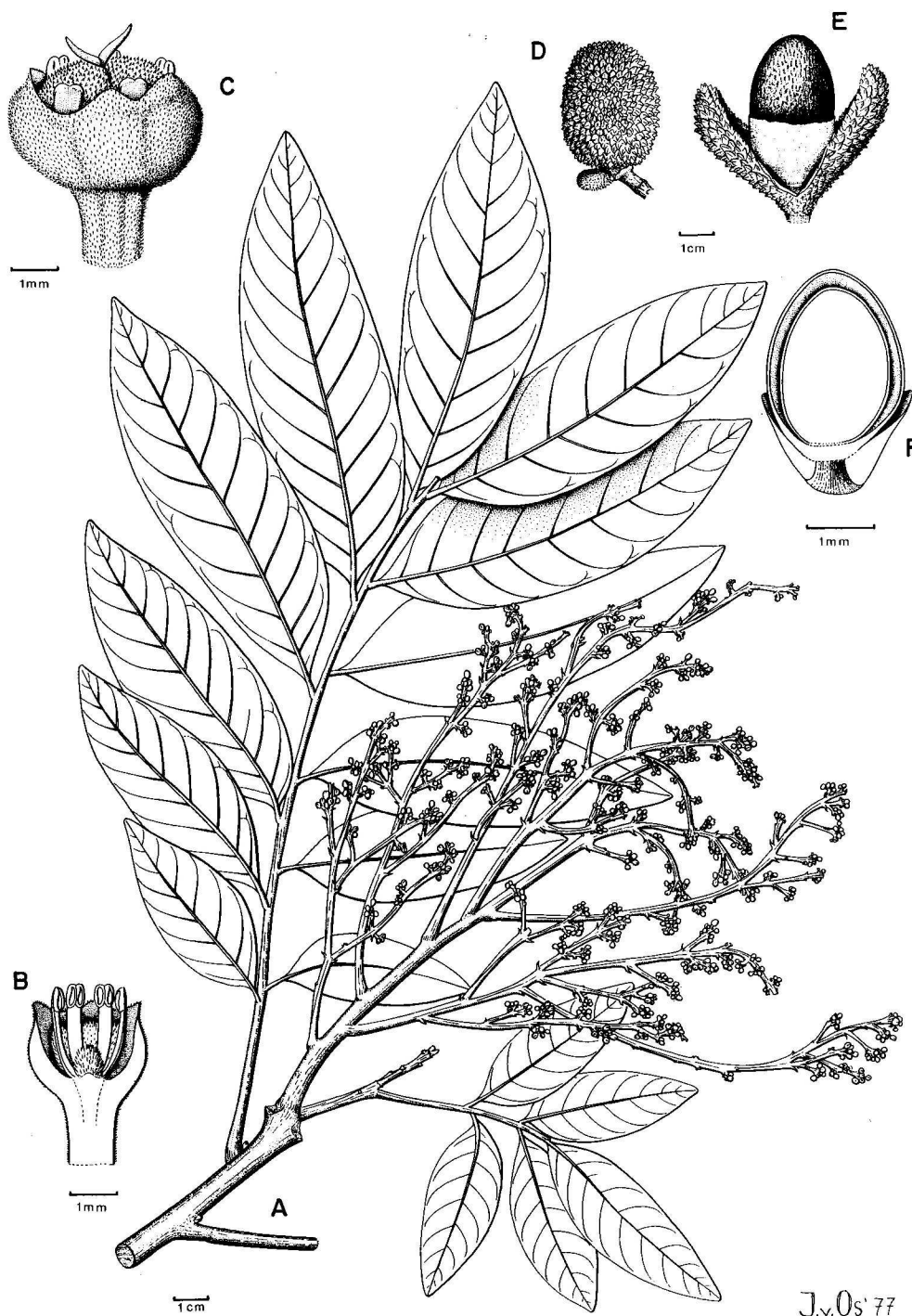


Fig. 4. *Cubilia cubili*. A, flowering leafy twig; B, male flower in longitudinal section; C, female flower; D, fruit; E, open fruit with seed; F, seed in longitudinal section. (A from FB 1996, B–C from PNH 22872, D from NIFS Cel. V/236 = Waturandang 221, E from Radlkofer in Engler, *Pflanzenr.* (1932–1933) f. 22, F from Kostermans 7011.)

calyx in male flowers *c.* 3 x 2 mm, opening *c.* 1 mm diameter, lobes minute; in female flowers 1.5–2 x 3–4 mm, opening wider than in male, lobes broad-triangular, *c.* 0.8 mm high; petals in male flowers elliptic, *c.* 1 x 0.7 mm, in female flower subovate, *c.* 1.5 x 1.5 mm; stamen filaments *c.* 1 x 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) x 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 x 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, *dictuon* = 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), exerted 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) x (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 x 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 x 0.4–0.7 mm, glabrous or sometimes sparsely hairy; ovary ellipsoid, 2-locular, (1.5–)1.8–2 x (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) x 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 x 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

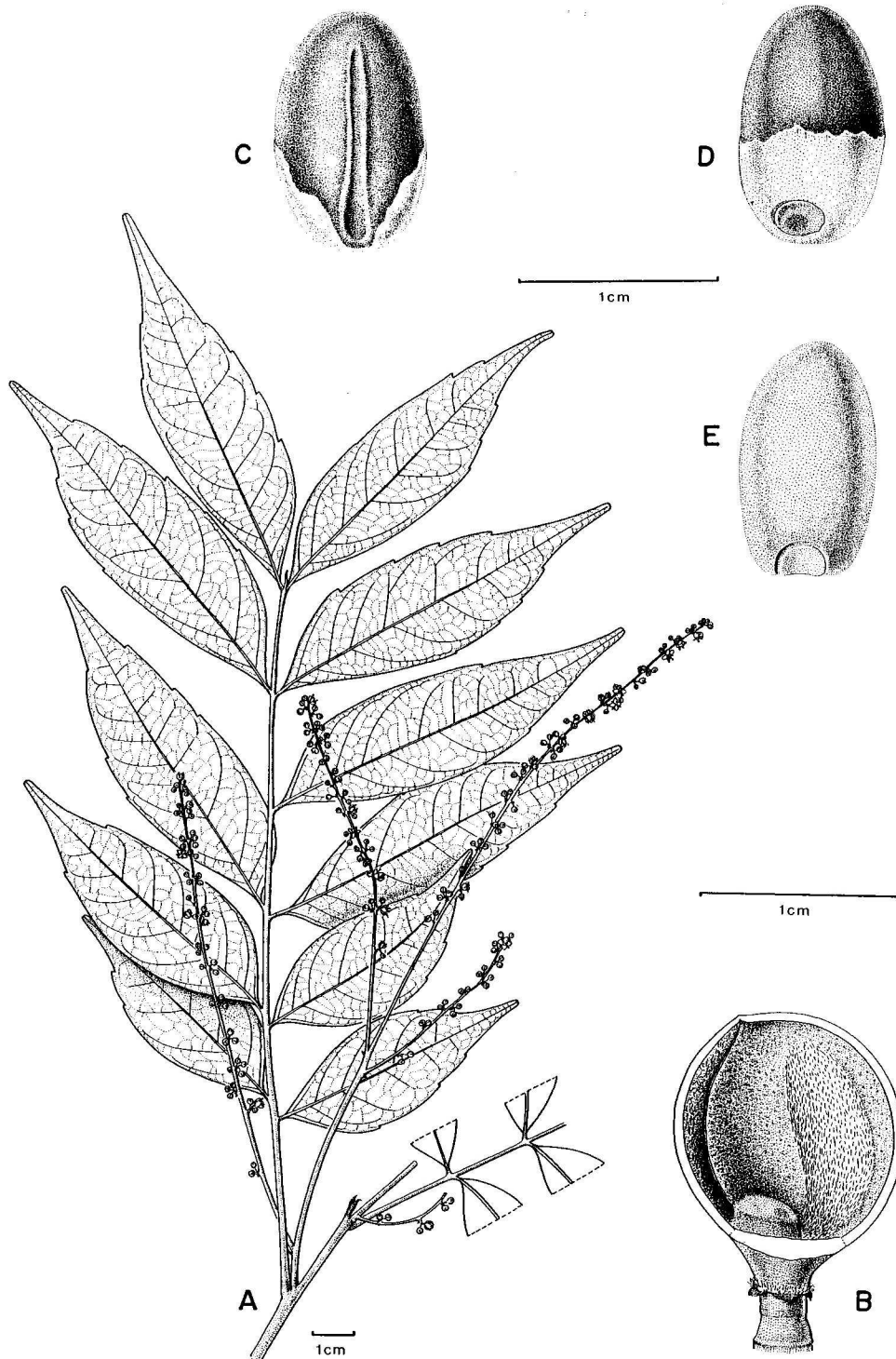


Fig. 5. *Dictyoneura acuminata* subsp. *acuminata*. A, flowering leafy twig; B, fruit valve from inside; C, seed, ventral view; D, seed, dorsal view; E, embryo. (A from SAN 37193), B–E from *Kostermans (6892.)*

papillose 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 x 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.

