

PANDACEAE
(formerly **EUPHORBIACEAE s.l.**
subfam. ACALYPHOIDEAE tribe GALEARIEAE)

(P.C. van Welzen, Leiden, The Netherlands)¹

Pandaceae ['Pandacées' Pierre, Bull. Mens. Soc. Linn. Paris (1896) 1255, 1256, nom. illeg.] Engl. & Gilg, Syllabus (ed. 7) (1912) 223, nom. cons.; Forman, Kew Bull. 20 (1966) 309; Meijer, Bot. Bull. Herb. Forest Dept. Sabah 10 (1968) 233; Airy Shaw, Kew Bull. 26 (1972) 362; Kew Bull., Addit. Ser. 4 (1975) 220; 8 (1980) 220; Kew Bull. 36 (1981) 365; 37 (1982) 36; G.L. Webster, Bot. J. Linn. Soc. 94 (1987) 6. — Type: *Panda* Pierre.

Bennettiaceae R.Br. in Benn. & R.Br., Pl. Jav. Rar. (1850) 250 (nom. prov.). — *Bennettiae* R.Br. ex Schnizl., Iconogr. Fam. Regn. Veg. 3 (1860) 172, f. 10-31. — Type: *Bennettia* R.Br., non Gray 1821 [= *Galearia* Zoll. & Moritzi].

Euphorbiaceae tribe *Galearieae* Benth. in Benth. & Hook.f., Gen. Pl. 3 (1880) 247, 287; G.L. Webster, Ann. Missouri Bot. Gard. 81 (1994) 67; Radcl.-Sm., Gen. Euphorbiacearum (2001) 125. — *Cluytieae* subtribe *Galeariinae* Pax in Engl. & Prantl, Nat. Pflanzenfam. 3, 5 (1890) 81; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 96; Pax in Engl. & Harms, Pflanzenfam. ed. 2, 19c (1931) 171. — Type: *Galearia* Zoll. & Moritzi.

Dioecious, evergreen shrubs to generally small trees; branches plagiotropic. *Indumentum* of simple hairs. *Stipules* triangular, small, (late) caducous. *Axillary buds* sometimes in axils of side branches (*Galearia*, *Panda*). *Leaves* simple, distichous; petiole short; blade symmetric to asymmetric, base asymmetric, margin eglandular (*Galearia*, *Panda*) or with minute glands (*Microdesmis*); venation pinnate with nerves looped and closed quite far from margin. *Inflorescences* axillary fascicles in *Microdesmis* or terminal (*Galearia*) or cauliflorous racemes (to panicles) (*Galearia*, *Panda*); staminate flowers generally in groups, pistillate flowers usually single per node or fewer per fascicle; bracts and bracteoles present. *Flowers* small, 5-merous, usually shortly pedicellate; calyx (4- or) 5-lobed, lobes valvate or imbricate; petals free, valvate or imbricate, longer than sepals, more or less straight to strongly convex (cucullate); disc absent. *Staminate flowers*: stamens 5, (8 or) 10 or 15, in a single or in two whorls (short and longer filaments), anthers 2-thecate, parallel, opening introrse or latrorse with lengthwise slits, connective often thick, in some species with apical appendage; pistillode present. *Pistillode flowers*: ovary ovoid, (1–)2–6-locular, ovules single per locule, pendulous, epitropous, anatropous or orthotropous (*Panda*); style absent, stigmas usually split several times. *Fruits* drupes, thin- or thick-walled, surface smooth to ribbed or angular to pustular. *Seeds* compressed, cotyledons thin, oily; endosperm copious; $n = 15$, $2n = 30$.

1) With contributions by P. Baas (wood anatomy) and R.W.J.M. van der Ham (pollen morphology).
— Drawings by Anita Walsmit Sachs.

DISTRIBUTION

The family comprises three genera, of which the monotypic *Panda* occurs in tropical West Africa, *Galearia* (5 species) is found in continental South East Asia, Malesia and the Solomon Islands, and *Microdesmis* (10 species) is disjunct in tropical West Africa, continental South East Asia and West Malesia.

TAXONOMY

The family was generally regarded as part of the Euphorbiaceae s.l. (Webster 1994; Radcliffe Smith 2001), and classified in the subfamily Acalyphoideae, tribe Galearieae. Forman (1966) was the first to realise that *Panda* resembled *Microdesmis* and especially *Galearia* (up to then only the latter two were combined in the tribe *Galearieae* by Bentham 1880). It is one of the small groups that has been moved inside and outside the Euphorbiaceae s.l. (Radcliffe-Smith 1987). Engler & Gilg (1912) even introduced the order Pandales with as sole family the Pandaceae. Molecular research (Wurdack et al. 2004) divided the Euphorbiaceae s.l. into five families, with the Pandaceae separate. Morphological differences between the Euphorbiaceae in a narrower sense and the Pandaceae were already known, like the narrower rays in the wood, the lack of an obturator in the seeds and a columella in the fruits (Euphorbiaceae have wider rays, possess an obturator and a columella in the fruit). In a way the drupaceous fruits are also different, because the vast majority of the Euphorbiaceae has capsules, but genera and species with drupes exist, also within the subfamily Acalyphoideae (e.g., several species of *Mallotus*).

The monotypic, West African *Centroplacus* was formerly included in this family, but is nowadays regarded as a separate family, Centroplacaceae. It differs in the inflorescences being cymes, a disc in the pistillate flowers, and capsular fruits. Wurdack et al. (2004) show it to be sister to the Pandaceae, but with low bootstrap support.

The Pandaceae are generally difficult to identify and often confused with the Flacourtiaceae (this family is nowadays divided over the Salicaceae and Achariaceae). *Galearia* has the same kind of distichous, asymmetric leaves as many genera in the Flacourtiaceae (but the latter lack the terminal inflorescences and show many differences in flower structure). *Microdesmis* is generally confused with *Flacourtia* and *Casearia* and *Microdesmis magallanensis* was even placed in the Oleaceae under *Worcesterianthus*. The family lacks simple diagnostic characters and is generally identified via the generic level, because *Galearia* with its long terminal or cauliflorous racemes and *Microdesmis* with its petaloid flowers in fascicles are normally easily recognised.

References: Bentham, G., in G. Bentham & J.D. Hooker f., Gen. Pl. 3 (1880) 247, 287. — Engler, H.G.A. & E.F. Gilg, Syllabus (ed. 7) (1912) 223. — Forman, L.L., The reinstatement of *Galearia* Zoll. & Mor. and *Microdesmis* Hook.f. in the Pandaceae. Kew Bull. 20 (1966) 309–318. — Radcliffe-Smith, A., Segregate families from the Euphorbiaceae. Bot. J. Linn. Soc. 94 (1987) 47–66; Gen. Euphorbiacearum (2001) 125–129. — Webster, G.L., Synopsis of the genera and suprageneric taxa of Euphorbiaceae. Ann. Missouri Bot. Gard. 81 (1994) 67, 68. — Wurdack, K.J., P. Hoffmann, R. Samuel, A. de Bruijn, M. van der Bank & M.W. Chase, Molecular phylogenetic analysis of Phyllanthaceae (Phyllanthoideae pro parte Euphorbiaceae sensu lato) using plastid RBCL DNA sequences. Amer. J. Bot. 91 (2004) 1882–1900.

WOOD ANATOMY

(P. Baas)

Wood anatomically *Galearia* strongly resembles the African genus *Panda*, in having diffuse-porous wood with vessels solitary and in short to long multiples, mixed simple and scalariform perforation plates, small alternate intervessel pits, vessel-ray pits with reduced borders, and vessel walls without helical thickenings. The thick-walled fibres have few simple to minutely bordered pits. Parenchyma is predominantly diffuse-in-aggregates or narrow bands. In contrast, *Microdesmis* has almost exclusively solitary vessels, scalariform perforations only, transitional intervessel pits, bordered vessel-ray pits, and occasional helical vessel wall thickenings. Its parenchyma is predominantly scanty paratracheal and diffuse-in-aggregates, and fibre-pits are numerous and minutely to distinctly bordered. All Pandaceae share wide plus narrow, heterocellular rays, with variously differentiated sheath cells. Prismatic crystals are restricted to ray cells in *Galearia*, but occur in both ray and axial parenchyma cells in *Microdesmis*. The data in the literature on *Microdesmis* wood anatomy are largely based on its African and Malagasy species *M. puberula*. If this species is representative for the whole genus the differences between *Microdesmis* and the other Pandaceae are very significant indeed, and suggest remote phylogenetic links at best.

Literature: Bamber, R.K., Fibre types in the wood of Euphorbiaceae. *Austral. J. Bot.* 22 (1974) 629–634. — Forman, L.L., The reinstatement of *Galearia* Zoll. & Mor. and *Microdesmis* Hook.f. in the Pandaceae. *Kew Bull.* 20 (1966) 309–318 (see appendix by C.R. Metcalfe & N. Parameswaran). — Hayden, W.J. & S.M. Hayden, Wood anatomy of the Acalyphoideae (Euphorbiaceae). *IAWA J.* 21 (2000) 213–235. — Ilic, J., *CSIRO Atlas of hardwoods*. Springer-Verlag Berlin (1991). — *Insidewood database 2002 onwards* (<http://insidewood.lib.ncsu.edu>). — Metcalfe, C.R. & L. Chalk, *Anatomy of the Dicotyledons*, Oxford, Clarendon Press (1950). — Stern, W.L., Kleinodendron and xylem anatomy of Cluytiaceae (Euphorbiaceae). *Amer. J. Bot.* 54 (1967) 663–676. — Westra, L.Y.Th. & J. Koek-Noorman, *Wood Atlas of the Euphorbiaceae*. *IAWA J. Supplement* 4 (2004).

POLLEN MORPHOLOGY

(R.W.J.M. van der Ham)

The pollen of the Pandaceae was described in detail by Nowicke (1984) and Nowicke et al. (1998). The pollen grains are shed as monads. Those of *Galearia* and *Microdesmis* are small (P by E = 10–23 by 9–16 μm), those of *Panda* clearly larger (P by E = 20–28 by 22–29 μm). The aperture system is 3-colporate in all three genera. The exine is tectate and has a distinct columellate infratectum. Pollen of *Galearia* and *Microdesmis* has a uniformly perforate to microreticulate tectum, while in *Panda* pollen the tectum is reticulate, with larger lumina towards the poles. The pollen morphology supports a close relationship between *Galearia* and *Microdesmis* (see also Punt 1962), but not necessarily between these genera and *Panda* (Nowicke 1984).

References: Nowicke, J.W., A palynological study of the Pandaceae. *Pollen et Spores* 26 (1984) 31–42. — Nowicke, J.W., M. Takahashi & G.L. Webster, Pollen morphology, exine structure and systematics of Acalyphoideae (Euphorbiaceae). Part 1. Tribes Clutiae (Clutia), Pogonophoreae (Pogonophora), Chaetocarpeae (Chaetocarpus, Trigonopleura), Pereae (Pera), Cheiloseae (Cheilosa, Neoscortechinia), Erismanthae pro parte (Erismanthus, Moultonianthus), Dicoelieae (Dicoelia), Galearieae (Galearia,

Microdesmis, Panda) and Ampereae (Amperea, *Monotaxis*). *Rev. Palaeobot. Palynol.* 102 (1998) 115–152. — Punt, W., Pollen morphology of the Euphorbiaceae with special reference to taxonomy. *Wentia* 7 (1962) 1–116.

KEY TO THE GENERA

- 1a. Flowers in terminal or cauliflorous, pendulous inflorescences. Leaf blades without glands along the margin. Calyx lobes valvate. Fruits hairy (when young). **1. Galearia**
- b. Flowers in axillary fascicles to shortly peduncled after several flowering periods. Leaf blade margins with glandular teeth or crenations. Calyx lobes imbricate. Fruits glabrous **2. Microdesmis**

1. GALEARIA

Galearia Zoll. & Moritz in Moritz, *Syst. Verz.* (1846) 19, nom. cons., non C.Presl, 1830, nom. rej.; Miq., *Fl. Ned. Ind.* 1, 2 (1859) 429; *Fl. Ned. Ind.*, *Eerste Bijv.* (1860) 469; Kurz, *Forest Fl. Burma* 2 (1877) 407; Benth. in Benth. & Hook.f., *Gen. Pl.* 3 (1880) 287; Hook.f., *Fl. Brit. India* 5 (1887) 377; Pax in Engl. & Prantl, *Pflanzenfam.* 3, 5 (1890) 81; Pax & K.Hoffm. in Engl., *Pflanzenfam.* IV.147.iii (1911) 97; Ridl., *Fl. Malay Penins.* 3 (1924) 254; Gagnep. in Lecomte, *Fl. Indo-Chine* 5 (1926) 456; Pax & K.Hoffm. in Engl. & Harms, *Pflanzenfam.* ed. 2, 19c (1931) 171; Forman, *Kew Bull.* 14 (1960) 311; 20 (1966) 309; Backer & Bakh.f., *Fl. Java* 1 (1963) 495; 3 (1968) 649; Meijer, *Bot. Bull. Herb. Forest Dept. Sabah* 10 (1968) 234; Forman, *Kew Bull.* 26 (1971) 155; Airy Shaw, *Kew Bull.* 26 (1972) 362; Whitmore, *Tree Fl. Malaya* 2 (1973) 97; Airy Shaw, *Kew Bull.*, *Addit. Ser.* 4 (1975) 220; 8 (1980) 220; *Kew Bull.* 36 (1981) 365; 37 (1982) 36; G.L.Webster, *Ann. Missouri Bot. Gard.* 81 (1994) 68; Radcl.-Sm., *Gen. Euphorbiacearum* (2001) 127; Pooma in Welzen & Chayam., *Fl. Thailand* 8, 2 (2007) 306. — *Galearia* subg. *Galearia*: Forman, *Kew Bull.* 14 (1960) 316; 20 (1966) 318. — Lectotype (Forman 1960): *Galearia pedicellata* Zoll. & Moritz [= *Galearia filiformis* (Blume) Boerl. See note].

Cremostachys Tul., *Ann. Sci. Nat., Bot. sér.* 3, 15 (1851) 259. — Lectotype (G.L.Webster 1994): *Cremostachys filiformis* (Blume) Tul. [= *Galearia filiformis* (Blume) Boerl.].

Bennettia R.Br. in Benth. & R.Br., *Pl. Jav. Rar.* (1852) 249, non Gray (1821); Baill., *Étude Gén. Euphorb.* (1858) 311; Müll.Arg. in DC., *Prodr.* 15, 2 (1866) 1036. — Type: *Bennettia javanica* R.Br. [= *Galearia filiformis* (Blume) Boerl.].

