

POLYGALACEAE (R. van der Meijden, Leiden)¹

Herbs (sometimes saprophytic), shrubs, lianas or trees. Stipules absent but stem sometimes provided with a pair of glands at the nodes. *Leaves* simple, entire, usually spirally arranged, sometimes alternate, (semi)decussate or verticillate, sometimes scale-like or absent. *Inflorescence* usually raceme-like and unbranched, (supra- or extra-)axillary and/or terminal, sometimes thyrsoid or fasciculate, rarely flowers solitary. Bracts present; bracteoles basal, rarely (*Salomonina*, *Epirixanthes*) absent. *Flowers* bisexual, more or less zygomorphous, rarely actinomorphic. *Sepals* 5, free and quincuncial, or the lower (abaxial) 2 connate, sometimes all connate, subequal or the lateral ones larger and then often wing-like (alae) and petaloid. *Petals* 3 or 5, free or variously united, occasionally also with the calyx, usually adnate to the base of the staminal tube or the filaments, subequal or more often unequal with the lower petal often keel-like and frequently pouched, lobed, or crested. *Stamens* 2–10, usually 8, filaments usually more or less connate except between the upper stamens, often adnate to the petals; anthers basifixed, tetra- or bi-, rarely trisporangiate, 1- or 2-locular, opening by a single and often oblique pore or by a longitudinal introrse slit. *Ovary* superior, usually 2-locular but occasionally 1-, 3-, 5-, 7- or 8-locular, sessile or sometimes stipitate; style simple but often variously dilated or lobed at apex, usually articulate with the ovary and nearly always deciduous in fruits. *Ovules* 1 per cell and subapical, or (in *Xanthophyllum*) 4—more in a 1-locular, bicarpellate ovary with 2 parietal placentas, anatropous, bitegmic and crassinucellate. *Fruit* various, a berry, capsule, samara or drupe.

Distribution. About 15 genera and over 1000 species, widespread in temperate and tropical regions of the world, especially well-developed in South America and South Africa. In *Malesia* 6 genera, of which *Polygala* and *Securidaca* (not in Australia) are cosmopolitan, *Xanthophyllum* and *Salomonina* Indo-Australian, *Epirixanthes* Indo-Malayan. The sixth genus is *Eriandra* which belongs to the tropical American tribe *Moutabeae*, of which 3 genera are known in South America; *Eriandra* occurs in New Guinea and the Solomon Islands and represents a marked example of disjunct, tropical trans-Pacific affinities.

Ecology. Very diverse, in wet or dry, open or closed, warm or rather cold habitats, in the lowlands or on mountains up to 3600 m; greatly varying in habit. *Epirixanthes* is a genus of small saprophytic (not parasitic) plants on humous soil in deep shade among litter of the rain-forest. *Salomonina* is an unseemly herb of open places. In *Polygala* there are woody shrubs in the undergrowth of the rain-forest, but most species are herbs of open country, several even preferring a seasonal climate; one species (§ *Melchiora*) is a climber of the rain-forest, like *Securidaca*. The species of *Xanthophyllum* and the monotypic *Eriandra* are trees of the rain-forest, sometimes of lofty size.

In some species of *Polygala* the occurrence of endomycorrhiza (VA-mycorrhiza) has been demonstrated (HEUBL, 1984).

Pollination. Most species seem to be adapted to cross-pollination, but thusfar actual observations have only been reported for some *Polygala* species (see there). In *Epirixanthes* the structure of the flowers seems fit for cross-pollination (see there). Self-pollination, however, has been re-

(1) For this revision the 1970 manuscripts have been used of three former students of Professor Van Steenis: F.C. Roest (*Polygala* sect. *Chamaebuxus*), L.P. Rijfkoogel (*Securidaca*), and Mrs. H.M.Y.J. André de la Porte-Janss (*Salomonina*, *Epirixanthes*).

ported for species in diverse genera, also for those species in which cross-pollination has been reported, or is suspected to be possible. It may be concluded tentatively that self-pollination is an effective second-chance possibility for reproduction in the *Polygalaceae*.

Dispersal. Corresponding to the diversity in fruit and seed types there is a great variation in dispersal types (VERKERKE, 1985). Especially in *Polygala* many dispersal types occur: myrmecochory, ornithochory, anemochory, diplochory, epizoochory. Ornithochory also occurs in *Diclidanthera*, *Carpolobia*, *Atroxima*, and probably in some *Xanthophyllum* species. *Moutabea* fruits have endozoochorous dispersal by monkeys (VAN ROOSMALEN, 1985); this may also be true for some *Xanthophyllum* species. Myrmecochory (or perhaps also anemochory) probably occurs in *Bredemeyera*, *Comesperma*, and *Epirixanthes*; anemochory also in *Monnina* and *Securidaca* (VAN ROOSMALEN, *l.c.*), but in the latter also hydrochory is possible. Epizoochory is the possible means of dispersal for *Salomonina*.

References: HEUBL, Mitt. Bot. Staatssamml. München 20 (1984) 222; VAN ROOSMALEN, Fr. Guianan Fl. (1985) 360; VERKERKE, J. Arn. Arb. 66 (1985) 385.

Morphology. Recently the morphology and ontogeny of ovules, fruits and seeds have been described (and reviewed) by VERKERKE; of *Polygala*: VERKERKE & BAUMAN (1980); of *Xanthophyllum*: VERKERKE (1984); of the remaining genera: VERKERKE (1985). LEINFELLNER (1972) demonstrated that there is no principal difference in the ontogeny of the unilocular, multiovulate ovary of *Xanthophyllum* and the bi- to octolocular, uniovulate ovary of the other *Polygalaceae*. The ontogeny of bi- and trisporangiate anthers of *Polygala* has been described by CHODAT (1891) and VENKATESH (1956). Stipular outgrowths or nodal glands are pseudostipules in the sense of WEBERLING (VAN DER MEIJDEN, 1982: 3). Contrary to the idealistic opinion of CHODAT (*l.c.*) (also adopted by HUTCHINSON, 1967) and CRONQUIST (1981), the primitive number of stamens is 8; the presence of 10 stamens (*Diclidanthera*; and a rare abnormality in *Xanthophyllum*) is a derived character.

References: CHODAT, Monogr. I (1891); CRONQUIST, Integr. Syst. (1981) 763; HUTCHINSON, Gen. Fl. Pl. 2 (1967) 338; LEINFELLNER, Oest. Bot. Z. 120 (1972) 51; VAN DER MEIJDEN, Leiden Bot. Ser. 7 (1982) 3; VENTAKESH, Bull. Torrey Bot. Club 83 (1956) 19–26; VERKERKE, Blumea 29 (1984) 409–421; J. Arn. Arb. 66 (1985) 353–394; VERKERKE & BOUMAN, Bot. Gaz. 141 (1980) 277–282.

Vegetative anatomy. The *Polygalaceae* exhibit an interesting diversity in their leaf and wood anatomy, which has only fragmentarily been explored, especially for the Malesian genera. Hairs if present are unicellular, or more rarely uniseriate. The lower epidermis is papillate in a number of species. Stomata may be of the anomocytic, paracytic or anisocytic type (all three types occur within the genus *Xanthophyllum*). An adaxial hypodermis is frequently present in the woody species with coriaceous leaves. The vascular pattern in petiole and midrib ranges from a single collateral bundle to a closed cylinder with accessory bundles (again the whole range of the family is represented in *Xanthophyllum*). The nodes are unilacunar. Unusual tracheoidal idioblasts in the leaf mesophyll are characteristic for *Xanthophyllum*.

The secondary xylem of the trees and climbers is characterised by largely solitary vessels with simple perforations, fibres with distinctly bordered pits and heterocellular rays which are usually narrow (1–2-seriate), but may be much wider in the *Moutabeae* (e.g. *Securidaca*). Axial parenchyma is mainly paratracheal in *Polygala*, apotracheally diffuse and diffuse-in-aggregates plus vascentric to loosely aliform in *Securidaca*, and apotracheally banded plus vascentric in *Xanthophyllum*. Included phloem occurs in the wood of *Securidaca* (and other *Moutabeae*).

Despite the anatomical distinctness of *Xanthophyllum* (mainly through its tracheoidal idioblasts), vegetative anatomy clearly witnesses affinity with other *Polygalaceae* (epidermal characters, overall leaf histology, solitary vessels and fibre type in the wood; the parenchyma distribution in some *Xanthophyllum* species is reminiscent of that of *Securidaca*). In its wood anatomy *Xanthophyllum* also recalls *Trigoniaceae*, especially *Trigoniastrum*.

References: BRIDGWATER & BAAS, IAWA Bull. n.s. 3 (1982) 115–125; DICKISON, Bot. J. Linn.

Soc. 67 (1973) 103–115; METCALFE & CHALK, *Anatomy of the Dicotyledons 1* (1950) 133–138; STYER, *J. Arn. Arb.* 58 (1977) 109–145.

Palynology. Pollen grains in *Polygalaceae* are mostly suboblate to prolate, sometimes equatorially constricted (*Epirixanthes cylindrica*), and measure from 25 to 62 μm . The apertural system is zonocolporate ('stephanocolporate') in all genera, the number of apertures ranging from 5 (*Xanthophyllum papuanum*) to 17, or up to 42 in *Polygala*. The endoapertures may be fused ('synorate') to form one broad, equatorial endoaperture, bordered by endexinous costae. In this way, the circle-shaped endoaperture divides a grain into two rigid halves, in which the colpi are no longer active in harmomegathic functioning. Volume accommodation in such a grain, and possibly also in grains with poorly separated pores, is achieved by folding of the flexible parts of the mesocolpia which cross the endoapertural zone (MULLER, 1979). Similar apertural systems and harmomegathic mechanisms occur in the genus *Utricularia* of the unrelated family *Lentibulariaceae* (THANIKAIMONI, 1966; HUYNH, 1968).

Exine stratification is mostly obscure using light microscopy. LARSON & SKVARLA (1961) demonstrated the presence of ectexine, endexine, and a columellate infratectal layer in *Polygala* with electron microscopy. The tectum is mostly smooth, pitted, or perforate, sometimes somewhat fossulate or scabrate. Large perforations ('aperturoid depressions', 'lacunae') may occupy the poles.

Pollen of the family *Polygalaceae* is very distinct. Supposed relationships with other families within the *Polygales* are not supported by pollen morphological evidence. Pollen of the family *Krameriaceae* is certainly dissimilar to that of *Polygalaceae* (ERDTMAN, 1944, 1952; SIMPSON & SKVARLA, 1981). On the other hand, the distinct pollen type represents a strong argument for inclusion of *Xanthophyllum* as a genus within *Polygalaceae*. Also in ascertaining the systematic position of *Diclidanthera* (ERDTMAN, 1944) and *Eriandra* (VAN ROYEN & VAN STEENIS, 1952) pollen morphology turned out to provide circumstantial or even deciding evidence.

It is not yet possible to key out all Malesian genera of *Polygalaceae* on the strength of pollen characters. Only one rough separation can be made: pollen of *Epirixanthes*, *Eriandra*, *Securidaca*, and *Xanthophyllum* mostly has 12 or less apertures, while grains in *Polygala* and *Salomonina* rarely have less than 12. Pollen of *Epirixanthes* is characterized by its heavy equatorial belt and involute colpus margins. These features probably represent derived states in *Polygalaceae*. Pollen of *Securidaca* has clearly separated endoapertures. This state may be considered as primitive, comparing with the synorate type in *Polygalaceae*.

References: ERDTMAN, Bot. Notis. (1944) 80–84; Pollen morphology and plant taxonomy, *Angiosperms* (1952) 332–333; HUYNH, Pollen et Spores 10 (1968) 11–55; LARSON & SKVARLA, Pollen et Spores 3 (1961) 21–32; MULLER, Ann. Missouri Bot. Gard. 66 (1979) 593–632; VAN ROYEN & VAN STEENIS, *J. Arn. Arb.* 33 (1952) 91–95; SIMPSON & SKVARLA, *Amer. J. Bot.* 68 (1981); THANIKAIMONI, Pollen et Spores 8 (1966) 265–284. — R.W.J.M. VAN DER HAM.

Phytochemistry & Chemotaxonomy. Chemical characters of the family were summarized and discussed by HEGNAUER (*Chemotaxonomie der Pflanzen* 5, 1969, 352–361, 459). A supplement will be included in volume 8. Glycosides releasing methyl salicylate on hydrolysis and saponins with triterpenic acids as their sapogenins are rather common in the family, especially in roots. The most characteristic genuine sapogenin of the family seems to be presenenenin, $\text{C}_{30}\text{H}_{46}\text{O}_7$, an acid-labile derivative of oleanolic acid; it was shown to be mainly sapogenin of roots of several members of *Bredemeyera*, *Carpolobia*, *Polygala* and *Securidaca*. Closely related sapogenins are polygalacic acid from *Polygala paenea* and bredemolic acid from *Bredemeyera floribunda*. Mono-, di- and trimethoxycinnamic acids as well as ferulic and sinapic acid occur widely; usually they are esterified with free sugars such as saccharose or with the sugar-part of the bidesmosidic saponins. Leaf flavonoids seem mostly to be glycosides of quercetin and kaempferol. Polygalitol (= aceritol = 1,5-anhydroglucitol) is a characteristic hexitol derivative of roots of many polygalaceous plants; it occurs free and combined with sugars. Seeds usually store mainly proteins and fatty oils, but no starch. There is still little known about the chemistry of

polygalaceous seed oils, but very unusual oils were shown to be produced by *Monnina emarginata* and *Polygala virgata*. Three groups of secondary metabolites have still to be mentioned notwithstanding the fact that they are known only from a few species of *Polygala* at present. These are polyhydroxylated xanthenes, and naphthalin- and bibenzyl- γ -butyrolactone-type lignans such as podophyllotoxin (e.g. *Polygala polygama*) and suchilactone (e.g. *Polygala chinensis*). Moreover, the Central American *Polygala paniculata* yielded a number of rutaceous coumarins and a diester of khellactone.

The taxonomic relevance of chemical characters was discussed by HEGNAUER in 1969. It may be added now that the occurrence of isoprenylated coumarins and an obvious total lack of irridoids agree well with the assumption of sapindalean (*sensu lato*) affinities. Tannins too seem to be totally lacking in *Polygalaceae*; this, however, does not contradict the just mentioned assumption, because within *Sapindales s.l.* a strong tendency to replace tannins by other types of secondary metabolites is apparent. Finally it should not be forgotten that several chemical characters may prove valuable in future for infrafamilial classification. — R. HEGNAUER.

Taxonomy. CRONQUIST's circumscription of the order *Polygalales* (1981: 763) reflects the general opinion of systematists; next to the *Polygalaceae* (with *Xanthophyllum* as a separate family) it includes the *Trigoniaceae*, *Vochysiaceae*, *Malpighiaceae* as well as the *Tremandraceae* and the *Krameriaceae*. Wood anatomical evidence (BRIDGWATER & BAAS, 1982) supports a close affinity of *Polygalaceae*, *Xanthophyllum* and *Trigoniaceae*, but not with the other families. VAN DER MEIJDEN (1982) found no arguments to include *Tremandraceae* and *Krameriaceae*. Although there seemed to be little evidence for the inclusion of *Krameriaceae* in the order (SIMPSON & SKVARLA, 1981; SIMPSON, 1982), the first author recently supported the classification of *Krameriaceae* next to *Polygalaceae*, mainly based on serological evidence (BUSE-JUNG, 1979).

Splitting off *Xanthophyllum* as a separate family has been based on incomplete or erroneous knowledge of the genus. Of the three characters mentioned by CRONQUIST (*l.c.*), two do not hold: filaments are often partly and sometimes halfway connate in *Xanthophyllum*, and seeds with copious endosperm occur in four of the seven subgenera. Thus *Xanthophyllum* differs in a single though compound character from other *Polygalaceae*, viz. in the structure of the ovary (which ontogenetically is largely similar to other *Polygalaceae*, cf. LEINFELLNER, *l.c.*); this differs in the reduced septa, in the doubling of the number of ovules per carpel, and in the height of insertion of the ovules. On the other hand *Xanthophyllum* has a number of striking similarities with other *Polygalaceae* in the structure of the flowers, as well as in some vegetative characters (the presence of laminar and nodal glands). Also studies on the morphology of ovules, fruits and seeds (VERKERKE, 1984, 1985), of foliar anatomy (DICKISON, 1973) and wood anatomy (BRIDGWATER & BAAS, 1982) do not present arguments to split *Xanthophyllum* from the *Polygalaceae*.

Mainly based on differences in floral structure, CHODAT (1891) distinguished three tribes in the family, *Polygaleae*, *Moutabeae* and *Xanthophylleae*. Both the studies of STYER (1977) and VERKERKE (1984, 1985) revealed that the differences between *Moutabeae* and *Polygaleae* are unclear; the results of vegetative and of seed anatomy do not correspond with differences in the flowers. Therefore a formal subdivision of the family is not presented.

References: BRIDGWATER & BAAS, IAWA Bull. n.s. 3 (1982) 115–125; BUSE-JUNG, Thesis, Kiel (1979); CHODAT, Monogr. I (1891); CRONQUIST, Integr. Syst. (1981) 763; DICKISON, J. Linn. Soc. Bot. 67 (1973) 103–115; LEINFELLNER, Oest. Bot. Z. 120 (1972) 51; VAN DER MEIJDEN, Leiden Bot. Ser. 7 (1982); SIMPSON, Taxon 31 (1982) 517–528; SIMPSON & SKVARLA, Amer. J. Bot. 68 (1981) 277–294; STYER, J. Arn. Arb. 58 (1977) 100–145; VERKERKE, Blumea 29 (1984) 409–421; J. Arn. Arb. 66 (1985) 353–394.

Bibliographical note. R. CHODAT published a monograph of the family in two parts in Mém. Soc. Phys. Hist. Nat. Genève, Suppl. 1890 (1891) 1–143, t. 1–12 and *ibid.* 31 (1893) 1–500, t. 13–35. Because of frequent mention of this basic work and the complicated reference, I refer to this work in simpler form, as follows: CHODAT, Monogr. I (1891) and CHODAT, Monogr. II (1893).

KEY TO THE GENERA

1. Herbs, sometimes woody at base.
 2. Lateral sepals larger than the 3 outer ones and petaloid, about as long as the petals. Lower petal (keel) appendiculate apically (except *P. tatarinowii*). Stamens 8. Fruit laterally dehiscent, the margins entire. Seed with a lobed aril at micropylar side **1. Polygala**
 2. All sepals subequal, not petaloid, much shorter than the petals. Keel apically inappendiculate. Stamens 2-6. Fruit either indehiscent, or laterally dehiscent and then the margins dentate or spinose. Seed exarillate.
 3. Autotrophic plant with (small) green leaves. Fruit laterally dehiscent, dentate or spinose along the margins, far exceeding the sepals. Pericarp pergamentaceous. Style S-curved at base, long. Disk absent. Anthers 4 or 6, rarely 5. Rachis of inflorescence winged **3. Salomonina**
 3. Saprophytic, echlorophyllous plant with scale-like leaves. Fruit indehiscent, enclosed by the sepals. Pericarp fleshy. Style straight or very short. Disk present (but indistinct), adnate to the base of the ovary, semi-annular or as a lobe. Anthers 3 or 5, rarely 2 or 4. Rachis terete **4. Epirixanthes**
1. Shrubs, trees or lianas.
 4. Sepals united at base, upper part of calyx caducous by a circumcission. Petals basally adnate to the calyx. Ovary 7- or 8-locular. Fruit (by abortion) often 4- or 5-locular. Seeds completely enclosed in an aril **5. Eriandra**
 4. Sepals free, caducous or 3 or 5 persistent. Petals free from the sepals. Ovary 1- or 2-locular. Seeds without an aril, or aril lobed.
 5. Petals 5. Lateral sepals not petaloid and less than twice as large as the other sepals. Ovary and fruit 1-locular with 4 or more ovules **6. Xanthophyllum**
 5. Petals 3 or with an additional pair of much-reduced ones. Lateral sepals (alae) petaloid and at least twice as large as the other sepals. Ovary 1- or 2-locular, each locule containing a single ovule.
 6. Ovary and fruit 1-locular. Fruit a distinct samara, indehiscent. Twigs with a pair of glands at the nodes. Seeds without appendages, glabrous **2. Securidaca**
 6. Ovary and fruit 2-locular. Capsule dehiscent, without a large wing. Nodal glands absent, rarely (6. *P. sumatrana*) pseudostipules present. Seeds either with a lobed aril, or very long-hairy . . . **1. Polygala**

1. POLYGALA

LINNÉ, Sp. Pl. 2 (1753) 701; Gen. Pl. ed. 5 (1754) 315; DC. Prod. 1 (1824) 321; BENTH. & HOOK. Gen. Pl. 1 (1862) 136; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 151; CHODAT, Monogr. I (1891); *ibid.* II (1893); E. & P. Nat. Pfl. Fam. 3, 4 (1896) 330; BLAKE, N. Amer. Fl. 25 (1924) 305; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961, '1958') 29; HUTCH. Gen. Fl. Pl. 2 (1967) 340; ADEMA, Blumea 4 (1966) 256. — *Chamaebuxus* (DC.) SPACH, Hist. Nat. Vég. Phan. 7 (1838, '1839') 125; OPIZ, Oekon. Neuigk. Verh. (1839) 526. — *Badiera* (non DC.) HASSK. Cat. Hort. Bog. (1845) 227, *p.p.* — *Semeiocardium* (non ZOLL.) HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 150. — Fig. 1-16.

Annual or perennial herbs, shrubs, small trees or rarely lianas. Stems or twigs rarely with nodal glands, these sometimes transformed into spines. *Leaves* alternate or verticillate, sometimes (sub)opposite, rarely caducous, sometimes scale-like or apparently absent. *Inflorescences* raceme-like or rarely paniculate, (supra-)axillary, terminal (and then often overtopped by side-branches) or lateral, sometimes in dense heads. *Sepals* 5 or the lower pair connate, unequal, caducous or persistent in fruit, the two lateral ones (alae) at least twice as large as the other ones and often petaloid. *Petals* 3, unequal, halfway adnate to the staminal tube and sometimes mutually connate into a single 3-lobed petal; some-

times with an additional pair of reduced lateral petals; lower petal (keel) boat-shaped, clawed, its blade entire or 3-lobed or basally auriculate, at apex with or less often without 2 entire or variously incised appendages (crest). *Stamens* 8, rarely 6, monadelphous or partly dia- or triadelphous; anthers usually bisporangiate by abortion of the outer microsporangiae, or sometimes tri- or tetrasporangiate, sessile or on a free filamentous stalk, opening by an apical pore or a V-shaped introrse slit common to both cells. *Disk* annular or variously reduced or often apparently absent. *Ovary* 2-celled, each locule with a single subapical ovule; style tip various, often 2-lobed, the apical lobe often sterile and variously dilated, the stigmatic lobe lateral or subapical. *Capsule* 2-celled or very rarely 1-celled by abortion, compressed contrary to the sept, often more or less winged, sometimes with a double wing, dehiscing by a marginal split, reniform to oblanceolate. *Seeds* various, usually at micropylar side with a lobed or unlobed appendage (aril) and/or with an elongate appendage, at the opposite chalazal side sometimes with a variously shaped appendage, rarely appendages at both sides lacking; glabrous to hairy, or rarely with a coma of hairs.

Distr. A polytypic genus comprising at least 500 *spp.* in tropical, subtropical, temperate and montane regions. The majority of species grow in tropical South and Central America, where *Polygala* also has its greatest infrageneric diversity. Both in North America and in South Africa secondary centres of speciation occur. Eurasia, North Africa, Malesia and Australia are rather poor in species. In *Malesia* the species can be referred to four little-related sections. *Sect. Melchiora* is monotypic and endemic to New Guinea, *sect. Pseudosemeiocardium* is common in Southeast Asia, *sect. Chamaebuxus* occurs over all continents except tropical South and Central America, and the largest (probably unnatural) *sect. Polygala* covers the same area as the genus. The majority of species in Malesia have rather restricted areas, with some notable exceptions, e.g., *P. persicariaefolia*, which also occurs in tropical Africa, and *P. paniculata*, an American species which is now a pantropical weed. Two species are endemic in Malesia.

Ecol. Species of *sect. Chamaebuxus* belong to the undergrowth of rain-forests, in Malesia occurring in submontane and montane forests, between 400 and 3000 m altitude. The single species of *sect. Melchiora* is a true liana of the tropical rain-forest. The remaining herbaceous species are heliophilous species growing in open terrains, in open woodland, with a preference for grasslands in seasonal areas; this is especially true for 9. *P. javana*, 12. *P. longifolia*, 14. *P. exsuarrosa*, 17. *P. wightiana*, and 18. *P. rhinanthoides*, which are all restricted to areas subject to a distinct or pronounced dry season.

Pollination. Self-pollination probably occurs in all species, although the flowers of the majority are attractive to insects. Many large-flowered species show structures which seem to be adaptations to pollinating insects (FAEGRI & VAN DER PIJL, 1979, for *P. chamaebuxus*), but in those species, too, self-pollination seems to occur frequently.

In a number of species pollen grains are deposited directly on the stigma, often already in the unopened flower (VENKATESH, 1956). In many species the style tip bears special pockets in various ways in which the pollen grains are deposited from the anthers. At that time the stigma can theoretically still be pollinated with foreign pollen grains, as for instance in *P. lutea* (MILLER, 1971) and *P. vulgaris* (HEUBL, 1984). According to HEUBL's observations, however, a visiting insect will effect self-pollination. Yet there are rather reliable records of hybrids of the latter species in nature (HEUBL, *l.c.*), and F₁-plants of artificially produced hybrids are often fertile. This must mean that cross-pollination (rarely) occurs in *P. vulgaris*. Only BRANTJES (1982) observed and described cross-pollination in the two Brazilian species *P. monticola* H.B.K. and *P. vauthieri* CHODAT. The pollination mechanism of those species is a very precise one, and if cross-pollination fails, the flowers are effectively self-pollinated.

Perhaps such examples of precision cross-pollination can be discovered in many other *Polygala* species, because it is rather unlikely that the great variation in style tips and stigma forms could have evolved in complete absence of gene-exchange. It is also possible that many species in which formerly cross-pollination was rare, have lost this possibility.

References: BRANTJES, Pl. Syst. Evol. 141 (1982) 41–52; FAEGRI & VAN DER PIL, Princ. Poll. Ecol. 3rd ed. (1979) 165, f. 6; HEUBL, Bot. Mitt. München 20 (1984) 234; MILLER, J. Arn. Arb. 52 (1971) 267; VENKATESH, Bull. Torrey Bot. Club 83 (1956) 19.

Taxon. In view of the surprisingly great variation in species-constant characters of diverse flowering and fruiting parts, it has been tried to split this large genus into a number of smaller genera. The large genus concept as adopted by R. CHODAT (Monogr. I, 1891, 93), the only author who revised all species, is still adopted, some minor questions regarding the status of some American groups set aside. CHODAT's infrageneric division of the genus, however, was unsuccessful, as had been pointed out by S.F. BLAKE in his revision of the North American species (1924), and more recently by ADEMA (1966) for the Malesian ones. This is probably due to the fact that two of CHODAT's major characters to define his sections, viz. the presence or absence of sepals at fruiting state, and of carinal appendages, are not constant in the different lineages: parallel developments (reductions *c.g.* reversions of character states) will have been developed in many of these lineages. Until a new revision of the tropical American species has been made, it will be impossible to make a balanced reconsideration of the status of the diverse groups of species within and outside the borderlines of this genus.

In the Indo-Australian area a great diversity of species is present, probably caused by diverse migration lines. Perhaps the Australian genus *Comesperma* should also be included in *Polygala*; see note under 4. *P. papuana*.

KEY TO THE SECTIONS AND SPECIES

1. Lateral sepals (alae) caducous at the beginning of fruit-setting. Disk present. Leaves usually with distinct petioles.
 2. Annual herbs up to 30 cm high. Flowers, fruits and seeds up to 3 mm long. *Spp.* 1–3. — 1. *Sect. Pseudo-semeiocardium*
 3. Keel without appendages at apex. Seed without tubercles, without black appendage at chalazal side
 1. ***P. tatarinowii***
 3. Keel with a pair of appendages near apex. Seed tuberculate, with a small or large black appendage at chalazal side.
 4. Capsule narrowly winged, longer than wide. Seed at chalazal side with a cylindrical appendage one third as long as the seed itself 2. ***P. malesiana***
 4. Capsule broadly winged, much wider than long. Seed at chalazal side with a small, knob-like appendage 3. ***P. cardiocarpa***
 2. Shrubs, small trees, or lianas. Flowers, fruits and seeds at least 5 mm long.
 5. Fruit much longer than wide, at base with 3 small, persistent sepals. Seed very long-hairy, without aril. Upper sepal flat. Lianas. *Sp.* 4. — 2. *Sect. Melchiora* 4. ***P. papuana***
 5. Fruit about as long as wide, without persistent sepals. Seed glabrous or shortly hairy, partly covered by an aril. 'Upper' sepal saccate. Shrubs or small trees. *Spp.* 5–8. — 3. *Sect. Chamaebuxus*
 6. Flowers 5–6 mm long. Style straight to near stigma. Seed nearly completely covered by the aril
 5. ***P. oreotrephe***
 6. Flowers at least 10 mm long. Style curved in apical half. Seed usually covered up to halfway by the aril.
 7. Capsule covered by a white layer of dense papillae, the wall not with prominent veins. Racemes in the forks 6. ***P. sumatrana***
 7. Capsule without white layer, with prominent longitudinal veins. Racemes (supra-)axillary.
 8. Appendages of the keel undivided. Racemes mostly reflexed or patent from the base 7. ***P. venenosa***
 8. Appendages of the keel divided into 7–10 ± connate lobes. Racemes erect or very rarely pendulous
 8. ***P. arillata***
 1. Lateral sepals (alae) persistent. Disk (apparently) absent. Leaves hardly petiolate. Annual to perennial herbs, sometimes woody at base. *Spp.* 9–20. — 4. *Sect. Polygala*
 9. Lateral sepals (alae) broadly ovate, hairy.
 10. Alae yellowish. Ovary and fruit hairy all over. Capsule narrowly winged. Stigma not recurved at apex, with 2 minute lobes 9. ***P. javana***
 10. Alae green. Ovary and fruit only hairy at margin. Stigma strongly recurved at apex, at inner side with one stigmatic lobe 18. ***P. rhinanthoides***
 9. Lateral sepals (broadly) elliptic or narrower, glabrous or hairy marginally, or rarely covered by stiff hairs.
 11. Alae nearly symmetric, petaloid (coloured).
 12. Alae 1.5–2 mm long. Stem set with small, shortly stalked glands. Capsule unwinged. Style obliquely cup-shaped at apex, at one end with a tuft of hairs 13. ***P. paniculata***

12. Alae 3–10 mm long. Stem eglandular. Capsule winged. Style not or hardly widened at apex, without a tuft of hairs.
13. Alae mucronate. Style (nearly) straight, (sub)apically with 2 small stigmatic lobes. Filaments nearly completely connate 10. *P. japonica*
13. Alae rounded at apex. Style curved in apical half, with one stigmatic lobe. Filaments free for at least one third.
14. Alae 6–7 mm long. Capsule hairy along margin. Racemes in the forks (but terminal on side-branches). Bracts and bracteoles persistent 11. *P. persicariaefolia*
14. Alae 3–4 (in fruit up to 5) mm long. Capsule glabrous. Racemes mostly terminal. Bracts and bracteoles early caducous 12. *P. longifolia*
11. Alae asymmetric, falcate, not petaloid (green).
15. Capsule and vegetative parts stiffly hairy. Appendages of keel little incised. Stigma apically neither widened nor sharply reflexed. 14. *P. exsuarrosa*
15. Capsule glabrous or hairy only at margin. Plants not stiffly hairy. Appendages of keel divided into a number of filiform or finger-shaped lobes. Stigma apically widened or sharply reflexed.
16. Capsule c. 2 mm long. Alae c. 3 mm long. Style apically widened, at one side with the stigmatic lobe 15. *P. polifolia*
16. Capsule (3–)3.5–5 mm long. Alae 4–6 mm long. Style apically strongly reflexed.
17. Plant with stiffly erect, long inflorescences. Apical part of the style very asymmetrically winged. Free parts of filaments triadelphous 17. *P. wightiana*
17. Plant with short inflorescences or, if with long ones, then these ascending. Style apically symmetrically winged. Free parts of filaments not connate.
18. Appendages of the keel finely divided into hair-like segments. Capsule almost orbicular, c. 4 by 4 mm 16. *P. chinensis*
18. Appendages of the keel divided into finger-shaped lobes. Capsule somewhat longer than wide, 2.5–4 by 2.5–3.5 mm.
19. Upper petals shorter than the keel, 2.5–3.5 mm long. Capsule at the margin both with curved as well as with short straight hairs. Inflorescences 0.5–2 cm long 20. *P. triflora*
19. Upper petals slightly longer than the keel, 2.5–4.5 mm long. Capsule at the margin with curved hairs only. Inflorescences 0.5–7 cm long. 19. *P. glaucoides*

1. Section *Pseudosemeiocardium*

ADEMA, *Blumea* 14 (1966) 256. — *Semeiocardium* (*non* ZOLL.) HASSK. in *Miq. Ann. Mus. Bot. Lugd.-Bat.* 1 (1863) 150. — *Polygala sect. Semeiocardium* [*non* (ZOLL.) HASSK.] CHODAT, *Monogr.* II (1893) 41.

Small, erect, branched, annual herbs. *Flowers* in terminal or axillary multiflowered unbranched racemes. *Sepals* caducous before fruit-setting. *Keel* with 2 hardly incised appendages, or inappendiculate. Disk annular or consisting of 1 or 2 lobes. *Style* ± tubular, curved in upper half, widened apically, at inner side with a single stigmatic lobe. *Capsule* orbicular to obovate, narrowly winged. *Seeds* black, shortly hairy, at micropylar side with a small appendage or with a lobed aril, at chalazal side with or without an appendage.

Distr. Southeast Asia and *Malesia*.

1. *Polygala tatarinowii* REGEL, *Bull. Soc. Nat. Mosc.* 34 (1861) 523, t. 7, f. 10, 11; FORBES & HEMSLEY, *J. Linn. Soc.* 23 (1888) 62; CRAIB, *Not. R. Bot. Gard. Edinb.* 11 (1919) 187; GAGNEP, *Fl. Gén. I.-C. Suppl.* 1 (1938) 226, f. 1–6; MAKINO, *Ill. Fl. Japan* (1954) 383; MUKHERJEE, *Bull. Bot. Soc. Beng.* 12 (1961) 34;

OHWI, *Fl. Japan* (1965) 587; ADEMA, *Blumea* 14 (1966) 256, f. 1; *ibid.* 18 (1970) 564; IQBAL DAR, *Fl. W. Pakist.* 52 (1973) 2, f. 1a–c; CHRTEK & KRISA, *Fl. Iranica* 124 (1977) 2; HUI-LIN LI *c.s.* *Fl. Taiwan* 3 (1977) 568, pl. 727; HARA, *En. Fl. Pl. Nep.* 2 (1979) 51. — *P. triphylla* (*non* BUCH.-HAM. *ex* D.DON,

1825) ROYLE, Ill. (1839) t. 19D, *non* BURM.f. 1768, *et auct. var. pro parte*; MERR. En. Philip. 2 (1923) 384. — *Semeiocardium hamiltonii* HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 151, *p.p.* — Fig. 1a–h.

Herb up to 25 cm. Stem glabrous, faintly ribbed. *Leaves* ovate to obovate, 2–35 by 1–20 mm, acute, base attenuate, laxly short-hairy, ciliate, 0.5–1 cm petioled. *Racemes* terminal, including the peduncle 1–10.5 cm; bracts and bracteoles early caducous. *Flowers* c. 1.5–2 mm long, glabrous, rosa-red to purple. *Sepals* blunt, the alae obovate, 5-nerved. Upper *petals* oblong, slightly longer than the keel; the keel inapplicable, apically minutely papillose. *Filaments* free for c. 1/4. *Ovary* orbicular; style curved and widened in apical half, obliquely truncate. *Capsule* symmetric, \pm quadrangular with rounded edges, apically to orbicular, c. 2 mm long, very narrowly winged all round (wings not visibly cross-veined), the truncate apex mucronate. *Seed* ellipsoid, not tuberculate, shortly hairy, at micropylar side with an obliquely lobed aril, at chalazal side inapplicable.

Distr. Iran to N. China, Korea, E. Siberia, Japan and Taiwan; in *Malesia*: Philippines (Luzon, Mindanao) and New Guinea (Sepik); apparently very rare.

Ecol. Open grassland, ascending to 2000 m.

Note. *Polygala furcata* ROYLE from N. India, Thailand and S. China differs in the following characters: keel with unlobed appendages, capsule not mucronate, seed tuberculate, almost globular, at chalazal side with a minute appendage.

2. *Polygala malesiana* ADEMA, Blumea 14 (1966) 257, f. 3, 4. — *P. triphylla* BUCH.-HAM. *ex* D. DON *var. glaucescens* [*non* WALL. Cat. (1831) 4182] BENN. Fl. Br. India 1 (1872) 201; KING, J. As. Soc. Beng. 59, ii (1890) 130. — *P. cardiocarpa* (*non* KURZ) RIDLEY, Fl. Mal. Pen. 1 (1922) 139, *p.p.*; MERR. En. Philip. 2 (1923) 383; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 36, *p.p.* — Fig. 1i–k.

Herb up to 25 cm. Stem glabrous, ribbed, 2- or 3-chotomously branched. *Leaves* mostly in pseudowhorls of 3, broadly elliptic to ovate, 10–55 by 9–25 mm, acute, base attenuate, laxly short-hairy, ciliate, 0.5–1 cm petioled. *Racemes* terminal or in a fork, including the peduncle 3–7.5 cm; bracts and bracteoles early caducous. *Flowers* 1.5–2 mm long, white with rosa crest. *Sepals* blunt, the alae obovate, 5-nerved. Upper *petals* oblong, about as long as the keel; keel with 2 broad 2-tipped appendages. *Filaments* free for 1/4–1/2, hairy along the upper suture. *Ovary* obcordate; style curved and widened in apical half, obliquely truncate apically. *Capsule* symmetric, obcordate, c. 2.5 mm long, apically notched, not mucronate, winged; wing cross-veined, distinctly widening

apically. *Seed* ellipsoid, tuberculate, shortly hairy, at micropylar side with an obliquely lobed aril, at chalazal side with an appendage one third as long as the seed; this somewhat narrower than the seed, truncate, ending in an orbicular, hollow, membranous lamella, which makes an angle of c. 45° with the seed.

Distr. Malesia: Malay Peninsula (Perak, Pahang, Selangor), Lesser Sunda Islands (Sumba, Flores), SE. Celebes (Tukangbesi Is.), Philippines (Bohol), Moluccas (Buru, Ceram, Kai and Aru Is.), and West New Guinea (Sorong and Vogelkop Peninsula).

Ecol. In Malaya and Celebes noted from limestone (should also be from Sumba), in open terrain, below 300 m.

Note. *Polygala isocarpa* CHODAT (*P. umbonata* CRAIB) differs in a number of small but constant characters, especially in the style, which is somewhat inflated and apically not widened, and in the chalazal appendage of the seed, of which the kidney-shaped, basal, hollow membranous lamella makes a right angle to the seed.

3. *Polygala cardiocarpa* KURZ, J. As. Soc. Beng. 41, ii (1872) 293; CHODAT, Monogr. II (1893) 42, *nomen*; CRAIB, Not. R. Bot. Gard. Edinb. 11 (1919) 187, 188; RIDLEY, Fl. Mal. Pen. 1 (1922) 139, *p.p.*; CRAIB, Fl. Siam. En. 1 (1931) 100; ADEMA, Blumea 14 (1966) 260, f. 6. — *Heterosamara birmanica* (O. K.) CHODAT, Bull. Herb. Boiss. 3 (1895) 128. — *P. palustris* LACE, Kew Bull. (1915) 344; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 36. — Fig. 1l–n.

Herb up to 25 cm. Stem glabrous, somewhat ribbed, towards apex trichotomously branched. *Leaves* ovate to elliptic, 6–55 by 4–30 mm, acute, base attenuate, laxly short-hairy, ciliate, 0.5–1.5 cm petioled. *Racemes* terminal or in a fork, including the peduncle 1.5–14 cm; bracts and bracteoles early caducous. *Flowers* c. 3 mm long, glabrous, orange-yellow to bright yellow. Outer *sepals* short-mucronate, alae broadly obovate, rounded, 3-nerved. Upper *petals* oblong, slightly longer than the keel; keel with 2 rounded appendages. *Filaments* free for 1/4–1/2. *Ovary* obcordate, the upper cell smaller; style curved and widened in apical half, obliquely truncate apically. *Capsule* asymmetric, broadly obcordate, c. 2.5 by 3.5 mm, provided with 2 unequal cross-veined wings. *Seed* \pm ellipsoid, tuberculate, shortly hairy, at micropylar side with a minute oblique appendage covered by a rather small, obliquely lobed aril, at chalazal side with a minute appendage.

Distr. Burma, Thailand; in *Malesia*: Malay Peninsula (Langkawi Is.).

Ecol. Apparently restricted to limestone rocks. In Langkawi at very low altitude, in Southeast Asian mainland ascending to 2000 m.

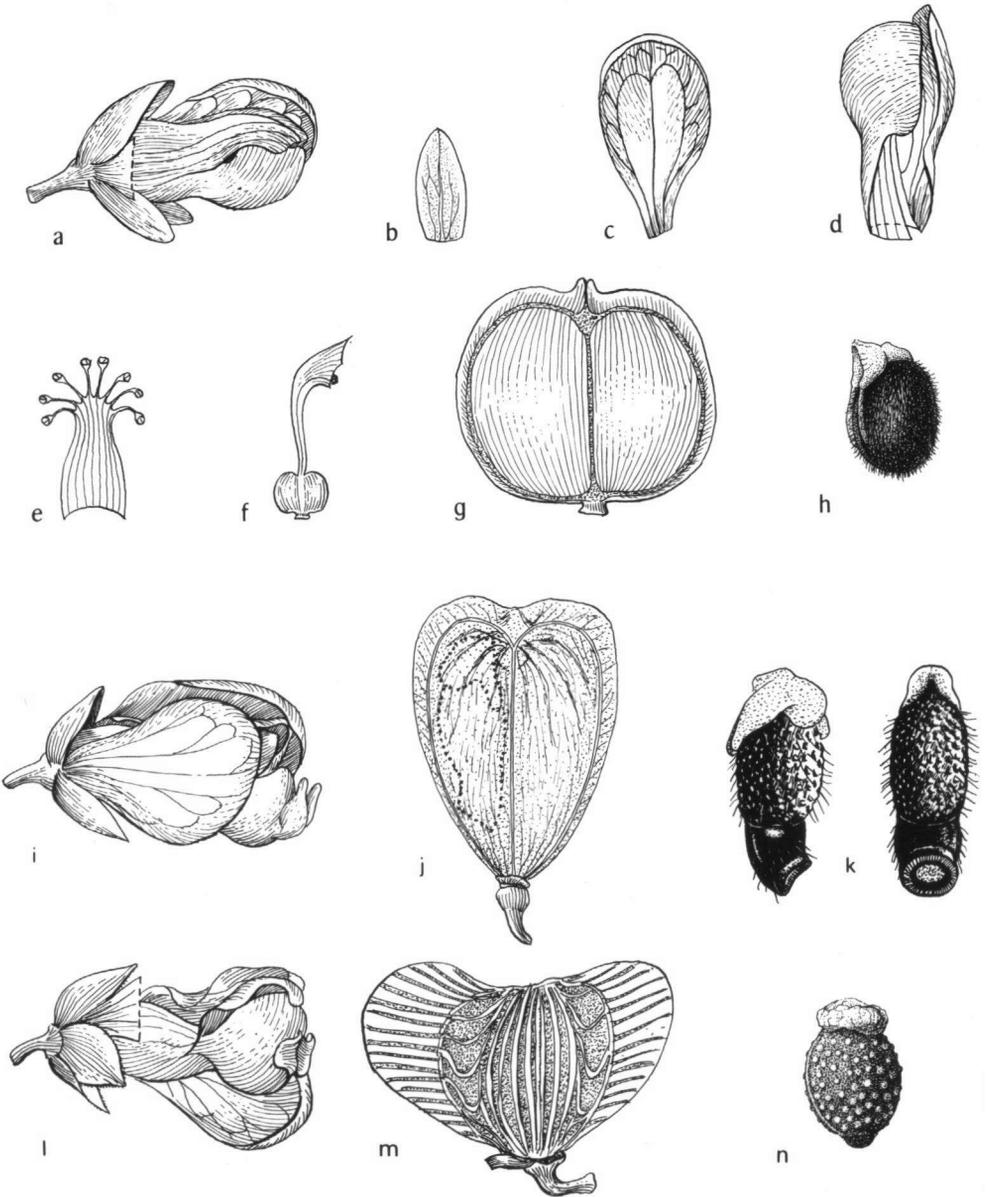


Fig. 1. *Polygala tatarinowii* REGEL. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. staminal tube laid open; f. pistil; g. fruit; h. seed. — *P. malesiana* ADEMA. i. Flower; j. fruit; k. seed, lateral and ventral view. All $\times 15$. — *P. cardiocarpa* KURZ. l. Flower; m. fruit; n. seed. All $\times 10$ (a–h RAMOS & EDAÑO BS 40317, i–k JENSEN 169, l–n CURTIS 3686).