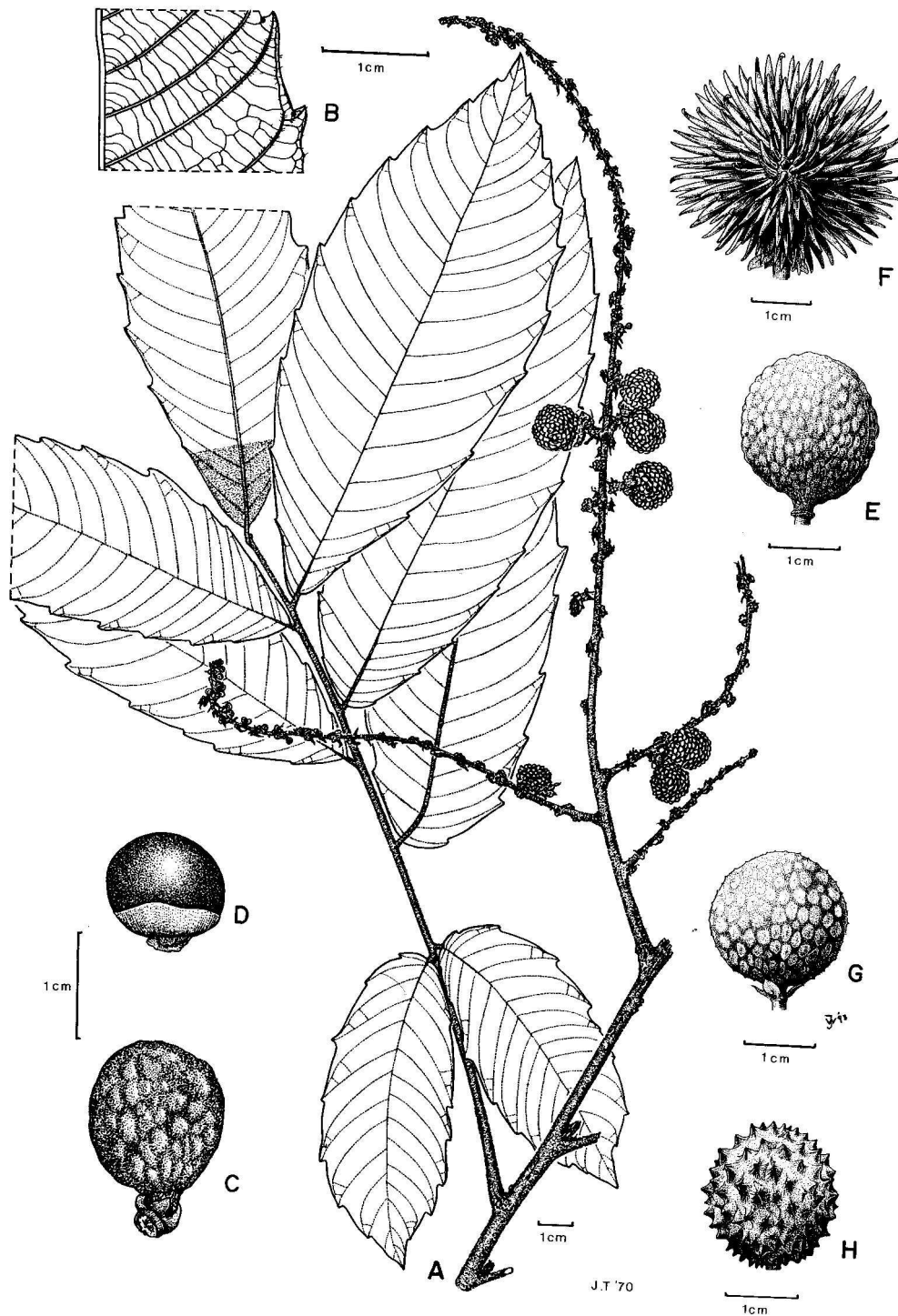


Fig. 6. *Dimocarpus dentatus* (A–D); *D. fumatus* (E); *D. longan* var. *echinatus* (F); *D. longan* var. *longan* (G); *D. longan* var. *malesianus* (H). A, fruiting leafy twig; B, detail of lower leaflet surface; C, fruit; D, young seed with partly developed arillode; E–H, fruits. (A–B from SAN 37193, 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 x 1.8–2 mm, sparsely hairy in the upper part inside; *petals* 5, *oblanceolate*, 3.5–4.2 x 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 x 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.

Fig. 6E.

(Latin, *fumatus* = smoke-coloured; the twigs)

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 x 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 x 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 arillode)

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-yen* 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 x 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 x 0.6–1.5 mm. **Flowers:** sepals 2–5 · 1–3 mm, partly short-hairy inside; petals 5, broadly to narrowly spatulate, 1.5–6 x 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 x 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 x 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 x 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* Turc., 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, Pflanzenr. 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

(Latin, *falcatus* = sickle-shaped; the leaflets)

Fig. 7.

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 x 1 cm, base strongly asymmetric; upper leaflets elliptic, often more or less sickle-shaped, to 23 x 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 x 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, thyrsoid 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, exserted, 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 *Glennia* 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. *Glennia 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.

Monoecious 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 x 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 x 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 x 4.5–6 cm, yellow when fresh, glabrous;

pericarp thick, fleshy, endocarp tough. **Seeds** more or less ovoid, 3–3.5 x 1.75–2.25 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, Leaf. 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; 6–26 x 3–13.5 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, 2–2.5 x 1.5–2.5 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 x 2 · 1 cm, often 1 lobe suppressed, then transversely ovoid and *c.* 1.25 x 1.5 · 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.

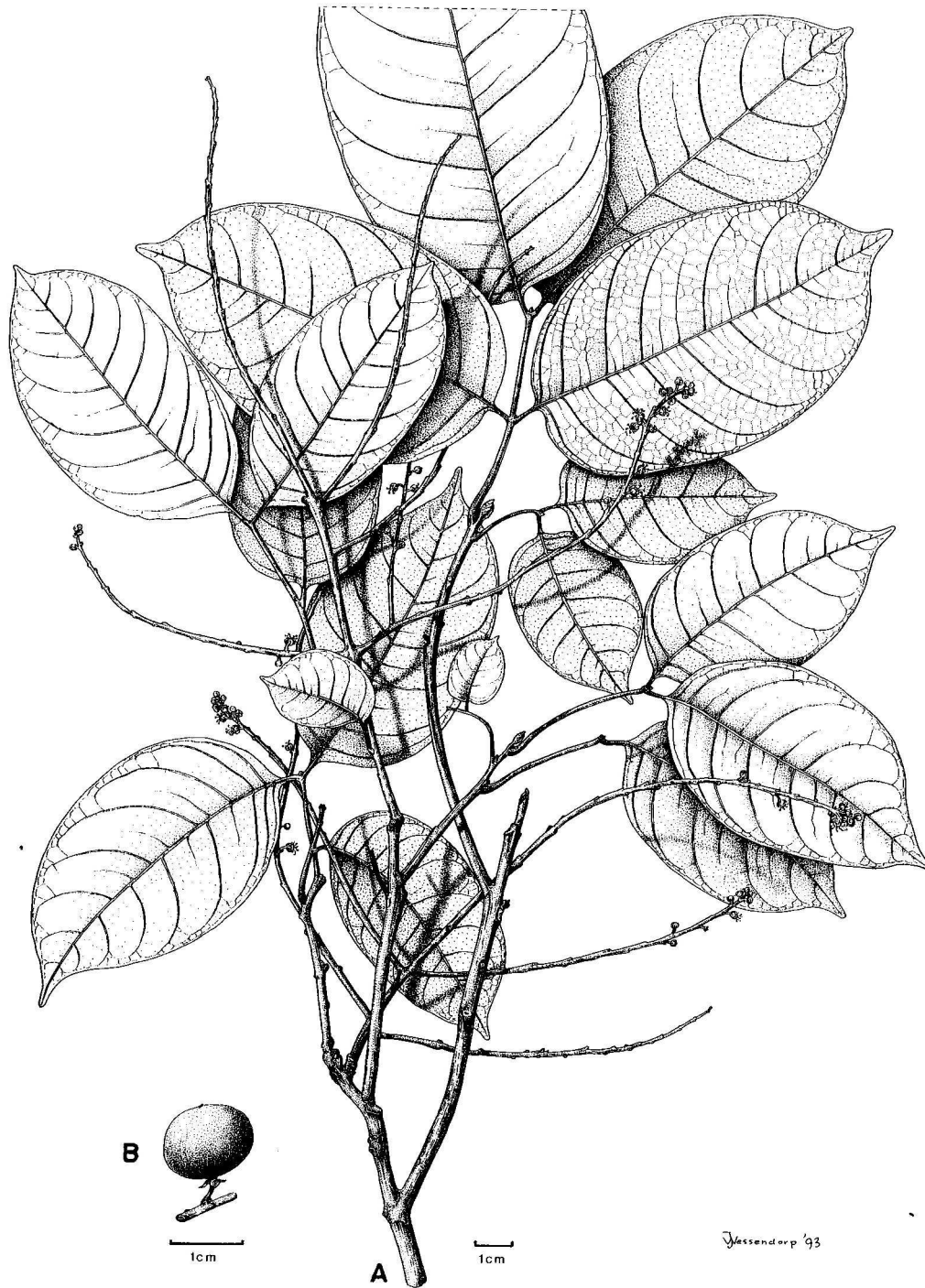


Fig. 8. *Glenniea thorelii*. A, flowering leafy twig; B, fruit. (A from *Lambach 1336*, B from *Boschproefstation T. 973*.)

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; cymules 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 x 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 x 1–2.3 mm, 3 inner larger ones 1.4–3.4 x 1.2–3.8 mm, margin petaloid; petals 5, white to yellow, slightly hairy, obovate, 1.8–3.8 x 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 x 1.3–2.6 cm, glabrous; stalks 2–5 mm long; lobes 8.5–14 x 8–16 mm. **Seeds** globose to obovoid, 8–10 x 7–8 mm; embryo 7–9 x 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 x 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 x 0.8–2.1 mm, 3 inner larger ones 1.4–3.4 x 1.2–3.6 mm, margin petaloid, white; *petals* 5, *elliptic to obovate*, 0.5–4 x 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 x 0.7–1.8 cm, *glabrous*; stalks 2–5 mm long; *lobes* 5–10 x 4–9.5 mm. **Seeds** obovoid, 5–9 x 4.1–7.3 mm; embryo 4–7.8 x 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.

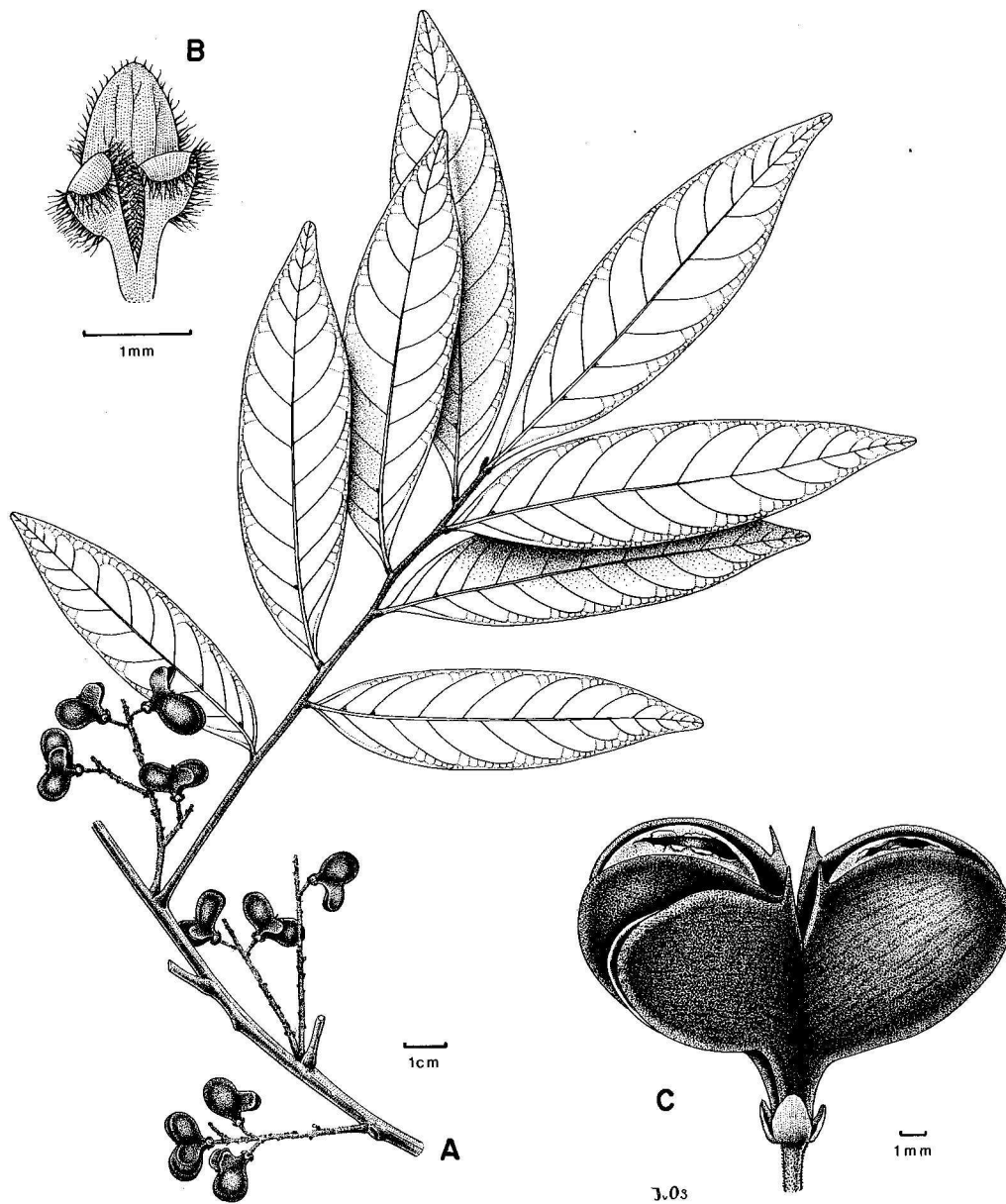


Fig. 9. *Guioa diplopetala*. A, fruiting leafy twig; B, petal; C, fruit. (A and C from *Rahayu & Maskura 540*, B from *Beumée A 765*.)