Shrubs to small (or big in *G. maingayi*) trees, dioecious, bole sometimes fluted or with buttresses; buds in shoot axils. *Indumentum* of simple short and/or long hairs, often of different colours. *Stipules* triangular, often thick, hairy outside, glabrous inside (except *G. aristifera*), entire or with side-lobes in *G. aristifera*, caducous to late caducous. *Leaves* simple, alternate, distichous; petiole short, cylindrical, flat or channelled above, subglabrous to hairy, slightly pulvinate; blades asymmetric, one side broader, pergamentaceous to coriaceous, drying green to brown, often somewhat bullate; base asymmetric, margin entire (to sometimes slightly crenate in *G. celebica*), flat to recurved, without glands, apex bluntly acuminate to caudate, upper surface smooth, glabrous to hairy on midrib, lower surface smooth, generally more hairy, venation pinnate, slightly raised or sunken above, raised beneath, nerves looped and closed towards margin, veins and veinlets coarsely reticulate. *Inflorescences* terminal (to cauliflorous in *G. celebica*), single, rarely several together when subterminal to many when cauliflorous; pendulous,

spike-like thyrses, seldom paniculate (generally after damage), subglabrous to hairy, up to 1 m long, staminate flowers in groups, pistillate flowers single (or sometimes in threes in *G. fulva*); bracts triangular, completely hairy or inside glabrous; bracteoles similar to bracts but smaller. *Flowers* (4- or) 5-merous; calyx 5-lobed, cupular, lobes basally connate, valvate, triangular, horizontally spreading, hairy outside, glabrous inside except for (partly) midrib in *G. fulva*, midrib inside thickened; petals (4 or) 5, free, valvate, fleshy; two types: type 1 convex or cucullate with thickened midrib inside, glabrous or apex hairy, latter often hook-like, type 2 more or less straight, tomentellous on both sides, apex acute; disc absent. *Staminate flowers* pedicellate; pedicel hairy, cylindrical, basally with an abscission zone; petals late caducous; stamens (8 or) 10 (or 15) in a single or in two whorls, often of different lengths, short ones epipetalous, long ones episealous, filaments thick, free or connate to each other and adnate to pistillode, glabrous or hairy, straight or S-shaped, anthers 2-thecate, thecae parallel to separated and almost horizontal, latrorse with lengthwise split; pistillode columnar to obovoid, glabrous to hairy, sealing the bud together with petals in subgenus *Galearia* (in subgenus *Orthopetalum* only the petals close the bud). *Pistillate flowers* generally on a short, cylindrical, hairy pedicel, elongating in fruit, usually with an abscission zone beneath the flower; calyx persistent; petals early caducous, straight, slightly cucullate or cucullate, glabrous to hairy; ovary ovoid, 2–6-locular, hirsute; ovules single per locule, pendulous, anatropous; style absent, stigmas completely split once and in several species several times partly, in *G. maingayi* stigmas inside crater-like apex of fruit. *Fruits* laterally flattened to ovoid to subglobular drupes, often ridged or angular, 4- or 5-cornered, hairy, glabrescent, wall fleshy or bony, either thin and entire or thick with cavities, woody when dry; columella absent. *Seeds* flattened, triangular, ecarunculate.

Distribution — An Asian genus of five species, ranging from Burma, Thailand and Vietnam throughout Malesia (unknown from the Lesser Sunda Islands and the Moluccas) to the Solomon Islands.

Note — Webster (1994) proposed *Galearia sessilis* Zoll. & Moritz as lectotype, because *G. pedicellata* (synonym of *G. filiformis*, lectotype by Forman 1960) can be confused with *Bennettia pedicellata* R.Br., another synonym of *G. filiformis*. However, this is against the code and thus the lectotype remains *G. pedicellata* (see also McNeill et al. 2006, International Code of Botanical Nomenclature, Vienna Code).

KEY TO THE SUBGENERA AND SPECIES

- 1a. Petals ± straight and flat, completely hairy (Fig. 7). Fruits laterally flattened to 5-cornered to subglobular, wall 6–17 mm thick, with cavities (Fig. 3e–p). Petioles channelled above. Filaments and connectives hairy. Ovaries 2–6-locular 2 (subg. *Orthopetalum*)
- b. Petals convex or cucullate, glabrous except often for a few apical hairs (Fig. 1). Fruits laterally flattened, wall thin, c. 0.4 mm thick, entire (Fig. 3a–d). Petioles flat above to cylindrical. Filaments and connectives glabrous. Ovaries 2-locular 3 (subg. *Galearia*)
- 2a. Inflorescences cauliflorous or terminal. Stamens connate to each other and adnate to pistillode; connective without appendage. Fruits laterally flattened to triangular

- to square to \pm cylindrical in transverse section, broadest basally or apically, usually angular; wall 6–8 mm thick. Stigmas on top of ovary (visible in pistillate flowers and fruits). — Sulawesi to Solomon Islands **4. *G. celebica***
- b. Inflorescences terminal. Stamens free from each other and pistillode, connective with short, c. 0.3 mm high appendage. Fruits subglobular to ovoid to angular-subglobular; wall 8–18 mm thick. Stigmas in crater-like opening of ovary. — South East Asia to Sumatra, Borneo and the Philippines **5. *G. maingayi***
- 3a. Plants hirsute with c. 1 mm long hairs. Stipules 6–15 mm long, usually with lateral lobes, hairy on both sides, seldom glabrous. Bracts (1.8–)4.5–31 mm long (check especially the basal ones; Fig. 2b). Pistillode with long hairs. Fruits densely hirsute **1. *G. aristifera***
- b. Plants subglabrous to hirsute with up to 1 mm long hairs. Stipules 0.8–3 mm long, glabrous inside. Bracts 0.7–2.7 mm long (Fig. 2a). Pistillode glabrous to hairy with short to long hairs. Fruits somewhat hairy 4
- 4a. Petals strongly cucullate, as deep as high, apex glabrous. Pistillode glabrous. Fruiting pedicel up to 2.5–4 mm long. Ovary with petaloid imprints. — Sumatra, Java **2. *G. filiformis***
- b. Petals cucullate, higher than deep, apex with few hairs. Pistillode hairy. Fruiting pedicel up to 12 mm long. Ovary without petaloid imprints. — South East Asia main land, Sumatra, Borneo, Philippines **3. *G. fulva***

Subgenus *Galearia*

Galearia Zoll. & Moritz subg. *Galearia*: Forman, Kew Bull. 14 (1960) 316; 20 (1966) 318; 26 (1971) 157. — *Galearia* Zoll. & Moritz sect. *Eugalearia* Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 98, nom. inval. — Type as genus.

Galearia sect. *Longibracteatae* Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 102. — Lectotype (selected here): *Galearia aristifera* Miq.

Leaves: petioles flat above to cylindrical. *Flowers*: convex or cucullate, glabrous except often for a few apical hairs. *Staminate flowers*: filaments and connectives glabrous. *Pistillate flowers*: ovaries 2-locular. *Fruits* laterally flattened, wall thin, c. 0.4 mm thick, entire.

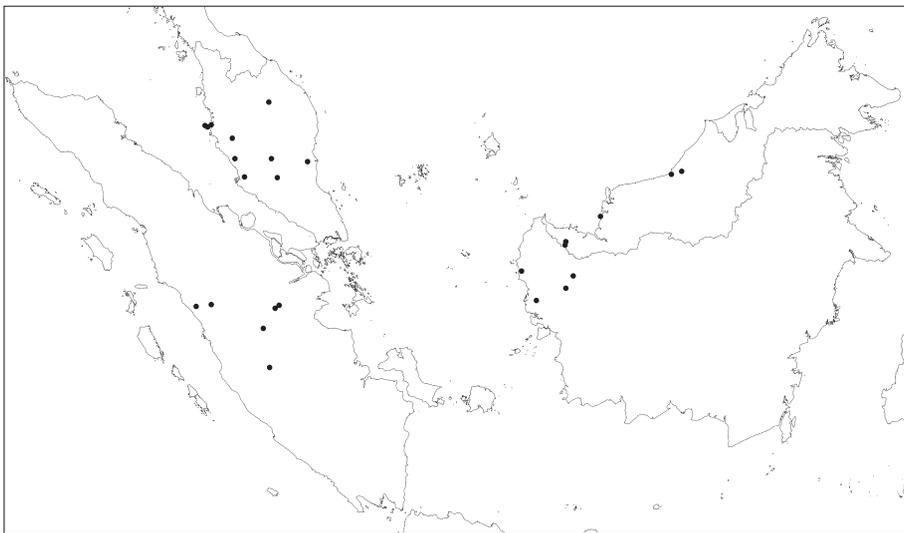
Three species in continental Southeast Asia and West Malesia.

1. *Galearia aristifera* Miq.

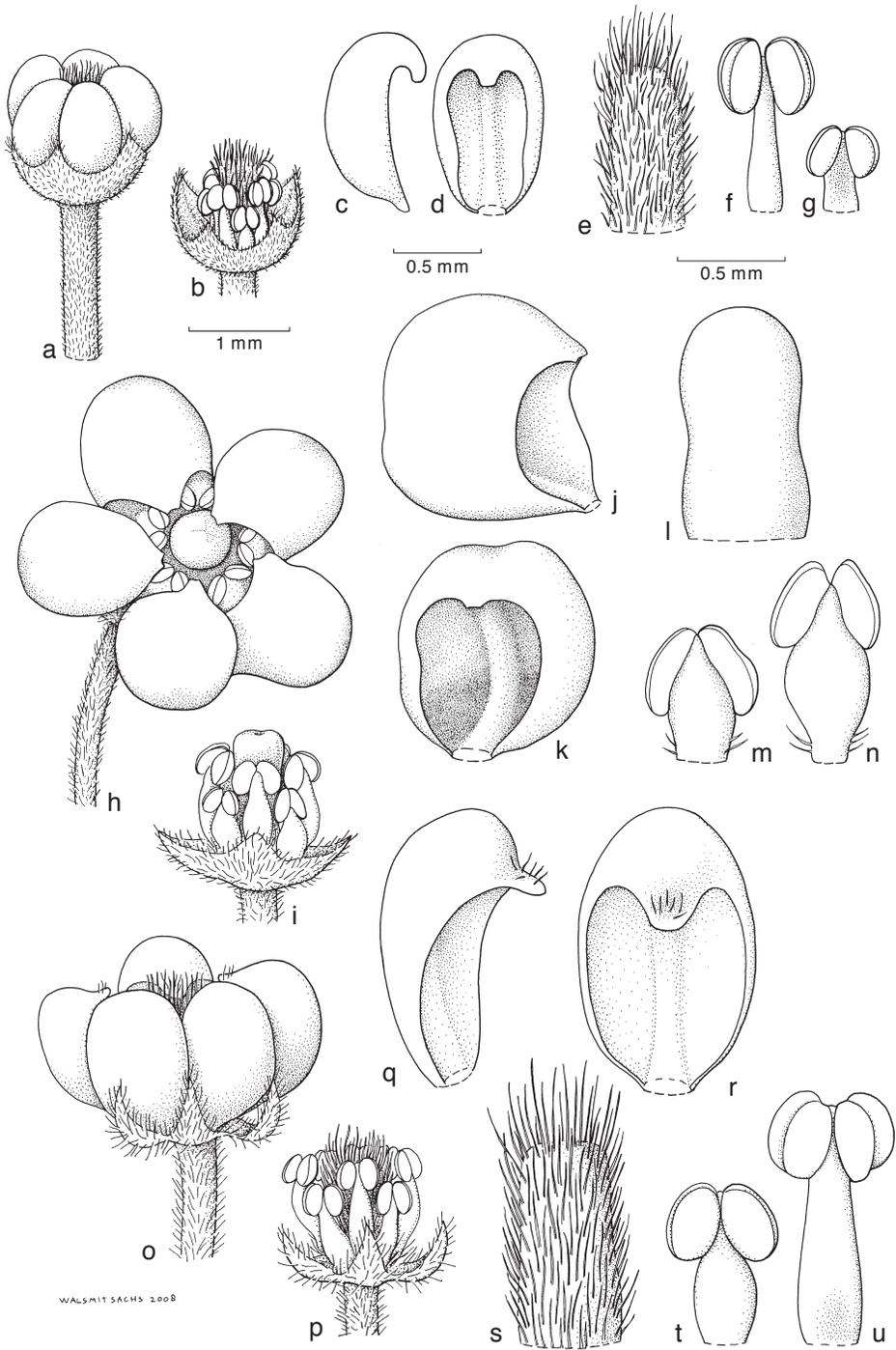
Galearia aristifera Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 471; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 102, f. 32; Merr., J. Straits Branch Roy. Asiat. Soc., Spec. No. (1921) 344; Pax & K.Hoffm., Mitt. Inst. Allg. Bot. Hamburg 7 (1931) 230; Forman, Kew Bull. 26 (1971) 159; Whitmore, Tree Fl. Malaya 2 (1973) 98; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 220; Kew Bull. 36 (1981) 366. — *Bennettia aristifera* (Miq.) Müll.Arg. in DC., Prodr. 15, 2 (1866) 1039. — Type: *Teijsmann HB 749* (holo U), West Sumatra, near Lubu(k)alang. *Galearia leptostachya* Pax in Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 102; Merr., J. Straits Branch Roy. Asiat. Soc., Spec. No. (1921) 345 ('*leptostachys*'). — Type: *Haviland & Hose 979* (iso K, L), Sarawak, near Kuching, Garai.