Note. Similar to *P. furcata* ROYLE from N. India, Thailand and S. China, especially in the seed. The latter has narrowly winged capsules without prominent venation.

2. Section *Melchiora* (STEEN.) MEIJDEN, *comb. nov.*

Bredemeyera sect. Melchiora STEEN. Acta Bot. Neerl. 17 (1968) 380 (Typus: *Bredemeyera papuana* STEEN.).

Liana. *Flowers* in short axillary racemes. Lateral *sepals* (alae) caducous before fruit-setting, other sepals persistent below the fruit. *Keel* inappendiculate. Disk indistinct, annular, slightly sunken in apex of pedicel, at upper side slightly protruding. *Ovary* apically elongated into a sterile part; style articulate with the ovary, curved in apical half, apically slightly 2-horned, stigma elliptic, terminal. *Capsule* much elongated, unwinged. *Seed* at micropylar and chalazal side with small appendages, completely set with hairs at least as long as the seed.

For distribution, ecology and taxonomy see the species.

4. *Polygala papuana* (STEEN.) MEIJDEN, *comb. nov.* — *Bredemeyera papuana* STEEN. Acta Bot. Neerl. 17 (1968) 380. — Fig. 2.

Liana, glabrous in all parts except sepals and seed. Twigs slightly angular. *Leaves* obovate-oblong to obovate-lanceolate, rarely lanceolate, c. 3.5–8.5 by 1.5–3 cm, shortly acuminate, gradually attenuate at base, nerves c. 5–7 pairs, 0.5–1.5 cm petioled. *Racemes* axillary, 1 or 2 together, including the peduncle 2–6 cm long. Bracts and bracteoles persistent (?). *Flowers* 4.5–6.5 mm long, white with red keel, on 3–5 mm long pedicels. *Sepals* adnate over 0.5–1 mm to the petals, ± orbicular shortly ciliate, the alae broadly obovate. Upper *petals* obliquely obovate to oblong; keel emarginate. *Filaments* halfway free. *Ovary* obovate, apically with a 1 mm long sterile part. *Capsule* obovate-linear, c. 18–22 by 2–2.5 mm, shortly acuminate at apex, gradually narrowed towards base, unwinged. *Seed* 5–7 by c. 1 mm, completely covered by white silky hairs c. 1.5 cm long.

Distr. *Malesia*: New Guinea.

Ecol. Thin vine in disturbed forest below 300 m.

Note. Recent Australian authors (THOMPSON, Fl. New South Wales 112, 1978, 2; PEDLEY, Austrobaileya 2, 1984, 7) claimed that this species belongs to the genus *Comesperma*. They agree with VAN STEENIS (*l.c.*) that *Comesperma* differs from the South American genus *Bredemeyera* in a single character; in the latter the carinal appendage bears the coma-hairs; in *Comesperma* the coma-hairs are present all over the seed or in two rows. It is dubious whether other differences exist. However, it is uncertain whether *Comesperma* itself is a good genus. Some *Comesperma* species (*viz.* those of *sect. Pro-*

sthemosperma F.v.M. Pl. Vict. 1862, 186) have no coma-hairs and no elongated capsule. *Comesperma* can only be upheld if it could be proven that this is a reversion (by reduction) of the evolution. If, however, these 'abnormal' *Comesperma* species represent the primitive character of fruit and seed, the genus cannot be upheld against *Polygala*. Thus far this important question has been neglected. On the other hand it should be noted that two species of *Polygala sect. Chamaebuxus* (*P. wattersii* HANCE and *P. mariesii* HEMSLEY, both from China) have 'typical' *Comesperma* fruits and seeds, but definitely do not belong to this group as can be demonstrated by the differences in floral characters. Thus there is good reason to assume that *Comesperma* should be merged into *Polygala*. The same may be true for *Bredemeyera*, but the present state of knowledge on this genus is still incomplete. In view of the weak differences of *Bredemeyera* and *Comesperma* with *Polygala*, there is no good reason to combine both (under *Bredemeyera*) as VAN STEENIS (*l.c.*) proposed. As a consequence *Bredemeyera papuana* is best considered for the present to be a species of *Polygala*.

The affinity of *P. papuana* with the typical representatives of *Comesperma* is unclear. Surprisingly, PEDLEY (*l.c.*) dismissed the difference in the calyx as 'rather trivial', whereas CHODAT used this character as the main one for his subdivision of the genus *Polygala*. As far as I am aware only one other species (*P. acicularis* OLIV. from tropical Africa) has caducous alae and persistent sepals. At present it seems better to keep *P. papuana* in a separate section, separate from *Comesperma* when considered as a section from *Polygala*.

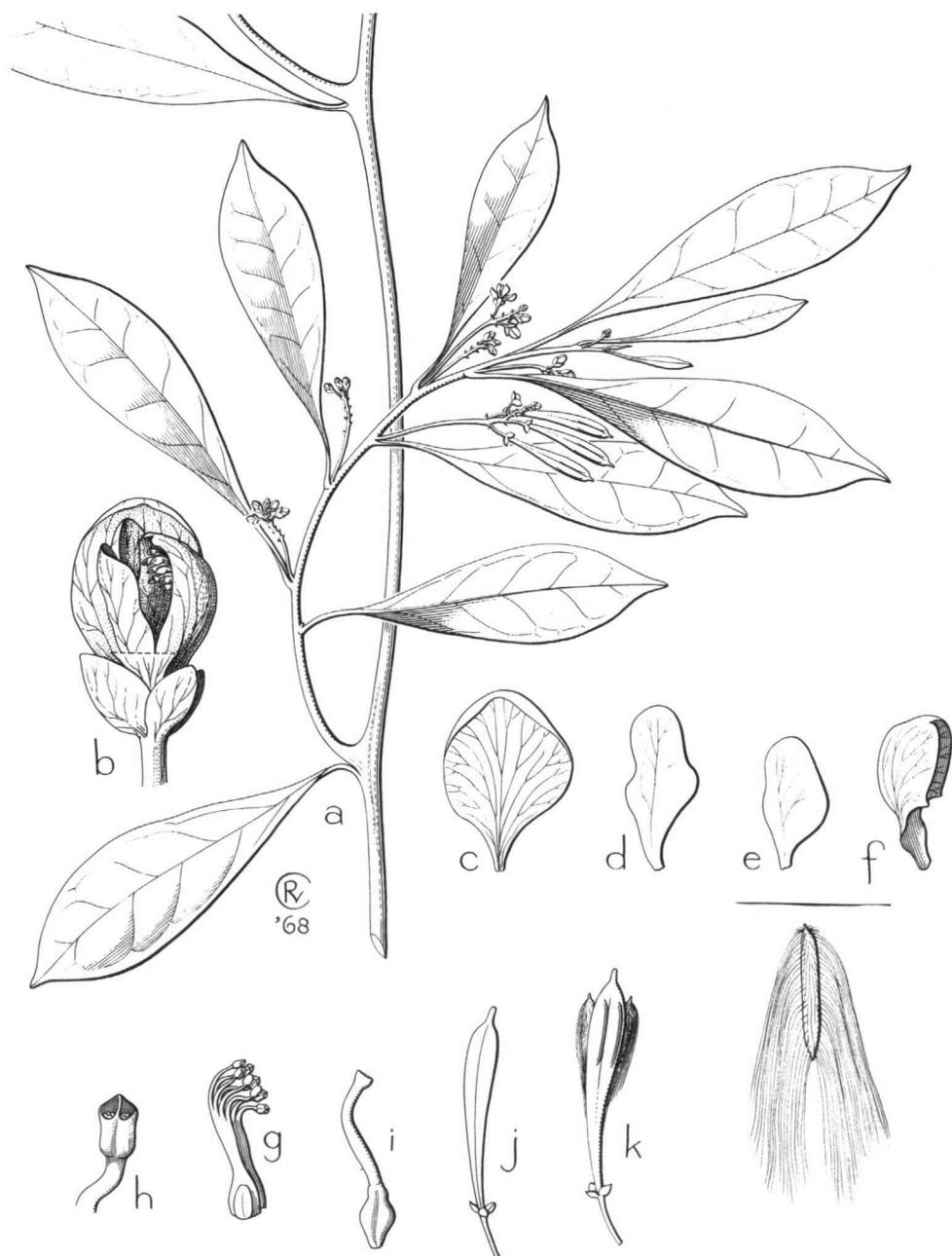


Fig. 2. *Polygala papuana* (STEEN.) MEUDEN. *a.* Habit, $\times 0.66$; *b.* flower; *c.* lateral petal; *d.* upper petal; *e.* ditto; *f.* keel; *g.* stamens; all $\times 4$; *h.* anther, $\times 16$; *i.* ovary and style, $\times 4$; *j.* young fruit, *k.* ripe fruit; $\times 1.3$; *l.* seed, $\times 2.5$ (*a, e, j-l* DOCTERS VAN LEEUWEN 10387, *b-d, f-i* LEDERMANN 9395).

3. Section Chamaebuxus

DC. Prod. 1 (1824) 331; CHODAT, Monogr. II (1893) 93. — *Chamaebuxus* (DC.) SPACH, Hist. Vég. Phan. 7 (1838) 125 ('1839'); OPIZ, Oekon. Neuigk. Verh. (1839) 526. — *Badiera sensu* HASSK. Cat. Hort. Bog. (1844) 227, p.p.

Little-branched shrubs or small trees up to 6 m high, or low chamaephytes with woody base, sometimes very spiny. Nodal glands sometimes present. *Inflorescences* mostly extra-axillary and unbranched, raceme-like, rarely branched, or very short, 1–2-flowered and axillary. *Flowers* mostly turned upside-down. *Sepals* caducous before fruit-setting, the adaxial one saccate. *Keel* with 2 fleshy, not or little-incised, rarely with strongly incised appendages. Disk annular or consisting of a single lobe. *Style* straight or curved in apical half, apically obliquely 2-fid, the apical lobe sterile, the stigmatic lobe subapical. *Capsule* about as wide as long or didymous, or sometimes (not in Mal.) spatulate, unwinged or narrowly winged. *Seed* at micropylar side with a short curved appendage and from there usually with a distinct, unlobed aril, at chalazal side inapplicable but chalazal area often slightly protruding; (sub)glabrous or (not in Mal.) completely covered with hairs at least twice as long as the seed.

5. *Polygala oreotrepes* BURTT, Not. R. Bot. Gard. Edinb. 29 (1969) 148, fig.; STONE, Fed. Mus. J. 26 (1981) 131. — *P. monticola* (non H.B.K., 1823) RID-

LEY, J. Linn. Soc. Bot. 38 (1908) 303; Fl. Mal. Pen. 1 (1922) 138; HEND. Gard. Bull. S. S. 4 (1927) 93; J. Fed. Mal. St. Mus. 13 (1927) 2; SYM. J. Mal. Br. R.

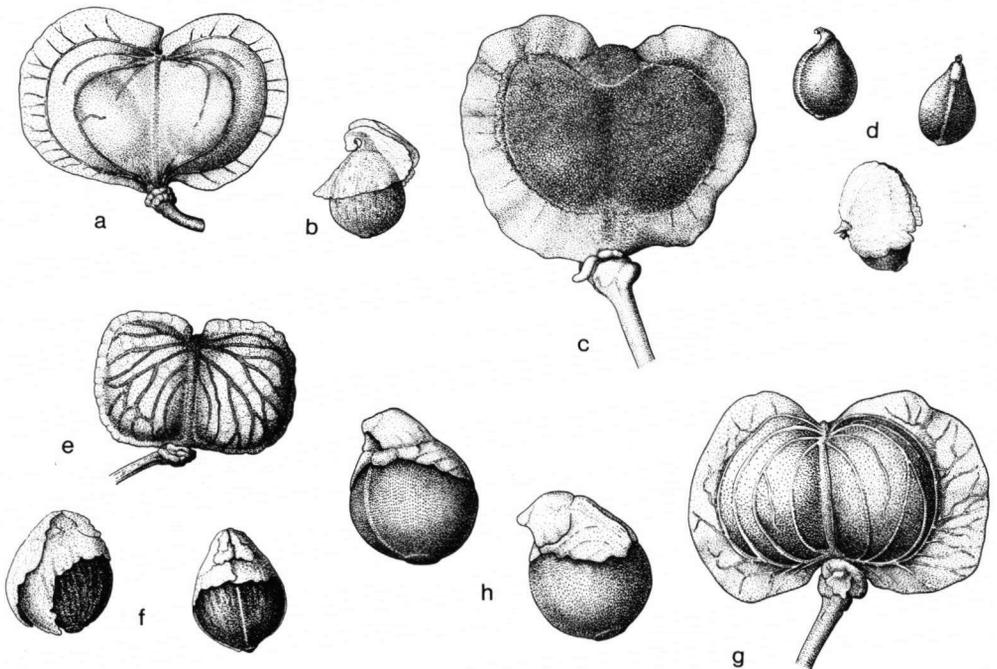


Fig. 3. *Polygala oreotrepes* BURTT. a. Capsule; b. seed. — *P. sumatrana* MIQ. c. Capsule; d. seeds. — *P. venosa* JUSS. ex POIR. e. Capsule; f. seeds. — *P. arillata* BUCH.-HAM. ex D.DON. g. Capsule; h. seeds. All $\times 5$ (a, b MAXWELL 78-320, b, c MORLEY 437, e, f PNH 117264, g, h MAXWELL 74-782).

As. Soc. 14 (1936) 347; HEND. Mal. Nat. J. 4 (1949) 30, f. 18. — Fig. 3a, b.

Erect, simple or branched shrub, 30–90 cm high. Twigs slightly angular, (sub)glabrous. *Leaves* oblong to lanceolate, 5–16 by 1–5 cm, acuminate or cuspidate, base attenuate, glabrous to hairy, chartaceous, petioled (petiole 0.5–2 cm). *Racemes* terminal, 1–4 together, erect, including the peduncle 4–16 cm, dense. Bracts and bracteoles early caducous. *Flowers* 5–6 mm long, white and yellow, later crimson and pink, on 1–3 mm long pedicels. *Sepals* rounded, usually ciliate, the abaxial one not strongly saccate, the alae elliptic to nearly orbicular. Upper *petals* lanceolate; keel with 2 deltoid, massive, wrinkled appendages. *Filaments* free for c. 1/4. Disk ± annular, abaxially protruding backwards. *Ovary* ± quadrangular with rounded edges; style straight or with slightly recurved apex, subapically at inner side with a knob-like stigmatic appendage and there laterally with 2 triangular, wing-like appendages. *Capsule* ± didymous, c. 7 by 12 mm, winged, with faintly protruding concentric nerves, coriaceous, purple, glabrous. *Seed* elliptic or orbicular, at micropylar side with a small appendage, black, glabrous, (nearly) completely covered by the smooth, orange to scarlet aril, the slightly protruding chalaza and the raphe distinctly visible.

Distr. *Malesia*: Malay Peninsula and Borneo (Sarawak: Murud), apparently very rare in the latter locality.

Ecol. Mountains, 1100–2500 m.

6. *Polygala sumatrana* MIQ. Fl. Ind. Bat., Suppl. (1861) 392; CHODAT, Bull. Herb. Boiss. 4 (1896) 234. — *P. glaucocarpa* RIDLEY, J. Fed. Mal. St. Mus. 84 (1917) 16. — Fig. 3c, d.

Erect, dichotomously branched small shrub. Twigs slightly angular, thinly strigose, glabrescent, at the nodes often with small, triangular pseudostipules. *Leaves* oblong to linear-lanceolate, 4.5–15 by 1.5–3.5 cm, cuspidate, base attenuate, thinly strigose, up to 2 cm petioled. *Racemes* terminal between 2 opposite twigs or leaves, erect, later pendulous, including the peduncle 3.5–7.5 cm, lax. Bracts and bracteoles early caducous. *Flowers* c. 15 mm long, white to pink and later violet, with yolk-yellow appendages on the keel, on 4–11 mm long pedicels. *Sepals* rounded, ciliate, the alae obovate-oblong. Upper *petals* lanceolate; keel with 2 large fleshy entire appendages. *Filaments* free for c. 1/4. Disk annular, abaxially protruding. *Ovary* ± quadrangular with rounded edges; style straight in basal half, in upper half falcate, apically weakly 2-fid, at inner side with the stigmatic lobe. *Capsule* broadly obovate, c. 9–10 by 11–14 mm, winged (wings not transverse-ly veined), without protruding nerves, coriaceous, very densely covered by white, orbicular, flat

papillae. *Seed* elliptic, at micropylar side with a small appendage, reddish brown, glabrous, up to about halfway covered by the smooth aril, the slightly protruding chalaza and the raphe distinctly visible.

Distr. *Malesia*: West, Central and East Sumatra. Ecol. Mountain forests, 1000–2200 m.

7. *Polygala venosa* JUSS. ex POIR. in Lamk, Encycl. 5 (1804) 493; DC. Prod. 1 (1824) 331; HASSK. Flora 25² (1842) Beibl. 2, 31; MIQ. Fl. Ind. Bat. 1, 2 (1858) 126; O.K. Rev. Gen. Pl. 1 (1891) 45, *incl. var. eramosa* O. K.; CHODAT, Monogr. II (1893) 98; RIDLEY, Trans. Linn. Soc. II, 3 (1893) 276; STAFF, *ibid.* 4 (1894) 131; MERR. Philip. J. Sc. 2 (1907) Bot. 277; BACKER, Schoolfl. Java (1911) 77; HALL.f. Meded. Rijksherb. 12 (1912) 26; KOORD. Exk. Fl. Java 2 (1912) 450; RIDLEY, J. Fed. Mal. St. Mus. 8⁴ (1917) 16; MERR. En. Born. (1921) 324; RIDLEY, Fl. Mal. Pen. 1 (1922) 137; MERR. En. Philip. 2 (1923) 385; BURK. Gard. Bull. S. S. 3 (1923) 34; KOORD. Fl. Tjibodas 2 (1923) 132; BURK. Gard. Bull. S. S. 3 (1925) 345; HEND. J. Mal. Br. R. As. Soc. 5 (1927) 242; MERR. Pl. Elm. Born. (1929) 133; CRAIB, Fl. Siam. En. 1 (1931) 104, *incl. var. robusta*; MERR. Contr. Arn. Arb. 8 (1934) 84; HEND. Mal. Nat. J. 4 (1949) 29; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 31; BACKER & BAKH.f. Fl. Java 1 (1963) 198; STEEN. Mount. Fl. Java (1972) pl. 41-5, *incl. ssp. pulchra* (HASSK.) STEEN., pl. 41-6. — *P. pulchra* HASSK. Flora 25² (1842) Beibl. 2, 32; CHODAT, Monogr. II (1893) 100; BACKER, Schoolfl. Java (1911) 77; KOORD. Exk. Fl. Java 2 (1912) 450; RIDLEY, Fl. Mal. Pen. 1 (1922) 137; RIDLEY, J. Str. Br. R. As. Soc. n. 87 (1923) 53; BACKER & BAKH.f. Fl. Java 1 (1963) 198. — *Badiera venosa* (POIR.) HASSK. Cat. Hort. Bog. (1844) 227. — *Badiera pulchra* (HASSK.) HASSK. l.c. 227. — *Chamaebuxus venosa* (POIR.) HASSK. Pl. Jav. Rar. (1848) 294; in Miq. Pl. Jungh. 1 (1851) 26, *incl. var. robusta, gracilis, aptera*; in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 154, *incl. subvar. obovata & elliptica, var. minor*. — *Chamaebuxus pulchra* (HASSK.) HASSK. Pl. Jav. Rar. (1848) 294; in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 152. — *P. simassan* MIQ. Fl. Ind. Bat., Suppl. (1861) 392. — Fig. 3e, f.

Erect, sparingly dichotomously branched shrub or small tree, 0.7–5 m high. Twigs terete, (sub)glabrous, fleshy or not, at the nodes sometimes with small pseudostipules. *Leaves* elliptic to lanceolate, 7–33 by 4–13 cm, acuminate, base attenuate, thinly strigose to glabrous, glaucescent beneath, 0.5–3 cm petioled. *Racemes* extra-axillary, mostly reflexed from the base, including the peduncle 2–26(–50) cm long, lax to dense; rachis straight and thick or thin and flexuous. Bracts and bracteoles early caducous. *Flowers* 13–20 mm long, upper petals white or magenta and turning violet, crest yellow and turning

dark violet to brownish, on 6–15(–20) mm long pedicels. *Sepals* white or yellowish, rounded, ciliate, alae obovate. Upper *petals* lanceolate; keel with 2 large massive, wrinkled appendages. *Filaments* free for about one third. Disk annular, sometimes abaxially protruding. *Ovary* obreniform to orbicular; style straight in lower half, in upper half falcate, apically weakly 2-fid, at inner side with the stigmatic lobe. *Capsule* obreniform to didymous, 5–8 by 7.5–12 mm, winged or unwinged, with more or less protruding concentric ribs, coriaceous, greenish purple to deep purple, glabrous. *Seeds* elliptic, at micropylar side with a small appendage, purplish black, glabrous, to halfway or nearly completely covered by the smooth, orange to scarlet aril, the slightly protruding chalaza and the raphe distinctly visible.

Distr. Malesia: Peninsular Thailand (Pattani), Malay Peninsula, Sumatra, Java, Borneo, Philippines.

Ecol. Undershrub or tree in forests, 0–2400 m.

Taxon. VAN STEENIS (1972) distinguished two ecological races: *ssp. pulchra*, with rather small leaves, non-fleshy stems, and lax inflorescence with thin, flexuous axes, and *ssp. venosa* with fleshy leaves and stems, dense inflorescence with thick, straight axes, the first occurring in submontane altitudes on stony, well-drained places in light forest on slopes and ridges, the latter in the depth of primary and secondary forest in deep moist humus, stream valleys and riparian. Also in Java intermediate forms occur. Outside Java the distinction between both types is less distinct or even obscure.

8. *Polygala arillata* BUCH.-HAM. ex D.DON, Prod. Fl. Nep. (1825) 199; WALL. Pl. As. Rar. 1 (1830) 100; MIQ. Fl. Ind. Bat. 1, 2 (1858) 125; BENN. Fl. Br. India 1 (1872) 200, *p.p.*; FORBES & HEMSLEY, J. Linn. Soc. 23 (1886) 59; CHODAT, Monogr. II (1893) 94; TRIMEN, Fl. Ceyl. 1 (1893) 79; BURK. Rec. Bot. Surv. India 4 (1910) 98; HAND.-MAZZ. Symb. Sinic. 7 (1933) 633; KANJILAL & DAS, Fl. Assam 1, 1 (1935) 87; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1938) 231; BANERJI, J. Bomb. Nat. Hist. Soc. 51 (1953) 555; KITAMURA, Fl. Pl. Nepal Himal. (1955) 170; SMITINAND, Thai For. Bull. 2 (1955) 3; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 31; SMITINAND, Nat. Hist. Bull. Siam Soc. 20 (1961) 43; LAUENER, Not. R. Bot.

Gard. Edinb. 26 (1965) 343; KANAI, Fl. E. Himal. (1966) 173; HANSEN c.s. Dansk Bot. Ark. 25 (1967) 83; KANAI, Phot. Pl. E. Himal. (1968) f. 138; MURATA, Acta Phyt. Geobot. 25 (1973) 116; HARA, En. Fl. Pl. Nepal 2 (1979) 50. — *Chamaebuxus arillata* (D.DON) HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 153; KURZ, Fl. Burma 1 (1877) 79, *p.p.* — *P. tonkinensis* CHODAT, Monogr. II (1893) 97. — *Crotalaria duboisii* LÉV. Bull. Soc. Bot. Fr. 51 (1904) 291, *cf.* LAUENER, *l.c.* — Fig. 3g, h.

Erect, dichotomously branched shrub or small tree, 1.5–6 m high. Twigs terete, glabrescent. *Leaves* oblong to ovate-lanceolate, 5–20 by 1.5–8 cm, cuspidate, base attenuate to obtuse, thinly hairy to glabrous, beneath somewhat glaucescent, up to 1.5 cm petioled. *Racemes* terminal, axillary or extra-axillary, erect or rarely pendulous at apex, including the 6–12.5 cm long peduncle, dense. Bracts and bracteoles early caducous. *Flowers* 11–20 mm long, yellow, turning orange and red, on 2–7(–9) mm long pedicels. *Sepals* rounded, ciliate, alae obovate. Upper *petals* lanceolate, keel with 2 much-incised appendages. *Filaments* free for one third. Disk annular. *Ovary* orbicular, sometimes ciliate; style straight in lower half, curved in upper half, apically weakly 2-fid, at inner side with the stigmatic lobe. *Capsule* ± orbicular or somewhat asymmetric, 8–10 by 12–15 mm winged, with prominent concentric ribs, coriaceous, glabrous. *Seeds* globular, at micropylar side with a distinct appendage, black, glabrous or sparsely hairy up to halfway covered by an irregularly lobed and apically rather strongly projecting aril, the little protruding chalaza and the raphe distinctly visible.

Distr. India and Sri Lanka, Nepal, Bhutan, S. China, Hongkong, Burma, Thailand, Indochina; in *Malesia*: Philippines (Palawan; see HANSEN, *l.c.*).

Ecol. Undershrub in forests from 1000–3000 m, in Palawan at 850 m.

Note. *Polygala trichocolpa* CHODAT with about the same distribution (but not yet found in *Malesia*) differs in the branched inflorescence and in the typical, galeate (helm-shaped) aril. *Polygala karenium* KURZ, from Burma to Vietnam and Yunnan, differs in the geniculate style which is nearly recurved in the apical half and is strongly thickened subapically, and in the unribbed capsule.

4. Section *Polygala*

Polygala sect. *Orthopolygala* CHODAT, Monogr. II (1893) 120, *nom. illeg.*

Little- to much-branched annuals to perennial herbs or low chamaephytes with woody base, or (not in Mal.) shrubs or small trees, sometimes nearly aphyllous. *Inflorescences* raceme-like, ter-



Fig. 4. *Polygala javana* DC. Habit, $\times 0.7$ (TEUSMANN s.n.).

minal, (supra-)axillary, or in the forks, unbranched, many or few-flowered. *Sepals* persistent in fruit, the lowest pair sometimes (not in Mal.) partly or wholly connate, or very rarely (not in Mal.) all or only the lateral ones caducous before fruit-setting. *Keel* with usually much-incised appendages or rarely (not in Mal.) inappendiculate. Disk apparently absent. *Style* and stigma variously shaped. *Capsule* mostly more or less orbicular, sometimes elongated, usually narrowly or sometimes widely winged. *Seeds* various, usually at micropylar side with a 2- or 3-lobed aril, sometimes (not in Mal.) with a translucent appendage along the raphe to the chalazal side; glabrous or hairy, rarely set with very long hairs, in the Malesian *spp.* at chalazal side inappendiculate.

9. *Polygala javana* DC. Prod. 1 (1824) 327; W. & A. Prod. 1 (1834) 38; MIQ. Fl. Ind. Bat. 1, 2 (1858) 124; THWAITES, En. (1864) 22; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 180; BENN. Fl. Br. India 1 (1872) 201; TRIMEN, Fl. Ceyl. 1 (1893) 80; BACKER, Schoolfl. Java (1911) 79; Onkruidfl. Suiker. (1934) 394, Atlas t. 375; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 44, *excl. var.*; BACKER & BAKH.f. Fl. Java 1 (1963) 198; ADEMA, Blumea 14 (1966) 261; MATTHEW, Fl. Tamil. Carnatic 1 (1981) 70. — *P. tinctoria* (non VAHL) HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 181, *p.p.* — Fig. 4, 5.

Perennial, erect, branched herb, up to 80 cm high. Stem terete, becoming woody at base, set with short curved hairs. *Leaves* mostly obovate-oblong, 5–35 by 2–12 mm, sessile, mucronate, with recurved margins shortly hairy at both sides, in transmitted light finely punctate-dotted. *Racemes* supra-axillary,

often leaf-opposed, the free part 2–8 cm long. Bracts persistent, \pm rhomboid, 1–2 mm long, hairy. *Flowers* 8–10 mm long, with purple crista and yellowish alae. *Sepals* mucronate, hairy on both sides, ciliate, the alae broadly ovate, flabellate-veined. Upper *petals* oblong, hairy inside in basal half; keel auriculate and there sometimes hairy, with 2 much-incised appendages. *Filaments* free for 1/8–1/3. *Ovary* \pm quadrangular with rounded sides, apically notched, hairy all over; style straight in lower half, curved in upper half, subapically at inner side with 2 small, spaced, stigmatic lobes, slightly widened between the lobes. *Capsule* smaller than the alae, \pm quadrangular, apically notched, with a narrow, membranous, veined margin, hairy. *Seeds* \pm globular, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. Sri Lanka and S. India; in *Malesia*: Java

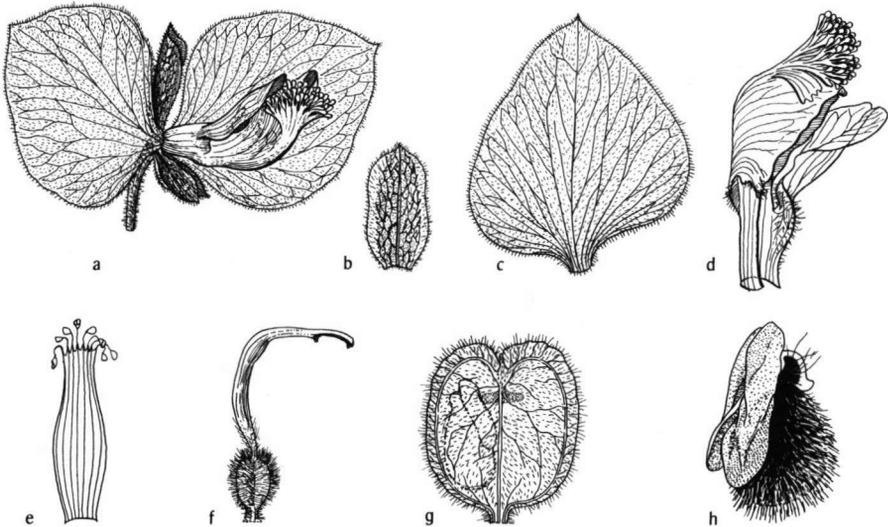


Fig. 5. *Polygala javana* DC. a. Flower; b. upper sepal; c. ala; all $\times 4$; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; all $\times 6$; g. fruit, $\times 4$; h. seed, $\times 6$ (a–f TEIJSMANN s.n., g, h BACKER 36532).

(from Semarang eastwards, incl. Madura & Kangean Is.), Lesser Sunda Islands (Bali, Lombok, Sumba, Sumbawa, Flores, Timor).

Ecology. Characteristic for areas subject to a strong dry season, in teak forests, between grass, several times on limestone, below 250 m, once at 700 m in Sumba.

10. *Polygala japonica* HOUTT. Handl. 10 (1779) t. 62 f. 1; DC. Prod. 1 (1824) 324; BENTH. Fl. Austr. 1 (1863) 138; CHODAT, Monogr. II (1893) 353; F.M. BAILEY, Queensl. Fl. 1 (1899) 78; MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 106; GAGNEP. Fl. Gén. I.-C. 1 (1909) 255; MERR. En. Philip. 2 (1923) 384; YAMAZUTA, List Manch. Pl. (1930) 176; MASAMUNE, Yakusima (1934) 263; MAKINO, Ill. Fl. Japan (1954) 382; OHWI, Fl. Japan (1965) 587; ADEMA, Blumea 14 (1966) 263, f. 8; Proc. R. Soc. Queensl. 80 (1969) 126; HORIKAWA, Atlas Jap. Fl. 1 (1972) 155; WILLIS, Pl. Vict. 2 (1972) 342; WALKER, Fl. Okinawa (1976) 623; HUI-LIN LI c.s. Fl. Taiwan 3 (1977) 558, f. 726; THOMPSON, Fl. New South Wales

112 (1978) 14. — *P. vulgaris* (non L.) THUNB. Fl. Jap. (1784) 277. — *P. veronicaea* F.v.M. Trans. Vict. Inst. 1 (1855) 117; CHODAT, Monogr. II (1893) 355 (*veronicaefolia*); DOMIN, Bibl. Bot. 89 (1927) 855; BURB. Fl. Austr. Cap. Terr. (1970) 244, t. 237. — *P. khasyana* HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 176. — *P. sibirica* (non L.) HASSK. l.c. 260; BENN. Fl. Br. India 1 (1872) 205, p.p.; EWART, Fl. Vict. (1931) 715. — *P. sibirica* L. var. *japonica* (HOUTT.) T. ITO, J. Coll. Sc. Univ. Tokyo 12 (1899) 311. — *P. luzoniensis* MERR. Philip. J. Sc. 1 (1906) Suppl. 202. — *P. hondoensis* NAKAI, Bot. Mag. Tokyo 36 (1922) 21. — Fig. 6.

Perennial, prostrate or ascending, branched undershrub 10–20 cm high, mostly developing a woody, rhizomatous, erect root crown or stem base. Stem terete, becoming woody at the base, set with short curved hairs. *Leaves* ovate to elliptic, the lower ones proportionally broadest, 5–15 by 3–8 mm, sessile, acute, with slightly recurved margin, prominent-reticulate veined, mostly minutely hairy on at least midrib and margin, in transmitted light faintly

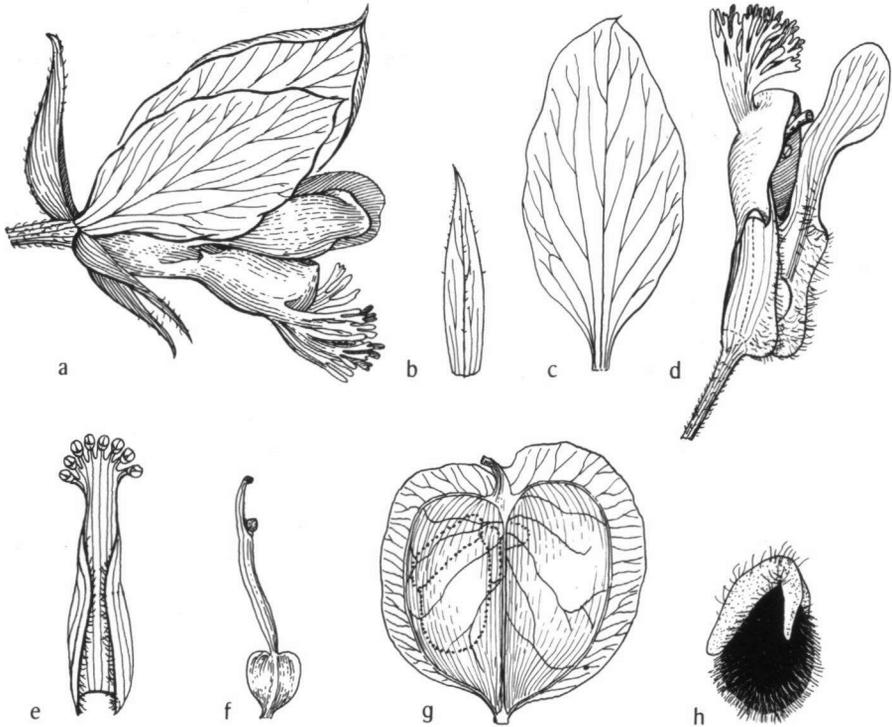


Fig. 6. *Polygala japonica* HOUTT. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 7$ (a–f SHAW MAYER s.n.; g, h BORGMANN 326).

finely punctate-dotted. *Racemes* supra-axillary, the free part 1–3 mm long, rather few-flowered. Bracts and bracteoles early caducous. *Flowers* 5–7 mm long, mauve or purple to deep lavender. *Sepals* mucronate, the outer shortly hairy, the alae elliptic, 3–5-nerved. Upper *petals* oblong, rarely (JACOBS 7428) absent or very much reduced, hairy inside in basal half; keel articulate, with 2 much-incised appendages. *Filaments* (nearly) connate to apex. *Ovary* broadly obovate, glabrous; style (nearly) straight, subapically at inner side with 2 small, spaced (1 mm) stigmatic lobes, the lower one \pm knob-like. *Capsule* broader and somewhat shorter than the alae, c. 4–5 by 5 mm, emarginate apically, with a rather wide (c. 1 mm), veined membranous margin which is apically often wider than basally. *Seeds* \pm ovoid, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. NE. India, Burma, Sri Lanka, Indochina, China, Japan, Korea and E. Siberia, also in the Ryukyu Is. and Taiwan, in E. Australia southwards to NE. Victoria; in *Malesia*: Philippines (Luzon, Mindoro) and New Guinea.

Ecol. Roadsides, grasslands, trodden ground in

the mountains, 1200–2600 m; in Japan from 0–1500(–2000) m.

Note. Closely allied to *P. sibirica* L., which occurs from Central Europe to Central China and NE. India (Khasya). This differs in the following characters: leaves mostly longer and narrower, ovary orbicular and ciliate, stigmas closer together, capsule oblong with narrower wing.

11. *Polygala persicariaefolia* DC. Prod. 1 (1824) 326; WALL. Pl. As. Rar. 2 (1831) 79, t. 184; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 178; OLIV. Fl. Trop. Afr. 1 (1868) 129; BENN. Fl. Br. India 1 (1872) 202; F.v.M. Descr. Not. Pap. Pl. 7 (1887) 26; CHODAT, Monogr. II (1893) 331; F.M.BAILEY, Queensl. Fl. 1 (1899) 78; K.SCH. & LAUT. Fl. Schutzgeb. Südsee, Nachtr. (1905) 326; F.M.BAILEY, Compr. Cat. Queensl. Pl. (1913) 43; MERR. En. Philip. 2 (1923) 384; CRAIB, Fl. Siam. En. 1 (1931) 103; MERR. Pap. Mich. Ac. Sc. 20 (1935) 100; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1938) 236; BANERJI, J. Bomb. Nat. Hist. Soc. 51 (1953) 555; *ibid.* 55 (1958) 251; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 45; BACKER & BAKH.f. Fl. Java 1 (1963) 199; BANERJI,

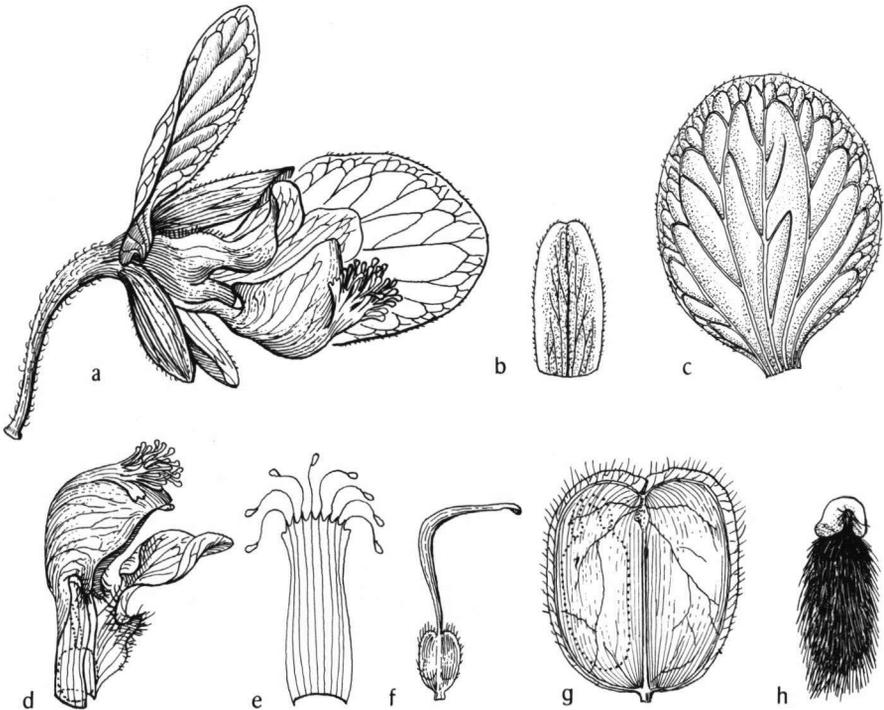


Fig. 7. *Polygala persicariaefolia* DC. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 7.5$ (a–f PRINGGO ATMODOJO 123; g, h IBOET 32).

Rec. Bot. Surv. India 19² (1965) 25; KANAI, Fl. E. Himal. (1966) 173; ADEMA, Blumea 14 (1966) 265, f. 9; Proc. R. Soc. Queensl. 80 (1969) 128; MATTHEW, Fl. Tamil. Carnatic 1 (1981) 72. — *P. buchanani* BUCH.-HAM. ex D.DON, Prod. Fl. Nepal. (1825) 199, nom. superfl., illeg. — *P. wallichiana* WIGHT, Ill. 1 (1831) 49, t. 22A. — *P. rufa* SPAN. Linnaea 15 (1841) 167, Ic. 40 (ined.). — *P. septemneria* MERR. Philip. J. Sc. 1 (1906) Suppl. 202. — Fig. 7.

Annual, erect, mostly branched herb, up to 70 cm high. Stem terete, set with short curved hairs. *Leaves* lanceolate to linear-lanceolate, 15–50 by 3–10 mm, shortly petioled, mucronate, with flat margin, thin, shortly hairy to (sub)glabrous, in transmitted light finely punctate-dotted. *Racemes* in the forks and terminal on the lateral branches, 1–10 cm long, rather few-flowered. Bracts persistent, lanceolate, c. 1 mm long, shortly hairy. *Flowers* 6–7 mm long, light violet turning purple, with whitish alae. *Sepals* blunt, ciliate or the alae sometimes completely glabrous, alae broadly elliptic to ± orbicular, 5-veined. Upper *petals* oblong, hairy inside in basal half; keel auriculate and there sometimes hairy, with 2 much-incised appendages. *Filaments* free for 1/4–1/2. *Ovary* elliptic, ciliate; style straight in lower half, curved in upper half, subapically at inner side with 2 closely approximate stigmatic lobes. *Capsule* somewhat smaller than the alae, c. 5 mm long, broadly elliptic, emarginate, with a rather narrow, veined, sparsely ciliate wing widening apically. *Seeds* oblong, at micropylar side with a small, unequally 3-lobed aril, black, hairy.

Distr. Africa (Angola via South Africa to Ethiopia), SE. Asia (India, Upper Burma, Thailand), S. China (Yunnan), also in Australia (N. Queensland); in *Malesia*: Sumatra (northern half), E. Java (Mt Idjen), Lesser Sunda Islands (Bali, Lombok, Flores, Timor, Alor), Philippines (Luzon) and throughout New Guinea.

Ecol. In waste and often arid or stony places, mainly in grasslands, along roadsides, on old lava-streams, etc., (300–)500–1500(–1800) m.

12. *Polygala longifolia* POIR. in Lamk. Encycl. 5 (1804) 501; DC. Prod. 1 (1824) 325; F.v.M. Descr. Not. Pap. Pl. 6 (1885) 4; CHODAT, Monogr. II (1893) 358; BURK. Rec. Bot. Surv. India 4 (1910) 98; BACKER, Schoolfl. Java (1911) 79; MERR. En. Philip. 2 (1923) 384; CRAIB, Fl. Siam. En. 1 (1931) 103; BANERJI, J. Bomb. Nat. Hist. Soc. 51 (1953) 555; KITAMURA, Fl. Pl. Nepal Himal. (1955) 171; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 40; BACKER & BAKH.f. Fl. Java 1 (1963) 199; LAUENER, Not. R. Bot. Gard. Edinb. 26 (1965) 344; ADEMA, Blumea 14 (1966) 266, f. 11; Proc. R. Soc. Queensl. 80 (1969) 127; WALKER, Fl. Okinawa (1976) 623; HARA, En. Fl. Pl. Nepal 2 (1979) 50; GILLI, Ann. Naturhist. Mus. Wien 83 (1980) 452; ANON. Icon. Corm. Sin. Suppl. 2 (1983) 183, f. 8783. — *P. leptalea* DC. Prod. 1 (1824) 325; BENTH. Fl. Austr. 1 (1863) 139; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 173; BENN. Fl. Br. India 1 (1872) 202; F.M. BAILEY, Queensl. Fl. 1 (1899) 78; DOMIN, Beitr. Fl. & Pfl. Geogr. Austr. 1 (1927) 855. — *P. oligophylla* DC. Prod. 1 (1824) 325; CHODAT, Monogr. II (1893) 353. — *P. discolor* BUCH.-HAM. ex D.DON, Prod. Fl. Nepal. (1825) 199. — *P. pyramidalis* LÉV. Bull. Soc. Bot. Fr. 51 (1904) 291. — *P. riukiuiensis* OHWI, J. Jap. Bot. 12 (1936) 661; MASAMUNE, En. Trach. 5 (1955) 148. — Fig. 8.

Annual, erect, little-branched herb up to 80 cm high. Stem ribbed, glabrous or upwards set with short, curved hairs. *Leaves* proportionally few, linear to linear-lanceolate, the lowest ones slightly broader, 10–55 by 1–6 mm, subsessile, acute, with recurved margins, (sub)glabrous, 1-nerved. *Racemes* mostly terminal, 2–20 cm long, dense. Bracts and bracteoles early caducous. *Flowers* 3–4, in fruit up to 5 mm long (including the alae), lilac, turning purple, when dry whitish. Outer *sepals* acute, glabrous to ciliate, alae elliptic to obovate, rounded, 3-nerved, glabrous. Upper *petals* oblong, glabrous or rarely hairy inside in basal half; keel not auriculate, glabrous or rarely sparsely hairy outside, apically with 2 rather few-divided appendages. *Filaments* free for

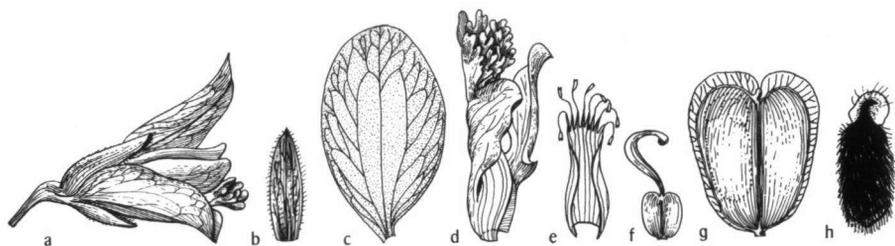


Fig. 8. *Polygala longifolia* POIR. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; all $\times 7$; h. seed, $\times 7.5$ (BRASS 32360).