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 x 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 x 1–3.3 mm, 3 inner larger ones 1.5–3.8 x 1.2–4 mm, margin petaloid; petals 5, elliptic to obovate, 1.8–3.8 x 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 x 1–2.3 cm, glabrous; stalks 2–5.5 mm long; lobes 6.5–13 x 7–12 mm. **Seeds** globose to obovoid, 5.3–8.5 x 5–7.5 mm; arillode edible; embryo 5–7.8 x 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.(Greek, *pleuron* = lateral outgrowth, *pteron* = wing; the winged petioles)

Fig. 10.

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).

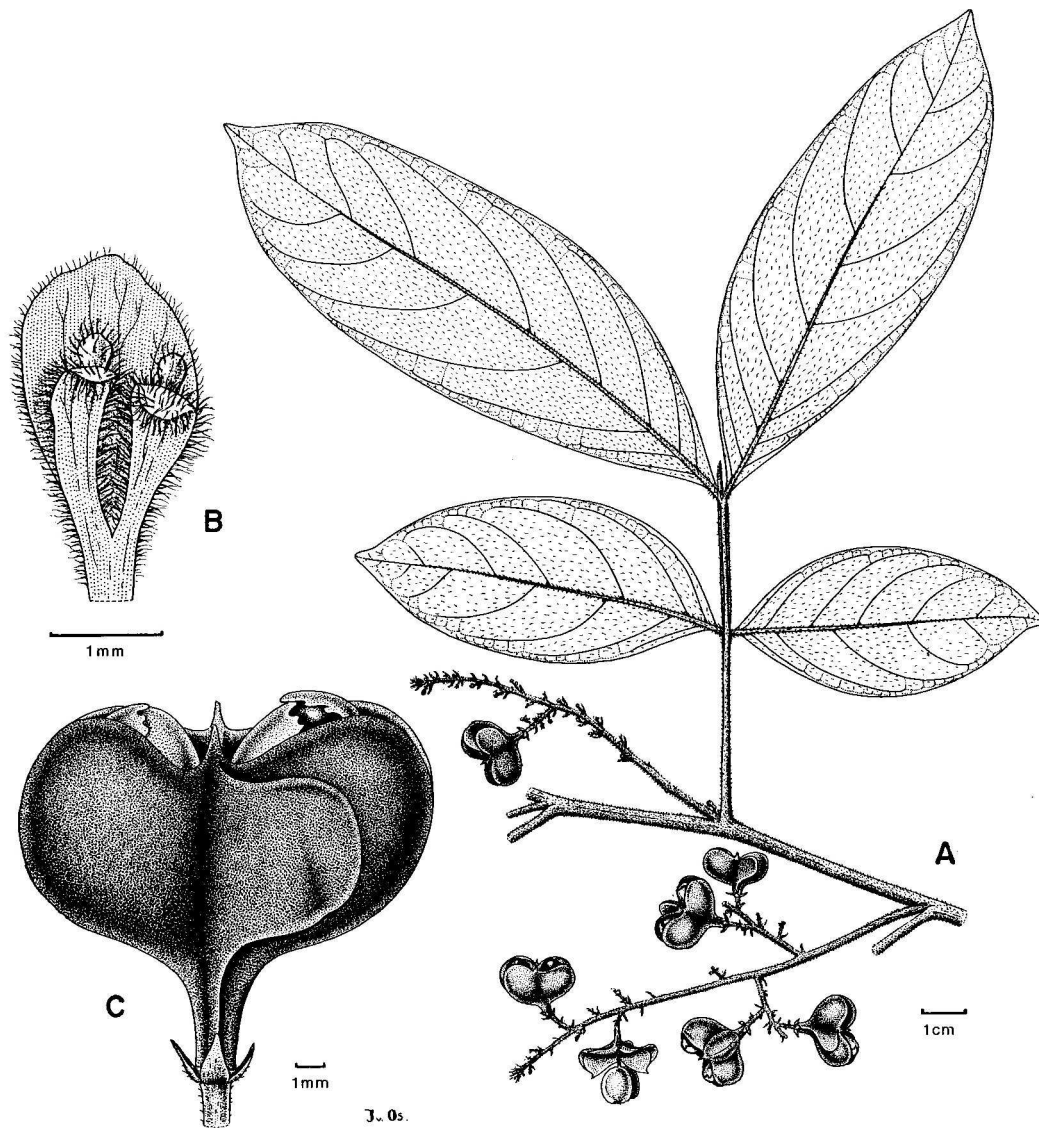


Fig. 10. *Guioa pleuroptaris*. A, fruiting leafy twig; B, petal; C, fruit. (A and C from Davidson 1325; B from Maxwell 81-34.)

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 x 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 x 0.6–2 mm, 3 inner larger ones 1.5–3.5 x 0.9–3.3 mm, margin petaloid; petals 5, elliptic to obovate, 1.3–3.5 x 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 x 1–2.5 cm, glabrous; stalks 2–5 mm long; lobes 7.5–13 x 6.5–13 mm. **Seeds** globose to obovoid, 5.5–9.7 x 5–8 mm; arillode yellow to orange, edible, sour; embryo 3.3–9 x 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), *tangkling 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-sericeous, domatia many, in the form of sunken sacs; elliptic to obovate, 2.4–14.6 x 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 x 0.8–1.5 mm, 3 inner larger ones 1.7–3 x 1.2–2.7 mm, margin petaloid; petals 5, elliptic to obovate, 1.1–2.8 x 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 x 1.2–2.2 cm, glabrous; stalks 4–7 mm long; lobes 8.5–11 x 8–12 mm. **Seeds** obovoid, 7.5–10.5 x 6–9 mm; arillode edible, with yellow exudate; embryo 6.8–9.2 x 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 x 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 x 0.8–2.1 mm, 3 inner larger ones 1.4–3.3 x 1.3–3.1 mm, margin petaloid; *petals* 5, obovate, 1.9–3.4 x 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 x 1–1.9 cm, *sparsely sericeous, glabrescent*; stalks 1.5–5 mm long; *lobes* 7–10 x 6.5–10 mm. **Seeds** globose to obovoid, 6.8–10 x 5.8–7.5 mm; embryo 5.9–8.3 x 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, Karimun-Djawa 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

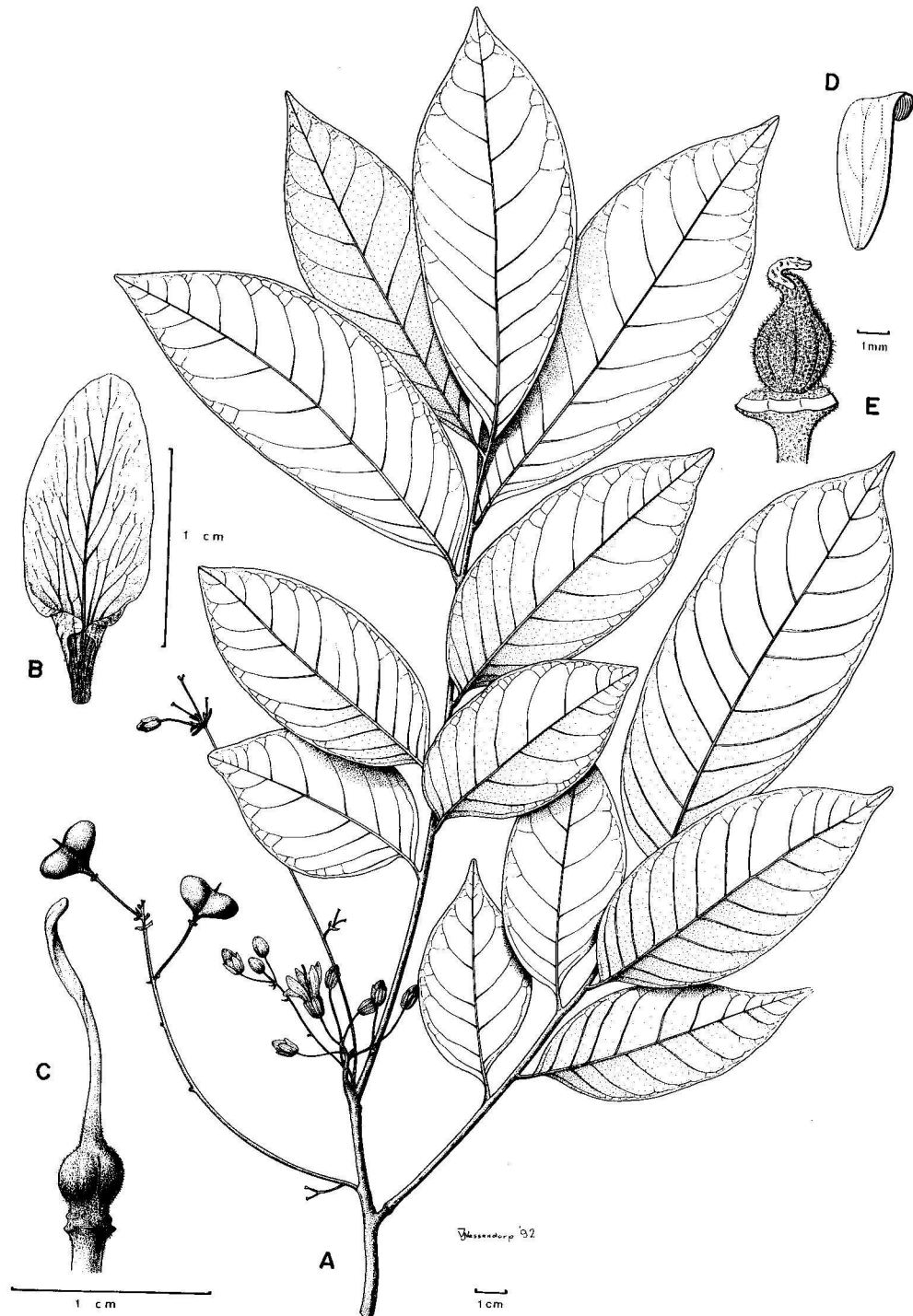


Fig. 11. *Harpullia arborea* (A–C); *H. cupanioides* (D–E). A, flowering and fruiting leafy twig; B, petal; C, ovary; D, petal; E, ovary. (A from PNH 12482, B–C from van Beusekom et al. 2862, D–E from Waterhouse 36 B.)