Shrubs to small trees, up to 5(–12) m, dbh up to 30 cm; flowering branches 2–3.5 mm thick, densely hairy (to almost glabrous), glabrescent. *Indumentum* hirsute, simple hairs, up to 1 mm long, usually short (yellow) and long hairs (yellow or dark brown) present. *Outer bark* smooth, chocolate brown and grey mottled. *Stipules* triangular, 6–15 by 0.5–1 mm, hairy, about halfway; with usually triangular lateral lobes. *Leaves*: petiole 4–7 mm long, cylindrical, hairy; blades elliptic (to somewhat obovate), 6.7–26.5 by 4.1–11.1 cm, length/width ratio 1.8–3.6, leathery, often somewhat bullate, drying light green to somewhat brownish light green, base emarginate to rounded, margin entire, flat, apex acuminate to cuspidate (to caudate), sometimes mucronulate, upper surface generally hairy on midrib and nerves, lower surface hairy all over with short and long hairs, venation slightly sunken above, nerves 9–11 per side. *Inflorescences* terminal, up to 100 cm long, pale green to greenish brown, hairy, seldom subglabrous, pistillate flowers single; bracts (1.8–)4.5–31 by 0.4–1 mm, hairy, seldom glabrous. *Flowers* 5-merous; calyx with 5 lobes, up to 0.7 mm deep, lobes triangular, 0.4–0.6 by 0.3–0.5 mm, inside glabrous; petals 5, cucullate, apex rounded, bent inwards, midrib very thick. *Staminate flowers* 3.5–5.3 mm diam., (pale) green; pedicel 3.5–5.3 mm long; petals elliptic, c. 1.3 by 1 mm, basally with few hairs; stamens 10 in two whorls, one shorter, other longer, filaments glabrous, c. 0.3 or c. 0.6 mm long, anthers 0.25–0.4 by c. 0.25 mm, thecae parallel, basifixed; pistillode 0.7–0.8 mm high, long hairy, especially on the top. *Pistillate flowers* c. 1.4 mm diam.; pedicel c. 0.5 mm high, elongating in fruit up to 2.5 mm; petals 5, elliptic, caducous, 2–3.5 by 0.7–1 mm; ovary subglobular, c. 1.3 by 1.3 mm, 2-locular, hirsute; ovules single per locule, pendulous, anatropous; style c. 0.5 mm high, stigmas 0.6–1.4 mm long, deeply bifid, with long papillae above. *Fruits* flattened ovoid drupes, c. 11 by 8.5 by 6 mm, densely hirsute, wall thin, woody. *Seeds* not seen. — **Fig. 1a–g, 2b; Map 1.**

Distribution — *Malesia*: Peninsular Malaysia, Sumatra, Borneo.



Map 1. Distribution of *Galearia aristifera* Miq.



Habitat & Ecology — (Edge of) primary forest, secondary forest, kerangas forest to common along logging roads in open places in deep clay to dry sandy soil, on level to steep terrain. Altitude: 20–770 m. Flowering: February to December; fruiting: June to September.

Vernacular names — Sumatra: Ekor ekor, Kajoe ekor badak, Kajoe ihoer badak, Kajoe ihoer here, Madang tjoemara djatie. Kalimantan: Perikas (Dayak), Tankai ajok.

Note — Very typical for this species are the long bracts in the inflorescences (4 mm and longer). However, on the Malay Peninsula these can be much shorter, c. 2 mm long, and then the species resembles *G. fulva*. Differences can still be found in the heavier indumentum of *G. aristifera* (generally far less dense in *G. fulva* but hairy exceptions occur), the pistillode (long hairs in *G. aristifera* and generally – not always – short ones in *G. fulva*) and the stipules ((1.8–)4.5–31 mm long and about halfway usually with triangular lateral lobes in *G. aristifera*, 1–3 mm long and without lateral lobes in *G. fulva*).

2. *Galearia filiformis* (Blume) Boerl.

Galearia filiformis (Blume) Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282 (see note); J.J.Sm., Meded. Dept. Landb. Ned.-Indië 10 (1910) 550 (= Koord. & Valetton, Bijdr. Boomsoort. Java 12); Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 98, f. 34; Backer & Bakh.f., Fl. Java 1 (1963) 495; Forman, Kew Bull. 26 (1971) 160, f. 1d, 2c; Airy Shaw, Kew Bull. 36 (1981) 366. — *Antidesma filiformis* Blume, Bijdr. 17 (1827) 1124. — *Cremostachys filiformis* (Blume) Tul., Ann. Sci. Nat., Bot. sér. 3, 15 (1851) 260. — *Bennettia filiformis* (Blume) Müll.Arg., Linnaea 34 (1865) 204; in DC., Prodr. 15, 2 (1866) 1038. — Lectotype (L sheets selected here, K sheet by Forman 1971): *Blume s.n.* (holo L, barcode L0157229; iso K, barcode K000253975, L, barcode L015720), Java, Mt Salak. See note 2.

Galearia pedicellata Zoll. & Moritzi in Moritzi, Syst. Verz. (1846) 19. — Type: *Zollinger 1410* (n.v., perhaps holo P, separate inflorescence removed = *Ostodes paniculata* Blume), Java, between Sudimanik and Tjiburial.

Galearia sessilis Zoll. & Moritzi in Moritzi, Syst. Verz. (1846) 19; Miq., Fl. Ind. Bat. 1, 2 (1859) 429. — Type: *Zollinger 567* (n.v., perhaps holo P), Java, Tjidurian R.

Bennettia javanica R.Br., Pl. Jav. Rar. (1852) 249, t. 50. — Type: *Horsfield s.n.* (holo BM), Java.

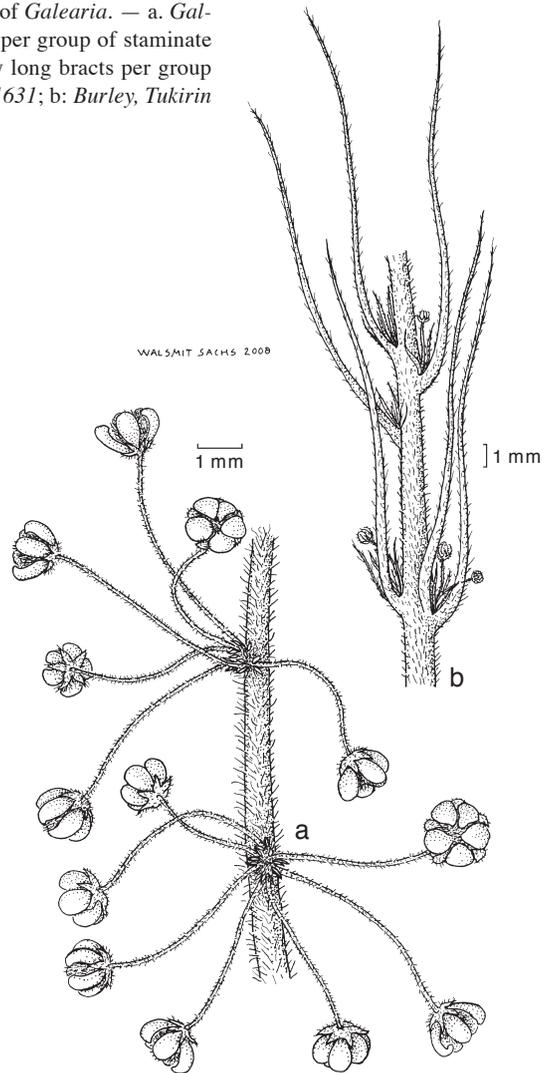
[*Ryparia* (*Ryparosa*) *dubia* Blume ex Baill., Étude Gén. Euphorb. (1858) 339, nom. nud. — Representative specimen: *Blume s.n.* (L, barcodes L0157215, L0157215).]

Shrubs to small trees, up to 10 m high, bole up to 3 m high, dbh up to 15 cm; flowering branches 1–3 mm thick, sericeous, glabrescent. *Indumentum* short (< 0.5 mm long) simple hairs, mainly sericeous, dark brown and yellow or yellow only. *Outer bark* smooth to fissured, very hard. *Stipules* triangular, 0.8–2 by 0.3–0.6 mm, outside hairy,

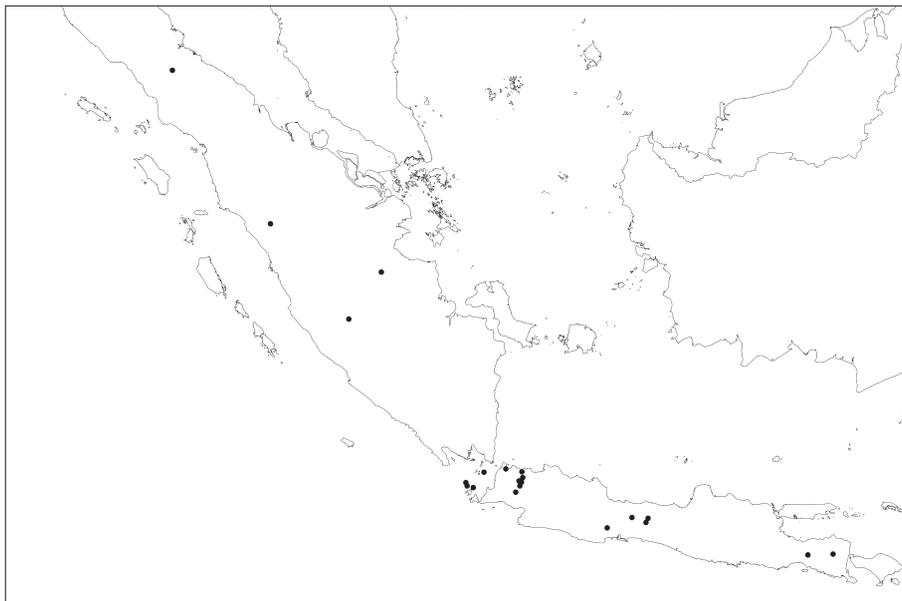
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Fig. 1. Staminate flowers of *Galearia* subg. *Galearia*. a–g: *Galearia aristifera* Miq. a. Flower; b. stamens and pistillode (petals removed); c. petal in lateral view (higher than deep); d. petal in ventral view; e. hairy pistillode; f. short stamen; g. long stamen. — h–n: *Galearia filiformis* (Blume) Boerl. h. Flower; i. stamens and pistillode (petals removed); j. petal in lateral view (deeper than high); k. petal in ventral view; l. glabrous pistillode; m. short stamen; n. long stamen. — o–u: *Galearia fulva* (Tul.) Miq. o. Flower; p. stamens and pistillode (petals removed); q. petal in lateral view (higher than deep, hairs apically); r. petal in ventral view; s. hairy pistillode; t. short stamen; u. long stamen (a–g: TFB (*Laumonier, Franken & Roos*) 1437; h–n: *Korthals s.n.*, s.d., L0157156; o–u: SAN (*M. Chai*) 21631; all L).

Fig. 2. Bracts in staminate inflorescences of *Galearia*. — a. *Galearia fulva* (Tul.) Miq.: very short bracts per group of staminate flowers; b. *Galearia aristifera* Miq.: very long bracts per group of staminate flowers (a: SAN (M. Chai) 21631; b: Burley, Tukirin et al. 1463; all L).



inside glabrous, usually late caducous. *Leaves*: petiole 2–3.5 mm long, flattened above, hairy; blades ovate to elliptic, 3–25 by 1.7–8 cm, length/width ratio 2.2–3.9, papery to coriaceous, brownish green when young, generally drying light green, base shortly attenuate to cuneate, margin entire, flat, apex long acuminate, often mucronulate, upper surface glabrous except for some hairs on basal part of midrib (and nerves), lower surface somewhat hairy, mainly on venation, venation generally slightly raised above but midrib flat, raised beneath, nerves 5–7 per side. *Inflorescences* terminal (or subterminal when several, probably due to sympodial length growth), up to 52 cm long, green, hairy, pistillate flowers single; bracts 0.8–1.5 by 0.25–0.5 mm, glabrous inside. *Buds* green. *Flowers* 5-merous, green to white; calyx with 5 lobes, 0.8–1.3 mm deep, lobes triangular, 0.4–0.6 by 0.4–0.7 mm, glabrous inside; petals 5, elliptic, cucullate, as deep



Map 2. Distribution of *Galearia filiformis* (Blume) Boerl.

as high, 1–1.2 by 0.8–1.3 mm, 1–1.5 mm deep, glabrous, midrib strongly thickened inside, often furrowed outside. *Staminate flowers* 3.6–4 mm diam.; pedicel 6.3–9 mm long; stamens 10 in two whorls, of different length, filaments glabrous, c. 0.5 or 0.5–0.7 mm long, often band-like in lateral view, often S-shaped; anthers 0.4–0.5 by 0.4–0.5 mm, thecae separated, \pm parallel, horizontal because of S-shape filaments, cream to light yellow; pistillode 0.7–0.8 by 0.5–1 mm diam., glabrous. *Pistillate flowers* 2.5–3 mm diam.; pedicel c. 0.4 mm long, elongating in fruit up to 2.5(–4) mm; ovary c. 1.2 by 1.3 mm, very shallowly 5-lobed with central furrow due to imprints of petals, 2-locular, stigmas c. 0.5 mm long, completely split several times. *Fruits* laterally flattened ovoid drupes, often with 2 ridges along edges, 9–9.5 by 6.2–7.2 by 5.5–7.1 mm, somewhat hairy, wall thin, woody, c. 0.4 mm thick, very light green to pale whitish green when immature. *Seeds* seen immature, c. 8.5 by 5.5 by 1 mm. — **Fig. 1h–n; Map 2.**

Distribution — *Malesia*: Sumatra, Java.

Habitat & Ecology — Primary rainforest rich in palms, secondary forest (with much bamboo), riparian forest, secondary montane forest, along sea coast, on rocks, coral, loam, ferrosol. Altitude: sea level up to 600(–1500) m. Flowering: March to May, July to September, November; fruiting: May, August, November.

Vernacular names — Java: Balung kaja (Blume 1827); Ki keretjek (Sundanese, Djasilin dialect).

Notes — 1. This species is easy to separate from *G. fulva* when flowering and the petals are still present (usually early caducous in pistillate flowers): *G. filiformis* has glabrous petals as deep as high and a glabrous pistillode, while *G. fulva* has petals with apical hairs, higher than deep and a hairy pistillode. When fruits or pistillate flowers lacking petals are present then the calyx in *G. filiformis* is glabrous inside, hairy in

G. fulva. Other, overlapping differences are the generally light green colour of dried leaves of *G. filiformis* vs light green to brownish in *G. fulva* and the pedicels of the fruits, up to 4 mm in *G. filiformis* and up to 12 mm in *G. fulva*. Geographically the species only overlap on Sumatra.

2. The combination *G. filiformis* was first published by Pax (1890) but with as authors (Blume) Benth. References to the basionym and the other combinations are missing, thus this new combination was not published validly. The first to make a valid new combination is Boerlage (1900).

3. *Galearia fulva* (Tul.) Miq.