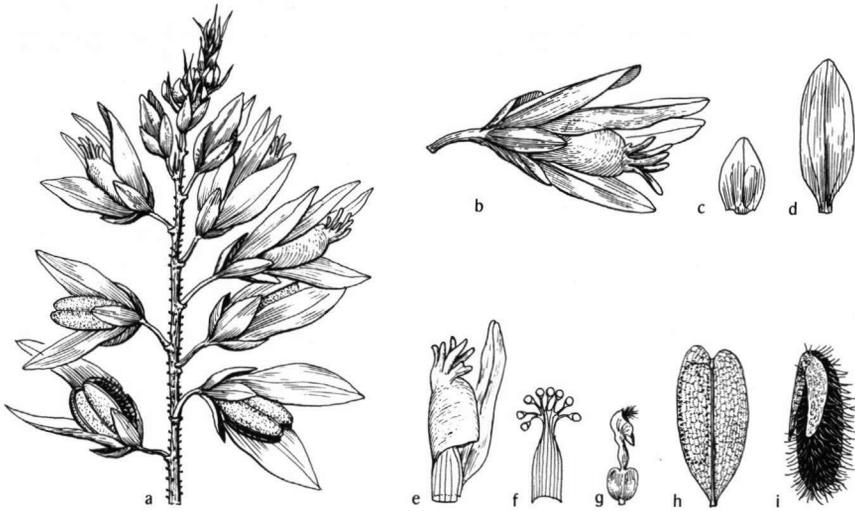


Fig. 9. *Polygala paniculata* LINNÉ. *a.* Inflorescence, $\times 8$; *b.* flower; *c.* upper sepal; *d.* ala; *e.* keel enveloping staminal tube, at right one petal; *f.* opened staminal tube; *g.* pistil; *h.* fruit; all $\times 10$; *i.* seed, $\times 12.5$ (ELBERT 218).

1/4–1/2. Ovary elliptic, glabrous; style strongly curved, (sub)apically at inner side with a single, relatively large, knob-shaped stigmatic lobe. Capsule shorter than the alae, broadly elliptic to obovate, *c.* 3–3.5 mm long, emarginate, with a narrow, veined, glabrous wing widening apically. Seeds oblong, at micropylar side with a small, unequally 3-lobed aril, dark, hairy.

Distr. Sri Lanka, India, Nepal, Thailand, Indochina, China, Ryukyu Is. and northern Australia; in *Malesia*: N. Sumatra, N. Borneo, SW. Celebes, Philippines (Luzon), Lesser Sunda Islands (Sumba), Moluccas (Kai Is.), and throughout New Guinea.

Ecol. Mainly grasslands (often burned), 0–1400 m; obviously with a preference for areas subject to a dry season.

Note. The type specimen, collected by COMMERSON (P, Fl) is said to hail from Java, but this is certainly an error, *cf.* Fl. Males. I, 1 (1950) xxix.

13. *Polygala paniculata* LINNÉ, Syst. ed. 10 (1759) 1154; Amoen. 5 (1759) 402; CHODAT, Monogr. II (1893) 229; K.SCH. & LAUT. Fl. Schutzgeb. Südsee, Nachtr. (1905) 285; BACKER, Schoolfl. Java (1911) 79; BACKER & SLOOTEN, Handb. Thee. (1924) 159; BACKER, Onkruidfl. Suiker. (1930) 393, Atlas t. 374; SINCLAIR, Gard. Bull. Sing. 14 (1953) 31; BACKER & BAKH.f. Fl. Java 1 (1963) 78; ADEMA, Blumea 14 (1966) 267; HANSEN c.s. Dansk Bot. Ark. 25 (1967) 84; ADEMA, Proc. R. Soc. Queensl. 80 (1969) 128;

STONE, Micronesica 6 (1970) 362; HENTY & PRITCH. Div. Bot. Lae, Bot. Bull. 7 (1973) 136; HUI-LIN LI c.s. Fl. Taiwan 3 (1977) 558; GILLI, Ann. Naturhist. Mus. Wien 83 (1980) 452; A.C.SMITH, Fl. Vit. Nova 3 (1985) 723. — *P. variabilis* (non H.B.K.) HASSK. Retzia (1855) 149. — *P. fernandesiana* PAIVA, Bol. Soc. Brot. III, 53 (1981) 1460. — Fig. 9.

Annual, erect, mostly much-branched herb, up to 50 cm high. Stem terete, set with numerous small shortly stalked glands. Leaves lanceolate to linear-lanceolate, 5–20 by 1–4 mm, shortly petioled, acute, margin slightly recurved, (sub)glabrous, 1-nerved, the lowest ones in one or more pseudowhorls of 4–5. Racemes all terminal, 2–15 cm long. Bracts and bracteoles early caducous. Flowers whitish or often purple tinged, 1.5–2 mm long, glabrous. Sepals lanceolate, obtuse, the alae weakly 3-nerved. Upper petals lanceolate; keel not auriculate, with 2 ± 6 -fid appendages. Filaments free for $\pm 1/8$. Ovary \pm orbicular; style straight to near apex, there curved and strongly widened in an asymmetrical, wide cup, terminally with a hair tuft, diametrically opposed to this with the stigmatic lobe. Capsule somewhat longer than the alae, \pm elliptic, *c.* 2 mm long, slightly notched, not winged. Seeds oblong, at micropylar side with a one-sided, deeply 2-fid aril, black, hairy.

Distr. Native in tropical America, from Brazil to Mexico. Introduced in Central tropical Africa (PAIVA, l.c.) and Indo-Australia. In *Malesia* unintentionally introduced as early as 1845 or 1846

(BACKER, 1930) and since then abundantly naturalized throughout. Also in NE. Australia, Taiwan, and S. Japan (Okinawa), further widespread in Melanesia (Bismarcks, Solomons, New Hebrides, New Caledonia), Micronesia (Carolines), Polynesia (Fiji, Samoa, Marquesas, and recently in Hawaii).

Ecol. Waste places and fields, often abundant, on different soil types, avoiding the driest areas, 0–2250 m.

14. *Polygala exsuarrosa* ADEMA, *Blumea* 14 (1966) 268; *Proc. R. Soc. Queensl.* 80 (1969) 125. — *P. arvensis* var. *squarrosa* BENTH. *Fl. Austr.* 1 (1863) 141, non *P. squarrosa* L.f., 1781. — **Fig. 10.**

Annual, erect or ascending, branched herb up to 15 cm high. Stem terete, set with long erect and short curved hairs. *Leaves* linear to linear-lanceolate, 5–15 by c. 1 mm, subsessile, mucronate, with recurved margin, sparingly set with long hairs, 1-nerved. *Racemes* supra-axillary, usually not more than 1 cm long, very dense. Bracts persistent, lanceolate, c. 1 mm long, hairy. *Flowers* 4–5 mm long, whitish with green alae. *Sepals* lanceolate, acuminate, hairy, the alae asymmetric, 3-nerved. Upper *petals* spatulate to oblong, hairy inside in basal half; keel auriculate, with 2 little-incised appendages. *Filaments* free for 1/3, the staminal tube adaxially split for 1/4 into two bundles of 4 filaments. *Ovary* asymmetrically quad-

rangular, patently hairy; style straight in basal half, curved in upper half, apically obliquely 2-fid, the upper part sterile, the stigmatic lobe situated at inner side. *Capsule* much shorter but somewhat wider than the alae, c. 2–2.5 mm long, asymmetrically quadrangular, deeply notched apically, narrowly winged, set with stiff, long hairs. *Seeds* ovoid, at micropylar side with an unequally 3-lobed aril, black, densely set with rather long appressed hairs.

Distr. Australia (Northern Territory; Queensland: Thursday I., Brisbane); in *Malesia*: SE. Moluccas, Aru Is. (Trangan), New Guinea (Cyclops Mts: 1 coll.; Papua: W. Distr., 1 coll.).

Ecol. Sandy savannah in hilly country, a few metres above sea-level.

Note. Similar to the Australian species *P. eriocephala* BENTH.; its affinity with that species should be further examined.

15. *Polygala polifolia* PREST, *Rel. Haenk.* 2 (1835) 101; *MERR.* *En. Philip.* 2 (1923) 384; HUI-LIN LI *c.s.* *Fl. Taiwan* 3 (1977) 558 ('*polyfolia*'). — *P. brachystachya* DC. *Prod.* 1 (1824) 326, non POIRET, 1816, *nom. illeg.*; MUKHERJEE, *Bull. Bot. Soc. Beng.* 12 (1961) 43 ('*brachistachyos*'), nec BLUME, 1825. — *P. telephoides* (non WILLD.) W. & A. *Prod.* 1 (1834) 36; THWAITES, *En. Pl. Zeyl.* (1864) 22; BENN. *Fl. Br. India* 1 (1872) 205; TRIMEN, *Fl. Ceyl.* 1 (1893) 80;

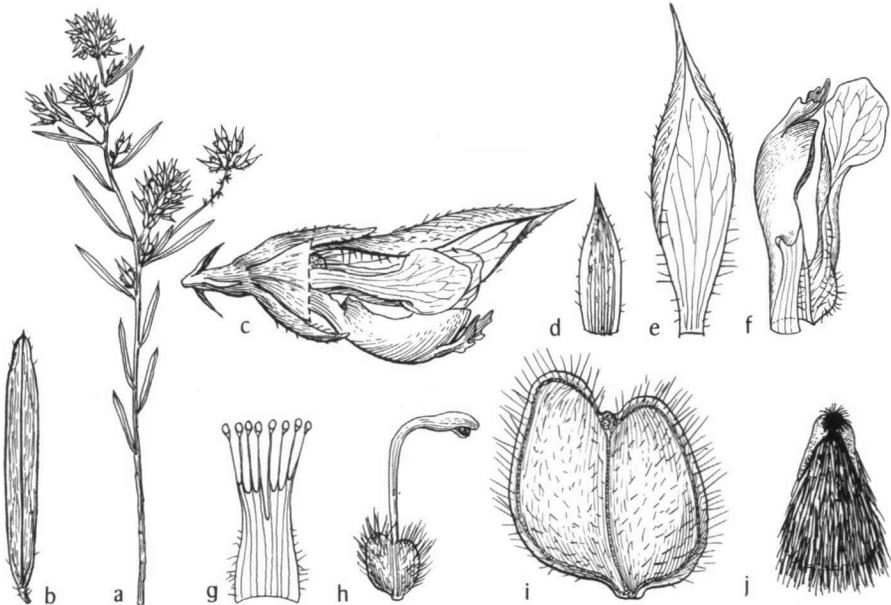


Fig. 10. *Polygala exsuarrosa* ADEMA. *a.* Habit, $\times 0.5$; *b.* leaf, $\times 2$; *c.* flower, one ala cut away; *d.* upper sepal; *e.* ala; *f.* keel enveloping staminal tube, at right one petal; *g.* opened staminal tube; *h.* pistil; *i.* fruit; *j.* seed. All $\times 10$ (BUWALDA 5344).

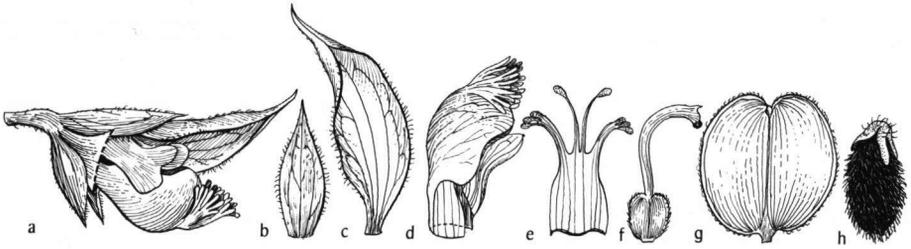


Fig. 11. *Polygala polifolia* PRESL. a. Flower, one ala cut away; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 10$ (RAHMAT SI TOROES 4561).

ADEMA, *Blumea* 14 (1966) 269, *in syn.*; NAKAJIMA, *Hokuriku J. Geobot.* 18 (1970) 124; MATTHEW, *Fl. Tamil. Carnatic* 1 (1981) 74. — *P. buxiformis* HASSK. in *Miq. Ann. Mus. Bot. Lugd.-Bat.* 1 (1863) 161. — *P. chinensis* (non L.) BENN. *Fl. Br. India* 1 (1872) 204; F.v.M. *Descr. Not. Pap. Pl.* 9 (1890) 55; CHODAT, *Monogr. II* (1893) 385; K.SCH. & LAUT. *Fl. Schutzgeb. Südsee, Nachtr.* (1905) 284; GIBBS, *J. Linn. Soc. Bot.* 42 (1914) 59; MERR. *En. Born.* (1921) 324; ADEMA, *Blumea* 14 (1966) 269, f. 15; YAMAZAKI, *J. Jap. Bot.* 49 (1974) 227; WALKER, *Fl. Okinawa* (1976) 623. — *P. warburgii* CHODAT *ex* WARB. *Bot. Jahrb.* 13 (1891) 346; CHODAT, *Monogr. II* (1893) 315. — *P. simadae* MASAMUNE, *J. Soc. Trop. Agr.* 3 (1931) 114; *En. Trach.* 5 (1955) 148. — *P. arvensis* (non WILLD.) ADEMA, *Blumea* 14 (1966) 269, *in syn.*; BURTT, *Not. R. Bot. Gard. Edinb.* 32 (1972) 404; IQBAL DAR, *Fl. W. Pakist.* 52 (1973) 7, f. 3a-c. — Fig. 11.

Annual, erect to prostrate, branched herb up to 50 (–70) cm high. Stem terete, set with short curved hairs. *Leaves* elliptic to lanceolate, 2–20 by 1–7 mm, subsessile, acute to mucronate, with slightly recurved margin, sparsely hairy to subglabrous, 1-nerved. *Racemes* supra-axillary, up to 1 cm long, few-flowered and cluster-like. Bracts persistent, minute, acute, ciliate. *Flowers* c. 2.5–3(–3.5) mm long, light to deep blue, turning violet, alae green and often partly red. *Sepals* lanceolate, acuminate, ciliate, alae asymmetric, 5-nerved. Upper *petals* \pm spatulate, emarginate, shorter than the keel; keel auriculate, at apex with 2 much-incised appendages. *Staminal tube* split halfway, with 2 single filaments and 2 bundles of 3 fully connate filaments with sessile anthers. *Ovary* broadly elliptic, ciliolate and sometimes minutely hairy; style curved in apical half, apically widened, stunted, on one side with a sterile, more or less pronounced tip, the other side (situated at inner side) with a more or less pronounced stigmatic lobe. *Capsule* shorter but wider than the alae, c. 1.5 mm long, almost orbicular, very narrowly winged, cilio-

late, further glabrous to sparsely hairy. *Seeds* oblong, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. Pakistan, Sri Lanka, India, Bangla Desh, Thailand, Indochina, China (and Hongkong), Taiwan, Ryukyu Is., Micronesia (Ponape) and northern Australia; in *Malesia*: Sumatra, Malay Peninsula (Johore), ?Java, Lesser Sunda Islands (Sumba), Celebes, Philippines (Mindoro, Luzon, Mindanao), Moluccas (Ceram, Ambon), New Guinea.

Ecol. Along roadsides, in grasslands, in waste places, 0–750(–1800 m).

Notes. Unfortunately MUKHERJEE's revision of the Indian and Burmese species of *Polygala* has been neglected by ADEMA, and following him, by subsequent authors. As a result it was not until BURTT (*l.c.*) showed that MERRILL (*l.c.*) correctly assigned the name *P. chinensis* L. to the next species, that that name was commonly used for the present species. Based on ADEMA's revision (1966), BURTT chose the name *P. arvensis* WILLD. for it. Examination of the type material of both *P. arvensis* WILLD. and *P. telephoides* WILLD. (in B) revealed, however, that those names also should be attributed to the next species. As *P. brachystachya* DC. (the name which MUKHERJEE chose) is a later homonym of POIRET's name, it cannot be accepted, thus preventing future confusion with *P. brachystachya* BLUME, which is a synonym of *P. glaucoides* L. As the type of *P. polifolia* (in PRC, kindly examined by Dr. J. CHRTEK) certainly belongs to the present species, this name must be chosen as the correct one.

The synonymy of this and the following species is very complicated, and must remain partly unclear, not only for the name *chinensis*, but likewise for the names *arvensis*, *brachystachya*, *elongata*, *linarifolia*, and *telephoides*. ADEMA (*l.c.*) did not succeed in unraveling this complex synonymy, and added a new series of mistakes in this matter.

The only sheet from Java is an old specimen from Krawang without indication of the collector; besides

it has monstrous flowers. It is suspected to be mislocalized because no later collections have been made of this species in Java.

16. *Polygala chinensis* LINNÉ, Sp. Pl. 1 (1753) 704; MERR. Trans. Am. Phil. Soc. 24² (1935) 228; *non auct. var.*; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 38, *excl. var. linearifolia et hirsuta*. — *P. glomerata* LOUR. Fl. Cochinch. (1790) 426; DC. Prod. 1 (1824) 326; MIQ. Fl. Ind. Bat. 1, 2 (1858) 125; BACKER, Schoolfl. Java (1911) 78; MERR. En. Born. (1921) 324; En. Philip. 2 (1923) 353; BACKER & SLOOTEN, Handb. Thee. (1924) 158; BACKER & BAKH.f. Fl. Java 1 (1963) 198; ADEMA, Blumea 14 (1966) 270, f. 16; BURTT, Not. R. Bot. Gard. Edinb. 32 (1972) 403. — *P. telephoides* WILLD. Sp. Pl. 3 (1803) 876; *non auct. plur.* — *P. arvensis* WILLD. Sp. Pl. 3 (1803) 876; ROXB. Fl. Ind. (ed. Carey) 3 (1832) 218; W. & A. Prod. (1834) 236; WALP. Rep. 1 (1842) 233; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 162; MATTHEW, Fl. Tamil. Carnatic 1 (1981) 65; *non BENTH.* 1864, *nec BURTT*, 1972. — ? *P. tranquebarica* MART. Denkschr. Bot. Ges. Regensb. 1 (1815) 186. — *P. densiflora* BLUME, Bijdr. (1825) 59; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 166; CHODAT, Monogr. II (1893) 380; K.SCH. & LAUT. Fl. Schutzgeb. Südsee, Nachtr. (1905) 284. — *P. toxoptera* TURCZ. Bull. Soc. Nat. Mosc. 27² (1854) 348. — **Fig. 12.**

Perennial, erect or ascending, mostly branched herb or undershrub up to 75 cm high, becoming woody at base, with a thickened root crown. Stem terete, becoming woody at base, set with curved short hairs and with straight long hairs. *Leaves* very variable, from broadly elliptic to lanceolate, 5–65 by 2–20 mm, shortly petioled, acute to mucronate, with slightly recurved margin, sparsely shortly hairy, few-nerved. *Racemes* supra-axillary, up to 1.5 cm long, few-flowered and cluster-like. Bracts caducous before or during anthesis, minute, lanceolate, ciliate. *Flowers* c. 4.5 mm long, white with green alae. *Sepals* lanceolate, acuminate and with a long mucro, ciliate, alae asymmetric, 5-nerved. Upper *petals* spatulate, about as long as the keel, inside hairy in basal half; keel more or less auriculate, with 2 bundles of filiform appendages. *Filaments* ± halfway free. *Ovary* orbicular, emarginate, ciliate; style strongly curved in the apical half, subapically strongly reflexed with the stigmatic lobe inside. *Capsule* shorter but somewhat wider than the alae, c. 4 by 4 mm, somewhat asymmetrically orbicular, notched, with a narrow distinctly ciliate wing. *Seed* ovoid, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. NE. India to S. China, Thailand and Indochina; in *Malesia*: Malay Peninsula (Penang), Sumatra, Java (very common in W. Java, much less so in Central and E. Java), Lesser Sunda Islands

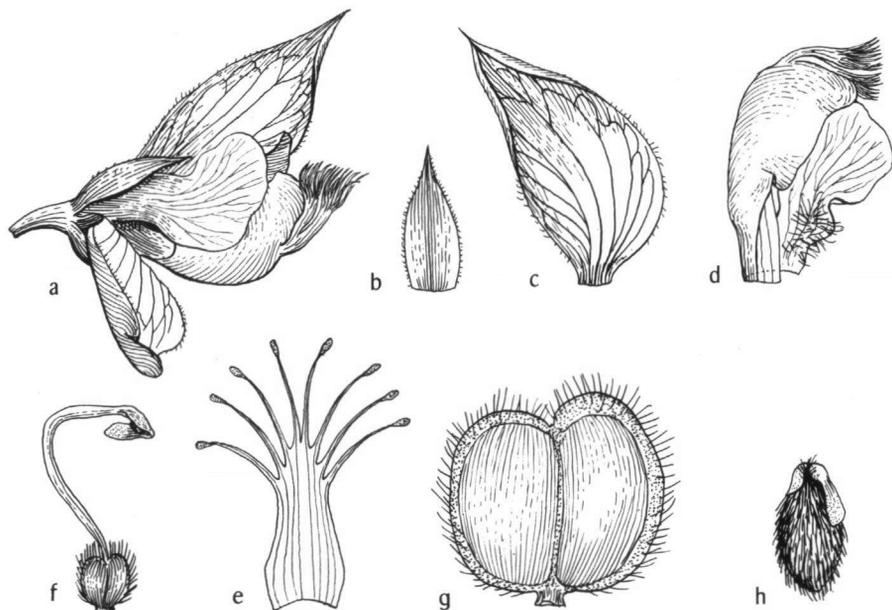


Fig. 12. *Polygala chinensis* LINNÉ. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 7$ (ADELBERG 313).

(Sumbawa, Sumba, Flores), SE. Borneo and Sarawak, Philippines (Luzon, Jolo, Mindanao), New Guinea.

Ecol. Waste places, rubber estates, grasslands, roadsides, largely restricted to everwet areas, from 0–1300 m, in Java several times reported from limestone.

Notes. The name *P. chinensis* L. has been misapplied in nearly all cases, most often for *P. polifolia*, but also for *P. triflora* and *P. glaucoides*. Therefore, BURTT (1972) rejected the name for the present species, addressing it as *P. glomerata*. I cannot follow this illegal procedure.

For remarks on synonymy, see under 15. *P. polifolia*.

17. *Polygala wightiana* W. & A. Prod. (1834) 38; WALP. Rep. 1 (1842) 232; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 170; CHODAT, Monogr. II (1893) 358; ADEMA, Blumea 14 (1966) 272, f. 17; Proc. R. Soc. Queensl. 80 (1969) 128; MATTHEW, Fl. Tamil. Carnatic 1 (1981) 74. — Fig. 13.

Annual, erect or ascending, little-branched herb up to 40 cm high. Stem terete, glabrous. *Leaves* linear-lanceolate, 7–20 by 1–2 mm, subsessile,

acute, mucronate, with slightly recurved margin, glabrous, 1-nerved. *Racemes* supra-axillary, the free part 5–17 cm long. Bracts persistent, lanceolate, minute, glabrous. *Flowers* c. 4 mm long, pale yellow to red with green alae. *Sepals* lanceolate, mucronate, apically sparsely ciliate, alae asymmetric, 3-nerved. Upper *petals* spatulate, somewhat longer than the keel, inside hairy in lower half, keel auriculate and there hairy, with two bundles of much-incised appendages. *Staminal tube* split halfway, with 2 partly connate filaments and 2 bundles of 3 largely connate filaments. *Ovary* elliptic, notched, (sub)glabrous; style strongly curved in apical half, subapically strongly recurved with the stigmatic lobe inside and with 2 wings, one below the stigma at lateral side, one median at the outer side of the curve. *Capsule* somewhat shorter than the alae, elliptic, strongly notched, c. 3.5 mm long, narrowly winged, (sub)glabrous. *Seeds* oblong to cylindrical, at micropylar side unequally shortly 3-lobed, black, hairy.

Distr. India (Deccan Peninsula; apparently rare) and Australia (N. Queensland); in *Malesia*: Lesser Sunda Islands (Flores).

Ecol. In open grassland obviously with a preference for areas subject to a dry season, 0–500 m.

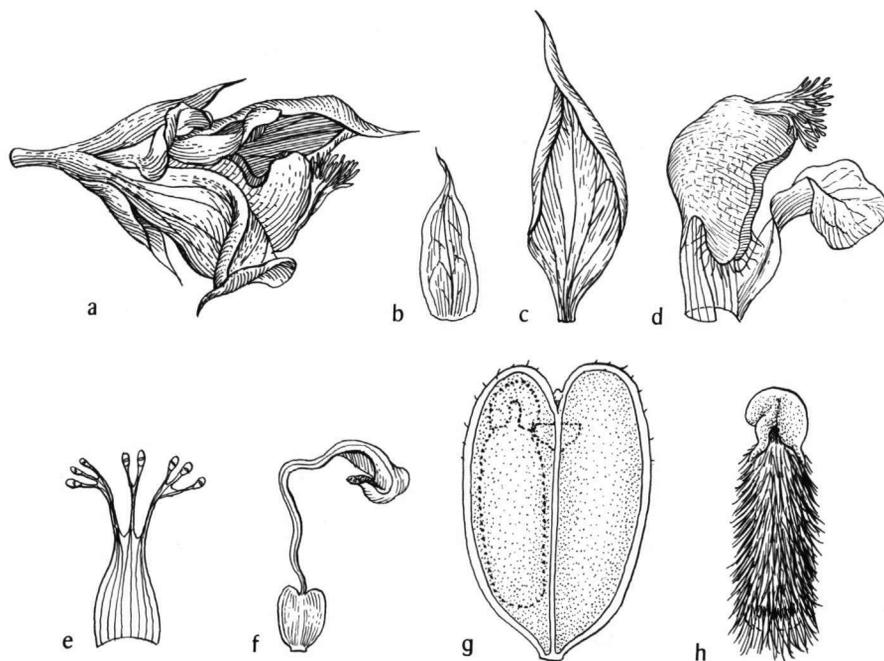


Fig. 13. *Polygala wightiana* W. & A. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 10$ (WALLICH 4190).

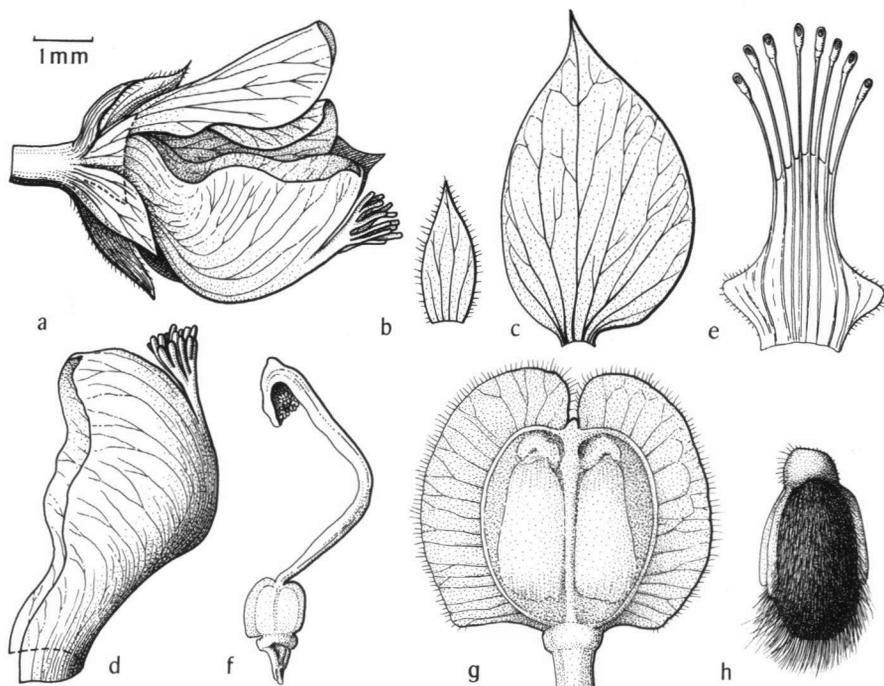


Fig. 14. *Polygala rhinanthoides* BENTH. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. Scale bar 1 mm.

18. *Polygala rhinanthoides* BENTH. Fl. Austr. 1 (1863) 140; CHODAT, Monogr. II (1893) 384; F.M. BAILEY, Queensl. Fl. 1 (1899) 79; BANKS & SOL. III. Bot. Voy. Endeav. 1 (1900) 9, t. 14; F.M. BAILEY, Compr. Cat. Queensl. Pl. (1913) 43; DOMIN, Bibl. Bot. 89 (1927) 856; ADEMA, Proc. R. Soc. Queensl. 80 (1969) 128. — Fig. 14.

Annual, erect to ascending, little-branched herb up to 70 cm high. Stem terete, set with short curved and few long erect hairs. Leaves lanceolate to linear-lanceolate, 15–55 by 2–10 mm, sessile, mucronate, with recurved margin, more or less hairy, 1-nerved or with very weak secondary nerves. Racemes (supra-)axillary, shorter to much longer than the leaves, the free part 1–10 cm long. Bracts persistent, minute, acute, hairy. Flowers 5–7 mm long, bright green or bluish, turning pinkish to purple with green alae. Outer sepals lanceolate, acute, shortly hairy, the alae broadly ovate, rounded, mucronate, many-nerved, hairy. Upper petals elliptic-spathulate, somewhat shorter than the keel; keel not auriculate, with 2 bundles of much incised short appendages. Filaments halfway free. Ovary ± quadrangular, notched at both ends, ciliate; style strongly curved in apical half, subapically strongly reflexed with the stigmatic lobe inside and with a small tooth

at the outer side of the curve. Capsule about as long as the alae, somewhat larger than broad to somewhat broader than long, c. 5 by 5–6 mm, deeply emarginate, broadly winged, the wings 1–2 mm wide and thinly veined and with patent ciliate hairs, fruit further glabrous. Seeds ellipsoid, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. Australia (Northern Territory, Queensland, Thursday I.); in *Malesia*: Papua New Guinea (W. Distr.: 3 coll.).

Ecol. Open savannah woodland and grassland at low altitude.

19. *Polygala glaucoides* LINNÉ, Sp. Pl. 1 (1753) 705; BENN. Fl. Br. India 1 (1872) 203, *excl. var.*; TRIMEN, Fl. Ceyl. 1 (1893) 80, *excl. var.* — *P. elongata* WILLD. Sp. Pl. 3 (1803) 879; DC. Prod. 1 (1824) 332; SPRENG. Syst. Verz. 3 (1826) 167; W. & A. Prod. 1 (1834) 38; THWAITES, En. (1864) 22; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 172; BENN. Fl. Br. India 1 (1872) 203, *p.p.*; CHODAT, Monogr. II (1893) 387, *excl. fig.*; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 36; *non* ADEMA, 1966. — *P. brachystachya* BLUME, Bijdr. (1825) 59, *nom. illeg.*; KING, J. As. Soc. Beng. 59, ii (1890) 130; RIDLEY, Fl. Mal. Pen. 1 (1922) 139, *non* DC. 1824, *nec* POIR.

1816. — *P. humilis* SPAN. Linnaea 15 (1841) 167; WALP. Rep. 1 (1842) 234; MIQ. Fl. Ind. Bat. 1, 2 (1858) 125; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 160. — *P. macrostachya* HASSK. *l.c.* 171. — *P. eumekes* HASSK. *l.c.* 172. — *P. chinensis* L. var. *brachystachya* (BLUME) BENN. Fl. Br. India 1 (1872) 204; BACKER, Schoolfl. Java (1911) 78. — *P. chinensis* L. var. *linearifolia* (non WILLD.) CHODAT, Monogr. II (1893) 381; MUKHERJEE, Bull. Bot. Soc. Beng. 12 (1961) 40; KANAI, Fl. E. Himal. (1966) 173. — *P. linearifolia* (non WILLD.) ADEMA, Blumea 14 (1966) 274, f. 19, *p.p.*, *excl. syn.*; Proc. R. Soc. Queensl. 80 (1969) 126, *p.p.*; THOMPSON, Fl. New South Wales 112 (1978) 15; HARA, En. Fl. Pl. Nepal 2 (1979) 50. — Fig. 15.

Erect to prostrate, usually much-branched herb, sometimes woody at base, up to 40 cm high. Stem terete, set with short, curved hairs. Leaves obovate-oblong to lanceolate, 3–4.5 by 1–8 mm, subsessile, mucronate, with recurved margin, shortly hairy, usually 1-nerved. Racemes usually supra-axillary, the free part 0.5–3–5(–10) cm long. Bracts usually persistent, minute, ciliate. Flowers (2.5–)3–4.5(–5) mm long, yellow with green and partly red alae. Sepals lanceolate, acuminate and with a short mucro, ciliolate, alae asymmetric, 5-nerved. Upper petals slightly longer than to \pm as long as the keel, spatulate, inside hairy in basal half; keel with 2 bundles of shortly incised appendages. Ovary \pm orbicular,

notched, ciliolate with crispate hairs; style strongly curved in apical part, subapically strongly reflexed with the stigmatic lobe inside. Capsule shorter than the alae, usually symmetric, broadly elliptic, 3–3.5 by 2.5–3 mm, notched, narrowly winged, the wings with short curved hairs only. Seeds ellipsoid, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. Sri Lanka, continental SE. Asia, N. Australia; in Malesia: W. Sumatra, Malay Peninsula (Singapore), Java, Lesser Sunda Islands (Timor), Celebes.

Ecol. In grassy places at low altitudes, probably in drier places than the next species.

Notes. This and the next species are rather similar. ADEMA (*l.c.*), unaware of the identity of LINNAEUS's *P. glaucoides* and *P. triflora*, unfortunately interchanged their names, and furthermore mixed the material of both species. After re-examination of the material of both, it appeared that their ranges are largely exclusive (although I have seen less material than ADEMA). Literature citation and distribution area as cited above must be somewhat inaccurate.

For additional remarks on the synonymy, see the note under *P. polifolia*.

20. *Polygala triflora* LINNÉ, Sp. Pl. 1 (1753) 705. — *P. linearifolia* WILLD. Sp. Pl. 3 (1803) 877; DC. Prod. 1 (1824) 326 ('*linearifolia*'); non ADEMA, 1966. — *P.*

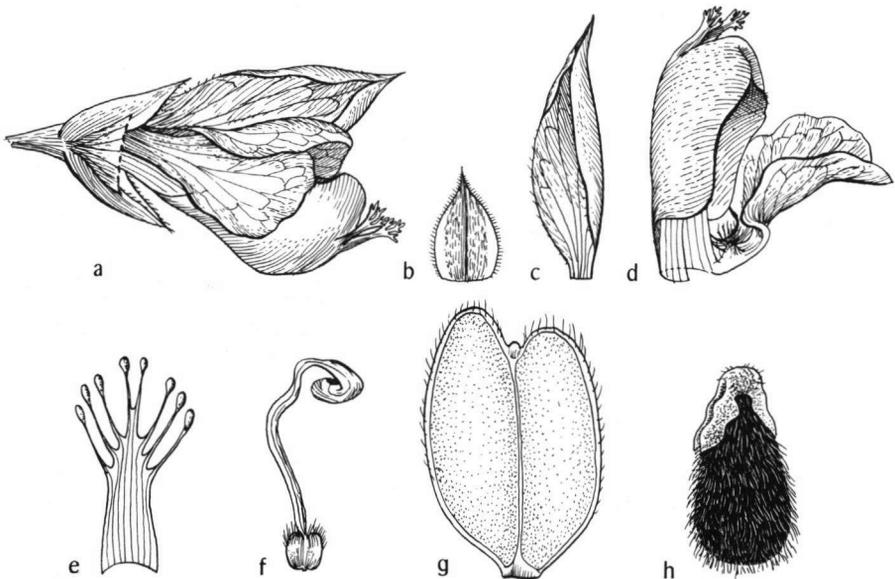


Fig. 15. *Polygala glaucoides* LINNÉ. a. Flower, one ala cut away; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; g. fruit; h. seed. All $\times 10$ (FENIX BS 26016).

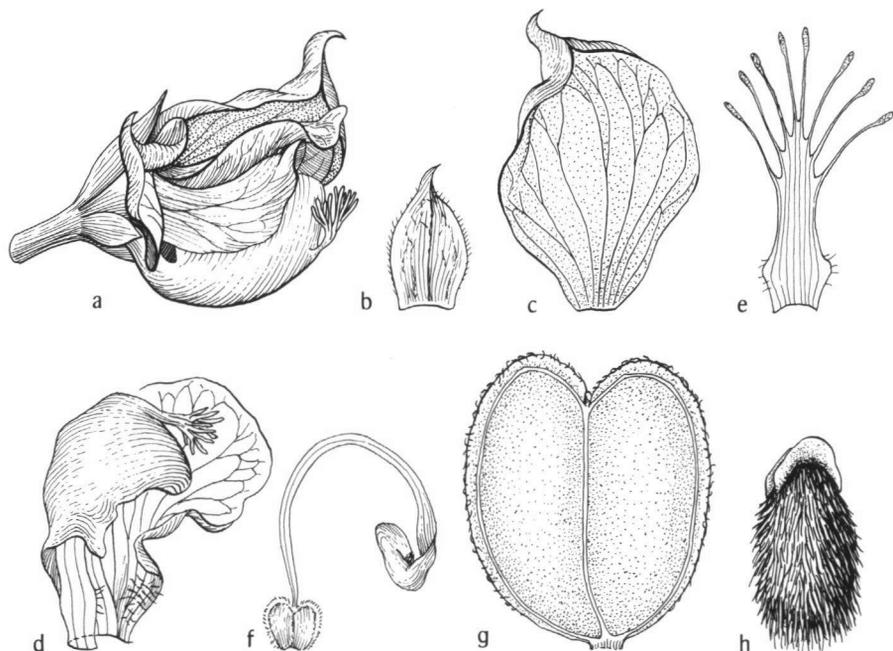


Fig. 16. *Polygala triflora* LINNÉ. a. Flower; b. upper sepal; c. ala; d. keel enveloping staminal tube, at right one petal; e. opened staminal tube; f. pistil; all $\times 10$; g. fruit; h. seed; both $\times 10$ (BACKER 23143).

prostrata WILLD. Sp. Pl. 3 (1803) 876. — *P. monspeliaca* (non L.) BLANCO, Fl. Filip. (1837) 557. — *P. arvensis* (non WILLD.) BENTH. Fl. Austr. 1 (1864) 140; F.M. BAILEY, Queensl. Fl. 1 (1899) 79. — *P. elongata* (non WILLD.) BENN. Fl. Br. India 1 (1872) 203, p.p.; K. SCH. & LAUT. Fl. Schutzgeb. Südsee, Nachtr. (1905) 289; MERR. Philip. J. Sc. 13 (1918) Bot. 20; En. Philip. 2 (1923) 383; ADEMA, Blumea 14 (1966) 273, p.p.; *ibid.* 17 (1969) 269; MATTHEW, Fl. Tamil Carnatic 1 (1981) 66. — *P. chinensis* L. var. *triflora* (L.) BENN. Fl. Br. India 1 (1872) 204. — *P. glaucooides* L. var. *triflora* (L.) TRIMEN, Fl. Ceyl. 1 (1893) 81. — Fig. 16.

Erect to prostrate, usually much-branched herb, sometimes woody at base, up to 40 cm high. Stem terete, set with short, curved hairs. Leaves lanceolate to linear-lanceolate, 5–50 by 1–5 mm, subsessile, mucronate, with recurved margins, shortly hairy, 1-nerved. Racemes usually supra-axillary, the free part 0.5–2 cm long. Bracts usually persistent, minute, ciliate. Flowers (3.5–)4–5 mm long, yellow or dull orange, with green and partly red alae. Sepals lanceolate, acuminate and with a short mucro, ciliate, alae asymmetric, 5-nerved. Upper petals slightly to distinctly shorter than the keel, spatulate, inside hairy in basal half; keel with 2 bundles of shortly incised appendages. Ovary quadrangular with rounded edges, stiffly hairy in upper part along the margin;

style strongly curved in apical part, subapically strongly reflexed with the stigmatic lobe inside. Capsule shorter than the alae, usually asymmetric, usually broadly elliptic, 3.5–4 by 2.5–3.5 mm, notched, narrowly winged, the wings with both short curved hairs as well as with long stiff hairs. Seeds ellipsoid, at micropylar side with an unequally 3-lobed aril, black, hairy.

Distr. Sri Lanka, continental SE. Asia, Australia; in Malesia: N. Sumatra, N. Borneo, Celebes, Moluccas (Ternate), Philippines (Palawan, Luzon, Mindanao), New Guinea.

Ecol. Open, grassy places, probably in climatologically wetter places than *P. glaucooides*, 0–1200 m.

Notes. ADEMA (*l.c.*) made some mistakes with this and the preceding species; see there. He stated that its occurrence in Malesia was uncertain, until 1969 when he mentioned its occurrence from New Guinea. My revision revealed that a considerable part of the collections identified by ADEMA as the former species, proved to belong to the present one. As holds for the preceding species, literature citation and distribution area of *P. triflora* must be somewhat inaccurate.

A single sheet from Java (in L) probably is wrongly labelled and collected in Sumatra.

For further notes on the synonymy, see under 15. *P. polifolia*.

2. SECURIDACA

LINNÉ, Syst. Nat. ed. 10 (1759) 1155, *nom. cons.*, *non* LINNÉ, 1753, *nec* MILL. 1754; DC. Prod. 1 (1824) 340; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 190; BENN. Fl. Br. India 1 (1872) 207; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 340; HUTCH. Gen. Fl. Pl. 2 (1967) 342. — *Elsota* ADANS. Fam. 2 (1763) 358; O.K. Rev. Gen. Pl. 1 (1891) 46; S.F. BLAKE, N. Austr. Fl. 25 (1924) 370. — *Corytholobium* MART. ex BENTH. Ann. Naturk. Mus. Wien 2 (1838) 93. — *Lophostylis* HOCHST. Flora 25 (1842) 229. — Fig. 17.

Big lianas to straggling shrubs. Twigs terete, sometimes twisted, glabrescent, at the nodes often with a pair of slightly protruding glands. *Leaves* alternate or distichous, petioled. *Inflorescences* raceme-like or usually paniculate, (supra-) axillary or terminal, at the nodes usually with a pair of protruding glands; bracts and bracteoles early caducous. *Sepals* 5, unequal, caducous before fruit-setting, ciliate, the lateral ones (alae) at least twice as large as the other ones and petaloid, unguiculate, auriculate. *Petals* 3, halfway adnate to the staminal tube or with an additional pair of reduced petals; upper petals spathulate, lower one (keel) boat-shaped, unguiculate, at apex with or rarely without a slightly 2-lobed, obliquely cup-shaped, hardly incised appendage (crest). *Stamens* 8, monadelphous; anthers bisporangiate by abortion of the outer microsporangia, sessile or on a free filamentous stalk, opening by an apical, oblique pore common to both cells. Disk annular, distinct after flowering. *Ovary* asymmetrical, 1-celled (by abortion of the second cell), 1-ovuled; style subterminal, curved in apical half, with a terminal, \pm 2-lobed stigma. *Fruit* a samara with a coriaceous wing (wing sometimes reduced), sometimes a second reduced wing present. *Seed* inappendiculate, glabrous, with thick cotyledons.

Distr. About 80 species, mainly in South and Central America, some in tropical Africa and in Southeast Asia and *Malesia*; not in Australia.

Ecol. Primary and secondary forests, along streams and in ravines, 0–1500 m.

