

# FLORA MALESIANA

SERIES I – SPERMATOPHYTA

*Flowering Plants*

Volume 11, part 3

*Sapindaceae*

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*(continued on inside back cover)*

# FLORA MALESIANA

## SERIES I — SPERMATOPHYTA

Volume 11 — part 3 — 1994

### Sapindaceae

by

F. Adema, P. W. Leenhouts, P. C. van Welzen

#### ERRATUM

Flora Malesiana Series I, Volume 11, part 2

In the family *Amaryllidaceae*, under *Curculigo*, unfortunately a wrong legend of Fig. 5 has been printed on page 369. For a correct legend, see below.

Fig. 5. *Curculigo orchiooides* Gaertn. a. Flowering plant. — *C. racemosa* Ridley. b. Inflorescence. — *C. erecta* Laut. c. Inflorescence. — *C. latifolia* Dryand. var. *latifolia*. d. Inflorescence. — *C. capitulata* (Lour.) Kuntze. e. Inflorescence (a: Zippel 272; b: Jacobs 5610; c: Brass 6994; d: Geesink & Hattink 6401; e: de Wilde & de Wilde-Duyfjes 13539).

Figure references given after the descriptions of these five *Curculigo* species on pages 367–370 should be changed as follows: *C. capitulata* = **Fig. 5e**; *C. erecta* = **Fig. 5c**; *C. latifolia* var. *latifolia* = **Fig. 5d**; *C. orchiooides* = **Fig. 5a**; *C. racemosa* = **Fig. 5b**.

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## SAPINDACEAE

(F. Adema, P.W. Leenhouts & P.C. van Welzen, Leiden, The Netherlands)<sup>1</sup>

*Sapindaceae* Juss., Gen. Pl. (1789) 246 ('*Sapindi*'); Radlk. in Engl., Pflanzenz. 98 (1931–1934) 1; Backer & Bakh. f., Fl. Java 2 (1965) 130; Abdulla in Fl. W. Pakistan 39 (1973) 1; S.T. Reynolds in Fl. Austral. 25 (1985) 4; Law Yuh-wu, Lo Hsin-shui, Wu Young-fen & Chen Te-chao in Fl. Reip. Pop. Sinicae 47 (1) (1985) 1. — Type genus: *Sapindus* L.

*Trees, shrubs or lianas*, rarely herbaceous climbers; monoecious, rarely dioecious or polygamous. *Indumentum* usually of solitary, simple hairs, sometimes also of two-branched hairs, stellate bundles of hairs, or scale hairs (then young parts, buds, and inflorescences viscid). *Leaves* spirally arranged, rarely opposite or whorled, simple, biternate, digitate or (bi)pinnate; true stipules usually absent, pseudo-stipules sometimes present. *Leaflets* alternate to opposite, symmetric to distinctly asymmetric, entire or dentate to serrate or crenate. *Inflorescences* axillary, often together pseudoterminal, terminal or ramiflorous, thyrsoid, with or without branches; bracts and bracteoles present. *Flowers* usually unisexual, rarely bisexual, actinomorphic or zygomorphic. *Sepals* 4 or 5, rarely more, free to almost totally connate, equal to distinctly unequal, and then the outer 1 or 2 much smaller than the inner three, herbaceous to petaloid, in bud imbricate, valvate or apert. *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 semi-annular, rarely with appendages or an erect (tubular) rim. *Stamens* 5–10(–74), usually 8, nearly always inserted within the disc, often exerted in male flowers; filaments glabrous or hairy; anthers basifixed, opening introrsely or latero-introrsely lengthwise; in female flowers present as staminodes with non-opening anthers. *Ovary* superior, 1–3(–8)-celled, lobed or not; style usually apical, rarely inserted between the lobes, stigma entire with (1), 2 or 3 lines or grooves, or (1-), 2- or 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 septicidal. *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 (notorrhizal embryo) to laterally besides each other (lomatorrhizal embryo).

Distribution — 140 genera with c. 1350 species, widespread in tropical and subtropical regions of the world, especially well represented in South America. In *Malesia* 42 genera with ca. 235 species.

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1) With contributions by: M. Davids (*Paranephelium*), J. van Dijk (*Dictyoneura*), B. Etman (*Rhysotoechia*), R.W.J.M. van der Ham (*Mischocarpus*, palynology), R. Hegnauer (phytochemistry), M. Jacobs (*Pometia*), R.K.W.M. Klaassen (wood anatomy), A.M. Schot (*Lepiderema*), H. Turner (*Arytera*), M. Vente (*Harpullia*).

Habitat — Primary or secondary rain forest, forest edges, shrubland, savannahs, coastal vegetations, often along rivers or roads; in everwet or seasonal conditions; mainly lowland, but also montane up to 3600 m altitude; on all kinds of soil. F. Adema

Ecological aspects — *Floral biology.* *Sapindaceae* have been recorded to be either monoecious or dioecious (see lists in Van der Ham 1990: 118, 119; and Van Welzen 1989: 41) except *Dodonaea* which can have bisexual flowers. Most *Sapindaceae* show dichogamy: three stages of floral development appear within the same inflorescence. The first flowers to appear are male (long filaments, dehiscent anthers, functional pollen, undeveloped pistil). After they have dropped, the second flush of flowers, female, opens (short filaments, indehiscent anthers, non-functional pollen, well-developed pistil). After fruit-set the third phase of flowers opens, organs of both sexes present but flowers functionally male (intermediate to long filaments, dehiscent anthers, functional pollen, more or less well-developed ovary). In duodichogamy the second and third phase usually repeat as fourth and fifth phase. The consecutive phases may overlap.

Dichogamous plants with synchronized flowering within the same plant are effectively dioecious too, which means that all *Sapindaceae* have to be cross-pollinated although self-pollination was reported for *Xerospermum noronhianum* (Appanah 1982; but see also Ha et al. 1988). There is apparently no self-incompatibility since interflower selfing occurs in several economically important plants (see references in Van der Ham 1990: 118). The *Sapindaceae* are mainly entomophilous; *Dodonaea* is the only genus within the family for which wind-pollination has been recorded (Keighery 1982; West 1982, 1984). The most important pollinators are bees, mainly of the genera *Trigona* (stingless bees) and *Apis* (honey bees). The former seem to be the main pollinators (Appanah 1982; Bawa 1977; Gondim 1984; Hawkeswood 1983; Subba Reddi et al. 1983; Uji 1987; Van Welzen et al. 1988). They may either be attracted by the nectar or by the pollen and many species are reported to have fragrant flowers; the attractant may be different for each species of *Trigona* (see discussion in Van der Ham 1990: 120). The trees seem to have three mechanisms to ensure cross-pollination by bees: a) The most important one is using the bees' memory (see references in Van der Ham 1990: 121; and Van Welzen 1989: 43) by attracting them to the trees with the first male phase in the (duo)dichogamous stages, after which the bees will return to the less attractive female flowers and the attractive bisexual flowers (Van der Ham 1990: 121, 122). b) Fluctuations in nectar productivity alternating between trees with male/bisexual flowers and female ones during day-time (see references in Van Welzen 1989: 42). c) Differences in nectar composition between male and female flowers (Appanah 1982). However, female flowers are visited far less often than male or bisexual flowers, as the latter are more colourful due to the usually exerted and coloured stamens. P.C. van Welzen

*Fruits and dispersal.* Young fruits of *Sapindaceae* are generally reported to be green, hard, and full of tannin. When mature, the colour changes, usually to red, and the fruit wall softens (Ha et al. 1988).

*Sapindaceae* may fruit throughout the year, once or twice per year. They tend to have a good harvest one season, followed by a poor one the next (Appanah 1982; Bawa 1977; Van Welzen & Verheij 1991).

Several fruit types occur in the Malesian *Sapindaceae*:

- a) Winged fruits, e.g. *Atalaya* and *Dodonaea*.
- b) Inflated fruits with a thin, papery wall, e.g. *Cardiospermum* and *Koelreuteria*.
- c) Drupaceous fruits, e.g. *Allophylus* and *Lepisanthes*.
- d) Berry-like fruits, e.g. *Filicium* and *Sapindus*.
- e) Dehiscent capsules, usually with (partial) arillodes around the seeds, e.g. in most *Cupanieae*.
- f) Indehiscent 'capsules', also usually with arillodes around the seeds, e.g. a few *Cupanieae* and most *Nephelieae*.

The seeds or fruits are mainly dispersed by birds and mammals. The smaller fruits, like those of *Allophylus* (type c; Docters van Leeuwen 1932) and the seeds of the *Cupanieae* (type e), are mainly eaten by birds, which are attracted by the contrasts in colour between fruit (yellow to mainly red), arillode (mainly yellow to red), and seed (shiny dark brown to black). Several genera (*Guioa*, *Mischocarpus*, and to a lesser degree *Sarcopteryx*) add movement as an attractant, as an appendage of the arillode (pseudo-funcle) is attached to the basal corner of the fruit on which the seed remains dangling after dehiscence. The seeds of the larger fruits in this group are mainly eaten by parrots, parakeets, and presumably pigeons (Ridley 1930: 487; Van Welzen 1989: 44).

The non-dehiscent and mainly large(r) fruits (type f) are eaten by mammals. In this category the commercially interesting species are found. These fruits, too, have the red colour as attractant. They are reported to be eaten and dispersed by man, monkey, fox-bat, sloth bear (*Melursus ursinus*), and pigs (Ridley 1930: 339–359). However, parakeets and parrots may eat these fruits too (Ridley 1930: 487).

Fruits of the types a and b are reported by Ridley (1930: 195) to be dispersed by wind or (sea)water, just like the woody seeds of *Pometia* and the fruits of *Sapindus* (Ridley 1930: 268–270).

P.C. van Welzen

*Germination and seedlings.* Usually, the seeds of *Sapindaceae* germinate readily, within a week, and passage through animal intestines is not a prerequisite. The seeds are short-lived and do not show dormancy. During germination the radicle and petioles swell and become terete. The testa usually opens at the place where the embryonic radicle is present. The radicle is quite often enclosed in a testal pouch. The testa subsequently opens along the pleurograms. Then the petioles, hypocotyl, and radicle elongate. The cotyledons, turning green, remain loosely enclosed in the testa. This type of germination is classified as *Horsfieldia* type and subtype (De Vogel 1980) and has been reported for several genera (Adema 1991; De Vogel 1980; Van Welzen 1989).

The seedlings may differ considerably in macromorphology from the mature plants. The first leaves are usually opposite (not alternate as in the adult). The rachis is usually slightly winged (wing usually absent). The margin of the leaflets is (crenate to) serrate (usually entire). There are no papillae and domatia on the lower surface of the leaflets. In size and number of leaflets the leaves of seedlings may differ dramatically from those in mature plants. Plants showing immature characters may flower and fruit (Van Welzen 1989: 45, 46), thus hampering species delimitation.

P.C. van Welzen

*Ant associations.* Several genera, *Alectryon* (Leenhouts 1988), *Guioa* (Van Welzen 1989: 218, 219), *Harpullia* (Leenhouts & Vente 1982), and *Sarcopteryx* (Van Welzen 1991) are reported to have associations with ants. The branchlets, which are hollow, are inhabited by ants. The branchlets are usually swollen below the nodes and in the swellings the nest openings can be found. Any profit to the plants in this possible symbiosis is still unknown.

P.C. van Welzen & F. Adema

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*Morphology — Indumentum.* Usually consisting of solitary simple hairs, sometimes of two-branched hairs (T-hairs, *Litchi*), or stellate tufts of hairs (*Dimocarpus*, *Glenniea*, *Harpullia*); scale hairs (glandular scales, ‘Schilffern’) are found in several genera, then young axes and leaflets with a sticky (viscid) exudate. Various types of glandular hairs may be present (Adema 1991; Adema & Van der Ham 1993; Van Welzen 1989). (See also the section on leaf anatomy.)

*Leaves.* Almost always spirally arranged, rarely opposite or whorled, usually pari- or imparipinnate, sometimes digitate, unifoliolate, or simple; if paripinnate often the rachis ending in an acumen. *Stipules* present in only a few genera (e.g. *Cardiospermum*); more often *pseudo-stipules* present: lowermost pair(s) of leaflets at the very base of the petiole, much smaller than and usually of a different shape as the other leaflets (e.g. *Alectryon repandodentata*, *Lepisanthes* subg. *Otophora*, *Pometia*). See Weberling & Leenhouts 1966; Weberling 1976.

*Inflorescences.* Axillary and often several together, pseudoterminal (terminal vegetative bud present), or terminal, or rami- or cauliflorous; often more or less thyrsoid or paniculate; cymes (cymules) one- to many-flowered, either dichasia, cincinni, or botryxes, various reductions may obscure their true form, however.

*Flowers.* Usually 4- or 5-merous, actinomorphic to strongly zygomorphic. *Sepals* entirely free, outer one or two much smaller than the inner three, and in bud imbricate (e.g. *Cupaniopsis*, *Guioa*, *Lepisanthes*) to highly connate, all equal and in bud apert (*Cubilia*, *Litchi*). *Petals* free, with or without a claw, often the inside with 1 or 2 scales or auricles (inrolled margins), especially in the latter case the petals obliquely funnel-shaped (‘peltaten Kronblätter’, Leinfellner 1958); the scales may be provided with crests (e.g. *Guioa*, *Sarcopteryx*, *Toechima*) or not. *Disc* complete or interrupted, annular or saucer-



like to semi-annular. *Ovary* 1-, 2-, or 3-celled, style shorter to longer than the ovary, stigma short or long, erect or recurved and lobed, or closed and with lines of stigmatic papillae on the outside.

*Fruits*. 1–3-celled, lobed or not, outside smooth, or wrinkled, or with warts, knobs, or spines.

*Seeds*. Usually covered by an arillode, either called a sarcotesta (when adnate to the exotesta) or an arillode (when free from the exotesta). See Van der Pijl (1955, 1957, 1966). In *Guioa*, *Mischocarpus*, and to a lesser extent *Sarcopteryx* the arillode is usually provided with an appendage (pseudo-funicle); endotesta often with a radicular pocket. Cotyledons either superposed above each other (notorrhizal embryo) or collateral beside each other (lomatorrhizal embryo), but there are many intermediates. F. Adema

*References*: Adema, F., Leiden Bot. Series 15 (1991) 1–190. — Adema, F. & R.W.J.M. van der Ham, *Blumea* 37 (1993) 173–215. — Leinfellner, W., *Österr. Bot. Zeitschr.* 105 (1958) 443–514. — Pijl, L. van der, *Proc. Kon. Ned. Akad. Wetensch., C*, 58 (1955) 154–161, 162–312; *Acta Bot. Neerl.* 6 (1957) 618–641; *Proc. Kon. Ned. Akad. Wetensch., C*, 69 (1966) 615–640. — Weberling, F., *Abhandl. Math.-Naturwiss. Kl. Akad. Wissensch. und Lit.* 2 (1976) 1–27. — Weberling, F. & P.W. Leenhouts, *Abhandl. Math.-Naturwiss. Kl. Akad. Wissensch. und Lit.* 10 (1966) 1–90. — Welzen, P.C. van, *Leiden Bot. Series* 12 (1989) 1–315.

*Palynology* — A worldwide survey of *Sapindaceae* pollen has been made by Muller & Leenhouts (1976). Monographic pollen studies of Malesian taxa include those by Adema (1991: *Cupaniopsis*), Adema & Van der Ham (1993: *Cnesmocarpon*, *Jagera*, *Trigonachras*), Van den Berg (1978: *Cubilia*, *Litchi*, *Pometia*), Van der Ham (1977: *Mischocarpus*; 1990: *Alectryon*, *Cubilia*, *Dimocarpus*, *Litchi*, *Nephelium*, *Pometia*, *Xerospermum*), Van der Ham & Van Heuven (1989: *Guioa*) and Muller (1970: *Lepisanthes*; 1971: *Dimocarpus*; 1973: *Glenniea*; 1985: *Harpullia*).

*Sapindaceae* pollen grains are usually isopolar or subisopolar monads but occasionally the tetrad configuration persists in mature pollen. Permanent tetrads occur only in *Magonia* (S America). Several genera of *Paullinieae* (in Malesia only *Cardiospermum*) have distinctly heteropolar grains. Grain size is usually between 20 and 30  $\mu\text{m}$ . The pollen of *Cubilia* is exceptionally small (av. 13  $\mu\text{m}$ ), while that of *Cardiospermum* is the largest in the family (up to 74  $\mu\text{m}$ ). Grain shape is oblate to prolate. Colporate pollen is usually subprolate to prolate (P/E 0.75–2.00), whereas pollen with small apertures (porate, brevicolporate) or with connected apertures (syncolporate, parasyncolporate) is relatively broader, with a more oblate shape (P/E 0.50–1.00). The equatorial outline is bluntly triangular to almost circular; the meridional outline is more or less elliptic to almost circular.

Generally *Sapindaceae* pollen is 3-aperturate, but often small percentages of grains with 2 and 4 apertures occur. The apertures are diverse, but lalongate, elliptic to subcircular endoapertures are nearly always present. The pollen types recognized by Muller & Leenhouts (1976) are based largely on ectoaperture features. Colporate pollen is the commonest type, being known from all 13 tribes; it is a relatively basic type like that of many other angiosperm families. Several probably derived types are restricted to one or a few tribes. The (para)syncolporate type is known only in the subfamily *Sapindoideae* (which is considered more derived than the *Dodonaeoideae*), being present in most *Cupanieae*

(Van der Ham 1990), the *Melicocceae* (*Castanospora*, *Tristira*, *Tristiropsis*), the *Nephelieae* (*Alectryon*) and the *Schleichereae* (*Schleichera*). Parasyncolporate and syncolporate (with and without apocolpial field, respectively) are not clear-cut character states. Moreover, several genera (e.g. *Alectryon*, *Arytera*, *Cupaniopsis*, *Elattostachys*) possess both colporate and (para)syncolporate pollen, and often intermediates as well. Reverse evolution, from (para)syncolporate to colporate, might have occurred in these groups. A trend towards (very) small ectoapertures includes the brevicolporate and porate types found in the *Melicocceae*, *Lepisantheae* (e.g. *Lepisanthes*), *Schleichereae*, *Nephelieae* (*Pometia*), *Thouinieae* (e.g. *Allophylus*) and *Paullinieae*. Pollen of *Cardiospermum* (*Paullinieae*) is heteropolar and has short demicolpi on the proximal side of the grain. Pollen of several related American genera has a demisyncolporate aperture system, and that of a few *Serjania* and *Urvillea* species a syncolporate aperture on one side and short demicolpi on the other. Therefore, (brevicol)porate *Paullinieae* pollen may have evolved from a syncolporate ancestral form while other (brevicol)porate groups (such as *Lepisanthes* spp.) might be derived from colporate forms. *Distichostemon* (N Australia) and a few *Harpullia* species have indistinct ectoapertures (cryptoaperturate).

The shape of an aperture determines much of its harmomegathic motion, caused by dehydration and rehydration of the protoplasm. Colporate apertures fold their equatorial parts inwards ( $P/E$  increases), whereas (parasyncolporate apertures fold their polar parts inwards ( $P/E$  decreases). Grains with small apertures may fold nonapertural parts of the exine, or show a peristatic mechanism (Van der Ham 1990).

The exine is usually clearly stratified (although this is not always visible with light microscopy), showing a tectum, a columellate infratectal layer and a nexine. In the *Dodonaeeae* [*Diplopeltis*, *Distichostemon* (both Australia) and *Dodoniaea*] the infratectal layer is granular/columellate, which might relate to wind-pollination. Mostly the nexine consists of a distinctly delimited foot layer and endexine. The endexine is thin in non-apertural parts, thickens towards the apertures, and is maximal along/under the apertures.

The ornamentation of the exine shows much variation. Striate, rugulate, psilate, and intermediate types are most common; (micro)echinate, scabrate and reticulate types are less frequent. In the subfamily *Dodonaeoideae*, rugulate pollen is rare and psilate pollen entirely absent. In the *Sapindoideae*, (micro)echinate and scabrate ornamentation is rare (only in the Malesian genera *Cubilia*, *Dimocarpus*, *Jagera* and *Trigonachras*), but it is common in the *Dodonaeoideae* in Malesia, e.g. *Dodoniaea* (scabrate), *Filicium* and *Ganophyllum* (both microechinate).

The tectum is usually perforated but less densely and less distinctly so towards the apertures. Perforate types are linked with more or less reticulate types. For example a rugulate/reticulate exine is found in *Cupaniopsis* spp., a (micro)echinate/reticulate exine in *Harpullia* spp., and a scabrate/reticulate exine in *Jagera*. Simple reticulate ornamentation is rare (e.g. *Cardiospermum*, *Pometia*). Striate ornamentation is often associated with a colporate aperture system, and rugulate with a (para)syncolporate aperture system, which probably reflects a functional, harmomegathic relation. Ornamentation often varies within genera while *Allophylus cobbe* (Muller 1979) and *Dimocarpus longan* (Van der Ham 1990, 1993) show remarkable infraspecific variation.

Muller & Leenhouts (1976) stated that the *Aceraceae* and *Hippocastanaceae* are not distinct from the *Sapindaceae*. Pollen of both families was described as colporate without any derived character. However, pollen of the *Hippocastanaceae* has characteristic verrucae on its colpus membranes. Pollen of *Handeliidendron* (*Harpullieae*, China) shows the same feature, which supports inclusion of the *Hippocastanaceae* in the *Harpullieae*.

*Fossil pollen.* Several *Sapindaceae* pollen types are sufficiently characteristic to be recognized in dispersed (sub)fossil state. The (para)syncolporate type (*Cupanioidites*, *Cupaniopsis* type) is widespread, and known from the Turonian (Africa) onwards (Van der Ham 1990). The oldest Malesian data are Miocene records (New Guinea). Other fairly recognizable types are the pollen of *Allophylus* (not yet found in Malesia), *Cardiospermum* (not indigenous in Malesia; to be found only in recent and subrecent deposits) and *Pometia* (Miocene Borneo).  
R.W.J.M. van der Ham

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*Wood anatomy* — The description presented below is based on the preliminary results of a detailed worldwide wood anatomical survey of the *Sapindaceae* (Klaassen in prep.). For general accounts see Metcalfe & Chalk (1950), and Solereder (1899). Information on individual genera is given by Anonymous (1986: *Pometia*); Balan Menon (1971: *Guioa*, *Harpullia*, *Lepisanthes*, *Nephelium*, *Pometia*, *Tristira*, *Xerospermum*); Burgess (1966: *Pometia*); Chowdhury & Ghosh (1963: *Allophylus*, *Arytera*, *Dodonaea*, *Erioglossum* [= *Lepisanthes*], *Filicium*, *Harpullia*, *Lepisanthes*, *Mischocarpus*, *Nephelium*, *Paranephelium*, *Pometia*, *Sapindus*, *Schleichera*, *Xerospermum*); Desch (1954: *Guioa*, *Harpullia*, *Lepisanthes*, *Nephelium*, *Pometia*, *Tristira*, *Xerospermum*); De Freitas (1958: *Ganophyllum*, *Schleichera*); Fundter & Wisse (1977: *Pometia*); Furuno (1977: *Ganophyllum*, *Pometia*); Furuno (1979: *Tristiropsis*); Hayashi (1991: *Sapindus*); Ilic (1991: *Alectryon*, *Allophylus*, *Arytera*, *Cupaniopsis*, *Dictyoneura*, *Dimocarpus*, *Diploglottis*, *Dodonaea*, *Elattostachys*, *Ganophyllum*, *Guioa*, *Harpullia*, *Jagera*, *Lepidopetalum*, *Lepisanthes*, *Mischocarpus*, *Nephelium*, *Pometia*, *Sapindus*, *Schleichera*, *Tristiropsis*, *Xerospermum*); ITTO report (1991: *Allophylus*, *Dodonaea*, *Ganophyllum*, *Harpullia*, *Koeleruteria*, *Nephelium*, *Pometia*, *Sapindus*, *Schleichera*); Kanehira (1924: *Litchi*, *Pometia*); Keating & Bolza (1982: *Pometia*); Koning-Vrolijk et al. (1962: *Pometia*); Martawijaya et al. (1986: *Pometia*); Meniado et al. (1981: *Dimocarpus*, *Ganophyllum*, *Pometia*); Moll & Janssonius (1911: *Dodonaea*, *Ganophyllum*, *Guioa*, *Harpullia*, *Lepisanthes*, *Mischocarpus*, *Nephelium*, *Pometia*, *Sapindus*, *Schleichera*, *Xerospermum*); Ogata (1983: *Ganophyllum*, *Pometia*, *Tristiropsis*); Pearson & Brown (1932: *Filicium*, *Schleichera*); Purkayastha et al. (1976: *Pometia*); Sudo (1970: *Dimocarpus*, *Ganophyllum*, *Litchi*, *Nephelium*, *Pometia*); Tang (1973: *Amesiodendron*, *Litchi*, *Mischocarpus*, *Nephelium*, *Pometia*).



The wood anatomy of the *Sapindaceae* of Malesia shows little variation, especially within the *Cupanieae*. This tribe contains two thirds of all the *Sapindaceae* genera and shows very little variation in vessel and pit dimensions, parenchyma distribution, ray composition and fibre type. On the other hand a wide variation is seen in the *Nephelieae*, the second largest tribe; all seven Malesian genera can be distinguished wood anatomically, using vessel and pit diameter and parenchyma distribution. All genera in the *Dodonaeae*, *Doratoxyleae*, *Harpullieae*, *Melicocceae* and the *Sapindeae* have abundant parenchyma; some genera have apotracheal and vasicentric to aliform parenchyma while others have mainly aliform to aliform-confluent parenchyma.

*General wood anatomical description.* Growth rings distinct to indistinct or absent, when present marked by differences in fibre wall thickness, or by marginal parenchyma. Ring porosity occurs probably only in temperate regions in *Sapindus* and *Koelreuteria*.

*Vessels* diffuse, round to oval with a radial diameter 60–120  $\mu\text{m}$ , or wider than 120  $\mu\text{m}$  in *Cubilia*, *Nephelium* and *Pometia*, usually 10–20/mm<sup>2</sup>, less than 10/mm<sup>2</sup> in *Cubilia*, *Nephelium*, *Pometia* and *Tristira*, and more than 20/mm<sup>2</sup> in *Dodonaea* and *Ganophyllum*. Less than 70% of the vessels are solitary, the remaining ones in radial multiples of 2–4. Vessel member length 250–600  $\mu\text{m}$ . Perforation plates simple in horizontal or oblique end walls. Intervessel pits alternate, round to polygonal, usually 4–6  $\mu\text{m}$  in horizontal diameter, pits larger in *Allophylus*, *Cubilia*, *Koelreuteria*, *Tristiropsis* and *Zollingeria*, and pits minute (smaller than 4  $\mu\text{m}$ ) in *Dimocarpus* and *Litchi*; pit apertures slit-like to round. Fine helical wall sculpturing present in half of the genera; distinct helical wall sculpturing only when ring-porous (*Sapindus* and *Koelreuteria*). Vessel-ray and vessel-parenchyma pits similar to intervessel pits but half-bordered, in some genera unilaterally compound. Vessel dimorphism not related to ring porosity in *Cardiospermum*.

*Libriform fibres* 600–1100  $\mu\text{m}$  long, with simple or minutely bordered pits mainly confined to the radial walls, thin- to medium thick-walled; very thick-walled in *Atalaya*, *Dodonaea*, *Lepisanthes*, *Nephelium* and *Schleichera*. Fibres septate in all genera except *Dodonaea*, *Harpullia* and *Tristira*. Fibre dimorphism – irregular wavy tangential bands of alternating thin- and more thick-walled fibres – in *Allophylus*, *Diploglottis* and *Paranephelium*.

*Parenchyma.* Half the genera have scanty paratracheal parenchyma. The others may have scarce, scarce to abundant or fully abundant apotracheal parenchyma (*Atalaya*, *Dodonaea*, *Filicium*, *Ganophyllum*, *Harpullia*, *Nephelium*, *Tristiropsis*); marginal parenchyma (*Filicium*, *Harpullia*, *Pometia*, *Tristira*, *Xerospermum*); vasicentric to aliform parenchyma (*Dodonaea*, *Filicium*, *Ganophyllum*, *Harpullia*, *Pometia*, *Tristira*, *Tristiropsis*, *Xerospermum*); or aliform-confluent to banded parenchyma (*Atalaya*, *Dodonaea*, *Lepisanthes*, *Nephelium*, *Sapindus*, *Zollingeria*).

*Rays* typically 1 or 2 cells wide, predominantly biseriate or wider in some species of *Atalaya*, *Dodonaea*, *Filicium*, *Harpullia*, *Sapindus*, *Tristiropsis* and *Zollingeria*. Rays of two distinct sizes occur in *Cardiospermum*: short uniseriate rays and 2–4-seriate rays exceeding 1 mm in length. Rays range from homocellular with exclusively procumbent cells to heterocellular with procumbent body cells and indistinct to distinct marginal rows of mainly square but sometimes upright cells.

*Crystals* typically in chambered crystalliferous strands, also in ray cells in *Atalaya*, *Cardiospermum*, *Elattostachys*, *Koelreuteria*, *Nephelium*, *Paranephelium* and *Tristira*.



The wood anatomy of *Gongrospermum* and *Sarcotoechia* is not known.

*Useful timber species:*

*Dimocarpus longan*: The sapwood is lighter in colour than, but not sharply defined from, the reddish brown heartwood. The wood is strong, tough, very hard, difficult to split, highly durable, easily but slowly drying with little or no degradation. *Dimocarpus* is used for shuttle pipes, bearings, textile weaving stands and rifle butts (Keating & Bolza 1982).

*Ganophyllum falcatum*: The sapwood is similar in colour to the yellow-brown hardwood. The wood is medium strong, heavy and durable, shrinks much in drying and is moderately difficult to work. *Ganophyllum* is used in house building, ship manufacturing, sporting goods and agricultural implements (ITTO 1991, as *Ganophyllum obliquum*).

*Harpullia arborea*: The sapwood is similar in colour as the yellow-brown heartwood. The wood is medium weak, medium heavy and shrinks little on drying. *Harpullia* is used for house building, furniture, plywood, packing boxes (ITTO 1991; Chowdhury & Ghosh 1963).

*Pometia pinnata*: The sapwood is lighter in colour than, but not sharply defined from the pink, red or red-brown hardwood. The wood is medium strong and medium hard, splits easily, is not durable, difficult to dry, and shrinks much on drying; in dry condition it is still susceptible to dimensional changes. *Pometia* is used for house and bridge construction, furniture, flooring, moulding, shipbuilding, tool handles, sporting goods, agricultural implements, packing boxes, bent wood, pulpwood (Anonymous 1986; Burgess 1966; Chowdhury & Ghosh 1963; Desch 1954; ITTO 1991; Keating & Bolza 1982; Martawijaya et al. 1986; Purkayastha et al. 1976).

*Schleichera oleosa*: The sapwood is distinct from the reddish heartwood. The wood is very heavy, very strong, not durable and difficult to work. *Schleichera* is used for house building, ship manufacturing, tool handles, musical instruments, agricultural implements, oil presses, fuelwood (ITTO 1991; Chowdhury & Ghosh 1963).

*Tristropsis acutangula* and *T. ferruginea*: The pale pink or cream to pinkish brown sapwood is distinct from the grey-brown to red-brown heartwood. The wood is not strong, easy to dry and not durable. *Tristropsis* is used for veneer and boards (Keating & Bolza 1982).

*Lesser used timbers:*

*Arytera litoralis*: The sapwood is similar in colour to the pinkish heartwood. The wood is hard, tough and heavy. *Arytera* is used for agricultural implement wood and tool handles (Chowdhury & Ghosh 1963).

*Dodonaea viscosa*: The sapwood is similar in colour to the yellowish brown to deep reddish brown heartwood, or sometimes lighter. The wood is hard, tough and strong, difficult to season because of splitting and cracking. *Dodonaea* is used for tool handles, fuelwood, walking sticks, turnery and engraving (Chowdhury & Ghosh 1963).

*Filicium decipiens*: The reddish brown heartwood is distinct to indistinct from the greyish white sapwood. The wood is very hard, very heavy, strong, tough, durable and not easy to season. *Filicium* is used for furniture and as construction wood (Chowdhury & Ghosh 1963).

*Litchi chinensis*: The reddish brown heartwood is distinct from the light pinkish to greyish brown sapwood. The wood is hard to very hard, heavy to very heavy, strong and tough and very durable. *Litchi* is used as general construction wood, for salt water piles, posts, beams, joists, rafters, flooring, keels and keelsons of ships (Chowdhury & Ghosh 1963).  
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Leaf anatomy — A general survey of the leaf anatomy of *Sapindaceae* can be found in Solereder (1899, 1908), and Metcalfe & Chalk (1950). Remarks on genera and species can be found throughout the works of Radlkofer (see e.g. Radlkofer 1879, 1883, 1931–1934). The tribe *Cupanieae* is best known up to now because of studies on *Cupaniopsis* (Adema 1991), *Cnesmocarpon*, *Jagera* and *Trigonachras* (Adema & Van der Ham 1993), and *Elattostachys* (unpublished data), and on *Guioa* (Van Welzen 1989).

*In surface view*. *Non-glandular hairs* none to abundant, abaxially usually more dense than adaxially, usually unicellular, with thick, or more rarely thin, sclerified walls, rather variable in length, hairs two-armed in *Litchi*, tufted ('stellate') in *Dimocarpus*, *Glenniea* and *Harpullia*. *Glandular hairs* none to abundant, at least on abaxial surface, consisting of either a single large ellipsoidal cell (*Cupaniopsis*, *Guioa*), or of 1–3 uniseriate stalk cells and a large glandular top cell, or of 4–16 uniseriate stalk cells and a small glandular top cell (*Cupaniopsis* species, *Diploglottis*, *Euphorianthus*, *Guioa hirsuta*), or of 1 or 2 stalk cells and a large glandular head consisting of several cells (species of *Jagera*, *Lepisanthes*, *Sapindus*). *Scale hairs* consisting of 1 stalk cell and a flat circular head of 6–10 thin-walled cells present in *Dictyoneura*, *Dodonaea*, *Filicium*, *Ganophyllum*, *Schleichera*. *Papillae* often present, sometimes connected by cuticular ridges (*Cnesmocarpon*, *Guioa*). Cuticle smooth to striate, if anticlinal walls undulate than often thinned in the loops of the undulations. *Unspecialized epidermal cells* polygonal, with straight to undulate anticlinal walls, often radiating around hairs and stomata; above midrib and veins square to rectangular, in rows parallel to the veins. *Stomata* predominantly cyclocytic, rarely anomo- or anisocytic, or in *Harpullia* paracytic; abaxially usually abundant, adaxially absent or rare, but rather common in *Cupaniopsis*.

*In transverse section. Lamina* dorsiventral. *Unspecialized epidermal cells* square to flat, rectangular or erect, especially above midrib and along margin; delicate vertical secondary division walls present in *Alectryon*, *Arytera*, *Cupaniopsis* (but not observed by Adema 1991), *Xerospermum*. *Hypodermis* usually present only above midrib and veins, a continuous layer in *Alectryon*, *Arytera*, *Cupaniopsis*, *Elattostachys* and *Harpullia*. *Mesophyll*: palisade tissue composed of 1 or 2, rarely up to 4 layers of long erect cells, transversely septate in *Alectryon*, *Nephelium*, *Pometia*; spongy tissue compact to rather loose, sclerenchymatous fibres or sclerosed cells present in *Cupaniopsis* (but not observed by Adema 1991), *Harpullia* and *Xerospermum*. *Midrib* raised abaxially, flat or raised adaxially, vascular bundles collateral, with a flat to arch-shaped adaxial strand and an abaxial arch, surrounded by a sclerenchyma sheath, in *Cupaniopsis*, *Diploglottis* and *Euphoriantus* with extra vascular strands in the pith, pith consisting of large, round to transverse-ellipsoidal cells, often filled with starch grains. *Minor veins* usually embedded in the mesophyll; *larger veins* may be vertically transcurrent. *Margin* with or without marginal vein, usually with normal mesophyll. *Crystals* none to abundant, usually rhomboidal, in ground tissue of midrib and veins, sometimes also in pith and/or phloem, rarely in palisade tissue or abaxial subepidermis. Druses are recorded for *Guioa*, *Lepisanthes*, *Rhyso-toechia* and *Sapindus*. *Secretory idioblasts* absent to usually abundant, small to very large, round to flat rectangular, or erect in palisade tissue, occurring in palisade tissue, spongy tissue, abaxial subepidermis, ground tissue of midrib; contents unknown, probably in most cases saponin (see also paragraph on Phytochemistry).

F. Adema

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**Chromosome numbers** — Some tens of chromosome numbers of mainly South American *Sapindaceae* are known and are listed below.

Apparently polyploidy is scarce in the family. So far, only one certain case of tetraploidy has been found for *Urvillea uniloba* var. *uniloba* (*Sapindoideae-Paullinieae*; Ferruci 1981a). Ferruci (1985) also made two counts for *Allophylus edulis* (*Sapindoideae-Thouinieae*), once  $2n = 14$  was found and once  $2n = 28$ . The first count,  $2n = 14$ , is doubtful as it is exceptional among all other *Sapindaceae*; quite likely, a haploid set of chromosomes was counted erroneously as a diploid set. The species complex *Allophylus cobbe* (of which *A. edulis* is a synonym) is probably not a polyploid complex as suggested by Leenhouts [Blumea 15 (1967) 301–358].

The basic chromosome numbers vary between  $x = 10$  and  $x = 18$ . The tribes which are considered to show more derived characters, like *Paullinieae* and *Thouinieae*, tend to have the lower basic numbers. The following chromosome base-numbers are a compilation from literature.

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|                       |   |                           |                          |
|-----------------------|---|---------------------------|--------------------------|
| <i>Dodonaeoideae</i>  | x = 10, 11, 12, 14, 15, 16                  | <i>Sapindoideae</i> (ctd) |                          |
| <i>Cossinieae</i>     | x = 10                                      |                           |                          |
| <i>Llagunoa</i>       | x = 10                                      | Group B                   | x = 11, 14, 15, 16       |
| <i>Dodonaeaceae</i>   | x = 14, 15, (16)                            | <i>Cupanieae</i>          | x = 14, 16               |
| <i>Dodonaea</i>       | x = 14, 15, (16)                            | <i>Aporrhiza</i>          | x = 14                   |
| <i>Doratoxyleae</i>   | x = 16                                      | <i>Blighia</i>            | x = 16                   |
| <i>Filicium</i>       | x = 16                                      | <i>Cupania</i>            | x = 16                   |
| <i>Harpullieae</i>    | x = 12, 15, 16                              | <i>Nephelieae</i>         | x = 11, 14, 15, 16       |
| <i>Harpullia</i>      | x = 15                                      | <i>Alectryon</i>          | x = 16                   |
| <i>Magonia</i>        | x = 15                                      | <i>Dimocarpus</i>         | x = 15                   |
| <i>Majidea</i>        | x = 12                                      | <i>Litchi</i>             | x = 14, 15               |
| <i>Ungnadia</i>       | x = 16                                      | <i>Nephelium</i>          | x = 11                   |
| <i>Xanthoceras</i>    | x = 15                                      | <i>Xerospermum</i>        | x = 16                   |
| <i>Koelreuterieae</i> | x = 11, 15, 16                              | <i>Schleichereae</i>      | x = 15, 16               |
| <i>Koelreuteria</i>   | x = 11, 15, 16                              | <i>Schleichera</i>        | x = 15, 16               |
| <br>                  |   |                           |                          |
| <i>Sapindoideae</i>   | x = (7?), 10, 11, 12, 13,<br>14, 15, 16, 18 | Group C                   | x = (7?), 10, 11, 12, 14 |
| Group A               | x = 13, 14, 15, 16, 18                      | <i>Paullinieae</i>        | x = 10, 11, 12           |
| <i>Lepisantheae</i>   | x = 13, 14, 15, 16                          | <i>Cardiospermum</i>      | x = 10, 11               |
| <i>Chytranthus</i>    | x = 16                                      | <i>Houssayanthus</i>      | x = 12                   |
| <i>Lepisanthes</i>    | x = 13, 14, 15                              | <i>Paullinia</i>          | x = 12                   |
| <i>Pancovia</i>       | x = 16                                      | <i>Serjania</i>           | x = 12                   |
| <i>Melicocceae</i>    | x = 16                                      | <i>Urvillea</i>           | x = 11                   |
| <i>Melicocca</i>      | x = 16                                      | <i>Thouinieae</i>         | x = (7?), 14             |
| <i>Sapindeae</i>      | x = 11, 15, 18                              | <i>Allophylus</i>         | x = (7?), 14             |
| <i>Deinbollia</i>     | x = 15                                      |                           |                          |
| <i>Sapindus</i>       | x = 11, 15, 18                              |                           |                          |

*Sources:* Ahuja & Natarajan, *Curr. Sci.* 26 (1957) 117. — Bhaduri & Bose, *Proc. 36th Ind. Sci. Congr.* pt. 3 (1949) 139–140. — Bowden, *Amer. J. Bot.* 32 (1945) 191–200. — Carr, *Amer. J. Bot.* 65 (1978) 238. — Chaudhuri, *Curr. Sci.* 9 (1940) 416. — Chen et al., *J. Wuhan Bot. Res.* 3 (1985) 423–428. — Diers, *Z. Bot.* 49 (1961) 437–488. — Eichhorn & Franquet, *Comp. Rend. Acad. Sci. Paris* 202 (1936) 1609. — Ferrucci, *Bonplandia* 5 (1981a) 73–81; 5 (1981b) 164–174; *Bolet. Soc. Argentina Bot.* 24 (1985) 200–202. — Fritsch, *Kulturpfl.* 18 (1970) 194. — Gill, Bir, Sidhu & Singhal in Löve, *Taxon* 33 (1984) 538. — Guervin, *Rev. Cyt. Biol. Veg.* 23 (1961) 4–87; *Bull. Mus. Nat. Hist. Nat. Paris* II, 33 (1961) 616–619; 36 (1965) 858–868. — Hair & Beuzenberg, *New Zeal. J. Sci.* 2 (1959) 148–156. — Janaki-Ammal in Darlington & Wylie, *Chrom. Atlas Flow. Pl.* (1955) 197. — Kadry, *Svensk Bot. Tidskr.* 45 (1951) 414–416. — Li Mao-xue, *Act. Bot. Bor.-Occ. Sinica* 7 (1987) 246–251, pl. II. — Maglio, Forni-Martins & da Cruz in Löve, *Taxon* 33 (1984) 536. — Mangelot & Mangelot, *Bull. Jard. Bot. État Brux.* 27 (1957) 639–654; 28 (1958) 315–329; *Rev. Cyt. Biol. Veg.* 25 (1962) 411–447. — Mehra, Khosla & Sareen, *Silvae Gen.* 21 (1972) 96–102. — Miège, *Ann. Fac. Sci. Univ. Dakar* 5 (1960) 75–86. — Nanda, *J. Ind. Bot. Soc.* 41 (1962) 271–277. — Ono, *Mem. Nat. Sci. Mus. Tokyo* 10 (1977) 63–76, pl. 6–8. — Ramirez, *Philipp. Agric.* 45 (1961) 340–342. — Sarkar, Chakraborty, Saha & Das in Löve, *Taxon* 25 (1976) 636. — Sarkar, Datta, Mallick & Chatterjee in Löve, *Taxon* 25 (1976) 649. — Sarkar, Datta, Chatterjee & Hazra in Löve, *Taxon* 31 (1982) 578. — Semple, *Ann. Missouri Bot. Gard.* 61 (1974) 902. — Simmonds, *Heredity* 8 (1954) 139–146. — Singhal, Gill & Bir in Löve, *Taxon* 29 (1980) 356. — Sugiura, *Bot. Mag. Tokyo* 45 (1931) 353–355. — West, *Brunonia* 7 (1984) 1–194.



Phytochemistry and Chemotaxonomy — Chemical characters of the family have recently been discussed twice (Hegnauer 1973, 1990). Radlkofer (1890) fully discussed the taxonomic meaning of the chemical characters detected by him during his painstaking anatomical investigations. It should be stressed that he predicted the wide occurrence of saponins in the family, and showed their taxon-specific location in twigs, leaves, calyces, pericarp, testa, and embryo, and their deposition in ordinary parenchymatic cells or in idioblasts of different size and shape. These idioblasts ('*Secretzellen*') tend to occur in many, but by no means all taxa of the family and contain mainly resinoid compounds, mucilages, tannins, or (and) saponins; in fresh tissues the content of these idioblasts was assumed to be latex-like. Radlkofer also described the distribution, size and shapes of calcium oxalate deposits in the family. Leaf and twig epidermata of *Sapindaceae* are sometimes mucilaginous; Radlkofer gave an exact description of the mucilage cells of the epidermis and their largely erratic occurrence in the family. The chemistry of sapindaceous mucilages is unexplored so far. Many taxa of *Dodonaea*, *Filicium*, *Ganophyllum* and *Llagunoa* have sticky, viscid exudates on leaves and twigs.

Recent phytochemical results with sapindaceous plants demonstrate clearly that their chemical characters have much to offer to botanists looking for infrafamilial and inter-familial affinities.

As already mentioned saponins occur widely in the family. The ichthyotoxic and detergent properties known from a large number of species are mainly derived from their saponins. Today the chemistry of these saponins is rather well known. Mono- and bidesmosidic saponins occur and their sapogenins are oleanene-type pentacyclic triterpenic acids such as oleanolic, medicagenic, and zanhic acids, and hederagenin, or polyhydroxylated derivatives of beta-amyrin such as barringtogenol, R1-barrigenol, and camelliagenin-A. Sapindaceous saponins are often acylated in the sapogenin- and/or sugar-part; acetic, angelic, and other acids are acylating agents. Steroidal sapogenins have not so far been found in the family. The resinous exudates of *Dodonaea* taxa contain labdanoid and clerodanoid diterpenes, and triterpenes of the lupane-series. Lupeol, betulin, and betulinic acid were isolated from the bark of *Schleichera oleosa*.

Accumulation of large amounts of quebrachitol, a monomethyl ether of l-inositol (= [-]-*chiro*-inositol) in leaves, barks, flowers, and fruits is highly characteristic of the family. This character is shared with *Aceraceae* and some *Hippocastanaceae*.

Polyphenolic compounds seem to be accumulated in the family mainly in the form of coumarins (e.g. scopoletin), coumarinolignans (e.g. cleomiscosin-A), flavonoids, proanthocyanidins (formerly leucoanthocyanidins), and tannins. Leaves of several taxa yielded glycosides of the flavonols kaempferol, quercetin, isorhamnetin, and sometimes myricetin, and of the flavone luteolin. Cuticular waxes and resinous exudates of *Dodonaea* species contain lipophilic flavonoids such as the prenylated and O-methylated kaempferol derivatives viscosol and aliarin, and di- and trimethyl ethers of kaempferol (e.g. santin), and of 6-hydroxykaempferol (e.g. penduletin). A flavanone, pinocembrin, was also isolated from twigs of *Dodonaea viscosa*. Oligomeric proanthocyanidins and condensed tannins seem to be more or less ubiquitous; they are mainly based on procyanidins, but may also contain prodelphinidins. Hydrolysable gallotannins do also occur in *Sapindaceae*. Fruits of *Harpullia pendula* yielded gallic acid, *m*-digallic acid, and galloyl glucoses,

and very recently the C-glucosidic gallic acid derivatives bergenin and 11-O-galloylbergenin were isolated from leaves of *Allophylus edulis* var. *edulis* [Planta Medica 56 (1990) 679]. The tannin content of dry bark may reach 15–20% and tannin-rich sapindaceous barks are used locally as tanning agents. As previously mentioned, tannins are sometimes deposited in idioblasts or so-called tannin sacs.

*Sapindaceae* store fatty oils, proteins, starch, and/or amyloid in taxon-specific combinations and amounts in their embryos (there is no endosperm as was early noted by Radlkofer). Amyloid is known only from *Cardiospermum*. Large amounts of starch or fatty oils seem to occur vicariously. From a taxonomic point of view the fatty oils seem to be the most interesting storage products of seeds. Three main types of seed oils can be distinguished within the family: a) Oils which consist of the usual triglycerides only; b) oils which also contain non-cyanogenic cyanolipids; c) oils which consist of triglycerides and cyanogenic cyanolipids; b- and c-type oils are taxonomic markers of *Sapindaceae*. In cyanolipids the triol glycerin is replaced by a leucine-derived mono- or diol with a branched C<sub>5</sub>-skeleton, one double bond, and a terminal cyano group, e.g. HO-CH<sub>2</sub>-C(CH<sub>3</sub>)=CH-CN (= x). The difference between the non-cyanogenic (e.g. with alcohol x) and cyanogenic cyanolipids consists in the presence of a so-called cyanohydrin group in the alcohol part of the latter, e.g. CH<sub>3</sub>-C(CH<sub>2</sub>)-CH(OR)-CN (= y; R = H = alcohol, in casu a mono-ol).

Cyanohydrins spontaneously release HCN; therefore an oil with the cyanolipid y with R = CO-(CH<sub>2</sub>)<sub>18</sub>-CH<sub>3</sub> yields on saponification the cyanogenic alcohol y with R = H. Obviously oils with cyanogenic cyanolipids are more or less toxic. Moreover, seed oils of *Sapindaceae* often contain unusual main fatty acids; arachidic, 11-eicosenoic, and dihydrosterculic acids are reported in literature. Arachidic and eicosenoic acids are preferentially combined with C<sub>5</sub>-alcohols, i.e. incorporated in cyanolipids, but may also be main fatty acids in oils without cyanolipids, such as the seed oil of *Blighia sapida*. A thorough analysis of the composition of the seed oils of a large number of taxa could be expected to disclose valuable characters for infrafamiliar classification.

Cyanolipids are structurally and biosynthetically linked with a third group of toxic constituents, the cyanogenic glucosides. If in y R is a glucosyl residue, the hydrophilic cyanogenic glucoside heterodendrin of *Heterodendrum oleaefolium* and other taxa results. Many *Sapindaceae* contain cyanogenic glucosides in dangerous amounts. Leaves of *Heterodendrum oleaefolium* can yield as much as 0.38% HCN (dry wt). The cyanoglucosides cardiospermin, its sulphate (ester with sulphuric acid), and heterodendrin (= dihydroacacipetalin) have been isolated from *Cardiospermum grandiflorum* and *Heterodendrum oleaefolium*. In the former species such glucosides occur throughout the plant. Probably all parts (including defatted seeds) of sapindaceous plants, which are cyanogenic, contain such glucosides; these have aglyca (i.e. cyanohydrins) identical or nearly so with the alcohols esterified with fatty acids in cyanogenic cyanolipids. In ripe seeds of many *Sapindaceae* cyanoglucosides are replaced by cyanolipids; others may have cyanoglucosides in place of cyanolipids. Cyanoglucosides such as heterodendrin form a biochemical link between *Sapindaceae* and *Leguminosae* (acacipetalin and heterodendrin in a number of *Acacia* species) and *Rosaceae-Spiraeoideae* (cardiospermin-type glucosides in *Sorbaria*).

A fourth type of toxic principles in the family is represented by hypoglycin-A and biosynthetically related nonproteinogenic amino acids, such as alpha-(methylenecyclopropyl)-glycine. They have a branched carbon chain of 6 or 7 C-atoms, and occur free or as glutamyl peptides in seeds and other parts of certain *Aceraceae*, *Hippocastanaceae*, and *Sapindaceae*. Hypoglycin-A was isolated for the first time from the 'edible' aril of *Blighia sapida* (Ackee tree) and subsequently traced as the cause of an intoxication known as 'Jamaica vomiting sickness'. The biogenetic origin of these amino acids has not yet been established with certainty. They were thought to be derived from leucine or isoleucine, but results of recent biogenetic investigations (Kean & Lewis 1981) make another pathway more probable. Threonine, a C<sub>4</sub> hydroxyamino acid, and two C<sub>1</sub>-units supplied by methionine, would give the skeleton of the C<sub>6</sub> amino acid alpha-(methylenecyclopropyl)-glycine which is accumulated, for instance, in seeds of *Litchi chinensis*. Elongation of the chain of this amino acid by a mechanism known from glucosinolates should then result in hypoglycin-type C<sub>7</sub> amino acids.

Finally some poorly known or erratically occurring classes of compounds should be mentioned. Essential oils were isolated from leaves of *Serjania piscatoria*, a fish poison plant, and *S. serrata*, from the wood of *Exothea copalillo* and from *Allophylus edulis* (= *A. cobbe*), but their composition is not yet known. Radlkofer gave lengthy descriptions of glandular hairs and excretory cells (idioblasts) of sapindaceous plants. These anatomical characters fully agree with the production and accumulation of essential oils by some members of the family.

Positive alkaloid reactions are reported in literature for a rather large number of *Sapindaceae*, but isolation and identification of alkaloid-like compounds are rare. Phenylacetamide was isolated from leaves of *Allophylus cobbe* and purine alkaloids (caffeine, theobromine, theophylline) accumulate in large amounts in seeds and other parts of some species of *Paullinia* (*P. cupana*, *P. sorbilis*, *P. triantennata*, *P. yoco*).

Fresh pericarps of *Blighia sapida* yielded a quinonoid substance named blighione (C<sub>16</sub>H<sub>20</sub>O<sub>8</sub>); its structure has not yet been elucidated.

In summary, production and accumulation of quebrachitol, cyanolipids, cardiospermin-type cyanoglycosides and hypoglycin-type amino acids are biochemical markers of the family which indicate affinities with *Aceraceae* and *Hippocastanaceae* on one side and with *Leguminosae* and the rosalean stock on the other.

R. Hegnauer

*References:* Hegnauer, R., Chemotaxonomie der Pflanzen 6 (1973) 271–287, 742, 786; 9 (1990) 486–496. — Kean, E.A. & C.E. Lewis, Phytochemistry 20 (1981) 2161. — Radlkofer, L., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 105–379 (especially p. 296–331, Anatomische Charaktere).

Uses — The wood of several species is used for timber. (See also paragraph on wood anatomy, p. 425.) Various species are used in medicine, as vegetable, as soap (*Sapindus saponaria*) or fish poison. The family includes ornamentals such as species of *Cardiospermum*, *Dictyonera*, *Filicium*, *Koelreuteria*, *Lepisanthes*. Some species are planted as garden fence (*Dodonaea angustifolia*), or as shade trees (*Dodonaea angustifolia*, *Filicium*).

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). F. Adema

*Sources:* Anonymous, The wealth of India. Raw materials. — Brown, W.H., Useful Pl. Philipp. 2 (1950) 356–369. — Burkill, I.H., Dict. Econ. Prod. Malay Penins. (1935); ed. 2 (1966). — Desch, H.E., Mal. For. Rec. 15 (1954) 528. — Heyne, K., Nutt. Pl. Indon. ed. 3 (1950) 988–1002. — Verheij, E.W.M. & R.E., Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991). — Welzen, P.C. van, A. Lamb & W.W.W. Wong, Edible Sapindaceae in Sabah, Nature Malaysiana 13 (1988) 10–25.

*Taxonomy* — The present system of the *Sapindaceae* follows that developed by Radlkofer (1890, 1931–1934) with only a few changes made by Muller & Leenhouts (1976).

Radlkofer (l.c.) divided the family in two subfamilies (*Eusapindaceae*, *Dyssapindaceae*) and fourteen tribes. The subfamily *Eusapindaceae* was divided by him in two groups: *Eusapindaceae nomophyllae* and *Eusapindaceae anomophyllae*. In the view of Radlkofer (l.c.) the *Dyssapindaceae* are derived from the *Eusapindaceae*.

Muller & Leenhouts (1976) in their survey of the pollen types accepted most of the system of Radlkofer. The main differences are that Muller & Leenhouts combined the tribes *Aphanieae* and *Lepisantheae* and so have only thirteen tribes, and did away with the division of the *Eusapindaceae*, proposing a more informal grouping in three groups A, B, and C. The most important change is that the *Dyssapindaceae* (as *Dodonaeoideae*) are considered to be an assemblage of relicts and that the *Eusapindaceae* (as *Sapindoideae*) are more homogeneous and derived.

The families *Hippocastanaceae* and *Aceraceae* are closely related to the *Sapindaceae* and may be included in that family, the former as a member of the tribe *Harpullieae*, the latter as a tribe of their own in the *Dodonaeoideae*.

An enumeration of the subfamilies and tribus, and of the genera occurring in Malesia is given below. F. Adema

A. *Dodonaeoideae* (= *Dyssapindaceae*)

1. *Cossinieae*: –
2. *Dodonaeae*: *Dodonaea*
3. *Doratoxyleae*: *Filicium*, *Ganophyllum*
4. *Harpullieae*: *Harpullia*
5. *Koelreuterieae*: *Koelreuteria*

B. *Sapindoideae* (= *Eusapindaceae*)

Group A

6. *Lepisantheae*: *Glenniea*, *Lepisanthes*, *Zollingeria*
7. *Melicocceae*: *Tristira*, *Tristiropsis*
8. *Sapindeae*: *Atalaya*, *Sapindus*

Group B

9. *Cupanieae*: *Amesiodendron*, *Arytera*, *Cnesmocarpon*, *Cupaniopsis*, *Dictyonera*, *Diploglottis*, *Elattostachys*, *Euphorianthus*, *Gloeocarpus*, *Gongrospermum*, *Guioa*, *Jagera*, *Lepiderema*, *Lepidopetalum*, *Mischocarpus*, *Paranephelium*, *Rhysotoechia*, *Sarcopteryx*, *Sarcotoechia*, *Synima*, *Toechima*, *Trigonachras*



10. *Nephelieae*: *Alectryon*, *Cubilia*, *Dimocarpus*, *Litchi*, *Nephelium*, *Pometia*, *Xerospermum*

11. *Schleicheriae*: *Schleichera*

Group C

12. *Paullinieae*: *Cardiospermum*

13. *Thouinieae*: *Allophyllus*

*References*: Muller, J. & P.W. Leenhouts. A general survey of pollen types in Sapindaceae in relation to taxonomy, in I.K. Ferguson & J. Muller (eds.), The evolutionary significance of the exine (1976) 407–445. — Radlkofer, L., Sitzungsber. Math-Phys. Cl. Königl. Bayer. Akad. Wiss. Münch. 20 (1890) 105–379; in A. Engler, Pflanzenr. 98 (1932–1934) 3–18.

KEY 1 TO THE MALESIAN GENERA  
(based on vegetative and flower characters)  
(F. Adema)

- 1a. Trees or shrubs, exceptionally lianas. Leaves simple, unifoliolate, (bi)pinnate or digitate. Inflorescences without basal tendrils . . . . . 2
- b. Herbaceous or woody climbers. Leaves biternate. Inflorescences with basal tendrils  
**Cardiospermum** (p. 483)
- 2a. Leaves simple, unifoliolate, (im)paripinnate or digitate . . . . . 3
- b. Leaves bipinnate . . . . . **Tristiropsis** (p. 742)
- 3a. Leaves imparipinnate . . . . . 4
- b. Leaves simple, unifoliolate, paripinnate or digitate . . . . . 5
- 4a. Pseudo-stipules present. Petals shorter than the sepals  
**Lepisanthes** subg. **Otophora** (p. 627)
- b. Pseudo-stipules absent. Petals longer than the sepals . . . **Paranephelium** (p. 693)
- 5a. Scale hairs present (rarely only visible in inflorescences), often also with solitary simple hairs. Young parts viscid . . . . . 6
- b. Indumentum consisting of solitary, simple hairs, sometimes mixed with stellate hair tufts, or two-branched hairs (*Litchi chinensis*). Young parts not viscid . . . . . 11  
N.B.: *Lepisanthes fruticosa* may have sticky inflorescences (race 'glandulosa' from Borneo).
- 6a. Leaves paripinnate. Ovules 1 or 2 per locule . . . . . 7
- b. Leaves simple. Ovules 2 per locule . . . . . **Dodonaea** (p. 522)
- 7a. Petals present, 5 . . . . . 8
- b. Petals absent . . . . . 9
- 8a. Leaf-rachis winged. Disc hairy. Filaments glabrous. Ovary 2-celled  
**Filicium decipiens** (p. 754)
- b. Leaf-rachis not winged. Disc glabrous. Filaments hairy. Ovary 3-celled  
**Lepiderema** (p. 618)
- 9a. Leaflets entire. Sepals connate up to halfway, not petaloid. Stigma lobed . . . . 10
- b. Leaflets subentire to crenate. Sepals free, petaloid. Stigma grooved  
**Dictyonera** (p. 507)

- 10a. Leaves (4-)5-8(-10)-jugate. Filaments of stamens glabrous. Ovules 2 per locule  
**Ganophyllum falcatum** (p. 538)
- b. Leaves (2-)3(-4)-jugate. Filaments of stamens sparsely hairy. Ovules 1 per locule  
**Schleichera oleosa** (p. 728)
- 11a. Leaves paripinnate, if unifoliolate than flowers regular, usually with 5 petals  
(*Lepisanthes senegalensis*) or without petals (*Glennia thorellii*, *Sarcotoechia plani-*  
*tiei*) . . . . . 12
- b. Leaves digitate, 1-5-foliolate. Flowers zygomorphic, 4-merous  
**Allophylus cobbe** (p. 459)
- 12a. Lower side of leaflets with naked glands . . . . . 13
- b. Lower side of leaflets without naked glands . . . . . 18
- 13a. Leaves without pseudo-stipules . . . . . 14
- b. Leaves with pseudo-stipules . . . . . **Pometia** (p. 698)
- 14a. Sepals free or basally connate, usually narrowly imbricate. Stamens usually 8 (6-  
10), filaments mostly hairy . . . . . 15
- b. Sepals almost totally connate, apert. Stamens 5, filaments glabrous or with few  
hairs . . . . . **Cubilia cubili** (p. 491)
- 15a. Ovary 2-, rarely 3-locular, warty . . . . . 16
- b. Ovary 3-locular, smooth . . . . . 17
- 16a. Leaves 1- or 2-jugate, exceptionally unifoliolate or 3-jugate. Hairs if present main-  
ly in stellate tufts. Petals absent or present. Disc hairy . . . . . **Dimocarpus** (p. 511)
- b. Leaves 1-7-jugate. Hairs if present solitary, simple. Petals present. Disc glabrous  
or rarely hairy . . . . . **Xerospermum** (p. 746)
- 17a. Leaflets finely dentate to serrate. Ovary with irritant hairs . . . . . **Jagera** (p. 614)
- b. Leaflets entire. Ovary without irritant hairs . . . . . **Trigonachras** (p. 734)
- 18a. Hairs often mainly in stellate tufts, mixed with solitary simple hairs (N.B.: In  
some cases these may be hard to find, especially when the leaflets are almost gla-  
brous) . . . . . 19
- b. Hairs solitary, simple, exceptionally two-branched (*Litchi chinensis*), if few small  
tufts of hairs present then leaves with pseudostipules (*Pometia*) . . . . . 21
- 19a. Sepals connate at the base. Petals absent or 1-5(-6) . . . . . 20
- b. Sepals free. Petals always 5 . . . . . **Harpullia** (p. 598)
- 20a. Sepals valvate to narrowly imbricate in bud. Petals absent. Stamens 6 or 7, fila-  
ments glabrous. Ovary smooth . . . . . **Glennia** (p. 540)
- b. Sepals imbricate in bud. Petals absent or present. Stamens (6-)8(-10), filaments  
usually hairy. Ovary tuberculate . . . . . **Dimocarpus** (p. 511)
- 21a. Leaves with pseudo-stipules . . . . . 22
- b. Leaves without pseudo-stipules . . . . . 24
- 22a. Leaflets entire or dentate (*Pometia pinnata*). Sepals slightly to distinctly unequal,  
free or up to halfway connate. Petals present . . . . . 23
- b. Leaflets dentate. Sepals equal, connate, somewhat less than halfway. Petals absent  
**Alectryon repandodontatus** (p. 457)
- 23a. Sepals free, imbricate, outer 1 or 2 distinctly smaller than inner 3. Stamens usually  
8 (4-10) . . . . . **Lepisanthes** subg. **Otophora** (p. 627)

- b. Sepals up to halfway connate, not imbricate, slightly unequal. Stamens 5 (or 6)  
**Pometia** (p. 698)
- 24a. Sepals free, imbricate, outer (1 or) 2 distinctly smaller than the inner three . . . . . 25
- b. Sepals free or up to almost completely connate, apert, valvate or (slightly) imbricate, usually all equal, rarely slightly unequal . . . . . 36
- 25a. Leaflets (apically) crenate, serrate or dentate . . . . . 26
- b. Leaflets entire . . . . . 28
- 26a. Branchlets straight. Petals with 2 scales . . . . . 27
- b. Branchlets sinuate. Petal margin slightly folded, hairy  
**Gloeocarpus patentivalvis** (p. 546)
- 27a. Leaf rachis often slightly winged. Leaflets shallowly crenate, or with few teeth near the apex, rarely (sub)serrate. Sepals petaloid, (sub)glabrous outside. Petal scales usually crested . . . . . **Guioa** (p. 548)
- b. Leaf rachis not winged. Leaflets dentate or serrate to crenate. Sepals not petaloid, at most the innermost one with a wide scarious rim, hairy outside. Petal scales not crested . . . . . **Cupaniopsis** (p. 493)
- 28a. Ovary and pistillode 2-celled . . . . . 29
- b. Ovary and pistillode 3- (or 4-)celled . . . . . 30
- 29a. Red glandular hairs present. Petals shorter than the sepals  
**Cupaniopsis bilocularis** (p. 497), **celebica** (p. 499), **platycarpa** (p. 503)
- b. No red glandular hairs. Petals as long as or longer than the sepals . . . . .  
**Lepisanthes tetraphylla** (p. 630), subg. **Aphania** (p. 627)
- 30a. Petals with 2 scales, or with auricles, but then sepals glabrous outside . . . . . 31
- b. Petals with 1 scale, rarely with a hairy ridge, if auricles present then sepals hairy outside . . . . . 33
- 31a. Sepals glabrous or slightly hairy outside . . . . . 32
- b. Sepals hairy outside . . . . . **Cupaniopsis** (p. 493)
- 32a. Leaves bicoloured, usually punctate, domatia normally present. Petal scales crested or not, auricles rarely present. Disc complete or interrupted . . . . . **Guioa** (p. 548)
- b. Leaves concoloured, not punctate, domatia absent. Petal scales or auricles not crested. Disc complete . . . . . **Rhysotoechia** (p. 704)
- 33a. Petiole and rachis marginate to winged or not. Inflorescences terminal, sometimes also in axils of the upper leaves. Stamens not exerted. Stigma conical or elongate, grooved. Ovules sessile on a thickened placenta . . . . . 34
- b. Petiole and rachis mostly not winged. Inflorescences terminal, axillary, rami- or cauliflorous. Stamens exerted or not. Stigma usually  $\pm$  capitate, globular or dome-shaped, slightly lobed, rarely elongate, grooved. Placenta with an obturator  
**Lepisanthes** (p. 627)
- 34a. Leaves 1–5-jugate. Petals 5. Disc complete, annular . . . . . 35
- b. Leaves 7–13-jugate. Petals 4. Disc interrupted, semi-lunate  
**Sapindus rarak** (p. 714)
- 35a. Petals with 1 scale . . . . . **Atalaya** (p. 479)
- b. Petals with auricles or a hairy ridge . . . . . **Sapindus** (p. 713)

- 36a. Petals usually absent, rarely up to 3 ..... 37
  - b. Petals present, usually 5, sometimes reduced ..... 43
- 37a. Ovary smooth or warty, 1- or 2-, exceptionally 3-celled, usually lobed; stigma lobed, exceptionally grooved (*Alectryon cardiocarpus*: ovary 2-celled) ..... 38
  - b. Ovary smooth, 3-celled, not lobed; stigma lobed or grooved ..... 40
- 38a. All hairs simple. Sepals connate or free, valvate or slightly imbricate. Ovary lobed ..... 39
  - b. Two-branched hairs often present. Sepals connate, apert. Ovary not lobed  
**Litchi chinensis (p. 654)**
- 39a. Ovary smooth. Sepals connate. Leaflets opposite or more rarely alternate, smooth below, not glaucous ..... **Alectryon** subg. **Alectryon (p. 450)**
  - b. Ovary warty. Sepals free or connate. Leaflets alternate or more rarely to opposite, finely papillate below, mostly glaucous ..... **Nephelium (p. 669)**
- 40a. Twigs puberulous, pubescent or patently hairy. Leaves 1–5(–7)-jugate. Sepals free and imbricate or almost free to connate and apert or valvate. Stamens exerted. Stigma grooved or short to long lobed ..... 41
  - b. Twigs strigose, at least when young. Leaves unifoliolate or 1–2-jugate. Sepals free, slightly imbricate. Stamens hardly exerted. Stigma slightly lobed  
**Sarcotoechia (p. 723)**
- 41a. Twigs puberulous or pubescent. Leaves 1–5(–6)-jugate. Sepals almost free to connate, apert or valvate ..... 42
  - b. Twigs patently hairy. Leaves 3–7-jugate. Sepals free, imbricate  
**Tristiria triptera (p. 740)**
- 42a. Leaves 1–5(–6)-jugate. Anthers glabrous or hairy. Ovary stipitate  
**Mischocarpus (p. 658)**
  - b. Leaves 2- or 3-jugate. Anthers glabrous. Ovary sessile  
**GongrospERMUM philippinense (p. 548)**
- 43a. Petals without scales or auricles ..... 44
  - b. Petals with scales or auricles ..... 47
- 44a. Sepals free or up to halfway connate, calyx flat or cup-shaped with a wide mouth and distinct lobes. Stamens 4–10. .... 45
  - b. Sepals almost totally connate, calyx urceolate with a narrow mouth and minute lobes. Stamens 5 ..... **Cubilia cubili (p. 491)**
- 45a. Inflorescences axillary, together often pseudoterminal, rarely truly terminal. Ovary warty ..... 46
  - b. Inflorescences ramiflorous. Ovary smooth ... **Mischocarpus paradoxus (p. 662)**
- 46a. Leaflets alternate to more rarely opposite, lower surface mostly glaucous, without glands, with domatia. Stamens 4–10. Stigma lobed ..... **Nephelium (p. 669)**
  - b. Leaflets opposite, lower surface not glaucous, with flat orbicular glands, without domatia. Stamens 8, exceptionally 7 or 9. Stigma grooved **Xerospermum (p. 746)**
- 47a. Twigs smooth or striate to slightly grooved. All leaves spirally arranged ..... 48
  - b. Twigs with either 10–12 deep grooves or 6 slight grooves, rarely striate. At least upper leaves opposite or whorled, rarely spirally arranged. Ovary with irritant hairs  
**Jagera (p. 614)**

- 48a. Petals with 1 scale, this sometimes deeply cleft . . . . . 49
- b. Petals with 2 scales or auricles . . . . . 52
- 49a. Leaflets entire, rarely slightly sinuous (*Nephelium compressum*). Disc swollen, mostly free of the torus, without a rim or a collar. Anthers hairy. Ovary 2-, sometimes 3-celled . . . . . 50
- b. Leaflets hardly to coarsely crenate- to serrate-dentate, rarely entire. Disc composed of a flat ring, adnate to the torus except for the margin and with an erect rim or tubular collar. Anthers glabrous. Ovary 3-celled
- Amesiodendron chinense** (p. 467)
- N.B.: *Paranephelium* with paripinnate leaves may key out here. From *Amesiodendron* it differs in the swollen disc without rim or collar, from *Nephelium* in the smooth, non-papillate lower surface of the leaflets, from *Lepidopetalum* and *Trigonachras* in the warty ovaries with lobed stigmas.
- 50a. Lower surface of leaflets smooth, not glaucous. Petal scale entire or bifid. Ovary smooth, stigma grooved . . . . . 51
- b. Lower surface of leaflets finely papillate, glaucous. Petal scale bilobed. Ovary warty, stigma lobed, lobes spreading or recoiled . . . . . **Nephelium** (p. 669)
- 51a. Lower surface of leaflets with axillary hairy domatia, without glands. Ovary 2-, rarely 3-celled, stigma folded outwards like an overhanging roof
- Lepidopetalum** (p. 620)
- b. Lower surface of leaflets without domatia, with glands. Ovary 3-celled, stigma cylindrical . . . . . **Trigonachras celebensis** (p. 737)
- 52a. Filaments glabrous. Stigma grooved . . . . . 53
- b. Filaments hairy, exceptionally glabrous (*Mischocarpus pentapetalus, triqueter*: ovary stipitate, stigma distinctly lobed). Stigma grooved or lobed . . . . . 54
- 53a. Sepals much connate. Petals with two scales
- Alectryon** subg. **Synalectryon** (p. 450)
- b. Sepals almost free. Petals with auricles . . . . . **Elattostachys** (p. 527)
- 54a. Upper surface of leaflets without wax, lower surface without small red glands 55
- b. Upper surface of leaflets often with wax, lower surface with small red glands
- Sarcopteryx** (p. 717)
- 55a. Twigs light to dark brown or grey to black. Ovary 2–5-celled, septa complete . 56
- b. Twigs white or silvery-grey. Ovary 1-celled, septa incomplete
- Zollingeria borneensis** (p. 754)
- 56a. Leaves 1–9-jugate. Disc glabrous, sometimes hairy. Anthers glabrous or hairy 57
- b. Leaves 1- (or rarely 2-)jugate. Disc densely hairy. Anthers glabrous
- Sarcotoechia** (p. 723)
- 57a. Petal scales with a large, ± lobed crest . . . . . 58
- b. Petal scales without or with an inconspicuous crest, rarely 1 or 2 scales with a small, fingerlike crest (*Diploglottis australis*) . . . . . 59
- 58a. Lower surface of leaflets smooth when dry. Inflorescences not branched
- Synima macrophylla** (p. 732)
- b. Lower surface of leaflets densely but minutely warty when dry. Inflorescences usually branched . . . . . **Toechima erythrocarpum** subsp. **papuanum** (p. 732)



- 59a. Ovary densely short- to long-hairy, without irritant hairs. Lower surface of leaflets usually without, rarely with (*Euphorianthus euneurus*) papillae ..... 60
- b. Ovary densely covered by short hairs and long irritant hairs. Lower surface of leaflets usually with papillae, if apparently not papillate than leaflets dentate (*Cnesmocarpon dentata*)..... **Cnesmocarpon** (p. 486)
- 60a. Venation of the leaflets  $\pm$  laxly reticulate. Petals with 2 scales. Ovary sessile or short-stipitate, stigma grooved or short-, rarely long-lobed. .... 61
- b. Venation of the leaflets densely reticulate. Petals usually with auricles. Ovary short-to long-stipitate, stigma distinctly lobed. .... **Mischocarpus** (p. 658)
- 61a. Petals as long as to longer than the sepals. Ovary 3-celled ..... 62
- b. Petals shorter than, rarely as long as the sepals. Ovary 2-or 3-celled  
**Arytera** (p. 467)
- 62a. Leaflets sparsely to rather densely hairy. Petal scales usually shorter than, rarely as long as the petals ..... 63
- b. Leaflets glabrous or very sparsely hairy. Petal scales nearly as long as the petals 64
- 63a. Young twigs striate. Leaves 4- or 5-jugate. Upper surface of leaflets not greenish or bluish grey. Petal scales crested or not. Disc interrupted  
**Diploglottis australis** (p. 520)
- b. Young twigs grooved. Leaves 4–9-jugate. Upper surface of leaflets, when dried, greenish or bluish grey. Petal scales not crested. Disc complete  
**Euphorianthus euneurus** (p. 536)
- 64a. Leaflets entire or crenulate, lower surface without small glands. Inflorescences axillary, sometimes together pseudoterminal; cymes dense, many-flowered  
**Synima cordierorum** (p. 730)
- b. Leaflets entire, lower surface usually with small glands. Inflorescences axillary, together mostly pseudoterminal, by the shifting aside and suppression of the terminal bud sometimes seemingly truly terminal; cymes lax, 1- or few-flowered  
**Trigonachras** (p. 734)

KEY 2 TO THE MALESIAN GENERA  
(based on vegetative and fruiting characters)  
(P.C. van Welzen)

### Short Key

The main key consists of several blocks of genera. The following short key can be used to start directly with these blocks. Stick to the sequence of this short key, not all *Sapindaceae* with pseudo-stipules are *Pometia*, other genera possess them as well.

1. Leaves:
- a. biternate ..... **Cardiospermum** (p. 483)
- b. bipinnate ..... **Tristiropsis** (p. 742)
- c. simple, unifoliolate, imparipinnate, digitate..... **Key, couplet 6**
- d. paripinnate ..... 2

2. Fruit:
  - a. with stinging hairs (Fig. 1a) . . . . . **Key, couplet 3**
  - b. winged, with apical crest, or small sharp margin along lobes (Fig. 2) . . . . . **Key, couplet 11**
  - c. warty, densely spiny, or densely scaled (Fig. 1b–j) . . . . . **Key, couplet 21**
  - d. smooth or wrinkled, no stinging hairs, no wings . . . . . 3
3. Seed:
  - a. naked, placenta not thickened . . . . . **Key, couplet 28**
  - b. with arillode and/or sarcotesta or placenta thickened . . . . . 4
4. Indumentum:
  - a. stellate or hairs in bundles, also simple hairs . . . . . **Key, couplet 37**
  - b. only simple hairs or glabrous . . . . . 5
5. Pseudo-stipules:
  - a. present . . . . . **Pometia** (*p.* 698)
  - b. absent . . . . . 6
6. Wall of fruit inside:
  - a. pilose, sometimes margin of valves only . . . . . **Key, couplet 40**
  - b. glabrous . . . . . **Key, couplet 52**

## Key

- 1a. Tree, shrub, or occasionally a woody climber. Leaves simple, unifoliolate, digitate or (bi)pinnate. Inflorescences without tendrils . . . . . 2
- b. Herbaceous or woody climber. Leaves biternate. Inflorescences with basal tendrils . . . . . **Cardiospermum** (*p.* 483)
- 2a. Fruit glabrous or velutinous with short (up to 1 mm long) non-stinging hairs . . . 4
- b. Fruit covered with long (more than 1 mm) stinging hairs, remaining stuck to the fingers (Fig. 1a) . . . . . 3
- 3a. Fruit not winged. Unbranched tree. Leaflets finely dentate, with glabrous glands regularly along midrib at lower surface resembling insect damage **Jagera** (*p.* 614)
- b. Fruit basally winged. Branching tree. Leaflets entire or roughly dentate, without glands at lower surface . . . . . **Cnesmocarpon** (*p.* 486)
- 4a. Leaves simple, unifoliolate, digitate or pinnate . . . . . 5
- b. Leaves bipinnate (observe absence of axillary buds on secondary rachises) . . . . . **Tristiropsis** (*p.* 742)
- 5a. Leaves all simple, unifoliolate, digitate, or imparipinnate . . . . . 6
- b. Leaves paripinnate or pseudo-imparipinnate (occasionally some leaves unifoliolate) . . . . . 10
- 6a. Fruit not winged. Leaves digitate or imparipinnate . . . . . 7
- b. Fruit winged (Fig. 2c). Leaves simple . . . . . **Dodonaea** (*p.* 522)
- 7a. Leaves unifoliolate or imparipinnate. Fruit either (slightly) lobed and coriaceous, or more or less globose and very woody, larger than 1 by 1.5 cm; if about 1 by 1.5 cm then rachis winged . . . . . 8
- b. Leaves (1–)3(–5)-digitate; rachis not winged. Fruit globose to obovoid, coriaceous, at most 0.4–1.3 by 0.3–0.8 cm . . . . . **Allophylus cobbe** (*p.* 459)

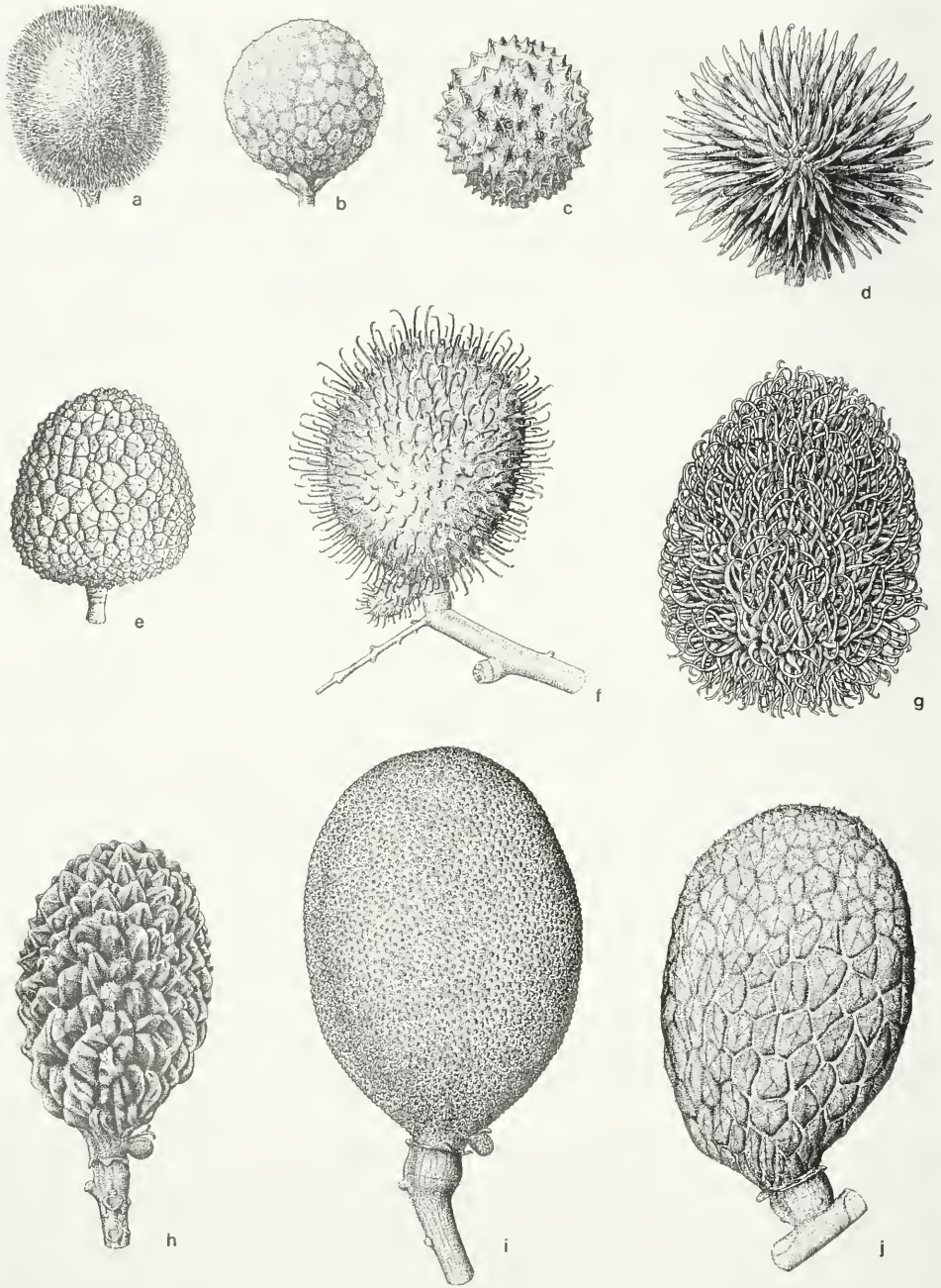


Fig. 1. Fruits with stinging hairs, spines, knobs, etc. — a. Fruits with stinging hairs; *Jagera javanica* (Blume) Blume ex Kalkman subsp. *javanica*. — b–j. Fruits with spines, knobs, etc. — b. *Dimocarpus longan* Lour. var. *longan*. — c. *Ibid.*, var. *malesianus* Leenh. — d. *Ibid.*, var. *echinatus* Leenh. — e. *Litchi chinensis* Sonn. — f. *Nephelium uncinatum* Radlk. — g. *N. meduseum* Leenh. — h. *N. juglandifolium* Blume. — i, j. *Xerospermum noronhianum* (Blume) Blume.



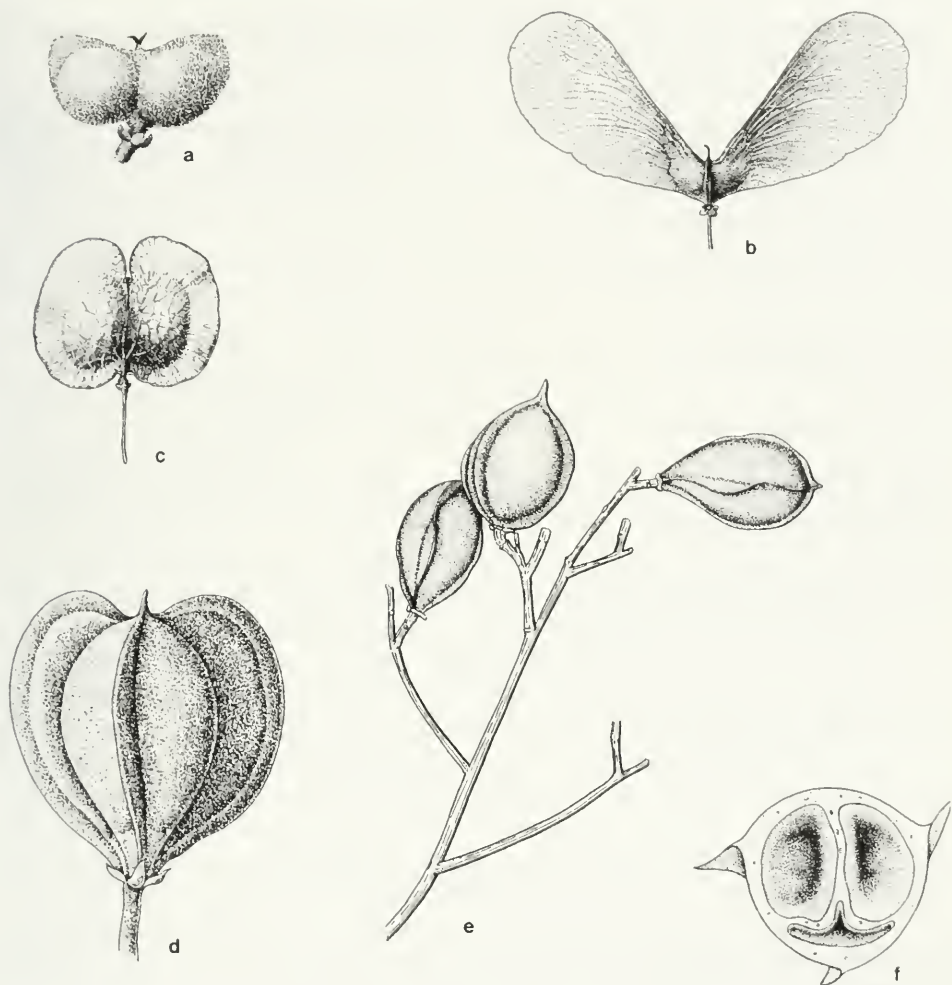


Fig. 2. Fruits with wings or crests. — a. Fruits crested: *Alectryon repandodentatus* Radlk. — b–f. Fruits winged. — b. *Atalaya salicifolia* (DC.) Blume. — c. *Dodonaea viscosa* Jacq. — d. *Sarcopteryx brachyphylla* Radlk. — e. *Tristira triptera* (Blanco) Radlk.; f. cross section.

- 8a. Hairs never in stellate tufts ..... 9
- b. Hairs mainly in stellate tufts ..... **Glenniea thorelii** (p. 544)
- 9a. Pseudo-stipules present or not; rachis winged or not. Fruit (slightly) lobed, smooth, coriaceous; wall glabrous inside ..... **Lepisanthes** subg. **Otophora** (p. 627)
- b. Pseudo-stipules absent; rachis not winged. Fruit subglobose, spiny to warty, woody; wall pilose inside ..... **Paranephelium** (p. 693)
- 10a. Fruit winged (Fig. 2b, c, e), or with a crest on top of locules (Fig. 2a), or with a narrow sharp margin along the locules (Fig. 2d) ..... 11
- b. Fruit without wings, crests, or sharp margins, margins blunt ..... 20

- 11a. Fruit winged (Fig. 2b–f) or with a sharp margin along the locules. Seeds naked, or with an arillode (seed cover free from testa), or with a smooth sarcotesta (seed cover adnate to testa) . . . . . 12
- b. Fruit with crest on top of locules (Fig. 2a). Seeds with a longitudinal strip of usually highly papillate sarcotesta (Fig. 3b) . . . . . **Alectryon** subg. **Alectryon** (p. 450)
- 12a. Wings of fruit taller than broad (Fig. 2c–e) . . . . . 13
- b. Wings of fruit broader than tall (Fig. 2b) . . . . . **Atalaya** (p. 479)
- 13a. Wings 4–10 mm broad. Seed naked . . . . . 14
- b. Wings less than 2 mm broad. Seed (partly) covered by an arillode or a sarcotesta . . . . . 15
- 14a. Fruit outside short pilose, inside glabrous, 1-locular, 3-carpellate  
**Zollingeria borneensis** (p. 754)
- b. Fruit outside glabrescent, inside pilose, 3-locular, 3-carpellate (Fig. 2e, f)  
**Tristira triptera** (p. 740)
- 15a. Fruit inside glabrous except sometimes some hairs on the fruit axis. Seed mainly to completely covered by an arillode (free from testa) . . . . . 16
- b. Fruit inside pilose. Seed partly covered by a sarcotesta (adnate to testa) . . . . . 17
- 16a. Indumentum absent to sericeous. Leaflets crenate to entire. Sepals dimorphic. Fruit coriaceous (*G. pteropoda*) to woody (*G. contracta*); pseudo-funicle absent (*G. contracta*) to present (*G. pteropoda*), long, curly, fruit axis beneath pseudo-funicle glabrous . . . . . **Guioa contracta** (p. 569), **G. pteropoda** (p. 590)
- b. Indumentum sericeous or hirsute. Leaflets entire. Sepals equal. Fruit coriaceous except for the woody base; pseudo-funicle usually short, straight (in *S. caudata* long and curly), fruit axis below pseudo-funicle hairy (in *S. caudata* glabrous)  
**Sarcopteryx** (p. 717)
- 17a. Leaflets coriaceous, without domatia or with small pockets. Fruit 3-locular . . . 18
- b. Leaflets thin, with hair tufts as domatia. Fruit 2- (or very seldom 3-)locular  
**Lepidopetalum** (p. 620)
- 18a. Fruits glabrous or shortly puberulous at most. Margin of leaflets entire to dentate/serrate . . . . . 19
- b. Fruits with appressed and patent hairs. Margin of leaflets dentate  
**Cnesmocarpon dentata** (p. 487)
- 19a. Inflorescence a spike (cymules reduced to 1 or 2 flowers)  
**Elattostachys** (p. 527)
- b. Inflorescence a thyrs (cymules di- or monochasial) . . . . . **Synima** (p. 730)
- 20a. Fruit warty to densely spiny or densely scaled (Fig. 1b–j) . . . . . 21
- b. Fruit smooth to wrinkled when dry . . . . . 27
- 21a. Fruit inside glabrous. Seeds with sarcotesta (adnate to testa) or arillode (free from testa) . . . . . 22
- b. Fruit inside hairy. Seed naked . . . . . **Paranephelium** (p. 693)
- 22a. Fruit completely covered with scales to simple spines . . . . . 23
- b. Fruit with very few simple or branched spines . . . . . **Schleichera oleosa** (p. 728)
- 23a. Seed with sarcotesta . . . . . 24
- b. Seed with arillode . . . . . 25

- 24a. Leaves 1–5(–18)-jugate, usually papillate below (dull), often minutely sericeous; without glands, often with domatia. Sepals free to more than halfway up connate. Spines and scales on fruit usually higher than broad (Fig. 1f–h) **Nephelium** (p. 669)
- b. Leaves 1–2(–3)-jugate, smooth below (more or less shiny), glabrous or hairy on midrib and nerves, not sericeous; often with scattered glands, without domatia. Sepals free or only basally connate. Spines on fruit lower than broad (Fig. 1i, j)  
**Xerospermum** (p. 746)
- 25a. Arillode covering seed (nearly) completely. Fruit indehiscent. Indumentum of tufted, 2-branched or simple hairs . . . . . 26
- b. Arillode covering lower half of seed only. Fruit dehiscent. Indumentum of simple hairs only . . . . . **Cubilia cubili** (p. 491)
- 26a. Indumentum often partly or mainly consisting of dense tufts of hairs. Glands present on lower side of leaflets near axils of veins (seldom absent in all leaflets). Seed about as high as broad . . . . . **Dimocarpus** (p. 511)
- b. Indumentum consisting of solitary, simple or 2-branched hairs. Glands absent. Seed higher than broad . . . . . **Litchi chinensis** (p. 654)
- 27a. Seed naked. Placenta not thickened and cup-shaped below seed . . . . . 28
- b. Seed with sarcotesta (can be a narrow basal ring around hilum) and/or arillode, or with thickened, cup-shaped placenta below seed . . . . . 36
- 28a. Leaves and twigs hairy and also covered with glandular scales (microscope!) . 29
- b. Leaves and twigs without glandular scales, at most hairs only . . . . . 30
- 29a. Rachis of leaves winged . . . . . **Filicium decipiens** (p. 754)
- b. Rachis of leaves without wing . . . . . **Ganophyllum falcatum** (p. 538)
- 30a. Fruit more or less hairy inside . . . . . 31
- b. Fruit glabrous inside . . . . . 34
- 31a. Fruit completely hairy inside . . . . . 32
- b. Fruit inside hairy only around placenta . . . . . **Sapindus** (p. 713)
- 32a. Fruit sessile, more or less ellipsoid (to shortly obovoid) to subglobular, indehiscent to dehiscent with 3 or 4 usually unequal valves, or tearing apart at random; 2- or 3-locular; either wall thick and hilum covering up to lower 3/4 of seed or wall thin and hilum covering less than lower 1/3 of seed . . . . . 33
- b. Fruit on broad stipe, obovoid, dehiscing loculicidally into 3 equal valves; 3-locular; wall thick, fleshy. Hilum covering less than lower 1/3 of seed  
**Trigonachras** (p. 734)
- 33a. Hairs short or none. Leaflets entire to serrate. Fruit capsular; wall 2.5–12 mm thick. Hilum covering up to lower 3/4 of seed . . . . . **Paranephelium** (p. 693)
- b. Hairs often more than 5 mm long. Leaflets entire. Fruit drupaceous; wall less than 2 mm thick. Hilum covering less than lower 1/5 of seed  
**Lepisanthes tetraphylla** (p. 630)
- 34a. Fruit indehiscent. Endotesta not ruminant . . . . . 35
- b. Fruit dehiscent. Endotesta ruminant . . . . . **Gongrospermum philippinense** (p. 548)
- 35a. Pseudo-stipules present or not; rachis winged or not; jugae 1 to more than 40. Outer (1 or) 2 sepals smaller. Fruit 2-, 3- (or 4-)locular, glabrous or pilose, less than 5 cm high; wall usually thin, sometimes thick and fleshy . . . . . **Lepisanthes** (p. 627)

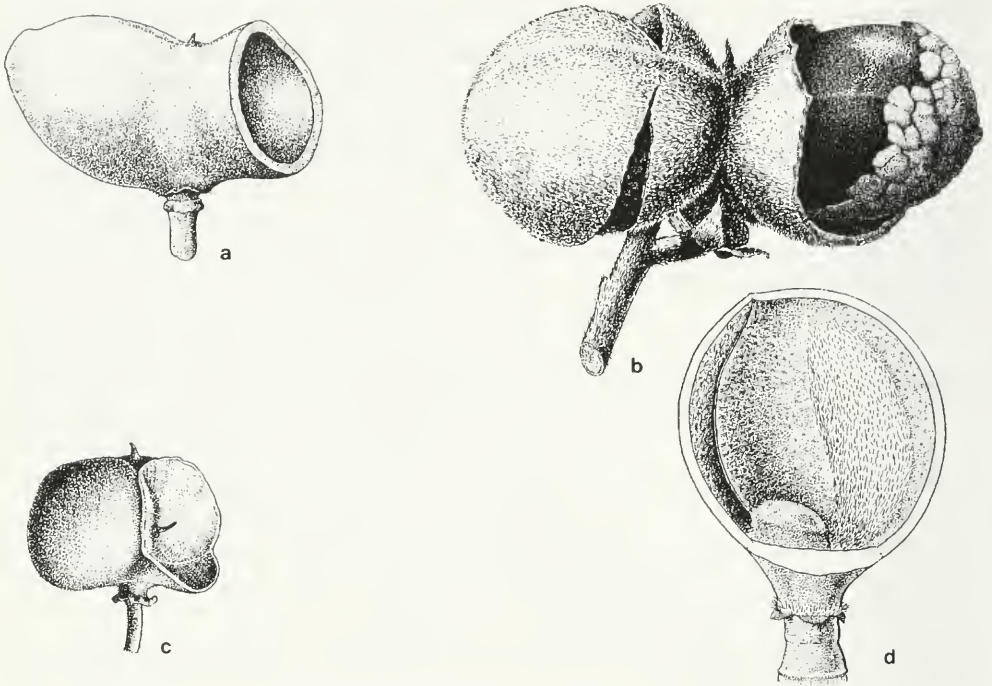


Fig. 3. Fruits and seeds, special features. — a–c. *Alectryon* Gaertn. — a. *A. glaber* (Blume) Radlk., fruit dehiscing with an irregular calyptra. — b. *A. ferrugineus* (Blume) Radlk., fruit dehiscing with an irregular calyptra, seed with a longitudinal strip of papillate sarcotesta. — c. *A. connatus* Radlk., fruit dehiscing septifragally. — d. *Dictyoneura acuminata* Blume subsp. *acuminata*, fruit valve inside with an extra, densely hairy, fleshy layer.

- b. Pseudo-stipules absent; rachis not winged; jugae 1–6. Sepals all equal. Fruit 2-locular, glabrous, either less than 2 cm high and wall rather thin or more than 6 cm high and wall very thick and fleshy. . . . . **Glenniea** (p. 540)
- 36a. Hairs in stellate tufts, also solitary . . . . . 37
- b. Only solitary hairs or plant glabrous . . . . . 38
- 37a. Fruit lobed, loculicidally dehiscent with valves. Hilum small, covering less than 1/6 of seed . . . . . **Harpullia** (p. 598)
- b. Fruit not lobed, breaking up irregularly. Hilum very large, covering up to 1/2 of seed . . . . . **Dimocarpus** (p. 511)
- 38a. Pseudo-stipules absent. Fruit lobed or not; carpels usually thin to thick, coriaceous to woody, rarely mesocarp fleshy when fresh (*Toechima*) . . . . . 39
- b. Pseudo-stipules present (sometimes reduced or early caducous: look for scar). Fruit lobed, but sometimes simple by abortion of one cell; exocarp thin, hard, mesocarp thick, juicy when fresh . . . . . **Pometia** (p. 698)
- 39a. Fruit completely hairy inside or hairs only along suture . . . . . 40
- b. Fruit glabrous inside but hairs sometimes present on the lower part of the axis . . . . . 52



- 40a. Fruit inside completely hairy, or sometimes hairs only along suture, but then stigma lobed and fruit not to hardy lobed, obovate . . . . . 41
- b. Fruit inside with hairs only along suture; fruit lobed, obcordate; stigma not lobed  
**Arytera** (p. 467)
- 41a. Fruit inside without a fleshy layer . . . . . 42
- b. Fruit inside with a fleshy layer, thickest in middle of the valves, decreasing in thickness towards margin of valves and towards dissepiments (Fig. 3d)  
**Dictyoneura acuminata** (p. 508)
- 42a. Fruit dehiscing loculicidally. Seed either (partly) covered by a smooth sarcotesta (adnate to testa) or an arillode (free from testa) . . . . . 43
- b. Fruit either forming an irregular cap during dehiscence (Fig. 3a, b), then seed covered with a longitudinal strip of usually highly papillate sarcotesta (subg. *Alectryon*; Fig. 3b), or fruit dehiscing septifragally (Fig. 3c), then seed partly covered by a basal arillode, attached to a sarcotestal annulus (subg. *Synalectryon*)  
**Alectryon** (p. 450)
- 43a. Seeds (partly) covered by a sarcotesta (N.B.: upper margin can be free from seed), arillode absent . . . . . 44
- b. Seed (partly) covered by an arillode, sarcotesta restricted to the attachment around the hilum . . . . . 48
- 44a. Fruit 2- or 3-locular, if 2-locular then fruit less than 1 cm high or outside glabrous . . . . . 45
- b. Fruit 2-locular, more than 3 cm high, velutinous outside  
**Cupaniopsis platycarpa** (p. 503)
- 45a. Fruit 2- or 3-locular, glabrous or very sparsely sericeous outside, not to strongly stipitate, if not stipitate fruit either less than 1.5 cm high or sarcotesta almost completely covering seed . . . . . 46
- b. Fruit 3-locular, glabrous or tomentose/tomentellous outside, not stipitate, more than 1.5 cm high, sarcotesta a 2- (or 3-)lobed basal cupule . . . . . 47
- 46a. Fruit glabrous outside. Leaflets with hair tufts forming domatia. Disc glabrous  
**Lepidopetalum** (p. 620)
- b. Fruit very sparsely sericeous outside. Leaflets without domatia. Disc pilose  
**Sarcotoechia** (p. 723)
- 47a. Leaflets with usually less than 10 major, spaced, strongly curved nerves. Fruit glabrous or tomentose outside; wall more than 2 mm thick  
**Toechima erythrocarpum** subsp. **papuanum** (p. 732)
- b. Leaflets with more than 14 major, dense, rather straight nerves. Fruit tomentellous outside; wall usually c. 1 mm thick . . . . . **Euphorianthus euneurus** (p. 536)
- 48a. Fruit usually not stipitate. Stigma erect, not lobed, only grooved (Fig. 4d). Arillode without basal extension . . . . . 49
- b. Fruit usually with a narrow stipe. Stigma lobed, lobes spreading (Fig. 4a–c). Arillode usually with a pseudo-funicle (Fig. 4g) . . . . . **Mischocarpus** (p. 658)
- 49a. Fruit wall thinly coriaceous to coriaceous, glabrous to pilose . . . . . 50
- b. Fruit wall woody, glabrous . . . . . **Elattostachys** (p. 527)

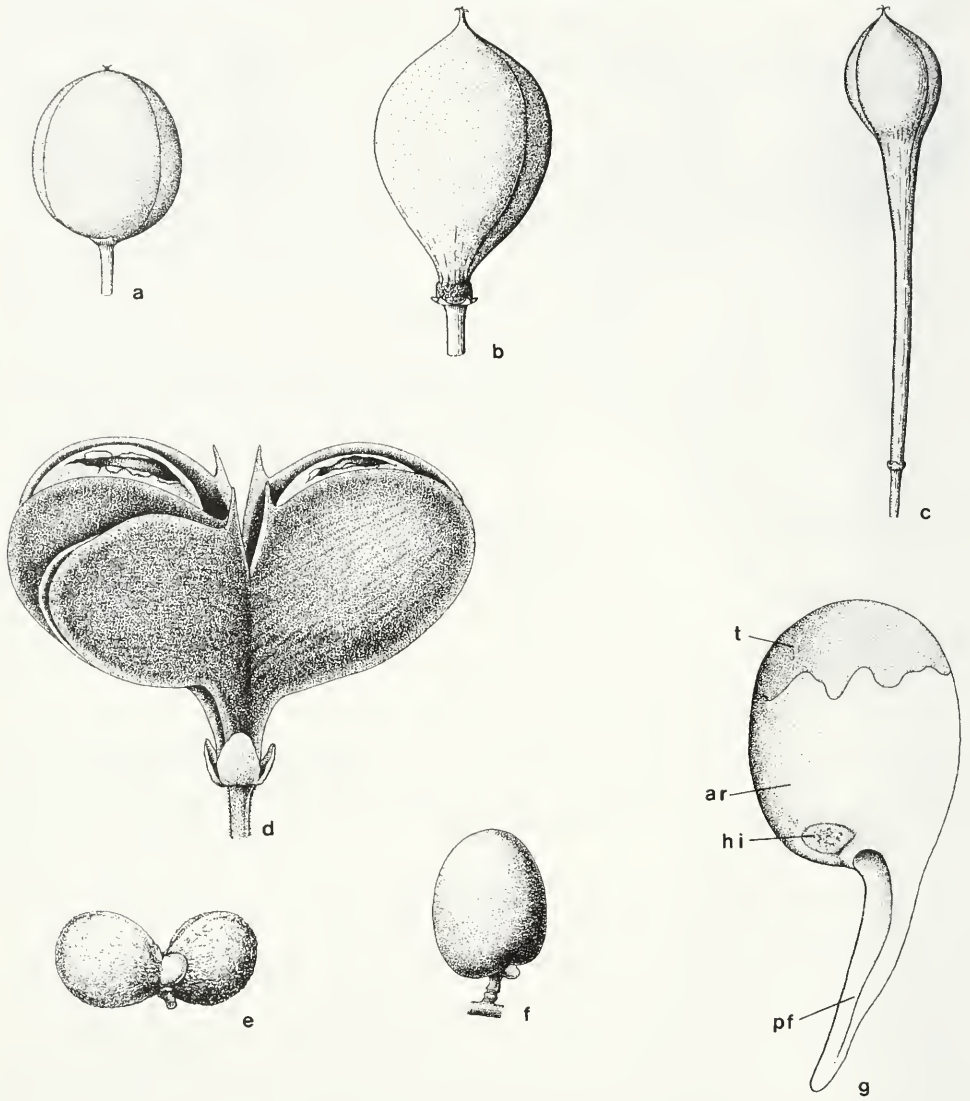


Fig. 4. Fruits stipitate or not, or lobed or not. — a–c. Fruits stipitate or not, not lobed. — a. Fruits sessile; *Mischocarpus paradoxus* Radlk. — b. Stipe short and broad; *M. largifolius* Radlk. — c. Stipe long and slender; *M. pyriformis* (F. Muell.) Radlk. subsp. *papuanus* (Radlk.) R.W. Ham. — d–f. Fruits lobed. — d. Fruits dehiscent loculicidally; *Guioa diplopetala* (Hassk.) Radlk. — e. *Lepisanthes multijuga* (Hook. f.) Leenh. — f. Just one lobe developed; *Pometia pinnata* Forst. & Forst. — g. Seed with a pseudo-funcle; *Mischocarpus triqueter* Radlk., ar = arillode, hi = hilum, pf = pseudo-funcle, t = testa.

- 50a. Fruit 3-locular, glabrous to hairy, lobed or not . . . . . 51  
 b. Fruit 2- (or 3-)locular, glabrous, lobed, lobes spreading  
     **Arytera brachyphylla** (p. 471)
- 51a. Sepals unequal. Disc uninterrupted. Fruit wall coriaceous. Seed ellipsoid to obovoid:  
 (lobed) arillode partly to completely covering seed . . . . . **Cupaniopsis** (p. 493)  
 b. Sepals equal. Disc interrupted. Fruit wall thinly coriaceous. Seed lenticular; bilobed  
 arillode covering seed . . . . . **Diploglottis australis** (p. 520)
- 52a. Placenta seldom thickened below seed. Seed (partly) covered by sarcotesta and/or  
 arillode . . . . . 53  
 b. Placenta thickened below seed, more or less cup-shaped. Seed naked  
     **Rhysotoechia** (p. 704)
- 53a. Fruit inside without a fleshy layer . . . . . 54  
 b. Fruit inside with a fleshy layer, thickest in middle of the valves, decreasing in thick-  
 ness towards margin of valves and towards dissepiments (Fig. 3d)  
     **Dictyoneura obtusa** (p. 510)
- 54a. Seeds covered with either an arillode (free from testa) or a glabrous sarcotesta (ad-  
 nate to testa). Fruit indehiscent or irregularly or loculicidally dehiscent . . . . . 55  
 b. Seeds either covered with a longitudinal strip of usually highly papillate sarcotesta,  
 locules of fruit forming an irregular cap during dehiscence (Fig. 3b, subg. *Alectry-*  
*on*); or seed partly covered with a smooth sarcotesta attached to an arillode, locules  
 dehiscent septifragally from dissepiments (Fig. 3c, subg. *Synalectryon*)  
     **Alectryon** (p. 450)
- 55a. Seed (partly) covered with a sarcotesta . . . . . 56  
 b. Seed (partly) covered with an arillode . . . . . 59
- 56a. Domatia absent; leaflets entire to crenate to dentate. Fruit 1-, 2-, or 3-locular . . . 57  
 b. Domatia consisting of tufts of hairs; leaflets entire. Fruit 2-locular  
     **Lepidopetalum fructoglabrum** (p. 622)
- 57a. Leaflets entire. Fruit 1–3-locular . . . . . 58  
 b. Leaflets crenate to dentate. Fruit 3-locular . . . **Amesiodendron chinense** (p. 467)
- 58a. Fruit 1-locular . . . . . **Nephelium maingayi** (p. 685)  
 b. Fruit 2- or 3-locular . . . . . **Rhysotoechia applanata** (p. 706)
- 59a. Fruit indehiscent or dehiscent irregularly . . . . . 60  
 b. Fruit loculicidally dehiscent . . . . . 61
- 60a. Fruit a 1- or 2-celled dry berry, indehiscent, not to hardly stipitate, ellipsoid; endo-  
 carp in dried state not detached from mesocarp . . . . . **Schleichera oleosa** (p. 728)  
 b. Fruit a 3-locular capsule (usually only 1 locus developed), dehiscent irregularly,  
 long-stipitate, globose; endocarp in dried state detached from mesocarp, forming  
 cupule around arillode . . . . . **Arytera macrobotrys** (p. 474), **A. bullata** (p. 471)
- 61a. Stigma a pyramidal remnant without recurved lobes on top of the fruit (check sever-  
 al fruits!) . . . . . 62  
 b. Stigma with recurved lobes . . . . . **Mischocarpus** (p. 658)
- 62a. Arillode with a basal pseudo-funicle (short and straight or long and sinuous). Fruit  
 lobed or not . . . . . 63  
 b. Arillode without a pseudo-funicle. Fruit not to hardly lobed . . . . . 64

- 63a. Fruit lobed (Fig. 4d), often clearly stipitate, wall coriaceous but woody in *G. contracta*. Pseudo-funcle long and sinuous. Sepals dimorphic . . . . . **Guioa** (p. 548)
- b. Fruit hardly lobed (Fig. 2d), stipe absent or inconspicuous, wall woody in lower half, more coriaceous in upper half. Pseudo-funcle usually short and straight, seldom long and sinuous (*S. caudata*). Sepals all equal . . . . . **Sarcopteryx** (p. 717)
- 64a. Branchlets more or less straight. Leaves 2–10-jugate. Scale hairs absent or present. Inflorescence ramiflorous to axillary to terminal. Fruit sessile to stipitate. . . . . 65
- b. Branchlets usually appearing sinuous because of distichous phyllotaxis. Leaves 5–14-jugate. Scale hairs absent. Inflorescence ramiflorous. Fruit hardly stipitate  
**Gloeocarpus** (p. 544)
- 65a. Scale hairs present in inflorescence. Pith in axis thin. Leaflets entire; apex not mucronulate. Disc glabrous. Fruit glabrous, wall thin, stipe very slender  
**Lepiderema** (p. 618)
- b. Scale hairs absent in inflorescence. Pith in axis thin to thick (up to 2/3 of diameter of twig). Leaflets entire to serrate to crenate; apex usually mucronulate. Disc glabrous, or with 5 bundles of hairs, or pilose. Fruit glabrous to pilose, wall thin to thick, stipe absent to broadly cuneate . . . . . **Cupaniopsis** (p. 493)

## ALECTRYON

(P.W. Leenhouts)

*Alectryon* Gaertn., Fruct. Sem. Pl. 1 (1788) 216, pl. 46; Radlk. in Engl., Pflanzenr. 98 (1933) 983; S.T. Reynolds, *Austrobaileya* 1 (1982) 472; in Fl. Austral. 25 (1985) 24; *Austrobaileya* 2 (1987) 332; Leenh., *Blumea* 33 (1988) 313. — Type species: *Alectryon excelsus* Gaertn.

*Spanoghea* Blume, *Rumphia* 3 (1847) 172. — Lectotype species (S.T. Reynolds, 1982): *Spanoghea ferruginea* Blume [= *Alectryon ferrugineus* (Blume) Radlk.].

Medium-sized to small *trees* or *shrubs*, sometimes monoecious. *Indumentum* of solitary simple hairs only. *Branchlets* terete. *Leaves* paripinnate, 1–8-jugate, unwinged; true stipules absent, lowermost pair of leaflets sometimes stipule-like. *Leaflets* opposite (or alternate), variably hairy (to glabrous), lower side smooth; base often oblique, then usually in the lower leaflets the acroscopic side and in the upper ones the basiscopic side stronger developed; margin entire or serrate, dentate, or crenate; nerves ending free or the upper ones looped and joined. *Inflorescences* axillary (or together pseudo-terminal, rarely ramiflorous), a thyse or panicle (or raceme). *Flowers* unisexual (or bisexual), actinomorphic. *Sepals* 4, 5 (or 6), from somewhat less than halfway to nearly completely connate, all equal, hardly or not petaloid, hairy on both sides (or inside glabrous). *Petals* absent or 4 or 5, about as long as to shorter than the sepals, short-clawed, with 2 scales without a crest, outside glabrous, margin ciliolate, inside hairy or glabrous. *Disc* uninterrupted, annular or ± lobed, without appendages, glabrous. *Stamens* (5–)8, exerted in male flowers; filaments hairy to glabrous; anthers basifixed, the base usually deeply cleft, usually glabrous, dehiscence latrorse or latro-introrse. *Pistil* sessile or short-stalked, densely hairy; ovary (1–)2–4(–5)-locular; style apical, columnar, mostly shorter than the ovary;



stigma grooved or with recoiled lobes. *Ovules* 1 per locule. *Fruits* sessile or short-stipitate, 1- or more-lobed, capsular, dehiscent either with a loculicidal calyptra or septifragally (along septum), smooth or slightly warty, hairy or finally glabrous, inside glabrous (or hairy). *Seeds* black, partly covered by a red sarcotesta (see under the subgenera). — **Fig. 5.**

**Distribution** — About 25 species in *E Malesia*, Australia, New Zealand, New Caledonia, New Hebrides, Solomon Islands, Fiji, Samoa, and Sandwich Islands.

**Habitat & Ecology** — Often in monsoon forest, in forest edges, river banks, or coastal vegetations, often on limestone, in the lowland but sometimes also montane. The seeds, with the contrasting light yellowish greenish capsules, the red sarcotesta, and the shining black testa, are probably mainly dispersed by birds.

**Uses** — Some species are good timber trees.

**Note** — *Alectryon* seems to be closest to *Heterodendrum* Desf. from E Australia and *Stadmania* Lam. (incl. *Smelophyllum* Radlk.) from the Mascarene Islands, Madagascar, and SE and S Africa.

#### KEY TO THE SPECIES

- 1a. Ovary 3–5-locular; fruits broadly ovoid, slightly lobed, septifragally dehiscent; seeds with a small sarcotesta around the hilum and the basal half enclosed by a cupular arillode (Subg. *Synalectryon*) . . . . . 2
- b. Ovary 1- or 2-, exceptionally 3-locular; fruits with  $\pm$  spreading lobes, dehiscent by an irregular calyptra; seeds largely covered by a sarcotesta with only a narrow, lobed, free margin (Subg. *Alectryon*) . . . . . 4
- 2a. Leaflets densely tomentellous at least on the midrib beneath . . . . . 3
- b. Leaflets subglabrous. . . . . **3. A. kangeanensis**
- 3a. Leaflets  $\pm$  acuminate; nerves not distinctly connected; fruit wall hard, inside glabrous . . . . . **1. A. affinis**
- b. Leaflets broadly rounded to slightly emarginate; nerves looped and joined; fruit wall pergamentaceous, inside hairy . . . . . **2. A. connatus**
- 4a. Lowermost pair of leaflets not stipule-like . . . . . 5
- b. Lowermost pair of leaflets stipule-like, attached near the base and much smaller than the others. . . . . **9. A. repandodentatus**
- 5a. Pistil 2- or 3-locular . . . . . 6
- b. Pistil 1-locular . . . . . **10. A. reticulatus**
- 6a. Leaflets entire; fruits usually with only 1 lobe developed, c. 15 by 12.5–15 mm diam., the wall corky, c. 1.5–2 mm thick; seeds with a smooth sarcotesta . . . . . 7
- b. Leaflets nearly always incised; often 2 fruit lobes developed, these c. 8–10 mm diam., the wall woody, 0.5–1 mm thick; seeds with a papillose sarcotesta . . . . . 8
- 7a. Leaflets acuminate at apex; midrib above prominulous; branchlets hollow, inhabited by ants . . . . . **8. A. myrmecophilus**
- b. Leaflets rounded at apex; midrib above slightly sunken; branchlets solid, without ants . . . . . **6. A. fuscus**

- 8a. Twigs terete to slightly grooved, up to 5 mm thick; petiole halfway along its length up to 2.5 mm thick; leaflets up to 16.5 by 6 cm . . . . . 9  
 b. Twigs strongly 5-grooved, 4–10 mm thick; petiole halfway along its length 2.5–8 mm thick; leaflets up to 45 by 17 cm . . . . . **5. A. ferrugineus**
- 9a. Margin of leaflets with some distant teeth mostly only in the upper half; fruits not or only slightly cordate . . . . . **7. A. glaber**  
 b. Margin of leaflets rather densely serrate-dentate nearly from the base; fruits deeply cordate . . . . . **4. A. cardiocarpus**

### Subgenus *Synalectryon*

*Alectryon* Gaertn. subg. *Synalectryon* (Radlk.) Leenh., Blumea 33 (1988) 315. — *Alectryon* Gaertn. sect. *Synalectryon* Radlk., Sapind. Holl.-Ind. (1879) 93. — Lectotype species (Leenhouts 1988): *Alectryon connatus* (F. Muell.) Radlk.

*Twigs* tomentellous, glabrescent; branchlets black or grey, glabrous. *Petiole* semi-terete; rachis above flat, ± carinate; leaf axes tomentellous, glabrescent or not. *Leaflets* pergamentaceous, entire. *Inflorescences* axillary, a thyrse, hairy, sparsely branched. *Sepals* 5, connate for halfway or more, hairy on both sides. *Petals* 5 (or absent in male flowers), the blade rounded, ciliolate, scales woolly. *Disc* especially in male flowers sometimes hardly developed. *Stamens* in male flowers 8 (always?) (to fewer in female flowers), filaments and anthers glabrous. *Pistil* 3–5-merous; stigma grooved. *Fruits* short-stipitate, broadly ovoid, slightly lobed, the base slightly concave, the apex apiculate, dehiscence septifragal; wall either pergamentaceous or hard, inside glabrous or hairy. *Seeds* with a sarcotesta around the hilum and the basal half enveloped by the cup-shaped arillode.

Distribution — Apart from the 3 *Malesian* species two more species belong to this subgenus, viz. *A. coriaceus* (Benth.) Radlk. and *A. subcinereus* (A. Gray) Radlk. from Queensland and New South Wales.

**1. *Alectryon affinis*** Radlk. in Engl. & Prantl. Nat. Pflanzenfam., Nachtr. 3 (1907) 205; Bot. Jahrb. 56 (1920) 275; in Engl., Pflanzenz. 98 (1933) 1001; Leenh., Blumea 33 (1988) 315. — Lectotype (Leenhouts 1988): *W. Fitzgerald* 30 (M holo), New Guinea.

Erect *shrub* with spreading, often pendulous branches, c. 3 m high, or *tree* up to 14 m high, dbh c. 19 cm; outer bark grey, shallowly fissured; inner bark red. *Twigs* grooved, c. 2.5 mm thick. *Leaves* 1–3-jugate; petiole 3–7.5 cm long, c. 1.5 mm thick; petiolules 2–4 mm long, above broadly grooved or flat. *Leaflets* opposite (to alternate), ovate to elliptic, 7–16 by 2.5–8 cm, index 2–3.5, above glabrous, beneath fairly densely short-hairy on midrib and nerves, in between sparsely ap-

pressed short-hairy to glabrous; base symmetric or in upper leaflets the basiscopic side slightly more developed, acute to obtuse, slightly attenuate; apex hardly to slightly acuminate, very apex rounded; midrib above flat to prominulous, nerves 0.5–1 cm apart, curved, ending free or the upper ones ± looped and joined near the margin, prominulous on both sides, intersecondary nerves few, veins and veinlets minutely reticulate, prominulous. *Inflorescences* up to 16 cm long, sparsely hairy, peduncle 1–3.5 cm long; branches few, up to 4 cm long but usually much shorter; cymules short-stalked, several-flowered; pedicels 2–5 mm long. *Sepals* c. 1 mm high. *Petals* c. 0.8 mm long, on both sides glabrous. *Stamens* 7 or 8; filaments c. 0.8 mm long; anthers c. 1.5 mm long, yellow to pink. *Fruits* c. 1 by 1.25 cm, yellowish brown, slightly warty, out-

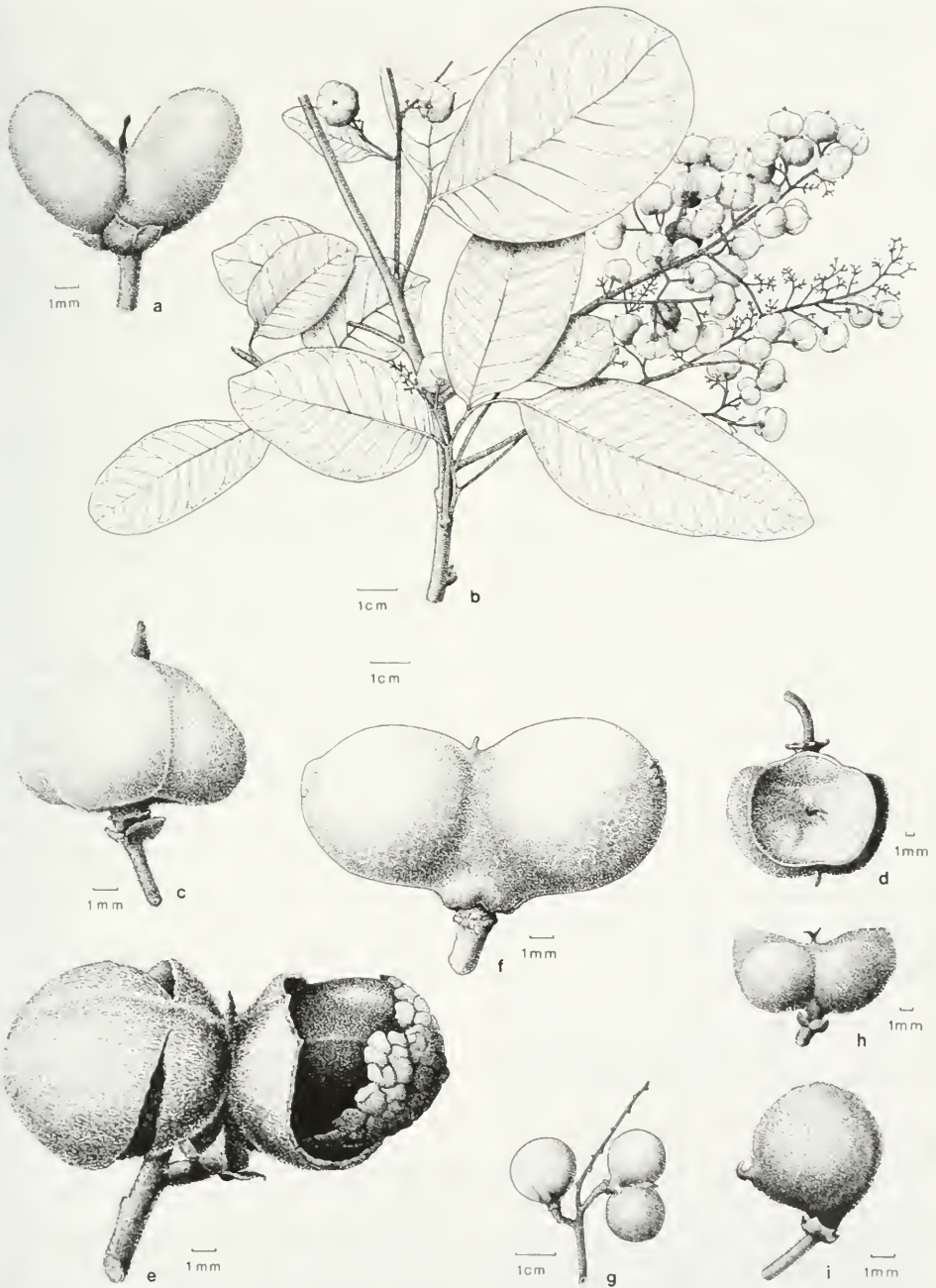


Fig. 5. *Alecryon* Gaertn. Habit and fruits. — *A. cardiocarpus* Leenh. a. Fruit. — *A. connatus* Radlk. b. Habit of fruit bearing twig; c. unopened fruit; d. partly dehiscent fruit. — *A. ferrugineus* (Blume) Radlk. e. Fruit. — *A. glaber* (Blume) Radlk. f. Fruit. — *A. myrmecophilus* Leenh. g. Fruit. — *A. repandodentatus* Radlk. h. Fruit. — *A. reticulatus* Radlk. i. Fruit (a: *BW* 4804; b, c: *Pullen* 6895; d: *Byrnes & Clarkson* 3622; e: *Fallen, Wiakuba & Lelean* 339; f: *Alston* 16075; g: *NGF* 45253; h: *Pullen* 6871; i: *Hartmann* s.n.).

side very sparsely hairy to glabrous, inside glabrous, wall hard, c. 0.5 mm thick.

Distribution – *Malesia*: Papua New Guinea. (Central and Northern Provinces).

Habitat & Ecology – Rather dry forest on rocky slope, patches of secondary forest in *Imperata* grassland. Altitude 150–750 m. Fl. July–Sept.; fr. Sept.

2. *Alectryon connatus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 340; in Engl., Pflanzenr. 98 (1933) 1000; S.T. Reynolds, *Austrobaileya* 1 (1982) 473, f. 37c; in Fl. Austral. 25 (1985) 25, f. 4f–h, map 25; Leenh., *Blumea* 33 (1988) 317, f. 1. — *Spanoghea connata* F. Muell., Trans. Philos. Inst. Victoria 3 (1859) 26. — Type: *Hill & Mueller s.n.* (MEL holo), Australia, Queensland.

*Tree* up to 20 m high, dbh c. 20 cm (or a *shrub*). *Twigs* grooved, 1.5–4 mm thick. *Leaves* 1–3-jugate; petiole 1–4.5 cm long, strongly flattened like the rachis; petiolules absent to up to 3 mm long, above broad and flat. *Leaflets* opposite to alternate, elliptic (to slightly obovate), 4.5–12.5 by 1.75–5 cm, index 1.5–3, above glabrous or sparsely hairy on midrib, nerves, and veins, beneath at first hairy all over, glabrescent with the exception of midrib and nerves; base symmetric to oblique, then the basicopic side broadest, acute to obtuse, attenuate or not; apex rounded to slightly emarginate; midrib above angular to rounded, nerves 0.75–1 cm apart, nearly straight, lower ones not joined, upper ones looped and joined near the margin, prominulous on both sides, intersecondary nerves often strongly developed, veins rather laxly reticulate, veinlets densely reticulate beneath. *Inflorescences* 6–12 cm long, fairly densely hairy; peduncle 1.5–3 cm long; pedicels c. 1 mm long. *Sepals* c. 1 mm high. *Petals* 0.5–1 mm long, inside with some woolly hairs; in male flowers sometimes absent. *Stamens* in male

flowers 8, in female flowers 5; filaments up to 1.5 mm long; anthers c. 1.5 mm long. *Fruits* 0.5–0.8 by 1–1.2 cm, outside sparsely tomentellous, inside sparsely woolly; wall thin-pergamentaceous. — **Fig. 5b–d.**

Distribution – Australia (Queensland) and *Malesia*: Papua New Guinea (Central Prov.).

Habitat & Ecology – Low monsoon scrub in the lowlands. Fr. mainly Apr.–July.

3. *Alectryon kangeanensis* Leenh., *Blumea* 32 (1987) 222; 33 (1988) 317. — Type: *Backer* 29552 (L holo; BRI, K, SING, U, UC), Kangean Archipelago.

*Twigs* grooved, 3.5–4.5 mm thick. *Leaves* 1–3-jugate; petiole 1–5 cm long, strongly flattened like the rachis; petiolules absent to up to 2 mm long, above broad and flat. *Leaflets* opposite to alternate, ovate to elliptic (to obovate), 8–15 by 2.5–5 cm, index 2.5–4, glaucous below, usually with scattered hairs on the midrib; base symmetrical to slightly oblique, acute; apex narrowly rounded; midrib above angular, nerves 0.5–1.5 cm apart, slightly curved, all (or except the lower ones) looped and joined near the margin, above hardly, beneath distinctly prominent, intersecondary nerves often well developed, veinlets densely reticulate, indistinct. *Inflorescences* 10–15 cm long, fairly densely hairy; branch 2–6 cm long; pedicels c. 3 mm long. *Sepals* c. 1 mm high. *Petals* c. 0.5 mm long, scale densely hairy. *Stamens*: filaments in male flowers c. 2 mm long; anthers c. 1.5 mm long, dehiscence latrorse. *Fruits* c. 0.75 by 1 cm, outside sparsely tomentellous, inside glabrous; wall pergamentaceous.

Distribution – *Malesia*: Kangean Archipelago (Paliat I., one collection only).

Habitat & Ecology – Altitude 50 m. Fl. and young fr. in May.

Note – The present species fairly strongly resembles *A. coriaceus* Radlk. from NE Australia.

### Subgenus *Alectryon*

*Alectryon* Gaertn. subg. *Alectryon*: Leenh., *Blumea* 33 (1988) 318. — *Alectryon* Gaertn. sect. *Eualectryon* Radlk., Sapind. Holl.-Ind. (1879) 93. — *Alectryon* Gaertn. sect. *Spanoghea* (Blume) Radlk., Sapind. Holl.-Ind. (1879) 93. — Type species as the genus.

*Twigs* variably hairy, ± glabrescent; branchlets grey to black (to brown), glabrous (or hairy). *Petiole* terete to semiterete (to triangular in cross section); rachis terete (to angular above, flat and strongly ribbed, or triangular in cross section); leaf axes hairy (or



glabrous). *Leaflets* mostly variably pergamentaceous (to herbaceous or papyraceous or thin-coriaceous); margin serrate, dentate, or crenate at least in the upper half (or entire). *Inflorescences* axillary (or ramiflorous), a sparsely branched panicle or thyrses (or raceme), densely hairy (to nearly glabrous). *Sepals* 4, 5, (6), somewhat less than halfway to nearly completely connate, hairy on both sides or on the outside only. *Petals* usually absent, if present blade kidney-shaped, inside woolly. *Stamens* 5–8; filaments variably hairy (or glabrous); anthers glabrous (or sparsely ciliate). *Pistil* (1- or 2- (or 3-)locular; stigma lobed (to grooved). *Fruits* sessile, lobed, the  $\pm$  spreading lobes often slightly carinate and shouldered, the wall woody or corky, dehiscence by an irregular calyptra. *Seeds* from around the hilum to near the apex with a narrow to usually very broad strip of strongly papillose sarcotesta with a lobed free margin.

Distribution — Like the genus; about 20 species.

**4. *Alectryon cardiocarpus*** Leenh., *Blumea* 32 (1987) 221; 33 (1988) 320. — Type: *BW* (*Versteegh*) 4804 (L. holo: BO), New Guinea.

*Alectryon reticulatus* auct. non Radlk.: Rehder, *J. Arnold Arbor.* 14 (1933) 63.

*Tree* up to 11 m high, dbh c. 20 cm; bark smooth, brown with conspicuous grey or white patches. *Twigs* terete, 4–5 mm thick, glabrescent. *Leaves* 3–5-jugate; petiole slightly flattened above, 4–7.5 cm long, 1.5–2.5 mm thick; petiolules 4–10 mm long, above broad and flat with the midrib raised; axes hairy, glabrescent. *Leaflets* (sub)opposite, ovate to elliptic, 6.5–16.5 by 2.5–6 cm, index 2–3.25, stiff-pergamentaceous; glabrous, or sparsely hairy on the midrib (also with a few hairs on the nerves beneath); base hardly to very oblique, the acroscopic side broader than the basiscopic side, rounded to acute, slightly attenuate or not; margin serrate-dentate; apex acute, mucronate; midrib above prominent; nerves 1–1.5 cm apart, obliquely patent, slightly curved, ending in marginal teeth, prominent on both sides; intersecondary nerves hardly developed, veins and veinlets laxly reticulate. *Inflorescences* axillary, panicles, up to c. 6 cm long; branches few, obliquely patent to patent, up to 6 cm long, rather many-flowered, densely hairy; peduncle c. 5 mm long; pedicels very short. *Sepals* 1–1.2 mm high, nearly completely connate, hairy at both sides to only inside sparsely hairy mainly basally. *Petals* absent. *Stamens*: filaments 0.8–1.75 mm long; anthers c. 1.25 mm long. *Pistil* 2-locular, stigma apparently grooved. *Fruits* 2-lobed, deeply cordate especially when young, smooth, lobes globular, c. 8 mm in diam., densely fulvous-tomentellous; wall c. 0.5 mm thick. — **Fig. 5a.**

Distribution — *Malesia*: New Guinea.

Habitat & Ecology — In monsoon scrub and secondary forest, on coastal limestone rocks, river

banks, and slopes, from sea level to 40 m altitude. Fl. May–June; fr. May–Aug.

Note — The present species is close to *A. ferrugineus*: it differs primarily by the small, deeply cordate fruits. Furthermore, *A. ferrugineus* is generally far more coarse and more hairy, and the hairs are not so reddish brown as in *A. cardiocarpus*.

**5. *Alectryon ferrugineus*** (Blume) Radlk., *Sapind. Holl.-Ind.* (1879) 14; in *Engl., Pflanzenr.* 98 (1933) 995; P. Royen, *Man. For. Trees Papua & New Guinea* 2 (1964) f. 2; Leenh., *Blumea* 33 (1988) 321. — *Spanoghea ferruginea* Blume, *Rumphia* 3 (1847) 173. — *Nephelium ferrugineum* F. Muell., *Descr. Notes Papuan Pl.* 1 (1876) 21. — Lectotype (Leenhouts 1988): *Zippeilus 158a* (L. holo), New Guinea.

*Alectryon strigosus* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 255; in *Engl., Pflanzenr.* 98 (1933) 991. — Type: *J. Chalmers s.n.* (MEL, n.v.), New Guinea.

*Jagera latifolia* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 264. — Type: *W. Sayer s.n.* (M holo: MEL), New Guinea.

*Alectryon mollis* Radlk. in K. Schum. & Laut., *Nachtr. Fl. Schutzgeb. Südsee* (1905) 308; in *Engl., Pflanzenr.* 98 (1933) 992. — Type: *Hellwig 3* (B $\dagger$  holo: BO, K), New Guinea.

*Alectryon macrophyllus* Kanehira & Hatusima, *Bot. Mag. Tokyo* 52 (1938) 413, f. 3. — Type: *Kanehira & Hatusima 4034* (FU, n.v.), New Guinea.

*Tree* up to 20 m high, dbh c. 25 cm, but mostly much smaller, or *shrub*: (with small buttresses); bark smooth, brown or grey to black. (patchy). *Twigs* strongly 5-grooved, 0.4–2 cm thick, fairly densely hairy, usually glabrescent. *Leaves* 2–8-jugate; petiole terete (to semiterete or triangular in

cross section), 2–29 cm long, 2.5–8 mm thick; petiolules 1–10 mm long, above flattened (or broadly grooved with or without a median rib, or terete). *Leaflets* opposite (to alternate), ovate to elliptic (to slightly falcate), 5.5–45 by 3–17 cm, index 1.75–3.5, pergamentaceous (or herbaceous or thin-coriaceous); mostly above densely hairy on midrib and nerves, beneath sparsely hairy all over to glabrous; base slightly to strongly oblique, in lower pairs of leaflets broader at the acroscopic side to basiscopic side broader in upper pairs, subcordate or rounded to acute, (slightly attenuate); margin dentate to serrate at least in the upper half (to subentire); apex rounded to acute-acuminate; midrib above prominulous or sometimes flat; nerves 0.75–2.5 cm apart, oblique-patent to widely spreading, curved to nearly straight, ending in the marginal teeth or not, above prominulous (to grooved), beneath prominent; intersecondary nerves variably developed; veins and veinlets laxly to densely reticulate, either prominulous on both sides or only beneath. *Inflorescences* axillary (or ramiflorous), panicles or thyrses, up to 30 cm long; branches few, patent, up to 12 cm long, often densely flowered, densely hairy; peduncle up to 2 cm long; pedicels 0–1.5 mm long. *Sepals* 0.75–1.5 mm high, connate, inside hairy. *Petals* absent (but see note). *Stamens*: filaments 0.5–2.25 mm long; anthers 1.25–2 mm long. *Pistil* 2-locular with a lobed stigma. *Fruits* 2-lobed (to only 1 lobe developed), carinate and angled to shouldered, fairly densely hairy but finally glabrescent, the lobes about globular, 8–10 mm diam.; wall 0.5–0.75 mm thick. — **Fig. 5e.**

Distribution — *Malesia*: Halmahera, Ternate, and New Guinea (mainly the eastern half).

Habitat & Ecology — In primary and secondary forests, often along edges, on stream banks, sometimes periodically flooded or in swampy places, often on limestone; sea level up to 300(–1950) m altitude. Fl. and fr. throughout the year.

Note — *Clemens 8489* from Papua New Guinea, Morobe Prov., Boana, is the only specimen that has flowers with petals, albeit strongly reduced; they are c. 0.8 mm long and the scale is represented by a rim of hairs only.

**6. *Alectryon fuscus*** Radlk., Philipp. J. Sc., Bot. 8 (1914) 461; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenr. 98 (1933) 999; Leenh., Blumea 33 (1988) 318. — Type: *Ahern 747* (M holotype; BO, NY), Philippines.

*Tree?* *Twigs* terete, 2.5–4 mm thick, blackish. *Leaves* 2–4-jugate; petiole semiterete, 2.5–5 cm long, c. 2 mm thick; petiolules 3–5 mm long, grooved above; axes glabrous or petiole and

rachis puberulous, especially above. *Leaflets* (sub)opposite, elliptic to somewhat ovate, 6.5–12 by 3–4 cm, index 2–3.5, pergamentaceous; glabrous or beneath on base of midrib with some hairs; base symmetrical, obtuse to acute; margin entire; apex rounded; midrib slightly grooved above; nerves 0.75–1 cm apart, patent, curved, mainly ending free, above inconspicuous, beneath prominulous; intersecondary nerves variably developed, veins and veinlets finely reticulate, prominulous on both sides. *Inflorescences* axillary, together pseudoterminal, widely branched thyrses, up to 10 cm long, puberulous. *Flowers* unknown. *Stigma* with 2 spreading lobes. *Fruits* 2-locular but usually only 1 lobe developed; lobes nearly globular, c. 15 by 12.5 mm, fulvous-tomentellous, glabrescent, smooth; wall corky, c. 1.5 mm thick. *Seeds*: sarcotesta smooth.

Distribution — *Malesia*: Philippines (Luzon).

Habitat & Ecology — “In thickets and forests at low altitude” (Merrill 1923). Fr. Jan. (ripe?).

**7. *Alectryon glaber*** (Blume) Radlk., Sapind. Holl.-Ind. (1879) 14; in Engl., Pflanzenr. 98 (1933) 993; Leenh., Blumea 33 (1988) 323, f. 2. — *Spanoghea glabra* Blume, Rumphia 3 (1847) 174. — Type: *Spanoghe 52* (L holotype), Lesser Sunda Islands.

*Alectryon serratus* Radlk., Sapind. Holl.-Ind. (1879) 15, 48; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 203; Atlas 1 (1913) pl. 126; Radlk. in Engl., Pflanzenr. 98 (1933) 994; Backer & Bakh. f., Fl. Java 2 (1965) 139. — Type: *Zollinger 2726* (FI holotype; BO, P), Java.

*Alectryon sphaerococcus* Radlk., Sapind. Holl.-Ind. (1879) 15, 49; in Engl., Pflanzenr. 98 (1933) 992. — Type: *Beccari it. sec. 2* (FI, n.v.), SE Celebes.

*Alectryon excisus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 460; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenr. 98 (1933) 994. — Type: *Ahern 470* (M holotype; BO), Philippines.

*Alectryon inaequilaterus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 460; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenr. 98 (1933) 990. — Type: *Merrill 5393* (M holotype), Philippines.

*Alectryon ochraceus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 460; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenr. 98 (1933) 994. — Type: *FB (Curran) 17455* (M holotype), Philippines.

*Alectryon celebicus* Radlk. [in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 3 (1907) 205, nom. nud.]

in Fedde, Rep. 18 (1922) 341; in Engl., Pflanzenz. 98 (1933) 989. — Type: *Koorders 18817* (M holotype; BO, L), Celebes.

*Alectryon ferrugineus* auct. non Radlk.: Koord., Minah. (1898) 401.

(Shrub or) tree up to 3 m high, dbh c. 30 cm; stem slightly fluted, with rather inconspicuous thick buttresses; bark smooth, pale brown to ash grey. Twigs slightly grooved to terete, up to 5 mm thick, usually early glabrescent. Leaves 2–5(–7)-jugate; petiole semiterete to terete, 1–8.5 cm long, (0.5–)1–2 mm thick; petiolules 1–8 mm long, terete to above flattened to hollowed with 1 or 3 ribs. Leaflets opposite (to alternate), ovate to elliptic, 4–14 by 1–5.5 cm, index 2–4.5, pergamentaceous to papyraceous; glabrous (to slightly hairy on the midrib and beneath on the nerves to, exceptionally, (sub)tomentose); base symmetrical to oblique, in lower leaflets the acroscopic, in upper ones the basiscopic side larger, acute to (broadest side) rounded, somewhat attenuate; margin mainly in the upper half only slightly serrate, dentate, or crenate (or entire); apex rounded to acute; midrib above prominulous; nerves 0.5–2 cm apart, spreading to fairly steep, curved to nearly straight, ending free or in marginal teeth, or looped and joined near the margin, prominulous on both sides (or flat above); intersecondary nerves variably developed, veins and veinlets laxly to minutely reticulate, prominulous on both sides (or beneath indistinct). Inflorescences axillary, racemes, panicles, (or thyrses), up to 9 cm long, simple or with some up to 4 cm long branches, few-flowered, hairy; peduncle 0.75–2.5 cm long; pedicels 1–1.5 mm long. Sepals c. 1 mm high, subconnate, inside hairy. Petals absent. Stamens: filaments short; anthers c. 1.2 mm long. Pistil 2- (or 3-)locular with a lobed stigma. Fruits 2-lobed and then often cordate (or only 1 lobe developed), carinate and shouldered (to slightly grooved), densely to sparsely fulvous (or ferruginous tomentose or tomentellous), the lobes almost globular, 0.9–1 by 0.75–0.9 cm; wall 0.5–1 mm thick. — **Fig. 5f.**

Distribution — *Malesia*: E Java, Lesser Sunda Islands (Sumbawa, Flores, Roti), Philippines (Palawan, Mindoro, Luzon, Negros, Sulu Islands, Mindanao), Celebes, Ceram, Kai Islands.

Habitat & Ecology — Preferably on coral limestone cliffs along the sea shore, also more inland on limestone ridges; from sea level to 1000 m altitude. Fl. Feb., Apr., May; fr. Feb.–June, Aug., Sept.–Nov.

Uses — Once reported as a good timber.

Note — The '*A. celebicus*' form differs only in being far more hairy.

**8. *Alectryon myrmecophilus*** Leenh., Blumea 32 (1987) 223; 33 (1988) 319. — Type: *Brass 29489* (L holotype), New Guinea.

Tree up to 18 m high, dbh up to 30 cm; bark dark brown or grey green, smooth. Twigs deeply grooved, up to c. 8 mm thick, fairly densely to sparsely hairy, glabrescent, branchlets reddish brown to black. Leaves 2–4-jugate; petiole semiterete to terete, 6–11 cm long, 2–2.5 mm thick; petiolules 3–10 mm long, above hollowed. Leaflets subopposite to alternate, elliptic, 7.5–20 by 3.5–7 cm, index 2–3, papyraceous to pergamentaceous; glabrous or beneath slightly puberulous on midrib and nerves; base symmetrical, acute to rounded, slightly attenuate; margin entire; apex tapering into a rather long and slender acute acumen; midrib above slightly raised; nerves 1–1.5 cm apart, spreading, curved, ending free, above slightly sunken, beneath prominent, intersecondary nerves exceptional; veins mainly transverse, veinlets laxly reticulate, rather inconspicuous. Inflorescences axillary, a thyse, up to 25 cm long, widely branched from the base, branches up to 10 cm long, obliquely patent; flowers in stalked, many-flowered cymes, densely minutely hairy. Sepals c. 0.8 mm high, somewhat less than halfway connate, inside glabrous or sericeous. Petals 5 (or absent), unguiculate, the blade kidney-shaped, c. 0.5 by 0.7 mm, outside glabrous, inside woolly. Stamens: filaments short; anthers c. 1 mm long. Pistil 2- (or 3-)locular. Fruits with mostly only 1 lobe developed, obovoid-globular, c. 16 by 14 mm, slightly carinate close to the style remnant, otherwise smooth, densely ferruginous-tomentellous; wall corky, c. 2 mm thick. Seeds: sarcotesta smooth. — **Fig. 5g.**

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.).

Habitat & Ecology — On river banks in forest at 650–1000 m altitude, in understorey of dense forest and in roadside scrub. Fl. June, Dec.; fr. Sept. The hollow branches are inhabited by ants.

Notes — 1. The present species is close to *A. fuscus*.

2. The collection *Jaheri 445* from the Kai Islands (BO) probably belongs to this species. It differs in the following characters: leaflets widest below the middle, the base slightly oblique, midrib above slightly sunken, nerves c. 0.75 cm apart, the fruit lobes c. 20 by 15 mm, fulvous tomentellous, the wall c. 4 mm thick.

3. The collection *NGF 5279* lacks petals.

**9. *Alectryon repandodentatus*** Radlk., Bot. Jahrb. 56 (1920) 274; in Engl., Pflanzenz. 98 (1933) 992; S.T. Reynolds, *Austrobaileya* 1 (1982) 479.



f. 37e; in Fl. Austral. 25 (1985) 31, f. 4i-j, map 34; Leenh., Blumea 33 (1988) 325, f. 3. — Type: *Loher s.n.* (M holo), New Guinea.

*Treelet*, up to 10 m high, dbh up to 20 cm, but often much smaller; bark rather smooth, light grey, often patchy. *Twigs* terete, 3–5 mm thick, fairly densely short fulvous-hairy; branchlets glabrous. *Leaves* 1–3- (or 4-)jugate; petiole terete, 0.75–4 cm long; petiolules 0–5 mm long, terete. *Leaflets*: basal pair often strongly falcate, upper pairs elliptic to obovate, 1.5–15 by 1–10 cm, basal pair stipule-like and much smaller than the others, middle and upper pair either of about the same size or the upper one distinctly bigger, index 1.25–2, fairly thin (to stiff pergamentaceous or ± bullate); midrib and nerves on both sides densely hairy, in between very sparsely above, beneath rather sparsely hairy; base symmetrical to variably oblique, in the basal pair the acroscopic side more strongly developed to in extreme cases the basiscopic side not developed at all, in the upper pair the basiscopic side stronger developed, the base rounded to slightly cordate (to obtuse to acute); margin dentate; apex rounded (or obtuse), mucronulate; midrib prominent and rounded on both sides; nerves 0.75–1.5 cm apart, ± obliquely patent, slightly curved to nearly straight, ending in marginal teeth, above slightly, beneath a bit more prominent; veins and veinlets above rather densely reticulate, beneath laxer. *Inflorescences* axillary, widely branched panicles, 3–10 cm long; branches up to 7 cm long, spreading, racemoid, densely hairy. *Sepals* 4, c. 1.5 mm high, somewhat less than half connate, inside sparsely hairy mainly on the lobes. *Petals* absent. *Stamens* 6 or 7; filaments c. 2.5 mm long; anthers 1–1.25 mm long. *Pistil* 2-locular, stigma slightly 2-lobed. *Fruits* 2-lobed, the lobes globular, 5–7 mm diam., above with a triangular to falcate, up to 7 mm long wing, densely shortly fulvous hairy. — **Fig. 5h.**

Distribution — *Malesia*: Papua New Guinea (Central Prov., around Port Moresby) and the Murray Islands in Torres Strait.

Habitat & Ecology — Mainly in coastal mon-

soon scrub, in and along the mangrove, also along the beach and in savannahs, on sandy as well as on rocky hills, from sea level to 150 m altitude. Fl. Mar., May, Aug.; fr. Apr., May, Aug., Oct.

Note — The present species most resembles *A. subdentatus* (Benth.) Radlk. f. *pseudostipularis* Radlk. from SE Queensland.

**10. *Alectryon reticulatus* Radlk.**, Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 255; in Engl., Pflanzenz. 98 (1933) 993; Leenh., Blumea 33 (1988) 327, f. 4. — Type: *Anonymous s.n.* (M holo), New Guinea.

*Tree to shrub?* *Twigs* angular or terete, 1–2.5 mm thick, subglabrous, glabrescent. *Leaves* 2- or 3-jugate; petiole semiterete, 2–3.5 cm long; petiolules (0–)3–5 mm long, above grooved with a fine rib. *Leaflets* alternate, elliptic, 5–9 by 2–3 cm, index 2.5–3, pergamentaceous; the midrib beneath sparsely appressed short-hairy, otherwise glabrous; base symmetrical or in upper leaflets slightly oblique, acute, attenuate; margin entire; apex not or slightly acuminate, narrowly rounded to slightly emarginate; midrib above prominulous; nerves 0.5–1 cm apart, spreading, nearly straight, indistinctly looped and joined towards the margin, prominulous on both sides; intersecondary nerves well developed, veins and veinlets laxly reticulate, prominulous on both sides. *Inflorescences* axillary, a slender thyse up to 11 cm long, in fruit still slightly hairy; peduncle c. 1 cm long; branches 1 or 2, patent; cymules (sub)sessile. *Flowers* unknown. *Sepals* probably 5, fairly highly connate, outside slightly hairy. *Pistil* 1-locular. *Fruits* subglobular, c. 7.5 mm diam., with a small stylar hook laterally halfway, stigma not lobed; wall rugose, subglabrous, hard, c. 0.5 mm thick. — **Fig. 5i.**

Distribution — *Malesia*: Islands in the Gulf of Papua and Torres Strait.

Note — Closely allied to *A. unilobatus* S.T. Reynolds, which is known from a few localities in Queensland only.



## ALLOPHYLUS

(P.W. Leenhouts)

- Allophylus* L., Sp. Pl. (1753) 348; Gen. Pl. ed. 5 (1754) 164; Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 201; in Engl., Pflanzenr. 98 (1932) 455; Leenh., Blumea 15 (1968) 301. — Type species: *Allophylus zeylanicus* L. [= *Allophylus cobbe* (L.) Raebusch].
- Gemella* Lour., Fl. Coch. (1760) 648, nom. illeg., non Hill (1761). — Type species: *Gemella trifolia* Lour. [= *Allophylus cobbe* (L.) Raebusch].
- Schmidelia* L., Mant. Pl. 1 (1767) 10, nom. illeg., non Boehm. in Ludwig (1760). — Type species: *Schmidelia racemosa* L. [= *Allophylus cobbe* (L.) Raebusch].
- Usubis* Burm. f., Fl. Ind. (1768) 89. — Type species: *Usubis triphylla* Burm. f. [= *Allophylus cobbe* (L.) Raebusch].
- Aporetica* Forst. & Forst., Char. Gen. Pl. (1775) 66, t. 66. — Type species: *Aporetica ternata* Forst. & Forst. [= *Allophylus cobbe* (L.) Raebusch].
- Ornitrophe* Comm. ex Juss., Gen. (1789) 247. — Type species: *Ornitrophe borbonica* Gmel. [= *Allophylus cobbe* (L.) Raebusch].

*Shrubs, small trees, or sometimes woody climbers, monoecious or dioecious. Indumentum* sometimes of stellate-fascicled hairs. *Leaves* digitate, (1–)3(–5)-foliolate. *Inflorescences* axillary, usually either simple or composed of a few long and slender, racemiform thyrses, sometimes paniculate. *Flowers* unisexual, obliquely zygomorphic. *Sepals* 4, free, imbricate, outer 2 distinctly narrower than the inner ones. *Petals* 4, nail-shaped to spatulate, inside above the claw with a 2-lobed scale (much smaller than to nearly as big as the blade) which is usually bearded. *Disc* ± interrupted abaxially, mostly lobed or restricted to glands in front of the petals, in female flowers sometimes saucer-shaped. *Stamens* 8, rarely fewer, all with about the same length, exerted in male flowers; filaments mostly sparsely woolly in the lower part. *Ovary* deeply 2- (or 3-)lobed, 2- (or 3-)celled, 1 ovule per cell; style 1, inserted between the lobes, more or less deeply 2- (or 3-) branched, the branches exceptionally also forked at the apex. *Fruits* drupaceous, mostly consisting of 1 mericarp only, globular to obovoid, thin-walled, mostly almost glabrous when ripe. *Seeds* without aril. — **Fig. 6.**

Distribution — Probably monotypic, though up to 250 species may be accepted. Circumtropical, in some regions penetrating into the Subtropics. See Herzog in Hannig & Winkler, Pfl. Areale 4 (1936) map 32b.

Note — Closely related to the Central and South American genus *Thouinia* Sm., which differs mainly by its winged fruits.

*Allophylus cobbe* (L.) Raebusch, Nomencl. ed. 3 (1779) 108; Hiern in Hook. f., Fl. Br. India 1 (1875) 673; Fern.-Vill., Nov. App. (1880) 51; Vidal, Phan. Cuming. (1885) 104; Kuntze, Rev. Gen. Pl. 1 (1891) 141; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66; Koord. & Valetton, Bijdr. Booms, Java 9 (1903) 146; Radlk. in Engl., Pflanzenr. 98 (1932) 594; Corner, Gard. Bull. Str. Settl. 10 (1939) 38; Wayside Trees

(1940) 584, f. 211, 213; Backer & Bakh. f., Fl. Java 2 (1965) 133. — *Rhus cobbe* L., Sp. Pl. (1753) 267; Burm. f., Fl. Ind. (1768) 75. — [*Ampacus litorea prima* Rumph., Herb. Amb. 2 (1741) 188. — *Ampacus litorea (angustifolia) minor* Rumph., Herb. Amb. 2 (1741) 189]. See Merr., Int. Rumph. (1917) 336, sub *Allophylus ternatus*. — *Schmidelia cobbe* (L.) DC., Prod. 1 (1824) 610, nom. illeg.; Wight, Ic. (1845) t.

- 964/2. — Type: *Herb. Hermann vol. 2, fol. 46* ('Kobbae') (BM), Sri Lanka.
- Allophylus ceylanicus* L., Sp. Pl. (1753) 348; Hiern in Hook. f., Fl. Br. India 1 (1875) 673; Fern.-Vill., Nov. App. (1880) 51; Radlk. in Engl., Pflanzenz. 98 (1932) 553. — Type: *Herb. Hermann 140, vol 3, fol. 54* (BM holo), Sri Lanka.
- Usubis triphylla* Burm. f., Fl. Ind. (1768) 89, t. 32, f. 1. — *Allophylus triphyllus* (Burm.) Merr., Philipp. J. Sc. 19 (1921) 363. — *Schmidelia racemosa* L., Mant. Pl. 1 (1767) 67, nom. illeg. — *Allophylus racemosus* (L.) Boerl., Handl. 1 (1890) 284, nom. illeg., non Swartz (1788); Radlk. in Engl., Pflanzenz. 98 (1932) 568; Merr., Comm. Lour. (1935) 246. — *Allophylus cobbe* (L.) Rauschel var. *racemosus* (L.) Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66. — *Ornitrophe schmidelia* Pers., Syn. Pl. 1 (1805) 412. — Type: *Herb. Linnaeus (Kleinhoff?)* (L), Java.
- Paullinia seriana* auct. non L.: Burm. f., Fl. Ind. (1768) 90, p.p.
- Aporetica ternata* Forst. & Forst., Char. Gen. Pl. (1775) 66, t. 66; Blanco, Fl. Filip. (1837) 290. — *Schmidelia ternata* (Forst. & Forst.) Cambess., Mém. Mus. Nat. Hist. Nat. Paris 18 (1829) 24, nom. illeg. — *Allophylus blancoi* Blume, Rumphia 3 (1847) 129. — *Allophylus ternatus* (Forst. & Forst.) Radlk. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5 (1895) 313, nom. illeg., non Lour. (1790); in Engl., Pflanzenz. 98 (1932) 572.
- Allophylus ternatus* Lour., Fl. Coch. (1790) 232; Roxb., Hort. Beng. (1814) 88 ('lanatus'); Ridley, Fl. Malay Penins. 1 (1922) 489.
- Gemella trifolia* Lour., Fl. Coch. (1790) 649. — *Aporetica gemella* DC., Prod. 1 (1824) 610, nom. illeg.; Blanco, Fl. Filip. ed. 2 (1845) 203.
- Ornitrophe integrifolia* Willd., Sp. Pl. 2, 1 (1799) 322; Roxb., Fl. Ind. ed. Carey (1832) 268. — *Allophylus integrifolius* Blume, Rumphia 3 (1847) 129, nom. illeg. — Type: *Commerson 407*, Borbonia.
- Schmidelia timoriensis* DC., Prod. 1 (1824) 611, nom. illeg. — *Allophylus timoriensis* (DC.) Blume, Rumphia 3 (1847) 130; Radlk. in Engl., Pflanzenz. 98 (1932) 587. — Type: *Riedlé s.n.*, Timor.
- Schmidelia bantamensis* Blume, Bijdr. (1825) 231, nom. illeg. — *Allophylus fulvinervis* (Blume) Blume var. *bantamensis* (Blume) Blume, Rumphia 3 (1847) 136. — *Allophylus cobbe* (L.) Rauschel subf. *bantamensis* (Blume) Backer, Fl. Batavia 1 (1907) 336. — Type: *Anonymous s.n.* (L), Java.
- Schmidelia fulvinervis* Blume, Bijdr. (1825) 231, nom. illeg. — *Allophylus fulvinervis* (Blume) Blume, Rumphia 3 (1847) 133, incl. var. *bullatus*, *burmannianus*, *fuscus*, *hircinus*, *montanus*, *reclinatus*, *sericeus*, *velutinus*; Miq., Fl. Ind. Bat. 1, 2 (1859) 576; Ridley, Fl. Malay Penins. 1 (1922) 489. — *Allophylus cobbe* (L.) Rauschel f. *fulvinervis* (Blume) Backer, Fl. Batavia 1 (1907). — Type of species: *Blume 1850* (L, U), Java.
- Schmidelia javensis* Blume, Bijdr. (1825) 232, nom. illeg. — *Allophylus javensis* (Blume) Blume, Rumphia 3 (1847) 126, incl. var. *cuspidata*, *racemosa*, *rigida*, *robusta*, *striata*; Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 231; in Engl., Pflanzenz. 98 (1932) 578. — *Allophylus javensis* (Blume) Blume var. *genuinus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 239. — Type of species: *Blume 1803* (L), Java.
- Schmidelia littoralis* Blume, Bijdr. (1825) 232, nom. illeg. — *Allophylus littoralis* (Blume) Blume, Rumphia 3 (1847) 124, incl. var. *repanda*, *serrulata*. — *Allophylus cobbe* (L.) Rauschel f. *littoralis* (Blume) Backer, Fl. Batavia 1 (1907) 337. — Type of species: *Blume 1683* (L), Java.
- Ornitrophe glabra* Roxb. [Hort. Beng. (1814) 28, nom. nud.], Fl. Ind. ed. Carey (1832) 267, nom. illeg. — *Schmidelia glabra* (Roxb.) Steud., Nomencl. ed. 2, 2 (1841) 531, nom. illeg.; Benth. in Hook. Lond. J. Bot. 2 (1843) 213. — *Allophylus glaber* Boerl., Handl. 1 (1890) 284, nom. illeg.; Ridley, Fl. Malay Penins. 1 (1922) 489; Radlk. in Engl., Pflanzenz. 98 (1932) 566. — *Allophylus cobbe* (L.) Rauschel var. *glabra* (Roxb.) Prain, Rec. Bot. Surv. India 1 (1898) 236, non Kuntze (1891). — Type: *Roxburgh s.n.*, India.
- Ornitrophe repanda* Roxb. [Hort. Beng. (1814) 88, nom. nud.], Fl. Ind. ed. Carey (1832) 269. — Type: *Roxburgh 2639*, Moluccas(?).
- Ornitrophe villosa* Roxb. [Hort. Beng. (1814) 28, nom. nud.], Fl. Ind. ed. Carey (1832) 265. — *Allophylus villosus* (Roxb.) Blume, Rumphia 3 (1847) 132; Ridley, Fl. Malay Penins. 1 (1922) 490; Radlk. in Engl., Pflanzenz. 98 (1932) 560. — *Allophylus cobbe* (L.) Rauschel f. *villosus* (Roxb.) Hiern in Hook. f., Fl. Br. India 1 (1875) 674. — Type: *Roxburgh s.n.*, India.
- Aporetica penicellata* Blanco, Fl. Filip. (1837) 291. — Neotypes: *Merrill Sp. Blanc. 962, 1028*, Luzon.
- Schmidelia macrophylla* Zipp. ex Span., Linnaea 15 (1841) 180, nom. nud., non DC. (1824). — Type: *Zippelius s.n.* (L), Timor.
- Schmidelia parviflora* Zipp. ex Span., Linnaea 15

- (1841) 180, nom. nud. — Type: *Spanoghe s.n.* (L.), Timor.
- Allophylus amboinensis* Blume, Rumphia 3 (1847) 129. — Type: *Zippelius s.n.* (L.), Ambon.
- Allophylus cambessedei* Blume, Rumphia 3 (1847) 129, nom. illeg.
- Allophylus celebicus* Blume, Rumphia 3 (1847) 128. — Type: *Forsten s.n.* (L, U), Celebes.
- Allophylus ligustrinus* Blume, Rumphia 3 (1847) 126. — *Schmidelia ligustrina* Blume ex Teijsm. & Binn., Cat. Hort. Bog. (1866) 391, nom. illeg. — Syntypes: *Korthals s.n.* (L), Sumatra; *Kuhl & van Hasselt s.n.* (L), Java.
- Allophylus rufescens* Blume, Rumphia 3 (1847) 137. — *Allophylus fulvinervis* (Blume) Blume var. *rufescens* (Blume) Miq., Fl. Ind. Bat. 1, 2 (1859) 576. — Type: *Anonymous s.n.* (L), Borneo.
- Allophylus rufescens* Blume var. *cuspidatus* Blume, Rumphia 3 (1847) 137. — Type: *Korthals s.n.* (L), Borneo.
- Allophylus rufescens* Blume var. *heterodon* Blume, Rumphia 3 (1847) 137. — Type: *Korthals s.n.* (L), Borneo.
- Allophylus rugosus* Blume, Rumphia 3 (1847) 138. — Type: *Anonymous s.n.* (L), Java.
- Allophylus sessilis* Blume, Rumphia 3 (1847) 125. — Type: *Junghuhn s.n.* (L), Java.
- Allophylus sumatranus* Blume, Rumphia 3 (1847) 132, incl. var. *crenulatus*, *elongatus*, *glabriusculus*, *politus*; Radlk. in Engl., Pflanzenr. 98 (1932) 586. — Type of species: *Anonymous s.n.* (L), Sumatra.
- Schmidelia leptostachya* Blume, Rumphia 3 (1847) 141, nom. illeg. — *Allophylus leptostachyus* (Blume) Boerl., Handl. 1 (1890) 284. — Type: *Anonymous s.n.* (L), Java.
- Schmidelia mutabilis* Blume, Rumphia 3 (1847) 140, nom. illeg.; Miq., Sumatra (1861) 199, 511. — *Allophylus mutabilis* (Blume) Boerl., Handl. 1 (1890) 284. — Syntypes: *Anonymous s.n.* (L), Blume 1205 (L), both Java.
- Schmidelia obovata* A. Gray, U. S. Expl. Exp. Bot. 1 (1854) 249, nom. illeg.; cf. Merr., Philipp. J. Sc., Bot. 3 (1908) 79. — Type: *Cuming 1502* (Fl. L. M), Philippines.
- Schmidelia grossedentata* Turcz., Bull. Soc. Nat. Moscou 31 (1858) 401, nom. illeg. — *Allophylus grossedentatus* (Turcz.) Fern.-Vill., Nov. App. (1880) 51; Lecomte in Fl. Indo-Chine 1 (1912) 1013; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 585. — *Allophylus cobbe* (L.) Raeuschel var. *grossedentata* (Turcz.) Vidal, Phan. Cuming. (1885) 105. — Type: *Cuming 640* (Fl. L. M), Luzon.
- Allophylus sundanus* Miq., Fl. Ind. Bat. 1, 2 (1859) 575, nom. illeg.
- Schmidelia tomentosa* Hook. f., Trans. Linn. Soc. 23 (1860) 164, nom. illeg. — *Allophylus tomentosus* Boerl., Handl. 1 (1890) 284. — Type: *Motley 245*, Borneo.
- Schmidelia mutabilis* Blume var. *subglabra* Miq., Sumatra (1861) 199, 511. — Type: *Diepenhorst HB 2330* (BO, L, U), Sumatra.
- Schmidelia fulvinervis* Blume var. *macrophylla* Teijsm. & Binn., Cat. Hort. Bog. (1866) 391, nom. nud.
- Allophylus dimorphus* Radlk., Sapind. Holl.-Ind. (1879) 17, 56; Merr., Fl. Manila (1912) 304; Enum. Philipp. Flow. Pl. 2 (1923) 494; Radlk. in Engl., Pflanzenr. 98 (1932) 602; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 929. — Type: *Lobb 456* (Fl. L), Malaya.
- Allophylus filiger* Radlk., Sapind. Holl.-Ind. (1879) 17, 56; in Engl., Pflanzenr. 98 (1932) 583. — Type: *Lobb 472* (Fl. L), Malaya.
- Allophylus leptococcus* Radlk., Sapind. Holl.-Ind. (1879) 12, 56; in Engl., Pflanzenr. 98 (1932) 581. — Type: *Beccari 2828* (Fl), Kei Islands.
- Allophylus cobbe* (L.) Raeuschel f. *blancoi* Fern.-Vill., Nov. App. (1880) 51. — *Allophylus cobbe* (L.) Raeuschel var. *blancoi* (Fern.-Vill.) Vidal, Phan. Cuming. (1885) 104. — Type unknown.
- Allophylus macrostachys* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 56; in Engl., Pflanzenr. 98 (1932) 584. — Syntypes: *Cuming 826* (Fl. L. M); *Warburg 13339, 13340, 13343*, all Luzon.
- Allophylus quinatus* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 57; in Engl., Pflanzenr. 98 (1932) 603. — Type: *Cuming 1270* (Fl. L, M), Luzon.
- Allophylus setulosus* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 68; in Engl., Pflanzenr. 98 (1932) 581. — Type: *Warburg 14919*, Philippines, Jolo.
- Allophylus micrococcus* Radlk. in K. Schum. & Laut., Nachr. Fl. Schutzgeb. Südsee (1905) 307; in Engl., Pflanzenr. 98 (1932) 599. — Syntypes: *Hellwig 294* (BO); *Lauterbach 1385* (SING), 2224 (WRSL), 2340 (WRSL), 2690; *Rodatz & Klink 2*; all Papua New Guinea.
- Allophylus unifoliolatus* Radlk. in Elmer, Leaf. Philipp. Bot. 1 (1907) 208; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 498; Radlk. in Engl., Pflanzenr. 98 (1932) 555. — Type: *Elmer 7329* (M), Leyte.
- Allophylus apiocarpus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 227, 238; in Engl., Pflanzenr. 98 (1932) 556. — Type: *FB 6120* (M, in protologue



- erroneously cited as 6420), Philippines, Cebu. *Allophylus chlorocarpus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 232, 239; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 494; Radlk. in Engl., Pflanzenr. 98 (1932) 586. — Type: *FB 3473* (M), Palawan.
- Allophylus insignis* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 234, 240; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 604. — Type: *Cuming 1447* (FI), Luzon.
- Allophylus dasythyrsus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 231, 239; in Engl., Pflanzenr. 98 (1932) 582. — Type: *Cuming 1332* (FI, L, M), Luzon.
- Allophylus hymenocalyx* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 229, 238; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 565. — Type: *Copeland 1635* (M), Mindanao.
- Allophylus largifolius* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 226, 238; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 552. — Type: *Merrill 5475* (BO, L, M), Mindanao.
- Allophylus malvaceus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 38 (1909) 231, 239; in Engl., Pflanzenr. 98 (1932) 583. — Type: *Cuning 1021* (FI), Luzon.
- Allophylus leucocladus* Radlk., Philipp. J. Sc., Bot. 6 (1911) 181, nom. illeg. — *Allophylus leucochrous* Radlk., Philipp. J. Sc., Bot. 8 (1914) 444; in Engl., Pflanzenr. 98 (1932) 582. — Type: *BS 6880* (M), Philippines, Polillo.
- Allophylus leptocladus* Radlk. in Elmer. Leaflet. Philipp. Bot. 5 (1913) 1602; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 593. — Type: *Elmer 11957* (BO, FI, L, M, U), Mindanao.
- Allophylus repandodentatus* Radlk. in Elmer. Leaflet. Philipp. Bot. 5 (1913) 1603; in Engl., Pflanzenr. 98 (1932) 600. — Type: *Elmer 11827* (BO, L, M), Mindanao.
- Allophylus simplicifolius* Radlk. in Elmer. Leaflet. Philipp. Bot. 5 (1913) 1601; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 496; Radlk. in Engl., Pflanzenr. 98 (1932) 558. — Syntypes: *Elmer 11138, 13590* (both BO, FI, L, M, U), Mindanao.
- Allophylus subincisodentatus* Radlk. in Elmer. Leaflet. Philipp. Bot. 5 (1913) 1603; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 497; Radlk. in Engl., Pflanzenr. 98 (1932) 599. — Type: *Elmer 11728* (BO, FI, L, M, U), Mindanao.
- Allophylus brevipetiolatus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 449; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 494; Radlk. in Engl., Pflanzenr. 98 (1932) 557. — Type: *Vidal 3693* (K), Panay.
- Allophylus granulatus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 451; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 495; Radlk. in Engl., Pflanzenr. 98 (1932) 577. — Type: *BS 12560* (M), Luzon.
- Allophylus peduncularis* Radlk., Philipp. J. Sc., Bot. 8 (1914) 450; in Engl., Pflanzenr. 98 (1932) 557. — Syntypes: *FB 12661* (PNH, in protologue erroneously cited as 1266), Philippines, Masbate; *Vidal 3716, 3740* (both K), Philippines, Ticao.
- Allophylus laetevirens* Ridley. Trans. Linn. Soc. Bot. 9 (1916) 32; Radlk. in Engl., Pflanzenr. 98 (1932) 604. — Type: *Kloss s.n.* (SING), Irian Jaya.
- Allophylus samarensis* Merr., Philipp. J. Sc., Bot. 11 (1916) 192; Enum. Philipp. Flow. Pl. 2 (1923) 496; Radlk. in Engl., Pflanzenr. 98 (1932) 553. — Type: *FB 24402*, Samar.
- Allophylus scandens* Ridley. J. Str. Br. Roy. As. Soc. 75 (1917) 26; Radlk. in Engl., Pflanzenr. 98 (1934) 1489. — Syntypes: *Haviland 987* (SING); *Hose 123* (BM); *Ridley s.n.* (SING); all Singapore.
- Allophylus stenophyllus* Merr., Philipp. J. Sc. 14 (1919) 417; Radlk. in Engl. Pflanzenr. 98 (1932) 603. — Type: *BS 32839* (BM, L, SING), Luzon.
- Allophylus lopezii* Merr., Philipp. J. Sc. 26 (1925) 469; Radlk. in Engl., Pflanzenr. 98 (1934) 1490. — Type: *BS 41387*, Philippines, Busuanga.
- Allophylus betongensis* Craib, Kew Bull. (1926) 359; Fl. Siam. Enum. 1 (1926) 322; Radlk. in Engl., Pflanzenr. 98 (1934) 1489. — Type: *Kerr 7665*, Thailand.
- Allophylus obliquus* Radlk. in Merr., Pl. Elm. Born. (1929) 173, nom. nud. — Type: *Elmer 21263* (L), Borneo.
- Allophylus bartlettii* Merr., Pap. Mich. Ac. Sc. 23 (1938) 183. — Type: *Rahmat 6933*, Sumatra.
- Allophylus cobbe* (L.) Raeuschel var. *glaber*, *limosus*, *marinus*, *velutinus*, *villosus* Corner, Gard. Bull. Str. Settl. 10 (1939) 40–42.
- Allophylus simplex* Quis., Philipp. J. Sc. 76, 3 (1944) 44, nom. illeg., non Baillon (1893). — Type: *Merrill 7262*, Palawan.
- This is only a partial list of synonyms, restricted to names used in Malesian context.



Mostly a *shrub* (sometimes straggling to lianoid) or *treelet*, more rarely a *tree* up to 25 m high, dbh 30 cm. *Twigs* terete, 3–8 mm in diameter, rather smooth to pustular-lenticellate, either glabrous with the exception of the sparsely appressed hairy terminal bud, or  $\pm$  persistently thinly to densely covered with often stellately tufted, appressed to patent, short, fulvous hairs; the glabrous parts at first shining reddish to blackish brown, later on silvery to yellowish grey to reddish brown. *Leaves* mostly 3-foliolate, sometimes part or all of them 1- or 5-foliolate (if 1-foliolate, then lateral leaflets often represented by minute, subulate appendages); petiole terete (rarely quadrangular), mostly flattened to grooved above especially at apex and base, 4.5–20 cm long, 1–3.5 mm thick, indumentum usually like the twig at a slightly earlier stage; petiolules 0–25 mm, the terminal one either of the same length, or up to 4 times as long as the lateral ones, indumentum like that of the petiole. *Leaflets* elliptic or oblong, more rarely lanceolate, laterals often ovate and oblique, terminal sometimes obovate, 2.5–35 by 1.5–22 cm (terminal one slightly to distinctly larger than the laterals), nearly membranous to fleshy or coriaceous, when dry above greenish to greyish or dark brown and dull to shining, beneath light green to reddish brown and dull (sometimes even glaucous) to shining, glabrous to (especially beneath) densely velvety, moreover often bearded in the axils of the nerves (when glabrous often with a distinct gland) and sometimes also of the veins; base cuneate to rounded, often slightly decurrent, in the terminal leaflet always narrower than in the laterals, in the latter hardly to distinctly oblique; apex  $\pm$  tapering acuminate; margin entire or (mostly sparsely) serrate, crenate, or dentate, sometimes lobed-dentate (mainly in Philippine races); midrib hardly prominent to keeled above, prominent beneath, nerves 6–15 per side, slanting, looped and joined near the margin or not, venation usually rather inconspicuous above, hardly conspicuous to prominent beneath. *Inflorescences* axillary, solitary or rarely 2 in one axil, simple to thyrsoid, up to 40 cm long, glabrous to densely pubescent, hairs mostly not distinctly stellately fasciated; peduncle usually about 1/3–1/5 of the total length, laxly to densely branched, flowers in subsessile to short-stalked, few- to rather many-flowered, umbel-like dichasia or sometimes in comb-like cincinni, in the upper part often solitary; bracts mostly minute, sometimes longer than the pedicels, subulate, slender. *Sepals* 1–2.5 by 0.8–2 mm (the inner ones hardly longer, but distinctly broader than the outer), green to whitish, entire to denticulate, mostly ciliolate, outside glabrous to sparsely appressed short-hairy mainly in the central part. *Petals* nail-

shaped to spatulate, 1–2.2 mm, white, the claw about 2/3 of the entire length, blade entire to bilobed, scale very small to nearly equalling the blade, nearly glabrous to densely woolly along the whole margin of the petal, and especially of the scale, the latter moreover often bearded. *Disc* in female flowers sometimes saucer-shaped, usually lobed, 0.2–0.8 mm high, glabrous or sometimes puberulous, orange. *Stamens* c. 8, subequal, in male flowers exerted; filaments mostly sparsely woolly in the lower part; anthers about 0.5 mm. *Pistil* in female flowers: ovary deeply 2- (or 3-)lobed, lobes obovoid, smooth or rough, glabrous or minutely stellate-fasciated 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; stigma with 2 (or 3) spreading, fairly long, rarely bifurcate lobes. *Fruits* mostly with only 1 mericarp developed, globular (smaller ones) to obovoid and narrowed at the base (larger ones), 4.5–12.5 by 3.5–8 mm, smooth to slightly wrinkled, red (black to brown when dry), somewhat fleshy and almost glabrous when ripe. – **Fig. 6.**

**Distribution** – Pantropical, in S America, S Africa, Madagascar, and SE Asia slightly penetrating into the Subtropics; throughout *Malesia*.

**Habitat & Ecology** – Under everwet as well as under seasonal conditions; on sandy beaches and coastal rocks, in and along the *Barringtonia* formation, in brackish as well as freshwater swamps, in open places, shrubberies, and along and in secondary as well as primary forests of all kinds, as well on limestone outcrops as on granitic boulders; from sea level up to 1500(–2000) m altitude. Fl., fr. Jan.–Dec. The flowers are visited by bees, the fruits are eaten by birds (see, e.g., Docters van Leeuwen, *Trop. Natuur* 21, 1932, 142, who mentions *Aplonis panayensis strigatus* Horsf., the Glossy Starling). For galls see Docters van Leeuwen, *Zoocecidia* (1926) 333, f. 601–603.

**Uses** – The wood is reported to be very hard but not very durable; it is mainly used as a timber for temporary structures and indoors, e.g. for rafters. Canes and hilts are made from the wood, as well as beaters for the cotton fruits (Mindoro). In the Bismarck Archipelago, poles and branches are used for floats of outrigger canoes and for marking the location of fish traps. Also used as firewood.

The pulped leaves, or an extraction or decoction of them, as well as a decoction of the roots and the bark, are used in native medicine against stomach-ache and fever. In Perak, a disease inside the mouth of children is cured with it. In Mindanao, the scraped bark is applied to rigid abdomen, the bark to burns. The berries, though a bit sour,



Fig. 6. *Allophylus cobbe* (L.) Raeuschel. a. Habit; b. male flower; c. petal from inside; d. female flower; e. fruit (a, e: *Forbes* 2557; b-d: *Maxwell* 77-375).

are eaten. In New Guinea fruits are used as a fish poison. See Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 104; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 988.

Chromosomes –  $2n = 28$ : Ferrucci, *Bolet. Soc. Argentina Bot.* 24 (1985) 200–202.

Notes – Like so many widely distributed spe-

cies with a wide ecological amplitude, *A. cobbe* comprises a great number of local races. This is even so within Malesia, though the variability is here rather restricted compared with that shown by this species in Africa and South America. Within a restricted region each of these races usually characterizes a well-circumscribed habitat. The picture

is simplest in W Malesia, especially in the Malay Peninsula, Sumatra, and Java. But even here most of the races turn out to be not sharply delimited against each other.