Galearia fulva (Tul.) Miq., Fl. Ind. Bat. 1, 2 (1850) 430; Hook.f., Fl. Brit. India 5 (1887) 378; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 101; Ridl., Fl. Malay Penins. 3 (1924) 257; Forman, Kew Bull. 26 (1971) 160, f. 1c, 2d; Airy Shaw, Kew Bull. 26 (1972) 362; Whitmore, Tree Fl. Malaya 2 (1973) 98; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 221; Kew Bull. 36 (1981) 366; Pooma in Welzen & Chayam., Fl. Thailand 8, 2 (2007) 306, f. 1, pl. XVII: 1.1–1.3. — *Cremostachys fulva* Tul., Ann. Sci. Nat., Bot. sér. 3, 15 (1851) 261. — *Bennettia fulva* (Tul.) Müll.Arg., Linnaea 34 (1865) 205; in DC., Prodr. 15, 2 (1866) 1037. — Type: *Wallich 8585C* parte ex Herb. Lindley (holo CGE; iso L), Penang.

Cremostachys lindlaeana Tul., Ann. Sci. Nat., Bot. sér. 3, 15 (1851) 262. — *Bennettia pedicellata* R.Br., Pl. Jav. Rar. (1852) 251, nom. inval., based on same type; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1039. — *Galearia pedicellata* (R.Br.) Miq., Fl. Ind. Bat. 1, 2 (1859) 430, non Zoll. & Moritzi (1846); Hook.f., Fl. Brit. India 5 (1887) 378; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 101; Ridl., Fl. Malay Penins. 3 (1924) 257; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 457, nom. inval. — *Bennettia lindlaeana* (Tul.) Müll.Arg., Linnaea 34 (1865) 205; in DC., Prodr. 15, 2 (1866) 1037 ('*lindleyana*'). — *Galearia lindlaeana* (Tul.) Hook.f., Fl. Brit. India 5 (1887) 379 ('*lindleyana*'); Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 98; Ridl., Fl. Malay Penins. 3 (1924) 255. — *Galearia caudata* Forman, Kew Bull. 14 (1960) 316, nom. inval. — Type: *Herb. Wallich 8484C* parte ex Herb. Lindley (holo CGE; iso K), Penang.

Bennettia affinis R.Br., Pl. Jav. Rar. (1852) 251; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1037. — *Galearia affinis* (R.Br.) Miq., Fl. Ind. Bat. 1, 2 (1859) 430; Hook.f., Fl. Brit. India 5 (1887) 379; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 99; Ridl., Fl. Malay Penins. 3 (1924) 255; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 458. — Type: *Finlayson* in *Herb. Wallich 8585B pro parte*, *Herb. Finlayson* (holo BM), Penang.

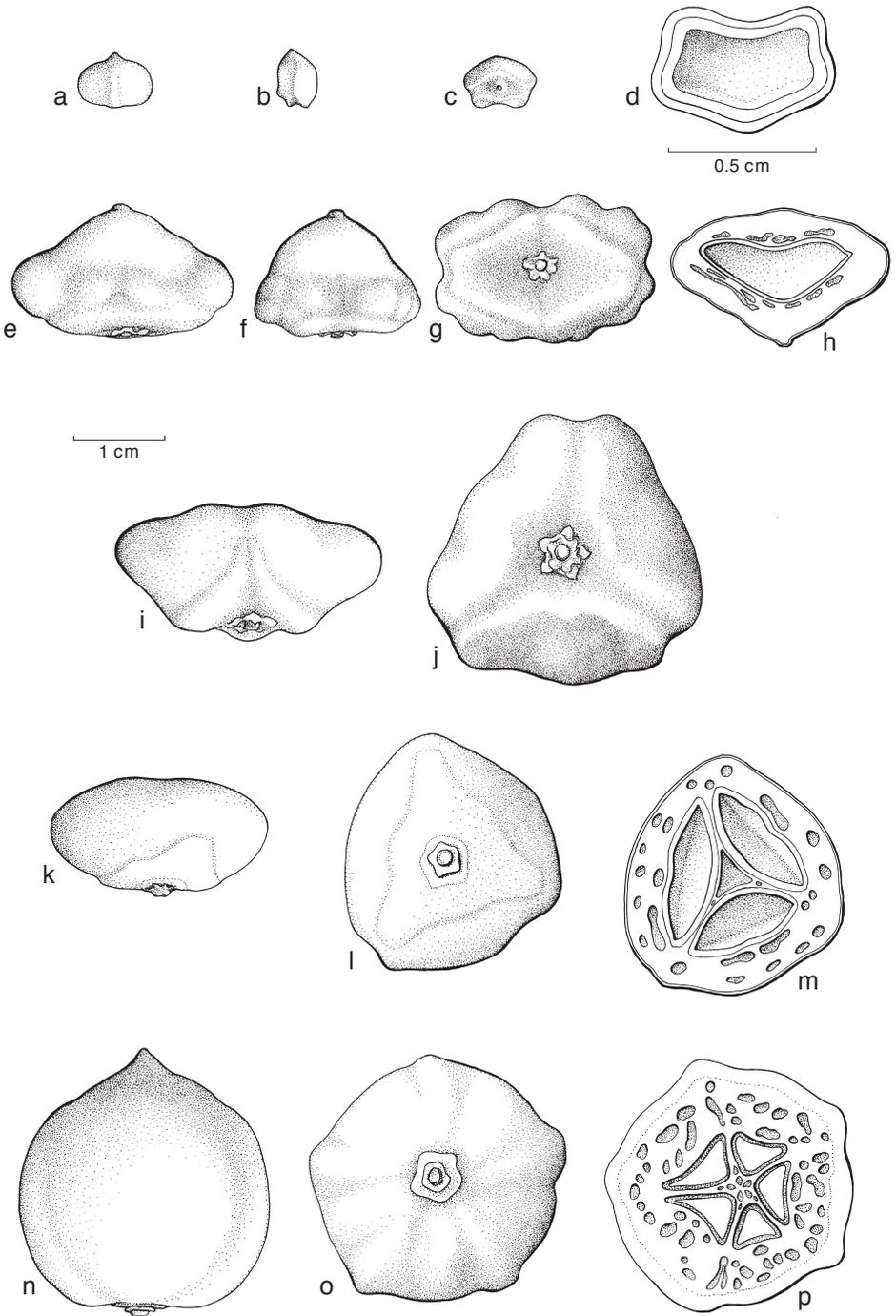
Bennettia finlaysonii R.Br., Pl. Jav. Rar. (1852) 251; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1039; Hook.f., Fl. Brit. India 5 (1887) 380. — *Galearia finlaysonii* (R.Br.) Miq., Fl. Ind. Bat. 1, 2 (1859) 429; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 100; Ridl., Fl. Malay Penins. 3 (1924) 257. — Type: *Finlayson* in *Herb. Wallich 8585* (no. 28) (holo BM; iso BM), Penang.

Bennettia jackiana R.Br., Pl. Jav. Rar. (1852) 251; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1039; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282. — *Galearia jackiana* (R.Br.) Miq., Fl. Ind. Bat. 1, 2 (1859) 430; Hook.f., Fl. Brit. India 5 (1887) 378; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 101. — Type: *Jack* in *Herb. Wallich 8585A* (holo BM), Penang.

Bennettia phlebocarpa R.Br., Pl. Jav. Rar. (1852) 251; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1038. — *Galearia phlebocarpa* (R.Br.) Miq., Fl. Ind. Bat. 1, 2 (1859) 429; Hook.f., Fl. Brit. India 5 (1887) 380; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 100; Ridl., Fl. Malay Penins. 3 (1924) 255; Merr., J. Straits Branch Roy. Asiatic Soc., Spec. No. (1921) 345; Pax & K.Hoffm., Mitt. Inst. Allg. Bot. Hamburg 7 (1931) 229; Meijer, Bot. Bull. Herb. Forest Dept. Sabah 7 (1967) 45. — Type: *Herb. Wallich 8585D* (holo BM; iso K, 2 sheets), Singapore.

- Bennettia wallichii* R.Br., Pl. Jav. Rar. (1852) 251; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1038. — *Galearia wallichii* (R.Br.) Kurz, Prelim. Rep. Forest Pegu, App. A (1875) cxiii; Forest Fl. Burma 2 (1877) 407; Hook.f., Fl. Brit. India 5 (1887) 379; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 100; Ridl., Fl. Malay Penins. 3 (1924) 256. — Type: *Herb. Wallich 8585E* (holo BM; iso K), Burma, Tavoy.
- Galearia elliptica* Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 469. — Syntypes: *Teijsmann HB 551* (K as s.n., U), Sumatra, Poeloe Pisang prope Padang; *Teijsmann HB 3825* (U, 2 sheets), Sumatra, Palembang, Muara-enim.
- Galearia splendens* Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 469; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 101. — *Bennettia splendens* (Miq.) Müll. Arg., Linnaea 34 (1865) 205; in DC., Prodr. 15, 2 (1866) 1038. — Type: *Teijsmann HB 550* (holo U; iso K, s.n.), Sumatra, Poeloe Pisang, prope Padang.
- Galearia sumatrana* Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 469. — Type: *Teijsmann HB 4307* (holo U; iso K, s.n.), Sumatra, prov. Lampong, near Kebang.
- Galearia angustifolia* Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 470. — Type: *Teijsmann HB 3925* (holo U; iso K as s.n.), Sumatra, Palembang, near Muara-enim.
- Bennettia subulata* Müll.Arg. in DC., Prodr. 15, 2 (1866) 1039. — *Galearia subulata* (Müll.Arg.) Hook.f., Fl. Brit. India 5 (1887) 379; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 102; Ridl., Fl. Malay Penins. 3 (1924) 258. — Type: ‘*Ex Herb. Lindley in Herb. Sonder*’ (probably *Herb. Wallich 8585C* p.p., the type of *Cremostachys fulva*) (holo MEL), Penang (Prince of Wales Island).
- Galearia helferi* Hook.f., Fl. Brit. India 5 (1887) 378; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 101. — Syntypes: *Helfer KD 4968* (K, NY), Burma, Tenasserim; *Kurz s.n.* (n.v.), Tenasserim.
- Galearia philippinensis* Merr., Philipp. J. Sci., Bot. 9 (1914) 482; Enum. Philipp. Fl. Pl. 2 (1923) 450. — Type: *BS (Reillo) 16319* (holo PNH†; iso K, L), Philippines, Basilan.
- Galearia minor* Gage, Rec. Bot. Surv. India 9 (1922) 234; Ridl., Fl. Malay Penins. 3 (1924) 256. — Lectotype (selected here): *Ridley s.n.* (holo SING), Pahang, Pulau Jellum. See note 1.
- Galearia ridleyi* Gage, Rec. Bot. Surv. India 9 (1922) 235; Ridl., Fl. Malay Penins. 3 (1924) 256. — Syntypes: *Lake & Kelsall s.n.* (SING, barcode 0097602), Johore, Gunung Janeng; *Lake & Kelsall s.n.* (SING, barcode 0097601), Johore, Simpai; *Ridley s.n.* (SING, barcode 0097603), Malay, Selangor, Dusun Tua.
- Galearia sessiliflora* Merr., J. Straits Branch Roy. Asiat. Soc. 86 (1922) 320; Pl. Elmer. Born. (1929) 161. — Type: *M. Ramos 1312* (iso US), Sabah, Batu Lima near Sandakan.
- Galearia stenophylla* Merr., J. Straits Branch Roy. Asiat. Soc. 86 (1922) 320; Meijer, Bot. Bull. Herb. Forest Dept. Sabah 7 (1967) 45; Forman, Kew Bull. 26 (1971) 159; Whitmore, Tree Fl. Malaya 2 (1973) 98; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 221. — Type: *Ramos 1542* (holo PNH†; iso K, L), Sabah, Batu Lima near Sandakan.
- Galearia dongnaiensis* Pierre ex Gagnep., Bull. Soc. Bot. France 71 (1925) 1025; in Lecomte, Fl. Indo-Chine 5 (1926) 457, f. 56: 1–6. — Type: *Pierre 1969* (holo P; iso K, P, 2 sheets), Vietnam, Prov. Bien-hoa, Mt Pong-lu.
- Galearia dolichobotrys* Merr., Philipp. J. Sci. 29 (1926) 384; Meijer, Bot. Bull. Herb. Forest Dept. Sabah 7 (1967) 45. — Type: *Castro & Melegrito 1377* (holo PNH†; iso A, K), Sabah, Banguay (Banggi) Island.
- Galearia lancifolia* Ridl., Bull. Misc. Inform. Kew (1926) 476. — Type: *Hume 9931* (holo K), Malaya, Selangor, Ulu Gombok.
- Galearia filiformis* auct. non (Blume) Boerl.: Merr., Philipp. J. Sci., Bot. 4 (1909) 280.

Shrubs to small trees, up to 20 m, bole up to 11 m high, dbh up to 25 cm; flowering branches 1–2 mm thick, glabrous to sericeous or hirsute, glabrescent. *Indumentum* short (< 0.5 mm long) to long (up to 1 mm long) simple hairs, sparsely to densely hirsute or sericeous, dark brown and yellow or yellow only. *Outer bark* smooth to slightly roughened (to slightly fissured to scaly), green to light brown to reddish brown to white to



light to dark grey, often patches of different colours; inner bark pale greenish to whitish to pale yellow to pink to red to brown, soft, granular, c. 3 mm thick; sapwood white to yellowish to pale orange to red, hard. *Stipules* triangular, 1–3 by 0.3–0.5 mm, hairy. *Leaves*: petiole 1.3–8 mm long, flattened above, glabrous to hairy; blades ovate to elliptic to obovate, 4.1–32 by 1.2–13.8 cm, length/width ratio 1.9–14.7, papery, flat to bullate, drying light green to somewhat brownish light green, base emarginate to attenuate, margin entire, flat to recurved, apex long acute to cuspidate, often mucronulate, upper surface glabrous to hairy on midrib and nerves, dark green, lower surface glabrous to hairy all over, pale glaucous to lighter green, venation slightly sunken to slightly raised above, nerves 7–11 (–22) per side. *Inflorescences* terminal, up to 110 cm long racemes (seldom paniculate), subglabrous to hairy, dark green to light brown, pistillate flowers single or three per node; bracts 0.7–2.7 by 0.25–0.5 mm, glabrous inside. *Flowers* (4- or) 5-merous, green (to white); buds yellow-green; calyx with (4 or) 5 lobes, 0.8–1.3 mm deep, lobes triangular to ovate, 0.5–1 by 0.4–0.6 mm, midrib inside generally (partly) hairy; petals (4 or) 5. *Staminate flowers* 2–3.2 mm diam.; pedicel 2.5–10 mm long; petals elliptic, cucullate with apex at right angles with rest, 1–1.8 by 0.7–1 mm, higher than deep, apex with hairs on abaxial surface; stamens (8 or) 10 in two whorls, of different length, filaments glabrous, 0.3–0.5 or 0.5–0.75 mm long, anthers c. 0.5 by 0.3 mm, thecae parallel; pistillode 0.5–0.7 by 0.3–0.5 mm diam., hairy with short to long hairs. *Pistillate flowers* 1.6–4 mm diam.; pedicel 0–3.5 mm long, elongating in fruit up to 12 mm; petals 5, elliptic, usually hairs on the apex, 2 types, one slightly cucullate, the other type cucullate with a long, inward bent hook-like apex and a stipe-like base (up to c. 0.7 mm long), 1.7–2 by c. 1 mm; ovary 0.8–1.2 by 0.8–1.2 mm, 2-locular, without petaloid imprints; stigmas 0.5–0.7 mm long, deeply bifid, lobes also split, with long papillae above. *Fruits* laterally flattened ovoid drupes with ridges along edges, 10.5–12 by 7.8–8.5 by 6–6.3 mm, somewhat hairy, glabrescent, yellowish to pale green to white, wall thin, woody, c. 0.4 mm thick. *Seeds* seen immature. — **Fig. 1o–u, 2a, 3a–d, 4–6; Map 3.**

Distribution — Burma, Thailand, Vietnam; in *Malesia*: Malay Peninsula, Sumatra, Borneo, Philippines.