& 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 x 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 x 3–5 mm, sparsely glandular hairy especially along the margin; *petals membranous, clawed*, obovate-oblong, 8–17 x 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 x 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 x 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 x 2.5–4.5 mm, persistent in fruit; *petals not clawed, thin-fleshy*, oblong-obovate to oblanceolate, 5–10 x 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 x 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 & Sutisna, 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 exerted, 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 x 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 x 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) x 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) x 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 x 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 x 2.5–3 mm, scale erect, slightly hood-shaped, 0.2–0.3x 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 x 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 x 1.5 cm; hilum rhomboid, c. 6 x 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.

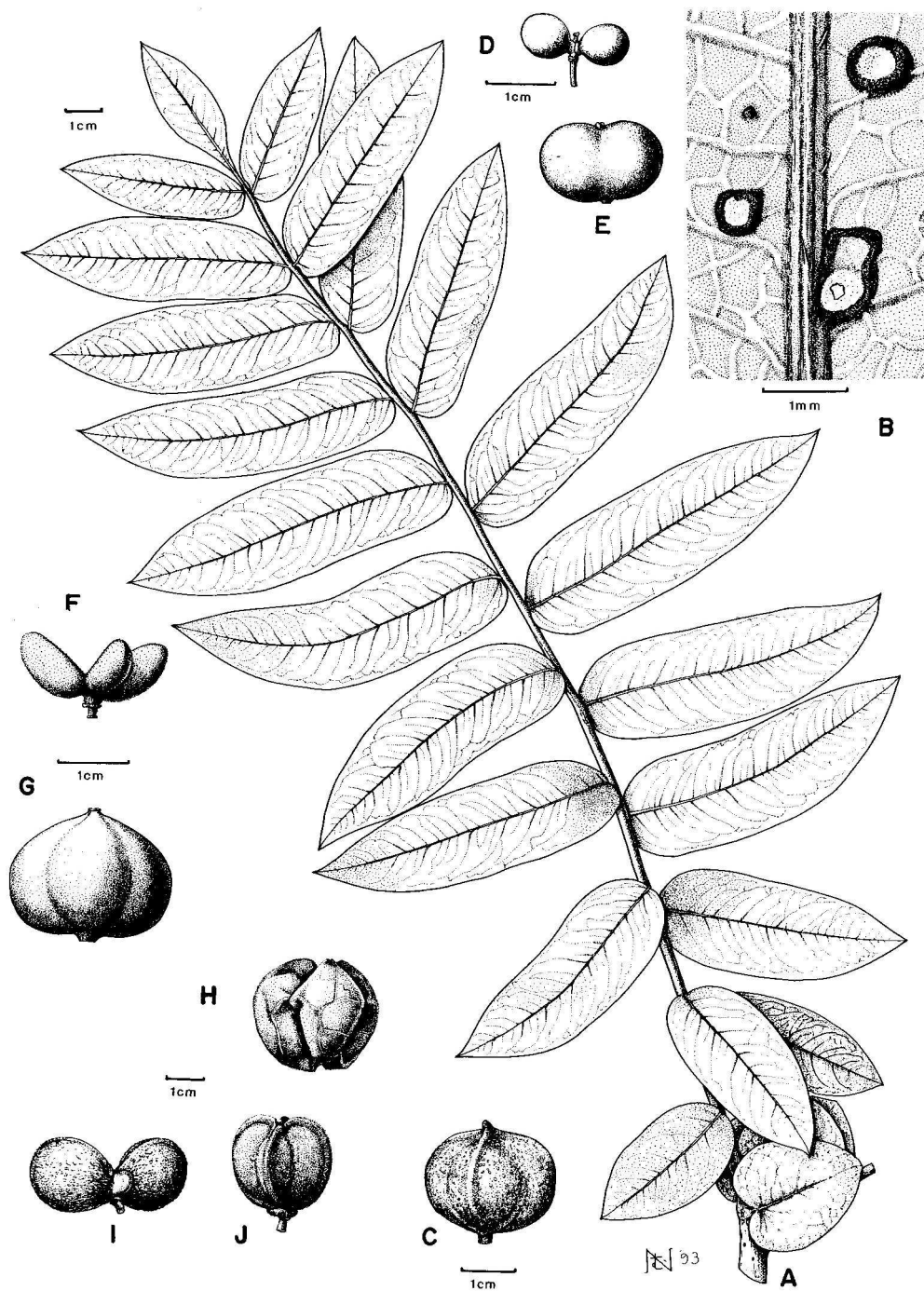


Fig. 12. *Lepisanthes amoena* (A–C); *L. senegalensis* (D); *L. fruticosa* (E); *L. rubiginosa* (F); *L. alata* (G); *L. falcata* subsp. *borneensis* (H); *L. multijuga* (I); *L. tetraphylla* (J). A, leaf; B, detail of lower surface of leaflet; C–J, fruits. (A–B from Danser 5474, C from Wirawan 63, D 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 *Endert 1702* and *Jaheri 1693* from Kalimantan, characterized by their rather large (15–23 x 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 x 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 x 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 x 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 & Sutasna *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 x 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, sessile, 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 x 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 x 1.2–2 mm, inner 3 more or less orbicular, 2.5–4 x 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 x 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 x 2.2–2.8 cm (fresh c. 2.5 x 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.

(Latin, *divaricatus* = spreading; the inflorescence branches)

Fig. 13.

l.c. (1969) 72, *l.c.* (1994) 638; Anderson *l.c.* 312; Whitmore, Tantra & Sutasna *l.c.* 312. **Basionym:** *Otophora divaricata* Radlk., Fedd. Repert. 18 (1922) 338, in Engler *l.c.* (1932) 758, Masamune *l.c.* 430.

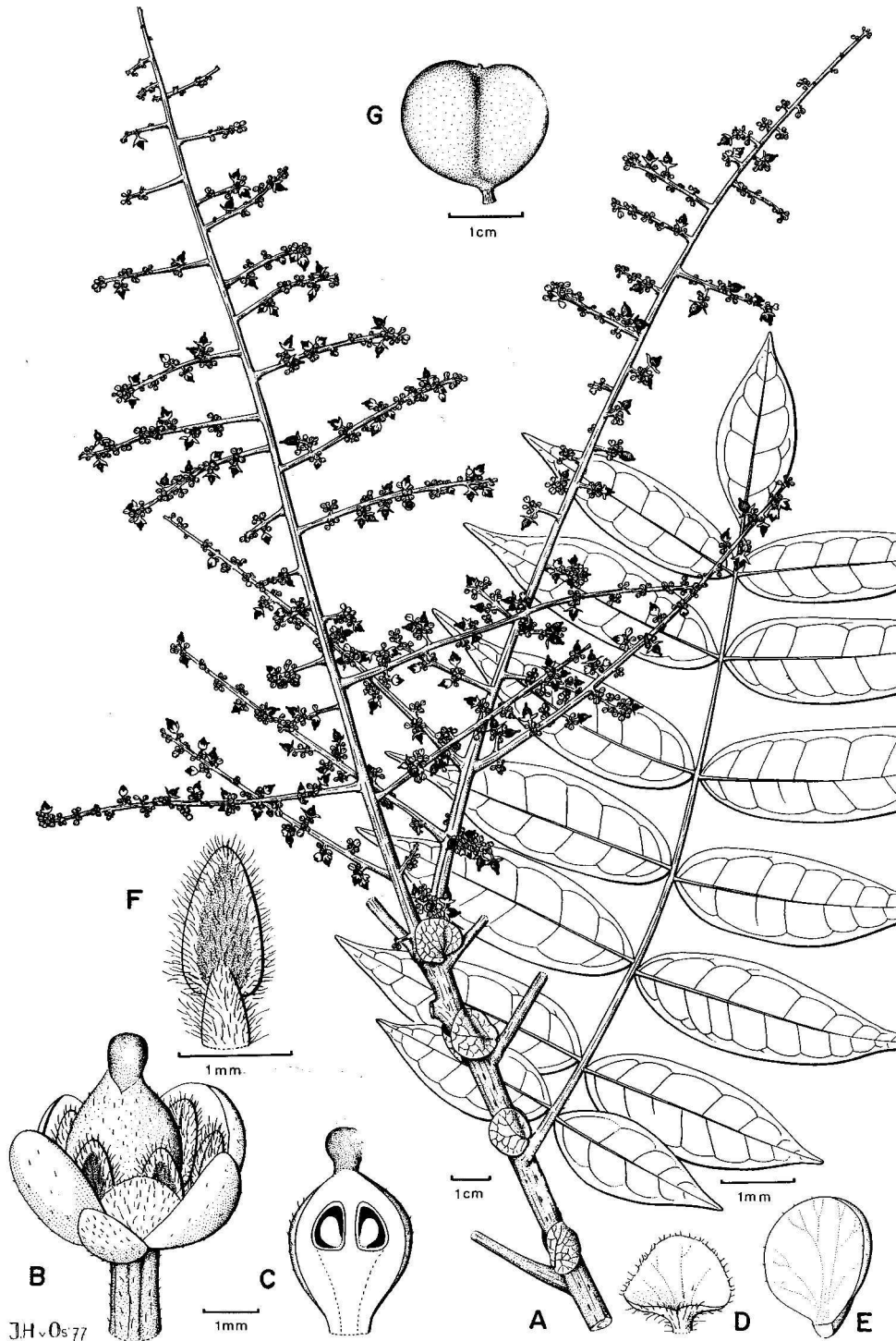


Fig. 13. *Lepsianthes divaricata* forma *divaricata*. A, flowering leafy twig; B, female flower; C, ovary in longitudinal section; D, petal from inside, E, sepal from inside; F, staminode from outside; G, fruit. (A–F from *S. 17527*, G from *Rehal 13015*.)

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 x (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 x 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 ciliolate, outer two broad-ovate to obovate, 1.8–2.2 x 1.2 mm, inner ones suborbicular to ovate, 1.8–3.5 x 1.8–2.2 mm; petals distinctly clawed, long-hairy, blade transversely subelliptic, 0.7–1.5 x 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 x 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 x 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 x 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.

Fig. 12H.