For the Malay Peninsula, Corner (Gard. Bull. Str. Settl. 10, 1939, 40) distinguished between 5 varieties; he already cited, however, several intermediates that broke down their limits.

Turning to Malesia as a whole, the picture becomes far more complicated, the delimitation of infraspecific taxa of more than local importance completely impossible. Thus '*A. javensis*' and '*A. sumatranus*', both inland species from Java resp. Sumatra, represent a pair of well-circumscribed, closely related but in some points distinctly different races. '*Allophylus cobbe* var. *glaber* Corner' from the Malay Peninsula is intermediate between these two, overlapping both; the characters that consistently distinguish the first two races, are here variable. On the other hand, '*A. sumatranus*' encompasses nearly the whole range of variability of '*A. cobbe* var. *glaber* Corner' and '*A. cobbe* var. *villosus* Corner', thus breaking down the differ-

ences between these two races from the Malay Peninsula.

Even the differences between races which in one region seem not to be closely related, characterizing very different habitats, may fade away in other regions. A fine example is given by '*A. timorensis*' and '*A. racemosus*'. In Java, these two races are well distinguishable; the former is restricted to the sandy beach and coastal rocks, the latter is an inland form. '*A. timorensis*' is distributed from the Malay Peninsula to far in the Pacific, and is rather uniform; only in New Guinea the range of variability is somewhat wider and here it intergrades completely with '*A. micrococcus*', a form of coastal as well as inland habitats. Typical '*A. racemosus*' is nearly restricted to Java; towards the East it grades into '*A. ternatus*' which, in turn, in New Guinea also grades into '*A. micrococcus*'.

It is thus impossible to subdivide *A. cobbe* for the whole of Malesia. On a local scale it may be possible to distinguish between the more important races, but the distinctions will not hold in studies that encompass a broader geographical range.

## AMESIODENDRON

(P.W. Leenhouts)

*Amesiodendron* Hu, Bull. Fan Mem. Inst. Biol. 7, Bot. (1936) 207; Yap in Tree Fl. Malaya 4 (1989) 437. — Type species: *Paranephelium chinense* Merr. [= *Amesiodendron chinense* (Merr.) Hu].

*Tree*, monoecious. *Indumentum* of solitary simple hairs only. *Leaves* paripinnate, 3–6-jugate; leaf axes sparsely minutely puberulous (to glabrous). *Leaflets* opposite to alternate, smooth beneath; the margin hardly to coarsely crenate- to serrate-dentate, especially in the upper half (to entire); domatia absent; nerves ending in the teeth or in the incisions, in the former case alternating with intersecondary nerves ending in the incisions or not, in entire parts nerves looped and joined near the margin. *Inflorescences* terminal and in the upper leaf axils. *Flowers* unisexual, regular. *Sepals* 5, ± valvate in bud, all equal, not petaloid, hairy on both sides, margin entire. *Petals* 5, shorter than or about equal to the sepals, not or hardly clawed, glabrous or inside slightly hairy in the upper part, entire, just above the base with a scale varying from somewhat shorter to much longer than the petal itself, woolly on both sides. *Disc* a ring adnate to the torus, flat except for the margin, with an erect rim to tubular collar up to c. 0.5 mm high, thin-fleshy, glabrous. *Stamens* (6) 7, 8 (9), distinctly exerted in male flowers; filaments sparsely woolly in the lower half (or for the greater part); anthers glabrous, dehiscence latrorse. *Pistil* short-stalked or sessile, densely hairy, 3-locular; ovules 1 per locule; style apical, somewhat longer than the ovary, apically with two stigmatic lines (or in fruit, probably only after fertilization, with two minute, hardly spreading lobes). *Fruits* capsular, hardly stipitate, with up to 3 partly connate globular lobes, loculicidally dehiscent, often ± crested along





Fig. 7. *Amesiodendron chinense* (Merr.) Hu. a. Habit; b. fruit (a: KEP 97776; b: de Wilde & de Wilde-Duyfjes 19226).



the suture outside, when young slightly coarsely warty, when mature a bit rough to scurfy; wall thick and woody, glabrous on both surfaces. *Seeds* with a large glabrous sarcotesta around the hilum. — **Fig. 7.**

Distribution — China (Guizhou, Yunnan, Guangdong, Guangxi, Hainan), Indo-China (Laos, Annam), and *Malesia*: Malay Peninsula, Sumatra. Probably monotypic.

Habitat — Lowland rain forest.

Note — As far as can be judged from the descriptions and figure the species *A. integrifoliolatum* and *A. tienlinensis*, both published by Lo, Acta Phytotax. Sin. 17, 2 (1979) 36, f. 3, show no essential differences from *A. chinense*.

**Amesiodendron chinense** (Merr.) Hu, Bull. Fan Mem. Inst. Biol. 7, Bot. (1936) 209; How & Ho, Acta Phytotax. Sin. 3 (1955) 399; Lo in Fl. Hainan. 3 (1974) 88, f. 586; Ming in Fl. Yunnan. 1 (1977) 280, t. 66 f. 1 & 2. — *Paranephe-lium chinense* Merr., Lingnan Sc. J. 14 (1935) 30, f. 10; Gagnep. in Fl. Indo-China, Suppl. 1 (1950) 971, f. 122: 14–18; Yap in Tree Fl. Malaya 4 (1989) 437. — Type: *S.K. Lau 131* (P iso), Hainan.

*Tree* up to 25 m high, dbh up to 60 cm, with buttresses up to 1.80 m high, crown dense, widely spreading, bark grey-brown, scaly. *Twigs* terete, 3–8 mm in diam., light greyish to yellowish (or reddish) brown, glabrous or sometimes minutely puberulous, densely warty lenticellate, later becoming more greyish and more smooth. *Leaves*: petiole 2–5 cm long, ± flattened above; rachis flattened above; petiolules 2–8 mm long, deeply grooved above. *Leaflets*: lower ones symmetrical, ovate, 4–15 by 1.25–4 cm, index 3–4, middle and upper ones asymmetrical and often slightly falcate, acroscopic side wider, elliptic, 8–15 by 2–4 cm, index 3.5–4, pergamentaceous to coriaceous (or chartaceous), glabrous (or above on the basal part of the midrib sparsely to fairly densely minutely puberulous); base acute, in the higher leaflets acute at the narrower side, rounded and attenuate at the broader side; apex often long-tapering, acute, mucronulate; midrib above a slender rib which may be slightly sunken towards the base, beneath prominent; nerves 5–7.5(–15) mm apart, straight or slightly curved,

strongly curved towards the margin, above mostly prominulous, beneath prominent; veins and veinlets rather reticulate, above often only the stronger veins visible, beneath prominulous and distinct. *Inflorescence* a widely and laxly branched thyrses, up to 30 cm long, densely puberulous; main branches few, erecto-patent, sparsely branching again. *Flowers* pink (outside *Malesia* apparently mostly white), in often ± opposite, nearly sessile, about 5-flowered cymes, in the lower parts of the branches rather distant, clustered towards the apices; pedicels of lateral flowers less than 1 mm long, of central flower up to 2.5 mm long; bracts caducous, bracteoles deltoid, minute. *Sepals* deltoid, c. 1 mm high. *Petals* transversely elliptic to orbicular, 0.8–1.2 by 0.6–1.4 mm; seale subquadrangular to triangular or heart-shaped, 0.5–1.2 by 1.2–1.4 mm, erect to bent. *Stamens* c. 4 mm long; filaments thread-like; anthers suborbicular, 0.33–0.5 mm long, red. *Pistil*: style c. 4 mm long, slender; locules glabrous inside. *Fruits* dark brown, usually only 1 or 2 lobe(s) developed, these globular, 3–3.5 cm in diam., connate for c. 2.5 cm; wall 2–5 mm thick. *Seeds* globular, 2.5–2.75 cm in diam., testa hard, smooth, shining reddish brown, around the hilum with an orbicular to kidney-shaped sarcotesta 1.5–2.5 by 1.5 cm. — **Fig. 7.**

Distribution — China, Indo-China, Insular Thailand, and *Malesia*: Sumatra (Aceh) and the Malay Peninsula (Perlis, Perak, Pahang, Selangor).

Habitat & Ecology — In and along primary rain forest on well-drained soils; up to 600 m altitude. Fl. (Feb.), Apr., May; fr. Jan., Nov.

## ARYTERA

(H. Turner)

*Arytera* Blume, Rumphia 3 (1849) 169; Radlk., Sapind. Holl.-Ind. (1879) 44; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 551; 20 (1890) 267, 293; in Engl., Pflanzenr. 98 (1933) 1268; R.W. Ham, Blumea 23 (1977) 289; S.T. Reynolds, Austrobaileya 2 (1985) 158; in Fl. Austral. 25 (1985) 87, 198. — Lec-

tootype species (S.T. Reynolds 1985): *Arytera xerocarpa* (Blume) Adelb. (= *Arytera litoralis* Blume).

*Zygolepis* Turcz., Bull. Soc. Nat. Moscou 21 (1848) 573. — Type species: *Zygolepis rufescens* Turcz.

*Trees* or rarely *shrubs*. *Indumentum* of solitary, simple hairs; glandular scales always absent in the Malesian species. *Twigs* terete, smooth to slightly rough, hairy at least when young. *Leaves* spirally arranged, paripinnate. 1–6-jugate, without pseudo-stipules; petiole (hemi)terete, pulvinate; rachis (hemi)terete; petiolules usually consisting of a pulvinus only, usually 1-grooved. *Leaflets* opposite to subopposite, rarely alternate, symmetric, usually not falcate, margin entire to slightly repand, not revolute, both surfaces smooth; domatia usually present in axils of major nerves, rarely completely absent. *Inflorescences* axillary to pseudoterminal, rarely ramiflorous; bracts and bracteoles triangular, outside hairy, inside usually glabrous; pedicels hairy. *Flowers* seemingly bisexual, probably functionally unisexual. *Calyx* 5-dentate to -partite, teeth triangular to ovate, apert to narrowly imbricate, all equal, rarely slightly unequal, margin entire. *Petals* (2–)5(–6), slightly longer to slightly shorter than the calyx; scales present, rarely completely absent, free or adnate to margin, or enation of margin, not crested. *Disc* complete, glabrous or hairy. *Stamens* 8 (6–10); filaments at least basally pilose; anthers pilose or glabrous. *Ovary* sessile, 2- or 3-locular, smooth, hairy; stigma apical, not lobed, with 2 or 3 stigmatic lines, or 2- or 3-lobed with lobes distinctly recurved in fruit. *Ovules* 1 per locule. *Fruits* with 1–3 well-developed lobes, loculicidal, central axis not thickened transversely, [in *A. bullata* and *A. macrobotrys* opening irregularly (loculicidal), central axis thickened transversely,] short- or long-stipitate, dissepiments complete, lobes laterally not or slightly flattened; exocarp thick, coriaceous, mesocarp thick, coriaceous to woody, endocarp thin, chartaceous, hairy at least on sutures of carpels (in *A. bullata* and *A. macrobotrys* thick, radially striate from the attachment of the seed up to 1/2–2/3 the height of the fruit, not covering the sutures or the fruit axis, sclerenchymatous, detaching from the fruit wall when mature, glabrous). *Seeds* (partly) covered by an apically open arillode, consisting of 1 or 2 layers, the outer or only one soft, yellow, the inner one firm, dark brown when dry; hilum basal; sclerotesta rather thin, coriaceous, endotesta even thinner, more membranous. — **Figs. 8, 9.**

**Distribution** — One widespread species from NE India throughout SE Asia up to Hainan and eastward across *Malesia* up to the Solomon Islands; in New Guinea (including the Bismarck Archipelago) 12 additional species, of which 4 also in Australia, and 1 other also in the Solomon Islands. Seven additional species in Australia, eight more in the Pacific.

**Habitat** — In various forest types.

#### KEY TO THE SPECIES

- 1a. Fruit wall glabrous inside, endocarp thick, sclerenchymatous, radially striate from the attachment of the seed and separating from the pericarp in ripe fruit. Arillode very thick. Calyx and petals punctate, calyx margin slightly membranous. Leaves 3–6-jugate, leaf rachis always glabrous. Inflorescence at least 17 cm long . . . . . 2

- b. Fruit wall hairy inside, at least on the sutures of the carpels, endocarp thin, chartaceous, not radially striate, not separating from the pericarp in ripe fruit. Arillode thin or thickened only towards the base. Calyx and petals usually not punctate, calyx margin not membranous. Leaves 1–4-jugate, leaf rachis usually hairy, at least when young. Inflorescence up to 18 cm long . . . . . 3
- 2a. Stipe of fruit 5–6 mm long. Arillode not alate. Petioles up to 5.5 cm long; leaflets very coriaceous. Petal claw 0.4–0.6 mm long . . . . . **3. A. bullata**
- b. Stipe of fruit 2–3 mm long. Arillode alate. Petioles longer than 6 cm; leaflets subcoriaceous to chartaceous. Petal claw 0.2–0.3 mm long . . . . . **6. A. macrobotrys**
- 3a. Indumentum of patent, crispate hairs . . . . . 4
- b. Indumentum of straight, usually rather appressed hairs . . . . . 8
- 4a. Leaves 1- or 2-jugate, rachis (excluding petiole) up to 5.5 cm long; nerves marginally indistinctly looped. Calyx teeth (sub)glabrous inside. Flowering twigs 1.5–5 mm thick . . . . . 5
- b. Leaves 4-jugate, rachis (excluding petiole) over 13 cm long; nerves marginally distinctly looped. Calyx teeth densely puberulous inside. Flowering twigs more than 5 mm thick . . . . . **10. A. multijuga**
- 5a. Bracts triangular, 0.3–1 mm long; pedicels at anthesis longer than 1.5 mm. Calyx deeply incised. Claw of petal usually longer than 0.2 mm . . . . . 6
- b. Bracts narrowly triangular, 0.8–1.5 mm long; pedicels at anthesis up to 1.5 mm long. Calyx connate up to 1/3. Claw of petal up to 0.2 mm long . . . . . **4. A. densiflora**
- 6a. Inflorescence rachis up to 15 cm long. Often several petals more or less reduced, at most hairy on outside and on margin, less than 1 mm long, about as long as the calyx . . . . . 7
- b. Inflorescence rachis not longer than 5 cm. Petals all developed, hairy on both sides, more than 1.5 mm long, slightly longer than the calyx . . . . . **8. A. morobeana**
- 7a. Petal blade ovate to suborbicular to obovate; scales free, almost linear, often one reduced, apex usually forked. Apex of leaflets acuminate . . . . . **5. A. lineosquamulata**
- b. Petal blade elliptic to semiorbicular; scales adnate to margin up to halfway, equal in size, apex broadened. Apex of leaflets rounded to slightly acuminate . . . . . **13. A. pseudofoveolata**
- 8a. Leaves (2-) 3- or 4-jugate, rachis (excluding petiole) up to 10.5 cm long; leaflet index up to 5, apex acuminate to caudate. Pedicels elongating up to 10 mm in fruit . . . . . 9
- b. Leaves all 1- or 2-jugate, rachis (excluding petiole) up to 5(–7.5) cm long; leaflet index less than 3.6, apex retuse to acuminate. Pedicel elongating up to 7 mm in fruit . . . . . 10
- 9a. Domatia large sacs, opening on top. Calyx 0.8–1.1 mm high. Petals never longer than calyx, (sub)pilose inside. Disc pilose. Margin of hypocotyl pilose . . . . . **12. A. novaebritanniae**
- b. Domatia often pustular sacs to pockets, rarely pits, opening in front, rarely on top. Calyx 1–1.5 mm high. Petals often slightly longer than calyx, glabrous inside. Disc glabrous, rarely pilose. Margin of hypocotyl glabrous . . . . . **6. A. litoralis**
- 10a. Arillode thick towards base, 2-layered. Leaves 1- or 2-jugate; domatia usually present; nerves basally indistinctly looped, midrib below usually (sub)puberulous, tertiary

- venation slightly to distinctly scalariform. Stigma not or very slightly lobe . . . 11
- b. Arillode thin, 1-layered. Leaves always 1-jugate; domatia always absent; nerves distinctly looped, midrib below glabrous, tertiary venation reticulate. Stigma distinctly lobed in fruit . . . . . **1. A. bifoliolata**
- 11a. Cotyledons (obliquely) above each other. Petals about as long as calyx, petal blades triangular to rhomboid to ovate, scales free. Anthers up to 1.3 mm long. Nerves indistinctly looped submarginally . . . . . 12
- b. Cotyledons beside each other. Petals shorter than calyx, scales adnate to margin. Anthers c. 0.6 mm long. Nerves with distinct submarginal loops towards the apex only . . . . . **8. A. miniata**
- 12a. Petals inside (sub)glabrous. Disc usually pilose. Venation above about the same colour as lamina. Style up to 2 mm long in fruit . . . . . 13
- b. Petals inside rather hairy. Disc glabrous. Venation above usually yellowish to reddish. Style up to 3 mm long in fruit. (Anther curved, connective slightly protruding) . . . . . **11. A. musca**
- 13a. Fruit wall inside completely pilose. Domatia many (sunken) sacs, opening on top. Leaflets broadly oblong-elliptic to -obovate, index up to 2.1; nerves on lower surface of leaflets almost flat, up to 14 mm apart; both surfaces of leaflets the same colour when dried . . . . . **2. A. brachyphylla**
- b. Fruit wall inside hairy on sutures only, rarely also on valves, but then always with a glabrous patch in the centre. Domatia many to few (rarely completely absent), often pustular sacs or pockets, opening in front. Leaflets ovate to elliptic, index up to 3.8; nerves on lower surface of leaflets raised, up to 35 mm apart; lower surface of leaflets usually more brownish than upper surface when dried . . . . . **6. A. litoralis**

**1. *Arytera bifoliolata*** S.T. Reynolds in Fl. Austral. 25 (1985) 198; *Austrobaileya* 2 (1985) 161.  
— Type: *Hyland 2533* (BRI holo), Australia.

*Tree or shrub* 5–10 m high, dbh c. 15 cm; bark smooth (or flaky), dark brown. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 1–4 mm thick. *Leaves* 1-jugate; petiole 0.6–5.5 cm long, hairy when young; petioles 2–10 mm long, not to slightly 1-grooved. *Leaflets* opposite, ovate to elliptic (obovate), 5.3–18.6 by 1.8–7 cm, index 1.9–3.6, not to slightly falcate, coriaceous to chartaceous, (punctate), upper surface glabrous, lower surface glabrous, concolorous with upper surface; base symmetric, acute to attenuate; apex rounded to slightly acuminate, very apex retuse to rounded (acute), not mucronulate; venation flat above and below, concolorous with lamina to midrib reddish-brown, midrib raised below, nerves distinctly looped submarginally, veins laxly reticulate, not distinct; domatia absent. *Inflorescences* axillary to pseudoterminal, branching basally and along rachis; rachis flattened, 2–9.5 cm long, hairy when young; first-order branches up to 3.5 cm long; cymules pleiochasial, 1–7-flow-

ered; bracts 0.5–0.6 mm long, bracteoles 0.2–0.4 mm long; pedicels 1–5 mm long, to 7 mm in fruit, hairy. *Flowers* 2–3 mm in diameter. *Calyx* 0.9–2 mm high, deeply incised, outside hairy, inside glabrous to subpuberulous, teeth equal, not punctate, margin not membranous, apex acute. *Petals* 5, ovate to rhombic, 1.6–2.5 by 0.5–1.3 mm, not punctate, claw 0.2–0.5 mm long, blade gradually decurrent into claw, margin entire, pilose, apex acute to acuminate, outside pilose, inside (sub)glabrous; scales 0.5–1.1 mm long, free, basally not auriculate, (apex broadened), rather densely pilose. *Disc* glabrous. *Stamens* 7–9; filaments 2.5–4 mm long, basally pilose; anthers 0.5–1.1 mm long, straight, pilose, connective not protruding. *Ovary* 2-locular; style and stigma elongating to 0.8–1.5 mm in fruit, in fruit distinctly 2-lobed, upper 0.8–1.5 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 0.6–1.3 by 0.5–1.7 cm, loculicidal, slightly to distinctly rugose to verrucose, subglabrous, stipe 0.5–2 mm long, broadly cuneate, lobes slightly flattened laterally, 6–11 by 4–7.5 mm, dorsally sharply angled to keeled; endocarp thin, chartaceous, pilose on sutures. *Seeds* ellipsoid to ovoid, flattened laterally, c. 10 by 5 mm; arillode completely covering



seed, lobed, not folded towards the base inside, thin, chartaceous, 1-layered.

Distribution – *Malesia*: SE Irian Jaya; Australia: Northern Territories, N Queensland.

Habitat & Ecology – Vine forests on lateritic soils, also on dunes, adjacent to mangroves, and along creeks among rain forest trees; altitude from sea level up to 250 m. Fl. Apr. (in Irian Jaya), Aug.–Dec.; fr. Nov., Dec.

2. *Arytera brachyphylla* Radlk., Sitzungsber. Math.-Phys., Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 552; in Engl., Pflanzenr. 98 (1933) 1277. — *Cupania brachyphylla* F. Muell., Notes Pap. Pl. 6 (1885) 6. — Type: *D'Albertis s.n.* (Fl. holo; M), New Guinea.

*Tree*. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; fruiting twigs 4–4.5 mm thick. *Leaves* 2-jugate; petiole 4–5.8 cm long; rachis 2.5–4.1 cm long, terete, glabrous to hairy; petiolules 4–9.5 mm long, 1-grooved. *Leaflets* opposite, oblong-elliptic to -obovate, 8.3–15 by 4.5–8.5 cm, index 1.5–2.1, not falcate, thickly chartaceous, not punctate, upper surface glabrous, lower surface (slightly) hairy on major nerves, colour slightly different from above; base symmetric, acute to almost rounded; apex rounded to shortly acuminate, very apex obtuse to rounded, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina, venation almost flat below, midrib distinctly raised, nerves indistinctly looped submarginally, veins scalariform, lax, not very distinct; domatia (sunken) sacs opening on top. *Inflorescences* axillary to pseudoterminal, branching basally and along rachis; rachis terete, 6.5–14 cm long, hairy when young; first-order branches up to 7 cm long; bracts and bracteoles not observed; pedicels to 4–6 mm long in fruit, hairy. *Flowers* not observed. *Calyx* c. 1.2 mm high, deeply incised, outside hairy, inside glabrous; teeth equal, not punctate, margin not membranous, apex acute. *Ovary* 2- (or 3-)locular; style and stigma elongating to 2–2.5 mm in fruit, not lobed, in fruit upper 0.7–1.5 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 0.8–1.3 by 0.9–2.1 cm, loculicidal, smooth to slightly verrucose, slightly hairy, stipe c. 2 mm long, slender, lobes not flattened laterally, 7.5–11 by 5.5–9.5 mm, dorsally rounded; endocarp thin, chartaceous, pilose. *Seeds* (sub)orbicular to slightly obovoid, not flattened laterally, 6–10 by 6–9 mm; arillode covering 1/2–2/3 of the seed, dentate to slightly lobed, not to slightly folded towards the base inside, thick towards base, coriaceous, 2-layered.

Distribution – *Malesia*: Papua New Guinea,

along the Fly River.

Habitat & Ecology – Unknown.

Note – Known only from the type specimen.

3. *Arytera bullata* H. Turner, Blumea 38 (1993) 137. — Type: *Hartley 12077* (A holo; CANB, K, LAE), New Guinea.

*Tree*, c. 36 m high, dbh c. 90 cm; bark smooth, light grey. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 6 mm thick. *Leaves* 3–6-jugate; petioles 4–5.5 cm long; rachis 4.5–9.5 cm long, hemiterete, glabrous; petiolules 6–9 mm long, 2-grooved. *Leaflets* subopposite to alternate, oblong-elliptic, 6.7–10.9 by 3–4 cm, index 2.2–2.9, slightly falcate and bullate, very coriaceous, punctate, upper surface glabrous, lower surface glabrous, colour slightly different from above; base symmetric, slightly attenuate to acute; apex obtuse to slightly acuminate, very apex retuse, not to minutely mucronulate; venation above slightly sunken, midrib raised, concolorous with lamina, venation below raised, nerves marginally distinctly looped, veins laxly reticulate, distinct; domatia large pits to sacs opening on top. *Inflorescences* pseudoterminal, branching along rachis; rachis flattened, 17–22.5 cm long, hairy when young; first-order branches up to 10 cm long; cy-mules dichasial, 7–15-flowered; bracts and bracteoles slightly punctate, bracts 0.3–0.8 mm long, bracteoles 0.2–0.3 mm long; pedicels 0.6–1 mm long, elongating up to 3 mm in fruit, hairy. *Flowers* 2 mm in diameter. *Calyx* 0.8–1 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, slightly punctate, margin slightly membranaceous, apex acute to obtuse. *Petals* 5, oblong-elliptic, 0.9–1 by 0.7–1 mm, slightly punctate, claw 0.4–0.6 mm long, blade abruptly decurrent into claw, margin entire, pilose at base of blade, apex rounded, outside glabrous, inside subpuberulous; scales absent or present, 0–0.2 mm long, free, basally auriculate, apex not broadened, pilose. *Disc* slightly lobed, glabrous. *Stamens* 7 or 8; filaments 2–2.3 mm long, basally pilose; anthers 0.3 mm long, straight, glabrous, connective not protruding. *Ovary* 3-locular; style and stigma elongating up to 0.7–1 mm in fruit, 3-lobed, in fruit upper 0.2–0.3 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 2.7–3 by 2.6–4.5 cm, opening irregularly, smooth to slightly rugose, glabrous, stipe 5–6 mm long, slender, lobes laterally not flattened, c. 24 by 17–18 mm, dorsally rounded; endocarp sclerenchymatous, radially striate from the attachment of the seed, detaching from the fruit wall when mature, glabrous. *Seeds* orbicular, not flattened laterally, c. 17 by c. 19 mm; arillode not alate, completely covering seed, not

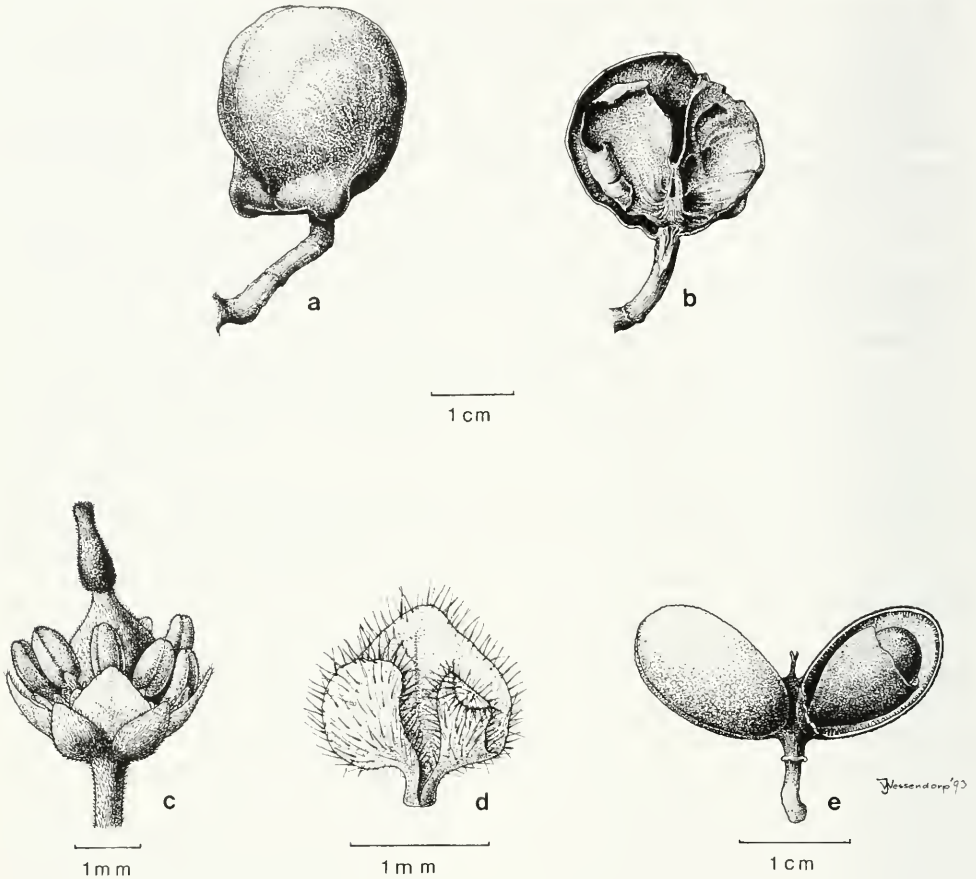


Fig. 8. *Arytera* Blume. Flower and fruits. — *A. bullata* Turner. a. Fruit; b. fruit wall from inside. — *A. litoralis* Blume. c. Female flower; d. petal from inside; e. fruit (a, b: Hartley 12077; c, d: Gibbs 2664; e: van Balgooy 6099).

lobed, not folded towards the base inside, very thick especially towards base, fleshy, coriaceous towards the base, 1-layered. — Fig. 8a, b.

Distribution — *Malesia*: Papua New Guinea (E Highlands Prov.).

Habitat & Ecology — In oak forest; altitude c. 1500 m. Fl. July.

4. *Arytera densiflora* Radlk., Bot. Jahrb. 56 (1920) 301; in Engl., Pflanzenr. 98 (1933) 1278. — Type: *Ledermann* 9555 (B holo, probably lost; K, L, M), New Guinea.

Tree 2–5 m high. *Indumentum* patent, crispate. *Branchlets* hairy when young; flowering twigs 3–5 mm thick. *Leaves* 2-jugate; petioles 3–9 (–18) cm long; rachis 2.5–4.5 cm long, (hemi)terete,

densely hairy; petiolules 5–7 mm long, 1-grooved. *Leaflets* opposite, elliptic, 6.6–20.7 by 4–8.8 cm, index 1.5–3.1, not falcate, chartaceous to slightly coriaceous. (punctate), upper surface glabrous, lower surface hairy especially on major nerves, colour slightly different from above; base slightly asymmetric, basicopic side broader (symmetric), slightly attenuate to acute; apex acuminate to cuspidate, very apex retuse to obtuse, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina to slightly reddish brown, venation raised below, nerves marginally indistinctly looped, veins scalariform, lax, distinct; domatia pockets to sacs opening in front. *Inflorescences* axillary to pseudoterminal to ramiflorous, branching basally and along rachis; rachis terete to slightly flattened, 4.5–16 cm long, densely hairy when

young; first-order branches up to 7.5 cm long; cymes dichasial to cincinnate, 1–6-flowered; bracts and bracteoles narrowly triangular, bracts 0.8–1.5 mm long, bracteoles 0.5–0.7 mm long; pedicels 0.8–1.5 mm long, hairy. *Flowers* 1.5–3 mm in diameter. *Calyx* 0.9–1.3 mm high, connate up to 1/3, outside hairy, inside glabrous; teeth equal, not punctate, margin not membranous, apex acute to obtuse. *Petals* 5, triangular to rhomboidal to almost orbicular, 0.7–1.4 by 0.5–0.9 mm, not punctate, claw 0.1–0.2 mm long, blade abruptly decurrent into claw, margin entire, pilose, apex rounded to acute, outside subpilose, inside (sub)glabrous; scales 0.2–0.5 mm long, free, basally not to slightly auriculate, apex broadened, densely pilose. *Disc* glabrous to subpilose on rim. *Stamens* 8; filaments 1–1.6 mm long, densely pilose; anthers 1.1–1.6 mm long, incurved, densely pilose, connective slightly protruding. *Ovary* 2-locular; style and stigma not lobed. *Fruits* not observed.

*Distribution* – *Malesia*: Papua New Guinea (central mountain range).

*Habitat & Ecology* – Primary forest, on well-drained volcanic soils; 600–850 m altitude. Fl. Oct.

*Note* – *Schodde* 2438 from Lake Kutubu has very large, sac-like domatia.

**5. *Arytera lineosquamulata*** H. Turner, *Blumea* 38 (1993) 138. — Type: *Carr 14969* (L holo; A, BM, K, NY), New Guinea.

*Tree* c. 12 m high. *Indumentum* patent, crispate. *Branchlets* hairy when young; flowering twigs 2–3 mm thick. *Leaves* 1- or 2-jugate; petioles 2–6 cm long; rachis 1.5–3.5 cm long, (hemi)terete, hairy; petiolules 5–8 mm long, 1-grooved. *Leaflets* opposite to subopposite, ovate to elliptic, 6.7–16.2 by 2.8–6 cm, index 2.2–2.8, not falcate, chartaceous to coriaceous, not punctate, upper surface glabrous, lower surface glabrous to sparsely hairy, especially on major nerves, colour slightly different from above; base symmetric, slightly attenuate to acute; apex acuminate, very apex obtuse to rounded, not mucronulate; venation flat above, midrib slightly raised, colour reddish, venation raised below, nerves marginally indistinctly looped, veins scalariform, lax, distinct; domatia small pockets to saes opening in front. *Inflorescences* axillary to pseudoterminal to ramiflorous on young branches, branching basally and along rachis; rachis terete, 5.5–15 cm long, densely hairy when young; first-order branches up to 8 cm long; cymes dichasial to monochasial, 1–4-flowered; bracts 0.3–1 mm long, bracteoles 0.1–0.3 mm long; pedicels 1–2 mm long, densely hairy. *Flowers* 1.5–3 mm in diameter. *Calyx* 0.9–1.2 mm high, deeply

incised, outside hairy, inside (sub)glabrous, teeth equal, not punctate, margin not membranous, apex acute to somewhat obtuse. *Petals* 2–5, often more or less reduced, obovate to ovate to suborbicular, 0.3–1 by 0.2–0.7 mm, not punctate, claw 0.2–0.3 mm long, blade abruptly to gradually decurrent into claw, margin entire, (sub)pilose, apex obtuse to acute, outside (sub)glabrous, inside glabrous; scales almost linear, often one or both reduced, 0.3–0.8 mm long, almost free, (basally auriculate), apex often forked, not broadened, sparsely pilose. *Disc* pilose on rim. *Stamens* 7 or 8; filaments in female flower 0.7–1.5 mm long, pilose; anthers in female flower 0.5–0.7 mm long, straight, pilose, connective not protruding. *Ovary* 2- (or 3-)locular; endocarp pilose on sutures of lobes; style and stigma not lobed. *Fruits* not observed.

*Distribution* – *Malesia*: Papua New Guinea (Central Prov.); Australia: N Queensland.

*Habitat & Ecology* – Secondary and semi-deciduous forests; altitude c. 1000 m. Fl. Nov.

**6. *Arytera litoralis*** Blume, *Rumphia* 3 (1849) 170; H. Turner, *Blumea* 38 (1993) 144. — *Euphoria xerocarpa* Blume, *Bijdr.* (1825) 234, p.p. (excl. fruits, see note 1), comb. illeg. — *Nephelium xerocarpum* Cambess., *Mém. Mus. Nat. Hist. Nat. Paris* 18 (1829) 30. — *Ratonia litoralis* Teijsm. & Binn., *Cat. Hort. Bogor* (1866) 216. — *Arytera ochracea* Blume ex Koord., *Exk. Fl. Java* 2 (1912) 542, in syn. — *Arytera litoralis* f. *genuina* Radlk. in Gibbs, *J. Linn. Soc. Bot.* 42 (1914) 65, nom. illeg. — *Arytera xerocarpa* (Blume) Adelb., *Blumea* 6 (1948) 324. — Lectotype (Turner 1993): *Blume 1314* (L holo), Nusa Kambangan, Indonesia.

*Zygolepis rufescens* Turcz., *Bull. Soc. Imp. Nat. Moscou* 21 (1848) 709. — *Ratonia zygolepis* Turcz., *Bull. Soc. Imp. Nat. Mosc.* 36 (1863) 586. — *Arytera rufescens* Radlk., *Sapind. Holl.-Ind.* (1879) 44. — *Ratonia rufescens* Fern.-Vill., *Nov. App.* (1880) 52. — *Arytera litoralis* f. *rufescens* Radlk. in Gibbs, *J. Linn. Soc. Bot.* 42 (1914) 65. — Type: *Coning 1761* (MW holo, n.v.; A, BM, K, MO, P), Cebu, Philippines.

*Arytera gigantosperma* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 674. — Type: *Beccari s.n.* (Fl holo; M), Sumatra.

*Arytera angustifolia* Radlk., *Sapind. Holl.-Ind.* (1879) 44. — *Arytera litoralis* f. *angustifolia* Radlk. in Gibbs, *J. Linn. Soc. Bot.* 42 (1914) 65. — Type: *Teijsmann s.n.* (U holo, n.v.; L), Java.

*Guioa geminata* Laut. & K. Schum. in K. Schum.



& Laut., Fl. Schutzgeb. Südsee (1900) 420. — *Arytera geminata* Radlk. in K. Schum. & Laut., Nachr. Fl. Schutzgeb. Südsee (1905) 308. — Type: *Lauterbach 2305* (B holo, probably lost; WRS�), New Guinea.

*Arytera litoralis* var. *major* King, J. As. Soc. Beng. 65, II (1896) 446. — *Arytera litoralis* f. *major* Radlk. in Gibbs, J. Linn. Soc. Bot. 42 (1914) 66. — Syntypes: *King's coll. 695, 885, 4456; Ridley 1609, 5995; Scortechini 20, Wray 3163*, Perak, Malaya.

*Nephelium mutabile* auct. non Blume: Miq., Fl. Ind. Bat., Suppl. I (1860) 198, 508.

More complete synonymy in H. Turner (1993).

*Trees*, rarely *shrubs*, 2–40 m high, dbh 7–91 cm; bark smooth, greyish green to reddish to almost black. *Indumentum* short appressed, straight. *Branchlets* hairy when young; flowering twigs 1–7 mm thick. *Leaves* 1–3(–4)-jugate; petioles 1.3–9.5 cm long; rachis 0.8–11.5 cm long, (hemi)terete, glabrous to hairy when young; petiolules 2–14 mm long, slightly to distinctly 1-grooved. *Leaflets* (sub)opposite, ovate to elliptic (to obovate), 4.2–31.1 by 1.4–12 cm, index 1.6–4.5, not falcate, slightly coriaceous to chartaceous, not to densely punctate, upper surface glabrous, lower surface glabrous to hairy especially on major nerves, colour the same as to (slightly) different from above; base symmetric, rarely oblique, then acroscopic side usually broader, (rounded to) acute to slightly attenuate; apex acuminate to cuspidate (retuse or rounded), very apex retuse to obtuse to rounded, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina to reddish brown or yellowish, venation raised below, nerves marginally indistinctly looped, veins (slightly) scalariform to almost reticulate, lax, not distinct; domatia often pustular, large to small pockets to sacs (pits) (absent), opening in front (on top). *Inflorescences* axillary to pseudoterminal (ramiflorous), branching along rachis (basally or unbranched); rachis terete to slightly flattened, 1.5–17 cm long, hairy when young; first-order branches up to 10 cm long; cymes dichasial (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 in diameter. *Calyx* 0.8–2 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, not punctate (punctate), margin not membranous, apex acute to acuminate. *Petals* (2–)5(–6), triangular to rhomboidal to (ob)ovate, 0.5–2.2 by 0.3–1.9 mm, not punctate, claw 0.1–0.4 mm long, blade usually gradually decurrent into claw, margin entire, (sub)pilose, apex obtuse to acute to acuminate, outside glabrous to pilose, inside

(sub)glabrous (to subpilose); scales 0.2–1.2 mm long, free to basally adnate to margin, (slightly auriculate basally), apex broadened (irregular), slightly to densely pilose. *Disc* glabrous to pilose. *Stamens* 6–8(–10); filaments 2–4 mm long, pilose; anthers 0.7–1.1 mm long, straight, pilose, connective not protruding. *Ovary* 2- (or 3-)locular; style and stigma elongating up to 3 mm in fruit, not to slightly 2 (or 3)-lobed, in fruit upper 0.5–2.5 mm stigmatic. *Fruits* with 1 or 2 (3) well-developed lobes, 0.7–3.6 by 0.5–2.3 cm, loculicidal, smooth to slightly rugose to verrucose, glabrous to slightly hairy, stipe 0–3 mm long, slender to broadly cuneate, lobes not to slightly flattened laterally, 8–23 by 5–21 mm, dorsally rounded to slightly angled; endocarp thin, chartaceous, pilose on sutures. *Seeds* ellipsoidal to orbicular, not to slightly flattened laterally, 6–24 by 5–19 mm; arillode covering the seed halfway to completely, dentate to lobed, not to slightly folded towards the base inside, thick towards base, coriaceous, 2-layered. — **Fig. 8c–e.**

*Distribution* — From NE India (Bay of Bengal) all over SE Asia up to S China (Hainan), throughout *Malesia*, up to the Solomon Islands.

*Habitat & Ecology* — In primary and secondary forests on all kinds of soils; altitude 0–1500 m. Fl., fr. throughout the year.

*Uses* — For a description of the timber, see p. 427.

*Notes* — 1. For a discussion of the nomenclatorial problems regarding *A. litoralis*, see H. Turner (1993).

2. A variable species, which cannot be divided into smaller entities, because intermediates between different forms can always be found. On the Lesser Sunda Islands east of Lombok and in New Guinea the leaves are generally 2-jugate with smaller domatia, and a less scalariform venation; also, the disc is usually rather densely pilose and the lower side of the leaflets often has a denser indumentum on the nerves. Here too, though, more 'typical' forms also occur. In Irian Jaya this species is reported to form buttresses.

3. Rarely (e.g. *NGF 5238, 15418, 29771*) the endocarp is almost completely pilose, with a glabrous patch near the centre of the valves only. These specimens have sometimes been identified as *A. brachyphylla*, from which they can be distinguished, however, by their less oblong leaflets with prominent lateral veins on the lower side.

7. *Arytera macrobotrys* (Merr. & L.M. Perry) R.W. Ham, Blumea 23 (1977) 291; S.T. Reynolds in Fl. Austral. 25 (1985) 90; *Austrobaileya* 2 (1985) 160. — *Mischocarpus macrobotrys* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940)



524. — Type: *Brass 7618* (A holotype: BRI), New Guinea.

*Tree* up to 20 m high, buttressed; bark slightly fissured, lenticellate, brown; sapwood corrugated. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 5–8 mm thick. *Leaves* 3–6-jugate; petioles 6–10.5 cm long; rachis 8.5–32.5 cm long, (hemi)terete, glabrous; petiolules 6–12 mm long. *Leaflets* subopposite to alternate, elliptic to slightly obovate, 7.7–18 by 3.3–5.9 cm, index 2.1–3.4, not falcate, subcoriaceous to chartaceous, densely punctate, upper surface glabrous, lower surface subglabrous, approximately concolorous with upper surface; base symmetric, attenuate to acute; apex acuminate, very apex retuse, minutely mucronulate; venation flat above, midrib slightly raised, colour yellowish to the same as that of lamina, venation raised below, nerves marginally distinctly looped, veins laxly reticulate, distinct; domatia sacs opening on top. *Inflorescences* axillary to pseudoterminal, branching along rachis, the latter flattened, 17–40 cm long, hairy when young; first-order branches up to 20 cm long; cyathules dichasial, 3–7-flowered; bracts and bracteoles punctate, bracts 0.3–1 mm long, bracteoles 0.1–0.4 mm long; pedicels 1.5–2 mm long, hairy. *Flowers* 1.5–1.7 mm in diameter. *Calyx* 0.5–0.9 mm high, connate up to 1/3, outside hairy, inside glabrous, teeth equal, punctate, margin slightly membranous, apex acute to obtuse. *Petals* 5, ovate, 0.8–1.1 by 0.6–1 mm, punctate, claw 0.2–0.3 mm long, blade gradually decurrent into claw, margin entire to slightly denticulate, pilose, apex rounded to acute, outside glabrous, inside pilose; scales minute to absent, up to 0.4 mm long, adnate to or enation of margin, (basally auriculate), apex not broadened (slightly broadened and forked), sparsely pilose. *Disc* glabrous. *Stamens* 7 or 8; filaments 1.8–2.5 mm long, pilose; anthers 0.3–0.4 mm long, straight, glabrous, connective not protruding. *Ovary* 3-locular; style and stigma elongating up to more than 2 mm in fruit, in fruit 3-lobed, upper c. 0.5 mm stigmatic, papillose. *Fruits* with 1 or 2 well-developed lobes, 1.8–3 by 1.8–2.8 cm, loculicidal or opening irregularly, smooth, glabrous, stipe 2–3 mm long, slender, lobes laterally not flattened, 1.8–2.8 by 1.8–3 cm, dorsally rounded; endocarp sclerenchymatous, radially striate from the attachment of the seed, detaching from the fruit wall when mature, glabrous. *Seeds* ovoid, slightly flattened laterally, c. 13 by 12 mm; arilode not alate, completely covering seed, not lobed, not folded towards the base inside, very thick, especially towards the base, fleshy to spongy, 1-layered.

*Distribution* — *Malesia*: Papua New Guinea (Western Prov.); Australia: N Queensland.

*Habitat & Ecology* — Substage or canopy tree, common on ridges; altitude 75–80 m. Fl. July, Aug.; fr. Oct., Nov.

8. *Arytera miniata* H. Turner, *Blumea* 38 (1993) 138. — Type: *Carr 11554* (L holotype: A. BM, CANB, K), New Guinea.

*Tree or shrub* 2–10 m high, dbh 2.5–12.5 cm; bark slightly suberose, grey to pale brown. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 1.5–2 mm thick, fruiting twigs 2–4.5 mm thick. *Leaves* 1- or 2-jugate; petioles 1–5 cm long; rachis 1.5–3.5 cm long, terete to hemiterete, (with a slight to distinct longitudinal ridge), hairy; petiolules 3–9 mm long, not to slightly 1-grooved. *Leaflets* opposite to subopposite, ovate to elliptic, 4–11.6 by 1.9–6 cm, index 1.4–2.5, not falcate, (slightly) coriaceous to somewhat chartaceous, not to slightly punctate, upper surface glabrous, lower surface slightly hairy especially on major nerves, slightly browner than above; base symmetric (asymmetric, basiscopic side broader), slightly attenuate to acute; apex retuse to slightly acuminate, very apex retuse to rounded, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina to reddish-yellow, venation raised below, nerves marginally indistinctly looped to more or less distinctly looped apically, veins more or less scalariform, lax, distinct; domatia somewhat pustulate (pockets to) sacs opening in front. *Inflorescences* axillary to pseudoterminal, branching along rachis; rachis terete, 3–10 cm long, hairy when young; first-order branches up to 9 cm long; bracts 0.4–0.8 mm long, bracteoles 0.2–0.3 mm long; pedicels 1.5–4 mm long in fruit, hairy. *Flowers* not observed. *Calyx* 0.6–1.5 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, not punctate, margin not membranous, apex acute. *Petals* 5, obovate, c. 1 by 0.6 mm, not punctate, claw c. 0.3 mm long, blade gradually decurrent into claw, margin entire, pilose, apex obtuse, outside and inside glabrous; scales c. 0.5 mm long, adnate to margin, basally not auriculate, apex broadened, pilose. *Disc* probably glabrous. *Stamens*: filaments in female flower c. 1 mm long, basally pilose; anthers in female flower c. 0.6 mm long, straight, pilose, connective not protruding. *Ovary* 2-locular; style and stigma elongating up to 1–2 mm in fruit, apically minutely 2-lobed, in fruit upper 1–1.5 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 0.7–1.3 by 0.7–1.7 cm, loculicidal, slightly rugose to verrucose, slightly hairy, stipe 1–3 mm long, slender, lobes not to slightly flattened laterally, 7–10 by 4–7 mm, dorsally rounded; endocarp thin, chartaceous, pilose along sutures. *Seeds* ellipsoid to

slightly ovoid, not flattened laterally, 8–9 by 5–6 mm; arillode completely covering seed, lobed, not folded towards the base inside, thin to slightly thickened towards base, coriaceous, 2-layered.

Distribution – *Malesia*: Papua New Guinea (Central Prov.).

Habitat & Ecology – Rain forest and semi-deciduous monsoonal forest, also on edge of mangrove, rare; altitude 0–30 m. Fl. probably Sept.; fr. Jan.–Mar.

**9. *Arytera morobeana*** H. Turner, *Blumea* 38 (1993) 139. — Type: LAE (*Katik & Taho*) 74816 (L. holo; A, BRI, CANB, LAE), New Guinea. *Arytera litoralis* auct. non Blume; Hartley et al., *Lloydia* 36 (1973) 269.

*Tree* c. 6–8 m high, dbh c. 8 cm; bark light grey to brown. *Indumentum* patent, crispate. *Branchlets* hairy when young; flowering twigs 1.5–5 mm thick. *Leaves* 1- or 2-jugate; petioles 2.5–7 cm long; rachis 1.8–3.5 cm long, (hemi)terete, hairy; petiolules 4–9 mm long, 1-grooved. *Leaflets* opposite, slightly ovate to elliptic to slightly obovate, 9.3–21.6 by 3.8–7.2 cm, index 2.1–3.2, not falcate, chartaceous, punctate, upper surface glabrous, lower surface subglabrous to hairy especially on major nerves, colour slightly to distinctly different from above; base symmetric to slightly asymmetric, then acroscopic side broader, slightly attenuate to acute; apex acute to acuminate (slightly retuse), very apex retuse to rounded to obtuse, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina, midrib reddish, venation raised below, nerves marginally indistinctly looped, veins scalariform, lax, distinct; domatia pockets to sacs opening in front. *Inflorescences* axillary to pseudoterminal, branching basally and along rachis; rachis terete to slightly flattened, 3–5 cm long, hairy when young; first-order branches up to 1.5–2 cm long; cymules monochasial, 1- or 2-flowered; bracts 0.3–0.9 mm long, bracteoles 0.2–0.4 mm long; pedicels 1.5–2 mm long, hairy. *Flowers* 2–2.5 mm in diameter. *Calyx* 1–1.5 mm high, deeply incised, outside hairy, inside (sub)glabrous, teeth equal, not punctate, margin not membranous, apex acute. *Petals* 5, elliptic, 1.5–1.8 by 0.8–1.2 mm, not punctate, claw 0.3–0.4 mm long, blade gradually decurrent into claw, margin entire, pilose, apex obtuse to acute, outside rather densely pilose, inside subglabrous to pilose; scales 0.8–1.2 mm long, free, basally not auriculate, apex broadened, rather densely pilose. *Disc* subglabrous to pilose on rim. *Stamens* 8 or 9; filaments in female flower 0.8–1.4 mm long, densely pilose; anthers in female flower 1–1.5 mm long, incurved, densely pilose, connec-

tive not protruding. *Ovary* 2-locular, inside pilose on sutures; style and stigma elongating up to 3 mm in developing fruit, minutely 2-lobed, upper 2 mm stigmatic. *Fruits* not observed.

Distribution – *Malesia*: Papua New Guinea (Morobe Prov.).

Habitat & Ecology – Lowland rain forest, altitude c. 100 m. Fl. Mar., Apr.

**10. *Arytera multijuga*** H. Turner, *Blumea* 38 (1993) 140. — Type: ANU (*Flenley*) 2846 (L. holo; A, BRI, CANB, K, LAE), New Guinea.

*Tree* c. 8 m high, dbh c. 10 cm; bark brown. *Indumentum* patent, crispate. *Branchlets* hairy when young; flowering twigs 5–10 mm thick. *Leaves* 4-jugate; petioles 9.5–13 cm long; rachis 13.5–18.5 cm long, terete, slightly 2-grooved, hairy; petiolules 3–10 mm long, not or indistinctly 2-grooved. *Leaflets* subopposite to alternate, elliptic to slightly obovate, 10.6–20.4 by 4.7–7.2 cm, index 2.3–3, not falcate, coriaceous, slightly punctate, upper surface slightly to densely hairy on major nerves, lower surface hairy, especially on major nerves, approximately concolorous with upper surface; base asymmetric, basiscopic side broader, acute; apex slightly cuspidate, very apex rounded, not mucronulate; venation flat above, midrib slightly raised, concolorous with lamina, venation raised below, nerves marginally distinctly looped, veins scalariform, lax, distinct; domatia minute pockets opening in front. *Inflorescences* axillary, branching along rachis; rachis terete, 4–11 cm long, hairy when young; first-order branches up to 7.5 cm long; cymules dichasial, 1–3-flowered; bracts 0.7–1 mm long, bracteoles 0.2–0.5 mm long; pedicels 1.5–3 mm long, hairy. *Flowers* 2.5–3 mm in diameter. *Calyx* deeply incised, outside hairy, inside densely puberulous, teeth slightly unequal, not punctate, margin not membranous, apex obtuse, 2 outer smaller teeth 1.1–1.4 mm high, 3 inner larger ones 1.7–2 mm high. *Petals* 5, elliptic to ovate, 1.1–1.9 by 0.8–1.2 mm, not punctate, claw c. 0.1 mm long, blade gradually decurrent into claw, margin entire (to slightly denticulate near apex), pilose, apex obtuse to acute, outside (sub)glabrous, inside subglabrous to subpuberulous; scales 0.4–0.9 mm long, adnate to margin, basally not auriculate, apex broadened, densely pilose. *Disc* glabrous. *Stamens* 7 or 8; filaments 2–3 mm long, pilose; anthers 1.1–1.4 mm long, straight, glabrous, connective slightly protruding. *Ovary* 3-locular; style and stigma not lobed. *Fruits* not observed. — **Fig. 9.**

Distribution – *Malesia*: Papua New Guinea (W Highlands Prov.).

Habitat & Ecology – In rain forest, on slope, in deep shade; altitude c. 2200 m. Fl. June.



Fig. 9. *Arytera multijuga* Turner. a. Habit; b. male flower; c. petal from inside (a-c: ANU (Flenley) 2846).



**11. *Arytera musca*** H. Turner, *Blumea* 38 (1993) 140. — Type: *Brass* 7620 (L holo; A, BM, BO), New Guinea.

*Arytera divaricata* auct. non F. Muell.; Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 522.

*Tree* 8–15 m high, dbh c. 12.5 cm; bark smooth or flaky, grey or brown. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 3–7 mm thick. *Leaves* 2-jugate; petioles 2.5–10.5 cm long; rachis 1.5–5 cm long, (hemi)terete to flattened with 2 more or less distinct longitudinal grooves, hairy to glabrescent; petiolules 4–9 mm long, 1-grooved. *Leaflets* opposite to subopposite, elliptic to slightly obovate, 4.5–19 by 2.2–8.8 cm, index 1.8–2.9, not falcate, thinly coriaceous to chartaceous, usually not punctate, upper surface glabrous, lower surface slightly hairy on major nerves, colour slightly different from above; base symmetric to slightly asymmetric, then basiscopic side broader, acute to slightly attenuate; apex obtuse to slightly acuminate, very apex retuse to obtuse, not mucronulate; venation flat above, midrib slightly raised, colour yellowish to reddish, venation raised below, nerves marginally indistinctly looped, veins weakly scalariform, lax, distinct; domatia pockets (to sacs) opening in front. *Inflorescences* axillary to pseudoterminal, branching along rachis (basally); rachis terete to slightly flattened, 4–12.5 cm long, hairy when young; first-order branches up to 6 cm long; cymules dichasial, 1–7-flowered; bracts 0.3–0.7 mm long, bracteoles 0.2–0.3 mm long; pedicels 1–4.5 mm long, hairy. *Flowers* 1.5–2 mm in diameter. *Calyx* 0.7–1.2 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, not punctate, margin not membranaceous, apex (sub)acute. *Petals* 2–5 (6), elliptic (to orbicular), 0.9–1.3 by 0.4–1 mm, not punctate, claw 0.1–0.3 mm long, blade gradually decurrent into claw, margin entire, pilose, apex obtuse to acute (to slightly acuminate), outside and inside subpilose; scales 0.5–0.8 mm long, free, basally not or slightly auriculate, apex (slightly) broadened, densely pilose. *Disc* glabrous. *Stamens* 8; filaments 1.5–2.5 mm long, pilose; anthers 1.1–1.3 mm long, incurved, pilose, connective slightly protruding. *Ovary* 2- (or 3-)locular; style and stigma elongating up to 1.5–3 mm in fruit, with a distinct thickening between style and stigma, not to slightly 2-lobed, in fruit upper 0.5–1 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 0.7–1.3 by 0.7–2.6 cm, loculicidal, smooth to slightly rugose, slightly hairy, stipe 0.5–2 mm long, slender, lobes sometimes flattened laterally, 9–15 by 6–10 mm, dorsally rounded; endocarp thin, chartaceous, pilose on sutures. *Seeds* orbicular, flat-

tened laterally, c. 6 by 6 mm; arilode completely covering seed, lobed, slightly folded towards the base inside, thick towards base, coriaceous, 2-layered.

*Distribution* – *Malesia*: Papua New Guinea (Western Prov.).

*Habitat & Ecology* – Rain forest and monsoon forest; altitude 15–30 m. Fl. Sept.; fr. Dec.

**12. *Arytera novaebritanniae*** H. Turner, *Blumea* 38 (1993) 141. — Type: *LAE* (*Stevens et al.*) 58188 (L holo; A, BRI, CANB, E, K, LAE, M, NSW), Papua New Guinea.

*Tree* 7–21 m high, dbh 25–30 cm, not buttressed; bark rugose, somewhat scaly, not to slightly fissured, dark grey to brown. *Indumentum* short, appressed, straight. *Branchlets* hairy when young; flowering twigs 2–3 mm thick, fruiting twigs 3.5–7 mm thick. *Leaves* 2–4-jugate; petioles 1–9 cm long; rachis 1.5–10.5 cm long, hemiterete, often with a ridge above, glabrous to slightly hairy when young; petiolules 1–7 mm long, not 1-grooved. *Leaflets* opposite to subopposite, ovate, 4.4–17.8 by 1.4–5.9 cm, index (2.3–)3–4.9, not to slightly falcate, coriaceous to chartaceous, (punctate), upper surface glabrous, lower surface glabrous to slightly hairy on major nerves, colour the same as to slightly different from above; base symmetric, acute; apex acuminate to caudate, very apex rounded, not mucronulate; venation flat above, colour the same as lamina, raised below, nerves marginally indistinctly looped, veins weakly scalariform, lax, distinct; domatia few to many large sacs opening on top. *Inflorescences* axillary to pseudoterminal, branching along rachis; rachis flattened when young, terete when in fruit, 3–18 cm long, hairy when young; first-order branches up to 3.5–4 cm long; cymules (irregularly) dichasial, 1–7-flowered; bracts 0.3–1 mm long, bracteoles 0.1–0.3 mm long; pedicels 3–5 mm long, elongating up to 5–8 mm in fruit, hairy when young. *Flowers* 2 mm in diameter. *Calyx* 0.8–1.1 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, not punctate, margin not membranaceous, apex acute. *Petals* 5, rhomboid to obovoid, 0.6–0.8 by 0.5–0.6 mm, not punctate, claw 0.1–0.3 mm long, blade gradually decurrent into claw, margin entire, pilose, apex obtuse, outside pilose, inside subglabrous to pilose; scales 0.6–0.7 mm long, free, basally not auriculate, apex broadened, densely pilose. *Disc* pilose. *Stamens* 7 or 8; filaments 2.2–2.8 mm long, pilose; anthers 0.8–0.9 mm long, straight, pilose, connective not protruding. *Ovary* 2- (or 3-)locular; style and stigma elongating up to 1.2–2.2 mm in fruit, not lobed, in fruit upper 0.6–



1 mm stigmatic. *Fruits* with 1 or 2 well-developed lobes, 1.5–2.2 by 1–2.9 cm, loculicidal, smooth, subglabrous to slightly hairy, stipe 1.5–2.5 mm long, slender, lobes laterally not flattened, 15–19 by 10–12 mm, dorsally angled; endocarp thin, chartaceous to coriaceous, (sub)puberulous on sutures. *Seeds* ovoid, not flattened laterally, c. 14 by 9 mm; arillode covering 1/2–3/4 of the seed, lobed, not folded towards the base inside, thick towards base, coriaceous, 2-layered.

*Distribution* – *Malesia*: Papua New Guinea (W New Britain); Solomon Islands.

*Habitat & Ecology* – Forest, on coral limestone; altitude 125–1200 m. Fl. May; fr. Apr., May.

**13. *Arytera pseudofoveolata*** H. Turner, *Blumea* 38 (1993) 142. — Type: *Brass* 5560 (A holotype; BM, BO, NY, US), New Guinea.

*Arytera* sp.: S.T. Reynolds in *Fl. Austral.* 25 (1985) 93; *Austrobaileya* 2 (1985) 165.

*Arytera foveolata* auct. non F. Muell.: Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 523.

Small tree. *Indumentum* patent, crispate. *Branchlets* hairy when young; flowering twigs 2.5–3 mm thick. *Leaves* 2-jugate; petioles 3.8–7.5 long; rachis 1.8–4.8 cm long, (hemi)terete, (with 2 longitudinal grooves), hairy; petiolules 3–10 mm long, 1-grooved. *Leaflets* opposite, ovate to obovate, 5.4–17.7 by 2–7.4 cm, index 2–3.2, not falcate, coriaceous to chartaceous, punctate or not so, upper surface glabrous, lower surface hairy on major nerves, colour different from above; base symmetric to slightly asymmetric, basiscopic (sometimes acroscopic) side broader, slightly attenuate to acute;

apex rounded to slightly acuminate, very apex retuse to rounded, not mucronulate; venation flat above, midrib usually slightly raised, concolorous with lamina to reddish or yellowish, venation raised below, nerves marginally indistinctly looped, veins scalariform, lax, distinct; domatia small, few pockets to (pustular) sacs opening in front. *Inflorescences* axillary to pseudoterminal, branching along rachis or not branching; rachis terete to slightly flattened, 3.5–14 cm long, hairy when young; first-order branches up to 5.5 cm long; cymules dichasial, 1–5-flowered; bracts 0.3–0.7 mm long, bracteoles 0.1–0.2 mm long; pedicels 1.5–3 mm long, hairy. *Flowers* 1.5–2 mm in diameter. *Calyx* 0.7–0.9 mm high, deeply incised, outside hairy, inside glabrous, teeth equal, not punctate, margin not membranous, apex acute to obtuse. *Petals* 3–5, elliptic to almost semiorbicular, 0.6–1 by 0.5–0.7 mm, not punctate, claw 0.1–0.4 mm long, blade gradually decurrent into claw, margin entire, subglabrous to subpilose, apex obtuse, outside and inside glabrous; scales 0.3–0.7 mm long, adnate to margin up to halfway, basally not auriculate, apex slightly broadened, sparsely pilose. *Disc* pilose on rim. *Stamens* 6–8; filaments 3–3.7 mm long, sparsely pilose; anthers 0.5–0.6 mm long, straight, subglabrous to subpilose, connective not protruding. *Ovary* 2-locular; style and stigma not observed. *Fruits* not observed.

*Distribution* – *Malesia*: Papua New Guinea (Central Prov.); Australia; Cape York area.

*Habitat & Ecology* – Vine forests, on soils derived from basic volcanic rocks and basalt; up to 100 m altitude. Fl. Nov.

## ATALAYA

(P.W. Leenhouts)

*Atalaya* [Span., *Comp. Bot. Mag.* 1 (1836) 345, nom. nud.] Blume, *Rumphia* 3 (1847) 186; Radlk. in *Engl. Pflanzenz.* 98 (1932) 605; S.T. Reynolds, *Austrobaileya* 1 (1981) 398. — Type species: *Atalaya salicifolius* (DC.) Blume.

Small trees or shrubs, monoecious. *Indumentum* never stellate-fascicled. *Leaves* paripinnate (towards the inflorescence sometimes ternate to 1-foliolate), up to 5-jugate; stipules absent; petiole and rachis often partly marginate to sometimes winged. *Leaflets* entire; petiolules short to very short, swollen. *Inflorescences* terminal and sometimes in the upper leaf-axils, paniculate. *Flowers* regular or nearly so. *Sepals* 5, free, imbricate, margin in Malesian species petaloid, outer 2 smaller. *Petals* 5 (in one Australian species 4), imbricate, (sub)equal, slightly longer than the calyx, clawed, outside variably pilose, inside above the claw provided with a small, long-hairy scale. *Disc* annular, complete (in one Australian species interrupted), slightly undulate, hairy or glabrous. *Stamens* 8, free,

all about equal, not exerted; filaments subulate, hairy at least in the lower half; anthers basally attached, oblong, emarginate at base, dehiscence latero-introse. *Ovary* triangular, 3-celled; style conical, slightly twisted, in Malesian species with 3 stigmatic lines; pistilode in male flowers minute or absent. *Ovules* 1 per cell, anatropous, apotropous, angular, attached about halfway the cell, sessile on a protuberance of the placenta. *Fruits* like 3-winged *Acer*-fruits (often, however, 1 or 2 cells abortive), breaking up to samarae with a dorsal, straight to curved, oblique wing, glabrous or tomentose. *Seeds* without aril, rootlet in a pocket. — **Figs. 10, 11.**

Distribution — 12 species: 9 in N and E Australia, of which one also in the Lesser Sunda Islands; 1 in SE New Guinea; 2 species in S Africa.

Habitat & Ecology — Tropical and subtropical regions with a periodically dry climate; light forests.

Notes — 1. The uppermost parts of the inflorescences are double bostryxes.

2. The genus seems to be closest to the Central American genus *Thouinidium* Sm.

3. Both Malesian species belong to sect. *Atalaya* (= *Euatlaya* Radlk.).

#### KEY TO THE SPECIES

- 1a. Fruits densely short-hairy. Leaflets mostly distinctly petiolulate, mostly oblique at the base. Sepals hairy outside. Petals distinctly clawed. . . . . **1. A. papuana**  
 b. Fruits glabrous. Leaflets subsessile, hardly or not oblique at the base. Sepals glabrous outside. Petals hardly clawed. . . . . **2. A. salicifolia**

**1. *Atalaya papuana*** (Radlk.) Leenh., *Blumea* 13 (1965) 126. — *Sapindus papuana* Radlk. in Engl., *Pflanzenr.* 98 (1932) 661. — Type: *Lister Turner s.n.* (BRI, L), 1925?, New Guinea.

*Guioa eriantha* Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 513; Welzen, *Leiden Bot. Series* 12 (1989) 304. — Type: *Brass 8244* (A, L), New Guinea.

*Tree* up to 23 m high, dbh up to 20 cm. *Branchlets* greyish brown, terete, rather densely inconspicuously lenticellate, young parts densely appressed fulvous short-hairy, early glabrescent. *Leaves* (1-) 2-3-jugate, glabrous; petiole slender, 2.5-6 cm, flattened, swollen at base; rachis up to 5 cm, towards the apex slightly broadened and sometimes marginate. *Leaflets* subsessile (or petiolules up to 1 cm long, swollen at base), opposite, elliptic, 5.5-22 by 3-8.5 cm, stiff-chartaceous, brownish- or yellowish- to greyish green when dried, beneath lighter and more dull; base cuneate and attenuate, often distinctly oblique; apex obtuse; midrib above slightly carinate, prominent beneath, nerves c. 12-14 per side, spreading, straight to slightly curved, only the upper ones looped and joined at the margin, slender, hardly prominent on either surface or prominent beneath, between every two nerves at least 1 intermediate vein  $\pm$  parallel and often near-

ly as strongly developed as these, veinlets prominent on both surfaces. *Inflorescences* pyramidal thyrsoid, 8-30 cm long, densely short fulvous-hairy, the branches ascending, in bigger inflorescences repeatedly thyrsoid, for the greater part bearing several short-stalked few-flowered cymes; bracts lanceolate, 4 mm long. *Flowers* reported to be creamy-white. *Sepals* with a broad, membranous, short-ciliate (partly glandular) margin, outside rather densely appressed short-hairy, outer obovate (-orbicular), 2.5-3.2 by 2-2.8 mm, inner nearly orbicular to obovate, 3-4 by 2.3-3 mm. *Petals* 0.8-1.5 mm long clawed, ovate to lanceolate, 2.5-3.6 by 1.5-2.5 mm, inside at base incurved-auriculate, outside the claw and at least the basal part of the blade appressed-hairy, inside the claw, the 'scales' and at least the basal half of the blade rather densely to sparsely woolly. *Disc* annular, low and thick, with undulate margin, rather densely short-hairy. *Stamens* in male flowers 4 mm long, filaments 2-3 mm long; in female flowers 2.5 mm long, filaments 1.5 mm long; anthers 1 mm long. *Pistil* 4.5 mm long; ovary 3.5 mm long, densely velvety; style 1 mm long, columnar, twisted, glabrous; stigma truncate, vaguely lobed; in male flowers rather reduced. *Fruits* densely appressed short-hairy, samarae 4 cm long, wing 1.5 cm wide, slightly curved upwards. — **Fig. 10.**



Fig. 10. *Atalaya papuana* (Radlk.) Leenh. a. Habit; b. flower; c. petal from inside; d. petal from outside; e. stamen; f. disc; g. ovary; h. fruit (a: Schodde 2740; b-g: Schodde 2742; h: Schodde 2807).



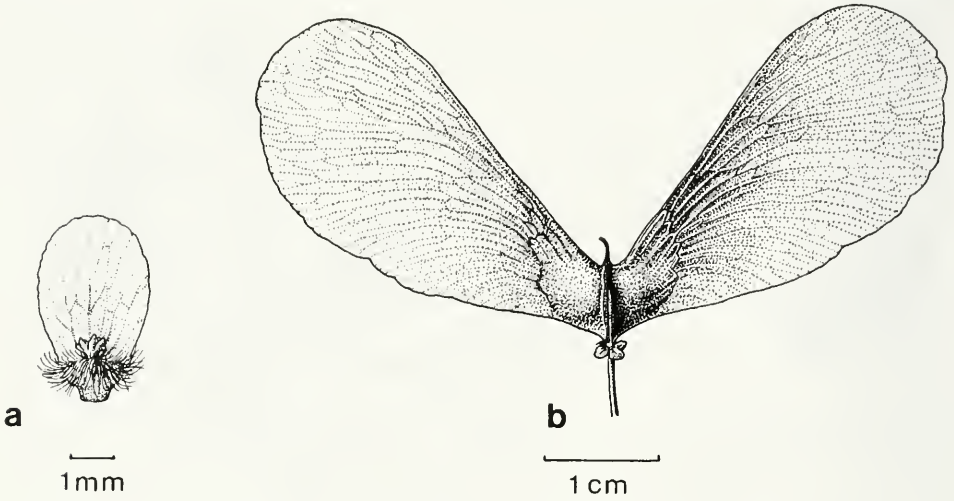


Fig. 11. *Atalaya salicifolia* (DC.) Blume. a. Petal from inside; b. fruit (a, b: *Kooy 1388*).

Distribution – *Malesia*: Papua New Guinea (Western and Central Provinces).

Habitat & Ecology – Coastal monsoon dune scrub, savannah forest, stunted pyric swamp forest, poor primary rain forest; lowland. Fl. June–Sept.; fr. Aug.–Sept.

Note – Apparently most closely related to *A. hemiglauca* (F. Muell.) Benth. from tropical and subtropical Australia.

2. *Atalaya salicifolia* (DC.) Blume, *Rumphia* 3 (1847) 186; Radlk. in Engl., *Pflanzenr.* 98 (1932) 609; Meijer Drees, *Comm. For. Res. Inst.* 33 (1951) 108; S.T. Reynolds, *Austrobaileya* 1 (1981) 400, f. 27A. — *Sapindus salicifolius* DC., *Prod.* 1 (1824) 608. — *Cupania salicifolia* (DC.) Descaisne, *Nouv. Ann. Mus. Hist. Nat. Paris* 3, 3 (1834) 443. — Type: *Gaudichaud s.n.* (?Riedlé) in Herb. DC., Timor.

*Atalaya bijuga* Span., *Comp. Bot. Mag.* 1 (1836) 345, nom. nud.

*Treelet* up to 15 m high, dbh up to 40 cm. *Branchlets* greyish brown, terete, rather densely minutely lenticellate, glabrous except for the sparsely appressed short-hairy tips, furthermore glabrous. *Leaves* 1–3-jugate (according to Blume sometimes ternate or 1-foliolate); petiole slender, 2.5–6 cm, terete at base, flattened and carinate at apex; rachis up to 7.5 cm, in the upper part flattened and broadened (to marginate). *Leaflets* subsessile (or with petiolules up to 3 mm long, swollen at base), opposite or subopposite, (elliptic or

oblong (rarely ovate-oblong) to lanceolate, sometimes slightly falcate, 6–16.5 by 1.5–4 cm, when dried greyish green to brown and shining above, lighter and dull beneath; base cuneate-attenuate; apex obtuse to rounded; midrib above slightly carinate, beneath more or less prominent, nerves 12–28 per side, nearly transverse, straight to slightly curved, looped and joined near the margin, slender, barely prominent on both sides, between every two nerves 1 or 2 intermediate veins nearly as strongly developed as these, veinlets almost as prominent. *Inflorescences* panicle, 15–25 cm long; branches long, erect, branched again, bearing in their upper half stalked, few-flowered cymes; bracts lanceolate, 1–2 mm long. *Sepals* with a broad, membranous, short-ciliate margin, outer nearly semi-orbicular, c. 2 mm diam., inner nearly orbicular, c. 3 mm diam. *Petals* obovate-cuneate, concave, short-clawed, c. 3 by 2.5 mm, outside sparsely hairy near the base, rather long ciliate at the base; scales nearly orbicular to deeply bilobed, c. 0.5 mm long, densely long-hairy. *Disc* annular, c. 0.5 mm high, thin, glabrous. *Stamens* in male flowers 3 mm long, filaments 2.5 mm long; in female flowers 2 mm long, filaments 1 mm long; anthers 1 mm long. *Pistil* 2 mm long; ovary hairy along the upper half of the angles; style slightly shorter, long-conical with thickened stigmatic lines in the upper part; in male flowers strongly reduced to absent. *Fruits* glabrous, samaras c. 2.5 cm long, wing 1 cm wide, straight. *Seeds* subovoid, c. 7.5 by 4 mm. — **Fig. 11.**

Distribution – *Malesia*: Lesser Sunda Islands



(Sumbawa, Sumba, Timor, and Leti): Australia.

Habitat & Ecology — Dryland forest; up to 500 (–1000) m altitude. Monsoon climate. Possibly preferably on limestone. Fl. Aug., Nov., Dec.; fr. Nov., Dec.

Note — The petals are unequal: the two upper ones are very concave and slightly oblique and their scales are deeply bilobed, the others are slightly concave, not oblique, and have nearly orbicular scales.

## CARDIOSPERMUM

(P.W. Leenhouts)

*Cardiospermum* L., Sp. Pl. (1753) 366; Gen. Pl. ed. 5 (1754) 171; Radlk. in Engl., Pflanzenz. 98 (1932) 370–413. — Type species: *Cardiospermum halicacabum* L.

Suffruticose or herbaceous *climbers* (some American species undershrubs), monoecious. *Indumentum* never stellate-fascicled. *Leaves* biternate (Malesian species), with minute stipules at the base. *Inflorescences* axillary, thyrsoid, mostly (some American species excepted) provided with a pair of tendrils. *Flowers* unisexual, obliquely zygomorphic. *Sepals* 5 or 4 (by coalescence of the abaxial two), free, imbricate, outer two smaller. *Petals* 4 (abaxial one missing), provided with a scale inside slightly above the base which is only slightly smaller and narrower than the petal itself; scales of adaxial petals almost simple, of abaxial ones hood-shaped, bearded, and crested. *Disc* a gland at the base of every petal, abaxial ones bigger and in some species at one side long-corniculate (sect. *Ceratadenia* Radlk. to which *C. grandiflora* belongs). *Stamens* 8, slightly curved upwards, unequal; in female flowers only slightly reduced. *Ovary* 3-angled, 3-celled, with a short style and a 3-lobed stigma; ovules 1 per cell, attached basally. *Fruits* capsular, 3-lobed, inflated, 3-celled, septicidal, papyraceous. *Seeds* with heart-shaped to orbicular hilum (sometimes described as arillode). — **Fig. 12.**

Distribution — About 12 species, mostly restricted to tropical and subtropical America; one species (*C. grandiflorum*) extending to Africa; *C. halicacabum* is a worldwide tropical and subtropical weed. See Herzog in Hannig & Winkler, Pfl. Areale 4 (1936) 36, map 32a.

Habitat — Apparently light-demanding plants of forest-edges, hedges, shrubberies, savannahs, etc., at low altitudes.

Ecology — For pollination see A.G. Hamilton, Rep. 7th Meet. Austral. Assoc. Adv. Sc. (1899) 559–560.

The mode of dispersal of the American/African species *C. grandiflorum*, which is sometimes cultivated as an ornamental in Malesia, is very peculiar, and hardly mentioned in botanical literature. The broadly spindle-shaped, inflated fruits are septicidal and septifragal; the dissepiments split into three elliptic, membranous wings, of nearly the same length and width as the fruit. Each seed is well-affixed to the centre of one of these wings. This is in clear contrast to the dispersal of *C. halicacabum*, the fruits of which are more strongly inflated – globular or even broader – and which seem to be dispersed as a whole, like little balloons.

Morphology — The inflorescence in its most complete form consists of a rather long peduncle with a pair of tendrils (subtended by bracts) slightly below its apex, and a rather short rachis with some pseudo-whorls of 3 lateral branches and a terminal partial inflorescence. The latter, as well as the partial inflorescences terminating the lateral branches,

is a few-flowered bostryx. Branches and flowers all have small, lanceolate bracts.

For the ontogeny of the flower see Payer, *Organog. de la Fleur* (1857) 149–153, t. 32.

For ovule and seed (especially the hilum) see Van der Pijl, *Acta Bot. Neerl.* 6 (1957) 624–627; Nair & Joseph, *J. Ind. Bot. Soc.* 39 (1960) 176–194 (n.v.).

For embryology see Kadry, *Svensk Bot. Tidskr.* 40 (1946) 111–126.

Notes — 1. The synonym *Physalis* Noroña, cited by Radlkofer with doubt on authority of Hasskarl (*Tijd. Nat. Gesch. Phys.* 11, 1844, 226) is probably erroneous. Noroña, *Verh. Bat. Gen. K. W.* 5 (1791) 23, cited: “*Physalis Halicacabum, Daun capo, nov. cogn.*” Apparently, he did not intend to describe a new species, but referred to *Physalis halicacabum* Crantz (*Inst.* 2, 1766, 370), a name often treated as synonymous with *Physalis alkekengi* L. (*Solanaceae*); the Sundanese vernacular *daun capo* also refers to *Physalis*.

2. The genus is most closely related to *Urvillea* Kunth (Central and South America).

#### KEY TO THE SPECIES

- 1a. Flowers 2–4 mm long; abaxial disc-lobes not corniculate. Inflorescences mostly consisting of one pseudo-whorl of 3 lateral branches. Fruits 3-lobed, globular, 2–4 cm in diameter . . . . . ***C. halicacabum***
- b. Flowers 8–10 mm long; abaxial disc-lobes long-corniculate. Inflorescences with several pseudo-whorls. Fruits 3-lobed, ellipsoid, up to 6.5 by 3.5 cm. Tropical and subtropical America and Africa. Ornamental, sometimes naturalized  
*C. grandiflorum* Swartz

***Cardiospermum halicacabum*** L., *Sp. Pl.* (1753) 366; Sims, *Bot. Mag.* 25 (1807) t. 1049; Wight,  *Ic.* 2 (1841) t. 508; Blume, *Rumphia* 3 (1847) 185; Griff., *Notul.* 4 (1854) 546; King, *J. As. Soc. Beng.* 65, II (1896) 421; Ridley, *J. Str. Br. Roy. As. Soc.* 45 (1906) 186; *Fl. Malay Penins.* 1 (1922) 488; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 493; Craib, *Fl. Siam. Enum.* 1 (1926) 321; Backer, *Onkruidfl. Suikerrietgr.* (1930) 419; Radlk. in Engl., *Pflanzenr.* 98 (1932) 379, f. 8A–C; Adelb., *Blumea* 6 (1948) 322; Hend., *Mal. Wild Fl. Dicot.* (1949) 59, f. 52; Steenis, *Fl. Sch. Indon.* (1949) 251; Gagnep. in *Fl. Indo-Chine, Suppl.* 1 (1950) 933; Hend., *Comm. Mal. Wild Fl.* (1961) 10, t. 2; Backer & Bakh. f., *Fl. Java* 2 (1965) 132. — [*Halicacabus peregrinus* Rumph., *Herb. Amb.* 6 (1750) 61, t. 24 f. 2.] — Type: *Herb. Clifford 151, Cardiospermum 1* (BM).

*Cardiospermum corindum* L., *Sp. Pl.* ed. 2 (1762) 526; Radlk. in Engl., *Pflanzenr.* 98 (1932) 397. — Neotype (Pennington 1993): *Houstou* s.n. (BM), Jamaica.

*Cardiospermum microcarpum* H.B.K., *Nov. Gen.* ed. 4, 5 (1841) 104. — *Cardiospermum halicacabum* L. var. *microcarpum* (H.B.K.) Blume,

*Rumphia* 3 (1847). — Type: *Humboldt & Bonpland 1184*, Venezuela.

*Cardiospermum luridum* Blume, *Rumphia* 3 (1847) 184. — *Cardiospermum halicacabum* L. var. *luridum* (Blume) Adelb., *Blumea* 6 (1948) 322. — Type: *Anonymous s.n.* (L), Java.

Annual or perennial *herbs* or *subscrubs*, often much branched mainly near the base. *Stems* deeply 5-sulcate, slender, glabrous to sparsely hairy. *Leaves* c. 5–8 by 5–8 cm, sparsely appressed-short-hairy to subglabrous; petiole 1.5–3 cm, slender, grooved; lateral petiolules c. 0.5 cm, terminal one c. 1 cm long, both narrowly winged; stipules lanceolate, caducous. *Leaflets* herbaceous, mostly about 3-partite and pinnately lobed, lobes and apex aristulate. *Inflorescences* patent, sparsely short-hairy, 5–14 cm long; peduncle 7–10 cm, slender, slightly above the tendrils terminated by a pseudo-whorl of 3 spreading, bracteate, long-stalked, few-flowered bostryxes (moreover rarely with an ebracteate, terminal bostryx); bracts lanceolate (lower) to elliptic (higher), 1–2 mm. *Flowers* 2–3.5 mm long, slender pedicelled. *Sepals* 4, concave, thin, subglabrous, green, tinged red, outer pair broadly ovate to suborbicular, 1–1.5 by 1.2 mm,



Fig. 12. *Cardiospermum halicacabum* L. a. Habit; b. stipules; c. fruit; d, e. petals from inside with scales; f. disc; g. ovary; h. seed (a, b, d–g: de Wilde 2765; c, h: de Raadt 54).

inner pair suborbicular to broad-elliptic, 2–2.5 by 1.5–2 mm, with white margins. *Petals* obovate-cuneate to orbicular, rounded and slightly emarginate at apex, 1.5–2.5 by 1–2 mm, at the base with some woolly hairs at the margin, otherwise glabrous, white to creamy with yellowish margin; scales glabrous but for the bearded apical part, those of adaxial petals narrow-obovate, somewhat oblique, 1.2–2 by nearly 1 mm, rounded at apex, slightly thicker than the petal itself, those of abaxial petals oblong, hood-shaped, about 1.2 mm long with a transverse crest of about 0.2 mm. *Disc* glabrous, abaxial lobes not corniculate. *Stamens*: filaments band-shaped, 0.8–2.5 mm, slightly hairy; anthers almost versatile, elliptic, 0.5 mm, yellow. *Ovary* obovoid, 2–3 mm, nearly glabrous to densely pubescent; style columnar, glabrous or with some hairs; stigma lobes short, thick; in male flowers pistil strongly reduced. *Fruits* 3-lobed, globular, 1.5–4 cm in diam., mostly sparsely short-hairy, green, reddish at base or with reddish veins. *Seeds* subglobular, c. 4 mm diam., dull-black, smooth, glabrous; hilum cordate, rather large, white. – **Fig. 12.**

**Distribution** – Probably of American origin, but now a fairly common weed of the Tropics and Subtropics; throughout *Malesia*.

**Habitat & Ecology** – Under everwet as well as under seasonal conditions, on acid as well as on basic soils, dry to marshy or even periodically flooded with fresh water, preferably in sunny places: waste ground, road-sides, grassland, shrubland, hedges in cultivated areas, also along forest edges and sometimes along sandy beaches. Altitude up to c. 1500 m. The fruits are dispersed by sea, by rivers, over short distances by the wind, but mainly by man. See Ridley, *Dispersal* (1930) 73, 268,

491. Fl., fr. Jan.–Dec.

**Uses** – Used as a vegetable and in medicine; baskets are made from the stems, the seeds are used as beads. For more details see Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 457; Dalziel, *Useful Pl. W. Trop. Afr.* (1937) 332; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 988.

**Chromosomes** –  $2n = 22$ : Kadry, *Svensk Bot. Tidskr.* 45 (1951) 414.

**Notes** – 1. Usually the flower developing first in every bostryx is female, all others are male.

2. In *Elbert 1985* the sepals are leafy and green, and the two lower ones are not completely connate.

3. The scales of the adaxial petals are probably also crested, but the crest is here lateral, turned towards the abaxial side of the flower. The suture is inconspicuous in typical *C. halicacabum*, often more clearly visible and even more or less concave (the scale then becoming laterally hood-shaped) in several forms of *C. corindum*. The scales of the abaxial petals have a central part which is more or less fleshy, and broad membranous wings; their crests are slightly concave. Probably, these scales are coherent in the flower.

4. For the reduction of *C. corindum* to *C. halicacabum* see Standley & Steyermark, *Fieldiana Bot.* 24, VI (1949) 240. *Cariospermum corindum* is a very variable species according to Radlkofer's monograph where it is subdivided into 14 forms. All Malesian specimens represent typical *halicacabum*, a form which is surprisingly uniform all over the world. There is slight variation in the sizes of flowers and fruits: var. *microcarpum* representing the relatively small-fruited, var. *luridum* the big-fruited specimens. In my opinion these varieties do not deserve any taxonomic status.

## CNESMOCARPON

(F. Adema)

*Cnesmocarpon* Adema, *Blumea* 37 (1993) 195. — Type species: *Guioa dasyantha* Radlk. [= *Cnesmocarpon dasyantha* (Radlk.) Adema].

Small or medium-sized *trees*, twigs, petioles and rachises lenticellate. *Indumentum* of solitary simple hairs. *Twigs* terete, striate to grooved. *Leaves* spirally arranged, paripinnate, 1–8-jugate, without pseudo-stipules, neither petiole nor rachis winged. *Leaflets* alternate to opposite, asymmetric, papillate below; petiolules pulvinate; margin entire or remotely dentate; midrib not or slightly prominent above; domatia absent or pocket-like. *Inflorescences* axillary or rarely ramiflorous, bracts and bracteoles subulate to triangular or ovate, both sides appressed-hairy. *Flowers* unisexual, regular. *Sepals* 5, free, imbricate, not petaloid, slightly unequal, both sides appressed-hairy. *Petals* 5, spatulate, shorter to



longer than the sepals, clawed, with 2 scales or auricles (in *C. dentata* sometimes absent). *Disc* complete or interrupted, glabrous. *Stamens* 8; filaments patently hairy; anthers glabrous or sparsely hairy. *Ovary* 3-celled, hairy; style apical with 3 stigmatic lines. *Fruits* 3-celled, basally 3-winged, loculicidal, outside velutinous and densely covered with irritating hairs, inside tomentose to appressed-hairy. *Seeds* obovoid, testa shiny black, sarcotesta carunculoid; cotyledons unequal, parallel or obliquely superposed. — **Figs. 13, 14.**

Distribution — Four species in Australia and *Malesia*: Papua New Guinea.

Habitat — Primary forest, lowland to montane (up to 2000 m altitude).

#### KEY TO THE SPECIES

- 1a. Leaflets entire, lower side whitish or glaucous . . . . . 2
- b. Leaflets remotely dentate, lower side green . . . . . **2. *C. dentata***
- 2a. Indumentum strigose. Upper side of leaflets totally glabrous . . . . . 3
- b. Indumentum puberulous to tomentose. Upper side of leaflets usually with a densely hairy midrib . . . . . **3. *C. discoloroides***
- 3a. Leaves (3-)4-5-jugate. Leaflets 6-18.5 by 2.5-5.5 cm, nerves 6-12 per side, 7-20(-28) mm apart. Up to 1000 m altitude . . . . . **1. *C. dasyantha***
- b. Leaves 2-3(-4)-jugate. Leaflets 8.5-19 by 3.5-8 cm, nerves 5-10 per side, 9-30 mm apart. 1600-2000 m altitude . . . . . **4. *C. montana***

**1. *Cnesmocarpon dasyantha*** (Radlk.) Adema, *Blumea* 37 (1993) 197. — *Guioa dasyantha* Radlk., *Bot. Jahrb.* 56 (1920) 277; in Engl., *Pflanzenr.* 98 (1933) 1159; Welzen, *Leiden Bot. Series* 12 (1989) 304. — *Jagera dasyantha* (Radlk.) S.T. Reynolds, *Austrobaileya* 3 (1991) 500. — Type: *Ledermann 10365* (L), Papua New Guinea, Sepik area.

*Jagera discolor* L.S. Smith ex S.T. Reynolds, *Austrobaileya* 1 (1981) 407, f. 28A; in *Fl. Austral.* 25 (1985) 67. — Type: *L.S. Smith 4977* (BRI, L), Australia, Queensland.

*Trees* 5-28 m high, dbh 15-30(-92.5) cm; bark smooth, light grey to red brown, inner bark pink to orange or red brown; wood pale creamy pink to reddish. *Twigs* striate to grooved, 2-5 mm in diam., (thinly) strigose, soon glabrous. *Leaves* (3-)4-5-jugate; petiole 1.5-9.5 cm, strongly pulvinate; rachis 2.5-19 cm, both flattened above, rounded below, striate, strigose to glabrous; petiolules 3-16 mm, flattened above, rounded below, grooved above, strigose to glabrous. *Leaflets* alternate or opposite, elliptic to ovate, 6-18.5 by 2.5-5.5 cm, index 1.9-3.4, mid or dark green above, greyish green or glaucous below, thickly chartaceous, above glabrous, below glabrous to thinly strigose, whitish when dry; base cuneate to rounded; apex acuminate, rarely cuspidate; margin entire; midrib not prominent above, nerves 6-12 per side, 7-20(-28) mm apart, angle to midrib 40-60°; domatia absent

or small, pocket-like. *Inflorescences* axillary, 6-10 cm long, with 1 to many branches, in fruit 5.5-15 cm long; bracts and bracteoles subulate to triangular or ovate, 0.2-2.5 by 0.1-1 mm; pedicels c. 3.7 mm long, articulated at midpoint, strigose. *Flower buds* ± globular, 1.9-2.5 by 2.2-2.5 mm; flowers white or cream. *Sepals* (broadly) ovate to triangular, 1.7-3.7 by 1.6-2.5 mm. *Petals* 2.1-2.4 by 1.2-1.7 mm, claw 0.5-0.9 mm, outside appressed-hairy at the claw, margin ciliate, inside appressed-hairy except apex; auricles woolly. *Disc* entire. Filaments of *staminodes* 1.5-2.1 mm; anthers 0.6 mm, glabrous. *Style* 1.2-1.4 mm, thinly hairy, stigma 0.2 mm. *Fruits* subglobular, 3-angled in cross section, 15 by 16 mm, wall at base very thick, thinning upwards, tomentose inside, but appressed-hairy by the seeds. *Seeds* 9 by 5 mm; cotyledons obliquely superposed. — **Fig. 13.**

Distribution — *Malesia*: Papua New Guinea (Sepik, W New Britain, Central and Western Prov.); Australia: N Queensland, between Mt Lewis and Mt Fox.

Habitat & Ecology — Primary forest, altitude 400-1000 m. Fl. Mar., Sept.; fr. Mar.

**2. *Cnesmocarpon dentata*** Adema, *Blumea* 37 (1993) 197. — Type: *Jacobs 9524* (BISH, BO, L), Papua New Guinea, Mt Bosavi.

*Trees* 6-26 m high; bark moderately smooth, patchy light and dark grey and brown, blaze thin,



Fig. 13. *Cnesmocarpon dasyantha* (Radlk.) Adema. a. Habit; b. detail of lower surface of leaflet (a, b: NGF 21918).

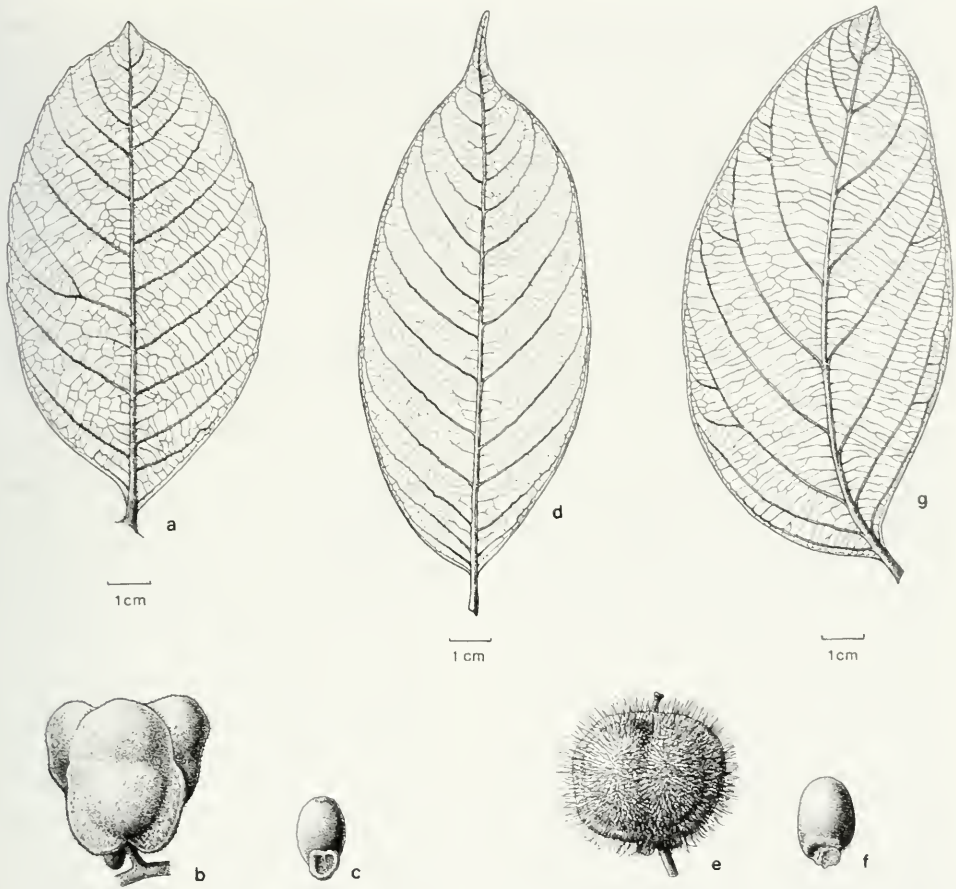


Fig. 14. *Cnesmocarpon* Adema. Leaflets, fruits and seeds. — *C. dentata* Adema. a. Leaflet lower surface; b. fruit; c. seed. — *C. discoloroides* Adema. d. Leaflet lower surface; e. fruit; f. seed. — *C. montana* Adema. g. Leaflet lower surface (a–c: *Jacobs* 9524; d–f: *LAE* 58053; g: *Carr* 13384).

red brown. *Twigs* striate, 2–5 mm in diam., short tomentose, glabrescent. *Leaves* 1–3-jugate; petiole 1.5–5 cm,  $\pm$  pulvinate, flattened above, rounded below; rachis (0–)1.5–12 cm, about terete, both striate, short tomentose; petiolules 3–8 mm, flattened above, rounded below, grooved, short tomentose. *Leaflets* opposite to alternate,  $\pm$  elliptic, 4.5–17.5 by 2.5–8 cm, index 1.8–2.8, green below, chartaceous, above and below almost glabrous, midrib densely, nerves thinly puberulous; margin dentate; midrib slightly prominent above, nerves 7–12 per side, mostly ending in a tooth, 5–20 mm apart, angle to midrib 45–75°; domatia absent. *Inflorescences* axillary, 3–8 cm long, with or without branches, in fruit 5–13.5 cm long; bracts and bracteoles triangular, 0.3–1.9 by 0.2–1.2 mm; pedicels c. 3 mm long, articulated at about midpoint, short tomentose. *Sepals* triangular to deltoid, 1.7–

2.5 by 1–1.8 mm. *Petals* 1.2–3 by 0.6–1.9 mm, claw 0.4–0.6 mm, outside appressed-hairy up to halfway, margin ciliate, inside appressed-hairy in lower half; appendages absent, or either 2 scales or auricles, woolly; corolla white. *Disc* interrupted. Filaments of *staminodes* 1.9–2.2 mm; anthers 0.6 mm, glabrous or thinly hairy. *Style* 2–3 mm, glabrous or thinly hairy, stigma 0.5–0.9 mm. *Fruits* about globular, basally 3-winged, glossy bright red to orange, succulent, very sour, 22 by 20 mm, wall c. 6 mm thick, succulent,  $\pm$  appressed hairy inside. *Seeds* black with yellow aril, 11 by 5 mm; cotyledons parallel. — **Fig. 14a–c.**

*Distribution* — *Malesia*: Papua New Guinea (W & S Highlands Prov.).

*Habitat & Ecology* — Primary forest, altitude 10–700 m. Volcanic soil. Fl., fr. Oct.



3. *Cnesmocarpon discoloroides* Adema, Blumea 37 (1993) 199. — Type: LAE 58053 (P.F. Stevens) (A. BISH, L), Papua New Guinea, Mt Shungol.

*Trees* 5–16 m high, dbh 5–25 cm; bark (greenish) grey to brown or black, slightly cracked, inner surface straw to dark (reddish) brown, under bark red or greenish, inner bark red or orange; wood white to orange brown. *Twigs* striate to grooved, 2–5(–10) mm in diam., shortly tomentose, glabrescent. *Leaves* (2–)4–5(–8)-jugate; petiole 3–11 cm, strongly pulvinate, flattened above, rounded below, towards the apex terete; rachis (2.5–)9.5–30.5 cm, about terete, both striate, shortly tomentose, glabrescent; petiolules 2–15 mm, flattened above, rounded below, grooved above, shortly tomentose, glabrescent. *Leaflets* alternate to opposite, elliptic to ovate, rarely obovate, mid or dark green above, pale green, greyish or glaucous below, 6–22 by 2.5–8.5 cm, index 1.7–3.2(–4.2), thickly chartaceous, above glabrous to thinly puberulous, midrib more densely so, below almost glabrous to thinly puberulous, midrib and nerves more densely so,  $\pm$  whitish when dry; base cuneate to rounded; apex short- or long-acuminate; margin entire, exceptionally undulate; midrib not prominent above, nerves 8–16 per side, 5–20 mm apart, angle to midrib 45–65°; domatia inconspicuous, pocket-like. *Inflorescences* axillary or ramiflorous, c. 1 cm long, branched or not, in fruit 3–17 cm long; bracts and bracteoles subulate to deltoid, 0.2–1.2 by 0.1–1.1 mm; pedicels 1.5 mm long, articulated 1/4 up their length, shortly tomentose. *Flower* buds about globular, yellow green, 1.7 by 1.9 mm; flowers only known from buds and from remains below the young fruits, white. *Sepals*  $\pm$  elliptic, inner ones apically with scarious rims, 1.7–3.1 by 1.5–2.2 mm, ciliate. *Petals* 3 by 1.2 mm, claw 1.2 mm, outside appressed-hairy at the claw, ciliate at the base of the blade, inside appressed-hairy except apex; auricles woolly.

*Disc* entire. Filaments of *staminodes* 2.2–2.5 mm; anthers 0.5–0.6 mm, glabrous. *Style* 1–1.9 mm, glabrous, stigma 0.4–0.7 mm. Young *fruits* red, 3-angled in cross section, tomentose inside. — **Fig. 14d–f.**

*Distribution* — *Malesia*: Papua New Guinea (W New Britain, Morobe, and Milne Bay Prov.).

*Habitat & Ecology* — Montane or hill forest, 0–1300 m altitude. Stony ground. Fl. May, Oct.; fr. Jan.–May, Oct.–Dec.

4. *Cnesmocarpon montana* Adema, Blumea 37 (1993) 199. — Type: Carr 14154 (BM, G. L. SING), Papua New Guinea, Alola.

*Trees* 8–10 m high. *Twigs* grooved, 2–3 mm in diam., strigose. *Leaves* 2–3(–4)-jugate; petiole 4.5–7 cm, strongly pulvinate, flattened above, rounded below, rarely towards the apex terete; rachis 4.5–12 mm, flattened above, rounded below, rarely terete, both striate, (thinly) strigose; petiolules 5–10 mm, flattened above, rounded below, grooved above. *Leaflets* alternate to opposite, elliptic to ovate, 8.5–19 by 3.5–8 cm, index 1.8–3, coriaceous, above glabrous, below rather densely strigose, whitish when dry; base cuneate to rounded; apex shortly and obtusely acuminate; margin entire; midrib not prominent above, nerves 5–10 per side, 9–30 mm apart, angle to midrib 40–45°; domatia absent. *Inflorescences* axillary, 16–19 cm long; branches in fruit at least 7 cm long; bracts and bracteoles  $\pm$  triangular, 0.4 by 0.4 mm; pedicels 4 mm long, articulated at midpoint, strigose. *Flower* buds brownish, flattened globular, 2 by 2–2.5 mm; flowers green or white. Young *fruits* reddish, tomentose inside. — **Fig. 14g.**

*Distribution* — *Malesia*: Papua New Guinea (Central Prov.).

*Habitat & Ecology* — Forest, altitude 1600–2000 m. Fl. Sept.–Nov.; fr. Jan.

## CUBILIA

(P.W. Leenhouts)

*Cubilia* Blume, Rumphia 3 (1849) 100; Radlk. in Engl., Pflanzenr. 98 (1932) 921–924; Leenh., Blumea 24 (1978) 297, 298. — Type species: *Cubilia blancoi* Blume [= *Cubilia cubili* (Blanco) Adelb.].

*Trees* medium-sized, monoecious. *Indumentum* of solitary, simple hairs; no glandular scales. *Leaves* spirally arranged, paripinnate, 3–7-jugate, without pseudo-stipules, glabrous, neither petiole nor rachis winged. *Leaflets* opposite to alternate; base equal-sided to oblique, in the latter case broadest at the acroscopic side; margin entire; nervation



mainly open but somewhat irregular. *Inflorescences* terminal or pseudo-terminal, cymules many-flowered, bracts inconspicuous. *Flowers* unisexual, regular. *Calyx* urceolate, the narrow mouth surrounded by 5 minute lobes, densely tomentellous on both surfaces, not petaloid. *Petals* 5, included in the calyx, hardly clawed, sericeous on both sides, the 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, dehiscent introrse. *Pistil* sessile, 2-carpellate, divided to near the base, warty and densely hairy; stigma sessile, inserted between the lobes, 2-lobed. *Ovules* 1 per cell, attached at the base. *Fruits* 2-parted, the parts obovoid, loculicidal, glabrous, densely aculeate, pericarp coriaceous, glabrous inside. *Seeds* attached basally, up to about halfway enveloped by a thin-fleshy  $\pm$  entire arillode, hilum large, nearly orbicular. — **Figs. 15, 16.**

Distribution — Monotypic.

***Cubilia cubili*** (Blanco) Adelm., *Blumea* 6 (1948) 325; Backer & Bakh. f., *Fl. Java* 2 (1965) 143; Leenh., *Blumea* 24 (1978) 397. — *Cubilia blancoi* Blume, *Rumphia* 3 (1847) 101, nom. illeg.; Merr., *Int. Rumph.* (1917) 338; *Sp. Blanc.* (1918) 240; *Enum. Philipp. Flow. Pl.* 2 (1923) 505; Radlk. in Engl., *Pflanzenr.* 98 (1932) 923, f. 22; Madulid, *Nat. Mus. Papers* 2, 1 (1991) 56. — *Euphoria cubili* Blanco, *Fl. Filip.* (1837) 287, nom. illeg.; ed. 2 (1845) 200; ed. 3, 2 (1878) 10. — Neotype (Leenhouts 1978): *Merrill Sp. Blanc.* 705 (BO, L), Luzon.

***Cubilia rumphii*** Blume, *Rumphia* 3 (1847) 100; Koord., *Minah.* (1898) 402; *lc. Bogor.* 1, 4 (1901) 51, t. 92, 93; Backer, *Schooffl.* (1911) 268; Koord., *Suppl. Cel.* 2 (1922) t. 52, 53, 3 (1922) 26. — *Boa Massy* Rumph., *Herb. Amb. Auct.* (1755) 5, t. 3. — Type: Rumphius, *Herb. Amb. Auct.* (1755) 5, t. 3.

*Trees* up to 25(–50) m high, dbh up to 75 cm, with up to 6 m high buttresses; bark usually smooth and reddish (sometimes greyish) brown. *Branchlets* terete, 4–8 mm in diam., reddbrown to cinnamon or purplish black, smooth to slightly grooved, lenticels inconspicuous, the tip appressed short fulvous hairy, otherwise glabrous. *Leaves* often with 2 buds, mostly only the lower one developing; petiole 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; petioles terete, above with a narrow groove, 3–7.5 mm long, mostly slender. *Leaflets* elliptic (to ovate), (5–)10–15(–40) by (2.5–)3–5(–10) cm, index 2–4, the upper often, sometimes all slightly falcate, chartaceous, often with a naked gland in or in front of some of the nerve axils beneath; base rounded

and attenuate to acute; apex (obtuse or) tapering (rarely rather abruptly) short to rather long broadly (rarely slender) obtuse- to acute-acuminate, mucronate or not; midrib slender, above prominulous to sunken, beneath mostly sharp-triangular, sometimes  $\pm$  rounded, nerves 1–2(–4) cm apart, angle to midrib 55–75°, slightly, towards the margin strongly curved, mostly free but for the uppermost ones, sometimes a few looped and joined towards the margin, prominulous above, more so beneath, intercalary veins variable, mostly feeble, veins and veinlets reticulate, above mostly faint, beneath prominulous. *Inflorescences* thyrsoid to corymbiform, up to 30 cm long, densely and minutely appressed brown hairy; branches sparsely branched; cymules with stalks to 1 cm long and up to c. 25-flowered; bracts triangular and hardly 0.5 mm to subulate and 3 mm; pedicels slender, 3–4 mm long, slightly thickening towards the apex. *Flowers* copper. *Calyx* in male flowers c. 3 mm high, 2 mm in diam., the opening c. 1 mm in diam., lobes minute; in female flowers 1.5–2 mm high, 3–4 mm in diam., the opening wider than in male, lobes broad-triangular, c. 0.8 mm high. *Petals* in male flowers elliptic, c. 1 by 0.6 mm, in female subovate, 1.5 by 1.5 mm. *Stamens*: filaments c. 1 by 0.2 mm; anthers c. 0.3 mm; stamens in female flowers hardly reduced. *Pistil* c. 1.5 mm high; stigma-lobes triangular, dorso-ventrally flattened, c. 1 mm long. *Fruit* parts 3–4(–5) by 2–2.5 cm, green to brown, the warts pyramidal to triangular, up to 2 mm long, pericarp c. 0.8 mm thick, endocarp smooth, white. *Seeds* ellipsoid-ovoid, 2.5 by 1.7 cm, testa smooth, shining dark brown, arillode to 6–10 mm high. — **Figs. 15, 16.**

Distribution — *Malesia*: eastern half of Borneo (incl. P. Laut), Philippines (Mindoro, Luzon, Samar, Biliran, Mindanao), Celebes, W Moluccas. Outside its area rarely cultivated in Java.



Fig. 15. *Cubilia cubili* (Blanco) Adelb. Habit (FB 1996).

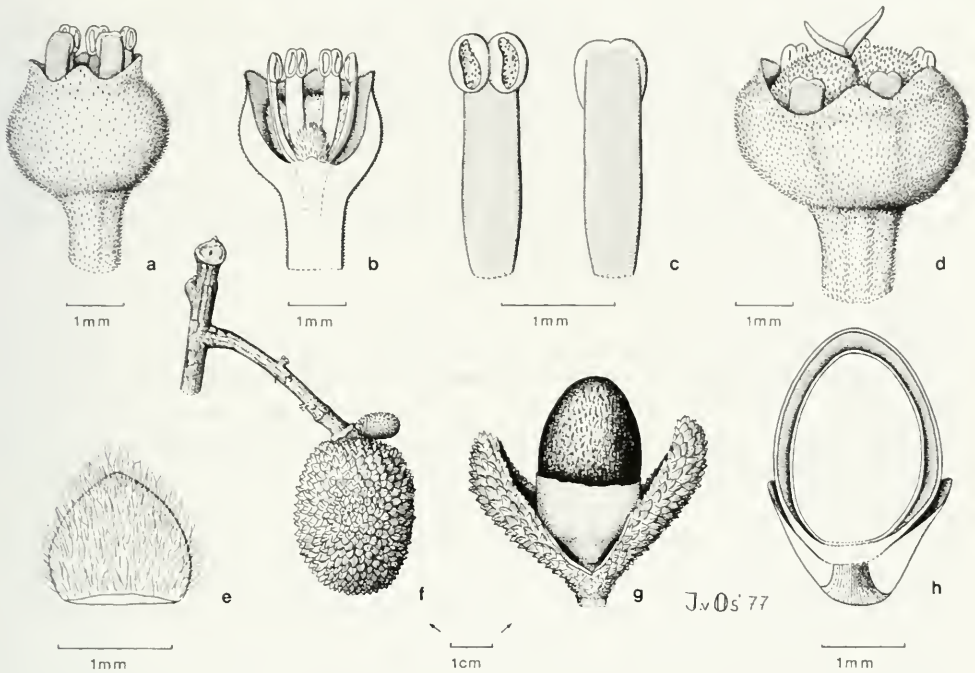


Fig. 16. *Cubilia cubili* (Blanco) Adelb. a. Male flower; b. *ibid.*, longitudinal section; c. female flower; e. petal; f. fruit; g. open fruit with seed; h. longitudinal section of seed (a–e: *PNH 22872*; f: *NIFS Cel. V/236 = Waturandang 221*; g: after Radlkofer (1931–1933), fig. 22; h: *Kostermans 7011*).

**Habitat & Ecology** – Primary and secondary forests, apparently mostly on poorly aerated, often basic soils, often along rivers; mostly at low altitudes, up to 600 m (*Koorders 22616*, Celebes, Minahassa, according to the label from 1700 m). Fl. Jan.–Dec.; fr. probably also Jan.–Dec.

**Uses** – The whitish to light reddish brown timber is used for indoor construction. The arillode is edible: the cooked or roasted seeds are eaten and are said to be comparable with but more delicious than *Castanea* seeds. See Brown, *Useful Pl. Philipp.* 2 (1950) 357, f. 174; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 1002; Kraemer, *Trees West. Pacific Reg.* (1951) 212, f. 75.

**Note** – Though the species as a whole is rather uniform it shows clinal variation in a few characters. In Borneo the leaves are 3–5-jugate, the glands on the lower side of the leaflets are uncommon, and the apex of the leaflets is obtuse or obtuse-acuminate; in the Philippines the leaves are sometimes 6-jugate, glands are always present, the apex of the leaflets is mostly acute-acuminate; in Celebes the leaves are 5- or 6-, sometimes 7-jugate, glands are always present (though rare in some specimens), the apex of the leaflets is sometimes acute-acuminate. The few trees grown in Java represent the Celebes form.

## CUPANIOPSIS

(F. Adema)

*Cupaniopsis* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 483, 498, 584; 20 (1890) 291, 357; *Bot. Jahrb.* 56 (1920) 283; in Engl., *Pflanzenr.* 98 (1933) 1177; S.T. Reynolds, *Austrobaileya* 2 (1984) 44; in *Fl. Austral.*



25 (1985) 55; A.C. Smith, Fl. Vitiensis Nova 3 (1985) 603. — *Cupaniopsis* sect. *Elatopetalum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 584; in Engl., Pflanzenr. 98 (1933) 1183. — Lectotype species (S.T. Reynolds 1984): *Cupania anacardioides* A. Rich. [= *Cupaniopsis anacardioides* (A. Rich.) Radlk.].

*Cupaniopsis* sect. *Macropetalum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 357; in Engl., Pflanzenr. 98 (1933) 1182. — Type species: *Cupaniopsis macropetala* Radlk.

*Shrubs* or small to medium sized, often unbranched palmoid *trees* ('Schopfbäume'). *Twigs* terete, smooth to striate or grooved. *Indumentum* of simple solitary hairs, sometimes mixed with red clavate glands, in many Pacific species mainly consisting of scale hairs. *Leaves* spirally arranged, paripinnate, 1–28-jugate; pseudo-stipules absent; petiole pulvinate; petiolules pulvinate, usually distinct. *Leaflets* opposite to alternate, lower ones usually smaller than the upper ones, thinly papyraceous to coriaceous, often punctate; margin entire to serrate or dentate, rarely lobed; upper surface often darker and shinier than the lower, lower surface rarely papillate; domatia absent or present. *Inflorescences* thyrsoid, axillary, often together pseudoterminal, branched or not, laxly to densely flowered; cymules dichasial, 1- to several-flowered; bracts and bracteoles acicular to deltoid, usually not persisting. *Flower* buds (flattened) globose to obovoid; flowers regular, unisexual, rarely bisexual, male flowers with a minute pistillode, female ones with rather large staminodes, otherwise not much different. *Sepals* (4 or) 5(–7), outer 2 distinctly smaller than inner 3, free, imbricate, often concave, especially the inner sepals with a narrow to wide petaloid rim to almost totally petaloid, usually persisting, margin usually ciliate and often also with small glandular hairs. *Petals* 5, elliptic to orbicular or spatulate, rhomboid or obovate, rarely clawed, often dentate at apex; scales 1 or 2, rarely crested, free or up to 3/4 connate with the margin of the petals, rarely auricles instead of scales. *Disc* entire, lobed. *Stamens* (5)–8–14, usually exerted in male flowers; filaments patently hairy, usually up to halfway, rarely glabrous; anthers shorter to longer than the filaments, glabrous to rather densely hairy. *Ovary* 2- or 3-locular, smooth, glabrous to densely hirsute, sessile or with a short gynophore; style apical, shorter than the ovary, with 2 or 3 stigmatic lines, rarely stigma lobed. *Ovules* 1 per locule. *Fruit* a loculicidal capsule, rarely distinctly lobed, (1-) 2- or 3-celled, sessile or with a short stipe, usually rounded in cross section, rarely keeled; pericarp coriaceous to woody, thin to rather thick, outside smooth to rugose, glabrous to hirsute, inside glabrous to tomentose or appressed-hairy. *Seeds* ellipsoid or globose to obovoid, often dorso-ventrally, rarely laterally flattened, arillode half to completely covering the seed, rarely (*C. platycarpa*) a sarcotesta, hilum oval, (sub)basal; sclerotesta woody, thin, usually black, endotesta membranous, brownish. — **Figs. 17–19.**

**Distribution** — 60 species; in *Malesia*: Celebes, Moluccas and New Guinea; N and E Australia, Caroline Islands (Truk Tol), Pacific from the Solomon Islands to Samoa and New Caledonia.

**Habitat & Ecology** — Secondary or primary forests, often in forest margins, road- and riversides, on floodplains and beaches. Rather indifferent to soil type. Altitude: sea level to lower montane zones. Usually rare.



## KEY TO THE SPECIES

- 1a. At least young parts with red glands. Lower side of leaflets sericeous. Pistillode, ovary and fruits 2-celled; stigma with 2 lines . . . . . 2
- b. Red glands absent. Lower side of leaflets glabrous to puberulous, if appressed hairy then not sericeous. Pistillode, ovary and fruits 3-celled; stigma with 3 lines . . . . . 4
- 2a. Axial parts villose to tomentose. Petals glabrous outside, with 1 scale. Stamens exerted. New Guinea. . . . . 3
- b. Axial parts strigose. Petals hairy outside, with 2 scales. Stamens not exerted. Celebes  
**5. *C. celebica***
- 3a. Leaflets usually with small, pocket-like domatia. Petalar scales crested. Fruits ellipsoid, lenticular or obcordate, 4–8 by 4–6 cm, stipe c. 10 mm long. Seeds 3.5–4 by 2–3 cm, with a sarcotesta . . . . . **11. *C. platycarpa***
- b. Leaflets without domatia. Petalar scales not crested. Fruits transversely ellipsoid to obreniform, 2 by 3 cm, stipe 1 mm long. Seeds 1 by 0.5 cm, with an arillode  
**3. *C. bilocularis***
- 4a. Stamens (or staminodes) 8 . . . . . 5
- b. Stamens (or staminodes) 10–14 . . . . . **12. *C. rhytidocarpa***
- 5a. Leaflets entire, rarely obscurely crenate . . . . . 6
- b. Leaflets dentate to serrate, rarely crenate or entire, but never all leaflets entire 10
- 6a. Axial parts strigose. Flowering twigs 1–5 mm in diam. Leaves (1–)2–6(–7)-jugate . . . . . 7
- b. Axial parts villose to tomentose. Flowering twigs 10–15 mm in diam. Leaves 6–11-jugate . . . . . 8
- 7a. Leaflets (narrowly) obovate or rarely elliptic, apex obtuse to rounded, often retuse, rarely shortly and broadly acuminate. Petals in male flowers elliptic to obovate, sometimes semicircular, 0.5–3.5 by 0.6–3.6 mm . . . . . **2. *C. anacardioides***
- b. Leaflets ovate, apex acuminate. Petals in male flowers lingulate, 1.8–2.3 by 0.5–0.7 mm . . . . . **14. *C. strigosa***
- 8a. Upper leaflets 25.5–32.5 by 6–7 mm, apex acuminate, petiolules 2–5 mm long. Anthers glabrous. . . . . 9
- b. Upper leaflets c. 21.5 by 7 mm, apex rounded, petiolules 15–17 mm long. Anthers hairy. Testa of seeds hairy at apex . . . . . **9. *C. napaensis***
- 9a. Leaves 6-jugate. Upper leaflets narrowly elliptic, c. 32.5 by 6 mm, petiolules 2–3 mm long. Inflorescences 10.5 cm long. Bracts subelliptic to acicular, 1.9–3 by 0.5–1.2 mm. . . . . **14. *C. phanerophlebia***
- b. Leaves c. 10-jugate. Upper leaflets ovate, c. 25.5 by 7.3 cm, petiolules 3–5 mm long. Inflorescences 19.5–35 cm long. Bracts narrowly triangular, 0.6–1 by 0.2–0.4 mm . . . . . **4. *C. bullata***
- 10a. Inflorescences longer than 3 cm, with long or short branches, laxly flowered. Petals shorter than, exceptionally as long as the sepals . . . . . 11
- b. Inflorescences up to 3 cm long, without, rarely with short branches, densely flowered. Petals longer than, rarely as long as or shorter than the sepals  
**8. *C. macropetala***
- 11a. Leaves (3–)4–18(–28)-jugate. Leaflets thinly papyraceous to coriaceous . . . . . 12

- b. Leaves 2–3-jugate. Leaflets coriaceous. . . . . 7. *C. euneura*
- 12a. Leaflets usually dentate in upper part, rarely entire. Endocarp villose . . . . . 14
- b. Leaflets dentate to serrate all around, rarely crenate or entire. Endocarp thinly to densely appressed hairy to more or less villose . . . . . 6. *C. curvidens*
- 13a. Leaflets (narrowly) obovate, rarely elliptic, apex acuminate, domatia pocket-like. Disc glabrous. Fruits more or less circular in cross section, apex rounded
- 13. *C. stenopetala*
- b. Leaflets elliptic, apex obtuse, domatia absent. Disc with 5 tufts of hairs. Fruits triangular in cross section, apex acute . . . . . 1. *C. acuticarpa*

1. *Cupaniopsis acuticarpa* Adema, Leiden Bot. Series 15 (1991) 75. — Type: NGF 22112 (CANB, K, L), Papua New Guinea, Central Prov.

*Shrubby treelet*, 1.5 m high, several stems together; wood soft. Flowering twigs c. 5 mm in diam., grooved, puberulous. *Leaves* 7–8-jugate; petiole 14–15 cm long, flattened above, rounded

below, towards the apex terete, striate, puberulous; rachis 27.7–30.5 cm long, terete, striate, puberulous; petiolules 4–6 cm, grooved above, puberulous. *Leaflets* alternate to opposite, elliptic, slightly asymmetric, c. 14 by 4 cm, index c. 3.5, chartaceous, above almost glabrous, midrib and nerves puberulous, below very thinly puberulous, midrib more densely so; base cuneate; apex obtuse; margin dentate in upper part, rarely entire; midrib

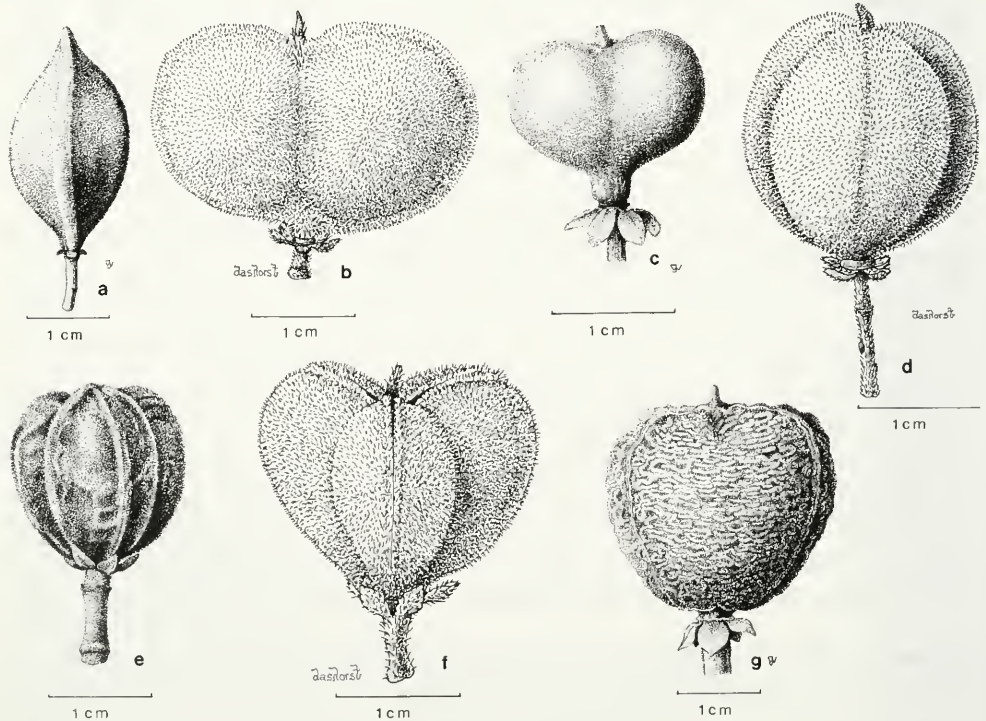


Fig. 17. *Cupaniopsis* Radlk. Fruits. — a. *C. acuticarpa* Adema. — b. *C. bilocularis* Adema. — c. *C. celebica* Adema. — d. *C. curvidens* Radlk. — e. *C. euneura* Adema. — f. *C. macropetala* Radlk. — g. *C. rhytidocarpa* Adema (a: NGF 22112; b: LAE 51730; c: Waturandang 47 (Cel. IV-84); d: Schodde 5701; e: NGF s.n.; f: Clemens 121; g: Hoogland & Womersley 3332).

slightly sunken above, nerves 19–21 per side, 4–10 mm apart, angle to midrib 70–80°. *Inflorescences* axillary, 13–16.5 cm long, with long branches, laxly flowered. *Flowers* known from young buds only. *Sepals* hairy on both sides. *Petals* with scales. *Disc* with 5 tufts of hairs. *Stamens* 8, anthers glabrous. Young *fruits* bright orange, 3-celled, triangular in cross section, acute at apex and base, outside yellowish villose, inside villose. Young *seeds* basally attached, with an arillode. — **Fig. 17a.**

*Distribution* — *Malesia*: Papua New Guinea (Central Prov.).

*Habitat & Ecology* — Monsoon pocket fringe with grassland. Altitude 30 m. Fr. Dec.

*Note* — This species resembles in some aspects *C. curvidens*, but differs greatly in hairiness and in the peculiar fruits with acute apices and bases; it is known from the type only.

**2. *Cupaniopsis anacardioides*** (A. Rich.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 530; in Engl., Pflanzenr. 98 (1933) 1186; S.T. Reynolds in Fl. Austral. 25 (1985) 58, map 71; Adema, Leiden Bot. Series 15 (1991) 77. — *Cupania anacardioides* A. Rich., Sert. Astrol. (1834) 33, t. 13. — Type: *Fraser s.n.* (P). Australia, Moreton Bay.

*Trees, treelets or shrubs*, (0.5–)2.5–20 m high, dbh up to 45 cm, usually much and widely branched; trunk fluted; bark green or grey to brown, smooth to finely rough, inner bark pink to brownish; wood white to (pinkish) brown, heartwood usually darker. Flowering *twigs* 1–4(–5) mm in diam., striate, rarely grooved, strigose, glabrescent. *Leaves* (1–)2–6(–7)-jugate; petiole 1–6(–10.5) cm long, flattened above, rounded below, towards the apex terete, strigose; rachis 0.5–16.5 cm long, flattened above, rounded below, at least towards the apex, striate, often grooved above, strigose, glabrescent; petiolules (0.5–)1–6(–13) mm, grooved above, shortly appressed-hairy (to almost glabrous). *Leaflets* opposite to alternate, (narrowly) obovate, rarely elliptic, symmetric to slightly asymmetric, upper (1.5–)5–16(–19) by 0.5–7.5 cm, index 1.2–3.8(–4.2), above dull or glossy, light to dark green, below paler so, sometimes greyish, (thinly) coriaceous, above glabrous, below glabrous to thinly shortly appressed-hairy, midrib usually a bit more densely so; base (broad-)cuneate, rarely rounded; apex obtuse to rounded, rarely shortly and broadly acuminate, often retuse, rarely emarginate; margin entire; midrib above rarely slightly prominent, or slightly sunken, nerves (5–)7–16(–20) per side, (2–)5–15(–22) mm apart, angle to midrib 50–70°. *Inflorescences* axillary to pseudoterminal, often pendulous, 2–36 cm long, with (very) long, rarely

short branches, rarely unbranched, laxly flowered; cymes dichasial, 1–several-flowered; bracts and bracteoles lanceolate to deltoid, sometimes semi-orbicular, 0.4–1 by 0.4–1.1 mm, not persisting, outside shortly appressed-hairy, margin short ciliate and rarely also with short glandular hairs, inside glabrous; pedicels 1.3–6 mm long, articulated at the base or up to halfway. *Flower* buds more or less globular, 1.8–4.2 by 2–4.8 mm. *Sepals* persisting, irregularly dentate, outside shortly appressed-hairy except rim, margin ciliate and with glandular hairs, inside glabrous, outer elliptic to almost orbicular, sometimes triangular, 0.8–3.8 by 0.8–4.2 mm, scarious rim narrow, inner more or less orbicular, 1.8–5.6 by 2.4–6 mm, scarious rim wide. *Petals* white, elliptic to broad-ovate (or semi-orbicular), 0.5–3.7 by 0.6–3.6 mm, with some appressed hairs in basal part or glabrous on both surfaces; scales 2, not crested, 0.5–1.7 mm high, long-ciliate. *Disc* green, glabrous or with few hairs to 5 tufts of hairs. *Stamens* 8, rarely 6 or 7, exerted; filaments pale pink, 1.2–4.2 mm long, patently hairy in lower half; anthers yellow, 1.2–2.9 mm long, glabrous or hairy; in female flowers filaments 1.3–3.6 mm long, anthers 1.2–3 mm long. *Ovary* 3-celled, shortly appressed-hairy, style 0.8–3.3 mm long; stigma 0.4–1.3 mm long, 3-lined; pistillode shortly appressed-hairy, sometimes also with longer hairs, 0.7–1.8 by 0.6–1.4 mm. *Fruits* green or yellow to orange brown, obpyramidal to ellipsoid, obscurely 3-lobed, 3-keeled or -ribbed at least when young, 9–20 by 10–21(–29) mm, stipe 1–2(–4) mm; wall 0.6–2.2 mm thick, outside almost smooth to rugose, velutinous, inside villose to appressed hairy. *Seeds* flattened ellipsoid, 5–14 by 4–9 mm, testa shiny black; arillode red, covering half to whole of the seed (sometimes oblique), lacerate or grossly dentate to lobed at apex, cotyledons unequal or equal, (obliquely) superposed, rarely (*Gulliver* 32) collateral.

*Distribution* — Australia (chiefly along the coast in W Australia, the Northern Territory, Queensland and New South Wales); *Malesia*: New Guinea (Irian Jaya, Merauke Dist.; Papua New Guinea, Western Prov.).

*Habitat & Ecology* — Rain forest on coastal plain or along rivers, savannah; altitude 5–30 m. Fl. Aug.; fr. Aug.–Nov. The species seems to be attractive to (green) ants.

*Uses* — Planted as a street or park tree.

**3. *Cupaniopsis bilocularis*** Adema, Leiden Bot. Series 15 (1991) 88. — Type: *LAE 51730* (A, CANB, K, L, LAE, US), Papua New Guinea, Western Prov.

*Trees* 3–15 m high, dbh 7–8 cm; bark smooth.



light to reddish brown; wood white. *Indumentum* on young parts and inflorescences dense golden-brown. Flowering *twigs* terete, 3–4 mm in diam., striate, villose, with reddish glands. *Leaves* 3–6(–8)-jugate; petiole 2–6.5 cm long, flattened above, rounded below in lower part, towards the apex terete; rachis 2–8.5(–16) cm long, terete; petiole and rachis striate, villose, with reddish glands; petiolules 2–5(–8) mm long, velutinous. *Leaflets* alternate to opposite, elliptic to ovate, (slightly) asymmetric, 2–11.5 by 1–3.5 cm, index 2–4, dull or glossy, dark to midgreen above, paler below, chartaceous, above almost glabrous, midrib villose, nerves more thinly so, below thinly to rather densely sericeous, midrib more densely so, reddish glands especially along midrib; base cuneate or rounded; apex long acuminate, acumen (5–)9–17 mm long, mucronate; margin entire; midrib above rather prominent, nerves 10–19 per side, 2–7 mm apart, angle to midrib 55–70(–75)°. *Inflorescences* axillary, 1 or 2 in an axil, 7–23 cm long, with long patent branches, laxly flowered; cymules dichasial, several-flowered; bracts and bracteoles acicular, 0.8–3.2 by 0.1–0.6 mm, not persisting, outside appressed-hairy, with reddish glands, inside glabrous; pedicels 1.5–3 mm long, articulated at the base. *Flower buds* olivaceous, globular, 2 by 2 mm. *Sepals* persisting, outside appressed-hairy, margin ciliate, inside with some hairs at the base to almost glabrous, outer  $\pm$  elliptic, 1.3–2.4 by 1–1.4 mm, with a narrow scarious rim, inner broadly elliptic to orbicular, 2–2.6 by 1.3–2 mm, with a rather wide scarious rim. *Petals* white or cream, broad-elliptic, 0.5–0.8 by 0.4–0.8 mm, glabrous on both surfaces, margin long-ciliate; scale 1, V-shaped to squarish, 0.6–0.8 mm long, not crested, apically with long, patent hairs. *Disc* glabrous. *Stamens* 8, exserted; filaments filiform, 1.2–1.8 mm long, hairy in basal part; anthers elliptic, 0.8–1.2 mm long, glabrous. *Ovary* 2-celled, hairy, with reddish glands; style 1.8–2.4 mm long; stigma 1.2–1.8 mm long, 2-lined to 2-lobed; pistillode densely hairy, 0.4–1 by 0.4–1 mm. *Fruits* brown or crimson, transversely ellipsoid to obreniform, emarginate, 2-celled, 20 by 30 mm, stipe c. 1 mm long; wall 0.2–0.4 mm thick, outside smooth to rugose, velutinous, with reddish glands, inside villose. *Seeds* ellipsoid, 10 by 6 mm, basally attached, testa shiny black; arillode almost totally covering the seed, cotyledons unequal, superposed. – **Fig. 17b.**

Distribution – *Malesia*: Papua New Guinea (E Sepik, W Highlands, Western Prov.).

Habitat & Ecology – Lowland ridge forest, garden regrowth, edge of swamp forest, lower montane rain forest; altitude 30–120(–2100) m. Fl., fr. June–Aug.

Notes – 1. In several flowers of *NGF 31983, 33447* only 5 or 6 stamens were found. Close study revealed that in those cases several stamen pairs grew together to form one stamen.

2. *Hoogland & Craven 10909* probably belongs to this species, although it has rather large leaves (petiole 4–6 cm long, rachis 14–16 cm long) with many (8) leaflets. *NGF 33447* has leaves with long petioles (4–6 cm long); its leaflets are the largest seen in this species (7.5–11.5 by 2.5–3.5 cm).

**4. *Cupaniopsis bullata*** Adema, Leiden Bot. Series 15 (1991) 90. — Type: *Lae 60052* (A, BRI, E, K, L, M), Papua New Guinea, Central Prov.

Small *tree*. Flowering *twigs* c. 10 mm in diam., grooved, villose with hairs of two lengths. *Leaves* c. 10-jugate; petiole flattened above, rounded below, towards the apex terete; rachis flattened above, rounded below to terete; petiole and rachis striate to grooved, villose hairs of two lengths; petiolules 3–5 mm long, grooved above. *Leaflets* alternate to opposite, ovate, bullate, slightly asymmetric, 19–25.5 by 7.5 cm, index 2.5–3.5, dark shiny green above, duller and darker below, chartaceous, above almost glabrous, midrib and nerves puberulous, below thinly puberulous, midrib and nerves puberulous; base rounded; apex acuminate, acumen 5–10 mm, acute; margin entire; midrib above scarcely prominent, nerves 19–29 per side, 10–14 mm apart, angle to midrib 70–75°. *Inflorescences* axillary, 1 or 2 per axil, 19.5–35 cm long, with long patent branches, laxly flowered; cymules several-flowered; bracts and bracteoles narrowly triangular, 0.6–1 by 0.2–0.4 mm, not persisting, outside appressed-hairy, inside glabrous; pedicels c. 1.4 mm long, articulated near the apex. *Sepals* persisting, reflexed at anthesis, outside appressed-hairy, inside with scattered hairs, outer broad-ovate, 2.4 by 1.9 mm, scarious rim narrow, inner orbicular, 3.6 by 2.6 mm, scarious rim wide. *Petals* pink, elliptic, 1.9–2.4 by 1–1.1 mm, outside with a tuft of appressed hairs at the base, margin with few glands, inside glabrous; scales 2, not crested, 0.7 mm long, long-woolly. *Disc* with 5 tufts of hairs. *Stamens* 8, exserted; filaments 1.2 mm long, patently hairy except at base; anthers 2.6 mm long, glabrous. *Fruits* orange-brown, 3-celled; wall thick, outside rugose, velutinous, inside villose.

Distribution – *Malesia*: Papua New Guinea (Central Prov.).

Habitat & Ecology – Secondary growth on ridge; altitude 1250 m. Fl. Sept.

Note – Only known from the type, which has male flowers and fruits.



**5. *Cupaniopsis celebica*** Adema, Leiden Bot. Series 15 (1991) 91. — Type: *Waturandang 47 (Cel/IV-84)* (BO, L), Celebes. Malili.

*Trees* 15–20 m high, dbh 20–38 cm. *Indumentum* on young parts and inflorescences dense, yellowish, mixed with very small reddish glands. Flowering *twigs* terete, c. 2 mm in diam., striate, strigose, when young also with reddish glands. *Leaves* 4–7-jugate; petiole 3–6 cm long, flattened above, rounded below, towards the apex terete; rachis 5–16 cm long, terete; petiole and rachis striate, strigose; petiolules 2–5 mm long, strigose. *Leaflets* alternate, elliptic to obovate, asymmetric, acroscopic side broader, 3.5–11.5 by 1.5–3.5 cm, index 2–4, chartaceous, above almost glabrous, midrib and nerves puberulous, below thinly to densely sericeous, especially when young with reddish glands; base cuneate to rounded; apex acute to acuminate, acumen 6–13 mm long, rounded or mucronate; margin entire; midrib above prominent, nerves 7–13 per side, 4–13 mm apart, angle to midrib 45–60°. *Inflorescences* axillary or pseudoterminal, 5–19.5 cm long, with long patent branches, laxly flowered; cymules dichasial, several-flowered; bracts and bracteoles not persisting; pedicels 3–3.6 mm long, articulated  $\pm$  halfway. *Flower* buds dark red. *Sepals* persisting, suborbicular, outside appressed-hairy except rim, margin ciliate and with reddish glands, inside with few hairs at the base, outer 2.2–2.3 by 1.3–2.4 mm, scarious rim narrow, inner 2.6–3 by 2–2.4 mm, scarious rim wide. *Petals* irregular-ovate to almost orbicular, dentate, 1.1–1.7 by 1.1–1.2 mm, outside appressed-hairy, inside glabrous; scales 2, not crested or with finger-like crests, 0.7–1 mm long, long-woolly at recurved apex. *Disc* glabrous. *Stamens* 9, not exerted; filaments c. 1.2 mm long, patently hairy; anthers c. 1.4 mm long, glabrous. *Ovary* 2-celled, outside hairy; style 2–2.4 mm long; stigma 0.8–1 mm long, 2-lined; pistillode hairy. Young *fruits* reddish yellow, cordate, with a 3.5 mm long stipe, outside smooth, velutinous, inside villose. Arillode completely covering young *seed*. — **Fig. 17c.**

Distribution — *Malesia*: Celebes (Malili).

Habitat & Ecology — Old forest on sloping clay; altitude 30–200 m. Fl. Apr.–May.

**6. *Cupaniopsis curvidens*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 359; in Engl., Pflanzenr. 98 (1933) 1191; Adema, Leiden Bot. Series 15 (1991) 97. — *Guioa curvidens* Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Lectotype (Adema 1991): *Forbes 308* (BM, E, FI, K, L, LAE, M, MEL), Papua New Guinea, Central Prov. Paratype: *Armit s.n.* (M).

*Cupaniopsis serrata* (F. Muell.) Radlk. f. *vestita* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 674; in Engl., Pflanzenr. 98 (1933) 1184. — Type: *Bec-cari PP273 (FI 2880, 2880A)* (FI), Irian Jaya, Ramoi.

*Cupaniopsis subserrata* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 358; in Engl., Pflanzenr. 98 (1933) 1189. — Type: *Anonymous s.n.* (M), Papua New Guinea.

*Cupaniopsis multidentens* Radlk., Bot. Jahrb. 56 (1920) 285; in Engl., Pflanzenr. 98 (1933) 1190. — Type: *Fitzgerald 11* (M), Papua New Guinea, Central Prov.

*Cupaniopsis gigantophylla* Radlk., Bot. Jahrb. 56 (1920) 289; in Engl., Pflanzenr. 98 (1933) 1195. — Type: *Ledermann 8389* (B $\dagger$ , fragments in K), Papua New Guinea, E Sepik Prov.

*Cupaniopsis flaccida* Radlk., Bot. Jahrb. 56 (1920) 290; in Engl., Pflanzenr. 98 (1933) 1195. — Syntypes: *Ledermann 11377* (B $\dagger$ , fragments in M), Papua New Guinea, Mt Hunstein; *12411a* (B $\dagger$ , fragments in M), Papua New Guinea, Fels-spitze.

*Cupaniopsis angustifolia* Radlk. in Fedde, Rep. 20 (1924) 33. — Type: *Djibda 707* (M), cult. in Bot. Gard. Bogor, no. III J 8.

*Cupaniopsis insularis* Radlk. in Engl., Pflanzenr. 98 (1933) 1190. — Syntypes: *C.T. White 748* (BRI, fragments in M), *748A* (BRI), Papua New Guinea, Central Prov., Yule Island.

*Cupaniopsis papuana* Radlk. in Engl., Pflanzenr. 98 (1933) 1190. — Type: *C.T. White 278* (BRI, fragments in M), Papua New Guinea.

*Cupaniopsis subdentata* Radlk. in Engl., Pflanzenr. 98 (1933) 1180, nom. inval. — *Cupaniopsis denticulata* Radlk. in Engl., Pflanzenr. 98 (1933) 1191 ('subdentata' in key). — Type: *Turner s.n.* (BRI, M, fragments in both only), Papua New Guinea, Central Prov.

*Cupaniopsis multijuga* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 515. — Type: *Brass 5660* (A, NY), Papua New Guinea, Central Prov.

*Cupaniopsis remotidens* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 516. — Type: *Brass 706* (A), Papua New Guinea, Central Prov.

*Cupaniopsis reticulata* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 517. — Type: *Brass 4134* (A, NY, UC), Papua New Guinea, Central Province.

*Cupaniopsis longifoliata* Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 74, f. 10. — Syntypes: *Kanehira & Hatusima 12940*, Irian Jaya, Waren; *14135* (A, BO), Irian Jaya.

*Shrubs* or small unbranched or sparsely branched, often palmoid *trees*, 1.5–15.5 m high.

dbh 4–10(–60) cm; stem hollow or with pith; bark more or less smooth, brown to mottled grey, inner bark cream or white to brown, underbark green to red brown, blaze straw or orange to purple brown; wood cream or white. *Indumentum* on young parts and inflorescences dense, brown. Flowering twigs terete, 4–18 mm in diam., grooved, pilose to villose, usually with hairs of two lengths. *Leaves* (4–)5–18(–28)-jugate; petiole (2–)5–39 cm long, upper side grooved at base, flattened above, rounded below, towards the apex terete; rachis (9.5–)11–78 cm long, terete, sometimes flattened above, rounded below in lower part and terete towards the apex; petiole and rachis striate, pilose to villose, sometimes with hairs of two lengths; petiolules 0–10(–15) mm long, pilose to villose, sometimes with hairs of two lengths. *Leaflets* opposite to alternate, usually (narrowly) elliptic, slightly asymmetric, 3–32 by 1–10.5 cm, index 1.8–6.3, red when young, later on dull to shiny, light to dark green, often darker or more greyish above, thinly paperyaceous to coriaceous, above and below almost glabrous to (thinly) pilose, midrib (thinly) pilose; base cuneate to rounded; apex obtuse to acuminate, acumen 2–24 mm long, rounded, emarginate or mucronate; margin usually serrate, sometimes dentate or more or less crenate, rarely entire; midrib above slightly prominent to slightly sunken, nerves (6–)9–28 per side, most ending in a tooth, 4–22 mm apart, angle to midrib 45–80°; domatia usually present, small, pocket-like. *Inflorescences* (supra-)axillary, 4.5–44 cm long, rarely 2 per axil, with long, rarely short patent branches, laxly flowered; cymules dichasial, 1–few-flowered; bracts and bracteoles acicular to deltoid, 0.4–5(–10) by 0.1–1.8 mm, not persisting, outside appressed-hairy, inside glabrous or with some appressed hairs at the base; pedicels 0.5–4.2 mm, articulated up to 2/3 above the base. *Flower buds* green or dark pink, globular to obovate, 1.4–4.8 by 1.6–4.6 mm; flowers scented. *Sepals* green or greenish white, inside pinkish, persisting or not, elliptic to orbicular, usually deflexed, concave, dentate at apex, outside appressed-hairy except rim, margin ciliate and with short glandular hairs, inside with some appressed hairs at the base, outer 1.2–4.6 by 0.8–3 mm, without or with a narrow scarious rim, inner 1.8–4.2 by 1.1–5 mm, scarious rim wide. *Petals* white to cream, sometimes pinkish to deep rose-red, about elliptic to almost orbicular, 0.4–5 by 0.2–3.2 mm, glabrous or with few appressed hairs on both surfaces; scales 2, not crested, 0.6–3 mm long, longwoolly. *Disc* glabrous or with some scattered hairs to 5 tufts of hairs. *Stamens* (5–)8(–10), exerted; filaments 0.8–3.2 mm long, patently hairy, rarely glabrous; anthers yellow, 0.8–2.8 mm long, gla-

brous or with few hairs; in female flowers filaments 1–2.4 mm long, anthers 1.1–2.4 mm long. *Ovary* 3-celled, hairy; style 1–4.6 mm long; stigma 0.8–2 mm long, 3-lined; pistillode hairy, 0.5–1.7 by 0.4–1.6 mm. *Fruits* mostly orange, brown when old, obpyramidal, 3-angled in cross section, 3-ribbed, 14–24 by 9–20 mm; wall 0.7–1.8 mm thick, outside rugose, villose, inside thinly to rather densely appressed-hairy to more or less villose, septa usually less densely hairy. *Seeds* basally attached, ellipsoid, 8–19 by 6–12 mm, testa black; arillode white or yellowish, covering half to almost the whole seed, oblique, lacerate to fimbriate; cotyledons equal, collateral, rarely unequal and superposed. — **Fig. 17d.**

Distribution — *Malesia*: New Guinea.

Habitat & Ecology — Primary or secondary rain forest, dense to open forest or low scrub patches in savannah; often along rivers, sometimes in swamp forest. Altitude 0–2700 m. Fl. Feb.–May(–Dec.); fr. (Feb.–)Aug.–Nov.

Note — *BW 13796* and *NGF 4673* are large trees. *Schodde 3061* has long petioles and rachises. *Carr 16082* has larger flower parts than the other specimens. *NGF 39981* and *Veldkamp 6758* have rather small petals. *Carr 13210* has only 1 seed per fruit. *EKN s.n.* has unequal, superposed cotyledons. Old leaves of *Brass 22174* are over 1 m long.

**7. *Cupaniopsis euneura*** Adema, *Leiden Bot. Series* 15 (1991) 103. — Type: *NGF s.n.* (*J. Womersley*) (BRI, K, L), Papua New Guinea, W Highlands Prov.

Flowering twigs 3–5 mm in diam., grooved, tomentose. *Leaves* 2–3-jugate; petiole 6.5–7.5 cm long, flattened above, rounded below, towards the apex terete; rachis 5.5–8 cm long, flattened above, rounded below, or terete; petiole and rachis striate, tomentose; petiolules 4–6 mm long, grooved above, tomentose. *Leaflets* alternate to subopposite, elliptic, rarely obovate, slightly asymmetric, 8.5–15 by 4.5–7 cm, index c. 2, coriaceous, above almost glabrous, midrib appressed-hairy, nerves with some appressed hairs, below rather thinly puberulous, especially on midrib and nerves; base cuneate to rounded; apex acuminate, acumen acute to obtuse; margin dentate in upper half; midrib slightly prominent above, nerves 9–13 per side, upper ones ending in a tooth, (5–)10–17 mm apart, angle to midrib 60–65°, domatia small, pocket-like. *Inflorescences* axillary, 12–16 cm long, with long patent branches, laxly flowered; cymules several-flowered; bracts and bracteoles 0.6–1.2 by 0.2–0.6 mm, not persisting, thick, appressed-hairy on both sides; pedicels 3.5–4.2 mm long, articulated at 1/3

above the base. *Sepals* persisting, rather thick, outside appressed-hairy, margin ciliate, inside appressed-hairy, the innermost only in the lower part, outer about deltoid, 1.1–1.4 by 1.2–1.4 mm, without scarious rim, inner triangular to obovate, 1.8–2.4 by 1.2–1.8 mm, without or with a narrow scarious rim. *Petals* elliptic to obovate, clawed, 1.7–2.3 by 1.1–1.2 mm, outside appressed-hairy at the base, margin ciliate, inside appressed-hairy in lower part; scales 2, not crested, 1.1–1.2 mm, adnate to the side of the petals, long woolly. *Disc* glabrous. *Stamens* 8, exserted; filaments filiform, 1.8–2.6 mm long, patently hairy except base and apex; anthers 1.1–1.3 mm long, glabrous. *Pistillode* 3-celled, 1.2 by 1.2 mm, hairy. *Fruits* 3-celled, globular, 14 by 14 mm, wall 0.7–1 mm thick, outside rugose, velutinous, inside sparingly appressed-hairy. *Seeds* 10 by 16 mm, testa shiny brown, arilode covering about 2/3, lacerate. — **Fig. 17e.**

Distribution — *Malesia*: Papua New Guinea (W Highlands Prov.).

Habitat & Ecology — Altitude 2100–2400 m. Fl. fr. July.

Note — Only known from the type specimen.

**8. *Cupaniopsis macropetala*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 357; in Engl. Pflanzenz. 98 (1933) 1182; Adema. Leiden Bot. Series 15 (1991) 135. — *Guioa macropetala* Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Type: *Warburg 20539* (BM, M, WRS), only fragments in the last two). Papua New Guinea, Bussum.

*Cupaniopsis grosseserrata* Radlk., Bot. Jahrb. 56 (1920) 284; in Engl. Pflanzenz. 98 (1933) 1182. — Type: *Ledermann 7223* (fragments in K, M), Papua New Guinea, E Sepik Prov.

*Cupaniopsis brachythyrsa* Radlk., Bot. Jahrb. 56 (1920) 285; in Engl. Pflanzenz. 98 (1933) 1183. — Type: *Ledermann 10698* (fragments in M), Papua New Guinea, E Sepik Prov.

*Shrubs* or *treelets* 1–6 m high, dbh 1.5–8 cm; bark smooth, finely striate, dark brown or black, underbark red, inner bark brown; wood reddish brown. *Indumentum* of young parts and inflorescences dense, brownish. Flowering *twigs* terete, 3–9 mm in diam., striate to grooved, thinly pilose to villose. *Leaves* 2–6(–10)-jugate; petiole 4.5–16.5 (–21.5) cm long, flattened above, rounded below, towards the apex terete; rachis 10–35.5(–45) cm long, terete; petiole and rachis striate, pilose to more or less villose; petiolules (0–)10(–20) mm long, ± terete, rarely grooved above, more or less velutinous. *Leaflets* opposite to alternate, (narrowly)

obovate to (narrowly) elliptic, slightly asymmetric, 6.5–35.5 by 2.5–12 cm, index 1.6–4.3, bright to dull, mid- to greyish or dark green above, paler green below, thinly to thickly papyraceous, above almost glabrous to thinly pilose, midrib and nerves more densely so, below (thinly) pilose, midrib and nerves usually more densely so; base cuneate to rounded; apex acuminate, sometimes acute, obtuse, or rounded, acumen 2–8(–15) mm long, usually mucronate; margin serrate, often only obscurely so in the lower part, rarely more or less dentate; midrib above slightly prominent to somewhat sunken, nerves 8–20 per side, at least the higher ones ending in a tooth, 4–27 mm apart, angle to midrib 50–80°; domatia, if present, obscure pocket-like. *Inflorescences* axillary, 1–3 cm long, in fruit up to 4.5 cm long, without or rarely with short branches, densely flowered, thinly pilose to ± villose; cymules 1-flowered; bracts and bracteoles triangular to deltoid, 1.2–3 by 0.7–1.8 mm, acute, thick, persisting, outside appressed-hairy, inside glabrous or with few hairs at the base; pedicels c. 1 mm, articulated at the base. *Flower buds* globular, 2.4–3 by 2.4–3 mm. *Sepals* broadly ovate to orbicular, persisting, concave, outside appressed-hairy except rim, margin ciliate, inside glabrous, outer 1.9–3.2 by 1.4–3.6 mm, scarious rim narrow to wide, inner 2.5–4.9 by 1.8–4.3 mm. *Petals* green, yellowish, or cream, ± elliptic to obovate, rarely (*Kanis 1135, LAE 61135*) with a distinct claw, irregularly dentate, 3–4.9 by 1.1–2.4 mm, outside glabrous or appressed-hairy in lower part, margin ciliate in lower part, inside glabrous or with few hairs in lower part; scales 2, not crested, 1.9–3 mm long, up to c. 2/3 adnate to the sides of the petal, woolly. *Disc* glabrous or with few scattered hairs to hairs in 5 tufts. *Stamens* 8, exserted; filaments 3–4.4 mm long, patently hairy; anthers 1.1–2 mm long, glabrous to hairy; in female flowers filaments 1.8–2.4 mm long, anthers 0.8–1.1 mm long. *Ovary* 3-celled, outside hairy; style 2.4 mm long; stigma 1.4 mm long, 3-lined; pistillode 1–1.2 by 1 mm. *Fruits* red to orange, inside yellowish, ellipsoid to obpyramidal, rounded triangular in cross section, 13–18 by 10–18 mm; wall 0.2–0.7 mm thick, outside smooth or rugose, villose, inside glabrous to thinly appressed-hairy. *Seeds* ellipsoid to globular, 10–14 by 6–10 mm, testa shiny black; arilode red to orange or golden brown, covering half to almost the whole seed, lacerate; cotyledons equal or unequal, collateral. — **Fig. 17f.**

Distribution — *Malesia*: New Guinea.

Habitat & Ecology — Primary or secondary forests, often on slopes, on limestone or old volcanic soil, along rivers or lakes; altitude 50–1550 m. Fl. (Mar.–)–Oct.(–Dec.); fr. Feb.–Oct.(–Dec.).



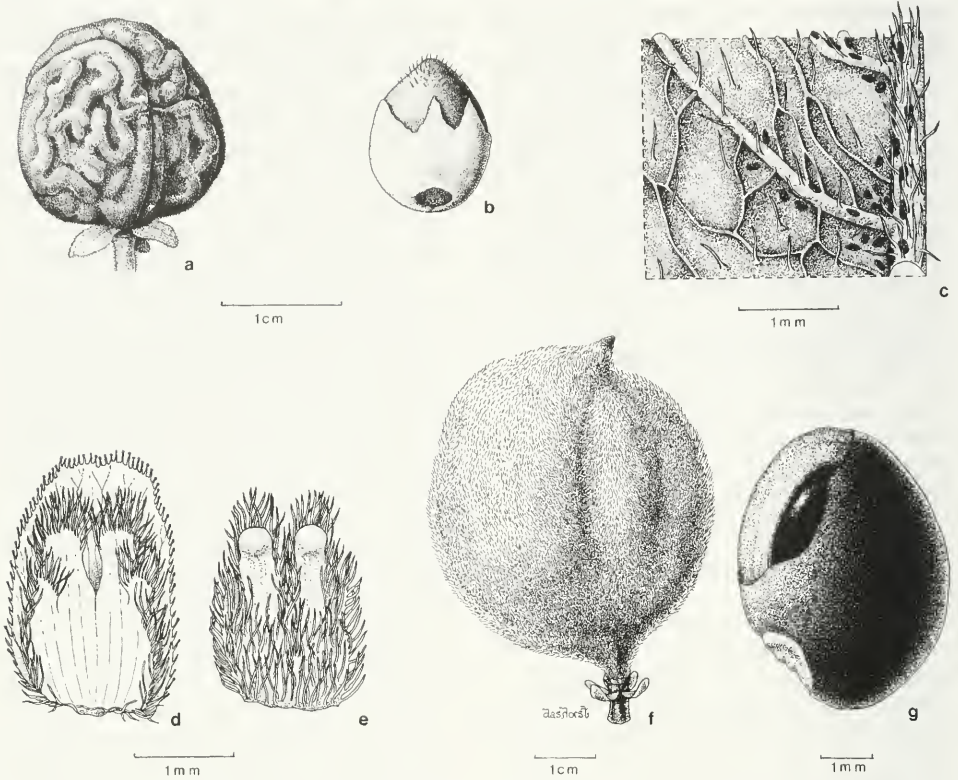


Fig. 18. *Cupaniopsis* Radlk. Details leaflets, petals, fruits and seeds. — *C. napaensis* Adema. a. Fruit; b. seed. — *C. platycarpa* Radlk. c. Detail lower surface leaflet; d. petal from inside; e. petal scale from outside; f. fruit; g. seed, part of sarcotesta removed (a, b: UPNG 4353; c, f, g: NGF 43860; d, e: NGF 46865).

Notes — 1. *Cupaniopsis macropetala* is a rather variable species, especially in shape and texture of the leaflets.

2. NGF 46853 tends to have a more appressed indumentum. *Clemens 121*, NGF 33021, and *van Royen 5482* have longer petioles, the last specimen also has more leaflets than all other specimens. *Clemens 670*, 1104 have long petiolules. *Kanis 1135* and *LAE 61135* have large flowers and petals with a 2.4 mm long claw.

9. *Cupaniopsis napaensis* Adema, Leiden Bot. Series 15 (1991) 142. — Type: UPNG 4353 (BISH, K, L, LAE), Papua New Guinea, Central Prov.

Several-stemmed palmoid tree, c. 7 m high. Flowering twigs c. 15 mm in diam., grooved, more or less tomentose, with hairs of two lengths. Leaves

11-jugate; petiole c. 11.5 cm long, flattened above, rounded below, towards the apex terete; rachis c. 47.5 cm long, terete, but flattened above, rounded below near petiolules; petiole and rachis striate,  $\pm$  tomentose, with hairs of two lengths; petiolules 15–17 mm long, grooved above, more or less tomentose. Leaflets (sub)opposite, elliptic, slightly asymmetric, c. 21.5 by 7.1 cm, index 3, olive-green above, paler below, chartaceous, above almost glabrous, midrib puberulous, nerves puberulous in lower part, thinning upwards, below thinly puberulous especially on midrib and nerves; base cuneate; apex rounded; margin entire to obscurely crenate; midrib above slightly sunken, nerves 10–18 per side, 12–17 mm apart, angle to midrib 60–70°. Inflorescences supra-axillary, c. 31.5 cm long, with long branches,  $\pm$  tomentose, laxly flowered. Flowers cream orange, only known from remains below the fruit. Sepals persisting. Disc with 5 tufts



of hairs. *Stamnodes* 8, filaments and anthers hairy. *Fruits* orange, 3-celled, wall 3.6 mm thick, outside rugose, tomentose, inside villose. *Seeds* 1.4 by 0.9 mm, basally attached, testa dark purple, with short hairs at the apex; arillose orange, lacerate, cotyledons equal, collateral. — **Fig. 18a, b.**

**Distribution** — *Malesia*: Papua New Guinea (Central Prov.).

**Habitat & Ecology** — Gallery scrub along edge of dry creek; altitude 10 m. Fr. Aug.

**Note** — Known from the type specimen only.

**10. *Cupaniopsis phanerophlebia* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 518; Adema, Leiden Bot. Series 15 (1991) 153.** — Type: *Brass* 7039 (A. L.), Papua New Guinea, Palmer River.

*Tree* c. 2 m high, unbranched, more or less palmoid. Flowering *twigs* c. 10 mm in diam., grooved, villose. *Leaves* 6-jugate; petiole c. 24 cm long, flattened above, rounded below, towards the apex terete; rachis c. 32 cm long, terete; petiole and rachis striate, villose with hairs of two lengths; petiolules 2–3 mm long, villose with hairs of two lengths. *Leaflets* alternate, narrowly elliptic, slightly asymmetric, 19.5–32.5 by 4.4–5.8 cm, index 4.4–5.6, chartaceous, above almost glabrous, midrib thinly short-hairy, towards the base also with longer hairs, below almost glabrous, midrib and (larger) nerves thinly short and rather long-hairy; base cuneate; apex long-acuminate, acumen 10–18 mm long, acute; margin entire; midrib above slightly sunken, nerves 19–28 per side, 9–15 mm apart, angle to midrib 55°. *Inflorescences* axillary, c. 10.5 cm long, with long patent branches, rather densely flowered; cymules dichasial, several-flowered; bracts and bracteoles about elliptic to acicular, acute, 1.9–3 by 0.5–1.2 mm, outside long appressed-hairy, apically with a tuft of hairs, inside glabrous; pedicels c. 1 mm long, articulated at the base. *Sepals* ± rhomboid, scarious rim wide, especially at apex and angles, outside appressed-hairy except rim, margin ciliate, inside glabrous, outer 2.4 by 2.3 mm, inner 2.8 by 2.4 mm. *Petals* ± rhomboid, 2.5–2.6 by 1.4 mm, outside appressed-hairy, margin ciliate in lower part, inside glabrous; scales 2, not crested, 1.4–1.6 mm long, hairy. *Disc* with 5 tufts of hairs. *Staminodes* 8, filaments 1.8 mm long, hairy throughout; anthers 1.3 mm long, glabrous. *Ovary* 3-celled, outside tomentose, inside glabrous, stigma 3-lined.

**Distribution** — *Malesia*: Papua New Guinea (Western Prov.).

**Habitat & Ecology** — Ridge forest undergrowth; altitude 100 m. Fl. June.

**Note** — Only known from the type specimen.

**11. *Cupaniopsis platycarpa* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 359; in Engl., Pflanzenr. 98 (1933) 1196; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 520; Adema, Leiden Bot. Series 15 (1991) 155.** — *Guioa platycarpa* Radlk. ex Dur. & Jacks., Ind. Kew., Suppl. 1 (1906) 190 (in errore). — Type: *Forbes* 790 (Fl. L. M. MEL), Papua New Guinea, Central Prov.

*Erioglossum edule* auct. non Blume: Baker in Rendle, J. Bot. 61, Suppl. (1923) 11.

*Trees* 12–33 m high, dbh 15–55 cm, bole slightly crooked, flanged to c. 5 m; bark smooth, grey to greyish green or medium brown, blaze straw, underbark light brown or green, inner bark yellowish brown to brown. *Indumentum* on young parts and inflorescences dense, golden to rusty brown, also with small, red, more or less clavate glands. Flowering *twigs* terete, 3–8(–9) mm in diam., striate to grooved, tomentose, glabrescent. *Leaves* (3–)4–6-jugate; petiole (2.5–)3–8(–11) cm long; rachis (5–)6.5–17 cm long; petiole and rachis terete, striate, tomentose; petiolules (2–)3–7 mm long, puberulous. *Leaflets* (sub)opposite, rarely alternate, elliptic, slightly asymmetric, 7–15 by 1.5–5 cm, index 2–3.6, shiny, light to dark green above, dull below, chartaceous, above almost glabrous, with reddish glands along the midrib and nerves, midrib puberulous, below thinly sericeous, usually with many reddish glands, midrib more densely hairy; base cuneate to rounded; apex acuminate, acumen 4–14 mm long, acute, sometimes mucronate; margin entire; midrib above slightly prominent, nerves 10–22 per side, (2–)5–12 mm apart, angle to midrib c. 60°, usually with small pocket-like domatia. *Inflorescences* axillary, 10–40 cm long, with long and short, or only short patent branches, laxly flowered; cymules dichasial, many-flowered; bracts and bracteoles acicular, 0.7–4 by 0.2–1.1 mm, not persisting, outside appressed-hairy, inside glabrous or with some short hairs at the base, margin with red glands; pedicels 0.8–1.1 mm long, articulated at the base, tomentose. *Flower* buds whitish with brown hairs, globular, 2.6–4 by 2.9–4 mm. *Sepals* white to yellow, not persisting, outside appressed-hairy except rim, margin ciliate and with small red glands, inside with some hairs at the base, outer about elliptic, 1.9–4.5 by 1.8–2.5 mm, scarious rim narrow, inner orbicular, 3.4–6.5 by 3–5 mm, scarious rim wide. *Petals* white or cream, elliptic or spatulate, not clawed, apically with few teeth to almost crenate, 2.5–4 by 1.3–2.5 mm, margin ciliate, but otherwise glabrous; scale 1, 2-crested, basifixed, 2–3.5 mm long, densely woolly, crests glabrous. *Disc* glabrous. *Stamens* 8, exerted; fila-

ments filiform, 2–6 mm long, pilose in basal third; anthers ellipsoid, 0.5–1.5 mm long, glabrous; in female flowers filaments thick, c. 2 mm long, pilose in lower half, anthers c. 1.5 mm long. *Ovary* 2-celled, outside velutinous; style 2 mm long; stigma 0.5–1 mm long, 2-lined; pistillode 2-celled, velutinous, 0.8–2 by 0.8–2 mm. *Fruits* dark yellow to golden brown, usually compressed, ellipsoid or more or less lens-shaped to obovate, 4–8 by 4–6 cm, 2-celled, acuminate, stipe 10 mm long; wall 0.7–1.7 mm thick, outside smooth, velutinous, inside whitish villose. *Seeds* ellipsoid, 3.5–4 by 2–3 cm, attached at 1/3 from the base of the cell, testa black; sarcotesta yellow or bright orange completely covering the seed, or sarcotesta up to halfway the seed and the rest of the seed covered by an arillode; hilum large, about 1/3 above the base; cotyledons more or less oblique superposed, unequal. — **Fig. 18c–g.**

Distribution — *Malesia*: Irian Jaya (Vogelkop and Jayapura Dist.); Papua New Guinea (Morobe and Central Prov.).

Habitat & Ecology — Rain forest on floodplain or lower slopes, young secondary forest on clay; altitude 100–850 m. Fl. Mar.–May; fr. Mar.–Aug.

Note — Occasionally a vegetative bud is found terminating the inflorescence. The petal scales in *Brass* 29225 are divided to halfway. In *Brass* 13698 most inflorescences bear galls instead of flowers. The fruits of *BW* 7574 are empty.

**12. *Cupaniopsis rhytidocarpa*** Adema, Leiden Bot. Series 15 (1991) 157. — Type: *Hoogland & Womersley* 3232 (A, BM, BRI, K, L, LAE), Papua New Guinea, Northern Prov.

*Trees* 15–21.5 m high, dbh 25–45 cm, buttressed to c. 1 m high, flanged, bole bent and fluted; bark pale grey to dark brown, smooth, underbark greenish or yellowish brown, inner bark light brown; wood white to red-brown. *Indumentum* on young parts dense, straw-coloured. Flowering *twigs* terete, 4–5 mm in diam., grooved, tomentose. *Leaves* 4–6-jugate; petiole 5–2.5 cm long, flattened above, rounded below; rachis 12–19 cm long, flattened above, rounded below, usually towards the apex terete, striate; petiole and rachis tomentose; petiolules (2–)5–8 mm long, grooved above, tomentose. *Leaflets* alternate, elliptic to obovate, slightly asymmetric, 8–15 by 3–5.5 cm, index 2.1–3.2, dark, glossy green above, chartaceous, above almost glabrous, midrib and nerves puberulous at least in basal part of leaflet, below almost glabrous to very thinly puberulous, midrib and nerves more or less puberulous; base cuneate; apex acuminate, acumen 4–28 mm, rounded; margin entire or obscurely crenate towards the apex; midrib above

slightly sunken, nerves 11–19 per side, 6–13 mm apart, angle to midrib (50–)70–80°; domatia small, pocket-like to more or less dome-shaped. *Inflorescences* axillary, 13–17 cm long, with short or long branches, laxly flowered; cymules 1-flowered; bracts and bracteoles lanceolate to deltoid, 0.6–2.5 by 0.4–1 mm, not persisting, outside appressed-hairy, inside glabrous; pedicels c. 2 mm long, articulated at the base. *Flower* buds globular, 4 by 4 mm, flowers only known in bud and from under the young fruits. *Sepals* persisting, more or less orbicular, concave, with a narrow to wide scarious rim, outside appressed-hairy except rim, margin ciliate in basal part, and with sessile glands, inside shortly appressed-hairy in basal part. *Petals* white, angular, 3-dentate at apex, appressed-hairy at the base on both sides; scales 2, not crested, woolly. *Disc* glabrous or with 5 tufts of hairs. *Stamens* 10, filaments and anthers hairy. *Pistillode* 3-celled, hairy. Young *fruits* yellowish or pale orange, more or less globular, wall 2.4–3.6 mm thick, outside rugose, velutinous, inside glabrous. Young *seeds* almost totally covered by the lacerate arillode, cotyledons collateral. — **Fig. 17g.**

Distribution — *Malesia*: Papua New Guinea (Northern and Central Prov.).

Habitat & Ecology — Primary or secondary forest; altitude 60–200 m. Fr. July.

**13. *Cupaniopsis stenopetala*** Radlk. in K. Sch. & Laut., Nachtr. Fl. Schutzgeb. Südsee (1905) 309; in Engl., Pflanzenz. 98 (1933) 1192; Adema, Leiden Bot. Series 15 (1991) 168. — *Cupaniopsis stenopetala* Radlk. f. *genuina* Radlk., Bot. Jahrb. 56 (1920) 286, nom. illeg. — Type: *Schlechter* 14436 (BM, BO, K, M, WRSL), Papua New Guinea, Torricelli Mts.

*Cupaniopsis oxypetala* Radlk., Bot. Jahrb. 56 (1920) 287, f. 1; in Engl., Pflanzenz. 98 (1934) 1193, f. 35. — Syntypes: *Ledermann* 7252, 7296 (K, M), 18533, all Papua New Guinea, E Sepik Prov.

*Trees* 3.5–25 m high, dbh 10–35 cm, bole flanged all the way up; bark pale grey or greenish to dark brown, smooth except for longitudinal cracks, underbark red, inner bark straw yellow to brown; wood straw or white. Flowering *twigs* terete, 2–6(–12) mm in diam., dark brown, striate to grooved, tomentose, glabrescent, exceptionally (*Hartley* 13129, *de Vogel* 3494) villose. *Leaves* (3–)4–6(–8)-jugate; petiole (3–)7–13 cm long, flattened above, rounded below, rarely towards the apex terete; rachis 9–26(–38) cm long, flattened above, rounded below, or terete, striate, more or less tomentose; petiolules 2–10 mm long, grooved above, tomentose. *Leaflets* alternate to opposite, (narrow-



Fig. 19. *Cupaniopsis stenopetala* Radlk. a. Habit; b. petal from inside; c. fruit; d. seed (a: Brass 31756; b: NGF 46834; c, d: Hoogland 4897).



ly) obovate, rarely elliptic, slightly asymmetric, 7–22 by 2.5–8 cm, index 1.8–4, reddish brown when young, later on glossy pale to dark green above, pale to medium green below, chartaceous, above and below almost glabrous, midrib and nerves almost glabrous to shortly appressed-hairy; base cuneate to rounded; apex acuminate, acumen 1–20 mm long, acute to rounded; margin (obtusely) dentate in upper part, rarely entire; midrib above slightly sunken to somewhat prominent, nerves (9–)10–19 per side, some of the upper ones ending in a tooth, 8–22 mm apart, angle to midrib (45–)55–80°; domatia small, pocket-like. *Inflorescences* axillary, 5–20(–34.5) cm long, with long or short, patent branches, tomentose, glabrescent, laxly flowered; cymes dichasial, several-flowered; bracts and bracteoles ovate to triangular, 0.6–5 by 0.4–2 mm, not persisting, outside appressed-hairy, inside glabrous or with some hairs at the base; pedicels 0.6–3.6 mm, articulated up to 2/3 above the base. *Flower buds* obovate to globular, 1.4–2.6 by 1–2.6 mm. *Sepals* white to brown, persisting, outside appressed-hairy except rim, margin ciliate and with glands, inside appressed-hairy, outer elliptic to triangular, 1–2.9 by 0.8–2.2 mm, scarious rim narrow, inner elliptic to orbicular, 1.6–3.5 by 0.8–2.9 mm, scarious rim wide, irregularly dentate at apex. *Petals* cream to pink, elliptic to obovate, 0.8–2.9 by 0.5–2.2 mm, glabrous or appressed-hairy in basal part on both sides, margin ciliate, sometimes (*Schlechter 14436*) with an apical tuft of hairs; scales 2, not crested, 0.6–1.3 mm long, long-woolly. *Disc* glabrous. *Stamens* 8, exserted; filaments pink, 1.4–2.6 mm long, patently hairy except apical part; anthers yellow, 0.8–2.6 mm long, glabrous, rarely hairy (*Conn & Kairo 454*, *NGF 49156*). *Ovary* 3-celled; style 2.3 mm long; stigma sometimes orange, 1.1 mm long, 3-lined; pistillode 0.4–1.3 by 0.4–1.3 mm, 3-celled, hairy. *Fruits* yellow to reddish brown, globular, 9–15 by 10–15 mm; wall 0.4–1.1 mm thick, outside rugose, villose, inside villose (see note 2). *Seeds* 9–10 by 6–8 mm, basally attached, testa shiny black; arillode pale orange, covering most of the seed, lacerate; cotyledons collateral. – **Fig. 19.**

Distribution – *Malesia*: Moluccas, Papua New Guinea.

Habitat & Ecology – Primary or secondary rain forest, often along rivers; altitude 15–1900 m. Fl. Apr.–Oct.; fr. May–Oct.

Notes – 1. Plants from lower altitudes are more appressed-hairy and have wider leaflets than those from higher altitudes.

2. *Schlechter 14436*, 19201 have elliptic leaflets and small flowers. *Conn & Kairo 454* has (in part) entire leaflets, large flower buds and flowers. The septum of the fruits of *Hoogland & Craven 10129* is sparsely hairy. In *Brass 7769* the inside of the fruit wall is thinly appressed-hairy, the septa are almost glabrous.

3. *Brass 32366* with (in part) entire leaflets, petals with a claw of 0.4–0.6 mm, and a reticulate instead of a rugulate ornamentation of the pollen grains, probably belongs to the present species. As does *UPNG 8098* which is larger in most parts than all other specimens.

**14. *Cupaniopsis strigosa* Adema, Leiden Bot. Series 15 (1991) 171. — Type: *bb 5461* (L), Celebes, Mt Bonthain.**

Flowering twigs c. 2 mm in diam., strigose. *Leaves* 3-jugate; petiole 5.5–6 cm long, flattened above, rounded below, towards the apex terete; rachis 7–7.5 cm long, terete; petiole and rachis striate, strigose; petiolules 5–7 mm long, grooved above, with some short appressed hairs. *Leaflets* alternate to opposite, ovate, slightly asymmetric, 8–11.2 by 2.4–3.2 cm, index 3–3.7, chartaceous, above and below almost totally glabrous, midrib with some very short appressed hairs; base cuneate; apex acuminate, acumen 8–16 mm long, rounded; margin entire; midrib above slightly prominent, nerves 12–16 per side, 5–7 mm apart. *Inflorescences* axillary, 2 per axil, c. 11 cm long, with long branches, laxly flowered. *Sepals* 6, scarious rim (rather) wide, outside shortly appressed-hairy in basal part, margin ciliate, also with dark coloured glands, inside with very few, appressed hairs, outer about elliptic, 1.6–1.9 by 1.2 mm, inner broadly elliptic, 2.2 by 1.9 mm. *Petals* 5, lingulate, 1.8–2.3 by 0.5–0.7 mm, outside and inside with some appressed hairs, margin ciliate; scales 2, not crested, 0.6–0.7 mm, woolly at the apex. *Disc* glabrous. *Stamens* 8, exserted; filaments 3.6 mm, patently hairy except upper quarter; anthers 0.6 mm, glabrous. *Pistillode* 3-celled, outside hairy. *Fruits* not known.

Distribution – *Malesia*: Celebes (Mt Bonthain).

Note – Only known from the type specimen.



## DICTYONEURA

(J. van Dijk)

*Dictyoneura* Blume, Rumphia 3 (1847) 163; Radlk. in Engl., Pflanzenr. 98 (1933) 1219; S.T. Reynolds, Austrobaileya 2 (1985) 153; in Fl. Austral. 25 (1985) 46; J. Dijk, Blumea 31 (1986) 437. — Lectotype species (S.T. Reynolds 1985): *Dictyoneura acuminata* Blume.

*Shrubs* to medium-sized *trees*, monoecious. *Indumentum* of simple, solitary hairs and small, round (glandular?) scales. *Twigs* terete, more or less grooved. *Leaves* spirally arranged, without stipules, paripinnate, 2–12-jugate. *Leaflets* alternate to opposite, variably hairy, sparsely to sometimes densely scaly; margin subentire to sparsely, sometimes coarsely (serrate-)crenate; domatia absent or pocket-like. *Inflorescences* axillary, often pseudoterminal, simple and raceme-like or  $\pm$  strongly branched; cymules 1–few-flowered; bracts and bracteoles densely hairy, mostly caducous. *Flowers* unisexual, actinomorphic. *Sepals* 5 (or 6), imbricate, slightly connate at the base, suborbicular to subelliptic, about equal or the inner- and/or outermost sepal distinctly smaller, persistent under the fruit. *Petals* none. *Disc* entire, swollen, tomentose. *Stamens* (4–)5(–6), exerted in male flowers; filaments usually long patently hairy in the basal half; anthers (basally to) halfway dorsally attached. *Ovary* (sub)sessile, 2- (or 3-)celled,  $\pm$  hairy, sparsely to densely scaly; style apical, shorter to little longer than the ovary, with 2 (or 3) stigmatic lines. *Ovules* 1 per locule, axillary. *Infructescences* with thickened axes. *Fruits* capsular, (sub)sessile, loculicidal, wall granular, inside  $\pm$  fleshy with a thicker fleshy layer in a narrow to broad strip along the dissepiment, covering the inside of the valves for 30–100%. *Seeds* ovoid to ellipsoid, 1 or 2 (or 3) per fruit; testa pergamentaceous or a  $\pm$  hard shell; sarcotesta on the ventral side cupular and covering 25–100% of the seed. — **Fig. 20.**

**Distribution** — *Malesia*: 2, maybe 3 species, in E Borneo, Philippines (northernmost Polillo, c. 15° N), C and S Celebes, Moluccas (Buru, Ceram, Halmahera, Obi), and New Guinea (including also New Britain and New Ireland).

**Habitat & Ecology** — Mostly understorey trees in primary and secondary forest, often found on river banks or otherwise at the edge of the forest, at altitudes 0–800 (–1900) m.

**Uses** — See under *Dictyoneura obtusa*.

### KEY TO THE SPECIES

- 1a. Leaflets up to 5 cm wide, mostly much narrower. . . . . 2
- b. At least the larger leaflets wider than 5 cm. . . . . **3. D. spec.**
- 2a. Fruits inside hairy. Petioles, at least those of the larger leaves, nearly always longer than 2 cm. . . . . **1. D. acuminata**
- b. Fruits inside (sub)glabrous. Petioles up to 2 cm long, very rarely up to 2.5 cm long . . . . . **2. D. obtusa**

1. *Dictyoneura acuminata* Blume, Rumphia 3 (1847) 163; Radlk. in Engl., Pflanzenr. 98 (1933) 1221; J. Dijk, Blumea 31 (1986) 441. — *Cupania acuminata* (Blume) Miq., Fl. Ind. Bat. 1. 2 (1859) 567. — Lectotype (Van Dijk 1986): *Muller s.n.* (L), Borneo.

*Dictyoneura sphaerocarpa* Radlk. in Elmer, Leafl. Philipp. Bot. 1 (1907) 209; Bot. Jahrb. 56 (1920) 292; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1221. — Type: *Elmer 7157* (BO, K, L, M), Leyte.

*Dictyoneura rhomboidea* Radlk., Philipp. J. Sc., Bot. 6 (1911) 182; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1221. — Type: *BS 10359* (K, M), Philippines, Polillo.

*Dictyoneura philippinensis* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1613; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1220. — Syntypes: *Clemens 'W'* (M), 532 (BO, M), 567 (M); *Elmer 10965* (BO, K, L, M), all Philippines, Mindanao.

*Dictyoneura subhirsuta* Radlk., Bot. Jahrb. 56 (1920) 292; in Engl., Pflanzenr. 98 (1933) 1222. — Type: *Ledermann 10047* (K, L), Papua New Guinea.

*Dictyoneura bamleri* auct. non K. Schum. & Laut.: Ridley, Trans. Linn. Soc. Bot. 9 (1916) 32; Radlk. in Engl., Pflanzenr. 98 (1933) 1223 (as for *Kloss s.n.*).