Habitat & Ecology — Primary rainforest, evergreen forest, kerangas forest, fresh water swamp forest, secondary forest, logged forest, open areas, ladangs; along streams, trails, roads, and on ridges on different kinds of soil (alluvial, clay, limestone, loam, sand, sandy clay, shale, ultrabasic (serpentinite); bedrock basalt, granitic, granodiorite, sandstone). Altitude: 8–1300 m. Flowering and fruiting whole year. Animals eat the fruits.

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Fig. 3. Fruit types in *Galearia* (Pandaceae; Euphorbiaceae s.l.). — a–d: Subgenus *Galearia*: *Galearia fulva* (Tul.) Miq. a. Lateral view; b. front view; c. basal view; d. transverse section with thin wall without cavities. — e–p: Subgenus *Orthopetalum* Forman: e–m: *Galearia celebica* Koord. e. Lateral view, widest beneath; f. front view; g. basal view; h. transverse section showing thick walls with cavities, 2-locular, one abortive; i. lateral view, widest above; j. basal view; k. lateral view, widest in middle; l. basal view; m. transverse section showing thick wall with cavities and 3 locules. — n–p: *Galearia maingayi* Hook.f. n. Lateral view; o. basal view; p. transverse section showing thick walls with cavities and 5 locules (a–d: *SAN (Lantoh) 72882*; e–h: *De Vogel 2547*; i, j: *P. van Royen & Sleumer 7095*; k–m: *M.S. Clemens 303*; n–p: *KEP FRI (Whitmore) 4462*; all L).

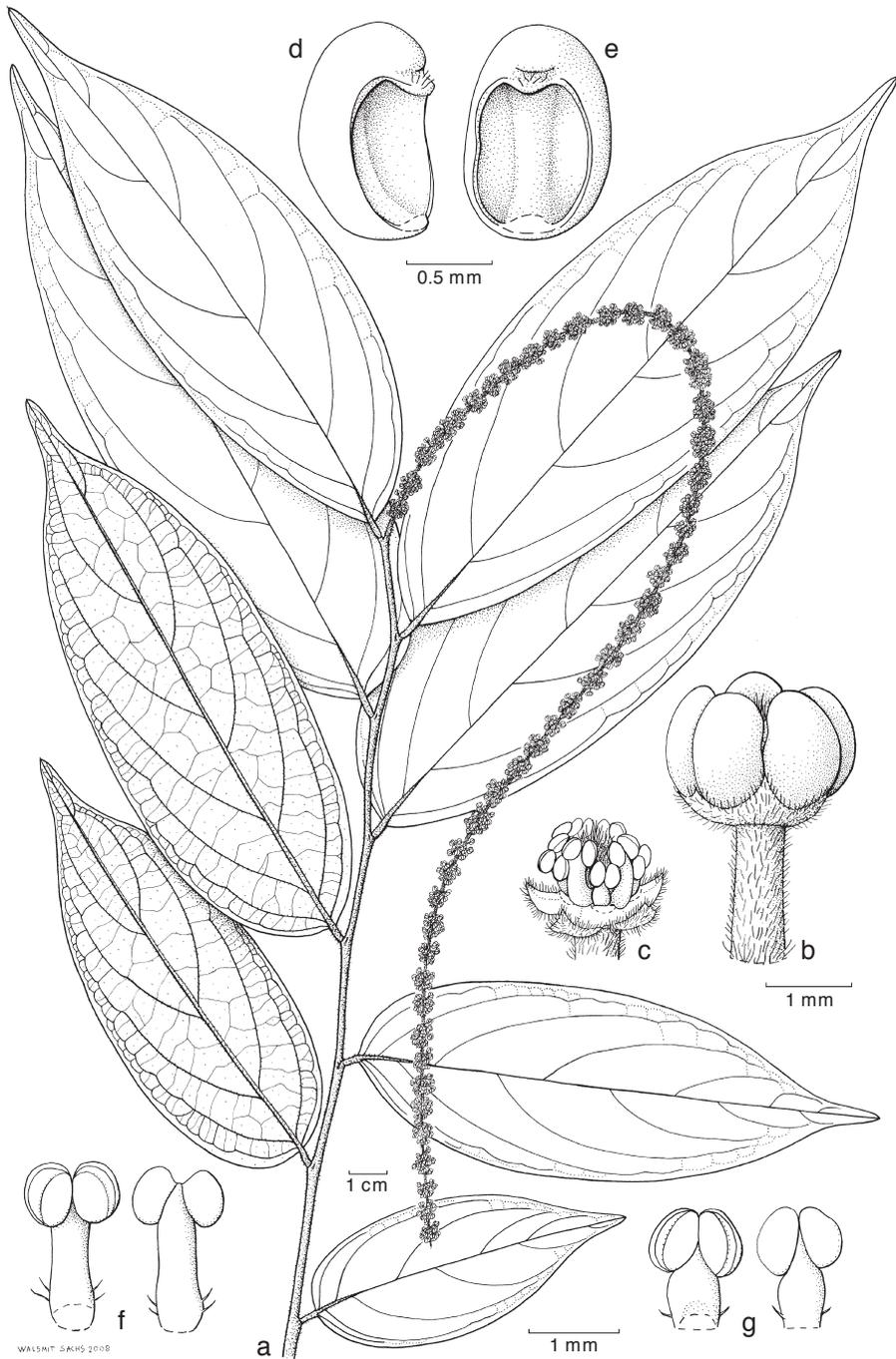


Fig. 4. *Galearia fulva* (Tul.) Miq. a. Habit; b. staminate flower; c. stamens and pistillode (petals removed); d. petal in lateral view; e. idem in ventral view; f. long stamens from ventral and dorsal side; g. idem, short stamens (all: *Ambriansyah & Z. Arifin W 910, L*).

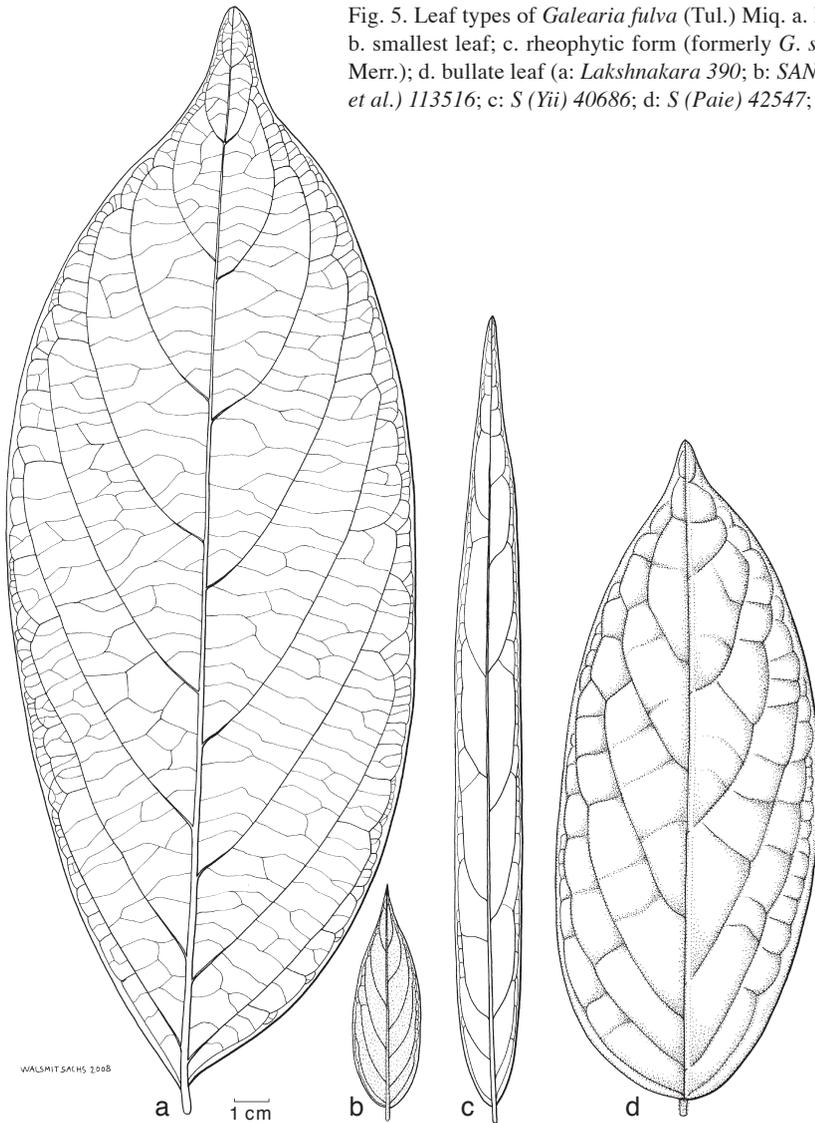


Fig. 5. Leaf types of *Galearia fulva* (Tul.) Miq. a. Large leaf; b. smallest leaf; c. rheophytic form (formerly *G. stenophylla* Merr.); d. bullate leaf (a: *Lakshmakara* 390; b: *SAN*(Joseph B. et al.) 113516; c: *S* (Yii) 40686; d: *S* (Paie) 42547; all L).

Vernacular names — Thailand: Ai-bao. Malaysia: Kelandes (Batek); Pnoron tbas (Semelai). Sumatra: Akar kuning; Kajoe ihoer badak. Borneo: Kayu busih; Kayu warna; Malatidong (Kedayan); Rukam gunung; Tis, Titidong (Dusun).

Uses — The stem is used to make spring and spear traps (Malay Peninsula, Semelai); the leaves are used as vegetable Dusun (Borneo) or in the sayur (Kalimantan Barat). In Thailand the root is used locally for fever.

Notes — 1. A lectotype is selected for *G. minor*, because one of the syntypes, *H.O. Forbes* 3096 (L) is *G. filiformis* and not *G. fulva*.

2. This species complex is very variable. *Galearia aristifera* almost merges into this species (see note under latter) and in this treatment *G. stenophylla* is not recognised

any more. In the following paragraphs several series are mentioned showing that all differences in shapes and sizes merge into each other. The only difference that still exist is the presence of two petal types in the pistillate flowers (Fig. 6). One type is generally found in *G. fulva* (rather straight, slightly cucullate petals), while the other type (cucullate with hook-like apex) is mainly present in the *G. stenophylla* form (however, no difference in fruits and staminate flowers with more typical *G. fulva*, and the leaf shapes gradually merge with *G. fulva*).

Series from *G. stenophylla* with long and narrow leaves (rheophytic type) to *G. fulva* with shorter, broader leaves, also a series from glabrous to hairy. All ovate: *S (Yii) 40686* (glabrous) and *M. Ramos 1542* (type *G. stenophylla*; hairy), both ovate, long and slender (19 by 1.7 cm), to *SAN (Bidin) 84815* (shorter, ovate, hairy; 12.3 by 11.8 cm), to *S (Paie) 26018* (shorter, relatively broader; 11.2 by 2.6 cm) to very small (*SAN (Joseph B et al.) 113516*; 4.7 by 1.3 cm). The apex in this series changes from gradually decurrent into an acute apex (narrow leaves) to acuminate/cuspidate (and occasionally caudate) (broader leaves).