(Latin, *falcatus* = sickle-shaped; the leaflets)

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 x 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 x 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 x 1.8–3.5 cm, densely brown short-velvety and corrugated outside. **Seeds** obovoid-globose, 15 x 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 fruticosus* 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 x 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 x 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 x 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 x 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 x 0.6–2 x 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 x 6–18 mm, 4–18 mm thick, hilum orbicular to lanceolate, to 6 x 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 x 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 x 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

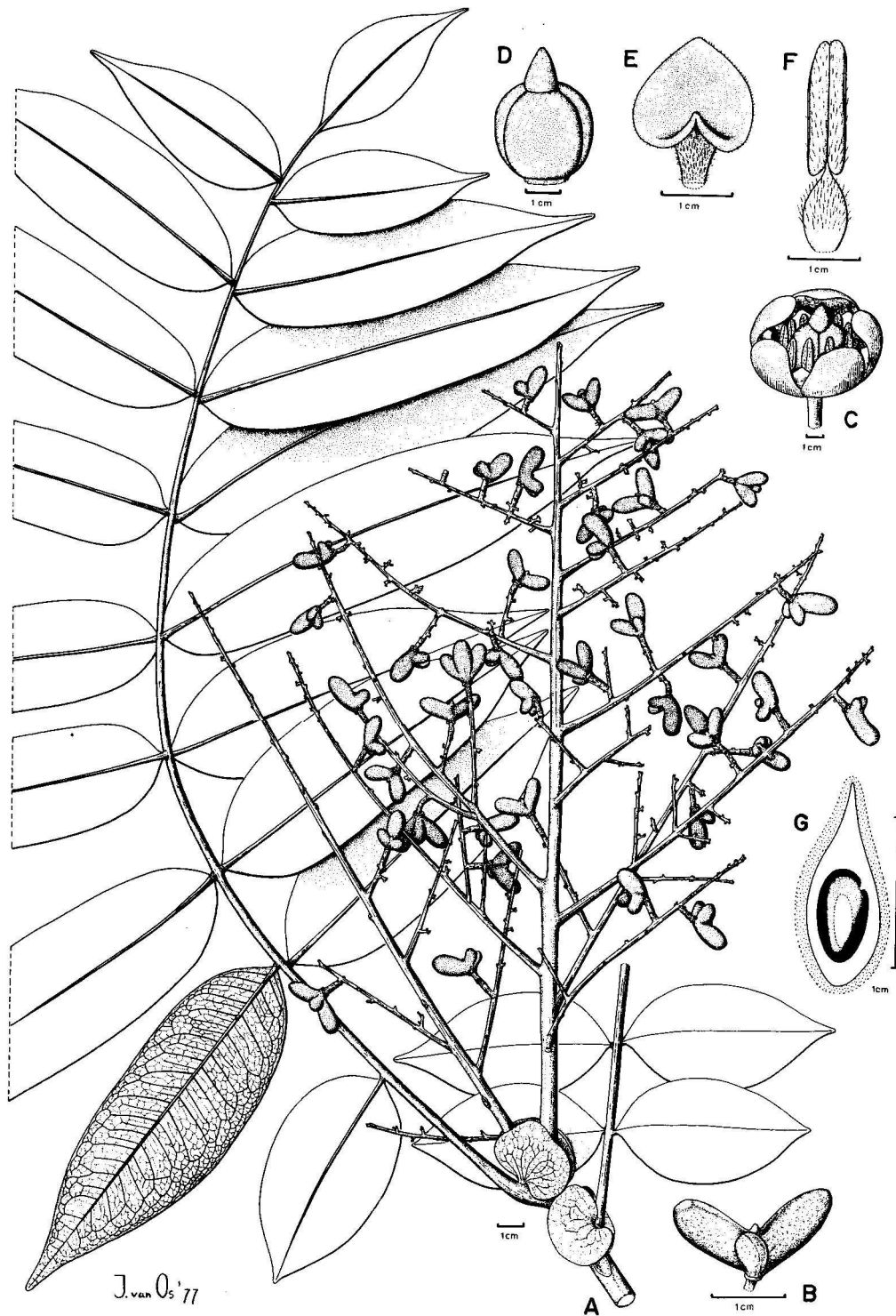


Fig. 14. *Lepisanthes kinabaluensis*. A, fruiting leafy twig; B, fruit; C, female flower; D, ovary; E, petal from inside; F, stamen; G, seed in longitudinal section. (A–B from RSNB 4998, C–G from RSNB

rose-red, sparsely ciliolate in the apical part, outer 2 ovate, 3.5–5 x 2.5–3 mm, inner 3 elliptic to rounded, 4–5 x 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 x 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 x 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.
(Latin, *multus* = many, *jugum* = leaflet pair)

Fig. 12I.

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, 2.5–7.5x2.5–5 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 x 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, 2.5–3x1.8–2.5 mm, inner 3 orbicular, with a broad petaloid margin, 3–4x2.5–4 mm; petals rather densely long-ciliate, sparsely hairy at the base or glabrous outside, blade broadly ovate, slightly subtruncate at base, *c.* 2x 2.5 mm, claw *c.* 0.5 mm, *scale slightly bilobed, about 0.3x 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. 22x13 mm, scabrous, glabrous, chocolate-coloured or yellow or orange when fresh. Seeds hazelnut-shaped, c. 12 x 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 x 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 x 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 x 2 mm*, with petaloid margin, inner ones broadly ovate, *c. 3 x 2 mm*, for the greater part petaloid; *petals white*, sparsely long-ciliate near the base, blade semi-transversely elliptic, *c. 1 x 1.8 mm*, claw *c. 0.4 mm long*, *scale broad, rounded to bilobed*, about 0.3–0.5x 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 x 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.

(Latin, *rubiginosus* = rust-coloured; the indumentum)

Fig. 12F.

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) x (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 x 1.2-2 mm, ciliate, inner three 1.8-2.8 x 2-3 mm, obtuse; petals 4 (or 5), blade 2-4 x 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 x 2-2.2 mm, densely appressed hairy, style cylindrical, *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 x 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 x 4 x 4 mm, hilum basal, small.

Vernacular names. Sabah—*borobogan* (Dusun Bundu), *damai* (Bajau), *lipupudsu* (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 & Sutisna *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.

Treelet, 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 x 2–15 cm (simple leaves to 60 x 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 x 0.8–1.2 mm, sometimes with a narrow, petaloid, crenulate margin, sparsely ciliolate, inner ones 3–4 x 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 x 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 x 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 x 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 “*dasypetala*”) 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. Reper. 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 x 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 x 6 mm. **Flowers**

white, sometimes greenish white, cream, or pink, sweet-scented; outer two sepals ovate to suborbicular, 1.2–7 x 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 x 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 exerted 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) x 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 x 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 x 5 mm, *with spreading lobes, densely warty*, stalk 1–1.5 mm long, style terete, *c.* 1 mm long. **Fruits** *c.* 3.5 x 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 x 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, phytogeography, 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-intorse, 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.

Fig. 16F.

(Greek, *penta* = five, *petalon* = petals; the flower)

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, Masamune *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, Masamune *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) x (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;

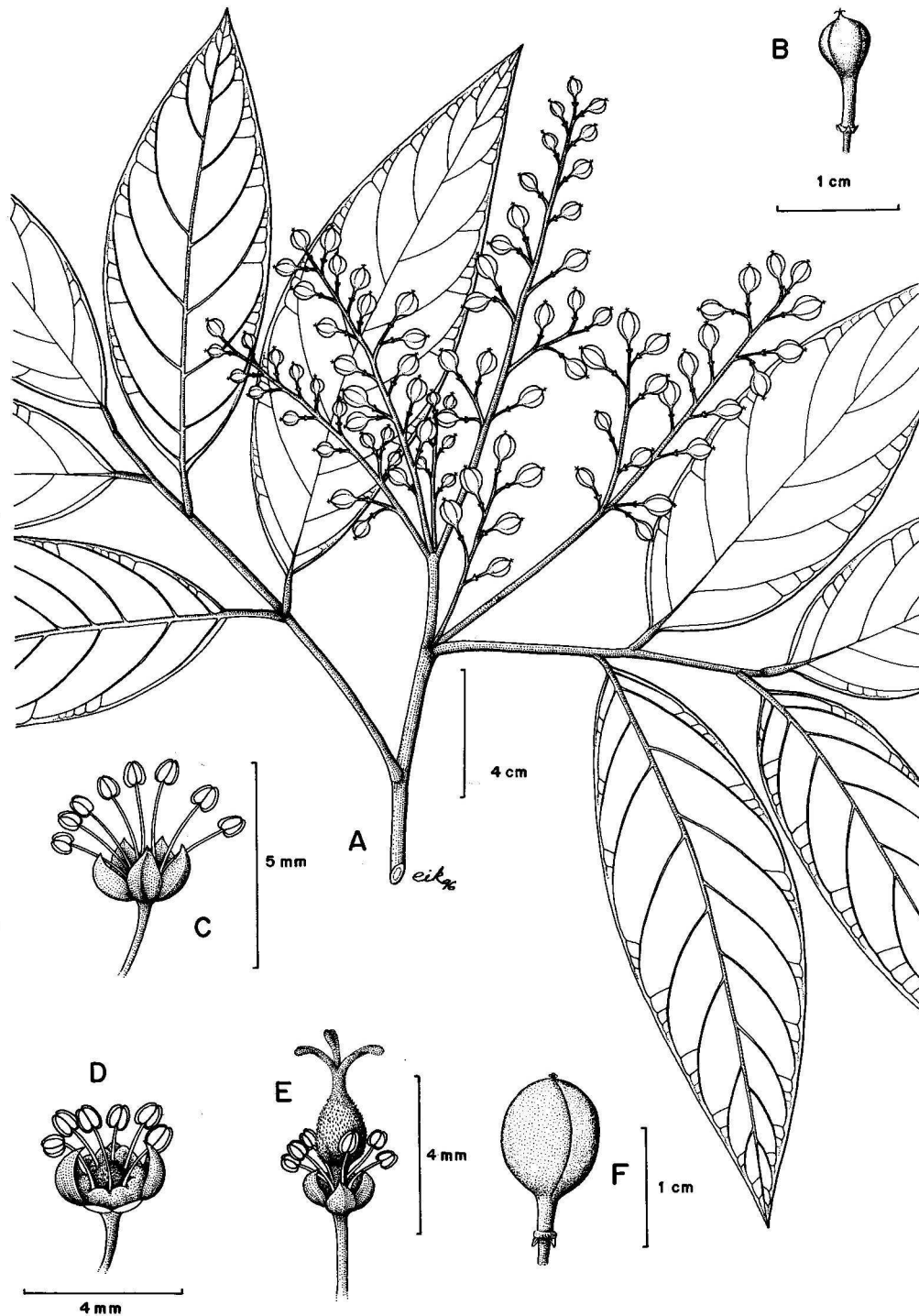


Fig. 16. *Mischoecarpus sondaicus* (A–E); *M. pentapetalus* (F). A, fructing leafy twig; B, fruit; C, male flower; D, male flower with two sepals removed; E, bisexual flower; F, fruit. (A–B from SAN 50950, C–D from SAN 116099, E from SAN 121647, F from PNH 34128.)

main axis to 40 cm long, secondary axes 1–20 cm long; cymules to 11 mm long; bracts triangular, 6–8 x 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 x 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 x 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 x 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) x 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 x mm, usually caducous. **Flowers:** *calyx connate for one-fourth to one-third its length*, triangular, 0.65–2 x 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 x 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, *nepheleon* = 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 dehiscent 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, knobbly 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 2.5x1.5 cm; fruit wall to 1 mm thick; appendages to 10 mm long. Intercostal veins reticulate.....**5. N. havilandii**
 Fruits to 6x3.5 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 x2.25 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 x3.5 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 x 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 x 2 x 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.

(Latin, *compressus* = laterally flattened; the fruit)

Fig. 17D.

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 & Sutisna *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 x 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 x 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 x 2.5 x 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.