KEY TO THE SPECIES

1. Flowers yellow. Staminal tube hairy inside, split in apical half, the filaments of the 2 parts connate to apex. Fruit with a second, smaller wing.
2. Keel glabrous, apically with a nearly undivided crest. Fruit (without wing) elliptic 3. *S. philippinensis*
2. Keel slightly hairy inside, apically inappendiculate. Fruit (without the wings) orbicular. 4. *S. ecristata*
1. Flowers pink to deep purple. Staminal tube completely glabrous, all filaments free for 1/4. Fruit only with a single large wing.
3. Leaf tip rounded to emarginate, at apex of midrib with a distinct hydathode. Vegetative parts almost glabrous. Outer sepals glabrous except for margin. Wing of fruit broadly attached to halfway, without stipe-like constriction 2. *S. atro-violacea*
3. Leaf tip acute to cuspidate, without apical hydathode. Young twigs, petioles and lower side of leaves shortly hairy. Outer sepals shortly hairy. Wing of fruit narrowly attached, stipe-like constricted in basal 1/3 part 1. *S. inappendiculata*

1. *Securidaca inappendiculata* HASSK. Flora 25² (1842) Beibl. 2, 32; Cat. Hort. Bog. (1844) 227; Pl. Jav. Rar. (1848) 295; WALP. Rep. 5 (1845) 1; KURZ, J. As. Soc. Beng. 43, ii (1874) 79; For. Fl. Burma 1

(1877) 80; CRAIB, Fl. Siam. En. 1 (1931) 104; HEND. J. Mal. Br. R. As. Soc. 17 (1939) 35; RAIZADA, J. Bomb. Nat. Hist. Soc. 48 (1952) 668; CHUN, Acta Phytotax. Sin. 7 (1958) 7; BACKER & BAKH.f. Fl. Java 1 (1963) 199; CHUN, Fl. Hainanica (1964) 368; BANERJI, Bull. Bot. Surv. India 10 (1968) 234; HARA, En. Fl. Pl. Nepal 2 (1979) 51; ANON. Icon. Corm. Sin. Suppl. 2 (1983) 172. — *S. paniculata* ROXB. [Hort. Beng. (1814) 53, *nomen*;] Fl. Ind. ed. Carey 3 (1832) 219, *non* LAMK, 1806. — *Lophostylis javanica* MIQ. Fl. Ind. Bat. 1, 2 (1858) 128. — *S. scandens* HAM. in Wall. [Cat. (1831) 4195, *nomen*] *ex* BENTH. Fl. Hongk. (1861) 45, *non* JACQ. 1760, *nec* POIR. 1806; SASAKI, Cat. Gov. Herb. Formosa Dept. For. (1930) 299. — *S. tavoyana* WALL. [Cat. (1831) 4196, *nomen*] *ex* BENN. Fl. Br. India 1 (1872) 208; FORBES, J. Linn. Soc. Bot. 23 (1886) 63; GAGNEP. Fl. Gén. I.-C. 1 (1909) 261; BACKER, Schoolfl. Java (1911) 79; KOORD. Exk. Fl. Java 2 (1912) 451; RIDLEY, Fl. Mal. Pen. 1 (1922) 141; MERR. Lingn. Sc. J. 5 (1927) 105; KANJILAL, Fl. Assam 1, 1 (1935) 98; MASAMUNE, Fl. Kainantensis (1943) 151; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1943) 238; HUNDLEY, List Trees, Shrubs etc. from Burma 3 (1961) 18. — *S. bracteata* BENN. Fl. Br. India 1 (1872) 208; KING, J. As. Soc. Beng. 59, ii (1890) 133; RIDLEY, Fl. Mal. Pen. 1 (1922) 141. — *Elsota bracteata* (BENN.) O.K. Rev. Gen. Pl. 1 (1891) 46. — *Elsota tavoyana* (BENN.) O. K. *l.c.* — *S. yaoshannensis* HAO in Fedde, Rep. 40 (1963) 213; ANON. Icon. Corm. Sin. Suppl. 2 (1983) 172.

KEY TO THE SUBSPECIES

1. Greatest width of leaf halfway. Pedicel (sub)glabrous **a. ssp. inappendiculata**
 1. Greatest width of leaf in basal half. Pedicel densely shortly hairy **b. ssp. corymbosa**

a. ssp. inappendiculata

Twigs with rather inconspicuous glands at the nodes. *Leaves* ovate to (ovate-)oblong, 5–12 by 2.5–5.5 cm, base rounded to acute, apex acute to cuspidate, above sparsely shortly hairy, beneath densely shortly hairy; petiole 3–8 mm, shortly hairy. *Inflorescences* branched, nodal glands indistinct. *Flowers* 5–7(–8) mm long, pink to deep purple, on 6–14 mm long pedicels. *Sepals* sparsely to densely shortly hairy, the alae about as long as the keel. Upper *petals* shorter than the keel, glabrous; keel apically crested, reduced lateral petals mostly present. *Filaments* free for 1/4. *Samara* basally orbicular, the wing up to 13 by 3 cm, narrowly attached, stalk-like constricted in basal 1/3 part; second wing absent; fruiting pedicel up to 22 mm. *Seed* globose.

Distr. From India through Burma, S. Thailand and Nepal to China; in *Malesia*: Sumatra, Malay Peninsula, W. Java (very rare), Borneo.

Ecol. Rain-forests below 1000 m.

b. ssp. corymbosa (TURCZ.) MEIJDEN, *stat. nov.* — *S. corymbosa* TURCZ. Bull. Soc. Nat. Mosc. 27² (1854) 2, 360; MERR. Sp. Blanc. (1918) 214; En. Philip. 2 (1923) 385; BROWN, Min. Prod. Philip. For. 3 (1921) 56; Useful Pl. Philip. 2 (1950) 280; SASAKI, Cat. Gov. Herb. Formosa Dept. For. (1930) 299; RIDLEY, Kew Bull. (1938) 115; MASAMUNE, En. Phan. Born. (1942) 378. — *S. volubilis* auct. (*non* LINNÉ, 1753) BLANCO, Fl. Filip. (1837) 555. — *S. complicata* auct. (*non* H.B.K. 1823) BLANCO, Fl. Filip. ed. 2 (1845) 388. — *S. cumingii* HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 190. — *Elsota corymbosa* (TURCZ.) O. K. Rev. Gen. Pl. 1 (1891) 46.

Distr. Malesia: Philippines (Luzon, Mindoro, Negros).

Ecol. Low and medium altitudes in rain-forest.

Note. The Philippine populations differ slightly but constantly vegetatively from the other populations. Although always separated as a distinct species, the absence of differences in flower or fruit is an argument to assume a close affinity between both taxa. In view of the replacing areas it seems appropriate to distinguish them as subspecies.

2. *Securidaca atro-violacea* ELMER, Leaf. Philip. Bot. 5 (1913) 1671; MERR. En. Philip. 2 (1923) 385.

Twigs with rather inconspicuous glands at the nodes. *Leaves* elliptic to oblong, 5–7 by 2–4 cm, base rounded to broadly cuneate, apex emarginate to rounded, at apex of midrib with a distinct hydathode, glabrous to sparsely shortly hairy; petiole 4–8 mm, shortly hairy. *Inflorescences* raceme-like or with a few side-branches, nodal glands indistinct. *Flowers* 5–7 mm long, purple, on 5–8 mm long, glabrous pedicels. *Sepals* ciliate, the alae about as long as the keel. Upper *petals* somewhat shorter than the keel, ciliate; keel apically crested; reduced lateral petals present. *Filaments* free for 1/4. *Samara* basally obliquely elliptic, the wing 3–4 cm long, broadly attached to halfway, not constricted; second wing absent; fruiting pedicel up to 10 mm. *Seed* ovoid.

Distr. Malesia: Philippines (Palawan).

Ecol. Disturbed forests on ultrabasic soil (RIDS-DALE), 100–600 m.

3. *Securidaca philippinensis* CHODAT, Bull. Herb. Boiss. 4 (1896) 233; BROWN, Min. Prod. Philip. For. 3 (1921) 58; Useful Pl. Philip. 2 (1950) 280; MERR. En. Philip. 2 (1923) 385.

Twigs with rather inconspicuous glands at the nodes. *Leaves* ovate to ovate-oblong, 4.5–6.5(–9.5) by 2.5–3.5(–4.5) cm, base rounded to broadly cuneate, apex acute to acuminate, nearly glabrous above, densely shortly hairy beneath; petioles c. 5 mm, shortly hairy. *Inflorescences* branched, nodal glands rather distinct at base of bracteoles. *Flowers* 5–8 mm long, yellow, on 5–9(–11) mm long shortly

hairy pedicels. *Sepals* ciliate, the outer densely shortly hairy, alae about as long as the keel, ciliate only. Upper *petals* about as long as the keel, usually hairy inside; keel glabrous, apically crested; reduced lateral petals usually present. *Filaments* hairy inside in basal part, at c. 1/4 split into two connate groups; anthers sessile. *Samara* basally elliptic, the wing 5–7.5 cm long; reduced second wing up to 2 mm wide. *Seed* oblong.

Distr. Malesia: Borneo (Sarawak), Celebes, Moluccas (Ambon, Buru), Philippines (Luzon, Leyte, Bohol, Negros, Panay, Mindanao, Palawan).

Ecol. Primary and secondary forests at low and medium altitudes (MERRILL).

4. *Securidaca ecristata* KASSAU in Fedde, Rep. 35 (1934) 160, incl. var. *nitida*. — *S. bracteata* var. *papuana* F.v.M. Descr. Not. Pap. Pl. 8 (1886) 41. — Fig. 17.

Twigs with rather inconspicuous glands at the nodes. *Leaves* ovate-oblong to ovate-lanceolate, 3.5–7(–9) by 1.5–2.5 (–3.5) cm, base rounded to broadly cuneate, apex acuminate to cuspidate, shortly hairy at both sides; petioles 3–5 mm, shortly hairy. *Inflorescences* unbranched or sometimes with few side-branches, nodal glands rather distinct at base of bracteoles. *Flowers* 3–5 mm long, yellow, on 5–6(–7) mm long, shortly hairy pedicels. *Sepals* ciliate, the outer shortly hairy, the alae about as long as the keel. Upper *petals* rather densely hairy inside in basal half, the keel slightly hairy inside basally, apically inappendiculate; reduced lateral petals present, very small. *Filaments* hairy at both sides in basal half, at c. 1/4 split into two connate groups; anthers sessile. *Samara* basally globose, the wing 3–8 cm long; second reduced wing distinct. *Seed* globose.

Distr. Malesia: New Guinea.

Ecol. Rain-forest below 1500 m.

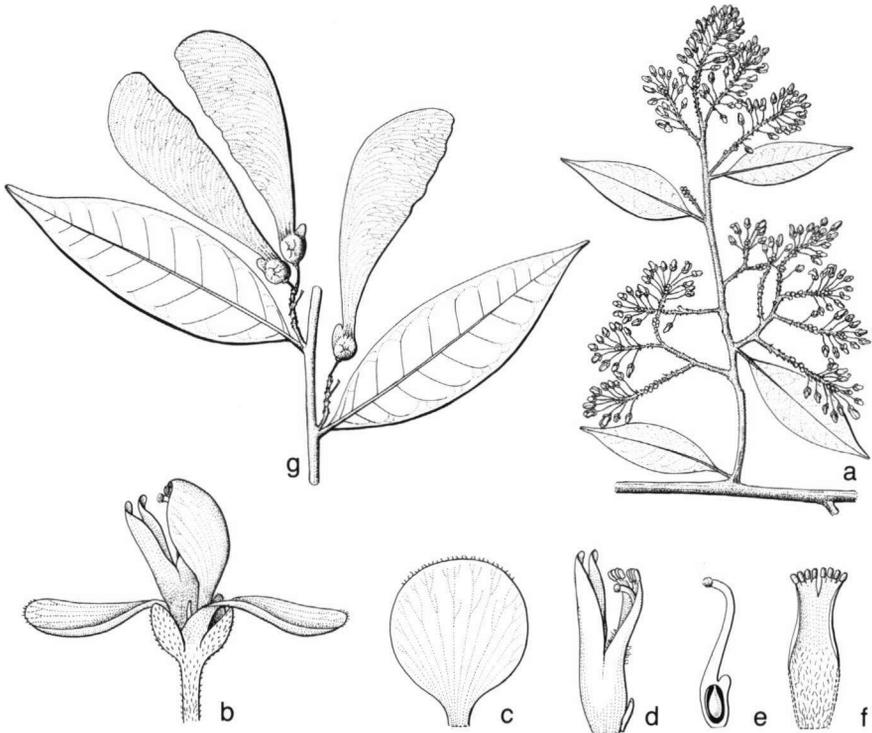


Fig. 17. *Securidaca ecristata* KASSAU. a. Habit flowering plant, $\times 0.5$; b. flower; c. keel; d. staminal tube with lateral and upper petals; e. gynoecium; f. staminal tube; all $\times 6$; g. habit fruiting plant, $\times 0.5$ (a–f MILLAR NGF 9917, g CLEMENS 8388).

3. SALOMONIA

LOUR. Fl. Coch. 1 (1790) 14, *nom. cons.*, *non* HEISTER *ex* FABRICIUS, Enum. 20 (1759); VAHL, En. Pl. 1 (1805) 8 (*'Salmonea'*); DC. Prod. Fl. Nep. (1825) 200; WIGHT, Ill. 1 (1840) 47; MIQ. Fl. Ind. Bat. 1, 2 (1858) 126; BENTH. Fl. Hongk. (1861) 43; BENTH. & HOOK. Gen. Pl. 1 (1862) 136; BENTH. Fl. Austr. 1 (1863) 138, *p.p.*; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 144; BENN. Fl. Br. India 1 (1872) 206, *p.p.*; BOERL. Handl. 1 (1890) 76; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 452, *p.p.*; BACKER & BAKH.f. Fl. Java 1 (1963) 199; BURBIDGE, Dict. Austr. Pl. Gen. (1963) 260; HUTCH. Gen. Pl. 2 (1967) 341, *p.p.*

Small erect annual herbs with aromatic roots. Stems without nodal glands, angular with 3 transparent wings. *Leaves* alternate, shortly petioled or sessile, glabrous or ciliate, 1–5-nerved. *Inflorescence* spike-like, terminal, the axes without nodal glands, winged; bracts early caducous or sometimes persistent, bracteoles absent. *Sepals* 5, unequal, much smaller than the petals, connate at very base, persistent, 1-nerved. *Petals* 3, unequal, asymmetric, halfway adnate to the staminal tube, the upper ones halfway connate to the lower one (keel) and slightly shorter than this; lower petal broad at base, narrowed in the middle, obliquely cup-shaped in apical part and completely enclosing stamens and stigma, apically inappendiculate. *Stamens* 4 or 6, rarely 5, monadelphous; anthers bisporangiate by abortion of the outer microsporangiae, sessile, opening by an introrse slit common to both cells. Disk absent. *Ovary* 2-celled, compressed contrary to the sept, each locule 1-ovuled; style strongly curved upwards at base and gradually recurved towards the slightly upturned apex; stigma 2-lobed, completely enclosed by the anthers in flower. *Capsule* transversally elliptic, laterally compressed, pergamentaceous, far exceeding the sepals, at the margin of each cell with a double row of 6–10 short or long teeth or spines. *Seed* elliptic, laterally flattened, glabrous, inappendiculate; albumen nearly absent in the ripe seed; embryo translucent, delicate, containing oil (even in dry state).

Distr. Sri Lanka, India, Nepal, China, Japan, S. Korea, Taiwan, Ryukyu Is., Micronesia (Kusaie), Indochina, Thailand, throughout *Malesia* to northern Australia. There are 3 *spp.*, of which 2 widespread and 1 endemic in SE. Thailand and neighbouring Cambodia.

Ecol. Sunny, open, usually wet places on sand, clay or rock, sometimes in deciduous or light forests, 0–1500 m.

Taxon. CHODAT (1896) and HUTCHINSON (1967) included *Epirixanthes* in *Salomonina*. The genera share indeed a number of derived characters indicating a close affinity. Probably because of the small and rather complex flowers the differences between both have generally escaped the attention of most botanists. The presence of a disk in *Epirixanthes* (absent in *Salomonina*) has never been mentioned. The androecium is very different: the strongly curved style with the anthers tightly enclosing the stigma in *Salomonina* versus the straight or very short style of *Epirixanthes* with longer or shorter stamens not enclosing the stigma. The fruits are also different (dehiscent versus indehiscent) and, of course, the habit differs as a result of the different ecology of both (auto- versus heterotrophy).

Note. The name *Salomonina* was given by LOUREIRO to honour the famous Jewish King Salomo, 'the first botanist'.

KEY TO THE SPECIES

1. All leaves shortly but distinctly petiolate, broadly ovate, never ciliate. Wall of cells of capsule with protruding, reticulate venation. Lower sepals equal to or somewhat smaller than the other sepals. Keel outside at lower side minutely papillose 1. *S. cantoniensis*
1. Leaves subsessile except the basal ones, ovate to ovate-lanceolate, margin glabrous or often set with stiff ciliae. Walls of cells of capsule without reticulate, protruding venation, often shortly sparsely hairy. Lower sepals distinctly larger than the other sepals. Keel not papillose outside 2. *S. ciliata*

1. *Salomonina cantoniensis* LOUR. Fl. Coch. 1 (1790) 14; VAHL, En. Pl. (1805) 8; DC. Prod. 1 (1824) 334; WALL. Cat. (1831) 4192; HASSK. in Miq. Pl. Jungh. 2 (1852) 123; MIQ. Fl. Ind. Bat. 1, 2 (1858) 127; BENTH. Fl. Hongk. (1861) 44; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 144; BENN. Fl. Br. India 1 (1872) 206; KING, J. As. Soc. Beng. 59, ii (1890) 132; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 330; BACKER, Schoolfl. Java (1911) 76; KOORD. Exk. Fl. Java 2 (1912) 453; MERR. En. Born. (1921) 324; RIDLEY, Fl. Mal. Pen. 1 (1922) 139; MERR. En. Philip. 2 (1923) 385; BACKER & SLOOT. Theeonkr. (1924) 160; HEYNE, Nutt. Pl. (1927) 901; MERR. Sarawak Mus. J. 3 (1928) 524; HAND.-MAZZ. Symb. Sin. 7 (1933) 634; BACKER, Onkruidfl. Suiker. (1934) 397; HEND. Mal. Nat. J. 4 (1949) 28; BANERJI, J. Bomb. Nat. Hist. Soc. 55 (1958) 251; BACKER & BAKH.f. Fl. Java 1 (1963) 199; BANERJI, Rec. Bot. Surv. India 19² (1966) 25; RAO, New Phyt. 63 (1964) 281; HARA, En. Fl. Pl. Nepal 2 (1979) 51; ANON. Icon. Corm. Sin. Suppl. 2 (1983) 184. — *S. edentula* DC. Prod. 1 (1824) 334; D.DON, Prod. Fl. Nepal. (1825) 200; WALL. Cat. (1831) 4194; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 146; BENN. Fl. Br. India 1 (1872) 206; BANERJI, J. Bomb. Nat. Hist. Soc. 51 (1953) 554; KANAI, Fl. E. Himal. (1966) 173. — *S. petiolata* D.DON, Prod. Fl. Nepal. (1825) 200, *nom. superfl.* — *Polygala trinervata* HAM. ex WALL. Cat. (1831) 4192B. — *Polygala undulata* ROXB. [Hort. Beng. (1814) 98, *nomen*.]; Fl. Ind. ed. Carey 3 (1832) 219, *cf.* ADEMA, Blumea 14 (1966) 276. — *S. trinervata* STEUD. Nom. ed. 2, 2 (1841) 373. — *S. subrotunda* HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 146.

Herb up to 30(–40) cm. Lateral stems often long and patent, stem glabrous, 0.5–1 mm wide, the wings up to 0.8 mm wide. Leaves broadly ovate, 4–15 by 3–10 mm, slightly cordate at base, acutish and mucronate at apex, 3–5-nerved, glabrous; petiole 0.5–2 mm. Flowers 1.7–2.3(–2.6) mm long, white to light violet. Sepals subequal, 0.5–0.8 mm long. Keel at lower side densely minutely papillose. Anthers 4 or 6, rarely 5, c. 0.15 mm long. Capsule c. 1 by 1.5–2 mm, walls of cells with protruding reticulate venation; spines up to 0.5(–0.75) mm long.

Distr. E. India and Nepal, Bangla Desh, Burma, Thailand, S. Vietnam to S. China (Yunnan); in *Malesia*: Sumatra (also Nias, Riouw, Banka), Malay

Peninsula (also Langkawi Is.), Java (also Madura I.), Lesser Sunda Islands (Sumbawa, Timor), Borneo, Celebes, Philippines (Luzon, Panay, Mindanao), Moluccas (Ceram, Ambon, Tanimbar Is.) and Misool I.; not recorded from New Guinea. Records for Japan and Australia are erroneous.

Ecol. Sunny or slightly shaded open places in grasslands, bracken, deciduous jungle or primary forests, usually on wet sand, clay or rock, not common, but locally abundant, 0–1500 m.

Note. Mixed collections of this and the next species are not uncommon.

2. *Salomonina ciliata* (L.) DC. Prod. 1 (1824) 334; HASSK. in Miq. Pl. Jungh. 2 (1852) 123; MIQ. Fl. Ind. Bat. 1, 2 (1858) 127; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 144; BENN. Fl. Br. India 1 (1872) 206; MERR. Philip. J. Sc. 7 (1912) Bot. 237; Fl. Manila (1912) 279; Sp. Blanc. (1918) 214; En. Born. (1921) 324; RIDLEY, Fl. Mal. Pen. 1 (1922) 140; MERR. En. Philip. 2 (1923) 386; SAKAI, Cat. Gov. Herb. (1930) 299; CRAIB, Fl. Siam. En. 1 (1931) 60, 90; ALSTON, Fl. Ceyl. Suppl. 6 (1931) 16; MASAMUNE, Yakusima (1934) 264; HOSOKAWA, Mat. Bot. Micron. 18 (1938) 155; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1939) 224; BACKER & BAKH.f. Fl. Java 1 (1963) 199; LAUENER, Not. R. Bot. Gard. Edinb. 26 (1965) 344; FOSBERG & SACHET, Micronesica 11 (1975) 83; HARA, En. Fl. Nepal 2 (1979) 51. — *Polygala ciliata* LINNÉ, Sp. Pl. 1 (1753) 701. — *S. oblongifolia* DC. Prod. 1 (1824) 334; WIGHT & ARN. Nov. Act. Ac. Caes. Leop.-Car. 18 (1836) 322; BENTH. Fl. Hongk. (1861) 44; Fl. Austr. 1 (1863) 138; BENN. Fl. Br. India 1 (1872) 207; KURZ, J. As. Soc. Beng. 43, ii (1874) 79; F.v.M. Austr. Pl. 1 (1882) 8; VIDAL, Phan. Cuming. (1885) 36; KING, J. As. Soc. Beng. 59, ii (1890) 132; TRIMEN, Fl. Ceyl. 1 (1893) 83; PRAIN, Bengal Pl. 1 (1903) 156; RIDLEY, Fl. Mal. Pen. 1 (1922) 140; BANERJI, J. Bomb. Nat. Hist. Soc. 51 (1953) 554; MASAMUNE, Sc. Rep. Kanazawa Univ. 3 (1955) 149; OHWI, Fl. Japan (1965) 587; HUI-LIN LI, Fl. Taiwan 3 (1977) 558, pl. 728; GILLI, Ann. Naturhist. Mus. Wien 83 (1980) 452; ANON. Icon. Corm. Sin. Suppl. 2 (1983) 185. — *S. sessilifolia* D.DON, Prod. Fl. Nepal. (1825) 201, *nom. superfl.*; BENN. Fl. Br. India 1 (1872) 207, '*sessiliflora*'. — *S. obovata* WIGHT, Ill. 1 (1831) 49, t. 22B. — *S. cordata* WIGHT, l.c. t. 22C; WIGHT & ARN. Nov. Act. Ac.

Caes. Leop.-Car. 18 (1836) 322; TRIMEN, Fl. Ceyl. 1 (1893) 83. — *Amorpha pedalis* BLANCO, Fl. Filip. (1837) 553; ed. 2 (1845) 387; ed. 3, 2 (1879) 348; cf. MERR. Sp. Blanc. (1918) 214. — *S. stricta* SIEB. & ZUCC. Abh. Ak. Wiss. München 4, 2 (1845) 152; MAKINO, Ill. Fl. Japan (1954) 382. — *S. arnottiana* MIQ. Analecta 3 (1852) 3. — *S. canarana* MIQ. l.c.; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 147. — *S. horneri* HASSK. in Miq. Pl. Jungh. (1852) 123; MIQ. Fl. Ind. Bat. 1, 2 (1858) 127; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 149. — *S. angulata* GRIFF. Notul. 4 (1854) 539; Ic. t. 585, f. 16. — *S. ramosissima* TURCZ. Bull. Soc. Nat. Mosc. 27² (1854) 352; F.-VILL. Nov. App. (1880) 14. — *S. rigida* HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 148. — *S. setoso-ciliata* HASSK. l.c. 149. — *S. uncinata* HASSK. l.c. 148; KOORD. Exk. Fl. Java 2 (1912) 453. — *S. longiciliata* KURZ, J. As. Soc. Beng. 41, ii (1872) 292. — *S. cavaleriei* LÉV. Bull. Soc. Bot. Fr. 51 (1904) 291. — *S. cantoniensis* auct.: HOSOKAWA, J. Agric. Kyushu Univ. 4, 6 (1935) 434; WALTER & RODIN, Contr. U.S. Nat. Herb. 30 (1949) 461; STONE, Micronesia 6 (1970) 362.

Herb up to 25 cm, branched or unbranched. Stem glabrous to sparingly ciliate, ribbed, c. 0.5 mm wide, the wings up to 0.5 mm wide. Leaves elliptic or ovate to oblong or ovate-lanceolate, 3–9 by 1–5 mm, truncate to attenuate at base, acutish and mucronate at apex, the margin glabrous to densely long-ciliate, usually 3-nerved; petiole up to 0.5 mm or in the basal leaves up to c. 1 mm. Flowers 1.5–2 mm long, pink

to purple. Sepals unequal, the lower ones distinctly larger than the other sepals, 1–1.5 mm long. Keel not papillose. Anthers 4, c. 0.15 mm long. Capsule 0.8–1 by 1.5–2 mm, walls of cells smooth, sometimes sparsely minutely hairy, not veined; spines at margin up to 0.5 mm long.

Distr. Sri Lanka, Bangla Desh, S. & E. India, Burma, Thailand, Indochina, China, Japan, S. Korea, Taiwan, Ryukyu Is., Marianas (Guam), Carolines (Yap), Australia (N. Australia, Queensland); in *Malesia*: Sumatra (incl. Banka & Billiton), W. Java (also Madura I.), Borneo (N. Sarawak, Brunei, Sabah; also Karimata I.), Celebes, Philippines (Luzon), Moluccas (Sula & Tanimbar Is.), New Guinea.

Ecol. Sunny or slightly shaded open places in grasslands or sometimes in deciduous forest, *Melaleuca* forest, teak forest, sand dunes, swamps; usually on wet fine quartz sand or on clay; locally rather common, 0–1250 m.

Note. Mixed collections of this and the former species are not uncommon.

Excluded species

Salomonina seguinii LÉV. Bull. Soc. Bot. Fr. 51 (1904) 291 = *Polygala furcata*, cf. LAUENER, Not. R. Bot. Gard. Edinb. 26 (1965) 343.

Salomonina martinii LÉV. Bull. Soc. Bot. Fr. 51 (1904) 290 = *Polygala tatarinowii* REGEL.

4. EPIRIXANTHES¹

BLUME, Cat. (1823) 25, 82; NEES, Flora 8 (1825) 133; ENDL. Gen. Pl. (1839) 728; REUTER in DC. Prod. 11 (1847) 44; MIQ. Fl. Ind. Bat. 1, 2 (1858) 127; BENTH. & HOOK. Gen. Pl. 1 (1862) 135; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 143; JOHOW in Pringsh. Bot. Jahrb. 20 (1889) 479; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 342; PENZIG, Ann. Jard. Bot. Btzg 17 (1901) 142, t. 20–26; STEEN. Trop. Natuur 23 (1934) 51, f. 10; Bull. Bot. Gard. Btzg III, 17 (1948) 461; BACKER & BAKH.f. Fl. Java 1 (1963) 200. — *Salomonina sect. Epirixanthes* (BLUME) BENN. Fl. Br. India 1 (1872) 207; KING, J. As. Soc. Beng. 59, ii (1890) 132. — *Salomonina* auct. plur. pro parte. — Fig. 18.

Echlorophyllous, small, erect, little-branched herbs with small, bract-like, erect leaves; roots not aromatic. Stems without nodal glands, terete, ribbed, un-

(1) In 1966 a preliminary study has been performed by H.M.Y.J. ANDRÉ DE LA PORTE-JANSS (Leiden). That manuscript was sent to T. WENDT (then Gray Herbarium, Cambridge, U.S.A.; at present Collegio de Postgraduados, Chapingo, Mexico) during his study of the genus. We received WENDT's unpublished manuscript in 1985 during the preparation of the *Polygalaceae* treatment for this flora. The present treatment is largely in accordance with that of WENDT. In nomenclatural sense, WENDT must be seen as the author of the two new species, viz. *E. pallida* and *E. kinabaluensis*, which are published here for the first time.

winged. *Leaves* sessile, erect, up to 4 mm long, glabrous or minutely ciliate, 1-nerved. *Inflorescences* terminal, spike-like, very dense, the axes without nodal glands, terete; bracts persistent or early caducous; bracteoles absent or (in *E. papuana*) present and persistent. *Sepals* 5, unequal, distinctly shorter than the petals, free or variously connate, persistent in fruit, glabrous to minutely ciliate. *Petals* 3, unequal, glabrous or apically papillose, asymmetric, halfway adnate to the staminal tube, the upper ones halfway connate to the lower one (keel) and about as long as this; free part of lower petal \pm boat-shaped, inappendiculate at apex. *Stamens* 2, 3 or 5, rarely 4, filaments completely connate or partly free; anthers bisporangiate by abortion of the outer microsporangia, sessile or on a free filamentous stalk, *c.* 0.2 mm long, opening by an introrse slit common to both cells or opening irregularly introrsely. *Disk* either semi-annular, enclosing the lower and lateral side of the ovary and accrescent during fruit-setting, or present only at adaxial (upper) side of the ovary as a lobe not accrescent in fruit. *Ovary* 2-locular, orbicular to elliptic and laterally slightly flattened, glabrous, each locule with a single apical epitropous ovule; style either rather long and straight and apically with a slightly 2-lobed stigma, or short and more or less bifurcate with a larger fertile upper lobe and a smaller sterile apically hollow lobe. *Fruit* indehiscent, largely enclosed by the sepals, broadly ellipsoid, apically rounded or faintly bilobed, with a fleshy pericarp. *Seeds* \pm ellipsoid, glabrous, with a soft, thickened tissue at micropylar side (aril?), along the raphe, and most distinctly so at chalazal side; albumen nearly absent in ripe seeds; embryo translucent, delicate, containing oil (even in dry state).

Distr. E. India to China and throughout *Malesia* as far as the Solomon Is. (San Cristobal); rare but very locally abundant. In all 5 *spp.*

Ecol. On humous soil between litter, in different types of rain-forests, sometimes locally abundant and together with other small saprophytes (*Burmanniaceae*, *Triuridaceae*); 0–1800 m.

According to RICHARDS (Trop. Rainforest, 1952) the saprophytes (including *Epirixanthes*) prefer intense shade and are not able to survive even a slight drying of the forest floor.

The fleshy disk at the base of the fruit might serve as a 'fruit-aril' and serve for dispersal by ants.

Pollination. At the beginning of flowering cross-pollination seems to be possible, because the stigma is then out of reach of the anthers. In later stages, however, either the filaments stretch a little so that the anthers surround the stigma (*E. elongata*), or (in the other species) ovary and style grow out a little so that the stigma is situated just at the base of the bursting anthers. At that time self-pollination is likely to occur. WIRZ (Flora 1, 1910, 395, f. 6) recorded that pollen grains germinated in the anthers, and directly grew into the stigma.

Taxon. Allied to *Salomonina*; see there.

Notes. 1. There is much more in a name than Shakespeare's Julia could suppose. *Epirixanthes* means flower growing on roots. BLUME described *Epirixanthes* as '*radicibus arborum innascentes*'. Though ZOLLINGER in 1854 already wrote '*inter folia emortua*', MIQUEL in 1858 called the *Epirixanthes* species '*rhizoparasitae*', CHODAT in 1896 wrote '*schmarotzende Pflanzen*', HENDERSON in 1949 described them as 'parasitic plants' and even in 1967 HUTCHINSON is misled by the name by calling it 'parasitic' on roots.

2. The spelling of the name *Epirixanthes* could be one for a crossword puzzle. BLUME started with *Epirixanthus*, which is thus the correct spelling. Later, however, he spelled the name *Epirhizanthes* on herbarium sheets. Ever since we can find all sorts of etymological variants: *Epirrhizanthes*, *Epirrhizanthé*, *Epirizanthes*, *Hyperixanthes* and *Epicryanthes*. In this revision only the correct spelling is used (H.M.Y.J. ANDRÉ DE LA PORTE-JANSS).

KEY TO THE SPECIES

1. Sepals free. Bracts caducous before the flowers are full-grown.
 2. Style longer than the ovary. Bracts cuspidate. 1. *E. elongata*
 2. Style much shorter than the ovary. Bracts rounded 5. *E. pallida*
1. Sepals connate for 1/4–3/4. Bracts persistent till or after the fruits have fallen.
 3. Flowers subtended by a bract and a pair of subulate bracteoles. Fruits fully enclosed by the sepals
 2. *E. papuana*
 3. Bracteoles absent. Apex of fruits not enclosed by the sepals.
 4. Bracts lanceolate, 2–2.5 by 0.5–0.6 mm 4. *E. kinabaluensis*
 4. Bracts elliptic to obovate, 1.5–2 by 0.8–1.2 mm 3. *E. cylindrica*

1. *Epirixanthes elongata* BLUME, Cat. (1823) 82; NEES, Flora 8 (1825) 133; REUTER in DC. Prod. 11 (1847) 44; ZOLL. Syst. Verz. 3 (1855) 58; MIQ. Fl. Ind. Bat. 1, 2 (1858) 128; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 143; PENZIG, Ann. Jard. Bot. Btzg 17 (1901) 142, t. 24–26; PILGER in E. & P. Nat. Pfl. Fam., Nachtr. 3 (1908) 190; WIRZ, Flora 1 (1910) 395; BACKER, Schoolfl. Java (1911) 75; MERR. En. Born. (1921) 325; STEEN. Trop. Natuur 23 (1934) 51, f. 10; PIJL, Rec. Trav. Bot. Néerl. 31 (1934) 761; SMITINAND, Thai For. Bull., Bot. 2 (1955) 2; BACKER & BAKH.f. Fl. Java 1 (1963) 200; HANSEN c.s. Dansk Bot. Ark. 25, 2 (1967) 83. — *E. linearis* BLUME, Cat. (1823) 82; REUTER in DC. Prod. 11 (1847) 44; MIQ.

Fl. Ind. Bat. 1, 2 (1858) 128. — *Salomonina aphylla* GRIFF. Proc. Linn. Soc. 1 (1844) 221; Trans. Linn. Soc. 14 (1845) 112; BENN. Fl. Br. India 1 (1872) 207; KING, J. As. Soc. Beng. 59, ii (1890) 132; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 342; JOSEPH, Bull. Bot. Surv. India 12 (1970) 73, f. 1–5. — *Salomonina parasitica* GRIFF. Not. 4 (1854) 538, t. 1598, f. 5. — *E. tenella* HOOK.f. Trans. Linn. Soc. 23 (1862) 158; C. MÜLL. in Walp. Ann. 7 (1868) 243. — *Salomonina elongata* (BLUME) KURZ ex KOORD. Exk. Fl. Java 2 (1912) 453; RIDLEY, Fl. Mal. Pen. 1 (1922) 140. — *E. aphylla* (GRIFF.) MERR. Philip. J. Sc. 13 (1918) Bot. 142. — Fig. 18.

Herb, up to 25 cm. Stem simple or branched in up-



Fig. 18. *Epirixanthes elongata* BLUME. (Photogr. A. ELSENER, Borneo, 28 May 1964).

per half, 0.5–2 mm wide, violet or reddish, set with minute clavate hairs or papillae. *Leaves* 2–3.5 mm long, ciliate-pilose, usually violet. *Spike* 0.5–6 cm by 2–3 mm, rather dense, acutish at apex. Bracts ovate, c. 1.2 by 0.5 mm, cuspidate, ciliolate-papillose, erect, caducous before the flowers are full-grown; bracteoles absent. *Flowers* 2–2.5 mm long, yellowish white. *Sepals* free, subequal, c. 1 mm long, ciliolate-papillose. *Anthers* 5, rarely 4, sessile or stipitate. Disk lobe present adaxially at the base of the ovary, difficultly discernible, not accrescent after flowering. *Ovary* ± orbicular; style longer than the ovary, c. 0.6 mm long, straight or apically slightly curved upwards, apically widened into the slightly 2-lobed stigma; gynoecium at first longer than the androecium, later equally long. *Fruit* reniform to broadly elliptic, c. 0.6 by 0.9 mm, enclosed by the slightly longer sepals.

Distr. E. India, S. Burma (Tavoy), N. Vietnam, S. China; in *Malesia*: Malay Peninsula, Sumatra, W. Java, Borneo, Moluccas (Ambon, Ceram).

2. *Epirixanthes papuana* J. J. SMITH in Fedde, Rep. 10 (1912) 286; Nova Guinea Bot. 8 (1914) 897; STEEN. Trop. Natuur 23 (1934) 51; BACKER & BAKH.f. Fl. Java 1 (1963) 200. — *Salomonina cylindrica* (BLUME) KURZ, p.p.: K. SCH. & LAUT. Nachtr. Fl. Schutzgeb. Südsee (1905) 285.

Herb to 25 cm, generally purplish red in most of its parts except the corolla. Stem often repeatedly branched in apical part, 1–3 mm wide, glabrous. *Leaves* 1.5–2.5 mm long, glabrous. *Spike* 0.5–6(–12) cm by 2.5–4.5 mm, very dense, rounded at apex. Bracts elliptic to obovate, 1–2 by c. 1 mm, rounded apically, glabrous, patent with slightly upturned apex, persistent till or after the fruits have fallen, at last reflexed; bracteoles always present, subulate, c. 1 mm long. *Flowers* 1.5–2.7 mm long, white but purple in bud. *Sepals* connate for 1/2–3/4, subequal, glabrous. *Stamens* usually 3 and then anthers sessile, rarely 2 and then filaments free to halfway. *Disk* very indistinct, semi-annular, enclosing and fully adnate to the basal part of the lateral and lower side of the ovary, hardly accrescent in fruit. *Ovary* broadly elliptic; style up to 0.1 mm long; stigma very asymmetrical, 0.2 mm long, the upper stigmatic lobe oblique, rounded, the lower lobe narrower and longer, directed a little downwards, hollow at apex; gynoecium shorter than androecium. *Fruit* broadly obovate, 0.7–0.9 by 0.7–0.9 mm, at base tightly enclosed by the fully adnate and very indistinct disk, the whole enclosed by the slightly longer sepals.

Distr. *Malesia*: N. Sumatra (incl. Enggano I.), W. Java, Borneo, Philippines (Luzon), Moluccas (Talaud, Ceram), New Guinea. Also in the Solomon Is. (San Cristobal).

3. *Epirixanthes cylindrica* BLUME, Cat. (1823) 82; NEES, Flora 8 (1825) 133; REUTER in DC. Prod. 11 (1847) 44; ZOLL. Syst. Verz. 3 (1855) 58; MIQ. Fl. Ind. Bat. 1, 2 (1858) 128, t. 15; HASSK. in Miq. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 143; BECC. Malesia 3 (1890) 325; KING, J. As. Soc. Beng. 59, ii (1890) 132; PENZIG, Ann. Jard. Bot. Btzg 17 (1901) 142, t. 20–23; MERR. Philip. J. Sc. 1 (1906) Suppl. 203; PILGER in E. & P. Nat. Pfl. Fam., Nachtr. 3 (1908) 190; BACKER, Schooffl. Java (1911) 76; WENT, Nova Guinea Bot. 8 (1909) 169; KOORD. Exk. Fl. Java 2 (1912) 453; MERR. En. Born. (1921) 325; En. Philip. 2 (1923) 386; STEEN. Trop. Natuur 23 (1934) 52; HEND. Mal. Nat. J. 4 (1949) 27; BACKER & BAKH.f. Fl. Java 1 (1963) 200. — *Salomonina cylindrica* (BLUME) KURZ, J. As. Soc. Beng. 43, ii (1874) 79; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 342; K. SCH. & LAUT. Nachtr. Fl. Schutzgeb. Südsee (1905) 285, p.p.; RIDLEY, Trans. Linn. Soc. II, Bot. 9 (1916) 19.

Herb, up to 25 cm, (sub)glabrous. Stem simple or branched, 1.5–2 mm wide. *Leaves* 2–4 mm long, slightly thickened at base, minutely sparsely papillose. *Spike* 0.5–6 cm by 4.5–5.5 mm, very dense, rounded at apex. Bracts elliptic to obovate, 1.5–2 by 0.8–1.2 mm, not thickened at base, at apex acutish and finely mucronate, imbricately covering the flower buds, patent with slightly upturned apex, persistent till or after the fruits have fallen, at last reflexed; bracteoles absent. *Flowers* c. 2.5 mm long. *Sepals* connate ± halfway, unequal, slightly cucullate, c. 1.5 mm long. *Anthers* 3 or 5, rarely 4, sessile. *Disk* rather distinct, enclosing the lower and lateral side of the ovary and adnate to it, expanding gradually in fruit and then visible as a rim near the base of it. *Ovary* broadly elliptic; style shorter than the ovary, subcylindrical, c. 0.1 mm long, unequally 2-lobed, the larger upper lobe stigmatic, the lower one tooth-like and hollow at apex; gynoecium somewhat shorter than the androecium. *Fruit* broadly elliptic, c. 1 by 1 mm, at base tightly enclosed by the disk, the whole enclosed by the somewhat shorter sepals.

Distr. Burma; in *Malesia*: Sumatra, W. Java, Borneo, New Guinea.

Note. Closely allied to the next species; see there.

4. *Epirixanthes kinabaluensis* WENDT, sp. nov.

A. E. cylindrica bracteis (ovatus)-lanceolatis, 2–2.5 × 0.5–0.6 mm, parum crassinervatis ad basin, gradatim attenuatis et mucronatis, gemmis florum partiter expositis, persistentibus tempore fructificandi differt. — *Typus*: CLEMENS 30039 (A holo; BO, G, L, NY, UC). See note 1 under the genus.

Herb up to 30 cm, glabrous. Stem simple or branched, 1–2.5 mm wide, tinged reddish. *Leaves* 2–3.5 mm long, slightly swollen at base, brown.

Spike 1.5–6 cm by 4–5 mm, very dense, rounded at apex. Bracts (ovate-)lanceolate, 2–2.5 by 0.5–0.6 mm, at base slightly thickened along midrib, very gradually narrowed into the acute and finely mucronate apex, not fully covering the flower buds, patent with upturned apex at flowering time, persistent until the fruit has fallen, then reflexed and eventually caducous; bracteoles absent. *Flowers* c. 2 mm long, milk-white with yellow-brown calyx. *Sepals* halfway connate, unequal, slightly cucullate, 1.5 mm long. *Anthers* 5, sessile. Disk rather distinct, enclosing the basal part of the lower and lateral side of the ovary and adnate to it, expanding gradually in fruit and then visible as a rim near the base of it. *Ovary* broadly elliptic; style shorter than the ovary, subcylindrical, c. 0.1 mm long, unequally 2-lobed, the larger upper lobe stigmatic, the lower one tooth-like and hollow at apex; gynoecium somewhat shorter than the androecium. *Fruit* broadly elliptic, c. 1 by 1 mm, at base tightly enclosed by the disk, the whole enclosed by the somewhat shorter sepals.

Distr. *Malesia*: Sumatra, Borneo.

Note. Very closely allied to *E. cylindrica*, from which it differs only by the narrower and longer bracts.

5. *Epirixanthes pallida* WENDT, *sp. nov.*

Sepala libera. Bracteeae ellipticae, 2–3 × 1–1.5 mm, compressae ad basin, obtusae, marginibus hyalinis, pallidae, imbricatae apicem spicae tectae, ante

tempus florendi caducae. Stylus brevis. — *Typus*: BROOKE 10498 (L). See note 1 under the genus.

Herb up to 15 cm, glabrous, straw-coloured. Stem simple or branched in upper half, 2–2.5 mm thick. *Leaves* 2–4 mm long, swollen at base. *Spike* 1–5 cm long, 2.5–3 mm thick, very dense, rounded at apex. Bracts elliptic, 2–3 by 1–1.5 mm, at base compressed along the midrib, at apex obtuse, the margin nearly hyaline, pallid in dry state, imbricately covering the younger part of the spike and completely hiding the flower buds, caducous at the beginning of flowering, thus leaving the fruiting calyx exposed; bracteoles absent. *Flowers* c. 1.8 mm long, whitish. *Sepals* free, unequal, the larger ones slightly cucullate, 0.8–1 mm long. *Anthers* 5, sessile. *Disk* rather distinct, enclosing the basal part of the lower and lateral side of the ovary and adnate to it, expanding gradually in fruit and then visible as a rim near the base of it. *Ovary* elliptic, style shorter than the ovary, subcylindrical, c. 0.2 mm long, unequally 2-lobed, the larger upper lobe stigmatic, the lower one tooth-like and hollow at apex; gynoecium somewhat shorter than androecium. *Fruit* broadly elliptic or nearly didymous, c. 0.6 by 0.8 mm, at base tightly enclosed by the disk, the whole enclosed by the slightly longer sepals.

Distr. *Malesia*: Borneo, Celebes.

Note. A distinct species, easily recognizable by its relatively large bracts which imbricately cover the upper part of the spike but are very early caducous.

5. ERIANDRA

ROYEN & STEEN. *J. Arn. Arb.* 33 (1952) 91, t. 1; STEEN. *Blumea* 12 (1964) 319; HUTCH. *Gen. Fl. Pl.* 2 (1967) 343.