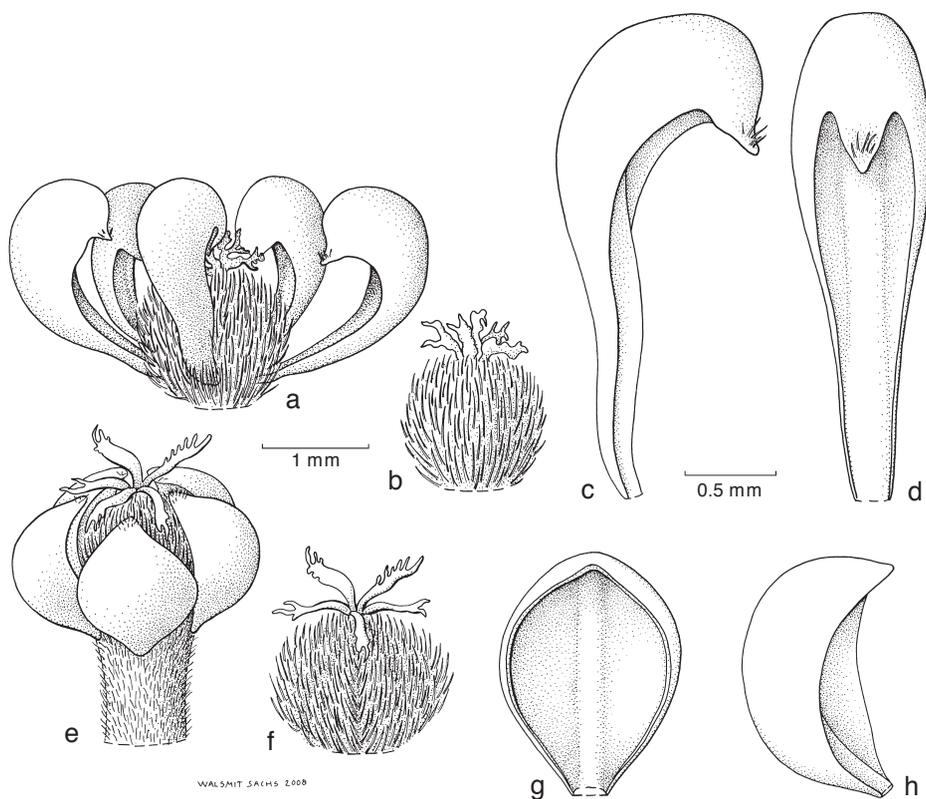
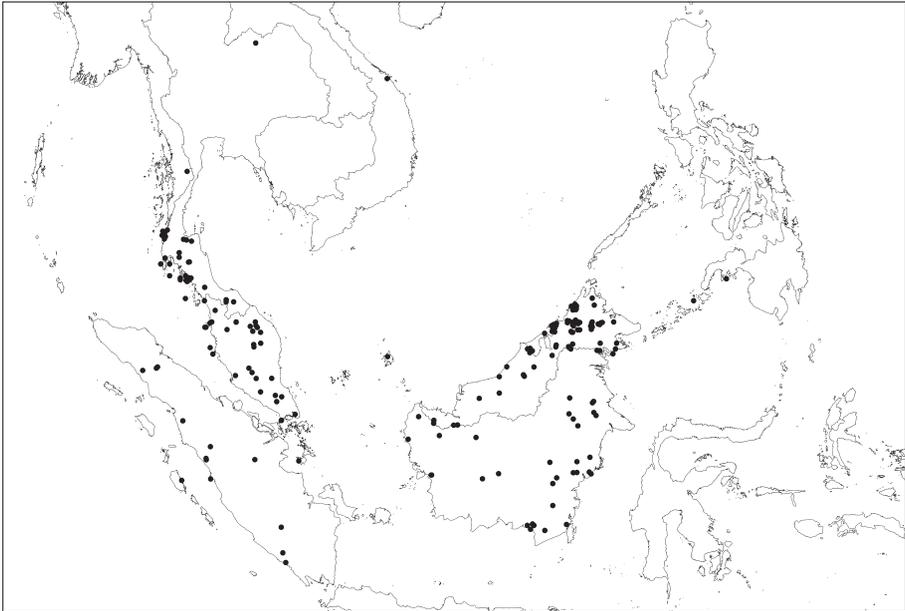


Fig. 6. Pistillate flower types of *Galearia fulva* (Tul.) Miq. — Cucullate type: a. Flower; b. pistil; c. petal in lateral view, cucullate; d. petal in ventral view. — Straight type: e. Flower; f. pistil; g. petal in ventral view; h. petal in lateral view, straight, apex not elongated (a–d: *SAN (Dewol, Leopold & Gary) 74978*; *Forman & Blewett 1136*; all L).



Map 3. Distribution of *Galearia fulva* (Tul.) Miq.

From small to larger and bullate leaves (all ovate): *S (Paie) 26018* (shorter, relatively broader; 11.2 by 2.6 cm) to broader and larger, and from a flat surface to more bullate: *S (Sibat ak Luang) 24625* (12.3 by 3.1 cm; flat) to *Castro & Melegrito 1377* (type *G. dolichobotrys*; 16.5 by 5.3 cm, flat) to *Shea 27028* (20.5 by 7.3 cm, bullate).

From ovate to elliptic/oblong (long and slender): *M. Ramos 1542* (type *G. stenophylla*) to *Veldkamp 8461* to *SAN (Amin et al.) 116397* to *SAN (Krispinus) 130005*.

From small leaves to large ones: *SAN (Joseph B et al.) 113516* (4.7 by 1.3 cm) to *S (Paie) 26018* (11.2 by 2.6 cm) to *Afriastini 86* (16.3 by 6.3 cm) to *R.J. Johns et al. 7564* (28 by 8.4 cm) to *Korthals s.n., L0157356* (29 by 14 cm), *SAN (Campbell et al.) 11873* (31 by 11 cm).

From ovate to obovate: *S (Paie) 26018* (ovate) to *Slik LUPRI-7617* (elliptic) to *Suzuki K 1222* (obovate, small leaves) and *Tuke P2 1013* (obovate, large leaves).

From green drying leaves to brown drying leaves: *SAN (Ampuria) 34161* (light green) to *Kessler et al. PK 1665* (greenish brown) to *Endert 3207* (brown).

From an attenuate leaf base to an emarginate base: *Suzuki K 1222* (attenuate) to *San (Dewol et al.) 109582* (rounded) to *Kostermans 10003* (emarginate). *Puasa 4647* has rounded and attenuate leaves.

Subgenus *Orthopetalum*

Galearia subg. *Orthopetalum* Forman, Kew Bull. 14 (1960) 316; 20 (1966) 318. — Type: *Galearia celebica* Koord.

Leaves: petioles channelled above. *Flowers*: petals ± straight and flat, completely hairy. *Staminate flowers*: filaments and connectives hairy. *Pistillate flowers*: ovaries

2–6-locular. *Fruits* laterally flattened to 5-cornered to subglobular, wall 6–17 mm thick, with cavities.

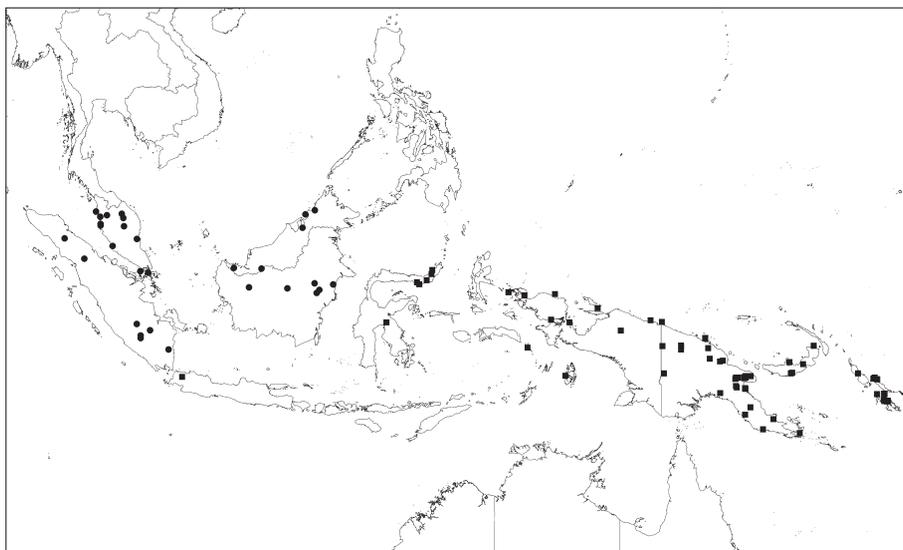
Two species, one in West Malesia (Malay Peninsula, Sumatra, Borneo), the other in East Malesia (Sulawesi, New Guinea) and the Solomon Islands.

4. *Galearia celebica* Koord.

Galearia celebica Koord., Meded. Lands Plantentuin 19 (1898) 626; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 282; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 103; Forman, Kew Bull. 14 (1960) 313; 20 (1966) 313, 318, 319, t. 5: 3, 4; 26 (1971) 157, f. 1b, 2b1-2; Airy Shaw, Kew Bull., Addit. Ser. 8 (1980) 220; Kew Bull. 37 (1982) 36. — *Galearia celebica* Koord. var. *celebica*: Forman, Kew Bull. 14 (1960) 315; 26 (1971) 158; Airy Shaw, Kew Bull., Addit. Ser. 8 (1980) 220; Kew Bull. 37 (1982) 36. — Lectotype (Forman 1960): *Koorders 16975* (L), Celebes, Prov. Minahassa. *Galearia fusca* Ridl., Fl. Malay Penins. 3 (1924) 257. — Type: *Burkill 6375* (holo K), Malaya, Negri Sembilan, Gemas.

Galearia celebica Koord. var. *pubescens* Forman, Kew Bull. 14 (1960) 315; 26 (1971) 158; Airy Shaw, Kew Bull., Addit. Ser. 8 (1980) 220. — Type: *NGF (A.G. Floyd) 7018* (holo K; iso L), Papua New Guinea, New Britain, Keravat, Keravat River.

(Shrubs to) small trees, up to 28 m high, bole up to 10 m high; dbh up to 40 cm; buttresses seldom present (Solomon Islands sometimes), thin and plank-like, steep to up 1.5 m high, (seldom fluted to first branch); flowering branches 2–40 mm thick, longitudinally grooved when dry, only young parts hairy (to completely). *Indumentum* simple hairs, either very short, whitish hairs (less than 0.5 mm long) and sometimes also long, yellowish, hirsute hairs (up to 1 mm long), see note. *Outer bark* light brown to greenish grey to grey, smooth (to fissured to scaly), c. 0.2 mm thick; under bark pale greenish cream to yellow to reddish to brown; inner bark pink to pinkish grey to dark red to brownish outside, coarsely fibrous to non-fibrous, soft, 3–6 mm thick; wood pale cream to straw to orange to orange-brown, firm, clean cutting, finely radially striate. *Stipules* triangular, 1.5–2 by 0.5–1 mm, outside subsericeous, inside glabrous, caducous. *Leaves*: petiole 3–8 mm long, channelled above, subglabrous to hirsute; blades (ovate to) elliptic, 7–32 by 3.3–12 cm, length/width ratio 2.1–3.6, papery to chartaceous, drying light green, base broadly attenuate, margin entire (to slightly crenate), apex usually damaged, acuminate, sometimes mucronulate, upper surface shiny (to dull) dark green above, glabrous to hairy on basal part of midrib, lower surface (sub)glabrous to softly hirsute, dull, pale to midgreen, venation slightly raised above, nerves 6–10 per side. *Inflorescences* cauliflorous and up to 30 together, or terminal and single, up to 75 cm long, damaged cauliflorous ones branching, side branches of racemes up to 100 cm long, subglabrous to hirsute, pistillate flowers single per node; bracts up to 0.5 by 0.5 mm, inside glabrous. *Flowers* 5-merous; calyx lobes 1.5–3 mm deep, glabrous inside, green, lobes shallow, 0.4–1 by 2–2.7 mm, apex rounded; petals ovate, 3.5–7 by 2–3.8 mm, concave, fleshy, c. 0.7 mm thick, apex acute, puberulous on both sides, white to cream to pale pink. *Staminate flowers* 5–15 mm diam., (faintly) scented; pedicel 5.7–20 mm long; stamens 10 (or 15), in a single whorl, connate to each other and adnate to pistillode, filaments very broad, strap-like, with thickened midrib, 1.5–2.3 mm high, hairy, white to pale pink, connective triangular, hairy, separating



Map 4. Distribution of *Galearia celebica* Koord. (■) and *G. maingayi* Hook.f. (●).

the thecae, anthers c. 0.7–0.8 by 0.6–0.7 mm, connective without appendix; pistillode 2.8–3.7 by 2.5–3 mm, puberulous, very pale green to light yellow. *Pistillate flowers* 3.7–4 mm diam., pedicel 3.7–10.5 mm long; ovary 2–4(–6)-locular, ovoid to obovoid, 2–3.2 by 1.8–2 mm, stigmas on top of ovary, 0.6–1 mm long, completely split, with a few papillae above and apical. *Fruits* laterally flattened to triangular to square to ± cylindrical in transverse section, broadest basally or apically, usually angular, 16–30 by 11–30 by 9–18 mm, subglabrous, whitish; wall very thick, 6–8 mm. *Seeds* c. 15 by 10 by 2.5 mm. — **Fig. 3e–m, 7a–d; Map 4.**

Distribution — Solomon Islands; in *Malesia*: Sulawesi, New Guinea (unknown for Moluccas).

Habitat & Ecology — (Disturbed) primary forest, alluvial forest, beach forest, Castanopsis forest, swamp forest, regrowth; river sides, along path, behind seashore; soil often periodically flooded, sand, sandy clay, reddish clay, coral, ultrabasic. Altitude: sea level up to 1100 m. Flowering and fruiting whole year.

Vernacular names — Irian Jaya: Ammiorapi (Roberbai, Japen dialect); Barboeroeroego; Kembien (Tehid); Wok (Mooi). Papua New Guinea: Manimk (Saki); Mapiok (Waskuk); Pahapi (Wagu); Papui (Dumpu); Ugan (Amele); Uriri (Faita). Solomon Islands: Bainonoo, O’oa (Kwara’ae).

Note — Forman (1960) recognized two varieties, based on the absence or presence of a dense indumentum of long, hirsute hairs. The two varieties are here synonymised, because there is a complete overlap in distribution and the density of the long hairs is rather variable, varying from subglabrous to absent in the inflorescences to present on leaves and inflorescences.