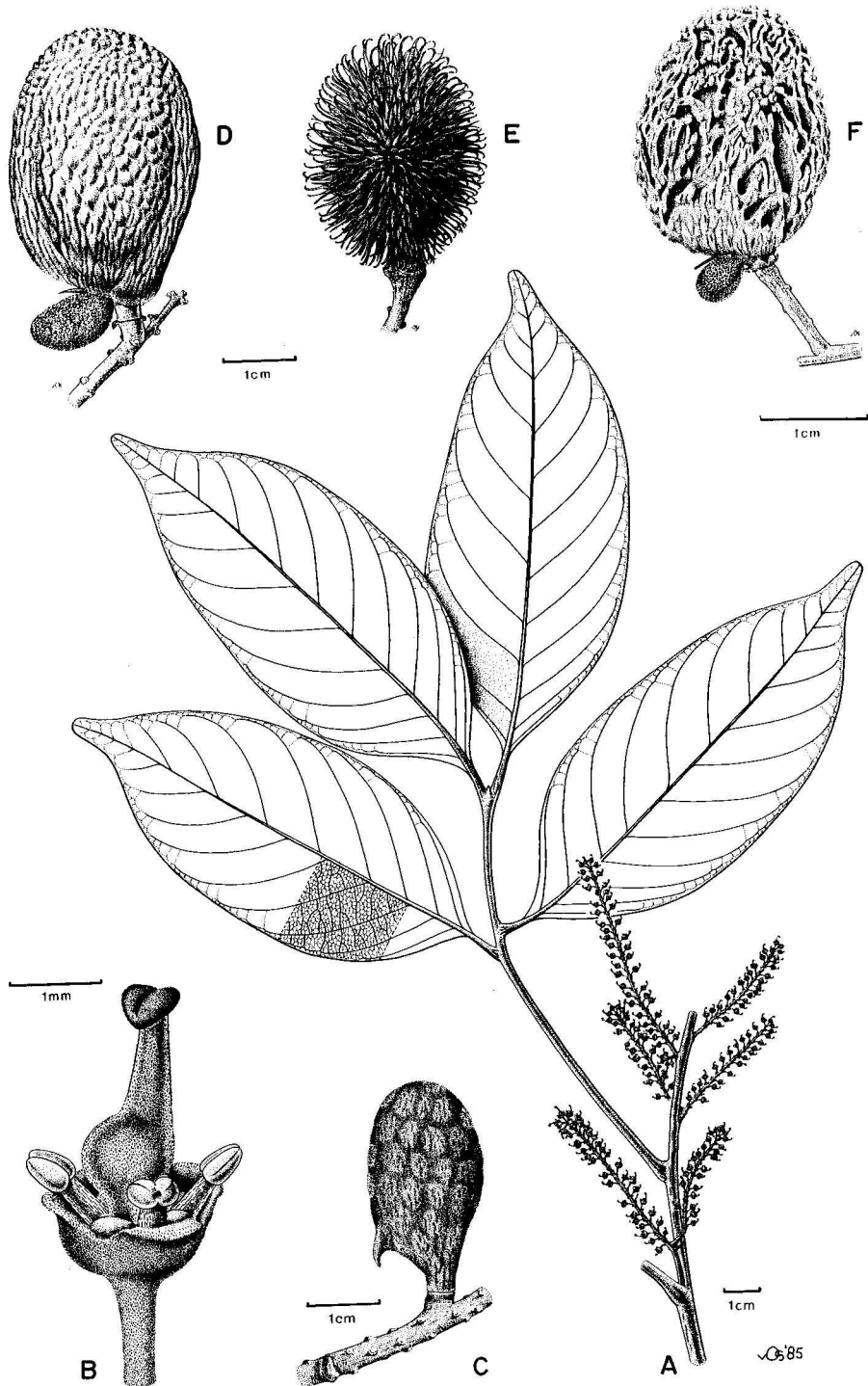


Fig. 17. *Nephelium maingayi* (A–C); *N. compressum* (D); *N. cuspidatum* (E); *N. daedaleum* (F). A, flowering leafy twig; B, female flower; C–F, fruits. (A–B from SAN 65365, C from SAN 38799, D from Beccari PB 1268, E from S. 27687, F from SAN 50490.)

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, thyrsoid, 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 born 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, Planzenr. 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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) x (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 x 3.5 cm; stamens (4–)5–8(–9). Fruits to 5 x 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 x 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 x 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 x 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 x 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 x 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 x 1.25–1.75 cm, x1–1.25 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)

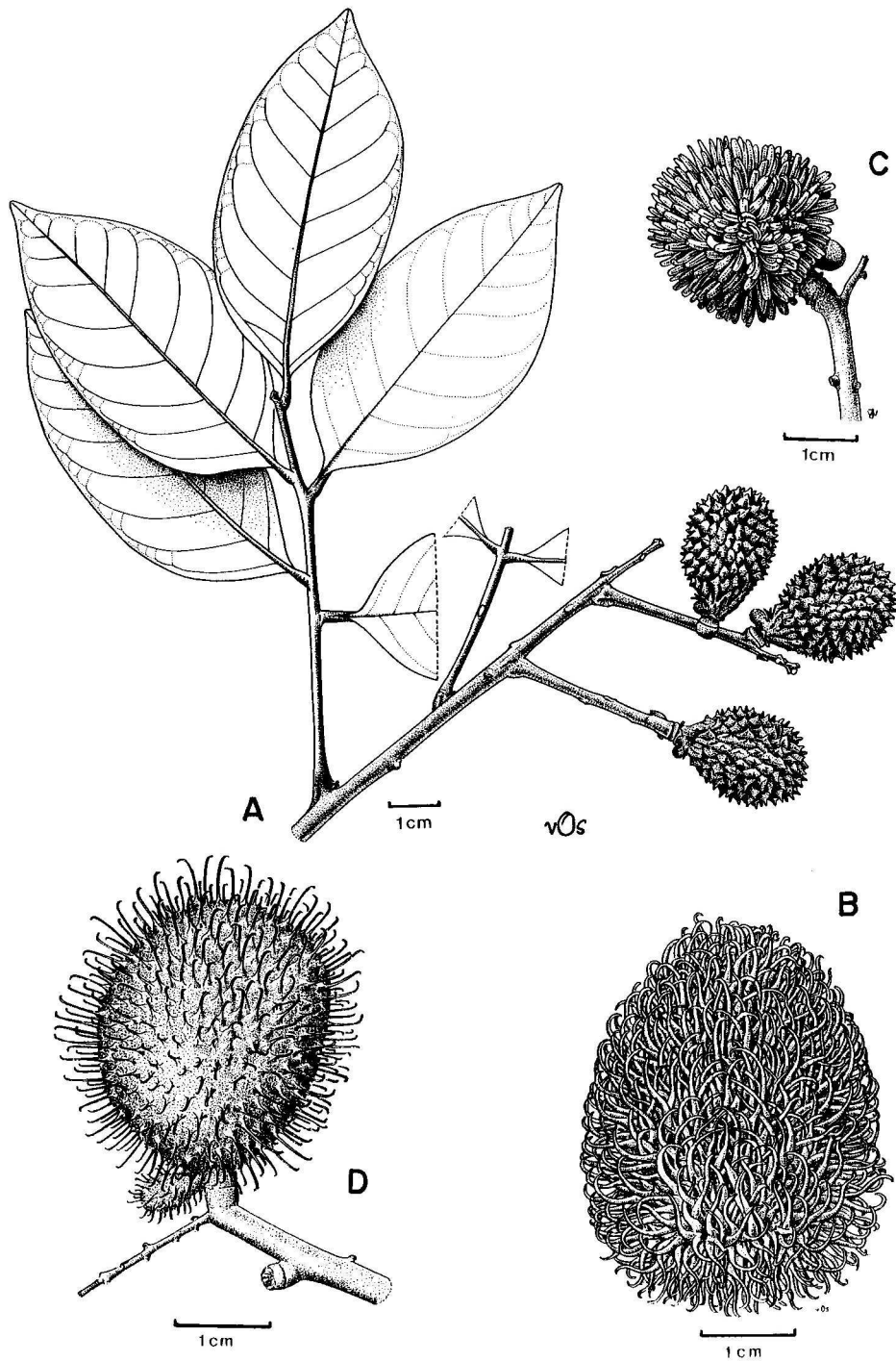


Fig. 18. *Nephelium papillatum* (A); *N. meduseum* (B); *N. ramboutan-ake* (C); *N. uncinatum* (D). A, fruiting leafy twig; B–D, fruits. (A from SAN 41845, B from S. 32399, C from FRI 10648, D from Hotta 12984.)

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 x 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 x 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 x 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 x2.5 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 x2.5–4.5 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 x1.75 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 0.6–1.8 mm, acute to mucronate; petals 5, blade small to absent (but mind the scale!), narrowly spatulate, 0–1.7 x 0–1 mm, glabrous to pilose outside, scale lobed, 1.5–2.1 x 0.9–2 mm; disc to 1 mm high, 2.5–3.5 mm diameter; stamens

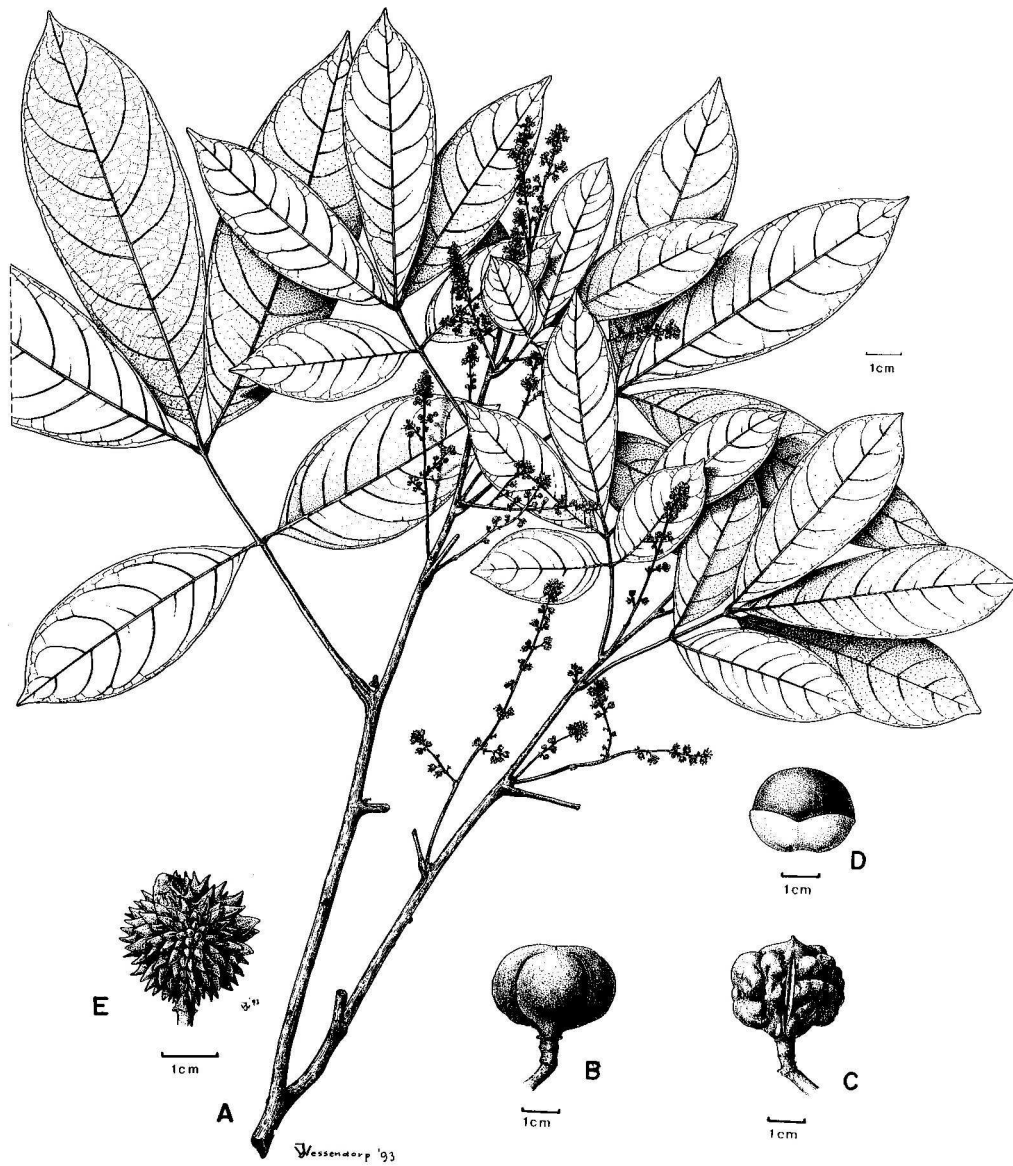


Fig. 19. *Paranephelium xestophyllum* (A–D); *P. joannis* (E). A, flowering leafy twig; B–C, fruits; D, seed; E, fruit. (A from Whitmore & Kade 3311, B from SAN 79936, C from Kostermans 13238, D from Boerlage, s.n., E from Kostermans 12670.)