Tree. Twigs apparently without nodal glands. *Leaves* alternate, petioled. *Inflorescences* fasciculate, axillary, short; bracts and bracteoles ± persistent; bracts at very base with a pair of inconspicuous glands. *Sepals* 5 (or 4), equal, connate in basal half and adnate to the base of the petals, caducous as a whole together with the petals at the beginning of fruit-setting by a circumcision, the connate basal part persistent. *Petals* 5 or 4, connate for 3/4, basally adnate to the sepals and halfway to the staminal tube, equal, the free parts half-orbicular. *Stamens* (8–)10, monadelphous; anthers hairy all round, tetrasporangiate, the inner microsporangiae fused in upper half, shorter than the outer ones; dehiscing at inner side by a sickle-shaped slit common to both loculi. Disk annular, inconspicuous, hairy. *Ovary* globose, 7–8-locular, each locule with 1 ovule; style terminal, straight; stigma capitate, slightly lobed. *Fruit* a fleshy globular berry, apically with a remnant of the style, basally with a remnant of the calyx tube. *Seeds* c. 4, flattened, radially, completely enveloped by an aril; testa very densely hairy; albumen fleshy.

Distr. Solomon Islands; in *Malesia*: New Guinea. Monotypic.

Ecol. Primary and secondary rain-forests, 0–150(–660) m.

Notes. In flowering and fruiting characters resembling the tropical American genus *Diclidanthera* MART., a genus of small trees and lianas differing in the 5-locular ovary (and fruit), the glabrous anthers, the constricted corolla tube and the exarillate seed. As the nearly regular flowers and the many-celled ovary are probably derived in the family, it is probable that both genera are closely allied.

STYER (J. Arn. Arb. 58, 1977, 124) studied the anatomy of *Eriandra*, and compared his results with those of the South American genera *Barnhartia* GLEASON, *Moutabea* AUBL. and *Diclidanthera*. He concluded (*l.c.* 139) that *Eriandra*, although a tree, has a 'lianos ancestry'.

1. *Eriandra fragrans* ROYEN & STEEN. J. Arn. Arb. 33 (1952) 91, t. 1; STEEN. Blumea 12 (1964) 319.

Tree up to 32 m, 70 m dbh. Twigs glabrous. *Leaves* oblong to (ob)lanceolate, 7–40 by 3–10 cm, narrowly cuneate at base, acutish or shortly acuminate at apex, coriaceous, glabrous above, slightly hairy on midrib beneath, in basal part beneath with 1–4 indistinct glands 0.2 mm diam.; midrib sunken above in basal half, nerves 5–16 pairs, finely prominent at both sides; petiole 1–2.5 cm, flattened above, wrinkled below, apically with a pair of indistinct glands 0.2 mm diam. Axis of raceme-like *fascicle* 2–20 mm long, shortly hairy to glabrous, at the nodes near the bracts with a pair of inconspicuous, tiny, slightly prominent glands. *Flowers* 5–6 mm long, white, fragrant, on 1–5 mm long pedicels. *Sepals* obovate-spahulate, 4–5.5 mm long, glabrous except for the

margin, the outer ones ciliate to base, the inner ones ciliate only apically. *Petals* free over c. 3 mm, the free parts reflexed during flowering; glabrous except for the ciliate incurved margins. *Staminal tube* glabrous outside, hairy inside; anthers elliptic, 3-locular in upper half, 4-locular at base, c. 1 mm long, hairy all round. *Ovary* glabrous; style 3–4 mm long, densely hairy. *Fruit* 2–4 cm diam., apically with a hairy remnant of the style. *Seeds* elliptic, c. 1.5 by 1 cm; aril c. 0.2 mm thick; indumentum of testa very dense, 1–2 mm thick.

Distr. Solomon Islands (New Georgia, Kolombangara); in *Malesia*: New Guinea.

Ecol. Primary and secondary rain-forests, usually in the valley bottoms or on plains near the coast, usually on well-drained sandy clay, sometimes on limestone, 0–150(–660) m.

6. XANTHOPHYLLUM

ROXB. Pl. Corom. 3 (1820, '1819') 81, *nom. cons.*; BENN. Fl. Br. India 1 (1872) 208; CHODAT, Bull. Herb. Boiss. 4 (1896) 254; in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 343; GAGNEP. in Desv. J. Bot. 21 (1908) 241; GAGNEP. Fl. Gén. I.-C. 1 (1909) 242; CHODAT in Merr. Pl. Elm. Born. (1929) 133; HUTCH. Gen. Fl. Pl. 2 (1967) 339; NG, Tree Fl. Mal. 1 (1972) 352; MEIJDEN, Leiden Bot. Ser. 7 (1982). — *Pelae* [HERMANNUS, Fl. Zeyl. (1717) 24 ('*Paelae*')] ADANSON, Fam. 2 (1763) 448, *nom. rejic.* — *Eystathes* LOUR. Fl. Coch. 1 (1790) 235, *nom. rejic.* — *Jakkia* BLUME, Cat. (1823) 17; Bijdr. (1825) 60 ('*Jackia*'), *non Jackia* WALL., *nec Jackia* SPRENGEL. — *Skaphium* MIQ. Fl. Ind. Bat., Suppl. (1861) 357. — *Bannisterodes* [L., Fl. Zeyl. (1747) 192 ('*Bannisterioides*')] O. K. Rev. Gen. Pl. 1 (1891) 45, *nom. illeg.* — Fig. 19–26.

Shrubs or trees. Twigs terete, sometimes with annular or cap-like nodal glands. Axillary buds 2–8, serial, each with 2 bud scales. *Leaves* alternate (or spiral), sometimes shifted-decussate, stalked, nearly always with glands beneath, mostly near base of blade. *Inflorescence* axillary, branched or sometimes unbranched, panicle- or raceme-like. *Flowers* solitary or in lower half with 3 (rarely more) together. *Sepals* 5, free, usually slightly unequal, usually caducous after flowering. *Petals* 5, usually unequal, free; lower petal (carina) usually boat-shaped, clawed, apically inappendiculate. *Stamens* nearly always

8, rarely 7, 9, or 8–10; 4 epipetalous, 2 placed at the base of the carina and adnate with it or not, 2 alternipetalous and opposite the lateral sepals; filaments free or connate basally, rarely halfway connate, very rarely triadelphous; anthers tetrasporangiate, opening introrsely with slits. Disk annular. *Gynoecium* usually as long as androecium; ovary usually shortly stipitate, syncarpous, composed of 2 median carpels, 1-locular or sometimes semi-2-locular; style terminal; stigma slightly bilobed or sometimes peltate; ovules 2-seriate, 4 or (6–)8–c. 20, very rarely c. 40. *Fruit* indehiscent (or very rarely irregularly 2-valved, not in Mal.), globular or rarely ellipsoid, c. 1–15 cm, usually with a hard pericarp. *Seed(s)* 1 or 4–20, inappendiculate, glabrous; embryo large, flat or thick; albumen copious to nearly absent.

Distr. About 94 species in tropical Southeast Asia, northwards to S. China and Hainan, throughout *Malesia* to Australia (N. Queensland); 76 *spp.* do not occur outside *Malesia*; 2 are endemic to Queensland.

Not a single species crosses WALLACE's plant-geographical demarcation line. Although only 7 *spp.* occur east of this line, at subgeneric level the greatest variation is found there. For that reason it is assumed that the genus originated in Austro-Malesia.

Ecol. By far the majority of the species grow in the tropical lowland rain-forest, mostly below 500 m. About 10 *spp.* (of which 3 *extra-Malesian* ones) are usually found between 500–1200(–1500) m, but sometimes also lower. About a dozen species are sometimes found in freshwater swamp forests, but they are not confined to that habitat, except 63 *X. ramiflorum*. Also nearly all of the continental Southeast Asian species seem to be confined to the rain-forest; 60. *X. lanceatum* is restricted to stream banks and swamps; 62. *X. virens* occurs in monsoon forests, tolerating rather long dry periods. Otherwise the ecology is for all species 'rain-forest', not specifically repeated.

Note. From the subdivision of the genus it appears that both the fruit and seed, and the flower structure are important for specific distinction, in addition to vegetative characters. Unfortunately the mature fruit is yet unknown in several species (*spp.* 4, 16, 25, 34, 35, 36, 37, 38, 41, 51, 52, 58) and flowers are unknown from *spp.* 40, 49, 61, 67, 68, and 76. Besides, specimens in fruit seldom carry flowers too, and the reverse. These factors have complicated the key and necessitated to enter many species twice or even thrice.

KEY TO THE SUBGENERA

1. Fruit 4–more-seeded.
 2. Embryo thick, covered by little endosperm. *Spp.* 72–76 V. *Subg. Brunophyllum*
 2. Embryo flat, covered by copious endosperm. *Spp.* 69–71 IV. *Subg. Exsertum*
1. Fruit 1- (exceptionally 2-)seeded.
 3. Stamens triadelphous. Embryo flat, covered by copious endosperm. *Spp.* 64–68 III. *Subg. Triadelphum*
 3. Stamens monadelphous or free. Embryo thick, without or with little endosperm.
 4. Stigma peltate. Twigs at the nodes with a pair of annular glands. *Sp.* 63 II. *Subg. Coriaceum*
 4. Stigma small, slightly bilobed. Nodal glands absent on the twigs. *Spp.* 1–62 I. *Subg. Xanthophyllum*

KEY TO THE SPECIES

1. Petiole and lower side of leaves densely patently hairy, at least on the midrib.
 2. Venation of 3rd order scalariform.
 3. Inflorescence axis at the nodes with 2 crateriform or cup-like glands.
 4. Leaves glaucous-papillose beneath, with 6–8 pairs of secondary nerves; laminar glands indistinct or only the basal ones distinct 3. *X. sulphureum*
 4. Leaves smooth beneath, with 12 or 13 pairs of secondary nerves; laminar glands numerous, distinct 4. *X. cockburnii*
 3. No glands present at the nodes of the inflorescence axis.
 5. Leaves glaucous-papillose beneath. Ovary and fruit hairy all round or in 4 rows in upper half 12. *X. rufum*

5. Leaves smooth beneath. Ovary and fruit glabrous or hairy in 2 rows in upper half.
6. Inflorescence brownish hairy. Sepals persistent in fruit, the outer *c.* 2–3 mm long, the inner *c.* 3.5–5 mm long. 11. *X. velutinum*
6. Inflorescence axis greyish white-hairy. Sepals caducous in fruit, the outer *c.* 4 mm long, the inner 5–6 mm long. 8. *X. pubescens*
2. Venation of 3rd order finely reticulate.
7. Ovules 4. Carina appressedly hairy outside, other petals appressedly hairy apically 57. *X. malayanum*
7. Ovules 8–16. Petals (sub)glabrous outside.
8. Sepals and inflorescence axis with hairs *c.* 1 mm long 50. *X. trichocladum*
8. Sepals and inflorescence axis with hairs 0.1–0.2(–0.4) mm long.
9. Leaf-blade bullate between the tertiary nerves 49. *X. reticulatum*
9. Leaf-blade flat or only the midrib raised in a shallow depression.
10. Pedicel 2.5–4.5(–5) mm long. Anthers 0.9–1.4 mm long. Flowers 11–12 mm long
48. *X. purpureum*
10. Pedicel 7.5–14 mm long. Anthers 1.5–2.2 mm long. Flowers 12.5–16.5 mm long.
11. Petiole 5–6 mm long. Flowers 16–16.5 mm long. Anthers *c.* 2.2 mm long 46. *X. beccarianum*
11. Petiole 1.5–2.5(–3) mm long. Flowers *c.* 12.5 mm long. Anthers 1.5–1.6 mm long
47. *X. pedicellatum*
1. Petiole and lower side of leaves shortly appressedly hairy or glabrous.
12. Leaves glaucous-papillose beneath.
13. Venation of 3rd order scalariform. Ovary hairy on median ribs. Fruits irregularly 4-sulcate
10. *X. schizocarpon*
13. Venation of 3rd order reticulate. Ovary glabrous or, if hairy, not especially hairy on the ribs. Fruit not 4-sulcate.
14. Ovary glabrous.
15. Ovules 4. Anthers 0.3–0.4 mm long.
16. Petiole (6–)7–11(–14) mm. Axillary buds very densely shortly hairy, not soon glabrescent. Inner sepals *c.* 2.5 mm long. Anthers hairy at base 14. *X. nigricans*
16. Petiole 5–6.5 mm. Axillary buds soon glabrescent. Inner sepals *c.* 4 mm long. Anthers glabrous or with very few hairs at base 15. *X. borneense*
15. Ovules 8–18. Anthers at least 0.7 mm long.
17. Axillary buds 3–7 mm long 43. *X. penibukanense*
17. Axillary buds up to 1 mm long.
18. Petiole (5–)8–12 mm long. Flowers up to 8.5 mm long. Fruit 1-seeded, up to 1.2 cm long
63. *X. ramiflorum*
18. Petiole 1.5–3 mm long. Flowers 15–16 mm long. Fruit 10- or more-seeded, at least 5 cm long
72. *X. brevipes*
14. Ovary hairy.
19. Ovules 8–16.
20. Petiole distinctly transversely wrinkled.
21. Petiole 8–15 mm long, gradually widened into the attenuate leaf base. Lower pair of nerves reaching beyond the middle of the leaf-blade. 43. *X. penibukanense*
21. Petiole 3–6(–7) mm long, abruptly ending into the cuneate or cordate leaf base. Nerves in the lower part of the leaf blade not reaching the middle of the blade 42. *X. discolor*
20. Petiole not transversally wrinkled.
22. Ovary and style appressedly hairy. Petiole (8–)10–14 mm long. Nerves 11–14 pairs
44. *X. pseudoadenotus*
22. Ovary and style patently hairy. Petiole 4–9 mm long. Nerves 6–13 pairs 45. *X. pulchrum*
19. Ovules 4.
23. Axillary buds at least 4 mm long.

24. (Upper) axillary bud situated (1.5–)3–15 mm above the leaf axil and placed on a 0.5–1.5 mm long stalk 41. *X. korthalsianum*
 Note: Compare also 61. *X. lateriflorum*.
24. Axillary bud situated in the leaf axil, sessile.
25. Scales of axillary bud at apex with 2 distinct thickenings 36. *X. clovis*
25. Scales of axillary bud not thickened at apex.
26. Petiole 26–31 mm 35. *X. petiolatum*
26. Petiole (excl. attenuate leaf base) up to 17 mm.
27. Axillary buds half-patent to patent, with their flat side perpendicular to the twig
 39. *X. bracteatum*
27. Axillary buds erect, usually with their flat side pressed against the twig.
28. Petals 6–8 mm long. Outer sepals 1.5–2.5 mm long, inner side 2.5–3.5 mm long. Anthers 0.4–0.5 mm long 28. *X. griffithii*
28. Petals c. 13 mm long. Outer sepals c. 3–4 mm long, inner sepals 3.5–5.5 mm long. Anthers c. 0.7 mm long 38. *X. angustigemma*
23. Axillary buds at most 1.5 mm long.
29. Leaf-blade 1.5–5(–6) by 0.5–1.5(–2) cm. Flowers solitary or in an up to 3-flowered inflorescence, 10–11 mm long, on 10–11 mm long pedicels 22. *X. parvifolium*
29. Leaf-blades, at least averagely, more than 5 cm long. Inflorescences either with more than 6 flowers, or the flowers 7.5–8.5 mm long on 1.5–3 mm long pedicels.
30. Inflorescence unbranched, bearing only 3–6 flowers. Fruit (immature) apically pointed
 20. *X. pauciflorum*
30. Inflorescence at least basally branched, with more than 6 flowers (sometimes seemingly unbranched if lower bracts resemble leaves). Fruit apically rounded.
31. Filaments of upper stamens slightly S-curved, above base with a blunt appendage directed inwards. Fruit globular, 1.1–1.7 cm diam.
32. Axillary buds more or less enclosed between the base of the petiole and a low ridge of the twig, not projecting outwards, wider than high 27. *X. impressum*
32. Axillary buds projecting outwards, at least twice as long as wide 29. *X. monticulum*
31. Filaments more or less straight, without appendage above base. Fruit (unknown in 58. *X. novoguinese*) broadly ellipsoid or apple-shaped, 3.5–8 cm diam.
33. Petiole 3–5 mm long. Axillary buds 2 or 3. Nerves c. 8–14 pairs. Fruit broadly ellipsoid to nearly globular, up to 3.5 cm diam., pericarp up to 3 mm thick 60. *X. lanceatum*
33. Petiole 6–10 mm long. Axillary buds 1 or 2. Nerves 5–8 pairs. Fruit (unknown in 58. *X. novoguinese*) large, up to 8 cm diam., apple-shaped, pericarp up to 30 mm thick.
34. Petals c. 7 mm long. Pedicel 1.5–2.5 mm long 58. *X. novoguinese*
34. Petals 10–12 mm long. Pedicel 3–4.5 mm long 59. *X. ngii*
12. Leaves smooth beneath.
35. Ovary hairy all round, not glabrous at lateral side.
36. Most axillary buds, at least in upper half of the twigs, 3 mm long or longer.
37. Axillary buds (8–)11–20(–30) by 6–12(–14) mm, \pm 1–3 times as long as wide, flat, at base attenuate and not thickened, at apex rounded to obtuse. (Flowers unknown) 40. *X. heterophyllum*
37. Axillary buds up to 11 mm long and basally thickened, or more than 3 times as long as wide and \pm acute, or smaller than 8 mm.
38. Axillary buds erect, flattened against the twig, very densely shortly hairy 37. *X. reflexum*
38. Axillary buds half-patent to patent, glabrous or sparsely shortly hairy.
39. Axillary buds at base narrow, not thickened.
40. Leaf base cordate with upturned margins. Leaves with 14–20 pairs of nerves. Petals 16 mm long
 25. *X. brigittae*
40. Leaf base attenuate and flat. Leaves with 5–7 pairs of nerves. Petals 10–12 mm long
 31. *X. incertum*
39. Axillary buds at base wide and strongly thickened.

41. Inflorescence unbranched. Petiole 4–6.5 mm. Leaves with 3–5 pairs of nerves **19. X. neglectum**
41. Inflorescence branched. Petiole 8–14 mm. Leaves with 7 or more pairs of nerves.
42. Petiole (18–)25–30 mm. Leaf-blade 22–42 cm long, finer nervation beneath indistinct
34. X. ceraceifolium
42. Petiole 8–18 mm, exceptionally longer. Nervation at lower side of leaf-blade distinctly prominent, or leaf-blade much shorter than 20 cm.
43. Leaf-blade up to 3 times as long as wide. Petiole 8–14(–16) mm. Nerves (6 or) 7–9(–11) pairs. Leaf base never cordate. Anthers 0.4–0.6(–0.7) mm long **30. X. vitellinum**
43. Leaf-blade c. 4–6 times as long as wide. Petiole (8–)15–18(–24) mm, if shorter than 15 mm, then leaf base cordate. Nerves (9–)13–20 pairs. Anthers (0.6–)0.7–1.2 mm long.
44. Leaf base cuneate to rounded, or cordate with the margins curved upwards and connate above the apex of the petiole. Petals (8.5–)9.5–12.5(–14.5) mm long. Anthers (0.6–)0.7–0.9(–1) mm long **32. X. adenotus**
44. Leaf base cordate, flat, or only with little upturning margins. Petals 15–18.5 mm long. Anthers 1.1–1.2 mm long **33. X. palawanense**
36. Most axillary buds up to c. 2 mm long.
45. Midrib sunken above over most of its length.
46. Petals \pm equal in size and form. Fruit black, 2–6 cm diam., seeds 4–12. (Compare also *70. X. amoenum*) **71. X. stipitatum**
46. Petals unequal. Fruit not black, up to 2 cm diam., 1-seeded.
47. Flowering.
48. Upper petals hairy inside to near apex **55. X. wrayi**
48. Upper petals hairy inside only at base.
49. Nerves 12–20 pairs. Filaments 1–3 mm connate **56. X. venosum**
49. Nerves 3–7 pairs. Filaments free at base.
50. Petiole glabrous or hairy only in the upper groove. Finer venation beneath not very distinct
54. X. eurhynchum
50. Petiole densely hairy all round. Finer venation at lower side very distinctly prominent
53. X. retinerve
47. Fruiting.
51. Fruit neither densely set with thick warts, nor ribbed.
52. Petiole glabrous or hairy only in the upper groove. Fruit densely hairy, smooth to slightly wrinkled or 2–4-sulcate, sometimes finely rugose, up to 1.5 cm diam. **54. X. eurhynchum**
52. Petiole densely hairy all round. Fruit rather sparsely hairy, smooth, up to 2.2 cm diam.
53. X. retinerve
51. Fruit densely set with thick warts, or verrucose and ribbed.
53. Fruit apically shortly but distinctly beaked, strongly verrucosely ribbed **56. X. venosum**
53. Fruit apically rounded, densely set with thick warts **54. X. eurhynchum**, **55. X. wrayi**
45. Midrib flat above or prominent, then sometimes with a groove in basal half.
54. Region of the twig above the leaf axil as well as the 2–4 very small and inconspicuous axillary buds densely shortly hairy.
55. Petiole glabrous or hairy only in the upper groove. Finer venation beneath not very distinct. Fruit either densely set with thick warts or densely hairy and smooth to slightly wrinkled or 2–4-sulcate
54. X. eurhynchum
55. Petiole densely hairy all round. Finer venation beneath very distinctly prominent. Fruit rather sparsely hairy, smooth **53. X. retinerve**
54. Twigs glabrous above the leaf axil. Axillary buds glabrous or sparsely hairy and soon glabrescent.
56. Axillary buds (2 or) 3–7, the upper one situated at least 1–2 mm above the leaf axil.
57. Upper axillary buds placed on a 1–2.5 mm long stalk. (Flowers unknown) **61. X. lateriflorum**
57. Upper axillary buds sessile on the twig **62. X. virens**
56. Axillary bud(s) seemingly 1, or 2, rarely 3, close together in the leaf axil.
58. Ovules 8–12. (Compare also *7. X. ferrugineum*) **51. X. erythrostachyum**

58. Ovules 4.
59. Inflorescence branched.
60. Leaf-blade c. 4–6 times as long as wide. Petiole (8–)15–18(–24) mm. Nerves (9–)13–20 pairs. Anthers (0.6–)0.7–0.9(–1) mm long 32. *X. adenotus*
60. Leaf-blade up to c. 3 times as long as wide. Petiole 8–14(–16) mm. Nerves (6 or) 7–9(–11) pairs. Anthers 0.4–0.6(–0.7) mm long 30. *X. vitellinum*
59. Inflorescence unbranched or sometimes with a side-branch at base.
61. Ovary (half-)patently hairy, fruit patently hairy.
62. Nerves c. 8–10 pairs. Pedicel of flowers 4.5–6 mm, of fruits 8–11 mm long. Petals 13–19 mm long. Anthers 0.8–1.2 mm long 24. *X. ancolanum*
62. Nerves 3–5 pairs. Pedicel of flowers c. 2 mm, of fruits c. 4.5 mm long. Anthers 0.3–0.4 mm long 19. *X. neglectum*
61. Ovary and fruit appressedly hairy.
63. Inner sepals 2–2.5 mm long.
64. Leaf base truncate to cordate. Carina auriculate. Filaments for 0.7–1 mm connate 21. *X. tardicrescens*
64. Leaf base cuneate to rounded. Carina gradually enlarged, not auriculate. Filaments free 18. *X. subcoriaceum*
63. Inner sepals 2.8–4.5 mm long.
65. Anthers 0.4–0.7 mm long. Gynoecium somewhat shorter than the carina. Laminar glands numerous 26. *X. tenuipetalum*
65. Anthers 1–1.2 mm long. Gynoecium 0.5–2 mm longer than the carina. Laminar glands 1–6.
66. Leaf base cordate with upturned margins. Nerves 14–20 pairs. Petiole 15–18 mm 25. *X. brigittae*
66. Leaf base attenuate and flat. Nerves 5–7 pairs. Petiole 6–10 mm . 23. *X. philippinense*
35. Ovary glabrous, at least at the lateral sides.
67. Nerves of 3rd order scalariform.
68. Inflorescence axis at the nodes with 2 crateriform glands.
69. Leaf base cuneate to rounded. Leaf-blade 5–25 by 2–12 cm. Nerves 4–10 pairs 1. *X. flavescens*
69. Leaf base cordate. Leaf-blade 20–50 by 6.5–20 cm. Nerves 14–20 pairs 2. *X. bullatum*
68. No glands present on inflorescence axis.
70. Ovary and fruit hairy on 4 ribs in apical half, hairs brown 13. *X. macrophyllum*
70. Ovary and fruit glabrous or hairy in 2 rows, hairs greyish.
71. Midrib flat beneath (prominent above) 9. *X. resupinatum*
71. Midrib prominent beneath (prominent to sunken above).
72. Inflorescence axis branched or unbranched, very densely set with flowers or scars of pedicels 5. *X. hosei*
72. Inflorescence axis branched, except in upper part not densely set with flowers or scars of pedicels.
73. Pedicels 1–1.5(–4) mm. Sepals thickened basally, not fleshy, when dry medium brown with light coloured margin; outer sepals very sparsely minutely hairy 6. *X. ferrugineum*
73. Pedicels (2–)4–10 mm long. Sepals, if thickened, somewhat fleshy, without a lighter coloured margin; outer sepals more densely hairy 7. *X. affine*
67. Nerves of 3rd order reticulate.
74. Ovules 4.
75. Petiole distinctly transversally wrinkled, 3.5–4.5(–6.5) mm. Nerves 3 or 4 pairs. Inflorescence and pedicels (sub)glabrous 16. *X. ovatifolium*
75. Petiole smooth, 6–11 mm. Nerves 4–6 pairs. Inflorescence and pedicels more or less densely shortly hairy 17. *X. tenue*
74. Ovules 8 or more.
76. Laminar glands rather numerous and distinct, 0.5–1 mm diam., nearly all situated in the 'axil' of secondary nerves and midrib. (Flowers and ripe fruits unknown) 68. *X. hildebrandii*
76. Laminar glands scattered or situated at the margin, not in the 'axil' of secondary nerves and midrib.

77. Flowering (flowers unknown in 67. *X. contractum* and 76. *X. chartaceum*).
78. Stamens triadelphous, *i.e.*, 6 stamens connate in 2 groups, and the remaining 2 stamens connate.
79. Laminar glands sometimes situated near margin of leaf-blade but never present on the margin itself. Anthers completely glabrous 66. *X. montanum*
79. Leaf-blade in upper half with at least 6 glands situated on the margin. Anthers shortly hairy along slits and at base.
80. Filaments and style densely and rather shortly patently hairy 65. *X. celebicum*
80. Filaments and style glabrous 64. *X. ellipticum*
78. Stamens either free or all connate except between upper petals.
81. Petals unequal, the lower middle one (carina) very distinct from the upper ones.
82. Petals black when dry. Twigs at the nodes with rather distinct annular glands. Filaments partly set with lanate hairs 73. *X. obscurum*
82. Petals reddish orange when dry. Twigs without nodal glands. Filaments with short, straight hairs near base. 52. *X. laeve*
81. Petals nearly equal in size and form.
83. Pedicel 1.5–4 mm. Stamens shorter than petals.
84. Filaments (nearly) free. Petals 7–8.5 mm long. Outer sepals 2.5–3.5 mm long, inner sepals 3–4.5 mm long 74. *X. papuanum*
84. Filaments connate to nearly halfway. Petals 9.5–12 mm long. Outer sepals 4–5.5 mm long, inner sepals 6–7 mm long. 75. *X. ecarinatum*
83. Pedicel at least 8 mm. Stamens longer than petals.
85. Petals 14–16 mm long. Stamens 17–22 mm long. Anthers hairy from base to apex, 1–1.3 mm long 69. *X. suberosum*
85. Petals 7–12 mm long. Stamens 11–13(–16) mm long. Anthers glabrous or with a few hairs at base, 0.7–0.9 mm long.
86. Petals (8–)9–11(–12) mm long. Style hairy to apex. Laminar glands 6–10(–20) 70. *X. amoenum*
86. Petals 7–7.5(–8) mm long. Style glabrous in upper half. Laminar glands 0–2(–4) 71. *X. stipitatum*
77. Fruiting.
87. Fruit small, less than 2 cm diam., 1- (or 2-) seeded (mature fruit not known in 52. *X. laeve* and 67. *X. contractum*).
88. At least 6 glands situated on the leaf margin itself, in upper part of the leaf-blade.
89. Pedicel 3–6(–8) mm 64. *X. ellipticum*
89. Pedicel 7–9.5 mm 65. *X. celebicum*
88. Laminar glands absent from margin of leaf-blade.
90. Midrib prominent above 67. *X. contractum*
90. Midrib sunken above.
91. Twigs at the nodes with distinct annular glands. Pedicel 4–5.5 mm 66. *X. montanum*
91. Twigs without nodal glands. Pedicel 8–15 mm. (Fruits unknown) 52. *X. laeve*
87. Fruit large, many-seeded.
92. Pericarp strongly wrinkled outside when dry.
93. Fruit globular to pear-shaped, black 76. *X. chartaceum*
93. Fruit ellipsoid, attenuate at apex and base when dry, orange to brown .. 75. *X. ecarinatum*
92. Pericarp remaining smooth when dry.
94. Fruit black. Seeds with copious albumen, with thin cotyledons 69. *X. suberosum*
70. *X. amoenum*
71. *X. stipitatum*
94. Fruit not black. Seeds (nearly) without albumen, with very thick cotyledons.
95. Seeds sticking to the pericarp when dry 74. *X. papuanum*
95. Seeds sticking together in drying, leaving shining reddish marks on inner side of the pericarp 73. *X. obscurum*

I. Subgenus *Xanthophyllum*

Nodal glands absent. Axillary buds sometimes very long, usually thickened basally, subacute, sometimes hairy. *Petiole* sometimes with glands, sometimes hairy. *Leaf-blade* sometimes hairy, base rarely cordate; tertiary nerves finely reticulate, or scalariform. *Inflorescence* usually branched. *Sepals* usually densely minutely greyish hairy out- and inside, sometimes with longer or differently coloured hairs, the inner ones often subglabrous in marginal area and often slightly keeled. *Petals* unequal, ciliate above base; carina unguiculate, boat-shaped, auriculate or not, usually densely hairy outside; lateral and upper petals narrow, usually oblanceolate to \pm linear, more or less flat, slightly constricted basally, usually glabrous outside, usually slightly hairy inside above insertion of filaments, upper petals often reflexed. *Ovary* sometimes semi-2-locular, glabrous to hairy; style usually hairy; stigma small, slightly 2-lobed, very rarely wider than apex of style; ovules 4 to c. 20. *Fruit* indehiscent, usually globular, usually c. 1.5–2 cm diam. *Seed(s)* 1 (or 2), rarely up to 4; testa 1- or 2-layered; albumen present or not; embryo globular, plumule not differentiated.

KEY TO THE SECTIONS

1. Tertiary nerves scalariform. Testa sticking to the inner side of the fruitwall in drying. Albumen absent. *Spp.* 1–13 1. *Sect. Xanthophyllum*
 1. Tertiary nerves finely reticulate. Testa sticking to the rest of the seed in drying. Albumen present, though sometimes scarce. *Spp.* 14–62 2. *Sect. Eystathes*

1. Section *Xanthophyllum*

Twigs usually densely patently hairy, sometimes glabrous. *Petiole* usually more or less smooth, sometimes with glands. *Leaf-blade*: tertiary nerves scalariform, prominent. *Petals*: carina usually shortly unguiculate. *Ovary* sometimes semi-2-locular (the marginal areas of the carpels touching the other ones along their length), glabrous, sometimes hairy in 2–8 rows, rarely hairy all round; ovules 6–16, or (not in Mal.) 4–10, in 7. *X. affine* very rarely 5. *Fruit* globular or sometimes pointed or 4-sulcate, smooth or sometimes tuberculate. *Seed(s)* 1 or occasionally 2 (in 1. *X. flavescens* often 2); testa reduced, without hard inner layer, sticking to the pericarp in drying, the raphe widely branched, hypostase not developed; albumen absent in ripe seed; radicle not exerted.

1. *Xanthophyllum flavescens* ROXB. Pl. Corom. 3 (1820) 82, t. 284, f. 2; WALL. Cat. (1831) 4198; ROXB. Fl. Ind. ed. Carey 1 (1832) 221; WALP. Rep. 1 (1842) 248; DRURY, Handb. Ind. Fl. 1 (1864) 56; KURZ, J. As. Soc. Beng. 42, ii (1873) 79, 80; Prelim. Rep. For. Pegu (1875) 26; For. Fl. Burma 1 (1877) 81; PRAIN, Beng. Pl. (1903) 236; BRANDIS, Indian Trees (1906) 44, *excl. syn.*; MEIJDEN, Leiden Bot. Ser. 7 (1982) 64. — *X. excelsum* (BLUME) MIQ. Fl. Ind. Bat. 1, 2 (1858) 129; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 274; BINNEND. Ann. Jard. Bot. Btzg 1 (1876) 172; KING, Mat. Fl. Mal. Pen. (1890) 142, *p.p.* (*sub X. affine*); K. &

V. Icon. Bog. 1, 1 (1897) 11, *p.p.* (*sub X. affine* β *excelsa*); BOERL. Cat. Hort. Bog. (1899) 58; K. & V. Bijdr. Booms. 5 (1900) 298; RACIB. Ann. Jard. Bot. Btzg 17 (1900) 53; BOORSMA, Bull. Dép. Agr. Ind. Néerl. 16 (1908) 3; GAGNEP. in Desv. J. Bot. 21 (1908) 253; Fl. Gén. I.-C. 1 (1909) 246; BACKER, Schoolfl. Java (1911) 80; KOORD. Exk. Fl. Java 2 (1912) 453; MERR. En. Born. (1921) 326, *p.p.*; RIDLEY, Fl. Mal. Pen. 1 (1922) 143, *p.p.* (*sub X. affine*); MERR. En. Philip. 2 (1923) 386, *p.p.*; BURK. Gard. Bull. S. S. 3 (1923) 35, *p.p.*; ENDERT, Tectona 18 (1925) 97; DOCTERS VAN LEEUWEN, Zoococidia

(1926) 273; HEYNE, Nutt. Pl. (1927) 901; CRAIB, Fl. Siam. En. 1 (1931) 105; BURK. Dict. (1935) 2268; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1939) 222; MASAMUNE, En. Phan. Born. (1942) 380; WYATT-SMITH, Mal. For. Rec. 17 (1952) 80, 363, p.p.; *ibid.* 23² (1963) f. 10, p.p. (*sub X. affine*); BACKER & BAKH.f. Fl. Java 1 (1963) 201; NG, Fed. Mus. J. n.s. 13 (1971) 137; Tree Fl. Mal. 1 (1972) 354, f. 1, p.p. — *Jakkia excelsa* BLUME, Bijdr. (1825) 62 ('*Jackia*'); G. DON, Gen. Hist. 1 (1831) 368. — *Monnina excelsa* (BLUME) SPRENGEL, Syst. Veg. 3 (1827) 265; STEUD. Nom. ed. 2, 2 (1841) 157. — *X. adenopodum* MIQ. Fl. Ind. Bat., Suppl. (1861) 393; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 277. — *Banisterodes excelsum* (BLUME) O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *X. affine var. adenopodum* (MIQ.) K. & V. Icon. Bog. 1, 1 (1897) 11. — *X. glandulosum* MERR. Philip. Gov. Lab. Bur. Bull. 35 (1905) 34; GAGNEP. in Desv. J. Bot. 21 (1908) 252; MERR. En. Philip. 2 (1923) 485. — *X. floriferum* ELMER, Leaf. Philip. Bot. 5 (1913) 1674. — *X. multiramiosum* ELMER, l.c. 1676; MERR. Philip. J. Sc. 27 (1925) 29. — *X. loheri* MERR. l.c. 29. — *X. pallidum* RIDLEY, Kew Bull. (1938) 113; MASAMUNE, En. Phan. Born. (1942) 380.

Tree, 8–36 m high, up to 1 m dbh. Twigs glabrous. *Petiole* (5–)7–15 mm, often seemingly longer when leaf base is attenuate, mostly in apical half with two rather distinct glands. *Leaf-blade* (5.2–)7–18(–25) by (2.3–)3–7(–12) cm, base often long attenuate with the margins of the leaf-blade curved upwards and gradually grading into the ridges of the petiole; above yellowish green to yellowish brown; beneath: secondary nerves (4–)6–8(–10) pairs, usually forming a rather distinct intramarginal nerve, venation sometimes indistinct; glands 1–10, scattered, 0.3–0.6(–0.9) mm diam., basal glands usually absent if petiole bears glands. *Inflorescences* often several together on one thickened node, rarely unbranched, as long as or longer than the leaves; axes slender, somewhat flattened, slightly grooved, thickened on the nodes and there with usually distinct, protruding glands, brownish, densely minutely patently hairy. *Flowers* usually with 3 together. *Pedicele* (2.5–)3–4.5 mm, rarely longer, densely minutely half-patently greyish hairy. *Sepals*: outer sepals 2.3–3(–3.6) by 1.4–2.7 mm; inner sepals 3–4.1 by 2.3–3.7 mm. *Petals* bright yellow, or white and the upper petals with a yellow spot, or fully white, when dry yellowish, the longest one (6–)7–8(–8.5) mm long; carina basally more or less densely hairy, in upper part outside densely patently hairy to glabrous, inside rather densely hairy to glabrous; lateral petals usually glabrous outside, mostly glabrous inside, upper petals reflexed, ciliate basally or up to 2/3 their length, usually glabrous outside, inside patently hairy or at base only. *Stamens*: filaments very rarely c. 1 mm connate; anthers (0.4–)0.5–0.6(–0.65) mm

long. *Ovary* glabrous to hairy in apical region on 4 ribs, very rarely (in one coll.) loosely hairy all over, often semi-2-locular; style sometimes glabrous in basal part; ovules 8–12, rarely 6. *Fruit* 1- to often 2-locular, the second chamber often reduced and seemingly enveloped by the pericarp; usually globular, up to c. 2 cm diam., smooth to irregularly low-tuberculate, rarely densely tuberculate, rather dull to somewhat shiny, yellowish to brownish; pericarp usually hard; pedicel up to 6(–7) mm long. *Seed(s)* 1 or 2.

Distr. Throughout tropical continental SE. Asia; in *Malesia*: Sumatra (incl. Simalur, Banka), Malay Peninsula, Borneo, Philippines (Luzon, Mindoro, Palawan, Masbate, Guimaras, Negros, Mindanao).

Note. Closely resembling 7. *X. affine*, and nearly always combined with that species in one taxon. The only reliable character distinguishing it from the latter species is the presence of nodal glands in the inflorescence. Due to the variability of *X. affine* it is difficult to identify sterile collections of both species. Differences are found in the petiole; in *X. flavescens* the petiole is glabrous and often bears a pair of glands, in *X. affine* the petiole is minutely hairy, and eglandular.

2. *Xanthophyllum bullatum* KING, J. As. Soc. Beng. 59, ii (1890) 142; BURK. & HEND. Gard. Bull. S. S. 4 (1928) 222; NG, Tree Fl. Mal. 1 (1972) 356, f. 1; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 146; MEUDEN, Leiden Bot. Ser. 7 (1982) 66.

Shrub or small tree, 3–4.5 m high, 6 cm dbh. Twigs appressedly hairy. *Petiole* c. 12–22 mm, rather densely minutely appressedly hairy. *Leaf-blade* 20–50 by 6.5–25 cm; base cordate; above yellowish green, bullate between midrib and secondary nerves, midrib strongly prominent to flat, secondary nerves rather strongly prominent, venation finely prominent; beneath creamish brown to light brownish green, minutely hairy on the nerves, secondary nerves 14–20 pairs, protruding, mostly forming a nearly complete, rather distinct intramarginal nerve, venation sometimes rather obscure; glands rather few and mainly along the margin, or numerous and scattered, 0.3–0.6 mm diam., basal glands (1 or sometimes 2 pairs) at very base on midrib. *Inflorescences* shorter than the leaves, mostly elongate and often very densely set with flowers; axes appressedly to patently minutely hairy, light to very dark brownish, with large, protruding nodal glands. *Pedicele* 5–7 mm, very densely minutely appressedly reddish brown hairy. *Sepals* minutely appressedly reddish brown hairy; outer sepals c. 4.5 by 3 mm, with or without protruding glands; inner sepals c. 6.5 by 3.7 mm, keeled. *Petals* white, when dry yellowish, the longest one 12 mm long; carina in apical part rather shortly appressedly hairy outside, minutely so

inside, further glabrous; other petals glabrous outside, glabrous or ciliate at base, shortly hairy or not inside in basal part, the lateral petals strongly bent, the upper petals strongly S-curved. *Stamens*: filaments glabrous or sparsely shortly hairy at base; anthers 0.8–1.2 mm long, ciliate along slits. *Ovary* slightly ribbed; style glabrous in basal part, apically shortly appressedly hairy; ovules 8–10. *Fruit* globular, up to 2 cm diam., dull, rather smooth, light brown; pericarp rather thin, not very hard.

Distr. *Malesia*: Malay Peninsula (Perak, Trengganu, Selangor).

3. *Xanthophyllum sulphureum* KING, J. As. Soc. Beng. 59, ii (1890) 143; GAGNEP. in Desv. J. Bot. 21 (1908) 252 ('*sulfureum*'); RIDLEY, Fl. Mal. Pen. 1 (1922) 145; WYATT-SMITH, Mal. For. Rec. 17 (1952) 81, 363; NG, Tree Fl. Mal. 1 (1972) 363, f. 4, excl. FRI 8041; MEIJDEN, Leiden Bot. Ser. 7 (1982) 67, f. 10c.

Small to large tree, 30–50 m high. Twigs finely reticulately wrinkled, brownish hairy, glabrescent. Axillary buds up to 2.8 mm long but often much smaller, rounded, densely hairy. *Petiole* 9–13 mm, very densely patently hairy. *Leaf-blade* 9–20 by 2.8–7.5 cm; above yellowish green, dull, midrib basally slightly prominent to slightly sunken and rather densely hairy, upwards sunken and glabrous, nerves and venation rather obscure; beneath glaucous-papillose, rather densely hairy especially on the nerves, secondary nerves 6–8 pairs, forming a rather distinct intramarginal nerve; basal glands perhaps always present but mostly hidden by the very prominent midrib and then scarcely visible, rarely not so and then distinct, c. 0.5 mm diam., other glands apparently few or possibly absent. *Inflorescences* shorter than the leaves; axes rather smooth, very densely brownish hairy, with distinct, large, prominent 'cap-like' nodal glands. *Pedicel* c. 4 mm, rather stout, very densely patently brownish pubescent. *Sepals* densely brownish patently shortly hairy at both sides; outer sepals 4 by 3.7 mm; inner sepals 5 by 4.2 mm, some with glandular spots, distinctly keeled. *Petals* yellow, when dry yellowish, the longest one 11 mm; carina very densely (nearly velvety) patently pubescent outside, densely pubescent inside in apical part; other petals woolly-tufted outside. *Stamens*: filaments nearly glabrous; anthers 0.5 mm long, cohering around the style. *Ovary* containing 16 ovules. *Fruit* globular, c. 2 cm diam., light brownish, dull, finely tuberculate; pericarp hard.

Distr. *Malesia*: Malay Peninsula (Perak, Kelantan, Pahang).

4. *Xanthophyllum cockburnii* MEIJDEN, Leiden Bot. Ser. 7 (1982) 67.

Tree, 20 m high, 30 cm dbh. Axillary buds densely

patently hairy. *Petiole* 8–12 mm, densely hairy. *Leaf-blade* 11–17 by 3.5–7 cm, base rounded to obtuse; above slightly bullate between midrib and secondary nerves, greenish or brownish yellow, midrib rather obscure, finely prominent to flat, secondary nerves obscure; beneath creamish to greenish yellow, rather densely patently hairy on the nerves, secondary nerves 12 or 13 pairs, forming a complete intramarginal nerve, fine venation obscure; glands c. 15–20, 0.2–0.4 mm diam., those at very base distinct, situated on midrib. *Inflorescences* shorter than to as long as the leaves; axes very densely reddish brown pubescent, with rather large nodal glands. *Pedicel* 4.5 mm. *Sepals* densely patently reddish brown hairy; outer sepals 3.8–4 by 3 mm; inner sepals 3.8–4 by 3–3.3 mm, keeled. *Petals* white, when dry yellowish, the longest one 11 mm; carina light yellowish velutinous outside, rather densely hairy inside in apical part; other petals glabrous or slightly hairy apically, not ciliate at base. *Stamens*: anthers 0.8–0.85 mm long, minutely hairy. *Ovary* containing 8 ovules. *Fruit* unknown.

Distr. *Malesia*: Malay Peninsula (Pahang, near Johore border, Upper Anak Endau R.). Once collected.

5. *Xanthophyllum hosei* RIDLEY, Kew Bull. (1938) 113; MASAMUNE, En. Phan. Born. (1942) 380; MEIJDEN, Leiden Bot. Ser. 7 (1982) 69.