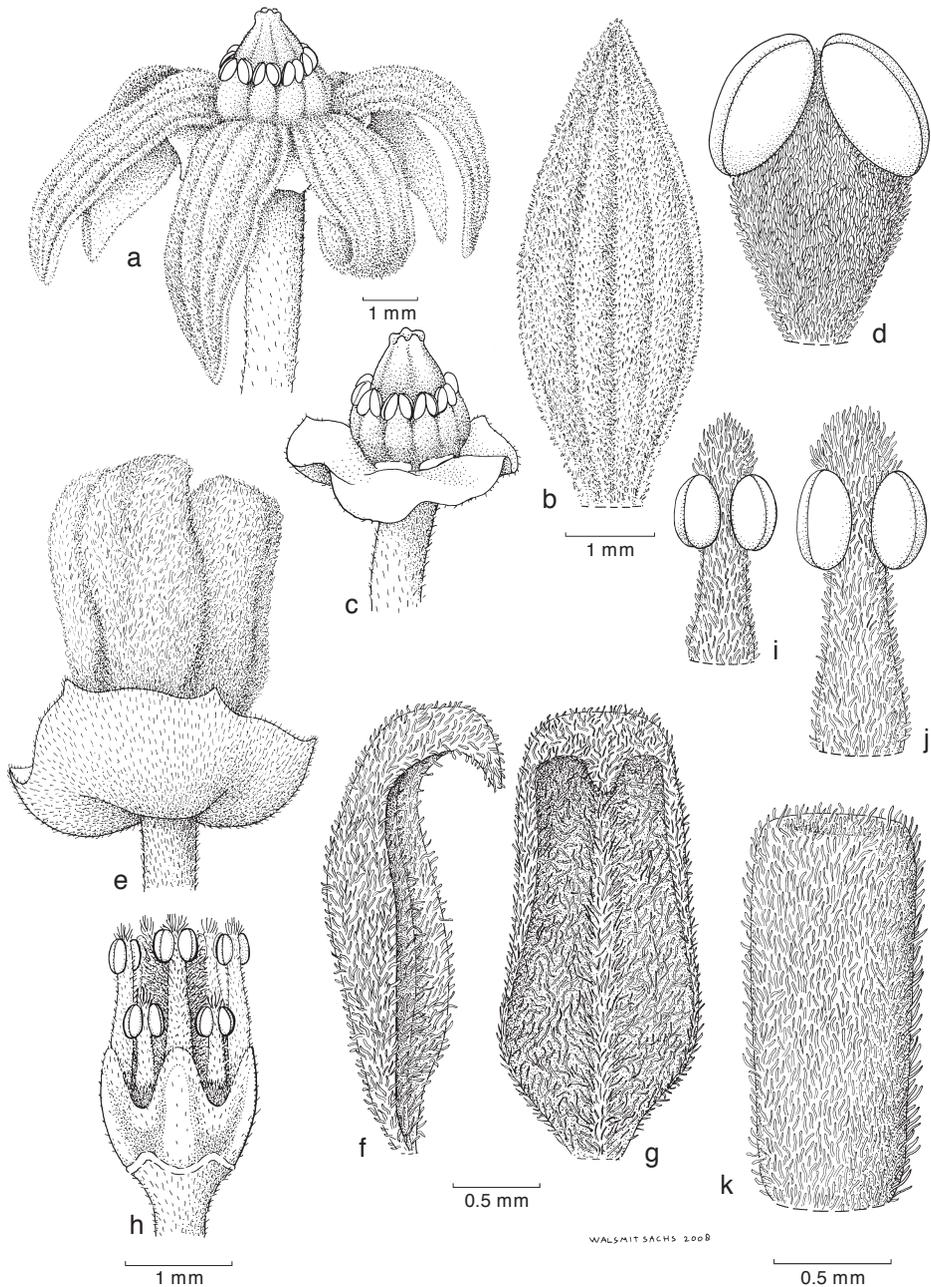


Fig. 7. Staminate flowers of *Galearia* subg. *Orthopetalum* Forman. a–d: *Galearia celebica* Koord. a. Flower with recurved petals; b. petal; c. stamens adnate to pistillode (petals removed); d. stamen. — e–k: *Galearia maingayi* Hook.f. e. Dehiscent bud; f. petal in lateral view; g. petal in ventral view; h. stamens and pistillode (petals removed); i. short stamen; j. long stamen; k. pistillode (a–d: *BW* (Koster) 4334, L; e–k: *Maingay* KD 1412, K).

5. *Galearia maingayi* Hook.f.

Galearia maingayi Hook.f., Fl. Brit. India 5 (1887) 377; Boerl., Handl. Fl. Ned. Ind. 3 (1900) 281; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 103; Ridl., Fl. Malay Penins. 3 (1924) 255; Forman, Kew Bull. 14 (1960) 311; 20 (1966) 312, f. 1.2; 26 (1971) 158, f. 1A, 2: A1, A2; Meijer, Bot. Bull. Herb. Forest Dept. Sabah 10 (1968) 233; Whitmore, Tree Fl. Malaya 2 (1973) 98; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 221; Kew Bull. 36 (1981) 367. — Syntypes: *Maingay* 2733 (*KD 1412*) (K, 2 sheets), Malacca; *Maingay* 3129 (*KD 1412/2*) (K), Malacca.

(Big) trees, up to 35 m high, bole up to 20 m high, dbh up to 80 cm; sometimes fluted or buttresses present, up to 3 m tall; flowering branchlets 2.5–3 mm thick, sericeous-tomentose, white to whitish green. *Indumentum* simple short (less than 0.5 mm long), mainly sericeous hairs, generally most parts rather glabrous except young branchlets. *Outer bark* white to grey to yellowish grey to yellowish to yellowish brown to light brown to greenish or dark brown, smooth to fissured to slightly vertically corky-ridged, peeling or not, yellow and grey-brown, 0.2–1 mm thick; under bark pinkish straw; inner bark pinkish straw to light red to dark red to red-brown, 6–15 mm thick, fibrous, rather brittle to very hard; wood yellowish to orange brown, hard. *Stipules* triangular, 0.8–1 by 0.6–0.7 mm, thick, outside subsericeous, inside glabrous, very early caducous. *Leaves*: petiole 5.5–13 mm long, channelled above, (sub)glabrous; blades ovate to elliptic, 5.2–20.5 by 2.1–6.7 cm, length/width ratio 2.5–3.1, coriaceous, drying brownish, base shortly attenuate to acute, margin entire, flat, apex bluntly acuminate, upper surface glabrous (to few hairs when young), glossy, green above, lower surface glabrous to subsericeous when young, paler green, young leaves light green, venation slightly raised above except for the slightly sunken midrib, nerves 9–11 per side. *Inflorescences* terminal, up to 18 cm long, sericeous; bracts up to 0.8 by 0.3 mm, thick, inside glabrous. *Flowers* 5-merous; calyx c. 1.5 mm deep, glabrous inside, lobes 5, triangular, c. 0.2 by 0.2 mm, apex acute; petals 5, elliptic, 3.1–3.5 by 0.8–1 mm, apex acute, hook-like, bend inwards, tomentellous on both sides, greenish white to white. *Staminate flowers* c. 4 mm diam. (young flower); pedicel up to 12 mm long; petals probably spreading horizontally; stamens 10, in two whorls, free, filaments cylindrical, hirsute, of two lengths, up to 1.7 mm long, connective with hairy apical appendage up to 0.3 mm long, anthers c. 0.4 by 0.6 mm; pistillode c. 2 by 0.5 mm, hairy. *Pistillate flowers* c. 2 mm diam., not fully open; pedicel c. 1.5 mm long, elongating up to 4.5 mm in fruit; ovary 4- or 5- (or 6-)locular, c. 1.2 by 1.2 mm, ribbed, apically narrowing and with crater-like opening, stigmas only seen as split bands on inside of apical opening, c. 0.4 mm long. *Fruits* subglobular to ovoid to angular-subglobular, 1.5–3.8 cm high by 2.1–4.5 cm diam., green when unripe, fleshy, woody when dry; wall very thick, 8–17 mm. *Seeds* flattened, boomerang-like in transverse section with hollow side extrorse, c. 7.5 mm long. — **Fig. 3n–p, 7e–k; Map 4.**

Distribution — Thailand (Peninsular: Narathiwat); in *Malesia*: Malay Peninsula, Sumatra, Borneo.

Habitat & Ecology — Primary forest, dipterocarp forest, disturbed forest, alluvial zone, sandy peat swamp, belukar; on sandy loam, sandstone derived soil, shales, clayey soil; bedrock basalt. Altitude: 20–800 m. Flowering: April, May, July; fruiting: January to November, eaten by animals.

Vernacular names — Sumatra: Katjang kajoe, Medang keli.

2. MICRODESMIS

Microdesmis Hook.f. ex Planch., Hooker's Icon. Pl. 8 (1848) t. 758; Baill., Étude Gén. Euphorb. (1858) 668; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1041; Benth. in Benth. & Hook.f., Gen. Pl. 3 (1880) 287; Hook.f., Fl. Brit. India 5 (1887) 380; Pax in Engl., Nat. Pflanzenfam. III, 5 (1890) 82; Pax & K.Hoffm. in Engl., Pflanzenr. IV.147.iii (1911) 105; Ridl., Fl. Malay Penins. 3 (1924) 258; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 458; Pax & K.Hoffm. in Engl. & Harms, Nat. Pflanzenfam. ed. 2, 19c (1931) 172; Robyns, Fl. Parc Nat. Alb. 1 (1948) 472; Keay, Fl. W. Trop. Afr., ed. 2, 1 (1958) 392; J.Léonard, Bull. Jard. Bot. État. Bruxelles 31 (1961) 159; Fl. Congo Rwanda-Burundi 8, 1 (1962) 102; J.-G.Adam, Mém. Mus. Natl. Hist. Nat., sér. B, Bot. 20 (1971) 499; Airy Shaw, Kew Bull. 26 (1972) 362; Whitmore, Tree Fl. Malaya 2 (1973) 118; Berhaut, Fl. III. Sénégal 3 (1975) 539; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 222; Kew Bull. 36 (1981) 367; Radcl.-Sm., Fl. Trop. E. Africa, Euphorb. 2 (1988) 581; G.L.Webster, Ann. Missouri Bot. Gard. 81 (1994) 68; Radcl.-Sm., Gen. Euphorbiacearum (2001) 126. — Type species: *M. puberula* Hook.f. ex Planch.

Tetragyne Miq., Fl. Ned. Ind., Eerste Bijv. (1860) 463; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1254. — Type species: *Tetragyne acuminata* Miq. (= *Microdesmis caseariifolia* Planch.).

Worcesterianthus Merr. (Olacaceae), Philipp. J. Sci., Bot. 9 (1914) 288; Sleumer in Engl. & Harms, Nat. Pflanzenfam. ed. 2, 16b (1935) 22. — Type species: *Worcesterianthus casearioides* Merr. (= *Microdesmis caseariifolia* Planch.).

Shrubs to trees, dioecious. *Indumentum* simple, whitish hairs, most parts glabrescent. *Stipules* triangular, persistent, outside hairy, inside glabrous. *Leaves* distichous, simple; petiole short, slender, not pulvinate, usually channelled above; blade with asymmetric base, margin laxly serrate to serrulate to seemingly entire in older leaves, tiny glands at apex of teeth or in very small crenations in entire leaves, venation pinnate, with few nerves, latter looping and closing far from margin, veinlets reticulate. *Inflorescences* axillary fascicles to shortly pedunculate after several flowering periods, peduncle with one to many flowers, pistillate fascicles usually with fewer flowers than staminate ones; bracts minute, triangular, sericeous outside, glabrous inside. *Flowers* shortly pedicelled, calyx (4- or) 5-lobed, hairy on both sides, hairs papilla-like, lobes imbricate; petals (4 or) 5, c. twice as long as sepals, hairy with papilla-like hairs in especially upper half on both sides, valvate or imbricate in bud; disc absent. *Staminate flowers*: stamens 5 (Africa), oppositisealous, or 10 (Asia) stamens, outer whorl with longer filaments, oppositisealous, inner whorl with shorter filaments, oppositipetalous, anthers basifixed, thecae 2, parallel, opening with introrse or latrorse longitudinal slits, connective slender, apex blunt or with long extension; pistillode columnar (Asia) or pentagonal in lower part and cylindrical in upper part (Africa). *Pistillate flowers*: ovary cylindrical with flat top, (1-)2-5-locular, glabrous to slightly hairy, 1 ovule per locule, styles absent, stigmas completely split, with long, pectinate papillae. *Fruits* ovoid to flattened ovoid drupes, glabrous, wall often knobly because of thickened parts in exocarp and/or endocarp, mesocarp fleshy, endocarp thick, wall knobly, basally with thickened triangular part, columella absent. *Seeds* compressed ovoid, without fleshy appendages.

Distribution — A palaeotropical genus of 10 species, 8 in Africa (subg. *Microdesmis*), 2 in Asia (subg. *Ganitrocarpus*).

Note — The genus is divided into two subgenera, subg. *Microdesmis* has 5 stamens and non-apiculate connectives; subg. *Ganitrocarpus* has 10 stamens. The second character for this subgenus, the apiculate connective, is redundant, because *M. magallanensis* lacks this extension of the connective.

Subgenus *Ganitrocarpus*

Microdesmis subg. *Ganitrocarpus* Planch., Hooker's Icon. Pl. 8 (1858) t. 758; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1041; Pax in Engl., Nat. Pflanzenfam. III, 5 (1890) 82; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 105; in Engl. & Harms, Nat. Pflanzenfam. ed. 2, 19c (1931) 172. — Type species: *Microdesmis caseariifolia* Planch.

Stamens 10.

Distribution — Two species in South East Asia of which one endemic in the Philippines (Luzon), the other ranging from continental South East Asia to the Philippines (Palawan).

KEY TO THE SPECIES OF SUBGENUS GANITROCARPUS

- 1a. Leaf blade length/width ratio 2.1–4.5, margin retrorse, indistinctly to distinctly serrulate, older ones entire. Connective of stamens with long apiculate appendage; pistillode 0.8–1.3 by 0.5–0.6 mm. Ovary glabrous. Fruits ovoid, 5–6.5 by 5–6.5 mm, warty. — SE Asia main land to the Philippines (Palawan) . . . **1. *M. caseariifolia***
- b. Leaf blade length/width ratio 1.4–2.9, margin entire (only very young, immature leaves laxly serrulate). Connective of stamens without appendage; pistillode c. 3 by 1 mm. Ovary basally hairy. Fruits flattened ovoid, 11–18 by 11–16 by 7–10 mm, smooth. — Philippines (Luzon, Sibuyan) **2. *M. magallanensis***

1. *Microdesmis caseariifolia* Planch.

Microdesmis caseariifolia Planch., Hooker's Icon. Pl. 8 (1848) t. 758 ('*caseariaefolia*'); Clos, Ann. Sci. Nat., Bot. sér. 4, 4 (1855) 382; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1041; Hook.f., Fl. Brit. India 5 (1887) 380; Pax & K.Hoffm. in Engl., Pflanzenz. IV.147.iii (1911) 106; Merr., Enum. Philipp. Fl. Pl. 2 (1923) 451; Ridl., Fl. Malay Penins. 3 (1924) 258; Gagnep. in Lecomte, Fl. Indo-Chine 5 (1926) 460, f. 56: 7–13; M.R.Hend., J. Malayan Branch Roy. Asiat. Soc. 17 (1939) 71; Airy Shaw, Kew Bull. 26 (1972) 362; Whitmore, Tree Fl. Malaya 2 (1973) 118; Airy Shaw, Kew Bull., Addit. Ser. 4 (1975) 222; Kew Bull. 36 (1981) 367. — Syntypes: *Griffith* (*KD 213?*) (K), Malacca; *Lobb 337* (K), (Myanmar, Moulmein).

Tetragyne acuminata Miq., Fl. Ned. Ind., Eerste Bijv. (1861) 463; Müll.Arg. in DC., Prodr. 15, 2 (1866) 1254; Hallier, Meded. Rijks-Herb. 1 ('1910', 1911) 11. — Type: *Teijsmann HB 4362* (holo U), Sumatra, Lampongs, Mangala.