7–8, filaments 2–4.5 mm long; ovary 3-locular. **Fruits** 2.5–4 x 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; isoelectotype 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 x 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 x 0.5–1.8 mm; petals (4–)5(–7), 1–2.5 x 0.7–2.7 mm, glabrous to woolly outside, scale emarginate to divided into 2 lobes, 1.1–2.2 x 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.
(Latin, *pinnatus* = with 2 rows of leaflets; the leaf)

Fig. 20.

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. & Binnem., 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

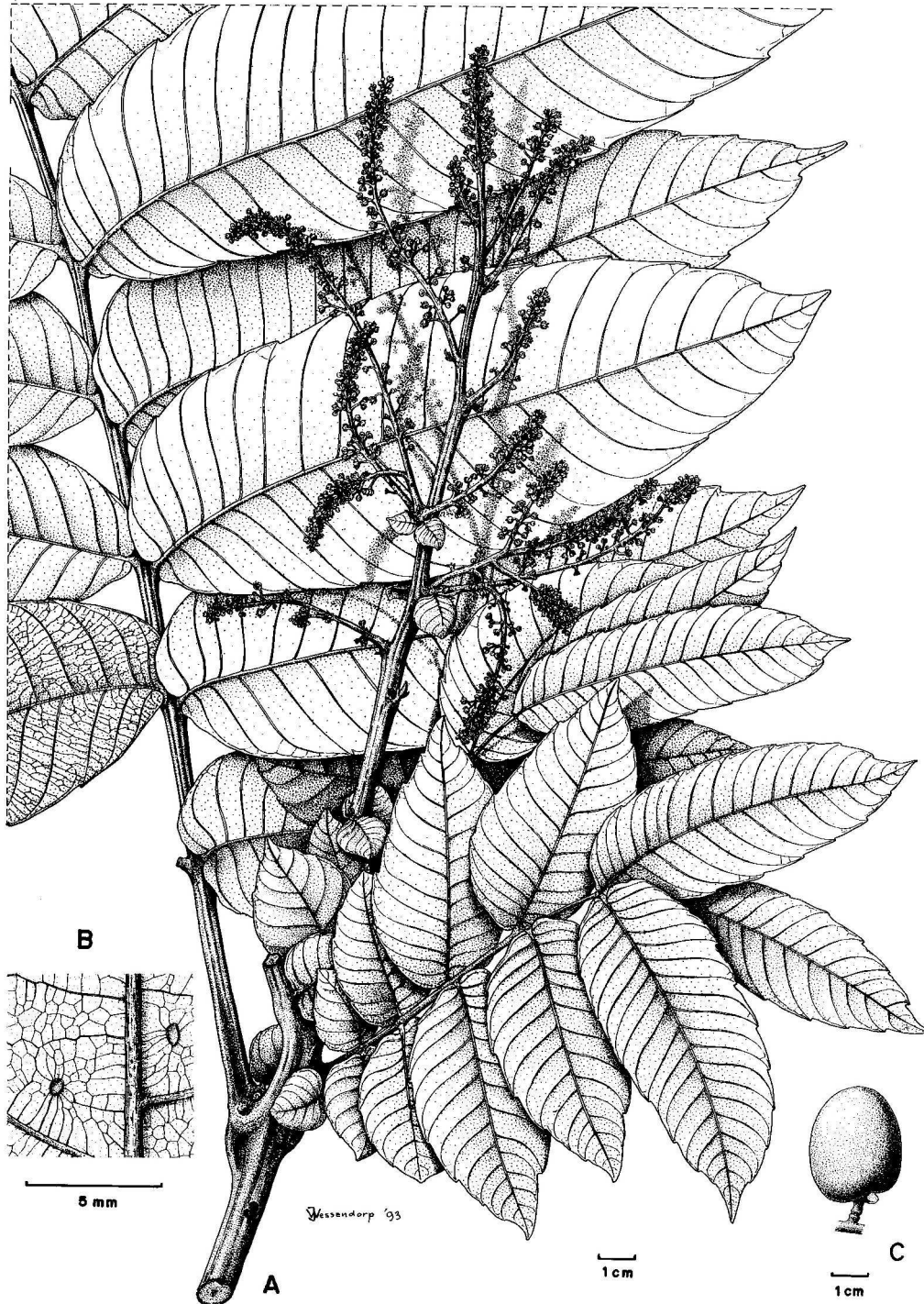


Fig. 20. *Pometia pinnata*. A, flowering leafy twig; B, detail of gland on lower surface of leaflet; C, fruit. (A from Hoogland 5048, B from King's coll., s.n., C from Clemens 5329.)

ovate, 0.4–3x0.25–5 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 x 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 x 0.3–1.2 mm, variably hairy outside, hairy or glabrous inside; petals shorter or longer than calyx, 0.4–1.3 x 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 x 2.5 mm, style 2–5.5 mm long. **Fruits** 1.5–5 x 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 x 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 x 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 x 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 x 0.75 mm, glabrous on both sides; petals shorter than the calyx, 0.65 x 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 x 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 thyrsoid*; bracts and bracteoles usually not persistent in fruit. **Flowers** *radially symmetrical, seemingly bisexual*; *sepals 5*, subpersistent 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.

(S.H. Koorders, 1863–1919, Forest Officer of the Dutch East Indies at Bogor)

Fig. 21.

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, Manado (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 x 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*, thyrsoid, 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 x 2.5 mm, inner ones orbicular, 3–3.5 x 3 mm; petals broadly obovate, *c.* 2.5 x 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 x 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 x 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*, *thyrsoid*, 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 exserted, 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.

Fig. 22.

(Latin, *acutus* = pointed; the leaflet apex)

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 x 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 x 1.25–1.75 mm, fairly densely short-sericeous on both sides to rather sparsely so inside, margin ciliate; petals 2–3 x 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, 4.5–5 x 2.25–3 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 x 1 cm, black and shiny; hilum basal, transversely elliptic, *c.* 7x5 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*, 5–10 x 1.75–4 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 x 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*, 7.5–11.5 x 3–4 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 x 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.

(Latin, *ferrugineus* = rusty brown; the indumentum)

Fig. 23.

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 thyrses, 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 x 2–2.2 mm, rather densely appressed hairy inside, margin entire, not petaloid; petal blade transversely half-elliptic, *c.* 1 x 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 x 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 *I.e.* (1932) 949; King *I.e.* 431; Ridley *I.e.* 497; Burkill, EPMP 2 (1935) 2272; Anderson *I.e.* 314; Leenhouts *I.e.* (1983) 391, *I.e.* (1994) 748; Whitmore & Tantra *I.e.* 216; Yap *I.e.* 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 x 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 x 1.4-2.5 mm, ciliate to woolly ciliate, glabrous or nearly so; petals obovate to spatulate, 1-3 x 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 x 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.*

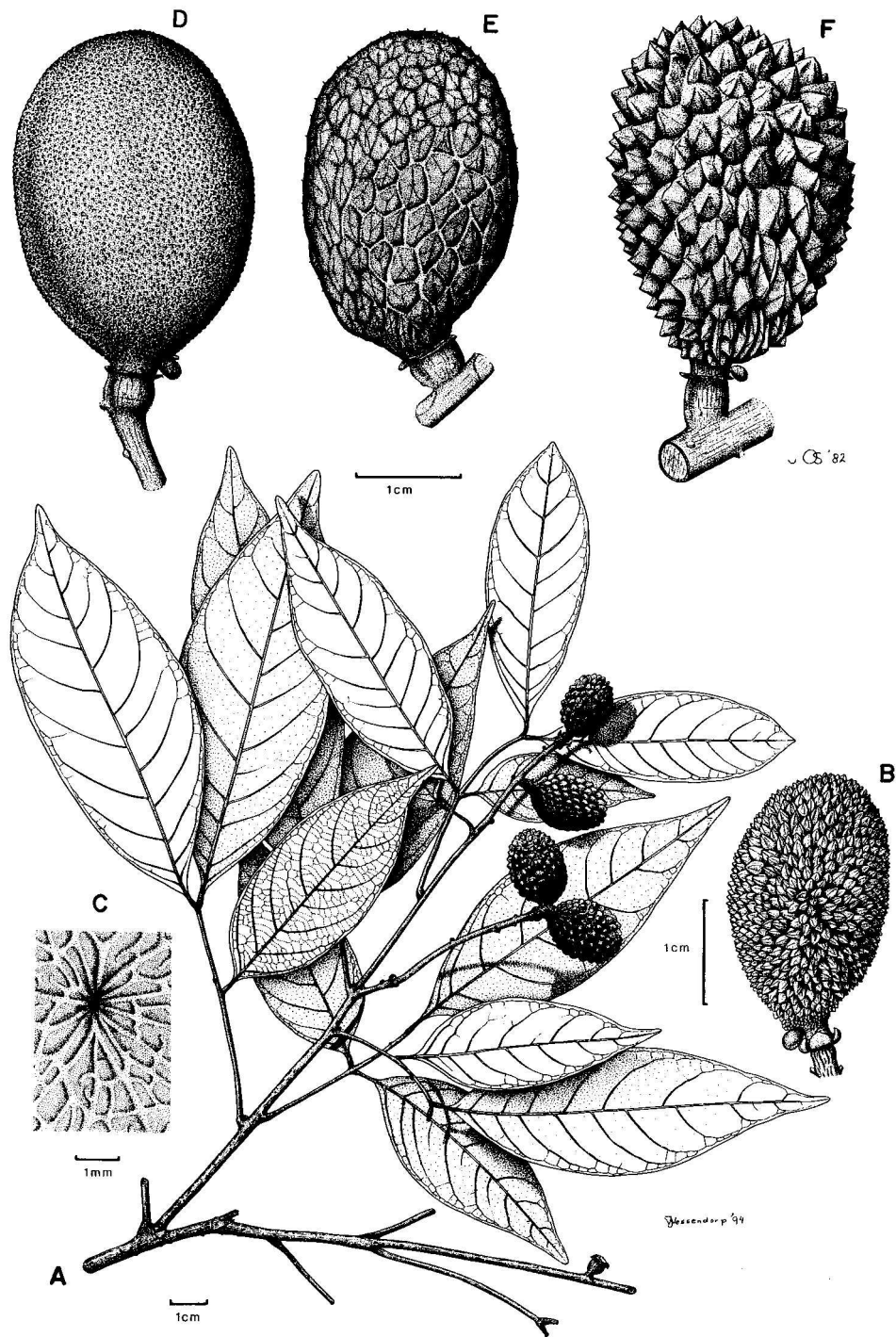


Fig. 24. *Xerospermum laevigatum* subsp. *laevigatum* (A); *X. laevigatum* subsp. *acuminatum* (B); *X. noronhianum* (C–F). A, fruiting leafy twig; B, fruit; C, gland on lower leaflet surface; D–F different sculptures of fruits. (A from *de Wilde & de Wilde-Duyffes* 18907, B from *SAN* 27301, C from *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.