*Trees*, sometimes treelets or shrubs, up to 12(–15) m high, dbh up to 20(–30) cm; bark greenish or greyish, smooth, inner bark (pale) brown; wood white. *Twigs* 2–5 mm thick. *Leaves* (2–)3–7(–11)-jugate; petiole 1.5–7.5 cm long; rachis 4–18 cm long, terete to marginate. *Leaflets* narrowly ovate (or elliptic), (2.5–)3.5–10.5(–18) by (1–)2–4(–5) cm, index (1.7–)2–4(–5), (slightly) oblique, pergamentaceous, sometimes coriaceous, above glabrous or rarely very sparsely hairy, except for the sparsely to densely short-hairy (or densely long-hairy) midrib, nerves, nerve axils, and margin at the base sometimes sparsely hairy, beneath short- or long-hairy, (very) sparsely (to densely) so on the midrib, nerve axils and margin at the base (very) sparsely so; apex acute or short to long acuminate, the very apex obtuse (or slightly retuse); nerves 5–16(–22) mm apart; domatia mostly absent. *Inflorescences* sometimes simple, mostly branched; bracts and bracteoles up to 3 mm long; pedicels up to 2 mm long. *Flowers* greenish, whitish or yellowish (brown), c. 5 mm in diam. *Sepals* 1.5–2.5 by 1–2 mm, outside glabrous or sparsely to sometimes densely hairy, inside subglabrous. *Disc* (1.2–)1.5–1.8 mm in diam. *Stamens*: 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 by 0.4–0.7 mm, glabrous or sometimes sparsely hairy. *Ovary* ellipsoid, 2-celled, (1.5–)1.8–2 by (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; pistillode 0.5–1.2 mm long. *Fruits* obovoid to globular, rarely transversely ellipsoid, outside mostly (very) sparsely hairy, often more densely so along the sutures, rarely densely hairy all over, mostly ± densely scaly, inside densely hairy. *Seeds* with pergamentaceous testa.

*Distribution* – *Malesia*: E Borneo, Philippines, C and S Celebes, Moluccas (Buru, Ceram, Halmahera), W and NE New Guinea.

#### KEY TO THE SUBSPECIES

- 1a. Fruits usually 1-seeded, 9–20 mm long. Sarcotesta covering up to 60% of the seed, dorsally interrupted by a (very) wide cuneate cleft. Inflorescences often more or less strongly branched . . . . . **a. subsp. *acuminata***  
 b. Fruits usually 2-seeded, 6–8 mm long. Sarcotesta covering more than 60% of the seed, dorsally interrupted by a narrow cleft. Inflorescences simple . . . . . **b. subsp. *microcarpa***

#### **a. subsp. *acuminata***

All synonyms except *Dictyoneura bamleri* auct.

*Inflorescences* mostly ± strongly branched, sometimes simple. *Fruits* from green through yellow and orange to red and finally brownish, 1- (rarely 2-)seeded, 9–14(–20) by 8–14(–20) mm, wall 1–1.5(–3) mm thick. *Seeds* subellipsoid, 8–12 by 5.5–8 mm, sarcotesta covering (25–)45–60% of the seed, dorsally interrupted by a (very) wide cuneate cleft; upper cotyledon mostly very much larger than the lower one. – **Fig. 20a–e.**

*Distribution* – *Malesia*: E Borneo, Philippines, C and S Celebes, Moluccas (Buru, Ceram, Halmahera), NE New Guinea.

*Habitat & Ecology* – Primary and secondary forest, often at the edge, along rivers, on the border of a lake, on ridges, or in open understorey; mostly on dry, sometimes on swampy soil; on limestone rock or sandy to loamy soil; altitude 0–1000 (–1700) m. Fl. mainly Feb.–Aug.; fr. the year round.

*Notes* – 1. The distribution of subsp. *acuminata* shows a gap between the Moluccas and the Sepik area in New Guinea. The Sepik collection (*Ledermann 10047*) deviates from all other collections in its densely puberulous axes and its well developed domatia.

2. Although the fruits and seeds show very lit-

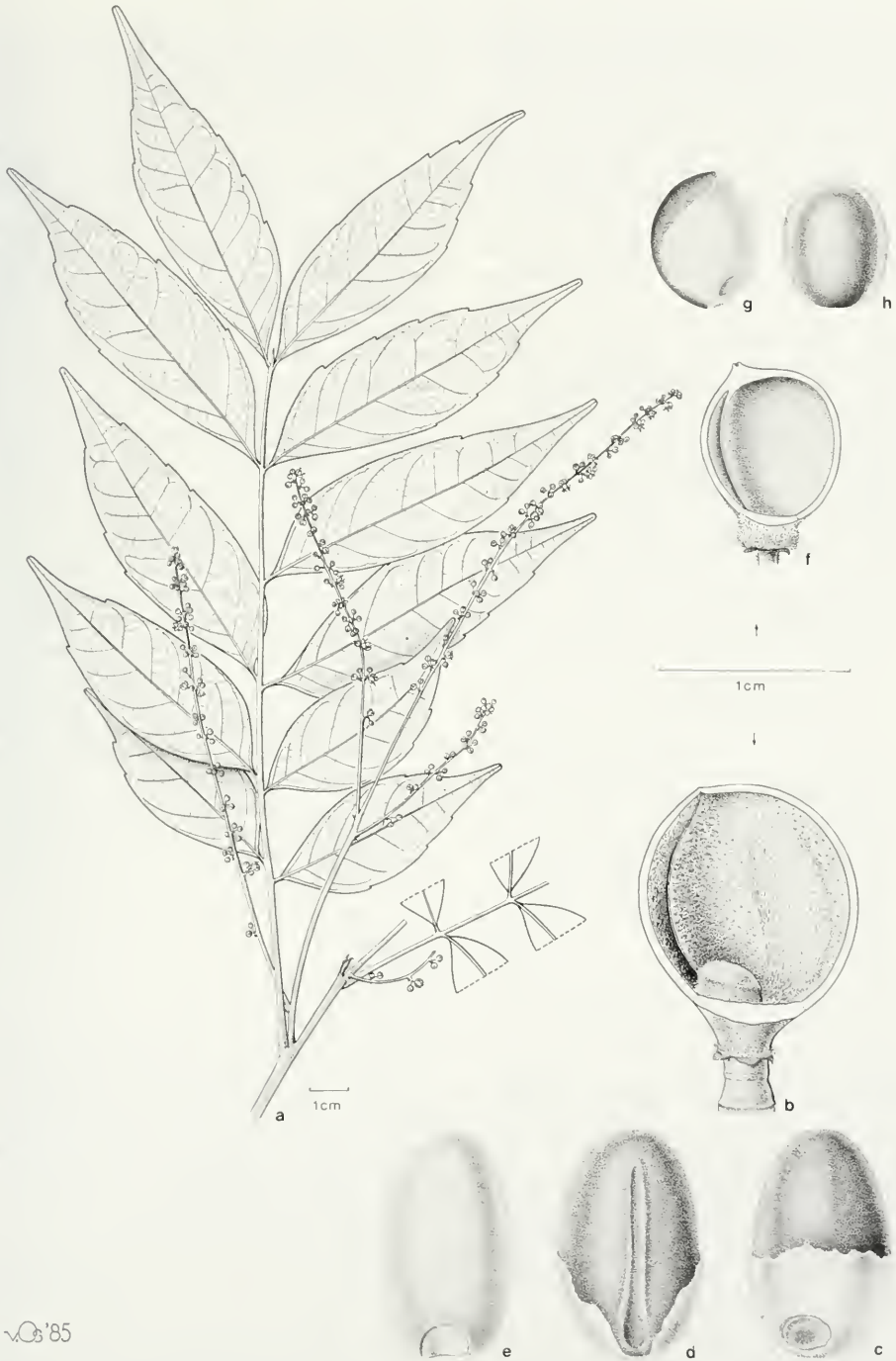


Fig. 20. *Dictyoneura* Blume. Habit, fruit and seeds. — *D. acuminata* Blume subsp. *acuminata*. a. Tip of flowering branch; b. fruit valve from inside; c. seed, ventral; d. seed, dorsal; e. embryo. — *D. obtusa* Blume. f. Fruit valve from inside; g. seed, lateral; h. seed, dorsal (a: SAN 90800; b–e: Kostermans 6892; f–h: NGF 29918).

the variation, there are a few deviating specimens: *BS 33717* has exceptionally large fruits up to 20 mm in diam.; *Binnendijk 14346* and *de Vogel 3207* have fruits with walls up to 3 mm thick, usually the walls are 1–1.5 mm thick. The fruits of *de Vogel 3207* are not scaly outside but have dense yellow hairs. *Kjellberg 2867* has a very short sarcotesta covering the seed for less than 30%.

**b. subsp. *microcarpa* J. Dijk, Blumea 31 (1986) 445.** — Type: *Aet 673* (K, L), W New Guinea. *Dictyoneura bamleri* auct.

*Inflorescences* simple. *Fruits* orange or red, 6–8 by 6–8 mm, sometimes 1-, mostly 2-seeded. *Seeds* ovoid, flattened, 5–7 by 3–4.5 mm, sarcotesta covering 60–80% of the seed, dorsally interrupted by a narrow cuneate cleft; upper cotyledon only slightly larger than the lower one.

Distribution – *Malesia*: W New Guinea.

Habitat & Ecology – Primary forest on level clayey soil; altitude up to 450 m. Fr. Aug., Nov.

**2. *Dictyoneura obtusa* Blume, Rumphia 3 (1847) 164; Radlk., Bot. Jahrb. 56 (1920) 293; in Engl., Pflanzenr. 98 (1933) 1223; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 4, 16, f. 7; Peekel, Fl. Bism. Archip., Bot. Bull. (Lae) 13 (1984) 339; J. Dijk, Blumea 31 (1986) 446.** — *Cupania obtusa* (Blume) Miq., Fl. Ind Bat. 1, 2 (1859) 567. — Type: *Zippelius s.n.* (K, L), New Guinea.

*Dictyoneura bamleri* K. Schum. & Laut., Fl. Schutzgeb. Südsee (1900) 421; Radlk., Bot. Jahrb. 56 (1920) 293; in Engl., Pflanzenr. 98 (1933) 1223. — Type: *Bamler 29* (M), New Guinea.

*Dictyoneura microcarpa* Radlk., Bot. Jahrb. 56 (1920) 293; in Engl., Pflanzenr. 98 (1933) 1222. — Type: *Branderhorst 282* (BO, K, L, M), New Guinea.

*Dictyoneura sphaerocarpa* auct. non Radlk.: Radlk., Nova Guinea 8 (1909) 172; Bot. Jahrb. 56 (1920) 292; in Engl., Pflanzenr. 98 (1933) 1221, as for *Branderhorst 260*.

*Dictyoneura spec.*, Streimann, Plants Upper Watut Watershed Papua New Guinea (1983) 169.

*Gleditschia spec.*, Kanehira & Hatusima, Bot. Mag. Tokyo 56 (1942) 362; Verdc., Man. New Guinea Leg., Bot. Bull. 11 (1979) 11.

Slender, much branched, bushy *trees*, sometimes *shrubs*, up to 15(–25) m high, dbh up to 20(–30) cm; bark grey to brown, or grey-brown blotched, smooth, rarely underbark red and green with finely anastomosing streaks; inner bark greenish, pinkish, reddish or (pale) brown; wood pinkish or pale

straw, sometimes white, heartwood pinkish straw, pale red, pinkish, or ginger. *Twigs* 1.5–4 mm thick. *Leaves* 3–9(–12)-jugate; petiole up to 1.5(–2.5) cm long; rachis 1.5–16 cm long, marginate to narrowly winged; petioles 0–2 mm long. *Leaflets* elliptic to ovate, (very) shiny, light to dark green, below often paler than above, reddish or purplish green when young, (0.6–)2–9(–12.5) by (0.4–)1–2.5(–3.5) cm, index (1.7–)2–3.5(–4.5), oblique, (thin-)pergamentaceous, above mostly short-hairy, sparsely to densely so on midrib (and nerves), veins, margin, and axils sometimes sparsely so, beneath short- or long-hairy, midrib and sometimes nerves, veins, and nerve axils sparsely to densely so; apex obtuse to acute, rarely very short acuminate, very apex obtuse to retuse; nerves (2.5–)5–13(–19) mm apart; domatia usually present and well developed. *Inflorescences* simple or sometimes sparingly branched, often only at the base; bracts and bracteoles up to 1.5 mm long; pedicels up to 1.5 mm long. *Flowers* white to yellow, 3–4(–5) mm in diam. *Sepals* 1.2–2 by 0.8–1.6 mm, the inner- or outermost (or both) sometimes smaller, outside sparsely to densely hairy, inside glabrous to sparsely hairy. *Disc* 1–1.5 mm in diam. *Stamens*: filaments with long-patent hairs, sometimes sparsely short-hairy, in male flowers (1.4–)1.8–2.6 mm long, in female flowers 0.6–1 mm long; anthers cordate to broadly ovate, 0.4–0.8 by 0.5–0.8 mm, glabrous. *Ovary* ovoid to ellipsoid, 2- (or 3-)celled, 1.1–1.8 by 0.7–1.4 mm, densely hairy, (very) sparsely scaly; style 0.6–1.2 mm long; pistillode 0.3–0.6(–1) mm long. *Fruits* somewhat fleshy, from brown green through orange(–yellow) to orange-red, finally orange-brown, subglobular to transversely ellipsoid, 6–8 (–12) by 6–8(–11) mm, 1- or 2- (or 3-)seeded, outside sparsely or sometimes densely hairy, (very) sparsely scaly, inside glabrous or with a few hairs near the placenta. *Seeds* ovoid to ellipsoid, rarely flattened, 4–9 by 4–7 mm, testa black, shining, more or less hard shell, sarcotesta (light) orange or yellow, covering (45–)60–100% of the seed, dorsally interrupted by a very narrow to very wide cuneate cleft; upper cotyledon slightly larger than the lower one. — **Fig. 20f–h.**

Distribution – *Malesia*: New Guinea, including New Britain and New Ireland.

Habitat & Ecology – Primary and secondary forest, sometimes (lower) montane forest or old gardens, or rarely plantings or open places, often on river banks or at the edge of the forest, mostly in the understorey, sometimes in the subcanopy layer, on flat to steep terrain or on ridges, sometimes swampy, also on old well drained volcanic soil; soil rocky, clayey, or sandy, over limestone; altitude 0–500(–1900) m. Fl. June–Nov.(–Feb.); fr.



almost the year round, but mostly Nov.–March. The fruits are eaten by birds.

Uses – Often used as an ornamental tree because of its orange fruits and reddish young leaves (Van Royen 1964: 4). The wood is used for house posts.

Notes – 1. The present species is rather variable. Several geographic and ecological races can be distinguished, but all are linked by intermediates. In West New Guinea and in higher altitudes in the East the specimens have comparatively small leaflets. '*Dictyoneura obtusa*', the western form, has many leaflets per leaf and often conspicuous yellow-haired domatia. The lower montane form, '*D. bamleri*', shows a tendency towards more glabrescent leaves with a wingless rachis and thicker glossy leaflets. Towards the East and at lower altitudes the leaflets become larger, the largest ones are found on New Britain and New Ireland. The plants from these islands are generally more coarse in all their parts. The southern form, '*D. microcarpa*', has leaves with few leaflets, only incised near the apex. In Morobe Province the leaflets are often rather strongly oblique, and in the Northern and Milne Bay Provinces the plants are densely puberulous all over.

2. Kanehira & Hatusima (1942) listed a specimen from New Guinea (Momi, *Kanehira & Hatusima 13128*) as *Gleditschia spec.* According to Verdcourt (1979) this is *D. obtusa*.

3. *Dictyoneura spec.*, see J. Dijk, *Blumea* 31 (1986) 448.

*Leaves*: petiole 3–6.5 cm, terete, rachis terete. *Leaflets* elliptic to (ob)ovate, (6.5–)9–21 by (3–)5–8 cm, index 1.7–3.2, (slightly) oblique, thin-coriaceous, above glabrous except for the (very) sparsely short-hairy midrib and nerves, beneath glabrous to sparsely hairy except for the densely hairy midrib and the sparsely to densely hairy nerves; apex (abruptly) acuminate, the very apex acute to obtuse to sometimes retuse; nerves (5–)10–20(–28) mm apart; domatia weakly developed.

Distribution – *Malesia*: Moluccas (Obi, *Atasrip 50*).

Note – The cited collection consists only of loose leaf-fragments mounted on several herbarium sheets. These fragments resemble the leaves of *D. acuminata*, but differ clearly in the size of the leaflets. No information is given about the plant or about particular ecological circumstances. The inadequate material and the complete absence of additional information make it impossible to say whether the collection belongs to *D. acuminata* or represents a new taxon. Therefore it seems wise to separate it from the rest of *Dictyoneura* without naming it, until more material becomes available.

#### EXCLUDED

*Dictyoneura integerrima* Radlk. in Fedde, Rep. 18 (1922) 343. — Type: *Koorders 10558* (BO), Sumatra = *Ganophyllum falcatum* Blume.

See Radlk. in Engl., *Pflanzenr.* 98 (1933) 1424; J. Dijk, *Blumea* 31 (1986) 449.

## DIMOCARPUS

(P.W. Leenhouts)

*Dimocarpus* Lour., *Fl. Coch.* (1790) 233; Leenh., *Blumea* 19 (1971) 113–131. — Lectotype species (Leenhouts 1971): *Dimocarpus lichi* Lour. [= *Dimocarpus longan* Lour.]. *More* Gaertn., *Fruct.* 2 (1791) 487, t. 180, f. 5, nom. inval.

*Pseudonephelium* Radlk. [*Sapind. Holl.-Ind.* (1879) 71, nom. inval.; in Durand, *Ind. Gen.* (1888) 76], *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 288; in Engl., *Pflanzenr.* 98 (1932) 912–914. — Type species: *Pseudonephelium fumatus* (Blume) Radlk. [= *Dimocarpus fumatus* Blume].

*Euphoria* auct. non Comm. ex Jussieu: Radlk. in Engl., *Pflanzenr.* 98 (1932) 894–910.

*Trees* or *shrubs*, mostly monoecious. *Indumentum* often partly or mainly consisting of dense tufts of hairs; no glandular scales. *Leaves* spirally arranged, paripinnate, rarely unifoliolate, 1–7-jugate, hairy, often glabrescent; without pseudo-stipules; neither petiole nor rachis winged. *Leaflets* (opposite or) alternate, not or hardly papillose beneath, lower side often with naked glands; base equal-sided to oblique; margin entire to dentate.

*Inflorescences* terminal and sometimes in the upper leaf-axils. *Flowers* unisexual, actinomorphic. *Sepals* 5 (or 6), confluent at base, imbricate, equal, not petaloid, outside densely tomentose, inside short-hairy at least in the upper part, not ciliate, entire. *Petals* 0–5 (or 6), mostly longer than sepals,  $\pm$  oblanceolate, no scale. *Disc* entire, 5-lobed, hairy. *Stamens* (6–)8(–10), either equal (mostly) or more or less distinctly alternately long and short, exserted or not; filaments usually hairy, often tufted; anthers glabrous. *Pistil* sessile, 2- (or 3-)merous; ovary 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 cell, attached axillary near the base. *Pistillode* small, densely pilose. *Infructescences* with thickened and sometimes lengthened pedicels; calyx persistent under the fruit, slightly or not accrescent. *Fruits*: nearly always only 1 lobe developed, globular or broad-ellipsoid, indehiscent or sometimes loculicidal, warty, sometimes smooth, rarely spiny, mostly glabrescent, inside smooth, glabrous. *Seeds*  $\pm$  globular; hilum subbasal, nearly orbicular, big; testa shining blackish brown, with a thin, translucent-white, fleshy arillode which is attached around the hilum. — **Figs. 21, 22.**

*Distribution* — Six species in S and SE Asia from Sri Lanka and India to eastern Malesia and Australia.

*Habitat & Ecology* — Mainly substage or understory trees of primary or sometimes secondary forests under everwet tropical conditions. The flowers, small but arranged into fairly big inflorescences, with a green calyx and often white petals, are sweet-scented and are probably pollinated by insects. The fruits, though indehiscent and protected by a hard, sometimes spiny wall, may be eaten by mammals because of the fresh, sweet arillode.

*Uses* — The fruits, especially of *D. longan* subsp. *longan*, are esteemed by the Chinese and others, and that subspecies is often planted, especially outside the area in which true Rambutans can grow. The wood of some species seems to be of good quality, but it is used only locally; it may be that sizeable stems are often hollow.

*Notes* — 1. *Dimocarpus* seems to be most closely related to *Otonophelium*, a monotypic genus from southern India that differs mainly by the presence of pseudo-stipules and the glabrous disk.

2. Though typical *Euphoria* (*Dimocarpus longan* var. *malesianus*) and typical *Pseudonephelium* (*Dimocarpus fumatus*) seem very different, the difference in several characters (hairs tufted or not, leaves entire or incised, absence or presence of naked glands on the lower side of the leaflets near or at the margin, calyx lobed nearly to the base or slightly less deeply, petals present or absent, densely hairy or nearly glabrous) is bridged by other species. *Dimocarpus foveolatus*, particularly noteworthy in this respect, is vegetatively a *Pseudonephelium* but has typical *Euphoria* flowers. Moreover, several characters show intermediate states, while the others are not obviously mutually correlated.

#### KEY TO THE SPECIES

- 1a. Glands on lower surface of leaflets in the nerve axils and elsewhere, usually near or along the margin. Leaflets mostly repand or dentate . . . . . 2
- b. Glands on lower surface of leaflets exclusively in the nerve axils, sometimes absent. Leaflets entire . . . . . **4. D. longan**

- 2a. Leaflets mostly repand, sometimes either entire or serrate-dentate. Leaves up to 4-jugate ..... 3  
 b. Leaflets serrate-dentate. Leaves 4–7-jugate ..... 1. *D. dentatus*  
 3a. Petals 5, well-developed. Disc velvety. Leaflets obtuse. Twig greyish white, faintly 5-grooved ..... 2. *D. foveolatus*  
 b. Petals mostly absent, rarely up to 4, rather strongly reduced. Disc woolly. Leaflets acuminate. Twig brown, terete ..... 3. *D. fumatus*

1. *Dimocarpus dentatus* Meijer ex Leenh., *Blumea* 19 (1971) 116. — *Euphoria* nov. spec., Meijer, Bot. News Bull. 9 (1967) 73. — Type: SAN 37193 (K. L.), Sabah.

*Trees* to 15(–24) m high, dbh up to 40 cm, sometimes with buttresses. *Twigs* terete with 5 faint grooves, 6.5–8 mm in diam., persistently densely and shortly ferruginous-tomentose, hairs tufted, older branches glabrous, brown, warty-lenticellate. *Leaves* 4–7-jugate, axial parts densely hairy; petiole 6–18 cm long, rounded, flattened mainly towards the base; petiolules 1–2 mm long, terete. *Leaflets* oblong(–obovate) to lanceolate, 5.5–24 by 3.2–9 cm, index 2–4, thin-coriaceous to stiff-chartaceous, above tomentose on midrib and – scattered – on nerves, glabrescent, beneath rather densely to sparsely tufted-hairy on midrib and nerves, between the nerves often with scattered tufts, pairs of, or solitary hairs, beneath with naked glands in the nerve axils and along the margin; base acute and equal-sided or slightly oblique and cordate in the lower leaflets; margin distantly serrate-dentate; apex acute to rounded, sometimes tapering acuminate; midrib flat above, nerves 0.8–1.5 cm apart, angle to midrib 50–70°, slightly curved to nearly straight, alternately ending in and between the marginal teeth, above sunken, veins scalariform, rather dense, above hardly visible, beneath prominent, veinlets finely reticulate, above mostly prominulous, beneath prominulous or sometimes hardly visible. *Inflorescences* 25–55 cm long, densely ferruginous-tomentose, hairs tufted; branches few, erecto-patent, up to c. 20 cm long, sparsely branched again, bearing rather many sessile, few-flowered, glomerulous cymules; bracts narrowly triangular, 4 mm long, patent to recurved; pedicels 1.5 mm. *Sepals* 2.5–3 by 1.8–2 mm, inside sparsely hairy in the upper part. *Petals* 5, oblanceolate, 3.5–4.2 by 1 mm, outside sericeous except at base and sometimes in the upper half, along the margin and inside densely long-hairy except at base. *Disc* velutinous. *Stamens*: filaments 2.2–4 mm long, patently tufted-hairy mainly towards the apex; anthers 0.8 mm long. *Fruits*: lobe(s) subglobular,

16 by 15 mm, with rather large, hardly raised, flat warts, granular, glabrous. — Fig. 21.

*Distribution* — *Malesia*: E and N Borneo (locally sometimes common).

*Habitat & Ecology* — Primary, sometimes secondary forests, in dry as well as in periodically inundated or marshy localities, on various but preferably rather rich soils; from sea level to 100(–750) m altitude. Fl. May, July, Oct., Nov.; fr. July–Aug.

*Uses* — Arillode sweet, edible.

2. *Dimocarpus foveolatus* (Radlk.) Leenh., *Blumea* 19 (1971) 118. — *Euphoria foveolatus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 457, nom. illeg.; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 503, p.p.; Radlk. in Engl., Pflanzenr. 98 (1932) 904. — Type: BS 7370 (M), Luzon.

*Tree*, 5 m high. *Twigs* terete with 5 faint grooves, 4 mm in diam., light grey, early glabrescent, hairs in short dense tufts. *Leaves* 2-jugate, axial parts subglabrous; petiole 2–2.5 cm long, flattened above; petiolules 5 mm long, broadly grooved above. *Leaflets* elliptic to ovate, 12.5–15 by 6–7 cm, index c. 2, coriaceous-chartaceous, glabrous, above finely punctate, beneath with a naked gland in the axil of each nerve and some scattered marginal glands; base equal-sided, rounded, decurrent; margin repand; apex obtuse; midrib slightly raised to hardly sunken above, nerves 1–1.5 cm apart, angle to midrib 70–75°, slightly curved, above prominulous, veins and veinlets hardly distinct, finely reticulate, equally prominent on both sides. *Inflorescences* 13–22 cm long; branches few, long, erect, short-velutinous, the hairs mainly densely tufted; cymules up to 7-flowered; bracts triangular-lanceolate, 3–4 mm long; pedicels c. 2 mm long. *Sepals* 4 by 3 mm, inside puberulous in the upper 2/3. *Petals* 5, narrow-spathulate, 5 by 1.5 mm, outside woolly except at very base and in upper 0.2, inside densely woolly except at base. *Disc* velutinous. *Stamens*: filaments c. 3.5 mm long, sparsely patent-hairy except at base; anthers 1 mm long. *Pistillode* small, 2-merous, velutinous. *Female flowers and fruits* not observed.

*Distribution* — *Malesia*: Philippines (Luzon,



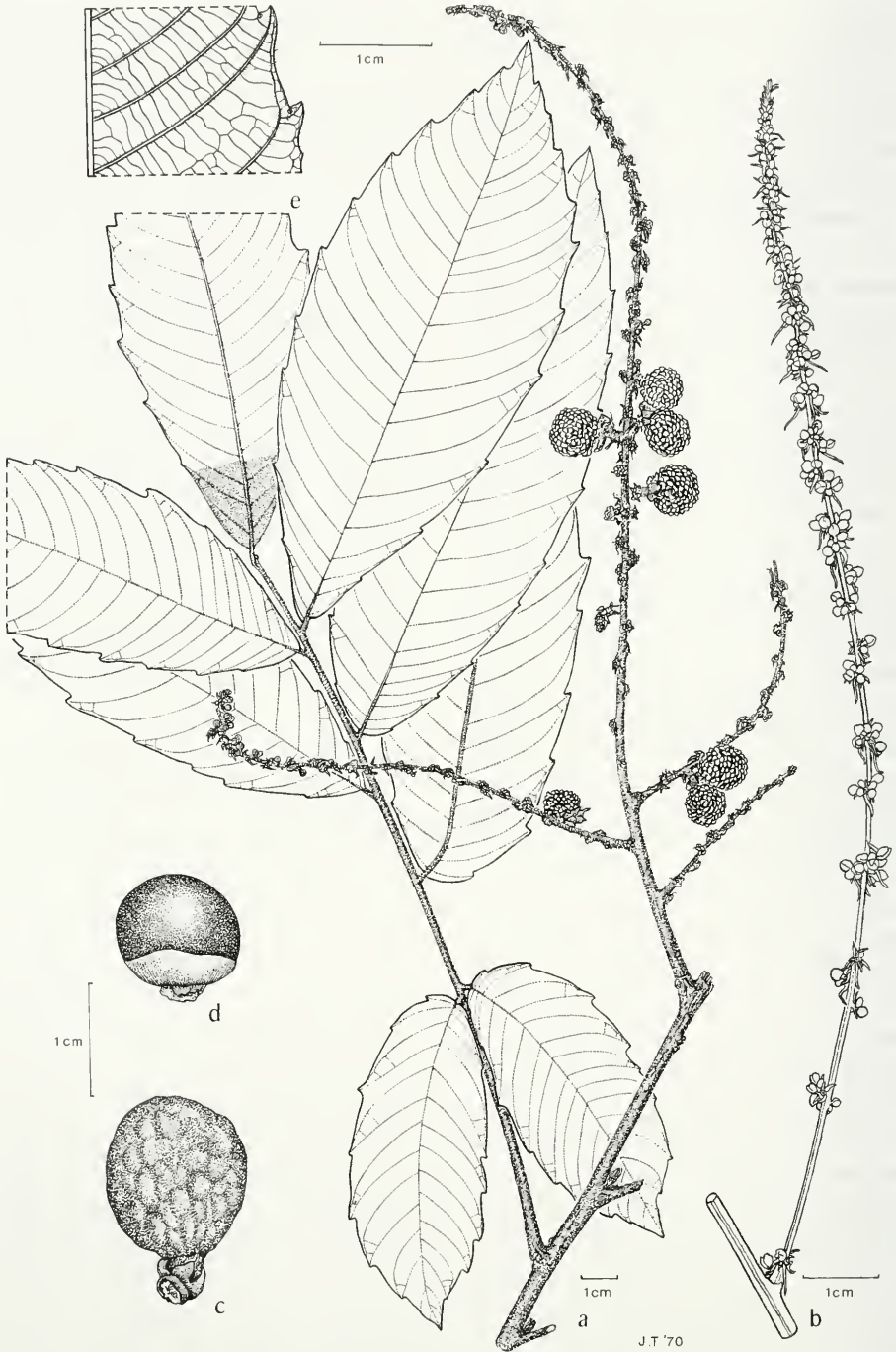


Fig. 21. *Dimocarpus dentatus* Leenh. a. Habit; b. part of inflorescence; c. fruit; d. young seed with partly developed arillode; e. detail lower surface leaflet (a, e: SAN 37193; b: SAN 62966; c, d: Kostermans 12654).



only once collected; the specimens from Samar and Panay mentioned by Merrill, l.c., belong to *D. fumatus*).

Habitat & Ecology — Fl. March.

Note — The present species is intermediate between 'typical' *Euphoria*, with which the flowers are in full agreement, and *Pseudonephelium*, the leaves of which it shares.

3. *Dimocarpus fumatus* (Blume) Leenh., *Blumea* 19 (1971) 119. — *Nepheium fumatum* Blume, *Rumphia* 3 (1847) 111. — *Pseudonephelium fumatum* (Blume) Radlk. [Sapind. Holl.-Ind. (1879) 71, nom. illeg.] in Engl., *Pflanzenr.* 98 (1932) 329. — Type: *Korthals s.n.* (or *Müller s.n.*?) (L), SE Borneo.

*Pseudonephelium javanicum* Radlk., *Flora* 118/119 (1925) 399; in Engl., *Pflanzenr.* 98 (1932) 913; Backer & Bakh. f., *Fl. Java* 2 (1965) 137. — Type: *Koorders 11130* (L, M), Central Java.

*Nepheium intermedium* auct. non Radlk.: Elmer, *Leafl. Philipp. Bot.* 10 (1939) 3808.

*Trees* up to 27 m high, dbh up to 1 m, rarely a shrub; sometimes with buttresses. *Twigs* terete, 2–7.5 mm in diam., dark to greyish brown, early glabrescent or glabrous, lenticels inconspicuous. *Leaves* 1–4-jugate or exceptionally reduced to 1 pseudoterminal leaflet, axial parts thin-hairy, mostly early glabrescent; petiole 1.5–12 cm long, above flat to sometimes slightly hollowed, exceptionally terete; petiolules 2.5–15 mm long, grooved above, often with a median rib. *Leaflets* elliptic to oblong, 6.5–28 by 2.5–10.5 cm, index 2–4, thin-coriaceous to sometimes papyraceous, above glabrous, beneath glabrous to sparsely hairy on midrib, in nerve axils, and on the nerves, beneath with a naked gland in (nearly) all nerve axils and some scattered along the margin (in the incisions if the margin is not entire); base equal-sided to oblique, cuneate to rounded, decurrent or not; margin sometimes entire, mostly repand to (mainly in the apical part) sinuous or distantly dentate; apex tapering to abruptly acuminate; midrib above slightly raised to hardly sunken, nerves 1–2.8 cm apart, angle to midrib 40–80°, nearly straight to moderately curved, not joined, above prominulous or rarely grooved, veins and veinlets mutually not much different, finely tessellate-reticulate, mostly inconspicuous above, distinct beneath. *Inflorescences* terminal or exceptionally axillary, up to 50 cm; branches few, long, spreading to erect, stronger ones often bearing near or at the base 1 or 2 feebler side branches, spicate with sessile, mostly many-flowered cymules, rather sparsely hairy, hairs mainly in small, appressed tufts, intermingled with patent

short solitary ones; bracts subulate, up to 3 mm long; pedicels 2–4 mm long, slender. *Sepals* up to 1/3 connate, 2–3 by 1.5–2.5 mm, inside tomentose. *Petals* 0(–4), spatulate, long-clawed, up to 1.2 by 0.3 mm, partly thin-woolly at both sides, sometimes sparsely glandular-ciliolate. *Disc* woolly. *Stamens*: filaments 1.5–2.5 mm long, glabrous or nearly so; anthers 0.6–0.8 mm long. *Fruits*: lobes 2–3.5 cm in diam., hardly warty to short-spiny, granular, glabrous; dehiscent by valves. — **Fig. 22 a, c.**

Distribution — Indochina, SE China (Kwangsi), and *Malesia*: Sumatra, Malay Peninsula, Java, Borneo and Philippines.

#### KEY TO THE SUBSPECIES

- 1a. Twigs nearly always more than 3 mm in diam. Leaves (2- or) 3–4-jugate . . . . . 2  
 b. Twigs rarely more than 3 mm in diam. Leaves 1- or 2- (exceptionally 3-)jugate or sometimes 1-foliolate. Philippines  
     c. subsp. **philippinensis**  
 2a. Petals absent or sometimes 1 rudimentary one present. Filaments glabrous. Borneo  
     a. subsp. **fumatus**  
 b. Petals 4, rudimentary. Filaments with some long hairs in the basal half. Sumatra, Java  
     b. subsp. **javensis**

- a. subsp. **fumatus** — *Nepheium fumatum* Blume — *Pseudonephelium fumatum* Radlk., p.p.

*Twigs* rarely less than 3 mm in diam., early glabrescent, hairs at least partly in small tufts. *Leaves* (2-) 3- or 4-jugate; petiole up to 11.5 cm long. *Leaflets* alternate to subopposite, 6.5–28 by 2.8–10.5 cm, index 2–4, beneath mostly very sparsely patent short-hairy in the basal part on midrib and nerves, above minutely punctate, base cuneate to ± rounded. *Inflorescences* lax, up to 45 cm. *Petals* absent or rarely 1, much reduced. *Filaments* glabrous. *Fruits* hardly warty.

Distribution — *Malesia*: Malay Peninsula (?) and Borneo.

Habitat & Ecology — In primary forests, as well on flat country as on slopes or hill tops or along river banks, mainly on sand, at altitudes mostly below 100 m, up to 1200(–1350) m. Fl. Apr.–July, Sept., Nov.; fr. July, Sept., Dec.

- b. subsp. **javensis** (Radlk.) Leenh., *Blumea* 19 (1971) 120. — *Pseudonephelium javanicum* Radlk.

*Twigs* c. 5 mm in diam., early glabrescent, hairs partly solitary, appressed, fugaceous, partly in small tufts which remain longer. *Leaves* 3–4-jugate; pet-

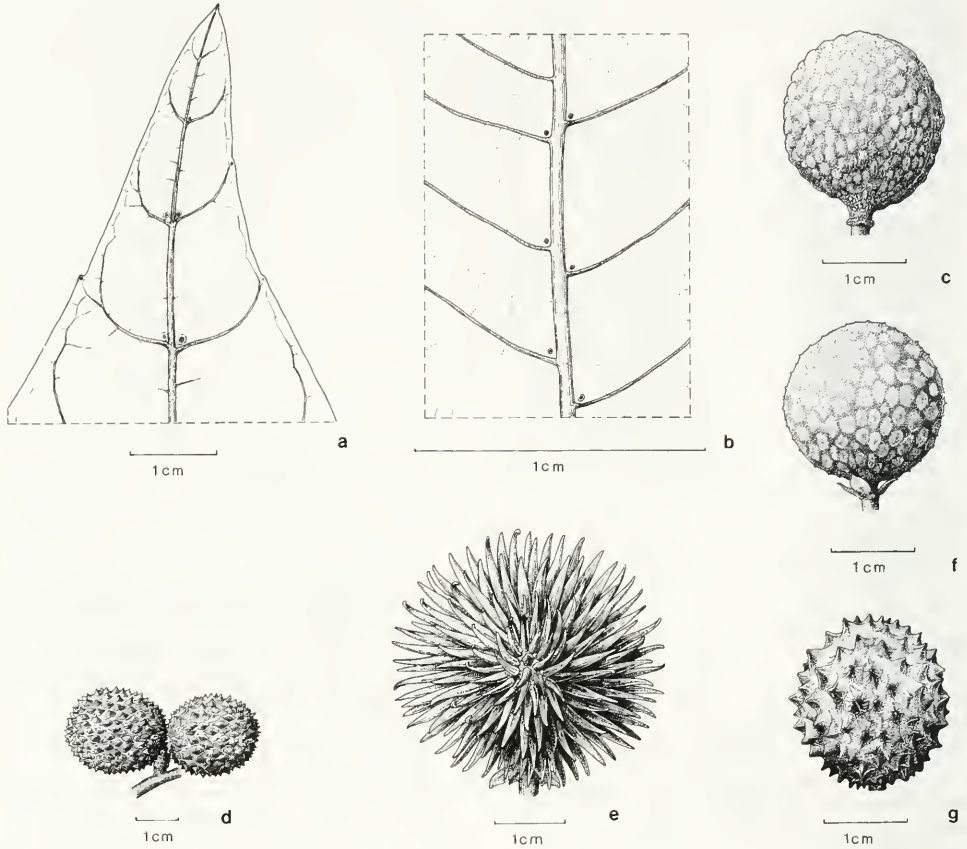


Fig. 22. *Dimocarpus* Lour. Details leaflets, fruits. — *D. fumatus* (Blume) Leenh. a. Detail lower surface leaflet; c. fruit. — *D. longan* Lour. subsp. *longan* var. *longan*. b. Detail lower surface leaflet; f. fruit. — *D. fumatus* (Blume) Leenh. subsp. *philippinensis* Leenh. d. Fruit. — *D. longan* Lour. subsp. *malesianus* Leenh. var. *echinatus* Leenh. e. Fruit. — *D. longan* Lour. subsp. *malesianus* Leenh. var. *malesianus*. g. Fruit (a, c: *Kostermans 13245*; b, f: *Tilley s.n.*; d: *PNH 78080*; e: *SAN 61671*; g: *Mamit S 32681*).

iole 9–12 cm long, terete; petiolules with a broad flat groove. *Leaflets* alternate, 20–24 by 6–7 cm, index 3–4, beneath sparsely tufted-hairy along the midrib and in the nerve axils, with some scattered hairs on the nerves, above finely punctate, base cuneate. *Inflorescences* incompletely known. *Petals* 4, reduced. *Filaments* with some woolly hairs in the basal half. *Fruits* not observed.

Distribution – *Malesia*: Sumatra (Benkulu, 1 coll.), Java (Banyumas, 1 coll.).

Habitat & Ecology – Between 300 and 900 m altitude. Fl. Nov.

c. subsp. **philippinensis** Leenh., *Blumea* 19 (1971) 121. — Type: *PNH 78086* (K, L, PNH), Luzon.

*Pseudonephelium fumatum* Radlk., p.p. — *Nephe-  
lium intermedium* auct. non Radlk.

*Twigs* rarely more than 3 mm in diam., glabrous. *Leaves* 1- or 2-jugate (exceptionally 1-foliolate or 3-jugate); petiole up to 10 cm long. *Leaflets* opposite or nearly so, 7–24 by 2.5–9 cm, index 2.5–3(–4), fully glabrous, above inconspicuously minutely punctate, base acute. *Inflorescences* rarely more than 20 cm long. *Petals* absent or rarely 1, much reduced. *Filaments* glabrous. *Fruits* short-spiny. — **Fig. 22d.**

Distribution – *Malesia*: Philippines (Luzon, Samar, Panay).

Habitat & Ecology – In forests from sea level

up to 900 m altitude. Fl. Feb.–Apr., July, Nov.; fr. Mar.–Apr.

Note — A fourth subspecies, subsp. *indochinensis* Leenh., occurs in Indo-China and Kwangsi.

**4. *Dimocarpus longan*** Lour., Fl. Coch. (1790) 233; ed. 2, 1 (1793) 288; J. Knight, Trans. Hort. Soc. 2 (1817/8) 400–502, t. 28(bis); Leenh., Blumea 19 (1971) 122. — *Euphoria verruculosa* Salisb., Prod. (1796) 280, nom. illeg. — *Euphoria longan* (Lour.) Steud., Nomencl. (1821) 328, nom. illeg.; Lindl., Bot. Reg. 20 (1835) t. 1729; Merr., Comm. Lour. (1935) 248. — *Nephelium longan* (Lour.) Hook., Curtis Bot. Mag. (1844) t. 4096; Kurz, J. As. Soc. Beng. 44, II (1876) 187. — *Nephelium longan-yan* Blume, Rumphia 3 (1847) 108. — Neotype (Leenhouts 1971): *Liao & Kuo 1598* (L, TAI), Taiwan.

[*Linkeng* Rumph., Herb. Amb. 1 (1741) 157.]

*Euphoria longana* Lam., Encycl. 3 (1792) 574, nom. illeg.; Backer, Schoofl. Java (1911) 265; Lecomte in Fl. Indo-Chine 1 (1912) 1046; Merr., Fl. Manila (1912) 305; Int. Rumph. (1917) 338; Groff, Lychee and Longan (1921); Merr., Enum. Philipp. Flow. Pl. 2 (1923) 503; Radlk. in Engl., Pflanzenz. 98 (1932) 898; Douglas & Baas Becking, Bull. Jard. Bot. Buitenzorg III, 17 (1947) 287, 289, t. 7; Lui, Illustr. Lign. Pl. Taiwan 2 (1962) 908; Backer & Bakh. f., Fl. Java 2 (1965) 136. — *Nephelium longana* (Lam.) Cambess., Mém. Mus. Nat. Hist. Nat. Paris 18 (1829) 30; Hassk., Tijds. Nat. Gesch. Phys. 11 (1844) 213; Hiern in Hook. f., Fl. Br. India 1 (1875) 688; Ridley, Fl. Malay Penins. 1 (1922) 499; Kanjilal & Das, Fl. Assam 1 (1936) 323. — Type: unknown.

*Euphoria lit-chi* auct. non Desfont.: Blanco, Fl. Filip. (1837) 285; ed. 2 (1845) 199; ed. 3, 2 (1878) 8.

*Nephelium malaiensis* Griff., Notul. 4 (1854) 549; Hiern in Hook. f., Fl. Br. India 1 (1875) 689; Ridley, Fl. Malay Penins. 1 (1922) 502; Dispersal (1930) 341; Corner, Wayside Trees (1940) 592, t. 179. Allen, Malayan Fruits (1967) 179, f. 65. — *Euphoria malaiensis* (Griff.) Radlk., Sapind. Holl.-Ind. (1879) 7, 26, 70–72, nom. illeg.; in Engl., Pflanzenz. 98 (1932) 909; Backer & Bakh. f., Fl. Java 2 (1965) 137. — *Euphoria malaiensis* Radlk. f. *genuina* Radlk., Sapind. Holl.-Ind. (1879) 71, nom. illeg. — Type: *Griffith KD 999* (K, L, M, W), Malay Peninsula.

*Sapindus cinereus* Turcz., Bull. Soc. Nat. Moscou 31 (1858) 402. — *Euphoria cinerea* (Turcz.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1878) 299, nom.

illeg.; in Engl., Pflanzenz. 98 (1932) 905. — Lectotype (Leenhouts 1971): *Cuming 1131* (BM, Fl. K. L.), Luzon.

*Pometia curtisii* King, J. As. Soc. Beng. 65, II (1896) 443. — Type: *Curtis 1668* (K, SING), Langkawi I.

*Euphoria gracilis* Radlk. in Elmer, Leaflet Philipp. Bot. 5 (1913) 1606, nom. illeg.; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 503; Radlk. in Engl., Pflanzenz. 98 (1932) 905. — Type: *Elmer 13482* (BM, BO, Fl. K. L. M), Philippines, Mindanao.

*Euphoria microcarpa* Radlk. in Engl., Pflanzenz. 98 (1932) 907, nom. illeg. — *Euphoria spec. nov.*, Merr., Philipp. J. Sc. 29 (1926) 388. — Type: *Castro & Melegrito 1650* (BM, K, M), Borneo, Banguay I.

More complete synonymy in Leenhouts (1971).

*Trees*, exceptionally *shrubs*, up to 30(–40) m high, dbh up to 30(–80) cm, buttresses up to 2 m high. *Twigs* terete with 5 faint grooves, 3–11 mm in diam., whitish to dark brown, mostly inconspicuously, sometimes warty lenticellate, rather densely ferruginous-tomentose with tufted hairs, mostly glabrescent. *Leaves* 2–4(–6)-jugate, axial parts variably, mostly densely hairy; petiole 3–20 cm long, (terete to) flattened above; petiolules 0.2–35 mm long, mostly grooved above. *Leaflets* elliptic (rarely ovate) to (ovate-)lanceolate, 3–45 by 1.8–20 cm, index 1–5, stiff-chartaceous to coriaceous, with or without naked glands or hair tufts in part of the nerve axils beneath, above often tomentose in basal part of midrib, beneath thinly tufted tomentose mainly on midrib and nerves, between the nerves often with paired or solitary hairs or subglabrous; base equal-sided to oblique, acute to rounded, rarely decurrent; margin entire; apex sometimes obtuse to acute, mostly tapering acute-(to obtuse-)acuminate; midrib sunken (rarely flat to raised) above, nerves 0.4–3 cm apart, angle to midrib 45–90°, straight to slightly curved, at least in lower half of leaflet not joined, above slightly prominent to faintly grooved, veins mostly  $\pm$  scalariform, rather dense, above often inconspicuous, beneath more or less prominent, veinlets reticulate, on both sides prominulous to hardly visible. *Inflorescences* 8–40 cm long, densely tufted-tomentose; branches few to several, solitary or sometimes paired, ascending, often rather long, partly and sparsely branched, upper parts of branches and branchlets bearing many subsessile to distinctly stalked (1–)3–5-flowered cymules; bracts patent, oblong-ovate to narrowly lanceolate, 1.5–5 by 0.6–1.5 mm; pedicels 1–3 mm long, rather slender. *Sepals* 2–5 by 1–3 mm, inside at least partly variably



short-hairy. *Petals* 5, broadly to narrowly spatulate. 1.5–6 by 0.8–2 mm, both sides for the greater part densely woolly (big ones) to subglabrous (small ones), apex especially inside if not woolly with sessile glands. *Disc* velutinous. *Stamens*: filaments 1–6 mm long, mostly woolly (hairs often tufted) except at base and less often at apex; anthers 0.6–1.5 mm long. *Fruits*: lobes broad-ellipsoid to globular, 1–3 by 1–3 cm, smooth to warty or with spines up to 1 cm long, sometimes granular, glabrescent.

**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).

**Uses** – For a description of the timber, see p. 427.

**Chromosomes** –  $2n = 30$ : Singhal et al. in Löve, *Taxon* 29 (1980) 356; Sarkar et al. in Löve, *Taxon* 31 (1982) 578.

#### KEY TO THE INFRASPECIFIC TAXA

1a. Leaflets nearly always equal-sided; midrib and nerves nearly always (distinctly) sunken above; petiolules often grooved

b. subsp. **malesianus** (see lead 2)

b. Leaflets mostly distinctly oblique at base; midrib nearly always flat or prominulous above, nerves above prominulous; petiolules rarely grooved . . . . . a. subsp. **longan**

2a. Fruits long-aculeate . . . . . b1. var. **echinatus**

b. Fruits smooth to warty . . . . . b2. var. **malesianus**

#### a. subsp. **longan**

This subspecies is subdivided into 4 varieties, 3 of which are restricted to continental Asia. All Malesian material belongs to:

var. **longan** — *Dimocarpus longan* Lour. — *Euphoria longana* Lam. — *Nephelium longana* (Lam.) Cambess., excl. auct. Philipp. (= var. *malesianus*) — *Nephelium longan* (Lour.) Hook. — *Nephelium long-yan* Blume.

*Twigs* 4–6 mm in diam., mostly dark brown, mostly warty lenticellate, finally becoming glabrescent. *Leaves* (2–)4- or 5-jugate; petiole 3–8 cm long, about terete; petiolules 2–10 mm, not to slightly grooved above. *Leaflets* usually opposite, oblong(-ovate) to (ob)lanceolate, 3–19 by 1.8–6.5 cm, index 2.5–4, stiff-chartaceous, mostly glabrous above, subglabrous beneath; domatia rare and never hairy; base at least in upper leaflets distinctly oblique, acute; apex obtuse to shortly, broadly, and obtusely acuminate; midrib nearly always flat to

prominulous above, nerves rather dense, 0.5–1.5 cm apart, angle to midrib 60–80°, irregular, usually prominulous above, veins and veinlets hardly different, finely reticulate, prominulous on both sides. *Inflorescences* 8–12 cm long, much branched; cymules 1- or 3-flowered, distinctly stalked. *Sepals* inside completely puberulous. *Petals* up to 3 by 1.5 mm, mostly subglabrous outside, sparsely hairy inside. *Fruits*: lobes subglobular, c. 1.2 cm in diam., mostly pustulate to granulate and nearly smooth, sometimes aculeate or colliculate. — **Fig. 22b, f.**

**Distribution** – Continental S and SE Asia and *Malesia*: probably indigenous only in the Malay Peninsula, naturalized in some places in N Borneo, Java, Luzon, and New Guinea.

**Habitat & Ecology** – Lowland rain forest, locally fairly common. Fl. June–Sept. The fruits are mentioned by Ridley, *Dispersal*, l.c. as being eaten by the Sloth Bear (*Melursus ursinus*).

**Uses** – Mainly in continental SE Asia, much less and mainly by the Chinese in *Malesia*, planted as a fruit tree (in *Malesia* the fruits were – are still? – often imported from China). The wood is rarely used but seems to provide a good construction timber, because of its fine polish also esteemed for furniture. The seeds contain saponin and are sometimes used as a soap substitute. See further: Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1547; Desch, *Mal. For. Rec.* 15 (1954) 531; Heyne, *Nutt. Pl. Indon. ed. 3* (1950) 996; Kraemer, *Trees W Pac. Reg.* (1951) 217, f.77; Ochse, *Ind. Vruchten* (1927) 244; Pételot, *Pl. Médic. Camb., Laos, Vietnam* 1 (1952) 199; Welzen, Lamb & Wong, *Nature Malaysiana* 13 (1988) 10–25; Wong Kai Choo & Saichol Ketsa in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.)* 2, *Edible fruits and nuts* (1991) 146–151.

**Note** – The few, scattered naturalized populations in *Malesia* are each very uniform and mutually mostly distinctly different. This depends doubtlessly on the source of origin of the material. The material from Java, cultivated as well as naturalized, and the single collection known naturalized from Borneo agree well with material from S China. Collections from E New Guinea are in good agreement with material from Hainan. The few collections from W New Guinea are all from the Vogelkop Peninsula and have no really good match among Asian material, although they come nearest to the form from Taiwan.

b. subsp. **malesianus** Leenh., *Blumea* 19 (1971) 126.

This nearly exclusively Malesian subspecies can further be divided into the following two varieties:



**b1. var. echinatus** Leenh., Blumea 19 (1971) 128.

Twigs 4–7 mm in diam., whitish or light brown, smooth, early glabrescent. Leaves 1–4-jugate; petiole 6–9 cm long, mostly terete; petiolules 3–15 mm long, grooved above. Leaflets 4–22 by 1.5–9 cm, hairy or not; domatia present or absent; base  $\pm$  equal-sided; apex acuminate; midrib sunken above, nerves rather dense, 1–1.8 cm apart, sunken above, veins transverse, often inconspicuous, veinlets slightly grooved beneath, invisible above. Inflorescences and flowers as in var. *malesianus*. Fruits: lobes 1.5–3 cm in diam., densely covered with 0.8–1 cm long flattened spines. — **Fig. 22c.**

Distribution — *Malesia*: Borneo, Philippines (Mindanao, Basilan).

Habitat & Ecology — Primary and secondary forest on blackish or sandy soil at 20–250 m altitude. Fr. Mar., May, Sept.–Nov.

Uses — The arilode is edible. See Madulid, Nat. Mus. Papers 2, 1 (1991) 58.

Note — As only specimens with fairly well-developed fruits can be separated from certain forms of var. *malesianus*, the data on var. *echinatus* are relatively incomplete. The material is so uniform, and the fruits are so exceptional among *Dimocarpus* that this form deserves varietal rank even though flowering material cannot be identified. Because of the fruits this variety can easily be confused with *Nephelium mutabile*, from which it differs, however, in the distinctive hair tufts and by the much bigger sepals.

**b2. var. malesianus** Leenh., Blumea 19 (1971) 126.

— *Nephelium longana* auct. non Cambess.: Philippine authors — *Nephelium malaiensis* Griff. — *Euphoria malaiensis* (Griff.) Radlk.

Twigs mostly smooth and early glabrescent. Leaves 2–4(–6)-jugate; petiole (3–)6–10(–20) cm long, mostly flattened above; petiolules usually grooved above. Leaflets opposite to alternate, often with (hairy) domatia, mostly slightly hairy; base mostly equal-sided; apex often acuminate; midrib nearly always sunken at least in the basal part, nerves variable, often sunken above, veins and veinlets usually distinctly different, veins mostly transverse, above sometimes sunken, veinlets often inconspicuous above. Inflorescences variable, flowers rarely solitary, cymules often subsessile. Petals distinctly longer than the sepals, nearly always densely woolly, fur-like especially inside. Fruits: lobes 1–2.2 by 1–2 cm, smooth to warty. — **Fig. 22g.**

Distribution — Burma, Laos, Cambodia, S Vietnam, and *Malesia*: Sumatra, Malay Peninsula,

Borneo, Philippines, Celebes (Menado, Muna I.), and Moluccas (Sula Islands: Mangoli).

Habitat & Ecology — Primary, more rarely secondary forests, often on slopes, on ridges, along river banks etc., on a variety of soils: basic, acid, sandy, clayey, usually dry, sometimes marshy; altitude 0–200(–600) m (*Forbes 3010* from Sumatra, Palembang, is said to have been collected at about 1700 m). Fl. mainly Feb., May–July; fr. mainly Apr.–Aug.

Uses — Sometimes planted as a fruit tree. The wood is used as a construction timber. See further: Burkill, Dict. Econ. Prod. Malay Penins. (1935); Kraemer, Trees W Pac. Reg. (1951) 217; Schneider, Bull. Bur. For. Philipp. 14 (1916) 146, f. 34; Whitford, Bull. Bur. For. Philipp. 10, 2 (1911) 53, t. 44.

Notes — The total range of variation of this variety is nearly as wide as that of the species as a whole. This is particularly true of the leaves and fruits; the flowers are rather uniform. Still, further subdivision seems at present impossible.

The variation is centred in Borneo: with sufficient material it is possible to separate here some 30 to 40 entities. As their delimitation is often vague, and as fruits are lacking for many of them, they cannot be clearly circumscribed.

In the Philippines, on the contrary, the situation is fairly simple: all fruiting material can be divided into two races, for a long time distinguished as species: '*Euphoria cinerea*' with big (c. 2 cm in diam.), densely thick-warty fruits, and '*Euphoria gracilis*' with small (1 cm or less in diam.), fine warty-fruits. The former is identical with some collections from Borneo (e.g. *Jaheri 1274*, *Kostermans 13326*), the latter with *Euphoria microcarpa* from N Borneo.

The Sumatran material is very uniform; it agrees completely with the N Bornean form usually identified as *Euphoria malaiensis*.

The Malay Peninsula has few forms. The common form is like that of Sumatra: this is true *Euphoria malaiensis* characterized by rather big (1.8 cm in diam.), nearly smooth fruits and large (up to c. 16 by 6 cm) leaflets. *Pometia curtisii* is very similar to '*gracilis*' from the Philippines and '*microcarpa*' from Borneo: it has smaller leaflets (up to c. 10 by 3 cm) and smaller (1.2 cm in diam.) fine-knobby or -spiny fruits. *SF 32405* may represent a third form: it is densely reddish brown velvety and large in all its parts.

The few specimens from Celebes and the Moluccas all lack fruits; they cannot further be placed.

The material from continental Asia is fairly uniform and agrees mainly with '*gracilis*'.

## DIPLOGLOTTIS

(P.W. Leenhouts)

*Diploglottis* Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 395; Radlk. in Engl., Pflanzenz. 98 (1933) 1224; S.T. Reynolds, *Austrobaileya* 1 (1981) 390; in Fl. Austral. 25 (1985) 33; *Austrobaileya* 2 (1987) 328. — Type species: *Cupania cunninghamii* Hook. [= *Diploglottis australis* (G. Don) Radlk.].

*Trees*, probably monoecious. *Indumentum* of solitary simple hairs only. *Twigs* terete, striate, fulvous-tomentellous, tardily glabrescent. *Leaves* paripinnate, 4- or 5-jugate (*Malesian* species); no pseudostipules; neither petiole nor rachis winged; leaf axes hairy like the twigs. *Leaflets* alternate (*Malesian* species), above without wax, beneath without papillae and red glands, entire, usually (*Malesian* species always) hairy; base symmetrical or sometimes slightly oblique; midrib above prominulous, beneath prominent, nerves prominent beneath, veins and veinlets prominulous on both sides. *Inflorescences* axillary, terminal ones together pseudoterminal, thyrsoid, mostly sparsely branched with divaricate branches, densely hairy like the twigs. *Flowers* unisexual, actinomorphic or  $\pm$  zygomorphic, white to cream. *Sepals* 5, free or nearly so, equal, not petaloid, outside hairy, inside hairy or glabrous. *Petals* 4 or 5, as long as or slightly longer than the calyx, relatively long-clawed, (sub)glabrous, inside with 2 hairy scales, crested or not. *Disc* uninterrupted to interrupted (*Malesian* species), glabrous. *Stamens* usually 8, exerted; filaments hairy in the lower half; anthers glabrous, basifixed, dehiscence latero-introrse. *Ovary* slightly 3-lobed, sessile, densely tomentellous, 3-locular, each locule with 1 ovule; style terminal, long and slender, very sparsely hairy; stigma grooved or slightly lobed. *Fruits* capsular, 3-lobed, not stipitate, smooth, tomentellous, glabrescent or not, not winged, completely 3-celled, loculicidal, inside sericeous. *Seeds* thick to thin lenticular, completely enveloped by a 2-lobed arillode, the latter without basal extension. — **Fig. 23.**

Distribution — In NE Australia 11 species, 1 also in *Malesia*: Papua New Guinea.

***Diploglottis australis*** (G. Don) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 278; in Engl., Pflanzenz. 98 (1933) 1225; Harden & Johnson, *Telopea* 2 (1986) 745. — *Stadmannia australis* G. Don, Gen. Hist. 1 (1831) 669. — Type: See note 1. *Cupania cunninghamii* Hook., Bot. Mag. 75 (1849) t. 4470. — *Diploglottis cunninghamii* Hook. f. ex Benth., Fl. Austral. 1 (1863) 454; F.M. Bailey, Queensl. Fl. 1 (1899) 287; S.T. Reynolds, *Austrobaileya* 1 (1981) 396, f. 25b; Stanley & E.M. Ross in Fl. SE Queensl. 1 (1983) 515, f. 79p; S.T. Reynolds in Fl. Austral. 25 (1985) 37, map 43. — Type: Cultivated in K.

*Cupania diphylostegia* F. Muell., Fragm. Phyt. Austral. 5 (1865/66) 145. — *Diploglottis diphylostegia* F. Muell. ex F.M. Bailey, Proc. Roy. Soc. Queensl. 1 (1884) 148; S.T. Reynolds, *Austrobaileya* 1 (1981) 397; in Fl. Austral. 25 (1985) 38, 199, f. 8, map 44; *Austrobaileya* 2 (1987) 330. — Lectotype (Reynolds 1985):

*Dallachy s.n.*, 30 Sept. 1865 (MEL, sh. 104164), Australia, Queensland.

*Tree* up to 12 m high, dbh up to 35 cm. *Twigs* 0.5–1 cm diam. *Leaves*: petiole subterete at the base, upwards soon becoming terete, 8–11.5 cm long by 3–4 mm thick; petiolules (sub)terete, 3–9 mm long. *Leaflets* elliptic, 9–20 by 4–7.5 cm, index 1.5–2.5, thin-pergamentaceous, on both sides of midrib and nerves densely tomentellous, above between the nerves sparsely sericeous,  $\pm$  glabrescent, beneath between the nerves usually densely (subpatently) sericeous; base acute to obtuse, attenuate; apex obtuse to acuminate; nerves 0.75–1.5 cm apart, slightly curved to straight, abruptly bent and  $\pm$  looped or not at the margin, above flat to slightly grooved; intersecondary nerves exceptional and feeble (to fairly well developed); veins and veinlets moderately laxly reticulate to dense and mainly transverse to the midrib. *Inflorescences* up to 30 cm long; branches rather stout, up to 3



Fig. 23. *Diploglottis australis* (G. Don) Radlk. a. Habit; b. fruit; c. seed (a: NGF 46737; b, c: Clemens 41671).



mm thick, fairly densely set with sessile few-flowered cymules. *Sepals* ovate, 1.2–2 by 0.6–1.5 mm, outside densely, inside sparsely hairy. *Petals* 4 or 5, spatulate, 1.2–2 by 0.8–1.3 mm, distinctly clawed; scales shorter than to as long as the petal, recurved, sometimes with a crest. *Disc* interrupted, orange. *Stamens* 8; filaments 1.3–3 mm long; anthers 0.5–0.6 mm long, pale yellow. *Pistil*: stigma grooved to slightly 3-lobed. *Fruits*: usually only 1 or 2 lobes developed; lobes 1.3–1.7 by 1–1.7 cm, bulging,  $\pm$  glabrescent, orange; wall papyraceous. *Seeds* 1–1.25 cm diam., thin-lenticular, brown; arillode bright orange-yellow. — **Fig. 23.**

Distribution — NE Australia and *Malesia*: Papua New Guinea (Northern and Morobe Provinces).

Habitat & Ecology — Secondary forest at 800–1000 m altitude. Fl. Feb.–Mar., Sept.; fr. Aug.

Uses — In Australia, the aril is used for making

jam and juices; the timber is considered suitable for general indoor work.

Notes — 1. In the discussion about the nomenclature of the present species I follow Harden & Johnson (1986); for a different opinion see Reynolds (1981). Whether Don's concise description, apparently based upon a seedling of which no herbarium specimen seems to exist, really refers to the present species may remain uncertain forever. Harden & Johnson's arguments seem rather convincing, however.

2. Vegetatively, *D. australis* strongly resembles *Euphorianthus euneurus* Leenh. from the same area in *Malesia*. The latter differs in the following characters: twigs grooved, not conspicuously lenticellate; petiole sharply semiterete with a narrow central groove; veinlets less densely scalariform, 2–3 mm apart instead of 0.75–1.5 mm.

## DODONAEA

(P.W. Leenhouts)

*Dodonaea* Miller, Gard. Dict. ed. 4, 1 (1754); Radlk. in Engl., Pflanzn. 98 (1933) 1350–1404; Leenh., Blumea 28 (1983) 271; West in Fl. Austral. 25 (1985) 114; Yap in Tree Fl. Malaya 4 (1989) 440. — Type species: *Dodonaea viscosa* Jacq.

*Shrubs* or *small trees*, usually dioecious. *Indumentum* in *Malesian* species of usually solitary simple hairs; the young parts, the inflorescences, and the ovaries often densely covered with disc-shaped glands and accordingly sticky resinous (see note). *Leaves* in *Malesian* species simple, glabrous or hairy, smooth, entire, the base symmetrical, long decurrent into the short petiole; midrib above  $\pm$  raised, nerves usually ending free. *Inflorescences* axillary or terminal. *Flowers* bisexual or unisexual, regular. *Sepals* (3) 4 or 5 (*Malesian* species), free, valvate, at base often slightly imbricate, all about equal, spreading in male flowers, erect to finally reflexed and caducous in female and bisexual flowers, not petaloid, entire, glandular and glabrous to sparsely hairy outside, along the margin tomentose-ciliate, glabrous to densely hairy inside. *Petals* absent. *Stamens* 5–15, not exerted; filaments very short, glabrous; anthers banana-shaped with 4 deep grooves, at apex apiculate and ciliate or not, dehiscence latrorse. *Staminodes* in female flowers hardly reduced to completely suppressed. *Disc* in female and bisexual flowers at most a slight glabrous swelling around the base of the short gynophore, in male flowers absent. *Ovary* densely glandular, 2–4-locular (*Malesian* species); style apical, longer than the ovary, deeply grooved and sometimes slightly twisted, glabrous, slightly glandular, hardly to deeply divided at apex; ovules 2 per locule, inserted at about halfway the axis, the upper one erect, the lower one pendulous. *Fruit* in *Malesian* species a winged septifragal capsule, smooth, glabrous or slightly hairy, sparsely glandular, glabrous inside; the wing higher than broad, deeply emarginate at apex, variably cordate at base. *Seeds* attached on a swollen funicle, subglobular, c. 2.5 mm in diam., smooth, black, slightly swollen around the hilum. — **Fig. 24.**



Distribution — About 65 species, mainly restricted to Australia, 3 species occurring in *Malesia* also, of which *D. polyandra* is restricted to only a small part of New Guinea, *D. viscosa* is pantropical, and *D. angustifolia* penetrates into the subtropics in several places. Also outside Australia, *D. elaeagnoides* is endemic in the Caribbean and *D. madagascariensis* is endemic in Madagascar.

Habitat & Ecology — For the habitat see under the species. Pollination is probably by wind. Factual information on dispersal is still practically lacking. The broad-winged fruits give the impression of being dispersed by wind; floating water may be another agent, especially for the coastal species. Whether or not the seeds are eaten by birds is unknown but as a means of dispersal this seems rather improbable. See Guppy, *Observ. Natur. Pacific* 2 (1906) 338–341; Ridley, *Dispersal* (1930) 74, 269–270.

Note — Due to the sticky glands paper fibres may stick to the herbarium specimens and may resemble hairs, even though the plants are glabrous. Take care!

## KEY TO THE SPECIES

- 1a. Nerves 2.5–8 mm apart, ending free. Sepals usually 4. Stamens 5–9. . . . . 2  
 b. Nerves 5–12.5 mm apart, distinctly looped and joined towards the margin. Sepals usually 5. Stamens 12–15. . . . . **2. *D. polyandra***
- 2a. Flowers bisexual. Scar of sepals under the fruit strongly lobed. Fruits nearly always 2-locular, straw-coloured or brownish. Coastal . . . . . **3. *D. viscosa***  
 b. Flowers unisexual, dioecious. Scar of sepals under the fruit usually annular, sometimes slightly lobed. Fruits often partly 3-locular, tinged reddish when ripe. Inland  
**1. *D. angustifolia***

**1. *Dodonaea angustifolia*** L. f., *Suppl. Pl.* (1782) 218. — *Dodonaea viscosa* Jacq. var. *angustifolia* Benth., *Fl. Austral.* 1 (1863) 476; West in *Fl. Austral.* 25 (1985) 122, map 150. — *Dodonaea viscosa* Jacq. f. *angustifolia* Sherff, *Amer. J. Bot.* 32 (1945) 214. — Lectotype: *Herb. Linné* 495: 4 & 5, India.

*Caryophyllaster litoreus* Rumph., *Herb. Amb.* 4 (1743) 110, pl. 50, p.p.?, nom. inval.

*Dodonaea burmanniana* DC., *Mém. Soc. Phys. Genève* 1 (1822) 447, excl. specimen Timor; *Prod.* 1 (1824) 616; Blume, *Bijdr.* (1825) 237; Wight, *Illustr.* 1 (1840) 141, pl. 52; Blume, *Rumphia* 3 (1847) 188. — *Dodonaea viscosa* Jacq. f. *burmanniana* Radlk. in *Mart., Fl. Brasil.* 13, 3 (1900) 646. — *Dodonaea viscosa* Jacq. subsp. *burmanniana* West, *Brunonia* 7 (1984) 37; in *Fl. Austral.* 25 (1985) 122, map 149. — Syntypes: *Delessert s.n.*, 1815 (G), Sri Lanka; *Leschenault s.n.*, 1821 (G), Bengal.

*Dodonaea schiedeana* Schlechtendal, *Linnaea* [17 (1843) 639, nom. nud.] 18 (1844) 49. — *Dodonaea viscosa* Jacq. f. *schiedeana* Radlk. in *Mart., Fl. Brasil.* 13, 3 (1900) 646; in *Engl., Pflanzenz.* 98 (1933) 1373. — Type: *Schiede s.n.* (n.v.), Mexico.

*Dodonaea waitziana* Blume, *Rumphia* 3 (1847) 189; Miq., *Fl. Ind. Bat.* 1, 2 (1859) 581. — *Dodonaea viscosa* Jacq. var. *waitziana* Kuntze, *Rev. Gen. Pl.* 1 (1891) 143. — *Dodonaea viscosa* Jacq. subf. *waitziana* Radlk. in *Engl., Pflanzenz.* 98 (1933) 1373. — *Dodonaea eriocarpa* Smith var. *waitziana* Sherff, *Amer. J. Bot.* 32 (1945) 212. — Type: *Waitz s.n.* (L, sh. 908.270-170), Java.

*Dodonaea* nov. spec.: Turcz., *Bull. Soc. Imp. Natur. Moscou* 31 (1858) 407. — *Dodonaea zollingeri* Turcz., *Bull. Soc. Imp. Natur. Moscou* 36, 1 (1863) 587. — Type: *Zollinger 2708* (Fl, L iso), Java.

*Dodonaea viscosa* Jacq. subf. *excisa* Radlk. in *Engl., Pflanzenz.* 98 (1933) 1369. — Syntypes: many mentioned.

*Dodonaea eriocarpa* Smith var. *minor* Sherff, *Amer. J. Bot.* 32 (1945) 212. — Type: *van Steenis 10881* (F holo?: L, SING), Java, Besoeki, W side of Jang Plateau..

*Dodonaea triquetra* auct. non Wendl.: Jungh., *Nat. Geneesk. Arch. Ned. Indië* 2 (1845) 36. — *Dodonaea montana* Jungh., *Java*, ed. 2, 1 (1853) 267, 585. — [*Dodonaea ferrea* Jungh., *Java*, ed. 2, 2 (1854) 321, 503, 822, 891, nom. nud.] —

Syntypes: *Junghuhn s.n.* (L. sh. 908.269-1465, 908.270-103, -123, -139, -143, 925.250-569), Java.

*Dodonaea viscosa* auct. non Jacq.: Vidal, Sinopsis (1883) Atlas p. 21, pl. 35; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 227, p.p.; Koord., Exk. Fl. Java 2 (1912) 543, p.p., 741, pl. 12; Koord. & Valetton, Atlas 1 (1913) f. 91; Troup, Silv. Ind. Trees 1 (1921) 225; Radlk. in Engl., Pflanz. 98 (1933) 1363, all but f. *repanda*; De Voogd, Trop. Natuur 27 (1938) 179, f. 5; Sherff, Field Mus. Nat. Hist. Bot. Ser. 23 (1947) 269, p.maj.p.; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 17, f. 1d, 9; Backer & Bakh. f., Fl. Java 2 (1965) 141, mountain form; Karkare-Khushalani & Mulay, Phytol. 11 (1966) 83-92 (embryology); Salmon, New Zeal. Flow. Pl. Colour, ed. 2 (1967) 52, f. 123-125; Steenis, Mount. Fl. Java (1972) pl. 49, f. 5.

*Tree or shrub*, dioecious (to monoecious), up to 20 m high, dbh up to 40 cm; bark smooth or furrowed, fibrous, peeling off longitudinally in long narrow strips; outer bark reddish to dark brown or grey, inner bark white to light brown; sapwood white, heartwood orange-brown to red. *Indumentum*: glabrous or the buds, young twigs, inflorescences, and infructescences sparsely to densely hirsute; hairs solitary (or in pairs or small tufts), short, dirty white to yellowish. *Leaves* ovate to elliptic (to elliptic-obovate), (including the petiole) 7.5-22 by 0.75-5 cm, index 3-9, thin pergamentaceous to chartaceous, coriaceous when alive; apex long-cuneate, very apex acute to rounded, mucronate; midrib above slightly raised and flat to moderately raised and rounded; nerves 2.5-8 mm apart, widely spreading to nearly patent to the midrib, ending free; intersecondary nerves often few and feeble or a strong one between every pair of nerves; reticulation very fine, above grooved (to invisible), beneath slightly grooved (or 1st order veinlets slightly raised). *Inflorescences* 4-7 cm long, with several about equally long  $\pm$  erect branches, rather dense, with up to c. 50 flowers; pedicels in fruit up to 2 cm long. *Flowers* polygamous, unisexual (or with some bisexual flowers on a male specimen). *Sepals* 4 (or 5), in male flowers ovate-elliptic, 2.75-3.5 by 2-2.25 mm, in female flowers elliptic, 2-3 by 1-1.5 mm, glabrous (to sparsely hairy outside) to fairly densely hairy inside, the margin partly to completely tomentose-ciliate; the scar under the fruit annular or more rarely lobed. *Stamens* 5-9, scars inconspicuous in fruit; filaments 0.2-0.4 mm long; anthers basally attached, 2.5-3 mm long, often with a few minute hairs at the apex; staminodes of apparently the filaments only. *Pistil* 2- (or 3-)

locular; ovary flattened or triangular-ellipsoid, 1.5-2.25 by 1.25-1.75 mm, glabrous or sparsely hairy; style columnar, 3.5-9 mm long, sparsely glandular, caducous; stigma irregularly lobed. *Fruits* flattened, broad ellipsoid to orbicular, 5-13.5 by 7-12 mm, pergamentaceous to membranous, sparsely but conspicuously glandular, glabrous (or sparsely hairy, mainly along the upper part of the suture); wing at the middle of the fruit 2-7.5 mm wide, thin-pergamentaceous; usually pinkish to light purplish, especially the wings (to pale brown). - **Fig. 24c.**

**Distribution** - Worldwide, in the Tropics and Subtropics; in *Malesia* known from Java, Lesser Sunda Islands, Philippines, Celebes, Moluccas, and New Guinea.

**Habitat & Ecology** - A common pioneer of secondary vegetation at higher altitudes; savannahs, tree fern grassland, abandoned gardens, shrubberies, forest edges, light forest, lower montane rain forest, on dry volcanic or loamy soils and on lava flows; at (sea level up to) 1200-3600 m altitude. Fl. and fr. the whole year round.

**Uses** - Planted as a garden fence and as a shade tree in plantations; it provides a good timber for building houses and is used as firewood. See Wealth of India, Raw Materials 3 (1952) 97, f. 56, 57 (sub *D. viscosa*).

**Notes** - 1. For a long time, the present species was considered to be synonymous with *D. viscosa* and went under that name. This is notwithstanding the fact that, especially in Java, two different forms were known, the one coastal, the other one at higher altitudes, forms that were also different in several morphological characters. Junghuhn was one of the very few botanists who separated the two as species. The great attention paid since Linné f. to the leaf shape instead of to the flowers and the authority of Radlkofer, who ranked the two as forms only, seem to be mainly responsible for this situation.

2. The form from Java, the Lesser Sunda Islands in part, and Celebes is the most hairy one of the species; the other specimens from the Lesser Sunda Islands, the Philippines, and New Guinea are glabrous or have at most a few hairs on the inflorescences.

3. Throughout its area, *D. angustifolia* seems to be adapted to a drier and cooler climate than *D. viscosa*.

2. ***Dodonaea polyandra*** Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 525; D.J. McGillivray, Telopea 1 (1975) 67; West in Fl. Austral. 25 (1985) 126, f. 28e, map 155. - Type: *Brass* 8379 (A holo; BRI, L), Central Papua New Guinea.



Fig. 24. *Dodonaea* Miller. Habit and fruits. — *D. viscosa* Jacq. a. Habit; b. fruit. — *D. angustifolia* L. f. c. Fruit. — *D. polyandra* Merr. & L.M. Perry. d. Fruit (a, b: Ding Hou 551; c: Eyma 4325; d: LAE 60476).

*Tree or shrub*, dioecious, up to 12 m high; bark smooth to rather rough, grey-brown to dark reddish brown, peeling off in strips; inner bark pale brown to red; wood white to cream. *Indumentum* glabrous. *Leaves* elliptic to elliptic-obovate, (in-

cluding the petiole) 6.5–12 by 1.8–4 cm, index 2.5–4, stiff pergamentaceous; apex not or only slightly acuminate, the very apex rounded or sometimes retuse; midrib slightly raised above; nerves 5–12.5 mm apart, widely spreading to erecto-patent, dis-



tinctly looped and joined near the margin; intersecondary nerves often present, fairly strong; reticulations very coarse, invisible above, indistinct below. *Inflorescences* 2–4 cm long, laxly and widely branched, with 12–15 flowers; pedicels in fruit up to 1.75 cm long. *Sepals* (4 or) 5, in male flowers ovate, c. 2.75 by 1.5 mm, in female flowers elliptic, c. 3.5 by 1 mm, both outside glandular; scar under the fruit annular, not lobed. *Stamens* 12–15; filaments c. 0.2 mm long; anthers attached on the back just above the base, c. 3 mm long; female flowers without staminodes. *Pistil* 3-locular; ovary triangular-ellipsoid, c. 2 mm high; style cylindrical, c. 8 mm long; stigma minutely lobed. *Fruits* flattened, ellipsoid, 14–15 by 8–11 mm, pergamentaceous, sparsely conspicuously glandular; wings at the middle of the fruit 4.5–7.5 mm wide, thin pergamentaceous; greenish sometimes with a purple tinge, the body sometimes brown. — **Fig. 24d.**

**Distribution** — Australia (NE Queensland) and **Malesia**: Papua New Guinea (Western Prov.; Bensbach and Morehead Subprov.).

**Habitat & Ecology** — Abandoned gardens, secondary forest, savannahs, forest edges, in rain forest along streams, up to 45 m altitude. Fl. Dec.: fr. July, Aug.

- 3. *Dodonaea viscosa*** Jacq., Enum. Syst. Pl. (1760) 19; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 227, p.p.; Koord., Exk. Fl. Java 2 (1912) 543, p.p.; Ridley, Fl. Malay Penins. 1 (1922) 510; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 514, p.p.; Radlk. in Engl., Pflanzenz. 98 (1933) 1363, p.p.; Corner, Wayside Trees (1940) 586, f. 214; Adelb., Blumea 6 (1948) 325, p.p.; Meyer Drees, Commun. Forest Res. Inst. 33 (1951) 108, p.p.; Backer & Bakh. f., Fl. Java 2 (1965) 141, beach form only; Leenh., Blumea 28 (1983) 271; West in Fl. Austral. 25 (1985) 120, f. 28a–d, map 148–154; Yap in Tree Fl. Malaya 4 (1989) 440. — *Dodonaea viscosa* Jacq. var. *vulgaris* Benth., Fl. Austral. 1 (1863) 476, nom. illeg. (ICBN art. 26.1). — Lectotype (Leenhouts 1983): *H. Sloane herb. v. 97* (BM), Jamaica.

*Caryophyllaster litoreus* Rumph., Herb. Amb. 4 (1743) 110, t. 50, p.p.?, nom. inval.

*Ptelea viscosa* L., Sp. Pl. (1753) 118; Burm. f., Fl. Indica (1768) 36. See Leenhouts (1983) for nomenclatural notes.

*Dodonaea burmanniana* DC., Mém. Soc. Phys. Genève 1 (1822) 447 as for the specimen from Timor (cf. Blume, Rumphia 3, 1847, 189, 190).

*Dodonaea repanda* Schumach. & Thonn., Königl. Danske Vidensk. Selsk. Skr. 3 (1827) 214. — *Dodonaea viscosa* f. *repanda* Radlk. in Mart.,

Fl. Brasil. 13, 3 (1900) 646. — Type: Not indicated.

*Dodonaea candolleana* Blume, Rumphia 3 (1847) 190. — *Dodonaea viscosa* var. *candolleana* Backer, Fl. Batavia 1 (1907) 354. — Syntypes: *Anonymous s.n.* (L, sh. 908.269-1364, -1485, 908.270-169), Java; *Herb. van Royen s.n.* (L, sh. 908.270-159), Java; *Zippelius s.n.* (L, sh. 908.270-129, New Guinea; -179, Ambon).

*Dodonaea candolleana* Blume var. *minor* Blume, Rumphia 3 (1847) 191. — *Dodonaea viscosa* Jacq. f. *minor* Backer, Fl. Batavia 1 (1907) 354. — Syntypes: *Anonymous s.n.* (L, sh. 908.270-114, -125, -145, -166), Java; *Anonymous s.n.* (L, sh. 908.270-126), Timor; *Anonymous s.n.* (L, sh. 908.270-146, -154), Ternate; *Forsten s.n.* (L, sh. 908.270-134, Ternate; -146, Timor); *Spanoghe s.n.* (L, sh. 908.250-555, 908.269-1384, 908.270-105), Timor.

[*Dodonaea littoralis* Jungh., Java, ed. 2, 1 (1853) 267, nom. nud.]

*Dodonaea viscosa* Jacq. f. *viridula* Kuntze, Rev. Gen. Pl. 1 (1891) 143. — Type not indicated, Java.

*Dodonaea dioica* auct. non DC.: Hensch., Vita Rumphii (1833) 107; Jungh., Nat. Geneesk. Arch. Ned. Indië 2 (1845) 37; non *D. dioeca* Roxb.

*Dodonaea angustifolia* auct. non L. f.: Blanco, Fl. Filip. (1837) 312, p.maj.p.

**Shrub or treelet**, up to 8 m high, dbh up to 20 cm; bark smooth with fine ridges, outer reddish brown, inner pale yellow; sapwood yellowish. *Indumentum* glabrous or nearly so. *Leaves* elliptic to obovate, (including the petiole) (5)–9–15 by (1.5)–2.5–4 cm, index 3–4.5, thin-pergamentaceous to papyraceous; apex narrowly rounded and minutely acuminate (to broadly rounded); midrib above moderately raised and rounded; nerves 4–8 mm apart, widely spreading, ending free; intersecondary nerves often present, well-developed; reticulations fine, above grooved, slightly raised beneath. *Inflorescences* 3–3.5 cm long, laxly and widely branched, with 12–15 flowers; pedicels in fruit 1.2–1.5 cm long. *Flowers* bisexual. *Sepals* (3 or) 4, elliptic, c. 2.75 by 1.5–1.75 mm, outside sometimes with a few paired hairs, the margin sparsely ciliate mainly towards the apex, glabrous inside; the scar under the fruit strongly lobed. *Stamens* 5–7, scars distinct in fruit; filament c. 0.2 mm long; anther basally attached, c. 1.8 mm long, ciliate at apex. *Pistil* 2- (or 3-)locular; ovary flattened-ellipsoid, c. 1.25 by 1 mm, glabrous; style columnar, 2–3 mm long, with some glands, caducous; stigma slightly lobed. *Fruits* inflated, reniform-cordate, 8–



12 by 11–16 mm, membranous, yellowish to light brown, very sparsely glandular, otherwise glabrous; wing at the middle of the fruit (1–)2.5–4 mm wide, membranous. — Fig. 24a, b.

Distribution — Pantropical, throughout *Malesia*.

Habitat & Ecology — Coastal vegetation on or behind sandy beaches or on limestone rocks; *Baringtonia* formation, *Casuarina* forest, also savannahs and Coconut plantations; sea level (up to 90 m altitude). Fl. and fr. throughout the year.

Uses — For a description of the timber, see p. 427.

Notes — 1. In literature, the distinction between *D. viscosa* and *D. angustifolia* is hardly ever made,

even though, in *Malesia* at least, one was aware of the existence of a coastal form, regarded here as true *D. viscosa*, and a montane form, *D. angustifolia*.

2. Rumphius' *Caryophyllaster litoreus* is probably also such a mixture: the name and the habitat point to *D. viscosa*, the description and the plate, however, seem to represent *D. angustifolia*.

#### EXCLUDED

*Dodonaea lamponga* Miq., Sumatra (1861) 200, 511 = *Pteleocarpa lamponga* (Miq.) Bakh. ex Heyne, Nutt. Pl. Indon. ed. 2 (1927) 1309 (usually assigned to *Boraginaceae*).

### ELATTOSTACHYS

(F. Adema)

*Elattostachys* (Blume) Radlk., Sapind. Holl.-Ind. (1879) 37; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 502, 600; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 211; Radlk., Bot. Jahrb. 56 (1920) 300; in Engl., Pflanzenr. 98 (1933) 1258; Backer & Bakh. f., Fl. Java 2 (1965) 140; S.T. Reynolds, Austrobaileya 2 (1985) 154; in Fl. Austral. 25 (1985) 69; Adema, Blumea 36 (1992) 541. — *Cupania* sect. *Elattostachys* Blume, Rumphia 3 (1847) 160; Miq., Fl. Ind. Bat. 1, 2 (1859) 565. — Lectotype species (S.T. Reynolds 1985): *Cupania zippeliana* Blume [= *Elattostachys zippeliana* (Blume) Radlk.].

*Trees* or *shrubs*. *Indumentum* of solitary hairs only. Flowering *twigs* terete, striate, rarely grooved. *Leaves* paripinnate, 2–6-jugate; petiole pulvinate, striate; rachis striate; petiolules usually pulvinate, flattened and grooved above, rounded below. *Leaflets* alternate, rarely (sub)opposite, usually (slightly) asymmetric, usually chartaceous; margin entire or (irregularly) dentate; domatia if present pocket-like to saccate. *Inflorescences* (supra-)axillary, thyrsoid, without or basally with 1 or 2 branches; cymes 1-flowered, bracts and bracteoles caducous, pedicels hairy. *Flowers* unisexual, male and female ones only slightly different in perianth. *Sepals* 5, (almost) free, not or basally slightly imbricate, not petaloid, almost equal, appressed-hairy on both surfaces. *Petals* 5, usually oblique funnel-shaped, clawed, with 2 auricles at the apex of the claw. *Disc* entire, cup-shaped, glabrous (in 1 Pacific species hairy). *Stamens* 8, exerted in the male flowers; filaments glabrous or exceptionally with few hairs; anthers hairy or glabrous. *Ovary* 3-celled, hairy; style apical, shorter than the ovary; stigma 3-lined; pistillode 3-celled, hairy. *Fruits* sessile, 3-celled, obovoid to globular or top-shaped, loculicidal, circular or rounded to sharply deltoid in cross section, wall woody, up to 6.5 mm thick, outside glabrous to velutinous, inside tomentose, rarely (Solomon Islands, New Caledonia) glabrous. *Seeds* ellipsoid to obovoid, testa shiny black or rarely brown, sarcotesta covering only a small part of the seed, 2-lobed or shield-like. — Figs. 25–27.

Distribution — About 20 species, in *Malesia* (except most of West *Malesia*), Australia, Solomon Islands, New Hebrides, New Caledonia, Fiji, Samoa, and Tonga.

Habitat — Primary and secondary, dry or wet rain forest, up to 2000 m altitude.

## KEY TO THE SPECIES OF MALESIA EXCEPT NEW GUINEA

- 1a. Domatia usually absent, if present inconspicuous, pocket-like, not hairy. Fruits 9–20 by 9–18 mm, wall 1.2–2.4(–3.7) mm thick. Sarcotesta 2-lobed . . . . . 2
- b. Domatia pocket-like or saccate, ciliate. Fruits 13–25 by 11–20 mm, wall 1.4–3.4 mm thick. Sarcotesta rounded, not lobed. (Inside of petals hairy. Anthers glabrous.)  
**10. E. zippeliana**
- 2a. Apex of leaflets acute. Infructescences 3–10 cm long. Fruits 10–20 by 9–18 mm, rounded deltoid in cross section. (Inside of petals glabrous. Anthers hairy.)  
**9. E. verrucosa**
- b. Apex of leaflets obtuse to rounded. Infructescences 1.5–3 cm long. Fruits 9–10 by 9–10 mm, about circular in cross section . . . . . **3. E. erythrocarpum**

## KEY TO THE SPECIES OF NEW GUINEA

- 1a. Axial parts glabrous or strigose . . . . . 2
- b. Axial parts densely tomentose . . . . . 4
- 2a. Apex of leaflets acute or acuminate . . . . . 3
- b. Apex of leaflets obtuse to rounded, rarely retuse . . . . . **8. E. tetraporandra**
- 3a. Fruits triquetrous in cross section, distinctly keeled, 20–35 by 20–25 mm, wall 3.7–5.5 mm thick . . . . . **2. E. angulosa**
- b. Fruits deltoid in cross section, not keeled, 10–13 by 10 mm, wall 1.4–2.1 mm thick  
**7. E. rubrofructus**
- 4a. Fruits 20–35 by 20–30 mm, wall 2.5–6.5 mm thick . . . . . 5
- b. Fruits 13–20(–25) by 11–20 mm, wall 1.3–2(–3.4) mm thick . . . . . 6
- 5a. Lower surface of leaflets (thinly) pilose. Anthers glabrous. Fruits obovoid to globular, wall 4–6.5 mm thick, outside glabrous to velutinous . . . . . **4. E. globosa**
- b. Lower surface of leaflets glabrous. Anthers hairy. Fruits ellipsoid, wall 2.5–2.9 mm thick, outside glabrous . . . . . **5. E. goropuensis**
- 6a. Leaflets with 8–20 nerves per side, upper and lower surface glabrous to pilose; petiolule 2–10 mm long. Outside of fruits glabrous to thinly appressed-hairy . . . . . 7
- b. Leaflets with 9 or 10 nerves per side, upper surface thinly, lower surface densely pilose; petiolule 1 or 2 mm long. Outside of fruits appressed-hairy  
**1. E. aiyurensis**
- 7a. Anthers 1.1–1.4 mm long. Fruits 13–15 by 12–14 mm, wall 1.3–1.9 mm thick, outside glabrous to thinly appressed-hairy. Seeds 5–8 by 3–4 mm **6. E. obliquinervis**
- b. Anthers 0.4–0.6 mm long. Fruits 13–25 by 11–20 mm, wall 1.4–3.4 mm thick, outside glabrous. Seeds 7–15 by 4–7 mm . . . . . **10. E. zippeliana**

**1. *Elattostachys aiyurensis*** Adema, Blumea 36 (1992) 543. — Type: *NGF 1042* (L), Papua New Guinea.

*Trees*, c. 30 m high, dbh c. 60 cm; outer bark brown with numerous small pustular lenticels, inner bark streaked red brown on pale background, within yellow brown tinged with pink; wood pale.

*Branches* densely short-tomentose; flowering twigs c. 2 mm in diam. *Leaves* 2-jugate; petiole 1.5–2 cm long; rachis 1.5–2 cm long, both ± terete, densely short-tomentose; petiolules 1–2 mm long, densely short-tomentose. *Leaflets* opposite, narrowly elliptic, slightly asymmetric, 6–11.5 by 2–4 cm, index 2.4–3, dark green above, rusty on the nerves below, thickly chartaceous, above thinly pilose,

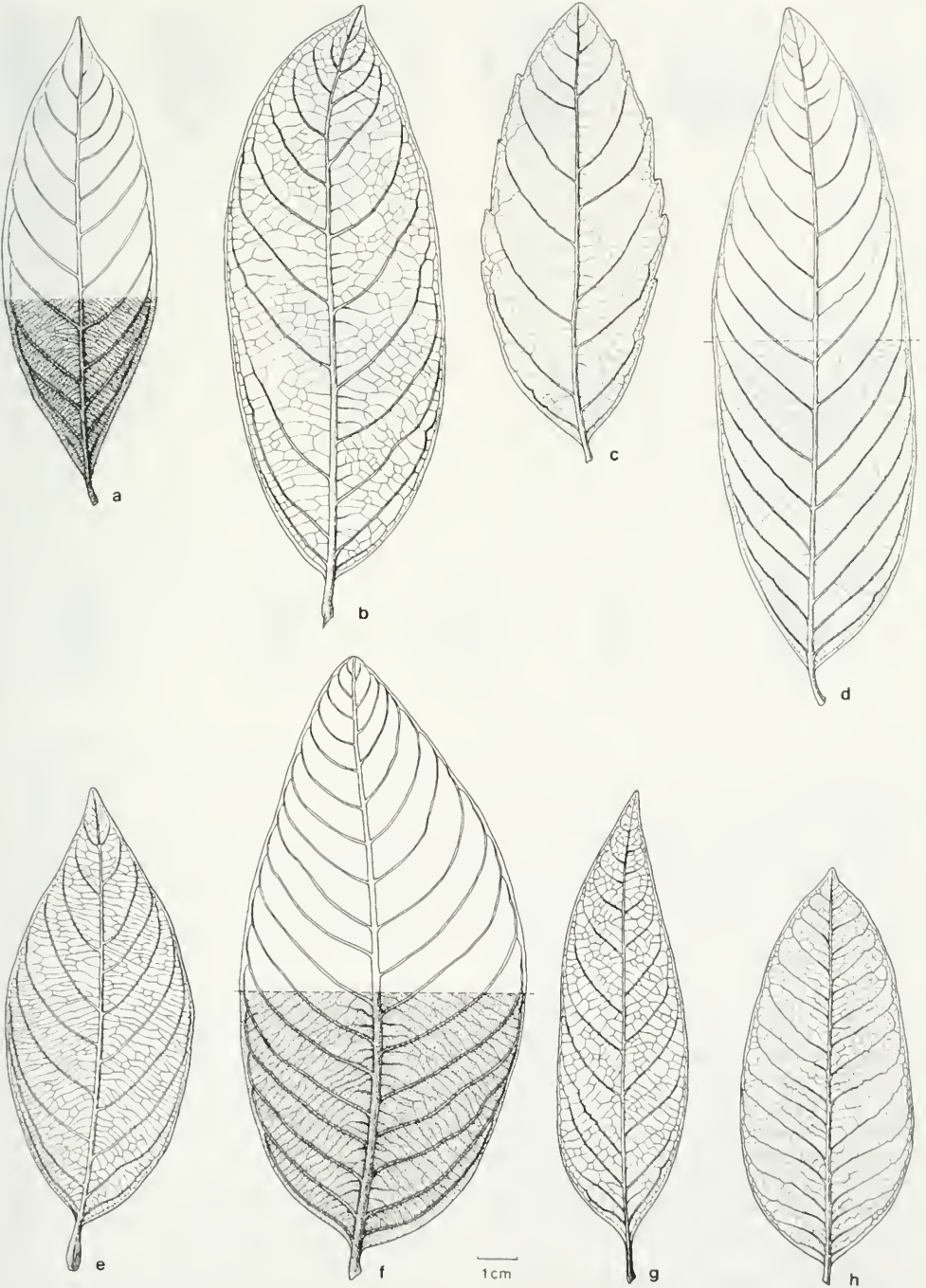


Fig. 25. *Elattostachys* (Blume) Radlk. Leaflets. — a. *E. aiyurensis* Adema. — b. *E. angulosa* Adema. — c. *E. erythrocarpum* Adema. — d. *E. globosa* Adema. — e. *E. goropuensis* Adema. — f. *E. obliquinervis* Radlk. — g. *E. rubrofructus* Adema. — h. *E. tetrapandra* Radlk. (a: NGF 1042; b: NGF 43733; c: Curran 3414; d: Forbes 567; e: Veldkamp & Stevens 5942; f: BW 12199; g: Brass 21977; h: UPNG 846).

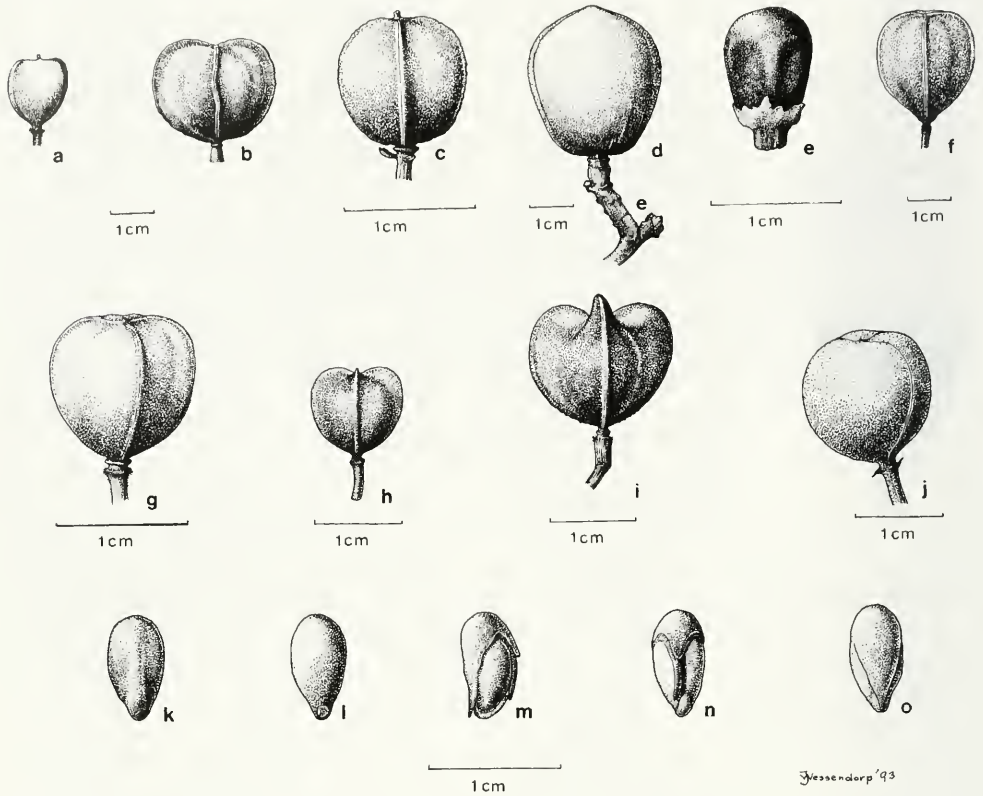


Fig. 26. *Elattostachys* (Blume) Radlk. Fruits, seeds and embryos. — *E. aiyurensis* Adema. a. Fruit. — *E. angulosa* Adema. b. Fruit. — *E. erythrocarpum* Adema. c. Fruit. — *E. globosa* Adema. d. Fruit; e. seed. — *E. goropuensis* Adema. f. Fruit. — *E. obliquinervis* Radlk. g. Fruit. — *E. rubrofructus* Adema. h. Fruit. — *E. tetraporandra* Radlk. i. Fruit. — *E. zippeliana* (Blume) Radlk. j. Fruit; k. seed, dorsal; l. seed, ventral; m. embryo, lateral; n. embryo, *ibid.*; o. *ibid.*, dorsal (a: NGF 1042; b: NGF 43733; c: Curran 3414; d, e: Forbes 567; f: Veldkamp & Stevens 5942; g: BW 12199; h: Brass 21977; i: UPNG 846; j–o: de Vriese *s.n.*).

midrib more densely so, below rather densely pilose, midrib and nerves more densely so; base cuneate; apex acute; margin entire; midrib prominent above, nerves 9–10 per side, 5–14 mm apart, angle to midrib 45–50°, venation scalariform; domatia small pocket-like. *Flowers* not observed. *Infructescences* c. 5.5 cm long. *Fruits* green or tinged with pink,  $\pm$  obovoid, almost circular in cross section, c. 17 by 14 mm, wall c. 2 mm thick, outside shortly appressed-hairy. *Seeds* not observed. — **Figs. 25a, 26a.**

**Distribution** — *Malesia*: Papua New Guinea (Madang Prov.).

**Habitat & Ecology** — Altitude 1500–2000 m. Fr. Oct.

**Notes** — 1. Only known from the type specimen. 2. Rather similar to *E. obliquinervis* but differ-

ent in the length of petioles, rachises and petiolules, in the hairiness of the leaflets, in the size of the fruits and the hairiness of the exocarp. The type specimen of the present species was collected at a much higher altitude than the specimens of *E. obliquinervis*.

**2. *Elattostachys angulosa* Adema, Blumea 36 (1992) 544.** — Type: Craven & Schodde 994 (A, K, L), Papua New Guinea.

Small trees, 6–20 m high, dbh 3–6 cm; bark smoothish, grey to dark brown, inner bark red or mid-brown; wood straw or creamish. *Branches* glabrous to strigose; flowering twigs 2–5 mm in diam. *Leaves* 2–4-jugate; petiole 3.5–13.5 cm long; rachis 7–22 cm long, both terete, striate, strigose,



glabrescent; petiolules (1–)5–15 mm long, short-hairy to glabrous. *Leaflets* elliptic, slightly asymmetric, 6.5–29 by 3.5–9.5 cm, index 1.5–3.5, mid or dark green above, paler below, chartaceous, above and below glabrous, midrib with (few) short hairs; base cuneate to rounded; apex acute or acuminate; margin entire; midrib (slightly) prominent above, nerves 10–17 per side, 5–22 mm apart, angle to midrib 50–70°, venation reticulate-scalariform; domatia if present pocket-like. *Flowers* cream, not observed. *Infructescences* 4–9 cm long. *Fruits* pale (yellowish) green to red, blackish brown when old, globular to obovoid, triquetrous in cross section, distinctly keeled, 20–35 by 20–25 mm, wall 3.7–5.5 mm thick, outside glabrous or (thinly) strigose. *Seeds* ellipsoid to obovoid, 10–11 by 6–7 mm, sarcotesta rounded, covering 1/3–1/5 of the seed. — **Figs. 25b, 26b.**

**Distribution** — *Malesia*: New Guinea (Irian Jaya: Manokwari; Papua New Guinea: W Sepik, Morobe, Gulf and Central Prov.).

**Habitat & Ecology** — Primary or secondary forest, or shaded edge of swamp; clay soil; altitude 90–1000 m. Fr. Mar.–Sept.

**Note** — *Craven & Schodde 994* from West Sepik Province has smaller fruits and seeds than the other specimens.

**3. *Elattostachys erythrocarpum*** Adema, *Blumea* 36 (1992) 541. — Type: *Eyma 1778* (K, L, U), Celebes.

Small *trees* or *shrubs*, c. 6 m high. *Branches* densely strigose, glabrescent; flowering twigs 1.5–2.5 mm in diam. *Leaves* 2–4-jugate; petiole 1.5–3 cm long; rachis 2–5 cm long, both flattened above, rounded below, densely strigose, glabrescent; petiolules 2–4 mm long, short-hairy. *Leaflets* elliptic to ovate, asymmetric, 5.5–11 by 2–5 cm, index 2.1–3.5, dark green, coriaceous, above and below glabrous; base rounded; apex obtuse to rounded; margin irregularly or remotely dentate; midrib (slightly) prominent above, nerves 5–11 per side, 5–20 mm apart, angle to midrib 60°, venation reticulate-scalariform; domatia absent. *Flowers* not observed. *Infructescences* 1.5–3 cm long. *Fruits* red, subglobular, ± circular in cross section, 9–10 by 9–10 mm, wall 1.2–1.5 mm thick, outside glabrous. *Seeds* ± obovoid, 6 by 4 mm, sarcotesta 2-lobed, covering up to 1/2 of the seed. — **Figs. 25c, 26c.**

**Distribution** — *Malesia*: Celebes.

**Habitat & Ecology** — Forest. Fr. May, Aug.

**Note** — In several aspects similar to *E. verrucosa*. The present species differs in its thicker leaflets with obtuse to rounded apices, its shorter

inflorescences, its smaller fruits that are more circular in cross section.

**4. *Elattostachys globosa*** Adema, *Blumea* 36 (1992) 545. — Type: *Forbes 567* (Fl, L, MEL), Papua New Guinea.

*Trees*, 6–15 m high, dbh 18–45 cm, bark rough or smooth, dark grey or (blackish) brown with grey patches, inner bark (chestnut) brown, blaze orange or light brown; wood white or creamish. *Branches* densely tomentose; flowering twigs 2–4 mm in diam. *Leaves* 2–4(–6)-jugate; petiole 3–14 cm long; rachis 2.5–21.5 cm long, both flattened above, rounded below, densely tomentose; petiolules 2–15 mm long, densely tomentose. *Leaflets* elliptic to ovate, (slightly) asymmetric, 7–36 by 3–12 cm, index 1.9–3.7, glossy dark or mid green above, paler and duller below, chartaceous, above glabrous to pilose, midrib (and nerves) glabrous to pilose, below (thinly) pilose, midrib and nerves more densely so; base cuneate to rounded; apex obtuse to rounded or acute or acuminate; margin entire, rarely apically dentate; midrib (slightly) prominent above, nerves 10–17 per side, 6–25 mm apart, angle to midrib 45–65°, venation scalariform; domatia small, pocket-like. *Inflorescences* 2–7.5 cm long, in fruit 2–8.5 cm long; bracts and bracteoles triangular or ovate to narrowly elliptic, 0.6–1.9 by 0.3–1.6 mm, outside appressed-hairy, inside glabrous or appressed-hairy; pedicels 1.7–2.2 mm long. *Flower buds* subglobular, 1.9 by 1.9 mm. *Sepals* ovate to elliptic, 1.6–2.5 by 0.6–1.3 mm. *Petals* cream, 0.8–1.4 by 0.8–1.2 mm, outside shortly appressed-hairy, margin ciliate, inside glabrous, claw 0.4–0.6 mm, auricles woolly. Filaments of *stamens* 0.5–0.8 mm long; anthers c. 1.2 mm long, glabrous. *Pistillode* 0.6–1 by 0.7–1 mm. *Fruits* glossy mid or pale green to reddish, or rose-purple, globular to obovoid, circular or rounded deltoid in cross section, 20–35 by 20–30 mm, wall 4–6.5 mm thick, outside glabrous to velutinous. *Seeds* ellipsoid to obovoid, 11–13 by 6–8 mm, sarcotesta rounded, covering 1/5–1/3 of the seed. — **Figs. 25d, 26d, e.**

**Distribution** — *Malesia*: Papua New Guinea (Morobe, Central, Gulf, and Milne Bay Prov.).

**Habitat & Ecology** — Lowland rain forest, margin of primary forest, river bank in secondary forest; alt. 15–1200 m. Fl. July, Aug.; fr. Mar.–Nov.

**5. *Elattostachys goropuensis*** Adema, *Blumea* 36 (1992) 547. — Type: *Veldkamp & Stevens 5942* (CANB, L, US), Papua New Guinea.

*Trees*, 30 m high. *Branches* short-tomentose; flowering twigs c. 3 mm in diam. *Leaves* 3-jugate;

petiole c. 7.5 cm long; rachis c. 12 cm long, both flattened above, rounded below, short-tomentose; petiolules 7–10 mm long, thinly short-hairy. *Leaflets* (broadly) elliptic to ovate, slightly asymmetric, 10.5–20 by 5–7.5 cm, index 2.1–2.6, chartaceous, above and below glabrous, midrib with short hairs; base (broadly) cuneate; apex acute; margin entire; midrib prominent above, nerves 10–15 per side, 12–22 mm apart, angle to midrib 45–55°, venation reticulate-scalariform; domatia small, pocket-like. *Inflorescences* 7 cm long, in fruit 11–15 cm long; bracts and bracteoles about deltoid, c. 0.6 by 0.7 mm, shortly appressed-hairy on both surfaces; pedicels c. 2 mm. *Flowers* green. *Sepals* elliptic or triangular, 1.9–2.5 by 0.9–1.4 mm. *Petals* 1.1–1.4 by 1–1.1 mm, shortly appressed-hairy on both surfaces, claw c. 0.2 mm long, auricles woolly. *Disc* c. 0.4 mm high. Filaments of *stamens* c. 0.9 mm long, with few hairs; anthers c. 1.2 mm long, hairy. *Pistillode* 1.2 by 0.9 mm. *Fruits* pink-scarlet, ellipsoid, rounded-deltoid in cross section, 25–30 by 20–25 mm, wall 2.5–2.9 mm thick, outside glabrous. *Seeds* black, sarcotesta small, basal, purple. – **Figs. 25e, 26f.**

Distribution – *Malesia*: Papua New Guinea (Northern Prov.).

Habitat & Ecology – *Euphorbia-Ficus* forest. Fr. July.

Note – Only known from the type specimen.

6. *Elattostachys obliquinervis* Radlk., Bot. Jahrb. 50 (1913) 78; 56 (1920) 300; in Engl., Pflanzenz. 98 (1933) 1262. — Type: *Schlechter 19424* (K, P), Papua New Guinea.

*Trees* or small *shrubs*, 3–32 m high, dbh 30 cm; outer bark smooth, greyish brown, inner bark straw, slash light brown; wood pale brownish yellow. *Branches* densely short-tomentose, glabrescent; flowering twigs 2–4 mm in diam. *Leaves* 2–4-jugate; petiole 2.5–6(–13) cm long; rachis 2–15 cm long, both terete or flattened above, rounded below, densely short-tomentose; petiolules 2–10 mm long, short-tomentose. *Leaflets* elliptic to ovate, (slightly) asymmetric, 7.5–13 by 3–6 cm, index 2.1–3.4, dark green above, light green below, (thick) chartaceous, above and below glabrous to pilose, midrib and nerves more densely so; base cuneate to rounded; apex acute or acuminate; margin entire; midrib prominent above, nerves 13–18 per side, 4–15 mm apart, angle to midrib 50–55°, venation reticulate-scalariform; domatia small, pocket-like. *Inflorescences* 2–8.5 cm long, in fruit 3.5–4.5 cm long; bracts and bracteoles triangular, 1.2 by 1 mm, outside appressed-hairy, inside with few hairs; pedicels 1.2–1.7 mm long. *Flower buds* yellowish brown.

*Sepals* rarely 6, elliptic, 1.5–1.9 by 0.7–1.1 mm. *Petals* 0.9–1.5 by 0.6–1.1 mm, outside with few appressed hairs, margin ciliate, inside appressed-hairy, claw 0.3–0.6 mm long, auricles woolly. *Disc* 0.5–0.6 mm high. Filaments of *stamens* 1.2–1.7 mm long; anthers 1.1–1.4 mm long, glabrous. *Pistillode* c. 1.4 by 0.9 mm. *Fruits* green turning orange red or brown when ripe, ellipsoid to obovoid or almost globular, rounded-deltoid in cross section, 11–15 by 12–14 mm, wall 1.2–1.9 mm thick, outside glabrous to thinly appressed-hairy. *Seeds* ellipsoid or obovoid, 5–8 by 3–4 mm, sarcotesta rounded or deltoid, covering 1/5–1/2 of the seed. – **Figs. 25f, 26g.**

Distribution – *Malesia*: New Guinea (Irian Jaya): Vogelkop; Papua New Guinea: Madang and Morobe Prov.).

Habitat & Ecology – (Depleted) primary forest or forest tracks. Sandy clay, or limestone with a thick clay cover; altitude 10–500 m. Fl. Nov.; fr. Jan.–Mar., Sept., Nov.

Note – *Van Royen 3222* has upper leaflets of at least 27 by 11.5 cm, and ramiflorous (?) inflorescences; its fruits are more sharply deltoid in cross section than those of the other specimens. *Robbins 1638* has upper leaflets of at least 22 by 8 cm and slightly smaller fruits than those of the other specimens.

7. *Elattostachys rubrofructus* Adema, Blumea 36 (1992) 547. — Type: *Brass 21977* (L, US), Papua New Guinea.

Small *trees* with several trunks, 5–16 m high, dbh 15–17.5 cm; bark smooth, brownish grey mottled with grey, inner bark pale brown; wood pale straw. *Branches* strigose; flowering twigs 2(–3) mm in diam. *Leaves* 2–5-jugate; petiole 2–4.5(–7.5) cm long, terete or flattened above, rounded below; rachis 3.5–13 cm long, flattened above, rounded below, both strigose; petiolules 2–5 mm long, short-hairy to glabrous. *Leaflets* (narrowly) elliptic or ovate, slightly asymmetric, 7–14 by 2.5–5 cm, index 1.8–4, chartaceous, above and below glabrous, midrib below glabrous or strigose; base cuneate to rounded; apex acute; margin entire; midrib prominent above, nerves 8–14 per side, 7–15 mm apart, angle to midrib c. 45°, venation reticulate-scalariform; domatia if present small, pocket-like. *Inflorescences* c. 4 cm long, in fruit 5–8.5 cm long; bracts and bracteoles ± triangular, c. 0.7 by 0.5 mm, shortly appressed-hairy on both surfaces; pedicels c. 4 mm long. *Flower buds* ± globular, 1.9–2 by 1.9 mm. *Sepals* (narrowly) elliptic, 2.9–3.2 by 1.1–1.6 mm. *Petals* creamy with reddish tinge, 1.6–1.9 by 1.2–1.7 mm, glabrous on both surfaces, claw

0.6 mm long, auricles ciliate. *Disc* c. 0.7 mm high. Filaments of *stamens* 1.6–1.9 mm long; anthers 1.7–1.9 mm long, hairy. *Pistillode* c. 1.7 by 0.7 mm. *Fruits* red, rarely cream suffused pink,  $\pm$  globular, deltoid in cross section. 10–13 by 10 mm, wall 1.4–2.1 mm thick, outside with scattered short hairs. *Seeds* broadly obovoid, 5–6 by 3 mm, sarcotesta rounded, covering up to 1/3 of the seed. — **Figs. 25g, 26h.**

**Distribution** — *Malesia*: Papua New Guinea (Morobe, Central and Milne Bay Prov.).

**Habitat & Ecology** — Understorey trees in rain forest, often along rivers, also in swamp at edge of lake; altitude 15–200 m. Once reported on limestone (*Brass* 21977). Fl. May; fr. Feb.–July.

**8. *Elattostachys tetraporandra*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 267; Bot. Jahrb. 56 (1920) 300; in Engl., Pflanzenz. 98 (1933) 1268; Rehder, J. Arnold Arbor. 14 (1933) 64. — Type: *Chalmers s.n.*, Papua New Guinea.

*Trees*, 5–30 m high, dbh 6–18 cm; bark rough or smooth, grey or brown, inner bark pale green or yellow; wood cream, hard. *Branches* shortly appressed-hairy to glabrous; flowering twigs 2–3(–4) mm in diam. *Leaves* 2–3(–4)-jugate; petiole 2–5.5 cm long; rachis 3–11 cm long, both flattened above, rounded below or almost terete, shortly appressed-hairy to glabrous; petiolules 2–6 mm long, glabrous. *Leaflets* elliptic to ovate, slightly asymmetric, 4.5–14 by 2–6.5 cm, index 1.5–3.1, (glossy) green above, usually duller and paler below, (thick) chartaceous, above and below glabrous, midrib below with few scattered hairs; base cuneate to rounded; apex obtuse to rounded, rarely retuse; margin entire; midrib (slightly) prominent above, nerves 9–14 per side, 5–15 mm apart, angle to midrib 45–70°, venation reticulate; domatia if present small, pocket-like. *Inflorescences* 2.5–9.5 cm long, in fruit 6–11.5 cm long; bracts and bracteoles ovate to deltoid, 0.6–1.4 by 0.7–1 mm, shortly appressed-hairy on both surfaces; pedicels 3.5–7.5 mm long. *Flower buds* subglobular, 1.6–1.9 by 1.6–1.9 mm. *Sepals* elliptic to ovate, 2.2–3.7 by 1.4–1.9 mm. *Petals* creamish, 1.7–2.7 by 1.7–2.1 mm, outside glabrous or with some hairs, margin ciliate, inside glabrous, claw 0.3–1.2 mm long, auricles woolly. *Disc* 0.7–1.2 mm high. Filaments of *stamens* 1.1–1.2 mm; anthers 2–2.2 mm, with some hairs; filaments of staminodes 3.4–3.5 mm long, anthers 2 mm long, with few hairs. *Style* 1.9–3.7 mm long; stigma 1–1.9 mm long. *Pistillode* c. 2.1 by 1 mm. *Fruits* pale green or cream when young, reddish when mature,  $\pm$  globular or obpyramidal, sharply

deltoid in cross section, keeled, 12–20 by 12–20 mm, wall 1.9–4 mm thick, outside glabrous to (thinly) shortly appressed-hairy (inside sometimes only thinly hairy). *Seeds* (narrowly) obovoid, 8–9 by 4–5 mm, sarcotesta rounded, covering 1/5–1/4 of the seed. — **Figs. 25h, 26i.**

**Distribution** — *Malesia*: Papua New Guinea (Central Prov.).

**Habitat & Ecology** — Coastal scrubs or bushes, open savannah grassland, edge of swamp; altitude 0–100 m. Fl. May–Oct.; fr. Jan.–Dec.

**Note** — *UPNG 846* has upper leaflets of at least 17 by 7.5 cm, although they are damaged.

**9. *Elattostachys verrucosa*** (Blume) Radlk., Sapind. Holl.-Ind. (1879) 12; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 601; Koord. & Valeton, Bijdr. Booms. Java 9 (1903) 212; Merr., Philipp. J. Sc., Bot. 3 (1908) 418; Backer, Schoolfl. Java (1911) 269; Radlk., Philipp. J. Sc., Bot. 8 (1913) 447; Koord. & Valeton, Atlas 1 (1913) f. 128; Hallier, Meded. Rijksherb. Leiden 22 (1914) 17; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 511; Backer & Bakh. f., Fl. Java 2 (1965) 140; Leenh., Blumea 17 (1969) 88; Schmutz, Fl. Manggarai 3 (1978) Sapind. 3. — *Cupania verrucosa* Blume, Rumphia 3 (1847) 161. — *Cupania mutabilis* Miq., Fl. Ind. Bat. 1, 2 (1859) 565, nom. illeg. — *Cupania mutabilis* Miq. var. *membranacea* Miq., Fl. Ind. Bat. 1, 2 (1859) 566, nom. illeg. — Lectotype (designated here): *Spanoghe s.n.* (L). Timor: paratype: *Blume s.n.* (L), Java. *Cupania distachya* Blume, Rumphia 3 (1847) 162. — *Cupania mutabilis* Miq. var. *coriacea* Miq., Fl. Ind. Bat. 1, 2 (1859) 566, nom. illeg. — Type: *Blume s.n.* (L), Java.

*Jagera glabra* Hassk., Hort. Bog. Descr. 1 (1858) 137. — Type: *Anonymous s.n.* (L).

*Melicocca javanica* Hassk., Hort. Bog. Descr. 1 (1858) 138; Leenh., Blumea 17 (1969) 88. — *Otophora javanica* (Hassk.) Miq., Fl. Ind. Bat. 1, 2 (1859) 511. — Type: not seen.

*Small trees or shrubs*, 4–22 m high, dbh 10–30 cm; bark smooth, brownish, 0.5–1 mm thick, living bark brownish, 3–10 mm thick; wood dirty white. *Branches* shortly appressed-hairy to short-tomentose, glabrescent; flowering twigs 1–3 mm in diam. *Leaves* 2–5-jugate; petiole 1.5–5.5 cm long, usually terete; rachis 1.5–12.5 cm long, flattened above, rounded below, both shortly appressed-hairy to short-tomentose, glabrescent; petiolules 2–7 mm long, shortly hairy to glabrous. *Leaflets* (narrowly) elliptic to ovate, slightly asymmetric, 4.5–19 by 1–5.5 cm, index 2.2–4.6(–8),





Fig. 27. *Elattostachys verrucosa* (Blume) Radlk. a. Habit; b. male flower; c. petal from inside; d. fruit; e. seed, dorsal (a–c: PNH 17438; d, e: Kostermans 19189).

chartaceous, above and below glabrous, midrib above exceptionally with few hairs, below glabrous to thinly pilose; base cuneate to rounded; apex

acute; margin entire or irregularly dentate; midrib slightly prominent above, nerves 8–20 per side, 3–17 mm apart, angle to midrib 40–70°, venation re-



ticulate-scalariform; domatia usually absent, if present very small pocket-like. *Inflorescences* 1.5–6.5 cm long, in fruit 3–10 cm long; bracts and bracteoles lanceolate to deltoid, 0.7–2 by 0.6–1.4 mm, shortly appressed-hairy on both surfaces; pedicels c. 1.9 mm long. *Flower* buds green or brown,  $\pm$  ovoid, flattened, c. 1.5 by 1.1 mm. *Sepals* pale green or pale pink, (broadly) elliptic, rarely lanceolate, 1–2.7 by 0.5–1.6 mm. *Petals* white, 0.6–2.1 by 0.7–1.9 mm, outside shortly appressed-hairy or glabrous, margin ciliate, inside glabrous, claw 0.2–1.2 mm long, auricles woolly or ciliate. *Disc* 0.5–1.1 mm high. Filaments of *stamens* pale pink, 1.2–3.8 mm long; anthers yellowish, 1.1–2 mm long, hairy. *Ovary* pale green; style 1.4–4 mm long; stigma 0.7–2 mm long. *Pistillode* 1.1–1.9 by 0.8–1.2 mm. *Fruits* green or red-brown to black outside, red-brown inside,  $\pm$  globular, rounded-deltoid in cross section, 10–20 by 9–18 mm, wall 1.2–2.4(–3.7) mm thick, outside glabrous. *Seeds* ellipsoid to obovoid, 4–11 by 4–8 mm, sarcotesta 2-lobed, covering up to (1/4–)1/2 of the seed. – **Fig. 27.**

**Distribution** – *Malesia*: Java, Philippines (Luzon, Mindoro, Palawan, Sulu), Celebes, Lesser Sunda Islands (Bali, Lombok, Sumbawa, Sumba, Flores, Wetar, Timor), Moluccas (Tanimbar Island).

**Habitat & Ecology** – Primary or secondary, semi-wet or dry forest. Reported on andesite, coral sand, limestone, tuff/breccia covered with loam and volcanic rock; altitude 0–1500 m. Fl. Mar.–Dec.; fr. Feb.–Dec.

**Notes** – 1. In this species the lower cotyledon only rarely tapers to a short point folded towards the rootlet.

2. *Verheyen 2015/17* and *Widjaja 1367* probably belong to this species, although they differ in their slightly larger fruits with thicker walls.

**10. *Elattostachys zippeliana*** (Blume) Radlk., Sapind. Holl.-Ind. (1879) 12; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 601; Bot. Jahrb. 56 (1920) 300; in Engl., Pflanzenr. 98 (1933) 1264; Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 76. — *Cupania zippeliana* Blume, Rumphia 3 (1847) 160; Miq., Fl. Ind. Bat. 1, 2 (1859) 565. — Type: *Zippel 217b* (L., ?P), New Guinea.

*Elattostachys duplicato-serrata* Radlk., Sapind. Holl.-Ind. (1879) 43; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9

(1879) 601; in Engl., Pflanzenr. 98 (1933) 1262. — Type: *De Vriese s.n.* (L), Celebes?

Small trees, 6–20 m high, dbh 15–25 cm; outer bark grey to brown or black, inner bark white to light brown; sapwood white or yellowish, heartwood brownish. *Branches* shortly appressed-hairy to short-tomentose, glabrescent; flowering twigs 1.5–3 mm in diam. *Leaves* (1–)2–4(–5)-jugate; petiole 1.5–9 cm long; rachis 2–14.5 cm long, both flattened above, rounded below or terete, shortly appressed-hairy to short-tomentose, glabrescent; petiolules 3–6 mm long, short-hairy to glabrous. *Leaflets* elliptic to (narrowly) ovate, slightly asymmetric, 2.5–17.5(–31) by 1–8 cm, index (1.5–)2–3.5, chartaceous, above glabrous, rarely midrib and nerves pilose, below glabrous to thinly pilose, midrib and nerves (thinly) pilose; base cuneate to rounded; apex acute, exceptionally acuminate; margin entire or irregularly dentate, occasionally double serrate; midrib slightly prominent above, nerves 8–19 per side, 4–17 mm apart, angle to midrib 45–65°, venation scalariform or reticulate-scalariform; domatia pocket-like to saccate, ciliate. *Inflorescences* 1–2.5 cm long, in fruit 2.5–11.5 cm long; bracts and bracteoles deltoid or triangular, 1–1.2 by 0.7–1.1 mm, short appressed hairy on both surfaces. *Sepals* about elliptic, 1.4–2.1 by 0.5–1 mm. *Petals* pale yellow tinged with pink, 1.2–1.7 by 0.6–1.2 mm, shortly appressed-hairy on both surfaces except apex, ciliate, claw 0.6–0.9 mm long, auricles ciliate. *Disc* 0.4–0.6 mm high, glabrous. Filaments of *stamens* 1.1–1.6 mm; anthers 0.4–0.6 mm, glabrous. *Style* c. 2.6 mm, stigma c. 1.2 mm. *Pistillode* c. 1.4 by 0.6 mm. *Fruits* green when young, later on pale yellow, orange red or red, brown or black when old, subglobular, rounded-deltoid in cross section, 13–25 by 11–20 mm, wall 1.4–3.4 mm thick, outside glabrous. *Seeds* ellipsoid to obovoid, 7–15 by 4–7 mm, sarcotesta shield-like, rounded, covering 1/5–1/3 of the seed. – **Fig. 26j–o.**

**Distribution** – *Malesia*: Borneo (S Kalimantan: Sampit region), Celebes, Moluccas, New Guinea (Irian Jaya).

**Habitat & Ecology** – Primary or secondary forest, often along rivers. (Rather) common, reported from clayey soils and, once, on limestone (*Meijer 10844*). Altitude 10–300 m. Fl. Mar.–Nov.; fr. Jan.–Nov.

**Uses** – Wood for house-building (Halmahera).

## EUPHORIANTHUS

(P.W. Leenhouts)

*Euphorianthus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 673; in Engl., Pflanzenr. 98 (1933) 1227–1229. — *Euphoriopsis* Radlk., Sapind. Holl.-Ind. (1879) 58, nom. illeg., non A. Massal., Sapind. Foss. Monogr. (1852) 12. — Type species: *Sapindus longifolius* Roxb. [= *Euphorianthus euneurus* (Miq.) Leenh.].

*Tree*, monoecious. *Indumentum* of solitary simple hairs only. *Leaves* paripinnate, 4–9-jugate; pseudostipules absent; neither petiole nor rachis winged. *Leaflets* opposite to alternate, glabrous or hairy, lower surface without red glands (papillose); base symmetrical to slightly oblique; entire; upper surface greenish to bluish grey when dry. *Inflorescences* axillary, terminal ones together pseudoterminal, thyrsoid. *Flowers* unisexual, regular. *Sepals* 5, free, equal, slightly imbricate, not petaloid, densely short-hairy on both sides. *Petals* 5, as long as to longer than the sepals, outside just above the base with a few hairs, inside with 2 recurved, woolly, crestless scales shorter than the petal. *Disc* uninterrupted, glabrous. *Stamens* (6) 7 or 8, much exserted; filaments hairy in the lower half; anthers glabrous. *Ovary* densely short-hairy, 3-locular, sessile; ovules 1 per locule; style apical, longer than the ovary, slightly hairy at the base; stigma grooved to slightly lobed. *Fruits* capsular, subglobular, not winged, loculicidal, smooth, densely short-hairy outside, pericarp thin-fleshy, c. 1 mm thick, incompletely 3-locular, the valves inside sericeous, septa nearly glabrous. *Seeds* obovoid, with a 2- (or 3-)lobed sarcotesta around the hilum. — **Fig. 28.**

Distribution — Monotypic; *E Malesia* from the Philippines to the New Hebrides.

Note — The present genus seems closest to *Diploglottis*; the main difference is in the seed which in the latter genus is lenticular and completely enveloped by an arillode.

*Euphorianthus euneurus* (Miq.) Leenh., Blumea 33 (1988) 198. — *Dysoxylum euneuron* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 22. — Type: *de Vriese & Teijsmann s.n.* (L. holo), Ceram.

*Sapindus longifolius* auct. non Vahl: Roxb., Hort. Bengal. (1814) 88; Fl. Ind. ed. 2, 2 (1832) 282. — *Euphoriopsis longifolia* Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 301, 302, nom. nud.] Sapind. Holl.-Ind. (1879) 19, 58, 98, nom. illeg. — *Euphorianthus longifolius* Radlk. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5 (1895) 348; in Engl., Pflanzenr. 98 (1933) 1228. — Type: *C. Smith in Herb. Roxb.* (n.v.).

*Euphorianthus obusatus* Radlk. [ex Koord., Minah. (1898) 406, nom. nud.] in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 3 (1907) 206; Philipp. J. Sc. 20 (1922) 660; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1229. — Lectotype (Leenhouts 1988): *Koorders 18839* (M), N Celebes. *Euphorianthus pallidus* Radlk., Bot. Jahrb. 56

(1920) 294; in Engl., Pflanzenr. 98 (1933) 1228. — Syntypes: *Ledermann 8129* (K), *10837* (M), *10837* (n.v.), New Guinea.

*Tree* up to 45 m high, dbh up to 45 cm. *Twigs* slightly (to strongly) grooved, 5–12 mm diam., densely fulvous (or ferruginous tomentellous), early to tardily glabrescent; bark dark purple brown, not lenticellate. *Leaves*: petiole sharply subterete, above with a narrow groove, 2–10 cm long, 2–5 mm broad; petiolules in lower leaflets terete and slender, up to 12 mm long, upwards becoming conical and shorter or absent, always above narrowly grooved. *Leaflets* ± elliptic, 6.5–25 by 2–8.5 cm, index 1.5–4.5, pergamentaceous (to papyraceous), above hairy on midrib (and nerves, beneath on the veins, or subglabrous); base acute to rounded, often slightly attenuate; apex retuse to tapering into a fairly long acute acumen, mostly mucronate; midrib above mostly sunken in a narrow groove, sometimes prominulous, beneath prominent; nerves more than 14 per side, 3–15 mm apart along the



Fig. 28. *Euphorianthus euneurus* (Miq.) Leenh. a. Habit; b. fruit (a: Rutten 2266; b: Teijsmann s.n.).

midrib, straight to usually slightly curved, at least the upper ones usually looped and joined towards the margin, prominulous (to slightly grooved) above, prominent below; intersecondary nerves hardly (to well-developed); veins and veinlets transversely reticulate (to laxly scalariform), above indistinct, beneath more prominent and often minute. *Inflorescences* up to c. 40 cm long with rather few divaricate to oblique-erect branches, hairy like the twigs. *Flowers* white, greenish white, or cream. *Sepals* ovate, 1.4–2.5 by 1–1.8 mm. *Petals* elliptic (to suborbicular or spatulate), 1.4–3 by 0.5–2 mm. *Stamens*: filaments 2–4 mm long; anthers 0.5–1 mm long. *Pistil*: ovary c. 1.5 mm high, style up to 4.5 mm long. *Fruits* (1–)1.5–2 cm diam., yellow,

not stipitate, apiculate. *Seeds* 10–16 by 7.5–11 mm. — **Fig. 28.**

Distribution — New Hebrides and *Malesia*: Lesser Sunda Islands (Alor), Philippines (Mindanao), Celebes, Moluccas (Halmahera, Sula Islands, Ceram), and New Guinea.

Habitat & Ecology — In primary and secondary forest, along the sea-shore and on slopes, from sea level up to 1100 m altitude. Fl. Sept.–June; fr. Jan., Aug., Nov.

Uses — The timber is used for house construction.

Note — Sometimes strongly resembling *Diploglottis australis* Radlk., for differences, see note 2 under that species.

## GANOPHYLLUM

(P.W. Leenhouts)

*Ganophyllum* Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 230; Radlk. in Engl., Pflanzenr. 98 (1933) 1423–1426. — Type species: *Ganophyllum falcatum* Blume.

Tall *trees*, possibly monoecious. *Indumentum*: only simple, solitary hairs on the inflorescence; glandular scales common on twigs, leaves, inflorescences, and the outside of the sepals; young parts sticky resinous. *Twigs* densely warty. *Leaves* paripinnate, 4–10-jugate; pseudostipules absent; neither petiole nor rachis winged. *Leaflets* alternate to rarely opposite, herbaceous to stiff-pergamentaceous; base slightly to strongly oblique; margin entire. *Inflorescences* axillary thyrses, flowers solitary or in small cymules on racemoid branches; bracts caducous. *Flowers* unisexual, actinomorphic. *Sepals* 4–6, nearly free to about halfway connate, valvate, all about equal, not petaloid, entire. *Petals* absent. *Disc* uninterrupted, 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 basally attached, laterally dehiscent. *Pistil* sessile, sparsely short-hairy; ovary 2- (or 3-)locular; 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, outside and inside glabrous, with 1 or 2 locules. *Seeds* 1 per locule, arillode absent. *Seedling* epigeal, leaves from the start paripinnate, first leaves with the petiole and rachis marginate. — **Fig. 29.**

Distribution — Two species, one in W and Central Africa, the other from the Andamans and Nicobars to NE Australia and the Solomon Islands, throughout *Malesia*.

Habitat — Canopy tree of evergreen and deciduous forest.

*Ganophyllum falcatum* Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 230; Oliver, Hooker's Icon. Pl. 14 (1880) 5, pl. 1308; Engl. in DC., Monogr. Phan. 4 (1883) 168, f. 45–50; Boerl. & Koord., Icon. Bogor. 1, 1 (1897) 57, pl. 17; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 231; Atlas 1 (1913) pl. 87; Merr., Sp. Blancoan. (1918) 210; Enum. Philipp. Flow. Pl. 2 (1923) 515; Lane-Poole, For. Res. Terr. Papua and New

Guinea (1925) 109; Radlk. in Engl., Pflanzenr. 98 (1933) 1424; F.S. Walker, For. Br. Solomon Is. (1948) 167; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 21, f. 1j, 10; Backer & Bakh. f., Fl. Java 2 (1965) 142; Whitmore, Guide For. B.S.I.P. (1966) 96; Foreman, Check List Bougainville (1971) 124, 125, fig.; Burger, Seedlings (1972) 322, f. 128; S.T. Reynolds, Austrobaileya 2 (1984) 32, f. 1h–j; in Fl. Aus-



tral. 25 (1985) 18. f. 3e, f, map 18; Yap in Tree Fl. Malaya 4 (1989) 440. — Type: *Anonymous s.n.* (L holo. sh. 902.35-69), New Guinea.

*Dictyonera integerrima* Radlk. [in Koord.-Schum., Syst. Verz. 2 (1914) 61, nom. nud.] in Fedde, Rep. 18 (1922) 343; in Engl., Pflanzenr. 98 (1933) 1223. — Type: *Koorders 10558* (BO holo), Sumatra.

*Tree* up to 42 m high, dbh up to 150 cm, with buttresses; bark dark to grey brown, peeling off

with papery flakes. *Twigs* terete. 4–9 mm thick. *Leaves* (4–)5–8(–10)-jugate; petiole 3.6–9 cm by 1.5–2.5 mm, subterete with an upwards widening groove above, grading into the rachis; petiolules 2–5 mm long, broadly hollowed above. *Leaflets* lowermost small, as little as 2.5 by 1 cm, relatively broad (sometimes less than twice as long as broad), ovate and strongly oblique, the upper ones up to 23 by 8 cm, relatively narrower (up to 3.5 times as long as broad), more elliptic, hardly oblique, but often  $\pm$  falcate; base with a broadly



Fig. 29. *Ganophyllum falcatum* Blume. a. Habit; b. fruit; c. seed; d. embryo (a: *Brass 2440*; b–d: *SAN 64306*).

rounded acroscopic and an often shorter narrowly acute basiscopic half in the more oblique leaflets to obtuse and nearly symmetrical in the less oblique leaflets; apex hardly to distinctly acuminate, the acumen short, broad, and rounded; midrib flat to slightly raised above, distinct below; nerves rather spaced, oblique-patent, mostly looped and joined (or free); intersecondary nerves many, distinct; reticulation rather lax, in thick leaflets indistinct above. *Inflorescences* up to 20 cm long, widely and especially the female ones sparsely branched; bracts and bracteoles broad-triangular scales; pedicels c. 2 mm long. *Sepals* 1.25–1.5 mm long, green, hairy inside. *Disc* orange, short-hairy. *Stamens*: filaments 3–4 mm long, white; anthers 0.75 mm long, yellow; staminodes in female flowers strongly reduced. *Pistil* c. 2.25 mm high, yellow-green; ovary ellipsoid, tapering into a columnar style; pistilode in male flowers well developed. *Fruits* ovoid, acute at apex, to subglobular, 10–20 by 7–10 mm, red; calyx persistent in fruit, reflexed. — **Fig. 29.**

**Distribution** — Andaman and Nicobar Islands to Australia (Western, the Northern Territory, and Queensland) and the Solomon Islands; in *Malesia*: Malaya (Johore), Sumatra, Java (mainly Central and East), Flores and Komodo, Borneo (Sabah), Philippines, Celebes, Moluccas, and New Guinea. Apparently now common only in New Guinea, but at the end of the last century still fairly common in at least eastern Java.

**Habitat & Ecology** — Primary and secondary rain forest, sometimes monsoon forest or savannah, along forest edges, on river banks, along the inner edge of the mangrove, on dry or temporarily flooded level land, on slopes, clay, sand, and stony soil over limestone; up to 700(–1200) m altitude. Fl. mainly Aug.–Nov.; fr. Nov.–Mar. The fruits are eaten by different kinds of birds (Japing & Oey Djoeng Sen, Tectona 29, 1936, 421, f. 29; Meijer Drees, Comm. Forest. Res. Inst. 33, 1951, 109).

**Uses** — Good timber wood; also used for matches and match boxes. Bark used in soap and as a fish poison. See: Boerl. & Koord., Teysmannia 7 (1896) 485; Japing & Oey Djoeng Sen, Tectona, 29 (1936) 421, f. 29; Quis., Philipp. J. Sc. 77 (1948) 161; Heyne, Nutt. Pl. Indon. ed. 3 (1950) 1001; W.H. Brown, Useful Pl. Philipp. 2 (1950) 361, f. 176.

**Uses** — For a description of the timber, see p. 427.

**Notes** — 1. There is somewhat more variation in New Guinea than in the rest of the area: the number of leaflets is variable but lower than to the West, the flowers are more often 4-merous whereas they are mostly 5-merous and not rarely 6-merous to the West, and the fruits are sometimes subglobular and then 2-loculed, each locule having one seed.

2. The African species, *G. giganteum* Hauman, differs slightly, but constantly, mainly in flowering characters: leaflets nearly sessile, sepals c. 2 mm long, always nearly free, disc glabrous, filament c. 5 mm long, fruits 2–2.2 by 1.5–2 cm, ovoid to ellipsoid with a thick (when dried 2–3 mm) fleshy mesocarp.

3. The present species strongly resembles *Koordersiodendron pinnatum* Merr. (*Anacardiaceae*); the latter mainly differing in the following characters: twigs smooth, leaf rachis neither grooved above nor narrowly triangular in cross section, axillary buds very conspicuous, leaflets always opposite, petiolules long and slender, no glandular scales, inflorescences densely hairy, fruits soft and accordingly flattened in the herbarium.

#### EXCLUDED

*Ganophyllum obliquum* Merr., Publ. Gov. Lab. Philipp. n. 27 (1905) 30. — *Boswellia obliqua* Blanco, Fl. Filip. ed. 2 (1845) 243 = *Dysoxylum* sp. (*Meliaceae*); see Merr., Sp. Blancoan. (1918) 210.

### GLENNIEA

(P.W. Leenhouts)

*Glenniea* Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 404; Radlk. in Engl., Pflanzenz. 98 (1932) 858; Leenh., Blumea 22 (1975) 411; Yap in Tree Fl. Malaya 4 (1989) 440. — Type species: *Sapindus unijugus* Thw. [= *Glenniea unijuga* (Thw.) Radlk.]. *Crossonephelis* Baill., Adansonia 11 (1874) 245; Radlk. in Engl., Pflanzenz. 98 (1932) 818; Leenh., Blumea 21 (1973) 91. — Type species: *Crossonephelis pervillei* Baill. [= *Glenniea pervillei* (Baill.) Leenh.] *Hedyachras* Radlk., Bot. Jahrb. 56 (1920) 258; in Engl., Pflanzenz. 98 (1932) 870. —

Type species: *Hedyachras philippinensis* Radlk. [= *Glenniea philippinensis* (Radlk.) Leenh.]

*Trees* (*Malesian* species), monoecious or dioecious. *Indumentum* mainly either of solitary hairs or small tufts only. *Leaves* spirally arranged or partly decussate, unifoliate or paripinnate, 1–6-jugate, *Malesian* species without pseudostipules, neither petiole nor rachis winged. *Leaflets* opposite to alternate, ovate to elliptic (*Malesian* species), beneath smooth, glabrous or variably hairy; base symmetrical or slightly oblique; margin in *Malesian* species (sub)entire; nerves looped and joined in the upper part only, veins and veinlets finely reticulate, prominulous at both sides. *Inflorescences* terminal and usually in the upper leaf-axils, thyrsoid or paniculate with few spreading branches. *Flowers* actinomorphic, unisexual, if monoecious male and female ones in the same inflorescence. *Sepals* 4 or 5, connate at base, valvate to narrowly imbricate in bud, spreading during and persistent and recoiled after anthesis, equal, deltoid, not petaloid, outside densely tomentose, inside in *Malesian* species variably tomentose. *Petals* in *Malesian* species absent. *Disc* for the greater part adnate to the base of the calyx, uninterrupted, broad and flat, more or less distinctly lobed, purplish black when dry, glabrous (or variably pubescent). *Stamens* 4–8 (*Malesian* species 6 or 7), equal, exserted, glabrous; filaments thread-like; anthers attached at the emarginate base, dehiscence lateral to introrse, *Malesian* species with broad connective; staminodes short. *Pistil* sessile, in *Malesian* species 2-locular; ovary in *Malesian* species tomentose; style apical, conical, with 2 stigmatic lobes or grooves; ovules 1 per cell; pistillode small, white woolly. *Fruit* svariable, indehiscent with a thick pericarp and membranous to thin-crustaceous endocarp, wings absent. *Seeds* with a thin-crustaceous testa, closely adhering to the endocarp, no arillode. — **Fig. 30.**

Distribution — 8 species, 3 of which in tropical Africa, 1 in Madagascar, 1 in Sri Lanka, and 3 in *Malesia*.

Habitat — The *Malesian* species are fairly tall trees of the lowland rain forest.

Note — The present genus clearly belongs to the general relationship of *Lepisanthes*. Its nearest allies seem to be the African genera *Placodiscus* Radlk. (mainly different by the sepals being connate higher up and by the pistil being constantly 3-merous) and *Chonopetalum* Radlk. (different by the presence of petals). The wide but scattered distribution of *Glenniea* is peculiar.

#### KEY TO THE SPECIES

- 1a. Fruit 6 cm long or more. Inflorescence densely hairy, densely set with many-flowered cymules . . . . . 2
- b. Fruit less than 2 cm long. Inflorescence sparsely hairy with scattered, few-flowered cymules to solitary flowers . . . . . **3. G. thorelii**
- 2a. Fruit faintly didymous or subglobular to ellipsoid, outside scurfy, pericarp dry, mealy when fresh, rather fibrous when dry. Leaves 2- or 3-jugate, often partly decussate. Bracts minute, inconspicuous . . . . . **1. G. penangensis**
- b. Fruit pear-shaped, smooth, pericarp fleshy. Leaves usually 4–6-jugate, always spirally arranged. Bracts 2–2.5 mm long, longer than the buds in the young inflorescence . . . . . **2. G. philippinensis**



**1. *Glennia penangensis*** (Ridley) Leenh., *Blumea* 22 (1975) 412. — *Tristira penangensis* Ridley, J. Str. Br. Roy. As. Soc. 82 (1920) 181; Fl. Malay Penins. 1 (1922) 496; 5 (1925) 302; Radlk. in Engl., Pflanzentr. 98 (1932) 870; (1934) 1497; Desch, Mal. For. Rec. 15 (1954) 535; Wyatt-Smith & Kochummen, Mal. For. Rec. 17, rev. ed. (1965) 360; Yap in Tree Fl. Malaya 4 (1989) 440. — *Crossonephelis penangensis* Leenh., *Blumea* 21 (1973) 98. — Type: *Curtis 1086* (SING holo), Malay Peninsula.

*Tree* up to 36 m high, dbh up to 70 cm; monoecious. Hairs mainly solitary. *Twigs* 3.5–6 mm in diam., at first canaliculate, later smooth or finely striate, dark purplish or reddish brown, fulvous-puberulous and with many minute light lenticels. *Leaves* mainly spirally arranged (to (sub)decussate), 2–4-jugate; petiole 4–14 cm long, usually strongly flattened above; petiolules 0.5–1(–2) cm long, usually with a broad flat groove above. *Leaflets* opposite (to alternate), 7–18 by 3–11 cm, index 1.5–2.5, stiff-chartaceous to subcoriaceous, (sub)glabrous; base often  $\pm$  oblique, (obtusely) rounded (to truncate), attenuate; apex emarginate to broadly and obtusely acuminate; midrib prominulous above, towards the base slightly sunken; nerves 1.5–2.5 cm apart, slightly curved, prominulous above, prominent beneath; intersecondary nerves hardly developed. *Inflorescences* thyrsoid, 15–20 cm long, fulvous-velutinous to tomentose; cymules crowded, glomerulous, sessile, several-flowered; pedicels 2–3 mm long; bracts and bracteoles triangular, up to 1 mm long. *Sepals* 4, valvate, c. 1.5 by 2 mm, inside subtomentose. *Disc* with a few scattered hairs. *Stamens* 6 or 7; filaments c. 3 mm long; anthers broad-ovate, c. 0.9 mm long, dehiscence latrorse. *Ovary* flattened ovoid, c. 2.5 mm high, tapering into the sturdy, c. 1.5 mm long style; stigma c. 0.75 mm long, grooved. *Infructescences* subtomentose, the axes and especially the pedicels much thickened, the latter c. 5 mm long. *Fruits* few, faintly didymous or (if only 1 seed developed) subglobular to ellipsoid, up to 9 by 7 cm, brown, scurfy, at first tufted-puberulous, finally glabrous, pericarp when dried 0.5–1 cm thick, hard, very fibrous (when fresh mealy and yellow), endocarp tough, glabrous inside, as far as could be ascertained. *Seeds* probably subglobular, 4–4.5 cm in diam., testa brown, smooth, glabrous. — **Fig. 30c.**

*Distribution* — *Malesia*: Malay Peninsula.

*Habitat & Ecology* — Lowland rain forest, up to 900 m altitude. Fl. Apr., Aug., Oct.; fr. Feb., June, July.

*Note* — Ridley described the ovary as being 3-angular and the number of stigmas as 3. This is

apparently a mistake: I found only 2-merous pistils, as in most other species of the genus.

**2. *Glennia philippinensis*** (Radlk.) Leenh., *Blumea* 22 (1975) 412. — *Hedyachras philippinensis* Radlk., Bot. Jahrb. 56 (1920) 258; in Engl., Pflanzentr. 98 (1932) 871; W.H. Brown, Useful Pl. Philipp. 2 (1950) 364, f. 177; Monsalud et al., Philipp. J. Sc. 95 (1969) 543. — *Crossonephelis philippinensis* Leenh., *Blumea* 21 (1973) 100. — Type: *FB (Villamil) 20635* (M holo; BM, K, L), Philippines.

*Sapindus* sp. Ceron, Cat. Pl. Herb. Manila (1892) 54, no. 2521.

*Tree* up to 18 m high, dbh up to 33 cm; monoecious. Hairs mainly solitary. *Twigs* c. 5 mm in diam., striate, dark purplish brown, fulvous-velutinous, gradually glabrescent, not conspicuously lenticellate. *Leaves* spirally arranged, (1)–4–6-jugate; petiole 3–9 cm long, in the basal part flat to grooved and with marginal ribs, higher up more or less flattened; petiolules 2–10 mm long, above with a broad and flat to narrow and deep groove. *Leaflets* opposite to alternate, 5–22 by 2.75–9 cm, index 1.75–3, stiff chartaceous, hairy on midrib (and nerves below to fully glabrous), hairy domatia in the nerve axils beneath; base  $\pm$  symmetrical, rounded in the lower, acute and attenuate in the upper leaflets; apex obtuse to broadly, and obtusely acuminate; midrib prominulous above; nerves 1–3.5 cm apart, slightly to distinctly curved, those in the upper half of the leaflets  $\pm$  distinctly looped and joined at some distance from the margin, prominulous above, more so beneath; intersecondary nerves  $\pm$  strongly developed. *Inflorescences* thyrsoid, up to c. 20–25 cm long, fulvous-velutinous; cymules crowded, sessile, glomerulous, several-flowered; pedicels 1.5–2 mm long; bracts and bracteoles lanceolate, 2–2.5 mm long. *Sepals* 4, valvate to narrowly imbricate, 2–3 by 1.5–2.5 mm, inside tomentose. *Disc* glabrous. *Stamens* 6 or 7; filaments c. 5 mm long; anthers broad-ellipsoid, c. 1 mm long, dehiscence introrse. *Ovary* orbiculate; style very short; stigma grooved. *Infructescences* unknown. *Fruits* pear-shaped, 6–7 by 4.5–6 cm when dried, yellow when fresh, glabrous, pericarp thick, fleshy, endocarp tough. *Seeds* subovoid, 3–3.5 by 1.75–2.25 cm, testa brown, smooth, glabrous.

*Distribution* — SE Thailand, Vietnam, and *Malesia*: Borneo (Sabah); Philippines (Luzon, Mt Maquilung; Panay; Dinagat I.).

*Habitat & Ecology* — In thickets and forests along streams at low altitudes. Fl. June, Oct.; fr. May–Dec.

*Uses* — The fruits are edible (Madulid, Nat. Mus. Papers 2, 1, 1991, 56).





Fig. 30. *Glenniea* Hook. f. Habit and fruits. — *G. thorelii* (Pierre) Leenh. a. Habit; b. fruit. — *G. penangensis* (Ridley) Leenh. c. Fruit (a: Lambach 1336; b: Boschproefstation T. 973; c: KEP/FRI 11320).

3. *Glennia thorelii* (Pierre) Leenh., *Blumea* 22 (1975) 412. — *Cnemidiscus thorelii* Pierre, Fl. Coch. (1894) t. 320a, text; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1016; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 976. — *Xerospermum thorelii* Pierre, Fl. Coch. (1894) t. 320a, nom. illeg. — *Crossonephelis thorelii* Leenh., *Blumea* 21 (1973) 101. — Type: *Pierre 4089* (P holo), S Vietnam.

*Lepisanthes palawauica* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1604; Merr., Enum. Philip. Flow. Pl. 2 (1923) 500; Radlk. in Engl., *Pflanzenr.* 98 (1932) 741; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 512. — *Alectryon* sp. Leenh., *Blumea* 17 (1969) 88. — *Crossonephelis palawauicus* Leenh., *Blumea* 21 (1973) 97. — Type: *Elmer 13046* (M holo; A, BO, E, FI, L, NY), Philippines.

*Tree* up to 30 m high, dbh up to 50 cm, buttressed; probably dioecious. Hairs mainly in small stellate tufts. *Twigs* 2–4 mm in diam., canaliculate, dark purple-brown, sparsely fulvous short sericeous, early glabrescent, with many small white lenticels. *Leaves* spirally arranged to (sub)decussate, 1-foliolate or 1- or 2-jugate; petiole 2.5–10 cm long, 3-angular to terete; petiolules 0.3–1.5 cm long, above with a shallow broad groove. *Leaflets* (sub)opposite, 6–26 by 3–13.5 cm, index 1.5–3, chartaceous, glabrous except for occasional hair tufts in some of the nerve axils beneath; base symmetrical to slightly oblique, cuneate to rounded, attenuate; apex (obtusely or) gradually to abruptly, broadly, and obtusely acuminate; midrib above prominulous, towards the base sometimes sunken; nerves 1.25–6 cm apart, usually strongly curved, about equally prominulous at both sides; intersecondary nerves faintly to sometimes strongly developed. *Inflorescences* thyrsoid to paniculate, up to 25 cm long, puberulous to tomentellous; cymules sometimes scattered, either few-flowered or flow-

ers solitary; pedicels up to 5 mm long; bracts and bracteoles 3-angular, up to 1 mm long. *Sepals* 4 or 5, valvate, 2–2.5 by 1.5–2.5 mm, inside tomentose with glabrous longitudinal strips. *Disc* glabrous to velutinous. *Stamens* 6 or 7; filaments c. 5 mm long; anthers ovate, c. 1 mm long, dehiscence latero-introrse. *Ovary* slightly 2-lobed; style short; stigma 2-lobed with short, thick lobes curved outwards, to knobby. *Inflorescences* hardly different from the inflorescences. *Fruits* few, 2-lobed, c. 1.25 by 2 by 1 cm, often 1 lobe suppressed, then transversely ovoid and c. 1.25 by 1.5 by 1.25 cm, smooth and glabrous, pericarp thin, fleshy. *Seeds*: testa closely adnate to the endocarp, hardly separable, thin-coriaceous. — **Fig. 30a, b.**

*Distribution* — S Vietnam and *Malesia*: Sumatra (Indragiri, Palembang), Borneo, Philippines (Palawan, Mindoro), and New Guinea (Vogelkop, Lower Fly R.).

*Habitat & Ecology* — Primary forest on alluvial plains, slopes, or ridges, also on river banks, at up to 200 m altitude. Fl. Apr., Oct., Dec.; fr. Mar., Sept.

*Uses* — Timber (Desch, Mal. For. Rec. 15, 1954, 529). The bark is easily inflammable and is used for kindling fires.

*Notes* — 1. There is some difference between the material from Sumatra and Borneo and that of the Philippines and New Guinea. The former has smaller leaves and flowers, often (especially Sumatra) hair tufts on the leaflets beneath, usually thyrsoid inflorescences, a (sub)glabrous disc, always 6 stamens, and the stigma distinctly lobed; the latter is more coarse, lacks hair tufts on the leaflets, has less branched inflorescences with fewer and nearly always solitary flowers, the disc is always densely hairy, and the number of stamens is often 7.

2. The name *Xerospermum thorelii* Pierre was illegitimate as it was mentioned under the plate only, whereas in the accompanying text *Cnemidiscus thorelii* was used (ICBN 1972, art. 34).

## GLOEOCARPUS

(P.C. van Welzen)

*Gloeocarpus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 464; in Engl., *Pflanzenr.* 98 (1933) 1208; Welzen, *Blumea* 35 (1991) 389–392, f. 1. — Type species: *Gloeocarpus crenatus* Radlk. [= *Gloeocarpus patentivalvis* (Radlk.) Radlk.].

*Tree*. *Indumentum* of simple hairs only. *Branchlets* terete, sinuous in appearance because of phyllotaxis, smooth, sericeous when young. *Leaves* paripinnate, without pseudostipules; petiole somewhat pulvinate; rachis not winged; petiolules represented by pul-



Fig. 31. *Gloeocarpus patentivalvis* (Radlk.) Radlk. a. Habit; b. inflorescence; c. infructescence; d. petal (a: Elmer 15058; b, d: PNH 37058; c: BS 41558).



vinus only. *Leaflets* coriaceous, asymmetrical, punctate; base attenuate; margin mainly crenate; on the lower surface a few glandular hairs consisting of a few stalk cells and a large apical cell occasionally present, domatia many, pockets; venation above usually flat, below raised; nerves apically marginally looped; veins densely reticulate, indistinct. *Inflorescences* ramiflorous, branching in axil, occasionally along rachis; cymules cincinnate to mainly dichasial. *Bracts* and *bracteoles* triangular, sericeous. *Pedicels* completely sericeous. *Flowers* apparently bisexual but presumably functionally male or female, zygomorphic. *Sepals* 5, imbricate, free, 2 outer ones smaller than 3 inner ones, inside and outside mainly basally sericeous, punctate. *Petals* 5, hardly clawed, pilose, punctate, (lower part of margins folded inwards); free scales absent. *Disc* uninterrupted, flat, broad, glabrous. *Stamens* 7 (or 8?); filaments pilose in lower half; anthers basifixed in cleft, dehiscence latrorse, papillate, pilose, glabrescent. *Pistil*: ovary 3-locular, smooth, especially apically hirsute; ovule 1 per locule; stigma almost sessile, pyramidal, longitudinally grooved, elongating in fruit together with style. *Fruit* an obovoid capsule, loculicidal, subcircular in transverse section, hardly stipitate, without wings, rough, not warty, outside and inside glabrous, black when dry, rather woody. *Arillode* completely covering the seed, no basal appendage, apically open. *Seeds* subbasally attached on a funicle-like structure, obovoid, triangular in transverse section; hilum more or less circular. — **Fig. 31.**

Distribution — *Malesia*: Philippines, endemic.

***Gloeocarpus patentivalvis*** (Radlk.) Radlk., Bot. Jahrb. 56 (1920) 253; in Engl., Pflanzenr. 98 (1933) 1208; Welzen, Blumea 35 (1991) 390. — *Cupaniopsis patentivalvis* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1612. — Type: *Elmer 9319* (PNH† holo; A, BM, FI, L, M, P), Philippines.

*Gloeocarpus crenatus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 464. — Type: *FB (Curran) 17647* (PNH† holo; K, M, NY, P, US), Philippines.

[*Gloeocarpus philippinensis* Elmer, Leafl. Philipp. Bot. 10 (1939) 3808, nom. inval. — Based on *Elmer 15058, 15176.*]

*Tree*, 8–15 m high, dbh 4–10 cm. *Indumentum* brown. Flowering *branchlets* 4–21 mm thick. *Leaves* 5–14-jugate; petiole 2.6–8.7 cm long; rachis 10.2–44 cm long; petiolule 2–4 mm long; rachis flattened above (with raised central part). *Leaflets* (elliptic to) obovate, 3.7–14.2 by 1.4–3.9 cm; margin (entire to) crenate (to serrate), (flat to) somewhat recurved; apex (obtuse to) acute to acuminate, very apex rounded; both surfaces smooth, slightly sericeous above, somewhat sericeous below, especially near pockets; venation usually flat above, raised below; nerves apically looped and joined near the margin, veins densely reticulate,

indistinct. *Inflorescences*: rachis up to 22.7 cm long, occasional branches up to 2.7 cm long; cymules (2–)3–4-flowered; flowers c. 5 mm in diam.; bracts 0.6–0.7 mm long; bracteoles 0.3–0.4 mm long; pedicels 3–8.5 mm long. *Sepals*: 2 outer ones 1.8–2.3 by 2–2.2 mm; 3 inner ones 2.3–3.5 by 2.5–3.7 mm, margin membranous. *Petals* rhombic, 0.5–0.8 by 0.3–0.7 mm. *Stamens*: filaments in male flower 3.8–5 mm long; anthers c. 0.8 by 0.4 mm. *Pistil*: ovary in male flower c. 0.4 mm high; style and stigma c. 0.2 mm high. *Fruits* with (1–)3 developed seeds, 1.3–1.5 cm high by 1–1.3 cm broad, stipe 2–3 mm high, yellowish brown, with sticky sap. *Seeds* 7–8.8 by 4.5–6.5 mm; hilum 0.8–1.8 mm in diam. — **Fig. 31.**

Distribution — *Malesia*: Philippines (Mindanao, Samar, Leyte, Luzon).

Habitat & Ecology — Found in primary dipterocarp forest, along ridges, along banks; 60–400 m altitude. Fl. July. Fr. Feb.–Mar., May, Dec.

Note — This species shows a clinal variation in the crenation and more or less in the size of the leaflets. In Mindanao, crenation is almost absent and the leaflets are large, on Samar the apex is crenate, and on Luzon the leaflets are completely crenate and they are usually smaller than those of Mindanao.



Fig. 32. *Gongrospermum philippinense* Radlk. a. Habit; b. fruit; c. seed, transverse section (a: BS 12358; b, c: BS 28236).

## GONGROSPERMUM

(P.C. van Welzen)

*GongrospERMUM* Radlk., Philipp. J. Sc., Bot. 8 (1914) 469; in Engl., Pflanzenr. 98 (1933) 1255; Welzen, Rheedia 1 (1991) 60. — Type species: *GongrospERMUM philippinense* Radlk.

*Trees?* *Indumentum* rusty-brown sericeous to tomentose, hairs simple. *Leaves* paripinnate, pseudostipules absent; petiole and petiolules pulvinate. *Leaflets* (sub)opposite, not punctate; lower surface papillate, domatia absent. *Inflorescences* axillary, thyrses, branching along rachis, the latter pilose when young; cymules aggregated, basally dichasial, apically cincinnate. Bracts and bracteoles triangular, completely tomentose. *Flowers* apparently bisexual, but male and female flowers discernible. *Sepals* 5, equal, basally connate, cupule-like, completely tomentose. *Petals* absent. *Disc* subcupular, flat, uninterrupted, 5-lobed, tomentose. *Stamens* 8; filaments tomentose, especially in lower half; anthers basifixed in cleft, glabrous, dehiscence latrorse in male flowers. *Pistil*: ovary pyramidal, tomentose, 3-locular, smooth, not lobed, sessile; ovule one per locule; style pyramidal, apically slightly opening and recurving, stigmas inside. *Fruit* scapsular, dehiscent, not lobed, stipitate, or winged, smooth, densely shortly pilose outside, margins obtuse; mesocarp corky, basally somewhat thicker; inside glabrous. *Seeds* without arillode; endotesta thick, ruminant. — **Fig. 32.**

Distribution — *Malesia*: Philippines (endemic on Luzon).

***GongrospERMUM philippinense*** Radlk., Philipp. J. Sc., Bot. 8 (1914) 471; in Engl., Pflanzenr. 98 (1933) 1256; Welzen, Rheedia 1 (1991) 60. — Type: *BS (McGregor) 12358* (M holotype: US), Philippines.

*Tree?* *Branches* grooved, smooth, flowering ones 4–7 mm thick. *Leaves* 2- or 3-jugate; rachis 10–17 cm long; petiole 7.5–8.5 cm long; petiolules up to 9 mm long. *Leaflets* ovate, 9–20 by 5–9 cm, ± asymmetric except for the base; the latter attenuate, asymmetric; margin entire, flat; apex acuminate, very apex emarginate to rounded; upper and lower surface smooth, (sub)glabrous; nerves 8–12 per side, marginally indistinctly looped. *Inflorescences*: rachis 12.5–30 cm long, branches up to 15 cm long; cymules up to 5-flowered. *Bracts* c. 0.7 by 0.7 mm; bracteoles 0.2–0.3 by 0.2–0.3 mm.

*Flowers* 2–3 mm in diam.; pedicel 1–1.8 mm long. *Calyx*: lobes triangular, 0.8–1.2 by 0.6–1.2 mm. *Stamens*: filaments in male flowers up to 1.5 mm long, in female flowers up to 1 mm long; anthers in male flowers c. 0.7 by 0.5 mm, in female flowers c. 0.5 by 0.5 mm. *Pistil*: ovary up to 0.8 mm long in male flowers, up to 2.2 mm in female flowers; style indistinct in male flowers, up to 0.8 mm long in female flowers. *Fruits* obovoid, rounded in cross section, c. 1.4 by 1.2 cm wide, brown, outside and inside smooth. *Seeds* obovoid, sharply triangular in cross section, c. 8 by 5 mm; hilum round, c. 2 mm in diam. — **Fig. 32.**

Distribution — *Malesia*: Philippines (endemic on Luzon).

Habitat & Ecology — Found in forests. Fl. at least in May and Nov.–Dec; fr. at least in Nov.–Dec.

## GUIOA

(P.C. van Welzen)

*Guioa* Cav., Icon. 4 (1798) 49, t. 373; Radlk. in Engl., Pflanzenr. 98 (1933) 1157. — *Cupania* sect. *Guioa* G. Don, Gen. Hist. 1 (1831) 668. — *Guioa* sect. *Euguioa* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 274, nom. illeg.; in Engl., Pflanzenr. 98 (1933) 1158; S.T. Reynolds in Fl. Austral. 25 (1985) 47;



- Yap in Tree Fl. Malaya 4 (1989) 441; Welzen, Leiden Bot. Series 12 (1989) 146. — Type species: *Guioa lentiscifolia* Cav.
- Dimereza* Labill., Sert. Austral. Caled. (1825) 51, t. 51. — *Diplopetalon* Spreng., Syst. Veg. 4, 2 (1827) 146, nom. illeg. — *Cupania* sect. *Dimereza* G. Don, Gen. Hist. 1 (1831) 668. — Type species: *Dimereza glauca* Labill. [= *Guioa glauca* (Labill.) Radlk.].
- Hemigyrosa* Blume, Rumphia 3 (1847) 165. — *Guioa* sect. *Hemigyrosa* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 274; in Engl., Pflanzenr. 98 (1933) 1164. — Type species: *Hemigyrosa perrottetii* Blume [= *Guioa koelreuteria* (Blanco) Merr.].

*Shrub to tree. Branchlets* usually sericeous to hirsute. *Indumentum* consisting of simple solitary hairs and indistinct glandular hairs. *Leaves* paripinnate, 1–9-jugate, without pseudostipules; petiole pulvinate; rachis terete to distinctly winged; petiolules pulvinate. *Leaflets* usually sessile, opposite (to alternate), often punctate; glandular hairs usually few near midrib, indistinct, white (*Guioa hirsuta*: distinct, red); upper surface usually darker than lower; lower surface smooth to whitish papillate, domatia usually present as sacs or pockets. *Inflorescence* a thyrse, (ramiflorous to) axillary (to pseudoterminal), usually few-flowered; cymules cincinnate (to dichasial). *Pedicels* articulate. *Flowers* zygomorphic, seemingly bisexual, but presumably actually unisexual. *Sepals* 5 (or 6), margin usually with glands; inner 3 sepals with a petaloid margin. *Petals* (4 or) 5 (or 6), usually distinctly clawed; (auricles and) scales usually present and then usually crested; petal between two adjacent large sepals usually with reduced blade and scales. *Disc* interrupted or uninterrupted, lobed, smooth, glabrous. *Stamens* 8 (or 7); anthers basifixed in cleft, dehiscence latrorse. *Pistil*: ovary 3-lobed, 3-locular, smooth, often on short gynophore; ovules 1 per locule; stigma sessile, pyramidal, longitudinally grooved; style elongating in fruit. *Fruit* an obcordate loculicidal capsule with 3 lobes, of which one to all develop; stipe narrow and high to broadly obconical and indistinguishable; lobes laterally flattened, obtuse (to sharp); exotesta coriaceous, thin; endotesta with pocket for radicle. *Seeds* orbicular to obovoid, black; arillode completely enveloping seed, apically open and lobed, basally with a rim from which usually a long folded pseudo-funicle joins the basal corner of the fruit, seed dangling on the pseudo-funicle in open fruit; hilum oval. — **Figs. 33–44.**

**Distribution** — 65 species in SE Asia (Thailand to S Vietnam as northern limit) throughout *Malesia* (43 species) to E Australia and into the Pacific up to Samoa and New Caledonia.

**Habitat & Ecology** — Often common. Usually in secondary forest, but also in the lower and middle storey of primary forest, along road- or riversides, margins of forest, beaches, plantation edges. Soil: rather indifferent, several species are (partly) found on ultrabasic (serpentine). Altitude sea level up to midmontane forest.

**Notes** — 1. An infrageneric classification can be found in Van Welzen (1989: 131–136).

2. A monographic study including a phylogenetic analysis (chapter 11) and historical biogeographical patterns of *Guioa* species mainly in relation to cicada genera (chapter 12) can also be found in Van Welzen (1989).



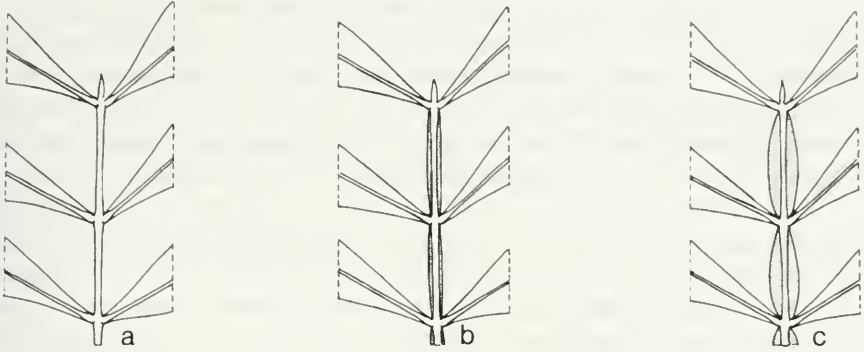


Fig. 33. *Guioa* Cav. a. Rachis not winged; b. ibid. slightly winged; c. ibid. broadly winged.

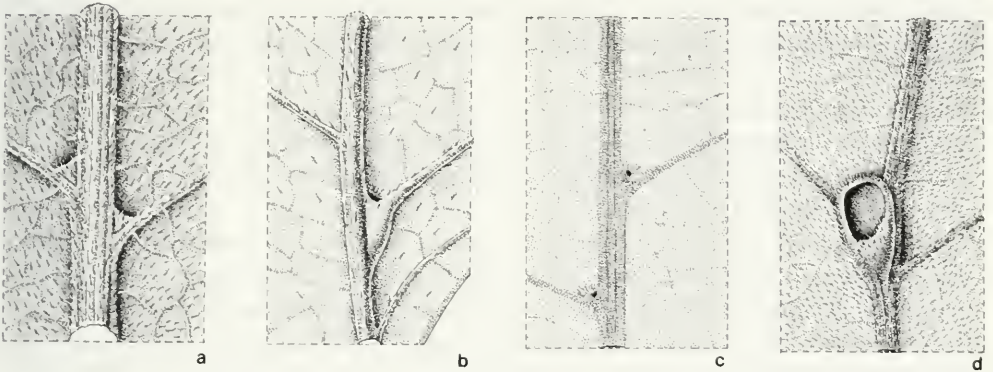


Fig. 34. *Guioa* Cav. Domatia types. a. Pockets; b. sac with opening in front; c. sunken sac, observe the flat midrib; d. large sac with opening on top.

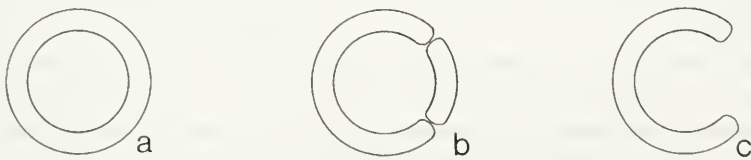


Fig. 35. *Guioa* Cav. Disc. a. Complete; b. with two small slits; c. interrupted by a large gap.

- 13a. Leaflets papillate below ..... 14
- b. Leaflets smooth below ..... 16
- 14a. Leaflets ± symmetrical to asymmetrical; (sub)sericeous below, domatia absent to many. Petals 1.4–1.7 by 0.3–1 mm; scales folded parts of margin (auricles; Fig. 36d); crest absent (Fig. 36h). Disc uninterrupted (Fig. 35a) ..... 15
- b. Leaflets asymmetrical, especially basally and apically; (sub)sericeous to usually hirsute below, domatia many. Petals 1.3–3.5 by 0.7–2.2 mm; scales free (Fig. 36a–c); crest usually present (Fig. 36k). Disc usually interrupted (Fig. 35c)

**30. *G. pleuropteris***



- 15a. Leaves 2–4-jugate. Leaflets  $\pm$  symmetrical; domatia 1 to many pocket-like sacs. Scales of petals infolded margins (Fig. 36d) . . . . . **16. *G. malukuensis***
- b. Leaves (3–)5–7-jugate. Leaflets asymmetrical; domatia absent or a single small sac. Scales of petals folded outwards . . . . . **21. *G. multijuga***
- 16a. Blade of petal (elliptic to) obovate, gradually decurrent into the claw (Fig. 36e) 17
- b. Blade of petal orbicular, sharp transition between blade and claw (Fig. 36f)  
**40. *G. truncata***
- 17a. Leaflets elliptic; apex abruptly (acuminate to) cuspidate; very apex obtuse (to acute)  
**7. *G. bijuga***
- b. Leaflets ovate (to elliptic); apex (obtuse to) usually gradually acuminate to caudate; very apex acute to usually mucronulate . . . . . **15. *G. koelreuteria***
- 18a. Leaflets below hirsute, sericeous or glabrous . . . . . 19
- b. Leaflets below puberulous on the veins . . . . . **14. *G. hospita***
- 19a. Leaflets below glabrous, sericeous or hirsute, without small red glandular hairs 20
- b. Leaflets below hirsute with small red glandular hairs besides simple hairs  
**13. *G. hirsuta***
- 20a. Leaflets below papillate . . . . . 21
- b. Leaflets below smooth . . . . . 41
- 21a. Disc uninterrupted (if in fruit check basal ring around several fruits; Fig. 35d) 22
- b. Disc interrupted (Fig. 35c) . . . . . 27
- 22a. Leaflets below glabrous to sericeous to hirsute, domatia absent to many; margin entire. Petal with folded auricles or scales (Fig. 36a–d); crest absent to present (Fig. 36h–k). Fruit 0.7–1.6 cm high, stipe slender to broadly obconical (Fig. 37) . . . 23
- b. Leaflets below hirsute, domatia many; margin usually with a few subapical teeth. Petal with scales (Fig. 36a–c); crest absent (Fig. 36h). Fruit 0.6–0.8 cm high, stipe slender (Fig. 37a) . . . . . **25. *G. oligotricha***
- 23a. Petals with scales (Fig. 36a–c). Stipe of fruit (unknown in *G. multijuga*) slender to broadly obconical (Fig. 37). Cotyledons (unknown in *G. multijuga*) subcollateral (Fig. 38b) . . . . . 24
- b. Petals with folded auricles (Fig. 36d). Stipe of fruit broadly obconical (Fig. 37c). Cotyledons superposed (Fig. 38a) . . . . . **39. *G. subsericea***
- 24a. Branchlets (not leaves or inflorescences) glabrous to sericeous. Leaflets symmetrical to basally asymmetrical, domatia absent to many, if many then apex of petal scales (very) much broadened (Fig. 36a) . . . . . 25
- b. Branchlets hirsute (to sericeous). Leaflets asymmetrical, especially base and apex, domatia many. Apex of petals scales not to hardly broadened (Fig. 36b)  
**30. *G. pleuropteris***
- 25a. Leaflets 2.3–24.3 cm long, lower surface glabrous (to slightly sericeous), domatia absent to many; very apex mucronulate or not. Petals 0.5–4 mm high and scales with a very broadened apex (Fig. 36a) or petals 0.3–1.8 mm high and apex of scales not broadened (Fig. 36b) . . . . . 26
- b. Leaflets 3.8–6.3 cm long, lower surface very sparsely subsericeous, at least a few leaflets with a single domatium, very apex mucronulate. Petals 1.5–1.7 mm long, apex of scales not broadened (Fig. 36b) . . . . . **21. *G. multijuga***

- 26a. Leaflets usually not mucronulate; domatia (absent to) many. Petals 0.5–4 mm long; apex of scale very broadened (Fig. 36a); crest seldom present, then part of pilose bifid scale apex (Fig. 36i, j). Fruit with a 2–5 mm high stipe . . . . . **10. *G. diplopetala***
- b. Leaflets usually mucronulate; domatia in at least some leaflets 1 (or 2). Petals 0.3–1.8 mm long; apex of scales not broadened (Fig. 36b); crest seldom present, then clavate, glabrous (Fig. 36k). Fruit stipe 0–3 mm long . . . . . **2. *G. acutifolia***
- 27a. Leaflets without domatia or with small pockets or sacs (Fig. 34a, b) . . . . . 28
- b. Leaflets with one highly domed sac (Fig. 34d) . . . . . **24. *G. novobritannica***
- 28a. Leaflets symmetrical to asymmetrical/falcate, venation usually raised only on lower surface, concolorous with lamina above, laxly to densely reticulate . . . . . 29
- b. Leaflets falcate, venation conspicuously raised on both sides, discolorous with lamina above, densely reticulate . . . . . **36. *G. reticulata***
- 29a. Leaflets ovate to elliptic to obovate, if obovate: branchlets at most sericeous, domatia absent to many. Petal blade obovate to circular, gradually or sharply decurrent into claw (Fig. 36e, f); crest absent to present, pilose part of bifid scale apex, or glabrous and clavate (Fig. 36h–k) . . . . . 30
- b. Lower leaflets often ovate, upper ones (elliptic to) obovate, domatia many. Branchlets hirsute (to sericeous). Petal blade obovate, gradually decurrent into claw (Fig. 36e); crest usually present, pilose part of bifid scale apex (Fig. 36i, j)
- 30. *G. pleuropteris***
- 30a. Leaflets not punctate . . . . . 31
- b. Leaflets punctate . . . . . 35
- 31a. Leaflets ovate (to elliptic), usually falcate, coriaceous to very coriaceous, margin flat (to revolute), apex (obtuse to) acuminate to caudate, usually mucronulate; domatia absent to many . . . . . 32
- b. Leaflets elliptic (to obovate), not falcate, very coriaceous, margin revolute, apex rounded to acuminate, not mucronulate; domatia absent or a single sac
- 26. *G. palawanica***
- 32a. Ovary subhirsute. Fruits glabrous . . . . . 33
- b. Ovary densely hirsute. Fruits sericeous, glabrescent . . . . . **35. *G. pubescens***
- 33a. Claw of petal 0.4–1.3 mm long; crest (absent to) pilose part of bifid scale apex, or subglabrous and clavate (Fig. 36i–k). Fruit with 2–5.5 mm long, slender stipe (Fig. 37a; unknown of *G. discolor*: leaflets strongly bicoloured) . . . . . 34
- b. Claw of petal c. 0.5 mm long; crest glabrous, clavate (Fig. 36k). Fruit with a c. 2 mm long, broadly obconical stipe (Fig. 37c). Leaflets bicoloured
- 31. *G. plurinervis***
- 34a. Lower surface of leaflets somewhat differently coloured from upper surface, glabrous to subsericeous (to hirsute), domatia absent to many . . . . . **15. *G. koelreuteria***
- b. Lower surface of leaflets very differently coloured from upper surface, sericeous, domatia absent or single . . . . . **11. *G. discolor***
- 35a. Leaflets ovate to obovate. Inflorescence subglabrous to usually shortly sericeous (to hirsute), hairs brown. Blade of petals elliptic to obovate, gradually decurrent into claw (Fig. 36e); those of *G. parvifoliola* unknown, this species with a subsericeous inflorescence) . . . . . 36

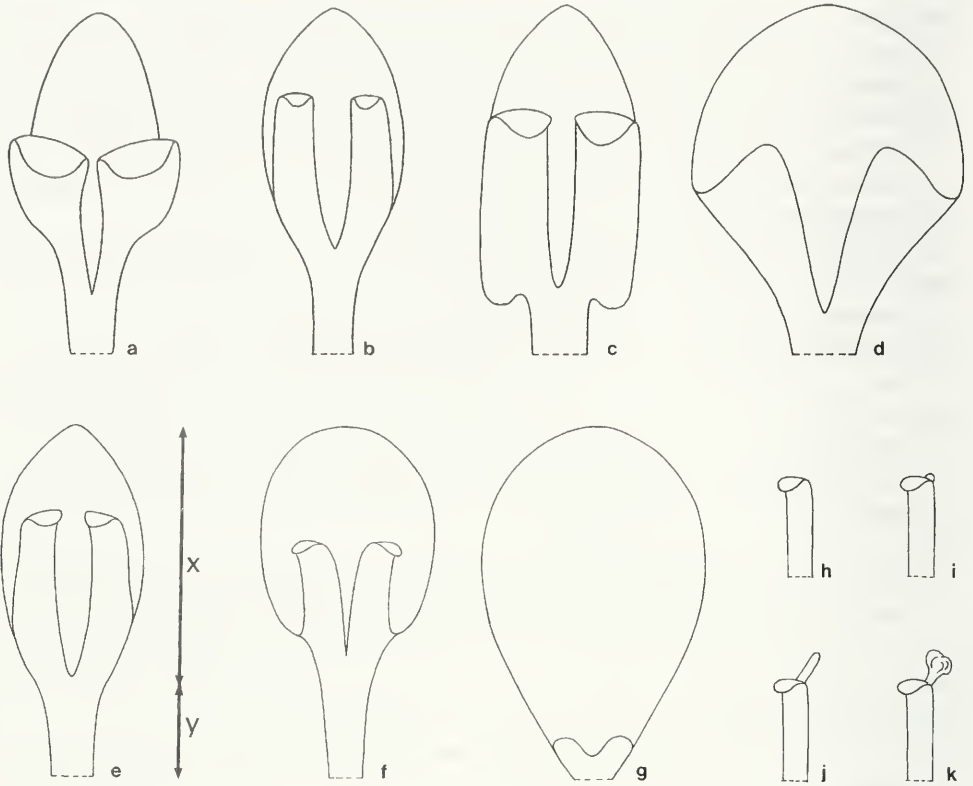


Fig. 36. *Guioa* Cav. Petals and petal scales, crests on petal scales. — a. Scale free, apex very broad; b. scale free, without auricles, apex narrow; c. scale free, with auricles, apex narrow; d. scales as folded margins of petals; e. transition between claw (y) and blade (x) gradual; f. transition between the claw and the blade abrupt; g. claw almost absent, auricles very small; h. scale without crest; i. crest very small; j. crest linear; k. crest clavate.