Small tree, up to 3.5 m high, dbh 3 cm. Twigs minutely appressedly hairy, soon glabrescent, or glabrous. *Petiole* 7–10 mm, minutely appressedly hairy. *Leaf-blade* 12–21 by 4.5–10 cm, base rounded to more or less obtuse, apex rather suddenly cuspidate to acuminate; above slightly bullate between midrib, secondary nerves, and intramarginal nerve, dark greyish green, midrib sunken, rather wide, other nervation finely prominent; beneath lighter coloured, sparsely minutely appressedly hairy in basal part especially on the nerves, secondary nerves 7–11 pairs, forming a distinct, (nearly) complete intramarginal nerve; glands 8 to very numerous, scattered, (0.2–)0.3–0.4 mm diam., basal glands larger. *Inflorescences* branched or unbranched, up to 12 cm long; axes slightly thickened, curved, smooth, dull, minutely very densely appressedly hairy, internodes (except at very base) very short, c. 0.5–1 mm long, thus giving the inflorescence a very dense-flowered appearance. *Pedicel* 2.5–4 mm, grooved, densely minutely appressedly hairy. *Sepals* glabrous to sparsely minutely appressedly hairy inside; outer sepals 2.1–2.5 by 2.5–2.8 mm, with 2–4 glandular spots, minutely densely appressedly hairy outside; inner sepals 3.5–3.8 by 2.2–2.6 mm, rather distinctly keeled and there densely minutely appressedly hairy, further more or less glabrous outside. *Petals* yellowish when dry, the

longest one c. 8.5 mm; carina sparsely appressedly hairy outside in middle part, glabrous inside; other petals ciliate to halfway, further glabrous. *Stamens*: filaments wide at base, sparsely appressedly hairy adaxially and abaxially to \pm halfway, further glabrous; anthers 0.85–1 mm long, ciliate along slits. *Ovary* nearly sessile, ribbed; style glabrous in basal 1/3 part, upwards rather densely appressedly hairy till the apex; ovules 7–10. *Fruit* (very young) not ribbed, finely pustulate; style persistent, recurved; sepals persistent.

Distr. *Malesia*: Borneo (Sarawak).

6. *Xanthophyllum ferrugineum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118; Leiden Bot. Ser. 7 (1982) 69.

Tree, up to 25 m high, up to 40(–60) cm dbh. Twigs glabrous. *Petiole* 9–14 mm. *Leaf-blade* 8–20 by 3–7 cm; above bright yellow to yellowish green, nerves finely prominent to rather obscure but mostly more distinct above than beneath; beneath midrib not very prominent, secondary nerves c. 5–7 pairs, finely prominent to rather obscure, intramarginal nerve indistinct, tertiary nerves finely prominent to obscure, fine venation mostly obscure; glands rather few, mainly situated near margin, 0.4–0.6 mm diam., basal glands similar. *Inflorescences* shorter than the leaves; axes more or less flattened, yellowish brown, densely to rather sparsely shortly patently hairy. *Pedicele* 1–1.5(–4) mm, densely minutely appressedly greyish hairy. *Sepals* possibly persistent in fruit, medium-brown with light brown margin when dry; outer sepals 3.7–4.8 by 3.5–4 mm, (sub)glabrous outside, often with (sometimes minute) glandular spots; inner sepals 4–5 by 4–4.2 mm, thickened in middle basal part, minutely appressedly hairy especially on the midrib, glabrous along the margin. *Petals* yellow, or white and the upper petals with a yellow spot, when dry yellowish, the longest one 8.5–10 mm long; carina very densely patently pubescent outside, densely pubescent in apical part inside; other petals glabrous or with few hairs in apical part outside. *Stamens*: anthers 0.5–0.7 mm long, minutely hairy. *Ovary* smooth or ribbed, glabrous, rarely sparsely appressedly hairy all round, apically often greyish hairy in 4 short rows; ovules 8–14. *Fruit* (immature) partly enclosed by the persistent sepals, ovoid, finely tuberculate, dull, yellowish brown.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Sabah, Tawau).

7. *Xanthophyllum affine* KORTH. ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 271; KURZ, J. As. Soc. Beng. 42, ii (1873) 80; BENN. Fl. Br. India 1 (1874) 209; KURZ, For. Fl. Burma 1 (1877) 82; F.-VILL. Nov. App. (1880) 14; KING, J. As. Soc. Beng. 59, ii (1890) 142, *p.p.*; CHODAT in E. & P. Nat. Pl. Fam. 3, 4

(1896) 345; K. & V. Icon. Bog. 1, 1 (1897) 11, *p.p.* (*a genuina*, t. 11, *p.p.*, excl. f. 12–14; RIDLEY, J. Str. Br. R. As. Soc. n. 33 (1900) 45; BRANDIS, Indian Trees (1906) 44; GAGNEP. in Desv. J. Bot. 21 (1908) 253; RIDLEY, J. Fed. Mal. St. Mus. 4 (1909) 5; J. Str. Br. R. As. Soc. n. 59 (1911) 73; MERR. En. Born. (1921) 326, *p.p.* (*sub X. excelsum*); RIDLEY, Fl. Mal. Pen. 1 (1922) 143, *p.p.*; BURK. Gard. Bull. S. S. 3 (1923) 35, *p.p.* (*sub X. excelsum*); MERR. En. Philip. 2 (1923) 386, *p.p.* (*sub X. excelsum*); BAKER, J. Bot. 62 (1924) Suppl. 7; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 345; HEND. *ibid.* 4 (1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; CHODAT in Merr. Pl. Elm. Born. (1929) 133; CRAIB, Fl. Siam. En. 1 (1931) 105; BURK. Dict. (1935) 2268, *p.p.*; KEITH, N. Born. For. Rec. 2 (1938) 225; DOCTERS VAN LEEUWEN, Ned. Kruidk. Arch. 51 (1941) 166, 167; MASAMUNE, En. Phan. Born. (1942) 379; WYATT-SMITH, Mal. For. Rec. 17 (1952) 80, 363, *p.p.* (*sub X. excelsum*); BALAN MENON, *ibid.* 19 (1956) 34; WYATT-SMITH, *ibid.* 23² (1963) f. 10, *p.p.*?; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88; NG, Fed. Mus. J. n.s. 13 (1971) 137; Tree Fl. Mal. 1 (1972) 354, f. 1, *p.p.*; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 146, 211 (*excl. n. 2934*); MEIJDEN, Leiden Bot. Ser. 7 (1982) 70, f. 2, 3A g–i, 10C, 11. — *Banisterodes affine* (MIQ.) O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *X. sarawakense* CHODAT, Bull. Herb. Boiss. 4 (1896) 262 (*'sarawakensis'*); GAGNEP. in Desv. J. Bot. 21 (1908) 252; MASAMUNE, En. Phan. Born. (1942) 381. — *X. excelsum* var. *affine* (MIQ.) BOERL. Cat. Hort. Bog. (1899) 59; HEYNE, Nutt. Pl. (1927) 901.

Tree, rarely a shrub, up to 15(–30) m, up to 40(–95) cm dbh. Twigs mostly very densely, sometimes rather sparsely, patently to appressedly minutely greyish hairy, glabrescent. Axillary buds 2 (or 3), often seemingly single, the upper bud often stalked, rarely supra-axillary for more than 0.5 mm. *Petiole* (5–)6–11(–17) mm, more or less densely minutely greyish hairy all round or at the upper side only, eglandular. *Leaf-blade* rarely linear-lanceolate, 6.5–18(–35) by (2–)3–8(–13) cm, base cuneate to rounded-attenuate, sometimes attenuate with the margins of the leaf-blade curved upwards and gradually grading into the ridges on the petiole, apex sometimes cuspidate; above sometimes slightly bulate between secondary nerves, yellowish to rather dark greyish green, often with a lighter strip along midrib and base of secondary nerves, midrib prominent to flat, rarely slightly sunken, in basal part often with a groove and often minutely hairy; beneath colorous or more brownish, sometimes more or less densely minutely hairy in basal part, secondary nerves 5–16 pairs, usually forming a more or less distinct intramarginal nerve in the apical half, intramarginal nerve rarely (nearly) complete to the base; glands very variable in number and size, usually dis-

tinct. *Inflorescences* shorter than the leaves; axes smooth, minutely greyish hairy; bracts sometimes with distinct glands. *Pedicel* (2-)4-11 mm, rarely longer, densely minutely greyish hairy. *Sepals* persistent or not in fruit, sometimes with small glands; outer sepals 1.7-5.5 by 1.8-4.7 mm; inner ones 2.1-7.8 by 2.1-5.2 mm. *Petals* white (or rarely pink), the upper ones with an orange-yellow spot, when dry yellowish, the longest one 6-17 mm; carina appressedly to half-patently, sometimes patently hairy outside, inside appressedly hairy or sometimes glabrous; other petals sometimes quite glabrous, usually hairy outside at base, upper petals hairy inside or only at base. *Stamens*: filaments glabrous to sparsely appressedly hairy in basal part; anthers 0.5-1.3 (-1.6) mm long. *Ovary* often semi-2-locular, smooth to distinctly ribbed, sometimes tuberculate, glabrous or sometimes greyish hairy in 2(-4) rows in apical part; ovules usually 8-12, very rarely 6 or 5, rarely up to 16. *Fruit* globular or somewhat longer than wide, rounded or slightly but sometimes rather sharply beaked apically, up to 1.5 cm diam., smooth to pustulate or tuberculate, sometimes ribbed, creamish to brown; pericarp not very thick; sepals (sub)persistent in fruit or not.

Distr. SE. Asia (Khasya, Laos, Thailand); in *Malesia*: Sumatra (also Banka), Malay Peninsula, Borneo (Sarawak, Brunei, Sabah), Philippines (Palawan, Culion, Busuanga).

Notes. Very variable, and probably not homogeneous; for a discussion, see VAN DER MEJDEN, *l.c.* 71-73.

Most authors have included *I. X. flavescens* in this species; see note under that species.

8. *Xanthophyllum pubescens* MEJDEN, Leiden Bot. Ser. 7 (1982) 73. — *Xanthophyllum spec. B* NG, Tree Fl. Mal. 1 (1972) 365, f. 5.

Shrub or small tree, up to 12 m, 5 cm dbh. Twigs more or less brownish hairy. Axillary buds densely patently rather shortly hairy. *Petiole* 10-12 mm, hairy like twig. *Leaf-blade* 15-28 by 5.5-9.5 cm; above greenish, more or less densely hairy on the nerves, glabrescent, midrib flat to slightly prominent; beneath lighter coloured, rather densely patently hairy, secondary nerves 8 or 9 pairs, forming a more or less distinct intramarginal nerve; glands (2-)7-14(-18), scattered, (0.5-)0.6-0.8(-1) mm diam. *Inflorescences* up to 10 cm long; axes densely patently greyish hairy; in basal part flowers with 3 together; bracts with 2 large glands. *Pedicel* 5-8 mm, very densely minutely greyish patently hairy. *Sepals* densely to very densely patently greyish hairy outside; outer sepals 3.8-4 by 2.7-4 mm; inner sepals 5.2-6.1 by 3.8-4.5 mm, slightly keeled. *Petals* white, the upper ones with a yellow spot, when dry yellowish, the longest one 12-13 mm; carina very

densely shortly half-patently whitish hairy outside, in apical part rather densely hairy inside; other petals glabrous or basally ciliate, or the upper petals minutely hairy inside above the base. *Stamens*: anthers 1.1-1.5 mm long, sometimes cohering around the stigma, ciliate along slits. *Ovary* containing 8-13 ovules. *Fruit* (immature) obovoid, dull, finely pustulate.

Distr. Malesia: Malay Peninsula (Pahang, Johore).

9. *Xanthophyllum resupinatum* MEJDEN, Bot. J. Linn. Soc. 67 (1973) 120; Leiden Bot. Ser. 7 (1982) 74.

Tree, up to 25 m, 40 cm dbh. Twigs glabrous. Axillary buds very inconspicuous, ± enclosed between basal part of the petiole and the twig. *Petiole* 4.5-7 mm, often appearing longer because of the narrow leaf base, transversely wrinkled. *Leaf-blade* 6-12.5 by 2.7-5 cm, attenuate into a narrow petiole-like part; above (very) shiny, greenish to dark olive-greenish, midrib distinctly prominent; beneath yellowish brown to greenish brown, very shiny, midrib flat to faintly sunken, rarely faintly prominent or a narrow crest, secondary nerves 4-7 pairs, forming an incomplete, indistinct intramarginal nerve, tertiary nerves rather indistinct to obscure; glands very few, mostly situated above the middle, 0.3-0.7 mm diam. *Inflorescences* shorter than the leaves; axes grooved, densely minutely appressedly greyish hairy. *Pedicel* slightly grooved, 4-5 mm, very densely minutely appressedly greyish hairy. *Sepals* dark brown to blackish; outer ones c. 3 by 2.4-3 mm, with scattered, indistinct, small glandular spots, sometimes with 2 protruding glands halfway; inner sepals c. 4-4.8 by 2.8-3.5 mm, slightly keeled, with few glandular spots. *Petals* white, when dry dark brownish, the longest one 7-9 mm; carina very densely half-patently greyish pubescent outside, ± hairy inside in apical part; other petals glabrous. *Stamens*: anthers 0.5-0.7 mm long, faintly hairy. *Ovary* dark brownish, ribbed, slightly appressedly hairy on the ribs in apical part, or glabrous; ovules 9-14. *Fruit* 1.2 cm diam., blackish, slightly shiny, finely pustulate; pericarp rather thin, hard.

Distr. Malesia: Borneo (Sarawak, E. Sabah, N. Kalimantan).

10. *Xanthophyllum schizocarpon* CHODAT in Merr. Pl. Elm. Born. (1929) 136; MASAMUNE, En. Phan. Born. (1942) 381; MEJDEN, Leiden Bot. Ser. 7 (1982) 74.

Tree, 10-25 m, 35 cm dbh. Twigs minutely appressedly hairy in younger parts to glabrous. Axillary buds 2 or 3, the upper one 0-3 mm above the axil. *Petiole* 5-7 mm, minutely appressedly hairy to glabrous. *Leaf-blade* 4.5-12 by 1.5-4.5 cm; above

greyish green, midrib sunken; beneath glaucous-papillose, minutely appressedly hairy on nerves, secondary nerves 6 or 7 pairs, not forming an intramarginal nerve, finer venation indistinct; glands numerous, scattered, c. 0.2 mm diam., basal glands (if present) c. 0.5 mm diam. *Inflorescences* often shortly supra-axillary, often 2 per leaf axil, unbranched, shorter than the leaves; axes faintly grooved, brownish, minutely appressedly hairy; lower bracts opposite. *Pedicel* 6–8 mm, slightly grooved, minutely densely more or less appressedly greyish hairy. *Sepals*: outer ones 2.5–3.8 by 2.3 mm; inner ones 3.1–4.3 by 3.2 mm, \pm keeled. *Petals* yellow, when dry yellowish, the longest one 6–7 mm; carina rather densely appressedly hairy outside, shortly hairy inside in apical part; lateral petals glabrous inside, further like the upper ones, upper petals glabrous to shortly hairy outside, shortly patently hairy inside up to 2/3. *Stamens*: 8 (or 9); anthers c. 0.3 mm long. *Ovary* slightly ribbed, brownish, appressedly hairy on median ribs; ovules 6–8. *Fruit* irregularly globular, c. 1.5 cm diam., mostly wider than high, irregularly 4-sulcate, dull, light greenish to yellowish brown; pericarp hard and irregular in thickness.

Distr. *Malesia*: Borneo (Sarawak: Mersing Hill & Lambir; Sabah: Tawau).

11. *Xanthophyllum velutinum* CHODAT, Bull. Herb. Boiss. 4 (1896) 259; MEIJDEN, Leiden Bot. Ser. 7 (1982) 75.

Tree, 5–25 m, 60 cm dbh. Twigs densely set with short and long hairs, longer hairs 0.3–0.8 mm long. Axillary buds 1–3 mm long, hairy like the twig. *Petiole* (4–)8–14(–16) mm long, hairy like the twig. *Leaf-blade* (6–)9–22 by 3–9 cm, apex cuspidate or sometimes acuminate; above greyish green, in basal part sometimes sparsely hairy especially on the nerves and midrib, midrib distinctly sunken, nerves and intramarginal nerve slightly sunken to flat and rather obscure, venation obscure; beneath brownish, hairy like the twig, rarely rather sparsely hairy, secondary nerves 8–11 (or 12) pairs, strongly prominent, forming a strongly prominent intramarginal nerve; glands (7–)10 or more, scattered, (0.2–)0.3–0.4(–0.6) mm diam., basal glands 0.9–1.2 mm long. *Inflorescences* about as long as the leaves; axes ribbed, very densely patently brownish hairy in the basal part; flowers with 3 together. *Pedicel* 1.5–6.5 mm, ribbed, very densely patently brown pubescent, rarely shortly hairy. *Sepals* persistent in fruit, greyish hairy; outer sepals 2.1–3.2 by 1.7–3 mm, with 2–4 glandular spots; inner sepals 3.5–5.3 by 2.4–3.4 mm, distinctly keeled. *Petals* white or yellow, when dry brownish orange, the longest one 9.5–10.5 mm long; carina more or less densely appressedly hairy outside, sparsely appressedly hairy inside in middle part; other petals ciliate in basal half, glabrous out-

side, upper petals reflexed. *Stamens*: filaments rather sparsely appressedly hairy till apex; anthers (0.75–)0.8–1.2 mm long, usually cohering around the stigma, ciliate along slits. *Ovary* sessile, distinctly ribbed, glabrous or sometimes hairy on 2 ribs down to halfway; style reflexed at end of anthesis; ovules (6–)8–12. *Fruit* (immature) ovoid, very sharply beaked, with 8 or more distinct ribs, finely pustulate to tuberculate, dull, greyish brown; pericarp thick, hard; pedicel crowned by persistent sepals.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Sabah).

12. *Xanthophyllum rufum* BENN. Fl. Br. India 1 (1874) 210; KING, Mat. Fl. Mal. Pen. (1890) 144; MAINGAY, Kew Bull. (1890) 113; GAGNEP. in Desv. J. Bot. 21 (1908) 252; RIDLEY, Fl. Mal. Pen. 1 (1922) 145; WATSON, Mal. For. Rec. 5 (1928) 249; BURK. Dict. (1935) 2269; WYATT-SMITH, Mal. For. Rec. 17 (1952) 81, 362; BALAN MENON, *ibid.* 19 (1956) 34; WYATT-SMITH, *ibid.* 23² (1963) f. 5, 9; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; NG, Tree Fl. Mal. 1 (1972) 361, f. 4; MEIJDEN, Leiden Bot. Ser. 7 (1982) 76, f. 3A-1, 12. — *Banisterodes rufum* (A.W. BENNETT) O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *X. flavum* RIDLEY, Kew Bull. (1925) 77. — *X. heteropleurum* CHODAT in Merr. Pl. Elm. Born. (1929) 134; MASAMUNE, En. Phan. Born. (1942) 380; NG, Tree Fl. Mal. 1 (1972) 363. — Fig. 19.

Tree, up to 32 m, 40 cm dbh. Twigs rufous-hairy. Axillary buds to 1.8 mm long, but often much smaller, densely pubescent. *Petiole* 7–21 mm, densely patently pubescent, more or less glabrescent, apically often with large glands. *Leaf-blade* 8–25 by 4–13 cm, base sometimes cordate; above bright (neon-like) yellow-green to light greyish green, midrib and nerves slightly sunken, venation indistinct; beneath light brownish to brownish green, papillose, rather densely hairy, secondary nerves 5–9 pairs, forming a rather distinct intramarginal nerve in apical or rarely also in basal part; glands very numerous, c. 0.1 mm diam., basal glands large, situated on the midrib at the very base of the leaf and then obscure, or at very apex of the petiole and then conspicuous. *Inflorescences* sometimes unbranched, shorter than to as long as the leaves; axes finely ribbed, very densely rufous-hairy; bracts conspicuous, persistent, often with distinct glands, bracteoles small, subsistent. *Pedicel* 4.5–7(–10) mm, ribbed, very densely rufous-hairy. *Sepals* persistent or not, sometimes present under fully ripe fruits (then up to c. 12 mm long), very densely rufous-hairy outside, glands present or not, inconspicuous; outer sepals c. 4–6 by 4–6 mm, mostly slightly ribbed; inner sepals c. 5–7 by 4–6 mm, keeled. *Petals* white, the upper ones with a yellow spot, when dry yellowish, the longest one 12–15 mm; carina very densely yellowish brown pu-

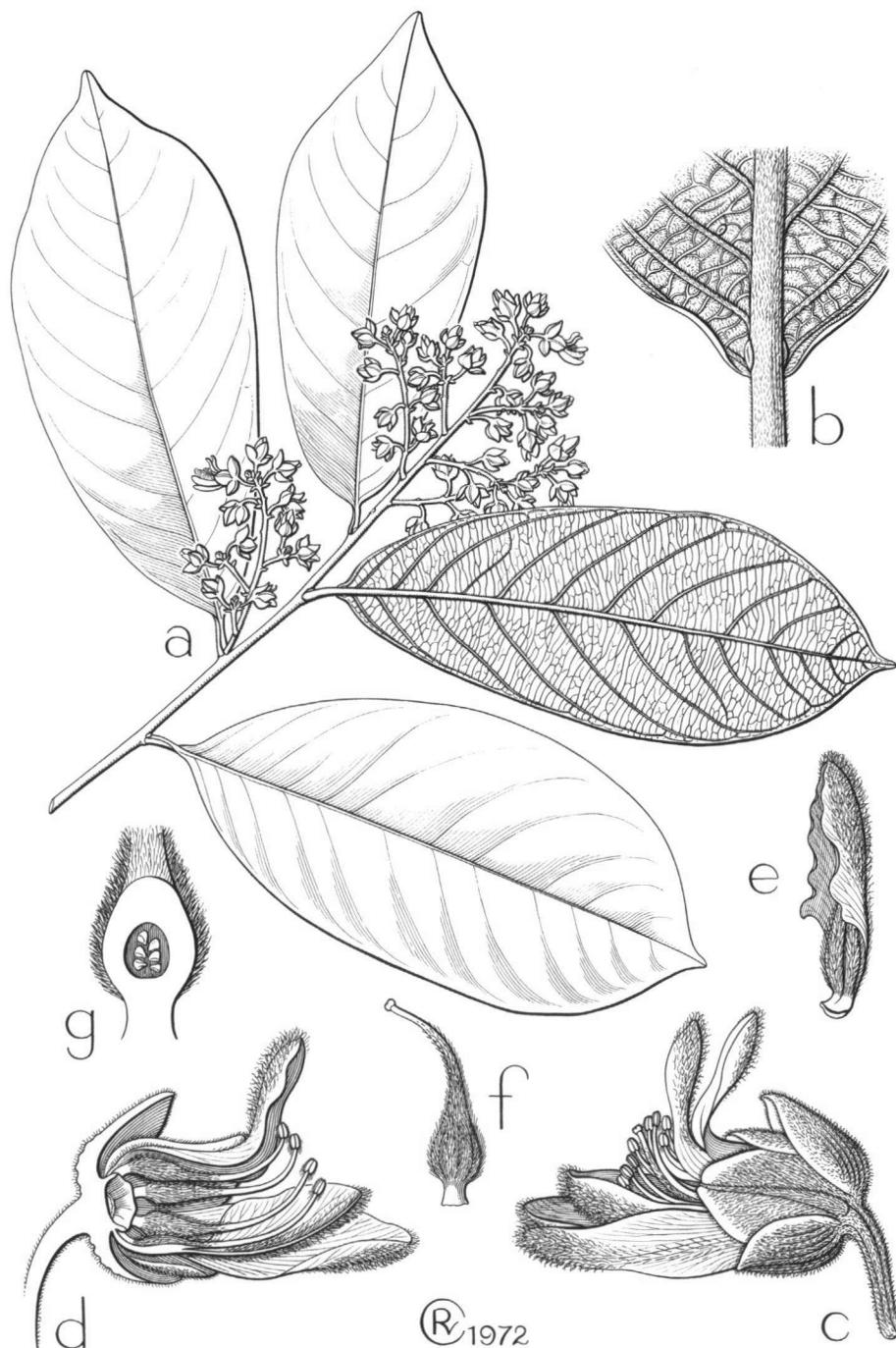


Fig. 19. *Xanthophyllum rufum* BENN. *a*. Habit, $\times 0.5$; *b*. base of leaf, $\times 2$; *c*. flower; *d*. flower, longitudinal section, gynoecium removed; *e*. carina with two stamens enclosed; *f*. gynoecium; all $\times 3$; *g*. ovary, longitudinal section, $\times 6$ (SAN 36554).

bescent outside, inside hairy in apical part; other petals pubescent outside in apical part or only apically tufted. *Stamens*: filaments glabrous; anthers 0.4–0.6 mm long, shortly hairy at base or glabrous. *Ovary* very densely rufous-pubescent all round or pubescent in 4(–8) rows, the median rows mostly longer than the lateral ones; style very densely rufous-pubescent in apical part; ovules 12–14. *Fruit* globular, up to 1.8 cm diam., often with 2–4, sometimes hairy ridges running down from the style-scar, yellowish green, dull, finely tuberculate; pericarp rather thick, hard; not rarely some sepals present.

Distr. Malesia: Sumatra, Malay Peninsula, Borneo.

Note. In most Bornean collections the ovary is hairy all round (or sometimes hairy in 8 rows), and the sepals are more or less persistent in fruit ('*X. heterophyllum*' CHODAT). In Malaya ('*X. rufum*') and Sumatra ('*X. flavum*' RIDLEY) the ovary is usually hairy in 4 rows, and the sepals are soon dropping off. These differences are not consistent in Malaya, however, as sometimes the ovary is hairy all round, or the sepals are persistent. Apart from those I did not find other differences; therefore it is not necessary to distinguish varieties based on these conspicuous but minor and grading differences.

13. *Xanthophyllum macrophyllum* BAKER, Kew Bull. (1896) 21; AIRY SHAW, Kew Bull. (1940) 252; MASAMUNE, En. Phan. Born. (1942) 380; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88; MEIJDEN, Leiden Bot. Ser. 7 (1982) 78.

Shrub or tree, up to 25 m, up to 30 cm dbh. Twigs glabrous. *Petiole* 10–18 mm, with (0–)2(–4) very distinct glands. *Leaf-blade* (10–)14–28 by (3.8–)4.5–10 cm, base often curved upwards and decurrent-attenuate; above sometimes slightly bullate between the secondary nerves, greenish, midrib slightly to distinctly prominent, rarely slightly sunken, nerves finely prominent; beneath mostly brownish green, secondary nerves 7–10 pairs, forming a nearly complete rather prominent intramarginal nerve; glands mostly rather few, scattered, 0.4–0.5 mm diam. *Inflorescences* sometimes unbranched, shorter than the leaves; axes grooved, appressedly brown-velvety; bracts often opposite, with 2 small indistinct glands. *Pedicele* 2–12 mm, appressedly brown-velvety. *Sepals* shortly appressedly brownish hairy outside, ribbed inside; outer sepals 5–6.5 by 3.8–6.2 mm; inner sepals 6–7.2 by 3.7–6.2 mm. *Petals* yellow, or white and the upper ones with a yellow spot, when dry yellowish to dark-brown, the longest one 13–16 mm long; carina appressedly velvety outside, more or less densely hairy inside in apical part; other petals glabrous or hairy outside in apical part. *Stamens*: anthers 0.55–0.75(–0.8) mm long, shortly hairy. *Ovary* sessile or shortly stipitate, creamish brown, often about 8-ribbed when dry, the median ribs most prominent and hairy over 1/3–2/3 their length, the other ribs hairy in apical part only; ovules 6–14. *Fruit* c. 2 cm diam., brownish to blackish, ribbed in apical part, thick-walled.

Distr. Malesia: Borneo (Sarawak, Sabah).

2. Section Eystathes

(LOUR.) MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 117; Leiden Bot. Ser. 7 (1982) 81. — *Eystathes* LOUR. Fl. Coch. 1 (1790) 235.

Twigs sometimes hairy. Axillary buds sometimes 3(–7), sometimes erect. *Leaves* sometimes shifted-decussate. *Leaf-blade*: tertiary nerves finely reticulate, mostly distinctly protruding. *Inflorescences*: bracts sometimes opposite in basal part. *Petals*: carina usually distinctly unguiculate. *Stamens*: filaments sometimes connate over up to 3 mm, rarely occasionally triadelphous, sometimes with a knob-like appendage at inner side. *Ovary* mostly densely hairy all round, rarely glabrous; stigma very rarely wider than the apex of the style; ovules 4 or 8–16 (rarely more, exceptionally 5 or 6). *Fruit* mostly globular, smooth or rarely tuberculate. *Seed(s)* 1 or occasionally 2, very rarely up to 4; testa with or without a hard inner layer; albumen thin but distinct; radicle exerted or not.

KEY TO THE SUBSECTIONS

1. Testa with a hard inner layer. Albumen forming a distinct layer. Embryo laterally near the base with 2 flattened areas. Radicle exerted. *Spp.* 14–57. 2a. *Subsect. Jakkia*
 1. Testa without a hard inner layer. Albumen very thin. Embryo without flattened areas near the base. Radicle not exerted. *Spp.* 58–62. 2b. *Subsect. Eystathes*

2a. Subsection *Jakkia*

(BL.) MEIJDEN, Leiden Bot. Ser. 7 (1982) 81. — *Jakkia* BLUME, Cat. (1823) 17.

Twigs and inflorescence axes without nodal appendages. Axillary buds mostly 2 (seemingly single) and close together, rarely up to 4 or the upper one supra-axillary. *Seed* 1 or seeds occasionally 2; testa with a hard inner layer; albumen forming a rather thin, distinct layer, which is very thin at the lateral sides of the cotyledons near the base of the embryo; embryo laterally near the base with 2 flattened areas, radicle exerted.

14. *Xanthophyllum nigricans* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; Leiden Bot. Ser. 7 (1982) 82.

Small tree, up to 15 m, 20 cm dbh. Twigs finely longitudinally wrinkled. Axillary buds 2 or 3 (or 4), 1.5–2.2 mm long, very densely shortly patently light-brown hairy. *Petiole* (6–)7–11(–14) mm. *Leaf-blade* 3.5–12 by 1.2–5.5 cm; above greyish olive-green (to brownish); beneath concolorous, or bluish because of thin waxy layer, (glaucous-)papillose, secondary nerves 5 or 6 (or 7) pairs, forming a more or less distinct intramarginal nerve; glands rather scarce or sometimes apparently absent, situated on or near the midrib, 0.1–0.2 mm diam., basal ones often slightly larger. *Inflorescences* unbranched, shorter than the leaves; axes flattened, angular, black, very sparsely appressedly hairy; flowers with 1–3 together. *Pedicel* 2–2.5 mm, black, nearly glabrous. *Sepals* glabrous outside, densely very shortly more or less patently hairy inside at base, further glabrous inside; outer sepals 1.8 by 1.7 mm; inner sepals 2.5 by 2.1 mm. *Petals* white, when dry dark reddish, very sparsely appressedly hairy outside, faintly ciliate apically, the longest one 8 mm long. *Stamens*: anthers c. 0.3 mm long. *Ovary* black, glabrous; style glabrous or basally very sparsely appressedly hairy; ovules 4. *Fruit* globular, up to 1.3 cm diam., dull, slightly wrinkled, brownish; pedicel up to 3 mm long.

Distr. Malesia: Borneo (Brunei, Sabah).

15. *Xanthophyllum borneense* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 277; MASAMUNE, En. Phan. Born. (1942) 379; MEIJDEN, Leiden Bot. Ser. 7 (1982) 82. — *X. glabrescens* RIDLEY, Kew Bull. (1938) 113; MASAMUNE, En. Phan. Born. (1942) 380.

Small tree, up to 5 (–8?) m high. Twigs more or less reticulately wrinkled. Axillary buds 2 (or 3), 1.2–1.8(–3) mm long. *Petiole* c. 5–6.5 mm. *Leaf-blade* 4–16 by 1.5–7 cm, margin undulate, apex acutish; above slightly bullate to flat between secondary nerves, greenish to brownish; beneath glaucous-papillose, secondary nerves 4–6 pairs, forming a rather distinct intramarginal nerve; glands numerous, scattered, 0.1–0.2 mm diam. *Inflorescences* unbranched, about as long as the leaves; axes flattened basally, angular, dull, light brownish, gla-

brous. *Pedicel* 1.5–2.5 mm, dull, brownish, glabrous. *Sepals* glabrous outside; outer sepals 3 by 2.1 mm; inner sepals 3.8 by 2.8 mm. *Petals* light brownish or orange when dry, minutely ciliate apically, the longest one 10–11 mm long; carina sparsely appressedly minutely hairy outside. *Stamens*: anthers c. 0.3 mm long, glabrous or with very few short hairs at base. *Ovary* completely glabrous; style very sparsely more or less appressedly hairy; ovules 4. *Fruit* globular to broadly ovoid, c. 1.8 cm diam., smooth, brown; pedicel c. 5 mm.

Distr. Malesia: Borneo (Sarawak, Sabah, SE. Borneo).

16. *Xanthophyllum ovatifolium* CHODAT, Bull. Herb. Boiss. 4 (1896) 258; MEIJDEN, Leiden Bot. Ser. 7 (1982) 83.

Axillary buds 2 (or 3), 1–1.8 mm long. *Petals* 3.5–4.5(–6.5) mm; glands present or not. *Leaf-blade* 3.5–9.5 by 1.4–6 cm, apex sometimes cuspidate; above rather dull, brownish to greenish, midrib little prominent at base; beneath dull, secondary nerves c. 3 or 4 pairs, not forming an intramarginal nerve; glands 8–20, usually situated halfway between margin and midrib, 0.4–0.5 mm diam., basal glands usually present, 0.5–0.6 mm diam. *Inflorescences* shorter than the leaves, unbranched; axes slightly flattened, brownish, glabrous to very sparsely appressedly hairy. *Pedicel* 7–8 mm, glabrous. *Sepals* glabrous outside; outer ones c. 2.8 by 1.7 mm; inner ones 3–3.5 by 1.8–2 mm. *Petals* white, when dry light brownish, ciliate at apex and base, further glabrous, the longest one 9–10 mm. *Stamens*: anthers 0.3–0.4 mm long, glabrous. *Ovary* glabrous; style sparsely appressedly hairy basally; ovules 4. *Fruit* unknown.

Distr. Malesia: Borneo (Sarawak).

17. *Xanthophyllum tenue* CHODAT in Merr. Pl. Elm. Born. (1929) 135; MASAMUNE, En. Phan. Born. (1942) 382; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88; MEIJDEN, Leiden Bot. Ser. 7 (1982) 83.

Tree, up to 25 m, 40 cm dbh. Twigs glabrous to rather densely very shortly patently hairy. Axillary buds 2 (or 3), 1.5–2.5 mm long, shortly hairy, some-

times irregular and larger because of cork-forming in apical region. *Petiole* 6–11 mm, not transversely wrinkled, shortly patently hairy to glabrous; glands absent or small. *Leaf-blade* (5–)7–16 by (2–)2.5–6.5 cm; above slightly bullate to flat between secondary nerves, dull, greyish green to light reddish brown, midrib glabrous to patently minutely hairy in basal half; beneath mostly rather dull, yellowish green, glabrous to minutely patently hairy, midrib slightly prominent to flat, secondary nerves 4–6 pairs, mostly forming a rather indistinct intramarginal nerve, venation mostly not very prominent, sometimes rather indistinct; glands (0–)4–25, often situated near midrib, 0.3–0.5(–0.7) mm diam.; basal glands often present, relatively large. *Inflorescences* much shorter than the leaves, unbranched; axes slightly angular, sparsely to rather densely patently shortly hairy. *Pedicel* (2.5–)4–6(–10) mm, rather sparsely to densely minutely hairy. *Sepals* nearly glabrous outside; outer sepals 2.1–2.8 by 1.3–2.5 mm, inner sepals 2.5–4(–4.5) by 1.5–3.2 mm. *Petals* yellowish or white, when dry orange, the longest one 8–9(–11.5) mm; carina sparsely to rather densely appressedly hairy outside, inside hairy to halfway or up to the apex; other petals glabrous to sparsely hairy outside, lateral petals hairy inside to halfway, upper petals hairy inside to apex. *Stamens*: filaments nearly free or connate over up to 1.5 mm; anthers c. 0.4 mm long. *Ovary* glabrous or less often rather sparsely appressedly hairy and probably soon glabrescent; style glabrous or less often sparsely appressedly hairy in basal part; ovules 4. *Fruit* globular, up to 1.8 cm diam., dull, wrinkled, light greenish brown; pericarp soft, thin; pedicel mostly up to 7 mm, reddish.

Distr. *Malesia*: Borneo (Sarawak, Sabah, Tawau, N. Kalimantan).

Ecol. Submontane rain-forest, 500–1200 m.

18. *Xanthophyllum subcoriaceum* (CHODAT) MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 120; Leiden Bot. Ser. 7 (1982) 85. — *X. ellipticum* var. *subcoriaceum* CHODAT in Merr. Pl. Elm. Born. (1929) 134; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88.

Shrub or small tree, up to 15 m, 20 cm dbh. Axillary buds 2 (or 3), (0.5–)1–2.7 mm long. *Petiole* 5–8.5 mm. *Leaf-blade* 5–12 by 1.5–5.5 cm, base sometimes more or less rounded, margin mostly strongly curved upwards when dry, apex cuspidate to acuminate; above sometimes slightly bullate between secondary nerves, dull, light greyish green to olive-green, secondary nerves mostly indistinct, venation mostly indistinct, sometimes scarcely visible, less often finely prominent; lower side yellowish green, secondary nerves (3 or) 4–6 pairs, forming a distinct intramarginal nerve, venation usually obscure; glands (0–)2–12, situated at some distance from the

midrib, 0.2–0.4 mm diam. *Inflorescences* unbranched, \pm as long as the leaves; axes angular, light brown, sparsely appressedly shortly hairy; lowermost bracts sometimes leaf-like. *Pedicel* 2.5–3.5 mm, mostly light brown, glabrous to sparsely minutely appressedly hairy. *Sepals* (nearly) glabrous outside; outer ones 1.6–1.8 by 1.4–1.8 mm; inner ones 2–2.5 by 2–2.5 mm. *Petals* white, when dry orange, faintly ciliate apically, outside glabrous except at base, longest one 8–10 mm. *Stamens*: anthers 0.5–0.7 mm long, sparsely hairy at base. *Ovary* 0.5–1.5 mm stipitate, subglabrous to rather densely appressedly hairy, rather soon partly glabrescent; style sparsely appressedly hairy; ovules 4. *Fruit* at first \pm ellipsoid with a sharp beak because of subsistent style, when mature globular, c. 1.7 cm diam., smooth, light green to brown, rather dull to shiny; pericarp thin; pedicel up to 5(–7) mm, mostly light brown.

Distr. *Malesia*: Borneo (Sarawak, Brunei, Sabah: Mt Kinabalu & Tawau).

19. *Xanthophyllum neglectum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; Leiden Bot. Ser. 7 (1982) 86. — *X. palembanicum* (non MIQ.) KEITH, N. Born. For. Rec. 2 (1938) 225.

Tree, up to 20 m, 20 cm dbh. Axillary buds 2, elliptic to ovate-oblong, 1.5–4(–6) mm long, acute, light yellowish brown. *Petiole* 4–6.5 mm, glabrous to sparsely very shortly hairy especially in the upper groove. *Leaf-blade* 5–12 by 1.8–5.5 cm, margin undulate; above dull, greyish green; beneath rather dull, sometimes slightly waxy, secondary nerves 3–5 pairs, forming a rather indistinct intramarginal nerve; glands 2–8, not in basal part, 0.2–0.3(–0.4) mm diam. *Inflorescences* unbranched, 1.5–5(–8) cm long, shorter than the leaves, bearing 3 or 4(–7) flowers; axes c. 0.5 mm diam., slightly flattened basally, light brown, rather sparsely patently shortly hairy. *Pedicel* c. 2 mm, slightly grooved, rather densely patently shortly hairy. *Sepals*: outer ones 2.2–2.5 by 2–2.3 mm; inner ones 2.8–3.5 by 2.2–3 mm. *Petals* white or yellowish, when dry light brownish, the longest one 7–10 mm; carina nearly glabrous to rather densely hairy outside, shortly hairy at both sides basally; other petals nearly glabrous except for some hairs at the base and apex. *Stamens*: filaments of abaxial 4 stamens basally widened and slightly thickened; anthers 0.3–0.4 mm long. *Ovary* patently hairy; ovules 4. *Fruit* (immature) ovoid, dull greyish green, hairy, slightly wrinkled when dry; pericarp rather soft; pedicel up to 4.5 mm, light brown.

Distr. *Malesia*: Borneo (E. Sabah, E. Kalimantan).

20. *Xanthophyllum pauciflorum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; Leiden Bot. Ser. 7 (1982) 87.

Tree, up to 21 m, 25 cm dbh. Twigs \pm as thick as the petioles, only a few internodes long. Axillary buds 2, 0.5–1.3 mm. *Petiole* 3.5–4.5 mm. *Leaf-blade* 4.8–8(–9) by 1.2–2.2(–3.5) cm, apex cuspidate to acuminate; above olive- to dark-green, rather dull; beneath glaucous-papillose, secondary nerves 4–6 pairs, not forming an intramarginal nerve; glands 2–7, 0.1(–0.2) mm diam. *Inflorescences* unbranched, much shorter than the leaves, bearing only 3–6 flowers; axes slender, slightly flattened, glabrous to sparsely very shortly patently hairy. *Pedicel* 1.5–2.5(–3) mm, very shortly patently hairy. *Sepals* with a small apical tuft; outer ones 2–2.2 by 1.5–1.8 mm, very sparsely very shortly hairy outside; inner ones c. 2.7 by 3 mm, glabrous outside. *Petals* yellowish, when dry yellowish orange, very sparsely hairy to glabrous outside, apically slightly tufted and distinctly ciliate, basally rather densely hairy at both sides, the longest one 7.5–8.5 mm long. *Stamens*: anthers c. 0.4 mm long, with few hairs at base. *Ovary* appressedly hairy; ovules 4. *Fruit* (immature) ovoid-globular, olive-brown, smooth, with a distinct remainder of the style, roughly pubescent, glabrescent.

Distr. *Malesia*: Borneo (Sarawak: Mersing Hill).

21. *Xanthophyllum tardicrescens* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 120; Leiden Bot. Ser. 7 (1982) 87.

Small tree, up to 6 m, 6 cm dbh. Twigs dull, bearing 1 or 2 (or 3) leaves per shoot. Axillary buds 2 (or 3?), smaller than 1 mm. *Petiole* 3.5–5 mm. *Leaf-blade* 7–16 by 2–5 cm, base rounded-truncate to -cordate; above dark greyish green, very dull, secondary nerves slightly sunken, venation obscured; beneath olive-greenish, dull, secondary nerves 3 or 4 pairs, the basal nerves long, reaching often beyond the middle of the leaf, or forming an intramarginal nerve, venation not distinct; glands 6–12, scattered, 0.2–0.3 mm diam. *Inflorescences* unbranched, \pm as long as the leaves; axes grooved, not flattened, nearly glabrous, light brown; flowers often with 2 or 3 together; bracts relatively long-persistent. *Pedicel* 3.5–4.5 mm, sparsely very shortly appressedly hairy. *Sepals* sometimes apically with tiny glandular spots; outer ones 2 by 2.1 mm; inner ones 2.3 by 2.3 mm. *Petals* white, the upper ones with a yellow spot, when dry yellowish orange, the longest one 7–8 mm; carina nearly glabrous outside; other petals glabrous. *Stamens*: filaments connate over 0.7–1 mm, very shortly hairy above base, further glabrous; anthers probably c. 0.7 mm long. *Ovary* very shortly stipitate, more or less appressedly hairy; ovules 4. *Fruit* (immature) smooth, slightly shiny, yellowish green, sparsely appressedly hairy, glabrescent; pericarp very thin.

Distr. *Malesia*: Borneo (Sarawak: Semengoh).

22. *Xanthophyllum parvifolium* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; Leiden Bot. Ser. 7 (1982) 88.

Tree, up to 25 m, 30 cm dbh. Twigs forming very short shoots bearing 2 or 3 leaves, the young ones very slender, c. 0.5 mm diam. Axillary buds 2, 0.7–1.2 mm long. *Petiole* 2–2.5 mm. *Leaf-blade* 1.6–5(–6) by 0.5–1.6(–1.9) cm, base rounded to cuneate; above shiny, yellowish or greenish brown, midrib flat or slightly prominent, nervation finely prominent to obscure; beneath glaucous-papillose, yellowish to reddish brown, secondary nerves 1–3 pairs, rather indistinct, forming an indistinct intramarginal nerve, venation rather indistinct; glands rather numerous, scattered, very small though relatively distinct, up to 0.1 mm diam. *Flowers* solitary in the upper leaf axils or twigs terminating in a 1–3-flowered inflorescence; this unbranched, shorter than to \pm as long as the leaves, up to c. 0.5 mm diam., up to 3.5 cm long, glabrous. *Pedicel* 10–11 mm, glabrous. *Sepals* purplish, (sub)glabrous outside, outer ones c. 2 by 1.6 mm, inner ones 3–3.4 by 1.8–2.3 mm. *Petals* light orange, when dry orange brown, very sparsely hairy at base and at very apex, further glabrous, the longest one 10–11 mm. *Stamens*: filaments widened and slightly thickened above their base and there densely rather shortly patently hairy, further glabrous; anthers 0.35–0.4 mm long, with few short hairs at base. *Ovary* c. 1 mm stipitate, appressedly hairy; style rather sparsely appressedly hairy in lower half, further glabrous; ovules 4. *Fruit* very shortly stipitate, globular, up to 1.1 cm diam., dull, light brown, very sparsely shortly appressedly hairy; pericarp rather thin; pedicel slender, 6.5–10 mm, completely glabrous.

Distr. *Malesia*: Borneo (Sarawak: Sabal For. Res., Lambir hills).

23. *Xanthophyllum philippinense* CHODAT, Bull. Herb. Boiss. 4 (1896) 261; MERR. En. Philip. 2 (1923) 387; MEIJDEN, Leiden Bot. Ser. 7 (1982) 88, f. 10A.