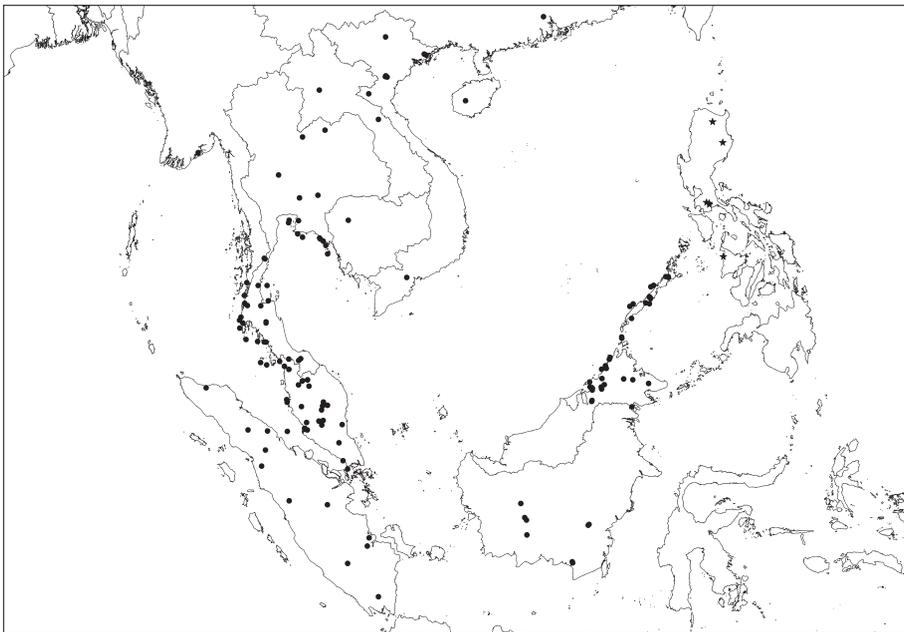
Microdesmis philippinensis Elmer, Leafl. Philipp. Bot. 4 (1911) 1300. — Syntypes: *Elmer 12620* (L), Philippines, Brooks Point (Addison Peak); *Elmer 13151* (L), Philippines, Palawan, Puerto Princesa (Mt Pulgar).

Shrubs to understorey trees, up to 15(–30) m high, dbh up to 25 cm, widely branched above the middle; branches with numerous, laxly lateral branches, green, flowering branches 1.3–1.8 mm thick; youngest part hairy, glabrescent. *Outer bark* grey (with light patches) to light yellow to greenish to reddish brown to dark brown to blackish, smooth, c. 0.2 mm thick; *inner bark* khaki-green to white to yellowish to reddish, c. 1.7 mm thick; *sapwood* white to white yellow to yellowish to pale orange to pale brownish, medium hard, odourless, tasteless. *Stipules* 1–3 by 0.3–0.6 mm. *Leaves*: petiole 3–11 mm long, pilose to (sub)glabrous, glabrescent, green; blades (ovate to) elliptic (to obovate), 14–18.5 by 3.5–9.7 cm, length/width ratio 2.1–4.5, papery to coria-

ceous, base rounded to attenuate, margin recurved, indistinctly to distinctly serrulate, older ones entire, apex acuminate to caudate, tip mucronulate, upper surface glabrous except usually for the hairy basal part of the midrib, glossy dark green, usually drying bluish green, rather shiny, lower surface (sub)glabrous to hairy, lighter green, drying dull light green(-brown), venation not to slightly raised above, raised beneath, nerves 5–8 pairs. *Flowers* white to greenish yellow to yellow to orange, fragrant. *Staminate flowers* 2.8–5.5 mm diam.; pedicel 1.7–3 mm long, pilose to (sub)glabrous; calyx 0.8–1.3 mm high, lobes basally united, ovate, 0.7–0.8 by 0.6–0.8 mm; petals elliptic to obovate, 1.6–2.8 by 0.8–1.4 mm, apex rounded, often somewhat incurved; stamens 10, outer filaments c. 0.7–0.8 mm long, inner ones 0.5–0.6 mm long, anthers c. 0.4 by 0.3 mm, connective with long apiculate extension, often not yet (fully) developed in bud; pistillode warty, 0.8–1.3 by 0.5–0.6 mm, glabrous. *Pistillate flowers* 3.3–9 mm diam.; pedicel 2–2.7 mm long, hairy; calyx 1.3–2 mm high, lobes ovate, 0.8–1.2 by 0.9–1.2 mm, thick; petals elliptic to obovate, 2.5–4.8 by 1.2–2.8 mm, like those of staminate flowers; ovary 1.3–1.8 by 0.9–1.3 mm, 2-locular, glabrous, one ovule per locule; stigmas 0.9–1.3 mm long. *Fruits* pendant, ovoid, 5–6.5 by 5–6.5 mm, warty, light green turning to deep orange to red; endocarp dark brown. *Seeds* c. 3.2 by 2 mm, black, crustaceous. — **Fig. 8a–g; Map 5.**

Distribution — Burma to South China, Hainan; in *Malesia*: Malay Peninsula, Sumatra, Borneo, Philippines (Palawan, Bancalan, Balabac; Merrill 1923).

Habitat & Ecology — On level to hilly terrain in primary lowland (dipterocarp) rainforest to mixed deciduous forest, riverine forest, secondary forest, logged areas, in



Map 5. Distribution of *Microdesmis caseariifolia* Planch. (●) and *M. magallanensis* (Elmer) Steenis (★).

thickets; on clay-loam, loam, sandy loam, sand, sandstone, limestone, granite, ultrabasic alluvial deposits, ultramafic chromite. Altitude: 10–800 m. Flowering and fruiting whole year.

Vernacular names — Vietnam: Chanh óc, Dok ko bang, A luan te he (Gagnepain 1926). Malay Peninsula: Chateng, Chareh rambeh; Chemberai burong (Temiar); Chem-pilai burong; Cheprai gila (Temuan); Kenidai badak, Sigoniah (partly after Ridley 1924). Sumatra: Kaju minak-minak (or Kaju miak-miak), Kaju tulang. Borneo: Kalimantan: Baranakan; Pirpingdamik; Sabah: Baleyusa andu (Dusun); Kolakos (Kadazan Tuaran); Luluning, Magapa-apa (Murtut); Pasiau (Kwijau). Philippines: Balanatu, Bunga-bunga, Manlato (Tagbanua); Banato (partly after Elmer 1911 and Merrill 1923).

Uses — Fresh plant juice is used against caries. Sometimes the timber is used for house construction (posts).

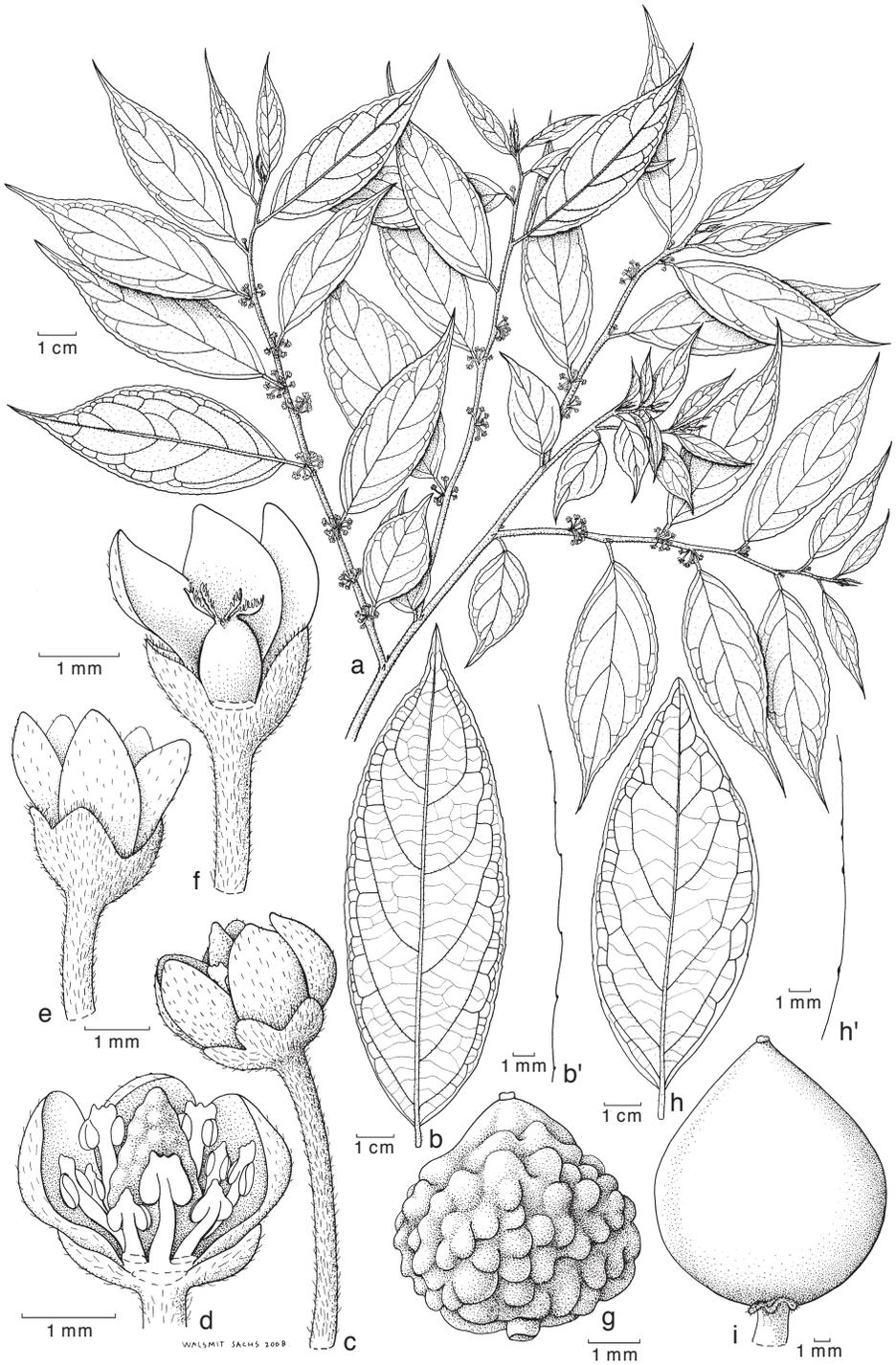
Note — Elmer (1911) recognized *M. philippinensis*, because it differs from *M. caseariifolia* in “petals not being orbicular nor pubescent on both sides; stamens in ours 10, their blunt anthers not long apiculate or caudate; and fruits when ripe yellow not red”. The Palawan specimens (formerly *M. philippinensis*) do not differ from the other *M. caseariifolia* specimens. The petals are never orbicular, vary between glabrescent and hairy, the stamens are always 10 and the long extension is absent when the bud is still young. Ripe fruits colour from yellow to red, thus probably Elmer did not see mature fruits.

2. *Microdesmis magallanensis* (Elmer) Steenis

Microdesmis magallanensis (Elmer) Steenis, Acta Bot. Neerl. 4 (1955) 480. — *Flacourtia magallanensis* Elmer (Flacourtiaceae), Leaflet Philipp. Bot. 4 (1912) 1519. — *Worcesterianthus magallanensis* (Elmer) Merr. (Olacaceae), Philipp. J. Sci., Bot. 10 (1915) 270; Enum. Philipp. Fl. Pl. 2 (1923) 117; Sleumer in Engl. & Harms, Nat. Pflanzenfam. ed. 2, 16b (1935) 22. — Type: *Elmer 12476* (iso L), Philippines, Sibuyan Island, Capiz Prov., Magallanes (Mt Giting-giting).

Worcesterianthus casearioides Merr. (Olacaceae), Philipp. J. Sci., Bot. 9 (1914) 288. — Type: *M. Ramos BS 14943* (n.v.), Philippines, Luzon, Laguna Prov., between San Antonio and Paete (Paratype: *M. Ramos BS 16541* (L, 2 sheets), Philippines, Luzon, Province of Laguna, San Antonio).

Shrubby or tree-like, up to 15 m high, dbh up to 30 cm; flowering branches 1.5–2 mm thick; youngest part hairy, glabrescent. *Outer bark* light brown; inner bark dark brown; wood yellowish. *Stipules* 0.5–1 by 0.5–0.6 mm. *Leaves*: petiole 6–9 mm long, pilose to (sub)glabrous, glabrescent; blades elliptic, 4.4–25 by 1.5–8.6 cm, length/width ratio 2.1–4.5, papery to coriaceous, base attenuate to widely cuneate, margin flat, entire with minute crenations in which minute glands, very young, immature leaves laxly serrulate with glands at teeth apices, apex acuminate (to caudate), tip not mucronulate, upper surface glabrous except usually for the hairy basal part of the midrib, usually drying shiny greenish to brownish, lower surface (sub)glabrous to somewhat hairy on venation, drying dull light greenish to brownish, venation not to slightly raised above, raised beneath, nerves 6–8 pairs. *Flowers* white. *Staminate flowers* c. 3 mm diam.; pedicel c. 0.5 mm long, pilose; calyx 1.3–1.8 mm high, connate for more than halfway, lobes triangular, c. 0.5 by 1 mm; petals ovate to elliptic, 2.4–3 by c. 1 mm, apex rounded to acute, incurved; stamens 10, outer filaments 1.8–2.3 mm long, inner ones c. 1.5 mm long, anthers c. 0.4 by 0.4 mm, connective without extension; pistillode warty, c. 3 by



1 mm, hairy. *Pistillate flowers* not seen, according to Merrill (1914): pedicel c. 2 mm long; calyx like in staminate flowers; petals elliptic, c. 4 by 1.6 mm; ovary 2-locular, basally hairy; stigmas c. 2 mm long. *Fruits* flattened ovoid, 11–18 by 11–16 by 7–10 mm, glabrous, smooth. *Seeds* not seen. — **Fig. 8h, i; Map 5.**

Distribution — *Malesia*: Endemic in the Philippines (Luzon, Sibuyan).

Habitat & Ecology — Dipterocarp forest. Altitude: c. 200 m. Flowering: April; fruiting: February, April, May, September to October.

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Fig. 8. *Microdesmis* Hook.f. ex Planch. — a–g: *Microdesmis caseariifolia* Planch. a. Habit; b. large leaf; b'. serrulate leaf margin with glandular teeth; c. staminate flower; d. staminate flower with 2 sepals and petals removed; e. pistillate flower; f. pistillate flower with 2 sepals and petals removed; g. fruit. — h–i: *Microdesmis magallanensis* (Elmer) Steenis. h. Small leaf; h'. leaf margin with glands in shallow crenations; i. fruit (a, c, d: Middleton *et al.* 4178; b, e, f: Kerr 18020; g: Soejarto, Ninh & Binh 9752; h, i: Elmer 12476; all L).