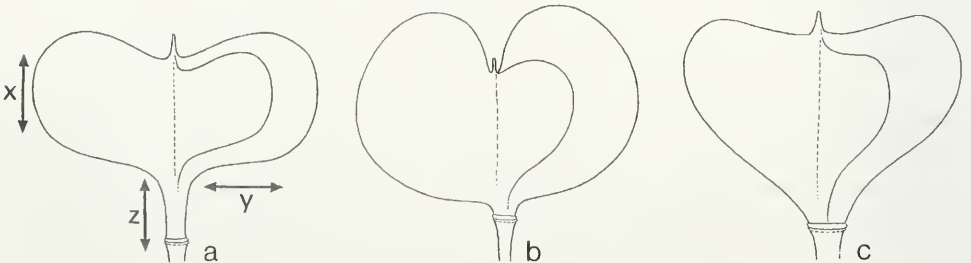


Fig. 37. *Guioa* Cav. Fruit shape (x: width of lobes; y: length of lobes; z: height of stipe). — a. Stipe high and slender, upper and lower margin of lobes parallel, straight; b. stipe almost absent, broad, lower and especially upper margin of lobes highly convex; c. stipe short, broadly cuneate, margin of lobes not parallel, straight.



- b. Leaflets ovate (to elliptic). Inflorescence densely long (sericeous to) hirsute, hairs golden. Blade of petals orbicular, sharp transition with claw (Fig. 36f)
- 22. *G. myriadenia***
- 36a. Domatia absent to 1 (to many); if many: crest on petal scales absent or pilose when present, cotyledons subcollateral (Fig. 38b) . . . . . 37
- b. Domatia 2 to many. Crest on petal scales glabrous. Cotyledons (obliquely) superposed (Fig. 38a) . . . . . **8. *G. comesperma***
- 37a. Sepals pilose on margin, outside (sub)glabrous. Leaflets 2–20 cm long, ovate to elliptic, apex (obtuse to) acuminate to caudate, mucronulate or not . . . . . 38
- b. Sepals pilose on margin and outside. Leaflets 1.6–3.9 cm long, elliptic to obovate, apex obtuse, not mucronulate . . . . . **27. *G. parvifoliola***
- 38a. Leaflets ovate (to elliptic), usually asymmetrical, very apex usually mucronulate. Petal scales usually with a glabrescent crest . . . . . 39
- b. Leaflets elliptic,  $\pm$  symmetrical, very apex mucronulate (then crest on petal scales glabrous) or not (then crest pilose) . . . . . 40
- 39a. Lobes of fruit much longer than high. Apex of leaflets abruptly narrowing
- 6. *G. bicolor***
- b. Lobes of fruit about as long as high. Apex of leaflets usually rather gradually narrowing . . . . . **15. *G. koelreuteria***
- 40a. Leaflets without domatia, apex acute to acuminate, mucronulate. Crest of petal scales glabrous, clavate (Fig. 36k) . . . . . **19. *G. misimaensis***
- b. Leaflets without or with one domatium, apex (acuminate to) cuspidate, not mucronulate. Crest of petal scales pilose, flat (Fig. 36i) . . . . . **7. *G. bijuga***
- 41a. Disc uninterrupted (if in fruit check basal ring around several fruits; Fig. 35a) 42
- b. Disc interrupted (Fig. 35c) . . . . . 49

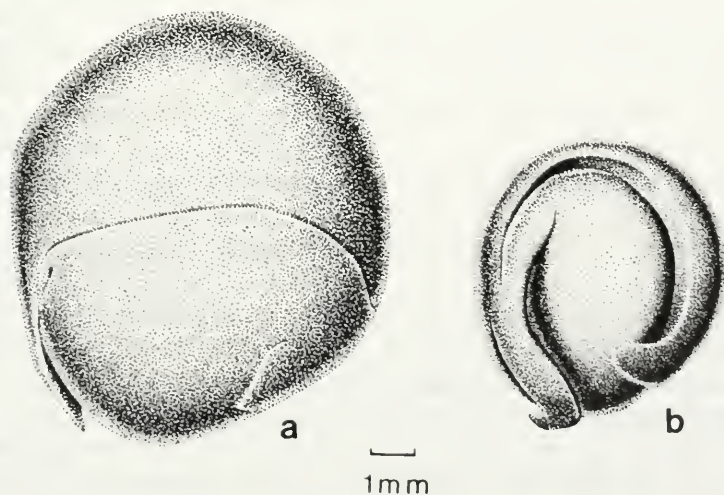


Fig. 38. *Guioa* Cav. Embryo types. — a. *G. lentiscifolia* Cav.: cotyledons superposed, apices almost not elongated. — b. *G. pleuropteris* (Blume) Radlk.: cotyledons secondarily collateral, apices elongated (a: Parks 16162; b: Currick 797).

- 42a. Leaves hirsute below. Apex of petal scales not broadened (Fig. 36b), crest absent or clavate and glabrous (Fig. 36h, k). Fruit of *G. oligotricha* 0.6–0.8 cm high (unknown for *G. molliuscula*) . . . . . 43
- b. Leaves glabrous to sericeous (to subvillose) below; if subvillose (*G. diplopetala*) then apex of petal scales very broadened (Fig. 36a), crest if present flat and pilose (Fig. 36i), fruit 0.7–1.5 cm high . . . . . 44
- 43a. Leaflets 6.6–17.8 cm long; domatia absent or single. Crest on petal scales clavate (Fig. 36k) . . . . . **20. G. molliuscula**
- b. Leaflets 4.1–9.1 cm long; domatia many. Crest on petal scales absent (Fig. 36h) . . . . . **25. G. oligotricha**
- 44a. Crest on petal scales clavate (Fig. 36k). Lobes of fruit much longer than high (1.5 times). Leaflets ovate to elliptic, domatia absent or present. Stipe of fruit 1–2.5 mm long . . . . . 45
- b. Crest on petal scales absent or flat (Fig. 36h, i). Lobes of fruit usually as long as high, if longer than leaflets elliptic, domatia absent, and stipe of fruit 2–3.3 mm long . . . . . 46
- 45a. Leaflets ovate, domatia absent. Stipe of fruit c. 2.5 mm high, lobes not horizontally . . . . . **38. G. scalariformis**
- b. Leaflets elliptic, domatia absent to a single in at least a few leaflets. Stipe of fruit 1–1.5 mm high, lobes horizontally . . . . . **4. G. aryterifolia**
- 46a. Petals 0.5–4 by 0.3–2.2 mm, if small: apex of petal scales much broadened (Fig. 36a). Fruits 0.7–2.2 by 0.7–1.8 cm . . . . . 47
- b. Petals 0.8–1.2 by 0.3–0.4 mm, apex of scales not broadened (Fig. 36b). Fruit 0.7–0.9 by 0.7–1.3 cm . . . . . **28. G. patentinervis**
- 47a. Leaflets (ovate to) elliptic; if ovate then apex of petal scales much broadened (Fig. 36a). Petal scales 0.3–2 mm long (Fig. 36b). . . . . 48
- b. Leaflets ovate. Petal scales very short (Fig. 36g), 0.1–0.3 mm long, apex not broadened . . . . . **5. G. asquamosa**
- 48a. Leaflets with (0 or 1 to) many domatia. Apex of petal scales (very) much broadened (Fig. 36a). Fruits 0.7–1.5 by 0.7–1.8 cm . . . . . **10. G. diplopetala**
- b. Leaflets without domatia. Apex of petal scales not broadened (Fig. 36b). Fruits 1.5–2.2 by 2–2.7 cm . . . . . **41. G. unguiculata**
- 49a. Leaflets ovate to elliptic, 2.9–24.2 by 1–8.9 cm, punctate or not, domatia absent or present . . . . . 50
- b. Leaflets ovate, 10.9–30 by 3.8–13.3 cm, not punctate, domatia absent . . . . . **12. G. grandifoliola**
- 50a. Domatia 2 to many . . . . . 51
- b. Domatia absent or one . . . . . 52
- 51a. Crest on petal scales clavate, glabrous (Fig. 36k). Fruit 0.8–1.5 cm high; cotyledons (obliquely) superposed, sometimes apex of upper elongated (Fig. 38a) . . . . . **8. G. comesperma**
- b. Crest on petal scales absent to usually present as a flat part (to a somewhat clavate part) of the scale apex, pilose (Fig. 36h–k). Fruit 1–2.2 cm high; cotyledons subcolateral, apices usually elongated (Fig. 38b) . . . . . **15. G. koelreuteria**

- 52a. Leaflets ovate to elliptic, with or without domatia. Fruit dehiscent completely, wall at suture less than 2 mm thick, pseudo-funcle on arillode (usually) present, if not or only partly then upper margin of fruit highly convex. . . . . 53
- b. Leaflets elliptic, without domatia. Fruit at most partly dehiscent, wall at suture up to 3.5 mm thick, upper margin of fruit straight, pseudo-funcle absent
- 9. *G. contracta***
- 53a. Petal scales basally not auriculate (Fig. 36b), membranous margin indistinct; crest absent or clavate or part of bifid scale apex (Fig. 36h–k) . . . . . 54
- b. Petal scales basally auriculate (Fig. 36c), membranous margin distinct; crest a linear appendage (Fig. 36j) . . . . . **1. *G. acuminata***
- 54a. Crest on petal scales absent or present, clavate or part of bifid scale apex, pilose (Fig. 36h–k) . . . . . 55
- b. Crest on petal scales clavate, glabrous (Fig. 36k) . . . . . 57
- 55a. Leaflets ovate to elliptic, domatium absent or present. Scales of petals free (Fig. 36a–c). Cotyledons subcollateral (Fig. 38b) . . . . . 56
- b. Leaflets elliptic, domatium absent. Scales of petals folded margins (Fig. 36d). Cotyledons presumably (obliquely) superposed (Fig. 38a) . . . . . **41. *G. unguiculata***
- 56a. Leaflets elliptic; apex abruptly (acuminate to) cuspidate, very apex obtuse (to acute)
- 7. *G. bijuga***
- b. Leaflets ovate (to elliptic); apex (obtuse to) usually gradually acuminate to caudate, very apex acute to usually mucronulate . . . . . **15. *G. koelreuteria***
- 57a. Leaflets elliptic . . . . . 58
- b. Leaflets ovate . . . . . **23. *G. normanbiensis***
- 58a. Leaflets subcoriaceous. Stipe of fruit 2–4 mm high; suture of fruit lobes flat to slightly convex (Fig. 37a) . . . . . **18. *G. membranifolia***
- b. Leaflets (sub)coriaceous. Stipe of fruit absent to up to 2 mm high; suture of fruit lobes usually highly convex, lobes almost touching (Fig. 37b) **37. *G. rigidiusecula***

## KEY TO THE SPECIES OF MALAY PENINSULA, SUMATRA, BORNEO, AND JAVA

- 1a. Rachis of leaves slightly to distinctly winged (Fig. 33b, c) . . . . . 2
- b. Rachis of leaves not winged (Fig. 33a) . . . . . 4
- 2a. Jugae (1–)2–7. Upper leaflets elliptic to obovate, lower surface densely greyish papillate, dull; domatia many. . . . . 3
- b. Jugae 1–4. Upper leaflets elliptic; lower surface smooth (to somewhat papillate), rather shiny; domatia absent or a single . . . . . **7. *G. bijuga***
- 3a. Wings along rachis narrow, up to 3 mm broad. Apex of leaflets (obtuse to) abruptly acuminate (to cuspidate); lower surface with a convex, raised midrib, hairs obliquely hirsute (to sericeous), domatia many, pockets (to sacs; Fig. 34a, b, d)
- 30. *G. pleuropteris***
- b. Wings along rachis always broad, up to 4 mm. Apex of leaflets gradually acuminate to cuspidate; lower surface with a hardly raised, flat midrib, hairs (very) sparsely sericeous, domatia many sacs (Fig. 34c) . . . . . **34. *G. pterorhachis***
- 4a. Domatia absent or one sac . . . . . 5
- b. Domatia two to many sacs to pockets . . . . . 8

- 5a. Petals 1.8–3.8 mm long; scales with at most a hardly broadened apex (Fig. 36a); crest always present (Fig. 36i–k). Disc interrupted (often almost uninterrupted; Fig. 35). Fruit lobes longer than high and usually sparsely sericeous or lobes about as long as high and glabrous . . . . . 6
- b. Petals 0.5–4 mm long; scales with a (very) much broadened apex (Fig. 36a); crest usually absent (Fig. 36h). Disc uninterrupted (sometimes with a small slit; Fig. 35a, b). Fruit lobes usually longer than high, glabrous . . . . . **10. G. diplopetala**
- 6a. Leaves 1–6-jugate. Leaflets ovate (to elliptic), asymmetrical; apex usually gradually acuminate to caudate, very apex acute to usually mucronulate . . . . . 7
- b. Leaves 1–4-jugate. Leaflets elliptic, usually symmetrical; apex abruptly (acuminate to) cuspidate, very apex usually obtuse (to acute), not mucronulate  
**7. G. bijuga**
- 7a. Leaflets below smooth, shiny, glabrous. Ovary subhirsute. Fruits glabrous  
**15. G. koelreuteria**
- b. Leaflets below papillate, dull, (slightly) shortly sericeous. Ovary densely hirsute. Fruits (very) sparsely sericeous, glabrescent . . . . . **35. G. pubescens**
- 8a. Upper leaflets ovate to obovate; lower surface papillate, hirsute and with many pockets (to sacs) or (slightly) shortly sericeous and with many sacs. Petals (elliptic to) obovate; apex of scales not to hardly broadened (Fig. 36b); crest (usually) present (Fig. 36i–k) . . . . . 9
- b. Upper leaflets (ovate to) elliptic; lower surface usually smooth, glabrous (to slightly sericeous to subvillose), many sacs. Petals elliptic; scales with a (very) much broadened apex (Fig. 36a); crest usually absent (Fig. 36h) . . . . . **10. G. diplopetala**
- 9a. Upper leaflets elliptic to obovate; apex (obtuse to) abruptly acuminate (to cuspidate); lower surface (sub)sericeous to hirsute, domatia pockets (to sacs; Fig. 34a–c). Ovary subhirsute. Fruits glabrous . . . . . **30. G. pleuropteris**
- b. Upper leaflets ovate (to elliptic); apex gradually acuminate to cuspidate; lower surface (slightly) shortly sericeous, domatia sacs (Fig. 34b). Ovary densely hirsute. Fruits (very) sparsely sericeous, glabrescent . . . . . **35. G. pubescens**

KEY TO THE SPECIES OF THE PHILIPPINES

- 1a. Leaflets smooth below, without papillae, rather shiny . . . . . 2
- b. Leaflets papillate below, dull, greyish or whitish . . . . . 5
- 2a. Rachis not (to slightly) winged (Fig. 33a, b). Blade of petals obovate, gradually decurrent into the claw (Fig. 36e) . . . . . 3
- b. Rachis slightly winged (Fig. 33b). Blade of petals orbicular, abruptly clawed (Fig. 36f) . . . . . **40. G. truncata**
- 3a. Apex of leaflets (obtuse to) acuminate to caudate. Scales of petals basically not auriculate (Fig. 36b), membranous margin along scales indistinct . . . . . 4
- b. Apex of leaflets (cuspidate to) caudate. Scales of petals basally auricled (Fig. 36c), membranous margin along scales distinct . . . . . **1. G. acuminata**
- 4a. Rachis often (slightly) winged (Fig. 33b, c). Leaflets elliptic, usually symmetrical; apex abruptly (acuminate to) cuspidate; very apex obtuse (to acute); domatia absent or 1 sac . . . . . **7. G. bijuga**



- b. Rachis terete to flattened and broadened (to slightly winged; Fig. 33). Leaflets ovate (to elliptic), asymmetrical; apex (obtuse to) usually gradually acuminate to caudate; very apex acute to usually mucronulate; domatia absent to many sacs (to pockets)
- 15. *G. koelreuteria***
- 5a. Rachis winged or not (Fig. 33). Leaflets ovate to obovate, (sub)coriaceous to very coriaceous, punctate or not; apex retuse to caudate; domatia absent to many. Inflorescence subglabrous to usually shortly brown sericeous to hirsute. Blade of petal obovate, gradually decurrent into claw (Fig. 36e); crest absent or part of bifid scale apex (to clavate; Fig. 36h–k) (N.B.: petals of *G. palawanica* and *G. parvifoliola* unknown) . . . . . 6
- b. Rachis not winged (Fig. 33a). Leaflets ovate (to elliptic), coriaceous, punctate; domatia (absent to 1—many sacs to) many pockets. Inflorescence long golden (sericeous to) hirsute. Blade of petal orbicular, sharp transition with claw (Fig. 36f); crest clavate, stipitate (Fig. 36k). . . . . **22. *G. myriadenia***
- 6a. Ovary subhirsute. Fruits glabrous . . . . . 7
- b. Ovary densely hirsute. Fruits sericeous, glabrescent . . . . . **35. *G. pubescens***
- 7a. Upper leaflets ovate to obovate; apex rounded to caudate; below (glabrous to) sericeous to hirsute, domatia absent to many pockets or sacs; venation usually conspicuously raised below only, above usually concolorous with lamina, densely to laxly reticulate, usually rather indistinct . . . . . 8
- b. Upper leaflets ovate; apex cuspidate to caudate; below sericeous, domatia a single (to many) sac(s); venation conspicuously raised on both sides, discoloured with lamina, densely reticulate, very distinct . . . . . **36. *G. reticulata***
- 8a. Upper leaflets ovate to obovate, 0.9–20 by 0.5–8.4 cm, if obovate either not punctate or base and apex asymmetrical . . . . . 9
- b. Upper leaflets elliptic to obovate, 1.6–3.9 by 0.5–1.2 cm, slightly asymmetrical, punctate . . . . . **27. *G. parvifoliola***
- 9a. Upper leaflets ovate to obovate, if obovate then punctate, basally and apically asymmetrical, domatia many . . . . . 10
- b. Upper leaflets elliptic to obovate, rather symmetrical, not punctate, domatia absent or 1 . . . . . **26. *G. palawanica***
- 10a. Rachis not (to slightly) winged (Fig. 33a, b). Upper leaflets ovate (to elliptic), symmetrical to usually basally asymmetrical; apex (obtuse to) acuminate to caudate; below glabrous to sericeous to subhirsute (Mindanao only), usually at least some leaflets longer than 7.5 cm; nerves marginally looped and joined, sometimes (leaflets ovate) less distinctly so in lower half . . . . . 11
- b. Rachis usually winged (Fig. 33b, c). Upper leaflets (elliptic to) obovate, apically and basally asymmetrical; apex (obtuse to) acute to acuminate (to cuspidate); below hirsute to (sub)sericeous, the (sub)sericeous leaflets always less than 7.5 cm long; nerves marginally looped and joined, but less distinctly so in the lower half
- 30. *G. pleuropteris***
- 11a. Leaflets below somewhat differently coloured from above, brownish-greyish when dry, (usually) punctate; apex abruptly to gradually narrowing . . . . . 12
- b. Leaflets below very differently coloured from above, almost whitish when dry, not punctate; apex gradually narrowing . . . . . **11. *G. discolor***

- 12a. Lobes of fruit about as long as high. Leaflets without domatia (then leaflets usually symmetrical) to many (then leaflets usually asymmetrical). Crest on petal scales (absent to) part of bifid scale apex (to clavate; Fig. 36h–k) . . . . . 13
- b. Lobes of fruit much longer than high. Leaflets without or with 1 domatium, asymmetrical. Crest on petal scales clavate (Fig. 36k) . . . . . **6. G. bicolor**
- 13a. Rachis often (slightly) winged (Fig. 33a, b). Leaflets elliptic, usually symmetrical; apex abruptly (acuminate to) cuspidate, very apex obtuse (to acute); domatia absent or 1 sac . . . . . **7. G. bijuga**
- b. Rachis terete to flattened and broadened (to slightly winged; Fig. 33a, b). Leaflets ovate (to elliptic) asymmetrical; apex (obtuse to) usually gradually acuminate to caudate, very apex acute to usually mucronulate; domatia absent to many sacs (to pockets) . . . . . **15. G. koelreuteria**

## KEY TO THE SPECIES OF CELEBES

- 1a. Axes and rachises, especially when young, hirsute. Lower surface of leaflets hirsute, with many red erect glands . . . . . **13. G. hirsuta**
- b. Axes and rachises glabrous to very subsericeous. Lower surface of leaflets glabrous, red glands absent . . . . . **10. G. diplopetalata**

## KEY TO THE SPECIES OF THE MOLUCCAS

- 1a. Margin of leaflets entire or with few subapical teeth. Petals 5. Suture of fruits blunt . . . . . 2
- b. Margin of leaflets crenate. Petals 4. Suture of fruits very sharp **33. G. pteropoda**
- 2a. Rachis slightly winged or not (Fig. 33a, b). Lower surface of the leaflets papillate, glabrous to sericeous . . . . . 3
- b. Rachis not winged (Fig. 33a). Lower surface of the leaflets not papillate, smooth, glabrous . . . . . 4
- 3a. Rachis slightly winged (Fig. 33b). Lower surface of leaflets sericeous; domatia 1 to many pocket-like sacs . . . . . **16. G. malukuensis**
- b. Rachis not winged (Fig. 33a). Lower surface of leaflets glabrous to sometimes very sparsely sericeous; domatia 1 (or 2) sac(s) . . . . . **2. G. acutifolia**
- 4a. Petals 1.4–3 mm high; crest of scales well developed, clavate (Fig. 36k). Disc interrupted (Fig. 35c). Fruit 1.4–2.4 cm high by 1–3.6 cm broad . . . . . **18. G. membranifolia**
- b. Petals 0.8–1.2 mm high; crest absent (Fig. 36h). Disc uninterrupted (Fig. 35a). Fruit 0.7–0.9 cm high by 0.7–1.3 cm broad . . . . . **28. G. patentinervis**

## KEY TO THE SPECIES IN THE LESSER SUNDA ISLANDS

- Petals with very short scales, up to 0.3 mm long (Fig. 36g) . . . . . **5. G. asquamosa**

## KEY TO THE SPECIES OF NEW GUINEA

- 1a. Leaflets and inflorescences hirsute or velutinous. Rachis not winged (Fig. 33a) 2  
 b. Leaflets and inflorescences glabrous, puberulous, tomentose, somewhat hirsute, or sericeous. If tomentose or somewhat hirsute then rachis winged (Fig. 33c) . . . . 4
- 2a. Lower surface of leaflets (smooth to) papillate, domatia (absent or 1 to) many. Crest of petal scales usually absent, seldom well developed (Fig. 36h, k). If leaflets smooth then many domatia and no crest (Fig. 36h) . . . . . 3  
 b. Lower surface of leaflets smooth, without papillae, domatia absent or a single sac. Crest of petal scales well developed (Fig. 36k) . . . . . **20. *G. molliuscula***
- 3a. Leaflets usually with a few subapical teeth; domatia many pockets. Inflorescences axillary, 1.2–6 cm long. Petals 0.7–1 by c. 0.3 mm; scales present (Fig. 36i), crestless. Stipe of fruit 1.5–2 mm high, slender (Fig. 37a) . . . . . **25. *G. oligotricha***  
 b. Leaflets entire; domatia absent to many pocket-like sacs. Inflorescences axillary to pseudoterminal, 1–26.6 cm long. Petals 0.9–2.3 by 0.5–1.6 mm; auricles present (Fig. 36d); crest usually absent (to developed). Stipe of fruit absent to up to 4 mm high, broadly obconical (Fig. 37c) . . . . . **39. *G. subsericea***
- 4a. Large inner sepals 0.8–3.2 by 0.9–3.5 mm. Petals (4 or) 5 (or 6). Sutures of fruit blunt; septa complete . . . . . 5  
 b. Large inner sepals 3–4 by 3–4.2 mm. Petals 4. Sutures of fruit very sharp; septa above attachment of funicle incomplete . . . . . **33. *G. pteropoda***
- 5a. Leaves 1–9-jugate, if all 1-jugate then leaflets usually longer than 7 cm . . . . . 6  
 b. Leaves all 1-jugate. Leaflets 1.1–6.3 cm long . . . . . **29. *G. pauciflora***
- 6a. Rachis winged, wing at least 0.5 mm broad (Fig. 33b, c) . . . . . 7  
 b. Rachis terete to flattened, not winged (Fig. 33a) . . . . . 13
- 7a. Rachis slightly to broadly winged (Fig. 33b, c); if broadly winged then 2 to many domatia present . . . . . 8  
 b. Rachis broadly winged (wing more than 2 mm broad; Fig. 33c). Domatia absent (or 1 sac) . . . . . **17. *G. melanopoda***
- 8a. Leaflets densely papillate below (dull, greyish) . . . . . 9  
 b. Leaflets smooth below (rather shiny), no papillae . . . . . 11
- 9a. Leaflets 1–2.4 by 0.4–0.9 cm; margin serrate or partly crenate in at least some leaflets; apex emarginate to acute . . . . . 10  
 b. Leaflets 3.8–6.3 by 1–1.7 cm; margin entire; apex acute . . . . . **21. *G. multijuga***
- 10a. Margin serrate in at least some leaflets; domatia 1, present in some leaflets  
     **43. *G. waigeoensis***  
 b. Margin entire except for the usually crenate apex; domatia absent. **3. *G. amabilis***
- 11a. Leaflets 0.8–6.5 by 0.5–2 cm; margin entire to usually (partly) crenate or serrate; domatia absent to many. Fruit blackish when dry, either 0.7–0.8 cm high with a slender stipe (Fig. 37a) or 1–2 cm high with a (rather) broadly obconical stipe (Fig. 37c) . . . . . 12  
 b. Leaflets 3.8–18.5 by 1.3–8.4 cm; margin entire; domatia 2 to many. Fruit reddish to reddish black when dry, 0.8–1.5 cm high, stipe slender (Fig. 37a)  
     **8. *G. comesperma***

- 12a. Leaflets entire or usually slightly crenate; apex retuse to obtuse (to acute). Petals c. 3.4 by 1.2 mm. Fruit 1.7–1.9 cm across . . . . . **32. *G. pseudoamabilis***
- b. Leaflets entire except for some subapical teeth; apex acuminate. Petals 0.2–1.1 by 0.1–0.2 mm. Fruit 0.6–0.9 cm across . . . . . **42. *G. venusta***
- 13a. Lower surface of leaflets glabrous or (sub)sericeous, domatia absent or a single sac (or one or two pockets) to many pocket-like sacs . . . . . 14
- b. Lower surface of leaflets puberulous on midrib and basal nerves, domatia many pockets . . . . . **14. *G. hospita***
- 14a. Leaflets below densely, long (greyish, dull) papillate, usually (sub)sericeous, if not sericeous then usually a single very large sac present (Fig. 34d) . . . . . 15
- b. Leaflets below (rather shiny) smooth (or at most very shortly papillate), glabrous (to very sparsely sericeous), sacs if present small (Fig. 34b) . . . . . 21
- 15a. Leaflets glabrous to (very sparsely) sericeous, domatia absent or a single small sac (or one or two pockets) to many pocket-like sacs (Fig. 34a, b) . . . . . 16
- b. Leaflets glabrous except for a few sericeous hairs around the domatium, latter single, very large, highly domed (Fig. 34d) . . . . . **24. *G. novobritannica***
- 16a. Disc interrupted (if in fruit, check several fruits!; Fig. 35c) . . . . . 17
- b. Disc uninterrupted (to with a small slit; Fig. 35a, b) . . . . . 19
- 17a. Leaflets with 0–2 pocket domatia (Fig. 35a); if 2 pockets present then fruit blackish when dry and stipe broadly obconical (Fig. 37c) . . . . . 18
- b. Leaflets with 2 to many domatia, basally sacs (Fig. 35b) to upwards pockets. Fruit reddish to reddish black when dry, stipe slender (Fig. 37a) . . . . . **8. *G. comesperma***
- 18a. Leaflets (sub)symmetrical, about 2.6–3 times as long as broad, coriaceous. Inflorescence subsericeous . . . . . **19. *G. misimaensis***
- b. Leaflets falcate, about 3.6–4.4 times as long as broad, coriaceous to very coriaceous. Inflorescence sericeous . . . . . **31. *G. plurinervis***
- 19a. Leaves either 1–3(–5)-jugate or (3–)5–7-jugate. Leaflets (ovate to) elliptic; below glabrous to very slightly sericeous, domatia 0, 1 (or 2) sacs. Scales of petals free (except for the adnate lower part; Fig. 36a–c), often folded outwards . . . . . 20
- b. Leaves 1–3-jugate. Leaflets ovate (to elliptic) below (sub)sericeous, domatia absent or 1 sac to many pocket-like sacs. Scales of petals present as inwardly folded, adnate auricles (Fig. 36d) . . . . . **39. *G. subsericea***
- 20a. Leaves 1–3(–5)-jugate; rachis not winged (Fig. 33a). Leaflets 2.8–23.5 cm long; lower surface glabrous, but sometimes very sparsely sericeous, especially on the midrib. Flower 1.5–2.5 mm in diam. Petals 0.3–1.8 mm long, claw absent or up to 0.2(–0.4) mm high; scales 0.1–1 mm long . . . . . **2. *G. acutifolia***
- b. Leaves (3–)5–7-jugate; rachis not to very slightly winged (Fig. 33a, b). Leaflets 3.8–6.3 cm long; lower surface very sparsely sericeous. Flower c. 2.8 mm in diam. Petals 1.5–1.7 mm long, claw c. 0.3 mm high; scales c. 1 mm long
- 21. *G. multijuga***
- 21a. Leaflets without or with 1 sac domatium. Fruit blackish when dry . . . . . 22
- b. Leaflets with 2 to many domatia, basally sacs to upwards pockets. Fruits reddish to reddish black when dry . . . . . **8. *G. comesperma***
- 22a. Some to all leaflets with a single (small) sac (Fig. 34b) . . . . . 23
- b. Domatia absent . . . . . 26



- 23a. Leaflets elliptic. Disc interrupted to uninterrupted (Fig. 35). Fruit 1.1–2.9 cm high; stipe absent or relatively short (c. 1/5–1/6 of fruit height), up to 4 mm high . . . 24
- b. Leaflets ovate. Disc interrupted (Fig. 35c). Fruit 1.2–1.5 cm high; stipe relatively high (c. 1/4 of fruit height), 3–3.5 mm high . . . . . **23. *G. normanbiensis***
- 24a. Disc interrupted (Fig. 35c). Stipe of fruit absent to up to 4 mm long; lobes about as long as high or higher than long (10–18 by 9–22 mm) . . . . . 25
- b. Disc uninterrupted (Fig. 35a). Stipe of fruit 1–1.5 mm long; lobes much longer than high (15–16 by 8–12.5 mm) . . . . . **4. *G. aryerifolia***
- 25a. Leaflets subcoriaceous. Fruit with a 2–4 mm high stipe; upper suture flat to slightly convex (Fig. 37a) . . . . . **18. *G. membranifolia***
- b. Leaflets (sub)coriaceous. Fruit with a 0–2 mm long stipe; upper suture usually highly convex (lobes almost touching; Fig. 37b) . . . . . **37. *G. rigidiuscula***
- 26a. Leaflets ovate . . . . . 27
- b. Leaflets elliptic . . . . . 28
- 27a. Leaflets 10.9–30 by 3.8–13.3 cm, index 2.1–2.9; upper surface usually with wax. Disc interrupted (Fig. 35c). Fruit wall 1–3 mm thick; stipe 1–1.5 mm high; lobes about as long as high, 12–16 by 10–14 mm . . . . . **12. *G. grandifoliola***
- b. Leaflets 11.9–22.7 by 6.1–10.7 cm, index 1.8–2.1; upper surface without wax. Disc uninterrupted (Fig. 35a). Fruit wall less than 1 mm thick; stipe c. 2.5 mm high; lobes usually longer than broad, c. 17 by 12 mm . . . . . **38. *G. scalariformis***
- 28a. Claw of petals either c. 0.4 mm high and then the crest of the scales well developed, clavate (Fig. 36k) or the claw c. 0.8 mm high and then the crest usually absent or present as part of a bifid scale apex (Fig. 36h, i). Disc (nearly) uninterrupted (Fig. 35a, b). Fruit wall rather thin (c. 1 mm thick); lobes much longer than high . . . 29
- b. Claw of petals 0.2–0.4 mm high; crest well developed, clavate (Fig. 36k). Disc interrupted (Fig. 35c). Fruit wall very thick (up to 3.5 mm); lobes about as long . . . . . **9. *G. contracta***
- 29a. Claw of petals c. 0.4 mm high; crest well developed, clavate (Fig. 36k). Disc uninterrupted (Fig. 35a). Stipe of fruit 1–1.5 mm high . . . . . **4. *G. aryerifolia***
- b. Claw of petals c. 0.8 mm high; crest usually absent or present as part of a bifid scale apex (Fig. 36h, i). Disc (nearly) uninterrupted (Fig. 35a, b). Stipe of fruit 2–3.3 mm high . . . . . **41. *G. unguiculata***

**1. *Guioa acuminata*** Radlk., Philipp. J. Sc., Bot. 8 (1914) 463; Merr., Enum. Philip. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenz. 98 (1933) 1172; Welzen, Leiden Bot. Series 12 (1989) 171, f. 61. — Lectotype (Van Welzen 1989); *BS (Ramos) 10916* (M holotype; US), Philippines.

*Guioa perrottetii* auct. non Radlk.: Sasaki, Cat. Gov. Herb. (1930) 328, p.p. (*Ramos 10916*).

*Tree*, 6–8 m high, dbh up to 12.5 cm. *Branchlets* sericeous when young; flowering twigs 2–4 mm thick. *Leaves* 1–3-jugate; rachis 1.9–12 cm long, basally terete to upwards flattened, (sub)glabrous, petiole 1.5–8.2 cm long; petiolules up to 0.7 cm

long. *Leaflets* opposite to subopposite, ovate to elliptic, somewhat falcate, 5.7–14.4 by 1.6–4.1 cm, index 2.6–4.2, asymmetrical, ascropic side broader, coriaceous, punctate; base attenuate; margin entire, flat (to revolute); apex (cuspidate to) caudate, mucronulate; upper surface glabrous; lower surface duller, not papillate, glabrous (to some sparse hairs), domatia a single sac on basiscopic side in axil of second nerve; venation raised; nerves 0.4–1.9 cm apart, marginally looped and joined; veins laxly reticulate, indistinct. *Inflorescences* axillary, branching basally to mainly along the sericeous, flattened, 2.8–16.5 cm long axis; first order branches up to 7.7 cm long; cymules cincinnate, c. 3-flowered; bracts and bracteoles triangular, out-

side sericeous, inside glabrous; bracts 0.7–2 mm long; bracteoles 0.5–0.8 mm long; pedicels 3–4.4 mm long, sericeous except (sub)glabrous above articulation. *Flowers* 4–4.3 mm in diam., white. *Sepals* 5, ovate, margin pilose, with glands, out- and inside glabrous; 2 outer smaller ones 1.5–2.3 by 1.2–2.6 mm; 3 inner larger ones 2.2–3.3 by 2.2–3.7 mm, margin petaloid. *Petals* 5, obovate, 3.3–3.7 by 1.2–1.3 mm, blade elliptic, gradually decurrent into the 0.4–0.8 mm long claw, margin pilose, out- and inside glabrous, apex obtuse; scales 2.3–3.2 mm long, free, basally auriculate, membranous margin distinct; crest a linear appendage, (sub)glabrous. *Disc* interrupted. *Stamens* 8; filament 2–5 mm long, pilose, especially basally; anther c. 0.5 mm long, glabrous. *Pistil*: ovary 0.4–2.1 mm long, subhirsute; style and stigma 0.3–1.5 mm long. *Fruits* with 2 or 3 well developed lobes, c. 1.3 by 1.5 cm, completely dehiscent, rugose-ruminate, glabrous, blackish when dry; stipe c. 4 mm long, slender; margin blunt; lobes c. 8 by 8 mm; wall at suture less than 2 mm thick; septa complete. *Seeds* seen immature: arillode with pseudo-funicle.

**Distribution** – *Malesia*: Philippines (Central & E Luzon, Polillo I.).

**Habitat & Ecology** – Secondary forest; altitude sea level up to 100 m. Fl. throughout the year.

**Note** – Fruiting specimens of *G. acuminata* are hardly distinguishable from *G. koelreuteria*; they only differ in the relatively longer leaf tip and the single instead of usually many domatia.

**2. *Guioa acutifolia* Radlk.**, [Sapind. Holl.-Ind. (1879) 11, nom. nud.] Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 608; Bot. Jahrb. 56 (1921) 278; in Engl., Pflanzenz. 98 (1933) 1159; C.T. White, Contr. Arnold Arbor. 4 (1933) 60; S.T. Reynolds, Austrobaileya 2 (1984) 53; in Fl. Austral. 25 (1985) 48, f. 11d–f, map 58; Welzen, Leiden Bot. Series 12 (1989) 172, f. 62, 63. — [*Cupania semiglaucua* var. *acutifolia* F. Muell. ex Radlk., Sapind. Holl.-Ind. (1879) 11, nom. nud.] — *Nephelium semiglaucum* var. *acutifolium* F. Muell. ex Bailey & White, Bot. Bull. Queensl. Dep. Agr. 18 (1916) 9. — Lectotype (Van Welzen 1989): *Dallachy s.n.* (M holotype: K, L, M, MEL, NSW), Australia.

(*Shrub* to *tree*, 2.5–25 m high, dbh 10–45 cm, spindly; outer bark nondescript, smooth to with small pustules and furrows, blotched variously grey to plum coloured, inner bark cream to pink to wine-red to light brown, with white fibrous vertical stripes; wood cream to light straw. *Branchlets* gla-

brous (to sparsely sericeous when young); flowering twigs 1–5(–15) mm thick. *Leaves* 1–3(–6)-jugate; rachis 1–25 cm long, basally terete (to upwards somewhat flattened), glabrous; petiole 0.5–6.6(–8.8) cm long; petiolules up to 0.9 cm long. *Leaflets* opposite to alternate, (ovate to) elliptic (to slightly falcate), 2.8–23.5 by 1.2–8.7 cm, index 1.8–4.7, usually symmetrical, subcoriaceous (to very coriaceous), usually punctate; base attenuate; margin entire, flat; apex (obtuse to) acute to cuspidate (to caudate), usually mucronulate; upper surface glabrous (except for the sparsely pilose midrib), (thick waxy layer); lower surface glaucous, papillate, glabrous (to very sparsely sericeous especially on the midrib), domatia usually present in some to all leaflets, 1 (or 2) often small sacs on basiscopic side in axil of second or third nerve (see note 3); venation on upper surface flat except for the basally raised midrib, on lower surface raised; nerves 0.2–3.9 cm apart, marginally looped and joined, (less so in lower part); veins laxly reticulate. *Inflorescences* axillary (to pseudoterminal), unbranched to branching basally and along the terete, usually sericeous, 0.4–16.8 cm long axis; first order branches up to 6 cm long; cymules cinnate to dichasial, 1–7(–10)-flowered; bracts and bracteoles deltate, outside sericeous, inside glabrous; bracts (0.2–)0.4–1.4 mm long; bracteoles 0.2–0.9 mm long; pedicels 0.5–4 mm long, usually sericeous except for the (sub)glabrous articulate part. *Flowers* 1.5–2.5 mm in diam., sweet scented. *Sepals* 5 (or 6), broadly ovate to orbicular, margin pilose, with glands, (outside sericeous), inside glabrous; 2 outer smaller ones 0.5–1.7 by 0.5–1.9 mm; 3 (or 4) inner larger ones 1–2.3 by 0.9–2.3 mm, margin petaloid. *Petals* 5, (rhombic to) obovate, 0.3–1.8 by 0.2–0.8 mm, white to tinged pinkish; claw 0–0.2(–0.4) mm high; margin pilose, outside and inside glabrous, apex obtuse to somewhat fimbriate; scales 0.1–1 mm long, free, apex not broadened; crest absent (to clavate on slender short stipe, glabrous). *Disc* uninterrupted. *Stamens* 8; filaments 0.7–3 mm long, completely pilose, especially basally; anthers 0.2–0.7 mm long, glabrous to papillate, pink. *Pistil*: ovary 0.2–1.3 mm high, sparsely hirsute; stigma and style 0.1–0.7(–2) mm long. *Fruits* with 1 or 2 (or 3) well developed lobes, 0.5–1.2 by 0.8–2 cm, smooth to rugose-ruminate, glabrous, red when fresh, blackish when dry; stipe 0–3 mm high, broadly obconical to slender; margin blunt; lobes 5.5–12 by 5–8 mm; septa complete. *Seeds* obovoid, 4–8 by 3–5 mm; hilum 0.7–1.7 mm long.

**Distribution** – *Malesia*: Moluccas, Irian Jaya (Vogelkop, Geelvinck Bay), Papua New Guinea (Western, Southern Highlands, Central Prov.); NE

Australia: N Queensland (Cook, N Kennedy and Wide Bay District).

**Habitat & Ecology** – Scarce to common understorey tree; in disturbed rain forests, secondary bamboo forests, tall secondary montane forests, regrowth thickets, *Araucaria* vine thickets, along margins of forests, beach forests, water, mangroves, *Melaleuca* swamps. For vegetation types and soils in Australia see J.G. Tracey, *Veget. Humid Trop. Region N. Queensl.* (1982) 106. Altitude sea level up to 1800 m. Fl. (Mar.–)May–Sept.(–Oct.); fr. Nov.–Jan.

**Notes** – J. Tracey (1982) records lowland and highland forms of *G. acutifolia*, but he did not explain by what criteria these forms can be recognized. Note, however, that a specimen of *G. comesperma* (Webb & Tracey 13251) was included in *G. acutifolia*.

2. Specimens found near salty water (along creeks, beaches, or on small islands) are sclerophyllous with a thick waxy layer on the upper surface. The same phenomenon can be observed in specimens of *G. bijuga* from poor, sandy soil in Borneo.

3. *Beccari* FI 2810 is exceptional as the leaflets sometimes have a small subapical tooth, like *G. oligotricha*, and instead of a single sac several pockets are present. This specimen may belong to a new species, but as there is no other similar material, it is still included in *G. acutifolia*.

4. Several specimens in New Guinea possess very long leaflet apices, which make them look different from the more typical specimens of *G. acutifolia*.

**3. *Guioa amabilis*** Kanehira & Hatusima, *Bot. Mag. Tokyo* 57 (1943) 76, f. 11; Welzen, *Leiden Bot. Series* 12 (1989) 176, f. 64. — Type: *Kanehira & Hatusima 13999* (TJ holo, n.v.; A), Irian Jaya.

**Shrub**, 1–5 m high. *Branchlets* shortly sericeous, especially when young; flowering twigs 1–3.5 mm thick. *Leaves* 3–5-jugate; rachis 0.6–5.4 cm long, slightly winged, wing at most 1 mm broad, slightly pilose, petiole 0.6–1.7 cm long. *Leaflets* subsessile, opposite to alternate, elliptic to obovate, 1–1.9 by 0.5–0.9 cm, index 1.7–2.4, often asymmetrical, then acroscopic side broader, very coriaceous, usually punctate; base attenuate; margin entire, except for the usually crenate apex, revolute; apex emarginate to acute, sometimes mucronulate; upper surface glabrous except for the sometimes puberulous midrib, often wax; lower surface duller, papillate, sericeous, domatia absent; venation on upper surface flat to slightly raised, raised below; nerves 0.1–0.4 cm apart, marginally looped

and joined; veins densely reticulate, inconspicuous. *Inflorescences* axillary to pseudoterminal, unbranched to at most branching along the terete, sericeous, 0.6–9.7 cm long axis; first order branches up to 0.5 cm long; cymules cincinnate, 1- or 2-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.5–1.3 mm long; bracteoles 0.3–0.6 mm long; pedicels 2–4 mm long, sericeous, articulate part less so. *Flowers* in bud; latter light green, tinged red. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, light green; 2 outer smaller ones 1.4–2 by 1.6–2.2 mm; 3 inner larger ones 2.2–3 by 2.2–3 mm, margin petaloid. *Petals* still immature, 5, clawed, white, margin pilose, outside and inside glabrous; scales still small. *Disc* uninterrupted. *Stamens* 8; filaments 1.7–2 mm long, completely pilose, especially basally, light green; anthers c. 0.6 mm long, glabrous, pink. *Pistil*: ovary c. 0.5 mm high, subhirsute; style and stigma c. 0.2 mm long. *Fruits* with 2 or 3 well developed lobes, 1–1.2 by 1.1–1.4 cm, smooth to slightly rugose, glabrous, brownish red when fresh, blackish when dry; stipe 1.5–2 mm high, broadly obconical; margin blunt; lobes 7–9 by 7–9 mm; septa complete. *Seeds* immature.

**Distribution** – *Malesia*: Irian Jaya (Vogelkop).

**Habitat & Ecology** – Scarce to common. Found at mountain forest edges and in occasionally burned scrubs. Soil: grey clay; altitude 2300–2500 m. Fl. Jan.

**4. *Guioa arysterifolia*** Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 357; *Bot. Jahrb.* 56 (1921) 282; Baker in Rendle, *J. Bot.* 61, Suppl. (1923) 11; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1174; P. Royen, *Man. For. Trees Papua & New Guinea* 2 (1964) 24, f. 11; Streimann, *Pl. Upper Watut Watershed* (1983) 169; Welzen, *Leiden Bot. Series* 12 (1989) 177, f. 65. — Lectotype (Van Welzen 1989): *Forbes 870* (M holo; BM, MEL, P), Papua New Guinea.

**Shrub to tree**, 5–20 m high, dbh up to 45 cm; bark grey, thin. *Branchlets* usually sericeous when young; flowering twigs 3–10 mm thick. *Leaves* 2–4-jugate; rachis 4–21 cm long, terete, glabrous, petiole 2.6–7.3 cm long. *Leaflets* subsessile, opposite to alternate, elliptic, 6.3–19.2 by 2.5–7.1 cm, index 2.2–3, usually rather symmetrical, (acroscopic side broader), coriaceous, usually punctate; base attenuate; margin entire, flat; apex acute to cuspidate, often mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous (to sparsely sericeous), domatia absent or at least in some leaflets a single small sac on basiscopic side in axil of second nerve; venation on upper side



flat (to raised), raised on lower; nerves 0.3–2.9 cm apart, usually marginally very indistinctly looped and joined, especially in the lower part of the leaflets; veins laxly reticulate, often distinct. *Inflorescences* axillary to ramiflorous, unbranched to branching basally and especially along the terete, sericeous, glabrescent, 3–13 cm long axis; first order branches up to 3.9 cm long; cymules cincinnate. c. 2-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.7–0.9 mm long; bracteoles 0.2–0.6 mm long; pedicels 3.3–5.5 mm long, sericeous. *Flowers* c. 3.2 mm in diam., sweet, faintly fragrant. *Sepals* 5, ovate, margin pilose, with glands, (outside sparsely pilose), inside glabrous; 2 outer smaller ones 1–1.7 by 1.2–2 mm; 3 inner larger ones 1.8–2.5 by 1.8–2.8 mm, margin petaloid. *Petals* 5, obovate, 1.8–1.9 by 0.6–0.9 mm, white; claw c. 0.4 mm high; margin pilose, apex acute, outside and inside subglabrous; scales c. 1 mm long, free; crest clavate, stipitate, apex lobed. *Disc* uninterrupted. *Stamens* 8; filaments 2.6–2.8 mm long, completely pilose, especially basally; anthers c. 0.5 mm long, glabrous. *Pistil*: ovary c. 0.3 mm long, subhirsute; style and stigma c. 0.1 mm long. *Fruits* with 1–3 well developed lobes, 1.3–1.6 by 1.6–3.3 cm, rough to slightly rugose or ribbed, glabrous, black when dry; stipe 1–1.5 mm high, slender; margin blunt; lobes 15–16 by 8–12.5 mm, broadly spreading; wall thin to rather thick, not exceeding 1 mm; septa complete. *Seeds* globose to obovoid, c. 10 by 7 mm; arilode without or with a small pseudo-funicle, but always with a basal rim; hilum c. 1.5 mm long.

Distribution – *Malesia*: Papua New Guinea (Central Prov.).

Habitat & Ecology – Common. Found in lowland rain forest, the edge of the forest, and in secondary forest.: altitude 50–1330 m. Fl. Apr.

Note – This species is part of the *G. rigidiuscula*-complex. The species can be distinguished by the venation with hardly joined nerves; the uninterrupted disc; the fruits with a short slender stipe, a thin wall, and lobes which are longer than high and which spread widely.

5. *Guioa asquamosa* Welzen, *Blumea* 33 (1988) 411; *Leiden Bot. Series* 12 (1989) 179, f. 66. — Type: *Metzner* 227 (L. holo), Timor.

*Guioa spec.*: Verheijen, *Dict. Manggarai Pl.*, Pac. Ling. ser. D, 43 (1982) 104.

*Tree*, medium-sized. *Branchlets* usually sericeous when young; flowering twigs 1.5–3 mm thick. *Leaves* 2–4-jugate; rachis 4.6–19 cm long, terete to apically flattened above, subglabrous, petiole 2.8–8 cm long; petiolules up to 0.9 cm long. *Leaflets* opposite (to alternate), ovate, 2.9–10.8 by

0.9–3.3 cm, index 2.9–3.9, asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate, not mucronulate; upper surface glabrous, (wax); lower surface duller, smooth, no papillae, glabrous to very sparsely pilose, domatia (0 or) 1 to many sac(s), in axil of basiscopic second nerve to in axils of most nerves; venation on upper side flat to raised, raised below; nerves 0.3–1.6 cm apart, marginally looped and joined; veins laxly reticulate, rather distinct. *Inflorescences* axillary, mainly branching along the terete to somewhat flattened, subsericeous, 2.2–13.2 cm long axis; first order branches up to 4.2 cm long; cymules cincinnate, 2- or 3-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 0.7–0.9 mm long; bracteoles 0.3–0.6 mm long; pedicels 3–6 mm long, subsericeous, articulate part less pilose. *Flowers* c. 4 mm in diam. *Sepals* 5, ovate, margin pilose, without glands, outside and inside glabrous; 2 outer smaller ones 1.3–1.8 by 1.3–1.8 mm; 3 inner larger ones 2.2–2.7 by 2.2–2.7 mm, margin petaloid. *Petals* 5, (elliptic to) obovate, 1.5–2.5 by 1.1–1.7 mm; claw 0.1–0.2 mm high; margin pilose, apex retuse to acute, outside and inside glabrous; scales free, very short, 0.1–0.3 mm high, apex not broadened; crest absent. *Disc* uninterrupted. *Stamens* 8; filaments 1.4–3.5 mm long, pilose, especially basally; anthers 0.4–0.7 mm long, glabrous. *Pistil*: ovary 0.5–1.5 mm high, subhirsute; style and stigma 0.2–1.5 mm long. *Fruits* with 1 or 2 well developed lobes, c. 1.4 by 1–1.4 cm, smooth, glabrous, blackish when dry; stipe c. 2 mm high, broadly obconical; margin blunt; lobes c. 9 by 9 mm. *Seeds* not mature.

Distribution – *Malesia*: Lesser Sunda Islands (Flores, Timor).

Habitat & Ecology – Altitude 800–1200 m. Fl. May–June.

6. *Guioa bicolor* Merr., *Philipp. J. Sc.* 17 (1920) 279; *Enum. Philipp Flow Pl.* 2 (1923) 507; *Radlk. in Engl., Pflanzenr.* 98 (1933) 1170; *Welzen, Leiden Bot. Series* 12 (1989) 181, f. 67. — Type: *BS (Ramos & Pascasio) 34487* (PNH† holo; A, K, P), Philippines.

*Tree*, 1–15 m high, dbh at least 4 cm; bark grey; wood white, hard. *Branchlets* sericeous when young, hairs brownish; flowering twigs 1–6 mm thick. *Leaves* 2–5-jugate; rachis 2.8–20.5 cm long, basally terete to apically flattened above, glabrous, petiole 2.1–9.1 cm long; petiolules up to 1 cm long. *Leaflets* opposite to subopposite, ovate to elliptic, 3.7–11.3 by 0.8–4.8 cm, index 2.4–4.6, asymmetrical, not falcate, acroscopic side broader, coriaceous to very coriaceous, punctate; base attenu-



ate; margin entire, flat to revolute; apex acuminate to caudate, usually abruptly narrowing (with a sinus), usually mucronulate; upper surface glabrous (except the puberulous midrib); lower surface dull, papillate, glabrous to shortly subsericeous, domatia absent to a single small sac on basiscopic side in axil of second nerve; venation raised, above concolorous with lamina; veins 0.2–2.3 cm apart, marginally looped and joined, but often less distinctly so in lower part of leaflets; nerves densely to laxly reticulate, rather distinct. *Inflorescences* axillary, unbranched to branching basally and along the flattened, subsericeous, glabrescent, 1.9–14.4 cm long axis; first order branches up to 6.4 cm long; cymes cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.6–1.3 mm long; bracteoles 0.3–0.9 mm long; pedicels 2.5–4.9 mm long, sericeous, glabrescent. *Buds* dark wine-red. *Sepals* 5, ovate, margin pilose, with glands, outside and inside (sub)glabrous, pink; 2 outer smaller ones 0.9–1.5 by 1.3–1.5 mm; 3 inner larger ones 2–3.5 by 1.8–3.5 mm, margin petaloid. *Petals* 5, elliptic, 2.8–3.2 by c. 1 mm, pinkish outside, white inside; blade elliptic, gradually decurrent into the c. 0.4 mm long claw, margin pilose, outside and inside glabrous, apex acute; scales c. 1.5 mm long, free, basally not auriculate, membranous margin distinct; crest a flat, pilose bifid part of scale apex when young, to clavate and glabrous when mature. *Disc* interrupted. *Stamens* 8; filaments c. 4 mm long, hirsute, especially basally; anthers c. 0.7 by 0.6 mm, glabrous, light pink. *Pistil*: ovary c. 0.6 mm high, subhirsute; style and stigma c. 0.4 mm long. *Fruits* with 1–3 well developed lobes, c. 1.5 by 1.5–2.1 cm, smooth, glabrous, blackish when dry; stipe c. 3.5 mm high, slender; margin blunt; lobes c. 11 by 5 mm. *Seeds* obovoid, c. 9 by 5 mm; hilum c. 1.4 mm long.

*Distribution* – *Malesia*: Philippines (Luzon, Mindanao, Sabtang I.).

*Habitat & Ecology* – On ridges, in woods, cut forest. Soil: iron deposits present; altitude 130–850 m. Bud: Apr.; fr. May.

7. *Guioa bijuga* (Hiern) Radlk., Sapind. Holl.-Ind. (1879) 38; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 521, 611; in Engl., Pflanzenz. 98 (1933) 1165; Corner, Gard. Bull. Str. Settl. 10 (1939) 44; Wayside Trees (1940) 588; Meijer, Bot. News Bull. 9 (1967) 74; Brüning, Heidewald Sarawak Brunei (1968) 372; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 153; Yap in Tree Fl. Malaya 4 (1989) 441; Welzen, Leiden Bot. Series 12 (1989) 183, f. 68, 69. — *Cupania pleuropteris* Blume var.

*bijuga* Hiern in Hook. f., Fl. Br. India 1 (1875) 677. — *Guioa pleuropteris* Radlk. var. *bijuga* King, J. As. Soc. Beng. 65, II (1896) 444; Ridley, Fl. Malay Penins. 1 (1922) 505. — Type: Wallich KD 8094 (K holo; BM, K), Malaya. [*Guioa rubrofusca* Radlk. ex Merr., Pl. Elm. Born. (1929) 175, nom. nud.; Radlk. in Engl., Pflanzenz. 98 (1933) 1177; Masamune, Enum. Phan. Born. (1942) 427. Based on *Elmer* 21392.] See note 2.

*Tree*, 3–30 m high, dbh 5 cm to 1 m; outer bark smooth to somewhat finely fissured, usually hard, usually whitish to (dark) grey with dark patches, also (red-)brown, inner bark yellow to red to brown, (fibrous); cambium white to yellow (to red); sapwood white with growth rings to brown; heartwood pinkish brown. *Branchlets* usually glabrous, at most shortly sericeous when young, hairs brownish; flowering twigs 1–7.5 mm thick. *Leaves* 1–4-jugate; rachis 0.8–16.8 cm long, usually flattened above, wing up to 2 mm broad, rachis at most puberulous, petiole 0.7–11 cm long. *Leaflets* subsessile, opposite to subopposite (to alternate), elliptic, 2.1–20 by 1.1–8.4 cm, index 1.2–4, usually symmetrical, subcoriaceous to very coriaceous, punctate; base sharply attenuate; margin entire, flat (to revolute); apex abruptly (acuminate to) cuspidate, very apex obtuse (to acute), not mucronulate; upper surface glabrous to slightly sericeous; lower surface duller, smooth (to slightly papillate), glabrous (to sparsely sericeous especially on the midrib), domatia absent or a single small sac on basiscopic side in axil of second or third nerve (see note 3); venation on upper surface (slightly sunken to) flat to raised, concolorous with lamina, below raised; nerves 0.3–4.2 cm apart, marginally looped and joined, (less so in lower third of leaflets); veins laxly reticulate, rather indistinct. *Inflorescences* axillary (to pseudoterminal), (unbranched to) branching basally to especially along the terete to flattened, glabrous to pilose, 0.7–16.5 cm long axis; first order branches up to 7.4 cm long; cymes cincinnate, 1–3(–6)-flowered; bracts and bracteoles deltate to triangular, outside sericeous, inside (sub)glabrous; bracts 0.5–1.9 mm long; bracteoles 0.2–1 mm long; pedicels 2.2–10 mm long, sericeous, (less so above articulation). *Flowers* 3.5–4.2 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside (sub)glabrous, green; 2 outer smaller ones 1–2.8 by 1–2.3 mm; 3 inner larger ones 1.4–3.4 by 1.2–3.8 mm, margin petaloid. *Petals* 5, obovate, 1.8–3.8 by 0.7–1.7 mm, white to yellow, blade obovate, gradually decurrent into the 0.4–1.2 mm high claw, margin pilose, outside and inside

(sub)glabrous, apex emarginate to acute; scales (0.8–)1.2–2 mm long, free, basally without auricles, membranous margin indistinct, apex not to hardly broadened; crest a pilose flat part of the bifid scale apex. *Disc* interrupted. *Stamens* 8; filaments 1.6–5 mm long, pilose, especially basally; anthers 0.2–0.4 mm long, glabrous. *Pistil*: ovary 0.3–1.8 mm high, sparsely hirsute; style and stigma 0.2–2.5 mm long. *Fruits* with 1–3 well developed lobes, 1.2–2.3 by 1.3–2.6 cm, smooth to somewhat ribbed or rugose-ruminate, glabrous, blackish when dry; stipe 2–5 mm high, rather slender; margin blunt; lobes 8.5–14 by 8–16 mm; wall less than 2 mm thick; septa complete. *Seeds* (globose to) obovoid, 8–9.8 by 7–7.8 mm; hilum 1.1–2 mm long; arillode with pseudo-funicle.

Distribution – Thailand to *Malesia*: Peninsular Malaysia, Sumatra, Borneo, Philippines (Balabac I., Palawan).

Habitat & Ecology – Often common. In lower and middle storey of primary and especially secondary forest, savannah (kerangas), along roads, rivers, margin of forest, mangrove, in peat swamp, sometimes in cultivated fields. Soil: sandstone, podsolized white sand, ultrabasic, red-yellow loam; altitude sea level up to 1525 m. Fl. mainly (Nov.–) Feb.–Mar.(–Apr.), less so in Aug.–Sept.; fr. mainly Mar.–June, less so in Sept. and Oct.

Notes – 1. Several specimens, growing on poor white sand, have smaller leaflets (3.2–14 by 1.5–7.9 cm), which are very thick and scleromorphic; leaflets of specimens on richer soil are 3.9–19.6 by 1.8–8.4 cm, thinner, less scleromorphic. The same phenomenon can be observed in *G. acutifolia*.

2. One specimen is exceptional; *S* 32186: leaflets with many pockets, lower surface very papillate and somewhat sericeous.

3. The difference between *G. bijuga* and *G. pubescens* is often vague on Borneo. Usually, *G. bijuga* has elliptic leaflets which are smooth and usually glabrous below; the fruits are glabrous too. *Guioa pubescens* usually has ovate leaflets, which are papillate below and sericeous, the fruits are glabrescent. On Borneo, *G. bijuga* can be papillate and somewhat sericeous, while *G. pubescens* can have rather elliptic and more glabrous leaflets, especially in Sarawak and on the Kinabalu. Even there the more ovate shape of the leaflets and the few hairs remaining on the fruit indicate *G. pubescens* and the flattened above to winged rachis indicates *G. bijuga*. There are also anatomical differences: *G. bijuga* always has secretory idioblasts, while *G. pubescens* always lacks them.

8. *Guioa comesperma* Radlk., Sitzungsber.

Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1870) 357; Bot. Jahrb. 50 (1914) 77; 56 (1921) 281; in Engl., Pflanzenr. 98 (1933) 1173; Peekel, Fl. Bismarck-Arch. (1984) 337, f. 545; Welzen, Leiden Bot. Series 12 (1989) 188, f. 71. — Lectotype (Van Welzen 1989): *MacGregor s.n.*, 1889, p.p. (M holotype; MEL), New Guinea.

*Nephelium winterianum* F.M. Bailey, Queensl. Agr. J. 3 (1898) 283. — Type: *Bailey s.n.* (BRI holotype; K), New Guinea.

*Guioa rigidiuscula* auct. non Radlk.: Hartley et al., Lloydia 36 (1973) 270.

*Guioa subsericea* auct. non Radlk.: Streimann, Pl. Upper Watut Watershed (1983) 169 (p.p.: *NGF* 9176, 14484).

*Guioa spec.*: Streimann, Pl. Upper Watut Watershed (1983) 169 (p.p.: *NGF* 14494).

(*Shrub* to *tree*, 2–18 m high, dbh 7–30 cm; outer bark smooth to finely vertically fissured to fluted, reddish brown to grey, usually patched, inner bark straw-coloured to pink to dark orange-red; sapwood white to pale pink, heartwood pinkish. *Branchlets* usually shortly sericeous when young, hairs brownish; flowering twigs 1.5–8 mm thick. *Leaves* 1–4-jugate; rachis 1.8–14.8 cm long, terete to winged, wing up to 3 mm broad, subglabrous, petiole 0.9–6.6 cm long; petiolules up to 0.7 cm long. *Leaflets* opposite to alternate, ovate to elliptic, 3.8–18.5 by 1.3–8.4 cm, index 2–3.8, often asymmetrical, acroscopic side broader, subcoriaceous, punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate (to caudate), usually mucronulate; upper surface glabrous (except midrib sparsely puberulous); lower surface duller, smooth (to papillate), glabrous to very sparsely sericeous, domatia small, 2 to many in axils of nerves, basally sacs to apically pockets; venation on upper side (slightly sunken) to flat (to raised), raised below; nerves 0.2–2.5(–3.5) cm apart, marginally looped and joined, (less distinctly so in lower part of leaflets); nerves laxly reticulate, often distinct. *Inflorescences* axillary to pseudoterminal, branching basally and along the terete to ribbed, subglabrous to sericeous, 1–17.6 cm long axis; first order branches up to 7.8 cm long; cymules cincinnate (to dichasial), 2–4(–7)-flowered; bracts and bracteoles deltate to triangular, outside sericeous, inside glabrous; bracts 0.4–1.3 mm long; bracteoles 0.2–0.6 mm long; pedicels 1.1–4.5 mm long, sericeous except subglabrous above articulation. *Flowers* 4–4.5 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, green to pinkish; 2 outer smaller ones 0.7–2 by 0.6–1.8 mm; 3 inner larger ones 1.8–3.2 by 1.7–3.5 mm, margin petaloid. *Pet-*

als (4 or) 5, elliptic, 2.1–3.8 by 0.6–1.7 mm, white to pale pink; blade gradually decurrent into the 0.3–0.8 mm high claw; margin and less so outside pilose, inside (sub)glabrous, apex acute; scales 0.7–2 mm long, free, basally not auriculate; crest clavate, long stiped, apex lobed, glabrous, yellow. *Disc* interrupted. *Stamens* 8; filaments 1.1–4.5 mm long, pilose, especially basally; anthers 0.3–0.8 mm long, sparsely pilose, (purplish) pink. *Pistil*: ovary 0.2–2 mm long, subhirsute; style and stigma 0.1–2 mm long. *Fruits* with 1–3 well developed lobes, 0.8–1.5 by 0.9–2 cm, smooth to rugosely ribbed, glabrous, red when fresh, reddish to reddish black when dry; stipe 1.5–4.5 mm high, slender; margin blunt; lobes 7–11 by 5.5–11 mm; septa complete. *Seeds* obovoid, 6–8.5 by 4.3–6.5(–8) mm, glossy dark brown; hilum 0.8–1.4 mm long.

Distribution – *Malesia*: Papua New Guinea (Southern Highlands, Western Highlands, Madang, Morobe, West & East New Britain, New Ireland, Manus, Northern, Milne Bay, Central Prov.) to NE Australia (Queensland: Cook Dist.).

Habitat & Ecology – In savannah, secondary forest, lower montane forest on steep slopes or ridges, sometimes in primary lowland rain forest; along banks of rivers, lakes, mangrove, beach. Usually found in more open vegetations. Vegetation type in Australia: Semideciduous mesophyll vine forest. Dominant plants in vegetation: *Casuarina*, *Eucalyptus deglupta*. Soil: alluvial, sand, limestone, rock, ultrabasic; altitude sea level up to 900 m. Fl. (Apr.–)May–Oct.(–Dec.); fr. Jan.–Oct.

Notes – 1. *Guioa comesperma* belongs to the *G. rigidiuscula*-complex.

2. A topocline can be found from the Central Province via Milne Bay towards the northern provinces. In Central Province the specimens have winged rachises, leaflets without papillae, and highly stipitate, small fruits with slender lobes. In Milne Bay the fruits are still the same, but the wing is seldom present and then usually very narrow. In Morobe Province and the other more northern and western provinces the specimens have no wings, the leaflets can be papillate, and the fruits are usually larger (lobes broad and stipe small).

3. Distinguishing between *G. subsericea* and specimens of *G. comesperma* with large fruits and papillate, subsericeous leaflets is difficult when the specimens bear fruit. Then the only difference is the disc, which is interrupted in *G. comesperma*, and uninterrupted in *G. subsericea*. Flowering specimens are easier to separate, because the petals are very different, those of *G. comesperma* are large (2.1–3.8 mm long) with long, broad, free scales with big crests, while in *G. subsericea* the petals are much smaller (0.9–2.1 mm long), have infold-

ed auricles as scales, and the crest is usually absent but can be as well developed as in *G. comesperma*.

9. *Guioa contracta* Radlk., Bot. Jahrb. 50 (1914) 77; 56 (1921) 283; in Engl., Pflanzenr. 98 (1933) 1174; Welzen, Leiden Bot. Series 12 (1989) 191, f. 72. — Type: *Schlechter 18269* (B<sup>+</sup> holo; K, P), New Guinea.

*Guioa arysterifolia* auct. non Radlk.: Hartley et al., Lloydia 36 (1973) 269.

*Guioa comesperma* auct. non Radlk.: Hartley et al., Lloydia 36 (1973) 270 (p.p.: Hartley 10976, 12635).

*Tree*, 5–27 m high, dbh 8–20 cm; outer bark smooth to faintly longitudinally fissured, light grey to reddish brown to dark blackish green, inner bark light straw to pale brown; wood soft, (straw-)white. *Branchlets* sericeous when young; flowering twigs 2.5–15 mm thick. *Leaves* 1–3-jugate; rachis 2.3–19.2 cm long, terete, (sub)glabrous, petiole 2–8.5 cm long; petiolule up to 1.1 cm long. *Leaflets* subopposite to alternate, elliptic, 7.6–24.2 by 3–8.9 cm, index 2.1–3.3, ± symmetrical, otherwise acroscopic side broader, subcoriaceous, punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate, very apex obtuse (to mucronulate); upper surface glabrous; lower surface duller, smooth, no papillae, glabrous to often very sparsely sericeous, domatia absent; venation on upper side flat, raised on lower; nerves 0.3–3.3 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins laxly reticulate, rather indistinct. *Inflorescences* cauli- to ramiflorous (to axillary), branching basally to mainly along the terete, subsericeous, 1.3–18 cm long axis; first order branches up to 8.3 cm long; cymes cincinnate, (1–)3–4-flowered; bracts and bracteoles triangular, outside hirsute, inside glabrous; bracts 0.5–1 mm long; bracteoles 0.2–0.5 mm long; pedicels 1.8–5 mm long, completely sericeous. *Flowers* 3.5–4 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, pale green; 2 outer smaller ones 0.7–1.4 by 1.1–2 mm; 3 inner larger ones 1.8–2.8 by 1.5–3 mm, margin petaloid. *Petals* 5, ovate to elliptic (to obovate), 1.7–2.8 by 0.5–1.3 mm, white; claw 0.2–0.4 mm high; margin and less so outside pilose, inside glabrous, apex rounded to acute; scales 0.7–1.6 mm long, free, basally not auriculate; crest clavate, stipitate, apex lobed. *Disc* interrupted. *Stamens* 8; filaments 1.2–3.5 mm long, completely pilose, especially basally pilose, white; anthers 0.4–0.6 mm long, glabrous to subpilose. *Pistil*: ovary 0.3–0.6 mm long, subhirsute; style and stigma 0.2–0.6 mm long. *Fruits*



with 1–3 well developed lobes, 1.4–1.9 by 1.3–2.4 cm, smooth to rugose, glabrous, not dehiscing to only (partly) dehiscing when completely ripe, red when fresh, blackish when dry; stipe 1–1.5 mm high, broadly obconical; margin blunt; lobes 11–15 by 9–15 mm, widening towards the axis in transverse view; wall at suture up to 3.5 mm thick; septa complete. *Seeds* obovoid, c. 8 by 7.5 mm; arilode without a pseudo-funicle, basal rim present; hilum c. 1 mm long.

Distribution – *Malesia*: Papua New Guinea (Madang, Morobe, Northern, and Central Prov.).

Habitat & Ecology – In lowland and montane rain forest, secondary forest bordering oak forest, scrubby forest along creeks and mangrove, along roadsides; altitude sea level up to 1500 m. Fl. Aug.–Oct.; Fr. July. Many twigs hollow with ants.

Note – *Guioa contracta* is part of the *G. rigidiuscula*-complex and it is characterized by its rather large, almost glabrous, elliptic leaflets without papillae and domatia, and its distinctive hardly lobed fruits. The lobes do not narrow towards the axis in transverse section, but widen; the wall is very thick (the fruits dehisce late and presumably only partly); the pseudo-funicle is reduced to a rim only.

**10. *Guioa diplopetala*** (Hassk.) Radlk., Sapind. Holl.-Ind. (1879) 88; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 514, 521, 543, 610; Valetton, Bull. Inst. Bot. Buitenzorg. 15 (1902) 10; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 207; Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 63; Moll & Janss., Mikrogr. Holz. 2 (1911) 377; Koord., Exk. Fl. Java 2 (1912) 542; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 507; Pl. Elm. Born. (1929) 175; Radlk. in Engl., Pflanzenr. 98 (1933) 1162; Desch, Mal. For. Rec. 15 (1954) 526; Salvosa, Lex. Philipp. Pl. (1963) 104; Backer & Bakh. f., Fl. Java 2 (1965) 140; Welzen, Leiden Bot. Series 12 (1989) 197, f. 76, 77. — *Cupania diplopetala* Hassk., Flora 25, 2, Beibl. (1842) 39; Cat. Hort. Bog. (1844) 224; Pl. Jav. Rar. (1848) 286. — *Guioa diplopetala* f. *genuina* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 610, nom. illeg.; in Engl., Pflanzenr. 98 (1933) 1162. — Type: not indicated, either Herbarium Hasskarl or Herbarium Bogoriense (n.v.), Java.

*Guioa squamosa* Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 303, nom. nud.] Sapind. Holl.-Ind. (1879) 38; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 544, 609;

King, J. As. Soc. Beng. 65, II (1896) 444; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66; Brandis, Ind. Trees (1906) 186; Lecomte in Fl. Indo-Chine 1 (1912) 1025; Ridley, Fl. Malay Penins. 1 (1922) 506; Radlk. in Engl., Pflanzenr. 98 (1933) 1161; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 981; Yap in Tree Fl. Malaya 4 (1989) 442. — [*Sapindus squamosa* Wall., non Roxb., Cat. (1847) 8097, nom. nud., nom. inval.] — *Guioa squamosa* f. *genuina* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 609, nom. illeg.; in Engl., Pflanzenr. 98 (1933) 1161. — Type: *Wallich 8097* (K holotype; A, BM, Fl. P.), Malay Peninsula.

*Cupania regularis* Blume, Rumphia 3 (1847) 159; Walp., Ann. 2 (1851/2) 214; Filet, Plantk. Woordenb. ed. 2 (1888) 277, nr. 8115. — *Guioa regularis* Radlk., Sapind. Holl.-Ind. (1879) 12, 41; Masamune, Enum. Phan. Born. (1942) 427. — *Guioa diplopetala* f. *borneensis* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 610; in Engl., Pflanzenr. 98 (1933) 1162. — *Guioa diplopetala* var. *borneensis* Radlk., Bot. Jahrb. 49 (1913) 370. — Lectotype (Van Welzen 1989): *Korthals s.n.*, no date (L, sh. 908.269-309), Borneo.

*Cupania minjalilen* Blume, Rumphia 3 (1847) 162. — *Guioa minjalilen* Radlk., Sapind. Holl.-Ind. (1879) 10, 37; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 609. — Lectotype (Van Welzen 1989): *Waitz s.n.* (L holotype; L, P), Java.

*Arytera karang* Miq., Sumatra (1861) 510; Filet, Plantk. Woordenb. ed. 2 (1888) 151, nr. 3862b. — Type: *Diepenhorst HB 2487* (U holotype; BO), Sumatra.

*Cupania fuscidula* Kurz, J. As. Soc. Beng. 41, II (1872) 302; *ibid.* 44, II (1875) 188, 189 (type); Hiern in Hook. f., Fl. Br. India 1 (1875) 676; Kurz, Fl. Burm. 1 (1877) 284. — *Guioa fuscidula* Radlk., Sapind. Holl.-Ind. (1879) 38; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 515, 609; King, J. As. Soc. Beng. 65, II (1896) 445; Brandis, Ind. Trees (1906) 186; Ridley, Fl. Malay Penins. 1 (1922) 506; Burk. & Hend., Gard. Bull. Str. Settl. 3 (1925) 363; Radlk. in Engl., Pflanzenr. 98 (1933) 1161; Corner, Gard. Bull. Str. Settl. 10 (1939) 44; Wayside Trees (1940) 588; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 979; Meijer, Bot. News Bull. 9 (1967) 75; Yap in Tree Fl. Malaya 4 (1989) 442. — Type: *Helper 993* (K holotype; A, L, M, P, W), Burma.

*Guioa squamosa* Radlk. f. *lineolata-punctata* Radlk., Sitzungsber. Math.-Phys. Cl. Königl.



- Bayer. Akad. Wiss. München 9 (1879) 609; in Engl., Pflanzn. 98 (1933) 1161. — Type: *Helfer 983* (K holotype; A, P), Burma.
- Guioa diplopetala* f. *microcarpa* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 610; in Engl., Pflanzn. 98 (1933) 1162. — Type: *Beccari FI 2812* (FI holotype, cited by Radlkofer as *Beccari 6*), Celebes.
- Guioa leptoneura* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 611, 618; in Engl., Pflanzn. 98 (1933) 1163. — Syntypes: *Beccari FI 2807* (FI, cited by Radlkofer as *Beccari 7*”). Celebes, Kandari Prov., Lepo-lepo; *Riedel s.n.* (BO, K, W), Celebes.
- Guioa fuscidula* (Kurz) Radlk. var. *glabrescens* King, J. As. Soc. Beng. 65, II (1896) 445; Ridley, Fl. Malay Penins. 1 (1922) 506. — Type: *Scortechini 1714* (K holotype), Malay Peninsula.
- Guioa microphylla* Radlk., Rec. Bot. Surv. India 3 (1908) 354; Ridley, Fl. Malay Penins. 1 (1922) 506; Radlk. in Engl., Pflanzn. 98 (1933) 1161; Corner, Gard. Bull. Str. Sett. 10 (1939) 43. — Type: *C. Curtis 1346* (K holotype), Malay Peninsula.
- Guioa bullata* Radlk. in Fedde, Rep. 18 (1922) 342; in Engl., Pflanzn. 98 (1933) 1164; Masamune, Enum. Phan. Born. (1942) 426. — Lectotype (Welzen, 1989): *Haviland 1003* (K holotype; M), Borneo (cited by Radlkofer as *Haviland 1063*).
- Guioa* sp. 1: Yap in Tree Fl. Malaya 4 (1989) 443. — Based on *KEP 99960* (KEP, n.v., SAN), Malaysia, Kedah Peak; *KEP FRI 3892* (K, L; KEP, n.v.), Malaysia.
- Guioa* sp. 2: Yap in Tree Fl. Malaya 4 (1989) 443. — Based on *KEP FRI 15969* (K, L; KEP, n.v.), Malaysia, Selangor, Fraser's Hill; *KEP FRI 19164* (K, KEP, L), Malaysia.
- ?*Guioa* sp. 3: Yap in Tree Fl. Malaya 4 (1989) 443. — Based on *KEP 56953* (KEP, n.v.), Malaysia.
- Arytera montana* auct. non Blume: Miq., Sumatra (1861) 510.
- Cupania glabrata* auct. non Kurz: Hiern in Hook. f., Fl. Br. India 1 (1875) 676, p.p. (*Wallich 8097, 8550*).
- Cupania griffithiana* auct. non Kurz: Kurz, J. As. Soc. Beng. 44, II (1875) 188, p.p. (*Helfer 983*); Fl. Burm. 1 (1877) 284. See Van Welzen (1989: 262) note 2 under *G. pleuropteris* for nomenclature.

*Shrub to tree*, 1–18.5 m high, dbh 3 cm to 1.3 m; outer bark smooth, grey-brown to grey-white, inner bark pink to pale brown; sapwood white to light yellow. *Branchlets* usually brown sericeous when young; flowering twigs 1.5–25 mm thick.

*Leaves* 1–9-jugate; rachis 2.3–33.5 cm long, terete to upwards flattened above, glabrous to subsericeous, petiole 1.4–13.5 cm long; petiolules 0–0.9 cm long. *Leaflets* opposite to alternate, (ovate to) elliptic, 2.3–24.3 by 0.8–7.8 cm, index (1.1)–2.5–5.9, (slightly) especially basally asymmetrical, the aeresopic side broader, coriaceous, usually punctate; base attenuate; margin entire (to crenate), flat (to revolute); apex (obtuse to) acuminate to cuspidate (to caudate), usually not mucronulate; upper surface usually glabrous to slightly sericeous; lower surface duller, smooth (to papillate), glabrous (to slightly sericeous to subvillous), domatia (0 or 1 to) many small sacs (to pockets), in axils of nerves; venation on upper surface (slightly sunken to) flat to raised, raised on lower side; nerves 0.2–3.7 cm apart, marginally looped and joined, (less distinctly so in lower part of leaflets); veins laxly reticulate, usually indistinct. *Inflorescences* (ramiflorous to) axillary (to pseudoterminal), (unbranched to) branching basally and along the terete to slightly flattened, subsericeous (to subhirsute), 0.4–18 cm long axis; first order branches up to 9 cm long; cymes cincinnate (to dichasial), 2–6-flowered; bracts and bracteoles deltate to triangular, outside sericeous, inside (sub)glabrous; bracts 0.5–2 mm long; bracteoles 0.2–0.9 mm long; pedicels 1.8–7.3 mm long, completely sericeous. *Flowers* 3–4.5 mm in diam., without scent. *Sepals* 5, ovate, margin and sometimes outside pilose, margin with glands, inside glabrous, green; 2 outer smaller ones 0.9–2.8 by 0.8–2.1 mm; 3 inner larger ones 1.4–3.4 by 1.2–3.6 mm, margin petaloid, white. *Petals* 5, elliptic to obovate, 0.5–4 by 0.3–2.2 mm, white; claw 0.2–1 mm high; margin pilose, outside and inside (sub)glabrous, apex rounded to acute; scales 0.3–2 mm long, free, apex (very) much broadened; crest usually absent to a pilose flat part of the bifid scale apex. *Disc* uninterrupted, yellow. *Stamens* 8; filaments 1.2–5 mm long, pilose, especially basally, white; anthers 0.3–0.8 mm long, glabrous to slightly pilose, pink. *Pistil*: ovary 0.2–2 mm long, subhirsute, light green to white; style and stigma 0.1–2 mm long. *Fruits* with 1–3 well developed lobes, 0.7–1.5 by 0.7–1.8 cm, smooth to somewhat ribbed, glabrous, red when fresh, blackish when dry; stipe 2–5 mm high, slender; margin blunt; lobes 5–10 by 4–9.5 mm. *Seeds* obovoid, 5–9 by 4.1–7.3 mm, black; hilum 0.8–2 mm long. — **Figs. 39, 40.**

**Distribution** — Burma, Thailand, Cambodia, Vietnam, *Malesia*: Malay Peninsula, Sumatra, Java, Borneo, Celebes.

**Habitat & Ecology** — Regularly encountered, but not common. In primary and especially in secondary forest, in heath forest, submontane forest, edge



Fig. 39. *Guioa diplopetala* (Hassk.) Radlk. a. Habit; b. petal; c. fruit (a, c: *Rahayu & Maskura* 540; b: *Beumée* A765).

of forest, along rivers, roads, seashore, in deserted cultivated fields, savannah (belukar). Soil: granitic sand, basalt, clay, loam on sandstone, limestone, marshy sand; altitude sea level up to 1700 m. Fl. Sept.–Apr.; fr. Dec.–Apr. Said to be poisonous

Uses – Boiled roots act against blennorrhoea (suppurating inflammation of mucous membranes; Pételot, *Pl. Medic. Cambodge, Laos, Viet-Nam* 1, 1952, 201). The wood is apparently usable for house

construction (De Clercq, *Nieuw Plantk. Wordenb.*, 1909, 251, nr. 1710), and is resistant against termites and used as poles (Gagnep. in *Fl. Indo-Chine, Suppl. 1*, 1950, 981). The wood of *G. bijuga*, rather similar to that of *G. diplopetala*, seems to be very vulnerable to insect attack. The arillode is presumably edible (Pételot, 1952).

Notes – 1. *Guioa diplopetala* is a very widespread and variable species, with a peculiar, almost

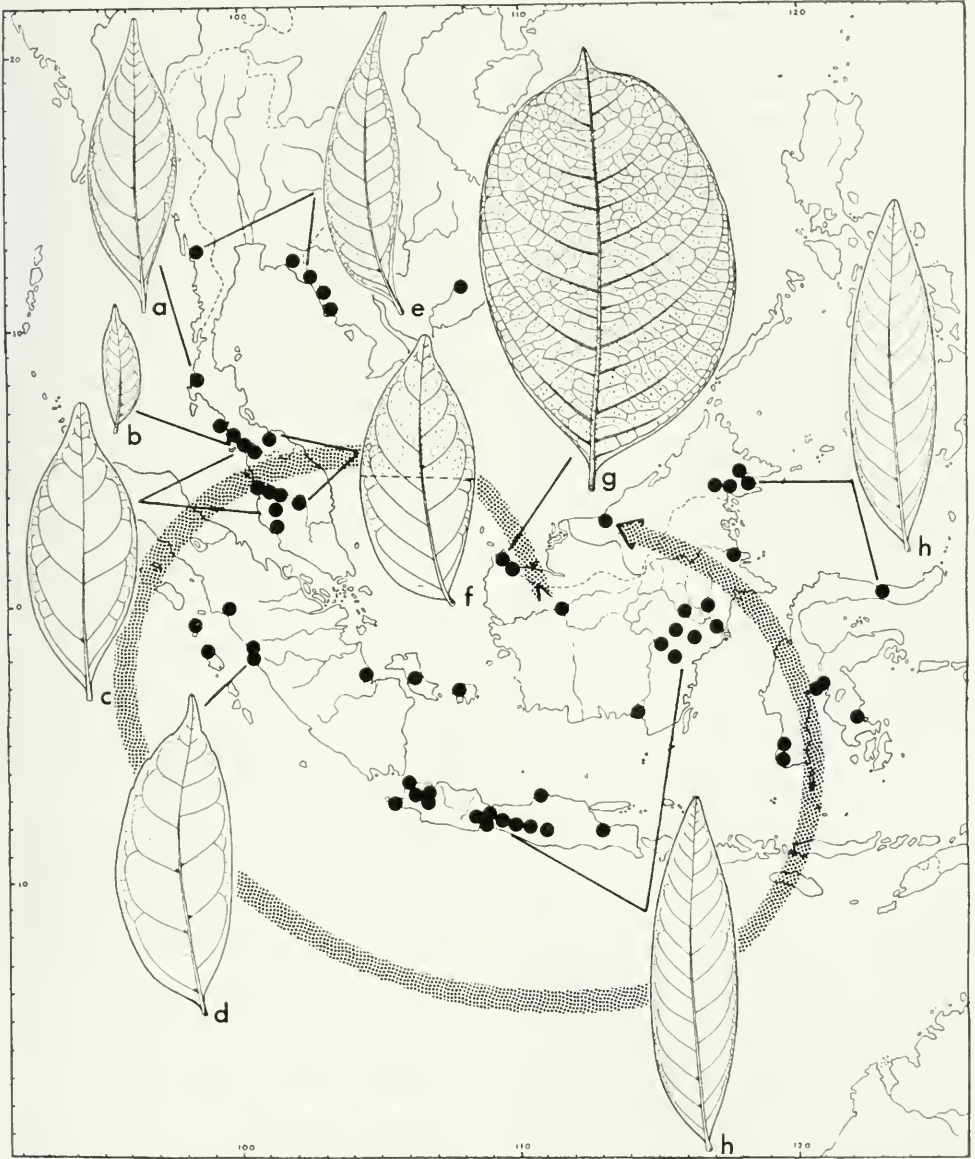


Fig. 40. *Guioa diplopetala* (Hassk.) Radlk. Distribution map showing the change in leaflet form from W to E Borneo (all leaflets c.  $\times 0.7$ ). — a. '*G. squamosa*' form; b. '*G. microphylla*' form; c. '*G. squamosa*' form; d. intermediate between the '*G. squamosa*' and '*G. diplopetala*' forms; e. '*G. squamosa*' form; f. upper half: '*G. fuscidula*' form, pilose; lower half: '*G. fuscidula* var. *glabrescens*' form, glabrous; g. '*G. bullata*' form; h. '*G. diplopetala*' form (a: Geesink et al. 7688; b: Curtis 1346; c: Curtis 1041; d: Iboet 304; e: Put 3024; f: upper half Helfer 993, lower half Scortechini 1714; g: Haviland 2137; h: Rahayu & Mas-kura 540).



circular distribution of forms, see Fig. 40. On Borneo two distinguishable forms are present (Fig. 40g, h); specimens which link these two forms are found on the Malay Peninsula, Sumatra, and Java (see arrow in Fig. 40). The form '*G. bullata*' has been described for the west point of Borneo (S Sarawak and SW Kalimantan; Fig. 40g shows an extreme form); the leaflets are broad, have a low leaf-index, an asymmetrical base, and are slightly villose below. The same form has been described for the Malay Peninsula as '*G. fuscidula*' (Fig. 40f upper half), and here the base can be even more asymmetrical, the indumentum is somewhat more hirsute. The latter form is connected to '*G. squamosa*' (Fig. 40a, c, e; synonym: *G. cambodiana*), and '*G. microphylla*' with very small leaflets (Fig. 40b), through '*G. fuscidula* var. *glabrescens*' (Fig. 40f, lower half), all from the Peninsula; '*G. squamosa*' has smaller asymmetrical leaflets with a somewhat higher leaf-index and lacks the hirsute indumentum. Intermediate forms between '*G. fuscidula*/*G. squamosa*' and typical '*G. diplopetalata*' (syn.: *G. regularis*) are found on Sumatra (Fig. 40d). Typical *G. diplopetalata* is found on Sumatra, Java, E Borneo (the other form of Borneo!) and Celebes (Fig. 40h); the leaflets are rather symmetrical, long, narrow (high leaf-index), and lack hairs (sometimes the leaflets are very sparsely pilose below). The two forms on Borneo are spatially separated by the geologically old (dating from before the glacial periods) Lupar River system in W Borneo. This river is also a border for other species from different families, e.g., 57 species of *Dipterocarpaceae* occur east or west of it (Ashton, Ann. Missouri Bot. Gard. 64, 1977, 694–705). The presence of the central mountain range in Borneo may have prevented a further mingling of both forms; however, few collections have been made in central Borneo and it is therefore possible that intermediates exist in Borneo itself.

2. From Java northwards to Borneo and Celebes the fruits gradually become somewhat smaller.

**11. *Guioa discolor*** Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1609; Philipp. J. Sc., Bot. 8 (1914) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 507; Radlk. in Engl., Pflanzenr. 98 (1933) 1168; Welzen, Leiden Bot. Series 12 (1989) 203, f. 78. — Lectotype (Van Welzen 1989): *Elmer 7493* (M holotype; A, BM, FI, K, L, NY, W), Philippines.

*Tree*, 6–13 m high, dbh 15–20 cm; outer bark grey; wood white, hard. *Branchlets* sericeous when young; flowering twigs 3–8.5 mm in diam. *Leaves* 3–5-jugate; rachis 4.3–22 cm long, basally terete to upwards flattened, subglabrous, petiole 1.8–8.3

cm long; petiolules up to 1 cm long. *Leaflets* opposite to subopposite, ovate, falcate, 4.9–14.4 by 1–3.6 cm, index 3.5–5, asymmetrical, acroscopic side broader, (very) coriaceous, not punctate; base attenuate; margin entire, flat to revolute; apex cuspidate to caudate, gradually narrowing, usually mucronulate; upper surface glabrous; lower surface dull, densely whitish papillate, sericeous, domatia 0 or 1 small sac on basicopic side in axil of second nerve; venation on upper surface flat (to raised), concolorous with lamina, below raised; nerves 0.2–1.8 cm apart, marginally looped and joined; veins laxly reticulate, usually rather indistinct. *Inflorescences* axillary, branching basally and along the usually flattened, brown sericeous, 1.3–9.5 cm long axis; first order branches up to 3.3 cm long; cymules cincinnate, c. 2-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 0.8–1.2 mm long; bracteoles 0.7–0.8 mm long; pedicels 1.8–4.5 mm long, sericeous except for the subglabrous articulate part. *Flowers* c. 4.2 mm in diam.; buds dark wine-red. *Sepals* 5, ovate, margin pilose, with glands, outside and inside (sub)glabrous, green to pink; 2 outer smaller ones 1.2–1.3 by 1.1–1.3 mm; 3 inner larger ones 1.5–2.2 by 1.5–2.2 mm, margin petaloid. *Petals* 5, elliptic to obovate, 2.5–2.7 by 0.6–1 mm, white to pink; blade obovate, gradually decurrent into the 0.7–1 mm long claw, margin pilose, outside and inside glabrous, apex obtuse to acute; scales 1.1–1.7 mm long, free; crest a pilose flat part of the bifid scale apex to subglabrous and clavate. *Disc* interrupted. *Stamens* 8; filaments 2.8–3.7 mm long, pilose, especially basally; anthers c. 0.3 mm long, glabrous, pink. *Pistil*: ovary 0.4–0.7 mm long, subhirsute; style and stigma 0.4–0.5 mm long. *Fruits* immature.

Distribution – *Malesia*: Philippines (Luzon, Samar).

Habitat & Ecology – Primary dipterocarp forest; altitude 90–850 m. Fl. May–June.

**12. *Guioa grandifoliola*** Welzen, Blumea 33 (1988) 412, pl. 4a, b; Leiden Bot. Series 12 (1989) 214, f. 83. — Type: *NGF (Streimann) 45154* (L holotype; BRI, K; LAE, n.v.). Papua New Guinea.

*Tree*, 5–25 m high, dbh 5–30 cm; outer bark slightly pustular, grey to red-brown, inner red-orange; wood of moderate weight and hardness, cream. *Branchlets* shortly sericeous when young; flowering twigs 5–19 mm thick. *Leaves* 2- or 3-jugate; rachis 5.8–21 cm long, terete, glabrous, petiole 1.7–9.5 cm long. *Leaflets* subsessile, opposite to subopposite, ovate, 10.9–30 by 3.8–13.3 cm, index 2.1–2.9, ± symmetrical, otherwise acro-



scopic side broader, coriaceous, not punctate; base attenuate; margin entire, flat; apex acute to cuspidate, mucronulate; upper surface glabrous, usually wax; lower surface duller, smooth, no papillae, glabrous, domatia absent; venation on upper side flat (to raised), raised on lower; nerves 0.4–4.3 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins laxly reticulate, indistinct. *Inflorescences* ramiflorous (to axillary), unbranched to branching basally and along the flattened to terete, (sub)sericeous, 0.7–12.7 cm long axis; first order branches up to 8.5 cm long; cymules cincinnate; bracts and bracteoles triangular, outside hirsute, inside glabrous; bracts 0.9–1 mm long; bracteoles 0.3–0.6 mm long; pedicels 4–5.6 mm long, sericeous except for the subglabrous articulate part. *Flowers* unknown. *Sepals* 5, ovate, margin pilose, outside and inside glabrous, light green; 2 outer smaller ones 0.8–1.7 by 1.5–1.8 mm, margin with glands; 3 inner larger ones 1.9–3 by 2–3 mm, margin petaloid, without glands. *Petals* unknown. *Disc* interrupted. *Stamens* unknown. *Pistil* unknown. *Fruits* with 1–3 well developed lobes, 1.2–1.6 by 2–2.7 cm, smooth to slightly rugose or ribbed, glabrous, red when fresh, black when dry; stipe 1–1.5 mm high, broadly obconical; margin blunt; lobes 12–16 by 10–14 mm; wall 1–3 mm thick near suture; septa complete. *Seeds* obovoid, c. 7.5 by 5.5 mm; pseudo-funicle often reduced in size to a basal rim on arilode; hilum c. 1.1 mm long.

Distribution – *Malesia*: Papua New Guinea (Morobe, Northern Prov.).

Habitat & Ecology – In lowland rain forest (Dipterocarp-dominated), advanced secondary forest and gallery forest; altitude sea level up to 400 m. Fr. Aug.

Note – *Guioa grandifoliola* is part of the *G. rigidiuscula*-complex and is characterized by its enormous, ovate leaflets without indumentum and domatia. The fruits are like those of *G. rigidiuscula*, only smaller.

**13. *Guioa hirsuta*** Welzen, *Blumea* 33 (1988) 412, pl. 1a–c; *Leiden Bot. Series* 12 (1989) 216, f. 84. — Type: *van Balgooy 3658* (L holotype; K; BO, n.v.), S Celebes.

*Shrub to tree*, 2–15 m high, dbh up to 19 cm; fluted; ornamental; outer bark brownish grey, not fissured, with many small elevated lenticels, inner bark cream-coloured; sapwood pale reddish cream, heartwood reddish ochre. *Branchlets* hirsute; flowering twigs 2.2–7 mm thick. *Leaves* 2–7-jugate; rachis 1.8–15.5 cm long, terete to upwards flattened above, hirsute, petiole 1.1–6.2 cm long. *Leaflets* subsessile, subopposite to alternate, (ovate to el-

liptic, 3–10.7 by 1–3.5 cm, index 2.4–3.8, usually somewhat asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, flat (to revolute); apex acuminate to cuspidate, usually not mucronulate; upper surface hirsute; lower surface duller, smooth, no papillae, hirsute, small red erect glands abundant, domatia many pockets in axils of nerves; venation on upper side flat, raised on lower; nerves 0.3–1.6 cm apart, marginally looped and joined; veins laxly reticulate, rather indistinct. *Inflorescences* axillary, branching basally and along the terete to somewhat flattened, hirsute, 1.5–17 cm long axis; first order branches up to 5 cm long; cymules cincinnate, 2- or 3-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 0.7–1 mm long; bracteoles 0.3–0.5 mm long; pedicels 1.8–4 mm long, sericeous, less so in articulate part. *Flowers* 3.2–3.5 mm in diam., buds green. *Sepals* 5, ovate, margin and basally the outside pilose, margin with glands, inside glabrous; 2 outer smaller ones 1–1.8 by 1–1.8 mm; 3 inner larger ones 1.8–2.8 by 1.4–3.2 mm, margin petaloid. *Petals* 5, elliptic, 1–1.9 by 0.3–0.7 mm; claw 0.4–0.8 mm high; margin pilose, outside and inside (sub)glabrous, apex obtuse; scales 0.9–1.3 mm long, free; crest absent (to slender pilose part of a bifid scale apex). *Disc* uninterrupted. *Stamens* 8; filaments 3.8–4.3 mm long, pilose, especially basally; anthers 0.4–0.5 mm long, glabrous. *Pistil*: ovary 0.3–0.5 mm long, subhirsute; stigma and style 0.1–0.6 mm long. *Fruits* with 1–3 well developed lobes, 0.7–1.1 by 0.7–1.5 cm, smooth to sometimes somewhat rugose-ruminate, glabrous, red when fresh, blackish when dry; stipe c. 1.5 mm high, slender; margin blunt; lobes 5–8 by 6.5–8 mm. *Seeds* obovoid, 5.2–5.3 by 2.9–4.2 mm, brown; hilum 1–1.1 mm long.

Distribution – *Malesia*: Celebes.

Habitat & Ecology – In swamp forest, disturbed forest, belukar, and along lakes. Vegetation usually with *Gleichenia*, *Imperata*, *Melastoma*. Soil: usually ultrabasic, sometimes siliceous or clayey; altitude sea level up to 1200 m. Fl. Apr.–July; Fr. Mar.–June.

**14. *Guioa hospita*** Radlk. [in Engl & Prantl, *Nat. Pflanzenfam.* 3, 5 (1895) 346, nom. nud.], *Bot. Jahrb.* 56 (1921) 281; in Engl., *Pflanzenr.* 98 (1933) 1173; Welzen, *Leiden Bot. Series* 12 (1989) 218, f. 85. — Type: *Expedition Royal Geographical Society of Australia s.n.*, Dec. 1890 (M holotype), New Guinea.

*Tree? Branchlets* puberulous when young; flowering twigs c. 5 mm thick. *Leaves* 1- or 2-jugate; rachis 6.8–16.5 cm long, terete, slightly puberulous, petiole 6.5–9.5 cm long. *Leaflets* subsessile,

opposite, ovate, 15.4–22.5 by 7.4–9 cm, index 2.1–2.5, subbasally asymmetrical, acroscopic side broader, subcoriaceous, punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate, mucronulate; upper surface puberulous on midrib and basal nerves; lower surface duller, smooth, no papillae, puberulous on venation, domatia many pockets in axils of nerves; venation on upper side flat, raised below; nerves 0.3–2.2 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins laxly reticulate, rather inconspicuous. *Infructescences* axillary, branching along the terete, puberulous, c. 11 cm long axis; first order branches up to 4.4 cm long; bracts and bracteoles caducous; pedicels 6–6.5 mm long, puberulous. *Flowers* absent. *Sepals* and *petals* caducous. *Disc* interrupted. *Stamens* and *pistil* absent. *Fruit* immature, with 1 or 2 developing lobes, c. 1.8 by c. 2.8 cm, slightly ribbed, glabrous, blackish when dry; stipe c. 6 mm high, slightly obconical; margin blunt; lobes c. 16 by 7 mm; septa complete. *Seeds* unknown.

Distribution – *Malesia*: Papua New Guinea (Gulf Prov.).

Habitat & Ecology – Stems of specimen seen often swollen beneath the nodes, harbouring insect nests, probably those of ants.

Note – This species is part of the *G. rigidiuscula*-complex and is distinct by its puberulous leaflets with many pockets, many and dense nerves, and very stipitate fruits with slender long lobes.

**15. *Guioa koelreuteria*** (Blanco) Merr., Sp. Blanc. (1918) 241; Brown, Min. Prod. Philipp. For. 3 (1921) 204; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 507; Radlk. in Engl., Pflanzenr. 98 (1933) 1172 (footnote); Guzman et al., Guide Philipp. Fl. Fauna 3 (1986) 300, f. 218; Welzen, Leiden Bot. Series 12 (1989) 219, f. 7b, 86. — *Sapindus koelreuteria* Blanco, Fl. Filip. (1837) 289 ('*kolreuteria*'). — *Koelreuteria arborea* Blanco, Fl. Filip. ed. 2 (1845) 202. — Neotype (Merrill 1918): *Merrill 644* (PNH<sup>+</sup> holo; BM, F. K. L. NY, P. W), Philippines.

*Hemigyrosa perrottetii* Blume, Rumphia 3 (1847) 165; Walp., Ann. 2 (1851/2) 212; Gray, U.S. Expl. Exp. Bot. 1 (1854) 251; Miq., Fl. Ind. Bat. 1, 2 (1859) 568; Fern.-Vill., Nov. App. (1883) 349. — *Guioa perrottetii* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 273; Sapind. Holl.-Ind. (1879) 39; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 614; Vidal, Rev. Pl. Vasc. Filip. (1886) 95; Ceron, Cat. Pl. Herb. Manila (1892) 53; Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904)

63; Merr., Philipp. J. Sc. 1, Suppl. (1906) 87; Fl. Manila (1912) 306; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; in Engl., Pflanzenr. 98 (1933) 1172. — Lectotype (Van Welzen 1989): *Perrottet s.n.*, no date (L holo; FI, L, P), Philippines.

*Guioa salicifolia* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1608; Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509; Radlk. in Engl., Pflanzenr. 98 (1933) 1165. — Type: *Elmer 12286* (M holo; A. BM, F. FI, K. L, NY, P. U. W), Philippines.

*Guioa mindorensis* Merr., Philipp. J. Sc. 20 (1922) 404; Enum. Philipp. Flow. Pl. 2 (1923) 508; Radlk. in Engl., Pflanzenr. 98 (1933) 1165. — Type: *BS (Ramos) 39639* (PNH<sup>+</sup> holo; A, K), Philippines.

*Guioa* spec.: Vidal, Rev. Pl. Vasc. Filip. (1886) 95, p.p. (*Vidal 1226, 1230*).

*Quassia simaruba* auct. non L.: Blanco., Fl. Filip. ed. 2 (1845) 247; Merr., Sp. Blanc. (1918) 241 (in syn.).

*Sapindus pubescens* auct. non Zoll. & Mor.: Zoll. & Mor. in Mor., Syst. Verz. (1846) 22, p.p. (*Perrottet s.n.*).

*Cupania regularis* auct. non Blume: Vidal, Sinopsis (1883) 21, f. 34 b.

*Guioa rigidiuscula* auct. non Radlk.: Vidal, Rev. Pl. Vasc. Filip. (1886) 95; Ceron, Cat. Pl. Herb. Manila (1892) 53.

*Guioa diplopetala* auct. non Radlk.: Meijer, Bot. News Bull. 9 (1967) 75.

*Shrub to tree*, 2–16 m high, dbh 2–50 cm; outer bark brown to dark greyish, smooth (to rough), inner pink to red-brown, fibrous; sapwood white to brownish, odourless, tasteless, rings slightly visible. *Branchlets* especially sericeous (to hirsute) when young; flowering twigs 1–7 mm thick. *Leaves* 1–6-jugate; rachis 2.4–20.5 cm long, terete to flattened and broadened (to slightly winged), subglabrous (to subhirsute), petiole 1–8 cm long; petiolules 0–0.7 cm long. *Leaflets* usually subsessile, opposite to alternate, ovate (to elliptic), 2.8–17.8 by 0.9–5.4 cm, index 1.7–5.7, usually asymmetrical, acroscopic side broader, (very) coriaceous, usually punctate; base attenuate; margin entire, flat (to revolute); apex (obtuse to) usually gradually acuminate to caudate, very apex (acute to) mucronulate; upper surface glabrous to subhirsute; lower surface duller, smooth (to slightly papillate), glabrous to subsericeous (to hirsute), domatia absent to many small sacs (to pockets) on basiscope side in axils of nerves; venation on upper surface (flat to) raised, usually concolorous with lamina, below raised; nerves 0.2–2.5 cm apart, marginally

looped and joined; veins laxly reticulate, usually distinct. *Inflorescences* axillary (to pseudoterminal), unbranched to branching basally and along the slightly flattened, brown (sub)sericeous (to hirsute), 0.8–20.5 cm long axis; first order branches up to 9.8 cm long; cymules cincinnate (see note 4), 2–5(–8)-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 0.5–1.5 mm long; bracteoles 0.2–1 mm long; pedicels 1.4–7 mm long, sericeous except for the usually subglabrous articulate part. *Flowers* 3.2–4 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside (sub)glabrous, pink; 2 outer smaller ones 1–3.1 by 1–3.3 mm; 3 inner larger ones 1.5–3.8 by 1.2–4 mm, margin petaloid. *Petals* 5, (elliptic to) obovate, 1.8–3.8 by 1–2.5 mm (see note 4), creamy white (to reddish); blade obovate, gradually decurrent into the 0.4–1.3 mm high claw, margin (and outside) pilose, inside (sub)glabrous, apex retuse to acute; scales 0.9–2.1 mm long, free, basally not auriculate, membranous margin indistinct, apex not to hardly broadened; crest (absent to) a pilose, flat part of the bifid scale apex (to somewhat swollen and clavate). *Disc* interrupted. *Stamens* 8 (or 9); filaments 1.2–5 mm long, pilose, especially basally; anthers 0.3–0.6 mm long, glabrous to pilose. *Pistil*: ovary 0.2–2.4 mm long, subhirsute; style and stigma 0.1–2.7 mm long. *Fruits* with 1–3 well developed lobes, 1–2.2 by 1–2.3 cm, completely dehiscent, smooth, glabrous, red when fresh, blackish when dry; stipe 2–5.5 mm high, slender; margin blunt; lobes 6.5–13 by 7–12 mm; septa complete. *Seeds* (globose to) obovoid, 5.3–8.5 by 5–7.5 mm; hilum 1–2.3 mm long; arillode with pseudo-funicle, edible.

*Distribution* – *Malesia*: Borneo (islands NE of Sabah), Philippines.

*Habitat & Ecology* – Common. In primary and especially in secondary forest, ridge forest, thickets, on heath, along the seashore, roads, streams, edges of plantations. Soil: sand, gravel, limestone, ultrabasic; altitude sea level up to 1350 m. Fl. (Aug.–)Nov.–Feb.(–Mar.); fr. Mar.–Oct.

*Uses* – The wood is used for agricultural implements and tool handles (Reyes in Desch, 1954). Oil extracted from the seeds can be used to cure certain skin diseases (Guerrero in Brown, Useful Pl. Philipp. 2, 1950, 363).

*Notes* – 1. *Guioa koelreuteria* is rather variable as can be expected of a species whose range extends over several islands. The leaflets differ much in size, most are small, but some can become rather large. The leaflets are usually rather thin, but some have thick coriaceous leaflets. A rather distinct form, found on Mindanao, Davao Prov., and occasionally on Guimaras Island, has leaflets which

always possess many domatia and short (combined with a few long) hairs sparsely all over the lower surface, while the inflorescences are patently pilose instead of (sub)sericeous.

2. The specimens which were described as *G. salicifolia* differ only slightly from 'normal' *G. koelreuteria*, the leaflets are more coriaceous and relatively narrower.

3. '*Guioa mindorensis*' is also distinguishable. The characters mentioned by Merrill (small leaflets, winged rachis) can also be found among more typical specimens of *G. koelreuteria*. On Mindoro two forms can be found, typical *G. koelreuteria* with leaflets without papillae and usually with a long cuspidate apex and '*G. mindorensis*' with papillae and a short, rather obtuse apex. The latter form is presumably found at higher altitudes.

4. One exceptional specimen, ANU 1652 from Mindanao, Mt Apo, has dichasial instead of monochasial cymes and the petals are almost completely reduced (the flowers are still young and may have opened prematurely because of drying).

**16. *Guioa malukuensis*** Welzen, Blumea 33 (1988) 418, pl. 5; Leiden Bot. Series 12 (1989) 227, f. 89. — Type: *Kostermans 1206* (L holotype: BRI, K, P; BO, n.v.), Moluccas.

*Tree*, c. 13 m high, dbh up to 20 cm; bark grey; wood hard. *Branchlets* shortly sericeous, especially when young; flowering twigs 3–3.5 mm in diam. *Leaves* 2–4-jugate; rachis 0.7–6 cm long, slightly winged, subsericeous, petiole 0.7–3 cm long. *Leaflets* subsessile, opposite to subopposite, elliptic, 3.4–7.2 by 1–2.2 cm, index 2.4–3.7,  $\pm$  symmetrical, coriaceous, punctate; base attenuate; margin entire, flat; apex acuminate, not mucronulate; upper surface subsericeous, especially the venation; lower surface dull, papillate, sericeous, domatia 1 to many pocket-like sac(s) in axils of nerves; venation on upper side flat, raised on lower; nerves 0.3–1.3 cm apart, marginally looped and joined; veins densely reticulate, distinct. *Inflorescences* axillary, branching basally and along the somewhat flattened, sericeous, 3.3–12.2 cm long axis; first order branches up to 3.3 cm long; cymules cincinnate; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts c. 0.9 mm long; bracteoles 0.3–0.4 mm long; pedicels 3.5–3.8 mm long, sericeous except for the (sub)glabrous articulate part. *Flowers* c. 3 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous; 2 outer smaller ones c. 1.2 by 1.2 mm; 3 inner larger ones 1.8–2.2 by 1.8–2.2 mm, margin petaloid. *Petals* 5, elliptic, c. 1.4 by 1 mm, white; claw c. 0.2 mm high; margin and less so outside



pilose, inside (sub)glabrous, apex retuse to rounded; scales inwardly folded auricles, c. 0.4 mm long; crest absent. *Disc* uninterrupted. *Stamens* 8; filaments c. 2.4 mm long, pilose, especially basally; anthers c. 0.4 mm long, glabrous. *Pistil* in young state. *Fruits* unknown.

Distribution – *Malesia*: Moluccas (Morotai I.).

Habitat & Ecology – Found at 1000 m altitude.

Note – This species strongly resembles *G. subsericea*, but the latter has a wingless rachis and asymmetrical leaflets with a cuspidate to caudate apex instead of a winged rachis, symmetrical leaflets, and an acuminate apex.

**17. *Guioa melanopoda*** Merr. & L.M. Perry, J.

Arnold Arbor. 21 (1940) 514; Welzen, Leiden Bot. Series 12 (1989) 230, f. 91. — Type: *Brass* 13699 (A holo; BM, K, L), Irian Jaya.

*Tree*, 8–15 m high. *Branchlets* glabrous except for some tomentose hairs on nodes; flowering twigs 3–6 mm thick. *Leaves* 3- or 4-jugate; rachis 3.2–20.5 cm long, winged, wing 2.5–3 mm broad, subtomentose, petiole 2.7–7.7 cm long. *Leaflets* subsessile, subopposite to alternate, (ovate to) elliptic, 8–16.4 by 2.4–5.6 cm, index 2.7–3.5, slightly asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, flat; apex cuspidate, mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous to sparsely sericeous, domatia absent (to a single pocket on basisopic side in axil of  $\pm$  second nerve); venation on upper side slightly sunken to flat, raised below; nerves 0.3–2.2 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins densely reticulate, rather conspicuous. *Inflorescences* axillary (to pseudoterminal), branching basally and along the terete, subtomentose, 2.7–6 cm long axis; first order branches up to 4 cm long; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.7–0.9 mm long; bracteoles 0.4–0.5 mm long; pedicels 1.8–2.2 mm long, completely slightly sericeous. *Flowers* unknown. *Sepals* 5, ovate, margin pilose, without glands, outside and inside glabrous; 2 outer smaller ones 1–1.2 by 0.9–1.2 mm; 3 inner larger ones c. 1.5 by 1.5 mm, margin petaloid. *Petals*, see note. *Disc* uninterrupted. *Stamens* and *pistil* unknown. *Fruits* with 1 or 2 well developed lobes, 0.9–1 by 0.8–1.3 cm, rugose, glabrous, red when fresh, blackish when dry; stipe 1.5–2.5 mm high, broadly obconical; margin blunt; lobes 8–9 by 6–6.5 mm; septa complete. *Seeds* obovoid, c. 6.5 by 5 mm; hilum c. 1.1 mm long.

Distribution – *Malesia*: Irian Jaya (Jayapura).

Habitat & Ecology – Rain forest substage to seral rain forest of river banks; altitude 850–1200

m. Fr. Feb.–Mar.

Note – One petal has been found, but it is not known whether this is one of the well developed petals or the usually more reduced one between the two adjacent large sepals. The petal is ovate, c. 2.8 by 1 mm, claw c. 0.2 mm high, margin slightly pilose, outside and inside glabrous; scales c. 0.6 mm long, free; crest absent.

- 18. *Guioa membranifolia*** Radlk., Sapind. Holl.-Ind. (1879) 11, 40; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 614 (typification); in Rech., Denkschr. K. Ak. Wiss. M.-N. Kl. Wien 89 (1913) 573, t. 6a, f. 11; Bot. Jahrb. 56 (1921) 282; Lauterb., Bot. Jahrb. 62 (1929) 555; Radlk. in Engl., Pflanzenr. 98 (1933) 1174; Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1947) 77; Welzen, Leiden Bot. Series 12 (1989) 232, f. 92. — Type: *Beccari* PP 807 (FI holo, cited by Radlkofer as *Beccari* 9), Irian Jaya.

*Tree*, 6–10 m high, dbh up to 10 cm; bark grey. *Branchlets* shortly sericeous when young; flowering twigs 2.5–8 mm long. *Leaves* 1–3-jugate; rachis 4.2–19.5 cm long, terete, glabrous, petiole 1.7–6.4 cm long. *Leaflets* subsessile, opposite to alternate, elliptic, 3.5–16.2 by 1.5–6.4 cm, index 2.3–3.8, usually slightly asymmetrical, acroscopic side broader, subcoriaceous, punctate; base attenuate; margin entire, flat; apex acute to cuspidate, mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous, domatia one small sac on basisopic side in axil of  $\pm$  second nerve; venation on upper side flat, raised below; nerves 0.2–2.3 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins laxly to densely reticulate, rather inconspicuous. *Inflorescences* ramiflorous to axillary, branching basally and along the flattened to terete, sericeous, 1.9–12.3 cm long axis; first order branches up to 5.2 cm long; cymules cinnate, 3- or 4-flowered; bracts and bracteoles triangular, outside hirsute, inside glabrous; bracts 0.5–0.8 mm long; bracteoles 0.2–0.4 mm long; pedicels 2–5.7 mm long, sericeous except for the subglabrous articulate part. *Flowers* 3.5–4 mm in diam., fragrant. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous; 2 outer smaller ones 1–1.5 by 1–1.8 mm, 3 inner larger ones 1.4–3.2 by 1.4–3 mm, margin petaloid. *Petals* 5, elliptic, 1.4–3 by 0.7–1.4 mm, white; claw 0.2–0.3 mm high; margin pilose, outside and inside subglabrous, apex acute; scales 0.8–2 mm long, free, basally not auriculate, membranous margin indistinct; crest clavate, stipitate, apex lobed, pilose. *Disc* interrupted. *Stamens* 8; filaments 1.8–3.5 mm long, pilose, especially



basally; anthers 0.4–0.8 mm long, glabrous. *Pistil*: ovary 0.2–0.8 mm long, subhirsute; style and stigma 0.1–0.7 mm long. *Fruits* with 1–3 well developed lobes, 1.4–2.4 by 1–3.6 cm, completely dehiscent, smooth to slightly rugose or ribbed, glabrous, red when fresh, black when dry; stipe 2–4 mm high, slender; suture about flat to slightly convex; margin blunt; lobes 10.5–16 by 10–13 mm; septa complete. *Seeds* obovoid, 8.5–9.7 by 6.5–7.2 mm; hilum c. 1.7 mm long; arillode with pseudo-funicle.

*Distribution* – *Malesia*: Moluccas (Halmahera, Morotai); Irian Jaya (Vogelkop, Geelvinck Bay, Jayapura).

*Habitat & Ecology* – In fringing rain forest; altitude 30–600 m. Fl. May–Aug.; fr. Mar.–May.

*Note* – *Guioa membranifolia* is part of the *G. rigidiuscula*-complex. Typical for this species are the elliptic leaflets without papillae and hairs, but with a single sac. The fruit is always clearly stipitate and the upper margin of the lobes is at most slightly convex.

**19. *Guioa misimaensis*** Welzen, *Blumea* 33 (1988) 418, pl. 9; *Leiden Bot. Series* 12 (1989) 235, f. 94. — Type: *Brass* 27661 (L. holo; K; LAE, n.v.), Papua New Guinea.

*Tree*, up to 20 m high, dbh up to 30 cm. *Branchlets* shortly sericeous when young; flowering twigs c. 4 mm thick. *Leaves* 1- or 2-jugate; rachis 4.2–7.6 cm long, flattened above, subsericeous, petiole 2.7–4.7 cm long; petiolules up to 0.9 cm long. *Leaflets* subopposite, elliptic, 10.2–13.9 by 3.9–4.7 cm, index 2.6–3, symmetrical, coriaceous, punctate; base attenuate; margin entire, flat; apex acute to acuminate, mucronulate; upper surface glabrous; lower surface dull, papillate, short sericeous, domatia absent; venation raised on both sides, concolorous with lamina; nerves 0.4–1.8 cm apart, marginally looped and joined; veins laxly reticulate, indistinct. *Inflorescences* axillary, branching along the flattened, subsericeous, 4.6–13.7 cm long axis; first order branches up to 4.9 cm long; cymules cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside subsericeous, inside glabrous; bracts c. 0.7 mm long; bracteoles c. 0.3 mm long; pedicels 2.5–3 mm long, subsericeous except for the (sub)glabrous articulate part. *Flowers* in bud. *Sepals* 5, ovate, margin pilose, outside and inside glabrous; 2 outer smaller ones 1–1.3 by c. 1.3 mm, margin with glands; 3 inner larger ones 1.8–2 by 2–2.2 mm, margin petaloid, without glands. *Petals* 5, immature, elliptic, blade gradually decurrent into the claw, margin pilose, outside and inside glabrous, apex acute, white; scales free; crest clavate, shortly stipitate, glabrous,

*Disc* interrupted. *Stamens* 8, immature; filaments pilose, especially basally; anthers glabrous. *Pistil*: ovary subhirsute. *Fruits* unknown.

*Distribution* – *Malesia*: Papua New Guinea (Milne Bay Prov.: Misima I.).

*Habitat & Ecology* – Common. In subcanopy of rain forest; altitude c. 150 m. Fr. Aug.

*Note* – *Guioa misimaensis* is part of the *G. rigidiuscula*-complex. This species may be distinguished by its symmetrical leaflets with papillae and short subsericeous hairs, its crested scales, and its interrupted disc.

**20. *Guioa molliuscula*** Radlk., *Bot. Jahrb.* 50 (1914) 76; 56 (1921) 280; in Engl., *Pflanzenr.* 98 (1933) 1163; Welzen, *Leiden Bot. Series* 12 (1989) 236, f. 95. — Type: *Schlechter* 19521 (B<sup>+</sup> holo; K, P), Papua New Guinea.

*Tree*, c. 10 m high. *Branchlets* velutinous; flowering twigs 2–4 mm thick. *Leaves* 1- or 2-jugate; rachis 2.2–9.5 cm long, terete, velutinous, petiole 1.1–4.8 cm long; petiolules up to 0.9 cm long. *Leaflets* usually subsessile, subopposite, ovate (to elliptic), 6.6–17.8 by 3.4–8.2 cm, index 1.9–2.3, ± symmetrical, coriaceous, punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate, mucronulate; upper surface especially hirsute on the venation; lower surface duller, smooth, not papillate, hirsute, domatia 0 or 1 sac on basiscopic side in axil of second nerve; venation on upper side flat, raised on lower; nerves 0.4–2.5 cm apart, marginally looped and joined; veins laxly reticulate, indistinct. *Inflorescences* axillary, hirsute, with very young buds. *Sepals* 5, margin with glands. *Petals* 5, elliptic, apex acute, white; scales free, apex not broadened; crest clavate, stipitate, glabrous. *Disc* uninterrupted. *Stamens* 8; filaments pilose; anthers glabrous. *Pistil*: ovary subhirsute. *Fruits* unknown.

*Distribution* – *Malesia*: Papua New Guinea (Morobe Prov.).

*Habitat & Ecology* – Understorey tree in alluvial swamp; altitude c. 10 m. Buds in Jan. and May.

*Notes* – 1. This species is part of the *G. rigidiuscula*-complex and is known only from two collections. These look rather different at first sight as one has much larger and less pilose leaflets. Distinctive of the species are the velutinous leaflets without papillae and the uninterrupted disc.

2. The shape of the leaflets, and even the hirsute appearance, resemble *G. subsericea*, of which specimens with a hirsute indumentum are occasionally found. The absence of papillae and the type of petal (well crested scales instead of usually crestless auricles) are characters not found in *G. subsericea*.

3. *Guioa molliuscula* also resembles *G. oligo-*

*tricha*; both have a hirsute indumentum, lack papillae (some specimens of *G. oligotricha* excepted), and have a uninterrupted disc. However, *G. oligotricha* has a different type of petal (smaller, less well developed scales, no crest), leaflets with many pockets as domatia instead of no domatia or a single sac, and often subapical teeth along the leaflet margins.

**21. *Guioa multijuga*** Welzen, *Blumea* 33 (1988) 418, pl. 7a, b; *Leiden Bot. Series* 12 (1989) 239, f. 97. — Type: *BW (van der Sijde) 4061* (L holotype; K, P; MAN, n.v.), Irian Jaya.

Small tree, up to 5 m high. *Branchlets* shortly sericeous when young; flowering twigs 2.5–4.5 mm thick. *Leaves* (3)5–7-jugate; rachis 7.3–14.7 cm long, terete, not to very slightly winged, subglabrous to subsericeous, petiole 1.6–4.5 cm long; petiolules up to 0.6 cm long. *Leaflets* opposite to subopposite, (ovate to) elliptic, 3.8–6.3 by 1–1.7 cm, index 3.7–4.7, asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, flat; apex acute to cuspidate, mucronulate; upper surface glabrous; lower surface dull, papillate, very sparsely subsericeous, domatia at least in some leaflets a single small sac on basiscopic side in axil of second nerve; venation on upper side flat, except for the raised midrib, raised below; nerves 0.2–0.9 cm apart, marginally looped and joined, (less distinctly so in lower part of leaflets); veins laxly reticulate, indistinct. *Inflorescences* axillary, branching basally and along the terete, slightly sericeous, 0.5–6.5 cm long axis; first order branches up to 0.9 cm long; cymules cincinnate, c. 2-flowered; bracts and bracteoles triangular, outside pilose, inside glabrous; bracts c. 1 mm long; bracteoles c. 0.4 mm long; pedicels 2.1–2.5 mm long, sericeous except for the subglabrous articulate part. *Flowers* c. 2.8 mm in diam., smelling sweet. *Sepals* 5, ovate, margin pilose, outside and inside glabrous; 2 outer smaller ones 1.2–1.5 by 0.8–0.9 mm, margin with glands; 3 inner larger ones 1.5–1.8 by 1.3–1.5 mm, margin petaloid, without glands. *Petals* 5, obovate, 1.5–1.7 by 0.3–0.5 mm, white; claw c. 0.3 mm high; margin densely pilose, outside and inside (sub)glabrous, apex acute; scales c. 1 mm long, free, folded outwards, apex not broadened; crest absent; petal between two adjacent large sepals not reduced. *Disc* uninterrupted. *Stamens* 8; filaments c. 2.3 mm long, pilose, especially basally; anthers 0.3–0.4 mm long, sparsely pilose. *Pistil*: ovary c. 0.7 mm high, subhirsute; style and stigma c. 0.5 mm long. *Fruits* unknown.

Distribution — *Malesia*: Irian Jaya (around Jayapura).

Habitat & Ecology — Rare; in old secondary forest and at edge rain forest-savannah on steep terrain. Soil: once recorded from clayey sand; altitude 100–185 m. Bud: Mar.; fl. Sept.

Note — *Guioa multijuga* looks much like *G. subsericea*; see also note 3 under the latter.

**22. *Guioa myriadenia*** Radlk. in Elmer, *Leaflet Philipp. Bot.* 5 (1913) 1610; *Philipp. J. Sc., Bot.* 8 (1914) 446; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 508; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1168; Welzen, *Leiden Bot. Series* 12 (1989) 240, f. 98. — Lectotype (Welzen, 1989): *Elmer 8704* (M holotype; FI, K, L, NY, W), Philippines.

*Guioa falcata* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 446, 461; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 507; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1167. — Type: *Elmer 5869* (M holotype; K, NSW, NY, P), Philippines.

*Guioa obtusa* Merr., *Philipp. J. Sc., Bot.* 12 (1917) 276; *Enum. Philipp. Flow. Pl.* 2 (1923) 508; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1170. — Type: *BS (Ramos & Edaña) 26636* (PNH<sup>†</sup> holotype; A, K, NY, P), Philippines.

[*Guioa ferruginea* Merr. ex Salvosa, *Lex. Philipp. Pl.* (1963) 105, nom. nud., based on *BS (Ramos) 42181*.]

*Shrub to tree*, 2–9 m high, dbh up to 6 cm; bark greyish white to mottled, hard; sapwood white, very hard. *Branchlets* golden (sericeous to) hirsute, especially when young; flowering twigs 1.5–6 mm thick. *Leaves* 2–5-jugate; rachis 1.8–16.2 cm long, basally terete to upwards dorsoventrally flattened, subsericeous to hirsute, petiole 1–6.3 cm long; petiolules up to 0.9 cm long. *Leaflets* opposite (to subopposite), ovate (to elliptic), often falcate, 2.5–14.5 by 1–4.5 cm, index 2.3–4.2, usually asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, (flat to) revolute; apex (rounded to) acuminate (to cuspidate), usually mucronulate; upper surface usually subsericeous to appressedly hirsute; lower surface dull, papillate, long sericeous to hirsute, domatia small, (1 to many sacs to) many pockets in axils of nerves; venation on upper side (slightly sunken to) flat (to raised), below raised; nerves 0.2–1.8 cm apart, marginally looped and joined; veins densely reticulate, distinct. *Inflorescences* axillary to pseudo-terminal, branching basally and along the flattened, densely golden (sericeous to) hirsute, 1.7–15.7 cm long axis; first order branches up to 7.6 cm long; cymules cincinnate, 2–4-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 1.5–2.5 mm long; bracteoles 0.5–1.8 mm long; pedicels 2.8–8 mm long, sericeous,

less so in articulate part. *Flowers* 3.5–4 mm in diam., not fragrant. *Sepals* 5, ovate, margin and outside pilose, margin with glands, inside glabrous, whitish; 2 outer smaller ones 1.6–2.5 by 1.1–2.4 mm; 3 inner larger ones 2–3.2 by 2–3.2 mm, margin petaloid. *Petals* 5, obovate, 2.5–4 by 1.3–1.7 mm, white to red; blade orbicular, abruptly clawed, latter 0.8–2 mm high, margin pilose, outside and inside (sub)glabrous, apex retuse to obtuse; scales 1.2–1.7 mm long, free; crest clavate, shortly stipitate, apex lobed, subglabrous, yellow. *Disc* interrupted, greenish yellow. *Stamens* 8; filaments 2–4.4 mm long, pilose, especially basally, white; anthers 0.3–0.6 mm long, glabrous, red. *Pistil*: ovary 0.4–2.3 mm long, subhirsute; style and stigma 0.1–1.5 mm long. *Fruits* with 1–3 well developed lobes, 1.1–1.4 by 1.1–1.8 cm, smooth, glabrous, blackish when dry; stipe 2.5–4 mm high, slender; margin blunt; lobes 8–9 by 7–10 mm. *Seeds* obovoid, c. 6.2 by 4.8 mm; hilum c. 1.9 mm long.

Distribution – *Malesia*: Philippines (Luzon).

Habitat & Ecology – In primary forest, forested slopes, mossy forest, along pine crest; altitude 270–1700 m. Fl. Dec.–Apr.; fr. July.

Notes – 1. This species can be distinguished by its ovate leaflets, reticulate venation, lower surface with sericeous to hirsute hairs, usually many pock-ets, punctation, sepals that are sericeous outside, and petals with a long claw, orbicular blade, and stipitate, clavate crests. Several forms are present, three of which are rather distinct. One form with leaflets with a sericeous lower surface occurs in the Benguet and Mountain Provinces. This form may be subdivided, some specimens have rather symmetrical leaflets, viz. *G. myriadenia* s.s., others have more falcate leaflets, viz. '*G. falcata*'. The second form, with hirsute indumentum, occurs in Rizal Province. Transitions between the two prevent the recognition of different species. The third form was known as *G. obtusa* (Tayabas Province) and has leaflets with a densely sericeous lower surface and obtuse apex. Only in the shorter apex it differs from the northern sericeous form with which it has a disjunct distribution (i.e., Benguet and Mountain Prov. are north and Tayabas south of Rizal).

2. Some specimens of *G. myriadenia* look remarkably like the '*G. lasiothyrsa*' form of *G. pleuropteris*. *Guioa myriadenia* has always a rather golden indumentum, not dull brown like *G. pleuropteris*, while the venation is denser and usually more distinct. The crest is also different, that of *G. pleuropteris*, if present, is part of a flat bifid scale apex, while that of *G. myriadenia* is clavate. The fruits of *G. pleuropteris* can be reddish when dry, those of *G. myriadenia* are black.

**23. *Guioa normanbiensis*** Welzen, *Blumea* 33 (1988) 418, pl. 6a–c; *Leiden Bot. Series* 12 (1989) 243, f. 99. — Type: *Brass* 25521 (L. holo; K), Papua New Guinea.

*Tree*, 7–20 m high, dbh at least 5 cm; bark brown; wood medium hard. *Branchlets* at most only sericeous when young; flowering twigs 3–13 mm thick. *Leaves* 2–4-jugate; rachis 4–17.7 cm long, terete, glabrous, petiole 3.5–7 cm long. *Leaflets* subsessile, opposite to alternate, ovate, 7–19.3 by 2.6–6.5 cm, index 2.7–3.2,  $\pm$  symmetrical, otherwise acroscopic side broader, coriaceous, (punctate); base attenuate; margin entire, flat; apex acuminate to cuspidate, mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous (to very sparsely sericeous), domatia a single small sac on basiscope side in axil of second nerve; venation on upper side flat (to raised), raised below; nerves 0.3–3.3 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins laxly reticulate, indistinct. *Inflorescences* ramiflorous to axillary, branching basally and along the flat to terete, subglabrous, 1.5–6.8 cm long axis; first order branches up to 2 cm long; cymules cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside hirsute, inside glabrous; bracts 0.7–1.1 mm long; bracteoles 0.3–0.8 mm long; pedicels 1.8–4 mm long, subglabrous except for the glabrous articulate part. *Flowers* c. 3.5 mm in diam. *Sepals* 5, ovate, margin pilose, outside and inside glabrous; 2 outer smaller ones 1–1.6 by 1.2–1.3 mm, margin with glands; 3 inner larger ones 1.9–2.8 by 1.7–2.7 mm, margin petaloid, without glands. *Petals* 5, obovate, c. 2 by 0.6–0.8 mm, white; claw c. 0.3 mm high; margin pilose, outside and inside (sub)glabrous, apex acute; scales 1.2–1.3 mm long, free, basally not auriculate, membranous margin indistinct; crest clavate, stipitate, apex lobed, glabrous. *Disc* interrupted. *Stamens* 8; filaments 2.7–3.1 mm long, pilose, especially basally; anthers c. 0.6 mm long, glabrous. *Pistil*: ovary c. 0.3 mm long, subhirsute; style and stigma c. 0.2 mm long. *Fruits* with 1–3 well developed lobes, 1.2–1.5 by 1.3–2.2 cm, completely dehiscent, smooth to somewhat ribbed, glabrous, blackish when dry; stipe 3–3.5 mm high, slender; margin blunt; lobes 11–15 by 7.5–9.5 mm; septa complete. *Seeds* immature; arillode with pseudo-funicle.

Distribution – *Malesia*: Papua New Guinea (Milne Bay Prov., Normanby I.).

Habitat & Ecology – Frequently in lowland rain forest, along gullies; altitude 3–200 m. Fl. Sept.

Note – *Guioa normanbiensis* is part of the *G. rigidiuscula*-complex. It has ovate leaflets, (almost)



without indumentum and without papillae, a single sac, and fruits with a long slender stipe and slender lobes.

**24. *Guioa novobritannica*** Welzen. *Blumea* 33 (1988) 419, pl. 17a, b; *Leiden Bot. Series 12* (1989) 244, f. 100. — Type: *NGF (Frodin) 26918* (L holotype; BM, BRI, CANB; LAE, n.v.), Papua New Guinea.

*Tree*, c. 20 m high, dbh up to 20 cm; buttresses absent; bark brown, moderately fissured, slightly scaly in places, red-brown; wood straw; odour and exudate absent. *Branchlets* sericeous when young; flowering twigs 2–2.5 mm thick. *Leaves* 1- or 2-jugate; rachis 1.2–4.3 cm long, flattened above, glabrous, petiole 1.3–2.7 cm long. *Leaflets* subsessile, opposite to subopposite, elliptic, 4.2–4.9 by 1.1–1.7 cm, index 2.9–3.8, asymmetrical, acropetic side broader, coriaceous, punctate; base attenuate; margin entire, flat; apex acuminate, mucronulate; upper surface glabrous; lower surface dull, papillate, glabrous except for a few hairs near domatium, latter a single, large, highly domed sac on basiscopic side in axil of  $\pm$  second nerve; venation on upper side flat, raised below; nerves 0.2–0.8 cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins densely reticulate, distinct. *Inflorescences* axillary, branching along the flattened, subsericeous, 3–10 cm long axis; first order branches up to 4.8 cm long; cymules cincinnate, c. 2-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.7–0.8 mm long; bracteoles 0.2–0.4 mm long; pedicels c. 3 mm long, sericeous except for the (sub)glabrous articulate part. *Flowers* c. 3.5 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous; 2 outer smaller ones c. 1.5 by 1.7 mm; 3 inner larger ones 1.8–2.5 by c. 1.8 mm, margin petaloid. *Petals* 5, elliptic, 3–3.2 by 1.2–1.3 mm, white; claw c. 0.8 mm high; margin pilose, outside and inside glabrous, apex obtuse to acute; scales 1.5–1.8 mm long, free; crest clavate, stipitate, apex lobed; petal between two adjacent large sepals not reduced in size. *Disc* interrupted. *Stamens* 8; filaments 1.7–1.8 mm long, pilose, especially basally; anthers c. 0.4 mm long, glabrous. *Pistil*: ovary c. 1.7 mm long, subhirsute; style and stigma c. 1.8 mm long. *Fruits* unknown.

*Distribution* — *Malesia*: Papua New Guinea (West New Britain Prov.).

*Habitat & Ecology* — In montane forest with dominant *Casuarina rumphiana*; altitude c. 800 m. Fl. May.

*Note* — *Guioa novobritannica* belongs to the *G. rigidiuscula*-complex. Typical for this species are

the small, falcate, papillate leaflets with a single large sac.

**25. *Guioa oligotricha*** Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 512; Welzen, *Leiden Bot. Series 12* (1989) 247, f. 102. — Type: *Brass 8290* (A holotype; BM, L), Papua New Guinea.

*Small tree*, 5–7.5 m high, dbh c. 10 cm. *Branchlets* hirsute when young; flowering twigs 2.5–11 mm thick. *Leaves* 1–3-jugate; rachis 2.1–8.5 cm long, terete, hirsute, petiole 1–2.7 cm long. *Leaflets* subsessile, opposite to alternate, ovate to elliptic, 4.1–9.1 by 2–4 cm, index 2.1–2.5, symmetrical, subcoriaceous, punctate; base acute; margin entire except usually for a few subapical teeth, flat to somewhat revolute; apex acuminate to cuspidate, sometimes mucronulate; upper surface glabrous to sparsely hirsute, midrib densely hirsute; lower surface duller, smooth to papillate, hirsute, domatia many pockets in axils of nerves; venation on upper side slightly sunken (except for the raised midrib), raised below; nerves 0.3–1.3 cm apart, marginally looped and joined, less distinctly so in lower third of leaflets; veins laxly scalariform to densely reticulate, rather distinct. *Inflorescences* axillary, unbranched to branching basally on the terete, hirsute, 1.2–6 cm long axis; first order branches up to 1.5 cm long; cymules cincinnate, 1- or 2-flowered; bracts and bracteoles narrowly triangular, outside hirsute, inside subglabrous; bracts c. 1 mm long; bracteoles 0.4–0.8 mm long; pedicels 1–3.2 mm long, hirsute except for the (sub)glabrous articulate part. *Flowers* c. 3 mm in diam. *Sepals* 5, ovate, margin and outside pilose, margin with few glands, inside glabrous; 2 outer smaller ones 1–1.3 by 0.8–1 mm; 3 inner larger ones 1.4–2.2 by 1.1–1.5 mm, margin petaloid. *Petals* 5, obovate, 0.7–1 by c. 0.3 mm, white; claw 0–0.3 mm high; margin and less so outside and inside hirsute, apex acute; scales 0.6–0.7 mm long, free, apex not broadened; crest absent. *Disc* uninterrupted. *Stamens* 8; filaments 1.1–1.8 mm long, pilose, especially basally; anthers c. 0.3 mm long, glabrous. *Pistil*: ovary c. 0.3 mm long, subhirsute; style and stigma c. 0.2 mm long. *Fruits* with 1–3 well developed lobes, 0.6–0.8 by 0.8–1.2 cm, smooth to rugose, glabrous, red when fresh, blackish when dry; stipe 1.5–2 mm high, slender; margin blunt; lobes 7.5–8 by 6–6.5 mm. *Seeds* obovoid, 5–6 by 3–4 mm; hilum c. 1 mm long.

*Distribution* — *Malesia*: Irian Jaya (Southern Div.) and Papua New Guinea (Western Prov.).

*Habitat & Ecology* — Common, in secondary forest, along edge of forest, river banks. Soil: recorded from clayey soil; altitude 50–150 m. Fl. Mar.; fr. Aug.–Nov.

Note — See note 3 under *G. molliuscula* and under *G. acutifolia* for the differences with *G. oligotricha*.

**26. *Guioa palawanica*** Welzen, *Blumea* 33 (1988) 419, pl. 15a, b; *Leiden Bot. Series* 12 (1989) 250, f. 104. — Type: *BS (Foxworthy)* 697 (L. holo; M), Philippines.

*Guioa glauca* auct. non Radlk.: Radlk., *Philipp. J. Sc.*, Bot. 8 (1913) 446; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 507; Radlk. in *Engl., Pflanzenz.* 98 (1933) 1171, p.p. (Philippine plants).

*Shrub to tree*, 1–8 m high, dbh c. 15 cm. *Branchlets* sericeous when young; flowering twigs 2.5–4.5 mm thick. *Leaves* 1–3-jugate; rachis 1.1–9.2 cm long, dorsally flattened, subglabrous (to sericeous), petiole 1–3.3 cm long; petiolules up to 1 cm long. *Leaflets* opposite to subopposite, elliptic (to obovate), 2.5–7.6 by 1–2.5 cm, index 2.1–3.4, rather symmetrical, very coriaceous, not punctate; base attenuate; margin entire, revolute; apex rounded to acuminate, very apex rounded to acute; upper surface glabrous except for the basally puberulous midrib; lower surface dull, papillate, shortly sericeous, domatia absent or 1 small sac on basiscopic side in axil of  $\pm$  second nerve; venation raised, concolorous with lamina; nerves 0.3–1.7 cm apart, marginally looped and joined; veins laxly reticulate, rather distinct. *Inflorescences* axillary, branching along the flattened, sericeous, glabrescent, 1.2–9.8 cm long axis; first order branches up to 3.9 cm long; cymules cincinnate; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts c. 1.3 mm long; bracteoles 0.3–0.8 mm long; pedicels 3.2–6.3 mm long, sericeous. *Flowers* unknown. *Sepals* 5, ovate, margin and outside sericeous, inside glabrous, glands along margin unknown; 2 outer smaller ones 1.4–2.2 by 1.9–2 mm; 3 inner larger ones c. 2.3 by 2–2.2 mm, margin petaloid. *Disc* interrupted. *Fruits* with 1–3 well developed lobes, 1.2–1.4 by 1.1–1.9 cm, smooth to rugose-ruminate to rough, glabrous, blackish when dry; stipe 2–3 mm high, slender; margin blunt; lobes 8–10 by 7–10 mm. *Seeds* obovoid, 7.5–8.5 by 6.2–6.8 mm; hilum 1–1.3 mm long.

Distribution — *Malesia*: Philippines (Palawan).

Habitat & Ecology — In lowland forest on ultrabasic rock, in stunted montane rain forest with many epiphytes, and along rivers; altitude 200–815 m. Fr. Nov.–Mar.

**27. *Guioa parvifoliola*** Merr., *Philipp. J. Sc.* 14 (1919) 417; *Enum. Philipp. Flow. Pl.* 2 (1923) 508; Radlk. in *Engl., Pflanzenz.* 98 (1933) 1170; Welzen, *Leiden Bot. Series* 12 (1989) 252, f.

105. — Type: *BS (Ramos)* 33187 (PNH $\dagger$  holo; A. K. P), Philippines.

*Tree? Branchlets* brownish sericeous when young; flowering twigs c. 3 mm thick. *Leaves* 2–3-jugate; rachis 0.7–4.8 cm long, dorsally flattened, subsericeous, petiole 1.1–1.3 cm long; petiolules up to 0.8 cm long. *Leaflets* opposite, elliptic to obovate, 1.6–3.9 by 0.5–1.2 cm, index c. 3.3, slightly asymmetrical, acroscopic side broader, very coriaceous, punctate; base attenuate; margin entire, revolute; apex obtuse, very apex rounded; upper surface glabrous except for the puberulous midrib; lower surface dull, papillate, shortly subsericeous, domatia a small single sac on basiscopic side in axil of  $\pm$  second nerve; venation raised; nerves 0.2–0.7 cm apart, marginally looped and joined; veins densely reticulate, concolorous with lamina, distinct. *Infructescences* axillary, not branching; rachis somewhat flattened, 2.3–3.7 cm long, subsericeous; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts c. 2.2 mm long; bracteoles 1.3–1.6 mm long; pedicels c. 4 mm long, sericeous, less so in articulate part. *Flowers* unknown. *Sepals* 5, ovate, margin and outside sericeous, inside glabrous, glands along margin unknown; 2 outer smaller ones c. 2 by 1.8 mm; 3 inner larger ones c. 2.6 by 2.8 mm, margin petaloid. *Disc* interrupted. *Fruits* with 1–3 well developed lobes, c. 0.9 by 1.1–1.2 cm, smooth, glabrous, blackish when dry; stipe c. 1.5 mm high, slender; margin blunt; lobes c. 7 by 6 mm. *Seeds* obovoid, c. 5 by 5 mm; hilum c. 1.2 mm long.

Distribution — *Malesia*: Philippines (Luzon; Ilocos Norte Prov.).

Habitat & Ecology — Dry slopes; altitude c. 700 m. Fr. Aug.

**28. *Guioa patentinervis*** Radlk., *Sapind. Holl.-Ind.* (1879) 11, 40; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 610, 618; in *Engl., Pflanzenz.* 98 (1933) 1163; Welzen, *Leiden Bot. Series* 12 (1989) 253, f. 106. — Lectotype (Van Welzen 1989): *de Vriese & Teijsmann s.n.* (L. holo; BO, K, L, M), Moluccas.

*Guioa spec.*: Merr., *Philipp. J. Sc.*, Bot. 11 (1916) 286. — *Guioa multipunctata* Radlk., *Philipp. J. Sc.*, Bot. 12 (1917) 83; in *Engl., Pflanzenz.* 98 (1933) 1163. — Type: *Robinson 1602* (M holo), Moluccas.

*Treelet*, 5–8 m high. *Branchlets* sericeous when young; flowering twigs 3–6.5 mm thick. *Leaves* 2–5-jugate; rachis 4.4–20 cm long, terete, glabrous, petiole 2.2–6.6 cm long. *Leaflets* subsessile, opposite to alternate, (ovate to) elliptic, 4.9–13.5 by

1.4–4.6 cm, index 2.4–3.8, slightly asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire (to with a tooth subapically on either side of the margin), flat; apex acuminate to cuspidate, usually not mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous, domatia (0 or) 1 (to many) sacs to in axils of nerves; venation flat on upper side, raised on lower; nerves 0.3–3 cm apart, marginally looped and joined; veins laxly reticulate, rather distinct, especially below. *Inflorescences* axillary, branching basally and along the terete to flattened, sericeous, 1.6–8.2 cm long axis; first order branches up to 3.1 cm long; cymules cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside sericeous, inside subglabrous; bracts 0.5–0.7 mm long; bracteoles 0.2–0.3 mm long; pedicels 1.2–3.2 mm long, sericeous except for the subglabrous articulate part. *Flowers* c. 2 mm in diam. *Sepals* 5, ovate, margin pilose, outside and inside glabrous; 2 outer smaller ones 0.8–1.9 by 0.8–1.3 mm, margin with few glands; 3 inner larger ones 1.3–2.5 by 1.3–1.9 mm, margin petaloid, without glands. *Petals* 5, very reduced, elliptic, 0.8–1.2 by 0.3–0.4 mm; claw 0.2–0.3 mm high; margin pilose, outside and inside glabrous, apex obtuse to acute; scales 0.3–0.4 mm long, free, apex very slender; crest absent. *Disc* uninterrupted. *Stamens* 8; filaments 1–2.3 mm long, pilose, especially basally; anthers c. 0.3 mm long, glabrous. *Pistil*: ovary 0.2–0.7 mm high, subhirsute; style and stigma 0.1–0.7 mm long. *Fruits* with 1–3 well developed lobes, 0.7–0.9 by 0.7–1.3 cm, smooth to somewhat rugose-ruminate, glabrous, red when fresh, blackish when dry; stipe c. 2 mm high, slender; margin blunt; lobes 5–7 by 4.5–5.5 mm. *Seeds* obovoid, 5–6.4 by 4–4.8 mm; hilum 0.7–1 mm long.

*Distribution* – *Malesia*: Moluccas (Ambon, Buru, Ceram, Obi).

*Habitat & Ecology* – In transition from coral sand beach to nickel-rich soil in open forest with very little undergrowth; altitude sea level up to 300 m. Fl. Jan.–Apr.; fr. Sept.–Nov.

*Uses* – Wood is used for the construction of houses.

**29. *Guioa pauciflora*** Radlk., Bot. Jahrb. 56 (1921) 279; Nova Guinea 11 (1926) 183; in Engl., Pflanzenr. 98 (1933) 1160; Welzen, Leiden Bot. Series 12 (1989) 255, f. 107. — Type: *Leder-mann 9026* (B† holo; K, SING), Papua New Guinea.

*Shrub to tree*, 3–25 m high. *Branchlets* sericeous, especially when young; flowering twigs c. 1.7 mm thick. *Leaves* 1-jugate; rachis 0.2–1.3 cm

long, terete, not to slightly winged, sericeous, petiole 0.2–1 cm long. *Leaflets* sessile, opposite, elliptic to obovate, 1.1–6.3 by 0.5–2.6 cm, index 2.2–3.3, ± symmetrical, coriaceous to very coriaceous, usually punctate; base attenuate; margin entire, flat to revolute; apex retuse to acuminate, sometimes mucronulate; upper surface glabrous, (wax); lower surface dull, papillate, glabrous to very sparsely sericeous, domatia absent or a single small or large sac on basisopic side in axil of second nerve; venation raised on both sides; nerves 0.2–1.1 cm apart, marginally looped and joined; veins densely reticulate, very conspicuous, even the veinlets. *Inflorescences* axillary, unbranched to branching basally on the terete, sericeous, c. 3.9 cm long axis; cymules cincinnate, 2-flowered; bracts and bracteoles immature or caducous; pedicels not yet full-grown. *Flowers* in bud. *Sepals* and *petals* 5, immature, white. *Disc* uninterrupted. *Stamens* 8, immature. *Pistil* not measured. *Fruits* with 2 or 3 well developed lobes, 1.1–1.2 by 1.1–1.2 cm, rugose, glabrous, blackish when dry; stipe c. 3.5 mm high, rather broadly obconical; margin blunt; lobes c. 8 by 5 mm; septa complete. *Seeds* unknown.

*Distribution* – *Malesia*: Irian Jaya (Snow Mts); Papua New Guinea (W & E Sepik Prov.). A seemingly somewhat disjunct distribution; the central area of New Guinea is very poorly collected, however.

*Habitat & Ecology* – Once recorded from limestone rocks on the crest of a steep slope. Presumably also in cloud forest (the dried specimens are moss-covered); altitude 500–2500 m. Buds and young fr. Oct.

*Note* – The three specimens studied are rather different. However, all have 1-jugate leaves, papillate leaflets with a very typical venation pattern, an uninterrupted disc, and rather small fruits with a broadly obconical stipe and slender lobes.

**30. *Guioa pleuropteris*** (Blume) Radlk., Sapind. Holl.-Ind. (1879) 10; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 520, 610; Stapf, Trans. Linn. Soc. Bot. 4 (1894) 119, 142; King, J. As. Soc. Beng. 65, II (1896) 444; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66; Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 63; Leconte in Fl. Indo-Chine 1 (1912) 1024, f. 127: 1–6; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; Bot. Jahrb. 49 (1913) 370; Merr., Enum. Born. (1921) 361; Ridley, Fl. Malay Penins. 1 (1922) 505; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 508; Craib, Fl. Siam. Enum. 1 (1926) 332; Steen., Bull. Jard. Bot. Buitenzorg, III, 12 (1931) 172, 187, 189; Radlk. in Engl., Pflanzenr. 98 (1933) 1164;



- Corner, Gard. Bull. Str. Settl. 10 (1939) 45; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 981, f. 124: 17–26; Salvosa, Lex. Philipp. Pl. (1963) 105; Meijer, Bot. News Bull. 9 (1967) 74; Martin, Introd. Ethnobot. Cambodge (1971) 90; Corner, Gard. Bull. Sing., Suppl. 1 (1978) 153; Yap in Tree Fl. Malaya 4 (1989) 442; Welzen, Leiden Bot. Series 12 (1989) 257, f. 109, 110. — *Cupania pleuropteris* Blume, Rumphia 3 (1847) 158; Hiern in Hook. f., Fl. Br. India 1 (1875) 677; Fern.-Vill., Nov. App. (1880) 51, p.p.: (1883) 349; Ridley, Trans. Linn. Soc. Bot. 3 (1893) 289. — Lectotype (Van Welzen 1989): *Korthals s.n.* (L holotype; L. W), Borneo.
- Cupania pleuropteris* var. *apiculata* Hiern in Hook. f., Fl. Br. India 1 (1875) 677. — *Cupania griffithiana* Kurz, J. As. Soc. Beng. 44, II (1876) 188. — *Guioa pleuropteris* f. *apiculata* Radlk. in Schmidt, Bot. Tidsskr. 32 (1915) 315. — Lectotype (Van Welzen 1989): *Maingay 442* (BM holotype; A. K. L), Malay Peninsula. For nomenclature see Welzen (1989) 262, note 2.
- Guioa aptera* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 62; Merr., Philipp. J. Sc., Suppl. 1 (1906) 87; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenz. 98 (1933) 1166. — Syntypes: *Warburg 11504, 13108* (n.v.), Philippines.
- Guioa lasiothyrsa* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 63; Merr., Philipp. J. Sc., Suppl. 1 (1906) 87; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 508; Radlk. in Engl., Pflanzenz. 98 (1933) 1166. — Type: *Merrill 852* (PNH<sup>+</sup> holotype; A. K. NY, SING), Philippines.
- Guioa subapiculata* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 64; Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Radlk. in Engl., Pflanzenz. 98 (1933) 1166. — Type: *Merrill 513* (PNH<sup>+</sup> holotype; A. K. NY), Philippines.
- Guioa lasiothyrsa* Radlk. f. *elmeri* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1609. — Syntypes: *Elmer 9315* (BM, F, Fl, L, K, M, W), *9342* (A, BM, BO, Fl, M, NY, W), Philippines.
- Guioa forbesii* Bak. f., J. Bot. 62, Suppl. (1924) 26. — Type: *Forbes 2617* (BM holotype; Fl, L, P), Sumatra.
- Shrub to tree*, up to 30 m high. dbh 5–60 cm (to 2 m); no buttresses; outer 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 grained, soft to hard, white to yellow, without odour or sap. *Branchlets* especially hirsute (to sericeous) when young; flowering twigs 1–6 mm thick. *Leaves* (1–)2–5(–7)-jugate; rachis 0.8–25.3 cm long, (terete to) upwards flattened, usually (slightly) winged, wing up to 3 mm broad, sericeous to hirsute, petiole 0.6–9.3 cm long. *Leaflets* usually subsessile, opposite to alternate, lower often ovate, upper (elliptic to) obovate, 0.9–18.7 by 0.5–8.3 cm, index 0.5–4.3, asymmetrical, especially the base and the apex, acroscopic side broader, (sub)coriaceous, usually punctate; base (acute to cuneate to) attenuate; margin entire, flat (to revolute); apex (obtusate to) usually abruptly acuminate (to cuspidate), often mucronulate; upper surface (glabrous to) sparsely sericeous to hirsute; lower surface dull, papillate, (sub)sericeous to usually hirsute, domatia many pockets (or sacs) in axils of nerves, raised; venation on upper surface (slightly sunken to) flat to raised, usually concolorous with lamina, below raised; midrib below raised, convex; nerves 0.2–4.9 cm apart, marginally looped and joined, less distinctly so in lower half of leaflets; veins laxly reticulate, usually distinct. *Inflorescences* axillary (to pseudoterminal), (unbranched to) branching basally and especially along the terete, usually brown hirsute, 0.5–21.6 cm long axis; first order branches up to 13.8 cm long; cymes cincinnate, 2–5-flowered; bracts and bracteoles (deltate to) triangular, outside sericeous, inside (sub)glabrous; bracts 0.7–3.8 mm long; bracteoles 0.2–1.5 mm long; pedicels 1.1–7 mm long, hirsute. *Flowers* 3–4.2 mm in diam., fragrant. *Sepals* 5, ovate, margin and less so outside pilose, margin with glands, inside (sub)glabrous, green to tinged reddish or whitish; 2 outer smaller ones 0.7–2.8 by 0.6–2 mm; 3 inner larger ones 1.5–3.5 by 0.9–3.3 mm, margin petaloid. *Petals* 5, (elliptic to) obovate, 1.3–3.5 by 0.7–2.2 mm, white; blade obovate, gradually decurrent into the 0.2–1 mm high claw, margin (and outside) pilose, inside glabrous, apex rounded (to acute); scales 0.8–2.2 mm long, free, apex not to hardly broadened; crest usually developed, a pilose flat part of the bifid scale apex, yellow. *Disc* (uninterrupted to) interrupted (gap often small). *Stamens* 8; filaments 1.3–5.1 mm long, pilose, especially basally, white; anthers 0.2–0.7 mm long, glabrous, pink. *Pistil* green; ovary 0.3–2.8 mm long, subhirsute; style and stigma 0.1–2.2 mm long. *Fruits* with 1–3 well developed lobes, 1–1.9 by 1–2.5 cm, smooth to somewhat ribbed to somewhat rugose-ruminate, glabrous, red when fresh, reddish (to blackish) when dry; stipe 2–5 mm high, slender; margin blunt; lobes 7.5–13 by 6.5–13 mm. *Seeds* globose to obovoid, 5.5–9.7 by 5–8 mm; hilum 1–3 mm long; arillose yellow to or-

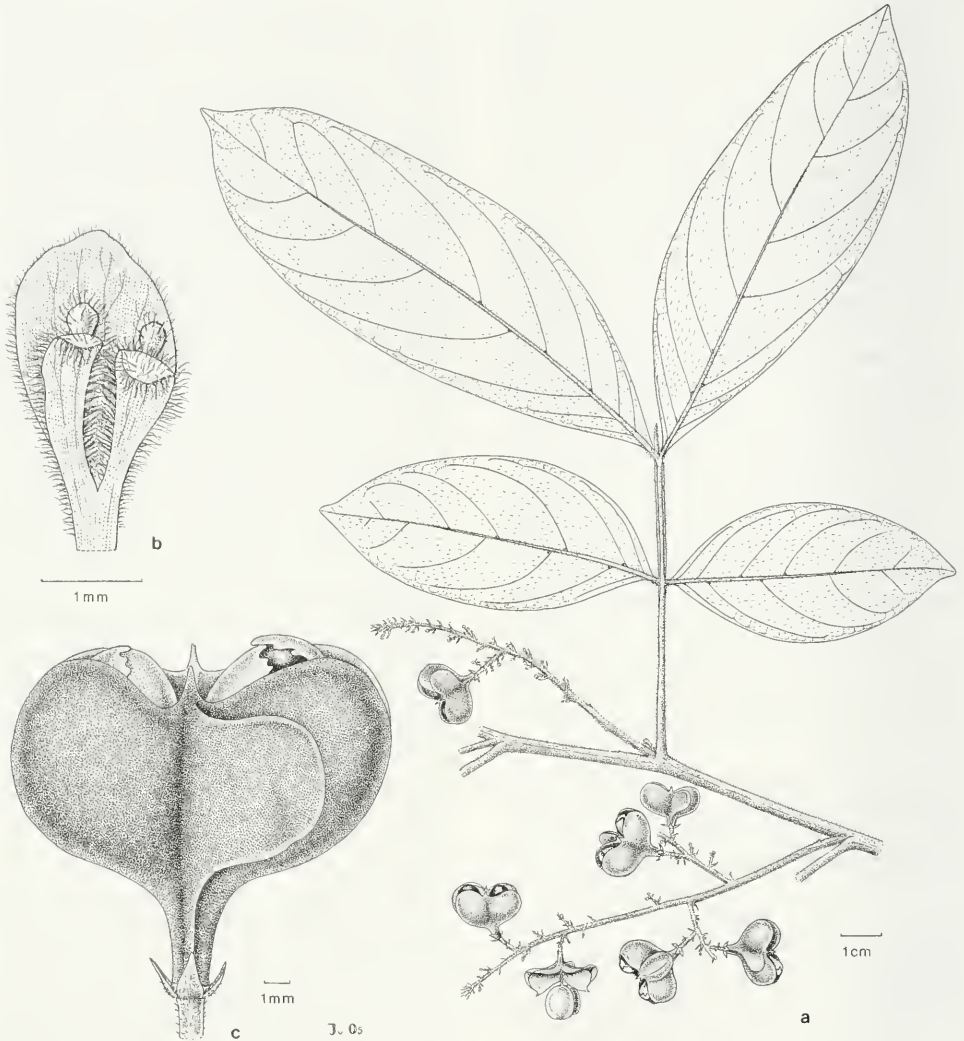


Fig. 41. *Guioa pleuroptervis* (Blume) Radlk. a. Habit; b. petal; c. fruit (a, c: Davidson 1325; b: Maxwell 81-34).

ange, edible, sour. – Figs. 38b, 41, 42.

Distribution – Burma, Cambodia (Kampot), Vietnam (Poulo-Condor, Hatien), Thailand, *Malesia*: E coast of Malay Peninsula, Sumatra, Borneo, Philippines.

Habitat & Ecology – (Rare to) very common, scattered in lower to middle storey of primary forest, on flat to hilly to mountainous land, on dry to periodically flooded soils (e.g. swamps). In primary and especially secondary forest; edges of forests, plantations; in open landscapes like cultivated land and belukar; in mossy forest; along riverbanks,

roads, sea. On Pulau Sekindan (Corner, Gard. Bull. Sing. 38, 1985, 19) in *Terminalia-Barringtonia* and *Eugenia grandis* formations. Soil: sandstone, brown stony soil, yellow sandy loam, black sand, ultrabasic alluvial deposits; altitude sea level up to 1800 m. Fl. Aug.–Mar. (–May); Philippines: Dec.–May; fr. throughout the year, mainly Feb.–Apr.

Uses – Wood is used for torches (Radlkofer, 1913); it is durable and elastic, but thin, therefore used in Indonesia as handles for axes and shafts of wagons and plows (Heyne, Nutt. Pl. Indon. ed. 3, 1950, 1000). The roots are used medically in NE

Pahang (Malaysia) in the form of a decoction against fever and stomach ache. The name *pokok serawan burung* probably refers to a medical use as 'serawan' = sprue (Burk., Dict. Econ. Prod. Malay Penins. ed. 2, 1966, 1134). Also used to exterminate intestinal worms.

Notes — 1. *Guioa pleuroptervis* is a rather variable species, and the very character to which it owns its name can be absent. The leaflets are usually obovate with a sharply decurrent short apex (see leaflet a and f in Fig. 42, but if the latter is elongated the shape becomes more elliptic, as is found in forms from Sumatra, N Borneo and Philippines. The indumentum on the lower surface of the leaflets is usually dense, seldom sparse, usually velutinous to occasionally sericeous; the hairs are

usually long, but can be short. The domatia are pockets, but an occasional pocket-like sac is also found.

The normal shape of the leaflets, found on the SE Asian mainland, most of Borneo and SE Philippines, is represented by the leaflets a and f in the distribution map (Fig. 42). The Philippines have several distinct forms, which cannot be separated as species. Two clines can be found in the Philippines (see arrows on map, Fig. 42). One cline ranges from Palawan to Culian and Busuanga I. (Calamian group). On Palawan the leaflets can be rather large and are usually densely velutinous on the lower surface. On the other two islands the size of the leaflets decreases dramatically, but they still remain very velutinous, this form has been described as

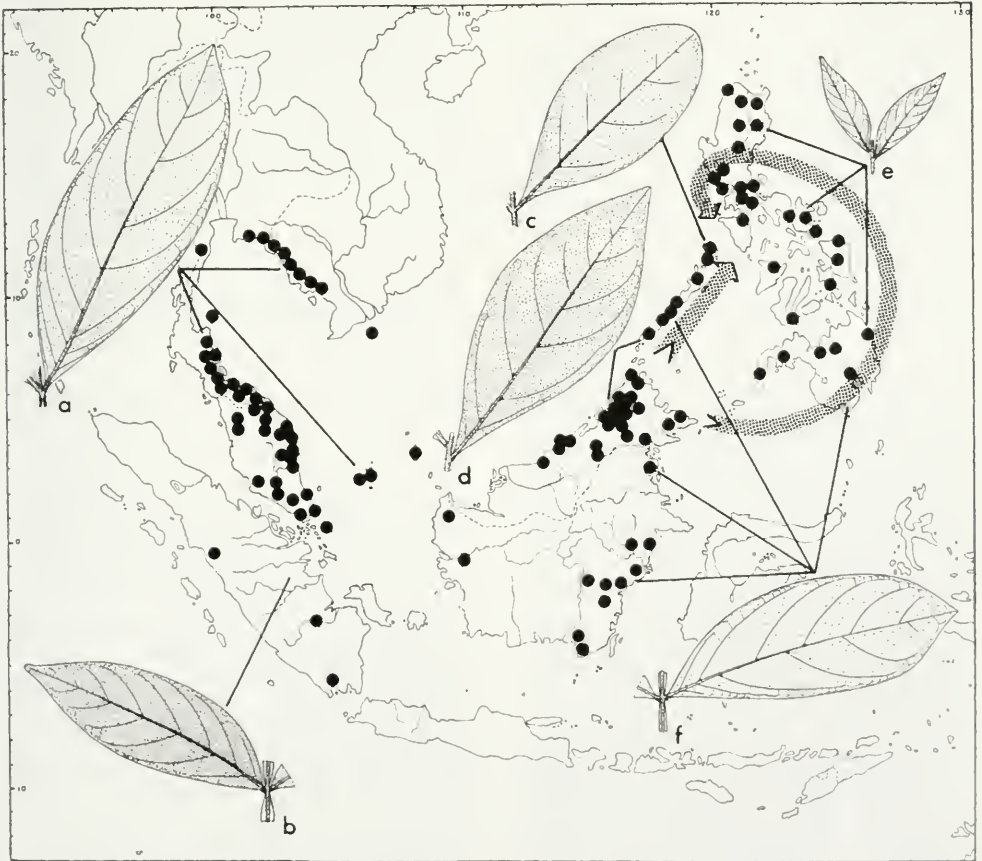


Fig. 42. *Guioa pleuroptervis* (Blume) Radlk. Distribution map showing two transformation series of leaflets (all c.  $\cdot$  0.7). — a. '*G. pleuroptervis*' form; b. '*G. forbesii*' form; c. '*G. subapiculata*' form; d. '*G. lasiothyrsa*' form; e. '*G. aptera*' form; f. '*G. pleuroptervis*' form (a: Davidson 1325; b: Forbes 2617; c: Merrill 513; d: Elmer 10880; e: Elmer 9315; f: van Niel 4263).



'*G. subapiculata*' (leaflet c). The forms on Palawan were described as *G. pleuropteris* (leaflet a, f) and the wingless specimens as '*G. lasiothyrsa*' (leaflet d). The other cline is found from Borneo via Mindanao to Panay, Negros, Leyte, Samar to Luzon and finally to Mindoro. On Mindanao the situation is rather complex, the rather large-leaved form of Palawan is found, together with a somewhat smaller form of the 'typical' *G. pleuropteris* (leaflet a and f) and a third form which was described as '*G. aptera*' and '*G. lasiothyrsa* f. *elmeri*' (leaflet e). This latter form is mainly found on Luzon, it has very asymmetrical and small leaflets, with often (few) sericeous hairs and sometimes (partly) sacs instead of pockets on the lower surface. All intermediates among these forms are found.

Morley & Flenley (in T.C. Whitmore: Biogeographical evolution of the Malay Archipelago, 1987, 50–59) show in a palaeogeographical reconstruction of the Sunda-Sahul region during the middle Pleistocene that a continuous landmass existed from N Borneo to Palawan and the Calamian group; this land mass is covered by one of the two clines; and another landmass existed from NE Borneo via Mindanao up to Luzon and Mindoro, the area occupied by the other cline. Probably the clines are the result of dispersal accompanied by phenological change.

In Kalimantan Timur (Borneo) some specimens resemble *G. pterorhachis*, but the midrib on the lower surface of the leaflets is convex instead of flat and hardly raised. Specimens from Sumatra were described as '*G. forbesii*' (leaflet b) because of the narrow, elliptic, rather than broad and obovate leaflets, which are densely velutinous below.

2. Merrill suggested that *Sapindus guisian* Blanco is synonymous with *G. pleuropteris*. This decision is incorrect, because of the large differences between the two. The full synonymy of *Sapindus guisian* and a discussion of the differences can be found in Welzen (1989) 263, note 3.

3. For the difference between the '*G. lasiothyrsa*' form of *G. pleuropteris* and *G. myriadenia* see note 2 under the latter.

- 31. *Guioa plurinervis*** Radlk. in Engl. & Prantl. Nat. Pflanzenfam. 3, 5 (1895) 346; Bot. Jahrb. 56 (1921) 280 (typification); in Engl., Pflanzenz. 98 (1933) 1169; Welzen, Leiden Bot. Series 12 (1989) 264, f. 111. — Type: *MacGregor s.n.*, 1890 (M holo; MEL), E Papua New Guinea.

*Treelet*, 5–12 m high, dbh c. 8 cm; outer bark black, inner bark pinkish brown; sapwood cream,

heartwood reddish brown. *Branchlets* sericeous when young; flowering twigs 3.5–5 mm thick. *Leaves* 2–5-jugate; rachis 4.3–15.2 cm long, somewhat flattened above, sericeous, petiole 3–6.1 cm long; petiolules up to 1 cm long. *Leaflets* opposite to alternate, ovate, falcate, 5.9–13.2 by 1.5–3.3 cm, index 3.6–4.4, asymmetrical, acroscopic side broader, coriaceous to very coriaceous, not punctate; base attenuate; margin entire, flat; apex cuspidate to caudate, mucronulate; upper surface glabrous except for the puberulous midrib; lower surface dull, papillate, shortly sericeous, domatia 0–2 pockets, especially on basicopic side in axil of second nerve; venation flat above, raised below; nerves 0.2–1.3 cm apart, marginally looped and joined; veins laxly reticulate, indistinct. *Inflorescences* axillary to pseudoterminal, branching along the flattened to terete, sericeous, 3.1–15 cm long axis; first order branches up to 4.8 cm long; cymules cincinnate, c. 4-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.9–1.1 mm long; bracteoles 0.5–0.6 mm long; pedicels 2.5–3 mm long, sericeous except for the (sub)glabrous articulate part. *Flowers* c. 3 mm in diam. *Sepals* 5, ovate, margin (and outside) pilose, margin with glands, inside glabrous; 2 outer smaller ones 0.9–1.2 by 1–1.3 mm; 3 inner larger ones 1.8–2.7 by 1.5–2.5 mm, margin petaloid. *Petals* 5, elliptic, 3–3.2 by 1.2–1.5 mm, blade obovate, gradually decurrent into the c. 0.5 mm high claw, margin pilose, outside and inside glabrous, apex acute; scales 1.7–1.8 mm long, free; crest clavate, stipitate, glabrous. *Disc* interrupted. *Stamens* 8; filaments c. 4.2 mm long, pilose, especially basally; anthers c. 0.7 mm long, pilose. *Pistil*: ovary c. 0.6 mm long, subhirsute; style and stigma c. 0.4 mm long. *Fruits* with 1–3 well developed lobes, 1–1.4 by 1–1.7 cm, slightly ribbed, glabrous, red when fresh, blackish when dry; stipe c. 2 mm high, broadly obconical, indistinct; margin blunt; lobes 8–9 by 7–9 mm; septa complete. *Seeds* obovoid, c. 9 by 6 mm; hilum c. 1.2 mm long.

Distribution – *Malesia*: Papua New Guinea (Milne Bay Prov.: Rossel Island).

Habitat & Ecology – Hill forest and secondary rain forest; altitude 10–50 m. Fl. July; fr. Oct.

Note – *Guioa plurinervis* belongs to the *G. rigiduscula*-complex. It is characterized by its falcate leaflets, which are papillate below.

- 32. *Guioa pseudoamabilis*** Welzen. Blumea 33 (1988) 419, pl. 13a–d; Leiden Bot. Series 12 (1989) 266, f. 112. — Type: *Vinas & Bellamy 261* (L holo; A, CBG, K, LAE, UPNG, WEI), Papua New Guinea.

*Guioa venusta* auct. non Radlk.; Hartley et al.,

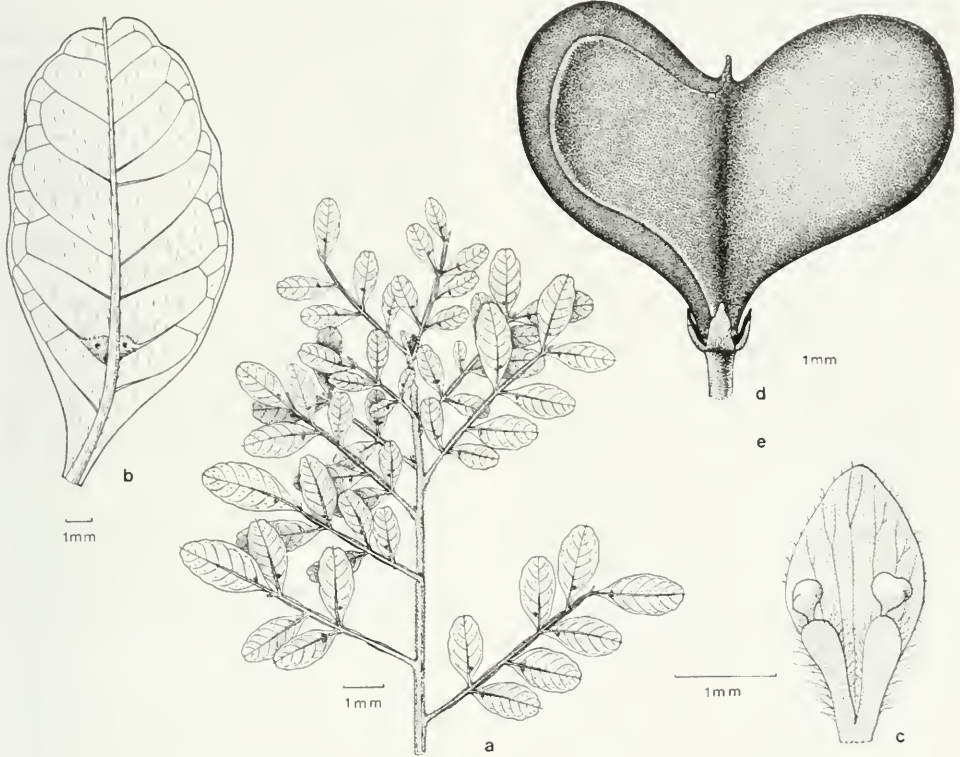


Fig. 43. *Guioa pseudoamabilis* Welzen. a. Habit; b. leaflet; c. petal; d. fruit (a, b: Saunders 802; c: Vinas & Bellamy 261; d: Hartley 12560).

Lloydia 36 (1973) 270; Streimann, Pl. Upper Watut Watershed (1983) 169.

*Shrub to tree*, 2–27 m high, dbh 1–60 cm; no buttresses; outer bark red to brown, smooth, inner bark straw-coloured; wood white. *Branchlets* sericeous to somewhat hirsute, especially when young; flowering twigs 1–4 mm thick. *Leaves* (1–)4–6-jugate; rachis 1.5–12 cm long, winged, wing up to 1 mm broad, subglabrous to sericeous, petiole 0.6–2.2 cm long. *Leaflets* subsessile, opposite to alternate, ovate to obovate, 0.8–4.3 by 0.5–2 cm, index 1–2.9, asymmetrical, acroscopic side broader, subcoriaceous, punctate; base attenuate; margin entire or usually slightly crenate, flat when crenate to revolute when entire; apex retuse to obtuse (to acute), mucronulate; upper surface (pilose, especially the midrib); lower surface duller, smooth, no papillae, usually sericeous, domatia in at least some leaflets one to several large, hirsute sacs in axils of subbasal nerves; venation on upper side flat to slightly raised, raised on lower; nerves 0.1–0.6 cm apart, marginally looped and joined; veins

densely reticulate, very inconspicuous. *Inflorescences* axillary to pseudoterminal, unbranched along the terete, sericeous, 2.5–8 cm long axis; first order branches up to 3.1 cm long; cymes cincinnate, c. 2-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.4–1.5 mm long; bracteoles 0.3–0.7 mm long; pedicels 3.3–6 mm long, sericeous, less so in articulate part. *Flowers* c. 4 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, pinkish; 2 outer smaller ones 1.1–1.8 by 1–2 mm; 3 inner larger ones 1.9–3.2 by 1.9–2.6 mm. *Petals* 5, elliptic, c. 3.4 by 1.2 mm, pinkish white; claw c. 0.5 mm long; margin pilose, outside and inside glabrous, apex acute; scales c. 0.7 mm long, free; crest stipitate, clavate, apex lobed. *Disc* uninterrupted. *Stamens* only seen in bud, 8; filaments pilose, especially basally; anthers glabrous. *Pistil* only seen in bud; ovary subhirsute. *Fruits* with 1–3 well developed lobes, 1.1–2 by 1.7–1.9 cm, smooth (to slightly ribbed), glabrous, red when fresh, blackish when dry; stipe 2–3 mm high, rather broadly obconical; margin blunt; lobes 10–

12 by 6–10 mm; septa complete. *Seeds* globose to obovoid, 7–9 by 6–7 mm; hilum 1.8–2.9 mm long. — **Fig. 43.**

Distribution — *Malesia*: Papua New Guinea (Enga, Eastern Highlands, and Morobe Prov.).

Habitat & Ecology — Occasional in submontane, montane, and moss forest with low vegetation (once recorded to be dominated by *Xanthomyrtus*, *Myrtaceae*). Soil: once found on well-drained latosol in strong shade; altitude 1800–3300 m. Fl. Jan.–Apr.; fr. Oct.–Dec.

**33. *Guioa pteropoda*** Radlk., Sapind. Holl.-Ind. (1879) 11, 41; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 614 (typification); Bot. Jahrb. 56 (1921) 28; in Engl., Pflanzenr. 98 (1933) 1174; Welzen, Leiden Bot. Series 12 (1989) 268, f. 113. — Type: *Beccari* *it. sec.* 16 (Fl. holo), New Guinea.

*Guioa crenifoliola* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 514. — Type: *Brass* 13082 (A holo; BM, L), Irian Jaya. See note.