Twigs often with numerous adventitious buds on older nodes. *Petioles* 6–10 mm, often grading into the narrow leaf base, mostly in middle part with glands. *Leaf-blade* 7–14 by 2.5–6 cm, apex acute; above shiny to rather dull; beneath \pm concolorous, rather dull, secondary nerves c. 5–7 pairs, apically hardly distinguishable; glands 1–6, 0.4–0.6 mm diam. *Inflorescences* unbranched or with one side-branch, up to 5 cm long, often several together in the leaf axils; axes rather dull, sparsely minutely hairy; lower bracts (sub)opposite. *Pedicel* c. 3.5 mm, reddish brown, densely minutely hairy. *Sepals*: outer ones c. 2.5 by 2 mm; inner ones c. 3.5 by 3 mm. *Petals* orange when dry, the longest one c. 12 mm; carina faintly appressedly hairy outside near apex; other petals nearly glabrous. *Stamens*: filaments

widened but hardly thickened above their base and there densely more or less woolly hairy, further glabrous; anthers c. 1.2 mm long. *Ovary* c. 2 mm stipitate, appressedly hairy; style very long (c. 10 mm), exserting over c. 2 mm from the carina, faintly appressedly hairy; ovules 4. *Fruit* c. 2 cm diam., smooth, light brown, faintly hairy; pedicel 2.5–6(–8) mm, minutely hairy. *Seed(s)* 1 or 2.

Distr. Malesia: Philippines (Luzon, Mindoro, Mindanao).

Ecol. In open flowers the stigma is exserted from the carina. This may mean that cross-pollination is obligatory.

24. *Xanthophyllum ancolanum* MIQ. Fl. Ind. Bat., Suppl. (1861) 394; CHODAT, Bull. Herb. Boiss. 4 (1896) 261; MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 275, incl. f. *angustifolia* MIQ.; MEIJDEN, Leiden Bot. Ser. 7 (1982) 89. — *X. palembanicum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 277. — *X. sumatranum* MIQ. l.c. 275; BAKER, J. Bot. 62 (1924) Suppl. 7.

Shrub or small tree, up to 4 m, 4 cm dbh. Twigs glabrous to densely short hairy. Axillary buds c. 1–2.5 mm long, hairy; older nodes often with numerous adventitious buds. *Petiole* (5–)7–15 mm, not transversely wrinkled, glabrous to densely shortly hairy, apically sometimes with glands. *Leaf-blade* 10–26 by (2.5–)3.5–10.5 cm, apex shortly acuminate to cuspidate; above greyish green, rather dull; beneath green, secondary nerves 8–10 pairs, at least in apical part forming an intramarginal nerve; glands mostly rather numerous, scattered, 0.2–0.5 mm diam., basal glands often present. *Inflorescences* situated at end of young twigs, but also axillary and on old nodes (plant partly ramiflorous), 1 (or 2) in each axil, erect to strongly reflexed, unbranched, or sometimes with a side-branch; axes 1–11 cm long, dark, rather sparsely shortly hairy; lower bracts (sub)opposite. *Pedicel* 4.5–6 mm, dark, rather sparsely minutely patently hairy. *Sepals* dark purple; outer ones 2.5–3.8 by 2.1–3.1 mm; inner ones 4.2–5.2 by 3–3.9 mm. *Petals* when dry light to dark orange, the longest one 13–19 mm long; carina long unguiculate, sparsely very shortly appressedly hairy outside; other petals very sparsely hairy outside to glabrous. *Stamens*: filaments connate over (0.7–)2–2.5 mm, slightly widened and hardly thickened above base; anthers 0.8–1.2 mm long, very shortly hairy at base. *Ovary* c. 2 mm stipitate, half-patently hairy; style exserted from the carina for less than 0.5 mm, sparsely hairy in 2 rows; ovules 4. *Fruit* (immature) shortly stalked, more or less globular, slightly beaked, brownish, hairy; pedicels 8–11 mm.

Distr. Malesia: Sumatra (North: Gajolands: Mt Bandahara; Central: N. of Padang; South: Lampong Distr.: Muaradua).

Ecol. Montane rain-forest, 500–1200 m.

25. *Xanthophyllum brigittae* MEIJDEN, *sp. nov.* — Fig. 20.

Gemmae axillares 2.5–3.5 mm longae. *Folia basi cordata incurvata*; *glandulae sparsae*; *nervis laterali-bus* 14–20-jugis; *petiolo* 15–18 mm longo. *Petala inaequalia, petalo longissimo* 16 mm longo; *carina subglabra, extus sparse appresse pilosa*. *Filamenta (sub)libera*; *antherae* 1 mm longae. *Ovarium sparse appresse pilosum*; *stylum appresse pilosum*; *ovula* 4. *Fructus ignotus*. — *Typus*: W.J.J.O. DE WILDE & B.E.E. DE WILDE DUYFJES 15060 (L).

Shrub, c. 2 m high. Twigs glabrous. Axillary buds ovate-oblong, 2.5–3.5 mm long, hardly thickened basally, sparsely shortly hairy; older nodes with numerous small adventitious buds. *Petiole* 15–18 mm, distinctly transversally wrinkled, apically with a pair of indistinct glands. *Leaf-blade* 25–50 by 9–12 cm; base cordate with the margins curved upwards above the base of the petiole; apex slightly acuminate; above greyish green, rather dull; beneath green, secondary nerves 14–20 pairs, in apical part forming a rather indistinct intramarginal nerve; glands indistinct, few, scattered, c. 0.1 mm diam., basal glands usually present, 0.3 mm diam. *Inflorescences* numerous in the upper part of young twigs and also on older nodes, 1 or 2 in each axil, patent or slightly reflexed, unbranched or basally sometimes with a side-branch; axes 4–10 cm long, dark, rather sparsely shortly hairy; lower bracts subopposite. *Pedicel* 3–4 mm, brown, densely shortly appressedly hairy. *Sepals* purplish brown, shortly hairy; outer ones c. 3 by 2.5 mm; inner ones c. 4.5 by 3 mm. *Petals* whitish with pink to lilac tips when fresh, light to dark orange when dry, the longest one c. 16 mm; carina unguiculate, sparsely shortly appressedly hairy outside; other petals (sub)glabrous outside. *Stamens*: filaments free or connate for 0.1 mm, hardly widened and not thickened above base; anthers 1 mm long, very shortly hairy at base. *Ovary* c. 1.5 mm stipitate, shortly appressedly hairy to near apex; ovules 4. *Fruit* unknown.

Distr. Malesia: N. Sumatra (Gajolands: Mt Leuser National Park).

Notes. Like 24. *X. ancolanum*, differing in the longer, distinctly transversally wrinkled petioles, the more numerous secondary nerves, the leaf base with its upturned margin (like in 32. *X. adenotus*) and its (nearly) free filaments.

Half a century ago VAN STEENIS collected (also on Mt Leuser) a fragment of this species (VAN STEENIS 10075, BO!), thrown down by monkeys, with a single flower and a small part of a single leaf. I erroneously attributed this to 51. *X. erythrosthachyum* GAGNEP. noting, however, that the single flower possessed 4 instead of 11 ovules. Having now a fine collection at hand, it turned out that the original count of the ovules in VAN STEENIS' collection was correct.

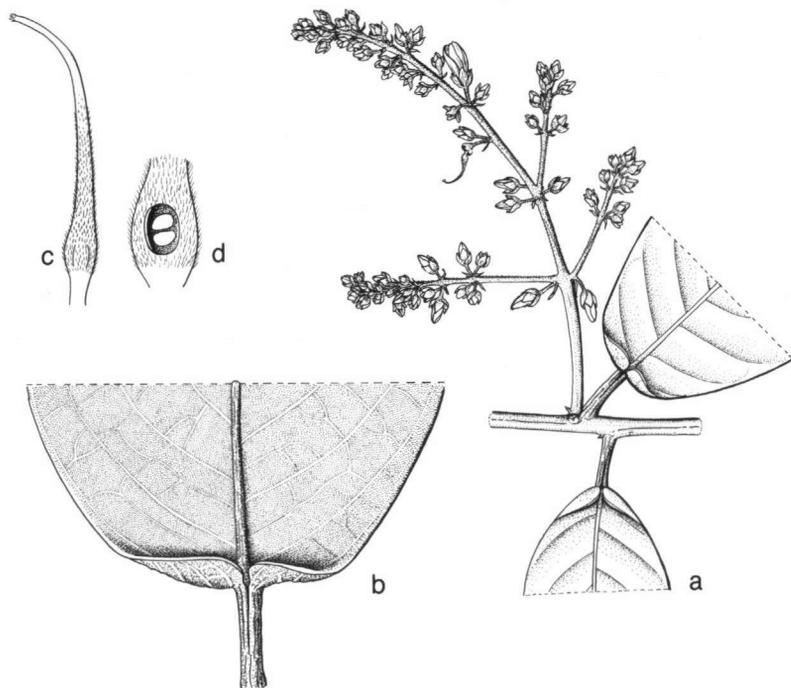


Fig. 20. *Xanthophyllum brigittae* MEIJDEN. *a.* Habit, $\times 0.5$; *b.* leaf base, $\times 1.5$; *c.* gynoeceium, $\times 3$; *d.* ovary, longitudinal section, $\times 6$ (DE WILDE & DE WILDE-DUYFJES 15728).

The present species is named in honour of Ms. BRIGITTA DE WILDE-DUYFJES who ardently assisted her husband in the botanical exploration of the Leuser National Park in the Gajolands of N. Sumatra.

26. *Xanthophyllum tenuipetalum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 120; Leiden Bot. Ser. 7 (1982) 89, f. 9a. — *X. affine* (non MIQ.) KOORD. Minah. (1898) 344.

Tree, up to 30 m, 40 cm dbh. Axillary buds 2 (or 3), 0.5–2.5 mm long, basally wrinkled, in apical part smooth or slightly keeled. *Petiole* 6–9 mm, often appearing somewhat longer because of the attenuate leaf base, always with 2 rather distinct glands usually situated in the middle part or at the (very) base. *Leaf-blade* 9–20 by 3.5–11 cm; above slightly bullate between the secondary nerves, shiny, dark to brownish green, nervation often very distinct; beneath slightly shiny, secondary nerves c. 6–8 pairs, apically difficult to count, forming an irregular and fine intramarginal nerve or ending in the venation; glands mostly very numerous, scattered, c. 0.3–0.5 mm

diam. *Inflorescences* also in lower leaf axils, unbranched or rarely with one short branch, up to 7 cm long; axes rather slender, smooth, very densely shortly more or less appressedly hairy; flowers with 3 together or in the apical part solitary; lower bracts (sub)opposite. *Pedicele* 2–4 mm, very densely nearly appressedly shortly hairy. *Sepals*: outer sepals 1.8–2.9 by 1.9–3 mm; inner sepals 2.9–3.5 by 2.6–3.2 mm. *Petals* rather thin, white (or yellow?) when fresh, when dry light brown or orange, not covering the stamens in anthesis, the longest one 10.5–12.5 mm; carina long-unguiculate, apically ciliate, rather sparsely to rather densely more or less appressedly woolly hairy outside in apical region and slightly so near the base, inside glabrous; other petals ciliate at very apex, near base sparsely to rather densely hairy on either side. *Stamens* 8, occasionally 9; filaments connate over 0.1–0.5 mm, rather densely more or less appressedly woolly hairy in basal half, glabrous upwards; anthers (0.5–)0.6–0.7 mm, sparsely ciliate along slits, sparsely and shortly hairy at base. *Ovary* appressedly hairy; style rather sparsely hairy; ovules 4. *Fruit* globular, 1.8–2 cm

diam., slightly shiny, light brown, faintly appressedly hairy; pericarp rather thin; pedicel up to 6 mm.

Distr. *Malesia*: N. & S. Celebes (Minahassa; Malili; Kendari; Muna I.), Moluccas (Taliabu & Kai Is.), West New Guinea (Vogelkop Peninsula).

27. *Xanthophyllum impressum* MEILDEN, Leiden Bot. Ser. 7 (1982) 90.

Tree, up to 23 m, 20 cm dbh. Axillary buds, when resting, mostly more or less enclosed between the base of the petiole and a low ridge of the twig, 1–1.8 by 1.5–2 mm, for c. 1 mm of its length uncovered; scales strongly thickened, especially at base, but leaving a narrow scar. *Petiole* 10–14 mm, sometimes with glands. *Leaf-blade* 10–20 by 3.5–9 cm, apex acutish to shortly acuminate; above rather dull, greyish green; beneath light yellowish green, papillose, secondary nerves c. 8 or 9 pairs, not forming an intramarginal nerve; glands scattered, probably rather numerous but often seemingly absent, up to 0.2 mm diam., exceptionally larger. *Inflorescences* up to 20 cm long; axes reddish brown, densely minutely appressedly hairy; lower bracts (sub)opposite. *Pedicel* 1.5–4 mm, grooved, appressedly shortly hairy. *Sepals*: outer sepals 2–2.5 by 2.6–3.3 mm; inner sepals 3.2–3.7 by 3.2–3.3 mm. *Petals* white, the upper ones with a yellow spot, when dry orange to dark red, sometimes with incrustations, the longest one 8.5–10.5 mm; carina densely more or less appressedly hairy outside; other petals glabrous outside. *Stamens*: filaments widened and thickened above base, there appressedly hairy, further glabrous; anthers 0.6–0.7 mm long, hairy to (sub)glabrous at base. *Ovary* nearly sessile, half-patently hairy; ovules 4. *Fruit* globular, c. 1.7 cm diam., dull, smooth, light brownish, appressedly hairy.

Distr. *Malesia*: E. Borneo (E. Sabah, E. Kalimantan), Philippines (Catanduanes).

28. *Xanthophyllum griffithii* Hook. f. ex A.W. BENNETT, Fl. Br. India 1 (1874) 210; KING, Mat. Fl. Mal. Pen. (1890) 136; MAINGAY, Kew Bull. (1890) 114; BRANDIS, Indian Trees (1906) 45; GAGNEP. in Desv. J. Bot. 21 (1908) 251; RIDLEY, Fl. Mal. Pen. 1 (1922) 149; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 346; HEND. *ibid.* 4 (1928) 222; BURK. Dict. (1935) 2269; WYATT-SMITH, Mal. For. Rec. 17 (1952) 80, 362; NG, Tree Fl. Mal. 1 (1972) 357, f. 2, *excl. var. curtisii et var. montanum*. Mal. For. 38 (1975) 85, f. 8.1 A–E, 8.2; MEILDEN, Leiden Bot. Ser. 7 (1982) 92. — *Banisterodes griffithii* (Hook. f. ex A.W. BENNETT) O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *X. parvum* CHODAT, Bull. Herb. Boiss. 4 (1896) 264. — *X. gracile* CHODAT, l.c. 256; K. & V. Bijdr. Booms. Java 5 (1900) 302; BACKER, Schoolfl. Java (1911) 80; KOORD. Exk. Fl. Java 2 (1912) 454. — *X. pseudostipulaceum* MERR.

pulaceum MERR. Philip. J. Sc. 10 (1915) Bot. 316; En. Philip. 2 (1923) 387.

Tree, up to 27 m, 40 cm dbh. Twigs glabrous to minutely patently hairy. Axillary buds erect to half-patent, (1.5–)3–8 mm long, not thickened at base, glabrous to densely minutely hairy; enclosing a pair of nearly similar buds of second order (those at base of a new twig often half-patent). *Petiole* 4–12 mm, sometimes with 1 or 2 glands in apical part. *Leaf-blade* 4–12(–15) by 1–4.5(–9) cm, apex sometimes cuspidate; above dark green to brownish; beneath lighter coloured, smooth to glaucous-papillose, secondary nerves 4–6 pairs, usually forming an indistinct intramarginal nerve in apical half; glands 4–20, scattered but often near midrib, 0.2–0.3 mm diam. *Inflorescences* up to 10 cm long, at very base with 2 side-axes or with a pair of buds of second order; axes often reddish brown, densely minutely patently hairy; lower bracts opposite. *Pedicel* 1–4.5 mm, grooved, densely minutely appressedly hairy. *Sepals* sometimes with 2 glands in apical part; outer sepals 1.6–2.5 by 2.1–2.7 mm; inner sepals 2.6–3.3 by 2.1–3 mm. *Petals* white, the upper ones with a yellow spot, when dry dark red to orange-red, the longest one (5–)7–8 mm long; carina densely more or less appressedly hairy outside; other petals glabrous to appressedly hairy outside in apical part. *Stamens*: filaments widened above base and with a knob-like, densely hairy appendage at inner side, further glabrous; anthers (0.3–)0.4(–0.5) mm long. *Ovary* 0.5–2 mm stalked, more or less appressedly hairy; ovules 4. *Fruit* globular, up to 1.5 cm diam., more or less smooth brown, appressedly hairy; pedicel up to 4 mm.

Distr. SE. Asia and *Malesia*.

Note. VAN DER MEILDEN (*l.c.*) distinguished 3 subspecies, of which the typical one (from Burma, Mergui) occurs outside *Malesia*.

KEY TO THE SUBSPECIES

1. Axillary buds half-patent, flat

a. *ssp. angustifolium*

1. Axillary buds erect, flattened against the twig, basally convex b. *ssp. erectum*

a. *ssp. angustifolium* (NG) MEILDEN, Leiden Bot. Ser. 7 (1982) 94. — *X. griffithii* var. *angustifolium* NG, Fed. Mus. J. n.s. 13 (1971) 137. — *X. parvum* CHODAT. — *X. gracile* CHODAT. — *X. pseudostipulaceum* MERR.

Axillary buds half-patent, elliptic to lanceolate, 1.5–8 mm long, at base often stalk-like constricted, more or less flat, wrinkled, glabrous or soon glabrescent. *Petiole* 4–8(–9) mm. *Leaf-blade* 4–8(–10) by 1–4(–5) cm, in juvenile shoots up to 10 by 2.5 cm; beneath glaucous-papillose to (nearly) smooth and

not glaucous, secondary nerves 4 or 5 (or 6) pairs; glands 0.2–0.3 mm diam. *Pedice*l 1.5–4.5 mm. *Petals*: longest ones 6.5–7.8 mm. *Stamens*: anthers 0.4 mm long. *Fruit* c. 1.1 cm diam.

Distr. *Malesia*: Central Sumatra (Indragiri), Malay Peninsula, Borneo (Sarawak, Sabah, E. Kalimantan), Philippines (Luzon).

Ecol. Usually in submontane rain-forest, up to 1400 m.

b. *ssp. erectum* MEIJDEN, *Leiden Bot. Ser. 7* (1982) 94. — *X. griffithii* HOOK.f. ex A.W.BENNETT, *excl. Mergui coll.*

Axillary buds erect or nearly so and flattened in their upper part against the twig, ovate to ovate-lanceolate, rarely elliptic, (3–)4–8 mm long, basally convex, slightly wrinkled, glabrous to densely minutely hairy. *Petiole* 6–12 mm. *Leaf-blade* 5–12(–15) by 2–4.5(–9) cm; beneath glaucous-papillose, secondary nerves c. 5 or 6 pairs; glands c. 0.2 mm diam. *Pedice*l 1–2(–3) mm. *Petals*: longest one (6.5–)7–8 mm. *Stamens*: anthers 0.4(–0.5) mm long. *Fruit* up to 1.5 cm diam.

Distr. *Malesia*: Malay Peninsula (common).

29. *Xanthophyllum monticolum* MEIJDEN, *Leiden Bot. Ser. 7* (1982) 95. — *X. griffithii* var. *montanum* NG, *Fed. Mus. J. n.s.* 13 (1971) 137; *Tree Fl. Mal.* (1972) 359, f. 2.

Tree, up to 10 m, 20 cm dbh. Axillary buds often appressed against the petiole, (1–)1.8–2.9 mm long, base wrinkled, apex acute. *Petiole* 9–14 mm. *Leaf-blade* 8–16 by 2–5(–7.5) cm; above usually dark green, sometimes brownish; beneath glaucous-papillose, secondary nerves 6–8 (or 9) pairs, in apical part forming a weak intramarginal nerve; glands 4–16, mostly in basal half near midrib, 0.2–0.3 mm diam., basal glands sometimes present, slit-like, c. 0.8 mm long. *Inflorescences* up to 12 cm long; axes angular, basally flattened, grooved, very densely minutely patently yellowish brown hairy; flowers solitary or in basal part with 2 together; lower bracts (sub)opposite. *Pedice*l 3.5–5 mm, slightly grooved, very densely appressedly hairy. *Sepals*: outer sepals 2.6–3 by 2.5–3 mm; inner sepals 4.4–5.5 by 3–4.5 mm. *Petals* whitish, when dry dark orange red, the longest one 10.5 mm long; carina rather densely appressedly hairy outside, subglabrous inside; other petals outside in basal part shortly appressedly hairy, further glabrous. *Stamens*: filaments widened above base and with a knob-like, rather densely hairy appendage at inner side, further glabrous; anthers 0.5–0.7 mm long. *Ovary* half-patently hairy, up to 1.5 mm stipitate, inserted on a rather wide, minutely hairy receptacle; ovules 4. *Fruit* globular, c. 1.7 cm diam., dark, shortly patently hairy; pericarp rather soft.

Distr. *Malesia*: Malay Peninsula (Cameron Highlands, Fraser's Hill, G. Benom).

Ecol. Submontane rain-forest, 1000–1500 m.

30. *Xanthophyllum vitellinum* (BLUME) DIETR. *Syn. Pl.* 2 (1840) 1277; WALP. *Rep.* 1 (1842) 248; HASSK. *Cat. Hort. Bog.* (1844) 227; *Pl. Jav. Rar.* (1848) 296; MIQ. *Fl. Ind. Bat.* 1, 2 (1858) 129; HASSK. in *Miq. Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 193; *Miq. l.c.* 272; TEJISM. & BINN. *Cat. Hort. Bog.* (1866) 218; CHODAT, *Monogr.* 1 (1891) t. 9, f. 1, 2; t. 12, f. 4c–e; BURCK, *Wand. Bot. Tuin Btzg* (1892) 31; WIESNER, *Ann. Jard. Bot. Btzg, Suppl.* 2 (1898) 97, t. 3; BOERL. *Cat. Hort. Bog.* (1899) 58; K. & V. *Bijdr. Booms. Java* 5 (1900) 294; VALETON, *Icon. Bog.* 1, 4 (1901) 9, t. 79; GAGNEP. in *Desv. J. Bot.* 21 (1908) 251; *Fl. Gén. I.-C.* 1 (1909) 243; BACKER, *Schoolfl. Java* (1911) 80; KOORD. *Exk. Fl. Java* 2 (1912) 453; MERR. *En. Born.* (1921) 326; BAKER, *J. Bot.* 62 (1924) *Suppl.* 7; DOCTERS VAN LEEUWEN, *Zoocacidia* (1926) 273, 274; GAGNEP. *Fl. Gén. I.-C. Suppl.* 1 (1939) 218; BACKER & BAKH.f. *Fl. Java* 1 (1963) 200; MEIJDEN, *Leiden Bot. Ser. 7* (1982) 97. — *Jakkia vitellina* BLUME, *Cat.* (1823) 17, 64; NEES, *Fl. Bot. Zeit.* 8 (1825) 120 ('*Jackia*'); BLUME, *Bijdr.* (1825) 61 ('*Jackia*'); G.DON, *Gen. Hist.* 1 (1831) 368. — *Jakkia longifolia* BLUME, *Bijdr.* (1825) 61 ('*Jackia*'); G.DON, *Gen. Hist.* 1 (1831) 368 ('*Jackia*'). — *Monnina longifolia* (BLUME) SPRENGEL, *Syst. Veg.* 3 (1827) 265. — *Monnina vitellina* (BLUME) SPRENGEL, *l.c.* 265; STEUDEL, *Nom. ed.* 2, 2 (1841) 157. — *X. longifolium* (BLUME) DIETR. *Syn. Pl.* 2 (1840) 1277; HASSK. *Cat. Hort. Bog.* (1844) 228; MIQ. *Fl. Ind. Bat.* 1, 2 (1858) 129; HASSK. in *Miq. Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 194. — *Monnina macrophylla* STEUDEL, *Nom. ed.* 2, 2 (1841) 157, *nom. illeg.* — *X. paniculatum* MIQ. *Fl. Ind. Bat., Suppl.* (1861) 393; BAKER, *J. Bot.* 62 (1924) *Suppl.* 7. — *X. flavescens* (non ROXB.) F.-VILL. *Nov. App.* (1880) 14; VIDAL, *Sinopsis* (1883) 13. — *X. griffithii* (non A.W.BENNETT) ROLFE, *J. Bot.* 23 (1885) 210; VIDAL, *Rev. Pl. Vasc. Filip.* (1886) 51; CERON, *Cat. Pl. Herb. Manila* (1892) 19. — *X. hookerianum* KING, *J. As. Soc. Beng.* 59, ii (1890) 139; RIDLEY, *Fl. Mal. Pen.* 1 (1922) 144; BURK. *Dict.* (1935) 2268; NG, *Tree Fl. Mal.* 1 (1972) 359. — *X. kunstleri* KING, *J. As. Soc. Beng.* 59, ii (1890) 139; *Ann. R. Bot. Gard. Calc.* 5 (1896) 137, pl. 162; RIDLEY, *J. Str. Br. R. As. Soc. n.* 33 (1900) 45; BURK. & HEND. *Gard. Bull. S. S.* 3 (1925) 346; WATSON, *Mal. For. Rec.* 5 (1928) 249; BURK. *Dict.* (1935) 2268; NG, *Tree Fl. Mal.* 1 (1972) 359. — *X. curtisii* KING, *J. As. Soc. Beng.* 59, ii (1890) 138; RIDLEY, *Fl. Mal. Pen.* 1 (1922) 146; BURK. *Dict.* (1935) 2269; KORIBA, *Gard. Bull. Sing.* 17 (1958) 19, f. 1; F. HALLÉ c.s. *Trop. Trees & Forests* (1978) 56; CORNER, *Gard. Bull. Sing. Suppl.* 1 (1978) 146, 211. — *Banisterodes longifolia* (BLUME)

O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *Banisterodes vitellinum* (BLUME) O. K. *l.c.* 46, *nom. illeg.* — *X. robustum* CHODAT, Bull. Herb. Boiss. 4 (1896) 262; MERR. En. Born. (1921) 326; En. Philip. 2 (1923) 387; MASAMUNE, En. Phan. Born. (1942) 381; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88. — *X. robustum* var. *elmeri* CHODAT in Merr. Pl. Elm. Born. (1929) 136; MASAMUNE, En. Phan. Born. (1942) 381. — *X. griffithii* var. *curtisii* (KING) NG, Tree Fl. Mal. 1 (1972) 359, f. 2.

Shrub or tree, up to 30 m, 36 cm dbh. Axillary buds varying from narrowly triangular with strongly thickened base and then often 1.5–3 mm long, to rhomboid-ovate or ovate-oblong and then often 6–11 mm long. *Petiole* 8–14(–16) mm, very often with a pair of glands in apical half. *Leaf-blade* 8–20(–30) by 3.5–11 cm, sometimes a few leaves of a twig smaller; above greyish green to yellowish brown; midrib protruding to nearly flat in basal half; beneath: secondary nerves (6 or) 7–9(–11) pairs, in apical half forming an indistinct intramarginal nerve; glands mostly more than 10, near midrib or scattered, 0.2–0.4 mm diam., basal glands mostly present. *Inflorescences* branched, 8–30 cm long, branches often in pairs in lower part; axes basally mostly strongly flattened, grooved, glabrous to densely shortly patently or less often appressedly hairy; in basal part flowers with up to 3 together, solitary in apical part; lower bracts nearly opposite. *Pedicel* 1.5–5.5 mm, very rarely longer, grooved, densely shortly patently (sometimes appressedly) hairy. *Sepals* basally often more or less thickened and wrinkled; outer sepals (1.7–)2–3.3(–3.9) by 1.9–4 mm; inner sepals (2.6–)3–5.3(–5.7) by (2.5–)3–4(–5) mm. *Petals* dark yellow to white, when dry orange to dark reddish and often with white incrustations, the longest one (7–)8–12, exceptionally up to 15.5 mm; carina densely appressedly hairy outside; other petals glabrous outside or with a few hairs at apex. *Stamens*: 8, very rarely 9; filaments free or connate over up to 0.7 mm, widened above base and with a knob-like, rather densely hairy appendage at inner side, further glabrous; anthers 0.4–0.6(–0.7) mm long. *Ovary* subsessile or up to 1 mm stipitate, half-patently hairy; style hairy in basal half, little hairy upwards; ovules 4. *Fruit* globular, up to 1.8 cm diam., often wrinkled when dry, rather dull or rarely shiny, usually light brown, sometimes dark reddish brown, hairy; pericarp rather thin.

Distr. Malesia: Sumatra (incl. Siberut & Simalur Is.), Malay Peninsula (incl. Penang), Java, Borneo, Philippines (Babuyan, Luzon, Mindanao). One of the most common species.

Note. Three collections from Sumatra, Riouw District (bb 24833, 27509, 30108) and an (otherwise different) collection from Borneo (S 23996) have an unusual type of axillary buds. The buds are globular

to ovoid, 1.5–2.5 mm long, rather strongly thickened in the middle and apical part. Such buds also occur in the sterile collection SF 20520 from the Anambas Is., in which, however, most axillary buds are very large and flat, c. 10–12 by 5–6 mm, resembling those of 40. *X. heterophyllum*.

31. *Xanthophyllum incertum* (BLUME) MEIJDEN, Leiden Bot. Ser. 7 (1982) 99, f. 3A–e. — *Guatteria incerta* BLUME, Fl. Java (1830) 100, t. 49B. — ? *X. acuminatissimum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 276. — *Monoon incertum* (BLUME) MIQ. *ibid.* 2 (1865) 19.

Small tree, to 10 m. Axillary buds narrowly triangular to lanceolate, (2–)4.5–10(–11) mm long, more or less wrinkled; buds of second order rarely present. *Petiole* (6–)8–10(–12) mm. *Leaf-blade* 6–16(–22) by 2.3–5.5(–8) cm, apex cuspidate; above dark green, shiny; beneath green, secondary nerves 5 or 6 (or 7) pairs, in apical part forming an intramarginal nerve; glands few, 0.2 mm diam., basal glands sometimes present. *Inflorescences* branched or unbranched, up to 7 cm long; axes densely shortly hairy; in basal part flowers with 3 together; lower bracts (sub)opposite. *Pedicel* 1.5–2 mm, densely shortly more or less appressedly hairy. *Sepals* sometimes with tiny glandular spots; outer sepals 2.8–3.5 by 3.1–4.1 mm; inner sepals 4.3–5.6 by 3.1–4.2 mm. *Petals* pinkish, reddish white or pale yellowish and purplish, when dry orange, the longest one 10.5–11.5 mm; carina shortly and rather sparsely appressedly hairy outside; other petals more or less glabrous or sometimes sparsely shortly hairy outside in apical part. *Stamens*: filaments free or connate over 0.5(–1) mm, widened above base and with a knob-like, shortly (half-)appressedly hairy appendage at inner side, further glabrous; filament of lateral alternipetalous stamens hairy to base in two rows; anthers 0.6–0.9 mm long. *Ovary* patently hairy; style nearly glabrous to rather densely appressedly hairy; ovules 4. *Fruit* globular, c. 1.5 cm diam., ± shiny, brown, densely patently hairy; pedicel up to 3.5(–6) mm.

Distr. Malesia: Central Sumatra (Toba Lands, Pajakumbuh, Mt Sago), West and Central Java.

Ecol. Montane rain-forest, (200–)500–1300 m.

32. *Xanthophyllum adenotus* MIQ. Fl. Ind. Bat., Suppl. (1861) 393; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 275; MEIJDEN, Leiden Bot. Ser. 7 (1982) 100. — *X. cordatum* KORTH. ex MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 274; MERR. En. Born. (1921) 325; RIDLEY, Kew Bull. (1925) 77; CHODAT in Merr. Pl. Elm. Born. (1929) 133, *incl. f. aequale* CHODAT; KEITH, N. Born. For. Rec. 2 (1938) 225; MASAMUNE,

En. Phan. Born. (1942) 379; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87. — *X. arsatii* C.E.C. FISCHER, Kew Bull. (1932) 176; MASAMUNE, En. Phan. Born. (1942) 379.

Shrub or small tree, up to 10 m, 25 cm dbh. Twigs glabrous or rarely minutely patently hairy. Axillary buds oblong or sometimes ovate-lanceolate, (1.3–)3–6(–10.5) mm long, the longer ones strongly thickened at base and usually suddenly widened and flattened upwards, usually glabrous, the smaller ones less distinctly flattened and usually rather densely shortly hairy; buds of second order often present. *Petiole* (8–)15–18(–23) mm, glabrous to rather densely minutely hairy, usually with 2 small, prominent glands. *Leaf-blade* (linear-)lanceolate, (9–)22–47 by (1.3–)5–10(–20) cm; base usually cordate with the margins curved upwards and connate above the apex of the petiole, or flat and rounded to broadly cuneate, apex acutish; above usually slightly bullate between secondary nerves and intramarginal nerve, greyish green to brown; beneath usually brownish, glabrous to minutely patently hairy all over, secondary nerves (9–)13–20 pairs, mostly forming a distinct, nearly complete intramarginal nerve; glands 2–6(–20), usually near the midrib (if few, only present in basal part), 0.3–0.4 mm diam. *Inflorescences* sometimes also axillary on the older nodes; axes slightly angular, slightly grooved, main axis basally usually sparsely minutely appressedly hairy, side axes and main axis in upper part more densely hairy; flowers solitary or very rarely with 2 together; lower bracts opposite. *Pedicel* (1–)1.5–2(–3.5) mm, more or less distinctly grooved, densely minutely appressedly to patently hairy. *Sepals* often with minute, rather distinct glands; outer sepals (2.1–)2.8–3.8(–4.1) by (2.4–)3–4.9 mm; inner sepals 3–5.5 by (2.8–)3.4–4.6 mm. *Petals* pinkish to pale violet, the upper petals with a yellow spot, when dry dark red, the longest one (8.5–)9.5–12.5(–14.5) mm; carina rather densely appressedly hairy outside, inside sparsely minutely hairy in apical part only, further glabrous; other petals very sparsely minutely hairy above base outside, sparsely patently hairy outside near apex, inside glabrous to hairy up to ± half-way. *Stamens*: filaments free or connate over 1(–2) mm, widened above base and especially those of abaxial stamens with a more or less distinct (half-)patently hairy knob-like thickening at inner side, further glabrous; anthers (0.6–)0.7–0.9(–1) mm long, ciliate along slits. *Ovary* (half-)patently hairy; style (rather) sparsely half-patently hairy in basal half, very sparsely hairy in apical half, glabrous near apex; ovules 4. *Fruit* globular, 1.5–1.8 cm diam., rather dull, light to reddish brown, distinctly hairy; pericarp thin, brittle.

Distr. *Malesia*: Sumatra, Borneo.

KEY TOT HE VARIETIES

1. Leaf-blade (4.5–)5–10(–20) cm wide. Secondary nerves 13–20 pairs, forming a nearly complete intramarginal nerve **a. var. adenotus**
1. Leaf-blade 2–5.2 cm wide. Secondary nerves 9–14 pairs, forming a weak, irregular intramarginal nerve **b. var. lineare**

a. var. adenotus

Axillary buds (1.8–)3–6(–10.5) mm long. *Petiole* (10–)15–21 mm, glabrous or hairy. *Leaf-blade* (15–)22–47 by (4.5–)5–15 cm, base cordate to cuneate. Secondary nerves 13–20 pairs, forming a distinct, nearly complete intramarginal nerve. *Flowers*: upper petals glabrous or hairy inside to about half-way.

Distr. *Malesia*: Sumatra, Borneo.

b. var. lineare MEIJER, Leiden Bot. Ser. 7 (1982) 101.

Axillary buds at upper side partly enclosed by a distinct ridge formed by the twig, 1.3–2.2 mm long. *Petiole* (8–)10–12(–18) mm, glabrous. *Leaf-blade* linear-lanceolate with more or less parallel sides over most of its length, (9–)13–30 by (1.3–)2–5.2 cm, base rounded to obtuse. Secondary nerves 9–14 pairs, forming a weak, irregular intramarginal nerve. *Flowers* rather small in all parts; upper petals shortly patently hairy inside to about half-way. *Fruit* unknown.

Distr. *Malesia*: Borneo (Sabah).

33. *Xanthophyllum palawanense* ELMER, Leaflet. Philip. Bot. 5 (1913) 1673; MEIJER, Leiden Bot. Ser. 7 (1982) 101. — *X. cordatum* (non MIQ.) MERR. En. Philip. 2 (1923) 386.

Small tree, up to 8 m, 5 cm dbh. Twigs sparsely minutely hairy, glabrescent, older nodes often strongly thickened and with numerous adventitious buds. Axillary buds oblong, 6–9 mm long, basally narrowed and strongly thickened, sparsely shortly hairy, glabrescent. *Petiole* 15–18 mm, more or less densely shortly hairy, with 2(–4) more or less distinctly protruding small glands. *Leaf-blade* ovate-oblong to ovate-lanceolate, rarely elliptic, c. 20–40 by (6–)8–12(–15) cm, base cordate, the margins at base flat or only little upturned, apex gradually narrowed to shortly acuminate; above often slightly bullate between secondary nerves and intramarginal nerve, dark green to greenish brown; beneath sparsely minutely hairy on the nerves in basal part, secondary nerves 9–12 pairs, often irregular, forming a nearly complete, somewhat irregular, intramarginal nerve; glands few, situated in middle and basal part, 0.2(–0.4) mm diam. *Inflorescences* sometimes also on older shoots from adventitious buds, up to 22 cm

long; axes angular, slightly grooved, densely shortly patently hairy; lower bracts opposite. *Pedicel* 2–3.5 mm, grooved, densely shortly half-patently hairy. *Sepals*: outer sepals 3.5–4.3 by 4.3–5 mm; inner sepals 5–5.9 by 4.3–4.5 mm. *Petals* dark red when dry, the longest one 15–18.5 mm; carina rather densely shortly appressedly hairy outside, glabrous inside except at base; other petals minutely sparsely appressedly hairy in basal part out- and inside, further glabrous. *Stamens*: filaments widened and slightly thickened above base and only there rather densely half-patently hairy; anthers 1.1–1.2 mm long, ciliate along slits. *Ovary* stipitate for 1–1.5 mm, half-patently hairy; style densely hairy in basal part, upwards sparsely hairy to near apex; ovules 4. *Fruit* globular, c. 1.7 cm diam., dull brown, rather distinctly half-patently hairy; pericarp rather thin, brittle; pedicel up to 5–6 mm.

Distr. *Malesia*: Southern Philippines (Palawan, Sulu Is.: Tawitawi, Jolo).

34. *Xanthophyllum ceraceifolium* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 117; Leiden Bot. Ser. 7 (1982) 102.

Small tree, up to 15 m, 16 cm dbh. Axillary buds elliptic to oblong, 5–7 mm long. *Petiole* (18–)25–30 mm. *Leaf-blade* 22–42 by 7–15.5 cm; above rather dull, greenish, beneath dull, concolorous, secondary nerves c. 8–10 pairs, little prominent, in apical part forming an indistinct intramarginal nerve, venation obscure; glands 2–8, 2 situated at the very base and 0.6–1 mm diam., the other ones (if present) scattered, sometimes close to midrib, 0.5 mm diam. *Inflorescences* much shorter than the leaf; axes strongly flattened basally, grooved, brown, minutely hairy; lower bracts (sub)opposite. *Pedicel* 2.5–3.5 mm, grooved, densely shortly patently hairy. *Sepals*: outer sepals 2.8–3.5 by 3.6–4.4 mm; inner sepals 4.5–4.9 by 3.6–4.7 mm. *Petals* yellowish, when dry dark red with large incrustations, glabrous inside, the longest one 9–10.5 mm; carina appressedly hairy outside. *Stamens*: filaments widened above base and with a distinct, rather shortly (half-)appressedly hairy knob-like thickening at inner side, further glabrous; anthers 0.6 mm long. *Ovary* nearly sessile, appressedly hairy; ovules 4. *Fruit* unknown.

Distr. *Malesia*: Borneo (Sarawak: Semengoh; Sabah).

35. *Xanthophyllum petiolatum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 103.

Tree, 14 m. Twigs minutely patently hairy. Axillary buds erect, oblong, c. 11–12 by 4 mm, base broad, rounded, apex rounded. *Petiole* 26–31 mm. *Leaf-blade* 6–13.5 by 4–7 cm, base rounded, apex rounded to slightly obtuse; above: midrib sunken in apical half, slightly prominent in basal half, second-

ary nerves slightly sunken; beneath glaucous-papillose, secondary nerves 6–8 pairs, forming an indistinct intramarginal nerve in apical part, venation hardly protruding; glands 1–3, situated in middle and apical part, mostly c. 0.4 mm diam., basal glands sometimes present, rather large. *Inflorescences* up to 15 cm long; axes dark, patently, extremely shortly hairy; lower bracts opposite. *Pedicel* 4 mm, grooved, densely very shortly half-patently hairy. *Sepals*: outer sepals 2.9 by 3.3 mm, slightly pustulate; inner sepals 4 by 3.3 mm. *Petals* dark red when dry, the longest one 11.5 mm; carina densely appressedly hairy outside; other petals glabrous to sparsely shortly hairy outside. *Stamens*: filaments connate over 0.5–0.8 mm between upper and lateral petals, connate over c. 1.5 mm between lateral petals and carina, the free parts constricted at very base and then widened and with a distinct densely hairy knob-like thickening at inner side, further glabrous; anthers 0.7 mm long. *Ovary* c. 1.5 mm stipitate, appressedly hairy; ovules 4. *Fruit* unknown.

Distr. *Malesia*: Borneo (Brunei: Andalau For. Res.).

36. *Xanthophyllum clovis* (STEEN. ex MEIJDEN) MEIJDEN, Leiden Bot. Ser. 7 (1982) 103. — *X. vitellinum* var. *clovis* STEEN. ex MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 120.

Tree, up to 14 m. Axillary buds with the form of a clove; scales 6.5–12 mm long, at base slightly enlarged and convex, distinctly enlarged at the rounded to ± emarginate apex, and there with 2 more or less distinctly prominent knob-like appendages; buds of second order c. 5–6 mm long, hardly thickened at apex. *Petiole* 9–17 mm. *Leaf-blade* 8.5–18 by 3.5–6.5 cm; above greenish to brownish; beneath glaucous-papillose, secondary nerves c. 7 or 8 pairs, forming an indistinct intramarginal nerve in apical half; glands few to rather numerous, mostly near the midrib, c. 0.2–0.3 mm, basal ones up to 0.5 mm diam. *Inflorescences* up to 20 cm long; axes dark, minutely patently hairy; in basal part flowers in clusters of up to 7 together; lower bracts opposite. *Pedicel* 4.5 mm, ± grooved, densely very shortly, ± appressedly hairy. *Sepals*: outer sepals 3 by 3.2 mm; inner sepals 4.1 by 4.1 mm, with tiny glandular spots at apex. *Petals* dark red when dry, the longest one 8.5 mm; carina appressedly hairy outside; other petals glabrous outside, the upper ones sparsely ciliate to halfway. *Stamens*: filaments widened above base and with a distinct densely appressedly hairy knob-like appendage at inner side, further glabrous; anthers 0.5 mm long. *Ovary* subsessile, half-patently hairy; style hairy in two rows to near apex; ovules 4. *Fruit* unknown.

Distr. *Malesia*: Borneo (Brunei, Sabah, Labuan I.), 3 collections.

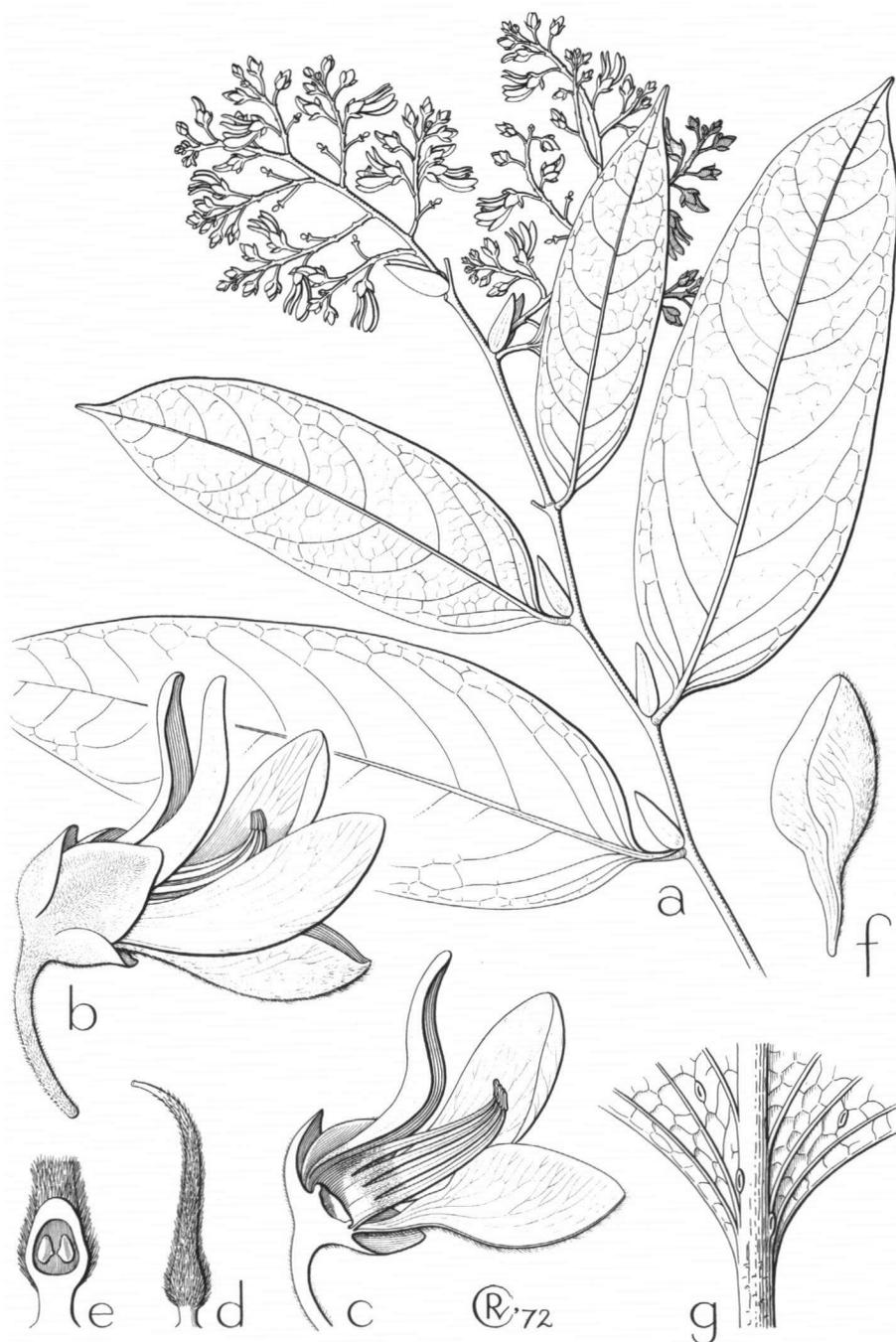


Fig. 21. *Xanthophyllum bracteatum* ЧОДАТ. a. Habit, $\times 0.5$; b. flower; c. flower, longitudinal section, gynoecium removed; d. gynoecium, all $\times 3$; e. ovary, longitudinal section, $\times 6$; f. carina, $\times 4$; g. base of leaf with glands, $\times 2.5$ (EDAÑO BS 28512).