I.e. (1983) 393, *I.e.* (1994) 749. Basionym: *Xerospermum acuminatum* Radlk. *I.e.* (1879) 25, Merrill *I.e.* 359, Masamune *I.e.* 432, Anderson *I.e.* 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 x 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 *I.e.* (1983) 392, *I.e.* (1994) 749; Yap *I.e.* 461. Synonym: *Xerospermum unijugum* Radlk., *Rec. Bot. Surv. Ind.* 3 (1907) 351, in Engler *I.e.* (1932) 948, Ridley *I.e.* (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 x 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

Fig. 24C-F.

(Fernando Noronha, Spanish biologist in the 18th century)

I.c. (1847) 100; Radlkofer in Engler *I.e.* (1932) 946; Backer & Bakhuizen/ *I.e.* 137; Leenhouts, *I.e.* (1983) 394, fig. 2a-c, e, *I.c.* (1994) 750, fig. 84b-e; Whitmore & Tantra *I.c. Ill.*; Yap *I.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. *I.c.* (1879) 7, 25, Merrill *I.c.* 359, Masamune *I.c.* 432; *X. muricatum* Radlk. in Engler & Prantl *I.c.* (1895) 331, fig. 168, Anderson *I.c.* 314; *X. echinulatum* Radlk. *I.c.* (1907) 350, Anderson *I.c.* 314; *X. intermedium* Radlk. *I.c.* (1907) 348, Anderson *I.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 x 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) x 1-2.4 mm, glabrous on both sides or at base hairy inside, ciliate; petals obovate to broadly spatulate, 1-2.8 x 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 x 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—*Hat, 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, thyrsoïd, 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.

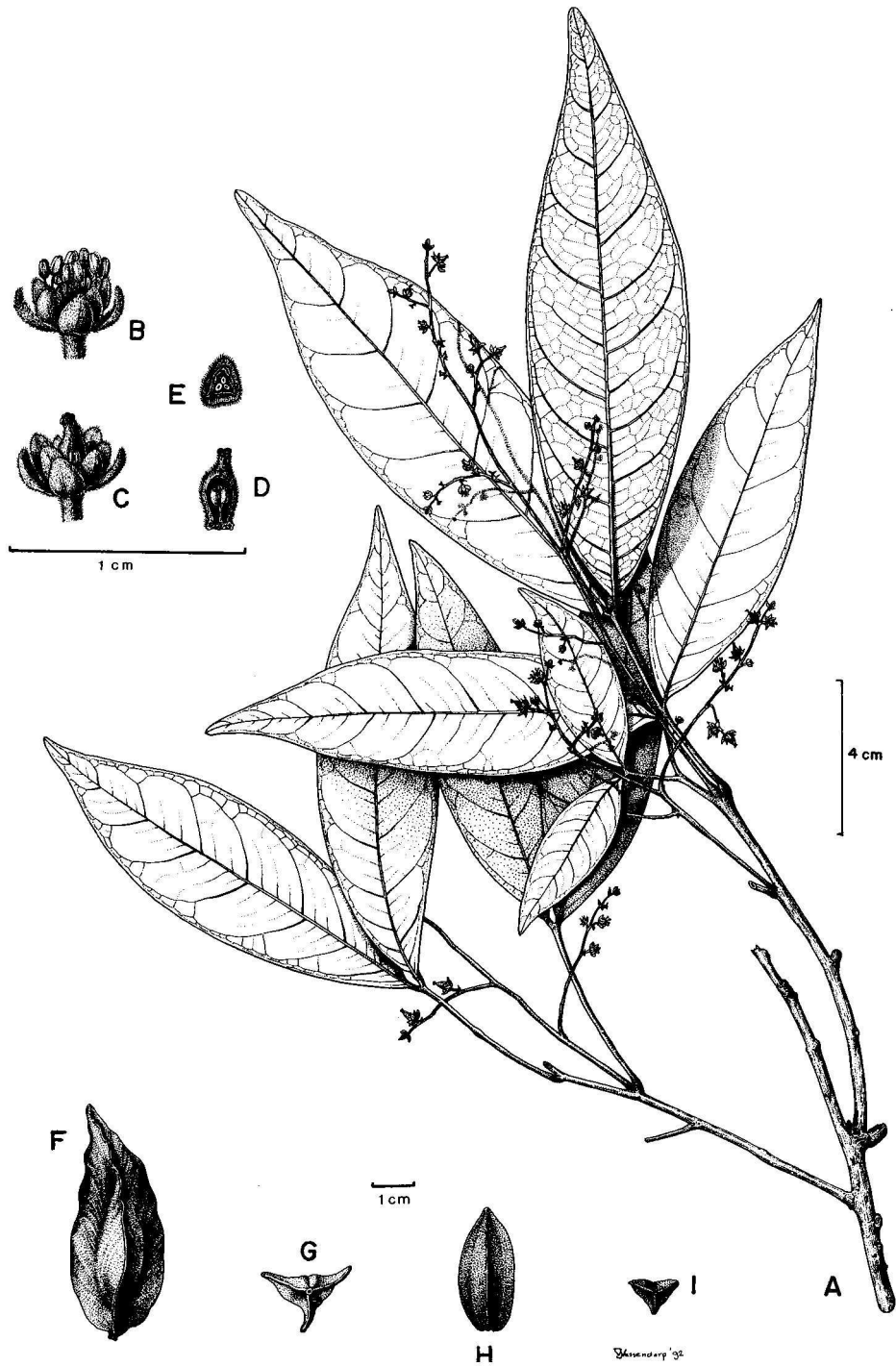


Fig. 25. *Zollingeria borneensis*. A, flowering leafy twig; B, male flower; C, female flower; D, ovary in longitudinal section; E, ovary in cross-section; F, fruit; G, fruit, bottom view; H, seed; I, seed, bottom view. (A–E from SAN 90057, F–I from Elmer 20888.)

Distribution. Three or four species in Myanmar, Laos, Thailand and Borneo; one species in Sabah.

Zollingeria borneensis Adema
(of Borneo)

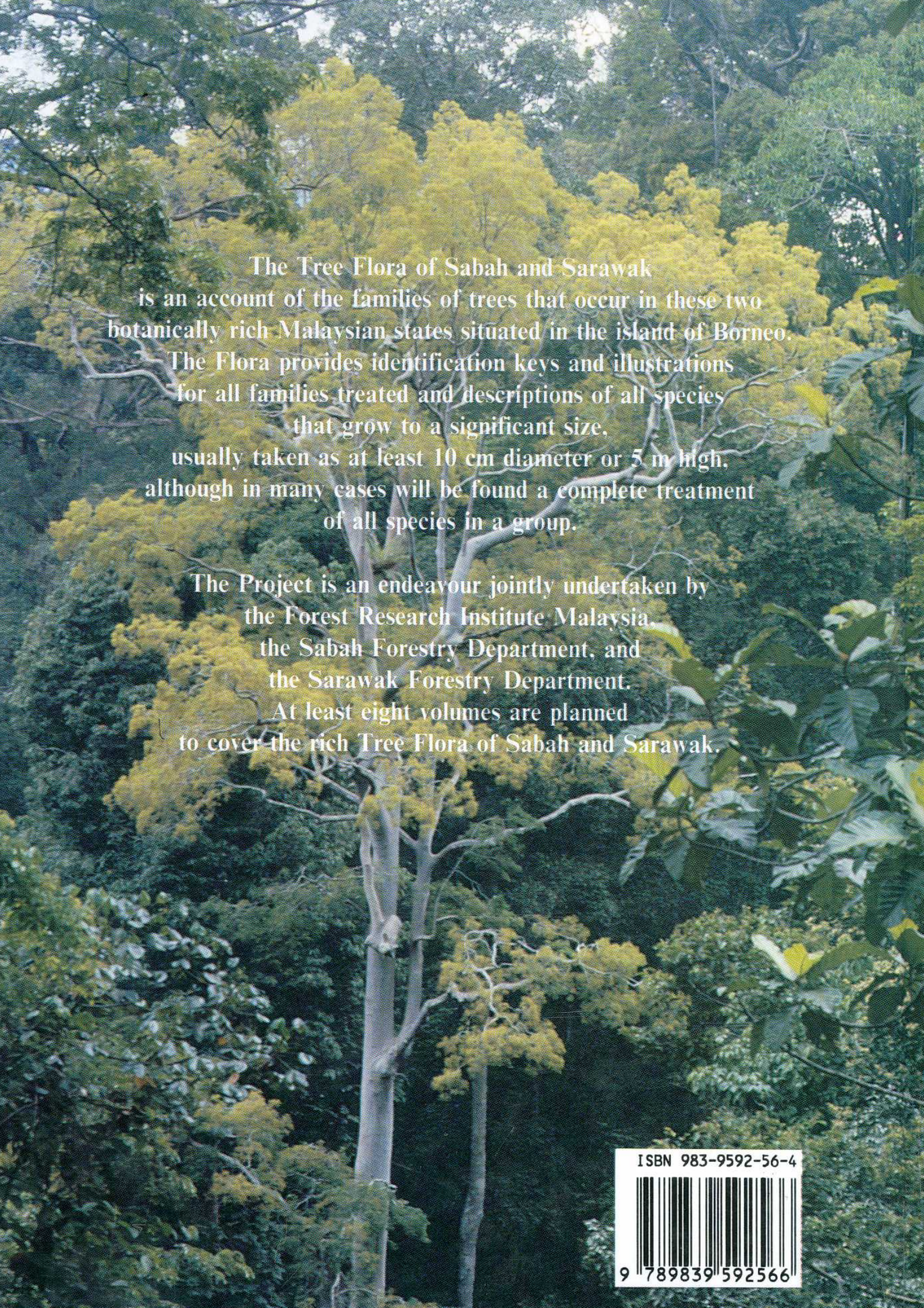
Fig. 25.

Blumea 37 (1992) 75, *l.e.* (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 ferrugineous 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 x 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 x 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 x 1.2-1.6 mm, apex rounded to retuse, appressed hairy on both sides; petals cuneate to spatulate, distinctly clawed, 1.4 - 2.4 x 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 x 1.9 mm. **Fruits** *prismatoid, sharply deltoid in cross section, 6-7 x 2.5-5 cm; fruit wall thin-coriaceous, striate and densely velutinous outside, glabrous inside.* **Seeds** *prismatoid, c.* 33 x 14 mm.

Distribution. Endemic to Sabah; uncommon.

Ecology. Primary forest, at *c.* 15 m. Flowering noted in February.



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

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