*Tree*, 13–20 m high, dbh 20–25 cm. *Branchlets* sericeous when very young; flowering twigs 3–4 mm thick. *Leaves* 2–7-jugate; rachis 1.9–17.3 cm long, terete, not to slightly winged, subglabrous, petiole 1.8–4.6 cm long. *Leaflets* subsessile, opposite to alternate, elliptic, 3.5–8.5 by 1.7–3.2 cm, index 2.1–3, asymmetrical, acroscopic side broader, (sub)coriaceous, not punctate; base attenuate; margin laxly crenate, slightly revolute; apex obtusely acuminate to caudate, usually mucronulate; upper surface glabrous, (wax); lower surface duller, smooth, no papillae, glabrous, domatia absent to several sacs, mainly on basiscopic side in axils of nerves; venation on upper side flat except for the raised midrib, slightly raised below, also the flat midrib; nerves 0.2–1 cm apart, marginally looped and joined; veins laxly reticulate, indistinct. *Inflorescences* axillary, unbranched to branching along the terete, subsericeous, 2.4–13 cm long axis; first order branches up to 5.3 cm long; cymules cinnate, c. 4-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.8–1 mm long; bracteoles 0.3–0.5 mm long; pedicels 3.8–8 mm long, glabrous or very sparsely pilose. *Flowers* c. 4 mm in diam. *Sepals* 5, ovate, margin pilose, outside and inside glabrous; 2 outer smaller ones 1.2–2.2 by 1.8–2.3 mm, margin with glands; 3 inner larger ones 3–4 by 3–4.2 mm, margin petaloid, without glands. *Petals* 4, obovate, 2.9–3.1 by 1.5–2.1 mm, white; claw 0.2–0.3 mm high; margin subglabrous, outside and inside glabrous, apex truncate to rounded; scales 2–2.2 mm long, free; crest usually a pilose bifid scale apex or clavate, glabrous. *Disc* interrupted, very asymmetri-

cal. *Stamens* 8; filaments 2.3–4.6 mm long, only basally pilose; anthers 0.3–0.4 mm long, glabrous. *Pistil*: ovary 0.4–0.6 mm long, subhirsute; style and stigma c. 0.3 mm long. *Fruits* with 2 or 3 well-developed lobes, c. 2 by 1.4 cm, smooth, glabrous, red when fresh, blackish when dry; stipe indistinct, broadly obconical; margin very sharp; lobes c. 0.8 by 1.6 cm; septa above attachment of funicle incomplete. *Seeds* immature.

Distribution — *Malesia*: S Moluccas (Ceram), Irian Jaya (Geelvink Bay, Jayapura).

Habitat & Ecology — Common. In primary forest along and in flood plains, in *Agathis* forest. Soil: clay, sand; altitude sea level up to 900 m. Fr. Mar.

Note — *Brass* 13082, 13702 (*G. crenifoliola*) are somewhat different from the other specimens in having leaves with a winged rachis and shorter, obtusely acute apices.

**34. *Guioa pterorhachis*** Welzen, Blumea 33 (1988) 419, pl. 12a, b; Leiden Bot. Series 12 (1989) 269, f. 114. — Type: *Elmer* 20268 (L holo; BM, F, K, M, NSW, P, U), Sabah.

*Guioa pleuropteris* auct. non Radlk.; Merr., Pl. Elm. Born. (1929) 175.

*Shrub to tree*, 3–16 m high, dbh 10 cm to 1.15 m; outer bark smooth, flaked, white to brown, soft, inner bark fibrous, pink to brown; cambium yellow; sapwood white to brown. *Branchlets* glabrous, at most sparsely sericeous when young; flowering twigs 2–5 mm thick. *Leaves* 3–7-jugate; rachis winged, wing up to 4 mm broad, (sub)glabrous, petiole 1.1–12.2 cm long. *Leaflets* subsessile, opposite to subopposite, elliptic (to obovate), 2.4–14.6 by 1–4.6 cm, index 1.9–3.9, often slightly asymmetrical, especially basally, then acroscopic side broader, (sub)coriaceous, punctate; base acute to attenuate to cuneate; margin entire, flat; apex gradually acuminate to cuspidate, sometimes mucronulate; upper surface glabrous (to puberulous on the midrib and venation; lower surface dull, papillate, (very) sparsely, usually shortly sericeous, domatia many sunken sacs in axils of nerves; venation on upper surface (slightly sunken to) flat to raised, raised on lower; midrib below hardly raised, flat; nerves 0.2–3.6 cm apart, marginally looped and joined, less so in lower half of leaflets; nerves laxly reticulate, rather indistinct. *Inflorescences* axillary (to pseudoterminal), (unbranched to) branching basally and along the terete, subsericeous, 1–20.8 cm long axis; first order branches up to 11.5 cm long; cymules cinnate, 2–5-flowered; bracts and bracteoles delatate to triangular, outside sericeous, inside (sub)glabrous; bracts 0.7–1.2 mm long; bracteoles 0.3–0.8 mm long; pedicels 2–7 mm long, sericeous. *Flowers* 3.5–4 mm



in diam. *Sepals* 5, ovate, margin (and outside) pilose, margin with glands, inside (sub)glabrous; 2 outer smaller ones 1–1.9 by 0.8–1.5 mm; 3 inner larger ones 1.7–3 by 1.2–2.7 mm, margin petaloid. *Petals* 5, elliptic (to obovate), 1.1–2.8 by 0.8–1.6 mm, white; claw 0.2–0.5 mm high; margin pilose, outside and inside glabrous, apex  $\pm$  acute; scales 1.1–2 mm long, free; crest a pilose flat part of bifid scale apex. *Disc* interrupted to uninterrupted. *Stamens* 8; filaments 2–5 mm long, pilose, especially basally; anthers c. 0.3 mm long, glabrous. *Pistil*: ovary 0.3–1 mm long, sparsely hirsute; style and stigma 0.1–1 mm long. *Fruits* with 1–3 well developed lobes, 1.4–1.9 by 1.2–2.2 cm, (smooth to) somewhat rugose-ruminate, glabrous, yellow to red when fresh, blackish when dry; stipe 4–7 mm high, slender; margin blunt; lobes 8.5–11 by 8–12 mm. *Seeds* obovoid, 7.5–10.5 by 6–9 mm; hilum 1.7–2 mm long; arillode edible, with yellow exudate.

Distribution – *Malesia*: Borneo (E Sabah: Sandakan & Tawau).

Habitat & Ecology – In understorey of primary and especially secondary forest, along rivers and roadsides, on flat to undulating country. Soil: white, yellow, or black sands; altitude sea level up to 30 (–500) m. Fl. (July–)Nov.–Jan.; fr. Nov.–May.

Uses – Firewood.

Note – *Guioa pterorhachis* resembles *G. pleuropteris* closely; specimens of the latter from Kalimantan Timur (Borneo) may differ only slightly from *G. pterorhachis* in having a raised and convex instead of a flat and hardly raised midrib on the lower surface of leaflets.

35. *Guioa pubescens* (Zoll. & Mor.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 302; Sapind. Holl.-Ind. (1879a) 10, 41 (lectotypification); Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879b) 543, 612; King, J. As. Soc. Beng. 65, II (1896) 445; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 210; Koord., Exk. Fl. Java 2 (1912) 541; Radlk., Philipp. J. Sc., Bot. 8 (1913) 446; in Elmer, Leaflet. Philipp. Bot. 5 (1913) 1616; Merr., Enum. Born. (1921) 361; Ridley, Fl. Malay Penins. 1 (1922) 506; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509; Radlk. in Engl., Pflanzenz. 98 (1933) 1169; Corner, Gard. Bull. Str. Settl. 10 (1939) 45; Wayside Trees (1940) 588, pl. 178; Desch, Mal. For. Rec. 15 (1954) 526; Backer & Bakh. f., Fl. Java 2 (1965) 140; Burk., Dict. Econ. Prod. Malay Penins. ed. 2 (1966) 1134; Keng, Gard. Bull. Sing. 35 (1982) 90;

Yap in Tree Fl. Malaya 4 (1989) 442; Welzen, Leiden Bot. Series 12 (1989) 272, f. 115, 116. — *Sapindus pubescens* Zoll. & Mor. in Mor., Syst. Verz. (1846) 22, p.p. (Zollinger 1105). — Lectotype (Radkofer 1879a): Zollinger 1105 (L. holo; A, BM, FI, P), Java.

*Arytera silaka* Miq., Sumatra (1861) 199, 510. — Type: Teijsmann HB 610 (U holo; BO), Sumatra.

*Cupania pallidula* Hiern in Hook. f., Fl. Br. India 1 (1875) 676; Ridley, Trans. Linn. Soc. Bot. 3 (1893) 289; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509. — Syntypes: Griffith s.n. (K); Maingay s.n. (K), Malay Peninsula.

*Guioa diplopeta* (Hassk.) Radlk. f. *dentata* Radlk., Sapind. Holl.-Ind. (1879) 88; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 610; in Engl., Pflanzenz. 98 (1933) 1162. — Type: Teijsmann HB 3741 (BO holo), Sumatra.

*Guioa perrottetii* auct. non Radlk.: Meijer, Bot. News Bull. 9 (1967) 75.

*Tree(let)*, 2–25 m high, dbh 1.3–85 cm; without buttresses; outer bark smooth, sometimes deeply fissured, hard, (greenish 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. *Branchlets* sericeous when young, hairs brown; flowering twigs 1.5–6 mm thick. *Leaves* (1–)2–6-jugate; rachis 2.1–29.5 cm long, terete (to upwards slightly flattened), subsericeous, petiole 1.4–10.8 cm long; petiolules up to 1 cm long. *Leaflets* opposite to alternate, ovate (to elliptic), often slightly falcate, 2.9–19.2 by 0.8–7.2 cm, index 1.3–5.5, especially basally asymmetrical, acroscopic side broader, coriaceous, not punctate; base attenuate; margin entire, flat (to revolute); apex gradually acuminate to cuspidate (to caudate), usually mucronulate; upper surface (glabrous to) sparsely shortly sericeous, (wax); lower surface dull, papillate, (slightly) shortly sericeous, domatia (0 or) 1 small sac to many sacs in axils of (basal) nerves; venation on upper surface (slightly sunken to) flat to raised, below usually raised, concolorous with lamina; nerves 0.3–3.3 cm apart, marginally looped and joined, (less so in lower third of leaflets); veins laxly reticulate, rather indistinct. *Inflorescences* axillary (to pseudoterminal), (unbranched to) branching basally to especially along the terete, brown sericeous, 1.4–24.2 cm long axis; first order branches up to 9.3 cm long; cymules cincinnate, 2–4-flowered; bracts and bracteoles deltate to triangular, outside sericeous, inside (sub)glabrous; 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 in diam.; buds green. *Sepals* 5, ovate, margin and often outside sericeous, margin with glands, inside (sub)glabrous, green to reddish; 2 outer smaller ones 1–2.8 by 0.8–2.1 mm; 3 inner larger ones 1.4–3.3 by 1.3–3.1 mm, margin petaloid. *Petals* 5, obovate, 1.9–3.4 by 0.7–1.8 mm, white to yellow; blade obovate, gradually decurrent into the 0.3–1.2 mm long claw, margin (and outside) pilose, inside glabrous, apex rounded (to acute); scales 1.1–2 mm long, free, apex not to hardly broadened; crest a pilose flat part of the bifid scale apex. *Disc* interrupted. *Stamens* 8; filaments 1.9–5.2 mm long, pilose, especially basally, white; anthers 0.2–0.4 mm long, glabrous, pink. *Pistil*: ovary 0.3–2 mm long, densely hirsute, yellowish green; style and stigma 0.1–2.5 mm long. *Fruit* with 1–3 well developed lobes, 1–1.5 by 1–1.9 cm, smooth (to somewhat ribbed), (very) sparsely sericeous, glabrescent, red when fresh, (reddish to) blackish when dry; stipe 1.5–5 mm high, slender; margin blunt; lobes 7–10 by 6.5–10 mm. *Seeds* globose to obovoid, 6.8–10 by 5.8–7.5 mm; hilum 1.1–2 mm long.

**Distribution** – *Malesia*: W Malaysia, Singapore, Sumatra, Bangka. W Java (Djawa Barat), Karimunjawa Island, Borneo (above equator), Philippines (Palawan).

**Habitat & Ecology** – Rare to rather common in primary and especially secondary forest, kerangas, peat swamp forests, forest along sea. Soil: sand, sandy loam, sandstone, rocky soil, limestone, ultrabasic, dry peat.; altitude sea level up to 1800 m. Fl. Singapore: July–Oct.; Java: Feb., Nov.; Borneo: Aug.–Feb.; Fr. Jan.–Apr.

**Uses** – The wood is used as a construction timber, in spite of the fact that it is brittle and the stem too narrow for sawing planks (Heyne, Nutt. Pl. Indon. ed. 3, 1950, 1001); however, recorded diameters indicate the opposite.

**Note** – See note 3 under *G. bijuga*.

**36. *Guioa reticulata*** Radlk., Philipp. J. Sc., Bot. 8 (1914) 446, 462; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509; Radlk. in Engl., Pflanzenz. 98 (1933) 1168; Welzen, Leiden Bot. Series 12 (1989) 277, f. 118. — Lectotype (Van Welzen 1989): *BS (Ramos) 7055* (M holo; NSW), Philippines.

*Guioa sulphurea* Radlk., Philipp. J. Sc., Bot. 8 (1914) 446, 462; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509; Radlk. in Engl., Pflanzenz. 98 (1933) 1167. — Type: *FB (Alvarez) 22429* (M holo; F. L., NSW), Philippines.

*Tree*, 7–8 m high, dbh c. 12.5 cm. *Branchlets*

golden sericeous (to hirsute) when young; flowering twigs 2–4 mm thick. *Leaves* 2–5-jugate; rachis 2.8–17 cm long, basally terete, upwards flattened above, subglabrous, petiole 1.5–6.3 cm long; petiolules up to 1 cm long. *Leaflets* opposite to alternate, ovate, falcate, 2.8–12 by 0.7–3 cm, index 3.5–4.5, asymmetrical, acroscopic side broader, coriaceous to very coriaceous, not punctate; base attenuate; margin entire, flat to revolute; apex cuspidate to caudate, usually mucronulate; upper surface glabrous to puberulous on the midrib; lower surface dull, papillate, short (to long) sericeous, domatia a single (to many) sac(s) on basisopic side in axil of second nerve, small; venation conspicuously raised, discolorous with lamina; nerves 0.3–2.1 cm apart, marginally looped and joined; veins densely reticulate, very distinct. *Inflorescences* axillary, branching basally and along the usually flattened, sericeous (to hirsute), 3.4–23.3 cm long axis; first order branches up to 11.2 cm long; cymes cincinnate (to dichasial), 2–5-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 1–1.8 mm long; bracteoles 0.3–1.1 mm long; pedicels 2.3–5 mm long, sericeous except for the usually subglabrous articulate part. *Flowers* 3.5–3.8 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, (outside pilose), inside glabrous; 2 outer smaller ones 1.5–2.2 by 1.1–2.2 mm; 3 inner larger ones 2.2–2.8 by 1.6–2.7 mm, margin petaloid. *Petals* 5, obovate, 2.8–3.1 by 1–1.5 mm, blade obovate, gradually decurrent into the 0.8–1.3 mm high claw, margin pilose, outside and inside (sub)glabrous, apex obtuse; scales 1.2–1.8 mm long, free; crest a pilose flat part of the bifid scale apex to clavate and subglabrous. *Disc* interrupted. *Stamens* 8; filaments 1.7–4 mm long, pilose, especially basally; anthers 0.4–0.6 mm long, glabrous. *Pistil*: ovary 0.4–2 mm long, subhirsute; style and stigma 0.3–1.2 mm long. *Fruits* with 1 or 2 well developed lobes, 1–1.1 by 1.2–1.4 cm, smooth, glabrous, red when fresh, blackish when dry; stipe c. 2 mm high, slender; margin blunt; lobes c. 7.5 by 7 mm. *Seeds* obovoid, c. 7.2 by 5.8 mm; hilum c. 2 mm long.

**Distribution** – *Malesia*: Philippines (Luzon).

**Habitat & Ecology** – In secondary forest, on forested slopes. Fl. Jan.–Feb.; fr. May.

**Notes** – 1. Several specimens have a patent, hirsute indumentum instead of the more common appressed sericeous hairs; they were described as a separate species (*G. sulphurea*). This phenomenon is also occasionally found in other species (e.g., *G. chrysea*, *G. subsericea*).

2. *Jacobs 7983* is exceptional because the inflorescences, pedicels, and sepals are very densely sericeous.

**37. *Guioa rigidiuscula*** Radlk., Sapind. Holl.-Ind. (1879) 11, 41; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 614 (typification); *ibid.* 20 (1890) 361; K. Schum. & Laut., Fl. Schutzgeb. Südsee (1900) 420; Radlk., Bot. Jahrb. 56 (1921) 282; Baker in Rendle, J. Bot. 61, Suppl. (1923) 11; Laut., Bot. Jahrb. 62 (1929) 555; Radlk. in Engl., Pflanzenz. 98 (1933) 1173; Rehder, J. Arnold Arbor. 14 (1933) 63; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 3, f. 1g; Welzen, Leiden Bot. Series 12 (1989) 281, f. 120. — Type: *Beccari Fl 2804* (Fl holo, cited by Radlkofer as *Beccari 8*), New Guinea.

*Shrub to tree*, 2–15 m high, dbh 10–24 cm; outer bark smooth, blotched variously grey to brown, inner bark brown, sap red; wood white to dark cream. *Branchlets* shortly sericeous when young; flowering twigs 2–6 mm thick. *Leaves* 1–4-jugate; rachis 2.2–17.2 cm long, terete (to somewhat flattened below jugae), subglabrous, petiole 1.3–8.2 cm long. *Leaflets* subsessile, opposite to alternate, elliptic, 3.6–17.1 by 1.2–6.3 cm, index 2.1–3.8, subsymmetrical, acropic side slightly broader, (sub)coriaceous, usually punctate; base attenuate; margin entire, flat; apex (acute to) acuminate to cuspidate (to caudate), usually mucronulate; upper surface glabrous, (puberulous on midrib); lower surface duller, smooth, no papillae, subglabrous, domatia in at least some leaflets a single small sac on basiscopic side in axil of second nerve; venation on upper side (slightly sunken to) flat (to raised), raised below; nerves 0.2–3.8 cm apart, marginally looped and joined, often less distinctly so in lower part of leaflets; veins laxly reticulate, indistinct. *Inflorescences* ramiflorous (to axillary), unbranched to branching basally and along the terete, sericeous, 1–13.3 cm long axis; first order branches up to 6.2 cm long; cymules cincinnate to dichasial, (1–)3–4(–5)-flowered; bracts and bracteoles triangular, outside hirsute, inside glabrous; bracts 0.4–1 mm long; bracteoles 0.2–0.6 mm long; pedicels 1.9–5.5 mm long, sericeous except for the subsericeous articulate part. *Flowers* 3.5–4 mm in diam., slightly fragrant; buds green-white. *Sepals* 5, ovate, margin pilose, outside and inside glabrous, white; 2 outer smaller ones 0.7–2 by 0.8–2.3 mm, margin with glands; 3 inner larger ones 1.8–3.2 by 1.5–3 mm, margin petaloid, at most with few glands. *Petals* 5, ovate to obovate, 1.5–4.2 by 0.7–1.6 mm, white; claw 0.2–0.5 mm high; margin and usually outside pilose, inside subglabrous, apex acute; scales 1–1.7 mm long, free, basally not auriculate, margin not distinctly membranous; crest clavate, stipitate, apex lobed. *Disc* interrupted. *Stamens* 8; filaments 1.3–3.7 mm long, pilose, espe-

cially basally, white; anthers 0.6–0.7 mm long, slightly pilose. *Pistil*: ovary 0.3–1.5 mm long, subhirsute; style and stigma 0.1–1.2 mm long. *Fruits* with 1–3 well developed lobes, i. 1–2.9 by 1.1–3.5 cm, completely dehiscent, smooth to rugose to rugosely ribbed, glabrous, red when fresh, blackish when dry; stipe 0–2 mm high, slender; margin blunt; suture usually highly convex, lobes almost touching; lobes 10–18 by 9–22 mm; septa complete. *Seeds* obovoid, c. 8.7 by 5.2 mm; arilode without or with a small pseudo-funicle, but always with a basal rim; hilum c. 1.3 mm long.

Distribution — *Malesia*: Irian Jaya (Jayapura); Papua New Guinea (E. Sepik, Morobe, Milne Bay, Central, Gulf Prov.).

Habitat & Ecology — In poor lowland rain forest, gallery forest along creek, monsoon forest, garden regrowth, along edge of scrub and eucalypt savannah, road-sides; altitude sea level up to 450(–935) m. Fl. Aug.–Sept.; fr. Jan.

Note — *Guioa rigidiuscula* is part of the *G. rigidiuscula*-complex. Typical are the elliptic, smooth leaflets with a single sac and the barely stipitate fruits with highly convex upper sutures.

**38. *Guioa scalariformis*** Welzen, Blumea 33 (1988) 420, pl. 20a–c; Leiden Bot. Series 12 (1989) 283, f. 121. — Type: *NGF (Sayers) 21576* (L holo; BM, CANB, U; LAE, n.v.), Papua New Guinea.

*Guioa spec.*: Hartley et al., Lloydia 36 (1973) 270 (p.p.: *Hartley 12459*); Streimann, Pl. Upper Watut Watershed (1983) 169 (p.p.: *Hartley 12459, NGF 21576*).

*Shrub to tree*, 3–10 m high, dbh up to 15 cm. *Branchlets* sericeous when young; flowering twigs 4–5.5 mm thick. *Leaves* 1- or 2-jugate; rachis 9.3–22.2 cm long, terete, glabrous, petiole 6–9.5 cm long. *Leaflets* subsessile, subopposite, ovate, 11.9–22.7 by 6.1–10.7 cm, index 1.8–2.1, subsymmetrical, acropic side somewhat broader, subcoriaceous, not punctate; base attenuate; margin entire, flat; apex acuminate to cuspidate, often mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous, domatia absent; venation on upper side flat to raised, raised below; nerves 0.3–2.9 cm apart, marginally rather looped and joined; veins laxly reticulate to scalariform, very distinct. *Inflorescences* axillary, branching along the flattened to terete, sericeous, glabrescent, 6.1–13.5 cm long axis; first order branches up to 7.8 cm long; cymules cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.7–1 mm long; bracteoles 0.3–0.4 mm long; pedicels 4.2–5.8 mm long, sericeous except for the glabrous articulate part. *Flow-*



ers c. 4 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, greenish white; 2 outer smaller ones 1.2–1.9 by 1.8–2.2 mm; 3 larger inner ones 2.4–3.2 by 1.2–2.5 mm, margin petaloid. *Petals* 5, obovate, 2.8–3 by 1.7–2 mm, white; claw c. 0.5 mm high; margin pilose, outside and inside glabrous, apex obtuse to acute; scales c. 1.8 mm long, free; crest clavate, stipitate, apex lobed; petal between two adjacent larger sepals not reduced in size. *Disc* uninterrupted. *Stamens* 8; filaments 2.5–3.8 mm long, pilose, especially basally; anthers 0.6–0.7 mm long, glabrous. *Pistil*: ovary c. 0.4 mm long, subhirsute; style and stigma c. 0.2 mm long. *Fruits* with 2 or 3 well developed lobes, c. 1.8 by 2.3–2.9 cm, slightly ribbed, glabrous, red when fresh, blackish when dry; stipe c. 2.5 mm high, slender; margin blunt; wall less than 1 mm thick at suture; lobes c. 17 by 12 mm; septa complete. *Seeds* globose, c. 11.2 by 9.8 mm; hilum c. 3 mm long.

Distribution – *Malesia*: Papua New Guinea (Morobe Province: near Wagau).

Habitat & Ecology – In primary mid-mountain forest; altitude 1500–1700 m. Fl. Dec.

Note – This species is part of the *G. rigidiuscula*-complex. It is distinctive in having large, broad leaflets with distinct venation, large petals, and an uninterrupted disc.

**39. *Guioa subsericea*** Radlk., Bot. Jahrb. 56 (1921) 277; in Engl., Pflanzenz. 98 (1933) 1158; Streimann, Pl. Upper Watut Watershed (1983) 169 (p.p.: *Hartley 11835*); Welzen, Leiden Bot. Series 12 (1989) 287. f. 123. — Lectotype (Van Welzen 1989); *Ledermann 10005* (L; K), NE New Guinea.

*Guioa molliuscula* auct. non Radlk.: Hartley et al., Lloydia 36 (1973) 270.

*Guioa dasyantha* auct. non Radlk.: Streimann, Pl. Upper Watut Watershed (1983) 169.

*Shrub to tree*, 3–30 m high, dbh 6–50 cm; outer bark usually smooth to longitudinally fissured or finely pustulated, greenish to greyish to reddish brown, inner bark white to red-brown, no exudate; sapwood white, (rings prominent), heartwood brown. *Branchlets* shortly sericeous (to hirsute), especially when young; flowering twigs 1.5–7 mm thick. *Leaves* 1–3-jugate; rachis 1.2–20 cm long, terete to somewhat flattened below the jugae, subsericeous (to hirsute), petiole 0.9–9 cm long; petiolules up to 0.9 cm long. *Leaflets* opposite to subopposite (to alternate), ovate (to elliptic), 3.5–18.3 by 0.9–9.3 cm, index 1.9–4.3, usually very asymmetrical, acroscopic side broader, coriaceous to very coriaceous, usually punctate; base attenuate;

margin entire, flat (to revolute), apex gradually (acuminate to) cuspidate to caudate, mucronulate; upper surface densely pilose when young to subsericeous when older, (wax); lower surface dull, papillate, (sub)sericeous (to hirsute), domatia absent to many small pocket-like sacs in axils of nerves; venation on upper side (slightly sunken to) flat (to raised), raised on lower; nerves 0.2–2.8 (–4.2) cm apart, marginally looped and joined, less distinctly so in lower part of leaflets; veins densely to laxly reticulate, usually distinct. *Inflorescences* axillary to pseudoterminal, branching basally and along the terete, sericeous (to hirsute), 1–26.6 cm long axis; first order branches up to 10.5 cm long; cymules cincinnate (to dichasial), 2–4(–6)-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.5–2.2 mm long; bracteoles 0.2–1.1 mm long; pedicels (1.2–)2.2–3.6(–6) mm long, sericeous except for the (sub) glabrous articulate part. *Flowers* c. 3 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, light to midgreen; 2 outer smaller ones 0.6–1.8 by 0.6–2.3 mm; 3 inner larger ones 0.8–3 by 1–3 mm, margin petaloid. *Petals* 5, rhombic to elliptic to obovate, 0.9–2.3 by 0.5–1.6 mm, white to yellow; claw 0.2–0.3 mm high; margin and less so outside pilose, inside (sub)glabrous, apex retuse to rounded; scales inwardly folded auricles, 0.3–1.2 mm high; crest absent (to clavate, shortly stipitate). *Disc* uninterrupted. *Stamens* 8; filaments 1.2–2.8 mm long, pilose, especially basally, white; anthers 0.4–0.6 mm long, glabrous to sparsely pilose, light pink to purplish red. *Pistil*: ovary 0.3–1.2 mm long, subhirsute, midgreen; style and stigma 0.2–1.3 mm long. *Fruits* with 1–3 well developed lobes, 0.9–1.6 by 0.9–2.4 cm, smooth to rugose to slightly ribbed, glabrous, red when fresh, usually blackish when dry; stipe 0–4 mm high, broadly obconical, indistinct; margin blunt; lobes 7–17 by 5–11 mm; septa complete. *Seeds* (globose to) obovoid, 5.8–7.8 by 3–8 mm; hilum 1–1.2 mm long; arillode orange. – **Fig. 44.**

Distribution – *Malesia*: Irian Jaya (Vogelkop, Jayapura); Papua New Guinea (W & E Sepik, Enga, Western Highlands, Chimbu, Southern Highlands, Morobe, Central, Milne Bay Provinces).

Habitat & Ecology – Occasional to fairly common in understorey (to subcanopy trees) in lower to midmontane primary forest, in secondary forest and along edges of wood, water and roads; often on steep slopes and ridges. Forests often dominated by *Castanopsis*, *Casuarina*, *Nothofagus*, and *Pandanus*. Soil: detritus mud, sand, laterite, stony clay or loam; wet; shade light to medium; altitude (70–)1000–3000 m. Fl. Feb.–July; fr. throughout the year.

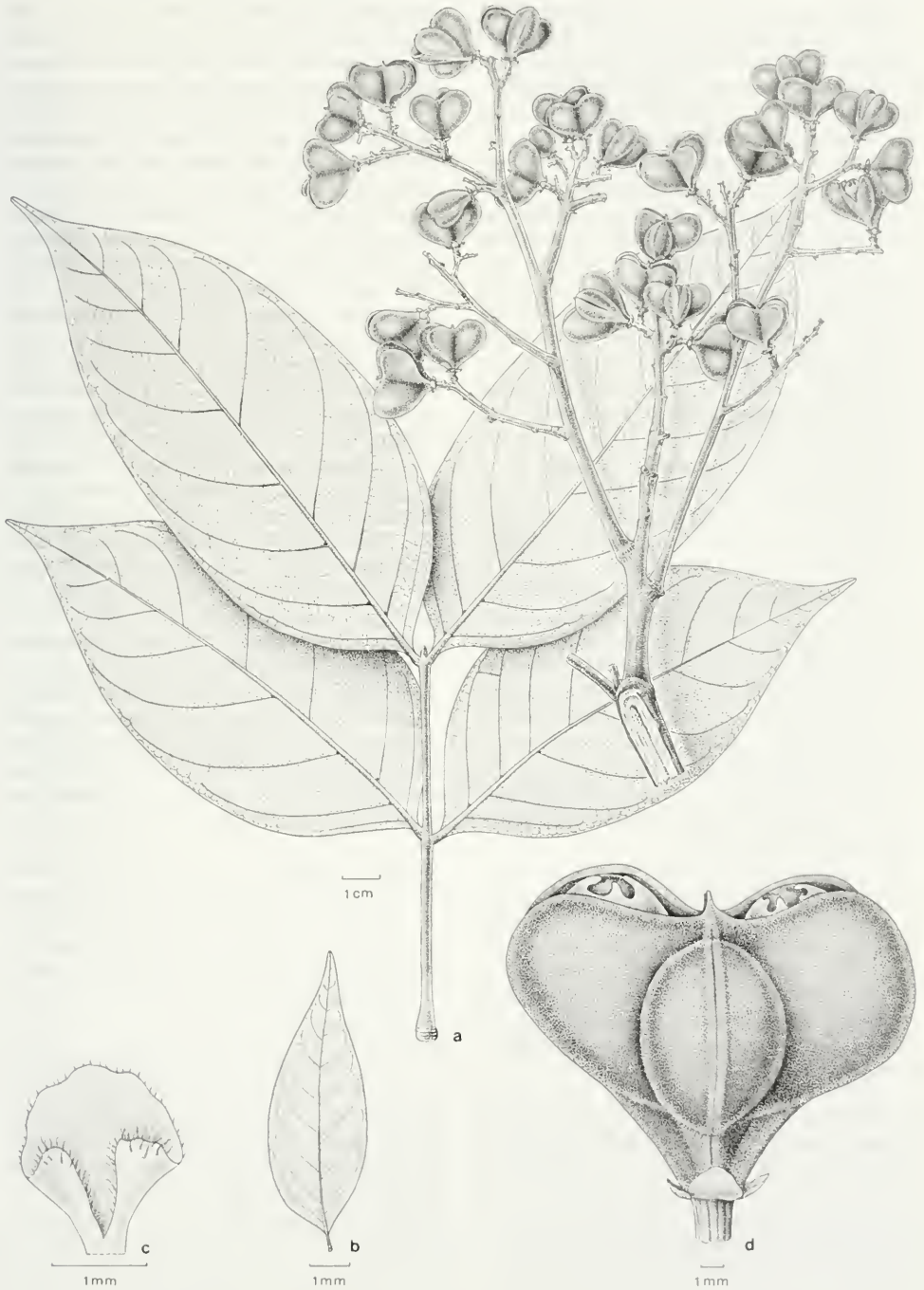


Fig. 44. *Guioia subsericea* Radlk. a. Habit with E New Guinean form of leaflets; b. leaflet of W New Guinean form; c. petal; d. fruit (a, d: ANU (Flenley) 2772; b: BW 4076; c: NGF 11042).

Notes – 1. *Guioa subsericea* is distinct because of its long-tipped leaflets that are sericeous and papillate below, an uninterrupted disc, and the basically broadly obconical fruits. The species is rather diverse, with some distinctive forms which are connected by intermediates. Most obvious is the topoecline between W and E New Guinea, although within W as well as E New Guinea there are reasonably uniform groups. Central New Guinea forms the transition zone. Plants in E New Guinea have larger leaflets (3.5–18.3 by 1.4–8.3 cm versus 3.6–9.8 by 0.9–3 cm), with usually longer hairs, and they have larger fruits (0.9–1.6 by 1–2.4 cm versus 0.9–1.2 by 0.9–1.4 cm). In Morobe and W Highland Provinces (Papua New Guinea) several specimens possess leaflets which are, in a dried condition, very coriaceous and very silvery on both surfaces of the leaflets.

*Guioa subsericea* has a sericeous indumentum, but some specimens are very hirsute and, at first sight, look like a different species. This phenomenon also occurs in other species of *Guioa*, e.g., *G. plenopteris*, *G. chrysea*, *G. villosa*.

2. *Guioa multijuga*, from Irian Jaya, is remarkably similar to *G. subsericea* from the same area; however, *G. multijuga* always has leaves with more than 3 jugae and the leaflets are almost glabrous below instead of sericeous. Furthermore, the petals have very different scales, those of *G. subsericea* are inwardly folded auricles, those of *G. multijuga* are free scales folded outwards.

3. The differences with *G. molliuscula*, *G. malukuensis*, and *G. comesperma* are discussed in notes under these species.

40. *Guioa truncata* Radlk. in Elmer, Leaflet Philipp. Bot. 5 (1913) 1611; Philipp. J. Sc., Bot. 8 (1913) 446; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 509; Radlk. in Engl., Pflanzenr. 98 (1933) 1171; Welzen, Leiden Bot. Series 12 (1989) 292, f. 125. — Type: *Elmer 11219* (M holo; A, BM, F, FI, K, L, NY, U, W), Philippines.

*Tree*, 5–7 m high, dbh 10–15 cm; bark dull brown, smooth; sapwood whitish, rather hard, odourless, tasteless, heartwood reddish brown. *Branchlets* sericeous when young; flowering twigs 2–3 mm thick. *Leaves* 2–3-jugate; rachis 2–10 cm long, basally terete to upwards flattened above, slightly winged, glabrous, petiole 1.9–3.8 cm long. *Leaflets* subsessile, opposite to subopposite, elliptic, 3.4–7.6 by 1.3–2.6 cm, index 2.6–3, asymmetrical, acroscopic side broader, coriaceous, punctate; base attenuate; margin entire, flat; apex acuminate, mucronulate; upper surface glabrous (except for the puberulous midrib); lower surface dull-

er, smooth, no papillae, glabrous to slightly pilose near domatia, latter a single to many sacs in axils of nerves; venation raised; nerves 0.4–1.6 cm apart, marginally looped and joined; veins laxly reticulate, distinct. *Inflorescences* axillary, branching basally to usually along the flattened, subsericeous, 4.3–15.4 cm long; first order branches up to 4.2 cm long; cymes cincinnate, c. 3-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts c. 0.8 mm long; bracteoles 0.3–0.7 mm long; pedicels c. 3.3 mm long, sericeous except for the subglabrous articulate part. *Flowers* c. 3 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous; 2 outer smaller ones 1.4–1.6 by 1–1.3 mm; 3 inner larger ones 2–3.1 by 1.8–2.6 mm, margin petaloid. *Petals* 5, obovate, c. 2.1 by 1.4 mm, white; blade orbicular, abruptly clawed; latter c. 0.7 mm high; margin pilose, apex rounded; scales c. 0.8 mm long, free; crest a flat subglabrous part of the slightly bifid scale apex. *Disc* interrupted. *Stamens* 8; filaments 2.9–3.1 mm long, pilose, especially basally; anthers c. 0.5 mm long, glabrous. *Pistil*: ovary c. 0.7 mm long, subhirsute; style and stigma c. 0.2 mm long. *Fruits* immature.

Distribution – *Malesia*: Philippines (Mindanao).

Habitat & Ecology – In dense moist forests and mossy forests; altitude 1300–2300 m. Fl. Mar.

Note – *PNH 118626* (*G. koelreuteria*) looks like *G. truncata*; but its venation is not as distinct, the leaflets are narrower, and do not possess large sac-like domatia. *Guioa koelreuteria* has at most one large sac, not several, as *G. truncata* usually has.

41. *Guioa unguiculata* Welzen, Blumea 33 (1988) 420, pl. 18a–c; Leiden Bot. Series 12 (1989) 294, f. 126. — Type: *Vink 16407* (L holo; BRI, K, NSW, P; LAE, n.v.), Papua New Guinea.

*Guioa membranifolia* auct. non Radlk.: Hartley et al., Lloydia 36 (1973) 270.

*Tree*(let), 5–20 m high; dbh up to 15 cm; outer bark smooth, greyish green to dark grey, inner bark straw coloured; wood straw coloured. *Branchlets* sericeous when young; flowering twigs 3–7 mm thick. *Leaves* 1–3-jugate; rachis 2–15.8 cm long, terete, glabrous, petiole 1.4–6.9 cm long. *Leaflets* subsessile, subopposite to alternate, elliptic, 6.3–17 by 1.9–6.5 cm, index 2.3–3.7, slightly asymmetrical, acroscopic side broader, (sub)coriaceous, usually punctate; base attenuate; margin entire, flat; apex acuminate to caudate, mucronulate; upper surface glabrous; lower surface duller, smooth, no papillae, glabrous except for a few hairs on venation (to sparsely sericeous), domatia absent; venation on upper side flat, raised below; nerves 0.3–2.9 cm apart, marginally looped and joined, less



distinctly so in lower part of leaflets: veins laxly reticulate, rather indistinct. *Inflorescences* axillary to ramiflorous, branching basally and along the flattened to terete, subsericeous, 2.2–8.5 cm long axis; first order branches up to 2.3 cm long; cymules cincinnate, 2–4-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.5–1 mm long; bracteoles 0.6–0.7 mm long; pedicels 2.8–6.2 mm long, sericeous except for the glabrous articulate part. *Flowers* c. 4 mm in diam. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous, light green; 2 outer smaller ones 1.2–2 by 1.5–2 mm; 3 larger inner ones 2–2.8 by 1.6–2.9 mm, margin petaloid. *Petals* 5, obovate, 2–3.2 by 1–1.5 mm, white; claw c. 0.8 mm high; margin pilose, outside and inside subpilose, apex rounded, somewhat fimbriate; scales 1.2–1.5 mm long, resembling folded margins, without basal auricles, without a distinct membranous margin; crest absent (to some scales with a bifid apex); petal between two adjacent larger sepals not reduced in size. *Disc* (nearly) uninterrupted, ochre-green. *Stamens* 8; filaments 2–3 mm long, pilose, especially basally, white; anthers 0.4–0.6 mm long, glabrous, light pink. *Pistil* green; ovary 0.4–1.5 mm long, subhirsute; style and stigma 0.2–1.5 mm long. *Fruits* with 1–3 well developed lobes, 1.5–2.2 by 2–2.7 cm, completely dehiscent, smooth to slightly rugose, black when dry; stipe 2–3.3 mm high, slender; margin blunt; wall less than 1 mm thick; lobes 13–18 by 8.5–12 mm; septa complete. *Seeds* not full-grown.

*Distribution* – *Malesia*: Papua New Guinea (Western Highlands, Madang, Morobe Prov.).

*Habitat & Ecology* – In open forest, oak forest, old secondary forest; altitude 1200–1900 m. Fl. Aug.–Sep. Fruits eaten by birds.

*Note* – *Guioa unguiculata* belongs to the *G. rigidiuscula*-complex. It has long-clawed petals with folded, apically bifid scales; a (nearly) uninterrupted disc; and leaflets which are smooth, without papillae or domatia on the lower side, and with a strongly raised venation.

**42. *Guioa venusta*** Radlk., Sapind. Holl.-Ind. (1879) 11, 40; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 609; Bot. Jahrb. 56 (1921) 280; in Engl., Pflanzenz. 98 (1933) 1160; Welzen, Leiden Bot. Series 12 (1989) 295, f. 127. — Type: *Beccari Fl 2813* (Fl. holo., cited by Radlkofer as *Beccari 5'*), New Guinea.

Small tree, 2–2.5 m high. *Branchlets* sericeous when young; flowering twigs 2.5–3 mm thick. *Leaves* 4–9-jugate; rachis 1.5–12.2 cm long, slightly winged, wing up to at most 0.5 mm broad, sub-

sericeous, petiole 1.3–2.4 cm long. *Leaflets* subsessile, opposite to alternate, elliptic, 1.8–6.5 by 0.6–2 cm, index 2.2–3.3, asymmetrical, acroscopic side broader, subcoriaceous, punctate; base attenuate to cuneate; margin entire except for some subapical teeth, flat to slightly revolute; apex acuminate, mucronulate; upper surface glabrous except for the basally puberulous midrib; lower surface duller, smooth, no papillae, glabrous to slightly sericeous, domatia many pockets in axils of nerves; venation on upper side slightly sunken to flat, raised below; nerves 0.2–1.2 cm apart, marginally looped and joined; veins laxly to densely reticulate, rather distinct. *Inflorescences* axillary, unbranched to branching basally and along the terete, pilose, 1.9–5.4 cm long axis; first order branches up to 3.4 cm long; cymules cincinnate, c. 4-flowered; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.3–0.6 mm long; bracteoles 0.3–0.4 mm long; pedicels 0.8–3 mm long, sericeous; less so in the articulate part. *Flowers* in bud. *Sepals* 5, ovate, margin pilose, with glands, outside and inside glabrous; 2 outer smaller ones 1.1–1.5 by 0.7–1.1 mm; 3 inner larger ones 1.4–1.8 by 1.3–1.5 mm, margin petaloid. *Petals* 5, immature, 0.2–1.1 by 0.1–0.2 mm, no distinct claw yet, margin pilose, outside and inside glabrous, white; scales slightly developed, free; crest (still?) absent. *Disc* uninterrupted. *Stamens* 8; filaments 1.7–2.2 mm long, pilose in lower half; anthers c. 0.3 mm long, glabrous. *Pistil*: ovary c. 0.2 mm long, subhirsute; style and stigma c. 0.1 mm long. *Fruits* with 1 or 2 well developed lobes, 0.7–0.8 by 0.6–0.9 cm, smooth to slightly rugose, glabrous, blackish when dry; stipe 2–2.2 mm high, slender; margin blunt; lobes 4–6 by 3.8–4.3 mm; septa complete. *Seeds* immature.

*Distribution* – *Malesia*: Irian Jaya (Schouten Island; Biak, and Japen Island).

*Habitat & Ecology* – On flat terrain, in secondary scrubby vegetation; altitude c. 60 m. Fl. Apr.

*Note* – The type of *G. venusta*, from Japen Island, is somewhat different from the specimens from Biak. It has smaller (1.8–3.9 by 0.6–1.2 cm versus 2.9–6.5 by 0.6–2 cm), more numerous pairs of leaflets (6–9 versus 4 or 5), and the petiole is more densely sericeous.

**43. *Guioa waigeoensis*** Welzen, Blumea 33 (1988) 420, pl. 19a, b; Leiden Bot. Series 12 (1989) 300, f. 129. — Type: *van Royen 5409* (l. holo.), W Irian Jaya.

*Arytera xerocarpa* auct. non Adelb.: P. Royen, Nova Guinea 5 (1960) 60.

Small tree, c. 4 m high, dbh c. 5 cm. *Branchlets* sericeous, especially when young; flowering twigs

c. 1 mm thick. *Leaves* 3- or 4-jugate; rachis 0.4–3.7 cm long, flattened above, slightly winged (wing less than 1 mm broad), subsericeous, petiole 0.4–0.8 cm long. *Leaflets* subsessile, opposite to subopposite, elliptic, 1.3–2.4 by 0.4–0.6 cm, index 3.3–4, rather symmetrical, coriaceous, punctate; base attenuate; margin at least in some leaflets slightly serrate, revolute; apex acute, mucronulate; upper surface subsericeous; lower surface dull, papillate, shortly sericeous, domatia in at least some leaflets a single, small sac on basiscopic side in axil of second nerve; venation flat to slightly raised on lower side; nerves 0.2–0.4 cm apart, marginally looped and joined; veins densely reticulate, indistinct. *Infructescences* axillary, not or at most branching along rachis; latter flattened, 1.2–2 cm long, sericeous; first order branches up to 0.6 cm long; bracts and bracteoles triangular, outside sericeous, inside glabrous; bracts 0.6–0.7 mm long; bracteoles c. 0.3 mm long; pedicels c. 5.8 mm long, sericeous except for the glabrous articulate part. *Flowers* white. *Sepals* 5, ovate, margin pilose, glands unknown, outside and inside glabrous; 2 outer smaller ones c. 1.8 by 1.3–1.9 mm; 3 inner larger ones 2–2.4 by 1.7–2.4 mm, margin petaloid. *Petals* unknown. *Disc* uninterrupted. *Stamens* and *pistil* unknown. *Fruits* with 1–3 well developed lobes (see note), c. 1.2 by 1.2 cm, smooth to slightly rugose, glabrous, blackish when dry; stipe c. 3 mm high, rather slender; margin blunt; lobes c. 8 by 7 mm; septa complete. *Seeds* still immature.

Distribution – *Malesia*: W Irian Jaya (Waigeo Island).

Habitat & Ecology – Relatively common tree, in hilly xerophytic vegetation; altitude c. 300 m.

Note – One fruit had 4 lobes instead of 3, which is unique in *Guioa*.

#### DUBIOUS NAME

*Guioa elegans* Radlk., Bot. Jahrb. 56 (1920) 280; in Engl., Pflanzenr. 98 (1933) 1162; Welzen. Leiden Bot. Series 12 (1989) 301. — Type: *Schultze Jena 337* (B<sup>+</sup> holotype), Papua New Guinea.

Note – Known only from the type, which is lost, and it cannot be identified by its description. Plants identified as *G. elegans* by Hartley et al. (Lloydia 36, 1973, 270) are *Toechima erythrocarpum* subsp. *papuanum*. Typical for *G. elegans* should be the small leaflets (6–8 by 1.5–2 cm) with revolute and sinuate margins, and the uninterrupted disc. The small leaflets with sinuate margins may be like those of *G. amabilis*, *G. pseudoamabilis*, or *G. pteropoda* (the latter a species also described by Radlkofer and therefore hardly likely to be identical to *G. elegans*). The first two have revolute margins and an uninterrupted disc; however, both are mountain species, and, moreover, *G. amabilis* is only found near the Anggi Lakes in the Vogelkop Peninsula (Irian Jaya).

### HARPULLIA

(P.W. Leenhouts & M. Vente)

*Harpullia* Roxb. [Hort. Beng. (1814) 86, nom. nud.] Fl. Ind. 2 (1824) 441; Radlk. in Engl., Pflanzenr. 98 (1933–1934) 1433; Leenh. & Vente, Blumea 28 (1982) 1; S.T. Reynolds in Fl. Austral. 25 (1985) 38; Yap in Tree Fl. Malaya 4 (1989) 443. — Type species: *Harpullia cupanioides* Roxb.

[*Donatophorus* Zipp. ex Macklot, Bijdr. Natuurk. Wetensch. 5 (1830) 181, nom. nud. — *Thanatophorus* Zipp. ex Walp., Ann. Bot. Syst. 2 (1851/52) 213, nom. inval. in syn. — Indicated type species: *Donatophorus erythrospermus* Zipp. ex Macklot (= *Harpullia cupanioides* Roxb.).]

*Otonychium* Blume, Rumphia 3 (1847) 179. — Type species: *Otonychium inbricatum* Blume [= *Harpullia arborea* (Blanco) Radlk.].

*Blancoa* Blume, Rumphia 3 (1847) 181, nom. illeg., non Lindl. (1840). — Type species: *Blancoa arborea* (Blanco) Blume [= *Harpullia arborea* (Blanco) Radlk.].

*Streptostigma* Thwaites, Hook. J. Bot. Kew Gard. Misc. 6 (1854) 298. — Type species: *Streptostigma viridiflorum* Thwaites [= *Harpullia arborea* (Blanco) Radlk.].

?*Apiocarpus* Montrouz., Mém. Acad. Roy. Sci. Lyon, Sect. Sci., sér. 2, 10 (1860) 190. —

Type species: *Apiocarpus moguinii* Montrouz. [= ?*Harpullia austrocaledonica* Bailon].

*Shrubs* to medium-sized *trees*, dioecious. *Indumentum* solitary and stellate tufts of simple hairs (and glandular hairs); no glandular scales. *Leaves* paripinnate, 1–9-jugate, without pseudostipules; (petiole and rachis winged). *Leaflets* alternate (or opposite), not papillate beneath; margin entire (Malesian species). *Inflorescences* axillary, (pseudoterminal), to truly terminal, solitary, or rami- and/or cauliflorous and often tufted, usually thyrses; bracts and bracteoles usually caducous. *Flowers* unisexual, actinomorphic. *Sepals* 5, free, imbricate, equal or the outer two sometimes slightly smaller, not petaloid, not ciliate, (glandular hairs mainly along the margin), entire. *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* uninterrupted (to divided into 5 lobes), without appendages. *Stamens* 5–8, in male flowers exserted; filaments glabrous; anthers basally attached, base cleft for up to 1/5, dehiscence latero-introrse. *Pistil* 2- or 3- (or 4-)locular; ovary sessile or short-stalked, hairy; ovules 1 or 2 per locule; style apical, shorter to much longer than the ovary, slender, often hooked and the upper part twisted, lower part hairy, with stigmatic lines usually till slightly above the base. *Fruits* loculicidal capsules, usually short-stipitate, not winged, 2- or 3-lobed, the lobes erect to spreading, inflated, rounded; wall pergamentaceous to woody. *Seeds* with a thin-crustaceous testa; arillode restricted to a narrow annular sarcotesta around the hilum, or composed of a basal sarcotestal part, covering half the seed, and an upper, free arilloidal part, reaching to near the apex, the arillode entire and without appendages; hilum covering less than 1/6 of the seed. — **Figs. 45–47.**

Distribution — 26 species, occurring from Sri Lanka and India through SE China and *Malesia* to Australia (Northern Territory, Queensland, and New South Wales to c. 32° 30' S), New Caledonia, and Tonga. See Avé in Van Balgooy (ed.), *Pacific Plant Areas* 4 (1984) 238, 239.

Habitat & Ecology — Mainly substage or lower storey trees of primary and sometimes secondary rain forests, sometimes growing in low or open forest or savannahs and in shrubberies on coastal dunes; altitude from sea level up to 2000 m. The seeds are probably mainly dispersed by birds, possibly also by mammals and lizards.

Pollen morphology — See Muller, *Blumea* 31 (1985) 161–218.

Note — For evolutionary notes see Muller, *Blumea* 31 (1985) 161–218 and Leenh., *Blumea* 31 (1985) 219–234.

#### KEY TO THE SPECIES

- 1a. Leaf rachis and petiole not winged . . . . . 2
- b. Leaf rachis and petiole winged . . . . . **16. *H. rhachiptera***
- 2a. Petals not clawed, without auricles, thin-fleshy. Arillode completely or nearly completely enveloping the seed . . . . . 3
- b. Petals clawed and auricled, membranous. Arillode restricted to a ring around the hilum . . . . . **1. *H. arborea***
- 3a. Stamens (7 or) 8 . . . . . 4
- b. Stamens 5(–7) . . . . . 6



- 4a. Leaves hairy ..... 5  
 b. Leaves glabrous ..... **10. *H. longipetala***
- 5a. Midrib above (in dried leaves) sunken, nerves flat to sunken. Fruit lobes erect, completely united over 3.5 cm ..... **7. *H. giganteacapsula***  
 b. Midrib and nerves above (in dried leaves) slightly raised. Fruit lobes widely spreading, partly united over 4–7 mm ..... **12. *H. oococca***
- 6a. Inflorescences ramiflorous, though usually initially in the leaf axils ..... 7  
 b. Inflorescences axillary to (rarely) terminal ..... 13
- 7a. Leaflets herbaceous to chartaceous, usually hairy. Sepals up to 7 mm long .... 8  
 b. Leaflets coriaceous, glabrous. Sepals 7–8 mm long ..... **13. *H. peekeliana***
- 8a. Inflorescences short, up to about 4 cm long, not or hardly branched ..... 9  
 b. Inflorescences longer than c. 4 cm, often repeatedly branched ..... 10
- 9a. Twigs slender, 2–7 mm thick. Fruits leathery, inside glabrous .. **15. *H. ramiflora***  
 b. Twigs stout, 8–15 mm thick. Fruits woody, usually hairy inside . **4. *H. cauliflora***
- 10a. Fruit wall  $\pm$  woody ..... 11  
 b. Fruit wall leathery ..... **15. *H. ramiflora***
- 11a. Petiolules 5 or more mm long. Inflorescences initially in foliate axils, up to 22 cm long ..... 12  
 b. Petiolules 0–4 mm long. Inflorescences exclusively ramiflorous/cauliflorous, up to 50 cm long ..... **14. *H. petiolaris***
- 12a. Leaflets abruptly acuminate. Axillary inflorescences solitary. Fruits 2.2–2.5 cm wide and about as high, hardly stipitate ..... **11. *H. myrmecophila***  
 b. Leaflets gradually acuminate. Axillary inflorescences clustered like the rami- and/or cauliflorous ones. Fruits 2.5–3.4 cm wide, c. 1.5 times as wide as high, distinctly stipitate ..... **17. *H. solomonensis***
- 13a. Fruit lobes spreading, usually united for less than 1 cm ..... 14  
 b. Fruit lobes erect, united for more than 1 cm, hence the fruit ovoid to obovoid . 16
- 14a. Leaflets acuminate. Hill and low montane ..... 15  
 b. Leaflets obtuse to rounded. Lowland ..... **9. *H. leptococca***
- 15a. Leaflets glabrous to sparsely hairy on midrib and nerves on both sides **3. *H. carrii***  
 b. Leaflets on midrib and nerves densely puberulous on both sides, beneath also sparsely so on veins and veinlets ..... **12. *H. oococca***
- 16a. Vegetative parts, at least when young, distinctly and  $\pm$  densely hairy ..... 17  
 b. Twigs glabrous except for the terminal bud, leaves glabrous or at most very sparsely hairy on axes, midrib, and nerves ..... **6. *H. cupanioides***
- 17a. Twigs rather slender, 3–10 mm thick. Leaves up to 5-jugate. Leaflets distinctly petiolulate, nerves above  $\pm$  raised ..... 18  
 b. Twigs rather stout, 9–15 mm thick. Leaves 5–9-jugate. Leaflets sessile, the nerves slightly sunken above ..... **5. *H. crustacea***
- 18a. Inflorescences erect, 1.5–15 cm long ..... 19  
 b. Inflorescences pendulous, up to 70 cm long ..... **18. *H. vaga***
- 19a. Leaflets at most thin-puberulous on midrib and nerves on both sides  
     **2. *H. camptoneura***  
 b. Leaflets hirsute on both sides, most densely so on the midrib and on the nerves on the upper side ..... **8. *H. hirsuta***

Subgenus *Otonychium*

*Harpullia* subg. *Otonychium* (Blume) Radlk., Sapind. Holl.-Ind. (1879) 52; in Engl., Pflanzenr. 98 (1934) 1438; Leenh. & Vente, Blumea 28 (1982) 9. — *Otonychium* Blume, Rumphia 3 (1847) 179. — *Harpullia* sect. *Euotonychium* Radlk., Sapind. Holl.-Ind. (1879) 52, nom. inval.; in Engl., Pflanzenr. 98 (1934) 1439. — Type species: *Otonychium imbricatum* Blume [= *Harpullia arborea* (Blanco) Radlk.].

*Blancoa* Blume, Rumphia 3 (1847) 181. — Type species: *Blancoa arborea* (Blanco) Blume [= *Harpullia arborea* (Blanco) Radlk.].

*Streptostigma* Thwaites, Hook. J. Bot. Kew Gard. Misc. 6 (1854) 298. — Type species: *Streptostigma viridiflorum* Thwaites [= *Harpullia arborea* (Blanco) Radlk.].

*Harpullia* sect. *Otonychidium* Radlk., Sapind. Holl.-Ind. (1879) 53; in Engl., Pflanzenr. 98 (1934) 1438. — Type species: *Harpullia pendula* Planch. ex F. Muell.

Sepals deciduous. Petals clawed and with a pair of infolded auricles just above the claw, membrabous. Style straight. Arillode restricted to a narrow sarcotestal ring around the hilum.

Distribution — 2 species, one restricted to Australia.

1. ***Harpullia arborea*** (Blanco) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16 (1887) 404; Lecomte in Fl. Indo-Chine 1 (1912) 1022; Le Renard, Ann. Sci. Nat. Bot. IX, 17 (1913) 373; Merr., Sp. Blanc. (1918) 243; Enum. Philipp. Flow. Pl. 2 (1923) 515; Craib, Fl. Siam. Enum. 1 (1926) 335; Radlk. in Engl., Pflanzenr. 98 (1934) 1456; Gagnep. in Fl. Indo-Chine. Suppl. 1 (1950) 954, f. 119: 18–21; Backer & Bakh. f., Fl. Java 2 (1965) 142; Leenh. & Vente, Blumea 28 (1982) 11; S.T. Reynolds in Fl. Austral. 25 (1985) 44, map 51; Yap in Tree Fl. Malaya 4 (1989) 444. — *Ptelea arborea* Blanco, Fl. Filip. (1837) 63. — *Seringia lanceolata* Blanco, Fl. Filip. ed. 2 (1845) 45, nom. illeg., non Steetz (1848); ed. 3, 1 (1877) 85. — *Blancoa arborea* Blume, Rumphia 3 (1847) 181, comb. illeg. — Neotype (Leenhouts & Vente 1982); *Merrill Sp. Blancoanae* 339 (A holo; BM, BO, K, L, NSW, P, US, W), Philippines.

*Otonychium imbricatum* Blume, Rumphia 3 (1847) 180. — *Harpullia imbricata* Thwaites, Enum. Pl. Zeyl. (1858) 56; Koord. & Valetou, Bijdr. Booms. Java 9 (1903) 236; Atlas 1 (1913) pl. 142: f–n. — Syntypes: *Korthals s.n.* (L), Central Sumatra; *Kühl & van Hasselt s.n.* (L), Java. ?*Harpullia blancoi* Fern.-Vill. in Mercado, Libro Medic. (1880) 4. — Type: unknown.

*Harpullia pedicellaris* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 279; in Engl., Pflanzenr. 98 (1934) 1454. — Type: *C. Hartmann s.n.*, 1887 (M holo; MEL), SE New Guinea.

*Harpullia glanduligera* Radlk. in Fedde, Rep. 20 (1924) 41; in Engl., Pflanzenr. 98 (1934) 1459. — Type: *Ledermann 6760* (B† holo; M), NE New Guinea.

*Harpullia arborea* var. *megalocarpa* Merr., Philipp. J. Sc. 27 (1925) 35. — Type: *Loher 13273* (PNH† holo), Philippines.

*Harpullia tomentosa* Ridley, Kew Bull. (1933) 192; Radlk. in Engl., Pflanzenr. 98 (1934) 1462. — Type: *Haviland 2232* (K holo), Sarawak.

*Harpullia sphaeroloboa* Radlk. in Engl., Pflanzenr. 98 (1934) 1454. — Type: *Bogor Hort. Bot. III.K.19a* (M holo; BO, BRI, U), Moluccas.

*Harpullia cupanioides* auct. non Roxb.: Fern.-Vill. in Blanco, Fl. Filip. ed. 3, Nov. App. (1880) 53, p.p.; Radlk., Meded. Rijks-Herb. 22 (1914) 20 as for *Elbert 3261*; in Engl., Pflanzenr. 98 (1934) 1444, as for Celebes.

*Harpullia sp.*: Ceron, Cat. Pl. Herb. Manila (1892) 55 as for *Vidal 2524 & 2526*.

*Harpullia sp. A*: Koord., Meded. Lands Plantentuin 12 (1894) 33.

*Arytera litoralis* auct. non Blume: Koord., Minah. (1898) 402.

(Shrub or tree, up to 33 m high, dbh up to 60 cm, but usually much smaller. Young parts ± densely hirsute, hairs rather long; (on lower side of midrib, in inflorescences, and sepals also with longer glandular hairs). Twigs 3.5–9 mm thick. Leaves 2–6-jugate; petiole 4.5–15 cm long; petiolules 3–8 mm long; all axes hairy, glabrescent. Leaflets ovate to elliptic, 5.5–30 by 2–10 cm, index 1.5–3.5, herbaceous; base oblique with the upper half cordate



Fig. 45. *Harpullia arborea* (Blanco) Radlk. Habit (PNH 12482).

or both sides acute, or symmetrical and acute to rounded; apex acute to rounded (to acuminate), acumen usually short, acute; above glabrous but for the midrib, beneath glabrous or sparsely hairy on midrib and very sparsely so on the nerves; midrib above flat to slightly raised; nerves 0.75–2.25

cm apart, above flat; (intersecondary nerves inconspicuous). *Inflorescences* axillary to rami- or cauliflorous, hairy, ramified only near the base into several axes of about the same length, up to 17 cm long, or with a distinct, up to 35 cm (in fruit up to 60 cm) long main axis with short branches; pedi-



cels in fruit 12–30 mm long. *Sepals* all equal, ovate to obovate, 5–10.5 by 3–5 mm, (some scattered glandular hairs especially along the margin). *Petals*: claw 3–7 mm long, blade obovate-oblong, 8–17 by 3–10 mm, white, outside glabrous or claw and lower half of blade mainly in the centre sparsely hairy, margin often ciliate mainly in the basal part, inside often sparsely hairy. *Disc* sparsely to densely hairy. *Stamens* 5(–7); filaments 10–17 mm long; anthers 2–2.5 mm long. *Pistil* 2(–4)-locular; style 14–17 mm long; ovules 1 or 2 per locule. *Fruits* 9–31 by 27–65 mm; stipe up to 4.5(–7) mm high; lobes spreading, slender ellipsoid to globular; outside prominently veined to smooth, red, fairly densely to sparsely hairy; wall thin, chartaceous to woody; inside reddish, sparsely hairy to glabrous. *Seeds* 1 or 2 per locule, black, mahogany-brown, or dark-purple; sarcotesta up to 2.5 mm wide, orange. — **Figs. 45, 46a–f.**

**Distribution** — Sri Lanka, the Deccan Peninsula from Maharashtra to the south, Assam, Thailand, S Vietnam, throughout *Malesia*, from the Solomon Islands to Samoa and Tonga, and N Queensland.

**Habitat & Ecology** — On ridges, slopes, and plains, in ravines and sometimes along or in swamps, on river banks, or along the seacoast; on fertile soil, clay, loam, or sand, in limestone areas

or on volcanic soils. Usually in well-drained primary rain forest, but also in secondary forests, in lowland, hill, lower and middle montane forest, also in *Araucaria* forest; exceptionally in open vegetation; sea level up to 1200 m altitude. Fl. and fr. 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. For a description of the timber, see p. 427. The oil pressed out of the seeds is used as an anti-rheumatic. See Brown, *Useful Pl. Philipp.* 2 (1950) 363; Desch, *Mal. For. Rec.* 15 (1954) 528 (timber).

**Notes** — 1. Though *H. arborea* is a variable species with many distinct local forms it is not possible to subdivide it. The most conspicuous difference is between the W Malesian population, up to and including Java and Borneo, with 2 ovules and thus 2 seeds per locule, and the E Malesian ones with usually only 1 ovule and 1 seed per locule. However, there is a wide overlap in the Philippines, and while the western material is rather uniform the number of ovules and seeds varies in the east.

2. *Harpullia arborea* seems to be scarce in W Malesia, whereas it is common in the eastern part.

### Subgenus *Harpullia*

*Harpullia* subg. *Harpullia*: Leenh. & Vente, *Blumea* 28 (1982) 15. — *Harpullia* Roxb., *Fl. Ind.* 2 (1824) 441. — *Harpullia* subg. *Euharpullia* Radlk., *Sapind. Holl.-Ind.* (1879) 52, nom. inval.; in Engl., *Pflanzenr.* 98 (1934) 1435. — Type species: *Harpullia cupanioides* Roxb.

*Donatophorus* Zipp. ex Macklot, *Bijdr. Natuurk. Wetensch.* 5 (1830) 181. — *Harpullia* sect. *Thanatophorus* Radlk., *Sapind. Holl.-Ind.* (1879) 52, nom. inval.; in Engl., *Pflanzenr.* 98 (1934) 1436. — Type species: *Donatophorus erythrospermus* Zipp. ex Macklot [= *Harpullia cupanioides* Roxb.].

?*Apiocarpus* Montrouz., *Mém. Acad. Roy. Sci. Lyon, Sect. Sci. sér.* 2, 10 (1860) 190. — Type species: *Apiocarpus moguinii* Montrouz. [= ?*Harpullia austrocaledonica* Bailon].

*Harpullia* sect. *Harpulliastrum* Baillon, *Adansonia* 11 (1874) 241; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1438. — Type species: *Harpullia austrocaledonica* Baillon.

Sepals nearly always persistent in fruit. Petals sessile with a broad or narrowed base, without auricles, thin-fleshy to rarely membranous. Style bent or hooked once or twice. Seeds with a complex arillode composed of a sarcotestal part and a free arillode.

**Distribution** — 24 species, as widely distributed as the genus with the exception of Sri Lanka, the New Hebrides, Fiji, Samoa, and Tonga.

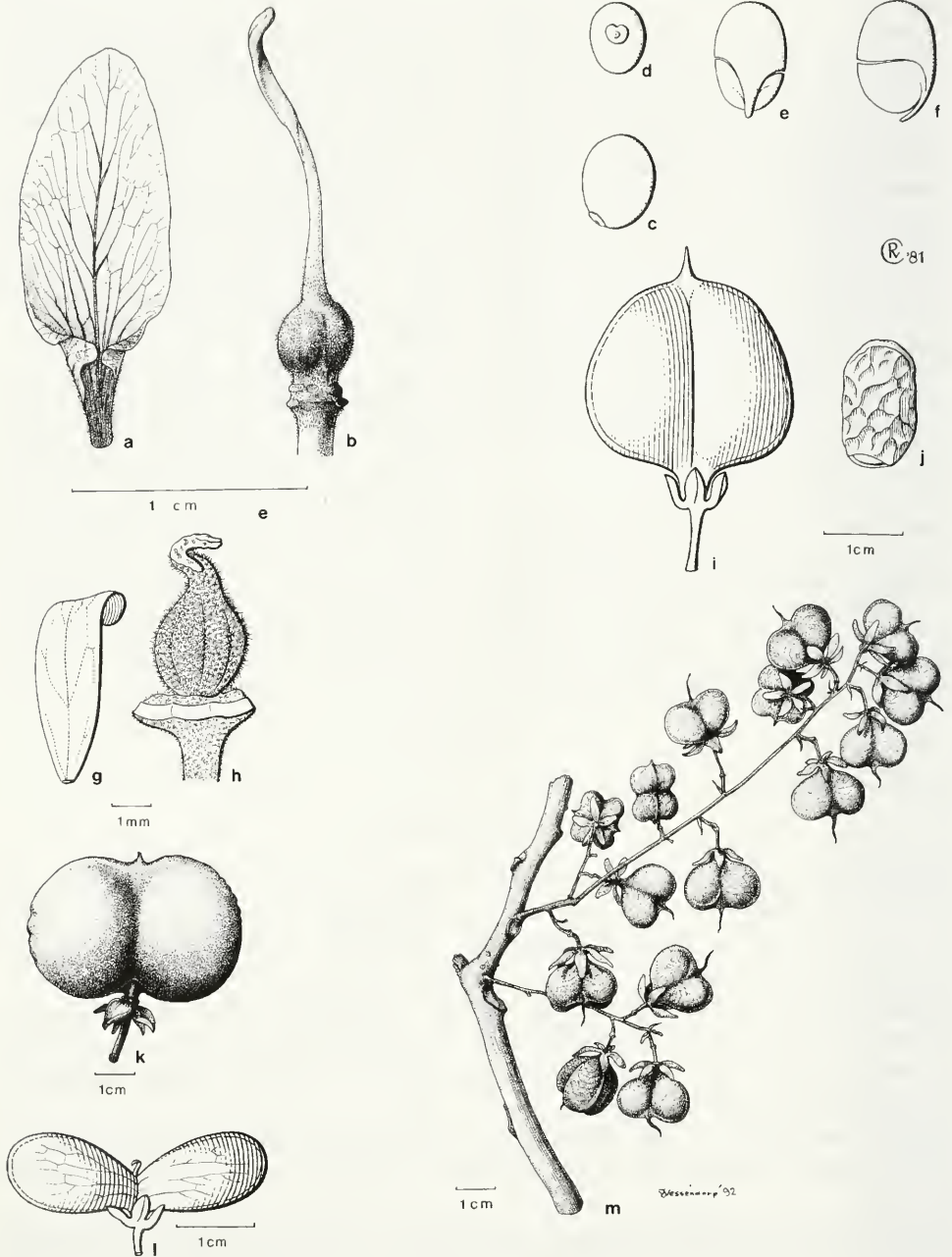


Fig. 46. *Harpullia* Roxb. Petals, ovary, infructescence, fruits, seeds, and embryos. — *H. arborea* (Blanco) Radlk. a. Petal; b. ovary; c. seed, lateral; d. *ibid.*, from below; e. embryo, dorsal; f. *ibid.*, lateral. — *H. cupanioides* Roxb. g. Petal; h. ovary. — *H. cauliflora* K. Schum. & Laut. i. Fruit; j. seed. — *H. gigantecapsula* Vente. k. Fruit. — *H. leptococca* Radlk. l. Fruit. — *H. raniflora* Radlk. m. Infructescence (a, b: van Beusekom *et al.* 3862; c, d: SAN 31225; e, f: Merrill 2843; g, h: Waterhouse 36B; i: Hoogland & Craven 10551; j: Brass 13802; k: LAE 62090; l: NGF 12367; m: Pullen 6609).

**2. *Harpullia camptoneura*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 360; Radlk. in Engl., Pflanzenz. 98 (1934) 1446; Leenh. & Vente. Blumea 28 (1982) 32. — Type: *Warburg s.n.*, 1881 (B† holo; M). NE New Guinea.

*Harpullia crustacea* auct. non Radlk.: K. Schum. & Laut., Fl. Schutzgeb. Südsee (1900) 424 as for *Lauterbach 601*.

*Shrub or treelet*, up to 4.5 m high. Twigs, leaf axes, and inflorescences densely, shortly, brownish puberulous, usually early glabrescent except for the inflorescences. Twigs 3.5–6 mm thick. Leaves 2–4-jugate; petiole 4–8 cm long; petiolules 2–8 mm long. Leaflets ovate (lowermost leaflets) to elliptic, 7–21 by 3.5–8 cm, index 1.75–3.25, stiff-pergamentaceous; base symmetrical (to slightly oblique), acute to rounded, not or slightly decurrent; apex acute, fairly abruptly (to hardly acuminate), acumen fairly short, rounded to acute; above (glabrous to) thin-puberulous on midrib and nerves, beneath with some scattered hair tufts on base of midrib only (to thin-puberulous on midrib and nerves); midrib above slightly raised to basally nearly flat; nerves 1.25–3 cm apart, above slightly raised; intersecondary nerves variably developed. Inflorescences axillary (to pseudoterminal), solitary, 1.5–15 cm long, sparsely and laxly branched, few- (to 1-)flowered; pedicels in flower c. 4 mm long. Only male flowers known. Sepals elliptic, c. 6 by 4 mm, persistent. Petals linear-lanceolate, c. 8 by 1.5 mm, white, glabrous. Disc uninterrupted, velvety. Stamens 5; filaments c. 5 mm long; anthers c. 2 mm long. Pistil 2-locular; ovules 1 per locule. Fruits transverse-ellipsoid, 20–25 by 25–30 mm, to subglobular, c. 2 cm in diam., the lobes erect, strongly bulging; stipe slightly hollowed, c. 1.5 mm long; apex obtuse; wall thin, hard, outside granulate and in old fruits coarsely reticulately veined, bright red, glabrous, inside glabrous or with scattered tufts of few hairs. Seeds black with a pink to bright red arillode.

Distribution — *Malesia*: NE New Guinea.

Habitat & Ecology — Primary and secondary rain forests, also *Castanopsis*-oak forest; 300–1500 m altitude. Fl. Jan., Oct.; fr. Jan., Mar., July. The fruits are said to be eaten by birds.

**3. *Harpullia carrii*** Leenh. in Leenh. & Vente, Blumea 28 (1982) 35. — Type: *Carr 12443* (L holo; K, SING), SE New Guinea.

*Shrub or treelet*, 1.8–2.4 m high. Twigs and leaf axes thin-puberulous, glabrescent, inflorescences and infructescences short-velvety. Twigs 3–5 mm thick. Leaves 1–5-jugate; petiole 4–10 cm long;

petiolules 3–9 mm long. Leaflets elliptic, 5.5–23 by 2.5–9.5 cm, index 1.75–3, pergamentaceous; base symmetrical (or oblique), acute to rounded, only slightly decurrent; apex acuminate, acumen short to long, slender to broad, rounded; glabrous to sparsely hairy on midrib (and nerves); midrib above slightly raised to flat; nerves 1.25–3 cm apart, slightly raised above; intersecondary nerves frequent, variably developed. Inflorescences restricted to the uppermost leaf axil (to the upper two axils), solitary or few together, 4.5–12 cm long, hardly to repeatedly branched from the base onwards; pedicels in fruit c. 3 mm long. Sepals elliptic to broad-ovate, 3.5–5 by 2–3 mm, persistent under the fruit. Petals glabrous (known in bud only). Disc uninterrupted, velvety. Stamens 5; anthers c. 1.2 mm long. Pistil 2- or 3-locular; style 2.5–3 mm long; ovules 1 per locule. Fruits with widely spreading ellipsoid lobes, c. 1.5 by 1.25 cm, the central axis 6–7 mm high; stipe c. 3 mm high; wall thin-woody, outside pustular or coarsely veined, orange, glabrous, inside glabrous.

Distribution — *Malesia*: Papua New Guinea (Central Prov., near Port Moresby).

Habitat & Ecology — In primary and secondary forest; on ridges and steep rocky hillside, in the savannah in gallery forest; 300–400(–1200) m altitude. Fl., fr. May.

Note — *Harpullia carrii* is distinctly closely allied to *H. leptococca* and occurs in the same restricted area. However, it has a distinctly different ecology and occurs at a higher altitude.

**4. *Harpullia cauliflora*** K. Schum. & Laut., Fl. Schutzgeb. Südsee (1900) 424; Radlk., Bot. Jahrb. 56 (1920) 312, p.p. (W New Guinea collections are *H. ramiflora*); in Engl., Pflanzenz. 98 (1934) 1440, p.p. (ditto); Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 525; Leenh. & Vente, Blumea 28 (1982) 40. — Type: *Kersting s.n. in herb. Lauterbach 2411* (B† holo; M, WRS�). NE New Guinea.

*Harpullia peekeliana* auct. non Melch.: Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 79.

*(Shrub to tree)*, up to 20 m high. dbh up to 20 cm. Twigs, leaf axes, inflorescences, and infructescences rather densely to sparsely puberulous, glabrescent to glabrous. Twigs 6–15 mm thick. Leaves 3–5-jugate; petiole 8–17 cm long; petiolules 4–12 mm long. Leaflets (ovate to) elliptic (to obovate), 2.5–33.5 by 5–13 cm, index 1.6–3, pergamentaceous to chartaceous; base symmetrical, acute, and gradually long-decurrent (especially upper leaflets) to oblique, rounded, and abruptly shortly attenuate (lower ones); apex tapering to abruptly acuminate, acumen straight to slightly



falcate, short to long, with rounded tip; on midrib and often on nerves densely to sparsely puberulous, especially beneath glabrescent; midrib above slightly raised; nerves 1.5–5.5 cm apart, slightly raised above; intersecondary nerves few to many, usually short and inconspicuous. *Inflorescences* axillary, rami-, and cauliflorous, in one or two groups of up to 3.5 cm long rachises, these not or hardly branched; pedicels in fruit 6–13 mm long. *Sepals* oblong-obovate to elliptic, 5–7 by 2.5–4.5 mm, outer 2 sometimes slightly smaller, persistent. *Petals* oblong, c. 7 by 3 mm or more, white, glabrous. *Disc* short-velvety. *Stamens* 5; filaments c. 4 mm long or more; anthers c. 3 mm long. *Pistil*: 2-locular; ovules 1 per locule. *Fruits* transversely broad-ellipsoid to subglobular (or subtrapezoid), 1.5–2.5 by 1.8–3.2 cm, base obtuse to rounded to sometimes nearly truncate; stipe up to 3.5 mm long; apex rounded to emarginate; wall up to 1 mm thick, woody, outside granulate with scattered prominent pustules and prominent irregular ridges, red, glabrous or sparsely puberulous, inside glabrous to densely, shortly tufted-hairy. *Seeds* black or dark brown with an orange to red arillode. — **Fig. 46i, j.**

Distribution — *Malesia*: New Guinea.

Habitat & Ecology — Understorey of primary rain forest on alluvial plains; soil rocky clay or a mixture of sand, clay, and peat; 50–700 m altitude. Fl. Mar., Apr., July; fr. Mar., June, Oct., Nov.

**5. *Harpullia crustacea*** Radlk. in K. Schum. & Hollr., Fl. Kais. Wilh. Land (1889) 67; in Engl., Pflanzenz. 98 (1934) 1442; Leenh. & Vente, Blumea 28 (1982) 31. — Type: *Hollrung 549* (M holo; BO, K, MEL), NE New Guinea.

*Harpullia cupanioides* auct. non Roxb.: Hartley et al., Lloydia 36 (1973) 270, p.p.

*Tree*, up to 24 m high, dbh up to 22.5 cm. Young parts, leaf axes, inflorescences, and infructescences sparsely to moderately densely short hirsute. *Twigs* 9–15 mm thick. *Leaves* up to 1 m long, 5–9-jugate; petiole 4–23 cm long; petiolules 0–3 mm long. *Leaflets* elliptic, 6–31 by 3–13 cm, index 1.8–3.4, papyraceous to thin-pergamentaceous; base symmetrical (or ± oblique), acute to rounded (to subcordate); apex (rounded and hardly apiculate to) tapering acuminate, acumen short to long, acute to rounded; above densely puberulous on the midrib, more sparsely so on the nerves (to very sparsely all over), beneath thin puberulous on midrib and nerves (and on veins); midrib above slightly raised; nerves 0.5–2.3 cm apart, sunken above; intersecondary nerves many and often strongly developed, making the nervation sometimes irregular; veins hardly raised at both sides. *Inflorescences* axillary, pendulous, 30–60 cm long, simple; pedicels in fruit

4–6 mm long. *Flowers* fragrant. *Sepals* broad-ovate, 4.5–6.5 by 4.2–4.5 mm, persistent. *Petals* oblanceolate, 7–9 by 2.5–3.5 mm, white (to cream or yellowish green), (outside basally slightly hairy). *Disc* uninterrupted, 5-lobed, velvety. *Stamens* 5; filaments 3–5.5 mm long; anthers 2.5–3 mm long. *Pistil* 2-locular; style 3.5–4 mm long; ovules 1 per locule. *Fruits* transversely flattened broad-ellipsoid, c. 2 by 3–3.5 cm; base slightly cordate to truncate, abruptly narrowed into a 1–2 mm long stipe; apex (slightly) emarginate; wall woody, outside prominently reticulate or pustulate, orange red, sparsely to moderately densely hairy, inside with a rather dense indumentum of longer tufted hairs.

Distribution — *Malesia*: E New Guinea.

Habitat & Ecology — In and along rain forest; on slopes, river banks, banks of mangrove creeks, also in swamps; on clay on volcanic rocks; sea level up to 480 m altitude. Fl. Feb./Mar., July, Sept., Nov./Dec.; fr. Apr., Dec.

**6. *Harpullia cupanioides*** Roxb., [Hort. Beng. (1814) 86, nom. nud. ('*cupanioides*')] Fl. Ind. 2 (1824) 442; Miq., Fl. Ind. Bat. 1, 2 (1859) 570; Radlk., Sapind. Holl.-Ind. (1879) 94; Fern.-Vill. in Blanco, Fl. Filip. ed. 3, Nov. App. (1880) 53 (p.p. = *H. arborea*); King, J. As. Soc. Beng. 65, II (1896) 451; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 239; Lecomte in Fl. Indo-Chine 1 (1912) 1022, f. 126: 6–8; Koord. & Valetton, Atlas 1 (1913) pl. 142: a–e; Radlk., Meded. Rijks-Herb. 22 (1914) 20 (*Elbert 3261* = *H. arborea*); Bot. Jahrb. 56 (1920) 313 (material from W New Guinea = *H. arborea*); Merr., Enum. Philipp. Flow. Pl. 2 (1923) 516 (*Ramos 30150* = *H. ramiflora*); Craib, Fl. Siam. Enum. 1 (1926) 335; Docters van Leeuwen, Zooecidia (1926) 337, f. 609 & 610; Radlk. in Engl., Pflanzenz. 98 (1934) 1444 (material from Celebes = *H. arborea*); Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 954; Backer & Bakh. f., Fl. Java 2 (1965) 142; Hartley et al., Lloydia 36 (1973) 270 (p.p. = *H. arborea*); Leenh. & Vente, Blumea 28 (1982) 26; Yap in Tree Fl. Malaya 4 (1989) 444. — Type: *Roxburgh s.n.*, 1813 (A, BO iso), Bangladesh.

*Ay-Assa Rumph.*, Herb. Amb. Auct. (1755) 20, nom. inval.; see Hassk., Abh. Naturf. Ges. Halle 9, 2 (1866) 329; Merr., Int. Rumph. (1917) 509.

*Tina rupestris* Blume, Bijdr. (1825) 235; Span., Linnaea 15 (1841) 181. — *Cupania rupestris* Cambess., Mém. Mus. Hist. Nat. 18 (1829) 29. — *Cupania blumei* Steud., Nomencl. ed. 2, 1 (1840) 453, nom. illeg. — *Harpullia rupestris* Blume, Rumphia 3 (1847) 175; Miq., Fl. Ind. Bat. 1, 2 (1859) 570; Radlk., Sapind. Holl.-Ind.

- (1879) 50, 94. — Lectotype (Blume 1847): *Blume 1625* (L. holo), Java.
- [*Donatophorus erythrospermus* Zipp. ex Macklot, *Bijdr. Natuurk. Wetensch.* 5 (1830) 181, nom. nud.].
- Harpullia confusa* Blume, *Rumphia* 3 (1847) 176; Ridley, *Fl. Malay Penins.* 1 (1922) 510; Burk., *Dict. Econ. Prod. Malay Penins.* (1935) 1128. — Syntypes: *Blume s.n.* (L), W Java; *Reinwardt s.n.* (L), E Java, Juti Kalangan.
- Harpullia fraxinifolia* Blume, *Rumphia* 3 (1847) 177; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1442. — Type: *Spanoghe s.n.* (L. holo; M. P), Timor.
- Harpullia fruticosa* Blume, *Rumphia* 3 (1847) 179; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1443. — Type: *Zippelius 168* (L. holo), W New Guinea.
- Harpullia juglandifolia* Blume, *Rumphia* 3 (1847) 177. — Syntypes: *Korthals s.n.* (L), Borneo; *Korthals s.n.* (L), SE Borneo, Dusun; *Muller s.n.* (L), Borneo; *Anonymous s.n.* (L), Borneo.
- Harpullia juglandifolia* Blume var. *multiflora* Blume, *Rumphia* 3 (1847) 177. — Type: *Jung-huhn s.n.* (L. holo), Sumatra.
- Harpullia thanatophora* Blume, *Rumphia* 3 (1847) 178; Gresh., *Meded. Lands Plantentuin* 10 (1893) 44; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1440. — *Harpullia cupanioides* Roxb. var. *latifolia* Miq., *Fl. Ind. Bat.* 1. 2 (1859) 571. — Syntypes: *Zippelius 134a* (A, L. S), *185b* (L), W New Guinea.
- Harpullia macrocalyx* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 473; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 516; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1441. — Type: *Loher 5891* (M. holo), Philippines.
- Harpullia obscura* Radlk., *Bot. Jahrb.* 56 (1920) 314; in Engl., *Pflanzenr.* 98 (1934) 1448. — Syntypes: *Ledermann 12494, 12968* (B†, M), both NE New Guinea.
- Harpullia longithyrsofera* Kanehira & Hatusima, *Bot. Mag. Tokyo* 57 (1943) 78, f. 12. — Type: *Kanehira & Hatusima 14234* (A, BO iso), W Irian Jaya.
- Harpullia* sp.: Ceron, *Cat. Pl. Herb. Manila* (1892) 55 as for *Vidal 2525 & 2527*.
- Walsura villosa* auct. non Wall.: Ridley, *Fl. Malay Penins.* 1 (1922) 412, as for coll. *Burn-Murdoch* from Gombak, Selangor.
- Harpullia reticulata* auct. non Radlk.: Radlk., *Nova Guinea* 14 (1926) 185; in Engl., *Pflanzenr.* 98 (1934) 1443, as for both collections by *Feuille-teau de Bruyn*.

(Shrub to tree): up to 20(–40) m high. dbh up to 40(–100) cm; (buttresses up to 2 m high and 2 m spreading). Twigs 2–10 mm thick; usually gla-

brous but for the terminal bud (to all young parts up to and including the infructescences densely appressedly short-hairy and usually early glabrescent). *Leaves* 1(–)3–6(–7)-jugate; petiole up to 20 cm long; petiolules 2–12 mm long; axes glabrous (or sparsely puberulous). *Leaflets* ovate (lower ones) to elliptic to obovate (upper ones), 5–36 by 2–15 cm, index 1.5–4, herbaceous to chartaceous; base symmetrical to oblique, acute or the broader apical half (rarely both halves) rounded, (not or) only slightly decurrent; apex acute to rounded to gradually to abruptly acuminate, acumen short to rather long, rounded or retuse (to acute); glabrous or very sparsely hairy on midrib and below on nerves; midrib above usually slightly raised to basally sunken, (or raised or sunken over its whole length); nerves 0.75–3 cm apart, above slightly sunken; intersecondary nerves feeble (or absent). *Inflorescences* axillary (to pseudoterminal to truly terminal), erect or pendulous, infructescences more often ± pendulous, solitary, 5–85 cm long, simple (or with a strong branch near the base), usually sparsely and ± widely branched, often ± few-flowered, the upper parts usually tardily hairy, for the rest glabrescent; pedicels in fruit 3–7.5 mm long; bracts small, simple (or ternate) leaves. *Flowers* fragrant. *Sepals* elliptic to suborbicular, 3–6 by 2.5–4.5 mm, persistent in fruit. *Petals* oblong-obovate to oblanceolate, 5–10 by 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. *Pistil* 2-locular; ovary light green, yellow, or reddish brown; style 1.75–6.5 mm long, light green, stigma whitish; ovules 1 per locule (to 2 in one of the locules). *Fruits* slightly kidney-shaped, transversely ellipsoid, broadly ovoid, obovoid, or globular, 12–20 by 12–32.5 mm; base rounded to truncate (to slightly concave); stipe 1–3 mm long; apex slightly concave to obtuse-angular, apiculate; wall leathery to woody, outside and inside red, outside variably hairy, early to late glabrescent, inside glabrous to very laxly rather long hairy or glandular hairy. *Seeds* shining brown to black with a bright glossy red arilode. — **Fig. 46g, h.**

Distribution — Southern China, Assam, the Andaman Islands, Bangladesh, Burma, Thailand, Indo-China, throughout *Malesia*, and the Northern Territory of Australia (Entrance 1., Port Essington).

Habitat & Ecology — Primary and secondary rain forest, more rarely in light forest, teak forest, tidal forest, scrub, or on open places; often on slopes and ridges, on river banks and along ravines, also on flats and along the beach, usually on dry (to swampy) soil; rocky, sand, clay, or loam, usually

on limestone on fertile volcanic soils; sea level up to 1200(–1800) m altitude. Fl. (Jan.–)Apr.–July(–Dec.); fr. (Jan.–)Apr.–Oct.(–Dec.).

Uses – The wood is used for charcoal and as firewood; the bark is used as a fish poison.

Notes – 1. *Harpullia cupanioides* is best distinguished from its allies by the combination of glabrous vegetative parts (except for the terminal buds) and exclusively axillary inflorescences. Notwithstanding its rather wide distribution it is not very variable. However, there is a gradual shift from a mainly western ‘*cupanioides*’ type towards an eastern ‘*thanatophora*’ type, the latter being characterized by fewer, larger, and broader leaflets with more distant nerves, by less hairy inflorescences, by smaller flowers, and by bigger fruits that are earlier glabrescent.

2. The type of *H. fruticosa* from West New Guinea is the only specimen in which the leaflets are quite densely hairy along the complete length of the midrib.

3. The two collections made by *Feuilletau de Bruyn* from Schouten Island differ in their thick coriaceous leaflets with very pronounced and dense reticulation.

4. A truly terminal inflorescence is known only from *Verheijen 3241*, from Flores.

5. A somewhat doubtful collection is *PNH (Stuit) 10113* from Mindanao. It differs mainly in its unusually big fruits, which are up to 25 by 45 mm. This may represent a separate species, though in the *H. cupanioides* alliance.

**7. *Harpullia giganteacapsula*** Vente in Leenh. & Vente, *Blumea* 28 (1982) 17. — Type: *NGF (Streimann & Kairo) 27614* (L holotype; BRI, K), NE New Guinea.

*Tree*, up to 20 m high, dbh up to 80 cm. Young parts with a short, dense, brown indumentum, glabrescent. *Twigs* 6–21 mm thick. *Leaves* (2–)4–5-jugate; petiole 7.5–35 cm long; petiolules 2–10 mm long; axes hairy, glabrescent. *Leaflets* elliptic to obovate (upper ones), 7.5–26 by 4–11 cm, index 1.7–3, herbaceous to thin-pergamentaceous; base symmetrical to slightly oblique, acute to rounded, short-decurrent; apex rather abruptly (or gradually) acuminate, acumen short to moderately long, acute to rounded; above slightly hairy on midrib (and nerves), beneath sparsely to densely hairy on midrib and nerves; midrib above sunken; nerves 1.2–4.3 cm apart, above flat or sunken; intersecondary nerves few, usually feeble. *Infructescences* axillary, 10–33 cm long, with few up to 6 cm long branches, hairy; bracts lanceolate, up to 2.5 cm long; pedicels in fruit up to 18 mm long. *Flowers* only known from remnants under the fruit. *Sepals*

broad-elliptic to suborbicular, 6–8 by 4.5–7 mm, persistent or caducous. *Disc* uninterrupted, hairy. *Stamens* 7 or 8 (scars). *Pistil* 2-locular; style c. 4.5 mm long; ovules 2 per locule, the lower one with a long thin funicle, probably abortive. *Fruits* transversely broad-ellipsoid, c. 35 by 58 mm; base emarginate, stipe 1–2 mm long; apex emarginate to truncate; lobes erect, strongly inflated; wall thin woody, outside minutely pustulate and sulcate, densely hairy, glabrescent, inside very sparsely hairy. *Seeds* 1 per locule. — **Fig. 46k.**

Distribution – *Malesia*: E New Guinea.

Habitat & Ecology – In forests on ridges and slopes; limestone; 1350–1850 m altitude. Fr. Apr.–June, Oct.

**8. *Harpullia hirsuta*** Radlk., *Nova Guinea* 8 (1912) 618; in Engl., *Pflanzenr.* 98 (1934) 1450; Leenh. & Vente, *Blumea* 28 (1982) 33. — Type: *von Römer 980* (L holotype; M), SW New Guinea.

*Tree*. Twigs and leaf axes brownish hirsute. *Twigs* c. 3 mm thick. *Leaves* 2- or 3-jugate; petiole 5–7 cm long; petiolules 4–6 mm long. *Leaflets* elliptic, 11–20 by 5–6.5 cm, index 2–3, pergamentaceous; base symmetrical or slightly oblique, acute and decurrent; apex acuminate, acumen long, falcate, with acute tip; above densely hirsute on midrib and nerves, more sparsely so all over, beneath hairy on midrib, sparsely so all over; midrib and nerves slightly raised above; nerves 1.5–2.5 cm apart; intersecondary nerves few. *Infructescences* axillary, probably unbranched, 1.5 cm long (or more?). *Flowers* known from female buds only. *Sepals* elliptic. *Petals* thin, not (yet?) clawed, not auriculate, glabrous. *Disc* densely long-hairy. *Stamens* 5. *Pistil* 2-locular; ovary densely hairy; ovules 1 per locule. *Fruits* unknown.

Distribution – *Malesia*: SW New Guinea (only known from the type); a second doubtful collection from the Vogelkop Peninsula.

Note – The present species is very incompletely known. It may be closest to *H. camptoneura*.

**9. *Harpullia leptococca*** Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 278; in Engl., *Pflanzenr.* 98 (1934) 1450; Leenh. & Vente, *Blumea* 28 (1982) 34. — Type: *Chalmers s.n.*, 1880 (M holotype; MEL), SE New Guinea.

*Harpullia camptoneura* auct. non Radlk.: Rehder, *J. Arnold Arbor.* 14 (1933) 64.

Erect bushy *tree*, up to 9 m high. Young parts, leaf axes, inflorescences, and infructescences densely, appressedly, minutely hairy. *Twigs* 3.5–7 mm thick. *Leaves* 2- or 3(–5)-jugate; petiole 2.5–8



cm long; petiolules 2–5(–7) mm long. *Leaflets* elliptic to obovate, 4.5–15 by 2.5–8 cm, index 1.5–3, chartaceous; base symmetrical to slightly oblique, rounded to acute and usually (abruptly) short-decurrent; apex rounded to obtuse (to slightly emarginate); glabrous or very sparsely hairy on the midrib below; midrib above slightly sunken to slightly raised; nerves 0.9–2(–2.6) cm apart, about equally prominent on both surfaces; intersecondary nerves rather many, usually rather feeble. *Inflorescences* axillary, pseudoterminal, or terminal, 8.5–30 cm long, solitary and simple or with 2 equally strong basal branches (to with some more higher up); pedicels in flower and fruit 2–4 mm long. *Sepals* obovate to elliptic to orbicular, 4–5.5 by 3–4 mm, persistent. *Petals* oblong to lanceolate to oblanceolate, 6–7.5 by 2–2.5 mm, creamy green to creamy white, glabrous (or in the same flower some slightly hairy). *Disc* uninterrupted, short-velvety. *Stamens* 5(–7). *Pistil* 2-locular; style 2.5–5 mm long; ovules 1 per locule (to 2 in one of the locules). *Fruits* with widely spreading, obovoid to ellipsoid lobes, 5–6 by 27–34 mm; base cordate to obtuse, stipe up to 2 mm long; wall pergamentaceous, outside smooth with faint longitudinal nerves, orange to red, sparsely short-hairy, inside very sparsely short-hairy. *Seeds* black with a red arillode. — **Fig. 46 I.**

**Distribution** — *Malesia*: SE New Guinea (Central Prov., mainly around Port Moresby and on Yule I.).

**Habitat & Ecology** — In and along coastal scrub, between strand vegetation and grassland, on savannah, in the undergrowth of semi-deciduous forest; along the shore, behind the mangrove, on tidal flats, also on sandhills and ridges; sea level up to 60 m altitude. Fl. Apr., Aug.; fr. Apr., July–Sept., Nov.

**10. *Harpullia longipetala*** Leenh. in Leenh. & Vente, *Blumea* 28 (1982) 18. — Type: *Carr 11498* (L. holo; K, SING), SE New Guinea.

*Shrub* or *tree*, up to 18 m high. dbh up to 20 cm. Glabrous but for shortly dark- to orange-brown velvety buds and inflorescences. *Twigs* 3–14 mm thick. *Leaves* 2–4-jugate; petiole 4–15 cm long; petiolules 5–10 mm long. *Leaflets* ± elliptic, 12.5–32 by 4–14 cm, index 2–4, thin- to stiff-pergamentaceous, chartaceous, or coriaceous; base symmetrical (to oblique), acute (to rounded lower), usually slightly decurrent; apex rounded to gradually to abruptly acuminate, acumen short (to long), rounded to acute; midrib usually slightly raised above; nerves 1–5 cm apart, above slightly to hardly raised; intersecondary nerves absent (to well developed). *Inflorescences* axillary, rami-, and cauliflorous, in dense groups, 2–2.5 cm long, axes racemoid, few-flowered; pedicels in fruit c. 1 cm long. *Sepals*:

outer roundish, c. 6 by 5 mm, inner broad-elliptic, c. 7 by 5 mm; persistent in fruit. *Petals* oblanceolate, c. 15 by 4 mm, white, cream, or very pale mauve, glabrous. *Disc* velvety. *Stamens* 8, white; filaments up to 9 mm long; anthers c. 2.5 mm long. *Pistil* 2-locular; style c. 4.5 mm long; ovules 2 per locule (to 1 in one of the locules). *Fruits* broad-cordate, c. 18 by 22–25 mm, widest at or above the middle, orange to red; base ± truncate to broadly rounded, stipe c. 2 mm long; wall leathery, outside densely short-velvety, ± glabrescent, inside very sparsely hairy to glabrous. *Seeds* usually 1 per locule, arillode bright red.

**Distribution** — *Malesia*: E New Guinea.

**Habitat & Ecology** — Rain forest, sometimes dry monsoon forest, swamp forest, or secondary forest; on river banks, hill sides, in gullies, also in coastal savannahs; usually below 100 m (up to 1650 m) altitude. Fl. Nov.–Feb. (–Apr., June, July, Sept.); fr. July–Sept. (Nov., Mar.).

**11. *Harpullia myrmecophila*** Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 526; Leenh. & Vente, *Blumea* 28 (1982) 39. — Type: *Brass 13414* (A holo; BO, L), NW New Guinea.

*Treelet*, up to 4 m high. All young parts, including twigs, leaf axes, and infructescences, moderately to (latter) densely puberulous, glabrescent. *Twigs* 6–7 mm thick. *Leaves* 3- or 4-jugate; petiole 8.5–11.5 cm long; petiolules 5–7 mm long. *Leaflets* elliptic, 14.5–24.5 by 7.5–9 cm, index 1.9–2.8, chartaceous; base symmetrical or in upper leaflets oblique, acute and gradually, to rounded and abruptly (lowermost leaflets) decurrent; apex ± abruptly acuminate, acumen rather long, straight (to falcate), the tip rounded; midrib and nerves above fairly densely, beneath sparsely puberulous; midrib and nerves above slightly raised; nerves 2.2–3.5 cm apart; intersecondary nerves few, short. *Inflorescences* axillary and solitary or ramiflorous and in clusters of c. 3, not to sparsely branched, 6–15 cm long; pedicels in flower and fruit 4–9 mm long. *Sepals* ovate to elliptic, 4.5–5 by 3–4 mm, persistent. *Petals* oblanceolate, c. 10 by 3.2 mm, greenish white, glabrous. *Disc* uninterrupted, short-velvety. *Stamens* 5; filaments c. 2.5 mm long; anthers 3.5–4 mm long. *Pistil* 2-locular; ovules 1 per locule. *Fruits* broad-ellipsoid, 24–26 by 22–25 mm, rounded at base and apex, stipe c. 0.5 mm long; wall thin, woody, outside granulate and irregularly pustulate, red, very sparsely minutely hairy, inside glabrous. *Seeds* with a yellow arillode.

**Distribution** — *Malesia*: NW New Guinea (Idenburg R. near Bernhard Camp).

**Habitat & Ecology** — Rain forest, on stream bank; altitude c. 850 m. Fl., fr. Mar.

12. *Harpullia oococca* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 278; in Engl., Pflanzenr. 98 (1934) 1449; Leenh. & Vente, Blumea 28 (1982) 35. — Type: *Sayer s.n.*, 1887 (M holo; MEL), SE New Guinea.

*Harpullia hirsuta* auct. non Radlk.: Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 77.

Straggling tree, c. 6 m high. Twigs and leaf axes sparsely puberulous, infructescences short-velvety. Twigs 2 mm thick (or more?). Leaves 3–(to more?)-jugate; petiole c. 2.5 cm long; petiolules 7–10 mm long. Leaflets elliptic, 10–30 by 5.5–11 cm, index 2–3, pergamentaceous; base symmetrical to slightly oblique, acute and slightly decurrent; apex rather abruptly acuminate, acumen short, acute; densely puberulous on midrib and nerves, more sparsely so on veins beneath; midrib slightly raised above; nerves 1.5–4 cm apart, hardly raised above; some intersecondary nerves strongly developed. Infructescences (position unknown) probably solitary, probably no more than 5–6 cm long, with some strong patent branches near the base; pedicels c. 7.5 mm long. Sepals elliptic, c. 5 by 3 mm, persistent. Disc velvety. Fruits with 2 widely spreading ellipsoid lobes of c. 1.5 by 1 cm, central axis 4–7 mm high with a c. 3 mm long stipe and crowned by a c. 5 mm long style; wall thin-woody, outside pustular, orange, thinly puberulous, probably glabrescent, inside glabrous. Seeds 1 per locule, orange with a deep carmine arillode.

Distribution – *Malesia*: New Guinea (SE, Central Prov., once collected; 2 doubtful collections from the West: Nassau Mts and near Nabire).

Habitat & Ecology – Altitude c. 600 m.

13. *Harpullia peekeliana* Melch., Notizbl. Bot. Gart. Berlin-Dahlem 10 (1928) 279; Radlk. in Engl., Pflanzenr. 98 (1934) 1461; Leenh. & Vente, Blumea 28 (1982) 44. — Type: *Peekel* 987 (B<sup>+</sup> holo), Papua New Guinea.

Tree, c. 12 m high. Vegetative parts glabrous, inflorescences olive-brown tomentellous. Leaves 2–4-jugate, 42–50 cm long; petiolules 5–15 mm long. Leaflets elliptic or oblong-elliptic, 18–40 by 11–16 cm, coriaceous; base symmetrical, short-attenuate; apex acuminate; midrib and nerves above not or hardly raised. Inflorescences rami- and cauliflorous, 2–10 cm long, paniculate; pedicels in flower 10–12 mm long. Only male flowers known. Sepals broad-elliptic, 7–8 by c. 5 mm. Petals c. 12 by 3.5 mm, narrowed at base, not auriculate, fleshy, glabrous. Disc low, tomentellous. Stamens 5, c. 9 mm long, filaments and anthers of about the same length. Pistil and fruits unknown.

Distribution – *Malesia*: New Ireland (Lamekot to Panamangaf); only known from the type.

Habitat & Ecology – Altitude c. 200 m. Fl. May.

Note – *Harpullia peekeliana* is only known from Melchior's original description: the type was lost in the Berlin fire and apparently there are no duplicates in other herbaria. There is hardly any doubt that it belongs to the alliance of *H. ramiflora*, where it seems nearest to *H. solomonensis*. Comparison is difficult as only male flowers have been described from *H. peekeliana*, while only fruits and the remains of the female flowers under these are known for *H. solomonensis*. The two specimens from the Bismarck Archipelago, referred to *H. solomonensis*, agree fairly well vegetatively with *H. peekeliana*, but their infructescences are axillary. Moreover, both are from coastal habitats, whereas Peekel collected his material at 200 m altitude. More collections from the Bismarck Archipelago are a prerequisite to establish the position of *H. peekeliana* and its relationship to *H. solomonensis*.

14. *Harpullia petiolaris* Radlk., Bot. Jahrb. 56 (1920) 315; in Engl., Pflanzenr. 98 (1934) 1450; Leenh. & Vente, Blumea 28 (1982) 41. — Lectotype (Leenhouts & Vente 1982); *Ledermann* 8814 (B<sup>+</sup> holo; M), NE New Guinea. *Harpullis cupanioides* auct. non Roxb.: Holth. & Lam, Blumea 5 (1942) 208.

Tree, up to 6(–20) m high, dbh c. 4 cm. Twigs, leaf axes, inflorescences, and infructescences (very) densely set with patent, short or long, brown hairs or minutely tomentose, ± early glabrescent. Twigs (5–)10–13 mm thick. Leaves 4–6(–7)-jugate; petiole 10–27(–33) cm long; petiolules 0–4 mm long. Leaflets ovate to elliptic, 9–44 by 3.5–15 cm, index 2.1–3.6, herbaceous to thin-pergamentaceous; base symmetrical and subcordate to rounded (to oblique with one half acute, the other rounded); apex gradually (or fairly abruptly) acuminate, acumen short to rather long with acute tip; glabrous to (sparsely above to) densely hairy on midrib and nerves, sparsely on veins below; midrib above ± raised; nerves 1–3.3 cm apart, above slightly sunken (to slightly raised); intersecondary nerves often strongly developed. Inflorescences cauliflorous, in groups of 1–5 rachises, 22–50 cm long, simple or with few widely spaced, erecto-patent, up to 7 cm long branches mainly in the basal half, lax; cymes scattered along rachis and branches; pedicels in fruit 5–8 mm long. Flowers without smell. Sepals broad-elliptic, 4–6.5 by 3.2–4.5 mm; in fruit persistent or caducous. Petals oblanceolate, (7–)11–12.5 by 2.5–4 mm, white, glabrous (to ciliate at base). Disc low, 5-angular, short-velvety. Stamens 5; filaments 2–5.5 mm long; anthers 3–4.75 mm long. Pistil 2-

locular; style c. 6 mm long; ovules 1 per locule. *Fruits* transversely ellipsoid, 16–20 by 26–28 mm; base slightly cordate to rounded, stipe 1–2 mm long; apex slightly emarginate or obtuse; wall woody, outside irregularly pustulate, red, puberulous to pubescent, glabrescent, inside glabrous. *Seeds* dark brown to black with a yellow to red arillode.

Distribution – *Malesia*: Borneo, Moluccas, and New Guinea.

#### KEY TO THE SUBSPECIES AND VARIETIES

- 1a. Twigs, leaves, inflorescences, and infructescences thin-puberulous. Nerves spaced . . . 2  
(a. subsp. **moluccana**)
- b. Twigs, leaf axes, midrib, and nerves on lower side of leaflets, and inflorescences ferruginous-velvety. Nervation rather dense  
d. subsp. **petiolaris**
- 2a. Sepals persistent in fruit. c. var. **moluccana**  
b. Sepals caducous short after fertilization  
b. var. **decidens**
- a. subsp. **moluccana** Leenh. in Leenh. & Vente, *Blumea* 28 (1982) 42. — Type: *De Vogel 4102* (L holotype), Moluccas.  
For characters see the key.  
Distribution – *Malesia*: Borneo and Moluccas.
- b. var. **decidens** Vente in Leenh. & Vente, *Blumea* 28 (1982) 43. — Type: *De Vogel 3077* (L holotype), Moluccas.  
For characters see the key.  
Distribution – *Malesia*: Moluccas (Halmahera).  
Habitat & Ecology – Rather dense primary forest, with very little undergrowth on plane or slight slope; soil clay; altitude 10–20 m. Fl., fr. Oct.
- c. var. **moluccana** — Leenh. & Vente, *Blumea* 28 (1982) 43.  
For characters see the key.  
Distribution – *Malesia*: Borneo and Moluccas (Batjan I.).  
Habitat & Ecology – Rather dense primary forest with little undergrowth on dry soil, clay with limestone boulders; altitude up to 500 m. Fr. May.
- d. subsp. **petiolaris** — Leenh. & Vente, *Blumea* 28 (1982) 42.  
For characters see the key.  
Distribution – *Malesia*: New Guinea.  
Habitat & Ecology – Primary and secondary forests. Fagaceous and marsh forest; altitude up to 1400 m. Fl. Mar., May, Sept., Nov.; fr. Oct.  
Uses – Sap is used for poisoning fish.

15. *Harpullia ramiflora* Radlk., *Sapind. Holl.-Ind.* (1879) 15, 54; in Engl., *Pflanzenr.* 98

(1934) 1439; S.T. Reynolds, *Austrobaileya* 1 (1981) 415, f. 29g; Leenh. & Vente, *Blumea* 28 (1982) 38; S.T. Reynolds in *Fl. Austral.* 25 (1985) 42, map 48. — Type: *Beccari herb. 2822* (F1 holotype), Aru Islands.

*Harpullia angustifolia* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 599; in Engl., *Pflanzenr.* 98 (1934) 1439. — Type: *d'Albertis s.n. in herb. Beccari 2892* (F1 holotype), SE New Guinea.

*Harpullia aeruginosa* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 278; in Engl., *Pflanzenr.* 98 (1934) 1448. — Type: *Chalmers s.n.*, 1885 (M holotype), SE New Guinea.

*Harpullia weinlandii* K. Schum. in K. Schum. & Laut., *Nachtr. Fl. Schutzgeb. Südsee* (1905) 310; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1449. — Type: *Weinland 258* (B<sup>+</sup> holotype; BRI, L, M, SING, US, WRSL), NE New Guinea.

*Harpullia reticulata* Radlk., *Bot. Jahrb.* 56 (1920) 313; in Engl., *Pflanzenr.* 98 (1934) 1443 (type only; further collections = *H. cupanioides*). — Type: *Branderhorst 439* (M holotype; BO), SW New Guinea.

*Harpullia cupanioides* auct. non Roxb.: Koord., *Nova Guinea* 8 (1909) 171; Radlk., *Bot. Jahrb.* 56 (1920) 313, as for W New Guinea; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 516, as for *Ramos 30150*; Rehder, *J. Arnold Arbor.* 14 (1933) 64.

*Harpullia cauliflora* auct. non K. Schum. & Laut.: Radlk., *Nova Guinea* 8 (1912) 618; *Bot. Jahrb.* 56 (1920) 312, as for W New Guinea; in Engl., *Pflanzenr.* 98 (1934) 1440, ditto.

*Harpullia camptoneura* auct. non Radlk.: Hartley et al., *Lloydia* 36 (1973) 270.

Bushy to sparsely branched *shrub* or *tree*, up to 15 m high. dbh up to 15 cm. Twigs and leaf axes, or only buds, inflorescences, and infructescences sparsely to densely variably hairy,  $\pm$  glabrescent. *Twigs* 3–11 mm thick. *Leaves* (1–)3–4(–7)-jugate; petiole (2–)5–14(–18) cm long; petiolules (2–)4–8(–11) mm long. *Leaflets* ovate to elliptic, ( $\pm$  falcate), (4–)8–20(–31) by (1.5–)3.5–8(–15) cm, index (1.5–)2–4, herbaceous to chartaceous,  $\pm$  bulate if thin; base symmetrical (to oblique), acute to (especially in the lower leaflets) rounded, not or variably decurrent; apex acute to (in obovate leaflets) rounded to acuminate, the acumen short to long, straight to strongly curved, acute to rounded, (mucronulate); glabrous to (sparsely to) densely hairy on midrib and nerves, sparsely between nerves below; midrib basally slightly sunken to apically slightly raised to completely raised; nerves 0.5–6 cm apart, above flat to raised; intersecondary nerves





Fig. 47. *Harpullia rhachiptera* Radlk. Leaf (LAE 51779).

hardly to fairly strongly developed. *Inflorescences* initially axillary, after leaf-drop rami- to cauliflorous, at first solitary (or some together), later clustered. (in fruit pendent), 1–20(–40) cm long, simple or sparsely branched, mainly in the lower part, few-flowered; pedicels in fruit 4–10 mm long. *Flowers* fragrant. *Sepals* ovate (outer) to elliptic (or inner orbicular), 3.5–6 by 2.5–4.5 mm, persistent. *Petals* (lanceolate or) oblanceolate to obovate, 6–13.5 by (1.5–)2–3 mm, white to creamy, glabrous. *Disc* uninterrupted, low, short-velvety (or thin-puberulous). *Stamens* 5; filaments 5–6.5 mm long; anthers 2.25–3.5 mm long. *Pistil* 2-locular; style (2–)4.5–7 mm long; ovules 1 per locule. *Fruits* transversely ellipsoid to broadly heart-shaped (or obtriangular), 11–16(–22) by 16–25 mm; base truncate to rounded (to angular), stipe 1–2(–3) mm long; apex emarginate (or truncate to rounded); wall pergamentaceous to leathery, outside minutely warty or coarsely reticulately veined (or smooth), orange to bright red, fairly densely puberulous to short-velvety, inside orange, glabrous or very sparsely hairy. *Seeds* black with a shining orange arillode. — **Fig. 46m.**

**Distribution** — *Malesia*: Philippines (Catanduanas), Moluccas (Halmahera), New Guinea; Queensland.

**Habitat & Ecology** — Mainly in the undergrowth or primary rain forest and in young secondary forest, in gallery forests, coastal scrub, monsoon forest, periodically flooded forest, and sago swamp; on river banks, in gulleys, on steep slopes and ridges; on stony soil, loam, or clay; altitude sea level up to 200(–1950) m. Fl., fr. Feb.–Sept.(–Nov.).

**16. *Harpullia rhachiptera*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 278; in Engl., Pflanzenr. 98 (1934) 1440; Verdc., Kew Bull. 32 (1977) 223; Leenh. & Vente, Blumea 28 (1982) 23. — Type: *Bäuerlen 191 = Capt. Everett's Exp. s.n.* (M holotype; MEL), SE New Guinea. [*Affonsea pteropoda* Kosterm., Adansonia n.s. 6 (1966) 371, pl. 5, nom. inval. — Lectotype (Verdcourt 1977): *d'Alberty herb. 3544 & 3544a* (F1), SE New Guinea.]

**Shrub**, less than 1 m high, to *treelet* up to 3 m high. Young parts, inflorescences, and infructescences densely, appressedly, shortly, brown hairy. *Twigs* 4–6 mm thick. *Leaves* 3- or 4-jugate; petiole 8–11 cm long, winged except for the basal 1/4–1/2, wings 2–3.5 mm wide; rachis winged, wings 4.5–6 mm wide, widest beneath leaflet; petiolules 0–3 mm long; axes hairy. *Leaflets* ovate to elliptic, 7.5–25 by 2.5–10 cm, index 2–3.75, herbaceous; base symmetrical, narrowly rounded to

subcordate; apex gradually to rather abruptly acuminate, acumen short to rather long, straight, with rounded tip; midrib and nerves very sparsely to densely minutely hairy, below also with glandular hairs; midrib above slightly raised; nerves 1.5–2.5 cm apart, slightly raised above; intersecondary nerves few, faint. *Inflorescences* axillary, simple or slightly branched, up to 3.5 cm long, few-flowered; pedicels in fruit 3–4 mm long. *Female flowers* unknown. *Sepals* elliptic or (outer) ovate, 4.5–5.5 by 2.5–3 mm, in fruit semipersistent. *Petals* oblanceolate, c. 9 by 2 mm, white, glabrous. *Disc* annular, puberulous. *Stamens* 5 or 6; filaments c. 8 mm long; anthers 2.3–2.5 mm long. *Pistil* 2-locular; style c. 3.5 mm long; ovules 1 per locule. *Fruits* broad-ellipsoid to subglobose, 14–22 by 18–20 mm, red, base obtuse to truncate, short-stipitate, apex (sub)emarginate; wall thin coriaceous, outside prominently coarsely reticulate and pustulate, pubescent, inside glabrous. *Seeds* black with a yellow to orange arillode. — **Fig. 47.**

**Distribution** — *Malesia*: New Guinea (Vogelkop Peninsula, Western Prov.).

**Habitat & Ecology** — In undergrowth of forest, also in swamp forest, on ridges and river banks; altitude 45–90 m. Fl. Aug.; fr. Apr.–June, Aug.

**Note** — The present species seems on the one hand to be allied with the Australian *H. fruticososa* group, especially with *H. rhyticarpa*, and on the other hand with *H. cupanioides*.

**17. *Harpullia solomonensis*** Vente in Leenh. & Vente, Blumea 28 (1982) 36. — Type: *Kajewski 1968* (BRI holotype; A, BISH, BO, P), Bougainville Island.

**Tree**, up to 18 m high, dbh up to 25 cm. *Twigs* and leaf axes subglabrous, infructescences thin-puberulous. *Twigs* 9–11 mm thick. *Leaves* 3-jugate, up to 75 cm long; petiole 9.5–18 cm long; petiolules (6–)9–12 mm long. *Leaflets* ovate to elliptic, 11–42 by 6–15.5 cm, index 1.8–2.7, herbaceous to pergamentaceous; base symmetrical, acute or rounded, short-decurrent; apex tapering-acuminate, acumen long; above sparsely puberulous on midrib (and nerves), beneath glabrous; midrib and nerves above flat to slightly raised, nerves 2–3.5 cm apart; intersecondary nerves few. *Inflorescences* axillary to cauliflorous, densely clustered, the rachises branched at base, the axillary ones up to 4.5 cm long, those on the trunk up to 22 cm long; pedicels 8–12 mm long. *Flowers* without or with a strong smell, greenish- to golden-yellow; known only from remnants under the fruit. *Sepals* (sub)orbicular to elliptic, (3–)4–6 by 3–5 mm, persistent. *Disc* short-velvety. *Stamens* 5. *Pistil* 2-locular; style c. 6 mm long; ovules 1 per locule. *Fruits*

with erect, ellipsoid lobes, (17-)23-24(-30) by (25-)28-34 mm; base broadly rounded, stipe c. 3 mm long; apex slightly emarginate; wall slightly woody, outside granulate, yellow to orange, variably minutely hairy, inside glabrous.

Distribution - Solomon Islands, possibly also in *Malesia* Bismarck Archipelago.

Habitat & Ecology - Well-drained primary rain forest on ridge tops, hill sides, and in deep valleys; altitude 150-250(-900) m. Fl. Apr., June, Nov.; fr. Mar.-Apr., June-July.

Notes - 1. *Harpullia solomonensis* differs from its nearest related species, *H. ramiflora*, particularly in its inflorescences, which, when axillary, are short, dense clusters developing from both axillary buds, in its usually longer pedicels, and in its larger fruits with a thicker and rather woody wall.

2. Two collections from the Bismarck Archipelago, *NGF 45722* from New Britain and *NGF 29839* from New Ireland, may belong to this species. However, the nearly unknown *H. peekeliana* was described from New Ireland and seems to be closest to *H. solomonensis*. This problem can be solved only when more material from the Bismarck Archipelago becomes available.

**18. *Harpullia vaga* Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 526; Leenh. & Vente, Blumea 28 (1982) 30. — Type: *Kajewski 2544* (A holo; BISH, BM, BO, BRI, L, P, SING), Solomon Islands.**

*Tree*, up to 18 m high, dbh up to 48 cm. *Indumentum* dense, short, yellowish brown, and hirsute. *Twigs* 4-10 mm thick, sometimes hardly more than the terminal bud hairy. *Leaves* (2- to) 3-5-jugate; petiole 4-14 cm long; petiolules 3-8(-10) mm long; axes fairly densely hairy, glabrescent. *Leaflets* ovate to elliptic, 4.75-27 by 2.5-8.5 cm, index 2-4.5, chartaceous to papyraceous; base oblique to symmetrical, acute to (lower) obtuse to rounded, attenuate; apex gradually acuminate, acumen long,

and acute (or short and rounded); above (glabrous to) sparsely hairy on midrib (and nerves), beneath subglabrous to thinly hairy (to densely tomentelous) all over, most densely on midrib and nerves; midrib above slightly raised to slightly sunken; nerves 1-2.5 cm apart, slightly raised above; intersecondary nerves few and usually feeble. *Inflorescences* axillary, solitary, pendulous, 10-37(-70) cm long, subspicate to thyrsoid; pedicels in fruit 5-10 mm long. *Sepals* ovate, 6-8 by 5-6 mm, persistent in fruit. *Petals* glabrous. *Disc* uninterrupted, puberulous. *Stamens* 5. *Pistil* 2-locular; ovules 1 or 2 per locule. *Fruits* transversely broad-ellipsoid, kidney-shaped, broad-ovoid, or subglobular, up to 3 by 4.5 cm; base obtuse or rounded, stipe c. 2.5 mm long; apex rounded or sub-emarginate; wall woody, 1-1.5 mm thick, outside orange, coarsely granulate (to with rather big pustules), subglabrous, inside glabrous.

Distribution - Queensland, the Solomon Islands, and *Malesia*: New Ireland (?).

Habitat & Ecology - In well-drained primary or rarely secondary rain forest on slopes or ridge; altitude sea level up to 200(-1200) m. Fl. May, July-Sept., Dec.; fr. Feb.-Mar., June-July, Dec.

Note - *NGF 46042* from the Namatanai Subdist., New Ireland, may belong to this species. The above description is based on material from the Solomons; *NGF 46042* differs in the following points: leaflets relatively broad, up to 20 by 9 cm, with the nerves widely spaced (up to 3.5 cm apart); old female flowers with relatively large sepals (8 by 5 mm). Its fruits are unknown, this makes it the more difficult to place this specimen with certainty.

#### EXCLUDED

*Otonychnium retusum* Miq., Fl. Ind. Bat. 1, 2 (1859) 572 = *Rhus taitensis* Guillemain, Ann. Sci. Nat. Bot. II, 7 (1837) 361 (*Anacardiaceae*). See Ding Hou in Fl. Males. I, 8 (1978) 537-538.

## JAGERA

(P.W. Leenhouts)

*Jagera* Blume, Rumphia 3 (1847) 155; Radlk. in Engl., Pflanzenr. 98 (1933) 1238-1243; Adema, Blumea 37 (1993) 195. — Type species: *Jagera javanica* (Blume) Blume ex Kalkman [= *Jagera speciosa* Blume].

*Trees*, often ± pachycaulous, or shrubs, monoecious. *Indumentum* of solitary simple hairs; no glandular scales. *Twigs* often strongly ribbed, with a thick pith and a very thin



wood cylinder; terminal bud protected by bud scales. *Leaves* often verticillate, sometimes opposite or spirally arranged, paripinnate, 4–40-jugate, without pseudo-stipules; petiole base swollen and beneath deeply 3-lobed, leaving a very characteristic scar, neither petiole nor rachis winged. *Leaflets* alternate to opposite, below with naked glands; base at the basiscopic side narrow, cuneate, at the acroscopic side broad and rounded; margin serrate to dentate (entire in an Australian variety of *J. pseudorhus*); midrib prominent above, nerves and veins raised on both sides, nerves ending in the marginal teeth. *Inflorescences* in the axils of bracts or normal leaves, together pseudoterminal, thyrses. *Flowers* unisexual, monoecious, regular. *Sepals* 5, slightly connate at base, narrowly imbricate, all equal, margin sometimes slightly petaloid, outside hairy, the margin (partly glandular) ciliolate, inside slightly hairy to glabrous, entire, in fruit persistent and slightly reflexed. *Petals* 5, as long as or slightly longer than the calyx, shortly clawed to sessile, glabrous or outside at the base and sometimes in the centre, and along the margin slightly hairy, entire, inside either auricled or with two, sometimes with one, erect woolly scale(s), exceptionally (an Australian subspecies of *J. javanica*) with a crest. *Disc* entire, lobed, without appendages, glabrous. *Stamens* 8 (7–10), in male flowers exerted, spreading; filaments at least slightly hairy at base (to completely hairy); anthers obovate, ciliate (or glabrous). *Ovary* sessile, hairy, 3-locular; style apical, about as long as the ovary, hairy, with 3 swollen stigmatic lines. *Ovules* 1 per locule. *Fruits* sessile, loculicidal, slightly warty, densely pilose with stiff, irritating hairs, inside also densely pilose. *Seeds* with a swollen annular sarcotesta around the hilum. — **Fig. 48.**

**Distribution** — Two species in the Moluccas, New Guinea, and Australia (Queensland and northern New South Wales).

**Habitat** — Understorey tree of different forest types.

#### KEY TO THE SPECIES

- 1a. Twigs 10–35 mm thick, with 10–12 deep grooves. Leaves mostly in whorls of up to 6, sometimes in a dense spiral, 13–40-jugate . . . . . **1. *J. javanica***  
 b. Twigs 3–5 mm thick, with 6 slight grooves. Leaves arranged in an irregular spiral, sometimes opposite, 4–17-jugate . . . . . **2. *J. pseudorhus***

**1. *Jagera javanica*** (Blume) Blume ex Kalkman, *Blumea* 7 (1953) 470; S.T. Reynolds in *Fl. Austral.* 25 (1985) 67. — *Garuga javanica* Blume, *Bijdr.* (1826) 1165. — *Jagera speciosa* Blume, *Rumphia* 3 (1847) 155, nom. illeg.; Miq., *Fl. Ind. Bat.* 1, 2 (1859) 564. — Type: ?*Korthals s.n.* (L).

[*Papaja litorea boeronensis Attehu dicta* Rumph., *Herb. Amb.* 1 (1741) 150, pl. 53, f. 2.]

*Sapindus serrata* Roxb., *Hort. Beng.* (1814) 88, nom. nudum, inval.; *Fl. Ind.* ed. Carey (1832) 284. — *Jagera roxburghii* Blume, *Rumphia* 3 (1847) 155, nom. illeg. — *Jagera serrata* (Roxb.) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Akad. Wiss. München* 8 (1878) 303; *Sapind.* *Holl.-Ind.* (1879) 36; in *Engl., Pflanzenz.* 98 (1933) 1241; S.T. Reynolds, *Austroba-*

*leya* 1 (1983) 411, f. 28E. — *Jagera serrata* (Roxb.) Radlk. f. *genuina* Radlk., *Bot. Jahrb.* 56 (1920) 297, nom. illeg. — Type: *Roxburgh s.n.*, Moluccas.

*Jagera serrata* (Roxb.) Radlk. f. *fulvinervis* Radlk., *Bot. Jahrb.* 56 (1920) 297. — Type: *Forbes 750* (F, L), New Guinea.

*Jagera macrophylla* Radlk., *Bot. Jahrb.* 56 (1920) 297, f. 3; in *Engl., Pflanzenz.* 98 (1933) 1243, f. 37. — Syntypes: *Moszkowski 341* (M), *Ledermann 10759, 10842*, all New Guinea.

The species is divided into two subspecies of which only one occurs in Malesia, the other one (subsp. *australiana* Leenh.) is restricted to N Australia.



Fig. 48. *Jagera* Blume. Habit, leaflet and fruit. — *J. javanica* (Blume) Blume ex Kalkman subsp. *javanica*. a. Habit, leafy part; b. *ibid.*, topmost part with inflorescences; c. fruit. — *J. pseudorhus* (A. Rich.) Radlk. d. Leaflet (a, b: *Kostermans & Soengeng* 70; c: *Hoogland* 4910; d: *Brass* 6437).

subsp. *javanica*

Not or sometimes sparsely branched pachycaulous tree, up to c. 12, rarely to 25 m high, dbh up to 20(–50) cm, sometimes with low buttresses; bark

rather smooth or sometimes pustular, greyish. Twigs 1–3.5 cm thick, with 10 or 12 deep grooves and a conspicuous sequence of zones with scars of bud scales, zones with 5 or 6 whorled leaf scars separated by up to 4 cm long internodes, and zones with

scars of inflorescences axillary to scars of bracts; usually densely hairy. *Leaves* mostly whorled, 13–40-jugate, 35–120 cm long; petiole 5–28 cm long, 3–9 mm thick, strongly 3-lobed below at the base; axes tomentellous; petiolules 1–3 mm long. *Leaflets* 2.5–20 by 1–6 cm, index 2.5–5, variably pergamentaceous, sometimes papyraceous or coriaceous, above on the midrib variably hairy, very sparsely so on the nerves, beneath hairy all over, mainly on midrib and nerves only, with 0 to many naked glands usually in 2 rows along the midrib; margin serrate to crenate-dentate; apex acute to acuminate. *Inflorescences* up to 1 m long, widely laxly branched, many-flowered, the flowers in nearly sessile, compact, few-flowered dichasia or in compact monochasia, densely hairy; pedicels 1–3 mm long, pendent in fruit. *Sepals* 1–1.8 by 0.8–1.5 mm. *Petals* ovate to obovate, 1–2 by 0.6–1.5 mm, inside with 2 scales or sometimes with 2 auricles. *Stamens*: filaments up to 3 mm long, partly woolly; at least near the base; anthers 1.3–1.8 by 0.8–1 mm, ciliate. *Fruits* obovoid to globular, 2.5 by 2 cm, pericarp hard, c. 2 mm thick. — **Fig. 48a–c.**

**Distribution** — *Malesia*: Moluccas and New Guinea.

**Habitat & Ecology** — Mostly an understorey tree, sometimes a canopy tree of primary and secondary rain forest, sometimes of swamp or savannah forest, often on slopes and ridges, sometimes on flat and river banks, sometimes periodically flooded, both on (limestone) rocks and on clay; mostly below 100 m altitude, sometimes up to 1050 m. Fl. mainly Feb.–July; fr. May–Dec.

**Notes** — 1. Unfortunately, the type material is labelled 'Java', hence Blume's specific epithet 'javanica'. Later on he realized that this material came from the Bogor Botanic Garden and had been introduced from the Moluccas (see Blume 1847).

2. Several characters show rather wide variation. *Forma fulvinervis* shows the extremes of some mostly independently varying characters. The density of the indumentum is especially variable: the most glabrous forms occur in the Moluccas, but not all Moluccan collections are glabrous.

**2. *Jagera pseudorhus* (A. Rich.) Radlk., Sapind.** Holl.-Ind. (1879) 37; in Engl., Pflanzent. 98 (1933) 1240; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 522; Francis, Austral. Rain-

for. Trees ed. 2 (1951) 256, f. 149–151; S.T. Reynolds, Austrobaileya 1 (1983) 409, f. 25A, 28B–D; Stanley & Ross, Fl. SE Queensl. 1 (1983) 509, f. 79K; S.T. Reynolds in Fl. Austral. 25 (1985) 67, f. 13E, F. — *Cupania pseudorhus* A. Rich. in Urva, Voy. Astrolabe 2, Bot. (1834) 34, pl. 14. — Type: *Fraser s.n.*, Australia.

*Jagera pseudorhus* f. *pilosiuscula* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 621. — Lectotype (S.T. Reynolds 1983): *Wawra* 628, Queensland.

The species is divided into two varieties: var. *pseudorhus*, with two forms: f. *pseudorhus* (S Queensland, northern New South Wales) and f. *pilosiuscula* Radlk., and var. *integerrima* S.T. Reynolds (Atherton Tableland). Only f. *pilosiuscula*, described below, occurs in Malesia.

*Trees*, up to 8, rarely up to 18 m high, dbh up to 12 cm; bark smooth or slightly pustular, patchy grey and brown. *Twigs* 3–5 mm thick, with 6 slight grooves, gradually becoming terete, sparsely hairy. *Leaves* arranged in an irregular spiral, upper ones sometimes opposite, 4–17-jugate, 6.5–32 cm long; petiole 2–7 cm long, 1–2 mm thick, below at base with 2 slight grooves; axes variably hairy; petiolules 1–2 mm long. *Leaflets* 4–11 by 1.25–3.5 cm, index 2–5, thin- to stiff-pergamentaceous, above on the midrib slightly hairy, beneath glabrous but for a few hairs on the midrib, with 0 to many naked glands in 1 row along the midrib; margin distantly serrate; apex tapering acuminate, acute. *Inflorescences* 4.5–20 cm long, sparsely hairy; branches up to 5 cm long, bearing several-flowered dichasia; pedicels 1.5–2 mm long. *Sepals* 1–1.8 by 0.6–1 mm. *Petals* ovate to orbicular, 1.4–2 by 1–1.5 mm, inside with one or two scale(s). *Stamens*: filaments 2.5–3 mm long, sparsely to densely long-hairy; anthers 1.5–2 by 0.8–0.9 mm, glabrous or slightly ciliate. *Fruits* obovoid, 1.75 by 1.25 cm; pericarp hard, c. 1 mm thick. — **Fig. 48d.**

**Distribution** — Queensland (south to Fraser Island); in *Malesia*: New Guinea (Irian Jaya: around Merauke; Papua New Guinea: Western Prov.).

**Habitat & Ecology** — In rain, monsoon, and savannah forest, on banks of rivers and lakes; from sea level to 30 m altitude. Fl. mainly Aug., Sept.; fr. Aug.



## LEPIDEREMA

(A.M. Schot)

*Lepiderema* Radlk., Sapind. Holl.-Ind. (1879) 99; in Engl., Pflanzenr. 98 (1933) 1216; S.T. Reynolds, *Austrobaileya* 1 (1982) 488; in Fl. Austral. 25 (1985) 52; Schot, *Blumea* 36 (1991) 235. — Type species: *Lepiderema papuana* Radlk.

(Small) trees. *Indumentum* of solitary hairs; (some) scale hairs present in inflorescences. *Branchlets* terete, more or less straight, pith narrow. *Leaves* paripinnate, pseudostipules absent; rachis above grooved, not winged. *Leaflets* opposite to subopposite, elliptic to narrowly elliptic, symmetrical except for the base, not punctate; base attenuate (to cuneate), oblique; margin entire, slightly curved; apex cuspidate, very apex obtuse, not mucronulate; both surfaces smooth, domatia absent below; venation raised to almost flat above, raised below; veins densely reticulate. *Inflorescences* pseudoterminal or axillary or ramiflorous thyrses, branches with scale-like hairs; cymules 1–7-flowered, dichasial. *Bracts* and *bracteoles* caducous. *Pedicels* sparsely hairy, glabrescent. *Sepals* 5, petaloid, connate at base, biseriate. *Petals* 5; claw very small to absent; scales absent. *Disc* uninterrupted. *Stamens* 8; filaments filiform; anthers basifixed, dehiscence latrorse. *Ovary* 3-locular, one ovule per locule; style pyramidal with three longitudinal stigmatic grooves. *Fruits* capsular, obovoid, loculicidal, not winged, stipe slender, outside and inside glabrous. *Seeds* obovoid, covered by an arillode; the latter open at apical end, without basal pseudofunicle. — **Fig. 49.**

Distribution — 8 species: 6 in Australia, 2 in *Malesia*: New Guinea.

Note — Only two specimens of *Lepiderema* are known from New Guinea, both being the types of the two *Malesian* species.

## KEY TO THE SPECIES

- 1a. Rachis of leaf shortly hirsute; midrib of leaflets sericeous on both sides; marginal loops indistinct ..... **1. *L. melanorrhachis***  
 b. Rachis of leaf glabrous; leaflets, including midrib, glabrous; marginal loops distinct ..... **2. *L. papuana***

**1. *Lepiderema melanorrhachis*** Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 521; P. Royen, *Man. For. Trees Papua & New Guinea* 2 (1964) f. 1k; Schot, *Blumea* 36 (1991) 237. — Type: *Brass* 7432 (A holotype; L), New Guinea.

*Tree*, tall, slender. Flowering *branchlets* 5–9 mm thick, slightly rough, very sparsely hirsute, black. *Leaves* 3–5-jugate; peduncle 2.2–7.8 cm long; rachis 4.5–14.2 cm long, shortly hirsute. *Leaflets* elliptic to narrowly elliptic, 4.7–14.3 by 2.4–5.7 cm; both surfaces glabrous except for the sericeous midrib; venation almost flat above; nerves curving towards margin, indistinctly joined. *Inflorescences* axillary to ramiflorous; rachis 4–9.5 cm long, hirsute; cymules (1–)3–7-flowered; pedicel c. 2 mm long, glabrous to sparsely hairy with scale-

like hairs, black; part above abscission zone c. 1 mm long. *Flowers* unknown. *Sepals* elliptic to suborbicular, glabrous, outer two c. 1 by 0.75 mm, inner three c. 1.5 by 1 mm. *Fruits* obovoid, 10–12 by 9–10 mm, not lobed, rough; stipe 3–4 mm long; wall thin. *Seeds* obovoid, c. 4.5 by 3 mm, only young ones seen. — **Fig. 49.**

Distribution — *Malesia*: Papua New Guinea (Fly River).

Habitat & Ecology — In forest canopy. Fr. Aug.

**2. *Lepiderema papuana*** Radlk., Sapind. Holl.-Ind. (1879) 100; in Engl., Pflanzenr. 98 (1933) 1217; P. Royen, *Man. For. Trees Papua & New Guinea* 2 (1964) 28; Schot, *Blumea* 36 (1991) 238. — Type: *Teijsmann HB 14250* (M holotype), Irian Jaya.



Fig. 49. *Lepiderema melanorrhachis* Merr. & L.M. Perry. a. Habit; b. fruit (a, b: Brass 7432).

(Presumably) small *tree*. Flowering *branchlets* c. 6 mm thick, glabrous. *Leaves* 3–5-jugate; peduncle 5.4–13.7 cm long; rachis 5.3–11.8 cm long, glabrous. *Leaflets* elliptic to narrowly elliptic, 4.6–16.5 by 2.2–5.8 cm; both surfaces glabrous; venation raised above; nerves looped and joined near the margin. *Inflorescences* pseudoterminal; rachis 3.8–6.9 cm long, shortly hirsute, branching at base; cymules 1-flowered; pedicel c. 1.75 mm long, shortly, sparsely hairy with simple and with scale hairs; part above abscission zone c. 1 mm long. *Flowers*

2.5–3 by c. 1.5 mm, probably only female ones seen. *Sepals* elliptic to suborbicular, glabrous, outer two c. 1 by 0.75 mm, inner three c. 2 by 1.25 mm. *Petals* 5, elliptic, c. 1.75–2 by 0.5–1.25 mm, glabrous to sparsely hairy; claw less than 0.1 mm long, hairy at base; apex rounded. *Stamens* 8; filaments 0.5–0.75 mm long, densely hairy at least at base; anthers c. 1 mm long, mainly hairy on connective. *Ovary* c. 1.5–2 mm long, glabrous; style and stigma c. 2 mm long. *Fruits* and *seeds* unknown.

Distribution – *Malesia*: Irian Jaya (Misool).

## LEPIDOPETALUM

(P.C. van Welzen)

*Lepidopetalum* Blume, Rumphia 3 (1847) 171; Radlk., Bot. Jahrb. 56 (1920) 56; in Engl., Pflanzenr. 98 (1933) 1316; S.T. Reynolds in Fl. Austral. 25 (1985) 87; Welzen et al., Blumea 36 (1992) 439. — Type species: *Lepidopetalum perrottetii* (Cambess.) Blume. *Lachnometalum* Turcz., Bull. Soc. Nat. Mosc. 21 (1848) 571. — Type species: *Lachnometalum glabrum* Turcz. [= *Lepidopetalum perrottetii* (Cambess.) Blume].

*Trees*; bark greyish brown, slightly fissured and/or with lenticels; indumentum of simple hairs only. *Branchlets* smooth to slightly grooved, sericeous when young. *Leaves* paripinnate, pulvinate at base, no pseudo-stipules or wings; petiolules present as pulvinus. *Leaflets* subopposite to opposite, basal ones ovate, upper ones elliptic (to obovate), slightly asymmetric, acroscopic side broader, thin, not punctate; base usually cuneate, asymmetric; margin entire, flat; both surfaces smooth, subglabrous except for at least the subsericeous basal part of the midrib, domatia as (a few) glabrescent hair tufts below; venation raised, especially below, nerves marginally looped, veins reticulate. *Inflorescences* ramiflorous to axillary to pseudoterminal, reduced thyrses with usually 3 cymules per node; rachis (sub)sericeous; cymules basally dichasial to apically cincinnate, those with male flowers often with an exceptional number of sepals, petals, and stamens in first developed flowers. *Bracts* and *bracteoles*: mainly margin and outside sericeous. *Pedicels* with glandular hairs besides simple ones, articulated. *Flowers* actinomorphic, yellowish white. *Sepals* (sub)equal, basally united; tube disc-shaped, c. 0.3 mm long; blades triangular (to ovate). *Petals*: claw c. 0.1 mm high; blade triangular; scales united into one, larger than blade, margin irregularly crenate, pilose; crests usually absent (to present). *Disc* circular, smooth, glabrous, enveloping base of stamens, without appendages. *Stamens* (7–)8(–10); filaments especially basally pilose; anthers basifixed, dehiscence latrorse, pilose. *Pistil*: ovary flat, 2- (or 3-)locular; ovules one per locule; style and stigma united, flat, triangular, stigmatic part folded outwards like overhanging roof. *Fruit* an obovoid, loculicidally dehiscent capsule, with usually 1 developed seed, flat when 2-locular, smooth to somewhat rough, outside glabrous, margin sharp, almost slightly winged, inside glabrous to pilose, red; stipitate or not; wall thin, coriaceous to woody, at most 2 mm thick. *Seeds* ellipsoid, triangular in transverse view, base straight to oblique, smooth, shiny, black; sarcotesta glabrous, covering seed only basally to almost completely, orange; testa thin, without radicle pocket on the inside. — **Figs. 50, 51.**



Distribution — 6 species from India (Andaman and Nicobar Islands; 1 non-endemic species) to NE Australia and the Solomon Islands (also 1 non-endemic species each); all species occurring in *Malesia*, mainly endemic.

Habitat & Ecology — Trees in primary and secondary forest, on waste land, along rivers and roads; sea level up to 1200 m altitude.

Note — The phylogeny and historical biogeography of *Lepidopetalum* are described in Van Welzen et al. (1992).

KEY TO THE SPECIES  
(based on flowering characters)

Caution: the differences in floral characters among the species are only slight. Therefore geography is used as an additional 'character'; however, due to insufficient collecting, the geographical ranges of some species may be larger than described in the key.

- 1a. Upper part of pedicels pilose . . . . . 2
- b. Upper part of pedicels glabrous except for glandular hairs . . . . . 5
- 2a. Disc as high as broad or broader than high (flat). Philippines, New Guinea, Solomons . . . . . 3
- b. Disc higher than broad. Nicobar Islands, Sumatra . . . . . **3. *L. montanum***
- 3a. Ovary (sub)glabrous (to pilose); if pilose then disc usually with slits. Petals 0.5–2.2 mm high, crests often present as ribs or as flat scales. New Guinea, Solomons . . . . . 4
- b. Ovary pilose; disc without slits. Petals 0.4–1 mm high, crests absent. Philippines . . . . . **4. *L. perrottetii***
- 4a. Disc as high as broad, without slits. Crests usually present on petal scales as ribs or as flat appendages. Ovary (sub)glabrous. N coast of New Guinea: E Geelvink Bay to Madang Province . . . . . **2. *L. micans***
- b. Disc flat to as high as broad, usually with slits. Crests usually absent, at most present as ribs. Ovary subglabrous to pilose. New Guinea: Peninsula to S coast to Vogelkop . . . . . **6. *L. xylocarpum***
- 5a. Stamens 8, some flowers of a cymule, especially the first flowering male ones, with 9 or more. Solomons and New Guinea (absent in Morobe Prov.) . . . . . 6
- b. Stamens 8. New Guinea: Morobe Province . . . . . **1. *L. fructoglabrum***
- 6a. Inflorescences up to 17 cm long, axillary to pseudoterminal. Each inflorescence with at least a few big bracts 1–3.3 mm long. Solomons and N New Guinea: Jayapura to Morobe Province to Bougainville . . . . . **5. *L. subdichotomum***
- b. Inflorescences up to 8.5 cm long, usually ramiflorous on thin twigs to axillary to pseudoterminal. Inflorescences with only small bracts 0.7–1.3 mm long. New Guinea: Peninsula to S coast to Vogelkop . . . . . **6. *L. xylocarpum***

KEY TO THE SPECIES  
(based on fruit characters)

- 1a. Fruit pilose inside . . . . . 2
- b. Fruit glabrous inside . . . . . **1. *L. fructoglabrum***

- 2a. Sarcotesta present only basally around hilum . . . . . 3
- b. Sarcotesta covering seed except for (part of) dorsal side . . . . . 5
- 3a. Upper part of pedicels sericeous. Sarcotesta with well developed obpyramidal basal outgrowth . . . . . 4
- b. Upper part of pedicels glabrous except for some glandular hairs. Sarcotesta with inconspicuous obpyramidal basal outgrowth . . . . . **5. *L. subdichotomum***
- 4a. Fruit 3.2–4.5 by 1.7–2.4 cm . . . . . **3. *L. montanum***
- b. Fruit 1.3–2.5 by 0.8–1.6 cm . . . . . **4. *L. perrottetii***
- 5a. Fruit long pilose inside, hairs c. 1.5 mm long. Sarcotesta covering seed except for small dorsal triangular part (Fig. 50b) . . . . . **2. *L. micans***
- b. Fruit short pilose inside, hairs c. 0.5 mm long. Sarcotesta covering seed except for dorsal side (Fig. 50g) . . . . . **6. *L. xylocarpum***

**1. *Lepidopetalum fructoglabrum*** Welzen in Welzen et al., *Blumea* 36 (1992) 455, f. 7. — Type: *Hartley 9948* (L holo; A, BRI, CANB, K), Papua New Guinea.  
*Lepidopetalum subdichotomum* auct. non Radlk.: S.T. Reynolds in *Fl. Austral.* 25 (1985) 87, f. 16, 21k, map 111.

*Tree*, 10–17 m high, dbh 7.5–50 cm; outer bark blotched light and dark grey to dark brown, smooth

to finely tessellated to rather warty, inner bark pinkish to reddish brown, hard; wood cream to dark straw, moderately hard and heavy, heartwood reddish brown. *Flowering branchlets* 1–4 mm in diam. *Leaves* 3- or 4-jugate; rachis 2.7–14.5 cm long, terete, subsericeous. *Leaflets* 3.2–17.5 by 1.4–6.1 cm; apex (acuminate to) caudate, very apex emarginate to rounded; upper surface glaucous when dry. *Inflorescences* mainly axillary to pseudoterminal, axes branching in axil and along rachis, all

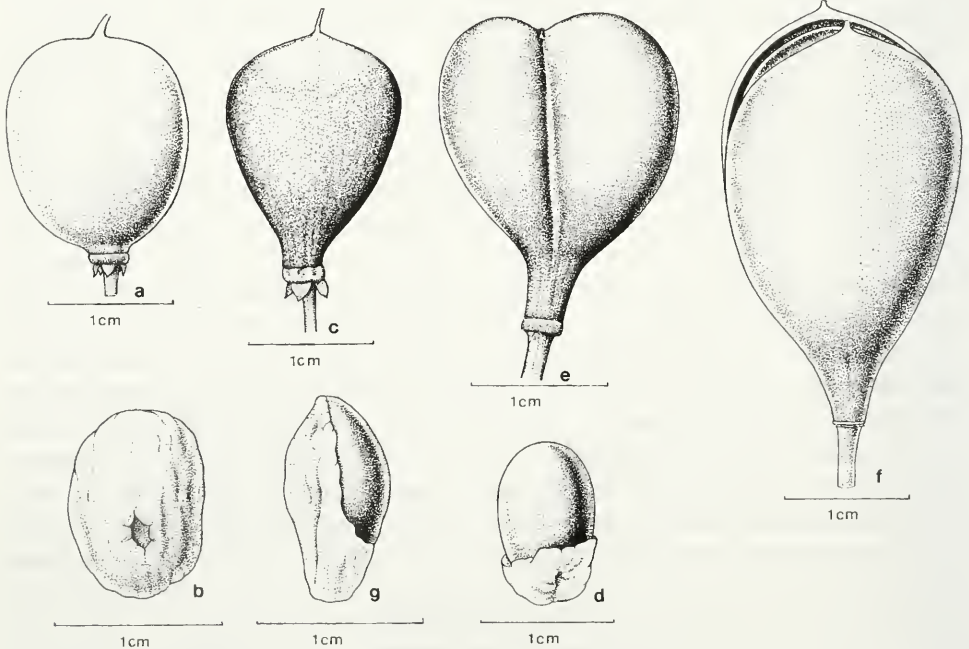


Fig. 50. *Lepidopetalum* Blume. Fruits and seeds. — *L. micans* Laut. & K. Schum. a. Fruit; b. seed. — *L. perrottetii* (Cambess.) Blume. c. Fruit; d. seed. — *L. subdichotomum* Radlk. e. Fruit. — *L. montanum* (Blume) Radlk. f. Fruit. — *L. xylocarpum* Radlk. g. Fruit (a, b: LAE 50083; c, d: FB 20524; e: BSIP 10242; f: King's coll. 7; g: NGF 27507).

up to 7.5 cm long. *Bracts* and *bracteoles* triangular: bracts 0.6–1 mm long; bracteoles 0.3–0.8 mm long. *Pedicels* subglabrous, upper part up to 5.7 mm long, glabrous except for some glandular hairs. *Flowers* 3.5–4.3 mm in diam. *Sepals* 5; lobes 1.3–1.8 by 0.7–1.1 mm, subglabrous. *Petals* 5; blade 0.8–1 by 0.7–1.3 mm, subpilose; scale 0.7–1.3 by 1–1.6 mm; crest absent (to well developed central ribs). *Disc* uninterrupted, c. 0.6 by 0.5 mm, broader than high. *Stamens* 8; filaments white, in male flowers 2.7–3.3 mm long, in female flowers 0.5–1.5 mm long; anthers 0.8–1.1 by 0.5–0.8 mm, yellowish. *Pistil*: ovary in male flowers c. 0.3 mm high, up to 2.6 mm high in female flowers, 2-locular, subglabrous; style and stigma in male flowers c. 0.1 mm high, in female flowers up to 1.3 mm high. *Fruits* 2–2.2 by 1.2–1.4 cm, inside glabrous; stipe absent. *Seeds* 1.1–1.3 by c. 0.9 cm, base straight; sarcotesta only around hilum, forming slight obpyramidal outgrowth below seed; hilum 2–4 mm long.

**Distribution** – *Malesia*: NE Papua New Guinea (Morobe Prov.).

**Habitat & Ecology** – Found in second storey of primary and secondary rain forest, periodically flooded forest, and along streams and roads; 30–900 m altitude. Fl. Aug.–Nov.; fr. Nov.–Feb.

**Chemical compounds** – Hartley et al. (Lloydia 36, 1973, 270) report *L. fructoglabrum* (as *L. hebecladum*) to be devoid of alkaloids in bark and leaves.

**2. *Lepidopetalum micans*** Laut. & K. Schum. in K. Schum. & Laut., Fl. Schutzgeb. Südsee (1901) 423; Welzen et al., Blumea 36 (1992) 456, f. 2a, 3c, 7. — Type: *Lauterbach* 2840 (B† holo; BM, K, M). Papua New Guinea.

*Lepidopetalum hebecladum* auct. non Radlk.: Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 269; K. Schum. & Laut., Fl. Schutzgeb. Südsee (1901) 422; Radlk., Bot. Jahrb. 56 (1920) 307; Nova Guinea 14 (1926) 184; in Engl., Pflanzenz. 98 (1933) 1319. In all references *Hollrung* 341 excluded; see note 1.

(*Shrub* to *tree*, 2–30 m high, 10–85 cm dbh; outer bark whitish to greyish brown, smooth to somewhat rough with numerous pustular lenticels, thin, hard, inner bark cream to orange to straw brown; wood white to brown, heartwood reddish brown. *Flowering branchlets* 1.5–2.5(–11) mm in diam. *Leaves* (2–)3–4(–5)-jugate; rachis 1.7–14 cm long, flat above, especially upper side sericeous. *Leaflets* 2–21 by 1–7 cm; apex acuminate to cuspidate, very apex emarginate to rounded. *Inflorescences* axillary to pseudoterminal, usually not

branching, rachis up to 8 cm long. *Bracts* and *bracteoles* triangular: bracts 1.1–1.6 mm long; bracteoles 0.3–1 mm long. *Pedicels* puberulous, upper part 1.8 (flower)–10 (fruit) mm long. *Flowers* 3.3–6.3 mm in diam. *Sepals* 5; lobes 1.2–3.3 by 0.7–2.3 mm, margin pilose. *Petals* 5; blade 0.5–2 by 0.8–2 mm, margin pilose, outside subglabrous; scale sometimes divided into two, 0.5–1.5 by 0.8–2.2 mm; crest (absent to) well developed central ribs to 2 small flat appendages. *Disc* uninterrupted, c. 0.5 mm high, as high as broad. *Stamens* (7–)8(–10); filaments in male flowers 1–3.3 mm long, in female flowers 0.8–1.3 mm long; anthers 0.8–1.2 by 0.6–1 mm. *Pistil*: ovary in male flowers 0.3–0.4 mm high, up to 2.5 mm high in female flowers, 2- (or occasionally 3-)locular, subglabrous; style and stigma in male flowers c. 0.1 mm high, in female flowers up to 1.2 mm high. *Fruits* 1.6–2.2 by 1–1.6 cm, inside densely hirsute with hairs up to 1.5 mm long; stipe absent to 2.5 mm high. *Seeds* 1.2–1.7 by 0.7–1.2 cm, base straight; sarcotesta covering seed almost completely except for small dorsal triangular spot; hilum 1.2–4 mm long. — **Fig. 50a, b.**

**Distribution** – *Malesia*: Along north coast of New Guinea from E Geelvink Bay (Irian Jaya) to Madang Prov. (Papua New Guinea).

**Habitat & Ecology** – Found in under- to middle storey of primary forest, secondary forest, swamp forest, and along rivers and roads. Soil: limestone, sandy clay. From sea level up to 425 m altitude. Fl. June–Nov.; fr. July–April.

**Notes** – 1. The type specimen of *L. hebecladum* (*Hollrung* 341) has always been interpreted incorrectly. This specimen is conspecific with *L. subdichotomum*. All other specimens, always identified as *L. hebecladum*, are *L. micans*.

2. *Lepidopetalum xylocarpum* strongly resembles *L. micans* in the western part of its distribution area. See note 3 under *L. micans*.

**3. *Lepidopetalum montanum*** (Blume) Radlk., Sapind. Holl.-Ind. (1879) 14; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 510, 535, 623; in Engl., Pflanzenz. 98 (1933) 1320; Welzen et al., Blumea 36 (1992) 457, f. 2b, 7. — *Arytera montana* Blume, Rumphia 3 (June 1847) 171. — *Ratonia montana* Fern.-Vill., Nov. App. (1880) 51, nom. illeg. — Type: *Korthals s.n.* (L holo), Sumatra (probably *Jughuhn* 41 in L and *de Vriese* 18 in L are the same specimen).

[*Connarus* ? *jackianus* Wall., Cat. (after 22 Oct. 1847) 8552, nom. nud.] — *Cupania jackiana* Hiern in Hook. f., Fl. Br. India 1 (1875) 678. — *Lepidopetalum jackianum* Radlk., Sapind. Holl.-



Ind. (1879) 45; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 535, 623; in Engl., Pflanzenr. 98 (1933) 1318. — Type: *Jack s.n.* (K holo; M), Nicobar Is.

*Tree*, 5–16 m high. *Flowering branchlets* 2–4 mm in diam. *Leaves* 2–4-jugate; rachis 1.9–14.7 cm long, terete, subsericeous. *Leaflets* 4.5–21 by 1.5–7.5 cm; apex acuminate, very apex rounded (Nicobar Islands) to almost acute (Sumatra). *Inflorescences* axillary to pseudoterminal, axes branching in axil or along rachis, all up to 11 cm long. *Bracts* and *bracteoles* triangular to long-triangular; bracts 0.8–2 mm long; bracteoles 0.3–1.6 mm long. *Pedicels* sericeous, upper part 1.2–6.3 mm long. *Flowers* 2.8–4.2 mm in diam. *Sepals* 5; lobes 1–2.8 by 0.8–1.4 mm, mainly outside sericeous. *Petals* 5; blade triangular, 0.6–1.2 by 0.5–1.1 mm, completely pilose; scale 0.8–1 by 0.8–1.5 mm; crests absent. *Disc* uninterrupted, 0.5–0.7 mm high, margin often revolute, higher than broad. *Stamens* 8; filaments in male flowers 1.2–3 mm long, yellow; anthers in male flowers 0.7–1.2 by 0.6–0.8 mm, pink to reddish purple. *Pistil*: ovary in male flowers 0.2–0.5 mm high, 2-locular, subglabrous; style and stigma in male flowers 0.05–0.1 mm high. *Fruits* 3.2–4.5 by 1.7–2.4 cm, inside densely hirsute with hairs 1–1.5 mm long; stipe 3–5 mm high. *Seeds* 1.9–2.2 by 1.3–1.7 cm, base oblique; sarcotesta covering seed at base, present around hilum, forming obpyramidal outgrowth below seed; hilum 7–8 mm long. — **Fig. 50f.**

Distribution — S Andaman and Nicobar Islands; *Malesia*: N Sumatra.

Habitat & Ecology — In primary forest, along rivers and roads; sea level up to 1000 m altitude. Rare to locally common. Fl. and fr. seemingly the whole year round. The seeds are eaten by *Calenas nicobarica* and other frugivorous pigeons (Prain, Proc. As. Soc. Beng. 1891, 167).

4. **Lepidopetalum perrottetii** (Cambess.) Blume. Rumphia 3 (1847) 172; Miq., Fl. Ind. Bat. 1, 2 (1859) 569; Radlk., Sapind. Holl.-Ind. (1879) 15, 46, 92; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 535, 622; Radlk. in Engl., Pflanzenr. 98 (1933) 1317; Welzen et al., Blumea 36 (1992) 458, f. 2c, 3a, 7. — *Cupania perrottetii* Cambess., Mém. Mus. Hist. Nat. Paris 18 (1829) 45. — Type: *Perrottet s.n.* (P holo; L. P), Philippines.

*Lachnopetalum glabrum* Turcz., Bull. Soc. Nat. Moscou 21 (1848) 572; Miq., Fl. Ind. Bat. 1, 2 (1859) 557. — *Ratonia lachnopetala* Turcz., Bull. Soc. Nat. Moscou 36 (1863, n.v.) 586, nom. illeg.. — Type: *Cuming 1169* (holo un-

known; iso L, M, MEL, NY, P), Philippines. *Cupania ? richii* A. Gray, U.S. Expl. Exped. Bot. 1 (1854) 257; Merr., Philipp. J. Sc., Bot. 3 (1908) 79. — Type: *U.S. Expl. Exped. s.n.* (A holo), Philippines.

*Shrub to tree*, 2–17 m high, dbh 6–25 cm. *Flowering branchlets* 3–5 mm in diam. *Leaves* 2–4-jugate; rachis 1.6–17.3 cm long, terete, (sub)sericeous. *Leaflets* 2.5–24 by 1.2–10 cm; apex acuminate, very apex (emarginate to) rounded. *Inflorescences* axillary with a tendency towards ramiflory, branching mainly in axil or along rachis, latter up to 7 cm long. *Bracts* and *bracteoles* triangular to long-triangular; bracts 1.1–2 mm long; bracteoles 0.6–1 mm long. *Pedicels* sericeous, upper part 2–8 mm long. *Flowers* c. 4 mm in diam. *Sepals* 5 (or 6); lobes 0.8–2.3 by 0.6–1.5 mm, mainly outside sericeous. *Petals* 5; blade triangular, 0.4–1 by 1–1.6 mm, completely pilose; scale 0.8–1.7 by 1.2–1.8 mm; crests absent. *Disc* uninterrupted, c. 0.4 mm high, broader than high. *Stamens* 8; filaments in male flowers 1.2–3.3 mm long, in female flowers 0.4–1.8 mm; anthers in male flowers 0.6–0.9 by 0.5–0.8 mm, in female flowers 0.4–0.7 by 0.5–0.8 mm. *Pistil*: ovary in male flowers 0.3–0.4 mm high, in female flowers 1.8–2.5 mm high, 2-locular, hirsute; style and stigma in male flowers 0.05–0.1 mm long, in female flowers 0.9–1.8 mm long. *Fruits* 1.3–2.5 by 0.8–1.6 cm, inside densely hirsute with hairs c. 0.5 mm long; stipe absent (to 2 mm high). *Seeds* 6–12 by 5–9.5 mm, base oblique; sarcotesta only around hilum, forming obpyramidal outgrowth below seed; hilum 0.8–1.1 mm long. — **Fig. 50c, d.**

Distribution — *Malesia*: Philippines (mainly E and N).

Habitat & Ecology — Found along roadsides, in secondary forest, on waste land, and along forest edges; sea level up to 1200 m altitude. Probably two flowering seasons: Jan.–Mar.(–Apr.) and May–June; fr. (Feb.–)March–June and Sept.–Nov.(–Feb.).

Note — Clinal variation exists from Mindanao to Luzon, the leaflets and fruits decrease in size.

5. **Lepidopetalum subdichotomum** Radlk. in K. Schum. & Hollr., Fl. Kais. Wilh. Land (1889) 67; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 269; Bot. Jahrb. 56 (1920) 307; in Engl., Pflanzenr. 98 (1933) 1319; S.T. Reynolds in Fl. Austral. 25 (1985) 87, f. 16, 21k, map 111; Welzen et al., Blumea 36 (1992) 460, f. 1, 2d, 7. — Type: *Hollrung 387* (B† holo; K, L, M, MEL, P). Papua New Guinea, Kaiser Wilhelmsland, Hatzfeldhafen.



Fig. 51. *Lepidopetalum subdichotomum* Radlk. a. Habit; b. hairtuft domatia; c. male flower; d. petal with scale from outside; e. female flower after pollination (a–d: Schodde & Craven 4092; e: BSIP 14557).

*Lepidopetalum hebecladum* Radlk. in K. Schum. & Hollr., Fl. Kais. Wilh. Land (1889) 67; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 269; Bot. Jahrb. 56 (1920) 307; in Engl., Pflanzenz. 98 (1933) 1319. — All references only include the type: *Hollrung 341* (B† holo; K. P.), Papua New Guinea, Kaiser Wilhelm Island, Hatzfeldhafen. See note 1.

*Tree*, 3–20 m high, girth 15 cm to 1 m; outer bark light to dark brown to grey, smooth to slightly fissured to scaly, soft, inner bark pinkish to middle brown; wood white to reddish brown, (soft to) hard. *Flowering branchlets* 2–4 mm in diam. *Leaves* 3- or 4-jugate; rachis 4–15.2 cm long, terete, subsericeous. *Leaflets* 3.6–19 by 1.3–8.5 cm; apex acuminate, very apex rounded. *Inflorescences* axillary to pseudoterminal, mainly branching along rachis, sometimes also in axil, rachis up to 17 cm long. *Bracts* and *bracteoles* triangular to at least a few obovate to leaf-like; bracts 1–3.3 mm long; bracteoles 0.4–0.7 mm long. *Pedicels* subglabrous, upper part 1.3 (flower)–12 (fruit) mm long, glabrous except for some glandular hairs. *Flowers* 3–5.5 mm in diam., fragrant. *Sepals* 5; lobes 0.8–2.3 by 0.8–1.6 mm, only margin subpilose. *Petals* 5; blade 0.7–1.6 by 0.8–1.6 mm, mainly margin subpilose; scale 0.5–1.3 by 1.1–2.5 mm; crest absent to well developed central ribs to 2 small appendages. *Disc* uninterrupted, 0.5–0.8 mm high, as high as broad. *Stamens* 8 or at least in some flowers 9; filaments in male flowers 2.2–2.7 mm long, in female flowers 0.8–1.7 mm long; anthers 0.7–1.2 by 0.6–1 mm. *Pistil*: ovary in male flowers 0.4–0.5 mm high, up to 2.5 mm high in female flowers, 2- (or 3-)locular, subglabrous; style and stigma in male flowers c. 0.1 mm high, in female flowers up to 1.3 mm high. *Fruits* 1.6–3.1 by 1–2.5 cm, inside densely hirsute with hairs 0.5–0.8 mm short; stipe 1–6 mm high. *Seeds* 1.3–1.7 by 0.9–1.1 cm, base straight; sarcotesta only around hilum, forming slight obpyramidal outgrowth below seed; hilum c. 1.5 mm long. — **Figs. 50e, 51.**

*Distribution* — Solomon Islands to *Malesia*: New Guinea (Irian Jaya): Jayapura; Papua New Guinea: W Sepik to Morobe Provinces, New Britain, New Ireland, Bougainville).

*Habitat & Ecology* — Found mainly in secondary forest, also in primary forest, littoral forest, and grassland. At least found on sandy clay. Occasionally common. From sea level up to 330 m altitude. Fl. and fr. throughout the year.

*Uses* — Wood is used in house construction (Bougainville).

*Notes* — 1. *Lepidopetalum hebecladum* has al-

ways been wrongly interpreted. The type specimen is conspecific with *L. subdichotomum*, while all other specimens have to be included in *L. micans*.

2. A geographical cline exists, the eastern specimens (Solomon Islands) have larger fruits than the western ones (New Guinea).

**6. *Lepidopetalum xylocarpum*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 269; Bot. Jahrb. 56 (1920) 307; in Engl., Pflanzenz. 98 (1933) 1319; Welzen et al., *Blumea* 36 (1992) 461, f. 3b, 7. — Lectotype (Van Welzen 1992): *Forbes 379* (M holo; BM, MEL), Papua New Guinea, base of Owen Stanley's Ranges, Sogerri region.

*Tree*, 4–22 m high; dbh 5–25 cm; (complex many-footed buttress system); outer bark blotched pale green and greyish to grey-brown to dark brown with many round pustular lenticels, inner bark straw to pinkish brown, shortly fibred; wood straw, turning pale redbrown to centre, moderately hard and heavy, splits very readily, tendency to rings. *Flowering branchlets* 1–3 mm in diam. *Leaves* 2–4-jugate; rachis 1.7–16 cm long, flat above, especially upper side sericeous. *Leaflets* 3–22.5 by 1.5–7.5 cm; apex (slightly) acuminate (to cuspidate), very apex emarginate to rounded (to mucronulate); above often glaucous when dry. *Inflorescences* usually ramiflorous on thin twigs to axillary to pseudoterminal, at most branching along rachis, latter up to 8.5 cm long. *Bracts* and *bracteoles* triangular; bracts 0.7–1.3 mm long, broad; bracteoles 0.4–0.5 mm long. *Pedicels* (sub)glabrous except for glandular hairs to puberulous, upper part 2.3 (flower)–9 (fruit) mm long. *Flowers* 3.5–5 mm in diam. *Sepals* 5 (see note 1); lobes 1.2–2.9 by 1–2.2 mm, margin and outside pilose. *Petals* 5 (see note 1); blade 0.5–2.2 by 0.7–2 mm, margin pilose, outside subglabrous; scale (divided into two) 0.4–1.3 by 1–2 mm; crest absent (to central ribs). *Disc* often with slits, usually 5-lobed, flat, 0.3–0.5 mm high, usually broader than high to as broad as high, pale green to yellow. *Stamens* 8(–10; see note 1); filaments white, in male flowers 1.8–3.3 mm long, in female flowers 0.7–1.6 mm long; anthers 0.7–1.3 by 0.4–1.2 mm, brown. *Pistil*: ovary in male flowers c. 0.4 mm high, up to 2.5 mm high in female flowers, 2- (or 3-)locular, subglabrous to pilose; style and stigma in male flowers up to 0.1 mm high, in female flowers up to 1.5 mm high. *Fruits* 1.7–3.6 by 1.2–2 cm, inside densely hirsute with hairs c. 0.5 mm short; stipe absent to 7 mm high. *Seeds* 1–1.9 by 0.7–1.1 cm, base straight; sarcotesta covering seed for greater part except for dorsal side; hilum 3–5.5 mm long. — **Fig. 50g.**



Distribution — NE Australia to *Malesia*: New Guinea (Irian Jaya: Vogelkop, Fakfak, Mimika, Digul; Papua New Guinea: Western, Gulf, Central, Milne Bay, and Northern Provinces). See also notes 2 and 3.

Habitat & Ecology — Growing in understorey of primary, secondary, lower montane, and gallery forest, and along rivers. Soil: alluvial, lava, limestone, loam. From sea level up to 700 m altitude. Fl. Sept.–Apr.; fr. Jan.–Aug.(–Nov.).

Uses — In the Vogelkop the wood is used to start fires (*BW (Moll) 12782*).

Notes — 1. Flowers, usually male, at the end of an inflorescence often show aberrant numbers of sepals (6), petals (6 or 7), and anthers (9 or 10).

2. There is geographical variation, with the eastern specimens having larger fruits than the western ones.

3. Specimens from the western part of the distribution area (*Aet 287, Bauerlen 449, bb 32673, BW 12782, Everill 449, Jacobs 9132, 9200, NGF 35311, and Versteeg 1356*) strongly resemble *L. micans*. The fruits are almost similar in shape, the only differences being the short hairs inside the fruit and the sarcotesta which does not cover the dorsal side of the seeds (in *L. micans* the hairs are long and the sarcotesta almost completely covers the seed except for a small dorsal triangle). Flowering specimens can be separated only if the pedicel is glabrous (it is always pilose in *L. micans*).

## LEPISANTHES

(P.W. Leenhouts)

- Lepisanthes* Blume, *Bijdr.* (1825) 237; Radlk. in *Engl., Pflanzenr.* 98 (1932) 726; Leenh., *Blumea* 17 (1969) 33–91. — *Lepisanthes* Blume sect. *Eulepisanthes* Radlk., *Sapind. Holl.-Ind.* (1879) 34, nom. illeg. — *Lepisanthes* Blume subg. & sect. *Lepisanthes* — Type species: *Lepisanthes montana* Blume [= *Lepisanthes tetraphylla* (Vahl) Radlk.].
- Erioglossum* Blume, *Bijdr.* (1825) 229; Radlk. in *Engl., Pflanzenr.* 98 (1932) 692. — *Lepisanthes* subg. *Erioglossum* (Blume) Leenh., *Blumea* 17 (1969) 60, 81. — Type species: *Erioglossum edule* Blume [= *Lepisanthes rubiginosa* (Roxb.) Leenh.].
- Aphania* Blume, *Bijdr.* (1825) 236; Radlk. in *Engl., Pflanzenr.* 98 (1932) 699. — *Aphania* Blume sect. *Euaphania* Radlk., *Sapind. Holl.-Ind.* (1879) 69, nom. illeg. — *Lepisanthes* Blume subg. *Aphania* (Blume) Leenh., *Blumea* 17 (1969) 60, 83. — Type species: *Aphania montana* Blume [= *Lepisanthes senegalensis* (Poir.) Leenh.].
- Otophora* Blume, *Rumphia* 3 (1847) 142; Radlk. in *Engl., Pflanzenr.* 98 (1932) 753. — *Otophora* Blume sect. *Euotophora* Radlk., *Sapind. Holl.-Ind.* (1879) 86, nom. illeg. — *Otolepis* Turcz. sect. *Otophora* (Blume) Kuntze in Post & Kuntze, *Lex. Phan.* (1903) 408. — *Lepisanthes* Blume subg. *Otophora* (Blume) Leenh., *Blumea* 17 (1969) 62, 70. — *Lepisanthes* Blume sect. *Otophora* (Blume) Leenh., *Blumea* 17 (1969) 71. — Lectotype species (Leenhouts 1969): *Otophora amoena* Blume [= *Lepisanthes amoena* (Blume) Leenh.].
- Otophora* Blume subg. or sect. *Pseudophora* Blume, *Rumphia* 3 (1847) 142, nom. inval. — *Otophora* Blume sect. *Pseudotophora* Radlk., *Sapind. Holl.-Ind.* (1879) 85. — *Otolepis* Turcz. sect. *Pseudotophora* (Radlk.) Kuntze in Post & Kuntze, *Lex. Phan.* (1903) 408, nom. illeg. — *Lepisanthes* Blume sect. *Pseudotophora* (Radlk.) Leenh., *Blumea* 17 (1969) 75. — Lectotype species (Leenhouts 1969): *Otophora fruticosa* Blume [= *Lepisanthes fruticosa* (Blume) Leenh.].
- Otolepis* Turcz., *Bull. Soc. Nat. Mosc.* 21 (1848) 572. — Type species: *Otolepis nigrescens* Turcz. (= *Lepisanthes fruticosa* (Blume) Leenh.).
- Hebecoccus* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 246; in *Engl., Pflanzenr.* 98 (1932) 719. — *Lepisanthes* Blume sect. *Hebecoc-*

*cus* (Radlk.) Leenh., *Blumea* 17 (1969) 60, 67. — Type species: *Hebecoccus ferrugineus* Radlk. [= *Lepisanthes ferruginea* (Radlk.) Leenh.].

*Otophora* Blume sect. *Anomotophora* Radlk., *Sapind. Holl.-Ind.* (1879) 85. — *Otolepis* Turcz. sect. *Anomotophora* (Radlk.) Kuntze in Post & Kuntze, *Lex. Phan.* (1903) 408. — *Lepisanthes* Blume sect. *Anomotophora* (Radlk.) Leenh., *Blumea* 17 (1969) 79. — Type species: *Otophora ramiflora* Radlk. [= *Lepisanthes ramiflora* (Radlk.) Leenh.]. For a more complete list of synonyms and references, see Leenhouts (1969).

*Trees* or *shrubs*, exceptionally lianas; mostly monoecious. *Indumentum* of solitary, simple hairs; no glandular scales. *Leaves* spirally arranged, pari- or imparipinnate, sometimes simple, 1- to more than 40-jugate, petiole and/or rachis winged or not, with or without pseudo-stipules. *Leaflets* opposite or alternate, not papillose beneath, margin entire. *Inflorescences* terminal, axillary, rami-, or cauliflorous, rarely sticky. *Flowers* unisexual, actinomorphic. *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, without appendage. *Stamens* mostly c. 8 (4–18), in male flowers not to distinctly exerted; filaments nearly always hairy mostly either the base or the apex excepted; anthers hairy or glabrous. *Ovary* sessile to short-stipitate, lobed or not, 2- or 3(–4)-celled: style apical, about as long as the ovary or stigma sessile; stigma globular or dome-shaped, slightly lobed. *Ovules* 1 per cell, subbasal to median, placenta with an obturator. *Fruits* sessile to short-stipitate, not to distinctly lobed, drupaceous: outside smooth (or slightly warty), hairy to glabrous; pericarp thin- (or thick-)fleshy, inside hairy or glabrous; septa mostly complete, sometimes interrupted or represented merely by a rib. *Seeds* with a shining brown to black, glabrous or sometimes hairy testa; without arillode or sarcotesta; hilum basal, small. — **Figs. 52–56.**

**Distribution** — 24 species in tropical Africa, Madagascar, S and SE Asia from Sri Lanka to Hainan, *Malesia*, and NW Australia.

**Habitat & Ecology** — Mainly under everwet, sometimes also (or even mainly) in seasonal conditions. Most species are treelets or shrubs (or trees up to 20 m high) of the middle and lower storeys of primary and secondary forests, probably especially on open places, escarpments, steep slopes, river banks, forest edges, clearings, etc., and of more open secondary vegetations; altitude from sea level to c. 2000 m.

The flowers have either a greenish calyx and creamy to white petals longer than the calyx, or (subg. *Otophora* and *Aphania*) a pinkish to red calyx not exceeded by the petals. They are small but are aggregated in small to large inflorescences, and are sweet-scented, and are probably pollinated by insects. The fruits of at least those species with a fleshy pericarp will be dispersed by animals.

**Taxonomy** — Several genera were combined into *Lepisanthes* by Leenhouts (l.c.). He subdivided the genus as follows (in brackets the number of species in *Malesia*):

Subgenus *Lepisanthes*

Section *Lepisanthes* (1)

Section *Hebecoccus* (2)





- b. Fruits not or slightly, rarely distinctly lobed, lobes  $\pm$  erect . . . . . 14
- 12a. Leaves imparipinnate. Fruits 3-lobed . . . . . 13
- b. Leaves paripinnate. Fruits nearly always 2-lobed . . . . . **16. L. senegalensis**
- 13a. Leaves 7–14-jugate. Twigs up to 1 cm in diam., tomentose . . . . . **6. L. kinabaluensis**
- b. Leaves (15–)30–40-jugate. Twigs 1.5–2 cm in diam., glabrous . . . . . **7. L. multijuga**
- 14a. Leaflets with pitted warts looking like small white scales. Leaves mostly imparipinnate, (3–)7–42-jugate. Inflorescences terminal and axillary . . . . . 15
- b. Leaflets densely finely pitted underneath. Leaves paripinnate or with a reduced terminal leaflet, 1–8(–14)-jugate. Inflorescences rarely terminal . . . . . 16
- 15a. Nervation open . . . . . **4. L. amoena**
- b. Nervation closed . . . . . **5. L. divaricata**
- 16a. Inflorescence and sepals densely hairy . . . . . **8. L. bengalan**
- b. Inflorescence and sepals glabrous . . . . . **9. L. fruticosa**

### Subgenus *Lepisanthes*

*Lepisanthes* Blume — For a complete synonymy see Leenhouts (1969: 62).

*Leaves* paripinnate, petiole and rachis not winged, without (outside Malesia exceptionally with) pseudo-stipules. *Leaflets* opposite to alternate, nervation open to closed. Outer *sepals* sericeous outside. *Petals* longer than sepals, outside at least partly sericeous, scale crested or not. *Disc* glabrous or hairy. *Stamens* (4–)8(–18); filaments longer than anthers. *Ovary* 2- or 3-celled, densely hairy to subglabrous. *Fruits* slightly, rarely distinctly lobed, densely hairy, rarely glabrous, septa never interrupted.

Distribution — S and SE Asia from Sri Lanka to Hainan, and *Malesia*.

### Section *Lepisanthes*

*Lepisanthes* Blume — *Lepisanthes* Blume sect. *Eulepisanthes* Radlk. — For a complete synonymy see Leenhouts (1969: 62).

*Shrubs* or *trees*. *Leaves* glabrous or at least petiole, rachis, and petiolules hairy. *Leaflets* without glandular-pitted warts, apex not mucronulate, midrib sunken to prominulous above, rounded to angular beneath. *Inflorescences* mostly axillary or rami- to cauliflorous, rarely terminal, solitary or fascicled, simple or (mostly sparsely) branched. *Petal scales* mostly crested. *Fruits* smooth or sometimes warty, outside densely hairy (to glabrous), pericarp thin, inside hairy or glabrous.

Distribution — As the subgenus; two species, one of which (*L. andamanica*) endemic in the Andaman Islands.

**1. *Lepisanthes tetraphylla*** (Vahl) Radlk., Sitzungsber. Math.Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 276; Ridley, Fl. Malay Penins. 5 (1925) 301; Craib, Fl. Siam. Enum. 1 (1926) 327; Radlk. in Engl., Pflanzenr. 98 (1932) 743, f. 15; Gagnep. in Fl. Indo-Chine, Suppl.1 (1950) 947; Leenh., Blumea 17 (1969)

39, 63. — *Sapindus tetraphylla* Vahl, Symb. 3 (1794) 54. — Type: *Koenig s.n.* (herb. Vahl, C), India.

*Lepisanthes montana* Blume, Bijdr. (1825) 238; Hiern in Hook. f., Fl. Br. India 1 (1875) 679; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 165; Atlas 1 (1913) t. 131; Radlk. in Engl.,

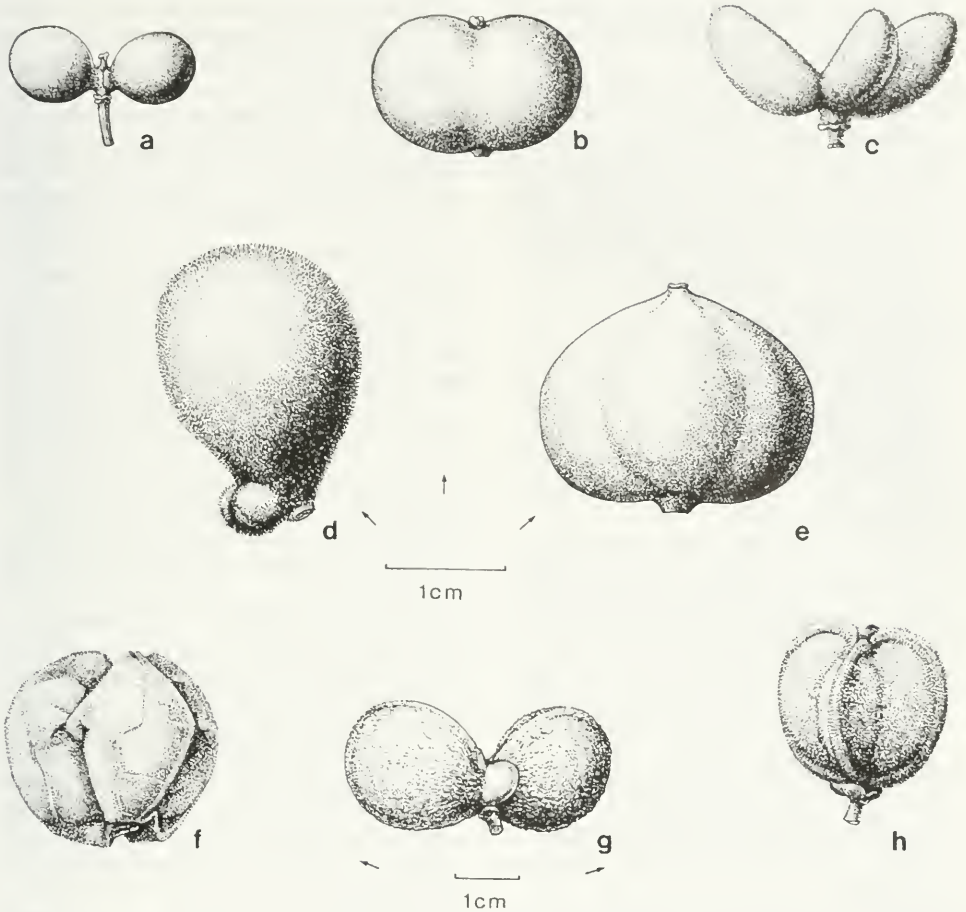


Fig. 52. *Lepisanthes* Blume. Fruits. — a. *L. senegalensis* (Poir.) Leenh. — b. *L. fruticosa* (Roxb.) Leenh. — c. *L. rubiginosa* (Roxb.) Leenh. — d. *L. ferruginea* (Radlk.) Leenh. — e. *L. alata* (Blume) Leenh. — f. *L. falcata* (Radlk.) Leenh. subsp. *borneensis* (Leenh.) Leenh. — g. *L. multijuga* (Hook. f.) Leenh. — h. *L. tetraphylla* (Vahl) Radlk. (a: *Kostermans* 60; b: *Nooteboom* 1323; c: *Kartawinata* 683; d: *SFN* 21731; e: *S* 40142; f: *SMHI* 618 (*Podzorski*); g: *Kokawa & Hotta* 2329; h: *SAN* 25591).

Pflanzenr. 98 (1932) 732; Adelb., *Blumea* 6 (1948) 323; Backer & Bakh. f., *Fl. Java* 2 (1965) 135. — Type: *Blume* 676 (L), W Java.  
*Lepisanthes sessiliflora* Blume, *Rumphia* 3 (1847) 153; Boerl., *Handl.* 1 (1890) 271 ('*sessilifolia*'); Radlk. in Engl., *Pflanzenr.* 98 (1932) 734. — Type: *Blume* 3100 (L), W Java.  
*Lepisanthes angustifolia* Blume, *Rumphia* 3 (1847) 154; Radlk. in Engl., *Pflanzenr.* 98 (1932) 735; Adelb., *Blumea* 6 (1948) 323. — Type: *Korthals s.n.* (L), W Java.  
*Hemigyrosa longifolia* Hiern in Hook. f., *Fl. Br. Ind.* 1 (1875) 671. — *Lepisanthes longifolia* (Hiern) Radlk., *Sitzungsber. Math.-Phys. Cl.*

*Königl. Bayer. Akad. Wiss. München* 8 (1878) 276; Ridley, *Fl. Malay Penins.* 1 (1922) 494; Radlk. in Engl., *Pflanzenr.* 98 (1932) 749. — *Anomosantes longifolia* (Hiern) Pierre, *Fl. Coch.* (1895) t. 327 text. — Syntypes: *Griffith KD 994* (M), *Maingay KD 446* (L, M), both Malay Peninsula.  
*Lepisanthes cuneata* Hiern in Hook. f., *Fl. Br. India* 1 (1875) 680; Ridley, *Fl. Malay Penins.* 1 (1922) 493; Radlk. in Engl., *Pflanzenr.* 98 (1932) 737. — Type: *Porter s.n.* (M), Malay Peninsula.  
*Lepisanthes eriolepis* Radlk., *Sapind. Holl.-Ind.* (1879) 36; Merr., *Enum. Philipp. Flow. Pl.* 2

- (1923) 500; Radlk. in Engl., Pflanz. 98 (1932) 738. — Type: *Cuming* 785 (A, Fl. K, M), Philippines, Luzon.
- Lepisanthes schizolepis* Radlk., Sapind. Holl.-Ind. (1879) 87, in Perkins, Fragm. Fl. Philipp. 1 (1904) 60; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 500; Radlk. in Engl., Pflanz. 98 (1932) 739. — *Lepisanthes schizolepis* Radlk. f. *genuina* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 60, nom. illeg.; in Engl., Pflanz. 98 (1932) 740. — Type: *Barthe s.n.* (M, P), Philippines, Luzon.
- Ostodes appendiculata* Hook. f., Fl. Br. India 5 (1887) 401. — *Lepisanthes kunstleri* King, J. As. Soc. Beng. 65, II (1896) 427, nom. illeg.; Ridley, Fl. Malay Penins. 1 (1922) 493; Radlk. in Engl., Pflanz. 98 (1932) 746. — *Lepisanthes appendiculata* (Hook. f.) Symington, Kew Bull. (1937) 320. — Type: *King's coll.* 4634 (K), Malay Peninsula.
- Lepisanthes scortechinii* King, J. As. Soc. Beng. 65, II (1896) 429; Ridley, Fl. Malay Penins. 1 (1922) 493; Radlk. in Engl., Pflanz. 98 (1932) 750. — Type: *Scortechinii* 2090 (CAL, K, M), Malay Peninsula.
- Lepisanthes blumeana* Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 168; Adelb., Blumea 6 (1948) 323; Backer & Bakh. f., Fl. Java 2 (1965) 135. — Type: *Koorders* 7406 (L, M), W Java.
- Lepisanthes viridis* Radlk., Philipp. J. Sc., Bot. 8 (1914) 454; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 500; Radlk. in Engl., Pflanz. 98 (1932) 735. — Type: *FB 9266* (M), Philippines, Mindanao.
- Lepisanthes acutissima* Radlk., Philipp. J. Sc. 20 (1922) 675; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 499; Radlk. in Engl., Pflanz. 98 (1932) 737. — Type: *Merrill* 9564 (M), Philippines, Palawan.
- Lepisanthes macrocarpa* Radlk., Philipp. J. Sc. 20 (1922) 657; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 500; Radlk. in Engl., Pflanz. 98 (1932) 738. — Type: *BS 19460* (M), Philippines, Luzon.
- Aglaiia chartacea* Kosterm., Reinwardtia 7 (1966) 261, f. 14. — Type: *Van Steenis* 6455 (BO), Sumatra.
- For a more complete list of synonyms and references, see Leenhouts (1969).
- Mostly a *shrub* or *treelet*, sometimes a *tree* up to 22.5 m high, dbh up to 60 cm. *Twigs* terete (to angular), up to 2.5 cm in diam., glabrous or variably fulvous to ferruginous hairy, mostly early glabrescent, usually at first dark (purplish) brown, later on often greyish brown, mostly conspicuously lenticellate. *Leaves* 2–10-jugate, axial parts glabrous or variably hairy; petioles 5–50 cm long; petiolules 2–25 mm. *Leaflets* lanceolate to elliptic, ovate to obovate, 7–55 by 2–10(–20) cm, chartaceous (pergammentaceous), glabrous or variably hairy; base slightly (or strongly) oblique to equal-sided, acute to rounded (or subcordate); apex tapering to abruptly acuminate, acumen short to long, obtuse to acute; nerves variable, at least the upper ones (rarely all) looped and joined or exceptionally connected by an intramarginal vein, above prominulous or sometimes sunken, beneath prominulous to prominent, intercalary veins variable, veins and veinlets finely reticulate. *Inflorescences* 2–70 cm long, variably, mostly shortly and densely hairy, hardly to long peduncled, the main branches often racemous; cymes patent, sessile or up to 0.5 cm long stalked, up to c. 7-flowered; bracts ovate-lanceolate to subulate, up to 5 mm long, rarely ovate and up to 7 by 6 mm; pedicels up to 6 mm. *Flowers* white, sometimes greenish white, cream, or pink, sweet-scented. *Sepals*: outer ovate to suborbicular, 1.2–7 by 1.2–6 mm, densely (sometimes partly glandular-)ciliate, inside glabrous (to sparsely hairy); inner 3 elliptic to orbicular, ovate to obovate, 2.2–6.2 by 1.8–6 mm, margin mostly narrow (to broad) petaloid, outside glabrous, crenulate to fimbriate-denticulate, indument otherwise like outer sepals. *Petals* 2.2–10 mm long, claw 0.5–2(–4) mm long, blade elliptic to oblong to ovate, 1.2–4 mm wide, more or less dentate in the upper part, outside mostly up to 2/3 sericeous, rarely subglabrous, margin glabrous or below insertion of scale sparsely to densely woolly-ciliate, rarely rest of the blade (partly glandular-)ciliate, inside glabrous or the claw (rarely also the base of the blade) sparsely hairy; scale mostly well-developed (rarely a hairy rim only), entire to deeply 2–4-lobed, glabrous, ciliate, or inside sparsely to densely woolly, without or more often with a crest which may vary from a small wart (then often present only in some of the petals of a flower) to a deeply bilobed duplication of the scale or to 2 brushes. *Stamens*: filaments 1.5–6.5 mm, sparsely to densely woolly, mostly mainly in the upper, rarely in the lower half; anthers (broad-)elliptic to oblong, ovate to obovate, 0.8–2.5 mm, connective broad and obtuse (rarely narrow and/or pointed), woolly to glabrous. *Ovary* and lower part of style densely hairy (to subglabrous). *Fruits* green when young, later yellowish, grey, or greyish pink (ripe?), flattened ellipsoid, shortly obovoid, or subglobose, slightly lobed, the lobes rarely carinate, 1.5–5 cm in diam. *Seeds* brown, testa papery, probably partly fleshy when fresh. — **Fig. 52h.**
- Distribution — SE Asia from Sri Lanka and the Deccan Peninsula to Hainan; *Malesia*: Sumatra,



Malay Peninsula, Borneo, Java (western half only, incl. also Nusa Kambangan), Philippines, N Celebes (one collection), Timor, and New Guinea.

**Habitat & Ecology** — Understorey of primary and secondary forests, also along forest edges, on river banks, and in more open country, as well on dry land as in swampy localities or periodically inundated places, or even in streams, on all kinds of soils; up to 1200 m altitude. Fl. Jan.–Dec.; fr. Nov.–July.

**Uses** — The wood of some forms is heavy, hard, and close-grained, and good for furniture and for turning. One specimen from the Malay Peninsula was said to be used in the preparation of dart poison. See also Burkill, *Dict. Econ. Pl. Malay Penins.* (1935) 1332, sub *L. kunstleri*.

**Chromosomes** —  $2n = 26$ : Sarkar et al. in Löve, *Taxon* 26 (1976) 636, 649.

**Notes** — 1. *Lepisanthes tetraphylla* is closest to *L. andamanica* King (S Andaman) which differs only by the shifting of the lower pair of leaflets to the very base of the leaf, simulating a pair of stipules.

2. *Lepisanthes tetraphylla* in the sense accepted here is a very polymorphous species. An extensive survey of the many forms distinguishable on a local scale can be found in Leenhouts, *Blumea* 17 (1969) 39–52. In some parts of the area (Malay Peninsula, Philippines) most of the specimens can easily be placed in distinct forms, in other parts the limits are vague, and in some parts (Borneo, Sumatra) new collections may not match any of the forms provisionally distinguished. Some of the

more important local forms are:

Malay Peninsula: '*longifolia*': large leaflets (18–38 by 5.5–9 cm); large (c. 8 mm long) ferruginous-hairy flowers; and warty fruits. — '*race 21*': indumentum of dense, short, patent, soft hairs intermingled with c. 5 mm long, stiff, irritating hairs; drooping catkin-like inflorescences with broad-ovate, large (5 by 5–6 mm) bracts. — '*hirta*': indumentum beautiful reddish, yellowish, or greyish brown velvety; large (19–39 by 7–17 cm) leaflets, with many straight nerves, hispid all over the lower surface, the hairs being on minute warts; and relatively large (4 by 4 mm) broad-ovate bracts. — '*cuneata*': glabrous twigs; sepals not petaloid; ovary 2-celled. — '*montana*' like '*cuneata*', but with midrib sunken above and ovary 3-celled.

Sumatra: '*lamponga*' is the predominant form, much resembling '*montana*' but usually with 4 petals, an interrupted disc and densely hairy seeds. — '*cuneata*' (but with 3-celled ovary) and '*hirta*' are known from the E Coast, '*montana*' from Palembang.

Java: '*montana*' but lacking any crest to the petal scale. — '*heterolepis*' like '*montana*', but with at least some of the petal scales ± crested. (The delimitation between these two forms is highly artificial.)

Timor: All material from Timor represents '*pal-lens*'.

Borneo: The main forms from Borneo are '*montana*' and '*heterolepis*'.

Philippines: The predominant form is '*schizolepis*'.

## Section Hebecoccus

*Lepisanthes* sect. *Hebecoccus* (Radlk.) Leenh., *Blumea* 17 (1969) 60, 67 (see there for complete synonymy). — *Hebecoccus* Radlk.

**Trees.** *Leaves* glabrous. *Leaflets* mostly with scattered glandular-pitted warts on both surfaces, apex mucronulate, midrib prominulous above, rounded beneath. *Inflorescences* in Malesian species terminal and in the upper leaf axils, spreadingly but sparsely branched. *Petals* 5, scale in Malesian species not crested. *Disc* entire. *Fruits* not or slightly lobed, smooth but with thick, fleshy pericarp which is more or less strongly wrinkled when dry, outside thinly to densely hairy, inside glabrous. *Seeds* glabrous.

**Distribution** — 5 species, 3 in continental Asia from Sri Lanka to Indo-China, the other 2 in *Malesia*.

2. *Lepisanthes falcata* (Radlk.) Leenh., *Blumea* 17 (1969) 69. — *Hebecoccus falcatus* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 453; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 499; Radlk. in Engl.,

*Pflanzenr.* 98 (1932) 721. — Lectotype (Leenhouts 1969): *FB 12631* (L, M), Philippines, Leyte.

*Hebecoccus inaequalis* Radlk., *Philipp. J. Sc., Bot.*

8 (1914) 453; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 499; Radlk. in Engl., Pflanz. 98 (1932) 721. — Type: *FB 6459* (L. M), Philippines, Cebu.

*Lepisanthes aphanococca* Leenh., *Blumea* 17 (1969) 67. — *Aphanococcus celebicus* Radlk. in Durand, Ind. Gen. (1888) 74; in Engl., Pflanz. 98 (1932) 723. — Type: *Riedel s.n.* (K. M), Celebes.

*Lepisanthes borneensis* Leenh., *Blumea* 17 (1969) 68. — Type: *Chew, Corner & Stainton RSNB 2936* (BO, L, SAR), Sabah.

*Tree*, up to 22 m high, dbh up to 40 cm. *Branchlets* terete, 1–1.5 cm in diam., greyish or silvery brown, when young sparsely yellowish brown tomentose to glabrous. *Leaves* 4–10-jugate; petiole terete to slightly flattened above, swollen at base, 7–25 cm, light yellowish green; petiolules grooved above, swollen, 4–15 mm. *Leaflets* subopposite to alternate, elliptic to ovate or oblong to lanceolate, widest at or below the middle, not or slightly falcate, 10–28 by 3–10 cm, index 2–3.5, thin- to stiff-chartaceous, shining bright green above, dull green beneath, glandular-pitted warts rather numerous on both sides or scattered on lower surface only; base equal-sided to oblique, acute to rounded and attenuate, or subcordate; apex acute to tapering acuminate; nerves c. 15 per side, 1.5–3 cm apart, angle to midrib 60–85° spreading, slightly to more curved, looped and joined at some distance from the margin or not, some intercalary veins sometimes as strongly developed as the nerves. *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; bracts narrowly triangular, c. 3 mm long; pedicels c. 1 mm. *Sepals* ovate to obovate to suborbicular, 3–4.5 by 2–4.5 mm. *Petals* 4–7 mm long, claw 0.75–2.5 mm long, blade elliptic to suborbicular, 2.3–5 mm long, outside claw and base of blade glabrous or sericeous, claw (and basal 1/5 of the blade) densely long-ciliate, inside glabrous or claw sparsely hairy; scale short and broad, entire, bilobed, or 3-dentate, densely bearded. *Stamens*: filaments 2–3 mm; anthers ovate, 1–1.5 mm. *Fruits* not or 3-lobed, often only 1 part developed, but sterile cells not visible, 1.8–2.5 by 1.8–3.5 cm, outside densely shortly brown velvety, corrugated. *Seeds* globular-obovoid, 15 by 8–10 mm, hilum basal, small, circular.

*Distribution* — *Malesia*: Borneo, Philippines, Celebes.

*Habitat & Ecology* — Primary mountain forests, rocky banks of streams, forested steep slopes and ridges; altitude 60–1500 m. Fl. Nov.; fr. Mar.

#### KEY TO THE SUBSPECIES

- 1a. All nerves looped and joined . . . . . 2  
 b. Only the nerves in the upper 1/3–1/4 of the leaflet distinctly looped and joined

b. subsp. **borneensis**

- 2a. Leaflets c. 25 by 7 cm, not falcate, base not oblique . . . . . c. subsp. **celebica**

- b. Leaflets up to 16 by 6 cm, slightly falcate, base oblique . . . . . a. subsp. **falcata**

#### a. subsp. **falcata**

*Leaves* 6–10-jugate. *Leaflets* 10–22 by 3–7 cm, slightly falcate, nervation closed, nerves looped and joined at some distance from the margin, many glandular-pitted warts on both sides. *Fruits* not lobed, usually only 1 part developed, c. 2 by 1.8 cm, wrinkled.

*Distribution* — *Malesia*: Philippines (Palawan, Luzon, Leyte, Cebu).

*Habitat & Ecology* — Forested slopes and ridges; altitude up to 320 m. Fl. Nov.; fr. Mar.

*Uses* — Good timber.

#### b. subsp. **borneensis** (Leenh.) Leenh., *Blumea* 18 (1970) 429. — *Lepisanthes borneensis* Leenh.

*Leaves* 4–6-jugate. *Leaflets* 14–28 by 4–10 cm, not or slightly falcate, glandular-pitted warts scattered on lower surface, base equal-sided or oblique, nervation mostly open, only the nerves in the upper 1/3–1/4 distinctly looped and joined at several mm from the margin. *Fruits* slightly 3-lobed, c. 2.5 by 3.5 cm, not rarely 1 or 2 cells not developed, finely wrinkled. — **Fig. 52f**.

*Distribution* — *Malesia*: Borneo, Philippines (Palawan).

*Habitat & Ecology* — Primary mountain forests and on rocky banks of streams; altitude 60–1500 m. Fl. Mar., June, Sept., Nov.; fr. Mar., May.

#### c. subsp. **celebica** (Radlk.) Leenh., *Blumea* 18 (1970) 429. — *Aphanococcus celebicus* Radlk. in Durand — *Lepisanthes aphanococca* Leenh.

*Leaves* at least 3-jugate (only upper part of leaf known). *Leaflets* 25–27 by 7–7.5 cm, not falcate, base not oblique, nervation closed, nerves looped and joined at some distance from the margin. *Fruits* not lobed, c. 1.8 by 2 cm, minutely wrinkled.

*Distribution* — *Malesia*: Celebes (once collected: Gorontalo).

*Habitat & Ecology* — Fr. June.

#### 3. *Lepisanthes ferruginea* (Radlk.) Leenh., *Blumea* 17 (1969) 69. — *Hebecoccus ferrugineus*

Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 301; Sapind. Holl.-Ind. (1879) 19, 22, 56, 68; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 162; Backer, Schooffl. Java (1911) 262; Koord. & Valetton, Atlas (1913) f. 134; Radlk. in Engl., Pflanzenr. 98 (1932) 720; Backer & Bakh. f., Fl. Java 2 (1965) 134. — Type: *Zollinger 3459* (Fl, L), Java.

*Sapindus laurifolia* auct. non Vahl: Teijsm. & Binn., Cat. Hort. Bog. (1866) 215, p.p.

*Tree*, up to 20 m high, dbh up to 60 cm. *Branchlets* terete, 6 mm in diam., slightly ribbed, greyish to yellowish brown, when young rather densely minutely hairy, glabrescent. *Leaves* (1–)2(–3)-jugate; petiole slightly flattened above, rounded beneath, swollen at base, 5–9 cm long; petiolules deeply sulcate above, slightly swollen, 3–5(–9) mm. *Leaflets* mostly opposite, oblong-ovate to oblong to lanceolate, 10–20 by 4–7.5 cm, chartaceous, brownish to greenish above, greenish beneath, glandular-pitted warts very scarce; base equal-sided, obtuse to acute; apex slightly tapering acuminate, acute to obtuse; nerves 1–3 cm apart, angle to midrib 45–80°, usually slightly curved, looped and joined at some distance from the margin, sometimes straight and not joined but for the few upper ones, some intercalary veins strongly developed, veins and veinlets finely reticulate. *Inflorescences*

up to 45 cm long, ferruginous to fulvous velvety, glabrescent; pedicels 2–4 mm long, deeply 3-grooved. *Sepals* in vivo bright green, outside fulvous-sericeous, margin glandular-ciliolate, inside glabrous, outer 2 oblong-ovate, 2.8 by 2 mm, inner 3 broadly obovate, 3.5 by 2.5 mm. *Petals* obovate-cuneate, 4.5 by 2.8 mm, white, hardly clawed, outside in the basal half densely appressed long-hairy, the margin except for the upper 1/3 long-ciliate; scale erect, slightly more than half as long as the petal, laterally partly adnate to its margin, the free part deltoid to bilobed, densely ciliate. *Disc* glabrous. *Stamens* slightly exerted; filaments 3.5 mm, densely long-hairy; anthers ovate, apiculate, 1 mm, glabrous. *Ovary* 1.5 mm, style conical, 1 mm, stigma faintly 3-lobed. *Fruits* slightly 3-lobed, mostly only 1 lobe developed, this globular, c. 2.5 cm in diam., densely ferruginous (when fresh orange to brown) velvety; pericarp in vivo 3 mm thick, orange. *Seeds* slightly flattened ellipsoid, 1.8 by 1.2 by 1 cm, testa shining, papery, hilum elliptic, 5 by 2 mm. — **Fig. 52d.**

*Distribution* — *Malesia*: Sumatra (once collected: East Coast, Sibolangit), Malay Peninsula (Perak: near G. Bubu; Tioman I.), Java (few: Bantam, Preanger, Pasuruan).

*Habitat & Ecology* — Primary rain forest, up to c. 450 m altitude. Fl. Feb.–Apr.; fr. Apr.–June, Aug.

*Uses* — Timber used for construction.

## Subgenus *Otophora*

*Lepisanthes* subg. *Otophora* (Blume) Leenh., Blumea 17 (1969) 60, 70 (see there for a complete synonymy). — *Otophora* Blume.

*Leaves* pari- or imparipinnate, petiole and rachis winged or not, with pseudo-stipules. *Leaflets* opposite to alternate, nervation open to closed. *Petals* shorter than sepals, outside mostly glabrous, scale not crested. *Disc* entire, glabrous or hairy. *Stamens* 5–10; filaments shorter than anthers. *Ovary* 2- or 3(–4)-celled (outside Malesia also 1-celled), often glabrous. *Fruits* mostly not or only slightly lobed, sometimes parted, glabrous or thin-hairy, septa often more or less interrupted.

*Distribution* — SE Asia from Burma (Mergui) and Hainan eastwards to the Moluccas.

## Section *Otophora*

*Lepisanthes* sect. *Otophora* (Blume) Leenh., Blumea 17 (1969) 60, 71 (see there for a complete synonymy). — *Otophora* Blume sect. *Eutophora* Radlk.

*Twigs* glabrous or glabrescent. *Leaves* usually imparipinnate, often many-jugate, hairy or glabrous; petiole and rachis not winged. *Leaflets* especially above with pitted warts



resembling small white scales, often hairy, midrib beneath usually rounded. *Inflorescences* terminal and axillary, mostly pyramidal, hairy or glabrous. *Sepals* 5 (or 6), mostly (sub)glabrous. *Petals* (4 or) 5, outside often hairy; scale either represented by two auricles, or lobed, ciliolate. *Anthers* hairy. *Ovary* 2- or 3-celled, hairy or glabrous. *Fruits* smooth to scurfy, hairy or glabrous; septa complete.

Distribution — 5 species, 1 in Hainan, the others in West Malesia as far as Borneo and Timor.

4. *Lepisanthes amoena* (Hassk.) Leenh., *Blumea* 17 (1969) 71. — *Melicocca amoena* Hassk., *Flora* 25, 2 (1842) Beibl. 39 ('*Melicoccus amoenus*'); *Tijd. Nat. Gesch. Phys.* 10 (1843) 139; *Aanteek. Nut Java* (1845) 17. — *Schleichera amoena* (Hassk.) Walp., *Rep.* 5 (1845) 366. — *Otophora amoena* (Hassk.) Blume, *Rumphia* 3 (1847) 142; *Koord. & Valetton, Bijdr. Booms. Java* 9 (1903) 172; *Backer, Schoolfl. Java* (1911) 263; *Radlk. in Engl., Pflanzenz.* 98 (1932) 771; *Backer & Bakh. f., Fl. Java* 2 (1965) 135. — *Otolepis amoena* (Hassk.) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Type: *Reinwardt s.n.* (L), Java.
- Otophora spectabilis* Blume, *Rumphia* 3 (1847) 142; *Koord. & Valetton, Bijdr. Booms. Java* 9 (1903) 171; *Atlas* 1 (1913) f. 130; *Radlk. in Engl., Pflanzenz.* 98 (1932) 772. — *Capura spectabilis* (Blume) Teijsm. & Binn., *Cat. Hort. Bog.* (1866) 214. — *Otolepis spectabilis* (Blume) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Type: *Anonymous s.n.* (L), Java.
- Otophora spectabilis* Blume var. *pubicosta* Blume, *Rumphia* 3 (1847) 143. — Syntypes: *Zippel s.n.*, *Anonymous s.n.*, both Java.
- Otophora confinis* Blume, *Rumphia* 3 (1847) 143. — Type: *Korthals s.n.* (L), E Borneo.
- Otophora imbricata* Blume, *Rumphia* 3 (1847) 144; *Ridley, Fl. Malay Penins.* 1 (1922) 495; *Radlk. in Engl., Pflanzenz.* 98 (1932) 773. — *Otolepis imbricata* (Blume) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Syntype: *Korthals s.n.* (L), Borneo.
- Otophora pubescens* Blume, *Rumphia* 3 (1847) 145; *Radlk. in Engl., Pflanzenz.* 98 (1932) 770. — *Otolepis pubescens* (Blume) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Syntypes: *Korthals s.n.* (L), Borneo; *S. Müller s.n.* (L), S Borneo.
- Otophora cordigera* Radlk., *Sapind. Holl.-Ind.* (1879) 85; *in Engl., Pflanzenz.* 98 (1932) 770. — *Otolepis cordigera* Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Type: *Beccari PB 3359* (FI, M), Borneo.
- Otophora stylicera* Radlk. *in Engl., Pflanzenz.* 98 (1932) 774. — Type: *Native collector 1784* (A, M), Borneo.

*Tree*, up to 10 m high, dbh up to 15 cm, or *shrub* up to 6 m. *Twigs* 0.8–1(–1.2) cm in diam., brown, when young sparsely, rarely rather densely, shortly fulvous hairy, mostly early glabrescent. *Leaves* imparipinnate, 7–42-jugate, up to 90 cm long, usually glabrous to thin-tomentose on axial parts, sometimes axial parts densely fulvous-tomentose, rarely moreover hirsute, glabrescent; flush from white over pink to salmon or coral-red; petiole terete to flattened above, 1–9 cm long; pseudo-stipules orbicular, ovate, or transversely elliptic, usually oblique, 1–6 by 0.8–6 cm, base truncate to deeply cordate, apex rounded, obtuse, acute, or shortly and broadly acuminate, some very oblique pseudo-stipules with a second more lateral apex, penni- or retinerved; pseudo-stipules usually connected with the normal leaflets by a series of intergrades. *Leaflets* opposite to alternate, (sub)sessile, linear or sometimes ovate-lanceolate, 7–22.5 by 1.2–5 cm, index 3.5–7, thin-chartaceous or pergamentaceous, greenish grey to dark brown above, yellowish- to red-brown beneath, glabrous to the midrib densely fulvous- to ferrugineous-tomentose above, sparsely hirsute beneath, rarely thinly hairy all over the lower surface, often on both surfaces or only above with scattered, minute, glandular-pitted warts; base oblique or not, obtuse to subcordate; apex obtuse to tapering acuminate, acumen short to long, obtuse to acute; nerves 0.5–2 cm apart, angle to midrib 65–85°, curved, only the upper ones looped and joined at some distance from the margin. *Inflorescences* terminal and axillary, pyramidal, up to 60 cm long, sparsely to densely short fulvous-hairy, the axial parts in vivo often reddish, rachis and main branches sharply 3-angular; branches nearly transverse to ascending, up to 30 cm long, the lower ones often with some short, spreading branches; cymes short-stalked to sessile, several- to 1-flowered; pedicels 2–4 mm. *Flowers* mostly reported to be white, sometimes creamy to yellow or pink to red, not scented. *Sepals* red, outside thinly appressed short-hairy to glabrous, inside glabrous to sparsely appressed short-hairy in the basal half, usually sparsely partly glandular ciliolate mainly towards the base, outer two ovate to oblong, 1.5–3.5 by 1.2–2 mm, inner 3 ± orbicu-



Fig. 53. *Lepisanthes amoena* (Hassk.) Leenh. a. Leaf; b. detail of lower surface of leaflet; c. fruit (a, b: Danser 5474; c: Wirawan 63).

lar, 2.5–4 by 2–3.5 mm. *Petals* white or red, usually up to 2/3 mm clawed, outside very sparsely to densely appressed long-hairy, inside variably hairy, claw and at least base of blade densely to very sparsely ciliate, blade subdeltoid to suborbicular, up to 1.5 by 1.2 mm, at base with 2 incurved,  $\pm$  connected lobes. *Disc* glabrous, orange or yellow. *Stamens* 7–9; filaments white or reddish; anthers 1.5–1.8 mm, densely hairy, yellowish. *Ovary* 3-celled, densely velvety to nearly glabrous, cream to reddish; style 1.5 mm. *Fruits* slightly 3-lobed, widest in or above the middle, 2–2.5 by 2.2–2.8 cm (fresh 2.5 by 3 cm), apiculate by the style base, (sometimes hardly) scurfy, thinly short-hairy to glabrous, in vivo light green, spotted brown when unripe, to brownish or purple when ripe, pulp yellowish to white. *Seeds* oblique-ellipsoid, hilum orbicular to lanceolate, small. — **Fig. 53.**

Distribution — *Malesia*: Sumatra, Malay Peninsula (Pahang, Selangor), Borneo, W Java, Timor (one collection).

Habitat & Ecology — Primary (or secondary) forests, scrub, or bamboo forests, often along rivers, in swamp forests, or even in periodically inundated localities, but also on dry-land, as well on acid as on basic soils, on loam or clay as well as on sand, at 0–400(–1650) m altitude. Fl., fr. Jan.–Dec. The often large pseudo-stipules, appressed to the twigs, are 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 against ulcers (Borneo) or an extract of the bark is used against hoarseness. The wood is reported to be very hard and was used for making hooks to catch crocodiles. The fruitpulp is sweet and edible. See Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 990; Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1613; Jansen et al. in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.)* 2, Edible fruits and nuts (1991) 343.

Notes — 1. *Lepisanthes amoena* occupies a central position in sect. *Otophora* and is more or less closely related to all the other species. It is itself a variable species but, apart from one race in Sumatra East Coast, no clearly delimited infraspecific taxa can be distinguished. That race, represented by *Lörzing* 4164, 5219 and 11988, all from around Sibolangit, differs from the above description constantly in a few characters: twigs 1.5 cm thick; leaves 40–50-jugate, 1–2 m long (from young, unbranched treelets), leaflets 12–13 by 1.8–2.2 cm, index 6–7, above midrib densely fulvous-tomentose, beneath mainly on the midrib thin-hirsute, base slightly cordate, nearly equal, apex long acute-acuminate, nerves rather dense, 0.5–1 cm apart, all looped and joined at some distance from

the margin; calyx light green to whitish; blade of petals 2.8–3 by 2.5 mm, scale sometimes hardly developed, glabrous; anthers glabrous; fruits densely ferruginous velvety, rarely glabrescent. What taxonomic status should be given to this race is not yet clear. It is doubtless nearest to what was described as *Otophora pubescens*.

2. Other variability is only somewhat discontinuous. Three ‘forms’ are more or less distinguishable, clearest in Borneo where they are also geographically more or less restricted. Outside of Borneo, the differences are often less clear, however. These races are: ‘*amoena*’: leaves rather many-jugate, leaflets not very narrow, linear, often greyish green above, reddish brown beneath. Throughout the area. — ‘*imbricata*’: leaves few-jugate, leaflets large, relatively wide, the sides not parallel, obtuse at base, brown. The series of intergrades between pseudo-stipules and leaflets on which *Otophora imbricata* was based, is exceptional. E Borneo and Java. — ‘*pubescens*’: leaves many-jugate, leaflets small and narrow, linear, cordate at base, mostly dark brown above, midrib usually hirsute beneath. W Borneo and Sumatra.

**5. *Lepisanthes divaricata*** (Radlk.) Leenh., *Blumea* 17 (1969) 72. — *Otophora divaricata* Radlk. in Fedde, *Rep.* 18 (1922) 338; in Engl., *Pflanzenr.* 98 (1932) 758. — Type: *Anonymous s.n.* (M, SAR), Sarawak.

*Otophora pyramidalis* Radlk. in Fedde, *Rep.* 18 (1922) 338; in Engl., *Pflanzenr.* 98 (1932) 759. — Type: *Native collector 375* (M), Sarawak.

*Otophora hinduensis* Radlk. in Fedde, *Rep.* 18 (1922) 339; in Engl., *Pflanzenr.* 98 (1932) 769. — Type: *Foxworthy 17* (M), Sarawak.

*Otophora macrocarpa* Ridley, *Kew Bull.* (1933) 190; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1494. — Type: *Haviland 67* (K, SAR), Sarawak.

*Small tree*, up to 7 m high, or *shrub*. Twigs 3–13 mm in diam., brown, glabrous to rather densely shortly ferruginous hairy and glabrescent. *Leaves* pari- or imparipinnate, (3–)7–11(–16)-jugate, 25–40 cm long, the axial parts ferruginous or fulvous short-hairy, glabrescent; petiole  $\pm$  terete, 2–6(–17) cm; pseudo-stipules suborbicular to elliptic, often slightly oblique, (0.4–)1–1.8 by (0.3–)1.2–2.2 cm, cordate to cuneate at base, rounded to acute at apex, reti-, palmati-, or penninerved. *Leaflets* opposite to alternate, sessile or with up to 2 mm long petiolules, elliptic to lanceolate, 7–20 by 2–7 cm, index 2.2–4, stiff-chartaceous, mostly greenish grey to blackish above, light to dark brown beneath, glabrous or the midrib ferruginous tomentose on both sides, mainly beneath with pitted warts; base sub-



cordate or rounded to cuneate, oblique, in terminal leaflet long attenuate; apex tapering acuminate, acute to obtuse; nerves 1–2.2 cm apart, angle to midrib c. 75°, nearly straight, distinctly looped and joined at some distance from the margin. *Inflorescences* terminal and in the upper leaf-axils, pyramidal, up 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. *Flowers* (orange-)yellow. *Sepals* sparsely (outer) to densely (inner), partly glandular ciliolate, outer two broad-ovate to obovate, 1.8–2.2 by 1.2 mm, inner suborbicular to ovate, 1.8–3.5 by 1.8–2.2 mm. *Petals* distinctly clawed, completely long-hairy, blade transversely semi-elliptic, 0.7–1.5 by 1.2–2 mm, auricled at base. *Disc* glabrous or fairly densely short-hairy. *Stamens* 5–8; anthers 1 mm, rather densely woolly. *Ovary* 2- or 3-celled, glabrous to thinly appressed-hairy; stigma sessile or on a short style. *Fruits* slightly 2- or 3-lobed, 2–3 by 2–3 cm, hardly pointed, smooth and glabrous, yellow to pale brown. *Seeds* obovoid, hilum elliptic, 3 mm long.

Distribution – *Malesia*: Borneo (Sarawak: near Kuching).

Habitat & Ecology – Disturbed kerangas or swamp forest behind the mangrove, at low altitude (up to 400 m). Fl. Oct.–July; fr. Oct.–Jan.

The following two forms can be distinguished:

a. forma **divaricata** — *Otophora divaricata* Radlk. — *Otophora macrocarpa* Ridley.

*Leaves* imparipinnate, 6- or more-jugate; pseudo-stipules orbicular, at least 8 by 8 mm, sessile, base rounded to cordate, never penninerved. *Leaflets* sessile, index 3–4, up to 4 cm wide, with parallel sides. *Ovary* 2-celled. – Fig. 54.

b. forma **lunduensis** (Radlk.) Leenh., *Blumea* 17 (1969) 72. — *Otophora lunduensis* Radlk.

*Leaves* paripinnate, up to 6-jugate; pseudo-stipules elliptic, up to 8 by 4 mm, subsessile, base cuneate to subcordate, mostly penninerved. *Leaflets* short-stalked, index 2.5–3, up to 7 cm wide, the sides not parallel. *Ovary* 3-celled.

Notes – 1. The species seems closest to *L. amoena*.

2. A few specimens are intermediate between the two forms. *Native collector* 375, the type of *Otophora pyramidalis*, comes near f. *lunduensis* but has the ovary 2-celled; *Daun (Haviland)* 917 and *Daun (Haviland)* s.n. (herb. SING 23156) look like f. *divaricata* but have a 3-celled ovary and small

pseudo-stipules, whereas *Daun (Haviland)* s.n., moreover, lacks the terminal leaflet.

6. **Lepisanthes kinabaluensis** Leenh., *Blumea* 17 (1969) 73. — Type: *Chew & Corner* RSNB 4998 (K. L.), Sabah.

*Tree*, up to 10 m high, or *shrub*. *Twigs* 0.8–1 cm in diam., dark purplish to greyish brown, densely and shortly fulvous-tomentose, glabrescent. *Leaves* imparipinnate, 7–14-jugate, up to 75 cm long, axial parts hairy like the young twigs; petiole terete, flattened towards the base, 5–13 cm long; pseudo-stipules orbicular to broad-ovate, 2–5 by 2.5–4 cm, deeply cordate at base, rounded or obtuse to short-acuminate at apex, penni- or retinerved, distinctly set off from the normal leaflets. *Leaflets* mostly about opposite, sessile or with up to 2 mm long petiolules, lanceolate to oblong, parallel-sided, 12–20 by 3.5–5 cm, index 3–5, pergamentaceous, mostly greyish green above, greenish beneath, glabrous or above on midrib shortly fulvous-tomentose, on both faces with scattered, glandular-pitted warts; base oblique to equal-sided, cuneate or lower half rounded; apex tapering acuminate, acumen long, acute or obtuse; nerves 1–2 cm apart, angle to midrib 70–75°, straight to slightly curved, more or less distinctly looped and joined near or at some distance from the margin. *Inflorescences* terminal, pyramidal, c. 25 cm high, red, densely short-hairy to subglabrous; branches patent, short-stalked to sessile; cymes several-flowered; pedicels up to 5 mm long. *Sepals* deep rose red, sparsely ciliolate in the apical part, outer 2 ovate, 3.5–5 by 2.5–3 mm, inner 3 elliptic to orbicular, 4–5 by 2.5–5 mm, especially the inner ones rather thin and probably for the greater part petaloid, sometimes more or less grading to the petals. *Petals* 4, 0.5 mm clawed, outside pink, towards the base more red, inside whitish, claw and base of blade ciliate, upper part sparsely ciliolate, further glabrous or outside appressed hairy, plate widerhomboid, 2.5 by 3.5 mm, scale bilobed or the lateral parts reflexed, the centre erect and hood-shaped, 2/5 as long as the blade. *Disc* glabrous or short-hairy. *Stamens* 7–10; anthers 2 mm. *Ovary* 3-celled, 3-angular-obovoid, 3-lobed, glabrous; stigma sessile, dome-shaped. *Fruits* 3-lobed, often 1 or 2 parts not developed, then style nearly basal, lobes spreading, ellipsoid, 3.2 by 2.2 cm, scabrous, glabrous, reported brown, yellow, orange, or purplish-red when ripe. – Fig. 55.

Distribution – *Malesia*: Borneo (Mt Kinabalu, Crocker Range).

Habitat & Ecology – In forest between 1200 and 2000 m altitude. Fl. Mar.–Apr.; fr. Jan., Mar.–Apr., June.



Fig. 54. *Lepsianthes divaricata* Leenh. f. *divaricata*. a. Habit; b. female flower; c. pistil, longitudinal section; d. petal from inside; e. sepal from inside; f. staminode from outside; g. fruit (a–f: *Brunig S 17527*; g: *Rehal 13015*).

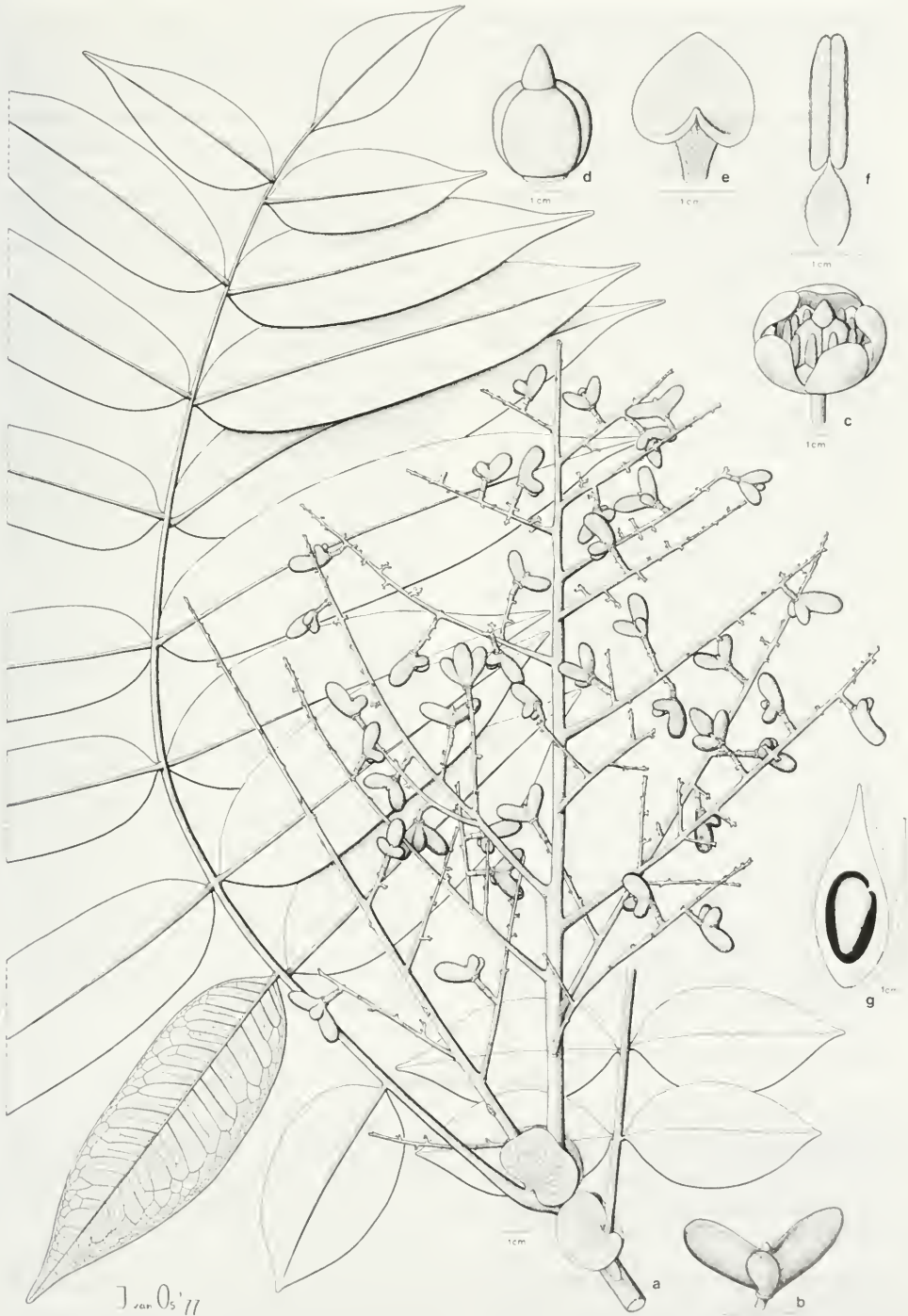


Fig. 55. *Lepsianthes kinabaluensis* Leenh. a. Habit; b. fruit; c. female flower; d. pistil; e. petal from inside; f. stamen; g. seed, longitudinal section (a, b: RSNB 4998; c-g: RSNB 4944).



Note – Apparently nearest to *L. multijuga*, and like that species different from *L. amoena* mainly by the deeply 3-lobed fruits.

**7. *Lepisanthes multijuga*** (Hook. f.) Leenh., *Blumea* 17 (1969) 73. — *Nephelium multijuga* Hook. f., *Trans. Linn. Soc.* 23 (1860) 164. — *Capura multijuga* Hook. f. ex Radlk., *Sapind. Holl.-Ind.* (1879) 11, nom. inval. — *Otophora multijuga* (Hook. f.) Merr., *Enum. Born. Pl.* (1921) 358; Radlk. in Engl., *Pflanzenr.* 98 (1932) 774. — Type: *Motley s.n.*, Borneo.

*Otophora tricocca* Radlk. in Merr., *Pl. Elm. Born.* (1929) 174, nom. nud. — Syntypes: *Elmer 20010, 20200* (both A, BO, L, M, SING), N Borneo.

*Otophora imbricata* auct. non Blume: Radlk., *Sapind. Holl.-Ind.* (1879) 82, p.p.

*Tree or shrub*, up to 12 m high, dbh up to 10 cm. *Twigs* 1.5–2 cm in diam., blackish to reddish brown, glabrous. *Leaves* imparipinnate, (15–)30–40-jugate, 80–90 cm to more than 1 m long, axial parts fulvous-tomentose, glabrescent; petiole terete to flattened above, 3–6(–8) cm long; pseudo-stipules 1 or 2 pairs, ovate to suborbicular, 2.5–7.5 by 2.5–5 cm, base cordate, apex acute, pennis to retinerved, more or less connected with the normal leaflets by intergrades. *Leaflets* opposite to alternate, (sub)sessile, linear-lanceolate, up to 18 by 3 cm, index 6–7, chartaceous, blackish brown to greenish grey above, medium to dark brown beneath, midrib above densely fulvous-tomentose, beneath very sparsely hairy to glabrous, above densely, beneath more sparsely covered with glandular-pitted warts; base rounded to subcordate, oblique; apex tapering acuminate, obtuse to acute; nerves 1–1.5 cm apart, angle to midrib 65–85°, slightly curved, vaguely looped and joined at a distance from the margin. *Inflorescences* terminal,

broad-thyrsoid, 25–30 cm high, subglabrous, sparsely branched; branches obliquely patent, up to 45(–60) cm long, narrowly thyrsoid; cymes scattered, short-stalked to sessile, condensed, few-flowered; pedicels 0.5–4 mm. *Flowers* red. *Sepals* outside very sparsely appressed short-hairy to glabrous, sparsely glandular-ciliolate, outer 2 elliptic to ovate, 2.5–3 by 1.8–2.5 mm, inner 3 orbicular, 3–4 by 2.5–4 mm, the latter with a broad petaloid margin. *Petals* 0.5 mm clawed, rather densely long ciliate, outside sparsely hairy at the base or glabrous, blade broad-ovate, subtruncate at base, 2 by 2.5 mm; scale slightly bilobed, about 1/3 as high as the blade, slightly recurved, ciliate. *Disc* glabrous. *Stamens* (6–)8; anthers 1.5–1.8 mm, long-ciliate to completely woolly. *Ovary* 3-celled, deeply grooved, glabrous; style conical. *Fruits* 3-lobed (if only 1 part is developed style near the base above the scars of the dropped sterile lobes), lobes spreading, oblique-ellipsoid, 22 by 13 mm, scabrous, glabrous, in vivo chocolate-coloured or yellow or orange. *Seeds* hazelnut-shaped, 12 by 9 mm. — **Fig. 52g.**

Distribution – *Malesia*: Borneo (Sabah, Labuan I.).

Habitat & Ecology – In primary and secondary forest, level land, at low altitude. Fl. July, Sept., Nov.; fr. Jan., Sept., Nov., Dec.

Notes – 1. Hooker f. in Benth. & Hook. f., *Gen. Pl.* 1 (1862) 405, included *Nephelium multijugum* in the genus *Capura*, but without making the combination. The name *Capura multijuga* was first used by Radlkofer, *Sapind. Holl.-Ind.* (1879) 11, but since it was placed under the genus *Otophora*, it was not accepted by him, and therefore is invalid.

2. The present species hardly differs from *L. amoena* except in the deeply 3-lobed fruits, a character, however, which seems to be of importance in this relationship. It shares this character with *L. kinabaluensis*.

### Section *Pseudotophora*

*Lepisanthes* sect. *Pseudotophora* (Radlk.) Leenh., *Blumea* 17 (1969) 60, 75 (see there for a complete synonymy). — *Otophora* subg. vel sect. *Pseudophora* Blume, *Rumphia* 3 (1847) 142, nom. inval. — *Otophora* sect. *Pseudotophora* Radlk., *Sapind. Holl.-Ind.* (1879) 85.

*Twigs* glabrous or sometimes hairy. *Leaves* mostly paripinnate, 1–8(–14)-jugate, mostly glabrous; petiole and rachis only very rarely winged. *Leaflets* nearly always densely finely pitted underneath, exceptionally with pitted warts, often glabrous, midrib beneath angular or more rarely rounded. *Inflorescences* rarely terminal, nearly always axillary, ramiflorous or cauliflorous, solitary or few together, simple or branched, hairy or glabrous. *Sepals* (3

or) 4 or 5, outside hairy or glabrous. *Petals* 4 or 5, outside glabrous or hairy; scale often faint, entire, hairy. *Stamens* 5–8(–10); anthers hairy or glabrous. *Ovary* 2- or 3(–4)-celled, mostly glabrous. *Fruits* rarely lobed, smooth, glabrous, septa mostly interrupted to nearly fully reduced.

Distribution – 2 species, in SE Asia and *Malesia* as far east as the Moluccas.

**8. *Lepisanthes bengalan*** Leenh., *Blumea* 17 (1969) 75. — Type: *Kostermans 4889* (L. SING), NE Borneo.

*Tree*, up to 12 m high, dbh up to 40 cm, or *shrub*. *Twigs* 1.2 cm in diam., shining olive-brown, slightly pustular lenticellate, glabrous. *Leaves* imparipinnate with a reduced terminal leaflet, 4–6-jugate, glabrous; petiole terete, swollen at base, 4–9 cm long; rachis in the lower part terete, central part angular above, upper part flat with lateral ribs to marginate beneath insertion of leaflets; petiolules 1 mm; pseudo-stipules suborbicular, c. 4 by 5 cm, sessile, cordate at base, rounded at apex, palmately retinerved. *Leaflets* subopposite, oblong, up to 17–19 by 5–7 cm, index c. 3.5, stiff-chartaceous, greyish green above, light- to red-brown beneath, above with scattered gland-warts, beneath densely finely pitted; base slightly oblique, narrowly rounded; apex obtuse to narrowly rounded; midrib beneath acute, nerves 1.5–3 cm apart, angle to midrib c. 65°, slightly curved, at least the upper ones distinctly looped and joined near the margin. *Inflorescences* axillary, 30–35 cm long, rachis subglabrous, widely branched; branches long, oblique-erect, densely fulvous-puberulous, some branched again; cymes sessile, few- to 1-flowered; pedicels rather thick, 2 mm long. *Sepals* 5, outer elliptic, 4.5 by 2.5 mm, inner suborbicular, 3.5 by 3 mm, all with petaloid margin, dark red, outside densely fulvous-puberulous, margin densely ciliolate, inside glabrous. *Petals* 5, sessile, elliptic, 3 by 2.5 mm, thick-fleshy, outside basally rather densely appressed short fulvous hairy, margin ciliolate; scale a narrow, reflexed, ciliolate strip. *Stamens* 8; anthers 1.5 mm, glabrous (in female flowers ciliolate along the sides). *Ovary* 3-celled, ciliate along the sides; pistillode densely hairy. *Infructescences* and *fruits* not observed: fruit described as dark purplish. — **Fig. 56.**

Distribution – *Malesia*: NE Borneo.

Habitat & Ecology – On ridges and in forest, on basic loam; altitudes up to 200 m. Fl. May; fr. June, Aug.

**9. *Lepisanthes fruticosa*** (Roxb.) Leenh., *Blumea* 17 (1969) 76. — *Sapindus fruticosa* Roxb., [Hort. Beng. (1814) 29, nom. nud.] Fl. Ind. ed. Carey (1832) 283. — *Otophora fruticosa*

(Roxb.) Blume, *Rumphia* 3 (1847) 142; Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 329; Sapind. Holl.-Ind. (1879) 31; Koord. & Valetton, *Bijdr. Booms. Java* 9 (1903) 174; Backer, *Schoolfl. Java* (1911) 264; Merr., *Fl. Manila* (1912) 305; Sp. Blanc. (1918) 239; Enum. Philipp. Flow. Pl. 2 (1923) 500; Radlk. in Engl., *Pflanzenr.* 98 (1932) 759; Backer & Bakh. f., *Fl. Java* 2 (1965) 135. — *Otolepis fruticosa* (Roxb.) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — *Capura fruticosa* (Roxb.) Vidal in Ceron, *Cat. Pl. Herb. Manila* (1892) 54. — Type: *Roxburgh s.n.*, Hort. Bot. Calcutta (introduced from the Moluccas).

*Sapindus baccata* Blanco, *Fl. Filip.* (1837) 290. — *Koelreuteria edulis* Blanco, *Fl. Filip.* ed. 2 (1845) 202, nom. illeg.; ed. 3, 2 (1878) 14. — *Otophora blancoi* Blume, *Rumphia* 3 (1847) 142, nom. illeg. — Neotype: *Merrill Sp. Blanc. 374* (A, BO, L), Philippines, Palawan.

*Otophora erythrocalyx* Hiern in Hook. f., *Fl. Br. India* 1 (1875) 680; Radlk. in Engl., *Pflanzenr.* 98 (1932) 769. — *Otolepis erythrocalyx* (Hiern) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Type: *Maingay KD 477* (M), Malay Peninsula.

*Otolepis sessilis* King, *J. As. Soc. Beng.* 65, II (1896) 430; Craib, *Fl. Siam. Enum.* 1 (1926) 328; Radlk. in Engl., *Pflanzenr.* 98 (1932) 763. — Syntypes: *King's collector 2460* (M), 5043 (M drawing), Malay Peninsula.

*Otophora resecta* Radlk., *Rec. Bot. Surv. India* 3 (1907) 346; Ridley, *Fl. Malay Penins.* 1 (1922) 495; Hend., *Gard. Bull. Str. Settl.* 4 (1928) 243; Radlk. in Engl., *Pflanzenr.* 98 (1932) 766. — Type: *Ridley 6948* (M, SING), Malay Peninsula.

*Otophora glandulosa* Radlk. [in Merr., *Pl. Elm. Born.* (1929) 174, nom. nud.] in Engl., *Pflanzenr.* 98 (1932) 763. — Type: *Elmer 20128* (A, BO, L, M, SING), N Borneo.

*Otophora acuminata* Radlk. in Engl., *Pflanzenr.* 98 (1932) 769. — Type: *Hallier 911* (L, M), W Indonesian Borneo.

*Otophora latifolia* Ridley, *Kew Bull.* (1933) 190, nom. illeg.; Radlk. in Engl., *Pflanzenr.* 98 (1934) 1494. — *Otophora glandulosa* Radlk. ex Ridley, *Kew Bull.* (1933) 490, nom. illeg., non Radlk. (1932). — Type: *Creagh s.n.* (K), N Borneo.



Fig. 56. *Lepisanthes bengalan* Leenh. a. Leaf; b. detail of lower surface of leaflet (a, b: *Kostermans* 4889).



For a more complete list of synonyms and references, see Leenhouts (1969).

*Shrub or tree*, 1.5–10(–15) m high, dbh 2–15 cm. *Twigs* 2.5–20 mm in diam., red when young, later variably brown to silvery grey, smooth or lenticellate, glabrous or sometimes variably fulvous-hairy and glabrescent. *Leaves* without or sometimes with a rather strongly reduced terminal leaflet, 1–8(–14)-jugate, 25 cm to more than 1 m long, mostly glabrous; petiole terete or sometimes flattened, 0.5–3.2 cm long; rachis terete to laterally flattened, in the upper part often marginate to exceptionally narrowly winged; petiolules 0–30 mm; pseudo-stipules very rarely absent, mostly persistent, ovate, obovate, elliptic, or orbicular, sometimes very oblique, 0.2–1.0 by 0.1–1.0 cm, base cordate to obtuse, apex obtuse to rounded or exceptionally furcate, reti- or palmatinerved, rarely penninerved. *Leaflets* opposite to alternate, ovate- to obovate-oblong to narrowly lanceolate, 9–40 by 2–12 cm, index 2–9, thin-chartaceous to coriaceous, often greyish above, brown beneath, above with scattered sunken glands, beneath sparsely to densely finely pitted or exceptionally with minute pitted warts on both faces, glabrous or sometimes beneath hairy mainly on the midrib; base oblique or not, subcordate to acute, mostly attenuate, in oblique leaflets lower half sometimes rounded, upper cuneate; apex obtuse (rarely acute) to acuminate, acumen short, broad, and obtuse to long, slender, and acute, sometimes mucronate; midrib beneath acute (to rounded), nerves 0.8–5 cm apart, angle to midrib 35–75°, straight to curved, none to all looped and joined. *Inflorescences* (terminal or) axillary to rami- or cauliflorous, solitary or (if cauliflorous) sometimes some together, simple or branched either with some to several ascending long branches from near the base or all over and pyramidal, up to 75 cm long, glabrous; cymes (sub)sessile (rarely up to 1 cm stalked), few- to several-flowered, in the upper part often flowers solitary, sometimes sticky (race '*glandulosa*'); pedicels filiform, 0.3–1(–1.5) cm long. *Flowers* scentless. *Sepals* 4–5, outer 2 sometimes smaller, elliptic, orbicular, or obovate, 2–4 by 1.5–3 mm, dark red (rarely yellow to white), margin, especially of the inner ones, petaloid, crenulate to fimbriate-ciliolate, glabrous or very sparsely glandular-ciliolate. *Petals* 4–5, short-clawed, blade broad-ovate or elliptic to obovate, 1.5–3 by 1–2 mm, dark red (rarely yellow to white), glabrous or rarely claw ciliate or outside hairy; either 2 auricles or 1 small and reflexed scale, scale and auricles ciliate. *Stamens* 5–8; anthers 1.2–2.2 mm, yellow to white, glabrous or hairy. *Ovary* 2- or 3(–4)-celled, glabrous; stigma (sub)sessile,

slightly lobed. *Inflorescences* with patent, mostly slender, up to 1.5 cm long pedicels. *Fruits* ovoid, ellipsoid, subglobular, or transversely ellipsoid, rarely distinctly lobed, 1–3 by 0.6–2 by 0.5–2 cm (fresh up to 4 cm in diam.), apparently white when young, dark red to blackish when ripe; fruit-wall thin, apparently fleshy when fresh; septum rarely complete, usually interrupted to (mostly) reduced to a rib all around. *Seeds* mostly 2, subglobular to semi-ellipsoid, flattened on the axial side, 8–23 by 6–18 by 4–18 mm, hilum orbicular to lanceolate, up to 6 by 3–4 mm. – **Fig. 52b.**

**Distribution** – Indo-China, Lower Burma, Thailand, and *Malesia*: Sumatra (Indragiri, one collection), Malay Peninsula, Borneo (not known from the southern part), Java (only Central Java, few collections, Semarang and Solo, possibly not indigenous), Philippines, Celebes, Lesser Sunda Islands (Dampo I. near Sumbawa: one old collection, wild?), Moluccas (Talaud, Ternate, Bacan, Ambon).

**Habitat & Ecology** – In primary and secondary vegetations, probably mainly in open places in the forest, along the edges, on ridges, along rivers, swamps, and the beach, also in logged areas, abandoned plantations, and grasslands, on dry to swampy, rich as well as poor, clayey as well as sandy, acid as well as basic soils, from sea level up to 600(–1400) m altitude. Fl., fr. mainly Dec.–May. Fruits sweet, eaten by birds, wild pigs and deer.

**Uses** – In Malaya, the roots are medicinally used. The wood is hard, durable, and heavy and is used for house-building in Malacca. Sometimes cultivated because of its edible fruits. See Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1614; Jansen et al. in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.) 2*, Edible fruits and nuts (1991) 343; Oehse, *Indische Vruchten* (1927) f.126.

**Notes** – 1. *Lepisanthes fruticosa* is a rather variable species. Though it is impossible to subdivide it into well delimited infraspecific taxa, often some races are locally clearly distinguishable.

In the Malay Peninsula there are two races: '*erythocalyx*', characterized by distinctly stalked leaflets, 5-merous flowers, and completely 3-celled fruits; and '*resecta*' (including also *O. sessilis*), with (sub)sessile leaflets, 4-merous flowers, and incompletely 2-celled fruits.

In Borneo there are three main races, '*acuminata*', '*fruticosa*', and '*glandulosa*', the latter having 2 ecotypes. Race '*acuminata*' is characterized by acute leaflets, rami- or cauliflorous inflorescences, 5-merous flowers, completely 3-celled fruits; it is restricted to the Kapuas basin. Race '*fruticosa*' has obtuse leaflets, axillary or sometimes terminal inflorescences, 4-merous flowers, and very

incompletely 2-celled fruits; it is apparently mostly restricted to N Borneo. Race '*glandulosa*' is characterized by obtuse leaflets, axillary and rami- or cauliflorous inflorescences, 5-merous flowers, densely short-hairy anthers, and very incompletely 2-celled fruits. The lowland form is rather widespread, a mountain form, mainly restricted to Mt Kinabalu, differs in the more slender petiole and rachis (the latter may be narrowly winged), smaller and more caducous pseudo-stipules, narrower leaflets with a longer attenuate apex, and the midrib more often rounded beneath.

Outside Borneo, '*fruticosa*' in the same strict sense is known from Java and the Lesser Sunda Islands, and it is identical with some material from the Philippines, Celebes, and the Moluccas. In the Philippines and E Malesia, however, it seems impossible to distinguish between races, as several characters seem to vary independently. This is true

not only of the vegetative parts, but the inflorescences may be axillary, rami-, or cauliflorous, the flowers are mostly 4-merous, but 5-merous flowers may be found in the same inflorescences, and both flower types have a 2-celled, but sometimes a 3-celled pistil.

2. *Meijer 4238*, the only collection known from Sumatra, seems to belong to the present species, but differs mainly by the narrow (1–1.5 mm wide) wings along petiole and rachis. *Sarawak For. Dept. S 18404* is distinctive in its completely 3-merous flowers and glandular pitted warts on both surfaces of the leaflets; furthermore, it strongly resembles '*acuminata*' in particular and that is why it was included here. *Ender 2922* (NE Borneo), apparently also the present species, is especially remarkable because of its very large (12 by 12 cm), coriaceous pseudo-stipules.

### Section Anomotophora

*Lepisanthes* sect. *Anomotophora* (Radlk.) Leenh., *Blumea* 17 (1969) 60, 79 (see there for complete synonymy). — *Otophora* Blume sect. *Anomotophora* Radlk., *Sapind. Holl.-Ind.* (1879) 85.

*Leaves* pari- or (more rarely) imparipinnate, 3–6(–13)-jugate, hairy or glabrous, petiole and rachis winged. *Leaflets* densely finely pitted underneath, glabrous or hairy, midrib beneath angular or rounded. *Inflorescences* axillary, rami- or cauliflorous, solitary or fascicled, simple or slightly branched, glabrous. *Sepals* 4 or 5 (or 6), outside glabrous. *Petals* 4 or 5 (or 6), outside nearly always glabrous; scale entire to bilobed, glabrous or hairy. *Stamens* 5–8; anthers (sub)glabrous. *Ovary* 2- or 3- (or 4)-celled, glabrous. *Fruits* not or slightly lobed, smooth, glabrous, septa mostly complete.

Distribution – 3 species, one in Indo-China, two in *W Malesia*.

10. *Lepisanthes alata* (Blume) Leenh., *Blumea* 17 (1969) 80. — *Otophora alata* Blume, *Rumphia* 3 (1847) 145; *Schoofl. Java* (1911) 264; *Koord., Exk. Fl. Java* 2 (1912) 538; *Koord. & Valetton, Atlas I* (1913) t. 129; *Radlk. in Engl., Pflanzn.* 98 (1932) 768; *Backer & Bakh. f., Fl. Java* 2 (1965) 135. — *Capura alata* (Blume) Teijsm. & Binn., *Cat. Hort. Bog.* (1866) 214. — *Otolepis alata* (Blume) Kuntze, *Rev. Gen. Pl.* 1 (1891) 144. — Lectotype (Leenhouts 1969): *Korthals s.n.* (L), S Borneo.
- Otophora edulis* C.E.C. Fischer, *Kew Bull.* (1932) 178; *Radlk. in Engl., Pflanzn.* 98 (1934) 1493. — Type: *Orolofo 1319* (K), N Borneo.

*Tree*, up to 15 m high, dbh up to 30 cm, or *shrub*. *Twigs* 1.2–0.8(–1.5) cm in diam., blackish brown

to grey, glabrous. *Leaves* paripinnate, 3–5(–13)-jugate, 20–45 cm (to more than 1 m long), glabrous; petiole angular above, exceptionally flat to rounded, 1.5–7.5(–25) cm long; wings of petiole and rachis 3–8 mm wide; pseudo-stipules oblique-ovate, 1–3(–8.5) by 0.8–2.2(–5) cm, base deeply cordate, apex obtuse, sometimes acuminate, pinnately. *Leaflets* opposite (to alternate), sessile or petiolules up to 2 mm long, lanceolate (exceptionally linear-lanceolate or oblong to obovate-oblong, lower sometimes ovate-lanceolate), 10–20(–45) by 1.8–4(–8) cm, index (3–)4–7(–14), thin-chartaceous, above greyish to blackish brown, beneath brown to greyish green; base mostly hardly oblique, acute and sometimes tapering, in oblique leaflets one half or both halves rounded; apex tapering long acuminate, acute; midrib beneath most-

ly acute, nerves 1–1.5(–2) cm apart, angle to midrib 55–70°, curved, at least those in the upper half of the leaflet looped and joined near the margin. *Inflorescence* often drooping, in vivo often purple to reddish brown, apparently mostly unisexual, though male and female ones on the same trees; male: usually axillary, narrowly thyrsoïd, unbranched, 20–25(–40) cm long, with scattered, sessile fascicles of 3–5(–7) flowers on 2–7 mm long pedicels; female: either in the lower leaf-axils, or rami- or cauliflorous, at least near the base with some branches about equalling the rachis, up to 45 cm long, with scattered, mostly solitary flowers on 6–13 mm long pedicels. *Flowers* in vivo dark wine-red to purple. *Sepals* obovate-orbicular, 2.5–4 by 2–3 mm, outer slightly smaller than inner, inner partly petaloid with crenulate margin, all sparsely glandular-ciliolate. *Petals* sessile (in *L. edulis* claw 0.5 mm), sparsely, partly glandular, ciliolate, glabrous or rarely sparsely appressed short-hairy outside in the basal half (*L. edulis*); blade suborbicular, up to 4 by 3 mm (*L. edulis* 2 by 2.5 mm), scale erect, slightly hood-shaped, 1/3–1/5 as long as blade, glabrous (*L. edulis* densely ciliolate). *Disc* glabrous, pink. *Stamens* 8; anthers 1.8 mm, subglabrous, yellow with white pollen. *Ovary* ellipsoid, 3- (or 4-) celled, pale mauve; style very short, stigma dome-shaped to flat, slightly 3-lobed, white. *Infructescences* with patent, up to 2 cm long, slender pedicels. *Fruits* shortly stipitate, trigonous-obovoid, 2.5–4 by 2.2–3 cm, apiculate, apparently dark brownish purple to nearly black when ripe, pulp rather thick, fleshy, white. *Seeds* ellipsoid, up to 2.5 by 1.5 cm, hilum rhomboid, 6 by 5 mm. — **Fig. 52e.**

**Distribution** — *Malesia*: Malay Peninsula (Johore, one collection), Borneo, and Java (probably only naturalized).

**Habitat & Ecology** — In and along forests, on river banks, etc.; on clay; altitude up to 100(–450) m. Fl. Aug.–May; fr. Aug.–Apr. Ants may live under the stipules [see Schimper, Pfl. Geogr. Physiol. Grundlage (1898) 165–166, f. 87].

**Uses** — The fruits and possibly also the seeds are eaten; in Sumatra, Java, and Borneo sometimes grown as a fruit tree. See Heyne, Nutt. Pl. Indon. ed. 3 (1950) 990; Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 343.

**Note** — *Lepisanthes alata* is as a whole a rather uniform species. Only a few specimens from Borneo deviate considerably from the mean in some characters. Among these *Endert 1702* and *Jaheri 1693* are both characterized by rather large (15–23 by 5–7.5 cm), relatively wide (index c. 3), distinctly obovate leaflets with rather spaced nerves

(1.5–2 cm apart). *Hotta 12660* from Brunei differs in its many-jugate leaf (13 pairs of leaflets), petiole and rachis rounded or flat above, very large stipules (8.5 by 5 cm), and very long and narrow leaflets (33 by 2.2 cm, index c. 14). *Orolfo 1319* from Sabah, the type of *Otophora edulis*, differs in its rather narrow leaflets (index 8) with nearly perpendicular nerves, petals which are distinctly clawed and are hairy outside and on the scale, and especially in its large fruits (c. 4 by 3 cm) with a thick, fleshy pulp (the wall of the ovary is already exceptionally thick). However, one should keep in mind that fleshy fruits are nearly always collected unripe and *Orolfo 1319* may be exceptional in this respect; furthermore, from the label it is not clear whether it was taken from a wild specimen or possibly some cultivar.

**11. *Lepisanthes ramiflora*** (Radlk.) Leenh., Blumea 17 (1969) 81. — *Otophora ramiflora* Radlk., Sapind. Holl.-Ind. (1879) 32, 85; in Engl., Pflanzenr. 98 (1932) 758. — *Otolepis ramiflora* (Radlk.) Kuntze, Rev. Gen. Pl. 1 (1891) 144. — Lectotype (Leenhouts 1969): *Beccari PB 364* (F1), Sarawak.

Small tree up to 22.5 m high and 2 cm in diam., or shrub. Twigs 5–7 mm in diam., yellowish to reddish brown, densely pustular-lenticellate, sparsely hirsute, early glabrescent. *Leaves* pari- (rarely impari-)pinnate, (3–)4–6-jugate, 40–50 cm; petiole and rachis sparsely hairy to subglabrous; petiole terete, 6–18 cm long; wings of petiole and rachis up to 5 mm wide; pseudo-stipules ovate, 0.8–3.5 by 0.5–2 cm, base cordate, apex acute to rounded, pinninerved. *Leaflets* (sub)opposite, sessile, oblong (sometimes slightly obovate), up to 33 by 10.5 cm, index 3–5, chartaceous, sometimes slightly bullate, grey or brown above to greenish beneath, midrib beneath at least near the base sparsely hirsute; base oblique, narrowed, cordate; apex tapering acuminate, acute; midrib rounded beneath, nerves 1–2.5 cm apart, angle to midrib 65–70°, more or less curved, at least those in the upper half distinctly looped and joined at some distance from the margin. *Inflorescences* cauliflorous, several to many fascicled on knobs on the stem, simple or hardly branched, racemoid, c. 1.5 cm long, flowers few; pedicels patent, 1.5–5 mm long, slender. *Flowers* 4-merous. *Sepals* pale pink, outer 2 elliptic, 2.5 by 2 mm, with petaloid margin, inner broad-ovate, 3 by 2 mm, for the greater part petaloid. *Petals* white, sparsely long ciliate near the base, 0.4 mm long clawed, blade semi-transversely ellipsoid, 1 by 1.8 mm; scale broad, rounded to bilobed, c. 0.3–0.5 as high as the blade, slightly hairy. *Disc* pale yellow,



glabrous. *Stamens* 5–7; anthers 1 mm, glabrous, cream-coloured. *Ovary* suborbicular, flattened, 2-celled, pale yellowish; style short, stigma dome-shaped, slightly bilobed, white. *Fruits* transverse-ly ellipsoid, slightly bilobed, 1 by 1.5 cm, crimson to dark purple, incompletely 2-celled. *Seeds* ellipsoid.

Distribution – *Malesia*: Borneo (Sarawak: around Kuching).

Habitat & Ecology – In primary and secondary forest on sandstone; altitude 0–100 m. Fl. Jan.–Feb., July–Sept., Nov.; fr. Jan., Oct., Nov.

Uses – The fruits are eaten.

Note – Closest to *L. amplifolia* (Pierre) Leenh., from S Vietnam, which has 5-merous flowers (according to Gagnepain), infructescences up to 40 cm long, widely branched, and completely 2-celled fruits.

### Subgenus *Erioglossum*

*Lepisanthes* subg. *Erioglossum* (Blume) Leenh., *Blumea* 17 (1969) 60, 81 (see there for complete synonymy). — *Erioglossum* Blume.

*Leaves* paripinnate, neither petiole nor rachis winged, without pseudo-stipules. *Leaflets* (sub)opposite, nervation open. *Petals* longer than sepals, outside subglabrous, scale crested. *Disc* interrupted, glabrous. *Stamens* 8; filaments longer than anthers. *Ovary* 3-celled, very sparsely to densely hairy. *Fruits* parted, (sub)glabrous, septa complete.

Distribution – 2 species, in SE Asia, *Malesia*, and NW Australia.

**12. *Lepisanthes membranifolia*** (Radlk.) Radlk., *Bot. Jahrb.* 56 (1920) 252; in Engl., *Pflanzenr.* 98 (1932) 746; Leenh., *Blumea* 17 (1969) 81. — *Erioglossum membranifolium* Radlk., *Sapind.* *Holl.-Ind.* (1879) 17, 55. — Lectotype (Leenh. 1969): *Beccari PP 317* (Fl, M), New Guinea.

*Treet.* *Twigs* terete, c. 6 mm in diam., dark brown, rather densely short-hairy, glabrescent. *Leaves* 3–5-jugate, the axial parts rather densely fulvous-hairy; petiole terete, at base only slightly swollen, 11–14 cm long; petiolules slightly grooved above, 2–5 mm long. *Leaflets* oblong to elliptic, 18–26 by 7–13 cm, index 2.5–3, herbaceous, on both sides hairy on midrib and nerves, beneath moreover sparsely so all over the surface; base slightly oblique, rounded to subcordate, sometimes attenuate; apex tapering obtuse-acuminate; midrib prominent above, more strongly so and rounded beneath, nerves 1.5–3 cm apart, angle to midrib 50–55°, straight to slightly curved, the upper ones looped and joined near the margin, slightly sunken above, prominulous beneath, veins and veinlets finely reticulate, veins more or less scalariform, above hardly visible, prominulous beneath. *Infructescences* axillary to pseudoterminal, thyrsoid, sometimes with a few short branches, 1.5–5 cm long, dense, with sessile, c. 7-flowered cymes, densely puberulous; bracts deltoid, 1 mm; pedicels 1.5 mm. *Flowers* white. *Sepals* ciliate, inside glabrous, outer ovate, 2.5 by 1.8 mm, inner obo-

vate to suborbicular, up to 3 by 2.5 mm, margin slightly petaloid. *Petals* 4, claw 1 mm, blade elliptic-ovate, 2 by 1.5 mm, outside slightly hairy just above the claw, woolly ciliate below insertion of scale, inside glabrous; scale folded, entire to emarginate, long-ciliate, doubled by the crest. *Stamens*: filaments 1.8 mm, rather thick, sparsely long-hairy in the upper half; anthers ellipsoid, 1 mm, connective rather narrow, glabrous. *Pistil* with some scattered hairs; ovary obovate, 3-lobed; style short, thick and terete; stigma cap-shaped; pistillode minute. *Fruits* not observed.

Distribution – *Malesia*: New Guinea (Vogelkop Peninsula, three collections).

Habitat & Ecology – Lowland forest. Fl. Aug.

Notes – 1. The position of the present species is not clear. Radlkofer originally described it in *Erioglossum*, but later referred it to *Lepisanthes* on the strength of anatomical characters. The question will be difficult to answer as long as the fruits are unknown; the obovate pistil, however, looks more like that of *Erioglossum* or *Aphania* than of *Lepisanthes* s. str.

2. It is possible that the vegetative parts as described are not representative for the mature tree; *Kostermans 2893* was collected from an unbranched tree only 2 m high, which does not appear more 'juvenile' than the two collections made by Beccari; they all look like suckers.

**13. *Lepisanthes rubiginosa*** (Roxb.) Leenh., *Blumea* 17 (1969) 82. — *Sapindus rubiginosa*

- Roxb., Pl. Corom. 1 (1796) 44, t. 62. — *Moulinisia rubiginosa* (Roxb.) G. Don, Gen. Hist. 1 (1831) 667. — *Erioglossum rubiginosum* (Roxb.) Blume, Rumphia 3 (1847) 118; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 498; Craib, Fl. Siam. Enum. 1 (1926) 325; Radlk. in Engl., Pflanzenr. 98 (1932) 693; Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 76; Steenis, Fl. Sch. Indon. (1949) 253; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 933, f. 116; Backer & Bakh. f., Fl. Java 2 (1965) 134. — Type: Roxb. Pl. Corom. 1 (1796) t. 62.
- Sapindus edulis* Blume, Cat. (1823) 64, nom. illeg., non Aiton (1789). — *Erioglossum edule* (Blume) Blume, Bijdr. (1825) 229; Rumphia 3 (1847) 119, t. 166; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 154; Lecomte in Fl. Indo-Chine 1 (1912) 1019; Koord. & Valetton, Atlas 1 (1913) f. 88; Merr., Sp. Blanc. (1918) 238; Ridley, Fl. Malay Penins. 1 (1922) 492, f. 49; Hend., Gard. Bull. Str. Settl. 4 (1928) 243. — *Uitenia edulis* (Blume) Steud., Nomencl. ed. 2, 2 (1841) 776, nom. inval. — *Erioglossum edule* (Blume) Blume var. *genuina* Blume ex Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 156, nom. illeg. — Type: Reinwardt 823 (L), Java (cultivated).
- Sapindus fraxinifolia* DC., Prod. 1 (1824) 608. — *Erioglossum edule* (Blume) Blume var. *fraxinifolia* (DC.) Blume, Rumphia 3 (1847) 120. — Type: Riedlé s.n. (L, P), Timor.
- Erioglossum edule* (Blume) Blume var. *album* Blume, Rumphia 3 (1847) 119. — Syntypes: Blume 120, s.n. (both L), W Java.
- Erioglossum edule* (Blume) Blume var. *subcorymbosum* Blume, Rumphia 3 (1847) 119. — *Erioglossum edule* (Blume) Blume var. *corymbosum* Teijsm. & Binn., Cat. Hort. Bog. (1866) 215, in errore? — Syntype: Blume s.n. (L), W Java.
- Lepisanthes hirta* Ridley, J. Fed. Mal. St. Mus. 10 (1920) 132; Radlk. in Engl., Pflanzenr. 98 (1932) 753. — Type: Ridley FMS 13161 (K, SING), Malay Peninsula.
- For complete synonymy see Leenhouts (1969).
- Shrub* or small *tree*, up to 16 m high, dbh up to 28 cm (*Forman* 239 from N Celebes reported to be 30 m high with a diameter of 60 cm; from India also reported to be a fairly big tree). *Indumentum* ferruginous to fulvous, sometimes and in some parts silvery-grey. *Branchlets* terete, grooved, c. 5(–15) mm in diam., densely short-hairy when young. *Leaves* (2–)3–6(–9)-jugate, often with a pseudo-terminal leaflet, velvety when young; petiole about terete, 7.5–12(–20) cm long, densely short-hairy, late glabrescent; petiolules up to 5(–10) mm long. *Leaflets* elliptic to lanceolate, (4.5–)6.5–18(–25) by (2–)3.5–8.5(–11) cm, stiff chartaceous, above greyish green to grey, beneath yellowish green to reddish brown, on both sides shortly and densely hairy on midrib and nerves, sparsely so all over the surface mainly beneath (velvety on the touch), more or less glabrescent; base rounded to broadly cuneate; apex obtuse to acute or acuminate, often mucronulate; midrib prominent above, rather strong and rounded beneath, nerves 8–12(–16) on either side, ascending to spreading, nearly straight to slightly curved, bent at the margin, not distinctly joined but for few upper ones, hardly prominent above, slightly so beneath, veins and veinlets inconspicuous above, beneath densely reticulate-scalariform and prominulous. *Inflorescences* 25–35(–50) cm long, densely ferruginous 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. *Flowers* sweet-scented. *Sepals* orbicular-ovate, slightly concave, green when fresh, margin sometimes petaloid, ciliate, inside glabrous or with a few hairs, outer two 1.2–2.2 by 1.2–2 mm, acute, inner three 1.8–2.8 by 2–3 mm, obtuse. *Petals* 4 (or 5), claw 0.5–1 mm, blade 2–4 by 1.5–2.2, crenulate in upper half, white to yellowish when fresh, long ciliate in upper part of the claw and – sparsely – in the narrowed lower part of the blade, outside with a few hairs at the base; scale c. 1.5–3 mm long, quadrangular to ± bilobed, slightly narrowed from base to apex, bearded, the appendage deeply bilobed, the lobes sometimes also bilobed, hairy; the abaxial petals shorter and narrower than the adaxial ones, and with a shorter scale. *Stamens* longest abaxially; filaments flattened, long white hairy, in male flowers (1.5–)3–5 mm long, in female 1.5 mm; anthers oblong-ovate, 0.8 mm, glabrous. *Ovary* 3-lobed, 1.2–1.8 by 2–2.2 mm, densely appressed-hairy; style cylindric, 2.2 mm long, bent near the obscurely 3-lobed apex, sparsely appressed-hairy in the lower 2/3; pistilode in female flowers c. 0.8 mm high, long hairy. *Fruits* 1-, 2-, or 3-lobed, lobes spreading, 8–13 by 7–8 mm, faintly carinate, dark purple to nearly black when ripe, subglabrous; endocarp thin but hard and tough, glabrous. *Seeds* oblong-ellipsoid, 9–11 by 4 by 4 mm, hilum basal, small. — **Fig. 52c.**
- Distribution — Continental SE Asia from northern India to Indo-China and SE China (Kwangtung, Hainan), *Malesia* and NW Australia (York Sound, Brunswick Bay).
- Habitat & Ecology — Under seasonal as well as everwet conditions, preferably on periodically dry,

rarely on marshy, fertile as well as sterile soils, both on heavy clay, on sand, and on limestone. A sub-stage tree or shrub of more open vegetation: in deciduous forests (common in the teak forests of C and E Java), in young secondary forests, shrubland, etc., along forest edges, roadsides, river banks, along the inner side of the mangrove; up to 300–1200 m altitude. Fl., fr. Jan.–Dec. [in the Malay Peninsula twice a year after dry periods, according to Corner, *Wayside Trees* (1940) 587, t. 177]. Flowers much visited by *Xylocarpa* sp. For galls see Docters van Leeuwen, *Zooecidia* (1926) 335, f. 604–608.

Uses – In India, where the trees seem to be a better size, the timber is said to be valuable, but in Malaysia it is used only for firewood and sometimes (Java) for rice-pounders and tool-handles. A decoction of 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. For further details see Burkill,

*Dict. Econ. Prod. Malay Penins.* (1935) 938; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 989; Ochse & Bakh., *Ind. Groenten* (1931) 648, f. 396.

Chromosomes –  $2n = 26$ ; Mehra et al., *Silvae Gen.* 21 (1972) 96–102.

Notes – 1. The inflorescences in the upper leaf axils are sometimes paired in which case the upper is the stronger one.

2. According to Corner (1940) the basal part of the inflorescence and of its branches bore female flowers which opened first, the more apical parts male flowers, which opened later. This is not confirmed by the study of numerous herbarium specimens. The inflorescences seem to be nearly exclusively either female, or male; in old inflorescences either (nearly) all flowers have fallen (probably male inflorescences) or there are a number of young fruits all over the inflorescence (female inflorescences; note that the infructescence, depicted by Corner, is also covered with fruits all over). Whether all inflorescences of a tree are the same, needs to be studied in the field.

### Subgenus *Aphania*

*Lepisanthes* subg. *Aphania* (Blume) Leenh., *Blumea* 17 (1969) 60, 83 (see there for complete synonymy). — *Aphania* Blume.

*Leaves* paripinnate, sometimes simple; petiole and/or rachis exceptionally winged, sometimes with pseudo-stipules. *Leaflets* mostly  $\pm$  opposite, nervation closed. *Petals* as long as the sepals, outside glabrous or partly sericeous, scale not crested. *Disc* mostly complete, glabrous. *Stamens* 5–7(–9); filaments as long as or longer than anthers. *Ovary* 2- (or 3-)celled, glabrous or sparsely pilose at the style base. *Fruits* lobed, glabrous, septa not interrupted.

Distribution – As the genus; 3 species.

14. *Lepisanthes dictyophylla* (Radlk.) Leenh., *Blumea* 17 (1969) 83. — *Cupaniopsis dictyophylla* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 359. — *Aphania dictyophylla* (Radlk.) Radlk., *Bot. Jahrb.* 56 (1920) 268; in Engl., *Pflanzenr.* 98 (1932) 713. — Type: *Sayer s.n.* (M), Papua New Guinea.

*Shrub* or *liana*, glabrous except the fulvous hairy buds and bracts. *Twigs* terete, c. 2.5 mm in diam., light grey-brown to ash-grey, smooth or slightly pustular-lenticellate. *Leaves* 3–4-jugate; petiole terete, 3–5 cm long, slightly swollen at base; rachis terete to angular above; petiolules narrowly grooved above, 2–5 mm long. *Leaflets*  $\pm$  opposite, ovate-oblong, 6–10.5 by 2.2–4.2 cm, stiff-charta-

ceous, greyish green above, the same or dark brown beneath, minutely pellucid-dotted; base broadly cuneate and attenuate to rounded, equal-sided; apex obtuse to tapering acuminate, acumen short, broad, and obtuse; midrib prominulous and acute above, prominent and angular beneath, nerves 0.5–1 cm apart, angle to midrib almost 90°, almost straight, looped and joined at some distance from the margin, equally prominulous on both surfaces, venation finely reticulate, equally prominulous on both surfaces. *Inflorescences* solitary, simple, 3.5–18 cm long; peduncle short, cymes distant, short-stalked to sessile, 1–5-flowered; pedicels up to 2 mm long. *Sepals* 5, sparsely ciliolate partly with glandular hairs, further glabrous or outside very sparsely puberulous, outer 2 distinctly smaller, ovate, 1.8 by 1.2 mm, inner broad-elliptic to orbicular, 2.5



by 1.8 mm, thinner towards the crenulate margin. *Petals* 5, subsessile, oblong-elliptic, up to 3 by 2 mm, fairly densely ciliolate; scale small, biparted, villous. *Disc* of 5,  $\pm$  separate, erect, glabrous lobes. *Stamens* 5, filaments partly hairy; anthers ovate, 1 mm long, glabrous. *Ovary* 2-celled, glabrous; style short; stigma slightly bilobed. *Fruits* not observed.

Distribution — *Malesia*: E New Guinea.

Habitat & Ecology — Understorey of rain forest; altitude 60 m. Fl. Aug.—Oct.

Note — Closely related to *L. senegalensis*.

**15. *Lepisanthes mixta*** Leenh., *Blumea* 17 (1969) 83, f. 2. — Type: *Docters van Leeuwen 11326* (K, L), Mamberano River, New Guinea.

*Shrub*, glabrous except for the inflorescences. *Twigs* terete, 4–8 mm in diam., blackish, verrucous by small, orbicular lenticels. *Leaves* sometimes with pseudoterminal leaflet, 3–6-jugate; petiole semiterete, 10–20 cm, swollen at base, narrowly winged at least in the upper part, wings if complete broadened at the base into a pair of up to 3 cm wide, semiorbicular pseudo-stipules, swollen at base; rachis flattened above, up to 5 mm wide winged. *Leaflets*  $\pm$  opposite, (sub)sessile with a swollen base, lanceolate, 17.5–30 by 3.5–5 cm, thin-chartaceous, yellowish to greyish green on either side; base equal-sided, cuneate to subcordate; apex long-tapering, obtuse; midrib prominent above, prominent and acute beneath, nerves 1–3.5 cm apart, angle to midrib 55–60°, straight to slightly curved, looped and joined at some distance from the margin, equally prominent on both surfaces, some intercalary veins strongly developed, venation rather coarsely reticulate, equally prominent on both surfaces or more distinct beneath. *Inflorescences* solitary, slender pyramidal thyrsoid, 25–30 cm long, minutely short fulvous hairy; peduncle up to 15 cm long, rather stout, branches patent, up to 6 cm, racemous, with many short-stalked, several-flowered cymes; pedicels 2–3 mm long, slender. *Flowers* (female not observed) white. *Sepals* 5, outer 1 or 2 smaller, ovate, 1.2–1.8 by 1–1.5 mm, with some scattered glands along the margin, inner orbicular-obovate, 2–2.5 by 2–2.2 mm, partly petaloid, ciliolate partly with glandular hairs. *Petals* (3–)5, short-clawed, oblong-elliptic, 2 by 1 mm, sparsely ciliolate partly with glandular hairs; scale small, bilobed. *Disc* complete, flat, more or less distinctly lobed. *Stamens* 5, anthers ovate, 1–1.5 mm, glabrous. *Pistillode* 2-merous, glabrous. *Fruits* 2-lobed, not stipitate, red, parts globular, 7.5 mm in diam.

Distribution — *Malesia*: W New Guinea (two collections seen).

Habitat & Ecology — In forest up to 60 m alti-

tude. Fl. Aug., Nov.; fr. Aug.

Note — This remarkable species has the fruits of subg. *Aphania*, but the habit of subg. *Otophora* because of its winged petiole and rachis. The latter character is most conspicuous in the type specimen in which the broad wings are widened at base into a kind of pseudo-stipule; the other specimen (*Aet* 679, Babo on McCluer Bay) has very narrow wings and lacks the pseudo-stipules. In all other characters the two agree completely.

**16. *Lepisanthes senegalensis*** (Poir.) Leenh., *Blumea* 17 (1969) 85. — *Sapindus senegalensis* Juss. ex Poir., *Encycl.* 6 (1805) 666. — *Aphania senegalensis* (Poir.) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 238; in *Engl., Pflanzenr.* 98 (1932) 703. — Type: *Adanson & Geoffroi f. s.n.* (P. Herb. Jussieu 11386), Senegal.

*Aphania montana* Blume, *Bijdr.* (1825) 236; *Koord. & Valetou. Bijdr. Booms. Java* 9 (1903) 158; *Atlas* 1 (1913) t. 132; *Radlk. in Engl., Pflanzenr.* 98 (1932) 711; *Backer & Bakh. f., Fl. Java* 2 (1965) 134. — *Sapindus montana* (Blume) Blume, *Rumphia* 3 (1847) 97. — Type: *Anonymous s.n.* (L, ?Blume), W Java.

*Euphoria verticillata* Lindl., *Bot. Reg.* (1827) t. 1059, nom. illeg. — *Nepheium verticillatum* (Lindl.) G. Don, *Gen. Hist.* 1 (1831) 670. — *Scytalia verticillata* (Lindl.) Roxb., *Hort. Beng.* (1814) 29; *Fl. Ind. ed. Carey* (1832) 273. — *Didymococcus verticillatus* (Lindl.) Blume, *Rumphia* 3 (1847) 103. — *Sapindus verticillatus* (Lindl.) Kurz, *Rep. Pegu, App. A* (1875) 38. — Type: *Roxburgh s.n.*, cult. Hort. Calcutta.

*Scytalia danura* Roxb., [*Hort. Beng.* (1814) 29, nom. nud.] *Fl. Ind. ed. Carey* (1832) 274. — *Aphania danura* (Roxb.) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 238; in *Engl., Pflanzenr.* 98 (1932) 716. — Type: *Roxburgh s.n.*, India.

*Sapindus cuspidata* Blume, *Rumphia* 3 (1847) 98. — *Aphania cuspidata* (Blume) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 238; in *Engl., Pflanzenr.* 98 (1932) 706. — Type: *Zippelius 210b* (L), SW New Guinea.

*Otophora paucijuga* Hiern in *Hook. f., Fl. Br. India* 1 (1875) 680. — *Aphania paucijuga* (Hiern) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 239; *Hend., Gard. Bull. Str. Settl.* 4 (1928) 243; *Radlk. in Engl., Pflanzenr.* 98 (1932) 708. — Type: *Maingay 1529 (= KD 462)* (K, L), Malacca.

- Aphania sphaerococca* Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 238, nom. nud.] Sapind. Holl.-Ind. (1879) 7, 21; in Engl., Pflanzentr. 98 (1932) 705. — Syntypes: *Beccari PP 503, PP 908* (both Fl. M), New Guinea.
- Aphania longipes* Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 239, nom. nud.] Sapind. Holl.-Ind. (1879) 68; in Engl., Pflanzentr. 98 (1932) 705. — Type: *Teijsmann HB 7872* (L. M), New Guinea.
- Aphania philippinensis* Radlk. in Perkins, *Fragm. Fl. Philipp.* 1 (1904) 60; in Engl., Pflanzentr. 98 (1932) 709. — Syntypes: *Ahem 216 p.p.* (M), Luzon; *Warburg 14597*, Philippines, Sulu Arch.
- Aphania boerlagei* Valetton, *ic. Bog.* 2 (1906) 281, t. 185; Radlk. in Engl., Pflanzentr. 98 (1932) 706. — Syntypes: *Hort. Bot. Bog. 43, 43a* (= *Teijsmann HB 12763*) (BO, L, M), SW Celebes.
- Aphania angustifolia* Radlk. in Elmer, *Leafl. Philipp. Bot.* 1 (1907) 209; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 499; Radlk. in Engl., Pflanzentr. 98 (1932) 710. — Type: *Elmer 7330* (BO, K, L, M), Philippines, Leyte.
- Hydnocarpus taniiana* Pulle, *Nova Guinea* 8 (1912) 671; cf. Sleumer in *Fl. Males.* I, 5 (1954) 33. — Type: *Gjellerup 262* (L), NW New Guinea.
- Aphania loheri* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 452; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 499; Radlk. in Engl., Pflanzentr. 98 (1932) 710. — Type: *Loher 5874* (K, L, M), Philippines, Luzon.
- Aphania macrophylla* Radlk. in Fedde, *Rep.* 18 (1922) 332; in Engl., Pflanzentr. 98 (1932) 713. — Type: *Koorders 18015* (L, M), N Celebes.
- Aphania dasypetala* Radlk. in Fedde, *Rep.* 18 (1922) 333; in Engl., Pflanzentr. 98 (1932) 714. — Type: *Native collector 709* (BO, K, L, M), Sarawak.
- Aphania fascicularis* Radlk. in Fedde, *Rep.* 18 (1922) 334; in Engl., Pflanzentr. 98 (1932) 714. — Type: *Warburg 18168* (M), Moluccas, Bacan.
- Aphania masakapu* Melch., *Notizbl. Berlin-Dahl.* 10 (1928) 277; Radlk. in Engl., Pflanzentr. 98 (1934) 1491. — Type: *Peekel 941*, Bismarck Archipelago, New Ireland.

*Treelet* or *shrub*, 0.5–24 m high, dbh up to 44 cm, exceptionally a liana (*Peekel 1083*, New Ireland); young parts densely to sparsely, appressedly, shortly fulvous to ferruginous hairy. *Twigs* terete, 2–6 mm in diam., greyish to brown or black, smooth to verruculose by many small, orbicular

lenticels. *Leaves* sometimes with a pseudoterminal leaflet, 1–4(–6)-jugate, or sometimes (some or all leaves, in the former case either scattered among pinnate leaves or only near the inflorescence) simple; lower pair of leaflets sometimes attached near or at the base, smaller and more caducous than other ones; in vivo young leaves pinkish with reddish petioles; petiole flattened to terete, 0–14 cm long, often much swollen at base, sometimes lenticellate like the twig; rachis terete to carinate above; petiolules terete, slightly flattened, or grooved, swollen, 2–15 cm long. *Leaflets* elliptic to lanceolate, widest about or below the middle, 7–35 by 2–15 cm (simple leaves up to 60 by 18 cm), chartaceous to subcoriaceous, greyish green (rarely olive or brown) above, greyish or yellowish green to light brown beneath, densely to sparsely minutely pellucid-dotted; base acute to obtuse, more or less attenuate (in sessile simple leaves subcordate, oblique or not); apex obtuse to acuminate, mucronulate, acumen up to 5 cm long, obtuse to acute; midrib faint to prominent above, beneath prominent, rounded, nerves 7–20 per side, 1–3 (in the large simple leaves up to 4) cm apart, angle to midrib 30–90°, straight to curved, looped and joined at some distance from the margin, prominent on both surfaces, between every two nerves usually 1 or 2 intercalary veins stronger developed, nerves and veins rather densely reticulate, prominent on both surfaces, especially beneath. *Inflorescences* hairy to subglabrous, few to several fascicled, simple or sparsely, mostly slender branched, up to 40 cm long racemes or narrow thyrses, or sometimes a single, widely though sparsely branched, up to 60 cm long thyrses with a strong peduncle and rachis; cymes distant, short-stalked, 3-flowered; pedicels 1–4(–8) mm long. *Flowers* slightly fragrant, female ones apparently developing first. *Sepals* 5 (rarely 4), in vivo mostly dark red, concave, outer 2 oblong-ovate to orbicular, rounded at apex, 1–3 by 0.8–1.2 mm, sometimes with a narrow, petaloid, crenulate margin, sparsely ciliolate, inner 3 up to 4 by 3 mm, mostly with a broad, petaloid, crenulate to fimbriate, ciliolate margin. *Petals* 5 (rarely 4), in vivo creamish or greenish white, imbricate, short-clawed to sessile, the blade elliptic to oblong, widest below to about the middle, 2.5–4.5 by 1–2 mm, entire, rounded, membranous but often thickened towards the centre and the base, ciliate at least near the base, furthermore mostly glabrous, sometimes more or less sericeous outside; scale minute to 2/5 of the length of the blade, simple to deeply bilobed (rarely divided into two minute auricles), sparsely ciliate to long-hairy (exceptionally glabrous). *Disc* entire ( $\pm$  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, in old flowers apparently longer than in mature ones, in vivo white, woolly in the lower 2/3, rarely subglabrous; anthers elliptic to ovate, 1–1.8 mm long, in vivo when young light yellow, old purplish brown, connective mostly apiculate. *Ovary* 2- (or 3-)lobed, 1.5–3 mm, hardly to up to 1.5 mm stipitate, mostly with some stiff hairs at the style base and in the basal part of the style; style cylindric, 1–2 mm long, straight to slightly curved; stigma sometimes decurrent halfway down the style, in vivo purple; pistillode often long pilose in the apical part. *Fruits* 2-lobed (often only 1 part developed), sessile or up to 2 mm stipitate, lobes short-ellipsoid to globular, 8–15 by 5–15 mm, smooth, when ripe in vivo dark red to black; endocarp eggshell-like, light brown. *Seeds* ovoid to globular,  $\pm$  attenuate towards the hilum, 7–8 by 6–7 mm, testa shining brown to black, hilum circular. — **Fig. 52a.**

**Distribution** — Tropical Africa, Madagascar, Sri Lanka and the SW Deccan Peninsula, NE India, E Pakistan, Burma to Indo-China and Hainan, the Andamans and Nicobars, and *Malesia*: all regions except the Lesser Sunda Islands, in Borneo known only from Sarawak, Brunei, and Sabah.

**Habitat & Ecology** — Under periodically dry as well as everwet conditions, in dry as well as marshy, fertile to rather sterile, well to badly aerated, acid to basic soils, clay or sand as well as marl and coral limestone rocks, mostly at low altitudes: 0–200(–500, rarely up to 1400) m. An understorey tree of rather light forests — in Borneo mixed Dipterocarp forest, in Java teak forest — and secondary forests, of river banks and coastal rocks. Fl. mainly July–Nov.; fr. mainly Jan.–Apr.

**Uses** — Wood hard, heavy, and durable, used in the Malay Peninsula for house-posts. The roots are used in medicine in Mindanao. From the leaves a shampoo is made (Mindanao). The fruits are edible. See Burkhill, *Diet. Econ. Prod. Malay Penins.* (1935) 190.

**Chromosomes** —  $2n = 28$ : Mangenot & Mangenot, *Rev. Cyt. Biol. Veg.* 25 (1962) 411–447;  $2n = 30$ : Saerkar et al. in Löve, *Taxon* 31 (1982) 578.

**Notes** — The Malesian material of this widely distributed species is rather variable, as is clear from the above description. This variability is mainly gradual, and sometimes clinal. The main race (Sumatra, Java, Borneo, Philippines, S Celebes, Moluccas) is '*montana*' with obtuse, rarely acuminate leaflets and short-stipitate fruits with short ellipsoid to subglobular lobes, grading to the east into '*cuspidata*' with more acuminate leaflets and sessile fruits with more globular lobes. In the Philippines the leaflets tend to become narrower (the series *philippinensis*–*angustifolia*–*loheri*), or the leaves have more jugae, up to 3 pairs of leaflets being normal. Unifoliolate leaves characterize '*macrophylla*' from N Celebes and '*Hydnocarpus tamiana*' from NW New Guinea. These may not be real local races, but plants flowering when young, both being taken from shrubs only. The flowers of '*montana*' are 5-merous, but some specimens from Sumatra have flowers with 5 and with 4 petals in the same inflorescence. These specimens have also some hairs on the outside of the petals, whereas the petals in '*montana*' are glabrous. In that way these Sumatran specimens form a transition to the races of continental SE Asia, as well as to the only other Malesian race which deserves to be mentioned, which is made up of '*paucijuga*' from the Malay Peninsula and '*dasyptetala*' from Borneo. This race differs from '*montana*' by often having 4 petals that are slightly ('*paucijuga*') to rather densely ('*dasyptetala*') sericeous outside, by the longer, stipitate ovary, and by the inconspicuous venation, the nerves are more widely spreading and more distinctly looped and joined at a slightly greater distance from the margin. All specimens from the Malay Peninsula represent '*paucijuga*', whereas both '*dasyptetala*' and '*montana*' are known from Borneo, there being apparently clearly distinct. It is not possible, however, to separate '*montana*' and '*paucijuga*–*dasyptetala*' as subspecies or varieties, as they are connected via Thailand and Indo-China by a chain of races. See for a more comprehensive discussion Leenhouts (1969: 55–59).

## LITCHI

(P.W. Leenhouts)

*Litchi* Sonn., *Voy. Ind. Or. Chine* 2 (1782) 230, t. 129; Radlk. in *Engl., Pflanzenr.* 98 (1932) 914; Leenh., *Blumea* 24 (1978) 398. — *Scytalia* Gaertn., *Fruct.* 1 (1788) 197, nom. illeg. — *Euphoria* Comm. ex Juss., *Gen.* (1789) 247, nom. illeg. — Type species: *Litchi chinensis* Sonn.



*Trees*, monoecious. *Indumentum* of solitary, simple or 2-branched hairs; no glandular scales. *Leaves* spirally arranged or sometimes partly, nearly opposite, especially towards the inflorescence, paripinnate. 1–4- (?sometimes 5-)jugate; pseudo-stipules absent; petiole and rachis not winged. *Leaflets* mostly (sub)opposite, beneath dull, margin entire to undulate, mainly in the upper part. *Inflorescences* terminal and axillary, thyrsoïd; bracts triangular, 0.5–2 mm long. *Flowers* actinomorphic, unisexual. *Calyx* 4- or 5-merous, outside and inside densely appressed short-hairy, the tube cupular, the lobes to 0.3–0.5 of 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. *Pistil* short-stalked; ovary 2- (?or 3-)celled; style terminal, shorter than the ovary; stigma consisting of 2 (or 3?) long, spreading to recoiled lobes. *Ovules* 1 per cell, basal. *Fruits* nearly always only 1 cell developed, hardly stipitate, ellipsoid, ovoid, or globular, 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. — **Fig. 57.**

Distribution — Monotypic.

Note — The names *Scytalia* and *Euphoria* are illegitimate as in both cases *Litchi* was included. *Dimocarpus*, however, is, contrary to the opinion of most authors, not considered synonymous, and hence not superfluous (see under that genus).

*Litchi chinensis* Sonn., Voy. Ind. Or. Chine 2 (1782) 230, t. 129; Lecomte in Fl. Indo-Chine 1 (1912) 1047, f. 131; Groff, Lychee and Longan (1921); Merr., Enum. Philipp. Flow. Pl. 2 (1923) 504; Radlk. in Engl., Pflanzenz. 98 (1932) 917, f. 21; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 966, f. 121: 8–11; Backer & Bakh. f., Fl. Java 2 (1965) 137; Poilane, J. Agr. Trop. Bot. Appl. 12 (1967) 541; Leenh., Blumea 24 (1978) 398. — *Sapindus edulis* Aiton. Hort. Kew. 2 (1789) 36. — *Euphoria lit-chi* Desfont., Tableau (1804) 135, nom. illeg.; Blume, Bijdr. (1825) 233. — *Nephelium lit-chi* (Desfont.) Cambess., Mém. Mus. Nat. Hist. Nat. Paris 18 (1829) 30, nom. illeg.; Wight, Ic. 1 (1838) t. 43; Blume, Rumphia 3 (1847) 106; Hiern in Hook. f., Fl. Br. India 1 (1875) 687; Watt, Dict. 5 (1891) 346; Backer, Fl. Batavia 1 (1907) 348; Dunn & Tutcher, Kew Bull. add. ser. 10 (1912) 67; Ridley, Dispersal (1930) 487; Corner, Wayside Trees (1940) 592; K. Ramesh Rao, Ind. Woods 2 (1963) 225. — Type: *Sonnerat 1062* (G, P), China.

*Euphoria lit-chi* Desfont. var. *undulata* Blume, Bijdr. (1825) 233, nom. illeg. — Type: *Blume s.n.* (L), Java.

*Euphoria didyma* Blanco, Fl. Filip. (1837) 288, nom. illeg.; ed. 2 (1845) 201; ed. 3, 2 (1878) 10. — *Nephelium didyma* (Blanco) Craib, Fl. Siam. Enum. 1 (1926) 329, pro basionym, spec-

imens excluded. — Neotype (Leenhouts 1978): *BS 17429* (L, P), Philippines, Luzon.

*Litchi philippinensis* Radlk. [ex Whitford, Philipp. J. Sc., Suppl. 1 (1906) 637, 645, 647, nom. nud.] Philipp. J. Sc., Bot. 8 (1914) 458; Schneider, Bull. For. Philipp. 14 (1916) 147; Groff, Lychee and Longan (1921) 34, f. 2; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 504; Radlk. in Engl., Pflanzenz. 98 (1932) 915. — *Litchi philippinensis* Radlk. f. *genuina* Radlk., Philipp. J. Sc., Bot. 8 (1914) 459, nom. illeg.; in Engl., Pflanzenz. 98 (1932) 916. — Lectotype (Leenhouts 1978): *FB 2995* (BO, L, M), Philippines, Luzon.

*Litchi philippinensis* Radlk. f. *mindanaensis* Radlk., Philipp. J. Sc., Bot. 8 (1914) 459; in Engl., Pflanzenz. 98 (1932) 916. — Type: *Elmer 13270* (BO, FI, L, M, P, U), Philippines, Mindanao.

*Litchi chinensis* Sonn. f. *glomeriflora* Radlk. in Engl., Pflanzenz. 98 (1932) 919. — Lectotype (Leenhouts 1978): *Blume s.n.* (L), Java.

*Branchlets* terete, striate, smooth, or densely lenticellate. *Petiole* terete to semiterete, swollen and slightly hollowed at base, 1.2–7 cm long, early glabrescent to glabrous, often pustular lenticellate; petiolules above deeply grooved, swollen toward the base. *Leaflets* smooth, above shining, glabrous to beneath fairly densely minutely appressed-hairy:

base equal-sided to sometimes oblique, acute, more or less attenuate; margin slightly recurved; apex mostly tapering (or more abruptly), short to long, obtuse- to acute-acuminate, sometimes rounded to slightly emarginate; midrib narrowly grooved above, nerves straight to curved, often slightly wavy or zigzagging, looped and joined near the margin or not, inconspicuous on both sides, veins coarsely reticulate, veinlets minutely tessellate; domatia absent. *Inflorescences* ferruginous-strigose. *Flowers* greenish white or yellowish, fragrant. *Stamens*: filaments filiform; anthers elliptic, apiculate to emarginate at apex, c. 1 mm long. *Pistil* 1.5–1 mm stipitate; ovary with spreading lobes, densely warty; style terete. *Seeds* ellipsoid, c. 2 by 1.5 cm, testa shining (blackish) brown, hilum basal, circular, 6–7 mm diam., arillode bluish white or light yellow to pinkish, up to 5 mm thick when fresh.

Distribution — See subspecies.

Notes — 1. Though being one of the Sapindaceous genera best known to the general public, to the taxonomist *Litchi* remains a genus full of mystery regarding its history, phylogeography, and taxonomy. The written history of *Litchi chinensis* goes back to c. 100 B.C. when the emperor Wu Ti of the Han Dynasty tried in vain to introduce it from northern Indo-China to Central E China. About the 8th century many varieties were widely cultivated in the southeastern provinces of China, probably for at least three centuries. Culture concentrated until the end of the 18th century in the coastal districts of the provinces of Kwangtung and Fukien, apparently at some time also in some more southern provinces, especially Yunnan, and probably in northern Indo-China (for history see Groff 1921). It seems astonishing that the culture of this highly prized fruit tree remained restricted for such a long time to a relatively restricted region, although the Chinese were for centuries the most active colonists of the Far East — though mainly as traders, far less as farmers. One reason may be that the seeds of *Litchi* are viable for a few days only outside the fresh fruits; another, that the propagation and culture of this species requires great skill, the species having very special demands as to climate and soil.

As in so many cases of old economic plants it is difficult to tell whether wild-growing specimens are really indigenous or naturalized. However, the restricted region where it has been in cultivation for such a long time very probably includes its original area. Its climatologic requirements give further indications where to look for its original area. The culture of *Litchi* in SE China is restricted by frost and drought, so that its natural area was probably a region with a somewhat warmer and wetter climate. On the other hand, subsp. *chinensis* re-

quires a drier and cooler season, otherwise it will hardly flower, so it is adapted to a region with a monsoon climate. All this agrees well with Poilane (1967) who reported *Litchi chinensis* as being fairly common growing in the wild in N Vietnam and Cambodia.

2. It is not clear whether the fruits of *L. chinensis* are finally dehiscent or not. They show a distinct suture, at least on the inside. It seems probable that at least the fruits of subsp. *philippinensis* are normally dehiscent, and possibly those of the other subspecies would behave in the same way when overripe.

3. *Nephelium lit-chi* is illegitimate as it refers back to *Litchi chinensis* via *Sapindus edulis* Aiton, and the epithet *chinensis* should have been used.

#### KEY TO THE SUBSPECIES

- 1a. Twigs slender, to 3.5 mm in diam. Cymules up to 5 mm long, staked, lax . . . . . 2
- b. Twigs thick, to 7 mm in diam. Cymules sessile, dense . . . . . **b. subsp. javensis**
- 2a. Leaves 2–4-jugate. Stamens mostly 6(–10). Fruits nearly smooth or rarely with up to 1 mm high, acute, pyramidal warts . . . . . **a. subsp. chinensis**
- b. Leaves 1- or 2- (or 3-)jugate. Stamens mostly 7 (or 6). Fruits with up to 3 mm high, acute, pyramidal warts . . . . . **c. subsp. philippinensis**
- a. subsp. chinensis** — *Litchi chinensis* Sonn. — *Euphoria lit-chi* Desfont. — *Nephelium lit-chi* Cambess.

*Tree*, up to 35 m high, dbh up to 1 m. *Branchlets* 2.5–3.5 mm in diam., greyish brown, when young with appressed, short, 2-branched, brown hairs, early glabrescent. Axillary buds 1 per leaf axil. *Leaves* 2–4-, exceptionally 5-jugate; petiole 0.8–1 mm in diam.; rachis above flat or grooved and with a fine central rib (lower) to carinate (upper interjugate), beneath rounded; petiolules 3–8 mm long. *Leaflets* elliptic, or (when relatively broad) obovate, (3–)8–11(–16) by 1.8–4 cm, index 2–4, chartaceous to coriaceous, mostly rather stiff; base if oblique broadest at acroscopic side; midrib beneath prominent and rounded, nerves 0.5–1 cm apart, angle to midrib 50–70°, veinlets clear. *Inflorescences* 15–30 cm long with few long erecto-patent branches, these sparsely branched mainly in their upper half; cymules erecto-patent, up to 5 mm long stalked, lax, 5–12-flowered; bracts 0.5–2 mm long; pedicels slender, 2–3(–4) mm long. *Calyx* 4- (or 5-)merous, c. 1.5 by 2 mm. *Disc* variably hairy to glabrous. *Stamens* 6(–10); filaments 2.5 mm long, rather densely hairy all over. *Ovary*



Fig. 57. *Litchi chinensis* Sonn. Habit, flowers and fruits. — Subsp. *philippinensis* (Radlk.) Leenh. a. Habit; b. male flower; c. female flower; f. fruit. — Subsp. *chinensis*. d. Fruit; e. *ibid.*, longitudinal section (a, b: FB 30836; c: BS 17429; d, e: *L. alc.* 8524).

2 by 5 mm; style 1 mm. *Fruits* c. 3.5 by 3 cm, bright red to purplish when ripe, nearly smooth or scaly to densely set with up to 1 mm high, flat, pyramidal, acute warts. — Fig. 57d, e.

*Distribution* — Probably originating from the northern part of the Indo-Chinese Peninsula or from SE China, now widely cultivated mainly in sub-

tropical regions; in *Malesia* possibly indigenous in the Malay Peninsula, Borneo and the Philippines, rarely cultivated (Malay Peninsula, Philippines), exceptionally naturalized and apparently hardly ever fruiting.

*Habitat* — Prefers a hot and wet climate with at least a short cool and dry season, but no frost. It



seems to favour compact, moist, and fertile soils, and is mostly grown at low altitudes on river banks, along dykes, between ditches or ponds, etc. The 'mountain lychee', which may represent the original form, however, is grown on dry land in the hills.

**Ecology** — The fruits are eaten by bats and parrots.

**Uses** — Cultivated for its fruits (*Litchi*, *Lychee*), mainly in SE China, Florida, Hawaii, and South Africa, from where they are exported, fresh, dried, or canned, to other parts of the world. The wood is also highly prized, reported to be hard, durable, and taking a fine polish (for a description of the timber, see p. 428). See Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1546; Groff, Ding & Groff, *Lingn. Agr. Rev.* 2 (1924) 34; Menzel in Verheij & Coronel (eds.), *Plant Res. SE Asia (PROSEA Handb. 2, Edible fruits and nuts)* (1991) 146; Ochse, *Indische Vruchten* (1927) 246, f. 119.

**Chromosomes** —  $2n = 28$ : Chaudhuri, *Curr. Sci.* 9 (1940) 416;  $2n = 30$ : Mehra et al., *Silvae Gen.* 21 (1972) 96–102.

**Note** — The many races of cultivated lychee are arranged into two groups, the 'water lychee' and the 'mountain lychee'. The former contains most (and the best) varieties, is cultivated in the lowlands, and has mostly nearly smooth fruits. The 'mountain lychee' is mainly used as a stock; it is grown in hilly regions, and has smaller and more prickly fruits. The latter may come nearer to the original wild form.

- b. subsp. **javensis** Leenh., *Blumea* 24 (1978) 401. — *Litchi chinensis* Sonn., auct. javan. — *Euphoria lit-chi* Desfont. var. *undulata* Blume — *Litchi chinensis* Sonn. f. *glomeriflora* Radlk.

**Branchlets** up to 7 mm in diam., greyish brown, glabrous. Axillary buds often 2 per axil, the upper of which more developed. **Leaves** 2–4-jugate; petiole mostly c. 1.5 mm in diam.; rachis often flattened as well beneath as above; petiolules 3–8 mm long. **Leaflets** (narrowly) elliptic, 5.5–10(–15) by 1.5–3.5(–5) cm, index 2.5–5, chartaceous to coriaceous; base if oblique broadest at ascropic side; margin tending towards being 'shouldered' towards the apex; midrib nearly always slender and angular beneath, nerves up to 1.8 cm apart, angle to midrib 50–70°, reticulations above always clear, beneath nearly always less conspicuous to sometimes invisible. **Inflorescences** 12–20 cm long with few long erecto-patent, spicoid, thick; branches usually unbranched; flowers in sessile clusters; pedicels up to 1 mm long. **Calyx** 4- (rarely 5-)merous, 0.8–1 by 2–2.5 mm. **Disc** sparsely hairy. **Stamens** 7–11; filaments 2 mm long, sparsely hairy in lower half only. **Ovary** 1 by 2 mm, according to

some authors exceptionally 3-celled; style 0.8 mm. **Fruits** as in subsp. *chinensis*.

**Distribution** — *Malesia*: Java; known only cultivated from a few localities, apparently rare.

**Habitat & Ecology** — Unlike subsp. *chinensis* this subspecies seems to thrive well under tropical everwet conditions. It is cultivated at altitudes up to c. 250 m. Fl. Feb.; fr. Mar.

**Uses** — The fruits are probably comparable in quality to those of subsp. *chinensis*.

**Notes** — 1. Subsp. *javensis* was always considered to be introduced from China, and that is why no special attention was paid to it. Only Radlkofer described it as a separate form but with the remark 'status morbosus'. It differs distinctly from subsp. *chinensis*, however, not only morphologically but also by being adapted to an everwet tropical climate. To my knowledge it cannot be linked to any of the Chinese cultivars; the spicoid inflorescences are especially distinctive. It is known only as a rarely cultivated fruit tree of West Java, at least from the 18th century onwards (*J. Burman 119* in L), but it may be indigenous.

2. *Litchi chinensis* subsp. *javensis* Leenh. is based upon *Litchi chinensis* f. *glomeriflora* Radlk.

- c. subsp. **philippinensis** (Radlk.) Leenh., *Blumea* 19 (1971) 129. — *Euphoria didyma* Blanco — *Litchi* sp. nov. Merr., *Philipp. J. Sc.*, Suppl. 1 (1906) 87. — *Litchi philippinensis* Radlk. — *Nephelium didymum* Craib.

**Tree**, up to 35 m high, dbh up to 1.25 m. **Branchlets** 1.5–3 mm in diam., (yellowish to silvery-)grey, glabrous. Axillary buds 1 per leaf axil. **Leaves** 1–3-, mostly 2-jugate; petiole c. 1 mm in diam.; rachis terete or above slightly flattened and carinate; petiolules 4–10 mm long. **Leaflets** elliptic, (7–)8–11(–14) by 2.8–4.5(–8) cm, index 2.5–3, stiff-coriaceous; base if oblique broadest at basiscopic side; midrib beneath prominent and rounded, nerves 0.8–1.5 cm apart, angle to midrib 60–85°, veinlets above invisible, beneath inconspicuous to clear (mainly as the surface over the veins and veinlets is not dull but sometimes even shining; see, however, f. *mindanaensis*). **Inflorescences** 6–14 cm long, often tufted (terminal one with 2 slightly smaller ones at the same level from the upper leaf axils, axillary ones with up to 4 smaller ones or with 2 strong branches from the base); branches few, (erecto-)patent, sparsely rebranched; cymules up to 5 mm long stalked, lax, 5–15-flowered; bracts 0.5–1 mm long; pedicels very slender, 2–5 mm long, in female flowers thickening shortly after fertilization. **Calyx** 4- or 5-merous, 1.8–2 by 2–3 mm. **Disc** hairy. **Stamens** (6 or) 7; filaments 2–4 mm long, densely hairy all over. **Ovary** 1 by 3.5 mm; style 1 mm. **Fruits**

2.5–3 by 2–2.5 cm, densely set with acute, pyramidal warts c. 4 mm diam. and up to 3 mm high. — Fig. 57a–c, f.

Distribution — *Malesia*: Philippines (Luzon, Sibuyan, Samar, Mindanao), SE New Guinea (Northern Prov.: *Hoogland* 3684).

Habitat & Ecology — Primary and secondary forests from sea level to 500 m altitude. Fl. Feb.–May; fr. Apr., July.

Wood anatomy — See Desch, *Mal. For. Rec.* 15 (1954) 532.

Uses — The wood is hard and durable and is used for house poles.

Notes — 1. The above description has been based exclusively upon *L. philippinensis* f. *genuina* Radlk. The only collection known from Mindanao, *Elmer* 13270, was described by Radlkofer as a separate form, f. *mindanaensis*. It differs in a few characters, as follows: Branchlets 3–4 mm in diam. Leaves 1- or 2-jugate; petiole 1–2 mm in diam.; index of leaflets 2–2.5, veins and veinlets beneath hardly visible, the whole lower surface being dull-papillose. As only this one specimen is known, and only 8 specimens of 'f. *genuina*', it is impossible to

decide on the taxonomic status of this form.

2. Subsp. *philippinensis* is not cultivated, and this makes it more probable that the only specimen known from New Guinea, collected from a 20 m high tree in the rain forest, was really wild.

3. Subsp. *philippinensis* is closely allied to subsp. *chinensis*; its small, prickly fruits are quite similar to those of the 'mountain lychee'. Its arillode is said to be short, covering only part of the seed. It is not certain, however, whether the fruits from which this character was noted were fully mature, and in subsp. *chinensis*, too, the arillode develops only very late.

4. Contrary to the opinion of Merrill (1918) and of most subsequent authors but in accordance with Radlkofer (1932), I am of the opinion that *Euphoria didyma* Blanco is synonymous with *Litchi chinensis* subsp. *philippinensis* and not with *Dimocarpus longan* var. *malesianus*. My arguments are: 1) in the description no mention is made of the corolla which in Philippine *Dimocarpus longan* is very conspicuous, and 2) *Dimocarpus longan* var. *malesianus* was already described by Blanco under the name of *Euphoria lit-chi*.

## MISCHOCARPUS

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

*Mischocarpus* Blume, *Bijdr.* (1825) 238, nom. cons.; *Rumphia* 3 (1849) 166; Radlk. in *Engl., Pflanzenz.* 98 (1933) 1288; R.W. Ham, *Blumea* 23 (1977) 251; S.T. Reynolds in *Fl. Austral.* (1985) 94; Yap in *Tree Fl. Malaya* 4 (1989) 449. — *Cupania* sect. *Mischocarpus* Miq., *Fl. Ind. Bat.* 1, 2 (1859) 566. — Type species: *Mischocarpus sundaicus* Blume.

*Pedicellia* Lour., *Fl. Coch.* (1790) 655, nom. rejic. (see under dubious names in R.W. Ham 1977). — Type species: *Pedicellia oppositifolia* Lour.

*Mischocodon* Radlk., *Bot. Jahrb.* 50 (1913) 79; in *Engl., Pflanzenz.* 98 (1933) 1327. — Type species: *Mischocodon reticulatus* Radlk.

*Shrubs* or (large) *trees* (with a slender unbranched stem), monoecious (or dioecious in *M. reticulatus*?). *Indumentum* of mostly appressed, single hairs only. *Leaves* paripinnate, leaflets larger towards the top, 1–6-jugate, no pseudo-stipules or wings; petiole subterete (to dorsoventrally flattened); petiolules present. *Leaflets* alternate to subopposite; base symmetrical (to slightly oblique); margin entire, flat (to revolute); apex (emarginate to) rounded to acuminate, often mucronulate; lower surface not papillate, red glands absent, domatia often present in axils of nerves; the latter looped and joined in the upper part (to indistinctly so in the lower 1/2–3/4); intersecondary nerves present, sometimes indistinct; veins forming a very regular reticulate, dense pattern,  $\pm$  prominent on both surfaces. *Inflorescences* pseudoterminal, axillary, and ramiflorous thyrses, nearly always branching, branches erect to spreading; cymules 1–7(–10)-flowered; pedicels 1–3(–5) mm long;

bracts triangular to lanceolate. *Flowers* unisexual. *Calyx* spreading or cup-shaped, 5- (or 6-)lobed, connate for up to 2/3, persistent in fruit; lobes subequal, (slightly imbricate at base). *Petals* 0–5, 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), exserted; filaments thread-like; anthers basifixed, dehiscence latrorse or latero-introrse, (connective with a lighter coloured wart at the top). *Pistil* (2- or 3- (or 4-)locular; ovules one per locule; ovary stipitate or subsessile; style apical, the upper part split into 3 ± recurved stigmatic lobes. *Fruits* a loculicidally dehiscent capsule, nearly always stipitate (only up to 1 mm high in *M. paradoxus*), not lobed, not winged, the cells about equally developed but the ovules abortive in (1 or 2 cells, red, smooth; stipe hollow; valves thin to almost woody, usually shrivelled after dehiscence; pericarp slightly fleshy; endocarp sclerenchymatic, complete and lining valves and distal parts of the septa, or incomplete, only along the sutures, glabrous or variably hairy. *Seeds* (hanging by the pseudo-funicle); testa shining, chestnut-brown, (nearly) completely covered by a thin-fleshy, translucent arillode, with an abaxial pseudo-funicle descending into the stipe; cotyledons superposed. — **Figs. 58, 59.**

**Distribution** — 15 species from SE Asia, throughout Malesia to Australia; in *Malesia* 9 species, 1 undescribed.

**Habitat & Ecology** — Shrubs and understorey trees of primary and sometimes secondary (rain) forest, from sea level (rocky sea coasts; saltwater creeks) up to 3000 m altitude. The fruits may be attractive to animals because of the showy, slightly fleshy arillode.

#### KEY TO THE SPECIES

- 1a. Midrib above either not visible, hidden in a narrow groove, or rarely visible as a very slender and sharp sunken line . . . . . 2
- b. Midrib above clearly visible, but sometimes covered with hairs . . . . . 4
- 2a. Nerves 12–30 per side. Calyx connate for 1/3. Petals not clawed. Disc annular or slightly cup-shaped. Stipe of fruit 0–6(–15) mm high . . . . . 3
- b. Nerves 6–15 per side. Calyx connate for 1/2–2/3. Petals clawed. Disc cup-shaped. Stipe of fruit 10–25 mm high . . . . . **5. *M. pyriformis***
- 3a. Inflorescences axillary, pseudoterminal, and ramiflorous. Calyx connate for 1/4. Petals 0–2. Disc not interrupted, c. 1.5 mm in diam., puberulous. Stipe of fruit 1.5–6(–15) mm high; endocarp pubescent to densely woolly . . . . . **2. *M. largifolius***
- b. Inflorescences ramiflorous (rarely also axillary). Calyx connate for 1/3. Petals (3–)5. Disc often interrupted, 0.75–1 mm in diam., glabrous or locally puberulous. Fruit not (or hardly) stipitate; endocarp glabrous . . . . . **3. *M. paradoxus***
- 4a. Midrib above more or less hairy in at least some leaflets . . . . . 5
- b. Midrib above always glabrous, rarely subglabrous (see *M. reticulatus*) . . . . . 6
- 5a. Petiolules 4–18(–25) mm long. Cymules stalked, short sericeous. Calyx connate for 1/3–2/3. Petals (0) 1–5. Filaments hairy. Fruits outside glabrous . . . . . **5. *M. pyriformis***
- b. Petiolules 2–5 mm long. Cymules almost sessile, long-hairy. Calyx connate for 1/3. Petals absent. Filaments glabrous. Fruit outside densely ferruginous . . . . . **1. *M. lachnocarpus***



- 6a. Inflorescences ramiflorous (rarely also axillary) . . . . . 7  
 b. Inflorescences axillary and pseudoterminal . . . . . 10  
 7a. Inflorescence branches more than 11 cm long, branching. Fruit without a stipe or stipe at most 3 mm high . . . . . 8  
 b. Inflorescence branches less than 11 cm long, branching or not. Fruit stipe at least 4 mm high . . . . . 9  
 8a. Fruits not stipitate or stipe at most 1 mm high. Calyx outside sparsely pubescent, inside puberulous near the base, often as a row of short hairs. Disc often irregularly deeply lobed to interrupted. Arillode without pseudo-funcle . . . **3. M. paradoxus**  
 b. Fruit stipe 1–3 mm high. Calyx outside glabrous, inside glabrous or with a few hairs. Disc slightly lobed. Arillode with short pseudo-funcle

**9. *Mischocarpus prob. spec. nov.***

- 9a. Inflorescence axes up to 10 cm long, not or very sparsely branched. Calyx hardly connate. Petals (2–)5. Filaments sparsely hairy or glabrous . . . . . **8. M. triqueter**  
 b. Inflorescence axes up to 5 cm long, branching. Calyx connate for 1/2–3/4. Petals absent. Filaments glabrous . . . . . **6. M. reticulatus**  
 10a. Midrib above prominent, angular to rounded. Calyx connate for 1/3 (if connate for more than 1/4, then petals absent and filaments glabrous). Petals well-developed but not clawed, or reduced to absent. Disc annular, 1–2(–3) mm in diam. Filaments hairy or glabrous . . . . . 11  
 b. Midrib above a prominulous to flattened slender line only. Calyx connate for 1/3–2/3. Petals 1–5, well developed, clawed. Disc cup-shaped, 0.5–1 mm in diam. Filaments ± hairy . . . . . **5. M. pyriformis**  
 11a. Leaflets (1 or) 2–6 per side; midrib above angular (to locally to rarely completely rounded); reticulation usually coarse. Calyx outside ± puberulous all over, hardly connate (rarely for 1/4). Petals 0–5. Filaments usually puberulous at least at the base (to glabrous); anthers glabrous or ± hairy . . . . . **4. M. pentapetalus**  
 b. Leaflets 1–3 (or 4) per side; midrib above rounded, locally (to completely) angular; reticulation usually fine and dense. Calyx outside ± hairy in the lower half only, connate for 1/4–1/3. Petals 0 (rarely up to 3 in Peninsular Malaysia). Filaments glabrous; anthers glabrous . . . . . **7. M. sundaicus**

**1. *Mischocarpus lachnocarpus*** (F. Muell.) Radlk., Sapind. Höll.-Ind. (1879) 43; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 536, 647; Domin, Bibl. Bot. 22 (1927) 910; C.T. White, Contr. Arnold Arbor. 4 (1933) 63; Radlk. in Engl., Pflanzenr. 98 (1933) 1304; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 523; R.W. Ham, Blumea 23 (1977) 268; S.T. Reynolds in Fl. Austral. 25 (1985) 96, f. 21a, b, map 123. — *Ratonia lachnocarpa* F. Muell., Fragm. Phyt. Austral. 4 (1864) 157; F.M. Bailey, Queensl. Fl. 1 (1899) 296; Queensl. Agr. J. 5 (1899) 396. — *Cupania lachnocarpa* F. Muell. [Fragm. Phyt. Austral. 4 (1864) 157, nom. inval.] Fragm. Phyt. Austral. 5 (1865) 6; 9 (1875) 91. — Lectotype (R.W.

Ham 1977): *Dallachy s.n.*, 14 Apr. 1864 (MEL holo, sh. 56003), Australia.

*Shrub or tree*, up to 20 m high; densely ferruginous pubescent to puberulous when young (to subglabrous). *Twigs* 2–4 mm in diam. *Leaves* 1- or 2- (or 3-)jugate; petiole 1–4.5(–7) cm long; petiolules 2–5 mm long. *Leaflets* elliptic to obovate, 4–14(–17) by 1.8–6.5 cm, index 1.5–3.2, pergamentaceous to coriaceous, (bullate); base acute (to obtuse); above puberulous to pubescent on the midrib (and nerves to the entire upper side laxly pubescent), beneath pubescent mainly on the midrib and nerves and along the margin, domatia absent or inconspicuously in the axils of the nerves; midrib above prominent, rounded; nerves 10–14 per side, above

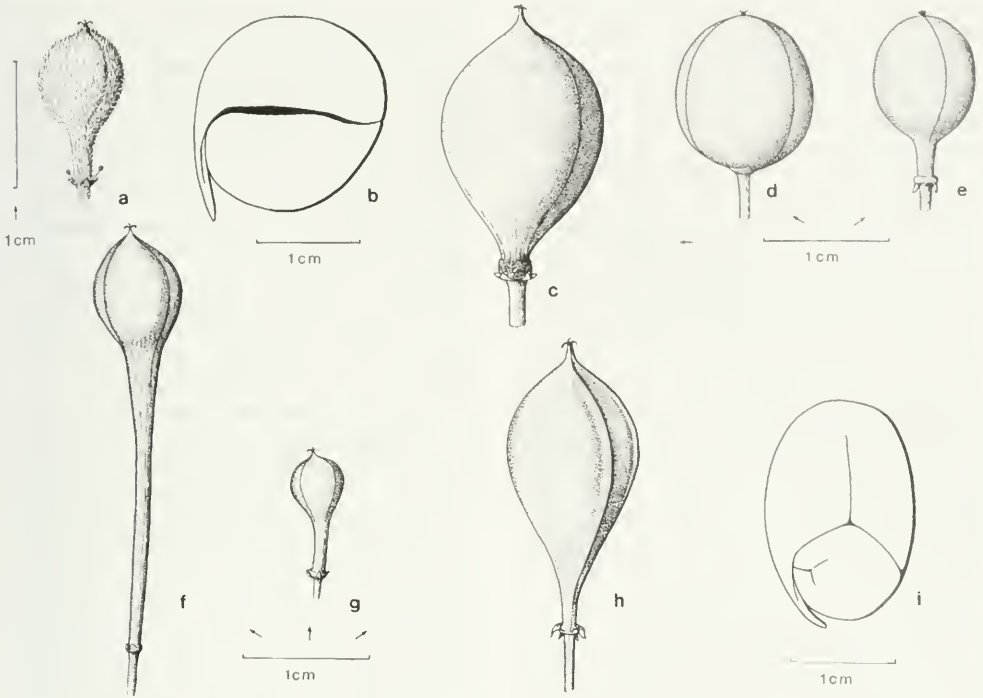


Fig. 58. *Mischocarpus* Blume. Fruits and embryos. — *M. lachnocarpus* (F. Muell.) Radlk. a. Fruit; b. embryo. — *M. largifolius* Radlk. c. Fruit. — *M. paradoxus* Radlk. d. Fruit. — *M. pentapetalus* (Roxb.) Radlk. e. Fruit. — *M. pyriformis* (F. Muell.) Radlk. subsp. *papuanus* (Radlk.) R.W. Ham. f. Fruit. — *M. sundaicus* Blume. g. Fruit. — *M. triqueter* Radlk. h. Fruit; i. embryo (a: MEL 56004; b: Dallachy s.n.; c: Scholde & Craven 3963; d: Forbes 309; e: PNH 34128; f: Chalmers s.n.; g: FB 24765; h: BS 42010; i: McGregor 271).

prominulous, beneath prominent; veins rather dense, above prominulous, beneath prominent, becoming more distinct towards the margin. *Inflorescences* axillary and pseudoterminal, up to 14 cm long; axes branched; cymules almost sessile, densely ferruginous pubescent; bracts triangular, up to 2 by 1 mm, outside densely ferruginous pubescent, inside nearly glabrous; pedicels up to 1 mm long. *Calyx* hardly connate; lobes triangular, c. 1.5 by 1 mm, subcoriaceous, outside pubescent to villous, inside glabrous or with a few hairs near the base. *Petals* 0. *Disc* annular, up to 1.5 mm in diam., puberulous. *Stamens* 8, up to 2 mm long; filaments glabrous; anthers papillate or not, glabrous (or pubescent). *Pistil* rather densely velutinous. *Fruits* 12–16(–20) mm high, densely ferruginous-villous to velutinous, (partly glabrescent); stipe 3–7 by c. 1 mm, seed-bearing part globose to ellipsoid to obovoid, triangular in cross section, apiculate for 1–2 mm, inside laxly pubescent to villous, mainly along the sutures; endocarp completely sclerenchy-

matic. *Seeds* globose, c. 7 mm long; cotyledons about equal, superposed. — Fig. 58a, b.

*Distribution* — Australia (N and E Queensland, NE New South Wales) and *Malesia*: New Guinea (Aru Islands and S and E Papua New Guinea up to Normanby I.).

*Habitat & Ecology* — Primary and secondary rain forest, also along streams in open savannah, up to 1300 m altitude. Fl. Dec.–July; fr. Mar.–Aug.

2. *Mischocarpus largifolius* Radlk., Bot. Jahrb. 56 (1920) 304, f. 4g–j; in Engl., Pflanzenr. 98 (1933) 1308, f. 38g–j; R.W. Ham. Blumea 23 (1977) 269. — Type: *Ledermann 12693* (B<sup>+</sup> holo; M), Papua New Guinea.

*Tree* up to 33 m high, dbh up to 1 m; puberulous, early glabrescent; buttresses usually present, up to 1 m high, 2 m spreading, and 3 cm thick; bark grey to darkbrown (to white), smooth. *Twigs* 3–10 mm in diam., sometimes grooved. *Leaves* 1–

4-jugate; petiole 4–20 cm long; petiolules 4–15 mm long. *Leaflets* ovate to elliptic, 7–38 by 2–16 cm, index 2–3, pergamentaceous to coriaceous. ( $\pm$  bullate); base rounded or obtuse (to acute), domatia absent or inconspicuously in the axils of the nerves below; midrib not visible above and hidden in a narrow groove, (or a very slender and sharp, sunken line); nerves 12–30 per side, usually very regular, moderately curved; veins usually very regularly reticulate, above prominent to indistinct, beneath prominent. *Inflorescences* axillary, pseudoterminal, and ramiflorous on branches up to 12 mm in diam., up to 32 cm long; axes branched; bracts up to 2 mm long. *Calyx* connate for up to 25%; lobes triangular, up to 1 by 1 mm, subcoriaceous to somewhat fleshy, outside sparsely, inside more densely pubescent, near the base with a dense row of hairs. *Petals* 0–2, elliptic, up to 1 by 0.5 mm, not clawed, inside pubescent, with two hairy auricles at the base. *Disc* annular, c. 1.5 mm in diam., puberulous. *Pistil* densely short sericeous. *Fruits* 14–28(–40) mm high, glossy, glabrous; stipe (0)–1.5–6(–15) by c. 1.5 mm; seed-bearing part ellipsoid to obovoid, triangular to rounded-triangular in cross section, up to 1.5 cm wide; endocarp thin, completely sclerenchymatic, pubescent to densely woolly; septa densely woolly to glabrous. *Seeds* ellipsoid, 10–14 mm long; cotyledons subcollateral, lower cotyledon folded, usually smaller than the upper one, (upper one folded). – **Fig. 58c.**

**Distribution** – Solomon Islands to *Malesia*: New Guinea (Irian Jaya: Vogelkop; Papua New Guinea: N coast up to Peninsula).

**Ecology** – Primary and secondary forest, from sea level up to 1300(–2800) m altitude. Fl. Mar.–May; fr. May–Oct. Twigs and leaf rachises often show holes in the bark and cavities inside as if they were inhabited by ants.

**3. *Mischocarpus paradoxus*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1920) 306; Baker, J. Bot. 61, Suppl. (1923) 11; Radlk. in Fedde, Rep. 20 (1924) 40; in Engl., Pflanzenr. 98 (1933) 1310; R.W. Ham, Blumea 23 (1977) 270. — Type: *Forbes 310* (M holo; BM, prob. L), New Guinea.

*Shrub* or *tree*, up to 5(–20?) m high; puberulous, early glabrescent. *Twigs* 3–8 mm in diam. *Leaves* 3- or 4-jugate; petiole 5–11(–17) cm long; petiolules 4–11(–15) mm long. *Leaflets* ovate to elliptic, 12–27 by 4.5–11 cm, index 1.8–3.2, pergamentaceous to subcoriaceous; base rounded (to obtuse or acute); domatia absent or inconspicuously in axils of nerves below; midrib above an angular

line, nearly always visible; nerves 12–24 per side, moderately curved; veins very regularly reticulate, prominent on both surfaces. *Inflorescences* ramiflorous, on 7–13 mm thick branches (to rarely axillary); axes up to 25 cm long, sparsely to rather strongly branched; bracts triangular, up to 1 mm high. *Calyx* connate for 1/3; lobes triangular, usually slightly acuminate, up to 1.2 by 0.5 mm, (unequal), subcoriaceous, outside sparsely pubescent, inside puberulous near the base, often as a row of short hairs. *Petals* (3)–5(–6),  $\pm$  elliptic, up to 0.5 mm long, not clawed, glabrous or with a few hairs near the base, not auriculate. *Disc* annular or slightly cup-shaped, often irregularly, deeply lobed to interrupted, 0.75–1 mm in diam., glabrous or locally sparsely puberulous. *Stamens* 8, up to 2 mm long; filaments pubescent; anthers smooth or locally inconspicuously papillate, glabrous. *Pistil* not or shortly stipitate, pubescent. *Fruits* globose, up to 1 cm in diam., not stipitate or stipe c. 1 mm long in unripe fruits, glabrous, with many light brown dots and faint remnants of a waxy covering, very shortly apiculate, thin-walled; endocarp incompletely sclerenchymatic, consisting of a c. 2 mm wide tapering plate at either side of the suture, glabrous; septa glabrous. *Seeds* up to 9 mm long, globose to ellipsoid, arillode without appendix; cotyledons subcollateral, lower cotyledon folded, usually smaller than the upper one. – **Fig. 58d.**

**Distribution** – *Malesia*: Papua New Guinea (Central Prov.).

**Ecology** – Primary and secondary forest; 400–1400 m altitude. Fl. June–Sept.; fr. Oct.–Nov.

**4. *Mischocarpus pentapetalus*** (Roxb.) Radlk., Sapind. Holl.-Ind. (1879) 43; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 646, 648; Lecomte in Fl. Indo-Chine. 1 (1912) 1028; Radlk. in Engl., Pflanzenr. 98 (1933) 1293; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 984; R.W. Ham, Blumea 23 (1977) 271; Yap in Tree Fl. Malaya 4 (1989) 449; Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 347. — *Schleichera pentapetala* Roxb., [Hort. Beng. (1814) 29, nom. nud.] Fl. Ind. ed. Carey (1832) 275. — *Schmidelia pentapetala* Wight, Ic. 2 (1840) t. 402, nom. illeg. — [*Cupania pentaphylla* Wight, Ic. 2 (1840) t. 402, nom. inval. — *Schleichera pentaphylla* Roxb. in Wight, Ic. 2 (1840) t. 402, nom. inval. —] *Cupania roxburghii* Wight, Ic. 2 (1840) t. 402, nom. illeg. — *Cupania pentaphylla* Hiern in Hook. f., Fl. Br. India 1 (1875) 678. — *Pedicellia pentapetala* Pierre, Fl. Coch. (1895) text with t. 324a.



- Type: *M.R. Smith (3041?)*, 1811 (BM holo), India.
- Mischocarpus sumatranus* Blume, Rumphia 3 (1847) 168; Radlk., Sapind. Holl.-Ind. (1879) 12, 44; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 646, 648; King, J. As. Soc. Beng. 65, II (1896) 448; Veleton, Bull. Inst. Bot. Buitenzorg 15 (1902) 10; Ridley, Fl. Malay Penins. 1 (1922) 508; Merr., Pl. Elmer. Born. (1929) 176; Radlk. in Engl., Pflanzenr. 98 (1933) 1298; Burk., Dict. Econ. Prod. Malay Penins. (1935) 1480; Corner, Wayside Trees (1940) 589; Adelb., Blumea 6 (1984) 234. — *Cupania sumatrana* Miq., Fl. Ind. Bat. 1, 2 (1859) 566; Hiern in Hook. f., Fl. Br. India 1 (1875) 678; Kurz., Rep. Pegu (1875) 32; Fl. Burma 1 (1877) 285; Kanjilal & Das, Fl. Assam 1 (1936) 317. — *Ratonia sumatrana* Kurz., Rep. Pegu (1875) App. A38, B40. — *Pedicellia sumatrana* Pierre, Fl. Coch. (1895) text with t. 323b. — Lectotype (R.W. Ham 1977): *Anonymous s.n.* (L holo, sh. 908.269-1030), S Sumatra.
- Mischocarpus fuscescens* Blume, Rumphia 3 (1847) 169; Radlk., Sapind. Holl.-Ind. (1879) 12, 43; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 646, 648; King, J. As. Soc. Beng. 65, II (1896) 447; Veleton, Bull. Inst. Bot. Buitenzorg 15 (1902) 10; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 221; Lecomte in Fl. Indo-Chine 1 (1912) 1028, excl. var. *bonii* H. Lecomte; Ridley, Fl. Malay Penins. 1 (1922) 508; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Radlk. in Engl., Pflanzenr. 98 (1933) 1294; Ramesh Rao, Ind. Woods 2 (1963) 223, f. 325; Backer & Bakh. f., Fl. Java 2 (1965) 141. — *Cupania fuscescens* Miq., Fl. Ind. Bat. 1, 2 (1859) 567. — *Pedicellia fuscescens* Pierre, Fl. Coch. (1895) text with t. 323b.; Hu, Bull. Fan Mem. Inst. Biol. 1 (1929) 31. — Lectotype (R.W. Ham 1977): *Anonymous s.n.* (L holo, sh. 908.269-555), Java.
- Schleichera subundulata* Turcz., Bull. Soc. Nat. Moscou 21 (1848) 574. — *Cupania subundulata* Rolfé, J. Bot. 23 (1885) 211; Vidal, Phaner. Cuming. (1885) 6, 105. — Type: *Cuming 507* (KW holo, n.v.; A, Fl. K. L. M. P. SING; KW, n.v.), Philippines.
- Mischocarpus salicifolius* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 64; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Radlk. in Engl., Pflanzenr. 98 (1933) 1297. — Type: *Merrill 1842* (B<sup>+</sup> holo; M, US), Philippines.
- Mischocarpus ellipticus* Radlk. in Elmer, Leafl. Philipp. Bot. 1 (1907) 210; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Radlk. in Engl., Pflanzenr. 98 (1933) 1294. — Type: *Elmer 7272* (M holo; A, BO, K), Philippines.
- Mischocarpus endotrichus* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1615; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Radlk. in Engl., Pflanzenr. 98 (1933) 1303. — Type: *Elmer 12977* (M holo; A, BM, BO, Fl. K, L, P, U, US), Philippines.
- Mischocarpus brachyphyllus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 472; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 512; Radlk. in Engl., Pflanzenr. 98 (1933) 1304. — Lectotype (R.W. Ham 1977): *Vanoverbergh 1175* (M holo; A, L, P, U, WRLS), Philippines.
- Mischocarpus sublaevis* Radlk., Philipp. J. Sc. 20 (1922) 662; in Engl., Pflanzenr. 98 (1933) 1303. — Type: *Wenzel 660* (error 600 in Radlk.) (M holo; A, BM), Philippines.
- Nephetium hosei* Ridley, Kew Bull. (1933) 191, type only; Harms in Engl., Pflanzenr. 98 (1934) 1500. — Type: *Hose 124* (BM? holo, n.v.; CGE, L), Sarawak.
- Shrub or tree* up to 15(–25) m high; puberulous on all young parts and especially in the inflorescences, brownish ferruginous, partly glabrescent. Twigs (2–)3–9(–12) mm in diam., brownish to reddish brown, (becoming greyish brown). Leaves (1–)2–5(–6)-jugate; petiole 3–25 cm long; petioles 3–12 mm long. Leaflets ovate to elliptic, (5–)7–20(–40) by (1–)2–6(–15) cm, index 2–5(–8), pergamentaceous to coriaceous; base rounded or angular; domatia usually present in the axils of the nerves below; midrib above prominent, angular (to rounded in the basal part or completely so), rather flat and broad in the basal part in big leaflets; nerves (6–)9–20(–25) per side, at least prominent on the lower surface, (hardly distinct from veins); veins usually coarsely reticulate, above hardly or not prominent, beneath prominent. Inflorescences axillary and pseudoterminal; main axis up to 40 cm long; secondary axes 1–20 cm long; cymules up to 11 mm long; bracts triangular, up to 6 by 1.5 mm (to 8 by 4 mm), (those of the secondary axes caducous). Calyx hardly connate, rarely so for 1/4; lobes triangular to ovate, 0.75–2 by 1–2 mm, subcoriaceous to slightly fleshy, sometimes 1(–3) nerves visible, outside puberulous to pubescent (to very sparsely so in the upper part), inside puberulous, at least at the base as a more or less dense row. Petals 0–5, usually unequal, ovate to elliptic, minute to 2 by 1 mm, glabrous or pubescent (usually at the base), not clawed, usually auriculate. Disc annular, (1–)1.5–2(–3) mm in diam., sometimes irregularly lobed, rarely with lobes protruding between the stamens, puberulous or glabrous. Sta-

*mens* 7 or 8, 3–4 mm long; filaments puberulous (to glabrous); anthers papillate, sparsely pubescent or glabrous. *Pistil* puberulous. *Fruits* (0.8–)1–2(–3) cm long, glabrous; stipe 2–11 by 1–2 mm; seed-bearing part globose to ellipsoid to obovoid, triangular (or triquetrous) in cross section, 0.4–1.4 cm in diam., inside glabrous (or completely, rather densely hairy); endocarp incomplete (2 mm thick at either side of the suture) to complete, usually less so in the fertile than in the sterile cells. *Seeds* up to 8(–12) mm long, ellipsoid to globose; cotyledons subcollateral, both or only the lower one folded, lower one usually smaller. — **Fig. 58c.**

**Distribution** — From India, Burma, SW China, throughout SE Asia, to W Malesia up to the line Philippines–Borneo–Java.

**Habitat & Ecology** — Primary and secondary forest; (300–)800–2000 m altitude. Fl. and fr. throughout the year, but the main periods different in the various regions, e.g. Java: fl. Nov., fr. Jan.–Mar.; Philippines: fl. Mar.–May, fr. Mar.–June.

**Notes** — 1. Many species formerly kept separate are included in *M. pentapetalus*. Two of these, '*M. endotrichus*' and '*M. brachyphyllus*', were distinguished by the presence of a hairy endocarp. Further species were differentiated on the variation in the petals. However, the whole range of variation, from 5 well-developed auriculate petals via 5 or less, reduced, non-auriculate ones, to petals absent, occurred in each of these species. Variation in the leaflets led to the description of several more species; '*M. sumatranus*' has leaflets with many pronounced nerves and is common in SE Asia, Sumatra, Borneo, and Luzon; '*M. fuscescens*' has leaflets with few, usually less pronounced nerves; it occurs throughout western Malaysia. The variation is extreme in N Borneo and the Philippines; leaflet length : breadth ratio varies here from 2 to 8 ('*M. ellipticus*' and '*M. salicifolius*' resp.), and leaflet sizes range from 5 by 2 cm up to 38 by 15 cm. Collections of the '*salicifolia*' type are widespread in the Philippines, while the '*ellipticus*' type comes usually from Samar, Leyte, Negros, and northern Mindanao, outside the Philippines being represented also in Indo-China ('*M. pentapetalus* var. *cambodianus*'). However, in spite of their variation in flowers and fruits, they are not different from material from India, China, Java, or elsewhere. Notwithstanding all this variation *M. pentapetalus* is a well-defined species.

2. See also note 2 under *M. sundaiicus*.

**5. *Mischocarpus pyriformis*** (F. Muell.) Radlk., Sapind. Holl.-Ind. (1879) 43; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 536, 647; Maiden & Betche,

Cens. N.S.W. Pl. (1916) 129; Domin, Bibl. Bot. 22 (1927) 910; Francis, Austral. Rain-For. Trees (1929) 235; ed. 2 (1951) 261; Radlk. in Engl., Pflanzenr. 98 (1933) 1305; Merr. & L.M. Perry, J. Arnold Arbor. 21 (1940) 523; R.W. Ham, Blumea 23 (1977) 275; S.T. Reynolds in Fl. Austral. 25 (1985) 97. — *Schmidelia pyriformis* F. Muell., Fragm. Phyt. Austral. 1 (1858) 2, comb. illeg. — *Cupania pyriformis* F. Muell., Fragm. Phyt. Austral. 2 (1860) 76; 5 (1865) 147; 9 (1875) 90; Ch. Moore, Fl. N.S.W. (1893) 91. — *Ratonia pyriformis* Benth., Fl. Austral. 1 (1863) 461. — Lectotype (R.W. Ham 1977): *Hill & Mueller s.n.* (MEL holo, sh. 56010; K, M, MEL), Queensland.

*Mischocarpus papuanus* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1924) 39; in Engl., Pflanzenr. 98 (1933) 1307; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) f. 14. — Type: *Chalmers s.n.*, 1885 (M holo), New Guinea.

*Mischocarpus retusus* Radlk., Bot. Jahrb. 56 (1920) 304, f. 4a–f; in Engl., Pflanzenr. 98 (1933) 1308, f. 38a–f. — Lectotype (R.W. Ham 1977): *Ledermann 11231* (B† holo; M), New Guinea.

**Shrub** or **tree** up to 30 m high; puberulous, glabrescent. **Twigs** 1.5–6 mm in diam., **Leaves** 1–4-jugate; petiole 1–8 cm long; petiolules 4–18(–25) mm long. **Leaflets** ovate to elliptic, 3.5–18 by 1.2–7 cm, index 2–3.5, pergamentaceous to coriaceous; base acute to obtuse (or rounded); margin flat to revolute; domatia absent or present. (conspicuous), usually restricted to the axils of the basal nerves below; midrib above not visible and hidden in a narrow groove, or (locally) visible as a slender, sunken to prominulous line, beneath prominent till the apex, (puberulous on both sides); nerves 6–15 per side, moderately (to irregularly) curved, above prominulous or slightly sunken (to hardly distinct from venation), beneath prominent to prominulous; veins rather densely reticulate, above prominulous to sunken, beneath prominent to prominulous. **Inflorescences** axillary and pseudoterminal, up to 25 cm long, axes branched; cymules often crowded to the end of the axes; bracts triangular, up to 1.5 mm long. **Calyx** cup-shaped, up to 2 mm high, connate for 1/2–2/3; lobes triangular, 0.3–0.8 mm long, subcoriaceous, outside densely appressedly short-hairy especially in the upper half, inside glabrous or puberulous. **Petals** 0–5, up to 1.5 mm long, clawed for 1/3–3/4, variably hairy, ciliate, mainly on the claw, scales, and auricles; claw usually clearly tubular, split inside; blade varying from triangular to ovate, usually with 2 scales or auricles at the base, usually with 2 or 3 rounded or acute lobes

at the apex. *Disc* annular to cup-shaped, uninterrupted, lobed, or interrupted once to several times, 0.5–1 mm in diam., glabrous. *Stamens* (7) 8, up to 3 mm long; filaments pubescent; anthers papillate, pubescent to puberulous or glabrous. *Pistil* stipitate; stipe usually grooved; ovary not grooved, short sericeous mainly in the upper half. *Fruits* up to 3.5 cm high, glabrous; stipe up to 2.5 cm long by 1.5 mm in diam. at the base; seed-bearing part globose to ellipsoid, rounded to triangular in cross section, up to 1 cm in diam., apiculate; endocarp partly or completely sclerenchymatic, glabrous (or locally hairy). *Seeds* ellipsoid, up to 7 mm long; cotyledons subcollateral, lower folded, usually smaller than the upper one.

Distribution – Australia (NE and E Queensland, NE New South Wales) and *Malesia*: New Guinea.

Habitat & Ecology – Subsp. *retusus* is found in the high mountains, subsp. *papuanus* at lower altitudes.

Note – Three subspecies can be recognized, of which one, subsp. *pyriformis*, is found only in Australia. The remaining two subspecies are readily separable in Papua New Guinea, but only with difficulty so in the Vogelkop in Irian Jaya.

#### KEY TO THE SUBSPECIES

1a. Leaflets not or very shortly acuminate; domatia 1 or 2(–7), usually conspicuous, very rarely absent. *Disc* c. 1 mm in diam. Anthers hairy

b. subsp. *retusus*

b. Leaflets with long and slender acumen, or acumen rarely short and broad; domatia 1 or 2 small ones or absent. *Disc* 0.5–1 mm in diam. Anthers glabrous (or with few hairs)

a. subsp. *papuanus*

a. subsp. *papuanus* (Radlk.) R.W. Ham, *Blumea* 23 (1977) 277. — *Mischocarpus papuanus* Radlk.

*Twigs* 1.5–4 mm in diam. *Leaves* (1–) 2- or 3-(4-)jugate; petiole 2–8 cm long; petiolules 4–20 mm long. *Leaflets* 5–16 by 2–6 cm, index 2–3, pergamentaceous to subcoriaceous; apex with a long and slender (or short and broad) acumen; domatia absent or 1 or 2 small ones in the axils of the basal nerves; nerves 7–15 per side. *Inflorescences* up to 20 cm long. *Calyx* lobes up to 0.5 mm long. *Petals* 1–5, up to 1 mm long. *Disc* 0.5–1 mm in diam. *Stamens* 7 or 8; anthers glabrous or with a few hairs. *Fruits* up to 3.5 cm high; stipe (10–)15–25 mm long, up to 1 mm in diam. at the base; seed-bearing part up to 1 cm in diam.; endocarp glabrous. – **Fig. 58f.**

Distribution – *Malesia*: Irian Jaya (N coast from

Vogelkop to Jayapura) and Papua New Guinea (Western, Morobe, and Gulf Prov.).

Habitat & Ecology – Primary rain forest; sea level up to 1200(–1800) m altitude. Fl. Mar.–July; fr. Mar., Apr., Aug.

b. subsp. *retusus* (Radlk.) R.W. Ham, *Blumea* 23 (1977) 277; S.Tl. Reynolds in *Fl. Austral.* 25 (1985) 98, map 127. — *Mischocarpus retusus* Radlk.

*Twigs* 2–3 mm in diam. *Leaves* 1- or 2-(3-)jugate; petiole 1–5 cm long; petiolules 4–18 mm long. *Leaflets* 3.5–13 by 1.2–4.5 cm, index 2–3.5, coriaceous; apex not or shortly acuminate; domatia (rarely absent to) usually conspicuous, 1 or 2(–7), usually in the axils of the basal nerves; nerves 6–12 per side. *Inflorescences* up to 15 cm long. *Calyx* lobes up to 0.8 mm long. *Petals* 4 or 5, up to 1.5 mm long. *Disc* c. 1 mm in diam. *Stamens* 8; anthers puberulous. *Fruits* up to 2.5 cm high; stipe 10–17(–20) mm long, up to 1.5 mm in diam. at the base; seed-bearing part up to 8 mm in diam.; endocarp sometimes with a few hairs.

Distribution – Australia (NE Queensland) and *Malesia*: Irian Jaya (Jayapura and Snow Mountains Prov.) and Papua New Guinea (E Sepik, W Highlands, S Highlands, Morobe, and Milne Bay Prov.).

Habitat & Ecology – Primary forest at (1000–) 1300–3000 m altitude. Fl. and fr. the whole year round.

6. *Mischocarpus reticulatus* (Radlk.) R.W. Ham, *Blumea* 23 (1977) 280. — *Mischocodon reticulatus* Radlk., *Bot. Jahrb.* 50 (1913) 80; 56 (1920) 308; in *Engl., Pflanzenz.* 98 (1933) 1328; Merr. & L.M. Perry, *J. Arnold Arbor.* 21 (1940) 524; P. Royen, *Man. For. Trees Papua & New Guinea* 2 (1964) 33; Hartley et al., *Lloydia* 36 (1973) 270. — Lectotype (R.W. Ham 1977): *Schlechter 17683* (B<sup>+</sup> holotype; M), New Guinea.

*Tree* up to 15 m high, dbh up to 0.75 m; puberulous, early glabrescent. *Twigs* 4–7 mm in diam., slightly grooved. *Leaves* 2–4-jugate; petiole 7–20 cm long; petiolules 7–14 mm long. *Leaflets* ovate to elliptic, 7–28 by 3.4–10 cm, index 2–3.2, pergamentaceous to subcoriaceous, slightly bullate; base acute to obtuse or rounded; domatia small, in the axils of the nerves (and intersecondary nerves) below; midrib prominent above, angular or locally obtuse, (sub)glabrous, (beneath puberulous); nerves 10–14 per side, moderately curved, prominent on both surfaces; veins prominent above and beneath. *Inflorescences* ramiflorous, on branches of at least 6–10 mm in diam., (to axillary), probably also cauliflorous; axes up to 5 cm long, branched, ferrugi-





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Fig. 59. *Mischochloa reticulata* (Radlk.) R.W. Ham. a. Part of twig, top leaflet from above; b. male inflorescence; c. male flower, calyx removed; d. female flower; e. *ibid.*, calyx removed; f. infructescence (a: Hartley 12423; b, c: Hartley 12534; d, e: Carr 14994; f: Clemens 8619).

neous puberulous; flowers solitary or rarely in pairs; pedicels up to 5 mm long; bracts lanceolate to ovate, up to 3 mm long. *Calyx* cup-shaped, 3–5 mm high, connate for 1/2–3/4, membranous, greenish white; lobes triangular, up to 2 by 2 mm, with 3 or 5 nerves, outside sparsely pubescent, inside glabrous or with a few hairs near the base. *Petals* absent. *Disc* annular to pentagonal, broad, nearly completely covering the receptacle, surrounding the base of the stamens, confluent with the base of the pistil, 2–3 mm in diam., glabrous or laterally puberulous. *Stamens* 5–7; filaments up to 11 mm long, filiform, glabrous; anthers smooth (or papillate at the apex), glabrous. *Pistil* glabrous or sparsely hairy, distinctly angular in cross section; style with 1–1.5 mm long, recurved, twisted stigmatic lobes. *Fruits* up to 2.5 cm high, glabrous; stipe 5–14 by c. 1.5 mm; seed-bearing part globose, up to 1 cm in diam., apiculate for 1–2 mm, inside glabrous; endocarp sclerenchymatic for 2/3 of the width of a valve. *Seeds* not known ripe. — **Fig. 59.**

Distribution — *Malesia*: Papua New Guinea (Madang, E Highlands, Morobe, and Central Prov.).

Habitat & Ecology — Mountain rain forest from 600–1650 m altitude. Fl. Mar., May, Sept.–Dec.; fr. July, Aug., Oct.

7. *Mischocarpus sundaicus* Blume, Bijdr. (1825) 238; Rumphia 3 (1847) 167; Radlk., Sapind. Holl.-Ind. (1879) 12, 91; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 646; King, J. As. Soc. Beng. 65, II (1896) 447; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 223; Lecomte in Fl. Indo-Chine 1 (1912) 1029, f. 128; Radlk., Bot. Jahrb. 56 (1920) 303; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Craib, Fl. Siam. Enum. 1 (1926) 333; Radlk. in Engl., Pflanzenr. 98 (1933) 1299; Burk., Dict. Econ. Prod. Malay Penins. (1935) 1479; Corner, Wayside Trees (1940) 589, f. 211, 212; Adelb., Blumea 6 (1948) 324; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 986; Backer & Bakh. f., Fl. Java 2 (1965) 141; R. W. Ham, Blumea 23 (1977) 281; Yap in Tree Fl. Malaya 4 (1989) 449. — *Cupania lessertiana* Cambess., Mém. Mus. Hist. Nat. Paris 18 (1829) 28, 46, t. 3, comb. illeg.; Hiern in Hook. f., Fl. Br. India 1 (1875) 678. — *Cupania mischocarpus* Steud., Nomencl. ed. 2, 1 (1840) 454, comb. illeg. — *Pedicellia sundaica* Pierre, Fl. Coch. (1895) t. 323b. — Lectotype (R. W. Ham 1977): *Anonymous s.n.* (L. holo, sh. 908,269-749), Java.

*Schleichera revoluta* Turcz., Bull. Soc. Nat. Moscou 21 (1848) 574. — *Cupania revoluta* Rolfe, J. Bot. 23 (1885) 211; Vidal, Phan. Cuming. (1885) 49, 105, non Radlk., comb. illeg. (ICBN

1972, art. 64). — Type: *Cuming 1387* (KW holo, n.v.; BM, K, L, P), Philippines.

*Cupania erythrorhachis* Miq., Sumatra (1861) 199, 509. — Type: *Teijsmann 4557* (U holo; BO, K, L, M), Sumatra.

*Mischocarpus lessertianus* Ridley, Fl. Malay Penins. 1 (1922) 508; Burk., Dict. Econ. Prod. Malay Penins. (1935) 1479. — Lectotype (R. W. Ham 1977): *Ridley 1908* (SING holo), Singapore.

[*Mischocarpus vulcanicus* Elmer ex Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513, nom. nud.; Elmer, Leafl. Philipp. Bot. 10 (1939) 3809, nom. nud. — Based on *Elmer 17092, 17116* (A, BM, BO, Fl. K, L, NY, P, U, UC, US; PNH †), Philippines.]

*Mischocarpus pyriformis* auct. non Radlk.: T. C. White, Contr. Arnold Arbor. 4 (1933) 63.

*Shrub* or *tree*, up to 10(–30) m high; puberulous in the young parts and inflorescences. *Twigs* 1.5–5 mm in diam., usually reddish brown. *Leaves* 1–3- (or 4-)jugate (or simple); petiole 1–11 cm long; petiolules 3–8 mm long. *Leaflets* ovate to elliptic, 4–17(–26) by 1.5–7(–10) cm, index 2–4.5, pergamentaceous to subcoriaceous; base rounded or angular; (margin slightly revolute); domatia usually present in the axils of the nerves below; midrib prominent above, broad to rather narrow, usually rounded, often locally angular (to completely so); nerves 8–15 per side, moderately curved, beneath prominent; veins densely reticulate, prominent to smooth above, beneath more prominent to the margin. *Inflorescences* axillary and pseudoterminial, 1.5–25 cm long, branched; cymules shortly stalked; pedicels 1–3 mm long; bracts triangular, up to 1.5 mm long (to up to 6 by 2 mm), usually caducous. *Calyx* connate for 1/4–1/3; lobes triangular, 0.65–2 by 0.5–1 mm, subcoriaceous, outside puberulous to pubescent in the lower half (to rarely so apically), inside glabrous (to a few hairs). *Petals* 0 (up to 3 in Peninsular Malaysia), up to 1.5 mm long, elliptic to oblong, glabrous or with a few hairs near the base, inconspicuously auriculate. *Disc* annular, 1–2 mm in diam., glabrous or sparsely puberulous. *Stamens* (6–)8(–9), up to 4 mm long; filaments glabrous; anthers not papillate, glabrous. *Pistil* puberulous. *Fruit* 7–17(–20) mm high, glabrous or very sparsely puberulous; stipe 2–14 by 1–1.5 mm; seed-bearing part globose to ellipsoid, round to faintly triangular in cross section, apiculus 1–2 by 0.5–1(–2) mm, inside glabrous (to pubescent along the sutures); endocarp completely sclerenchymatic. *Seeds* globose to ellipsoid, up to 7 mm long; cotyledons superposed, about equal. — **Fig. 58g.**

Distribution – From India and S China through SE Asia and throughout *Malesia*. Absent from Australia, see note 3.

Habitat & Ecology – Primary and secondary forest in lowland and coastal regions; sea level up to 800(–1600) m altitude. Fl. mostly Jan.–Aug.; fr. mostly May–Dec.

Notes – 1. In a few collections, restricted to Peninsular Malaysia, petals occur. The petals strongly resemble those of *M. pentapetalus* and other species in the ‘*pentapetalus*-group’ (*M. pentapetalus*, *M. triquetus*, *M. largifolius*, *M. paradoxus*, *M. reticulatus*, and *M. grandissimus*).

2. The delimitation between *M. sundaicus* and *M. pentapetalus* is not sharp for some characters and that is why Gagnepain (Not. Syst. 13, 1947, 34, 35) suggested hybridization between these two species. Detailed studies on this problem are needed (see also below, the note under *Mischocarpus prob. spec. nov.*).

3. S.T. Reynolds (in Fl. Austral. 25, 1985, 101) reports that *M. sundaicus* is absent from Australia. The specimens attributed to *M. sundaicus* by R.W. Ham (1977) were described by her as three new species: *M. australis*, *M. macrocarpus*, and *M. stipitatis*. They differ from *M. sundaicus* in the much-branched panicle with cymules on longer pedicels, the hairy inner surface of the fruit, the persistent broad style base, the larger bracts and dorsiventrally flattened petioles. As Australia is outside the scope of Flora Malesiana, no decision about the status of these new species has been made.

8. *Mischocarpus triquetus* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 65; Merr., Enum. Philipp. Flow. Pl. 2 (1925) 514; Radlk. in Engl. Pflanzenz. 98 (1933) 1297. — *Mischocarpus fuscescens* auct. non Blume: Vidal. Revis. (1886) 95, no. 720, 1039; Cat. Herb. (1892) 83, no. 720, 1039. — Lectotype (R.W. Ham 1977): *Ahem* 262 (B<sup>+</sup> holotype; BO, US), Philippines. *Mischocarpus cauliflorus* Radlk., Philipp. J. Sc., Bot. 8 (1914) 471; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 513; Radlk. in Engl., Pflanzenz. 98 (1933) 1298. — Type: *McGregor* 271 (M holotype; K, US), Philippines.

Small tree, up to 6 m high, dbh up to 12 cm, not or hardly branching; puberulous, early glabrescent. Twigs 4–9 mm in diam., usually grooved. Leaves (2- or) 3–5-jugate; petiole 7–17 cm long; petiolules 8–15 mm long. Leaflets ovate to obovate, 5–26 by 2–10 cm, index 2–4.5, pergamentaceous to subcoriaceous; base acute (to obtuse); domatia absent or inconspicuously in the axils of the nerves below; midrib above prominent, angular; nerves 7–13 per side, moderately curved; nerves and veins promi-

nent on both surfaces. Inflorescences ramiflorous on up to 15 mm thick branches consisting of 1–7, up to 10 cm long axes, simple (or sparsely branched at the base); bracts triangular, up to 1 mm long. Calyx lobes hardly connate, triangular to ovate, 1.5–2.5 by 1–2 mm, membranous with 1 or 3 visible nerves, outside sparsely pubescent, inside glabrous or with a few hairs near the base. Petals (2–)5, elliptic, c. 1.5 by 1 mm, sparsely accrescent to 3 by 2 mm in young fruits, not clawed, glabrous; auricles usually present, sparsely pubescent. Disc annular, usually with lobes protruding between the stamens, ± confluent with the base of the fruit, 1.5–2 mm in diam., glabrous. Stamens 8, 3–4 mm long; filaments glabrous to sparsely puberulous; anthers papillate, glabrous. Pistil hardly stipitate, distinctly triangular, hairy. Fruits up to 3 cm high, glabrous; stipe 4–12 mm high, triangular in cross section; seed-bearing part ellipsoid to obovoid, triangular (or rounded-triangular) in cross section, up to 1.2 cm in diam., apiculate for 1–3 mm, inside glabrous; endocarp thin. (nearly) completely sclerrenchymatic. Seeds ellipsoid, up to 1.2 cm long; cotyledons subcollateral, both folded, the lower usually smaller than the upper. — Fig. 58h, i.

Distribution – *Malesia*: Philippines (Luzon, Mindoro, Guimaras, Negros).

Habitat & Ecology – Primary forest up to 500 m altitude. Fl. Oct., Jan.; fr. Feb.–July.

9. *Mischocarpus prob. spec. nov.*: R.W. Ham, Blumea 23 (1977) 286. — Based on UPNG (*Mil-lar*) 1042 (K), Papua New Guinea.

Small tree, c. 6 m high; puberulous in infructescences, glabrescent. Twigs 6–8 mm in diam. Leaves c. 3-jugate; petiole c. 17 cm long; petiolules c. 1 cm long. Leaflets elliptic, 12–16 by 4–5 cm, index c. 3, subcoriaceous; base acute; domatia very inconspicuous, in the axils of the nerves below; midrib above prominent, angular to locally rounded; nerves c. 15 per side, moderately curved; veins regularly reticulate, prominent on both surfaces. Inflorescences and flowers unknown. Infructescences ramiflorous, 13–16 cm long, branched. Calyx in fruit connate for 1/4, lobes slightly unequal, triangular to ovate, c. 1.5 by 1 mm, outside glabrous, inside glabrous or with a few hairs, subcoriaceous at the base, towards the top somewhat membranous with visible nerves, not accrescent. Petals: 1 was found together with 1 scar of a petal: elliptic, c. 0.75 by 0.5 mm, not clawed, without scales or auricles, glabrous. Disc in fruit annular, 1.5–2 mm in diam., slightly lobed, glabrous with lenticel-like dots. Fruits immature, green, probably all sterile, 8–10 mm high, glabrous; stipe 1–3 mm high, slightly lobed at the base, grading into



the seed-bearing part; the latter about rounded-triangular in cross section, 5–7 mm in diam., inside pubescent on axial and sutural parts, sclerenchyma just reaching into the septa. *Seeds* hardly developed (although fruit seemingly mature); arillose with a slightly lobed pseudo-funicle  $\pm$  as long as the stalk.

Distribution — *Malesia*: Papua New Guinea (Central Prov.).

Ecology — In rain forest. Fruiting at least in March.

Note — This is doubtlessly a *Mischocarpus* in the 'pentapetalus-group', probably closest related to *M. largifolius* and *M. paradoxus*. It may be a new species, but the specimen may also be a hybrid, because of the sterile fruits, either between *M. largifolius* and *M. paradoxus*, or between *M. sundauicus* and one of the latter two species.

## NEPHELIUM

(P.W. Leenhouts)

*Nephelium* L., Mant. Pl. 1 (1767) 18; Radlk. in Engl., Pflanzenr. 98 (1932) 950; Leenh., Blumea 31 (1986) 373 [see there for more synonyms on the (sub)sectional level]. — Type species: *Nephelium lappaceum* L.

Medium-sized to tall *trees* or rarely *shrubs*, probably dioecious, sometimes monoecious. *Indumentum* of solitary simple hairs, glandular scales absent. *Leaves* spirally arranged, paripinnate, (1-foliolate or) 1–5(–18)-jugate, without pseudo-stipules; neither petiole nor rachis winged. *Leaflets* alternate to more rarely opposite, beneath mostly distinctly glaucous, finely papillate, domatia often present, margin entire or rarely repand, nervation open (except in *N. subfalcatum*). *Inflorescences* in some species all axillary, in most at least partly pseudoterminal, in some truly terminal, in *N. cuspidatum* also rami- and cauliflorous. *Flowers* actinomorphic. *Sepals* (4 or) 5 (or 6), free to more than half-way up connate, valvate or sometimes (when the sepals are nearly free) slightly imbricate, all equal, not petaloid, entire, outside and inside hairy, outside more sparsely and with shorter hairs than inside, not ciliate, without glands. *Petals* shorter than the calyx. 5 (or 6), clawed, well developed, with a bilobed scale without appendages, hairy on both sides, entire, or 1–4 reduced, or often none. *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. *Pistil* densely hairy; ovary short-stalked, (1- or) 2(–4)-celled, mostly warty; style usually well developed; stigmas fairly long, spreading to finally recurved. *Ovules* 1 per cell, half enveloped by an outgrowth of the placenta. *Fruits* 1-, exceptionally 2-lobed; stipe short to inconspicuous; body ellipsoid to subglobose, the surface warty to spiny, exceptionally nearly smooth; pericarp thin- to thick-coriaceous or exceptionally corky to nearly woody, inside glabrous, apparently often at least in the apical part finally loculicidal, either rather irregular or with two about equal valves. *Seeds*: hilum nearly basal; micropylar wart apical or mostly subapical; sarcotesta covering the whole seed, with the exception of 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. — Figs. 60–63.

Distribution — 22 species; SE Asia from Yunnan and Assam to Hainan and *Malesia*: W *Malesia*, Philippines, Celebes, and Moluccas.

Habitat & Ecology — Middle storey of rain forests at low to medium altitudes, some-

times in deciduous or savannah forest. The fruits are mainly eaten by monkeys and fruit bats; the fruits of some species seem to be dispersed by water.

Uses — The sarcotesta of a few species is eaten, but only *N. lappaceum* (Rambutan) is commonly cultivated as a fruit tree. The timber is hardly of any importance.

Note — Identification is hardly possible without  $\pm$  mature fruits. Therefore, under many species notes have been given regarding differences with other comparable species from the same area.

#### KEY TO THE SPECIES

- 1a. Pistil 2(–4)-merous. (Exceptionally a few flowers with a 1-merous ovary) . . . . . 2  
 b. Pistil 1-merous . . . . . **13. *N. maingayi***
- 2a. Fruit wall coriaceous or eggshell-like, rarely more than 1(–7) mm thick . . . . . 3  
 b. Fruit wall hard, corky, 3–6 mm thick, the saccate base and the carina of the fruit solid . . . . . **2. *N. compressum***
- 3a. Fruits warty, the warts without a distinct apical appendage. (In a few cases this character may be difficult. Try both ways) . . . . . 4  
 b. Fruits not warty, the appendages usually distinctly divided into a broader or thicker basal and a narrower apical part . . . . . 9
- 4a. At least the upper half of the fruit appendages densely puberulous . . . . . 5  
 b. Fruits glabrous . . . . . 6
- 5a. Leaf axes densely tomentellous, sometimes glabrescent. Leaflets hairy all over above, soon glabrescent, the midrib sometimes excepted, tomentose on midrib and nerves beneath, densely sericeous in between. Calyx 3 mm high . . . . . **5. *N. daedalum***  
 b. Leaf axes sparsely puberulous to glabrous. Leaflets glabrous above, sparsely sericeous all over beneath, sometimes glabrescent. Calyx up to 1.75 mm high  
 . . . . . **15. *N. melanomiscum***
- 6a. Leaflets mostly widest at about 1/3 above the base; reticulation on upper side dense. Fruits aculeate . . . . . 7  
 b. Leaflets widest at or sometimes slightly below the middle; reticulation on upper side lax. Fruits tuberculate . . . . . 8
- 7a. Leaflets obtuse to acute; veins reticulate; domatia usually present. Burma, Thailand, Indochina . . . . . **8. *N. hypoleucum***  
 b. Leaflets tapering into a long and broad acumen; veins especially on the lower side rather distinctly scalariform; domatia absent. Borneo . . . . . **1. *N. aculeatum***
- 8a. Leaves up to 7-jugate. Leaflets usually almost parallel-sided, abruptly rounded at the base, flat when dried. Fruits coarsely warty, the warts  $\pm$  arranged into longitudinal rows. Malay Peninsula, Sumatra, Java . . . . . **9. *N. juglandifolium***  
 b. Leaves 2- or 3-jugate. Leaflets with strongly curved sides, tapering to the cuneate base, often curled or rolled up when dried. Fruits densely knobby like a small *Pandanus* fruit head, the knobs not confluent. Borneo  
 . . . . . An unusual form of **18. *N. ramboutan-ake***
- 9a. Fruit appendages distinctly puberulous all over . . . . . 10  
 b. Fruits (sub)glabrous or exceptionally with a hair tuft on the tops of the appendages . . . . . 15

- 10a. Petiolules above grooved. Leaflets symmetrical ..... 11  
 b. Petiolules above not grooved. Leaflets slightly falcate ... **12. N. macrophyllum**
- 11a. Leaflets beneath glabrous or nearly so ..... 12  
 b. Leaflets beneath densely tomentose on and along midrib and nerves, distinctly to moderately densely sericeous in between ..... **6. N. hamulatum**
- 12a. Veins and veinlets densely reticulate, above not very conspicuous, beneath inconspicuous. Leaflets drying brown ..... 13  
 b. Veins and veinlets on both sides of the leaflets conspicuously  $\pm$  laxly reticulate. Leaflets drying green ..... **19. N. reticulatum**
- 13a. Twigs and leaf axes (sub)glabrous. Fruit appendages less than 10 mm long. Vietnam, Thailand, Malay Peninsula ..... 14  
 b. Twigs and leaf axes tomentellous or puberulous, early glabrescent. Fruit appendages c. 15 mm long. Borneo ..... **14. N. meduseum**
- 14a. Domatia usually present. Sepals 2–3 mm long. Fruit appendages filiform, c. 7 mm long, sparsely puberulous ..... **3. N. costatum**  
 b. Domatia absent. Sepals 1–1.8 mm long. Fruit appendages ligulate to strap-shaped, up to 6(–9) mm long,  $\pm$  densely puberulous ..... **16. N. melliferum**
- 15a. Domatia present ..... 16  
 b. Domatia absent ..... 21
- 16a. Reticulation on the upper side of the leaflets dense ..... 17  
 b. Reticulation on the upper side of the leaflets lax ..... 19
- 17a. Fruits up to 2.5 by 1.5 cm, wall up to 1 mm thick, appendages up to 10 mm long. Venation reticulate ..... 18  
 b. Fruits up to 6 by 3.5 cm, wall up to 2.5 mm thick, appendages usually more than 10(–20) mm. Venation often tending to scalariform ..... **10. N. lappaceum**
- 18a. Leaves typically up to 6-jugate. Leaflets up to 5.5 times as long as wide, distinctly long- and slender-acuminate, parallel-sided. Fruit appendages sparse, 2–3(–8) mm long, upper part ligulate ..... **11. N. laurinum**  
 b. Leaves 1- or 2-jugate. Leaflets c. 2–3.5 times as long as wide, short- and broad-acuminate, sides curved. Fruit appendages dense, 8–10 mm long, upper part filiform ..... **7. N. havilandii**
- 19a. Inflorescences usually truly terminal, not ending in a vegetative bud, infructescences thus also terminal. Fruit appendages  $\pm$  hair-like or sometimes  $\pm$  tongue-shaped. Leaflets when dried mostly flat ..... 20  
 b. Inflorescences axillary and pseudoterminal, the latter ending in a vegetative bud, infructescences thus lateral. Fruits mostly densely spiny, sometimes knobby. Leaflets when dried often curled or rolled up ..... **18. N. ramboutan-ake**
- 20a. Leaflets pergamentaceous, apex not mucronate, midrib raised above, intercalated veins well developed, venation reticulate. Fruits up to 3 by 2.25 cm, appendages sparse and short, up to 7.5 mm long ..... **21. N. uncinatum**  
 b. Leaflets coriaceous, apex usually mucronate, midrib usually sunken above, intercalated veins mostly inconspicuous, venation tending to scalariform. Fruits up to 6 by 3.5 cm, appendages dense, up to 2 cm long ..... **10. N. lappaceum**
- 21a. Fruit appendages mostly filiform. Leaflets mostly flat when dried. .... 22



- b. Fruit with long spines. Leaflets when dried often curled or rolled up
- 18. N. ramboutan-ake**
- 22a. Leaflets nearly always hairy below, at least on the midrib . . . . . 23
- b. Leaflets below glabrous or at most with a few minute hairs along the midrib . . . . . 24
- 23a. Twigs and leaves usually densely though sometimes minutely hairy, rarely glabrous. Inflorescences axillary and/or pseudoterminal . . . . . **4. N. cuspidatum**
- b. Twigs and leaves sparsely hairy to glabrous. Inflorescences mostly truly terminal
- 10. N. lappaceum**
- 24a. Apical part of the fruit appendages thread- or hair-like, up to 15 mm long. Leaflets rather abruptly ± caudate-acuminate . . . . . 25
- b. Apical part of the fruit appendages nipple-like, 1–2 mm long. Leaflets hardly short- and broad-acuminate . . . . . **17. N. papillatum**
- 25a. Reticulations of the leaflets minute, not elongated parallel to the nerves. Apical part of the fruit appendages up to 10 mm long, slightly hairy . . . . . **19. N. reticulatum**
- b. Reticulations of the leaflets lax, elongated parallel to the nerves. Apical part of the fruit appendages up to 15 mm long, glabrous . . . . . **20. N. subfalcatum**

**1. Nephelium aculeatum** Leenh., Blumea 31 (1986) 382. — Type: *Meijer Nbfd San 48559* (K. L. SAN), Sabah.

Medium-sized tree. Twigs 7 mm or more in diam., tomentellous but early glabrescent. Leaves 4-jugate; petiole 8–10 cm long, 2 mm thick, terete; axes tomentellous to subglabrous; petiolules 5–8 mm long, above narrowly deeply grooved without a rib. Leaflets ovate to elliptic, 9–19 by 4.5–5.5 cm, index 2–3.5, stiff-pergamentaceous, above glabrous, beneath puberulous on midrib and nerves, in between fairly densely minutely sericeous; no domatia; base rounded to obtuse, slightly attenuate; parallel-sided usually in the lower two thirds; apex gradually acuminate, acumen rather long and broad; midrib above grooved, nerves 0.75–1 cm apart, above hardly prominulous, no intercalated veins, veins fairly densely scalariform, prominulous at both sides, veinlets finely reticulate, above prominulous, beneath only partly visible. Inflorescences probably axillary. Flowers not observed. Fruits: 1 or 2 lobes developed, these oblique-ellipsoid, 3 by 2 by 1.75 cm, glabrous, fairly densely 2 mm long acumulate.

Distribution – *Malesia*: Borneo (Sabah).

Habitat & Ecology – Secondary forest. Fr. Aug.

Uses – Fruits edible. See Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2. Edible fruits and nuts (1991) 348.

Note – Though the present species resembles *N. hypoleucum* both in leaf shape and in fruit, the two may not be particularly closely related.

**2. Nephelium compressum** Radlk., Sapind. Holl.-Ind. (1879) 9, 28; in Engl., Pflanzenz. 98 (1933)

980; Leenh., Blumea 31 (1986) 382. — Type: *Beccari PB 1268* (BO, FI, K, M, NY), Sarawak.

Twigs 6–8 mm in diam., tomentose, glabrescent. Leaves 3–5-jugate; petiole 4.5–12 cm long, 2–4 mm thick, above grooved or somewhat rounded towards the apex; axes tomentose, finally glabrescent; petiolules 2–5 mm long, above broadly and shallowly grooved with a strong median rib. Leaflets elliptic to obovate, 4.5–18 by 2.75–7.5 cm, index 1.5–3, stiff-coriaceous, above tomentose on the midrib, soon mostly glabrescent, beneath densely tomentose on midrib, nerves, and intercalated veins, thinly so in between, domatia absent; base rounded to (upper leaflets) obtuse to acute; sides curved; margin repand; apex apiculate or with a short, broad, acute to rounded acumen; midrib above prominulous, nerves 0.5–1.25 cm apart, above sunken, intercalated veins well developed, veins densely scalariform, above slightly grooved or not, beneath well visible, veinlets minutely reticulate, visible above only. Inflorescence a widely branched terminal or pseudoterminal thyrsse. Sepals free or nearly so, 2–2.2 mm long. Petals 5, 1.25–1.8 by 1.1–1.4 mm, white, claw 0.3–0.4 mm long, claw and most of the blade outside, and sometimes base of blade inside woolly; scale 0.2–0.25 mm high, consisting of 2 connate, reflexed, rounded lobes. Disc glabrous. Stamens 7 or 8. Pistil 2-celled. Fruits flattened ellipsoid, 4–4.5 by 2.5 by 1.25–1.75 cm, saccate at the abaxial side, tomentellous, partly glabrescent, rugose-warty; wall hard, corky, 3–6 mm thick, the saccate base and the carina solid. — **Fig. 60a, b.**

Distribution – *Malesia*: Borneo (Sarawak, near Kuching).

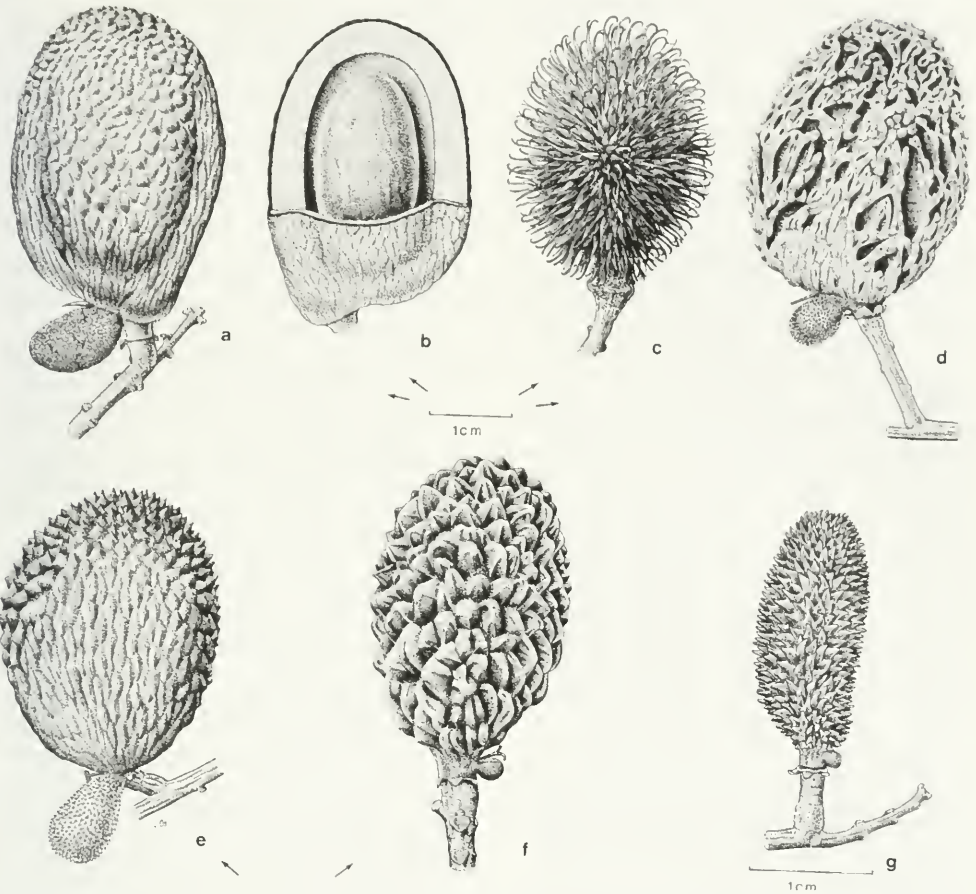


Fig. 60. *Nephelium* L. Fruits. — a. *N. compressum* Radlk.; b. *ibid.*, fruit wall partly removed. — c. *N. cuspidatum* Blume. — d. *N. daedaleum* Radlk. — e. *N. hypoleucum* Kurz. — f. *N. juglandifolium* Blume. — g. *N. laurinum* Blume. — h. *N. meduseum* Leenh. — i. *N. ramboutan-ake* (Labill.) Leenh. — j. *N. uncinatum* Leenh. (a, b: Beccari PB 1268; c: S. 27687; d: SAN 50490; e: Geesink et al. 6475; f: M. Shah s.n.; g: Griffith 996; h: S 32399; i: FRI 10648; j: Hotta 12984).

Ecology — Fl. Mar.; fr. Dec.

Note — This species is characterized by its peculiar fruits which appear to be dispersed by water rather than by animals as judged from the thick corky wall and the thin sarcotesta. Vegetatively, however, it is not clearly separable from *N. cuspidatum* 'erriopetalum'. The best characters are the slightly bullate leaflets with sunken nerves and usually slightly sunken veins on the upper surface in this species, against the hardly bullate leaflets with narrowly grooved nerves and usually prominulous veins in 'erriopetalum'. The flowering collections that are added to the fruiting type on the basis of these characters differ from 'erriopetalum'

by the rather large and widely branched, thyrsoid, terminal or pseudoterminal inflorescences (in 'erriopetalum' they are mainly axillary or sometimes even borne on the branch and stem; they consist of a few spike-like branches) and by the nearly free and slightly imbricate sepals and the well developed corolla ('erriopetalum' has more connate and valvate sepals and lacks, or has only a few, reduced petals).

3. *Nephelium costatum* Hiern in Hook. f., Fl. Br. India 1 (1875) 688; Ridley, Fl. Malay Penins. 1 (1922) 501, p.p.; Radlk. in Engl., Pflanzenr. 98 (1933) 972, p.p.; Leenh., Blumea 31 (1986) 384.

— Type: *Maingay 3283* (= *KD 440*) (K, L, M), Malay Peninsula.

*Nepheium longana* (Lam.) Cambess. var. *hypoleuca* (Kurz) King, J. As. Soc. Beng. 65, II (1896) 435, as for *Maingay 440* from Malaya.

*Tree*, up to 17.5 m high, dbh up to 50 cm. *Twigs* 4–6 mm or more in diam., glabrous. *Leaves* 2–4-jugate; petiole 3.5–12 cm long, 1.5–2.5 mm thick, semiterete to terete; axes glabrous; petiolules 6–13 mm long, above grooved, with or without a median rib. *Leaflets* ± elliptic, 8–21 by 4–7 cm, index 2–3, coriaceous, glabrous or exceptionally sericeous beneath, usually with pocket-like domatia; base rounded or sometimes obtuse, slightly attenuate; sides curved; apex obtuse to acute, sometimes shortly acuminate; midrib above a fine raised line, nerves 0.75–2 cm apart, above slightly grooved, intercalated veins few, veins and veinlets not much different, ± densely reticulate, equally prominulous at both sides. *Inflorescences* terminal. *Sepals* free, 2–3 mm long. *Petals* 4 or 5, 0.6–1.8 by c. 1 mm, both sides at least in the lower half densely woolly. *Disc* glabrous. *Stamens* (6)–8. *Ovary* 2-celled. *Fruits* ellipsoid, bulging to one side, c. 2.5 by 2 cm, densely set with broad-based, curved, filamentous appendages c. 7 mm long, sparsely puberulous; wall coriaceous, thin.

Distribution – *Malesia*: Malay Peninsula.

Habitat & Ecology – Secondary forest, lowland. Fl. Mar., Apr.; fr. Aug.

Notes. 1. Close to *N. meduseum* and *N. macrophyllum*, both from Borneo, and to *N. melliferum*, mainly from continental Asia.

2. Since King (l.c.) the present species has been confused with *N. hamulatum*, mainly because the collections *Goodenough 1352* and *Scortechini 1992*, both *N. hamulatum*, have wrongly been identified with this species. Therefore, notes on the timber published without any reference to collection numbers are untrustworthy and have been omitted.

**4. *Nepheium cuspidatum*** Blume, Rumphia 3 (1847) 110; Radlk. in Engl., Pflanzenr. 98 (1933) 977; Leenh., Blumea 31 (1986) 385. — Type: *Korthals s.n.* (L), Borneo.

*Nepheium eriopetalum* Miq., Sumatra (1861) 198, 508; Radlk., Sapind. Holl.-Ind. (1879) 26, 72; Ridley, Fl. Malay Penins. 1 (1922) 502; Hend., Gard. Bull. Str. Settl. 4 (1928) 243; Radlk. in Engl., Pflanzenr. 98 (1933) 979; Corner, Wayside Trees (1940) 591. — Lectotype (Leenhouts 1986): *Junghuhn s.n.* (L), Sumatra.

*Nepheium beccarianum* Radlk., Sapind. Holl.-Ind. (1879) 9, 27; in Engl., Pflanzenr. 98 (1933) 978. — Lectotype (Leenhouts 1986): *Beccari PB 2279* (FI), Sarawak.

*Nepheium multinerve* Radlk., Sapind. Holl.-Ind. (1879) 9, 27; in Engl., Pflanzenr. 98 (1933) 979.

— Type: *Beccari PB 2820* (FI), Sarawak.

*Nepheium ophiodes* Radlk., Sapind. Holl.-Ind. (1879) 77, 78; Ridley, Fl. Malay Penins. 1 (1922) 502; Radlk. in Engl., Pflanzenr. 98 (1933) 965; Corner, Wayside Trees (1940) 593, f. 215. — Type: *Maingay KD 543*, p.p. (B, K), Malay Peninsula.

*Nepheium bassacense* Pierre, Fl. For. Coch. (1894) pl. 319 B; Radlk. in Engl., Pflanzenr. 98 (1933) 965. — Type: *Harmand 1427* (= *Herb. Pierre 5690*) (K, M, P), Vietnam.

*Nepheium dasyneurum* Radlk., Rec. Bot. Surv. India 3 (1907) 353; in Engl., Pflanzenr. 98 (1933) 977. — Type: *Forbes 2842* (CAL, FI, L, P, SING), Sumatra.

*Nepheium obliquinervis* Radlk., Rec. Bot. Surv. India 3 (1907) 354; in Engl., Pflanzenr. 98 (1933) 978. — Syntypes: *Goodenough 1304* (SING), *1782* (L, SING), Malay Peninsula.

*Nepheium robustum* Radlk. in Elmer, Leaf. Philipp. Bot. 5 (1913) 1607; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 505; Radlk. in Engl., Pflanzenr. 98 (1933) 966. — Type: *Elmer 12934* (BO, FI, L, M, NY, U), Philippines, Palawan.

*Nepheium chryseum* auct. non Blume: Merr., Pl. Elm. Born. (1929) 174.

*Nepheium spec.*: Merr., Pl. Elm. Born. (1929) 175.

*Tree*, up to 40 m high, dbh up to 80 cm, sometimes with small buttresses, rarely a *shrub*. *Twigs* 2.5–15 mm in diam., tomentellous, tomentose, or velvety, mostly only late glabrescent. *Leaves* (1)–2–9(–13)-jugate; petiole 2.5–21 cm long, 1–6 mm thick, terete to semiterete, in the latter case sometimes above with a longitudinal groove; axes mostly long remaining hairy; petiolules 2–7.5(–15) mm long, above variably grooved or sometimes flat, with or without a median rib. *Leaflets* (narrowly) elliptic, 6–35 by 1.75–12.5 cm, index 1.5–5, coriaceous or chartaceous, above glabrous to variably hairy along the midrib and on the lower nerves, rarely all over the surface, beneath variably hairy all over, between the nerves often minutely sericeous; domatia absent; base acute to broadly rounded, exceptionally subcordate, mostly variably attenuate; sides curved to straight and parallel; apex rounded to acute, mostly acuminate, the acumen up to 2.5 cm long, slender to sometimes broad, acute to sometimes obtuse; midrib above sunken to prominulous, nerves 0.5–2 cm apart, above prominulous to slightly grooved, intercalated veins variably developed, veins and veinlets either together closely or sometimes laxly reticulate, or the former ± clearly scalariform, at least the veinlets beneath often hardly visible. *Inflorescences* most-



ly in the upper leaf axils, together pseudoterminal, sometimes terminal, also rami- or cauliflorous, often long pendulous racemes or spikes. *Sepals* hardly to up 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 or 8 (or 9). *Ovary* 2-celled. *Fruits* ellipsoid to sometimes globular, 2–4 by 2–3 cm, glabrous or sometimes slightly hairy at the tip of the appendages, mostly densely set with appendages, those filiform to narrowly strap-shaped and up to 2 cm long, or sometimes ligulate and 5–6 mm long, straight or often curved or curled, at base globular, pyramidal, or triangular and in the latter case often connate; wall coriaceous, thin. — **Fig. 60c.**

**Distribution** — Burma, Thailand, Cambodia, Vietnam, and *Malesia*: Sumatra, Malay Peninsula, Borneo, W Java, and Philippines (Palawan).

**Habitat & Ecology** — Usually a lower storey tree of primary or sometimes secondary rain forest on dry land, mainly on ridges and slopes, rarely on plains or river banks; preferably on fertile sandy loam derived from igneous rocks, rarely on sandstone or limestone; altitude 0–200(–800) m. Fl. mainly Nov.–Mar.; fr. mainly May–Sept.

**Uses** — Locally cultivated as a fruit tree. The wood is sometimes used for constructions but is not of a very good quality. See Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1544, 1548; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 997.

**Note** — In the delimitation presently accepted *N. cuspidatum* is a rather complex species. The extremes included, e.g. *N. robustum* and *N. dasyneurum*, seem very different. However, it appears that the common and widespread *N. eriopetalum* is connected directly or indirectly with all other forms and that either no separation is possible at all, or only on unimportant (e.g. the coarsely reticulate venation of *N. robustum* and to a lesser degree of *N. bassacense*, versus the very minute reticulum of the other forms) or untrustworthy (e.g. hairiness or the degree of reduction of the corolla) characters. As far as could be seen from the field labels there are no clear ecological differences either; all but *N. eriopetalum* are rather restricted geographically.

In order to enhance the accessibility of the group as a whole a subdivision into six varieties was made, two of which have been divided into subvarieties.

#### KEY TO THE VARIETIES

- 1a. Venation laxly reticulate, prominent on both sides of the leaflet . . . . . 2  
 b. Venation on the upper side of the leaflets minutely reticulate, often inconspicuous to hardly visible . . . . . 4

- 2a. Slender. Twigs 0.25–1 cm in diam. Leaves 1–5(–8)-jugate. Leaflets linear or elliptic, up to 20 cm long, 2.5–8.5 cm broad. Continental Asia, Malay Peninsula, Sumatra . . . . . 3  
 b. Robust. Twigs up to 1.5 cm in diam. Leaves 4–9-jugate. Leaflets linear, 10–35 by 5–10 cm. Borneo, Palawan . . . . . f. var. **robustum**
- 3a. Leaflets elliptic, not or sometimes slightly acuminate; nerves above prominulous to flat; intercalated veins hardly conspicuous. Continental Asia, Malay Peninsula . . . . . b. var. **bassacense**  
 b. Leaflets linear with a long and slender acumen; nerves above sunken; intercalated veins well developed. Malay Peninsula, Sumatra  
     a2. var. **cuspidatum** subvar. **dasyneura**
- 4a. Leaflets beneath rather densely ± patently hairy, especially on the veins, in between glabrous or sometimes sparsely patently or loosely appressedly hairy, the indumentum thus emphasizing the venation . . . . . 5  
 b. Leaflets beneath between the nerves either minutely sericeous, the indumentum obscuring the venation, or ± glabrous . . . . . 6
- 5a. Twigs and leaf axes hairy. Largest leaflets 20–35 cm long, up to 5 times as long as wide; nervation not conspicuously dense, nerves in the central part of the leaflets 0.5–2 mm apart. Malay Peninsula, Sumatra, Borneo  
     c. var. **eriopetalum**  
 b. Twigs and leaf axes early glabrescent. Leaflets up to 17 cm long, 2–2.5 times as long as wide; nervation dense, nerves in the central part of the leaflets 0.5–0.75 mm apart. Borneo  
     d. var. **multinerve**
- 6a. Petiole terete nearly to the base. Leaflets flexible pergamentaceous or papyraceous when dried, apex distinctly, mostly long, slender, acute acuminate . . . . . 7  
 b. Petiole strongly flattened at base. Leaflets stiff-pergamentaceous, apex obtuse to rounded, hardly acuminate. Malay Peninsula, Sumatra  
     e1. var. **ophiodes** subvar. **ophiodes**
- 7a. Leaflets linear with parallel sides, beneath glabrous or early glabrescent. Twigs and leaves soon glabrous (Borneo) or hairy (Malay Peninsula, Sumatra) (var. *cuspidatum*) . . . . . 8  
 b. Leaflets elliptic with gradually curved sides, beneath ± sericeous. Twigs, leaf axes, and midrib beneath densely hairy. Borneo  
     e2. var. **ophiodes** subvar. **beccarianum**
- 8a. Fruit appendages straight, upper part 2–4 mm long. Borneo  
     a1. var. **cuspidatum** subvar. **cuspidatum**  
 b. Fruit appendages curved, upper part c. 8–10 mm long. Malaya  
     a2. var. **cuspidatum** subvar. **dasyneura**

a. var. **cuspidatum** — *Nephelium cuspidatum*  
Blume s. str.

a1. subvar. **cuspidatum**

Twigs 3.5–6 mm in diam., tomentellous, mostly soon glabrous. *Petiolules* 4–7.5 mm long, above narrowly shallowly grooved, sometimes with a faint median rib. *Leaflets* 1.75–5 cm broad, index 2.5–5, the sides (nearly) straight and parallel; apex acuminate, acumen long and slender; midrib above sunken, often as a fine rim in a groove. Nerves above flat to slightly grooved, intercalated veins often well developed, reticulum above dense. *Inflorescences* pseudoterminal. *Sepals* slightly connate, 1.1–1.2 mm long. *Petals* absent, or one, reduced. *Fruit* appendages dense, linguulate-triangular, 5–6 mm long, slightly curved.

Distribution — *Malesia*: Borneo.

a2. subvar. **dasyneurum** (Radlk.) Leenh., *Blumea* 31 (1986) 388. — *Nephelium dasyneurum* Radlk. — *Nephelium obliquinerve* Radlk.

Twigs 2.5–7.5 mm in diam., tomentellous to tomentose, becoming ultimately glabrescent. *Petiolules* 3–7 mm long, above slightly to narrowly and deeply grooved, with lateral ribs and mostly a faint to strong median one. *Leaflets* 2.5–6 cm broad, index 2.5–4.5, the sides mostly nearly straight and parallel; midrib above slightly sunken, nerves above finely grooved, intercalated veins usually numerous, well developed, reticulum above dense to sometimes rather lax. *Inflorescences* axillary, together mostly pseudoterminal, sometimes terminal. *Sepals* connate up to 25%, 1.5–2 mm long. *Petals* absent or up to 5, reduced. *Fruit* appendages dense, filiform to narrowly strap-shaped, at base broadened and often confluent, up to slightly more than 1 cm long, curved in their upper half.

Distribution — *Malesia*: Sumatra, Malay Peninsula.

Note — *Nephelium cuspidatum* var. *cuspidatum* resembles *N. lappaceum* var. *pallens* but has more jugate leaves, a long, slender acumen, and shorter and stiffer fruit appendages.

b. var. **bassacense** (Pierre) Leenh., *Blumea* 31 (1986) 387. — *Nephelium bassacense* Pierre.

Twigs 4–10 mm in diam., densely tomentose but often rather early glabrescent. *Petiolules* 2–6 mm long, above broadly shallowly grooved, with or without a median rib. *Leaflets* 4–8.5 cm broad, index 1.5–4, the sides curved to nearly straight and parallel; apex not or sometimes slightly acuminate; midrib above prominulous to sunken, nerves above

prominulous to flat, intercalated veins mostly few and feeble, reticulum above rather lax. *Inflorescences* pseudoterminal to terminal. *Sepals* connate up to c. 10%, 1.3–2 mm long. *Petals* absent. *Fruit* appendages dense, filiform, broadened at base, up to 1.5 cm long.

Distribution — Burma, Cambodia, Vietnam, and Peninsular Thailand (Dist. Ranong, Lambing, one collection).

Note — This variety resembles *N. hypoleucum*, from the same area, in its vegetative parts and its inflorescences, but the latter differs in its glabrous or early glabrescent twigs and leaves.

c. var. **eripetalum** (Miq.) Leenh., *Blumea* 31 (1986) 389. — *Nephelium eripetalum* Miq.

Twigs 5–13 mm in diam., tomentose, velvety or sometimes woolly. *Petiolules* 2–10 mm long, variably grooved or sometimes terete, usually with a median rib. *Leaflets* 3–12.5 cm broad, index 2–5, the sides nearly straight and parallel to mostly only slightly curved; midrib above prominulous to sometimes slightly sunken, nerves above finely grooved or sometimes flat, intercalated veins often many and well-developed, reticulum above dense. *Inflorescences* pseudoterminal and more rarely axillary. *Sepals* 20–40% connate, 1.8–2.5 mm long. *Petals* absent (or up to 5, reduced). *Fruit* appendages dense, strap-shaped to sometimes filiform, at base swollen, pyramidal, or broadened, 1–2 cm long, straight or sometimes curled if filiform.

Distribution — *Malesia*: Sumatra, Malay Peninsula, Borneo, and W Java (Mt Batu, once collected).

Note — Vegetatively, the present variety strongly resembles *N. compressum*; for differences see there.

d. var. **multinerve** (Radlk.) Leenh., *Blumea* 31 (1986) 389. — *Nephelium multinerve* Radlk.

Twigs 7 mm or more in diam., tomentose and early glabrescent or glabrous. *Petiolules* 5–12.5 mm long, above narrowly shallowly grooved without a median rib. *Leaflets* 6–8.5 cm broad, index 2–2.5, the sides curved; midrib above sunken in a narrow groove, nerves above prominulous, intercalated veins hardly developed, reticulum above dense. *Inflorescences* not observed. *Sepals* at least 35% connate, c. 1.75 mm long. *Petals* not seen (present according to Radlkofer 1933). *Fruit* appendages very dense, arranged in longitudinal rows, narrowly triangular to strap-shaped, c. 8 mm long.

Distribution — *Malesia*: Borneo (Sarawak).

Note — This variety much resembles two other

taxa from Borneo, viz. *N. lappaceum* var. *xanthioides* and a form of *N. ramboutan-ake* mentioned in the notes under that species. The latter differs from the former two by its leaflets, which are fully glabrous below; *N. lappaceum* var. *xanthioides* has leaflets which are puberulous on the midrib below, very sparsely so on the nerves, whereas in between there are only appressed and minute, very sparse hairs; *N. cuspidatum* var. *multinerve* is thinly tomentose on the veins and veinlets on the lower side of the leaflets, but the midrib and nerves are nearly glabrous. There are also slight differences in the nervation and in the fruit appendages between all these taxa. Moreover, *N. lappaceum* var. *xanthioides* has terminal inflorescences, whereas *N. ramboutan-ake* has axillary, together pseudoterminal inflorescences, and hence axillary infructescences.

e. var. **ophiodes** (Radlk.) Leenh., Blumea 31 (1986) 390. — *Nephegium ophiodes* Radlk.

e1. subvar. **ophiodes** (Radlk.) Leenh., Blumea 31 (1986) 390.

*Twigs* 2.5–10 mm in diam., mostly tomentose and often rather early glabrescent. *Petioliules* 3–7.5 mm long, above flat to slightly broadly grooved with mostly 3 strong ribs. *Leaflets* 2.5–8 cm broad, index 2.25–4, the sides straight and nearly parallel to curved; midrib above raised as a fine rib to sometimes sunken, nerves above finely grooved to sometimes flat, intercalated veins hardly to sometimes clearly developed, reticulum above dense. *Inflorescences* pseudoterminal. *Sepals* 20–40% connate, 1.4–2 mm long. *Petals* absent or exceptionally a single reduced one present. *Fruit* appendages dense, filiform or narrowly strap-shaped, broadened to swollen at base, up to 1.5 cm long, curled.

Distribution – *Malesia*: Sumatra (Eastcoast, Simelungun, one collection), Malay Peninsula.

e2. subvar. **beccarianum** (Radlk.) Leenh., Blumea 31 (1986) 390. — *Nephegium beccarianum* Radlk.

*Twigs* 5–6 mm or more in diam., tomentose. *Petioliules* 2–7 mm long, above broadly and shallowly grooved with a strong median rib. *Leaflets* 2–5 cm broad, index 2.5–5, the sides curved; midrib above slightly raised to slightly sunken, nerves above flat to slightly grooved, intercalated veins often rather strongly developed, reticulum above dense. *Inflorescences* axillary. *Sepals* hardly connate, 1.8 mm long. *Petals* absent (present according to Radlkofer 1933). *Fruit* appendages dense, narrowly strap-shaped, bulbous-based, up to 1 cm long.

Distribution – *Malesia*: Borneo (Sarawak, Sabah).

f. var. **robustum** (Radlk.) Leenh., Blumea 31 (1986) 391. — *Nephegium robustum* Radlk.

*Twigs* 5–15 mm in diam., tomentellous. *Petioliules* 7–15 mm long, above broadly or narrowly shallowly grooved without or with a strong median rib to flat. *Leaflets* up to 35 cm long and 5–10 cm broad, index 2.5–5, the sides straight and parallel to slightly curved; midrib above flat to sunken, nerves above prominulous to slightly sunken, intercalated veins usually at most only slightly developed, reticulum above lax. *Inflorescences* terminal. *Sepals* 25–50% connate, 1.3–1.8 mm long. *Petals* absent. *Fruit* appendages dense, narrowly strap-shaped to filiform, gradually thickened or broadened to the base, c. 1.5 cm long, curled.

Distribution – *Malesia*: Borneo, Philippines (Palawan: Mt Pulgar, one collection).

5. **Nephegium daedaleum** Radlk., Sapind. Holl.-Ind. (1879) 9, 27; in Engl., Pflanzenz. 98 (1933) 980; Leenh., Blumea 31 (1986) 391. — Type: *Beccari PB 2818* (FI, K), Sarawak.

*Tree*, up to 33 m high, dbh up to 70 cm, sometimes with buttresses. *Twigs* 2–5 mm thick, tomentellous, glabrescent. *Leaves* 1–3(–5)-jugate; petiole 2–9.5 cm long, 1–2 mm thick, terete to semiterete; axes tomentellous, sometimes glabrescent; petiolules 5–9 mm long, above variably grooved, mostly with a median rib. *Leaflets* elliptic, 6.5–18 by 2.5–7 cm, index 2–3.5, pergamentaceous, above hairy all over, soon glabrescent the midrib sometimes excepted, beneath tomentose on midrib and nerves, densely sericeous in between; domatia absent; base acute to rounded; sides curved; apex not to abruptly acuminate, acumen short and broad to long and slender, obtuse; midrib above prominulous, nerves 0.5–1.25 cm apart, above slightly grooved, intercalated veins often well developed, reticulum above minute, inconspicuous or invisible, beneath mostly invisible, sometimes the veins prominulous, a bit scalariform. *Inflorescences* terminal. *Sepals* nearly free, c. 3 mm long. *Petals* 4 or 5, 1.75–2 by 1.5–2 mm, the claw up to 1 mm long, the blade auricled to funnel-shaped, at least claw and outside of blade densely woolly. *Disc* glabrous. *Stamens* 8 (sometimes less?). *Ovary* 2-celled. *Fruits* flattened-ellipsoid, bulging at base to the abaxial side, 4 by 2.25 by 1.5 cm, densely shortly pubescent, fairly densely set with pyramidal warts c. 1.5 mm high, deeply irregularly fissured longitudinally (possibly thin-fleshy when fresh and rupturing only when dry; after boiling



the surface closes up and the fissures are glabrous inside); wall coriaceous, 2–2.5 mm thick. — **Fig. 60d.**

Distribution — *Malesia*: Borneo (Sarawak and Sabah).

Habitat & Ecology — Primary kerangas or mixed Dipterocarp forest on slopes or ridges. Soil sandstone, sandy clay, or loam. Altitude up to 570 m but usually not above 100 m. Fl. May, Sept.; fr. June, Aug., Sept., Nov.

Uses — Sometimes cultivated, probably because of the fruit.

Note — Specimens of this species may key out as *N. hamulatum*, which differs in shorter petiolules that are narrowly deeply grooved above, smaller stiff-coriaceous leaflets, the usually barely evident intercalated veins, the far shorter sepals, and above all the distinct differentiation of the fruit appendages into a broad basal and a narrowed apical part.

**6. *Nephelium hamulatum*** Radlk., Sapind. Holl.-Ind. (1879) 78 p.p. (fruits only); Radlk. in Engl., Pflanzenr. 98 (1933) 967 p.p.; Leenh., Blumea 31 (1986) 392. — Neotype (Leenh. 1986): *Maingay 1628* (= *KD 450* p.p.) (K, L), Malay Peninsula.

*Nephelium herveyi* Ridley, J. Straits Branch Roy. Asiat. Soc. 82 (1920) 180; Fl. Malay Penins. 1 (1922) 500; Radlk. in Engl., Pflanzenr. 98 (1933) 982. — Lectotype (Leenh. 1986): *Curtis 1389* (K, SING), Malay Peninsula.

*Tree*, up to 24 m high, dbh up to 40 cm, with low buttresses. *Twigs* 2–4 mm in diam., puberulous, late glabrescent. *Leaves* 1–4-jugate; petiole 1.5–5.5 cm long, 1–1.5 mm thick, terete to semi-terete; axes tomentellous or puberulous, variably glabrescent; petiolules 2–5 mm long, above narrowly and deeply grooved without a median rib. *Leaflets* elliptic to obovate, 5–12.5 by 2–4.5 cm, index 2.25–3.5, stiff-coriaceous, above sparsely puberulous on the midrib to glabrous, beneath tomentellous on midrib and nerves, densely to thinly short-sericeous in between; domatia absent; base rounded to acute; sides curved; apex with a short, broad, obtuse to rounded acumen; midrib above a slender sunken rib, nerves 0.4–1 cm apart, slightly grooved above, intercalated veins variable, few well developed, reticulum minute, beneath prominulous to invisible. *Inflorescences* pseudoterminal to probably terminal. *Sepals* slightly connate only, c. 1.5 mm long. *Petals* absent. *Disc* glabrous. *Stamens* 6 or 7. *Ovary* 2-celled. *Fruits* ellipsoid, at least 3 by 2 cm, densely aculeate, the appendages bulbous-based, flattened, acuminate triangular to acicular, straight or curved, obtuse, 3–6 mm long, woody,

at least the apical part densely ferruginous-puberulous; wall coriaceous, c. 0.5 mm thick.

Distribution — *Malesia*: Malay Peninsula.

Habitat & Ecology — Primary and secondary forest on sandy soils; altitudes below 100 m. Fl. Oct.; fr. Jan., June, July.

Note — The present species is similar to *N. melififerum*; for differences see under that species.

**7. *Nephelium havilandii*** Leenh., Blumea 31 (1986) 394. — Type: *Haviland 2241* (K, L, SING), Sarawak.

*Tree*, c. 8 m high. *Twigs* 2.5 mm in diam., glabrous. *Leaves* 1- or 2-jugate; petiole 2.25–5 cm long, 1–1.5 mm thick, above slightly hollowed; axes subglabrous; petiolules 3–5 mm long, above broadly rather deeply grooved, often with a faint median rib. *Leaflets* elliptic, 6–9 by 3–4.25 cm, index c. 2, coriaceous, above glabrous, beneath thinly minutely sericeous; domatia present, glands naked or covered by a hair tuft, or absent; base slightly oblique, acute, attenuate; sides curved; apex not to shortly acuminate, narrowly rounded; midrib above a slender prominulous rib, nerves 0.5–1.5 cm apart, above prominulous, intercalated veins well developed or sometimes absent, reticulum above moderately coarse, distinctly prominulous, beneath less prominent. *Inflorescences* axillary. *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 outside glabrous, inside woolly in the lower half, or on both sides woolly mainly in the lower half. *Disc* woolly. *Stamens* c. 7. *Ovary* 2-celled. *Fruits* ellipsoid, c. 2–2.5 by 1.25 cm, glabrous, appendages dense, 8–10 mm long, bulbous-based, the apical part triangular in cross section, curved; wall coriaceous, c. 0.5 mm thick.

Distribution — *Malesia*: Borneo (Sarawak, W Kalimantan).

Ecology — Fl. Oct.; fr. Feb., Nov.

Note — The present species is probably allied with *N. laurinum*, which is mainly restricted to Malaya and Sumatra. Notwithstanding the resemblance in leaflets and fruits *N. havilandii* and *N. uncinatum* do not seem to be closely allied: in flower characters *N. havilandii* is relatively 'primitive', and *N. uncinatum* far more derived.

**8. *Nephelium hypoleucum*** Kurz, J. As. Soc. Beng. 41, II (1872) 50; Radlk., Sapind. Holl.-Ind. (1879) 28; Craib, Fl. Siam. Enum. 1 (1926) 330; Radlk. in Engl., Pflanzenr. 98 (1933) 975; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 968. — *Nephelium longana* Cambess. var. *hypoleucum* (Kurz) King, J. As. Soc. Beng. 65, II (1896) 435. — Type: *Brandis 691* (K, M), Burma.

*Tree*, up to 30 m high, dbh up to 1.40 m, or rarely shrub. *Twigs* 2.5–8 mm in diam., glabrous or puberulous and early glabrescent. *Leaves* 1–4(–5)-jugate; petiole 3–16 cm long, 1–3 mm thick, terete to semiterete; axes fairly densely puberulous, early to late glabrescent; petiolules (3–)5–11 mm long, above grooved, with or without a median rib. *Leaflets* ovate, rarely elliptic, 6.5–30 by 2–8 cm, index (1.5–)2–3(–4.5), stiff-pergamentaceous, above glabrous or sparsely minutely hairy on the basal part of the midrib, beneath fairly densely minutely sericeous to glabrous; domatia common to sometimes absent; base rounded to acute; sides slightly curved to often straight; margin often repand; apex obtuse to acute; midrib above prominulous to sunken, nerves 0.75–3 cm apart, above prominulous to flat, intercalated veins often well developed, reticulum rather fine, above mostly slightly more raised than beneath. *Inflorescences* terminal and in the upper leaf axils; male and female flowers sometimes in the same inflorescence. *Sepals* slightly (to halfway up connate), 1.3–2.6 mm long. *Petals* either absent or up to 6, spatulate or not, 1.4–2 mm long, on both sides woolly. *Disc* glabrous. *Stamens* 7–10. *Ovary* 2- (or 3-) celled. *Fruits* ellipsoid, 2–3 by 1.5–2.25 cm, rather densely warty, the warts pyramidal or linear, up to 1.5 mm high, acute, glabrous; wall coriaceous, c. 0.5 mm thick. — **Figs. 60e, 61a.**

**Distribution** — Burma, Indo-China, and Thailand, incl. insular Thailand (Kraburi).

**Habitat & Ecology** — Rain forest on fertile sandy soils at low altitude. Fl. Dec.–Feb.; fr. Feb.–June.

**Notes** — 1. The leaves may resemble those of *Dimocarpus longan*, which, however, have stellate hair tufts, though sometimes minute and only occurring on the lower side of the leaflets on midrib and nerves. *Nepheleum hypoleucum*, on the contrary, has mostly minute appressed hairs on the lower side of the leaflets between the nerves.

2. Vegetatively, the present species also strongly resembles *N. melliferum*. The main differences are that in *N. hypoleucum* the leaflets are mostly widest at about 1/3–1/4 above the base, and the venation is rather densely reticulate, on the lower surface the veins are prominent and the veinlets almost not; whereas in *N. melliferum* the leaflets are nearly always widest about halfway, and the venation is densely reticulate, on the lower surface the veins and veinlets both are prominent.

3. Another taxon occurring in the same area and vegetatively resembling *N. hypoleucum* is *N. cuspidatum* var. *bassacense*. The latter has far more hairy twigs and leaves and the reticulum on the upper side of the leaflets is distinctly more lax.

4. The only other species with leaflets widest

only slightly above the base is *N. laurinum*; for differences see there.

**9. *Nepheleum juglandifolium*** Blume, Rumphia 3 (1847) 106; Valetton, Bull. Inst. Bot. Buitenzorg 15 (1902); Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 188; Radlk. in Engl., Pflanzenr. 98 (1933) 971; Backer & Bakh. f., Fl. Java 2 (1965) 138; Leenh., Blumea 31 (1986) 396. — Type: *Anonymous s.n.* (L, NY), W Java.

*Nepheleum altissimum* Teijsm. & Binn., Nat. Tijds. Ned.-Indië 2 (1851) 306; Ned. Kruidk. Arch. 3 (1855) 410. — Type: *Bogor Bot. Gard. III.E.25a* (BO, L, M), W Java.

*Nepheleum tuberculatum* Radlk., Rec. Bot. Surv. India 3 (1907) 352; Ridley, Fl. Malay Penins. 1 (1922) 501; Radlk. in Engl., Pflanzenr. 98 (1933) 970. — Syntypes: *King's collector 7903* (M); *Scortechini 1767* (K, M), both Malaya.

*Tree*, up to 30 m high, dbh up to 90 cm. *Twigs* 4–12.5 mm in diam., variably hairy, mostly early glabrescent. *Leaves* (1–)3–7-jugate; petiole 6–14 cm long, 2–4 mm thick, terete to semiterete or triangular in cross section; axes variably hairy, glabrescent; petiolules 4–10 mm long, above flat to slightly grooved, without or with a faint median rib. *Leaflets* (narrowly) elliptic, rarely ovate, 7.5–32 by 2.5–9.5 cm, index 3(–5), thin-coriaceous to thin-pergamentaceous, glabrous or beneath sparsely short-hairy; domatia rare; base rounded, obtuse, or acute; sides slightly curved or straight and parallel; apex obtuse to rounded, mostly not, sometimes shortly, broadly, and obtusely acuminate; midrib above prominulous to slightly sunken, nerves 0.75–2.25 cm apart, above prominulous to slightly grooved, intercalated veins none or few; veins and veinlets distinctly different, the former scalariform, reticulation coarse, above prominent, beneath inconspicuous. *Inflorescences* pseudoterminal. *Sepals* slightly or up to c. 35% connate, 1.5–2 mm long. *Petals* none. *Disc* hairy. *Stamens* 7 or 8. *Ovary* 2-celled. *Fruits* slightly flattened ellipsoid, 3.5–5 by 2.5 by 2 cm, glabrous, coarsely warty, the warts ± arranged into longitudinal rows, ± obtuse triangular, usually flattened, up to 4 mm high; wall coriaceous, c. 1 mm thick. — **Fig. 60f.**

**Distribution** — *Malesia*: Sumatra, Malay Peninsula, and W Java.

**Habitat & Ecology** — In rain forest and open jungle, mostly at low altitudes, up to 650 m. Fl. Feb., July, Aug.; fr. July.

**Uses** — Sarcotesta around the seed edible. See Jansen et al. in Verheij & Coronel (eds.), Plant Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 348.

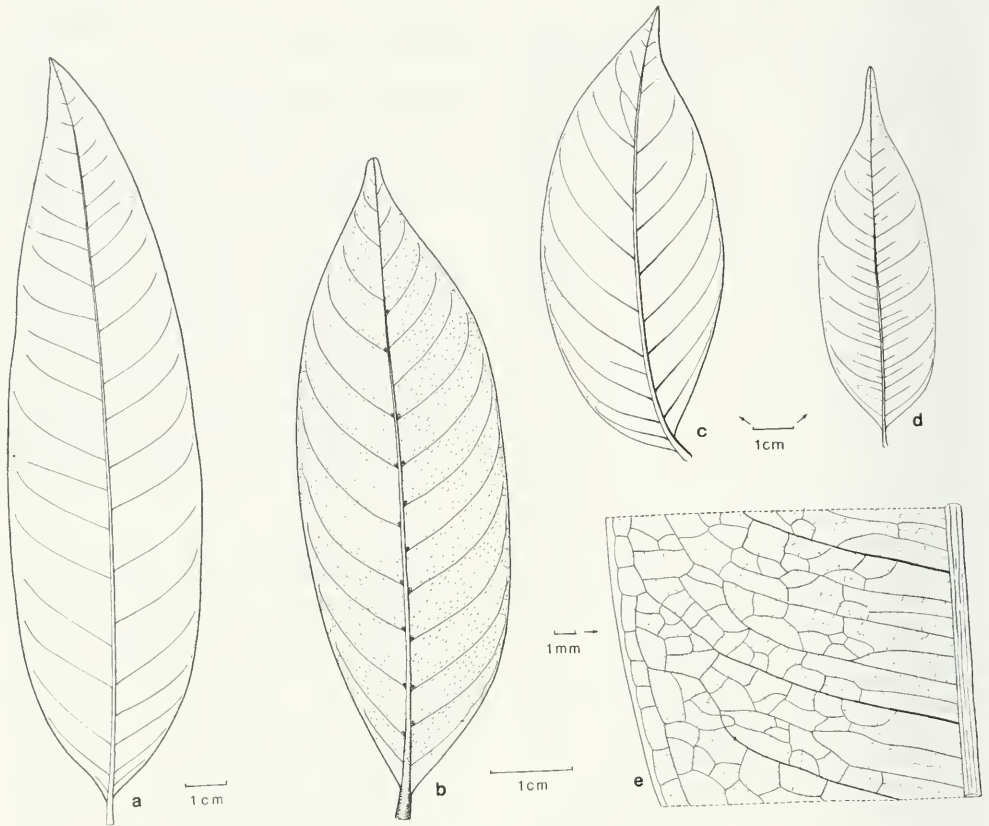


Fig. 61. *Nephelium* L. Leaflets. — a. *N. hypoleucum* Kurz. — b. *N. uncinatum* Radlk. — c. *N. macrophyllum* Radlk. — d. *N. subfalcatum* Radlk.; e. *ibid.*, detail lower side (a: Dickason 6802; b: Meijer 38905; c: S 25393; d. e: SAN 15153).

Note — Vegetatively, the present species may resemble *N. lappaceum* var. *pallens*. The latter differs distinctly by its far more slender twigs and petioles, however.

10. *Nephelium lappaceum* L., Mant. Pl. 1 (1767) 125; Gaertn., Fruct. 1 (1791) 272, pl. 140; Thunb., Fl. Java (1825) 11; Blume, Rumphia 3 (1847) 103; Hassk., Pl. Jav. Rar. (1848) 287; Miq., Fl. Ind. Bat. 1, 2 (1859) 554; Bisschop Grevelink, Pl. Ned. Ind. (1883) 504; Koord., Minah. (1898) 406; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 186; Backer, Schoofl. Java (1911) 266; Ridley, Fl. Malay Penins. 1 (1922) 499; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 504; Holtum, Gard. Bull. Str. Settl. 5 (1931) 199; Radlk. in Engl., Pflanzenr. 98 (1932) 957, f. 24; Merr., Comm. Fl. Coch. (1935) 249; Corner, Wayside Trees (1940) 592;

P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 33, f. 15; Backer & Bakh. f., Fl. Java 2 (1965) 138; Wyatt-Smith & Kochummen, Mal. For. Rec. 17, rev. ed. (1965) 308; Valmayor et al., Philipp. Agric. 54 (1971) 359; H.S. Yong, Nature Malaysiana 4, 3 (1979) 4; Henty, Bot. Bull. Papua New Guinea 12 (1980) 122, f. 71; H.S. Yong, Magnificent Plants (1981) 126; F.C. Ho, Trop. Pl. Taiwan in Colour 3 (1982) 233; Leenh., Blumea 31 (1986) 398. — *Euphoria nephelium* Poir., Dict. Sci. Nat. 27 (1823) 59, nom. illeg.; Blume, Bijdr. (1825) 235. — *Euphoria nephelium* DC., Prod. 1 (1824) 612, nom. illeg. — Neotype (Leenhouts 1986); Bogor Bot. Gard. III.H.10 (= Carocci-Buzi 190, Nedi 12, Sutrisno 71) (BO, L, M, NY, U).

*Nephelium glabrum* Noroña, Verh. Bat. Gen. K. W. 5 (1791) 21, nom. nud. (with authors on Malaya this is *N. maingayi*, with Hasskarl it is *N.*



*ramboutan-ake*, and with authors on the Philippines it is *Dinocarpus longan*).

*Litchi* ('*Litsea*') *ramboutan* Labill. in DC., Bull. Soc. Philomath. Paris 2 (1801) 161, nom. illeg. — *Euphoria ramb-outan* Labill., Mém. Inst. Sci. divers Savans Sci. Math. 1 (1806) 472, pl. 1, nom. illeg. — *Nephelium rambutan* Schnizl., Icon. 4 (1866) text with pl. 230, nom. illeg. — Type: Mém. Inst. Sci. divers Savans Sci. Math. 1 (1806) 472, pl. 1.

*Nephelium glabrum* Reinw. ex Blume, Cat. (1823) 111, nom. nud. — *Euphoria glabra* Blume, Bijdr. (1825) 233, nom. illeg. — *Nephelium glabrum* Cambess., Mém. Mus. Nat. Hist. Nat. 18 (1829) 30. — *Nephelium lappaceum* L. var. *glabrum* Blume, Rumphia 3 (1847) 104; Valetton, Bull. Inst. Bot. Buitenzorg 15 (1902) 3. — Type: *Anonymus s.n.* (L).

*Nephelium chryseum* Blume, Rumphia 3 (1847) 105; Miq., Fl. Ind. Bat. 1, 2 (1859) 554; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 504; Radlk. in Engl., Pflanzenr. 98 (1933) 962. — Lectotype (Leenhouts 1986); *Korthals s.n.* (L), Borneo.

*Nephelium mutabile* Blume var. *pallens* Hiern in Hook. f., Fl. Br. India 1 (1875) 687. — *Nephelium pallens* (Hiern) Radlk., Rec. Bot. Surv. India 3 (1907) 351; in Engl., Pflanzenr. 98 (1933) 961. — Lectotype (Leenhouts 1986): *Maingay 1527* (= *KD 454* p.p.) (K), Malay Peninsula.

*Nephelium xanthoides* Radlk., Sapind. Holl.-Ind. (1879) 9, 27; Beccari, For. Born. (1902) 601; Radlk. in Engl., Pflanzenr. 98 (1933) 966. — Type: *Beccari PB 2849* (FI), Sarawak.

*Nephelium sufferrugineum* Radlk., Sapind. Holl.-Ind. (1879) 77; in Engl., Pflanzenr. 98 (1932) 956; Ridley, Kew Bull. (1933) 191. — *Nephelium glabrum* Noroña var. *sufferrugineum* (Radlk.) Ridley, Fl. Malay Penins. 1 (1922) 499. — Syntypes: *Griffith KD 1000* (BO), *Maingay 1526* (= *KD 449* p.p.) (BO), Malay Peninsula.

*Nephelium maculatum* Radlk., Flora 118–119 (1925) 400; in Engl., Pflanzenr. 98 (1933) 981. — Type: *Koorders 38975* (BO), W Java.

*Nephelium obovatum* Ridley, Kew Bull. (1933) 191; Radlk. in Engl., Pflanzenr. (1934) 1500. — Type: *Haviland 2275* (BM, K, L, SING), Sarawak.

Some more synonyms in Leenhouts (1986).

*Tree* or sometimes shrub. *Twigs* 1.5–10 mm or more in diam., glabrous but for the terminal bud to persistently hairy. *Leaves* 1-foliate to 6-jugate; petiole 1.5–16 cm long, 1–3.5 mm thick, terete to semiterete and sometimes grooved above; axes

variably hairy, early to late glabrescent; petiolules 1.5–12 mm long, above broadly and shallowly grooved with or without a median rib and sometimes with strong lateral ribs to narrowly grooved or flat without any rib. *Leaflets* ovate to obovate, 5–28 by 2–10.5 cm, index 1.25–4.5, coriaceous, above glabrous or sometimes slightly hairy on the midrib, beneath variably hairy; domatia common to absent; base acute to rounded, attenuate or not; sides strongly curved to nearly straight and parallel; apex acute to truncate or not; midrib above prominulous to slightly sunken, nerves 0.5–2 cm apart, above prominulous to slightly sunken, intercalated veins mostly inconspicuous, veins and veinlets finely or coarsely reticulate, veins often tending to scalariform, often raised above. *Inflorescences* axillary, together pseudoterminal, sometimes truly terminal. *Sepals* nearly free to more than halfway connate, 0.7–2.1 mm long. *Petals* mostly absent, sometimes up to 4, reduced, claw 1.1 mm long, blade 0.5 by 0.5 mm, margin infolded and connate towards the base, outside glabrous or with a few long hairs, margin long ciliate, inside woolly. *Disc* hairy or glabrous. *Stamens* (4–)5–8(–9). *Ovary* 2- (or 3-)celled. *Fruits* hardly stalked, ellipsoid to subglobular, up to 6 by 3.5 cm, glabrous, rather thinly to mostly densely set with bulbous- or broad-based, tapering to strap-shaped or filiform, ± curved, 0.5–2 cm long appendages; wall coriaceous, up to 2.5 mm thick.

*Distribution* – Yunnan, Hainan, Indo-China, and *Malesia*: Sumatra, Malay Peninsula, Borneo, Java, Philippines, and Celebes.

*Habitat* – Lower or middle storey forest trees, mainly of low altitudes.

*Chromosomes* –  $2n = 22$ ; Ramirez, Philipp. Agric. 45 (1961) 340–342.

*Note* – The only 'good' difference between *N. lappaceum* and *N. ramboutan-ake* is in the fruit appendages. In the former they have a small and inconspicuous basal part and a long, filiform upper part, whereas in the latter the basal part is relatively large, triangular to ovate in shape, and tapering into a short and broad, often thick and stiff apical part.

#### KEY TO THE VARIETIES

- 1a. Leaflets often relatively narrow, mostly widest about or below the middle, the sides often nearly straight and parallel, apex usually acuminate, beneath usually distinctly glaucous, nerves fairly steep and only slightly curved
- 2 b. Leaflets relatively broad, mostly widest above the middle, the sides strongly curved, apex rarely acuminate, beneath hardly or not glaucous,

nerves widely spreading and strongly curved

**a. var. *lappaceum***

2a. Leaflets narrow, mostly 3–4 cm wide, index up to 4.5, with slightly curved to nearly parallel sides, midrib beneath often glabrous, veins and veinlets reticulate, veins often tending to scalariform. . . . . **b. var. *pallens***

b. Leaflets up to 10 cm wide, index up to 3.5, with mostly curved sides, midrib beneath densely tomentellous, veins mostly distinctly scalariform, sometimes tending to coarsely reticulate, veinlets reticulate

**c. var. *xanthioides***

**a. var. *lappaceum*** — *Nephelium lappaceum* L. — *Nephelium glabrum* Noroña — *Litchi ramboutan* Labill. — *Nephelium glabrum* Reinw. ex Blume — *Nephelium sufferrugineum* Radlk. — *Nephelium maculatum* Radlk. — *Nephelium obovatum* Ridley.

*Tree*, up to 27 m high, dbh up to 70 cm, buttresses up to 1.50 m high, or shrub. *Twigs* 3–9 mm in diam., puberulous or tomentose, early glabrescent to persistently hairy. *Leaves* 1-foliolate to 5-jugate; petiole 1.5–12 cm long, 1–3 mm thick, terete to semiterete; axes variably hairy, early to late glabrescent; petiolules 2–10 mm long, mostly broadly and shallowly grooved with a strong to sometimes faint median rib. *Leaflets* 5–22 by 2.5–10.5 cm, index 1.25–3, widest mostly above, sometimes at or below the middle, beneath hardly glaucous, above glabrous, beneath sparsely hairy on the midrib, still more sparsely so on the nerves, in between the nerves mostly glabrous, sometimes sparsely, rarely densely appressedly short-hairy; domatia present; base obtuse to sometimes rounded; sides mostly strongly curved; apex obtuse, rounded, or sometimes truncate to slightly emarginate, sometimes apiculate or slightly acuminate, rarely tapering into a cuneate and acute acumen; nerves 0.75–2 cm apart, spreading and strongly curved, veins and veinlets on both surfaces hardly to distinctly (especially beneath) different, coarsely to sometimes rather finely reticulate. *Sepals* 4 or 5(–7), mostly slightly connate, 1.1–2.1 mm long, outside mostly thinly to densely appressedly short-hairy, inside mostly densely appressedly long-hairy to woolly. *Stamens* 5–8. *Fruits* large and with a thin wall.

*Distribution* — Thailand and *Malesia*: Sumatra, Malay Peninsula, Borneo, W and C Java, Philippines (Palawan, Basilan), and possibly Ceram. Commonly cultivated, also in other parts of the Tropics, and doubtless not rarely escaped and sometimes naturalized.

*Habitat & Ecology* — In different types of primary and secondary forest, on both slopes and flat land, on ridges and ravines, along rivers or roads, on dry land and in swamps, preferring fertile clay, but also found on peat, tuff, podsolized sand, or limestone; altitude up to 600(–1300) m. Fl. mainly Aug.–Mar.; fr. May–July, Dec. See Brünig, Heidewald Sarawak Brunei (1968) 373 (sub *N. sufferrugineum*). The fruits are eaten by flying foxes and fruitbats [Ridley, *Dispersal* (1930) 339].

*Uses* — Commonly cultivated as a fruit tree. See, among others: Allen, *Malayan fruits* (1967) 175, f. 63; Almeyda et al., *Neglected Tropical Fruits* 6. Rambutan (1979); Burkill, *Dict. Econ. Prod. Malay Penins.* (1935) 1545; H.F. Chin & H.S. Yong, *Malaysian Fruits in Colour* (1982) 6; Heyne, *Nutt. Pl. Indon.* ed. 3 (1950) 997; Ochse, *Ind. Vruucht.* (1927) 248, f. 120–122; Ochse & Bakh., *Fruits Fruitcult.* (1931) 139, pl. 54, 55; Popenoe, *Man. Trop. Fruits* (1920) 327; *Wealth of India* 7 (1966) 13, f. 8; Van Welzen, Lamb & Wong, *Nature Malaysiana* 13 (1988) 10–25; Van Welzen & Verheij in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.)* 2, *Edible fruits and nuts* (1991) 233–235.

*Notes* — 1. As with many commonly cultivated plants it is difficult to decide what is its natural area of distribution and where it is naturalized. I have the impression that var. *lappaceum* is native in Thailand and West Malesia, though many of the collections, especially from Java are doubtful, being either collected near kampongs or in cultivated areas, or lacking sufficient information on the locality. The Philippine material may be of truly wild origin: var. *lappaceum* is common on Borneo, Palawan has a strong Bornean element in its flora, and Basilan is not far from Palawan. On the other hand, I strongly doubt that the species is native on Ceram: only one old collection is known without any detailed information on the locality.

2. Specimens of *N. hypoleucum* may resemble the present variety. They differ mainly in being (nearly) glabrous all over and by their often distinctly ovate leaflets with a densely reticulate, not very conspicuous venation. In this variety the upper leaflets at least are often obovate with a cuneate base and the reticulation is often very clear and on both sides prominent. The fruits are distinctly different: in *N. hypoleucum* with pyramidal or linear, up to 1.5 mm high warts, in *N. lappaceum* with bulbous- or broad-based, tapering to strap-shaped or filiform, 0.5–2 cm long appendages.

3. *Nephelium lappaceum* var. *lappaceum* and *N. ramboutan-ake* sometimes resemble each other vegetatively. However, typical *N. ramboutan-ake* clearly differs from the present variety in its leaf-

lets: they are elliptic with the angle of the base and the apex being about the same, the apex itself is nearly always distinctly acuminate, they are thin-pergamentaceous, in the herbarium often curled or rolled up, glaucous beneath, the nerves are rather numerous, widely spreading, light brown beneath in the dried leaflets, and the nervation is faint on both sides. In *N. lappaceum* var. *lappaceum* the upper leaflets tend to be obovate, and the base is distinctly more acute than the apex, they are coriaceous, flat when dried, at most hardly glaucous, the apex is rounded or sometimes slightly acuminate, with few steep nerves which are gradually curved upwards and are mostly dark purplish brown to nearly black in the dried leaflets; the venation is prominent on both sides.

**b. var. pallens** (Hiern) Leenh., *Blumea* 31 (1986) 402. — *Nepheium mutabile* Blume var. *pallens* Hiern — *Nepheium chryseum* Blume.

*Tree*, up to 44 m high, dbh up to 1.25 m, with up to 4 m high buttresses, sometimes shrub. *Twigs* 1.5–7 mm in diam., glabrous with the exception of the terminal bud or densely puberulous or tomentellous and early to sometimes late glabrescent. *Leaves* (1–)3–5(–8)-jugate; petiole 2.5–12 cm long, 1–2.5 mm thick, terete to sometimes ± semiterete; axes densely short-hairy to glabrous; petiolules (1.5–)3–8 mm long, above broadly and shallowly grooved with or without a median rib and sometimes strong lateral ribs to narrowly grooved lacking a rib. *Leaflets* 5.5–12(–20) by (2–)3–4(–7) cm, index 2.5–3.75(–4.5), widest about or somewhat below the middle, sometimes slightly falcate, beneath mostly distinctly glaucous, above glabrous or sometimes slightly puberulous on the midrib, beneath midrib and nerves mostly glabrous, between the nerves mostly minutely sericeous, glabrescent or not; domatia common to absent; base acute to sometimes obtuse or rounded; sides slightly curved to nearly straight and parallel; apex either narrowly rounded to sometimes acute, or tapering into a mostly fairly short and broad, rounded or acute acumen; nerves 0.5–1(–2) cm apart, slightly curved, veins and veinlets rather finely to rather coarsely reticulate, the veins often tending to be scalariform. *Sepals* 4 or 5, rarely 6, up to halfway connate, 1–2 mm long, outside sparsely to densely appressedly short-hairy, inside densely velutinous. *Stamens* (4–)5–8(–9). *Fruits* up to 5 by 3.5 cm, wall 1.5–2.5 mm thick.

*Distribution* – China (Yunnan, Hainan), Thailand, Indo-China, and *Malesia*: Sumatra, Malay Peninsula, Borneo, S Philippines (Palawan, Sulu Islands), Celebes.

*Habitat & Ecology* – In primary or sometimes

old secondary rain forest, sometimes in mixed peat swamp forest, on ridges and slopes as well as on flat land, in ravines, on river banks, sometimes along roads or in open places, mostly on sand, also on loam or clay, sometimes on ultrabasic; altitude up to 400(–1350) m. Fl. mainly Feb.–July; fr. May–Sept.

Notes – 1. There is a gradual shift in the variation of some characters from West to East. In continental Asia, Malaya, and Sumatra the leaves are up to 5-jugate, in Borneo they are sometimes 6-jugate, in the Sulu Islands they may be 7-jugate, and in Celebes they are up to 8-jugate. Domatia are common in the continental Asian forms, more rare in material from Malaya and Sumatra, and rare to absent further East.

2. This variety may be confused with *N. cuspidatum* var. *cuspidatum*, with *N. juglandifolium*, and with *N. ramboutan-ake*. For differences, see under these taxa.

**c. var. xanthioides** (Radlk.) Leenh., *Blumea* 31 (1986) 403. — *Nepheium xanthioides* Radlk. — *Nepheium lappaceum* auct. non L.; Airy Shaw, *Kew Bull.* (1940) 258.

*Tree*, up to 30 m high, dbh up to 60 cm, with up to 2 m high buttresses. *Twigs* 6–10 mm or more in diam., tomentellous. *Leaves* 2–5-jugate; petiole 10–16 cm long, (1.5–)2–3.5 mm thick, above rounded to flat and sometimes grooved; axes tomentellous; petiolules 5–12 mm long, above fairly broadly and shallowly grooved to rather flat, without or sometimes with lateral ribs, without a median rib. *Leaflets* 9–28 by 3–10 cm, index 2.5–3.5, widest about the middle (upper leaflets often slightly above, lower ones slightly below the middle), beneath variably glaucous, above glabrous or sometimes in the basal half of the midrib very sparsely puberulous, beneath densely tomentellous on the midrib, more sparsely so or sometimes fairly densely appressedly short-hairy on the nerves, in between sparsely minutely hairy; domatia rare; base obtuse to rounded; sides curved to sometimes nearly straight; apex tapering into a short to rather long, slender, rounded or sometimes acute acumen; nerves 0.6–1.75 cm apart, fairly steep and only slightly curved, veins mostly densely scalariform, sometimes tending to coarsely reticulate, veinlets reticulate, beneath inconspicuous to hardly visible. *Sepals* 4 or 5, connate up to halfway, 0.7–1.6 mm long, on both sides densely hairy. *Stamens* 5 or 6. *Fruits* 3 by 2 by 1.25 cm, wall c. 1 mm thick.

*Distribution* – *Malesia*: Borneo.

*Habitat & Ecology* – In primary and secondary forest on slopes and ridges, sometimes also on flat land, sometimes on river banks and in marshes, on



clay, loam, or sand, sometimes on limestone; altitude up to 600 m. Fl. Mar., July–Oct.; fr. Jan., Aug.

Uses – Locally grown as a fruit tree, mainly in Sarawak.

Note – The present variety resembles *N. cuspidatum* var. *multinerve* and a Bornean form of *N. ramboutan-ake*; for differences, see under the former.

**11. *Nephelium laurinum*** Blume, Rumphia 3 (1847) 109; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 191; Radlk. in Engl., Pflanzenr. 98 (1933) 974; Backer & Bakh. f., Fl. Java 2 (1965) 138; Leenh., Blumea 31 (1986) 404. — Type: *Korthals s.n.* (L), Sumatra.

*Nephelium rubescens* Hiern in Hook. f., Fl. Br. India 1 (1875) 688, p.p.; Ridley, Fl. Malay Penins. 1 (1922) 500; Radlk. in Engl., Pflanzenr. 98 (1933) 974; Corner, Wayside Trees ed. 2 (1952) 593; Gard. Bull. Sing., Suppl. 1 (1978) 153; H. Keng, Gard. Bull. Sing. 35 (1982) 91. — Lectotype (Leenhouts 1986): *Griffith KD 996* (FI, K, L, M, NY, P), Malay Peninsula.

*Nephelium herveyi* Ridley, J. Str. Br. Roy. As. Soc. 82 (1920) 180, p.p., excl. type.

*Nephelium caudifolium* Ridley, Fl. Malay Penins. 1 (1922) 500; Radlk. in Engl., Pflanzenr. 98 (1933) 981. — Type: *KEP 4752* (K, SING), Malay Peninsula.

*Tree*, up to 24 m high, dbh up to 90 cm. *Twigs* 2–6 mm in diam., puberulous and early glabrescent to glabrous. *Leaves* 1–6-jugate; petiole 2–10 cm long, 1–2.5 mm thick, terete to semiterete; axes variably hairy or glabrous; petiolules 2–9 mm long, narrowly deeply grooved without a median rib or broadly grooved and sometimes with  $\pm$  strongly lateral ribs or with a median rib. *Leaflets* elliptic to (narrowly) ovate, 5–18.5 by 1.5–4.25 cm, index 2–5.5, stiff-pergamentaceous to coriaceous, above glabrous or sometimes very sparsely hairy on the midrib, beneath very sparsely to fairly densely puberulous on midrib and nerves, between the nerves fairly densely minutely sericeous to glabrous; domatia present; base rounded to acute, attenuate; sides straight and parallel to slightly curved; apex acuminate, acumen short to long, broad to slender, rounded to emarginate or sometimes acute; midrib above a slender rib, slightly sunken or prominulous towards the apex, nerves 0.5–1.2 cm apart, above prominulous to slightly sunken, intercalated veins well developed, nerve pattern regular and dense, veins and veinlets on both sides hardly or beneath  $\pm$  distinctly different, above mostly reticulate. *Inflorescences* mostly terminal, sometimes pseudoterminal, the lower branches axillary. *Sepals* up to c. 20% connate, 2–

3 mm long. *Petals* 0–5, (obovate-)lanceolate, 1.6–2.3 mm long, at least the lower half woolly-ciliate. *Disc* glabrous. *Stamens* (7 or) 8. *Ovary* 2(–4)-celled. *Fruits* more often with two carpels developing than in most species, slightly curved obovoid (especially when young) to ellipsoid, c. 2.5 by 1.5 by 1.25 cm, finally glabrous, fairly sparsely set with 2–3(–8) mm long triangular appendages with short, curved, tongue-shaped apical part; wall coriaceous, barely 1 mm thick. — **Fig. 60g.**

*Distribution* – *Malesia*: Sumatra, Malay Peninsula, and Borneo (W Kalimantan, near Mt Klam, one collection). Blume (1847) mentions also West Java, but no material nor any later record from that area is known (see also Koorders & Valetton, l.c.).

*Habitat & Ecology* – Dense jungle on wet ground, in fresh water swamps, and along rivers, locally common; altitude below 100 m. Fl. Mar.–Aug.; fr. Jan.

*Notes* – 1. As the greatest width of the leaflets is often only slightly above the base, this species may resemble *N. hypoleucum*. However, the latter differs in the broader leaflets with an obtuse to rounded apex and with nerves prominent beneath; the leaflets of *N. laurinum* are mostly caudate-acuminate and the nerves are only slightly raised beneath.

2. This species is well characterized by the  $\pm$  parallel-sided, long-acuminate leaflets and the fruit lobes both of which relatively often start developing. The leaflets of *N. subfalcatum* are of the same shape, but the venation is lax and elongated parallel to the nerves, whereas in *N. laurinum* it is densely, regularly, and finely reticulate.

**12. *Nephelium macrophyllum*** Radlk., Sapind. Holl.-Ind. (1879) 9, 27; in Engl., Pflanzenr. 98 (1933) 973; Leenh., Blumea 31 (1986) 406. — Type: *Beccari PB 2500* (FI, M, NY), Sarawak.

*Tree*, 24 m high, dbh up to 40 cm. *Twigs* 3–6 mm in diam., sparsely puberulous to glabrous. *Leaves* 1- or 2-jugate; petiole 4–7 cm long, 1–2.5 mm thick, semiterete to above obtuse-angular; axes glabrous or sometimes very sparsely minutely puberulous; petiolules 1.5–7 mm long, thick, above slightly bulging. *Leaflets* elliptic, 10–22.5 by 5–10 cm, index 2–2.75, thick-coriaceous, above glabrous, beneath sparsely puberulous on midrib and nerves, in between fairly densely minutely sericeous; domatia present; base acute to rounded, slightly attenuate; sides curved; apex tapering into short acute acumen; midrib above prominulous, nerves 1–3 cm apart, above slightly sunken, few well-developed intercalated veins, veins a bit tending to scalariform, above prominulous or sometimes hardly visible, beneath prominulous, veinlets finely

reticulate, above prominulous to hardly visible, beneath hardly visible. *Inflorescences* pseudoterminal. *Flowers* known only from remains under the fruit. *Sepals* probably only slightly connate, c. 2 mm long. *Petals* present according to Radlkofer. *Disc* glabrous. *Ovary* 2-, rarely 3-celled. *Fruits* ellipsoid, c. 3.5 by 2 cm, appendages dense, c. 7.5 mm long, bulbous-based, the upper part tongue-shaped, slightly curved, densely ferrugineous-puberulous; wall coriaceous, c. 2 mm thick. — **Fig. 61c.**

**Distribution** — *Malesia*: Borneo (Sarawak, near Kuching).

**Habitat & Ecology** — In primary lowland Dipterocarp forest on hill slope; altitude 90 m. Fr. Sept.

**Notes** — 1. I could not find any trace of petals, which were mentioned by Radlkofer, nor of stamens. However, because of the systematic position of this species a complete or nearly complete corolla and 8 or somewhat fewer stamens are to be expected.

2. The fruits of the present species may superficially resemble those of *N. ramboutan-ake*. However, the latter species has glabrous fruits, and also differs in its much thinner leaflets.

3. This species sometimes shows some vegetative resemblance to *N. melanomiscum*. As far as can be judged from the few specimens available of both species, *N. macrophyllum* is characterized by asymmetrical, slightly falcate leaflets, whereas *N. melanomiscum*, like most species of *Nephelium*, has symmetrical leaflets. The fruits of both species are distinctly different.

**13. *Nephelium maingayi*** Hiern in Hook. f., Fl. Br. India 1 (1875) 688 (fruiting material only); Radlk., Sapind. Holl.-Ind. (1879) 69–70; Veleton, Bull. Inst. Bot. Buitenzorg 15 (1902) 5; Radlk. in Engl., Pflanzenz. 98 (1933) 964; Brüning, Mitt. Bundesforsch. Anst. Frost- und Holzwirtsch. Reibek 68 (1968) 373. — *Nephelium lappaceum* L. var. *maingayi* (Hiern) Veleton, Bull. Inst. Bot. Buitenzorg 15 (1902) 7, nom. inval. — Lectotype (Leenhouts 1986): *Maingay 1120* (K), Malay Peninsula.

*Nephelium lappaceum* auct. non L.: Radlk., Sapind. Holl.-Ind. (1879) 73 (as to *Herb. Bog. 14459*).

*Nephelium glabrum* auct. non Noroña; King, J. As. Soc. Beng. 65, II (1896) 433; Ridley, Fl. Malay Penins. 1 (1922) 499 (excl. var. *sufferrugineum*); Corner, Gard. Bull. Sing., Suppl. 1 (1978) 153.

*Nephelium lappaceum* L. var. *glabrum* auct. non Blume; Radlk., Sapind. Holl.-Ind. (1879) 73 (as to *Herb. Bog. 14335*).

*Xerospermum spec.*, Merr., Pl. Elm. Born. (1929) 175 (as to *Elmer 21703, 21801*).

**Tree**, up to 40 m high, dbh up to 90 cm, sometimes with up to 1.40 m high buttresses. **Twigs** 2–7.5 mm in diam., glabrous. **Leaves** 1-foliolate to 3(–5)-jugate; petiole 1–10 cm long, 1–3 mm thick, terete to semiterete; axes early glabrescent or sometimes glabrous; petiolules 4–17.5 mm long, above grooved, no ribs. **Leaflets** ± elliptic to obovate, 5.75–22 by 2.75–9 cm, index 1.5–3.5, pergamentaceous, glabrous or beneath sometimes very sparsely hairy on midrib and nerves; domatia absent; base rounded to acute, mostly attenuate; sides curved; apex without or with an obtuse to acute acumen; midrib above sunken to prominulous, nerves 0.5–2.5 cm apart, above slightly grooved to prominulous, no intercalated veins, veins and veinlets coarsely reticulate, prominulous on both sides. **Inflorescences** axillary to terminal. **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-celled, style lateral, with 1 stigma. **Fruits** with a 2–3 mm long stipe, the body ± flattened-ellipsoid, 2–2.75 by 1.25–1.75 by 1–1.25 cm, style remnant a small point or hook just above the stipe, the surface variably warty, slightly puberulous around and especially beneath the style remnant, for the rest glabrous; wall coriaceous, 1–1.5 mm thick. — **Fig. 62.**

**Distribution** — *Malesia*: Sumatra, Malay Peninsula, Borneo.

**Habitat & Ecology** — Primary and secondary forests on flat land (often peat swamps and periodically flooded river banks), slopes, and ridges, apart from peat often on sandy or clay soils, mostly at low to medium altitudes, exceptionally at 1000–1600 m. Fl. mainly Jan.–Apr., also July–Oct.; fr. Jan., Mar.–Apr., Aug.–Nov.

**Uses** — The timber is good and is used for many purposes; the sarcotesta is edible but of no importance. See Heyne, Nutt. Pl. Indon. ed. 3 (1950) 998; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1544 (*N. glabrum*).

**Notes** — 1. *Nephelium maingayi* is the most derived and distinctive species of the genus as far as the flower characters are concerned: a highly connate calyx, no petals, only 4–6 stamens, and a 1-celled pistil.

2. At first sight it seems possible to distinguish between two taxa, one characterized by rather broad, barely or not acuminate, coarsely reticulate leaflets, less than halfway connate calyx, annular and glabrous disc, and smooth fruits; the other by usually narrower, more distinctly acuminate leaflets with denser nerves and a finer reticulation, more



Fig. 62. *Nephelium maingayi* Hiern. a. Habit; b. female flower; c. fruit (a, b: SAN 65365; c: SAN 38799).

than halfway connate calyx, disc consisting of mostly hairy knobs between the stamens, and warty fruits. Furthermore, in Borneo the first kind has more often 1-jugate, the latter 2–3-jugate leaves. However, the characters are not really well correlated, and the two taxa are not sharply delimited;

there is also no correlation with ecology or geography.

**14. *Nephelium meduseum*** Leenh., *Blumea* 31 (1986) 409. — Type: *Sarawak FDS 41142* (K, L), Sarawak.



*Tree*, up to 27 m high. dbh up to 50 cm, with up to 1.20 m high buttresses. *Twigs* 3–5 mm in diam., tomentellous, fairly early glabrescent. *Leaves* 2–5-jugate; petiole 2–7 cm long, 1.5–2 mm thick, semiterete; axes puberulous, glabrescent; petiolules 3–12 mm long, broadly shallowly grooved, mostly with a broad but not very strong median rib. *Leaflets* elliptic, 5–12.5 by 2.5–5 cm, index 2–3, thin-coriaceous to stiff-pergamentaceous, above puberulous along the midrib, mostly early glabrescent, beneath along midrib and nerves rather long-hairy, mainly glabrescent, further glabrous or nearly so; domatia absent; base acute to obtuse, slightly attenuate; sides curved; apex either tapering acuminate with a fairly long, broad, obtuse acumen, or acutely apiculate, or not acuminate at all; midrib above a slender prominulous rib, nerves 0.75–1 cm apart, above slightly sunken, intercalated veins mostly well developed though usually only few per leaflet, veins and veinlets above together finely reticulate, prominulous, beneath veins coarsely reticulate to scalariform, veinlets as above to inconspicuous. *Inflorescences* terminal. *Flowers* only known from old ones and the remains under the fruit. *Sepals* hardly connate. *Petals* at least 3. 1.6 mm long, claw slender, 1 mm long, blade ovate, 0.7 mm wide, the margin in the basal half of the blade incurved, sparsely woolly but for the apex and the inside of the blade. *Disc* glabrous. *Ovary* 2-celled. *Fruits* ellipsoid to subglobular, 3.25–4 by 2.5–3 cm, densely fulvous puberulous, densely set with filiform, curled appendages, c. 15 mm long, swollen at the base; wall coriaceous, c. 1 mm thick. — **Fig. 60h.**

Distribution — *Malesia*: Borneo (Sarawak, Brunei, and W Kalimantan).

Habitat & Ecology — In primary (Mixed Dipterocarp) forest on hills, ridges, and slopes, on yellow sandy clay; altitude up to 450 m. Fr. Jan., Oct.

Uses — The sarcotesta is eaten. See JANSEN et al. in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.)* 2. Edible fruits and nuts (1991) 348.

Notes — 1. The number of stamens is unknown, but in view of the relatively primitive flower it seems reasonable to suppose that this will be about 7 or 8.

2. In contrast to all other species of *Nephelium* studied by me the embryo does not fill the seed completely; the sclerotesta is relatively thick, very hard, and fibrous inside, an inner layer apparently splits off and surrounds the embryo. Whether this is natural or is caused by how the soft inner layer dries is not clear.

3. This species seems closest to *N. costatum* and *N. melliferum*; see under the former species.

4. The leaves strongly resemble those of *N. dae-*

*daleum* and *N. hamulatum*, which, however, differ by the dense indumentum on the lower side of their leaflets.

**15. *Nephelium melanomiscum*** Radlk., Sapind. Holl.-Ind. (1879) 74; in Engl., *Pflanzenr.* 98 (1933) 972; Leenh., *Blumea* 31 (1986) 410. — Type: *Beccari PB 3918* (FI), Sarawak.

*Nephelium xerospermoides* Radlk. in Elmer, *Leafl. Philipp. Bot.* 5 (1913) 1608; Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 505; Radlk. in Engl., *Pflanzenr.* 98 (1933) 976. — Syntypes: *Elmer 11205* (BO, FI, K, L, M, NY, U, WRSL); *FB 15215* (K, M), both Philippines (Mindanao).

*Tree*, up to 20 m high. dbh up to 36 cm, with up to 1.20 m high buttresses. *Twigs* 2–6 mm in diam., when young puberulous or tomentellous, soon glabrous. *Leaves* 1-foliolate to 5-jugate; petiole 1–6 cm long, 1–2 mm thick, terete to semiterete, sometimes grooved above; axes sparsely puberulous to glabrous; petiolules 3–8 mm long, above broadly to narrowly deeply grooved, with or without a median rib. *Leaflets* 3.5–14 by 1.5–6 cm, index 1.75–4.5, widest in or sometimes slightly above or below the middle, pergamentaceous, above glabrous or puberulous on the base of the midrib, beneath sparsely minutely sericeous all over, sometimes glabrescent; domatia present or absent (Bornean material) or always absent (Philippine material); base acute (to rounded), slightly attenuate; sides curved; apex rounded to emarginate or tapering into a short to long, narrow to broad, acute to rounded acumen; midrib above prominulous (to sunken), nerves 0.75–1.5 cm apart, above prominulous to grooved, intercalated veins mostly well developed, veins and veinlets mostly well differentiated, especially beneath, ± finely reticulate, above often more prominent than beneath. *Inflorescences* terminal, also sometimes pseudoterminal. *Sepals* less than 30–65% connate, 1.3–1.75 mm long. *Petals* not seen (according to Radlkofer 2 or 3 reduced ones present). *Disc* glabrous. *Stamens* 6. *Ovary* 2- (or 3-) celled. *Fruits* ellipsoid, c. 3.75 by 2.5 cm, densely fulvous puberulous, at least in the upper half of the appendages, these dense, 1.5–2 mm high, not differentiated into a basal and an apical part, at the base of the fruit forming longitudinal ribs, in the central part of the fruit triangles, towards the apex pyramidal warts; wall fairly hard, c. 0.75 mm thick.

Distribution — *Malesia*: Borneo, Philippines (Mindanao).

Habitat & Ecology — Primary and old secondary forest on slopes, river banks, and hill tops, on fertile alluvial soil; altitude up to 375(–1350) m. Fl. Oct.; fr. Jan.

Uses – Sarcotesta edible, see Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 348.

Note – The present species can resemble *N. macropyllum*; for differences see there.

**16. *Nephelium melliferum*** Gagnep., Notul. Syst. (Paris) 13 (1947) 35; in Fl. Indo-Chine, Suppl. 1 (1950) 969, f. 122: 8–13; Leenh., Blumea 31 (1986) 412. — Lectotype (Leenhouts 1986): *Poilane 29554* (K, P), Vietnam.

*Nephelium parviflorum* Gagnep., Notul. Syst. (Paris) 13 (1947) 36, nom. illeg., non Walpers (1845); in Fl. Indo-Chine, Suppl. 1 (1950) 968, f. 122: 1–7.

*Tree*, up to 27 m high, dbh up to 60 cm. *Twigs* 2.5–7 mm in diam., (sub)glabrous. *Leaves* 1–5-jugate; petiole 2–7.5 cm long, 1.25–2 mm thick, semiterete to sometimes terete; axes (sub)glabrous; petiolules 3–9 mm long, either narrowly and deeply grooved without, or broadly and shallowly grooved with a faint to strong median rib. *Leaflets* (narrowly) ovate to obovate, 4.5–16 by 2–6 cm, index 1.5–4.5, pergamentaceous; above sparsely puberulous on the midrib to glabrous, beneath the same and sometimes  $\pm$  sparsely minutely sericeous all over; domatia absent; base acute to obtuse or sometimes rounded, sometimes attenuate; sides curved to nearly straight; apex mostly rounded, sometimes either emarginate, or acute to slightly acuminate; midrib above either prominulous or sunken, nerves 0.5–1.5 cm apart, above prominulous to sunken, intercalated veins strongly developed, making the nerve pattern rather irregular, veins and veinlets above somewhat, beneath sometimes distinctly different, above densely reticulate, prominulous on both sides. *Inflorescences* pseudoterminal to terminal. *Sepals* nearly free, 1–1.8 mm long. *Petals* 2–5, elliptic, narrowed at base, 0.8–1.3 mm long, both sides woolly, no scale. *Disc* glabrous. *Stamens* (7 or) 8. *Ovary* 2-celled. *Fruits* ellipsoid, 3.25–4 by 2.25 cm, the appendages rather dense to dense, up to 6(–9) mm long, triangular, pyramidal, or conical at the base, tapering into a tongue- or strap-shaped, curved upper part,  $\pm$  densely golden brown puberulous; wall coriaceous, thin.

Distribution – Lower Burma, Thailand, Vietnam, and Malesia: Peninsular Thailand (Klawng Samwng), Malay Peninsula.

Habitat & Ecology – In evergreen or sometimes deciduous forests, on steep ridges, on sandstone; altitude up to 800 m. Fl. Mar., June, Dec.; fr. Apr.–July.

Uses – The sarcotesta is sometimes eaten. See

Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 349.

Notes – 1. This species seems nearest to *N. hypoleucum* and *N. laurinum*. It differs from both in the absence of domatia and in the hairy fruit appendages. Furthermore, *N. hypoleucum* differs in the only minutely warty fruits and the  $\pm$  ovate leaflets; *N. melliferum* has at most a few leaflets that are widest just below the middle. *Nephelium laurinum* differs in the mostly  $\pm$  parallel-sided, often long-acuminate leaflets. One of the two collections from Malaya, *KEP FRI 20336*, has the slightly curved oblong fruits which are typical of *N. laurinum*, but the appendages are densely hairy. The type of *N. laurinum* from Sumatra, on the other hand, bears very young fruits that resemble those of *N. melliferum*, but the appendages are already nearly glabrous. These three species, which show a geographical overlap also, are doubtless closely allied and are separated only on the assumption that characters like hairy or glabrous fruits, the kind of fruit appendages, and minor details of leaf shape and venation delimit species.

2. *Nephelium humulatum* also shows some resemblance to the present species, but is easily distinguishable by the mostly rather dense indumentum on the lower side of the leaflets.

3. Sterile and flowering material of *N. melliferum* may show a strong resemblance to *Mischocarpus pentapetalus* Radlk. The latter differs among others by the more lax and far more distinct venation and by the towards the apex more petal-like sepals, which are thinly strigose hairy, in *N. melliferum* they are densely puberulous.

**17. *Nephelium papillatum*** Leenh., Blumea 31 (1986) 413. — Type: *NBFD SAN 41845* (L, SAN), Sabah.

*Tree*, up to 36 m high, dbh up to 85 cm, with up to 2 m high buttresses. *Twigs* 1.5–3.5 mm in diam., glabrous. *Leaves* 1–3-jugate; petiole 2–5 cm long, 1–1.5 mm thick, semiterete; axes glabrous; petiolules 5–8 mm long, above narrowly deeply grooved without a median rib. *Leaflets* elliptic, 4.5–10.5 by 2.5–4.5 cm, index c. 2, stiff-pergamentaceous, glabrous; domatia absent; base acute to obtuse, attenuate; sides curved; apex hardly obtuse-acuminate; midrib above slightly sunken to flat, nerves 0.5–1.25 cm apart, prominulous above, intercalated veins well developed, making the nervation  $\pm$  irregular, veins and veinlets rather coarsely reticulate, slightly more prominent above than beneath. *Inflorescences* axillary, together partly pseudoterminal. *Flowers* known only from remains

under the fruit. *Sepals* 5, outside at least sparsely puberulous. *Disc* glabrous. *Stamens* 7. *Ovary* 2-celled. *Fruits* ellipsoid, 2.25 by 1.75 cm glabrous, appendages fairly dense, c. 3 mm high, pyramidal with a nipple-like, up to 2 mm long apical part; wall rather woody, 1 mm thick. — **Fig. 63.**

Distribution — *Malasia*: Borneo (Sabah).

Habitat & Ecology — Primary hill and mountain forest at 1350–1950 m altitude. Fr. Nov.

18. ***Nephelium ramboutan-ake*** (Labill.) Leenh., *Blumea* 31 (1986) 415. — *Litchi ramboutan-ake* Labill. in DC., *Bull. Soc. Philomath. Paris* 2 (1801) 161 ('*Litsea*'). — *Euphoria ramboutan-ake* Labill., *Mém. Inst. Sci. divers Savans Sci. Math.* 1 (1806) 474, pl. 2, nom. illeg. — Type: *Herb. Jussieu 11382* (P).

*Nephelium mutabile* Blume, *Rumphia* 3 (1847) 104; Miq., *Fl. Ind. Bat.* 1, 2 (1859) 555; Hiern in Hook. f., *Fl. Br. India* 1 (1875) 686 (excl. var. *pallens*); Valetton, *Bull. Inst. Bot. Buitenzorg* 15 (1902) 7; Koord. & Valetton, *Bijdr. Booms. Java* 9 (1903) 192; Backer, *Schoolfl. Java* (1911) 266; Ridley, *Fl. Malay Penins.* 1 (1922) 501 (excl. var. *pallens*); Merr., *Enum. Philipp. Flow. Pl.* 2 (1923) 505 (excl. var. *pallens*); Ridley, *Dispersal* (1930) 344; Radlk. in Engl., *Pflanzenr.* 98 (1933) 967; Corner, *Wayside Trees* (1940) 593, f. 215; Backer & Bakh. f., *Fl. Java* 2 (1965) 138; Meijer, *Bot. Bull. Herb. Sandakan* 11 (1968) pl. between p. 111 and 112 (seedling); H.S. Yong, *Magnificent Plants* (1981) 128. — Lectotype (Leenhouts 1986): *Blume s.n.* (L), Java.



Fig. 63. *Nephelium papillatum* Leenh. Part of fruiting twig (SAN 41845).



- Nephelium mutabile* Blume var. *rigida* Blume, Rumphia 3 (1847) 104. — Syntypes: *Anonymus s.n.* (L), Java.
- Nephelium mutabile* Blume var. *trigyna* Blume, Rumphia 3 (1847) 104. — Syntypes: *Anonymus s.n.* (L), Java.
- Nephelium glabrum* Noroña var. *album, nigrum, rubrum* Hassk., Pl. Jav. Rar. (1848) 290. — Type unknown.
- Nephelium intermedium* Radlk. in Perkins, Fragm. Fl. Philipp. 1 (1904) 61; in Engl., Pflanzenr. 98 (1933) 963. — Syntypes: *Ahern 204* (M), *Warburg 11672, 12007* (M), Philippines, Luzon; *Warburg 14918* (M), Philippines, Jolo (not *Warburg 13109 = Dinocarpus longan* Lour. var. *malesianus* Leenh.).
- Nephelium philippinense* Monsalud et al., Philipp. J. Sc. 95 (1966) 541, nom. inval.
- Nephelium spec.*, Ceron, Cat. Pl. Herb. Manila (1892) 55 (Vidal 215).
- Euphoria longana* auct. non Lam.: Blume, Bijdr. (1825) 233.
- Nephelium glabrum* auct. non Noroña: Hassk., Pl. Jav. Rar. (1848) 290.
- Cubilia blancoi* auct. non Blume: Vidal, Rev. Pl. Vasc. Filip. (1886) 96; Ceron, Cat. Pl. Herb. Manila (1892) 54.
- Nephelium chryseum* auct. non Blume: King, J. As. Soc. Beng. 65, II (1896) 437; Ridley, J. Str. Br. Roy. As. Soc. 33 (1900) 66.

*Tree*, mostly less than 10 m, sometimes up to 36 m high, dbh up to 60 cm, with up to 2.40 m high buttresses. *Twigs* 1.5–7 mm in diam., puberulous or tomentellous, either persistently so or early glabrescent to sometimes glabrous nearly from the start. *Leaves* (1-foliolate or) 1–7-jugate; petiole 0.75–11.5 cm long, 0.75–2.5 mm thick, terete to semiterete; axes densely hairy to glabrous; petiolules 3–8 (in the Philippines up to 12.5) mm long, mostly narrowly and deeply grooved, without or with only a faint median rib, sometimes more broadly and shallowly so and with a stronger rib. *Leaflets* (narrowly) elliptic (especially in the Philippines more often widest slightly below the middle), 4–20 by 1.75–11 cm, index 1.75–4.5, thin-pergamentaceous to thin-coriaceous, above puberulous on the midrib to glabrous, beneath sparsely puberulous on the base of the midrib, furthermore all over the surface densely minutely sericeous, to sometimes glabrous; domatia mostly common, sometimes scarce or absent; base acute or (especially on the Asian continent and in the Philippines) in lower leaflets obtuse to rounded, attenuate; sides mostly curved, sometimes nearly straight; apex mostly acuminate, the acumen usually short, broad,

obtuse; midrib above prominulous to exceptionally slightly sunken, usually a slender rib, in the Philippines often broader and more rounded, nerves 0.5–2 cm apart, above slightly sunken to sometimes prominulous, intercalated veins variable, venation mostly reticulate,  $\pm$  tending to scalariform, sometimes conspicuously and rather densely scalariform, either above prominulous, beneath hardly visible, or in the eastern races prominulous on both sides. *Inflorescences* axillary, partly together pseudoterminal. *Sepals* slightly or up to halfway connate, 1–2.75 mm long. *Petals* absent. *Disc* glabrous. *Stamens* 5–8. *Ovary* 2- (rarely 3-)celled. *Fruits* ellipsoid to subglobose, 4–6.5 by 2.5–5 cm, glabrous, coarsely spiny, spines up to 1.5 cm long, bulbous-based and often confluent at the base, or sometimes knobby, knobs short tongue-shaped; wall coriaceous, up to 7 mm thick. — **Fig. 60i.**

*Distribution* — Assam, Burma, and *Malesia*: Sumatra, Malay Peninsula, Borneo, Java (doubtful), Philippines, Moluccas (indigenous?).

*Habitat & Ecology* — Primary or sometimes secondary forest on flats as well as on slopes, often on river banks but rarely in swamps, usually on sand or clay, more rarely on a rocky soil, then mostly sandstone or basalt, rarely limestone; altitude 0–200(–1950) m. *Fl.* mainly Feb.–Apr. and July–Sept.; *fr.* May–July and Oct.–Dec.

*Uses* — Cultivated as a fruit tree; the timber is also used. See Heyne, Nutt. Pl. Indon. ed. 3 (1950) 999; Ochse, Ind. Vruucht. (1927) 256, f. 123, 124; Ochse & Bakh., Fruits Fruitcult. (1931) 143, pl. 56; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1547; W.H. Brown, Useful Pl. Philipp. 2 (1950) 367, f. 178; Kraemer, Trees West. Pacific Reg. (1951) 220, f. 78; Allen, Malayan Fruits (1967) 177, f. 64; Chin & Yong, Malaysian Fruits in Colour (1982) 8; Seibert in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 233.

*Notes* — 1. This species is rather a variable one, as already noted by Blume in his specific epithet *mutabile*. ‘Typical’ material, as it is commonly found in Malaya, Sumatra, Java, and Borneo, is characterized by thin-pergamentaceous leaflets which are commonly rolled up in the herbarium, unlike most other species of *Nephelium*: they are reddish brown above and glaucous beneath; the midrib is slightly raised and slender above, the nerves are rather steeply ascending, and distinctly curved; domatia are common; the reticulation is fairly lax and usually visible above.

The most distinct form is restricted to Borneo and is characterized by 1–3-jugate leaves, relatively large, thin-coriaceous leaflets which are glabrous above and often so beneath, lack domatia, have a

midrib that is hardly raised to slightly sunken and more rounded above, and dense, steeply ascending, and nearly straight nerves. The veins and veinlets are clearly different, the former being mostly rather densely scalariform and raised on both sides, the latter more vaguely laxly reticulate. This form resembles *N. lappaceum* var. *xanthioides* but differs in its leaflets, which are nearly glabrous beneath, at least on the midrib, by the midrib itself, which is at least at the base slightly raised above, and the mainly axillary inflorescences and especially infructescences. *Nephelium lappaceum* var. *xanthioides* has the midrib densely hairy beneath, slightly sunken above at the base, and has terminal inflorescences and infructescences. The Philippine material lies more or less in between the typical form and the Bornean form.

*Nephelium intermedium* represents a morphologically extreme population from the Philippines, mainly characterized by the relatively long and slender fruit appendages. The only character given by Radlkofer which does not fit with *N. ramboutan-ake* is the hairiness of the disk. This could not be checked in the very fragmentary type material left; otherwise comparable Philippine collections have a glabrous disk. However, one of the syntypes of *N. intermedium*, Warburg 13109, is *Dimocarpus longan* Lour. subsp. *malesianus* Leenh. and this flowering specimen has a hairy disk, so this may be the source of the mistake. Apparently, with the name *intermedium* Radlkofer intended to express that this species was in between *N. ramboutan-ake* and *N. lappaceum* L. var. *pallens* (Hiern) Leenh., in both general appearance as well as in some characters.

The fruits of *Kostermans 13333* (E Kalimantan, Sangkulirang Dist., Mt Medadem, N of Sangkulirang) are quite unusual: the appendages are very dense, thick knobby, c. 5 mm high, and lack an apical part; they resemble small fruit heads of a *Pandanus*.

2. It is difficult to say whether the rather few and mostly old collections from Java were gathered from wild trees, even though at least West Java lies within the natural area of the species. The occurrence in the Moluccas does not seem natural: it lies distinctly outside the area of the species, and the collections seen by me represent the typical western form, not the Philippine one, and at least the collections made by Labillardière in the early 1790's were derived from cultivated trees, which were said to have been imported by Chinese.

3. *Nephelium ramboutan-ake* may easily be confused with *Dimocarpus longan* Lour. var. *echinatus* Leenh. because of a sometimes strong resemblance in the leaves; the fruits are nearly iden-

tical. In principle, both species are clearly different in the kind of hairs they bear: the former has solitary hairs, the latter stellate hair tufts. However, both may be nearly glabrous, *Nephelium ramboutan-ake* then having only very sparse minute appressed hairs on the lower leaf side. *Dimocarpus longan* var. *echinatus* having a few minute hair tufts on the lower side of the nerves but so minute that even at  $\times 10$  magnification they are hardly visible. A good additional character is that the bark of the twigs is usually white in *Dimocarpus longan*, brownish in *Nephelium ramboutan-ake*.

4. The fruits of the present species may resemble those of *N. macrophyllum*; for differences between the two species, see there.

5. *Nephelium lappaceum* var. *pallens* may resemble *N. ramboutan-ake*. Good characters in which the former differs from the latter are among others the midrib which is flat to sunken above instead of mostly raised, veins and veinlets that are slightly raised above instead of inconspicuous, the reticulation is rather dense, not lax.

**19. *Nephelium reticulatum* Radlk., Sapind. Holl.-Ind. (1879) 9, 27; Becc., For. Born. (1902) 600, 601; Radlk. in Engl. Pflanzenr. 98 (1932) 955; Leenh., Blumea 31 (1986) 419. — Type: *Beccari PB 2819* (FI), Sarawak.**

*Tree*, up to 25 m high, dbh up to 70 cm, sometimes with small buttresses. *Twigs* 4–5 mm in diam., the youngest parts puberulous, for the rest glabrous. *Leaves* 4(–7)-jugate; petiole 6–18.5 cm long, 1.5–3 mm thick, terete to slightly hollowed above; axes thinly puberulous, glabrescent; petiolules 2–10 mm long, narrowly and deeply to broadly and shallowly grooved, lacking or with 3 ribs. *Leaflets* (narrowly) elliptic (to ovate) 6.5–20 by 2.5–5.5 cm, index 2–4, pergamentaceous, glabrous or sometimes beneath sparsely puberulous on the midrib and with few scattered, appressed, minute hairs all over the surface; domatia absent; base rounded to acute, attenuate; sides slightly curved; apex abruptly to tapering acuminate, acumen short to fairly long, cuneate, acute; midrib above a slightly sunken fine rib, nerves 0.75–1.25(–1.5) cm apart, above prominent, intercalated veins variably developed, veins and veinlets conspicuously moderately coarsely to minutely reticulate, prominent on both sides. *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. *Petals* 5–0, up to 1.8 mm long, claw 1 mm, blade 1.5 mm wide, outside sparsely, inside densely hairy, but for the upper half of the blade. *Disc* glabrous. *Stamens* 5–8. *Ovary*

2-celled. *Fruits* ellipsoid, 4 by 2.5 cm, appendages dense, narrowly strap-shaped, thin-puberulous, glabrescent, bulbous to triangular at the base, curved, up to c. 1 cm long; wall coriaceous, c. 1 mm thick.

Distribution – *Malesia*: Borneo.

Habitat & Ecology – Primary forest on flat or hilly country; soil sandy; altitude up to c. 400 m. Fl. Apr., May, July, Aug., Oct.; fr. Jan.

Uses – Apparently locally cultivated for the fruits. See Jansen et al. in Verheij & Coronel (eds.), *Pl. Res. SE Asia (PROSEA Handb.) 2*, Edible fruits and nuts (1991) 349.

Note – Conspicuous characters of the present species are the relatively many-jugate leaves with leaflets that in the herbarium are bright green (brown in nearly all other species) and have the reticulation distinctly raised on both sides.

**20. *Nephelium subfalcatum*** Radlk., *Rec. Bot. Surv. India* 3 (1907) 353; in Engl., *Pflanzenr.* 98 (193) 973; Leenh., *Blumea* 31 (1986) 420. — Type: *Forbes 3092* (K, L, M, SING), Sumatra.

*Tree*, up to 35 m high, dbh up to 60 cm, with up to 2 m high buttresses. *Twigs* 1.5–5 mm thick, puberulous, mostly early glabrescent. *Leaves* 1-foliolate to 5-jugate; petiole 1.5–7 cm long, 0.75–1.5 mm thick, terete to semiterete; axes sparsely puberulous and mostly glabrescent, or glabrous from the beginning; petiolules 3–10 mm long, above mostly narrowly and deeply, sometimes only slightly grooved, without a median rib but mostly with swollen lateral ribs. *Leaflets* (narrowly) ovate to elliptic, 4–15 by 1.5–5 cm, index 2.25–4.75, thin-pergamantaceous to coriaceous, glabrous or sometimes beneath along the midrib with a few minute appressed hairs; domatia absent; base acute to rounded, attenuate; sides mostly slightly, sometimes strongly curved, sometimes nearly parallel; apex obtuse or rounded or tapering acuminate, the acumen short, broad, and rounded to long, slender, and acute; midrib above sunken to, sometimes prominulous, nerves 0.5–1.5 cm apart, above prominulous,  $\pm$  distinctly looped and joined near the margin, nervation rather irregular because of the often great number of variably developed intercalated veins, veins clearly differentiated from veinlets, reticulation very coarse, prominulous at both sides. *Inflorescences* axillary, pseudoterminal, or terminal. *Sepals* variably but mostly rather high up connate, 1–2 mm long. *Petals* absent. *Disc* glabrous (6–)8. *Ovary* 2-celled. *Fruits* ellipsoid, 3.25–3.75 by 2.5 cm, glabrous,  $\pm$  densely set with strap-shaped to filiform, curved, up to c. 15 mm long, appendages, bulbous to triangular at

the base, confluent or not; wall hard coriaceous, up to c. 3 mm thick. – **Fig. 61d, e.**

Distribution – *Malesia*: Sumatra, Malay Peninsula, Borneo.

Habitat & Ecology – Primary Mixed Dipterocarp forest on slopes and ridges, on sandy and loam soils; altitude mainly below 500 m, exceptionally up to 975 m. Fl. Aug.; fr. Dec.–Feb.

Notes – 1. At first sight, the material from Borneo seems rather different from that of Malaya and Sumatra. The main differences are that the Bornean material is more glabrous, the margin of the petiolules is not swollen, the apex of the leaflets is long-, slender-, and acute-acuminate, and the fruit appendages are somewhat longer. But these differences are not sharp, they do not hold for all Bornean specimens, and *KEP FRI 13331*, from Malaya agrees nearly completely with the Bornean form. Accordingly, a subdivision seems unwarranted.

2. The leaves of the present species resemble in shape strongly *N. laurinum*; for differences, see under that species.

3. The Bornean form of *N. subfalcatum* in particular comes close to *N. uncinatum*; for differences, see there.

**21. *Nephelium uncinatum*** Radlk. ex Leenh., *Blumea* 31 (1986) 421; Radlk. in Merr., *Pl. Elm. Born.* (1929) 175, nom. nud.; in Engl., *Pflanzenr.* 98 (1933) 983, nom. nud.; Meijer, *Bot. News Bull.* 9 (1967) 75, nomen. — Type: *Elmer 21708* (BO, L, M, NY, SING, U), Sabah.

*Tree*, up to 25(–40?) m high, dbh up to 45 cm, with up to 1.5 m high buttresses. *Twigs* 2.5–4.5 mm in diam., puberulous, late glabrescent. *Leaves* (1-foliolate to) 3–7(–9, rarely up to 18)-jugate; petiole 3–9 cm long, 1–1.5 mm thick, terete; axes densely minutely hairy, rarely fully glabrescent; petiolules (1–)2–4 mm long, above broadly shallowly grooved with a strong median rib. *Leaflets* (narrowly) elliptic to obovate, sometimes slightly falcate, 4.75–11 by 1.5–3.5 cm, index 2.5–5(–6), pergamentaceous, above puberulous in the basal part of the midrib, to subglabrous, beneath sparsely hairy on midrib and nerves, in between minutely sericeous; domatia present; base acute, decurrent; sides slightly curved; apex tapering to fairly abruptly acuminate, acumen short (to long), broad, obtuse (to acute); midrib above raised, nerves 3–8 mm apart, nearly patent, above prominulous, intercalated veins well developed, veins and veinlets clearly different, coarsely reticulate, prominulous but rather inconspicuous on both sides. *Inflorescences* terminal or pseudoterminal and in the



upper leaf axils. *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, the lobes protruding between the stamens, in female flowers less conspicuous, glabrous or with some hairs. *Stamens* 5 or 6. *Ovary* 2-celled, sometimes in the same specimen also 1-celled. *Fruits* ellipsoid to subglobular, 2.75–3 by 2–2.25 cm, glabrous, fairly sparsely set with thick warts tapering into or more abruptly terminated by an up to 7.5 mm long, filiform, curved appendage; wall coriaceous, 1–2 mm thick. — **Figs. 60j, 61b.**

**Distribution** — *Malesia*: Sumatra, Malay Peninsula (Selangor), Borneo.

**Habitat & Ecology** — Primary and sometimes old secondary forest mainly on hill slopes and ridges on well drained soils, rarely along a swamp, mostly on sand, sometimes on sandy loam, exceptionally on rocky soil; altitude up to 330 m. *Fl.* mainly Apr.–June, sometimes Aug.–Oct. and Dec.; *fr.* Dec., Mar.

**Uses** — In Kalimantan sometimes cultivated, probably for the fruits.

#### INSUFFICIENTLY KNOWN

***Nephelium* nov. spec.**, Leenh., *Blumea* 31 (1986) 423.

*Tree*, up to 45 m high, dbh up to 1.30 m, with up to 1.50 m high buttresses. *Twigs* 3 mm thick, puberulous but mostly early glabrescent. *Leaves* 1–3-jugate; petiole 2–5 cm long, 1–1.5 mm thick, terete to semiterete; axes puberulous, glabrescent;

petiolules 3–4 mm long, above narrowly deeply grooved. *Leaflets* elliptic to ovate, 5–10.5 by 1.5–3.25 cm, index c. 3, pergamentaceous, above glabrous or sometimes slightly puberulous in the basal part of the midrib, beneath sparsely hairy in midrib and nerves, fairly densely minutely sericeous in between, glabrescent; domatia common; base oblique, acute, slightly to not attenuate; sides curved; apex acute to tapering acute-acuminate; midrib above sunken in a narrow groove, nerves 0.5–1 cm apart, above prominulous to flat, intercalated veins often well developed, making the nervation somewhat irregular, veins and veinlets above hardly different, beneath veinlets inconspicuous, reticulation above rather dense, prominent. *Inflorescences* pseudoterminal or terminal. *Flowers*: only old female ones available. *Sepals* 5, c. 10–20% connate, c. 2 mm long, densely hairy on both sides. *Petals* absent or some reduced ones present. *Disc* glabrous. *Stamens* unknown. *Ovary* 2-celled, often both lobes at least in the beginning equally developed, densely warty with an indument of caducous long hairs and densely puberulous. *Fruits* probably warty and puberulous.

**Distribution** — *Malesia*: Malay Peninsula (Perak, Bukit Tapah).

**Habitat & Ecology** — Primary forest on slope at c. 1750 m altitude. *Fl.* Apr.

**Note** — The present species, incompletely known from a few specimens and from one locality only, seems different from all other accepted species. As neither the flowers nor the fruits are well known, naming it seems premature. Its alliance is not yet clear.

### PARANEPHELIUM

(M. Davids)

*Paranephelium* Miq., Sumatra (1861) 509; Radlk. in Engl., *Pflanzenr.* 98 (1933) 1321; Davids, *Blumea* 29 (1984) 425; Yap in *Tree Fl. Malaya* 4 (1989) 456; non *Paranephelius* Poeppig & Endl., *Nov. Gen. Sp.* 3 (1843) 42, t. 248 (*Compositae*). — *Mildea* Miq., *Ann. Mus. Bot. Lugd.-Bat.* 3 (1867) 88, nom. illeg.; non Griseb., *Cat. Pl. Cub.* (1866) 63 (*Piperaceae*). — Type species: *Paranephelium xestophyllum* Miq. *Scyphopetalum* Hiern in Hook. f., *Fl. Br. India* 1 (1875) 675. — Type: *Scyphopetalum ramiflorum* Hiern (= *Paranephelium xestophyllum* Miq.).

*Trees* or sometimes *shrubs*, monoecious. *Indumentum* of solitary simple hairs only. *Leaves* imparipinnate or (pari)pinnate, 1–6-jugate; no pseudo-stipules; petiole and rachis terete, not winged. *Leaflets* smooth beneath; the margin entire to dentate; nervation open, when the margin is dentate each second nerve is ending in a tooth. *Inflorescences* ramiflorous, axillary, or terminal. *Flowers* unisexual, regular. *Sepals* (4 or) 5(–7), slightly

connate to free, all equal (to very unequal), not petaloid, outside white to dark yellow hairy, margin ciliate, inside white sericeous, no glands, margin entire. *Petals* (4 or) 5(-7), longer than the sepals, distinctly clawed to broadly truncate at base, outside usually glabrous to laxly woolly, inside glabrous; blade variably developed to nearly completely reduced; scale usually larger than the blade, emarginate to divided into two lobes, both sides orange woolly especially at the upper margin; crest absent. *Disc* composed of a flat ring adnate to the torus except for the margin, thin fleshy, glabrous, margin with an erect rim to tubular collar up to 1 mm high. *Stamens* 5-8 (or 9), distinctly exerted in male flowers, glabrous; dehiscence latrorse. *Pistil* sessile; ovary densely tuberculate, each tubercle bearing a stiff erect hair, further glabrous to minutely hairy, (1-)3- (or 4-)locular; ovules 1 per locule; style apical, longer than the ovary, laxly to densely short-strigose; stigma flat to with recurved lobes up to 1.5 mm long. *Fruits* capsular,  $\pm$  globular, sessile, not winged, smooth via rough, ribbed, or warty to densely spiny, loculicidally dehiscent with 3 or 4 mostly unequal valves or tearing apart at random; wall thick, fibrous-woody; hairy inside. *Seeds* usually 1 per fruit only, about globular to slightly 2- or 3-lobed; no arillode, but the white hilar spot covering up to 3/4 of the seed; the membranous remains of the septae with the non-developed ovules are tightly pressed against the seed. — **Figs. 64, 65.**

**Distribution** — 4 species, distributed in SE Asia from Yunnan and Burma to Hainan, Vietnam, and Thailand, and in *W Malesia*: Sumatra, Malay Peninsula, Borneo, and Philippines (Mindanao); the citation for Celebes by Radlkofer in Engl., Pflanzenr. 98 (1931) 16, is neither repeated in his revision of the genus, nor confirmed elsewhere and seems rather improbable.

**Habitat & Ecology** — Mainly medium-sized trees in the lower storeys of various kinds of lowland forest. The seeds are said to be eaten by monkeys.

**Uses** — Of slight importance, only the seeds are eaten; oil pressed from the seeds was formerly used for lamps.

**Notes** — 1. The flowers are usually unisexual, the plant is usually monoecious. Sometimes, however, the stamens and the pistil are both well developed and the flowers may be bisexual. On the other hand, some specimens seem to bear flowers of one sex only; accordingly, these flowers may be dioecious.

2. The variability of the fruit in shape as well as in appendages of the surface is rather remarkable at first sight, and delimitation of the species on fruit characters, as by Radlkofer, appeared reasonable. Two problems developed: 1) the series of fruit shapes and of different kinds of appendages showed no clear interruptions; 2) most fruit characters did not show any clear correlation with other characters. From study of fruits collected from the same tree, but at different times, it became clear that characters other than those of the fruit are of greater importance in the species delimitation.

3. The genus nearest allied to *Parenephelium* seems to be *Amesiodendron*. The latter genus is clearly distinct by its paripinnate leaves and the hairy filaments of the stamens.

#### KEY TO THE SPECIES

- |                                |   |
|--------------------------------|---|
| 1a. Leaflets dentate . . . . . | 2 |
| b. Leaflets entire . . . . .   | 3 |

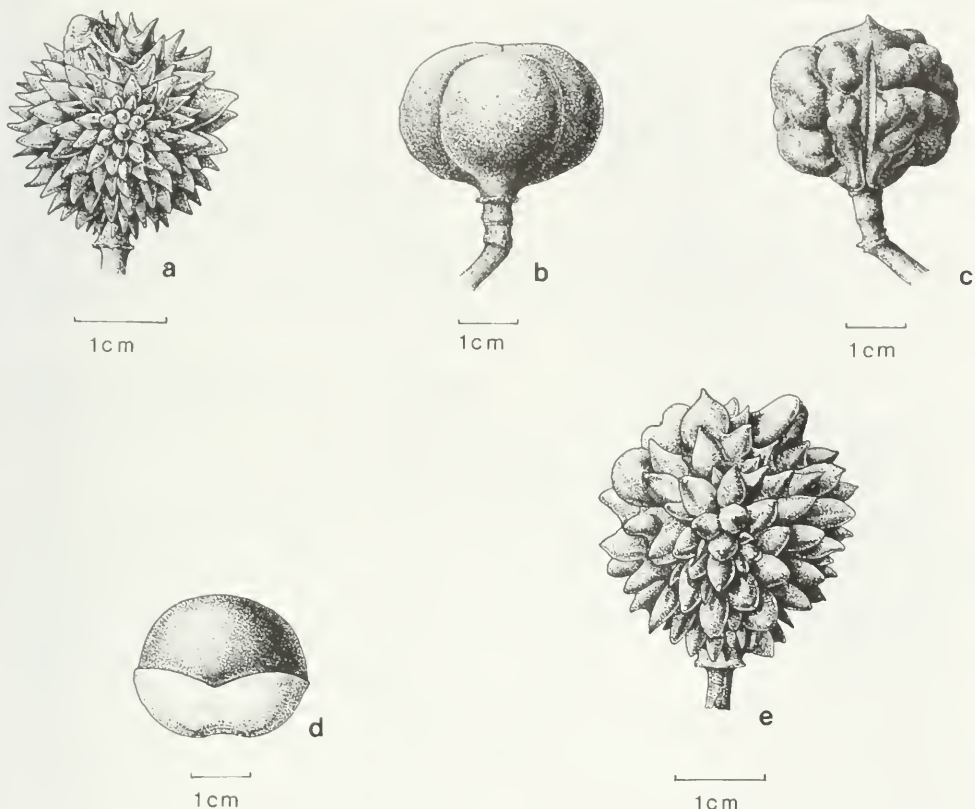


Fig. 64. *Paranephelium* Miq. Fruits and seed. — *P. joannis* Davids. a. Fruit. — *P. xestophyllum* Miq. b–c. Fruits; d. seed. — *P. spirei* Lecomte. e. Fruit (a: *Kostermans 12670*; b: *SAN 79936*; c: *Kostermans 13238*; d: *Boerlage s.n.*; e: *Poilane 7050*).

- 2a. Midrib of the leaflets visible above . . . . . **3. *P. spirei***  
 b. Midrib of the leaflets entirely sunken above, invisible . . . . . **2. *P. macrophyllum***  
 3a. Nerves straight, abruptly curving near the margin; veins densely scalariform (more lax if leaflets large and petiolules at least 4 mm in diam.) . . . . . **1. *P. joannis***  
 b. Nerves curving gradually; veins laxly reticulate (sometimes laxly scalariform if leaflets large, but petiolules at most 4 mm in diam.) . . . . . **4. *P. xestophyllum***

**1. *Paranephelium joannis*** Davids, *Blumea* 29 (1984) 434, f. 2, 3a. — Type: *Endert 3460* (L. holo). Central E Borneo.

(Shrub to tree, up to 24 m high, dbh 10–40(–60) cm; buttresses up to 1.5 m high or with stilt-roots). Twigs 6–13 mm in diam., tomentose. Leaves 2- or 3-jugate, (laxly) tomentose, glabrescent; petiole 8–25 cm by 3–7 mm; petiolules 7–22 by 1–8 mm. Leaflets (elliptic to) obovate, 10–50 by 4–22 cm, index 1.7–3.7, coriaceous, tomentose above on midrib, beneath usually on midrib, nerves, (veins,

and veinlets); base symmetrical or asymmetrical, acute; margin entire; apex emarginate to acute or cuspidate, mucronulate or not; midrib ± raised in a groove above, always visible, nerves sunken to slightly raised, veins densely to (in very large leaflets) laxly scalariform. Inflorescences axillary to terminal, stout and often clustered. 20–38 cm long, densely yellow tomentose to strigose. Flowers sweetly fragrant, white. Sepals 5 (or 6), connate at base, deltoid to ovate, 0.2–2.3 by 0.6–1.8 mm, acute to mucronate. Petals 5, blade small to absent (but mind the scale!), narrowly spatulate, 0–1.7 by 0–



1 mm, outside glabrous to pilose; scale lobed, 1.5–2.1 by 0.9–2 mm. *Disc* up to 1 mm high, 2.5–3.5 mm in diam. *Stamens* 7 or 8; filaments 2–4.5 mm long. *Pistil* with 3 locules. *Fruits* 2.5–4 by 3.5–4.5 cm, yellowish or brownish or red to black, laxly to densely spiny, glabrous to densely shortly strigose. — **Fig. 64a.**

Distribution — *Malesia*: Borneo.

Habitat & Ecology — Primary forest, often on river banks, sometimes on a slope, on clay or sand, sandstone or limestone; sea level up to 300(–450) m altitude. Fl. Mar.–Apr., Aug.–Sept., Nov.; fr. July–Nov., Jan.–Feb.

Uses — The seeds are edible when cooked.

2. ***Paranephelium macrophyllum*** King, J. As. Soc. Beng. 65, II (1896) 450; Ridley, Fl. Malay Penins. I (1922) 509; Craib, Fl. Siam. Enum. I (1926) 334; Radlk. in Engl., Pflanzentr. 98 (1933) 1323; Corner, Wayside Trees (1952) 594, f. 211; Keng, Malayan Seed Plants (1969) f. 118; Davids, Blumea 29 (1984) 432, f. 2; Yap in Tree Fl. Malaya 4 (1989) 456. — Lectotype (Davids 1984): *King's coll. 7027* (CAL holo, n.v.; K, L, M), Malacca.

*Tree* up to 12 m high, dbh 10–40(–60) cm, sometimes a shrub. *Twigs* 10–15 mm in diam., light to dark brown, tomentose, glabrescent. *Leaves* 3–5-jugate, glabrous (or rachis beneath sparsely hairy); petiole 11.5–20 cm by 3–6 mm; petiolules 5–17(–27) by 1.5–4 mm. *Leaflets* elliptic, 6–32 by 3–13 cm, index 1.3–3.3, thick pergamentaceous; base symmetrical to asymmetrical, cuneate in especially the terminal leaflet to rounded (to slightly attenuate); margin dentate; apex emarginate to rounded (or ± abruptly short-acuminate), mucronulate or not; midrib and nerves deeply sunken above, the former invisible; venation lax, reticulate to scalariform, ± inconspicuous. *Inflorescences* axillary (to terminal), stout, often single, 25–60 cm long, tomentose. *Flowers* fragrant. *Sepals* 5, slightly connate at base, all equal, deltoid to broadly ovate, acute, 1–2.1 by 1.2–2.3 mm, reddish. *Petals* obtriangular to suborbicular, 1–2 by 0.8–1.8 mm, pink to white, outside glabrous; scale emarginate to lobed, 1–2 by 1.5–3.3 mm, yellow-hairy. *Disc* up to 1 mm high, 2–3 mm in diam. *Stamens* 7 or 8; filaments up to 3.5 mm long. *Pistil* with 3 (or 4) locules. *Fruits* 2–3 by 2.5–3.7 cm; greyish brown to red, densely spiny, glabrous.

Distribution — *Malesia*: Malay Peninsula (Thailand, Kedah, Perak).

Habitat & Ecology — In open secondary forest and evergreen scrub, along rivers, in plains, more rarely on rocks or hills, on a rich soil, often on

limestone; sea level up to 300 m altitude. Fl. Feb.–Apr., July–Sept.; fr. July, Oct.–Feb.(–Apr.).

Uses — The oil of the seed is used for the skin and as lamp oil.

3. ***Paranephelium spirei*** Lecomte, Notul. Syst. 2 (1911) 6; in Fl. Indo-Chine 1 (1912) 1026; Radlk. in Engl., Pflanzentr. 98 (1933) 1326; Gagnep. in Fl. Indo-Chine, Suppl. I (1950) 972; Davids, Blumea 29 (1984) 430, f. 1; Yap in Tree Fl. Malaya 4 (1989) 456. — Type: *Wang 45007* (n.v.), Hainan.

(*Shrub* to *tree*) up to 25 m high, dbh 20–30 cm. *Twigs* 3.5–7.5 mm in diam., smooth, light to dark brown, often dark yellow laxly tomentose. *Leaves* 2–4-jugate, the axes usually tomentose; petiole 1.6–11 cm by 1.5–3 mm; petiolules 1–18(–25) by 1–2.5 mm. *Leaflets* elliptic, 5–34 by 2–14.5 cm, index 2–3.7, thick papery; base symmetrical or nearly so, acute to rounded and attenuate; margin dentate; apex acuminate to caudate, in the terminal leaflet often rounded; midrib and nerves prominent to flat above, veins and veinlets variably reticulate (to laxly scalariform). *Inflorescences* axillary to terminal, usually a stout branched axis (to clustered), 8–28 cm long, densely hairy. *Flowers* strongly scented. *Sepals* 5(–7), usually slightly connate at base, equal (or unequal), narrowly triangular, linear, or broadly ovate to elliptic, acute to rounded, 1.2–2 by 0.5–1.8 mm. *Petals* variable, 1.2–2 by 0.8–1.7 mm, outside laxly woolly (to glabrous); scale emarginate to divided into 2 lobes, 1.5–2.5 by 1–2 mm. *Disc* up to 0.7 mm high and 2–3 mm in diam., (erect rim absent). *Stamens* 7 or 8; filaments up to 4.2 mm long. *Pistil* with (1) 2 or 3 locules. *Fruits* 2.5–4 by 3–4.3 cm, dull brown to brownish black, densely to laxly variably spiny, glabrous to minutely hairy. — **Fig. 64e.**

Distribution — Hainan, Indo-China, and *Malesia*: Malay Peninsula.

Habitat & Ecology — In different kinds of forests, often along rivers, sometimes on gentle slopes, on clay or sand; 100–500 m altitude. Fl. Mar., May; fr. May–July.

Uses — The seeds may be eaten.

4. ***Paranephelium xestophyllum*** Miq., Sumatra (1861) 198, 509; Radlk., Sapind. Holl.-Ind. (1879) 80; Pierre, Fl. Cochinchine (1895) t. 327a; Brandis, Indian Trees (1906) 187; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 514; Radlk. in Engl., Pflanzentr. 98 (1933) 1324; Davids, Blumea 29 (1984) 437, f. 1, 3b–i; Yap in Tree Fl. Malaya 4 (1989) 457. — *Mildea xystophyllum* Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867)



Fig. 65. *Paranehelium xestophyllum* Miq. Habit (Whitmore & Kade 3311).

89, comb. illeg. — Lectotype (Davids 1984): *Teijsmann HB 4218* (L holo; K), Sumatra.  
*Paranehelium gibbosum* Teijsm. & Binn., Nat. Tijd. Ned.-Indië 29 (1866) 254; Radlk., Sapind. Holl.-Ind. (1879) 29, 79, 80; in Engl., Pflanzenz. 98 (1933) 1325. — *Mildea gibbosa* Miq., Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 89, t. 5a, comb. illeg. — Type: *Teijsmann & Binnendijk s.n.* (*Herb. J. Kurz*) (BO holo, n.v.; FI, M), W Sumatra.  
*Paranehelium nitidum* King, J. As. Soc. Beng. 65,

II (1896) 450; Ridley, Fl. Malay Penins. I (1922) 509; Radlk. in Engl., Pflanzenz. 98 (1933) 1326. — Syntypes: *King's collector 7416; 7410* (= 7710?); both Malay Peninsula (K, M, SING).  
*Paranehelium acanthocarpum* Radlk. ex Koord.-Schum., Syst. Verz. 2 (1914) 61; Radlk. in Fedde, Rep. 19 (1922) 344; in Engl., Pflanzenz. 98 (1933) 1324. — *Sapindaceae sp. A*: Koord.-Schum., Syst. Verz. 2 (1910) 5. — Type: *Koorders 10515* (M holo; L), Sumatra.  
*Nepheleum forbesii* Baker, J. Bot. 62, Suppl. (1924)

26; Radlk. in Engl., Pflanzenr. 98 (1933) 982. — Type: *Forbes 1592* (BM holo, n.v.; Fl. K. L., P. SING), Sumatra.

*Pometia forbesii* Baker, J. Bot. 62, Suppl. (1924) 26; Radlk. in Engl., Pflanzenr. 98 (1932) 936; Jacobs, Reinwardtia 6 (1962) 141. — Type: *Forbes 2825* (BM holo, n.v.; L), Sumatra.

(Shrub to tree up to 20(–40) m high, dbh 10–45(–75) cm, often with stiltroots up to 60 cm, or with buttresses up to 70 cm high. Twigs 3–10 mm in diam., mostly light brown, minutely laxly hairy to glabrous (up to dark yellow tomentose). Leaves 1–6-jugate, ± densely minutely hairy on the axes; petiole 0.8–1.7 cm by 1–4 mm; petiolules 1–20 by 0.8–4 mm. Leaflets elliptic (or in the lowermost pair ovate), 3–4.2 by 1.1–1.4 cm, index 1.4–5, thick papery, the midrib minutely hairy on both sides, mainly at the base, (hairy on the nerves beneath); base symmetrical (or strongly asymmetrical in the lowermost pair), narrowly cuneate to obtuse, attenuate or not; margin entire, (± undulate); apex acute to rounded, acuminate or not; midrib above ± raised in a furrow to slightly prominent, nerves sunken or flat to slightly raised in a groove, veins ± laxly reticulate to scalariform. Inflorescences usually ramiflorous (to axillary to terminal), delicate and clustered, 2–30 cm long, laxly to densely velutinous and hispid. Flowers fragrant, white to greenish white to yellowish. Sepals (4 or) 5 (or) 6, connate at base to free, equal to very unequal, del-

tate or narrowly triangular to broadly ovate (to linear), acute to acuminate, (2-tipped), 0.8–2 by 0.5–1.8 mm. Petals (4 or) 5(–7), variably shaped, 1–2.5 by 0.7–2.7 mm, outside glabrous (to woolly); scale (emarginate to) divided into 2 lobes, 1.1–2.2 by 1.2–3 mm. Disc 0.7–1.5 mm high, 1–2.8 mm in diam., (at the base with a few hair tufts alternating with the petals). Stamens 5–8 (or) 9; filaments up to 4 mm long. Pistil with (2 or) 3 (or) 4 locules. Fruits up to 7 cm in diam., 2- or 3-lobed or globular, brown, yellow, or grey, smooth or laxly to densely ± irregularly gibbose, or warty to spiny, glabrous. — Figs. 64b–d, 65.

Distribution — China (Yunnan), Burma, Thailand, Indo-China (Laos and Annam), and *Malesia*: Malay Peninsula, Sumatra, Borneo, and Philippines (Mindanao).

Habitat & Ecology — A tree of the lower canopy or higher understorey of various kinds of forest, often along rivers, rarely in often seasonal swamps, also on hill slopes, rarely on dry ridges or summits, typical of wetter soils on clay, podsol, sand over igneous rock, sandstone or limestone; sea level up to 300(–1100) m altitude. Fl. and fr. nearly the year round but mainly fl. in Feb.–July and fr. in May–Sept. In Borneo the seeds are eaten by Proboscis monkeys.

Uses — Good firewood but rarely used for timber. From the seeds lamp oil can be pressed, and they are edible when baked or boiled.

## POMETIA

(M. Jacobs)

*Pometia* Forst. & Forst., Char. Gen. Pl. (1775) 55, t. 55; Radlk. in Engl., Pflanzenr. 98 (1932) 924–936; Jacobs, Reinwardtia 6 (1962) 109–144. — Type species: *Pometia pinnata* Forst. & Forst.

*Irina* [Noroña, Verh. Bat. Gen. K. W. 5 (1791) 65, nom. nud.] Blume, Bijdr. (1825) 229. — *Eccremanthus* Thwaites, Hook. J. Bot. Kew Misc. 7 (1855) 272. — Syntype species: *Irina glabra* Blume, *I. integerrima* Blume, *I. tomentosa* Blume.

*Dabanus* Rumph. [Herb. Amb. 3 (1743) 31–32, t. 16, 17] ex Kuntze, Rev. Gen. Pl. 1 (1891) 143, nom. illeg. — Type species: *Dabanus pinnata* (Forst. & Forst.) Kuntze [= *Pometia pinnata* Forst. & Forst.].

Medium-sized to large trees, often buttressed, with a red exudate when cut, monoecious. *Indumentum* mainly of solitary hairs, sometimes mixed with some small tufts of hairs; no glandular scales. Twigs terete to 5-grooved, lenticels mostly inconspicuous, sometimes warty. Vegetative buds 1 per axil. Leaves spirally arranged, paripinnate, 4–13-jugate; basal leaflets stipule-like, often strongly reduced and caducous; petiole pulvinate, neither petiole nor rachis winged; petiolules broadly attached, nearly always either above



with 2 lateral grooves, or with a broad flat groove, or narrowly winged; young leaves crimson, very conspicuous. *Leaflets* opposite to alternate, lower ones always smaller, beneath not papillose, often with large orbicular glands at least to both sides near the base, often in some to several nerve axils, sometimes scattered over the surface, exceptionally in the marginal incisions; margin entire to dentate. *Inflorescences* terminal and sometimes in the upper leaf axils, thyrsoid; the branches mostly long, racemiform; cymules short, all of about the same length, patent or nearly so, once dichasial, both branches bostrycoid, condensed, the axes usually partly connate, higher up cymules reduced to 2 seemingly collateral flowers, each bracteate, finally to a single bracteate flower; leaves at base of inflorescence often reduced to mainly the pseudo-stipules; bracts narrowly triangular to filiform, those of primary branches sometimes reduced leaves with 2 or 3 pairs of leaflets; bracteoles absent; pedicels terete, slender, articulated, lengthened and swollen in fruit. *Flowers* actinomorphic, unisexual. *Sepals* 5, slightly to more than halfway connate, valvate in bud, the 2 outer ones usually slightly smaller, not petaloid, entire, persistent in fruit. *Petals* 5 (rarely 0), much shorter to distinctly longer than the calyx, not or hardly clawed, (nearly) entire, without appendages. *Disc* annular, cushion-shaped, not lobed,  $\pm$  wavy. *Stamens* 5 (6), in male flowers long exserted; filaments filiform, hairy mainly in the lower half or glabrous; anthers densely minutely papillose. *Pistil* sessile; ovary cordate, 2- (or 3-)celled; style about as long as to longer than the ovary. *Ovules* 1 per cell. *Fruits* sessile, mostly only 1 part 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 fruit wall, the other covering the seed. *Seeds* oblique ovoid, reddish-brown, fully enveloped by a thin fleshy arillode, hilum orbicular, c. 5 mm diam. — **Figs. 66, 67.**

**Distribution** — Two species; Sri Lanka, Andaman and Nicobar Islands, Indo-Chinese Peninsula, Taiwan, *Malesia*, and Pacific to Fiji, Samoa, and Tonga. See Jacobs, *Blumea*, Suppl. 5 (1966) 90, map 50.

**Habitat** — Lower storey and canopy trees of the tropical rain forest, primary as well as secondary, at low to medium altitudes.

**Ecology** — 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 large witches' brooms are a common and conspicuous feature; they represent mostly repeatedly dissected leaves, but sometimes also (parts of) inflorescences; the origin is unknown.

**Notes** — 1. *Pometia* seems nearest allied with *Dimocarpus* with which it shares characters like the orbicular glands on the lower side of the leaflets and, when the leaflets are incised, the typical nervation. They also have similarities in floral structure, the free arillode, and the tendency to develop pseudo-stipules (as in *Otonephelium*, from the same alliance).

2. The name *Dabanus* Kuntze is illegitimate because of the citation of *Pometia* as a synonym.

3. The pseudo-stipules are rather variably developed. Usually, the lower 2 or 3 pairs



Fig. 66. *Pometia pinnata* Forst. & Forst. Habit (Hoogland 5048).

of leaflets are progressively more or less strongly reduced and stipule-like. The reduction of the basal pair is distinctly correlated with its place on the petiole: the nearer to the base, the more reduced it is. It may vary from a pair of normal, though smallish leaflets inserted on the petiole some distance above its base to a pair of very small, strongly falcate leaflets, with the basiscopic side completely suppressed. If these pseudo-stipules are attached slightly above the base they are rather persistent, or only the blade is caducous and the petiolule is left: if they are attached at the very base they are often caducous and, being  $\pm$  sessile, leave only an inconspicuous scar.

## KEY TO THE SPECIES

- 1a. Leaflets acicular to coarsely dentate, nerves sunken above, venation hardly or not prominent ..... **1. *P. pinnata***
- b. Leaflets entire, nerves prominulous above, venation prominent on both sides  
**2. *P. ridleyi***
- 1. *Pometia pinnata*** Forst. & Forst., Char. Gen. Pl. (1775) 55, t. 55; Whitford, Bull. Bur. For. Philipp. 10 (1911) 54, t. 45; Koord. & Valetton, Atlas 1 (1913) t. 90; Merr., Int. Rumph. (1917) 339; Ridley, Fl. Malay Penins. 1 (1922) 504; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 505; Lane-Poole, For. Res. (1925) 109; Docters van Leeuwen, Zooecidia (1926) 337, f. 611; Radlk. in Engl., Pflanzenr. 98 (1932) 929; F.S. Walker, For. Br. Solomon Is. (1948) 167; Kraemer, Trees W Pacific Reg. (1951) 222, f. 79; Desch, Mal. For. Rec. 15 (1954) 534, t. 107, f. 2; Browne, For. Trees Sarawak & Brunei (1955) 318; Graca de Freitas, Madeiras de Timor 1 (1955) 33–35, t. 4; Bos, Meded. Landbouwhogeschool 57, 1 (1957) 39, f. 20; Yuncker, Bull. Bish. Mus. 220 (1959) 173; Jutte & Hof, Nova Guinea 10, Bot. (1962) 170–174, f. 4; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 2, 37; Backer & Bakh. f., Fl. Java 2 (1965) 139; Smythies, Common Sarawak Trees (1965) 119; Burgess, Timbers of Sabah (1966) 443–446, f. 52; Whitmore, Guide For. B.S.I.P. (1966) 97; Meijer, Bot. Bull. Herb. Sandakan 10 (1968) fig. between p. 138 & 139. — *Euphoria pometia* Poir., Dict. Sc. Nat. Paris 27 (1823) 59, nom. illeg. — *Nephelium pinnatum* (Forst. & Forst.) Cambess., Mém. Mus. Nat. Hist. Nat. Paris 18 (1829) 30; Spach, Hist. Nat. Végét. Phan. 3 (1843) 63. — *Dabanus pinnatus* (Forst. & Forst.) Kuntze, Rev. Gen. Pl. 1 (1891) 143, nom. illeg. — *Pometia pinnata* Forst. & Forst. f. *pinnata* Jacobs, Reinwardtia 6 (1962) 120; Foreman, Check List Bougainville (1971) 158. — Type: *Forster s.n.* (BM, W), New Hebrides, Namoka.
- Irina glabra* Blume, Bijdr. (1825) 230. — *Pometia glabra* (Blume) Teijsm. & Binn., Cat. Hort. Bogor (1866) 214. — *Pometia pinnata* Forst. & Forst. var. *javanica* Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 196. — *Pometia pinnata* Forst. & Forst. f. *glabra* (Blume) Jacobs, Reinwardtia 6 (1962) 125. — Type: *Blume 738* (L), Java.
- Irina tomentosa* Blume, Bijdr. (1825) 230; Hassk., Pl. Jav. Rar. (1848) 116. — *Pometia tomentosa* (Blume) Teijsm. & Binn., Cat. Hort. Bogor (1866) 214; Koord. & Valetton, Bijdr. Booms. Java 9 (1903); Backer, Schoolfl. (1911) 267; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 506; Docters van Leeuwen, Zooecidia (1926) 338; Radlk. in Engl., Pflanzenr. 98 (1932) 934; Meijer Drees, Comm. For. Res. Inst. 33 (1951) 110. — *Pometia pinnata* Forst. & Forst. f. *tomentosa* (Blume) Jacobs, Reinwardtia 6 (1962) 130; Foreman, Check List Bougainville (1971) 160. — Type: *Blume 1489* (K, L), W Java.
- Irina alnifolia* Blume, Rumphia 3 (1847) 117. — *Irina tomentosa* Blume var. *alnifolia* (Blume) Miq., Fl. Ind. Bat. 1, 2 (1859) 558. — *Pometia alnifolia* (Blume) King, J. As. Soc. Beng. 65, II (1896) 442; Ridley, Fl. Malay Penins. 1 (1922) 504; Radlk. in Engl., Pflanzenr. 98 (1932) 928; Corner, Wayside Trees (1940) 595; Desch, Mal. For. Rec. 15 (1954) 533. — *Pometia pinnata* Forst. & Forst. f. *alnifolia* (Blume) Jacobs, Reinwardtia 6 (1962) 129. — Type: *Korthals s.n.* (K, L), Sumatra.
- Irina tomentosa* Blume var. *cuspidata* Blume, Rumphia 3 (1847) 116. — *Pometia tomentosa* (Blume) Teijsm. & Binn. var. *cuspidata* (Blume) J. Britten in Forbes, Wand. (1885) 502. — *Pome-*



- tia pinnata* Forst. & Forst. f. *cuspidata* (Blume) Jacobs, Reinwardtia 6 (1962) 132. — Type: *Spanoghe s.n.* (L), Timor.
- Nephelium acuminatum* Hook. f., Trans. Linn. Soc. 23 (1860) 164. — *Pometia acuminata* (Hook. f.) Radlk., Sapind. Holl.-Ind (1879) 9; in Engl., Pflanzenr. 98 (1932) 933. — *Dabanus acuminatus* (Hook. f.) Kuntze, Rev. Gen. Pl. 1 (1891) 143, nom. illeg. — *Pometia pinnata* Forst. & Forst. f. *acuminata* (Hook. f.) Jacobs, Reinwardtia 6 (1962) 128; Anderson, Gard. Bull. Sing. 20 (1963) 169. — Type: *Low 34* (K), Borneo.
- Pometia macrocarpa* Kurz, J. As. Soc. Beng. 44, II (1876) 205; Radlk. in Engl., Pflanzenr. 98 (1932) 927. — *Pometia pinnata* Forst. & Forst. f. *macrocarpa* (Kurz) Jacobs, Reinwardtia 6 (1962) 130. — Type: *Maingay 463* (BM, CAL, K, L), Malaya.
- Pometia coriacea* Radlk., Bot. Jahrb. 50 (1913) 75; in Engl., Pflanzenr. 98 (1932) 928; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 37, 39, f. 16. — Type: *Schlechter 16138*, New Guinea.
- Pometia pinnata* Forst. & Forst. f. *repanda* Jacobs, Reinwardtia 6 (1962) 127. — Type: *PNH 9627* (L, PNH), Luzon.
- For more complete synonymy and references, see Jacobs, l.c.

*Tree*, up to 50 m, dbh up to 1.40 m, nearly always with buttresses up to 5 m high, spreading to 3 m, and to 15 cm thick. Young parts very early to late glabrescent. *Leaves* up to more than 1 m long, 4–13-jugate; axial parts glabrous to densely hairy; pseudo-stipules elliptic to ovate, 0.4–3 by 0.25–5 cm, index 1–2.5, (straight to) strongly falcate, the basiscopic side often strongly reduced to completely suppressed, caducous to persistent, otherwise like the leaflets; petiolules 1.5–4 mm long. *Leaflets* ovate to obovate, slightly to distinctly falcate, 6–32 by 2–13 cm, index 2–4, pergamentaceous to coriaceous, glabrous or variably hairy, variably glandular; margin acicular or coarsely dentate; apex (acute to) gradually (rarely rather abruptly) acuminate, acumen up to 2 cm long, broad to slender, mostly mucronate; nerves 1.5–2.5 cm apart, every second nerve ending in or protruding from a marginal tooth, those in-between gradually curving towards the margin and becoming feebler, all nerves sunken above, venation hardly or not prominent. *Inflorescences* erect to drooping, 15–70 cm long, mostly hairy; bracts usually absent apart from those of the primary flowers of the cymules; pedicels 1–4 mm long, slender to filiform, articulated in the lower 1/5. *Calyx* 1–2.5 mm in diam., sepals variably connate, lobes 0.5–1.5 by 0.3–1.2 mm, outside

variably hairy, inside hairy or glabrous. *Petals* shorter to longer than calyx, 0.4–1.3 by 0.3–1.6 mm, outside hairy or sometimes glabrous. *Stamens*: filaments 2–6 mm long, glabrous to completely hairy; anthers 0.5–1 mm long. *Pistil*: ovary 0.8–1.2 by up to 2.5 mm, style 2–5.5 mm long. *Fruits* 1.5–5 by 1–3 cm, pericarp in the lower part 1 mm, in the upper part up to at least 7 mm thick. *Seeds* up to 2.5 by 1.5 cm. — **Figs. 66, 67a, b.**

*Distribution* — As the genus; throughout *Malesia*.

*Habitat & Ecology* — Primary and secondary forests; dry land, swamps, or temporarily inundated habitats; slopes, ridges and plains, in some regions especially common on river banks; on various soils; altitude 0–900(–1700) m. Fl., fr. throughout the year, although locally often mainly seasonal.

*Uses* — Throughout its area the wood of this tree is used for several purposes, the fruits are eaten, and according to a few reports a decoction of the bark can be used medicinally. The species is of major importance mainly in New Guinea where it is the most abundant tree (10–35%, and often also by volume) in large tracts of lowland rain forest, making it one of the most important timber trees. Preferred are the small-leaved forms (f. *repanda*) from well-drained sites which generally reach larger diameters and have straight cylindrical boles; the large-leaved forms (mainly f. *glabra*) occur mainly on the less well-drained sites, reach smaller diameters, and the bole has a less favourable form. See p. 427 for a description of the timber.

In Borneo, 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. It is known under the vernacular name *enselan*.

See for uses also Heyne, Nutt. Pl. Indon. ed. 3 (1950) 999; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1797.

*Notes* — 1. *Pometia pinnata* is a variable species. Jacobs (1962) gave an extensive treatment of the variability, and subdivided the species into eight forms. These forms reflect the variability quite well, but they cover only part of the material, an important part being intermediate between two or even more forms. Some of these forms are rather widespread, others are restricted to a small part of *Malesia*, some are common, others are rare. Most islands or island groups in *Malesia* are inhabited by three forms. These are locally  $\pm$  distinguishable morphologically, may show different ecological preferences, and may even be known by different local names, depending on the importance the tree has in rural economy. As identification of single specimens to one of these forms is nearly impossible it seems of no use to treat them here

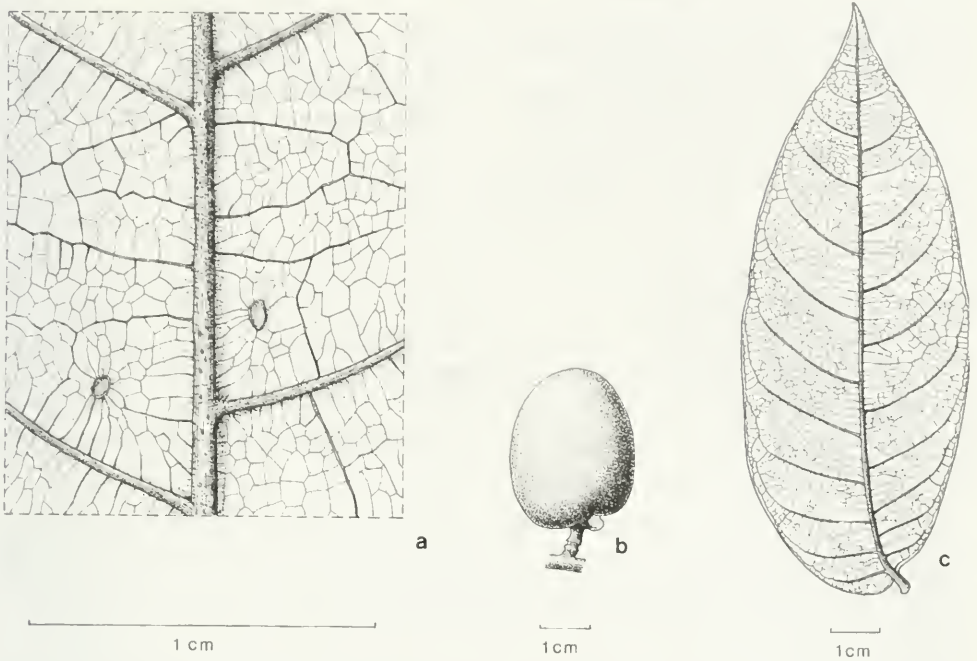


Fig. 67. *Pometia* Forst. & Forst. Leaflets and fruit. — *P. pinnata* Forst. & Forst. a. Detail lower surface leaflet; b. fruit. — *P. ridleyi* King. c. Leaflet from below (a: King's coll. s.n.; b: Clemens 5329; c: Achmad 1400).

extensively. A key to, as well as descriptions, of these forms can be found in the paper by Jacobs.

2. The name *Euphoria pometia* as well as the combinations under *Dabanus* are illegitimate as the generic names are not legitimate; in the former case, moreover, the epithet *pinnata* should have been used.

3. Three specimens, *Spanoghe* s.n. from Timor (type of *Irina tomentosa* var. *cuspidata*), Schmutz 3574 from Flores, and Brass 8181 from Papua New Guinea (representing f. *repanda*) show many minute pellucid dots in their leaflets, they were not observed in any other collection.

2. *Pometia ridleyi* King [J. As. Soc. Beng. 65, 11 (1896) 443, nom. inval.] ex Radlk. in Engl., Pflanzenr. 98 (1932) 927; Wong, Mal. For. 24 (1962) 154, t. 1-4; Jacobs, Reinwardtia 6 (1962) 119; Wyatt-Smith & Kochummen, Mal. For. Rec. 17, rev. ed. (1965) 336. — Type: *Goedenough 1099* (CAL, K, M, SING), Malaya.

*Tree*, up to 40 m. dbh up to 1.50 m, with steep buttresses up to 3 m high. Young parts very early glabrescent. *Leaves* 6-8-jugate; axial parts (sub)glabrous; pseudo-stipules  $\pm$  elliptic, 0.6-1 by

0.2-0.5 cm, index 2-3, strongly falcate, the basiscopic side fully suppressed,  $\pm$  caducous, otherwise as the leaflets; petiolules 1.5-2 mm long. *Leaflets*  $\pm$  elliptic, 7.5-15 by 2.8-5.5 cm, index 2.5-4, middle ones hardly to distinctly falcate, chartaceous, glabrous but for a few scattered hairs on the midrib beneath, glandless or exceptionally with a gland in the axils of 1 or 2 nerves; margin entire; apex gradually to rather abruptly acuminate, acumens up to 1 cm long, acute; nerves 0.5-1 cm apart, all alike, gradually bending towards the margin and more or less distinctly looped and joined, above distinctly prominulous; venation prominent at both sides. *Inflorescences* erect, 17-25 cm long, (sub)glabrous; bracts present under all flowers; pedicels c. 2 mm long, rather slender, articulated 1/4-1/3 above the base. *Calyx* 2.5 mm in diam., sepals connate for 15-20%, lobes 1.5 by 0.75 mm, both sides glabrous. *Petals* shorter than the calyx, 0.65 by 0.8-1 mm, outside glabrous. *Stamens*: filaments 2.2 mm long, very sparsely hairy at base; anthers 0.75 mm long. *Pistil*: style 3.5 mm long. *Fruits* (ripe?) c. 2 by 2 cm. *Seeds* not observed. — Fig. 67c.

*Distribution* — *Malesia*: Sumatra (East Coast, Simalur), Malay Peninsula, Borneo (Sabah). See

Jacobs, *Blumea*, Suppl. 5 (1966) map 50.  
 Habitat & Ecology – Primary and bamboo forests; altitude up to 200 m. Fl. July, Sept.  
 Note – King’s original publication was invalid as the name was clearly a provisional one only.

EXCLUDED

*Irina integerrima* Blume, *Bijdr.* (1825) 231 = **Meliosma sumatrana** (Jack)Walp.(*Sabiaceae*).  
 See Beusekom, *Blumea* 19 (1972) 486.

**RHYSOTOECHIA**  
 (B. Etman)

*Rhysotoechia* Radlk., *Sapind.* *Holl.-Ind.* (1879) 61, 62; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 484, 489, 541; 10 (1890) 264, 291; in *Engl., Pflanzenr.* 98 (1933) 1209; S.T. Reynolds, *Austrobaileya* 2 (1984) 41; in *Fl. Austral.* 25 (1985) 63; Etman, *Blumea* 39 (1994) in press. — Lectotype species (S.T. Reynolds 1984): *Rhysotoechia mortoniana* (F. Muell.) Radlk. (based on *Cupania mortoniana* F. Muell.).

*Trees*, small to medium sized, or *shrubs*. *Branchlets* terete, rough to smooth. *Indumentum* if present mostly of simple, appressed hairs. *Leaves* (im)paripinnate; petiole and rachis terete, slightly winged or not, petiole pulvinate; petiolules pulvinate, sometimes absent. *Leaflets* opposite to alternate, lower surface with domed cells; base symmetric to slightly oblique; margin entire; domatia absent. *Inflorescences* axillary, subterminal or ramiflorous, paniculate or thyrsoid; bracts and bracteoles usually not persistent in fruit. *Flowers* regular, 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* 8 (or 7); filaments especially towards the base pilose or velutinous; anthers often with a few hairs. *Ovary* 3- (or 2-)celled, sericeous; style usually glabrous, elongating in fruit. *Ovules* 1 per cell. *Fruits* obcordate to reniform, with one to all lobes developing, loculicidal, outside rugose to ribbed, often laxly hairy, inside (densely) papillose, stipe absent to very distinct. *Seeds* obovoid to orbicular, covered by a cup-shaped arillode (or a sarcotesta), except at the apex; hilum round; pseudohilum round to reniform. — **Figs. 68, 69.**

Distribution — 14 species in Australia and *Malesia*: Borneo, Philippines, Celebes, Moluccas, New Guinea.

Habitat — In rain forest on lowland, often coastal, to high up in the mountains.

Note — Distinctive of *Rhysotoechia* are the glabrous leaves, glossy above, slightly dull below, and the fruits, which are densely papillose inside.

KEY TO THE SPECIES

- 1a. Ovary 3-locular . . . . . 2
- b. Ovary 2-locular . . . . . **2. R. bilocularis**
- 2a. Petiole of leaves present. Flowering twigs less than 13 mm thick. Leaflets papery to coriaceous . . . . . 3
- b. Petiole of leaves absent. Flowering twigs 10–15 mm thick. Leaflets ± coriaceous . . . . . **3. R. congesta**



- 3a. Specimen flowering ..... 4  
 b. Specimen fruiting ..... 9
- 4a. Petal scales absent ..... 5  
 b. Petal scales folded margins of petal ..... 8
- 5a. Flowers 4–5 mm diam. Petals pilose on both sides towards the base; margins glabrous or pilose. Lateral nerves of leaflets 0.5–1.8 cm apart. Petiole 1.3–6 cm long ..... 6  
 b. Flowers 6–8 mm diam. Petals outside pilose, inside glabrous or very laxly hairy; margins pilose. Lateral nerves of leaflets 0.5–3 cm apart. Petiole 2–17 cm long ..... 7
- 6a. Inflorescences paniculate. Leaflets opposite to alternate, margin (slightly) recurved. Petiolule a pulvinus only, rarely up to 4 mm long. Margin of petals pilose  
**10. R. robertsonii**
- b. Inflorescences thyrsoid, branching only at the base, giving the impression of a tuft of inflorescences. Leaflets opposite, sometimes subopposite, margin flattened to slightly recurved. Petiolule 5–10 mm long. Margins of petals glabrous  
**7. R. multiscapa**
- 7a. Leaflets ovate to elliptic, pergamentaceous to coriaceous, apex usually acuminate, sometimes obtuse, acute or cuspidate. Petiolule 7–22 mm long, if shorter, then always inflorescences ramiflorous ..... **9. R. ramiflora**
- b. Leaflets obovate to elliptic, coriaceous, apex obtuse to distinctly acuminate, then always abruptly narrowing. Petiolule a pulvinus only or up to 10 mm long  
**6. R. koordersii**
- 8a. Leaflets ovate, index 3.2–4.5. Petals pilose outside, glabrous inside  
**4. R. elongata**
- b. Leaflets elliptic, index 2.1–2.8. Petals pilose on both sides ..... **1. R. applanata**
- 9a. Fruit sutures glabrous ..... 10  
 b. Fruit sutures densely setose ..... **4. R. elongata**
- 10a. Stipe of fruit less than 3 mm long ..... 11  
 b. Stipe of fruit longer than 3 mm ..... 14
- 11a. Stipe of fruit present. Apex of leaflets acute to caudate; midrib prominent above 12  
 b. Stipe of fruit absent. Apex of leaflets obtuse with a slightly emarginate tip; midrib flattened to slightly sunken above ..... **8. R. obtusa**
- 12a. Petiolule usually a pulvinus only, up to 13 mm long. Apex of leaflets acute to cuspidate ..... 13  
 b. Petiolule 9–18 mm long. Apex of leaflets caudate ..... **5. R. gracilipes**
- 13a. Fruit reniform to depressed globose, 1.7–2.5 by 2–2.5 cm. Arillode present. Pulvinus of leaflets 1–2 mm long ..... **10. R. robertsonii**
- b. Fruit obcordate, 1.2–1.5 by 1.2–1.7 cm. Sarcotesta present. Pulvinus of leaflets 5–13 mm long ..... **1. R. applanata**
- 14a. Leaflets ovate to elliptic, pergamentaceous to coriaceous, apex usually acuminate, sometimes obtuse, acute or cuspidate. Petiolule 7–22 mm long, if shorter, then always inflorescences ramiflorous ..... **9. R. ramiflora**
- b. Leaflets obovate to elliptic, coriaceous, apex obtuse to acuminate. Petiolule usually a pulvinus only, up to 10 mm long ..... **7. R. koordersii**

1. *Rhysotoechia applanata* Etman, Blumea 39 (1994) in press. — Type: *Floyd & Hoogland 3834* (A, CANB, L, LAE, US), Papua New Guinea.

*Tree*, 15–20 m high, dbh c. 45 cm, outer bark dark brown, inner bark orange brown, heartwood pinkish brown. *Branchlets* slightly rough, reddish brown with green dots to greyish black; flowering twigs 5–6.5 mm thick. *Leaves* 1–3-jugate, sometimes with a terminal leaflet; petiole 2.5–7 cm long, terete to flattened above, sometimes slightly winged below the lowermost pair of leaflets, slightly ribbed, glabrous; rachis 3.5–7 cm long, terete to angular, slightly winged below the jugae, slightly ribbed, glabrous; petiolule a pulvinus only, 5–13 mm long, grooved, glabrous. *Leaflets* opposite to subopposite, elliptic, 9.5–20 by 4–8.5 cm, index 2.1–2.8, pergamentaceous, both sides glabrous; base symmetric, usually acute, sometimes slightly attenuate; margin (slightly) recurved; apex acuminate; midrib prominent, slightly ribbed to smooth, lateral nerves 1–3.2 cm apart, sometimes slightly sunken above, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins laxly reticulate, on upper surface flattened to slightly raised. *Inflorescences* axillary, thyrsoid, branching at the base, to 3 cm long, densely puberulous; cymules 1-flowered; bracts and bracteoles to 1 mm long; pedicels 1–1.5 mm long. *Flowers* only seen in bud. *Sepals* glabrous on both sides, margin glabrous to very laxly ciliate, outer ones ovate, inner ones orbicular. *Petals* broadly elliptic, outside pilose only at the base, inside pilose towards the base; claw very short, glabrous; margins coarsely lobed, pilose towards the base; apex rounded; scales as folded margins of petal, thickened, velutinous. *Disc* glabrous. *Stamens* 8; filaments velutinous; anthers laxly puberulous. *Pistil*: ovary sericeous; style and stigma very immature. *Fruits* orbicordate, 1.2–1.5 by 1.2–1.7 cm, outside rugose, very wrinkled, glabrous, inside densely papillose, stipe 2–3 mm high, lobes 1–3, well developed, 1.2–1.4 by 0.6–0.7 cm; style 0.5–1 mm long. *Seeds* ellipsoid to obovoid, 1–1.3 by 0.7–0.8 cm, sarcotesta covering the lower part of the seed; hilum 0.5–1 mm diam.; pseudohilum 1–1.2 cm diam.

Distribution – *Malesia*: Papua New Guinea (Owen Stanley Range).

Habitat & Ecology – Coastal rain forest or hill forest; altitude from sea level up to 400 m. Fl., fr. Sept.

2. *Rhysotoechia bilocularis* Etman, Blumea 39 (1994) in press. — Type: *van Royen 4710* (A, CANB, L), Irian Jaya.

*Small tree*, c. 4 m high, dbh c. 10 cm. *Branchlets* slightly rough, (reddish) brown; flowering twigs 4–5 mm thick. *Leaves* 4-jugate, sometimes with a terminal leaflet; petiole 6–8 cm long, terete to flattened above, smooth, glabrous; rachis 13–19 cm long, terete to flattened above, very slightly winged below the jugae, smooth, glabrous; petiolules 0.5–1.2 cm long, flattened, glabrous; pulvinus 2–4 mm long, grooved, glabrous. *Leaflets* subopposite to alternate, ovate to elliptic, 7–19.5 by 3–6.5 cm, index 2.3–3.1, (thin) pergamentaceous, both sides glabrous; base usually symmetric to slightly oblique, attenuate; margin (slightly) recurved; apex not abruptly narrowing, acuminate, sometimes acute; midrib slightly prominent, angular, lateral nerves 0.5–1.5 apart, almost perpendicular to the midrib towards the base, marginally distinctly looped, intercalated veins not distinctly curved towards the base, veins very densely reticulate, on upper surface slightly raised. *Inflorescences* axillary, thyrsoid, branching at the base, to 7 cm long, laxly puberulous; copiously flowering; bracts and bracteoles 0.5–1 mm long; pedicels 1–2 mm long. *Flowers* only seen in bud. *Sepals*: both sides glabrous, margin laxly ciliate, outer ones broadly elliptic, inner ones orbicular. *Petals* broadly ovate, outside glabrous, inside pilose; claw distinct; margins coarsely lobed, thickened and recurved towards the base, pilose; apex rounded; scales absent. *Disc* glabrous. *Stamens* 7 or 8; filaments velutinous; anthers puberulous. *Ovary* 2-locular, sericeous; style and stigma very immature. *Fruits* not observed.

Distribution – *Malesia*: Irian Jaya (Merauke Dist.).

Habitat & Ecology – River bank in primary rain forest; altitude 70 m. Fl. Aug.

3. *Rhysotoechia congesta* Etman, Blumea 39 (1994) in press. — Type: *NGF 29309* (A, CANB, L, LAE), Papua New Guinea.

*Tree*, 6–21 m high, dbh 42 cm, not buttressed, with somewhat gnarled divided trunk, narrow crown of erect branches, outer bark dark brown with minute fissures, inner bark light brown. *Branchlets* rough, greenish brown to greenish black; flowering twigs 10–15 mm thick. *Leaves* 1–3-jugate; petiole absent; rachis to 20 cm long, terete to flattened below the jugae, sometimes slightly winged below the jugae, ribbed, glabrous; petiolule a pulvinus only, 5–8 mm long, flattened above, glabrous. *Leaflets* opposite, elliptic to obovate, 12–30 by 6–14 cm, index 1.6–2.8, ± coriaceous, both sides glabrous; base distinctly oblique, obtuse to rounded; margin (strongly) recurved; apex acute to obtuse; midrib flattened, slightly sunken, ribbed, lateral



Fig. 68. *Rhysoetochia congesta* Etman. Habit (NGF 29309).

nerves 2–5 cm apart, usually slightly sunken, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins very laxly reticulate, on upper surface slightly raised. *Inflorescences* axillary or subterminal or rami-

florous, paniculate, branching at the base, very laxly puberulous to glabrous when old; bracts, bracteoles, pedicels and *flowers* not observed. *Fruits* globose with an emarginate apex, attenuate at the base, 2–2.5 by 1.8–2.3 cm, outside slightly rugose, gla-



brous, inside papillose; stipe 3–5 mm high; lobes 1–3, well developed, 1.5–1.7 by 1–1.1 cm; style c. 1 mm long. *Seeds* ovoid, c. 12 by 10 mm; hilum c. 4 mm diam.; pseudohilum c. 6 mm diam. — **Fig. 68.**

Distribution — *Malesia*: Papua New Guinea (E Highlands and Morobe Prov.).

Habitat & Ecology — Forest; altitude 210–1260 m. Fl. Jan.; fr. Nov.

**4. *Rhysotoechia elongata*** Radlk., Bot. Jahrb. 56 (1920) 291; in Engl., Pflanzenz. 98 (1933) 1211; Etman, Blumea 39 (1994) in press. — Lectotype (Etman 1994): *Fitzgerald s.n.*, New Guinea.

*Tree or shrub*, up to 2 m high. *Branchlets* smooth, greyish brown to greyish black; flowering twigs 2–6 mm thick. *Leaves* 2–4-jugate; petiole 4–12 cm long, terete to flattened above, sometimes ribbed, glabrous; rachis 4–34 cm long, angular, slightly winged below the jugae, ribbed, glabrous; petiolules 1–10 mm long, (slightly) grooved, glabrous, pulvinus 1–3 mm long, grooved, glabrous. *Leaflets* opposite to subopposite, ovate, 10–27 by 3–7 cm, index 3.2–4.5, papery to (thin) pergamentaceous, both sides glabrous; base symmetric or slightly oblique, acute to attenuate; margin slightly recurved; apex usually abruptly narrowing but not very distinctly so, acute to cuspidate; midrib prominent, angular, lateral nerves 0.6–2 cm apart, almost perpendicular to the midrib towards the base, marginally distinctly looped, intercalated veins not distinctly curved towards the base, veins very densely reticulate, on the upper surface slightly raised. *Inflorescences* axillary, thyrsoid, not branching at the base, to 2.5 cm long, puberulous; bracts and bracteoles 0.5–1 mm long; pedicels 1–3 mm long. *Flowers* c. 5 mm in diam. *Sepals*: both sides glabrous, margin very laxly ciliate; outer ones broadly ovate, c. 2 by 1.5 mm; inner ones elliptic, c. 3 by 2 mm. *Petals* obovate, 2–3 by 1–2 mm, outside velutinous, proximally pubescent, inside glabrous; claw c. 1 mm high, both sides densely velutinous; margins lobed, slightly recurved towards the base, glabrous; apex obtuse; scales as folded margins of petal, lobed, 0.3–0.6 mm high, glabrous. *Disc* glabrous. *Stamens* 8; filaments c. 2 mm long, velutinous; anthers c. 1 mm long, laxly puberulous. *Pistil* immature; ovary sericeous; style and stigma not observed. *Fruits* orbiculate, 1–1.5 by 1–1.2 cm, outside rugose, laxly puberulous, inside smooth, along the sutures densely setose; stipe 1–3 mm high; lobes 3, well developed, c. 6 by 5 mm; style not observed. *Seeds* not observed.

Distribution — *Malesia*: Papua New Guinea (Owen Stanley Range).

Habitat & Ecology — (Poor) lowland forest; altitude 100–360 m. Fl. June–Sept.; fr. July.

**5. *Rhysotoechia gracilipes*** Radlk. in Engl. & Prantl, Nat. Pflanzenfam. 3, 5 (1895) 347; Bot. Jahrb. 56 (1920) 291; in Engl., Pflanzenz. 98 (1933) 1215; Etman, Blumea 39 (1994) in press. — Type: *MacGregor s.n.* (M. MEL), Papua New Guinea.

*Branchlets* smooth to slightly rough, reddish black to brownish black; flowering twigs c. 4 mm thick. *Leaves* 1–4-jugate; petiole 6.5–8 cm long, terete, very slender, ribbed, glabrous; rachis 12–16 cm long, terete, very slender, ribbed, glabrous; petiolules 1–1.8 cm long, flattened, glabrous, pulvinus 3–8 mm long, distinctly grooved, glabrous. *Leaflets* opposite, usually ovate, sometimes elliptic, 10–15 by 4.5–6.8 cm, index 2.1–3.5, papery to thin pergamentaceous, both sides glabrous; base symmetric, attenuate; margin not recurved; apex abruptly narrowing, caudate; midrib prominent, distally flattened, slightly ribbed to smooth, lateral nerves 0.9–1.8 cm apart, marginally looped, intercalated veins curved towards the base, veins densely reticulate, on upper surface slightly raised. *Inflorescences* subterminal, not branching at the base; bracts, bracteoles, pedicels and *flowers* not observed. *Fruits* orbiculate, c. 1.5 by c. 1.2 cm, outside rugose, laxly puberulous, inside densely papillose; stipe c. 3 mm high; lobes 3, well developed, 0.8–1.5 by 0.5–0.8 cm; style c. 1 mm long. *Seeds* c. 1.2 cm long; hilum c. 2 mm diam; pseudohilum c. 3 mm diam.

Distribution — *Malesia*: Papua New Guinea (Central Prov.).

Ecology — Fr. Dec.

Note — All vegetative parts look rather vulnerable and slender. The rachis, petiole and petiolule are, in some specimens, only 1 mm thick.

**6. *Rhysotoechia koordersii*** Radlk. in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 3 (1907) 206; in Fedde, Rep. 18 (1922) 343; in Engl., Pflanzenz. 98 (1933) 1213; Etman, Blumea 39 (1994) in press. — Type: *Koorders 18844* (BO, K. L. M), Menado.

*Rhysotoechia mortoniana* auct. non (F. Muell.) Radlk.: Koord., Minah. 19 (1898) 407.

*Tree*, up to 19 m high, dbh 2–25 cm, outer bark smooth, dark green to blackish brown, inner bark yellowish to ochre, thin. *Branchlets* rough to smooth, greenish brown to greyish black to reddish black; flowering twigs 3–6 mm thick. *Leaves* 1–4-jugate; petiole 2–11 cm long, slightly angular to terete, sometimes slightly winged below the low-

ermost pair of leaflets, (slightly) ribbed, glabrous; rachis 2.5–20 cm long, angular, slightly winged below the jugae, ribbed, glabrous; petiolule usually a pulvinus only, up to 10 mm long, slightly grooved, glabrous; pulvinus 2–5 mm long, grooved, glabrous. *Leaflets* usually subopposite, sometimes opposite, obovate to elliptic, 6–23 by 1–11 cm, index 2–3.7, coriaceous, both sides glabrous; base sometimes very slightly oblique but never distinctly so, acute to attenuate; margin (not) slightly recurved; apex obtuse to distinctly acuminate, then always abruptly narrowing; midrib prominent, smooth to angular, lateral nerves 0.5–3 cm apart, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins laxly reticulate, on the upper side slightly raised. *Inflorescences* axillary, thyrsoïd, branching at the base, to 19 cm long, laxly puberulous; cymules 1-flowered; bracts and bracteoles 0.5–1 mm long; pedicels 4–9 mm long. *Flowers* c. 7 mm in diam. *Sepals*: both sides glabrous, margin ciliate; outer ones broadly ovate, 3–2.5 by 2.5 mm; inner ones orbicular, 3.5–3 by 3 mm. *Petals* broadly obovate, c. 2.5 by 2 mm; outside pilose, inside laxly pilose; claw c. 0.8 mm high, both sides pilose; margins coarsely lobed, slightly thickened towards the base, densely pilose; apex rounded; 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, laxly puberulous. *Fruits* obcordate, attenuate at the base, 1.5–1.7 by 1.3–1.5 cm, outside rugose, very laxly puberulous, inside smooth; stipe slender, 5–7 mm high; lobes 1–3, well developed, 0.8–1 by 0.6–0.7 cm; style c. 0.5 mm long. *Seeds* not observed.

Distribution – *Malesia*: Borneo (Kalimantan: Kota Belud and Beluran District). Celebes (Mali-li, Minahassa).

Habitat & Ecology – Forest; altitude from sea level up to 700 m. Fl. Apr.; fr. May.

Note – *Rhysotoechia koordersii* shows an overall similarity with *R. ramiflora*, although there are a few differences. These are best observed in the specimens of both species from Celebes. The overlap in the third character in the table below is caused by the *R. koordersii* specimens from Kalimantan. The differences are, in my opinion, large enough for *R. koordersii* and *R. acuminata* to remain separate species, although they must be closely related.

7. *Rhysotoechia multiscapa* Etman, Blumea 39 (1994) in press. — Type: Carr 14999 (CANB, L), Papua New Guinea.

*Tree*, up to 16.5 m high. *Branchlets* rough, greyish black; flowering twigs 4–7 mm thick. *Leaves* 2–4-jugate; petiole 2–6 cm long; rachis 2–8.5 cm long; petiole and rachis terete to flattened above, ribbed, glabrous; petiolules 5–10 mm long, flattened to grooved towards the pulvinus, glabrous, pulvinus 3–5 mm long, grooved, glabrous. *Leaflets* opposite to subopposite, usually elliptic, sometimes obovate or ovate, 8–14 by 2.5–5 cm, index 2.3–3.6, coriaceous, both sides glabrous; base symmetric, not abruptly narrowing, acute to attenuate; margin not to slightly recurved; apex acute to acuminate, then slightly abruptly narrowing; midrib prominent, smooth to angular, very laxly puberulous, lateral nerves 0.5–1.8 cm apart, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins densely reticulate, on upper surface slightly raised. *Inflorescences* axillary or subterminal, thyrsoïd, branching at the base, to 9 cm long, very laxly puberulous, copiously flowered; cymules 1- or 2-flowered; bracts and bracteoles c. 1 mm long; pedicels c. 2 mm long. *Flowers* c. 4 mm in diam. *Sepals*: both sides glabrous, margin very laxly ciliate, outer ones broadly ovate, 1.5–1.7 by 1.8–2 mm, inner ones orbicular, 2.2–2.5 by 2 mm. *Petals* broadly obovate, 1.8–2 by 2–2.4 mm, both sides pilose towards the base; claw 0.5–0.6 mm high, inside glabrous, outside densely pilose; margins coarsely lobed, thickened towards the base, sometimes slightly recurved towards the base, glabrous; apex rounded; scales absent. *Disc* glabrous. *Stamens* 8; filaments 2.2–2.5 mm long, velutinous; anthers c. 0.5 mm long, glabrous to very laxly puberulous. *Pistillode* sericeous. *Fruits* not observed. — Fig. 69.

Distribution – *Malesia*: Papua New Guinea (Owen Stanley Range).

Habitat & Ecology – Forest; altitude 1280 m. Fl. Nov.

8. *Rhysotoechia obtusa* Etman, Blumea 39 (1994) in press. — Type: NGF 27986 (A, CANB, L, LAE), Papua New Guinea.

*Tree or shrub*, 4–6 m high, outer bark grey to dark grey to light brown, middle bark light green, inner bark cream, wood of medium hardness, straw-

|                      | leaflet form        | leaflet apex        | petiolule |
|----------------------|---------------------|---------------------|-----------|
| <i>R. ramiflora</i>  | ovate to elliptic   | acute to cuspidate  | 7–22 mm   |
| <i>R. koordersii</i> | obovate to elliptic | obtuse to acuminate | 0–10 mm   |

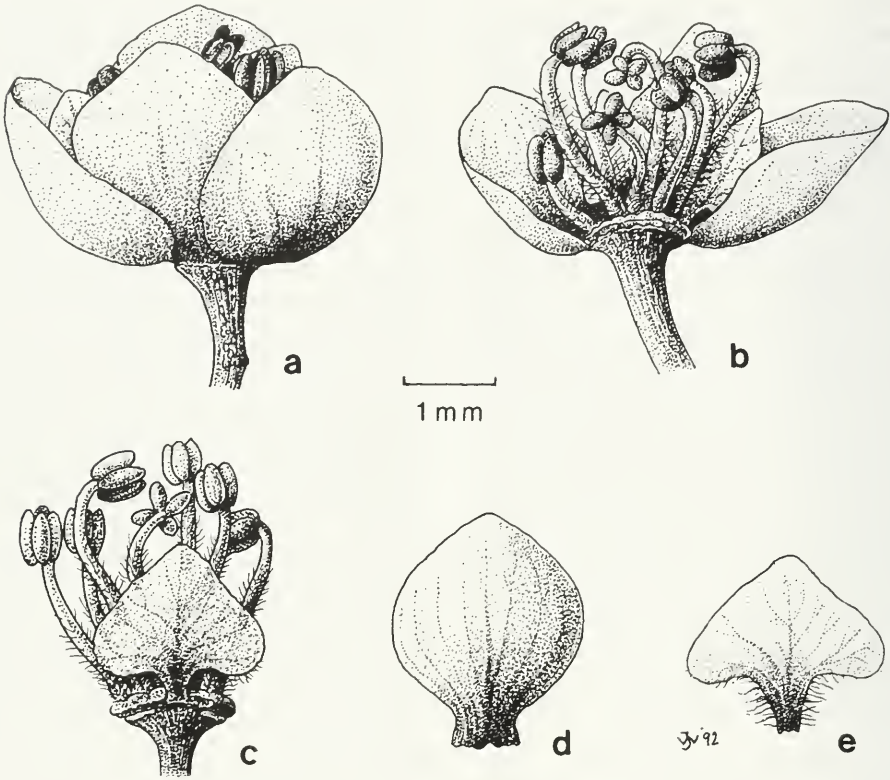


Fig. 69. *Rhysotoechia multiscapa* Etman. a. Male flower; b. *ibid.*, one sepal removed; c. *ibid.*, one petal left; d. sepal; e. petal (a–c: Carr 14999).

coloured. *Branchlets* rough, greenish black to greyish black to reddish black; flowering twigs 4–7 mm thick. *Leaves* 1–4-jugate, often with a terminal leaflet; petiole 2.5–6 cm long, terete to angular, usually slightly winged below the lowermost pair of leaflets, ribbed, glabrous; rachis 2.5–10.5 cm long, angular, slightly winged below the jugae, ribbed, glabrous; petiolules 6–11 mm long, grooved, glabrous; pulvinus 2–5 mm long, grooved, glabrous. *Leaflets* opposite to subopposite, ovate to elliptic, rarely obovate, 7–16 by 3–6 cm, index 2.6–3.1. (thick) pergamentaceous, both sides glabrous; base sometimes very slightly oblique, usually abruptly narrowing, attenuate; margin (slightly) recurved; apex obtuse to slightly emarginate; midrib flattened to slightly sunken, angular, lateral nerves 0.7–2.5 apart, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins laxly reticulate, on upper surface slightly raised. *Inflorescences* axillary or subterminal, paniculate, branching at the base, to 4 cm long, puberulous; bracts and bracteoles to 1 mm long; pedi-

cels 1.5–2 mm long. *Flowers* not observed. *Fruits* 1.5–1.8 by 2–2.5 cm, outside smooth to slightly rugose, laxly strigose, laxly papillose, inside densely papillose; stipe absent; lobes 3, well developed, 0.9–1.4 by 1.1–1.3 cm; style not observed. *Seeds* immature or only partly present, ellipsoid; hilum 0.5 mm diam.; pseudohilum 5 mm diam.

*Distribution* – *Malesia*: Papua New Guinea (Central Prov.).

*Habitat & Ecology* – Low lying country in or at the edge of mixed secondary forest; often subject to flooding. Altitude about sea level. Fl. Sept.; fr. Dec.–Jan.

9. *Rhysotoechia ramiflora* Radlk., Sapind. *Holl.-Ind.* (1879) 19, 62; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 542, 657; in *Engl., Pflanzenr.* 98 (1933) 1214; Etman, *Blumea* 39 (1994) in press. — Type: *Beccari it. sec. 10* (M). Celebes.

*Rhysotoechia acuminata* Radlk., *Philipp. J. Sc., Bot.* 8 (1913) 465, 466; Merr., *Enum. Philipp.*



Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenz. 98 (1933) 1213. — Type: *Loher* 5882 (K, M), Luzon.

*Rhysotoechia striata* Radlk., Philipp. J. Sc., Bot. 8 (1913) 466; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenz. 98 (1933) 1213. — Lectotype (Etman 1994): *Clemens* 1067 (M), Mindanao. Paratypes: *Clemens* 'K', 778, 978.

*Tree or shrub*, up to c. 8 m, dbh 3–30 cm, sparsely branched, bark smooth, grey brown, thin. *Branchlets* smooth to slightly rough, greyish black to reddish black to light brown; flowering twigs 4–13 mm thick. *Leaves* 1–4-jugate; petiole 3–17 cm long, terete to flattened above, sometimes slightly winged below the first jugum, (slightly) ribbed, glabrous; rachis 4.5–22 cm long, terete to flattened or slightly angular above, usually slightly winged below the jugae, (slightly) ribbed, glabrous; petiolules 0.7–2.2 cm long, flattened to slightly grooved, glabrous, pulvinus 3–10 mm long, grooved, glabrous. *Leaflets* opposite to subopposite, rarely alternate, ovate to elliptic, rarely obovate, 9–31 by 4–12 cm, index 1.8–3.3, pergamentaceous to coriaceous, both sides glabrous; base symmetric (or slightly oblique), attenuate, rarely acute; margin not to slightly recurved; apex acuminate, sometimes obtuse, acute or cuspidate, often abruptly narrowing; midrib prominent, angular to ribbed, lateral nerves 1–3 cm apart, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins laxly reticulate, on upper surface slightly raised. *Inflorescences* axillary, subterminal or ramiflorous, thyrsoid, branching at the base or not, to 13 cm long, very laxly puberulous to glabrous; cymules 1-flowered; bracts and bracteoles 0.5–1 mm long; pedicels 2–4 mm long. *Flowers* 6–8 mm in diam. *Sepals* glabrous except for (laxly) ciliate margins, outer ones broadly elliptic, c. 2.5 by 2 mm, inner ones broadly ovate, c. 3.5 by 2.5 mm. *Petals* broadly obovate, 1.6–2 by 1.8–2 mm, outside (laxly) pilose, inside glabrous, claw 0.2–0.4 mm high, margins coarsely lobed, apex rounded; scales absent. *Disc* glabrous. *Stamens* 8; filaments 3–5 mm long, velutinous towards the base; anthers c. 1 mm long, puberulous. *Ovary* c. 1 mm long, densely sericeous; style and stigma c. 2 mm long, the first laxly puberulous. *Fruits* obovate, 1.8–2.5 by 1.6–2.1 cm, outside rugose to ribbed, laxly puberulous, inside (densely) papillose; stipe 0.5–1 cm long; lobes 1–3, well developed, 1–1.5 by 0.7–0.9 cm; style 0.5–1 mm long. *Seeds* ellipsoid or ovate, 1–1.7 cm by 6–10 mm; hilum 2–3 mm diam.; pseudohilum 0.4–1.1 cm diam.

Distribution — *Malesia*: Borneo (E Kalimantan),

Philippines (Luzon, Samar, Mindanao, Sulu), Celebes.

*Habitat & Ecology* — Mixed dipterocarp forest, in forest margins, river banks or forest slopes or limestone hills; altitude 30–600 m. Fl. May–June and Oct.–Nov.; fr. Feb.–May.

*Note* — This species is very variable in a number of characters, for example: form and thickness of the leaflets, smoothness of petiole and rachis, way in which the inflorescences are borne on the branches, number of cells developed in the fruits, and length of the stipe.

**10. *Rhysotoechia robertsonii*** (F. Muell.) Radlk., Sitzungsber. Mat.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 542, 657; in Engl., Pflanzenz. 98 (1933) 1214; S.T. Reynolds, *Austrobaileya* 2 (1984) 42; in Fl. Austral. 25 (1985) 65. — *Cupania robertsonii* F. Muell., Fragm. Phyt. Austral. 5 (1866) 146; Etman, *Blumea* 39 (1994) in press. — Type: *Dallachy s.n.* (L. M, MEL), Rockingham Bay, Australia.

*Rhysotoechia contermina* Domin, *Bibl. Bot.* 89 (1927) 905. — Type: *Domin s.n.*, p.p., Harvey's Creek, Australia.

*Tree*, 6–25 m high, dbh 10–75 cm, low buttressed, outer bark patchy grey to dark grey to brown to green, (moderately) smooth except for the fine cracking and stippling, scrape red-brown, inner bark fibrous, cream. *Branchlets* rough to smooth, greenish brown to greyish brown; flowering twigs 4–6 mm thick. *Leaves* 1–4-jugate; petiole 1.3–6 cm long, terete to flattened above, slightly winged below the lowermost pair of leaflets, slightly ribbed, very laxly puberulous to glabrous; rachis 2.5–8 cm long, angular, slightly winged below the jugae, slightly ribbed, laxly puberulous to glabrous; petiolule usually a pulvinus only, up to 4 mm long, flattened above, very laxly puberulous; pulvinus 1–2 mm long, slightly grooved, very laxly puberulous. *Leaflets* opposite to alternate, ovate to elliptic, 6–20 by 2–7 cm, index 2.2–4.8, pergamentaceous, both sides very laxly puberulous; base sometimes slightly oblique, acute to attenuate; margin (slightly) recurved; apex sometimes abruptly narrowing, acute to cuspidate; midrib prominent, angular, lateral nerves 0.5–1.5 apart, basally indistinctly, apically distinctly looped, intercalated veins not very distinct, veins densely reticulate, on upper surface slightly raised. *Inflorescences* axillary, paniculate, 10.5–17.5 cm long, laxly puberulous; bracts and bracteoles 0.5–0.7 mm long; pedicels 1–2 mm long. *Flowers* 4–5 mm in diam. *Sepals*: both sides glabrous, margin ciliate; outer ones broadly ovate, 1.5–2 by 1–1.2 mm; inner ones or-

bicular to elliptic, 2–2.5 by 1.5–2 mm. *Petals* obovate, 1.2–1.5 by 1–1.5 mm, outside pilose only at the base, inside pilose towards the base; claw c. 0.2 mm high, glabrous; margins lobed, thickened towards the base, pilose; apex rounded; scales absent. *Disc* glabrous. *Stamens* 8; filaments c. 3 mm long, velutinous towards the base; anthers c. 0.8 mm long, sometimes with a few hairs. *Ovary* c. 2 mm high, laxly sericeous towards the style; style c. 1 mm high, laxly sericeous; stigma 0.5–0.7 mm high, laxly strigose. *Fruits* reniform to depressed globose, 1.7–2.5 by 2–2.5 cm; outside rugose, glabrous, inside densely papillose; stipe 2–3 mm high; lobes 3, well developed, 1–1.2 by 1.2–2.2 cm; style c. 1 mm long. *Seeds* obovoid, 1–1.3 by 0.8–1 mm; hilum c. 0.5 mm diam.; pseudohilum c. 2 mm diam.

Distribution – *Malesia*: Papua New Guinea (Western Prov.); Australia (Queensland).

Habitat & Ecology – Found in rain forests from low hills to riverine, and on and near creek banks. Soil: alluvial, dark clay loam; altitude 20–450 m. Vegetation with *Eugenia*, and *Callistemon* as dominant species. Fl. July–Oct.; fr. Oct.–Dec.

#### IMPERFECTLY KNOWN SPECIES

***Rhysotoechia grandifolia*** Radlk., Sapind. Holl.-Ind. (1879) 89, 132, 249; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 542, 657; in Engl., Pflanzenz. 98 (1933) 1212; Etman, Blumea 39 (1994) in press. — Lectotype (Etman 1994): *Korthals 11* (L), Borneo. Paratype: *Teijsmann 7488*, Moluccas, Geben.

*Rhysotoechia grandiflora* Radlk. ex Merr., J. Str. Br. Roy. As. Soc., special issue (1921) 361, misspelled name.

*Shrub*, up to 2 m high. *Branchlets* slightly rough, reddish black to brownish black; flowering twigs c. 6 mm thick. *Leaves* 2–4-jugate, rarely with one subterminal leaflet; petiole 4–10 cm long; rachis 3–20 cm long; petiole and rachis terete to flattened above, slightly ribbed, glabrous; petiolules 1.5–2 cm long, flattened to slightly grooved, glabrous; pulvinus 5–7 mm long, grooved, bulbously thickened, glabrous. *Leaflets* opposite, rarely subopposite, ovate to elliptic, 13–24 by 6.5–9.5 cm, index 2.1–3,  $\pm$  coriaceous, both sides glabrous; base symmetric, sometimes slightly oblique, usually abruptly narrowing, attenuate; margin not to slightly recurved; apex acuminate; midrib prominent, ribbed, lateral nerves 1.5–3 cm apart, basally indistinctly, apically distinctly looped, intercalated veins curved towards the base, veins laxly reticulate. *Inflorescences*, *flowers* and *fruits* not observed.

Distribution – *Malesia*: Borneo (Kalimantan), Moluccas (Geben, Obi Island, W Part, Jikodolong).

Habitat & Ecology – Rather open coastal forest, transition zone between coral beach sand and red porous nickel soil; altitude 30 m. Fr. Nov.

Note – None of the three collections studied has inflorescences or fruits. The foliar characters of the collection made by Korthals are remarkably similar to *R. acuminata*. The leaves (including the pulvini) in the other two collections (made by De Vogel and Teijsmann) of *R. grandifolia* are much thicker than in *R. acuminata*. According to Radlkofer, *R. grandifolia* has sessile fruits, in contrast with *R. acuminata* whose fruits are distinctly stipitate. Also, the pulvini of *R. grandifolia* are ‘bulbously thickened’ and not normally thickened as in *R. acuminata*. This character cannot be observed in the Korthals-collection.

Although I doubt whether *R. grandifolia* can be separated from *R. acuminata*, the absence of flowers and fruits in the specimens studied keeps me from concluding that *R. grandifolia* and *R. acuminata* are conspecific.

***Rhysotoechia longipaniculata*** Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 79, f. 13. — Type: *Kanehira & Hatusima 11534*, New Guinea, Nabire (n.v.).

***Rhysotoechia momiensis*** Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 81, f. 13. — Type: *Kanehira & Hatusima 14148*, New Guinea, Momi (n.v.).

***Rhysotoechia spec.***

*Tree*, up to 1.8 m high. *Branchlets* smooth to slightly rough, brownish black to greyish black; flowering twigs c. 5 mm thick. *Leaves* 3–5-jugate; petiole 5–10 cm long, terete, smooth, glabrous; rachis 8–17 cm long, terete, sometimes slightly winged below the jugae, smooth, glabrous; petiolules 5–15 mm long, slightly grooved, glabrous; pulvinus 1–4 mm long, grooved, sometimes wrinkled, glabrous. *Leaflets* opposite to subopposite, elliptic, 10–22 by 4–7 cm, index 2.3–3.1, (thick) pergamentaceous, both sides glabrous; base symmetric, attenuate; margin not to slightly recurved; apex abruptly narrowing, acuminate to cuspidate; midrib flattened to prominent, smooth to ribbed, lateral nerves 0.5–2.5 cm apart, basally open, apically looped, intercalated veins curved towards the base; veins densely reticulate, on upper surface slightly raised. *Inflorescences* axillary, thyrsoid, branching at the base, to 8 cm long, very laxly puberulous; cymes 1-flowered; bracts and bracteoles 0.1–0.3 mm long; pedicels 1–1.5 mm long.

*Flowers* only seen in bud. *Sepals*: both sides glabrous, margin laxly ciliate, outer ones broadly ovate, inner ones orbicular. *Petals* orbicular, outside velutinous towards the base, inside pilose towards the base; claw absent to very short; margins lobed, glabrous; apex rounded; scales free, not very distinct, pilose. *Disc* glabrous. *Stamens* 8; filaments densely velutinous towards the base; anthers gla-

brous. *Ovary* 3-locular, glabrous; style and stigma very immature, glabrous. *Fruits* not observed.

*Distribution* — *Malesia*: Irian Jaya (Waigeo Island).

*Habitat & Ecology* — Upper stretches of creek in primary forest; altitude c. 30 m. Fl. Feb.

*Note* — This may be a new species, but the material is too scanty to be certain of this.

## SAPINDUS

(P.W. Leenhouts)

*Sapindus* L., Gen. Pl. ed. 5 (1754) 171; Sp. Pl. (1753) 367; Radlk. in Engl., Pflanzenr. 98 (1932) 630–668. — Type species: *Sapindus saponaria* L.

*Electra* Noroña, Verh. Bat. Gen. K. W. 5 (1791), nom. nud. — *Dittelasma* Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 395. — Type species: *Dittelasma rarak* (DC.) Hook. f. [= *Sapindus rarak* DC.].

*Trees*, monoecious. *Indumentum* of solitary, simple hairs. *Leaves* paripinnate (in young specimens sometimes imparipinnate), in Malesian species up to 13-jugate; no pseudo-stipules; petiole and rachis marginated to winged or not. *Leaflets* often more or less oblique to falcate, entire. *Inflorescences* terminal, thyrsoid, widely branched. *Flowers* regular or zygomorphic. *Calyx* 5-merous, sepals free, imbricate, outer 2 smaller, (hardly) petaloid. *Petals* 4 or 5, imbricate, equal, as long as to slightly longer than the calyx, short-clawed, with a scale which may be nearly as long as the petal itself, reduced to a transverse ridge, or represented by a pair of auricles. *Disc* annular or semi-annular, glabrous or hairy. *Stamens* 8, free, all about equal, not or hardly exerted; filaments hairy at least at the base; anthers ellipsoid, cleft at base. *Ovary* 3-lobed, 3-celled; style terminal, simple, slender, about as long as the ovary, straight or bent, with 3 stigmatic lines; pistilode in male flowers minute. *Ovules* 1 per cell, sessile on a thickened angular placenta. *Fruits* 3-parted, often 1 or 2 parts abortive, breaking up into globular to obovoid drupes, pulp containing much saponin, endocarp pergamentaceous, hairy around the placenta. *Seeds* without arillode or sarcotesta, globular or ellipsoid, smooth, black, testa bony, hilum linear, slightly impressed.

*Distribution* — 10 species, 2 of which restricted to Central and southern North America, a third one throughout tropical America and (autochthonous?) in the Tropics (and Subtropics) of Africa, Asia, and the Pacific; 6 species in continental S and SE Asia, one of these also in western *Malesia*, one species endemic in Hawaii. — **Fig. 70.**

*Habitat & Ecology* — Tropical and subtropical regions, as well under everwet as under seasonal conditions; at low to medium altitudes; in forests and thickets.

*Uses* — The fruits of some species are widely used as a substitute for soap ('Soap nuts').

*Notes* — 1. Apparently closest related to the African genera *Deinbollia* Schum. & Thonn. and *Hornea* Baker.

2. Radlkofer subdivided the genus into four sections. Of these, the following three are represented in *Malesia*: sect. *Sapindus* (*S. saponaria* L.), sect. *Daxysapindus* Radlk. (*S. trifoliatum* L., sometimes planted) and sect. *Dittelasma* (Hook. f.) Radlk. (*S. rarak* DC.),



## KEY TO THE SPECIES

- 1a. Leaves 1–5-jugate. Petals 5, the scale represented by a hairy ridge or a pair of auricles. Disc annular . . . . . 2  
 b. Leaves (7–)9–13-jugate. Petals 4, with a scale of the same shape and size. Disc semi-annular . . . . . **1. *S. rarak***
- 2a. Calyx outside with some hairs at the base only. Disc, pistil, and fruit glabrous  
     **2. *S. saponaria***  
 b. Calyx outside hairy all over. Disc, pistil, and fruit hairy. India and Ceylon. In Malesia sometimes planted (Fig. 70e) . . . . . *S. trifolius* L.

**1. *Sapindus rarak*** DC., Prod. 1 (1824) 608; Blume, Rumphia 3 (1847) 91, t. 167; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 150; Atlas 1 (1913) f. 89; Radlk. in Engl., Pflanzenr. 98 (1932) 663; Steenis, Fl. Sch. Indon. (1949) 252; Backer & Bakh. f., Fl. Java 2 (1965) 133. — [*Saponaria Rarak* Rumph., Herb. Amb. 2 (1741) 134.] — *Dittelasma rarak* (DC.) Hook. f. in Benth. & Hook. f., Gen. Pl. 1 (1862) 395. — Type: *Lahaye s.n.* in Herb. Prod., Granata. *Sapindus angustifolius* Blume, Rumphia 3 (1847) 99. — Type: *Van Royen s.n.* (L).

*Tree*, up to 42 m high, dbh up to 1 m. *Branchlets* terete, up to 1 cm thick, inconspicuously lenticellate, brownish to blackish, fulvous tomentellous, glabrescent. *Leaves* (7–)9–13-jugate, up to 50 cm long, glabrous; petiole ± terete, somewhat flattened and thickened at base, up to 9 cm long; rachis not winged; petiolules 2–5 mm long. *Leaflets* subopposite to alternate, lanceolate-ovate, mostly oblique and slightly falcate, 7–16 by 2–3.5 cm, chartaceous; base very oblique, lower half acute, upper half rounded-attenuate to cuneate; apex obtuse to tapering acute-acuminate, mucronate; midrib slightly raised above, more strongly so beneath, nerves many, rather dense, oblique, curved, not joined, rather well developed, prominulous on both surfaces, like the intermediate veins and rather densely reticulate veinlets. *Inflorescences* up to c. 35 cm long, densely fulvous- to ferruginous-tomentellous. *Flowers* zygomorphic, white. *Sepals* flat, hardly petaloid, outside densely appressed fulvous-hairy, outer broad-ovate to suborbicular, 2–3 by 1.5–2 mm, inner obovate, 3–4 by 1.8–2 mm. *Petals* 4, lanceolate-ovate to elliptic, 3 by 1–2 mm, short-clawed, outside densely appressed long fulvous-hairy, woolly along the margin; scale 1/3 shorter than the petal, of about the same shape, truncate and slightly incurved at apex, along the margin and especially at the apex densely woolly. *Disc* semi-annular, glabrous. *Stamens*: filaments densely long-hairy outside and along the margin, the apical part excepted, in male flowers 2.5 mm, in fe-

male ones 1.2–1.5 mm; anthers 0.3–0.5 mm, in male flowers glabrous, in female ones sparsely hairy. *Pistil* glabrous, 3.5–4 mm. *Fruits*: parts subglobular, 2 by 1.8 cm, carinate, red, glabrous. *Seeds* subglobular, 1.2–1.5 cm diam. — **Fig. 70d.**

*Distribution* — Assam, Burma, Thailand, Indo-China, Taiwan; in *Malesia*: Sumatra (known from a few localities only), Bangka, Malay Peninsula, Java, Madura, Lombok, Sumbawa; widely cultivated, also in other parts of Malesia. It is difficult to distinguish between wild and naturalized specimens.

*Habitat & Ecology* — Forests, mainly under seasonal conditions; c. 200–1600 m altitude. Fl. Jan.–Feb., June, Sept.–Nov.; fr. Jan., Feb., Apr.–Aug.

*Uses* — Wood hard, but not durable. Fruits and seeds used like those of *S. saponaria*. See Heyne, Nutt. Pl. Indon. ed. 3 (1950) 988; Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1958.

*Note* — *Sapindus pimatus* Mill., Gard. Dict. ed. 8 (1768) has since De Candolle often been cited as a possible synonym. From Miller's short description — based upon seedlings cultivated in England — it is clear, however, that *S. pinnatus* cannot be identified with *S. rarak*. He clearly mentions the leaves as being winged; moreover, he says that the species is more hardy than *S. saponaria*, which, on comparing the areas of distribution of the two species, is hardly to be expected of *S. rarak*. Apparently, his name refers either to seedlings of a race of *S. saponaria* with 8 or 10 pairs of leaflets, more than usual, or to another genus with seeds like those of *Sapindus*.

**2. *Sapindus saponaria*** L., Sp. Pl. (1753) 367; Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 364; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 498; Radlk. in Engl., Pflanzenr. 98 (1932) 639, f. 14; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) f. 19. — Lectotype (Pennington 1992): Plukenet, Phytographia (1692) t. 217, f. 7.



Fig. 70. *Sapindus saponaria* L. a. Habit; b. petal; c. fruit. — *S. rarak* DC. d. Fruit. — *S. trifolius* L. e. Fruit (a, b: Iboet 255; c: Schodde 2779; d: Boerlage s.n.; e: Kostermans 25836).

*Sapindus mikorossi* Gaertn., Fruct. 1 (1788) 342, t. 70, f. 3g, h; Radlk. in Engl., Pflanzenr. 98 (1932) 651; Corner, Wayside Trees (1940) 595, f. 212. — Type unknown.

*Sapindus forsythii* DC., Prod. 1 (1824) 607. — Type: *Forsyth s.n.* in Herb. Prod., Granata.

*Quassia tricarpa* Blanco, Fl. Filip. (1837) 351, p.p.; ed. 3 (1878) t. 388; Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 16 (1887) 399. — Neotype: *Merrill Sp. Blanc. 183* (BO, L), Luzon.

*Sapindus vitiensis* A. Gray, U. S. Expl. Exp. Bot. 1 (1854) 251; Radlk. in Engl., Pflanzenr. 98

(1932) 655. — Type: *U. S. Expl. Exp. s.n.* (US), Fiji.

*Sapindus microcarpus* Jardin, Mém. Soc. Sc. Nat. Math. Herb. 5 (1857) 295, 307; non Ruiz & Pavon (1804). — *Sapindus saponaria* L. f. *microcarpa* (Jardin) Radlk. in Martius, Fl. Bras. 13, 3 (1900) 517. — *Sapindus saponaria* L. var. *jardiniana* F.B.H. Brown, Bull. Bish. Mus. 130 (1935) 160. — Type: *Jardin s.n.*, Marquesas, c. 1845.

*Sapindus halicus* Radlk., Sitzungsber. Math.-Phys.-Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 396; Sapind. Holl.-Ind. (1879) 7, 20, 67;

in Engl., Pflanzenz. 98 (1932) 655. — Type: *Teijsmann s.n.*, Bali.

?*Sapindus oocarpus* Radlk., Not. Syst. 1 (1910) 302; in Engl., Pflanzenz. 98 (1932) 654; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 939. — Type: *Balansa 3430* (P), Tonkin.

*Tree*, up to 25 m high, dbh up to 56 cm. *Branchlets* terete, up to 7 mm thick, often conspicuously lenticellate, ashy grey to brown, glabrous to rather densely fulvous-hairy and glabrescent. *Leaves* 1–5-jugate, up to 40 cm long; petiole terete to 3-angular in cross section, marginated to winged towards the lower pair of leaflets or not, 1.5–5.5 cm long, hardly to distinctly swollen at base; rachis marginated to winged beneath every pair of leaflets or not. *Leaflets* (sub)opposite, elliptic to lanceolate, widest about or below the middle, mostly slightly oblique and falcate, 6–16 by 3–6 cm, chartaceous, glabrous; base more or less oblique, cuneate; apex emarginate or obtuse to acute; midrib flat to prominulous above, prominent beneath, nerves 10–15 pairs, slightly curved to nearly straight, upper ones looped and joined, prominulous on both surface as are the often strongly developed intermediate veins and the densely reticulate veinlets. *Inflorescences* up to 25 cm long, densely shortly fulvous-tomentose. *Flowers* regular, cream. *Sepals* orbicular to broad-ovate, concave, mostly with a broad petaloid margin, ciliolate and with some appressed hairs near the base, outer 1–1.2 mm in diam., inner 2 by 1.5–2 mm. *Petals* 5, oblong-ovate to ovate, 1.5–2.5 by 1–1.2 mm, short-clawed, woolly-ciliate and outside at least at the base long hairy, inside above the claw either with a hairy ridge or with two involute, hairy auricles. *Disc* annular, glabrous. *Stamens*: filaments 0.5–1 mm, variably hairy; anthers 0.5–1 mm, glabrous. *Pistil* glabrous, 2 mm. *Fruits*: parts subglobular, 0.8–1.2 cm in diam., not carinate, glabrous. *Seeds* subglobular, 0.8–1 cm diam. — **Fig. 70a–c.**

*Distribution* — Apparently originating from tropical and subtropical America (from Florida to N Argentine), widely cultivated and naturalized in the Tropics and Subtropics; in Asia distributed from Central Japan, Quelpaert I. near Korea, and Central China to India, partly at least under cultivation; in *Malesia* known from Philippines, Lesser Sunda Islands, and Papua New Guinea (Central Prov., around Rigo only), possibly always introduced by man.

*Habitat & Ecology* — In more or less open, mostly secondary forests at up to 500 m altitude. In Lesser Sunda Islands and New Guinea: fl. Mar.–June; fr. May, Aug.; in Philippines: fl. Oct., Nov.; fr. Jan., Mar., Apr. For dispersal (over short distances possibly by sea-currents, but mainly by man) see Ridley, Dispersal (1930) 268.

*Uses* — Ornamental tree. Fibres of inner bark used for ropes. Roots, bark, leaves, but especially fruits used as a substitute for soap because of the high amount of saponin; for the same reason the fruits are used as a fish poison. Seeds formerly used as buttons and beads. Several parts used in medicine. See Burkill, Dict. Econ. Prod. Malay Penins. (1935) 1959; Brown, Useful Pl. Philipp. 2 (1950) 369; Quisumbing, Philipp. J. Sc. 77 (1948) 162; Walker, Imp. Trees Ryukyu (1954) 197, f. 119.

*Chromosomes* —  $2n = 22$ : Ono, Mem. Nat. Sci. Mus. Tokyo 10 (1977) 63–76;  $2n = 30$ : Mehra et al., Silvae Gen. 21 (1972) 96–102;  $2n = 36$ : Sarkar et al. in Löve, Taxon 26 (1976) 636, 649.

*Note* — The delimitation of *Sapindus saponaria* as given here is wider than Radlkofe's by the inclusion of *S. balicus*, *mukorossi*, *oocarpus*, and *vitiensis*. The distinction between these 'species' was very vague. The continental Asian forms — *S. mukorossi* and allies — are closely related to the American ones. The Malesian and Pacific forms were distinguished by Radlkofe as f. *microcarpus*, characterized only by the slightly smaller fruits. There are three distinguishable Malesian races, each rather uniform. In '*S. balicus*' the petiole and rachis are never winged; the leaflets are rather thin, obtuse and often emarginate at the apex, with 10–12 pairs of nerves, the upper ones joined at some distance from the margin, and intercalary veins not strongly developed; the flowers are small with petaloid sepals and only partly hairy petals. In the Philippine race the petiole and rachis are often winged; the leaflets are thicker, often acute to acuminate at apex, with 12–15 pairs of nerves, the upper ones of which are joined quite near the margin, and with often 3 intermediate veins strongly developed between every pair; the flowers are slightly bigger, with petaloid sepals and nearly glabrous petals. The New Guinea race is characterized mainly by elliptic, hardly oblique and not falcate leaflets, by hardly petaloid sepals, and by petals which are outside entirely and rather densely hairy.



**SARCOPTERYX**

(P.C. van Welzen)

*Sarcopteryx* Radlk., Sapind. Holl.-Ind. (1879) 19, 57, 97, 98; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 486–490, 500, 544, 658, 659; in Engl., Pflanzenr. 98 (1933) 1232–1238, f. 36; S.T. Reynolds, Austrobaileya 2 (1984) 53–57, f. 5; in Fl. Austral. 25 (1985) 72–77, f. 18a–f, map 92–96; Welzen, Blumea 36 (1991) 87–103, figs., maps. — Lectotype species (S.T. Reynolds 1984): *Sarcopteryx squamosa* (Roxb.) Radlk.

Shrub to tree. *Indumentum* of simple solitary hairs and red glandular hairs only. *Branchlets* smooth to slightly grooved. *Leaves* paripinnate, 1–7-jugate, pseudo-stipules absent, not winged; petiolules usually present. *Leaflets*: base attenuate; margin entire; both surfaces smooth; on lower surface domatia at most shallow pockets in axils of nerves, small red glands present; venation raised; nerves especially towards the apex marginally looped; veins reticulate. *Inflorescences* usually in the upper leaf axils and pseudoterminal, usually only with a few branches; cymules cincinnate (to dichasial). *Flowers* apparently bisexual but presumably functionally male or female. *Sepals* 5, equal in size, basally connate. *Petals* 5, clawed, margin sometimes auriculate near base, outside and inside sericeous at base; scales 2, densely pilose along outer margin, apex, and inner surface; crest a small enation or well developed, clavate and glabrous. *Disc* uninterrupted. *Stamens* 8; filaments especially basally pilose; anthers dehiscence latrorse, usually papillate, usually slightly pilose, connective usually appendaged. *Pistil*: ovary 3- (or 4-)locular, densely hirsute; style and stigma triangular, not lobed, grooved, elongating in fruit. *Fruits* an obcordate loculicidally dehiscent capsule, smooth, somewhat lobed, slightly winged, wings narrow at most, stipe usually present; inside glabrous except for a hair tuft below the placenta and hidden by the arilloid appendage (absent in *S. caudata*); mesocarp woody in stipe and lower part of seed chambers. *Arillode* completely covering seed, usually with a straight, sometimes a curled appendage (*S. caudata*). *Seeds* obovoid; hilum triangular, relatively large. — **Figs. 71–73.**

*Distribution* — 12 species; in *Malesia* 7 species, one widespread over Moluccas and New Guinea, the other 6 endemic in New Guinea. The remaining 5 species endemic in the rain forests of E Australia.

*Habitat & Ecology* — Mainly found in primary, secondary, and montane (moss) forests, also along roads, rivers, and edges of forests, sometimes in regularly burned vegetation. *Soils*: clay, sand, sandstone, volcanic soil, peat, occasionally ultrabasic; sometimes marshy; sea level up to 2800 m altitude. Sometimes branches myrmecophilous.

## KEY TO THE SPECIES

- 1a. Leaflets below glabrous or sericeous on basal part of midrib . . . . . 2  
 b. Leaflets below hirsute or villose on basal part of midrib . . . . . 3  
 2a. Leaflets with very distinct venation, apex cuspidate to caudate. Sepals 1.3–2.3 by 1.2–2 mm. Petals 2.8–4.3 by 2.2–2.5 mm, apex acute. Arillode with a curled basal appendix. Hairs absent below placenta . . . . . 2. ***S. caudata***

- b. Leaflets with distinct venation, apex acuminate to caudate. Sepals 0.7–1.7 by 0.7–1.8 mm. Petals 1.3–3.5 by 1.1–3 mm, apex truncate. Arillode with a straight appendix. Hairs below placenta . . . . . **7. *S. squamosa***
- 3a. Leaves 1–5-jugate; petiolule up to 11 mm long. Leaflets ovate to elliptic, 3–18.3 by 1.2–7 cm, slightly to densely pilose . . . . . 4
- b. Leaves (1–)2–7-jugate; petiolule a pulvinus only. Leaflets ovate, 0.9–4.2 by 0.3–1.8 cm, densely pilose . . . . . **3. *S. coriacea***
- 4a. Leaflets punctate or not, with or without domatia; nerves at base marginally looped or not. Petals 1.1–2.5 by 0.8–2 mm, claw 0.1–0.5(–1.3) mm high; crest on scales absent (Fig. 71c) to well-developed (Fig. 71a). Fruit with a 3.5–4.5 mm high stipe . . . . . 5
- b. Leaflets punctate, usually with shallow domatia; nerves marginally looped. Petals 2.6–2.8 by 2.4–2.8 mm, claw c. 0.7 mm high; crest on scales well-developed (Fig. 71a). Fruit with a 5–9 mm high stipe . . . . . **1. *S. brachyphylla***
- 5a. Crest on petal scales absent (Fig. 71c) or slightly developed (Fig. 71a). Leaflets often with shallow domatia . . . . . 6
- b. Crest on petal scales large (Fig. 71a). Leaflets seldom with domatia **4. *S. crispata***
- 6a. Leaflets ovate to elliptic, 3.7–17.2 by 1.5–5.5 cm, with shallow domatia below; apex acuminate to cuspidate (to caudate). Sepals 1.5–3 by 1–1.8 mm. Petals 1.3–2.5 by 1–2 mm, margin auriculate near claw (Fig. 71a). . . . . **5. *S. rigida***
- b. Leaflets ovate (to elliptic), 3–8 by 1.8–4 cm, domatia absent; apex acuminate. Sepals 1.2–1.8 by 0.6–0.8 mm. Petals 1.1–1.4 by 0.8–1 mm, margin not auriculate near claw (Fig. 71b–d) . . . . . **6. *S. rubiginosa***

**1. *Sarcopteryx brachyphylla*** Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 265; Bot. Jahrb. 56 (1920) 297; in Engl., Pflanzenr. 98 (1933) 1237; Welzen, Blumea 36 (1991) 92, f. 1a, 3, map 1. — Type: *W. Sayer s.n.*, 1887 (M holo), Papua New Guinea.

*Tree*, 3–25 m high; dbh 10–40 cm; outer bark brown to patchy grey and white, minutely tuberculate, inner bark fawn with pale pink spots; sapwood cream with black streaks; indumentum rufous. *Branchlets* crispy hirsute especially when young; flowering twigs 2–4.5 mm thick. *Leaves* 1–3(–4)-jugate; petiolule up to 7(–11) mm long.



Fig. 71. *Sarcopteryx* Radlk. Petals from inside. — a. *S. brachyphylla* Radlk., margin with auricles (arrow). — b. *S. squamosa* (Roxb.) Radlk., margin without auricles (arrow). — c. *S. rigida* Radlk., margin without auricles. — d. *S. caudata* Welzen, margin without auricles (a: Fisher 62; b: Atje 283; c: van Valkenburg 33; d: Schodde & Craven 4884).

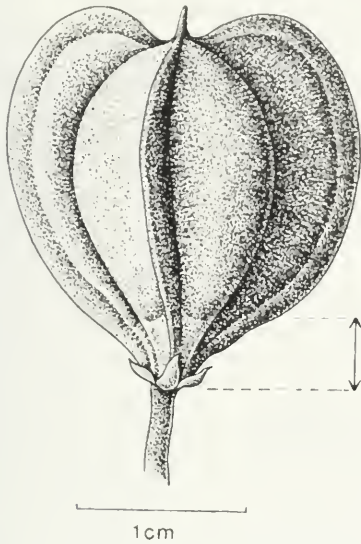


Fig. 72. *Sarcopteryx brachyphylla* Radlk. Fruit, typical are the stipe (arrow) and the winged edges (Pullen 7969).

*Leaflets* ovate to elliptic, 3.3–13.5 by 1.2–5.8 cm, asymmetrical, coriaceous, punctate; base asymmetrical; margin flat (to slightly recurved); apex (acute to) acuminate to cuspidate, usually mucronulate; upper surface mainly crispy hirsute on midrib, often with wax; lower surface hirsute, domatia usually as shallow pockets; nerves marginally looped; veins distinct. *Inflorescences* in upper leaf axils and pseudoterminal, rather slender, hirsute, up to 12.5 cm long, usually with a few branches; cymules cincinnate (to partly dichasial), 2–4-flowered; bracts and bracteoles triangular, sericeous; bracts up to 3 mm long; bracteoles up to 1.2 mm long. *Flowers* c. 6 mm in diam. *Sepals* ovate, 0.7–1.6 by 1–1.5 mm, sericeous, green. *Petals* obovate, white, blade elliptic, 2.6–2.8 by 2.4–2.8 mm, claw up to 0.7 mm high, broadly cuneate, margin auriculate near claw, apex rounded; scales 1.3–1.8 mm long, yellow; crest large, clavate, usually glabrous. *Stamens*: filaments 2.6–3.2 mm long; anthers 0.8–0.9 by 0.5–0.7 mm. *Pistil*: male ovary c. 0.9 mm high, style and stigma c. 0.2 mm long; female ovary c. 2.8 mm high, green, style and stigma c. 2.9 mm long, yellow to reddish. *Fruits* 1.8–2.2 by 1.6–2.1 cm, red, stipe 5–9 mm high, broadly triangular, lobes with 2–4 mm broad wings; hair tuft below placenta. *Arillode* yellow to orange, with straight appendage. *Seeds* obovoid, 7–12.5 by 5–6.7 mm. – Figs. 71a, 72.

*Distribution* – *Malesia*: Papua New Guinea

(Northern, Central, and Milne Bay Prov.).

*Habitat & Ecology* – Found in primary hilly to montane rain forest, *Castanopsis* forest, moss forest, edge of forest; soil marshy; 1500–2065 m altitude. Fl. June–Aug.; Fr. June–Dec.

*Note* – See note under *Sarcopteryx rigida*.

2. *Sarcopteryx caudata* Welzen, *Blumea* 36 (1991) 95, f. 1d, 4, map 1. — Type: Hoogland & Pullen 5437 (L. holo.; BM, BRI, K, US), Papua New Guinea.

*Shrub* to *tree*, up to 23 m high, dbh up to 45 cm; outer bark dark red-brown to grey-brown, smooth to with many pustular lenticels, with fine reticulate cracks and with fairly numerous horizontal ridges, inner bark (straw-)brown; wood straw, heartwood pale brown to brown. *Branchlets* sericeous (to hirsute) when young; flowering twigs 1–5 mm thick. *Leaves* 2–5-jugate; petiole up to 7 mm long. *Leaflets* elliptic, 3.5–11.1 by 1.4–3.9 cm, almost symmetrical to asymmetrical, coriaceous, not (to slightly) punctate; base somewhat asymmetrical; margin flat; apex cuspidate to caudate, mucronulate; upper surface (slightly) sericeous on midrib; lower surface (slightly) sericeous; domatia absent; nerves marginally looped; veins highly distinct. *Inflorescences* in upper leaf axils and pseudoterminal, rather sturdy, sericeous-hirsute, up to 12.3 cm long, with a few up to 3.7 cm long branches; cymules dichasial to cincinnate, 2–4-flowered; bracts and bracteoles triangular, sericeous; bracts up to 2.3 mm long; bracteoles up to 1.9 mm long. *Flowers* 4.2–7 mm in diam. *Sepals* ovate, 1.3–2.3 by 1.2–2 mm, hirsute, green. *Petals* obovate, white, apex acute; crest on scales absent to minute. *Male flowers*: petals 3.8–4.3 by 2.2–2.5 mm, claw 0.2–0.3 mm high, scales 1.8–2.8 mm long; stamens: filaments 3.2–9.6 mm long, pale green, anthers 0.8–1.1 by 0.4–0.7 mm, dark red; pistil: ovary 0.4–0.7 mm high, style and stigma 0.1–0.3 mm long. *Female flowers*: petals 2.8–3.9 by 2.2–2.3 mm, claw c. 0.2 mm high, scales 1.3–2.3 mm long; stamens: filaments 1.3–2.2 mm long, pale green, anthers 0.8–1.1 by 0.4–0.7 mm; pistil pale green, ovary 1.8–2.8 mm high, style and stigma 1.4–4.2 mm long. *Fruits* c. 1.4 by 1.5 cm, smooth, glabrescent, red-brown, stipe low, c. 3.5 mm high, lobes with c. 1 mm broad wings; no tuft of hairs below placenta. *Arillode* with a curled appendage. *Seeds* obovoid, c. 6 by 4.5 mm. – Figs. 71d, 73.

*Distribution* – *Malesia*: Irian Jaya (Wissel Lakes, Baliem Valley, Valentijn Mts); Papua New Guinea (E Highlands and Morobe Prov.).

*Habitat & Ecology* – Found in primary (*Nothofagus*), secondary, and montane forest. Soil: clay,





Fig. 73. *Sarcopteryx caudata* Welzen. Habit (Schodde & Craven 4884).

peat, white sandstone. Rather scarce to locally common; 1750–2500 m alt. Fl. Apr.–June; fr. Aug. (based on 1 specimen).

Note – Specimens from western New Guinea have leaflets with a somewhat shorter tip and less mucronulate than the other specimens of this species.

3. *Sarcopteryx coriacea* Radlk., Sapind. Holl.-Ind. (1879) 98; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 544, 659 (typification); in Engl., Pflanzenr. 98 (1933) 1235; Welzen, Blumea 36 (1991) 96, map 1. — Type: *D'Urville 29118* (P holo: M), Irian Jaya.

*Shrub*, 1–3 m high. *Branchlets* hirsute when young; flowering twigs 1.5–2.5 mm thick. *Leaves* (1–)2–7-jugate; petiolule a pulvinus only. *Leaflets* ovate, 0.9–4.2 by 0.3–1.8 cm. (slightly) asymmetrical, coriaceous, not punctate; base sometimes asymmetrical; margin flat; apex acuminate, sometimes asymmetrical, mucronulate; upper surface hirsute, glabrescent; lower surface densely hirsute; domatia absent; nerves marginally looped; veins very distinct. *Inflorescences* axillary (to pseudoterminal), slender, hirsute, up to 6.2 cm long, not branching or with a few up to 5 cm long branches; cymules cincinnate, 2- or 3-flowered; bracts and bracteoles triangular, sericeous; bracts up to 2 mm long; bracteoles up to 1.1 mm long. *Flowers* less than 2 mm in diam., young? *Sepals* deltate, 0.8–1.4 by 0.6–1.1 mm, hirsute, light green to yellowish brown. *Petals* orbicular, white (to yellow). *Male flowers*: petals 1.3–1.8 by 1.1–1.6 mm, claw c. 0.3 mm, scale c. 0.8 mm high with a small glabrous crest; stamens: filaments c. 2.7 mm long, anthers 0.4–0.6 mm long, yellow to orange to brownish pink; pistil: ovary c. 0.6 mm high, style and stigma 0.1–0.3 mm long. *Female flowers*: petals c. 1 by 1 mm, claw c. 0.2 mm, scales c. 0.4 mm high, without crest; stamens: filaments c. 0.7 mm long, anthers 0.4–0.6 mm long; pistil: c. 1.2 mm high, brownish green; style and stigma 0.1–0.3 mm long. *Fruits* 1–1.4 by 0.9–1.2 cm, smooth, glabrous, red to purplish, stipe absent, lobes with less than 0.5 mm wide wings; tuft of hairs below placenta. *Arillode* with a straight appendage. *Seeds* obovoid, c. 9 by 6 mm.

Distribution – *Malesia*: Irian Jaya (Vogelkop).

Habitat & Ecology – Found in primary and secondary forest, edge of mossy forest, open heath, fire vegetation. Soil: coarse sand, grey clay. Rather scarce to locally common; 800–2300 m altitude. Fl. Jan.–Apr.; fr. Oct.–Mar.

4. *Sarcopteryx crispata* Welzen, *Blumea* 36 (1991) 96. — Type: *Clemens 709* (L), Papua New Guinea.

(*Shrub* to) *tree*, up to 33 m high, dbh up to 60 cm; no buttresses; outer bark brownish to black with numerous small pustular lenticels which sometimes form longitudinal lines, inner bark brown or red-brown streaks on paler background; sapwood pale to brown, heartwood yellow-brown. *Branchlets* crispy hirsute especially when young; flowering twigs 2.5–6.5 mm thick. *Leaves* (1–)2–5-jugate; petiolule up to 7 mm long. *Leaflets* ovate to elliptic, 3.7–18.3 by 1.8–7 cm, symmetrical to asymmetrical, thin to coriaceous, punctate or not; base (sometimes) asymmetrical; margin flat to slightly recurved; apex acute to acuminate (to cuspidate),

usually mucronulate; upper surface mainly crispy hirsute on midrib; lower surface hirsute; domatia absent (or few shallow pockets); nerves mainly upwards marginally looped; veins distinct. *Inflorescences* in upper leaf axils and pseudoterminal, often rather sturdy, hirsute, up to 23.6 cm long, usually with a few up to 7.6 cm long branches; cymules cincinnate (to partly dichasial), up to 5-flowered; bracts and bracteoles triangular, sericeous; bracts up to 2 mm long; bracteoles up to 0.9 mm long. *Flowers* 3–4.8 mm in diam.; buds brown pilose. *Sepals* ovate, 1.1–1.6 by 0.6–1.4 mm, sericeous, green. *Petals* obovate, blade rhombic, 1.5–2.2 by 1.2–2 mm, white, claw 0.3–0.5 mm high, rather slender, margin not auriculate, apex truncate to rounded, outside and inside basally sericeous; scales 0.6–1.7 mm long, yellow; crest large, broad to high, clavate, usually glabrous. *Disc* yellow. *Male flowers*: stamens: filaments 3–4.4 mm long, white, anthers 0.7–1 by 0.6–0.8 mm, pinkish to red; ovary 0.6–0.7 mm high, style and stigma 0.2–0.4 mm long. *Female flowers*: stamens: filaments 1.4–2.5 mm long, anthers 0.6–0.9 by 0.4–0.7 mm; pistil: ovary 1.4–2.2 mm high, style and stigma 1.8–3.4 mm long. *Fruits* 1.9–2 by 1.5–1.7 cm, smooth, glabrescent, red, stipe 3.5–4.5 mm high, broadly triangular, lobes with 2–4 mm broad wings; axis with hairs below placenta. *Arillode* yellow, with straight appendage. *Seeds* obovoid, 7.5–8.5 by 4.5–6 mm.

Distribution – *Malesia*: Irian Jaya (S of the Vogelkop, Biak I., Noemfoor I., and along the N coast near the border of Papua New Guinea); Papua New Guinea (W Highlands, Morobe, Western, and Central Prov.). A somewhat disjunct distribution which is probably due to insufficient collecting.

Habitat & Ecology – Found in understorey of primary and secondary rain forest, in oak and *Nothofagus* forest, and along the road. Soil: well-drained volcanic soil, sand, stone, clay; 10–2000 m altitude. Fl. June–Nov.; young fr. Nov.–Mar. Stems sometimes myrmecophilous.

5. *Sarcopteryx rigida* Radlk., *Bot. Jahrb.* 56 (1920) 296, f. 2; in Engl., *Pflanzenr.* 98 (1933) 1236, f. 36; Welzen, *Blumea* 36 (1991) 98, f. 1c, map 2. — Lectotype (Van Welzen 1991): *Ledermann 11500* (M), Papua New Guinea. *Arytera sordida* Radlk., *Bot. Jahrb.* 56 (1920) 301; in Engl., *Pflanzenr.* 98 (1933) 1279. — *Sarcopteryx sordida* (Radlk.) R.W. Ham, *Blumea* 23 (1977) 290. — Type: *Ledermann 12492* (B: holo; M), E Papua New Guinea.

*Tree*, 3–15 m high, dbh 3–12 cm; outer bark brown to light cream-grey, smooth, inner bark orange; wood white to light straw, hard. *Branchlets*

crispy hirsute especially when young; flowering twigs 2–4 mm thick. *Leaves* 1–3(–4)-jugate; petiolule up to 9 mm long. *Leaflets* ovate to elliptic, 3.7–17.2 by 1.5–5.5 cm, subsymmetrical to asymmetrical, coriaceous, usually not punctate; base slightly asymmetrical; margin flat to slightly recurved; apex acuminate to cuspidate (to caudate), not mucronulate; upper surface mainly crispy hirsute on midrib, often with wax; lower surface rufous-hirsute; domatia present as shallow pockets; nerves usually marginally looped; veins distinct. *Inflorescences* in upper leaf axils and pseudoterminal, rather slender, hirsute, up to 16.2 cm long, sometimes with a few up to 2.8 cm long branches; cymules cincinnate, 1–3-flowered; bracts and bracteoles triangular, sericeous; bracts up to 2.7 mm long; bracteoles up to 1.1 mm long. *Flowers* 2.7–4 mm in diam.; buds brown pilose. *Sepals* deltate, 1.5–3 by 1–1.8 mm, sericeous, green. *Petals* obovate, white, blade rhombic, 1.3–2.5 by 1–2 mm, claw 0.5–1.3 mm high, rather slender, margin auriculate between claw and blade, apex rounded, outside and inside basally sericeous; scales 0.5–1.2 mm long, yellow; crest absent or very small and then clavate and usually glabrous. *Stamens*: female filaments 1.8–2.9 mm long, white; anthers 0.6–1 by 0.4–0.7 mm, red. *Pistil*: female ovary 0.8–1 mm high, light green, style and stigma 0.2–0.6 mm long. *Fruits* seen immature, red, winged, glabrescent; stipe low; axis below placenta with few hairs. *Arillode* with straight appendage. *Seeds* seen immature, obovoid. — **Fig. 71c.**

Distribution — *Malesia*: Papua New Guinea (W Sepik, W Highlands, S Highlands, E Highlands, and Morobe Prov.).

Habitat & Ecology — Found in understorey of *Nothofagus-Castanopsis* forest, lower montane rain forest; 1600–2800 m altitude. Fl. Jan., Feb.; young fr. May–Feb. (or Oct.–May).

Note — *Sarcopteryx rigida* differs from *S. brachyphylla* in having petal scales without or with a small crest only and a smaller fruit with a short stipe.

**6. *Sarcopteryx rubiginosa*** Welzen, *Blumea* 36 (1991) 98, map 2. — Type: *Vinas 18* (L holo; LAE; A, BFC, CBG, K, UPNG, n.v.), Papua New Guinea.

Small *tree*, 7–10 m high, dbh up to 16 cm; outer bark (reddish) brown, rough, inner salmon to brown; wood white, hard. *Branchlets* hirsute when young; flowering twigs 2–3.5 mm thick. *Leaves* 2- or 3-jugate; petiolule up to 6 mm long. *Leaflets* ovate (to elliptic), 3–8 by 1.8–4 cm, somewhat asymmetrical, coriaceous, not punctate; base somewhat asymmetrical; margin flat; apex acuminate,

not mucronulate; upper surface pilose on midrib; lower surface hirsute; domatia absent; nerves marginally looped; veins distinct. *Inflorescences* in upper leaf axils to pseudoterminal, slender, hirsute, up to 8 cm long, not branching or with a few up to 2.4 cm long branches; cymules cincinnate, 1- or 2-flowered; bracts and bracteoles triangular, sericeous; bracts up to 2 mm long; bracteoles up to 1.1 mm long. *Flowers* c. 3 mm in diam. *Sepals* ovate, 1.2–1.8 by 0.6–0.8 mm, hirsute. *Petals* orbicular to elliptic, 1.1–1.4 by 0.8–1 mm, white, claw 0.1–0.2 mm high, margin not auriculate near claw, apex obtuse; scales 0.4–0.7 mm high, without crest. *Stamens*: filaments 0.7–1 mm long; anthers 0.5–0.7 mm long. *Pistil*: ovary 0.6–1 mm high; style and stigma 0.1–0.2 mm long. *Fruits* unknown.

Distribution — *Malesia*: Papua New Guinea (Morobe Prov.).

Habitat & Ecology — Found in montane (fagaceous) moss forest; 1800–2300 m altitude. Fl. Nov., Dec.

**7. *Sarcopteryx squamosa*** (Roxb.) Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 8 (1878) 303, nom. illeg. (genus not yet described); *Sapind. Holl.-Ind.* (1879) 19, 57, 97; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 544, 659; in Engl., *Pflanzenr.* 98 (1933) 1234; Welzen, *Blumea* 36 (1991) 101, f. 1b, 5, map 2. — *Sapindus squamosus* Roxb., [Hort. Beng. (1814) 88, nom. nud.] *Fl. Ind.* 2 (1832) 282. — Type: *Roxburgh s.n.* (BR holo), Irian Jaya.

*Sarcopteryx melanophloea* Radlk., *Sapind. Holl.-Ind.* (1879) 19, 57; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 9 (1879) 544, 659; in Engl., *Pflanzenr.* 98 (1933) 1234; Streimann, *Pl. Upper Watut Watershed* (1983) 170. — Type: *Beccari PP 15* (FI holo; M), New Guinea.

*Sarcopteryx holcaneura* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 266; in Engl., *Pflanzenr.* 98 (1933) 1233. — Type: *MacGregor s.n.*, 1890 (M holo; MEL, sh. 31988), E New Guinea.

(*Shrub* to *tree*, 2–25 m high, dbh up to 30 cm; (low buttresses); outer bark rather smooth, thin flaky to finely fissured, grey-green to dark brown, inner bark pinkish straw to purplish to red-brown, hard, non-fibrous; wood straw to orange-pink, surface corrugated; indumentum brown. *Branchlets* sericeous when young; flowering twigs 2–6.5 mm thick. *Leaves* 1–4(–5)-jugate; petiolule up to 5(–7) mm long. *Leaflets* ovate to elliptic, 4.6–23.5 by 1.3–8.4 cm, usually asymmetrical, rather thin to coriaceous, usually punctate; base usually asym-



metrical; margin flat (to somewhat revolute); apex acuminate to caudate, mucronulate; upper surface at most sericeous on midrib, usually with wax; lower surface not to (slightly) sericeous on midrib; domatia absent (to few pockets apically); nerves mainly apically marginally looped; veins distinct. *Inflorescences* in upper leaf axils and pseudoterminal, rather slender, 0.8–2 mm thick, sericeous, up to 25.5 cm long, usually with a few up to 11.4 cm long branches; cymules cincinnate (to partly dichasial), 2- or 3(–6)-flowered; bracts and bracteoles triangular, sericeous; bracts up to 3 mm long; bracteoles up to 1.3 mm long. *Flowers* 2.5–5.2 mm in diam., fragrant. *Sepals* deltate to ovate, 0.7–1.7 by 0.7–1.8 mm, sericeous, pale green to yellowish brown. *Petals* obovate, apex truncate, frayed, white; scales yellow; crest small to large, often flat and linear, apically glabrous. *Male flowers*: petals 1.7–3.5 by 1.8–3 mm, claw 0.2–0.7 mm high, scales 1–1.6 mm long; stamens: filaments 2.8–6.6 mm long, white, anthers 0.5–0.8 by 0.3–0.7 mm, orange to red; pistil: ovary 0.3–1 mm high, style and

stigma 0.1–1 mm long. *Female flowers*: petals 1.3–1.8 by 1.1–1.7 mm, claw 0.1–0.3 mm high, scales 0.5–0.9 mm high; stamens: filaments 0.8–3.3 mm long, anthers 0.4–0.8 by 0.3–0.5 mm; pistil yellowish green, ovary 0.8–1.5 mm high, style and stigma 0.3–2.5 mm long. *Disc* yellowish green to red. *Fruits* 1.2–2.1 cm high by 1–2.2 cm broad, smooth, glabrescent, purplish red, stipe low, 3–6.5 mm high, lobes with 1–3 mm broad wings; tuft of hairs below placenta. *Arillode* yellow to red, with a straight appendage. *Seeds* obovoid, 5.5–10 by 3.7–6 mm, brown. — **Fig. 71b.**

*Distribution* — *Malesia*: Moluccas, N Irian Jaya, Papua New Guinea (mainly in the coastal provinces).

*Habitat & Ecology* — Found in primary and mainly secondary forest, especially along edges: roads, mangrove, savannah, rivers. Often found on sometimes inundated land. Soil: often (silt) clay, also ultrabasic; sea level up to 1575 m altitude. Usually common. Branches sometimes hollow and filled with ants. Fl. Jan.–Apr., June–Sept.; fr. Mar.–July. Sept.–Dec.

## SARCOTOECHIA

(P.W. Leenhouts)

*Sarcotoechia* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 501; in Engl., Pflanzenr. 98 (1933) 1256; S.T. Reynolds, *Austrobaileya* 2 (1985) 181; in Fl. Austral. 25 (1985) 82; Leenh., *Blumea* 33 (1988) 198. — Lectotype species (S.T. Reynolds 1985): *Sarcotoechia cuneata* Radlk.

*Tree*, monoecious. *Indumentum* of solitary, simple, densely appressed, short brown hairs only. *Twigs* glabrous except for the tip. *Leaves* paripinnate, unifoliolate or 1- or 2-jugate (*Malesian* species); no pseudo-stipules; neither petiole nor rachis winged; petiolules strongly swollen. *Leaflets* opposite (*Malesian* species), not papillose, (sub)glabrous, without domatia or red glands; base symmetrical, acute; margin entire (except for 2 Australian species); midrib above prominulous, beneath prominent; nerves widely spreading. *Inflorescences* axillary and sometimes ramiflorous, racemose, simple or with 1 or 2 basal branches. *Flowers* unisexual, actinomorphic. *Sepals* 5, free, slightly imbricate, equal, not petaloid, outside sparsely, inside densely hairy. *Petals* 5 or 0, shorter than the sepals, outside near the base sparsely hairy, inside long-hairy in the lower half, with woolly auricles, no crest. *Disc* complete, densely hairy (New Guinea) or glabrous (Australia). *Stamens* (5–)7 (or 8), hardly exerted; filaments hairy; anthers glabrous. *Pistil* hairy; ovary 2- or 3-locular with 1 ovule per locule; smooth, not lobed; style apical, about as long as the ovary; stigma slightly lobed. *Fruits* capsular, dehiscence loculicidal, completely 2- or 3-celled, slightly 2- or 3-lobed, not winged, shortly stipitate, outside  $\pm$  smooth, very sparsely shortly sericeous, pericarp  $\pm$  fleshy, completely 2- or 3-celled, inside densely woolly. *Seeds* ellipsoid, glossy blackish brown; sarcotesta annular around the hilum to cupular and covering up to about a third part of the seed. — **Figs. 74, 75.**

Distribution — 10 or 11 species; 6 of these, occurring in northern Queensland, belong to subgenus *Sarcotoechia*, characterized by a glabrous disc; 4 or possibly 5 species occur in Papua New Guinea and belong to subgenus *Pilosodiscus* Leenh., characterized by a hairy disc.

## KEY TO THE SPECIES

- 1a. Petals present (scars visible under the fruit) . . . . . 2  
 b. Petals absent or only 1 or 2 present . . . . . 3  
 2a. Ovary 3-locular. Twigs fairly persistently angular. Leaflets bullate, the apex emarginate, rounded or obtuse . . . . . **1. *S. angulata***  
 b. Ovary 2-locular. Twigs terete. Leaflets flat, the apex acutely acuminate . . . . . **3. *S. bilocularis***  
 3a. Leaflets 7–20 by 3–6 cm, flat, the apex tapering into a broad rounded acumen. Lowland . . . . . **4. *S. planitiei***  
 b. Leaflets 4.5–8 by 1.5–3.5 cm,  $\pm$  bullate, the apex emarginate, rounded, or obtuse. Montane . . . . . **2. *S. apetala***

**1. *Sarcotoechia angulata*** Leenh., *Blumea* 33 (1988) 200. — Type: *LAE (Stevens) 51061* (L. holo), New Guinea.

*Tree* up to 24 m high, dbh up to 35–40 cm. *Young twigs* characteristically angular when dried, gradually becoming terete, c. 5 mm diam., pustular lenticellate, light greyish brown. *Leaves* 1-jugate; petiole semiterete, c. 1.5 cm by 1.5 mm; leaf axes sparsely hairy to subglabrous. *Leaflets* elliptic, 5.5–7 by 3–3.5 cm, index c. 2, stiff-pergamentaceous,  $\pm$  bullate, glabrous; base attenuate; margin strongly recurved; apex emarginate, rounded, or obtuse; nerves c. 1 cm apart, slightly curved, ending free, about equally prominulous on both sides; veins and veinlets very laxly reticulate, prominulous on both sides. *Inflorescences* up to 7 cm long, densely hairy, glabrescent; pedicels c. 2 mm long. *Sepals* ovate, c. 1.5 by 1.1 mm. *Petals* 5, elliptic, short-clawed, c. 1.2 by 1 mm. *Stamens* 7; anthers c. 0.8 mm long. *Pistillode* 3-locular. *Fruits* and *seeds* unknown. — **Fig. 75a.**

Distribution — *Malesia*: Papua New Guinea (1 collection from the Eastern Highlands Prov.).

Habitat & Ecology — In mixed forest at 2550 m altitude. Fl. Nov.

Note — The species resembles vegetatively *S. apetala* with twigs also  $\pm$  angular at first.

**2. *Sarcotoechia apetala*** Leenh., *Blumea* 33 (1988) 202. — Type: *Hartley 12505* (L. holo; K), New Guinea.

Cf. *Mischocarpus*: Hartley et al., *Lloydia* 36 (1973) 270.

*Tree*, 10–20 m high, dbh up to 30 cm. *Twigs* at first angular, becoming terete, 2.5–5 mm diam., canaliculate, pustular lenticellate, light grey to light greyish brown. *Leaves* 1-jugate; petiole semiterete to sometimes narrowly and deeply grooved above, 0.5–1.5 cm by 1–2.5 mm; petiolules almost absent; leaf axes glabrous. *Leaflets* elliptic to obovate, 4.5–8 by 1.5–3.5 cm, index 2–3, stiff-pergamentaceous, often bullate, glabrous; base attenuate; margin strongly recurved; apex emarginate, rounded, or obtuse; nerves 0.5–1 cm apart, slightly curved, nervation dense, distinctly looped and joined near the margin, or nerves more distant and ending free; veins laxly reticulate, inconspicuous or distinct above if nerves are more distant. *Inflorescences* 1–7 cm long, densely hairy, glabrescent; pedicels c. 2 mm long. *Sepals* ovate, 1–1.3 by 1–1.6 mm. *Petals* absent. *Stamens* 5 or 7; anthers 0.6–0.8 mm long. *Pistil* 3-locular. *Fruits* transversely triangular ellipsoid, c. 8 by 8 mm, at base narrowed into a short stipe. *Seeds* partly covered by a sarcotesta with a narrow free margin. — **Fig. 74.**

Distribution — *Malesia*: Papua New Guinea (Morobe, Northern, and Eastern Highlands Prov.).

Habitat & Ecology — Subcanopy of montane rain forest at 1800–2200 m altitude. Fl. Aug.; fr. Sept.–Oct.

**3. *Sarcotoechia bilocularis*** Leenh., *Blumea* 33 (1988) 200. — Type: *NGF (Sayers) 21569* (L. holo), New Guinea.

*Treelet* up to 4.5 m high, dbh at least 7.5 cm. *Twigs* very early terete, 2.5–3.5 mm diam., rather



Fig. 74. *Sarcotoechia apetala* Leenh. a. Habit; b. detail of lower surface of leaflet; c. fruit (a–c: *Brass* 31795).





Fig. 75. *Sarcotoechia* Radlk. Lower surfaces of leaflets in detail and fruits. — *S. angulata* Leenh. a. Detail of lower surface of leaflet. — *S. bilocularis* Leenh. b. Detail of lower surface of leaflet; c. fruit. — *S. planitiei* Leenh. d. Detail of lower surface of leaflet; e. fruit (a: LAE 51061; b, c: NGF 21569; d, e: Pullen 8401).

smooth, light greyish brown. *Leaves* 1-jugate; petiole semiterete, 1–2 cm long by c. 1.5 mm broad; petiolules 3–5 mm long; leaf axes glabrous. *Leaflets* elliptic, 9.5–12 by 3.25–4.5 cm, index c. 3, flat, stiff pergamentaceous, glabrous; base attenuate; margin slightly recurved; apex mostly tapering into a short acute acumen; nerves 1–1.75 cm apart, strongly curved, the upper ones looped and joined at some distance from the margin, above prominulous, beneath prominent; veins laxly reticulate, equally prominulous on both sides. *Infructescences* up to 12 cm long, thinly puberulous; pedicels slender, up to 4 mm long. *Flowers* described from remains under fruits. *Petals*: scars present. *Stamens*: 7 or 8 scars present. *Pistil* 2-locular. *Fruits* transversely ellipsoid to subglobular, c. 8 by 10 mm, at base narrowed into a short stipe. *Seeds* with a small sarcotesta around the hilum. — **Fig. 75b, c.**

*Distribution* — *Malesia*: Papua New Guinea (1 collection from Wagau, Morobe Prov.).

*Habitat & Ecology* — Forest edge on ridge or steep slope; 1500 m altitude. Fr. Jan.

*Note* — This species vegetatively resembles *S. planitiei*.

#### 4. *Sarcotoechia planitiei* Leenh., Blumea 33

(1988) 201. — *Type*: Pullen 8401 (L holo), New Guinea.

*Trees* up to 25 m high, dbh up to 40 cm. *Twigs* terete, finely grooved, 2–4 mm diam., densely pustular lenticellate, yellowish to greyish brown. *Leaves* unifoliolate or 1- or 2-jugate; petiole terete or above flattened with a narrow groove, (0.7–)1.5–3 cm by 1–2 mm; petiolules 2–3 mm long; leaf axes densely puberulous, glabrescent. *Leaflets* elliptic to obovate, 7–20 by 3–7 cm, index 2.5–3.5, thin-pergamentaceous, glabrous; base sometimes slightly attenuate; margin flat; apex obtuse or ± tapering into a broad rounded acumen; nerves (0.5–)1–2.5 cm apart, strongly curved to nearly straight, only the few uppermost ones looped, above prominulous, beneath prominent; veins and veinlets laxly reticulate, prominulous on both sides. *Infructescences* up to 15 cm long, puberulous. *Bracts* and *bracteoles* ± deltoid, 0.2–0.5 by 0.2–0.5 mm, outside and inside appressed-hairy. *Pedicels* c. 2.5 mm long, hairy. *Male flowers* somewhat smaller than the female ones. *Sepals* deltoid, 0.7–1.1 by 0.5–1.1 mm, inside at the base also with a row of longer hairs. *Petals* absent or 1 or 2 reduced ones present, ± spatulate, 0.6–1.1 by 0.2–0.6 mm. *Sta-*

*mens* 7 or 8; in male flowers: filaments 2–2.9 mm long, anthers c. 0.5 mm long; in female flowers: filaments 0.7–1 mm long, glabrous or with 1 or 2 hairs, anthers 0.4–0.5 mm long. *Pistil* 3-locular; style c. 0.9 mm long; stigma c. 0.4 mm long; pistillode c. 0.6 by 0.7 mm. *Fruits* immature, 3-celled,  $\pm$  globular. *Seeds* with at least the lower third covered by a cupular sarcotesta with a narrow, lobed, free margin. — **Fig. 75d, e.**

Distribution — *Malesia*: Moluccas (Ambon, Ceram), SE New Guinea (Milne Bay Prov., near Mayu R.).

Habitat & Ecology — Rain forest on plain; soil well-drained gravel; 150–350 m altitude. Fr. July.

Note — The description of the flowers is based on material from the Moluccas.

5. *Sarcotoechia* sp.: Leenh., *Blumea* 33 (1988) 202. — Based on *Pullen* 5452 (L), SE New Guinea.

*Tree* up to 28 m high. *Twigs* terete, finely grooved, c. 3 mm diam., greyish brown, densely pustular-lenticellate. *Leaves* 1-jugate; petiole semi-

terete, 1–1.75 cm by c. 1 mm; petiolules c. 3 mm long; leaf axes slightly puberulous, glabrescent. *Leaflets* obovate, 7.5–9.5 by 2–3 cm, index 3–3.75, pergamentaceous, above slightly puberulous on the base of the midrib, furthermore glabrous; apex mostly tapering into a short, broad, rounded acumens, sometimes narrowly rounded; nerves 0.75–1 cm apart, usually strongly curved, only the few uppermost ones looped and joined, above prominulous, beneath slightly more so; veins and veinlets above laxly, beneath rather densely reticulate, prominulous. *Young inflorescences* like erect catkins, densely minutely hairy. *Flowers* and *fruits* unknown.

Distribution — *Malesia*: SE New Guinea (Northern Prov., Hydrographers Range).

Habitat — Rain forest at 1100 m altitude.

Note — As the flowers are too young for analysis it is unknown whether the disc is hairy or glabrous. When hairy the specimen, *Pullen* 5452, resembles *S. planitiei*, but, when glabrous, it may be one of the Australian species, probably *S. cuneata* Radlk. or possibly *S. lanceolata* (C.T. White) S.T. Reynolds.

## SCHLEICHERA

(P.W. Leenhouts)

*Schleichera* Willd., *Sp. Pl.* 4, 2 (1806) 1096, nom. cons.; Radlk. in *Engl., Pflanzenr.* 98 (1933) 872. — *Cussambium* Lamk, *Encycl.* 2 (1786) 230. — Type species: *Schleichera trijuga* Willd. [= *Schleichera oleosa* (Lour.) Oken].

*Trees*; dioecious. *Indumentum* of solitary, simple hairs; young parts with glandular hairs and more or less sticky resinous. *Leaves* paripinnate, 2–4-jugate; rachis not winged; no pseudo-stipules. *Leaflets* subopposite (to alternate); margin entire; domatia absent. *Inflorescences* in the defoliated part of the branchlets above the leaf-scars, sometimes axillary, fascicles of a few simple (female) or sparsely branching (male) thyrses, the basal part with scattered, many-flowered fascicles, the upper part spicate. *Flowers*: sometimes male and female flowers present in the same inflorescence, then one of the two kinds predominating, and the other may be sterile. *Sepals* 4 or 5 (or 6), connate in lower fourth, slightly valvate but soon apert, the lobes all equal, not petaloid. *Petals* absent. *Disc* uninterrupted, more or less patelliform, sinuate, glabrous or sparsely hairy. *Stamens* (5 or) 6–8 (or 9), long exerted in male flowers; filaments filiform; anthers basifixed in a cleft, dehiscence introrse, glabrous. *Pistil* (2- or) 3- (or 4-)locular; ovary sparsely to densely pilose and glandular; style subglabrous, with recurved stigmatic lobes; ovules 1 per locule. *Fruit* a hard-crustaceous, dry berry, 1- (or 2-)celled, not winged, either smooth or with patent, simple or branched, strong thorns, glabrescent; inside glabrous. *Seeds* completely enveloped by an arillode, which is thin-papery and often adhering to the endocarp when dried. — **Fig. 76.**

Distribution — Monotypic.

**Schleichera oleosa** (Lour.) Oken, Allg. Naturgesch. Bot. 2 (1841) 1341; Merr., Int. Rumph. (1917) 337; Coster, Ann. Jard. Bot. Buitenzorg 33 (1923) 138; Ochse & Bakh., Ind. Groent. (1931) 650, f. 397; Merr., Comm. Lour. (1935) 247; Japing & Oey Djoen Seng, Tectona 29 (1936) 552, f. 35; Steup, Trop. Natuur 27 (1938) 140; Nath. Fam. Burm. Flow. Pl. 1 (1963) 176; Backer & Bakh. f., Fl. Java 2 (1965) 136. — *Cussambium* Rumph., Herb. Amb. 1 (1741) 154, t. 57, nom. inval. — *Pistacia oleosa* Lour., Fl. Coch. (1790) 615. — *Schleichera trijuga* Willd., Sp. Pl. 4, 2 (1806) 1096; Blume, Rumphia 3 (1847) 147; Bedd., Fl. Sylv. (1871) t. 119; Brandis, For. Fl. (1874) 105, t. 20; Hiern in Hook. f., Fl. Br. India 1 (1875) 681; Koord. & Veleton, Bijdr. Booms. Java 9 (1903) 177; Atlas (1913) t. 86; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 516; Craib, Fl. Siam. Enum. 1 (1926) 328; Dammerman, Nat. Tijd. Ned.-Indië 86 (1926) 42; Radlk. in Engl., Pflanzenz. 98 (1932) 874; Kanjilal & Das, Fl. Assam 1 (1936) 320; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 988, f. 126. — *Melicocca trijuga* Juss., Mém. Mus. Hist. Nat. Paris 3 (1817) 187, t. 8. — *Stadmannia trijuga* Spreng., Syst. 2 (1825) 243. — *Cussambium glabrum* Ham., Mem. Wern. Nat. Hist. Soc. 5 (1826) 356. — *Cussambium spinosum* Ham., Mem. Wern. Nat. Hist. Soc. 5 (1826) 356. — *Schleichera aculeata* Kostel., Allg. Med. Pharm. Fl. 5 (1836) 1829, nom. illeg. — *Stadmannia sideroxylon* (non DC.) Hassk., Tijd. Nat. Gesch. Phys. 10 (1843) 130. — *Cussambium oleosum* O. Kuntze, Rev. Gen. Pl. 1 (1891) 143; Pierre, Fl. Coch. (1895) t. 328, f. b. — Type: Rumphius (1741) t. 57.

*Tree*, up to 40 m high, dbh up to 2 m, but usually much less; (with slight buttresses), the bole usually crooked. *Branches* terete, striate, 2–5(–8) mm diam., black when young, later yellowish brown to ashy; young parts sparsely, shortly fulvous-sericeous and with sessile glands. *Leaves* (2- or 3- (or 4-)jugate; axial parts usually early glabrescent; young leaves deep purple; petiole terete to more or less flattened or slightly grooved above, 2–6(–8) cm long, pulvinate; rachis terete to 3-angular; petiolules swollen, slightly grooved above, 1–3 mm long. *Leaflets* elliptic to obovate, 4.5–18.5(–25) by 2.5–9 cm, chartaceous to coriaceous, dark brown or greyish green above, medium brown to greenish beneath, (sub)glabrous; base subsacate to cuculate, often oblique; margin entire to repandous; apex obtuse or emarginate (to shortly acuminate); nerves 12–15 or more per side, straight to slightly curved, looped and joined near the margin with the

exception of the lower ones; intersecondary nerves often more or less strongly developed; reticulation fine, dense, prominulous on both surfaces. *Inflorescences* 6–15 cm long, sparsely hairy. *Flowers* pale yellow or pale green. *Sepal* lobes ovate to deltoid, c. 1.5 mm high, obtuse to acute, thin-hairy on both sides, the margin ciliate (and glandular), deciduous in fruit. *Stamens*: filaments c. 2 mm long, sparsely hairy; anthers broad-elliptic, c. 0.75 mm long, slightly emarginate at apex. *Pistil* strongly reduced in male flowers; ovary ovoid, slightly 3-angular and indistinctly 3-sulcate, c. 1.25 mm long; style rather thick, 1.25–1.5 mm long. *Fruits* broad-ovoid to subglobular, c. 15 by 13 mm when 1-seeded, or transversely ellipsoid, slightly flattened, somewhat bilobed, 17–20 by c. 18 by 14 mm when 2-seeded, narrowed at base, pointed at apex, granular, yellow. *Seeds* subglobular, c. 12 by 10 by 8 mm; hilum orbicular; testa dull medium-brown, smooth and glabrous; arillode yellow and subacid. — **Fig. 76.**

*Distribution* – Tropical SE Asia from Sri Lanka and the western Deccan to Indo-China; in *Malesia*: Java, Lesser Sunda Islands, Central and SW Celebes, the islands of Saleyer, Kabaëna, and Muna, Moluccas (Ambon, Banda, cited also from Ceram and the Kai Islands). Although cited by Miquel (Sumatra, 1861, 199) from Sumatra, I saw only cultivated specimens from there, and none of them seen by him. As to the probably erroneous, old records for the Philippines, see Radlkofer (in Engl., Pflanzenz. 98, 1932, 877, footnote), and Merrill (Enum. Philipp. Flow. Pl. 2, 1923, 516). I am uncertain about the status of this tree in Malesia. It is possible that it is not autochthonous, but introduced by man. It has several uses and is often cultivated. (The species thrives only in the drier parts, however, hence the distribution gap in everwet W Malesia. Tradesmen may have brought the seeds to several parts of the Archipelago, and it is interesting that the common Hindu name, *kusam*, is very like the most common name in Malesia, *kusambi*. See Carthaus (Tectona 2, 1909, 318).

*Habitat & Ecology* – Typical in regions subject to a dry period, e.g., in Java the parts with natural teak-forest. On dry to periodically rather swampy soils of several types; in monsoon forest as well as parkland or savannahs with only scattered trees. The plants are fire-resistant (cf. Meijer Drees, Comm. For. Res. Inst. 33, 1951, 110). Usually at low altitudes, up to 900(–1200) m. Seedlings are light-demanding. Fl. in the beginning of the dry season; fr. about half a year later. Deciduous, but completely leafless during a few days only. The seeds are eaten by mammals (probably mainly *Viverridae*) and birds; furthermore, dispersal would



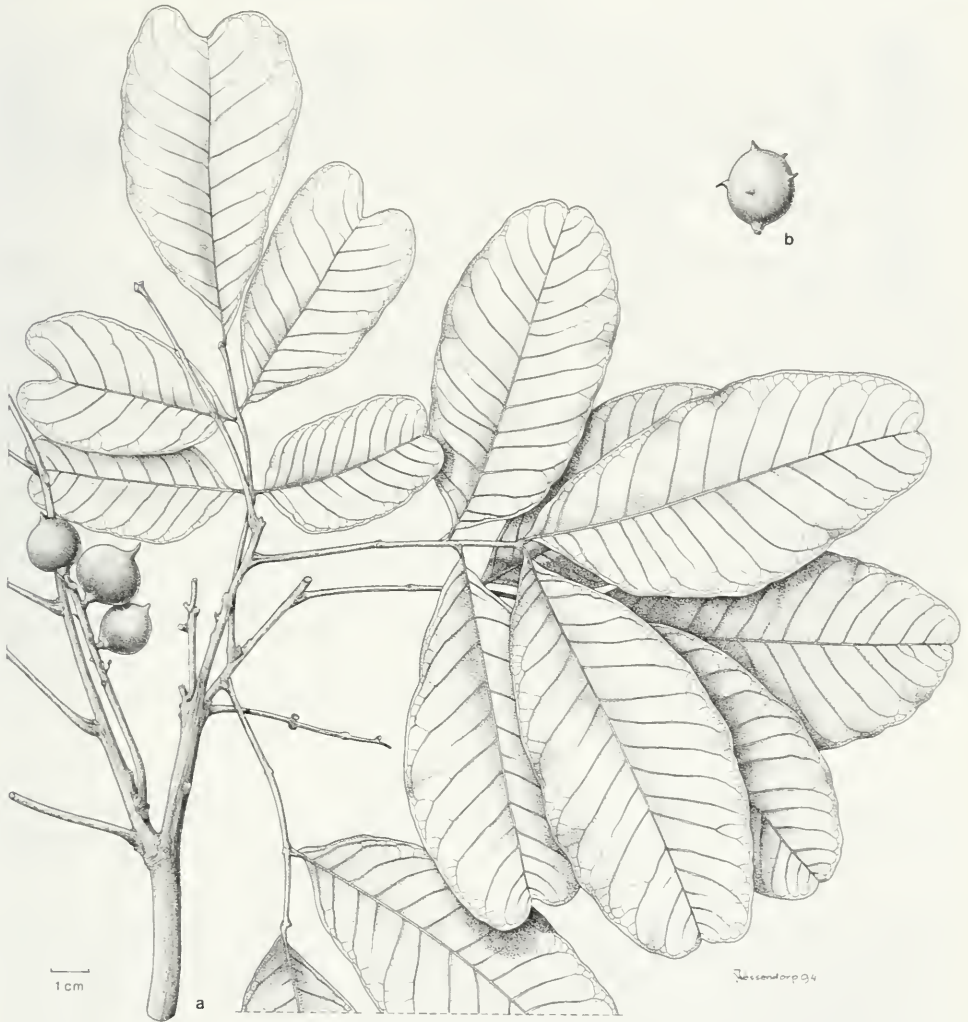


Fig. 76. *Schleicheria oleosa* (Lour.) Oken. a. Habit. b. fruit with spines (a: Buwalda 3177; b: Colfs 290).

be by termites (cf. Ridley, *Dispersal*, 1930, 167, 351).

Uses — Wood for timber and especially for an excellent charcoal; bark used for dyeing and in native medicine. For a description of the timber, see p. 427. Young leaves eaten as a vegetable; fruits

(arillode) eaten as a titbit; from the seed an oil is pressed which is used for several purposes, among others in native medicine and as a constituent of the true Makassar oil. See Heyne (*Nutt. Pl. Indon.* ed. 3, 1950, 990–996).

## SYNIMA

(P.W. Leenhouts &amp; F. Adema)

*Synima* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 501; in Engl., Pflanzenr. 98 (1933) 1254–1255; Reynolds, *Austrobaileya* 2 (1985) 186; in Fl. Austral. 25 (1985) 82, 202. — Type species: *Synima cordierorum* (F. Muell.) Radlk.

*Trees*, monoecious. *Indumentum* of solitary simple hairs; no glandular scales. *Twigs* terete. *Leaves* spirally arranged, paripinnate, 2–7-jugate; no pseudo-stipules; neither petiole nor rachis winged. *Leaflets* opposite to alternate, beneath smooth, without domatia or glands, margin entire or crenate to serrate. *Inflorescences* axillary, together sometimes pseudoterminal, thyrsoid. *Flowers* unisexual, regular. *Sepals* 5, free, equal, not or slightly imbricate, not petaloid, on both sides hairy. *Petals* 5, longer than the sepals, ciliate but otherwise glabrous, inside with 2 recurved, woolly, not to distinctly crested scales nearly as long as the petal. *Disc* entire, glabrous. *Stamens* 8, exerted, filaments and sometimes anthers hairy. *Ovary* 3-celled, densely hairy; style apical, about as long as the ovary, densely hairy; stigma slightly lobed. *Ovules* 1 per cell. *Fruits* 3-celled, faintly 3-lobed, loculicidal, valves in lower part remaining fused, marginated at the corners, stipe short, pericarp fleshy. *Seeds* covered with a sarcotesta except for an adaxial strip; cotyledons unequal, collateral. — **Fig. 77.**

Distribution — Australia (N Queensland) and SE New Guinea; two species.

## KEY TO THE SPECIES

- 1a. Inflorescences with patent branches . . . . . **1. *S. cordierorum***  
 b. Inflorescences unbranched . . . . . **2. *S. macrophylla***

**1. *Synima cordierorum*** (F. Muell.) Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 513, 546 ('*cordierii*'); in Engl., Pflanzenr. 98 (1933) 1255; Henderson & S.T. Reynolds, Austr. Syst. Bot. Newsl. 43 (1985) 21; S.T. Reynolds, *Austrobaileya* 2 (1985) 186, f. 6G–I; in Fl. Austral. 25 (1985) 82. — *Cupania cordierii* F. Muell., Fragm. 9 (1875) 93. — Type: *Dallachy s.n.* (L, MEL), Australia.

*Tree*, up to 27 m high, dbh up to 40 cm. *Indumentum* densely fulvous tomentellous. *Twigs* 4–6 mm in diam. *Leaves* 3–5-jugate; petiole flattened above, rounded below, 4–6 cm long; axes hairy, especially so at base, upwards glabrescent; petiolules 2–10 mm long, grooved above, strongly swollen at base. *Leaflets* elliptic (or ovate), 6.25–13 by 2.25–4.5 cm, index (2–)3, stiff-pergamentaceous, very sparsely hairy below towards the base on midrib and nerves, otherwise glabrous; base in the lower leaflets symmetric, in the upper ones

oblique, acute (or rounded), attenuate; margin entire, undulate, or crenulate; apex rounded to acute or slightly acuminate; midrib above slightly raised, beneath prominent and rounded, nerves c. 1 cm apart, widely spreading, strongly curved, ending free or sometimes  $\pm$  looped and joined, above hardly raised, beneath strongly raised, veins and veinlets moderately coarsely reticulate, beneath somewhat more prominent than above. *Inflorescences* up to 30 cm long, densely hairy, with few erecto-patent branches, the flowers in short, dense, many-flowered cymules. *Flowers* white. *Sepals* 1–1.1 mm high, inside densely sericeous. *Petals* 1.2–1.4 by 1.1–1.5 mm, short-clawed, scales not crested. *Stamens*: filaments 2.5 mm long; anthers 0.6 mm long. *Fruits* 20 by 18 mm, bright red, outside sparsely puberulous, inside densely woolly. *Seeds* obliquely obovoid-ellipsoid, 13 by 6 mm, testa shining black, sarcotesta yellow. — **Fig. 77a–f.**

Distribution—Australia (Queensland: Cook Dist.) and Malesia: Ceram, New Guinea (Irian Jaya: Merauke Dist.; Papua New Guinea: Fergusson Island).



Fig. 77. *Synima* Radlk. Habit, fruits, seeds and embryos. — *S. cordierorum* (F. Muell.) Radlk. a. Habit; b. fruit; c. seed ventral view; d. seed, dorsal view; e. embryo, lateral view; f. embryo, ventral view. — *S. macrophylla* Reynolds. g. Fruit; h. seed, ventral view; i. seed, dorsal view (a: Pullen 7445; b–f: Gray 765; g–i: Brass 26088).



Habitat & Ecology – Lowland rain forest; altitude 700 m. Fl. Oct.; fr. Dec.

2. *Synima macrophylla* S.T. Reynolds in Fl. Austral. 25 (1985) 82, 202; *Austrobaileya* 2 (1985) 187. — Type: *Webb & Tracey 8223* (BRI, L), Queensland.

Small tree, 1.5–3 m high (in Australia up to 11 m). *Indumentum* short-tomentose, brownish. *Twigs* 4–10 mm in diam., grooved. *Leaves* 2–6-jugate; petiole 4.5–18 cm, slightly to strongly pulvinate, rachis 11–28 cm, both terete or flattened above, rounded below; petiolule 5–15 mm, grooved above. *Leaflets* elliptic to narrowly ovate, 8–23 by 3.5–11 cm, index 2–3.6, dark green above, mid green below, chartaceous, almost glabrous on both surfaces,

midrib with few short hairs; base oblique, cuneate to rounded; apex acute to obtuse or acuminate; midrib slightly prominent above, nerves 5–10 per side, 9–20 mm apart, angle to midrib 60–90°. *Inflorescences* 5.5–28 cm, not branched. *Flowers* white. *Fruits* obpyramidal, rounded deltoid in cross section, red, 17–21 by 15–20 mm, stipe c. 6 mm, outside thinly appressed-hairy, inside villous or more appressed-hairy. *Seeds* narrowly obovoid, 11–13 by 5–6 mm, testa shiny black, sarcotesta yellow; hypocotyl with very short hairs. — **Fig. 77g–i.**

Distribution – Australia (N Queensland) and *Malesia*: Papua New Guinea (Western and Milne Bay Prov.).

Habitat & Ecology – Lower montane or mossy oak forest; altitude 150–900 m. Fr. June, Dec.

## TOECHIMA

(P.W. Leenhouts)

*Toechima* Radlk., Sapind. Holl.-Ind. (1879) 60; in Engl., Pflanzendr. 98 (1933) 1249; S.T. Reynolds, *Austrobaileya* 2 (1985) 176; in Fl. Austral. 25 (1985) 77; Leenh., *Blumea* 33 (1988) 203. — Lectotype species (S.T. Reynolds, *Austrobaileya* 2): *Toechima erythrocarpum* (F. Muell.) Radlk.

*Trees*, monoecious. *Indumentum* of solitary simple hairs only. *Twigs* terete. *Leaves* paripinnate, 1–6-jugate; neither pseudo-stipules, nor wings; petiolules above slightly grooved, pulvinate. *Leaflets* opposite to alternate, densely minutely warty beneath, small red glands absent; margin entire (*Malesian* species). *Inflorescences* axillary, usually branching, together sometimes pseudoterminal, thyrsoid. *Flowers* unisexual. *Sepals* 5, nearly free, valvate to narrowly imbricate in bud, all equal, not petaloid. *Petals* 5, as long as to distinctly longer than the calyx, hardly to longly clawed; blade with 2 erect or recurved, densely woolly, distinctly crested scales nearly as long as the petal. *Disc* uninterrupted, erect, thick,  $\pm$  5-lobed, glabrous. *Stamens* 8, in male flowers long exerted; filaments filiform; anthers glabrous, dehiscence latero-introrse. *Pistil* sessile, densely hairy; ovary 3-locular (*Malesian* species) with 1 ovule per locule; septa complete; style apical, longer than the ovary; stigma grooved or slightly lobed. *Fruits* capsular, dehiscence loculicidal, 3-angular-globular, sessile, not winged; outside  $\pm$  smooth, glabrous or tomentose, inside densely woolly but for a fleshy cupular part around the placenta; pericarp thick, hard-fleshy. *Seeds* ellipsoid; testa smooth, shiny brownish black; a small sarcotesta with a narrow, free arillode margin at both sides of the nearly basal hilum. — **Fig. 78.**

Distribution — 6 species, in Australia (Queensland and northern New South Wales to the Wilson R.) and *Malesia* (New Guinea, 1 species).

*Toechima erythrocarpum* (F. Muell.) Radlk., Sapind. Holl.-Ind. (1879) 60; in Engl., Pflanzendr. 98 (1933) 1252; S.T. Reynolds, *Austrobaileya* 2 (1985) 178; in Fl. Austral. 25 (1985) 79, f.

19a–d, map 100; Leenh., *Blumea* 33 (1988) 204. — *Cupania erythrocarpa* F. Muell., *Fragm. Phyt. Austral.* 5 (1985) 7. — Type: *Dallachy s.n.* (iso in NSW, sh. 166318, 166319), Australia.

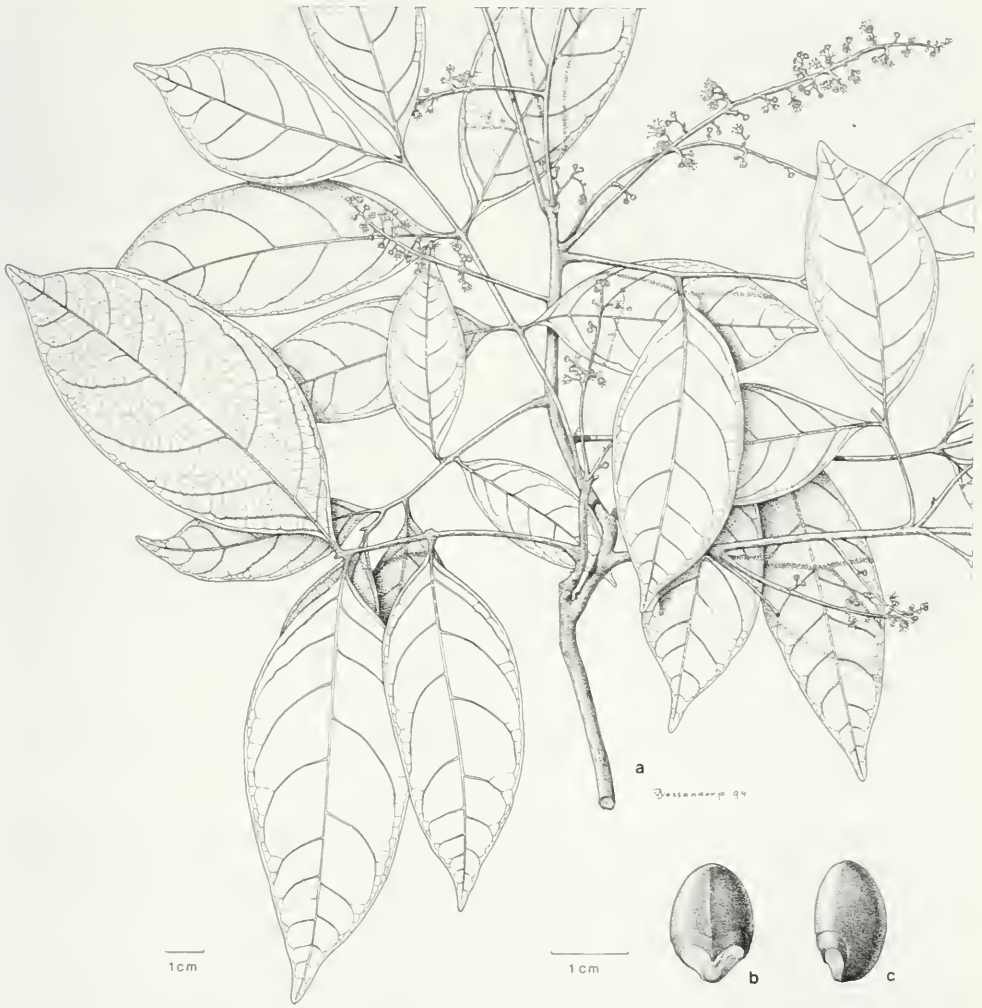


Fig. 78. *Toechima erythrocarpum* (F. Muell.) Radlk. subsp. *papuanum* Leenh. a. Habit; b. seed, ventral view; c. seed, lateral view (a: Schodde 2866; b, c: NGF 8568).

subsp. **papuanum** Leenh., *Blumea* 33 (1988) 204.

— *Toechima livescens* Radlk., *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 266; in Engl., *Pflanzenr.* 98 (1933) 1253; Hartley et al., *Lloydia* 36 (1973) 270. — Syntypes: *Forbes 374* (Fl, L, M, P), 637, 761, 804 (Fl, L, M), New Guinea.

*Toechima subteretes* Radlk., *Sapind. Holl.-Ind.* (1879) 19, 60; in Engl., *Pflanzenr.* 98 (1933) 1254. — Type: *Beccari it. sec. 17* (Fl holo), New Guinea.

*Toechima hirsutum* Radlk. in K. Schum. & Hollr., *Fl. Kais. Wilh. Land* (1889) 67; *Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss.*

*München* 20 (1890) 266; in Engl., *Pflanzenr.* 98 (1933) 1253. — Type: *Hollrung 820* (M holo), New Guinea.

*Toechima* sp.: Hartley et al., *Lloydia* 36 (1973) 270. — Based on *Hartley 10724*.

Not cf. *Toechima*: Hartley et al., *Lloydia* 36 (1973) 270 (*Hartley 10716*) (= *Alectryon affinis* Radlk.).

*Treelet* or *tree*, up to 30 m high by 60 cm dbh; (with low buttresses). *Twigs* appressedly minutely brown-hairy and early glabrescent (to persistently loosely appressedly to ± patently brown hirsute to tomentose). *Leaves* (1–)3–6-jugate; petiole subterete (to terete), 4–9 cm long, 1.5–3.5 mm thick;

petiolules 1–10 mm long; axes (sub)glabrous (to hairy). *Leaflets* (sub)elliptic, 4–21 by 2–6.5 cm, index 2–3, thin- to stiff-pergamentaceous, greenish to bluish grey above, dark brown beneath when dry, glabrous to on the midrib and beneath on the nerves sparsely hairy, (with some small domatia or axillary hair tufts beneath); base slightly oblique to symmetrical; apex acute to acuminate; midrib above prominulous, nerves less than 10 per side, up to 3 cm apart, usually erecto-patent and strongly curved, ending free, above hardly prominent; intersecondary nerves variably developed; reticulation lax. *Inflorescences* up to 30 cm long with few to several long patent to rather erect branches, the flowers in sessile, dense, many-flowered tufts; densely puberulous. *Sepal* lobes triangular, 1.25–1.8 by 1.25–2 mm, on both sides variably hairy,  $\pm$  ciliate, no glands, margin entire. *Petals* shortly and broadly to long and narrowly clawed; blade elliptic to transversely elliptic, 1.2–2 by 1.5–2 mm, glabrous or outside slightly hairy near the base, inside densely appressed-hairy, entire or slightly toothed to emarginate at apex. *Stamens*: filament 3.5–4.5 mm long, densely (to sparsely) woolly usu-

ally with the exception of the uppermost part; anther suborbicular, c. 0.4 mm long. *Pistil*: ovary c. 1.8 mm long; style slender, c. 2.5 mm high. *Fruits* 2–2.5 cm diam., glabrous (to tomentellous); wall 5–7 mm thick. *Seeds* 14–18 by 8–10 mm, hilum and sarcotesta together c. 10 by 3 mm. – **Fig. 78.**

Distribution – *Malesia*: New Guinea. A second subspecies, subsp. *erythrocarpum*, in northern Queensland.

Habitat & Ecology – An understory tree of primary and secondary rain forest on well-drained but mostly alluvial soils, sometimes in mangrove or on river banks; up to 900 m altitude. Fl. Jan.–Oct., mainly June–Sept.; fr. Jan.–Mar. and June–Oct.

#### EXCLUDED

*Toechina plurinerve* Radlk. in Fedde, Rep. 20 (1924) 36; in Engl., Pflanzenr. 98 (1933) 1252.

Based upon material cultivated in the Bogor Botanic Garden of unknown origin, this seems identical with the Australian species *T. daemelianum* Radlk.

## TRIGONACHRAS

(P.W. Leenhouts)

*Trigonachras* Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 299, 304, nom. inval.] Sapind. Holl.-Ind. (1879) 46; in Engl., Pflanzenr. 98 (1933) 1243; Leenh., Blumea 33 (1988) 204; Yap in Tree Fl. Malaya 4 (1989) 459. — Lectotype species (Leenhouts 1988): *Trigonachras acuta* Radlk.

*Trees*, monoecious. *Indumentum* of solitary simple hairs only. *Leaves* paripinnate, 1–9-jugate; no pseudo-stipules; neither petiole nor rachis winged. *Leaflets* opposite to alternate, pergamentaceous; margin entire; upper surface without wax, below sometimes with brownish glands in axils of nerves, without papillae; midrib above prominulous; nerves prominulous on both sides. *Inflorescences* axillary, together usually pseudoterminal, thyrsoid, hairy,  $\pm$  glabrescent; cymes lax, 1- or few-flowered. *Flowers* regular, unisexual. *Sepals* 5, free, slightly imbricate, all about equal or sometimes the outer two slightly smaller, sometimes thinned out to the margin, no glands, margin entire. *Petals* 5, longer than the calyx, distinctly clawed; claw densely ciliate; blade entire, inside with (1 or) 2 erect, densely woolly, not crested scales nearly as long as the blade. *Disc* uninterrupted, annular,  $\pm$  thick, glabrous. *Stamens* (7) 8 (9), in male flowers long exserted; filaments filiform, broadened to the base; anthers obovoid, dehiscence latero-introrse to latrorse. *Pistil* sessile, densely hairy; ovary 3-locular with 1 ovule per locule; septa complete; style apical, about as long as the ovary; stigma grooved or slightly lobed. *Fruits* distinctly stipitate, capsular, loculicidal, dehiscing into 3 equal valves, not winged, smooth, outside minutely hairy or glabrous, inside usually densely and woolly hairy; pericarp



hard-fleshy. *Seeds* ellipsoid, testa smooth, shining, black to brown; hilum nearly basal, elliptic, fairly big, but covering less than one third of seed; no arillode. — **Figs. 79, 80.**

**Distribution** — 8 species in *Malesia*: Malay Peninsula, Sumatra, Borneo, Philippines, Celebes, and New Guinea.

**Habitat & Ecology** — Medium-sized trees from lowland forest, primary as well as secondary, often in marshes.

#### KEY TO THE SPECIES

- 1a. Mature fruits hairy . . . . . 2
- b. Mature fruits glabrous . . . . . 4
- 2a. Fruits 2–3 by 1.5–2 cm. Philippines . . . . . **3. *T. cultrata***
- b. Fruits 4.5 by 2.25 cm or more. Not Philippines . . . . . 3
- 3a. Fruits up to 3 cm wide, the wall c. 1 mm thick. West Malesia . . . . . **1. *T. acuta***
- b. Fruits c. 4 cm wide, the wall c. 10 mm thick. New Guinea . . . . . **5. *T. papuensis***
- 4a. Leaflets tapering into an acute acumen . . . . . 5
- b. Leaflets not acuminate . . . . . 6
- 5a. Leaves 7-jugate; petiolules 3–5 mm long. Borneo . . . . . **7. *T. nov. sp. B***
- b. Leaves 1–4-jugate; petiolules 7–10 mm long. Philippines . . . . . **4. *T. cuspidata***
- 6a. Leaves 3–5-jugate; petiole terete. Borneo, Philippines . . . . . 7
- b. Leaves 1- or 2-jugate; petiole flat above. Celebes . . . . . **2. *T. celebensis***
- 7a. Petiolules 3–9 mm long; leaflets 5–10 by 1.75–4 cm. Borneo . . . . . **6. *T. nov. sp. A***
- b. Petiolules 12–15 mm long; leaflets 11–15 by 5–6 mm. Philippines . . . . . **8. *T. nov. sp. C***

**1. *Trigonachras acuta*** (Hiern) Radlk., Sapind. Holl.-Ind. (1879) 46; in Engl., Pflanzenr. 98 (1933) 1245; Corner, Wayside Trees (1940) 596, f. 212; Gard. Bull. Sing., Suppl. 1 (1978) 153; H. Keng, Gard. Bull. Sing. 35 (1982) 91; Leenh., Blumea 33 (1988) 206; Yap in Tree Fl. Malaya 4 (1989) 459. — *Sapindaceae* Wall., Cat. (1848) nr. 9036. — *Cupania acuta* Hiern in Hook. f., Fl. Br. India 1 (1875) 677. — Syntypes: *Main-gay* KD 445 (CGE, K, L), Malay Peninsula; *Wallich* 9036 (K), Singapore.

*Tree* up to 25 m high, dbh up to 50 cm; with buttresses. *Twigs* subterete, when young  $\pm$  angular, 3–6 mm diam., grey to black, brown tomentelous, glabrescent. *Leaves* 3–8-jugate; petiole subterete to terete, 1.5–6 cm long by 1–2 mm broad; petiolules subterete to grooved above, 3–6 mm long. *Leaflets* opposite to alternate, ovate to elliptic, 4.5–12 by 1.5–4 cm, index 2.25–4.5, slightly falcate, thin- to rather stiff-pergamentaceous, glabrous or with some appressed hairs on the lower side of the midrib with small glands in the nerve axils beneath; base symmetrical to oblique, narrower at the basiscopic side, obtuse to acute (or rounded), slightly

attenuate; apex usually tapering into an acute acumen (or acute to obtuse); nerves 0.5–1.5 cm apart, spreading, strongly curved, ending free; reticulation fairly coarse, equally raised on both sides. *Inflorescences* pseudoterminal (and terminal), 10–20 cm long, without or with a few long branches, usually few-flowered, fulvous-puberulous. *Sepals* broad-ovate, 1.3–1.75 by 1.25–1.75 mm, fairly densely short sericeous on both sides to rather sparse inside, margin ciliate. *Petals* 2–3 by 1.6–2.5 mm; (claw with a few hairs outside); blade orbicular, glabrous, inside with 2 scales somewhat more than half as long as the petal. *Stamens* 7 or 8; filaments up to 5.5 mm long, fairly densely patently long hairy except for the upper fourth; anthers c. 1 mm long, glabrous. *Pistil* 3- (or 4-)locular, shortly brown-hairy; ovary slightly trigonous, tapering into the at least equally long style; stigma grooved. *Fruits*  $\pm$  triangular-clavate, apiculate, 4.5–5 by 2.25–3 cm, brown tomentelous, red when fresh; wall c. 1 mm thick, hard, thick and fleshy when fresh, endocarp wrinkled, sparsely to densely woolly. *Seeds* c. 1.5 by 1 cm, black and shiny; hilum basal, transversely elliptic, c. 7 by 5 mm. — **Fig. 79.**



Fig. 79. *Trigonachras acuta* (Hiern) Radlk. a. Habit; b. fruit (a, b: SAN 40845).

Distribution — *Malesia*: Sumatra, Malay Peninsula, and Borneo (Sabah).

Habitat & Ecology — In primary and secondary forests, often in swamps, along river banks, along roads, on slopes and ridges, often on sandy soils; sea level up to 225 m altitude. Fl. Apr.–June; fr. Feb., July–Sep., Nov.

2. *Trigonachras celebensis* Leenh., *Blumea* 33 (1988) 211. — Type: *Prawiroatmodjo & Soewoko 1747* (L holotype), SE Celebes.

*Tree* up to 25 m high, dbh up to 35 cm; with buttresses. *Twigs* terete, 3–4 mm diam., dark red-brown to blackish, glabrous. *Leaves* 1- or 2-jugate; petiole subterete, 3–9 cm long by c. 1.5 mm broad; petiolules above flattened, 5–12 mm long. *Leaflets* opposite to alternate, ovate to elliptic, 6–15 by 2–6 cm, index 2–3.5, straight to subfalcate, variably pergamentaceous, glabrous, with some small glands along the basal part of the midrib beneath, not glaucous below; base hardly to distinctly oblique, acute or rounded, attenuate; apex rounded to acute; nerves 1–2 cm apart, spreading, rather strongly curved or at first nearly straight, ending free; intersecondary nerves  $\pm$  strongly developed; reticulation rather coarse, prominent on both sides. *Inflorescences* pseudoterminal, 6–15 cm long, sparsely branched, rather densely appressedly shortly yellowish brown hairy. *Sepals* broad-ovate, 1.3–2.25 by 1.2–1.6 mm, outside sparsely appressed-hairy, inside the same to glabrous. *Petals* long-clawed, 1.6–2.5 by 1–1.5 mm; claw and base of plate outside sparsely appressed-hairy to glabrous; blade elliptic, inside glabrous, with 2 scales or sometimes 1 entire scale. *Stamens* 8 or 9; filaments c. 6 mm long, woolly in the lower 2/5; anthers 1.1–1.4 mm long, subglabrous to fairly densely appressed-hairy. *Fruits* triangular-ellipsoid, 2.75–3 by c. 2 cm, abruptly narrowed into a 0.5–0.75 cm long stipe,  $\pm$  apiculate, glabrous, orange; wall c. 3 mm thick, fleshy; endocarp densely woolly. *Seeds* unknown. — **Fig. 80a, b.**

Distribution — *Malesia*: Celebes (Central, Southeast).

Habitat & Ecology — Primary and secondary dryland forest on limestone or clay; up to c. 250 m altitude. Fl. Nov.–Dec.; fr. Nov.

Uses — The timber is worthless because it soon decays.

3. *Trigonachras cultrata* (Turcz.) Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 299, nom. inval.] *Sapind. Holl.-Ind.* (1879) 46; in Engl., *Pflanzenr.* 98 (1933) 1246; Leenh., *Blumea* 33 (1988) 207. — *Sapindus cultratus* Turcz., *Bull. Soc. Imp.*

*Nat. Moscou* 31 (1858) 403. — Type: *Cuming 1304* (Fl. L. M. P. SING), Philippines.

*Trigonachras brachycarpa* Radlk. in Elmer, *Leafl. Philipp. Bot.* 5 (1913) 1614; in Engl., *Pflanzenr.* 98 (1933) 1248. — Type: *Elmer 10949* (M holotype), Fl. K. L. NY, U), Philippines.

*Trigonachras obliqua* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 467; in Engl., *Pflanzenr.* 98 (1933) 1247, p.p. — Type: *FB (Bernardo) 13108* (M), Philippines (Luzon, Cagayan Prov.).

*Trigonachras rigida* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 467, p.p.; in Engl., *Pflanzenr.* 98 (1933) 1247, p.p. — Lectotype (Leenhouts 1988): *Merrill 2967* (M holotype; BM, K, NY), Philippines.

*Trigonachras membranacea* Radlk., *Philipp. J. Sc., Bot.* 8 (1914) 468; in Engl., *Pflanzenr.* 98 (1933) 1248. — Syntypes: *FB (Clark) 1073* (M, NY); *Vidal 2488, 2500* (K); all Philippines.

*Tree* up to 22 m high, dbh up to 50 cm. *Twigs* terete, when young angular, 3.5–9 mm diam., light to purplish grey, early to late glabrescent. *Leaves* 5–9-jugate; petiole (sub)terete, mostly flattened at the base, 3–13.5 cm long by 1–4 mm thick; petiolules slightly grooved above, 2.5–8 mm long. *Leaflets* opposite to alternate, ovate (to elliptic), 3.5–18 by 1.5–7 cm, index 2–4, straight to falcate, (thin-)pergamentaceous, glabrous to sometimes sparsely hairy on the basal half of the midrib, usually small glands in some to most of the nerve axils beneath; base oblique to sometimes symmetrical, rounded to acute, attenuate; apex acute (to rounded); nerves 1–3 cm apart, widely to steeply spreading, variably curved, ending free; reticulation rather coarse (or dense beneath), beneath mostly more prominent than above. *Inflorescences* together pseudoterminal, up to 40 cm long, with few spreading branches, rather densely ferruginous puberulous,  $\pm$  glabrescent. *Sepals* ovate, 2–2.2 by 1.6–2 mm, outside densely, inside densely to sparsely hairy, not ciliate. *Petals*: claw c. 1 mm long, blade transverse-elliptic, in total 3–3.5 by 2–3 mm, claw and basal half of blade outside sparsely woolly, inside glabrous, inside with 2 scales. *Stamens* 8; filaments 6.5–7.5 mm long, in the lower half variably woolly; anthers 1.4–1.5 mm long, glabrous. *Fruits* globular to triangular-obovoid, 2–3 by 1.5–2 cm, stipe up to 1 cm long, usually apiculate, densely ferruginous or fulvous puberulous to tomentose; wall 1–3 mm thick, fleshy, endocarp finely transversely wrinkled, sparsely (to densely woolly). *Seeds* 11–12.5 by 7–8 mm, black; hilum suborbicular to transverse-elliptic, 2–6 by 2–6 mm. — **Fig. 80c.**

Distribution — *Malesia*: Philippines.

Habitat & Ecology — In primary forest, on ridges, along rivers, and near the sea shore; sea level



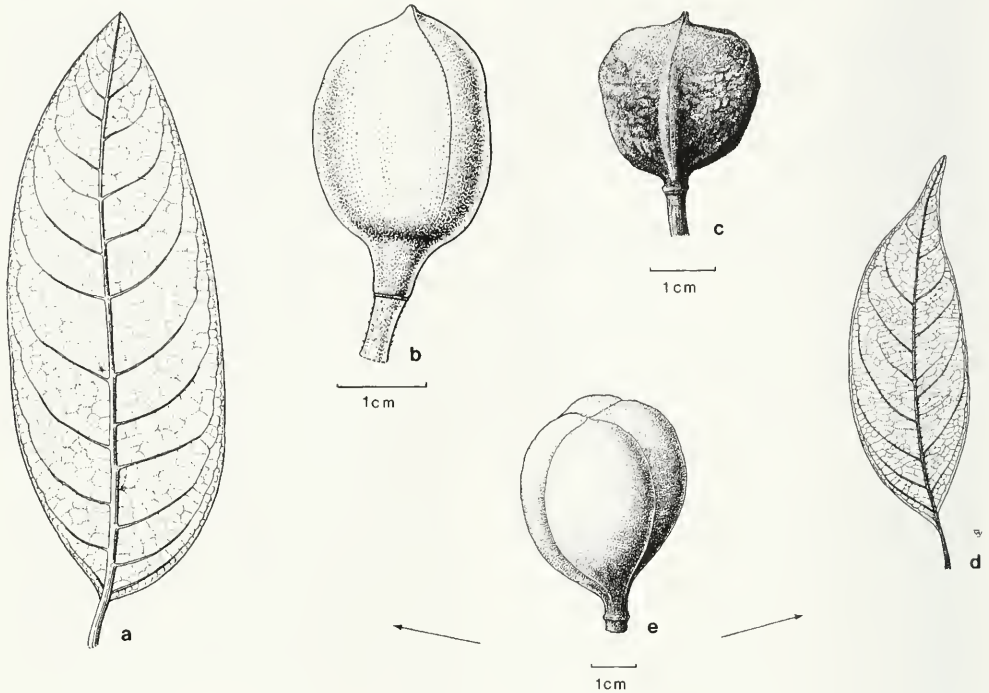


Fig. 80. *Trigonachras* Radlk. Leaflets and fruits. — *T. celebensis* Leenh. a. Lower surface of leaflet; b. fruit. — *T. cultrata* (Turcz.) Radlk. c. Fruit. — *T. cuspidata* Radlk. d. Leaflet lower surface. — *T. papuensis* Leenh. e. Fruit (a, b: *Prawiroatmodjo* & *Soewoko* 1747; c: *PNH* 37151; d: *BS* 20467; e: *NGF* 42923).

up to 500 m alt. Fl. Apr. and May; fr. June–Aug.

Note – Most of the collections are nearly glabrous, but some from Luzon have densely tomentose twigs, leaf axes, and inflorescences.

**4. *Trigonachras cuspidata* Radlk.**, Philipp. J. Sc., Bot. 6 (1911) 182; in Engl., Pflanzenz. 98 (1933) 1246; Leenh., Blumea 33 (1988) 210. — Type: *FB* (*Hagger*) 1411 (M), Philippines.

*Trigonachras falcatuscuspidata* Radlk., Philipp. J. Sc. 20 (1922) 661; in Engl., Pflanzenz. 98 (1933) 1247. — Lectotype (Leenhouts 1988): *BS* (*Ramos*) 14920 (M holo; BM), Philippines.

*Trigonachras rigida* Radlk., Philipp. J. Sc., Bot. 8 (1914) 467, p.p., excl. type.

Tree up to 15 m high, dbh up to 40 cm. Twigs terete, 4–5 mm diam., blackish, glabrous. Leaves 1–4-jugate; petiole (sub)terete, 3–6.5 cm long by 1–2 mm broad; petiolules above slightly grooved, 7–15 mm long. Leaflets opposite, elliptic, 5–14 by 2–4.75 cm, index 2–3, slightly falcate, stiff-pergammentaceous, glabrous, without glands; base ob-

lique, acute, attenuate; apex with a  $\pm$  tapering long acute acuminate; nerves 1–2 cm apart, spreading, strongly curved, ending free; reticulation coarse, prominulous on both sides. Inflorescences seemingly terminal as the vegetative terminal bud is mostly shifted aside and suppressed, c. 12 cm long, sparsely branched, densely appressedly shortly brown hairy. Sepals broad-ovate, c. 1.5 by 2 mm, outside and inside sparsely hairy. Petals: blade broad-ovate, 1.5–3 by c. 1.3 mm, glabrous, inside with 2 short scales. Stamens 8; filaments c. 5 mm long, woolly in lower two thirds; anthers c. 1.5 mm long, sparsely ciliate. Pistil 3-locular. Fruits triangular-ellipsoid, 4–5 by 2–3 cm, stipitate and apiculate or not, glabrous; wall fleshy, c. 5 mm thick, endocarp densely brown woolly. Seeds c. 1.5 by 0.75 cm, brown; hilum basal, suborbicular. — **Fig. 80d.**

Distribution – *Malesia*: Philippines (Luzon, Polillo, possibly also Mindanao).

Habitat & Ecology – Behind mangrove and in lowland forests. Fl. Feb.–Mar.; fr. June–July.

5. *Trigonachras papuensis* Leenh., *Blumea* 33 (1988) 212. — Type: *NGF (Henty) 20513* (L holotype; K), New Guinea.

*Tree* up to 30 m high, dbh up to 100 cm; with buttresses. *Twigs* terete, when young  $\pm$  angular, 4–7 mm diam., grey to blackish, brown tomentellous, early glabrescent. *Leaves* 3–5-jugate; petiole terete, flattened to the base, 5–11 cm long by 1.5–2.5 mm broad; petiolules above slightly grooved, 5–15 mm long. *Leaflets* opposite to alternate, ovate, 5.5–14 by 2–5.25 cm, index 2–5, falcate, thin- to stiff-pergamentaceous, glabrous, often with glands in the nerve axils (and in the branching of the veins) beneath; base oblique (or symmetrical), acute (to obtuse), attenuate; apex acute (to tapering into an acute acumen); nerves 0.75–1.5 cm apart, widely spreading, usually strongly curved, ending free (or  $\pm$  looped and joined); reticulation coarse, above more prominent than beneath. *Inflorescences* pseudoterminal, up to 12 cm long, sparsely branched, fulvous puberulous. *Sepals* broad-ovate, outside and inside sparsely sericeous. *Petals* glabrous, inside with 2 scales. *Stamens* 8; anthers ciliate. *Pistil* 3-locular, densely brownish hairy. *Fruits* ellipsoid to obovoid, not or shortly stipitate, not apiculate, 4.5–6 by c. 4 cm, light brown tomentellous,  $\pm$  glabrescent; wall c. 1 cm thick,  $\pm$  fleshy, endocarp wrinkled, ferruginous tomentose. *Seeds* unknown. — **Fig. 80e.**

Distribution — *Malesia*: Papua New Guinea (Central and Milne Bay Prov., Fergusson Is.).

Habitat & Ecology — Rain forest or secondary vegetation on hills, flood plains, and river banks; up to 200 m altitude. Fl. Dec.; fr. Mar., June, Nov.

Uses — Used as a fish poison.

6. *Trigonachras* nov. sp. A: Leenh., *Blumea* 33 (1988) 207. — Based on *SAN 75360* (L, SAN), Sabah.

*Tree*, 30 m high, dbh up to 35 cm. *Twigs* terete, c. 5 mm diam., grey, glabrous. *Leaves* 3–5-jugate; petiole terete, 3.5–4 cm long by 1.5–2 mm thick; petiolules above slightly grooved, 3–9 mm long. *Leaflets* opposite, elliptic, 5–10 by 1.75–4 cm, index 2.5–3, slightly falcate, stiff-pergamentaceous, glabrous, without glands; base hardly to distinctly oblique, acute, strongly attenuate; apex acute; nerves 1–1.5 cm apart, spreading, straight, ending free; reticulation coarse, on both sides prominent. *Inflorescences* pseudoterminal, 12–15 cm long, in fruit sparsely branched, fairly densely puberulous. *Flowers* only known from remains under the fruit. *Sepals* outside sparsely, inside densely hairy. *Fruits* (probably young) 3-angular-obovoid, c. 2.75 by 1.5 cm, narrowed to the base, apiculate,

glabrous; wall somewhat fleshy, at least 1 mm thick, endocarp densely woolly.

Distribution — *Malesia*: Borneo (Sabah, 1 collection).

Habitat & Ecology — Hill side at 180 m altitude. Young fruits in July.

Note — Presumably allied with *T. acuta*.

7. *Trigonachras* nov. sp. B: Leenh., *Blumea* 33 (1988) 209. — Based on *S 28037* (L), Sarawak.

*Tree*, 25 m high, dbh up to 65 cm; with buttresses. *Twigs* terete, c. 4 mm diam., brownish black, subtomentellous, early glabrescent. *Leaves* 7-jugate; petiole subterete, c. 5 cm long by 2 mm thick; petiolules above slightly grooved, 3–5 mm long. *Leaflets* (sub)opposite, ovate, 7.5–11.5 by 3–4 cm, index 2.5–3, slightly falcate, membranous (young?), above glabrous, beneath tomentellous on the midrib, small glands in the lower nerve axils; base oblique, basiscopic side acute and strongly attenuate, ascroscopic side rounded and hardly attenuate; apex tapering into acute acumen; nerves c. 1 cm apart, straight to slightly curved, ending free; reticulation above dense, beneath coarse, on both sides prominent. *Inflorescences* and *flowers* unknown. *Fruits* triangular ellipsoid, c. 3 by 2 cm, stipitate, apiculate, wrinkled, glabrous.

Distribution — *Malesia*: Borneo (Sarawak, 1 collection).

Habitat & Ecology — On limestone slope, grey sandy soil; 250 m altitude. Fr. Sept.

Note — Possibly related to *T. nov. sp. C* from Mindanao.

8. *Trigonachras* nov. sp. C: Leenh., *Blumea* 33 (1988) 210. — Based on *BS 83920* (NY), Philippines.

*Tree*, up to 20 m high, dbh up to 40 cm. *Twigs* terete, c. 8 mm diam., dark grey, glabrous. *Leaves* 5-jugate; petiole terete, c. 9.5 cm long by 2.5 mm thick; petiolules above broadly shallowly grooved, 12–15 mm long. *Leaflets* (sub)opposite, elliptic, 11–15 by 5–6 cm, index 2–3, straight to subfalcate, pergamentaceous, glabrous, some glands in the lower nerve axils below; base hardly oblique, acute, attenuate; apex acute or the very apex rounded; nerves 1.75–2.25 cm apart, spreading, moderately curved, ending free; reticulation rather coarse, beneath more prominent than above. *Inflorescences* and *flowers* unknown. *Infructescences* pseudoterminal, c. 30 cm long, hardly branched, puberulous, glabrescent. *Fruits* globular, 3–3.25 by 2.25–2.5 cm, abruptly narrowed into a c. 5 mm long stipe, apiculate, slightly wrinkled, glabrous; wall fleshy,

1–2 mm thick; endocarp densely woolly. *Seeds* unknown.

Distribution — *Malesia*: Philippines (Mindanao, 1 collection).

Habitat & Ecology — In dry forest at low altitude.

Note — Resembles *T. nov. sp. B* and *T. celebensis* in the alliance of *T. cuspidata*.

## TRISTIRA

(P.W. Leenhouts)

*Tristira* Radlk., Sapind. Holl.-Ind. (1879) 63, 98; in Engl., Pflanzenr. 98 (1932) 867. — Lectotype species (here proposed): *Tristira harpullioides* Radlk. [= *Tristira triptera* (Blanco) Radlk.].

*Tree*, monoecious. *Indumentum* of solitary, simple hairs only. *Leaves* paripinnate, 3–7-jugate, without pseudo-stipules, neither petiole nor rachis winged. *Leaflets* opposite to alternate, not papillate beneath, velutinous beneath and on midrib and nerves above, glabrescent above; base oblique, the acroscopic side broadest. *Inflorescences* terminal and in the upper leaf-axils, thyrsoid; bracts conspicuous, up to c. 6 mm long; cymes up to c. 7-flowered. *Flowers* actinomorphic, unisexual, male and female in the same inflorescences. *Sepals* 5, free, imbricate, outer 2 slightly smaller, the inner more or less petaloid towards the margin, outside and inside densely appressedly short-hairy. *Petals* absent. *Disc* uninterrupted, woolly to glabrous, without appendages. *Stamens* 8 or 9, exerted in male flowers; filaments densely patent hairy at base; anthers glabrous (in female flowers ciliate), dehiscent latero-introrse. *Ovary* short-stipitate, smooth, densely fulvous-pilose, 3-locular, tapering into the terminal style; latter slightly longer than the ovary and sparsely appressed-hairy, bearing in the upper part 3 stigmatic grooves; ovules 1 per locule. *Fruit* indehiscent, sessile or stipitate, trigonous-ellipsoid to -globular, slightly grooved, winged; latter higher than broad; exocarp coriaceous (thin-fleshy when fresh), mesocarp fibrous-woody, endocarp hard-woody, inside rather densely white woolly. *Seeds* glabrous, without arillode, not winged. — **Fig. 81.**

Distribution — Monotypic.

*Tristira triptera* (Blanco) Radlk., Sapind. Holl.-Ind. (1879) 62, 63; Merr., Sp. Blanc. (1918) 239; Enum. Philipp. Flow. Pl. 2 (1923) 502; Radlk. in Engl., Pflanzenr. 98 (1932) 868; Kraemer, Trees West. Pacific Reg. (1951) 224, f. 80, excl. seed. — *Melicocca triptera* Blanco, Fl. Filip. ed. 2 (1845) 203; ed. 3, 2 (1878) 16. — *Zollingeria triptera* Rolfe, J. Linn. Soc. Bot. 21 (1884) 309. — Type: *Blanco s.n.* (G-DC, acc. to Radlk.), Philippines.

*Tristira harpullioides* Radlk., Sapind. Holl.-Ind. (1879) 19, 62, 63; in Engl., Pflanzenr. 98 (1932) 869. — Type: *Beccari hb.* 2838 (FI holo), Moluccas.

*Guioa* sp.: Vidal, Rev. Pl. Vasc. Filip. (1886) 95, pro no. 220; Ceron, Cat. Pl. Herb. Manila (1892) 53, pro *Vidal 220*.

*Tristira celebica* Boerl. & Koord. in Koord., Minah. (1898) 407; Koord., Suppl. Cel. 2 (1922)

t. 54; Radlk. in Engl., Pflanzenr. 98 (1932) 869. — Type: *Koorders 18840* (BO holo; M), N Celebes.

*Tristira pubescens* Merr., Publ. Gov. Lab. Philipp. 6 (1904) 12; Radlk. in Engl., Pflanzenr. 98 (1932) 869. — *Tristira pubescens* Merr. f. *genuina* Radlk., Philipp. J. Sc., Bot. 8 (1914) 456, nom. illeg. — Type: *Merrill 2842* (PNH† holo; BM, K, M), Philippines.

*Tristira pubescens* Merr. f. *hemidasya* Radlk., Philipp. J. Sc., Bot. 8 (1914) 456. — Type: *Ahern FB 421* (M holo; BO, K, SING), Philippines.

*Zollingeria macrocarpa* auct. non Kurz: Fern.-Vill., Nov. App. (1880) 53; Vidal, Sinopsis (1883) t. 35 f. c.

*Tree*, 6–12(–20) m high, dbh up to 15 cm, bark white. *Branchlets* terete, 3–6 mm diam., ferrugin-





Fig. 81. *Tristira triptera* Radlk. a. Habit fruiting branch; b. cross section of fruit; c. female flower, stamino-  
nodes already dropped; d. male flower; e. stamen (a: *Clemens 17902*; b: *Santos 5153*; c–e: *PNH 7442*).

ous-velutinous, early to late glabrescent, shiny greyish to purple-brown or black, scattered (often very sparsely) minutely pustular-lenticellate. *Leaves* (3-)5(-7)-jugate (those near the inflorescences 1- or 2-jugate), axial parts sparsely hairy,  $\pm$  glabrescent, to tardily ferruginous-velutinous; petiole  $\pm$  flattened to grooved, at least at base, 3.5–8 cm long, base somewhat pulvinate; rachis above flat with a narrow keel; petiolules above flat to deeply grooved, 2–4(-10) mm long. *Leaflets* ovate (lower leaflets) to elliptic (upper leaflets), rarely obovate, (3-)5–10(-16) by (1.2-)1.5–4(-6.2) cm, index 2–3.5, thin-chartaceous, above shiny; base acute to rounded, distinctly attenuate; margin entire [to (partly) crenate]; apex obtuse to emarginate, mucronulate or not; midrib above slender, prominulous to slightly sunken, with a fine keel, beneath prominent and rounded; nerves 0.8–1 cm apart, slightly curved, only the upper ones more or less looped and joined towards the margin, prominulous on both sides; intersecondary nerves few; reticulations fine, prominulous on both surfaces. *Inflorescences* 7–30 cm long, with few erecto-patent branches; latter sparsely rebranched, sparsely to densely fulvous- to ferruginous-velutinous, cymules up to 7 mm long, with short stalk; pedicels slender, 2–3 mm long, hairy; bracts persistent, patent, linear, up to c. 6 by 1 mm, with a short petiole, chartaceous, margin recurved, apex acute, midrib distinct. *Flowers* creamy. *Sepals*: margin densely ciliate; outer broad-obovate to elliptic, 2.2–2.8 by 1.8–2.5 mm, thick, base broad, margin subentire; inner orbicular to elliptic, 2.2–3 by 1.8–2.8 mm, thinner, base narrow, margin crenulate to entire. *Disc* broad and flat. *Stamens*: filaments thread-like, tapering from base to apex, 2.2–

3.5 mm long; anthers basifixed, oblong, 1.2–2.3 mm long, at base cleft over c. 40%, at the apex with a rounded (glandular?) appendage. *Ovary* sharply trigonous-ellipsoid, c. 2.5 mm high; style slender, c. 3 mm long, stigmatic part curved in old flowers. *Infructescences* sometimes still velutinous; sepals persistent and slightly accrescent. *Fruits* 2.5–3.5 by 1.5–2.5 cm; wings coriaceous, up to 1 cm broad, centrally widest or broadening from base to apex, apically connate, either emarginate or tapering into the 3–4 mm long style rest; pericarp c. 1 mm thick. *Seeds* with basal, orbicular, small hilum; testa shining blackish-brown. — **Fig. 81.**

**Distribution** — *Malesia*: E Philippines (from Luzon to Mindanao), Celebes, Moluccas (Sula Islands, Ceram).

**Habitat & Ecology** — In forest on coral limestone, on cliffs along the beach, in hill forest, from sea level to c. 200 m altitude. Fl. Oct.–Feb., fr. Aug.–Mar.

**Note** — The infraspecific variation is mainly in the degree of hairiness, the shape of the fruit, and the crenation of the leaflet-margins. The first character, primarily used by Merrill and Radlkofer to delimit some species, grades throughout the range of the species. The shape of the fruit also grades from globular with the wings only touching at the apex (emarginate) to ellipsoid with the wings united and tapering into the styler apiculum. The laxly crenate leaf-margin, used by Koorders and Radlkofer to characterize *T. celebica* from Celebes, is also and even better shown by *FB (Miranda) 20542* from Mindanao, while other specimens show a tendency towards it. None of these characters are correlated.

## TRISTIOPSIS

(P.W. Leenhouts)

*Tristiopsis* Radlk. in Dur., Index Gen. Phan. (1888) 76; in Engl., Pflanzenr. 98 (1932) 861; S.T. Reynolds in Fl. Austral. 25 (1985) 11. — Lectotype species (here proposed):

*Tristiopsis acutangula* Radlk.

*Palaoea* Kanehira, Bot. Mag. Tokyo 49 (1935) 271. — Type species: *Palaoea falcata* Kanehira [= *Tristiopsis acutangula* Radlk.].

*Trees*, monoecious. *Indumentum* of solitary, simple hairs only. *Branches* (sub)terete, densely minutely tomentose, glabrescent. *Leaves* bipinnate or the upper ones at least forked, with several leaflets per branch; neither pseudo-stipules, nor winged; petiole pulvinate,  $\pm$  flattened above; pinnae alternate, rarely opposite, unequally pinnulate. *Leaflets* alternate to subopposite, chartaceous, glabrous or variably hairy; base oblique; margin entire; midrib prominent beneath; nerves dense, spreading, reticulations elongated

parallel with the nerves, rather lax, prominulous on both surfaces. *Inflorescences* thyrses, axillary towards the end of the branches; peduncle pulvinate; branches few, spreading, bearing few to many, short- to long-stalked, few- to many-flowered (in the upper parts reduced to 1 flower) cymes; pedicels articulated at base. *Flowers* fairly big. *Sepals* 5, free, imbricate, concave, the two outer ones slightly or hardly smaller, fleshy, margin petaloid or not, outside appressedly, densely, shortly tomentose, margin ciliate. *Petals* 0 or 5, slightly shorter than the sepals, clawed or not, outside mainly towards the base sericeous, margin ciliate; scale single, (somewhat) bifid, hairy, not crested. *Disc* uninterrupted. *Stamens* 8(–13), hardly or not exerted; filaments filiform; anthers basifixed, ovate-oblong, cleft at base for a third at most, the apex of the connective usually rounded-apiculate by a gland which is dark when dry, dehiscence latrorse. *Pistil* densely, appressedly fulvous-hairy; ovary conical-ovoid, faintly 3(–5)-gonous, 3(–5)-locular, tapering into a short style with a 3-grooved stigma. *Ovules* 1 per locule. *Fruits* subdrupaceous, (1–)3(–5)-celled, shortly attenuate to short-stipitate at base, shortly apiculate at apex, densely minutely tomentose, subglabrescent; wall thin, pericarp fibrous, endocarp woody; inside variably hairy. *Seeds* brown, hilum basal, orbicular; no arillode. — **Fig. 82.**

Distribution — 3 species from the Marianas to Christmas Island (Pacific Ocean), Queensland, and the Solomon Islands; in *Malesia*: from Philippines and Borneo towards the east. See Leenh. & Balgooy, *Blumea*, Suppl. 5 (1966) 198, map 109.

Habitat — Canopy trees of primary and secondary forests at low to medium altitudes.

#### KEY TO THE SPECIES

- 1a. Indumentum yellowish brown . . . . . 2  
 b. Indumentum reddish brown . . . . . **3. *T. ferruginea***  
 2a. Sepals with a few hairs only inside. Petals present. Ovary 3(–5)-locular  
     **1. *T. acutangula***  
 b. Sepals densely hairy inside. Petals absent. Ovary 2-locular . . . . . **2. *T. apetala***

1. *Tristiropsis acutangula* Radlk. [in Dur., Index Gen. Phan. (1888) 76, nom. nud.] Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 248; in Engl., Pflanzenr. 98 (1932) 863; Whitmore, Gard. Bull. Sing. 22 (1967) 17; Foreman, Check List Bougainville (1971) 176, fig. — Type: *Guppy* 272 (K holo), Solomon Islands.

*Burseraceae?* Hemsl., J. Linn. Soc. Bot. 25 (1890) 353.

*Tristiropsis obtusangula* Radlk. [in Dur., Index Gen. Phan. (1888) 76, nom. nud.] Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20 (1890) 248; in Engl., Pflanzenr. 98 (1932) 863; Hosokawa, Trans. Nat. Hist. Soc. Form. 25 (1935) 30. — Type: *Gaudichaud s.n.* (P holo), Mariana Islands.

*Tristiropsis subangula* K. Schum. in K. Schum. & Laut., Nachtr. Fl. Schutzgeb. Südsee (1905) 310; Radlk. in Engl., Pflanzenr. 98 (1932) 864. —

Type: *Weinland* 251 (B<sup>+</sup> holo: K), New Guinea.

*Tristiropsis canarioides* Boerl. ex Valetton, Ic. Bog. 2 (Feb. 1906) 285, t. 186 & 187; Radlk. in Engl., Pflanzenr. 98 (1932) 865; Meijer Drees, Comm. For. Res. Inst. 33 (1951) 110; P. Royen, Man. For. Trees Papua & New Guinea 2 (1964) 49; Backer & Bakh. f., Fl. Java 2 (1965) 136; S.T. Reynolds in Fl. Austral. 25 (1985) 12, map 8. — Type: *Teijsmann s.n.* (BO holo), W New Guinea.

*Tristiropsis nativitatis* Hemsl. ex Ridley, J. Str. Br. Roy. Asiat. Soc. 45 (June 1906) 182; Guillaumin, Ann. Jard. Bot. Buitenzorg 26 (1912) 214; Radlk. in Engl., Pflanzenr. 98 (1932) 866. — *Tristiropsis ridleyi* Hemsl., Hooker's Icon. Pl. (Dec. 1906) t. 2812, nom. illeg. — Type: *Ridley* 67 (K, P), Christmas Island.

*Tristiropsis ovata* Radlk. in Elmer, Leafl. Philipp. Bot. 5 (1913) 1605; in Engl., Pflanzenr. 98





Fig. 82. *Tristiropsis* Radlk. Habit, sepals and ovaries. — *T. ferruginea* Leenh. a. Habit; b. petal from inside; c. ovary. — *T. acutangula* Radlk. d. Petal from inside; e. ovary. — *T. apetala* Leenh. f. Ovary (a: Kostermans 21330; b, c: Anderson 4626; d, e: LAE 4092; f: LAE 62105).

(1932) 865. — Type: *Elmer 11909* (M holotype; BM, K), Philippines.

*Tristiropsis dentata* Radlk., Denkschr. Kais. Akad. Wiss. Math.-Naturwiss. Kl. 89 (1913) 572; in Engl., Pflanzenr. 98 (1932) 866. — Syntypes: *Rechinger 4916 & 4620* (W, n.v.), Bougainville. *Tristiropsis subfalcata* Radlk., Philipp. J. Sc., Bot. 8 (1914) 455; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 502; Radlk. in Engl., Pflanzenr. 98 (1932) 864. — Type: *Hallier 4584* (PNH<sup>+</sup> holotype; L), Philippines.

*Tristiropsis oblonga* Radlk., Philipp. J. Sc., Bot. 8 (1914) 456; in Engl., Pflanzenr. 98 (1932) 864. — Type: *FB (Merritt) 4063* (PNH<sup>+</sup> holotype; K, M), Philippines.

*Palaoea falcata* Kanehira, Bot. Mag. Tokyo 49 (1935) 271, f. 25. — *Tristiropsis falcata* Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 83 ('*Tristylopsis*'). — Syntypes: *Kanehira 2426* (K, P), Caroline Islands, Palau, Peliliu; *Kanehira 2427* (n.v.), Caroline Islands.

*Tristiropsis novoguineensis* Kanehira & Hatusima, Bot. Mag. Tokyo 57 (1943) 83, f. 15 ('*Tristylopsis*'). — Type: *Kanehira & Hatusima 14249* (n.v.), W New Guinea.

*Tree*, up to 35(–53) m, dbh up to at least 6 cm, often with buttresses up to 3 m high, 4 m wide, and 6 cm thick. *Branchlets* 4–10 mm thick, fulvous-tomentose, glabrescent and then shiny purple-brown, older parts more or less pustular lenticellate. *Leaves* up to 2 m long; petiole up to 20 cm long or more and up to 1.5 cm thick, rachis terete, the ultimate parts flattened to flat above; petiolules 1–8 mm long, above with a broad and flat groove, slightly pulvinate. *Leaflets* ovate to elliptic, 5–18 by 1.5–8 cm, index 2–4, glabrous (or bearded in the nerve-axils beneath); base acute to obtuse (or truncate); margin entire to subundulate; apex (emarginate to) obtuse (to acute), often mucronulate; midrib above slightly sunken, broad, nerves 0.75–1.5 cm apart, nearly straight to slightly curved, all looped and joined near the margin, faint; intersecondary nerves well developed, often joined with the marginal arches. *Thyraxes* up to 40 cm long, densely, appressedly, shortly, brownish hairy; peduncle up to 15 cm long; stalks to cymes up to 8 mm long; pedicels slender, 3–10 mm long. *Sepals* cream to greenish, persistent and black in fruit, outer 2 elliptic-ovate to orbicular, c. 3 by 2.5 mm; inner  $\pm$  obovate, c. 4 by 3 mm, margin petaloid, crenulate at apex, with a few hairs inside. *Petals* cuneate at base, broad-elliptic to broad-ovate, 2.5–3.5 by 2.2–2.5 mm, creamy-white, margin below the insertion of the scale long-ciliate, furthermore sparsely ciliate, apex crenulate, inside glabrous; scale about 0.5–0.6th the length of the petal, di-

vided till the base, woolly on the inner surface. *Disc* divided into a thick, spreading outer and a thin, erect inner wall, black, glabrous or the latter ciliate. *Stamens*: filaments c. 3 mm long, patent-hairy at least in the upper 0.6th part; anther c. 1.5 mm long, densely hairy on the dorsal side of the connective, sometimes also on the ventral side. *Pistil*: ovary c. 3 mm long; style slightly curved, c. 2 mm long. *Fruits* ellipsoid to subglobular, widest about or above the middle, narrowed to short-stipitate at base, 3–4-angular to 3–4-ribbed in cross section, 20–30 by 14–25 mm, yellowish green to dark-yellow when ripe, patently short-hairy inside, often sterile but well developed. — **Fig. 82d, e.**

**Distribution** — Marianas (Guam), Carolines (Palau Is.), Solomon Islands, Queensland, and *Malaysia*: Christmas Island, Kangean Archipelago, Bawean, Madura (acc. to Meijer Drees), Flores, Timor, SE Borneo, Philippines (Mindoro, Guimaras I., Basilan, Mindanao), P. Muna near SE Celebes, Moluccas (Halmahera, Sula and Kai Islands), New Guinea, and the Admiralty Islands.

**Habitat & Ecology** — A canopy tree of primary or secondary forests on soils with permanently high groundwater; mainly of low altitudes, up to about 500(–850) m altitude. Fl. Jan. –Aug., Oct.–Nov.; fr. Jan.–Nov. Flowers with a sweet smell.

**Uses** — The wood is said to be hard, heavy, and durable, and is used as a timber. For a description of the timber, see p. 427.

**Note** — *Tristiropsis obtusangula* Radlk., the other syntype of the genus, is almost certainly conspecific with *T. acutangula*. The type specimen of the former (*Gaudichaud s.n.* in P) differs only by the distinctly stipitate, flattened-ellipsoid (not at all angular) fruits. It is from the Marianas; just like the other specimen available (*Moran 4680*, Guam), which is in flower and shows no differences with *T. acutangula*.

**2. *Tristiropsis apetala*** Leenh., Blumea 24 (1878) 509. — Type: *LAE (Katik) 62105* (L holotype), New Guinea.

*Tree*, 8 m high, dbh up to 26 cm. *Branchlets* unknown. *Leaves* at least c. 1.5 m long, glabrous; petiole terete, canaliculate, c. 26 cm long by 1.25 cm thick; rachis terete, on the upper side with a slender rib; petiolules 1–4 mm long, above with a broad and flat groove, pulvinate. *Leaflets* alternate, ovate, falcate, c. 18 by 7.5 cm, index c. 2.5, pergamentaceous, glabrous; base acute at the narrow basiscopic side, rounded at the broad acroscopic side, attenuate; apex tapering to a short, cuneate, acute acumen; midrib above prominulous, slender; nerves 1–1.75 cm apart, nearly straight to slightly curved, ending free, faint at both sides; intersec-

ondary nerves common but not reaching more than halfway the margin. *Thyrse* c. 30 cm long, thinly minutely hairy, only the ultimate branches more densely so; peduncle hardly or not pulvinate, c. 3 cm long; cymules sessile (or with up to 2 mm long stalks); pedicels slender, 0.75–2.5 mm long. *Sepals* yellow, broad-ovate, outer c. 3 by 3.5 mm, inner c. 3.5 by 4 mm, margin thin, slightly crenulate, outside and inside densely appressedly short-hairy. *Petals* absent. *Disc* broad, flat, adnate to the base of the sepals, glabrous. *Stamens* 8, slightly exerted; filaments attached in the basal part, c. 3.5 mm long, sparsely woolly all over; anthers c. 1.75 mm long, the apex without a distinct gland, connective as well as thecae fairly densely woolly. *Pistillode* 2-locular. *Fruits* unknown. — **Fig. 82f.**

**Distribution** — *Malesia*: Papua New Guinea (Madang Prov.); known from the type only.

**Habitat & Ecology** — Rain forest at 90 m altitude.

**Note** — The present species is unique in the genus because it lacks petals. Moreover, it differs from *T. acutangula*, the species it resembles most, in the sepals being as densely hairy inside as outside. The apetalous flowers with a broad and flat disc are also found in other genera like *Glennia* Hook. f. and *Mischocarpus* Blume.

**3. *Tristiropsis ferruginea*** Leenh., *Blumea* 13 (1966) 395. — Type: *SF (Carr)* 27276 (SING holotype), Borneo.

*Tree*, up to 30 m, dbh up to 40 cm. *Branchlets* c. 1 cm thick, when young densely orange-brown to ferruginous tomentellous, glabrescent. *Leaves*: petioles 6–10 cm long; ultimate parts of the rachis above flattened to keeled; petiolules up to 2 mm long, above keeled, pulvinate. *Leaflets* alternate, ovate, 5–10 by 1.8–3 cm, index c. 3, beneath bearded in the nerve-axils, furthermore glabrous or thinly

tomentose on the nerves beneath and on the midrib; base acute to obtuse, decurrent; apex tapering acuminate, acumen acute; midrib above slender and prominulous, nerves 0.5–1 cm apart, curved to straight, only the upper ones looped and joined near the margin, prominulous on both sides, but more strongly so beneath; intersecondary nerves more or less well developed, parallel to the nerves. *Thyrse* up to 17 cm long, densely tomentellous; peduncle 2–5 cm long; cymes with 1–2 mm long stalks; pedicels 1–2 mm long. *Sepals* dark purple, hardly or not persistent in fruit, outer and inner hardly different (outer 2 broad-ovate, inner broad-obovate), c. 2.5 by 2–2.2 mm, inside rather densely appressed-hairy, margin entire, apparently not petaloid. *Petals* with a c. 1.25 mm long claw, the blade transversely half-elliptic, c. 1 by 1.5 mm, margin below the insertion of the scale densely woolly, upper part densely ciliate, apically crenulate, inside woolly, the claw more densely so than the blade; scale reaching about halfway the blade, slightly bilobed, completely woolly. *Disc* 5-lobed, the lobes in the centre deeply hollowed, hence each ± annular, the part towards the centre of the flower densely hairy, furthermore glabrous. *Stamens* 8; filaments 1–2 mm long, rather densely woolly in the lower 0.7th part; anthers c. 0.8 mm long, glabrous. *Fruits* subglobose, c. 22 by 17 mm, at base contracted into a c. 1 mm long stipe, densely ferruginous tomentellous, (1-) 2- (or 3-) celled, inside densely ferruginous velvety. — **Fig. 82a–c.**

**Distribution** — *Malesia*: Borneo (Sarawak, Baram Dist., G. Api; Sabah, Mt Kinabalu; E Kutei, Sangkulirang Dist.).

**Habitat & Ecology** — Primary forest on limestone; up to 500 m altitude. Fl. May, July; fr. Aug., Oct.

**Uses** — For a description of the timber, see p. 427.

## XEROSPERMUM

(P.W. Leenhouts)

*Xerospermum* Blume, *Rumphia* 3 (1847) 99; Radlk. in Engl., *Pflanzenr.* 98 (1932) 936; Leenh., *Blumea* 28 (1983) 389; Yap in *Tree Fl. Malaya* 4 (1989) 460. — *Xerospermum* sect. *Tetrasepalum* Radlk. [in Dur., *Index Gen. Phan.* (1887) 76, nom. nud.] in Engl. & Prantl, *Nat. Pflanzenfam.* 3, 5 (1895) 331, nom. illeg. — Type species: *Xerospermum noronhianum* Blume.

*Xerospermum* sect. *Pentasepalum* Radlk. [in Dur., *Index Gen. Phan.* (1887) 76, nom. nud.] in Engl. & Prantl, *Nat. Pflanzenfam.* 3, 5 (1895) 331. — Syntype species: *Xerospermum acuminatum* Radlk. (= *X. laevigatum* Radlk.), *X. laevigatum* Radlk.



Medium-sized *trees* (or *shrubs*), dioecious. *Indumentum* of solitary simple hairs only. *Branchlets* terete, lenticels many, scattered, pustular but usually inconspicuous; wood reddish brown. *Leaves* paripinnate, (unifoliolate to) 1- or 2- (or 3-)jugate, without pseudo-stipules; petiole subterete to terete, at the base slightly swollen and hollowed above; neither petiole nor rachis winged. *Leaflets* opposite, neither papillate nor glaucous beneath, glabrous or puberulous on the nerves below and on the midrib, glabrescent, usually on the lower side with few to several orbicular flat glands in the nerve axils and/or scattered all over the leaf surface, mainly in the basal half; no domatia; base (sub)symmetrical; margin entire. *Inflorescences* usually solitary in the lower leaf axils and tufted in the upper leaf axils; these tufts consist of a central axis and two to several branches in the axils of bud scales; the more branches to a cluster the shorter and the more equal they are; the central axis of such a cluster may end in a vegetative terminal bud and develop later in a vegetative branch; bracts usually caducous. *Flowers* actinomorphic, 4- or 5-merous, unisexual. *Sepals* free or slightly connate, either all about equal or the outer two slightly smaller, the outer usually with a narrow, the inner with a broad membranous margin to nearly completely membranous. *Petals* about equal to or 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), hardly to distinctly exerted in male flowers; filaments at least partly woolly; anthers attached dorsally at the base, dehiscence latrorse, glabrous or with a few hairs, sometimes ciliate. *Pistil* 2- (or 3-)locular; ovary deeply lobed, warty with on top of each wart a stiff brown hair; style apical, columnar, broadened to the apex, relatively short, with a few hairs or glabrous; stigma arched, elliptic with a longitudinal groove, (deeply cleft in fruit); ovules 1 per locule, nearly basally attached. *Fruits* with 1 (or 2) lobes developed, in the latter case lobes widely spreading, not winged, the lobes ellipsoid to subglobular, capsular, probably finally loculicidally dehiscent; the fruit wall outside spiny, warty, or colliculate to granular, soon glabrous, spines broader than high; inside smooth or slightly colliculate, glabrous. *Seeds* ellipsoid to subglobular, completely covered by a thin sarcotesta except for the basal hilum; testa inside with a pocket in which the radicle fits. — **Figs. 83, 84.**

Distribution — Bangla Desh, Assam, Burma, the Indochinese Peninsula, and *Malesia*: Malay Peninsula, Sumatra, Java, Borneo, Two species.

Habitat & Ecology — Often common in the middle and lower stories of the lowland and lower montane rain forests. The fruits are said to be eaten by birds, monkeys, and bats.

Uses — The thin yellow to orange sarcotesta is eaten, but is not of importance. The opinions on the timber quality are rather divergent: fire wood, inferior timber, or a good, tough, and durable timber. See Heyne, Nutt. Pl. Indon. ed. 3 (1950) 997; Burkill, Dict. Econ. Prod. Malay Penins. ed. 2, 2 (1966) 2313.

Note — In the older literature there was some confusion regarding the sarcotesta. With Hiern in Hook. f., Fl. Br. India 1 (1875) 686, the description reads: "testa ... fleshy, pilose, simulating an aril." This became with Kurz, For. Fl. Burma 1 (1877) 295: "Seeds without arillus, the testa pilose, fleshy outside and arillus-like" (see also Kanjilal, Das & Purkay., Fl. Assam 1, 1936, 232). The mention of the sarcotesta as being pilose is incomprehensible.

## KEY TO THE SPECIES

- 1a. Flowers 5-merous. Pedicels in fruit not much swollen, 1.5–2.5(–3.5) mm thick  
**1. *X. laevigatum***
- b. Flowers 4-merous. Pedicels in fruit distinctly swollen, (3.5–)5–7 mm thick  
**2. *X. noronhianum***

1. ***Xerospermum laevigatum*** Radlk., [Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 305, nom. nud.] Sapind. Holl.-Ind. (1879) 23, 25; in Engl., Pflanzenr.

98 (1932) 949; Burk., Dict. Econ. Prod. Malay Penins. (1935) 2272; Wyatt-Smith & Kochummen, Mal. For. Rec. 17, rev. ed. (1965) 364; Leenh., Blumea 28 (1983) 391; Yap in Tree Fl.



Fig. 83. *Xerospermum laevigatum* Radlk. subsp. *laevigatum*. Habit (de Wilde & de Wilde-Duyffes 18907).

Malaya 4 (1989) 461. — Type: *Griffith KD 1006/1* (K holotype), Burma.

*Xerospermum acuminatum* Radlk., Sapind. Holl.-Ind. (1879) 7, 25; in Engl., Pflanzenr. 98 (1932) 948. — Type: *Beccari PB 3468* (not 3408 as given by Radlk., 1879) (FI holotype; K, P), W Borneo.

*Xerospermum unijugum* Radlk., Rec. Bot. Serv. India 3 (1907) 351; in Engl., Pflanzenr. 98 (1932) 948. — Type: *F. Kehding 090* (FI holotype), Malay Peninsula.

*Xerospermum muricatum* auct. non Radlk.: J.A.R. Anderson, Gard. Bull. Sing. 20 (1963) 169.

(*Shrub* to *tree*, up to 36 m high, dbh up to 1 m. *Twigs* 1–5 mm thick, glabrous. *Leaves*: petiole 0.4–7 cm long; petiolules 0.3–1.5 cm long; leaf axes glabrous. *Leaflets* elliptic, 4.5–18 by 1.75–10 cm, index 1.75–3.75, coriaceous, glabrous, (without or) with few to several glands; base acute to rounded, decurrent; apex (rounded to acute or) variably acuminate; the upper (to most) nerves  $\pm$  distinctly joined; intersecondary veins variable; veinlets rather finely reticulate, prominulous at both sides, sometimes beneath more so than above. *Inflorescences* up to 20 cm long if solitary, no more than 5 cm if tufted; well developed axes with scattered side-branches, these patent and short or erecto-patent and long; branches as well as the main axis (in its upper part) bearing several lax and often several-flowered cymes, the lower long-stalked, consisting of a central flower and two sometimes long and many-flowered monochasial branches, the upper sessile and monochasial, often, if the axis is short, together forming a dense cluster of branches and flowers; bracts deltoid to lanceolate, up to 1.5 mm long, sparsely hairy; pedicels 1.5–5 mm long. *Flowers* 5-merous. *Sepals* free, all about equal or the outer two distinctly smaller, ovate to obovate, especially the outer two concave, 1.6–2.8 by 1.4–2.5 mm, ciliate (to woolly-ciliate), glabrous or nearly so (in Sumatra exceptionally outside and sometimes also inside thinly puberulous). *Petals* obovate to spatulate, 1–3 by 0.5–1.2 mm, bigger in male than in female flowers, whitish, variably woolly. *Disc* uninterrupted or interrupted, yellow. *Stamens* (7 or) 8; filaments 2–5 mm long, woolly in the lower half to all over but for the apex; anthers 0.6–0.9 mm long, glabrous. *Pedicels* in fruit only slightly swollen, 1.5–2.5(–3.5) mm thick. *Fruit* lobe(s) globular to oblong-ellipsoid, 2.5–3.75 by 1.5–2.5 cm, densely aculeate, orange to pinkish; wall coriaceous, c. 0.5 mm thick.

**Distribution** – Burma (Mergui Archipelago) and **Malesia**: Malay Peninsula, Sumatra, Borneo.

## KEY TO THE SUBSPECIES

1a. Disc uninterrupted. Leaflets usually oblong to elliptic, not or slightly acuminate

a. subsp. **laevigatum**

b. Disc in female flowers nearly always, in male flowers sometimes interrupted. Leaflets broad-elliptic, distinctly acuminate

b. subsp. **acuminatum**

a. subsp. **laevigatum**: Leenh., Blumea 28 (1983) 392, f. 1a; Yap in Tree Fl. Malaya 4 (1989) 461. For synonyms, type, and more literature see *X. laevigatum* Radlk. and *X. unijugum* Radlk. under the species.

(*Shrub* to *tree*, up to 36 m high, dbh up to 1 m; buttresses up to 2.5 m high, up to 2.3 m spreading, thick, (branching). *Twigs* rather slender, up to 4 mm thick. *Leaves*: petiole up to 4.5 cm long; rachis 2–3 cm long; leaflets usually oblong to elliptic, flat to slightly dorsiventrally curved, apex usually not or shortly acuminate. *Inflorescences* up to 12 cm long, thin-puberulous, glabrescent. *Sepals* all nearly equal, usually thin and petal-like, not always glabrous. *Petals* up to 2 by 0.8 mm. *Disc* uninterrupted. – **Fig. 83.**

**Distribution** – As the species.

**Habitat & Ecology** – Primary and sometimes secondary forests, on dry land, crests, etc., on sandy clay or sandstone; up to 700 m altitude. Fl. Feb.–Mar., Sept., Dec.; fr. July, Aug., Dec.

b. subsp. **acuminatum** (Radlk.) Leenh., Blumea 28 (1983) 393, f. 1b, d, e, 2d.

See for synonyms, type, and literature *X. acuminatum* Radlk. and *X. muricatum* auct. under the species.

(*Shrub* to *tree*, up to 20 m high, dbh up to 24 cm; (with slight buttresses or) with stiltroots. *Twigs* 1.5–5 mm thick. *Leaves*: petiole up to 7 cm long; rachis also up to 7 cm long; leaflets usually broad-elliptic, fairly strongly dorsiventrally curved, apex usually distinctly acuminate, acumen usually cuneate and acute, up to 3 cm long. *Inflorescences* if axillary 2 cm long or more, glabrous or rarely sparsely hairy. *Sepals*: outer ones distinctly smaller than inner ones, all fleshy or inner partly petaloid, glabrous but for the margin. *Petals* up to 3 by 1.2 mm. *Disc* in female flowers nearly always interrupted in front of the inner sepal which lies in between the two outer ones (in *S* 9007, however, at the same place as in male flowers), in male flowers either uninterrupted or interrupted in front of the outermost one of the three inner sepals. – **Fig. 84a.**



Distribution – *Malesia*: Borneo (Sabah, Brunei, Sarawak, West Kalimantan).

Habitat & Ecology – Peat swamp forest; up to 30 m altitude. Fl. apparently throughout the year; ripe fr. known from Mar. and Apr.

**2. *Xerospermum noronhianum*** (Blume) Blume, Rumphia 3 (1847) 100; Miq., Fl. Ind. Bat. 1, 2 (1859) 552; Hiern in Hook. f., Fl. Br. India 1 (1875) 686, p.p.; Kurz, For. Fl. Burma 1 (1877) 295; Ridley, Trans. Linn. Soc. London, Bot. 3 (1893) 289; Koord. & Valetton, Bijdr. Booms. Java 9 (1903) 182; Atlas 4 (1918) pl. 797; Radlk. in Engl., Pflanzenz. 98 (1932) 946; Kanjilal, Das & Purkay., Fl. Assam 1 (1936) 322; Adelb., Blumea 6 (1948) 324; Backer & Bakh. f., Fl. Java 2 (1965) 137; Leenh., Blumea 28 (1983) 394, f. 1c, 2a–c, e; Yap in Tree Fl. Malaya 4 (1989) 461; Jansen et al. in Verheij & Coronel (eds.), Pl. Res. SE Asia (PROSEA Handb.) 2, Edible fruits and nuts (1991) 365. — *Euphoria noronhiana* Blume, Bijdr. (1825) 234, comb. illeg. — *Nepheium noronhianum* Cambess., Mém. Mus. Hist. Nat. Paris 18 (1829) 30. — Lectotype (Leenhouts 1983): *Blume s.n.* (L sh. 908.272–748), Java.

*Euphoria xerocarpa* Blume, Bijdr. (1825) 234, comb. illeg. (for lectotypification see Blume, Rumphia 3, 1847, 100). — *Nepheium xerocarpum* Cambess., Mém. Mus. Hist. Nat. Paris 18 (1829) 30. — *Arytera xerocarpa* Adelb., Blumea 6 (1948) 324, nom. superfl. — Type: unknown (described from Nusa Kambangan near Java).

[*Sapindus glabratus* Wall., Cat. (1847) no. 8095, nom. nud.]

*Cupania glabrata* Kurz, J. As. Soc. Beng. 41, 11 (1872) 303; not Fern.-Vill., Nov. App. (1883) 349 [= *Guioa koelreuteria* (Blanco) Merr.]. — *Xerospermum glabratum* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8 (1878) 300; *Sapind. Holl.-Ind.* (1879) 23; Craib, Fl. Siam. Enum. 1 (1926) 329; Radlk. in Engl., Pflanzenz. 98 (1932) 946; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 957. — Type: *Kurz 2058* (K, M), Burma.

*Xerospermum lanceolatum* Radlk., Sapind. Holl.-Ind. (1879) 7, 25; in Engl., Pflanzenz. 98 (1932) 943. — Type: *Beccari PB 1031* (FI holo; K, M, P), Sarawak.

[*Nepheium muricatum* Griff., Cat. (1865) no. 1004, nom. nud. —] *Xerospermum muricatum* Radlk. [Sapind. Holl.-Ind. (1879) 23, 69, nom. inval.] in Engl. & Prantl, Nat. Pflanzenfam. 3, 5 (1895) 331, f. 168; in Engl., Pflanzenz. 98 (1932) 940, f. 23; Corner, Wayside Trees (1940) 596, f. 215;

non J.A.R. Anderson, Gard. Bull. Sing. 20 (1963) 169 (= *Xerospermum laevigatum* subsp. *acuminatum*). — Type: *Griffith KD 1004* (M holo; K, L, P), Malay Peninsula.

*Xerospermum wallichii* King, J. As. Soc. Beng. 65, 11 (1896) 432; Ridley, Fl. Malay Penins. 1 (1922) 498; Radlk. in Engl., Pflanzenz. 98 (1932) 943; M.R. Henderson, J. Mal. Br. As. Soc. 17 (1939) 42; Chin, Limest. Fl. Malaya (1973) 483. — Lectotype (Leenhouts 1983): *King's coll. 8725* (CAL holo?, n.v.; K), Malay Peninsula.

*Xerospermum brachyphyllum* Radlk., Rec. Bot. Surv. India 3 (1907) 348; in Engl., Pflanzenz. 98 (1932) 942. — Type: *Forbes 452* (G holo, n.v.; BO, L), W Java.

*Xerospermum cylindrocarpum* Radlk., Rec. Bot. Surv. India 3 (1907) 348; in Engl., Pflanzenz. 98 (1932) 942. — Type: *Forbes 2715* (B† holo; FI, L, P, SING), Sumatra.

*Xerospermum echinulatum* Radlk., Rec. Bot. Surv. India 3 (1907) 350; Ridley, Fl. Malay Penins. 1 (1922) 497; Radlk. in Engl., Pflanzenz. 98 (1932) 944. — Syntypes: *King's coll. 8637* (K, L), Malay Peninsula, Perak, near Ulu Kerling; *Scortechini 2104* (K, L, P), Malay Peninsula.

*Xerospermum intermedium* Radlk., Rec. Bot. Surv. India 3 (1907) 348; Ridley, Fl. Malay Penins. 1 (1922) 497; Craib, Fl. Siam. Enum. 1 (1926) 329; Radlk. in Engl., Pflanzenz. 98 (1932) 944; Gagnep. in Fl. Indo-Chine, Suppl. 1 (1950) 958. — Syntypes: *Curtis 3436* (K, SING), Malay Peninsula, Dindings, Lumot; *Helper KD 1005* (FI, K, L, M, P), Burma, King's Island; *Helper 143* = *KD 1006* (FI, K, L, M), Tenasserim and Andamans; *Kehding 90* (FI), Malay Peninsula.

*Xerospermum fallax* Radlk. in Fedde, Rep. 18 (1922) 340; in Engl., Pflanzenz. 98 (1932) 942. — Type: *Blume in Hb. Martens* (M holo), Java.

*Xerospermum testudineum* Radlk. in Fedde, Rep. 18 (1922) 340; in Engl., Pflanzenz. 98 (1932) 941. — Syntypes: *Bogor Bot. Gard. III.H.17* = *Sutrisno 1* = *Teijsmann 6676* (BO, L, M, P), Sumatra, Lampongs; *Bogor Bot. Gard. III.I.28* = *Diepenhorst s.n.* (BO, L, M), Sumatra W Coast, Priaman; *Forbes 1216a* (B, n.v.), Java; *Jelinek* (W, n.v.), Java.

*Xerospermum xanthophyllum* Radlk., Flora 118–119 (1925) 400; in Engl., Pflanzenz. 98 (1932) 941. — Type: *Bogor Bot. Gard. III.I.50a* (M holo; BO, L, P).

*Xerospermum* spec.: Corner, Wayside Trees (1940) 597, f. 215.

*Nepheium maingayi* auct. non Hiern: Hiern in Hook. f., Fl. Br. India 1 (1875) 688, p.p., excluding the type (cf. Radlk. in Engl., Pflanzenz. 98, 1933, 964).

*Tree*, up to 25(–30) m high, dbh up to 30(–75) cm. (with buttresses). *Twigs* 1.5–5.5 mm thick, variably densely short hairy, early glabrescent. *Leaves*: petiole 1–7 cm long; petiolules 1–12 mm long; leaf axes glabrous or thinly to densely brownish or fulvous puberulous, glabrescent. *Leaflets* ± elliptic, up to 50 by 30 cm, index 1.5–2.5(–6.5), pergamentaceous to coriaceous, glands few to many; base obtuse to acute; apex rounded to variably acuminate; nerves ending free but for the few uppermost ones; intersecondary nerves not conspicuous; veins and veinlets finely to laxly reticulate, about equally raised on both sides to smooth (or slightly sunk-

en) on the upper side. *Inflorescences* up to 25 cm long if solitary, much shorter if tufted; axes simple or with some short patent branches in the lower part, all branches bearing few to many sessile or subsessile, very condensed, few- to several-flowered cymes, towards the apex reduced to solitary flowers; bracts deltoid to lanceolate, up to 1.5 mm long, sparsely hairy; pedicels c. 2 mm long. *Flowers* 4-merous. *Sepals* free or slightly connate, the outer two usually slightly smaller than the inner ones, ovate to obovate, 1–2(–3) by 1–2.4 mm, outside and inside glabrous or hairy (nearly always inside at the base), ciliate. *Petals* obovate to broadly

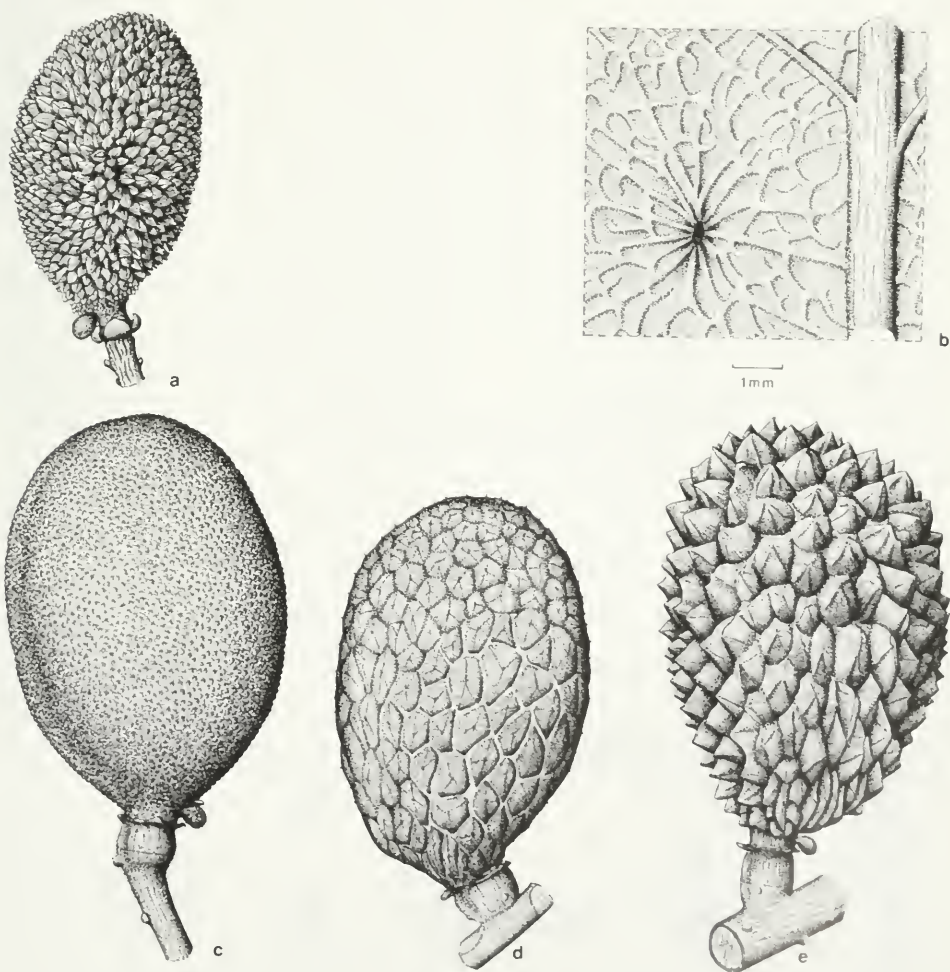


Fig. 84. *Xerospermum* Blume. Detail of leaflet, fruits. — *X. laevigatum* Radlk. subsp. *acumination* (Radlk.) Leenh. a. Fruit. — *X. noronhianum* (Blume) Blume. b. Detail lower surface of leaflet; c–e. fruits showing differences in sculpture (a: SAN 27301; b: FRI Ja 6185; c: KEP/FRI 10748; d: Stone & Sidek 12523; e: KEP 29472).

spatulate, 1–2.8 by 0.5–1.7 mm, short- to long-clawed with an ovate to transversely elliptic blade, variably woolly, nearly always with the exception of the base outside, inside often sparsely hairy to glabrous. *Disc* uninterrupted. *Stamens* 8 (9); filaments 1.5–2.5 mm long, woolly with the exception of base and apex to woolly in the upper half (to glabrous); anthers 0.3–0.8 mm long, glabrous or with a few hairs, (ciliate). *Pedicels* in fruit strongly swollen, (3.5–)5–7 mm thick. *Fruit* lobes ellipsoid to subglobose (or obovoid), 1.75–5 by 1.25–5 cm, aculeate or tuberculate (and/or colliculate to granulate), red or darkbrown; wall coriaceous, corky, or woody, 0.65–2.5 mm thick. – **Fig. 84 b–e.**

Distribution – As the genus.

Habitat & Ecology – Primary and secondary rain forest, sometimes in peat forest, heath forest, or bamboo forest, on plains as well as on slopes and crests, in dry places but also on river banks, along marshes, or in periodically flooded localities, on different kinds of soil (sand, sandy clay, fertile volcanic loam, peat, subsoil granite, sandstone, or limestone); sea level up to 300(–1500) m altitude. Especially in continental Asia (Thailand, Indo-China) often common. Fl. throughout the year but mainly Jan.–Apr. and also rather frequently Aug.–Dec.; fr. mainly Jan.–Aug. The fruits are eaten by birds and monkeys.

Notes – 1. The variation in leaves, flowers, and especially the fruits, is extensive but continuous in this species. At first sight it is difficult to imagine that a rough fruit without any appendages could belong to the same species as a fairly densely spiny fruit. However, the rough fruit shows a basic pattern corresponding with bundles of spines in the aculeate fruits, moreover, fruits with short spines are still rough in the grooves between the bundles of spines. As to the flowers, the greatest variation is in the hairiness of the sepals and petals. The only entity that is reasonably well characterized is '*Xerospermum wallichii*'. It has relatively broad leaflets with a laxly reticulate venation; the sepals are glabrous on both sides, the petals are glabrous

inside, and the fruits are rough and without spines. The only one of these characters that seems to be exclusive is that of the petals; all other characters are extremes in a continuous series. Typical '*X. wallichii*' is only known from the Malay Peninsula where it appears to be rather common. It is undesirable to segregate such a local, morphologically rather extreme but hardly sharply delimited form from the rest of the species.

2. The two combinations under *Euphoria*, viz. *E. noronhiana* and *E. xerocarpa*, are illegitimate as *Euphoria* is illegitimate; see Leenh., *Blumea* 19 (1971) 116.

3. Blume's *Euphoria xerocarpa* was based upon both flowering and fruiting material. Both the importance Blume attached to the fruit characters in the *Sapindaceae* in general and the specific epithet point to the fruiting part as the most logical choice for a lectotype. This is fully in accordance with Blume's own choice: in 1847 (*Rumphia* 3: 100) he recognized the fruiting part as belonging to his new genus *Xerospermum*, where he placed it in the synonymy of *X. noronhianum*. The flowering part became the basis of a new genus and species, *Arytera litoralis*. A century later, Adelbert (*Blumea* 6, 1948, 324) made a different choice. The fruiting part remained under *X. noronhianum*, and the flowering part became the lectotype of *Euphoria xerocarpa*. Accordingly, *Euphoria xerocarpa* became synonymous with *Arytera litoralis*, and as the epithet *xerocarpa* was older than *litoralis*, a new combination had to be made, *Arytera xerocarpa*. As Blume's lectotypification was much earlier and more in accordance with all evidence available, the combination *Arytera xerocarpa* was superfluous and hence illegitimate.

4. The 1879 publication of *Xerospermum muricatum* was invalid as it was actually a nomen nudum. The few characters mentioned were only differences between *Nephelium* and *Xerospermum*, and lead to the conclusion that the species belongs to *Xerospermum*. The references to older publications are either to nomina nuda or to mixtures. See Radlk., *Sapind. Holl.-Ind.* (1879) 69–70.

## ZOLLINGERIA

(F. Adema)

*Zollingeria* Kurz, *J. As. Soc. Beng.* 41, II (1872) 303, nom. cons.; *Ra. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München* 20 (1890) 293; in Engl., *Pflanzenr.* 98 (1933) 724; Adema, *Blumea* 37 (1992) 73. — Type species: *Zollingeria macrocarpa* Kurz.





Fig. 85. *Zollingeria borneensis* Adema. a. Habit; b. male flower; c. female flower; d. ovary, longitudinal section; e. ovary, cross section; f. fruit; g. fruit, bottom view; h. seed; i. seed, bottom view (a–c: SAN 90057; f–i: Elmer 20888).

*Trees*, monoecious. *Indumentum* of solitary simple hairs, no glands. *Twigs* terete. *Leaves* spirally arranged, paripinnate, 1–8-jugate; pseudo-stipules absent; neither petiole nor rachis winged. *Leaflets* opposite to alternate, margin entire. *Inflorescences* axillary, thyrsoid, branched. *Flowers* unisexual, regular (or zygomorphic). *Sepals* 5, free, slightly to distinctly unequal, (not) imbricate, not petaloid, outside hairy (or glabrous). *Petals* 5 (or 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* at the base 3-celled, higher up 1-celled; style 3-lined or 3-lobed. *Ovules* 1 per cell. *Fruit* 1-celled, 3-winged, indehiscent. *Seeds* 1 per fruit, without arilode or sarcotesta. — **Fig. 85.**

Distribution — 2 or 3 species in Burma, Laos and Thailand; 1 in *Malesia*: Borneo (Sabah).

**Zollingeria borneensis** Adema, Blumea 37 (1992) 73–76. — Type: *Elmer 20888* (A, F, L, U), Sabah.

*Trees*, 60 m high, clear bole 3 m high, dbh 70 cm. Bark whitish, inner bark pale yellow, 0.7 cm; sapwood white. *Indumentum* ferruginous tomentellous. *Twigs* 2–3 mm in diam., striate, silvery-grey, with many small lenticels, soon glabrous. *Leaves* (1-) 2- or 3-jugate; petiole 1–6.5 cm long, pulvinate; rachis 1–10.5 cm long; petiole and rachis semiterete, striate, short patently hairy; petiolules reduced to pulvinus, 1–4 mm long, semiterete, short-hairy. *Leaflets* ± elliptic, 9.5–20 by 2–6 cm, index 2.9–3.6, chartaceous, above and below glabrous, midrib and nerves sparsely to densely short-hairy; base slightly oblique, (broadly) cuneate; apex acuminate, very apex rounded; midrib prominent above, nerves 9–12 per side, 8–28 mm apart, angle to midrib 60–65°. *Inflorescences* together pseudoterminal, 6–14 cm long; cymes several-flowered; bracts and bracteoles acicular, 0.6–1.2 by 0.1–0.4 mm, outside and inside hairy; pedicels 1.5–2.5 mm long, articulated near the base.

angular, hairy. *Flower buds* about globular, 1.7 by 1.9 mm. *Flowers* yellowish to green; male ones somewhat smaller than the female ones. *Sepals* triangular to spatulate, not imbricate, thinned towards the margin especially apically, slightly unequal, 1.7–2.6 by 1.2–1.6 mm, apex rounded to retuse, outside and inside appressed-hairy, ciliate. *Petals* cuneate to spatulate, distinctly clawed, 1.4–2.4 by 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. Filaments of *stamens* 1.5 mm long, anthers 0.4 mm long; in female flowers filaments 1.2–1.6 mm long, anthers 0.5–0.6 mm long. *Ovary* outside hairy, inside glabrous; style 1 mm long, stigma ± capitate, 3-lobed; pistillode 3 by 1.9 mm. *Fruits* prismatic, sharply deltoid in cross section, 6–7 by 2.5–5 cm; wall thin, coriaceous, outside striate, densely velutinous, inside glabrous. *Seeds* prismatic, 33 by 14 mm. — **Fig. 85.**

Distribution — *Malesia*: Borneo (Sabah).

Habitat & Ecology — Primary forest, altitude 15 m. Fl. Feb.

#### CULTIVATED, EXOTIC SAPINDACEAE

**Filicium decipiens** (Wight & Arn.) Thw., Enum. Pl. Zeyl. (1864) 58, sub *Pteridophyllum decipiens*, 408; Radlk. in Engl., Pflanzenr. 98 (1933) 1427; Backer & Bakh. f., Fl. Java 2 (1965) 142.

*Trees*. *Indumentum* sparse, sericeous, most parts with scale hairs. *Leaves* alternate, paripinnate, 5–many-jugate, rachis (broadly) winged. *Leaflets* narrow, long, shiny; nerves many, straight, scalariform; domatia absent. *Inflorescences* axillary to pseudoterminal panicles. *Flowers* unisexual.

*Sepals* 5, equal, ovate, ciliate, with scale hairs outside. *Petals* 5, elliptic, about as large as sepals, ciliate; scales and auricles absent. *Disc* flat, complete, 5-lobed, densely pilose. *Stamens* 5, glabrous, exerted in male flowers, anthers not opening in female flowers. *Ovary* compressed-globose, finely hairy at base, 2-locular, rudimentary in male flowers; style short; stigma 2-lobed; one ovule per locule. *Fruit* a drupe, smooth, glabrous, thin-walled. *Seeds* without fleshy structure. — **Fig. 86.**



Fig. 86. *Filicium decipiens* (Wight & Arn.) Thw. a. Habit; b. fruit (a: SAN 71299; b: SAN 73581).

Distribution – Indigenous in S India and Sri Lanka, but now a pantropical ornamental. In *Malesia* locally cultivated as an ornamental (e.g. street tree) in Java and the Lesser Sunda Islands.

*Koelreuteria paniculata* Laxm., Nov. Comm. Acad. Petrop. 16 (1772) 561, t. 18; P. Royen, Manual For. Trees Papua New Guinea 2, Sapindaceae (1964) 28.



Deciduous trees. Young parts puberulous. *Leaves* alternate, imparipinnate or bipinnate. *Leaflets* dentate to divided. *Inflorescences* large terminal panicles. *Flowers* unisexual, zygomorphic. *Sepals* 5, connate at base, slightly unequal. *Petals* 4, longer than sepals, yellow, reddish at base, turned upwards; scales 2. *Disc* undulate, lowest or interrupted at the place of the missing petal. *Stamens* 8, exerted in male flowers. *Fruits* bladder-like, inflated, loculicidal capsules. *Seeds* globose, without fleshy structures.

Distribution – Indigenous in Korea and China; widely cultivated elsewhere. In *Malesia* according to Van Royen, l.c., cultivated in New Guinea as an ornamental. No herbarium material seen.

Several indigenous species are also found cultivated as fruit trees: *Dimocarpus longan*, *Litchi sinensis*, *Nephelium* species, especially *N. lappaceum*. They have been treated under the respective genera.

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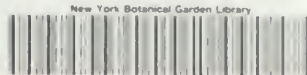
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Publication Department  
Rijksherbarium / Hortus Botanicus  
P. O. Box 9514  
2300 RA Leiden  
The Netherlands

Fax (31) (71) 273511