37. *Xanthophyllum reflexum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 104.

Small tree, up to 10 m, 12 cm dbh. Twigs minutely patently hairy. Axillary buds erect, appressed against twig, scales laterally flattened, triangular, 3–4.5 mm long, minutely densely patently hairy. *Petiole* 9–10 mm, densely minutely hairy. *Leaf-blade* 11–18 by 3.5–5.5 cm; above rather dull, dark greenish to yellowish brown, midrib \pm sunken, nervation rather obscure; beneath nearly concolorous, secondary nerves c. 6–9 pairs, not very distinct, in apical part forming an indistinct intramarginal nerve, venation rather obscure; glands 2 (or 3), situated near base, 0.4–0.7 mm diam. *Inflorescences* shorter than the leaves; axes dark, very densely more or less patently hairy; lower bracts opposite. *Pedicel* 2.5–3 mm, \pm grooved, very densely shortly patently hairy. *Sepals*: outer sepals 2.2–2.5 by 3.4–3.6 mm; inner sepals 3.8–3.9 by 3.6–4.9 mm. *Petals* yellowish white, when dry dark red, the longest one 13–14 mm; carina densely more or less appressedly hairy outside; other petals glabrous. *Stamens*: filaments widened above base and with a knob-like shortly (half-)appressedly hairy appendage at inner side, further glabrous; anthers 0.7–0.8 mm long, hairy or nearly glabrous at base. *Ovary* sessile, half-patently hairy; ovules 4. *Fruit* unknown.

Distr. Malesia: Borneo (Sarawak: Semengoh).

38. *Xanthophyllum angustigemma* MEIJDEN, Leiden Bot. Ser. 7 (1982) 104.

Axillary buds erect or nearly so, mostly flattened against twig; scales ovate-lanceolate, 6–9 mm long, not thickened at base; buds of second order distinct, 3.5–5 mm long. *Petiole* 10–14 mm. *Leaf-blade* c. 6–12 by 2.5–5.8 cm; above greyish green to brownish green; beneath glaucous-papillose, secondary nerves c. 5–7 pairs, usually forming an indistinct intramarginal nerve in apical part; glands rather numerous, scattered, 0.1–0.2 mm diam. *Inflorescences* about as long as the leaves; axes dark, minutely patently hairy; in basal part flowers with 3 together; lower bracts opposite. *Pedicel* 3.5–4 mm, very densely whitish shortly patently hairy. *Sepals*: outer sepals 3.2–3.7 by 2.9–3.3 mm; inner sepals 3.7–5.4 by 2.3–3.2 mm. *Petals* dark red when dry, the longest one c. 13 mm; carina densely half-patently hairy outside; other petals faintly hairy along midrib outside. *Stamens*: filaments c. 2 mm connate, the free parts constricted at very base and then widened and slightly thickened, only there densely half-patently hairy; anthers 0.7 mm long. *Ovary* half-patently hairy; ovules 4. *Fruit* unknown.

Distr. Malesia: Philippines (Luzon, Samar), 2 collections.

39. *Xanthophyllum bracteatum* CHODAT, Bull. Herb. Boiss. 4 (1896) 258; MERR. En. Philip. 2 (1923) 386; MEIJDEN, Leiden Bot. Ser. 7 (1982) 105, f. 15. — Fig. 21.

Axillary buds (ob)ovate-oblong to linear-lanceolate, 7–20 by 1.5–6 mm, basally slightly wrinkled, acute, more or less flat. *Petiole* 5–11(–14) mm, sometimes with glands. *Leaf-blade* 9.5–25 by 3–8 cm, rounded-attenuate to cordate; above (yellowish) green, midrib nearly flat to distinctly prominent; beneath glaucous-papillose, secondary nerves 10–12 pairs, forming a rather distinct intramarginal nerve; glands scattered, numerous, 0.1–0.2 mm diam. *Inflorescences* up to 10 cm long; axes (rather) densely minutely patently hairy, smooth to pustulate, angular, reddish; flowers solitary or in basal part with up to 3 together, sometimes turned upside-down; lower bracts opposite. *Pedicel* 5–7 mm, slender, very densely patently shortly whitish hairy. *Sepals*: outer sepals c. 3 by 2.1 mm; inner sepals c. 5–5.5 by 4–4.5 mm. *Petals* dark red when dry, the longest one c. 14–17 mm; carina rather densely more or less appressedly hairy outside in middle and apical part; other petals nearly glabrous outside. *Stamens*: filaments connate over 1–3 mm, widened and hardly thickened above base, basally rather densely whitish hairy in 2 rows; anthers c. 1–1.2 mm. *Ovary* more or less patently whitish hairy; ovules 4. *Fruit* (immature) globular, yellowish brown; pericarp thin.

Distr. Malesia: Philippines (Luzon).

40. *Xanthophyllum heterophyllum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 107. — *X. pseudostipulaceum* (non MERR.) MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; WEBERLING, Beitr. Biol. Pfl. 50 (1974) 279, f. 1, II.

Tree, up to 33 m, 70 cm dbh. Axillary buds elliptic to oblong, (8–)11–20(–30) by 6–12(–14) mm; scales flat, wrinkled, indistinctly nerved, more or less shiny, sometimes in middle part with 1–4 rather indistinct glands, base shortly attenuate, apex rounded to obtuse. *Petiole* 7–15 mm. *Leaf-blade* (3–)4.5–12 (–19) by (1.8–)2.5–5(–7.5) cm, apex shortly acuminate to cuspidate; above \pm shiny, brownish green; beneath yellowish brown, secondary nerves 7–10(–12) pairs, not forming an intramarginal nerve; glands few to many, mostly situated in middle and apical part, 0.2–0.4 mm diam. *Inflorescences* branched; axes densely patently shortly hairy; lower bracts opposite. *Flowers* unknown. *Fruit* globular, up to 1.7 cm diam., shiny, brown, slightly hairy; pericarp rather soft; pedicel 1.5–2.5 mm, densely shortly patently hairy. *Seed* 1; 3 ovules abortive.

Distr. Malesia: Borneo (Sarawak, Brunei, Sabah).

Note. Although quite a number of collections are known, these are either vegetative or in fruit.

41. *Xanthophyllum korthalsianum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 277; MEIJDEN, Leiden Bot. Ser. 7 (1982) 107.

Tree, up to 21 m, 23 cm dbh. Axillary buds inserted (1.5-)3-15 mm above the axils on 1-2 mm long stalks; scales elliptic to linear-lanceolate, 6-18 by 1.5-8 mm long, faintly nerved. *Petiole* 7-10 mm, glands present or not. *Leaf-blade* 8-14 by 2.5-5 cm; above often slightly bullate between the secondary nerves, mostly dark green, secondary nerves finely prominent to obscure, venation obscure to finely prominent; beneath glaucous-papillose, secondary nerves 6-8 pairs, forming a \pm distinct intramarginal nerve; glands either not numerous, mostly situated near midrib, and c. 0.3 mm diam., or numerous, scattered, and 0.1-0.2 mm diam. *Inflorescences* shorter to much longer than the leaves, the lower branches distinctly supra-axillary, (sub)opposite; axes densely minutely hairy, more or less grooved, angular. *Pedicel* 1.5-2 mm, grooved, densely patently minutely hairy. *Sepals* glabrous inside except for a few hairs at the very base; outer sepals c. 2 by 2 mm; inner sepals c. 3.5 by 3 mm. *Petals* incompletely known, carina and lateral petals unknown; upper petal probably c. 8.5 mm long, sparsely hairy at apex. *Stamens*: unknown. *Ovary* patently whitish hairy (short and long fine hairs mixed); style and stigma unknown; ovules 4. *Fruit* unknown.

Distr. *Malesia*: Central Sumatra, Borneo (Sarawak, SE. Kalimantan), 4 collections.

42. *Xanthophyllum discolor* CHODAT, Bull. Herb. Boiss. 4 (1896) 257; RIDLEY, Fl. Mal. Pen. 1 (1922) 147; WATSON, Mal. For. Rec. 5 (1928) 249; BURK. Dict. (1935) 2268; WYATT-SMITH, Mal. For. Rec. 23² (1963) f. 8; NG, Tree Fl. Mal. 1 (1972) 356, f. 1; MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118, incl. *ssp. macranthum* MEIJDEN; Leiden Bot. Ser. 7 (1982) 108, f. 3A-q. — *X. macranthum* CHODAT ex ELMER, Leaf. Philip. Bot. 5 (1913) 1674, *nomen*. — *X. hypoleucum* MERR. Pl. Elm. Born. (1929) 135 (excl. BS 44034); KEITH, N. Born. For. Rec. 2 (1938) 225; MASAMUNE, En. Phan. Born. (1942) 380; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88. — *X. flavovirens* ELMER, Leaf. Philip. Bot. 10 (1939) 3776, *nom. inval. (anglice)*.

Very low shrub or small tree, 1-10 m, up to 10 cm dbh. Axillary buds narrowly triangular, c. 2.5-6 mm long, basally and centrally thickened, acute, shiny. *Petiole* 3-6(-7) mm, often rather shiny. *Leaf-blade* 3.8-25 by 1.6-10 cm, base obtuse to cordate or cuneate, apex acutish; above rarely faintly bullate between the secondary nerves, light to dark greyish green, midrib mostly slightly sunken, sometimes a little prominent, venation rather indistinct; beneath glaucous-papillose to nearly smooth, secondary nerves (5 or) 6-13 pairs, forming a mostly rather in-

distinct intramarginal nerve; glands numerous, scattered, c. 0.1 mm diam., the basal ones often somewhat larger. *Inflorescences* unbranched or rarely with one branch, much shorter than to three times as long as the leaves; axes mostly very slender, mostly less than 1 mm thick, (rather) sparsely minutely hairy; in basal part flowers usually with 3 together; bracts small, either with 2 large glands (in Bornean material) and then rather long-persistent, or eglandular (in Malayan and Philippine collections) and then soon caducous; lower bracts (sub)opposite. *Pedicel* 2-25 mm, slightly grooved, appressedly to patently, sparsely to rather densely hairy, rarely glabrous. *Sepals* rarely glabrous outside; outer sepals (1.5-)2-4 by (1.3-)2-3.5 mm, without or with (in most Bornean material) very distinct glands; inner sepals 3-6 by 4-6 mm. *Petals* white or pinkish, when dry brownish to dark reddish, nearly glabrous, apically with few hairs, basally inside slightly hairy, the longest one 11-23 mm. *Stamens*: filaments free or connate over up to 2 mm; anthers 2-2.5 mm long, minutely hairy all over. *Ovary* sessile to distinctly stipitate, appressedly whitish hairy; ovules 8-15. *Fruit* globular, up to 1.8-3 cm diam., dull, light brownish; pericarp thin, rather brittle.

Distr. *Malesia*: Malay Peninsula, Borneo, Philippines.

KEY TO THE SUBSPECIES

1. Inflorescence less than half as long as the leaves. Inner sepals 3-3.8 mm long. Longest petals 11-15 mm a. *ssp. discolor*
1. Inflorescence 0.5-3 times as long as the leaves. Inner sepals 5-6 mm long. Longest petals 15-23 mm b. *ssp. macranthum*

a. *ssp. discolor* — *X. discolor* CHODAT. — *X. hypoleucum* MERR.

Very low shrub or small tree, up to 10 m. Secondary nerves (5 or) 6 or 7(-9) pairs. *Inflorescences* mostly much less than (rarely up to) half as long as the leaves, often few-flowered. *Pedicel* 2-8.5 mm. *Sepals*: outer sepals (1.5-)2-2.5 by (1.3-)2-2.5 mm; inner sepals 3-3.8 by 4-4.5 mm. Longest *petals* 11-15 mm. *Fruit* up to 1.8 cm diam.

Distr. *Malesia*: Malay Peninsula (Johore; Singapore), Borneo.

b. *ssp. macranthum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118; Leiden Bot. Ser. 7 (1982) 109, f. 3A-q.

Low shrub or small tree up to 8 m. Secondary nerves 6-13 pairs. *Inflorescences* half as long to three times as long as the leaves, many-flowered. *Pedicel* 10-25 mm. *Sepals*: outer sepals 2.8-4 by 2.2-3.5 mm; inner sepals 5-6 by 4.2-6 mm. Longest *petals* 15-23 mm. *Fruit* up to 3 cm diam.

Distr. *Malesia*: throughout the Philippines.

43. *Xanthophyllum penibukanense* HEINE, Mitt. Bot. Staatssamml. München 6 (1955) 215; Pfl. Clemens Kinab. (1953) 50; MEIJER, Bot. News Bull. Sandakan 7 (1967) 88; MEIJDEN, Leiden Bot. Ser. 7 (1982) 110, f. 9b.

Small shrub or tree, up to 12 m, 30 cm dbh. Axillary buds ovate-oblong, 3.2–7 mm long, acute, flat, but basally strongly thickened, there often with exuberant cork-forming which may hide the scale completely, greyish to cream-coloured, more or less shiny. *Petiole* 8–15 mm, often seemingly much longer because of the long-attenuate leaf base. *Leaf-blade* (5–)7–28 by 2.3–10 cm, base long-attenuate, above dark green, shiny, midrib slightly sunken to slightly prominent basally, further \pm prominent, secondary nerves and venation very distinct, sometimes even more distinct than beneath; glaucous-papillose beneath, secondary nerves c. 4–6 pairs, first nerves reaching to halfway or further, intramarginal nerve in apical part rather distinct; glands very numerous, scattered, 0.1–0.2 mm diam. *Inflorescences* unbranched, shorter than the leaves; axes minutely rather sparsely appressedly hairy to nearly glabrous; in basal part flowers with up to 3 together. *Pedicel* 2.5–6 mm, more or less smooth, minutely sparsely to densely, appressedly hairy. *Sepals* sparsely hairy along the midrib to (nearly) glabrous outside, often some with rather distinct glandular spots; outer sepals 2.7–2.9 by 2.1–2.4 mm; inner sepals 3.1–3.3 by 3–3.2 mm. *Petals* creamish white to light purplish, the upper ones with a yellow spot, when dry orange, glabrous outside, apically and basally sparsely ciliate, the longest one 11–13 mm. *Stamens*: filaments connate over up to 2.5 mm; anthers c. 1.2–1.8 mm long, often minutely hairy all over. *Ovary* 1–2 mm stipitate, glabrous to densely appressedly whitish hairy; style thinly appressedly hairy in basal part, further glabrous; ovules 8–12. *Fruit* sometimes distinctly stipitate, globular, c. 1.5 cm diam., \pm shiny, brownish, glabrous or nearly so; pericarp thin; pedicel up to 10 mm.

Distr. *Malesia*: Borneo (Sarawak, E. Kalimantan).

Ecol. Mostly found in mountain forests, 500–1500(–1800?) m.

Note. Very variable in the indumentum of the ovary.

44. *Xanthophyllum pseudoadenotus* MEIJDEN, Leiden Bot. Ser. 7 (1982) 110. — *X. stapfii* CHODAT, Bull. Herb. Boiss. 4 (1896) 260, *p.p.*, *pro specim.* HAVILAND 1620.

Small tree, up to 9 m, 12 cm dbh. Axillary buds oblong, 3–6 mm long, basally strongly thickened, obtuse, probably glabrous; secondary and adven-

titious buds often present, numerous. *Petiole* (8–)10.5–14 mm, smooth. *Leaf-blade* 13–32 by 5–10.5 cm, base attenuate to cordate, apex acutish; above dark green, often slightly bullate between the secondary nerves, midrib prominent, often with a groove from halfway down; beneath glaucous-papillose, secondary nerves 11–14 pairs, forming a rather distinct complete intramarginal nerve; glands numerous, smaller than 0.1 mm diam. *Inflorescences* 1.5–6 cm long, also arising from adventitious buds on older nodes, unbranched; axes minutely appressedly hairy (hairs 0.1 mm long). *Pedicel* 5–6 mm, minutely appressedly hairy (hairs 0.1 mm long). *Sepals*: outer sepals 2 by 2 mm; inner sepals 3.2 by 2.7 mm. *Petals* subglabrous, brownish orange when dry, the longest c. 15 mm. *Stamens*: filaments c. 1.5 mm connate; anthers 2 mm long, ciliate along slits. *Ovary* minutely appressedly hairy (hairs 0.1–0.2 mm long); style glabrous in apical part; ovules 9–11. *Fruit* globular, c. 1.5 cm diam., minutely appressedly hairy; pericarp thin, brittle; pedicel up to 7 mm.

Distr. *Malesia*: Borneo (Sarawak, Sabah).

Note. Resembling 45. *X. pulchrum* ssp. *stapfii*, differing in the shorter, appressed hairs of inflorescence and flowering parts, in the greater number of secondary nerves which form a distinct intramarginal nerve, in the longer pedicel, and in the smaller sepals.

45. *Xanthophyllum pulchrum* KING, J. As. Soc. Beng. 59, ii (1890) 141; Ann. R. Bot. Gard. Calc. 5 (1896) 138, pl. 164; GAGNEP. in Desv. J. Bot. 21 (1908) 252; RIDLEY, Fl. Mal. Pen. 1 (1922) 146; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 346; Ng, Tree Fl. Mal. 1 (1972) 361, f. 3; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 27, 147, 211; MEIJDEN, Leiden Bot. Ser. 7 (1982) 111. — *X. stapfii* CHODAT, Bull. Herb. Boiss. 4 (1896) 260 (*excl.* HAVILAND 1620); in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 345 (*'stapferi'*); MERR. En. Born. (1921) 326; MASAMUNE, En. Phan. Born. (1942) 381. — *X. densiflorum* CHODAT, Bull. Herb. Boiss. 4 (1896) 256; MERR. En. Born. (1921) 325; MASAMUNE, En. Phan. Born. (1942) 379.

Small shrub to small tree, up to 8 m. Twigs glabrous to minutely patently hairy. Axillary buds ovate, 1.8–3.5(–5?) mm long, very thick (mostly not especially basally), obtuse, light brown and often more or less reddish, often irregular because of cork-forming. *Petiole* 4–9 mm, the young ones nearly smooth, not transversely wrinkled, glabrous to minutely densely patently hairy all round, the older ones soon becoming transversely cracked, more or less corky; glands often present, mostly rather distinct. *Leaf-blade* (5.5–)7.5–30 by 2.4–11.5 cm; base rounded-cordate, rarely rounded, obtuse, or cuneate-rounded, apex acutish, rarely rounded; above rarely bullate between midrib and secondary nerves, greyish green, midrib slightly sunken to flat, rarely

indistinctly prominent; beneath glaucous-papillose, secondary nerves (6 or) 7–12 (or 13) pairs, forming mostly an indistinct intramarginal nerve in apical half; glands numerous, scattered, c. 0.1–0.2 mm diam. *Inflorescences* at end of young twigs but also axillary, not rarely on old nodes, unbranched, shorter than the leaves, many-flowered; axes stiff, minutely patently hairy; in basal part flowers with up to 3 together. *Pedicel* 2.5–3.5(–4.5) mm, finely grooved, very densely minutely patently hairy. *Sepals* often with rather distinct glands; outer sepals 2.1–5 by 2.7–4.2 mm; inner sepals 3.2–6 by 3.2–4.9 mm. *Petals* pink or whitish, when dry red or brownish orange, slightly hairy apically and basally inside, further glabrous, the longest one 13–18 mm. *Stamens*: anthers (1.3–)1.7–2.5(–3.6) mm long, faintly hairy at base, sparsely ciliate along slits. *Ovary* up to 2 mm stipitate, patently light brownish pubescent; style glabrous in apical part; ovules 12–16. *Fruit* globular, up to 2 cm diam.; pericarp thin.

Distr. *Malesia*: Sumatra, Malay Peninsula, Borneo.

KEY TO THE SUBSPECIES

1. Secondary nerves 6 or 7 pairs. Longest petals 12–16 mm. Anthers 1.3–1.8 mm long

a. *ssp. pulchrum*

1. Secondary nerves 7–13 pairs. Longest petals 15–18 mm. Anthers (1.7–)1–3.6 mm long

b. *ssp. stapfii*

a. *ssp. pulchrum* — *X. pulchrum* KING.

Petiole 4–6.5 mm. Secondary nerves (6 or) 7 pairs. Outer *sepals* 2.1–4 by 2.7–3.9 mm, inner sepals 3.2–4.7 by 3.4–4.3 mm. Longest *petals* 12–16 mm. *Anthers* 1.3–1.8 mm long.

Distr. *Malesia*: Sumatra, Malay Peninsula (incl. Penang I.).

b. *ssp. stapfii* (CHODAT) MEIJDEN, Leiden Bot. Ser. 7 (1982) 112. — *X. stapfii* CHODAT. — *X. densiflorum* CHODAT.

Petiole (4–)5–9 mm. Secondary nerves 7–12 (or 13) pairs. Outer *sepals* 3.4–5 by 3.1–4.2 mm, inner sepals 3.6–6 by 3.2–4.9 mm. Longest *petals* 15–18 mm. *Anthers* (1.7–)2.1–2.5(–3.6) mm long.

Distr. *Malesia*: Borneo (Sarawak, Kalimantan).

46. *Xanthophyllum beccarianum* CHODAT, Bull. Herb. Boiss. 4 (1896) 257; Monogr. I (1891) t. 9, f. 3; MERR. En. Born. (1921) 325; MASAMUNE, En. Phan. Born. (1942) 379; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; MEIJDEN, Leiden Bot. Ser. 7 (1982) 112.

Tree, up to 12 m, 17 cm dbh. Twigs very densely patently hairy (hairs up to 1 mm). Axillary buds tri-

angular, 0.5–4.5 mm long, basally strongly thickened, acutish. *Petiole* 5–6 mm, very densely hairy. *Leaf-blade* 9.5–19 by 4–8 cm, base cordate, apex acutish; above dark green; beneath glaucous-papillose, rather sparsely hairy, midrib rather densely hairy, secondary nerves c. 6–8 pairs, forming an indistinct intramarginal nerve in apical part; glands numerous, scattered, c. 0.1 mm diam. *Inflorescences* unbranched, shorter than the leaves; axes densely minutely hairy (hairs up to 0.4 mm); in basal part flowers with up to 3 together, sometimes turned upside-down. *Pedicel* 7.5–9.5 mm, densely patently minutely hairy (hairs up to 0.25(–0.4) mm). *Sepals* nearly glabrous (very shortly hairy); outer sepals 2.5–2.7 by 3–3.6 mm, with rather distinct glandular spots; inner sepals 3.2–4 by 2.8–3.4 mm. *Petals* orange-red when dry, glabrous except for the ciliate base, the longest one c. 16–16.5 mm long, minutely hairy at base along margin, further glabrous. *Stamens*: anthers 2.2 mm long. *Ovary* patently hairy; style glabrous in apical half; ovules 13. *Fruit* (immature) apically pointed; pedicel c. 10–12 mm.

Distr. *Malesia*: Borneo (Sarawak).

47. *Xanthophyllum pedicellatum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 113.

Shrub to tree, 3.5–23 m, 60 cm dbh. Twigs densely patently brownish hairy, glabrescent. Axillary buds narrowly triangular, 1.5–3.5 mm long, hairy. *Petiole* 1.5–2.5(–3) cm, very densely patently hairy. *Leaf-blade* (5–)9–11 by (1–)1.5–3(–4) cm, base cuneate to rounded or slightly cordate, apex usually acutish; above dark green, shiny, beneath glaucous-papillose, hairy mainly on midrib, secondary nerves c. 7 or 8 pairs, forming an indistinct intramarginal nerve or not; glands very numerous, scattered, c. 0.1 mm diam. *Inflorescences* unbranched, as long as the leaves; axes densely minutely patently hairy, some hairs up to 0.5 mm. *Pedicel* (9–)10–15 mm, minutely patently hairy. *Sepals* very sparsely minutely hairy outside, glabrous inside except at very base; outer sepals c. 2–2.5 by 2 mm; inner sepals c. 3–3.5 by 2–2.4 mm. *Petals* pinkish, when dry orange-red, glabrous except for ciliate base, the longest one 12.5 mm. *Stamens*: anthers 1.5–1.6 mm long, sparsely minutely hairy at base. *Ovary* nearly sessile, half-patently brownish pubescent; style glabrous in apical part; ovules 9–11. *Fruit* globular, c. 2.2 cm diam., light brownish, hairy; pericarp thin.

Distr. *Malesia*: Borneo (E. Sabah).

48. *Xanthophyllum purpureum* RIDLEY, Kew Bull. (1938) 114; MEIJDEN, Leiden Bot. Ser. 7 (1982) 114. — *X. molle* RIDLEY, Kew Bull. (1938) 114.

Shrub or small tree, up to 5 m, 10 cm dbh. Twigs very densely patently hairy. Axillary buds narrowly triangular, (1.5–)3–5 mm long, basally thickened.

Petiole c. 5 mm, densely hairy. *Leaf-blade* (6-)10-20 by (1.5-)2.5-9 cm, base cordate to rounded-attenuate, rarely cuneate, apex acutish; above green, midrib slightly sunken to flat; beneath glaucous-papillose, more or less densely hairy all over or only on nerves, secondary nerves (5 or) 6 or 7 pairs, not or only in apical part forming an intramarginal nerve; glands numerous, scattered, c. 0.1 mm diam. *Inflorescences* unbranched, shorter than the leaves, often curved downwards; axes sparsely minutely hairy (hairs up to 0.2 mm long); in basal part flowers with 3 together. *Pedicel* 2.5-5 mm, minutely densely hairy (hairs up to 0.2-0.3 mm). *Sepals* rather densely minutely hairy outside (hairs 0.1 mm), subglabrous inside, often with tiny, rather indistinct glandular spots; outer sepals 1.8-3 by 2.1-2.6 mm; inner sepals 2.7-4.3 by 2.7-3.5 mm. *Petals* (light) purple to rosa-violet, when dry orange-red, ciliate at base and apex, further glabrous, the longest one 11-12(-14?) mm. *Stamens*: filaments free or 0.4 mm connate; anthers 0.9-1.4 mm long, glabrous to shortly hairy at base. *Ovary* subsessile or c. 1.5 mm stipulate, patently hairy; style glabrous in apical half; ovules 8-14. *Fruit* globular, 1.2-1.5 cm diam., usually with remnant of style, hairy; pericarp thin; pedicel curved.

Distr. *Malesia*: Borneo (Sarawak, Sabah, NE. Kalimantan).

49. *Xanthophyllum reticulatum* CHODAT in Merr. Pl. Elm. Born. (1929) 136; MEIJDEN, Leiden Bot. Ser. 7 (1982) 114.

Small tree, 2.5-15 m. Twigs very densely patently hairy (hairs up to 1 mm long). Axillary buds narrowly triangular, 4-6(-7.5) mm long, hairy. *Petiole* c. 5 mm, densely pubescent. *Leaf-blade* 7-19 by 3-5.5 cm, base obtuse to rounded, apex acutish; above dark green, midrib, secondary nerves and part of finer nervation sunken, midrib hairy at very base; beneath green, smooth or indistinctly papillose, hairy on midrib and on basal part of nerves, secondary nerves c. 8 pairs (difficult to count), tertiary nerves strongly protruding, blade bullate in-between; finer nerves not strongly prominent; glands numerous, scattered, c. 0.1 mm diam. *Flowers* unknown. *Inflorescences* 0.8-4.5 cm long, unbranched; axes shortly sparsely hairy (hairs up to 0.25 mm long). *Fruit* globular, c. 1.5 cm diam., sessile, with remnant of style, hairy; pedicel 5-10.5 mm, minutely patently hairy (hairs up to 0.2 mm long). *Seed* 1; abortive ovules 11-13.

Distr. *Malesia*: Borneo (Sabah).

50. *Xanthophyllum trichocladum* CHODAT in Merr. Pl. Elm. Born. (1929) 137; MASAMUNE, En. Phan. Born. (1942) 382; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; MEIJDEN, Leiden Bot. Ser. 7 (1982) 115.

Shrub or small tree, up to 12 m, 13 cm dbh. Twigs very densely patently hairy. Axillary buds ovate-oblong, (1.5-)2.5-5(-6) mm long, densely hairy. *Petiole* c. 4-7 mm, very densely hairy. *Leaf-blade* 11-31 by 3-9 cm, base cordate, covering upper side of petiole, apex acutish; above green, dull, hairy on the midrib; midrib distinctly sunken, rarely flat, secondary nerves and intramarginal nerve faintly sunken, rarely slightly prominent, venation little prominent; beneath glaucous-papillose, pubescent all over, secondary nerves c. 9(-12) pairs, forming a distinct intramarginal nerve; glands very numerous, scattered, c. 0.1 mm diam. *Inflorescences* unbranched, shorter than to as long as the leaves or sometimes with one side-branch at very base; axes very densely brownish patently pubescent (most hairs 0.5-0.8 mm long); flowers often turned upside-down. *Pedicel* 5-7 mm, very densely brownish hairy (hairs up to 1 mm long); pedicels of flower buds at first curved downwards, of open flowers turned upwards and often half-twisted, rarely straight, pedicels of fruits curved downwards again. *Sepals* very densely brownish pubescent outside (hairs up to 1 mm long); outer sepals 3.2-3.8(-4) by 2.7-3.2 mm; inner sepals 3.2-4.2(-5.6) by 3.2-4.2 mm. *Petals* pink, the upper ones with a yellow spot, when dry dark reddish, the longest one 13(-16) mm; carina glabrous to sparsely appressedly hairy outside along central veins; other petals glabrous except for a few hairs at base, sometimes sparsely ciliate in basal part. *Stamens*: filaments free or 0.1-0.5(-1.5) mm connate; anthers 2.2-3 mm long, faintly hairy at base, ciliate along slits. *Ovary* patently hairy; ovules 11-16. *Fruit* globular, c. 1.5 cm diam., densely hairy; pericarp rather thin; pedicel subsistent in fruit.

Distr. *Malesia*: Borneo (Sarawak, E. Sabah, Samarinda).

51. *Xanthophyllum erythrostachyum* GAGNEP. in Desv. J. Bot. 21 (1908) 250; Bull. Soc. Bot. Fr. 56 (1909) 36; MEIJDEN, Leiden Bot. Ser. 7 (1982) 115, excl. STEENIS 10075. — *X. forbesii* BAKER, J. Bot. 62 (1924) Suppl. 7, nom. superfl.

Axillary buds 0.8-1.5 mm long, minutely hairy, glabrous. *Petiole* 3-4 mm. *Leaf-blade* 10-20.5 by 4-5.5 cm, base cordate to cordate-truncate, apex distinctly acuminate; upper side dull, greyish green, midrib prominent, nervation rather obscure; beneath greenish, secondary nerves 8-10 pairs, rather indistinct, forming an indistinct intramarginal nerve in upper part, venation rather obscure; glands numerous, 0.2-0.3 mm diam. *Inflorescences* unbranched or with one side-branch, up to 8 cm long; axes angular, orange, rather sparsely appressedly minutely hairy. *Pedicel* 4-4.5 mm, rather densely appressedly minutely hairy. *Sepals*: outer sepals 2.7-3 by 1.8-2.2 mm, with rather distinct glands; inner sepals

3.5–4 by 2.7–3.2 mm. *Petals* whitish tinged with rosa, when dry reddish orange, the longest one 13 mm; carina outside glabrous to rather sparsely patently minutely hairy near base, near apex very sparsely appressedly hairy, further glabrous; other petals glabrous. *Stamens*: filaments 0.3 mm connate; anthers 1–1.2 mm long, glabrous at base, ciliate along slits. *Ovary* appressedly rather shortly brownish hairy; ovules 11. *Fruit* unknown.

Distr. *Malesia*: S. Sumatra (Lampung Distr.), one collection.

52. *Xanthophyllum laeve* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118 ('*leavis*'); Leiden Bot. Ser. 7 (1982) 116.

Shrub or small tree, 3–6 m. Axillary buds c. 1 mm long. *Petiole* 5–7 mm. *Leaf-blade* 4.5–13.5 by 1.9–5.3 cm, apex cuspidate; above greenish to reddish brown, dull, midrib sunken, hardly visible, nerves obscure to slightly protruding; beneath light greenish to reddish brown, secondary nerves c. 5 pairs, rather indistinct to slightly protruding, forming an indistinct intramarginal nerve, venation indistinct; glands rather few, near midrib, 0.3–0.4 mm diam. *Inflorescences* branched or unbranched, shorter than the leaves; axes glabrous, more or less smooth. *Pedice*l 8–15 mm, grooved, dark, glabrous. *Sepals*: outer sepals 1.8–2.1 by 2.4 mm; inner sepals 2.8–3 by 2.8 mm. *Petals* white with red spots, when dry reddish orange, the longest one 11–13 mm; carina shortly sparsely appressedly hairy outside, shortly hairy inside; other petals sparsely hairy outside near apex. *Stamens*: anthers c. 0.5 mm long. *Ovary* glabrous or with a few hairs; style very sparsely more or less appressedly hairy; ovules 8. *Fruit* unknown.

Distr. *Malesia*: NE. Sumatra (Sibolangit), 2 collections.

53. *Xanthophyllum retinerve* MEIJDEN, Leiden Bot. Ser. 7 (1982) 117.

Tree, up to 12 m, 20 cm dbh. Twigs sparsely shortly appressedly hairy, glabrescent; axillary region shortly densely appressedly hairy. Axillary buds mostly 3, inconspicuous, shortly densely appressedly hairy, the upper one 1–2 mm supra-axillary, sometimes more distinct and up to 0.8 mm long. *Petiole* 6–16 mm, appressedly shortly hairy. *Leaf-blade* 7–14 by 2.5–5 cm, apex shortly acuminate to cuspidate; above (greenish) brown, midrib sunken to slightly prominent; beneath reddish brown, sometimes glaucous, sparsely shortly hairy, secondary nerves 5–7 pairs, sometimes forming an indistinct intramarginal nerve; glands 0–2, mostly close to midrib, 0.2(–0.4) mm diam. *Inflorescences* up to 10 cm long, with 2 opposite branches directly above base; axes densely appressedly shortly hairy; lower

bracts of side axes opposite. *Pedice*l 2–2.5 mm, densely appressedly shortly hairy. *Sepals* sometimes with tiny glands; outer sepals 1.4–1.5 by 1.3–1.4 mm; inner sepals 2.1–2.2 by 2.2–2.3 mm. *Petals* white, when dry orange-red, glabrous inside, the longest one c. 6.5 mm; carina appressedly hairy outside; other petals sparsely hairy apically. *Stamens*: anthers 0.3–0.4 mm long. *Ovary* (sub)sessile, faintly ribbed, densely shortly appressedly hairy; ovules 4. *Fruit* globular, up to 2.2 cm diam., smooth, rather dull, brown, sparsely appressedly hairy; pericarp c. 4 mm thick, rather hard; pedicel up to 4 mm.

Distr. *Malesia*: Malay Peninsula (Perak; Trengganu; Fraser's Hill).

54. *Xanthophyllum eurhynchum* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 277; KING, J. As. Soc. Beng. 59, ii (1890) 137; GAGNEP. in Desv. J. Bot. 21 (1908) 252; BAKER, J. Bot. 62 (1924) Suppl. 7; MEIJDEN, Leiden Bot. Ser. 7 (1982) 117, f. 3A-a,b. — *X. maingayi* HOOK.f. ex A.W.BENNETT, Fl. Br. India 1 (1874) 210; KING, Mat. Fl. Pen. (1890) 136; GAGNEP. in Desv. J. Bot. 21 (1908) 252; BURK. Gard. Bull. S. S. 3 (1923) 35; WYATT-SMITH, Mal. For. Rec. 17 (1952) 362; BALAN MENON, *ibid.* 19 (1956) 34; NG, Tree Fl. Mal. 1 (1972) 360, f. 3; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 146, 147, 211. — *Banisterodes maingayi* (A.W.BENNETT) O. K. Rev. Gen. Pl. 1 (1891) 46, *nom. illeg.* — *X. verrucosum* CHODAT, Bull. Herb. Boiss. 4 (1896) 263; RIDLEY, Fl. Mal. Pen. 1 (1922) 147; HEND. Gard. Bull. S. S. 4 (1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; WYATT-SMITH, *ibid.* 17 (1952) 364. — *X. palembanicum* (non MIQ.) KING, J. As. Soc. Beng. 59, ii (1890) 137; GAGNEP. in Desv. J. Bot. 21 (1908) 251; RIDLEY, Fl. Mal. Pen. 1 (1922) 149; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 346; WATSON, Mal. For. Rec. 5 (1928) 249; CRAIB, Fl. Siam. En. 1 (1931) 105; BURK. Dict. (1935) 2269.

Shrub or tree, 3–20 m, up to 20 cm dbh. Twigs glabrous to minutely patently hairy, mostly soon glabrescent; axillary region shortly densely patently hairy. Axillary buds 2–4, usually less than 0.5 mm long, mostly very densely patently hairy, the upper one sometimes slightly supra-axillary. *Petiole* 3–9(–11), exceptionally up to 14 mm, glabrous to shortly rather densely hairy in the upper groove, rarely (in some Sumatran coll.) shortly hairy all round; glands mostly indistinct. *Leaf-blade* rarely linear-lanceolate, (2.5–)3.5–15(–18) by 1(–)2–5(–7) cm, apex acuminate to cuspidate; above sometimes slightly bullate between the secondary nerves, greyish green, midrib slightly sunken or sometimes flat to slightly prominent; beneath rather dull, mostly glabrous, yellowish green, secondary nerves 3–5 (or 6) pairs, forming a rather distinct intramarginal nerve; glands (0–)2–7(–11), 0.1–0.3

(-0.4) mm diam. *Inflorescences* solitary or with 2 together, mostly unbranched or sometimes with a few short side axes at base; axes angular to terete, minutely hairy; flowers solitary or in basal part with 3 together; bracts and bracteoles relatively long-persistent. *Pedice*l (1-2-4(-7.5) mm, densely minutely hairy. *Sepals*: outer sepals 1.6-2.3 by 1.4-2.3 mm; inner sepals 2.6-3.6 by 2-3.3 mm. *Petals*: white, when dry yellowish, the longest one 7-8.5(-9) mm; carina mostly bent outwards in open flowers, thus exposing the stamens, rather densely appressedly hairy outside, inside minutely hairy in apical part, ciliate in basal half; other petals glabrous to sparsely hairy outside at apex. *Stamens*: anthers (0.4-0.5 mm long. *Ovary* (subsessile, more or less ribbed, more or less appressedly hairy with hairs of different length; ovules 4. *Fruit* globular to broadly ellipsoid, sometimes irregularly 2-4-sulcate, 1.2-1.8 cm diam., more or less smooth to strongly warty, light brown, velvety to densely appressedly hairy.

Distr. S. Thailand; *Malesia*: Malay Peninsula (also Penang and Singapore), Sumatra.

KEY TO THE SUBSPECIES

1. Fruit with distinct warts arranged in longitudinal rows **a. ssp. eurhynchum**

1. Fruit more or less smooth, transversely wrinkled or finely rugose or irregularly grooved

b. ssp. maingayi

a. ssp. eurhynchum MEIJDEN, Leiden Bot. Ser. 7 (1982) 119, f. 3A-b. — *X. eurhynchum* MIQ. — *X. verrucosum* CHODAT.

Fruit globular, 1.5-1.8 cm diam., strongly warty, densely appressedly hairy between the warts.

Distr. S. Thailand; in *Malesia*: Malay Peninsula (incl. Penang I.), Sumatra.

b. ssp. maingayi (HOOK.f. ex A.W.BENNETT) MEIJDEN, Leiden Bot. Ser. 7 (1982) 119, f. 3A-a. — *X. maingayi* HOOK.f. ex A.W.BENNETT, Fl. Br. Ind. 1 (1874) 210. — *X. palembanicum* (non MIQ.) KING.

Fruit broadly ellipsoid, often irregularly formed, 1.2-1.5 cm diam., sometimes 2-4-sulcate, surface at lateral sides usually with depressions of irregular size or transversely wrinkled, sometimes finely rugose, very densely shortly velvety.

Distr. S. Thailand; in *Malesia*: Malay Peninsula (incl. Singapore).

55. Xanthophyllum wrayi KING, J. As. Soc. Beng. 59, ii (1890) 138; Ann. R. Bot. Gard. Calc. 5 (1896) 138, pl. 164; GAGNEP. in Desv. J. Bot. 21 (1908) 251; RIDLEY, Fl. Mal. Pen. 1 (1922) 148; BURK. & HEND. Gard. Bull. S. S. 3 (1925) 346; HEND. *ibid.* 4 (1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; BURK.

Dict. (1935) 2268; NG, Tree Fl. Mal. 1 (1972) 363, f. 5; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 147, 211; MEIJDEN, Leiden Bot. Ser. 7 (1982) 119, f. 3A-c. — *X. puberulum* RIDLEY, J. Str. Br. R. As. Soc. n. 73 (1916) 139; HEND. Gard. Bull. S. S. 4 (1928) 222.

Shrub to small tree, up to 10 m. Twigs shortly densely patently to appressedly hairy, rarely glabrous except for the densely hairy area above the leaf axil. Axillary buds 2 or 3, densely hairy, up to c. 0.5 mm long. *Petiole* (5-7-11(-14) mm, usually not transversely wrinkled, densely minutely hairy all round, rarely hairy only in the upper groove, often with rather distinct prominent glands. *Leaf-blade* 10-30 by 3.5-13 cm, base rarely cordate; above often slightly bullate between the secondary nerves, mostly greyish green, midrib deeply sunken and mostly hairy in basal part; beneath yellowish green, rather dull, minutely hairy or rarely glabrous, secondary nerves 8-15 pairs, forming a distinct intramarginal nerve; glands (2-4-14, often (very) close to the midrib, sometimes present only in upper part, (0.3-0.5-0.7 mm diam. *Inflorescences* shorter than to \pm as long as the leaves; axes strongly ribbed, flattened at base, densely minutely hairy; in basal part flowers with 3 together; bracts and bracteoles relatively long-persistent. *Pedice*l 2.5-7 mm, densely minutely patently hairy. *Sepals*: outer sepals 2.1-3 by 1.5-2.1 mm, sometimes with small glands; inner sepals 2.8-4 by 2-2.5 mm. *Petals* white to lilac, the upper ones with a yellow spot, when dry yellowish, the longest one 5.8-7.5(-8) mm; carina densely minutely hairy in apical part outside and inside; other petals sparsely hairy outside in apical part, lateral petals minutely hairy inside above insertion of filaments, upper petals rather densely patently hairy inside up to apex. *Stamens*: filaments connate over 0.5-2 mm or sometimes triadelphous, sparsely minutely hairy in basal part to densely more or less patently hairy in middle part; anthers 0.4-0.5 mm long. *Ovary* patently to appressedly hairy; style patently hairy in basal part, in apical half sparsely hairy to glabrous; ovules 4. *Fruit* more or less globular, up to c. 1.5 cm diam., verrucately ribbed to strongly tuberculate-warty, apically rounded or with the style-scar sunken; pedicel 2-6 mm.

Distr. Peninsular Thailand; in *Malesia*: Malay Peninsula (incl. Penang I.).

56. Xanthophyllum venosum KING, J. As. Soc. Beng. 59, ii (1890) 139; RIDLEY, Fl. Mal. Pen. 1 (1922) 222; MEIJDEN, Leiden Bot. Ser. 7 (1982) 120, f. 3A-d.

Shrub to small tree, up to 10 m. Twigs rather densely hairy in axillary area, further glabrous to sparsely minutely hairy. Axillary buds 2-4, up to 0.5 mm long, hairy. *Petiole* (12-)15-21(-27) mm, glabrous to sparsely minutely hairy, not transversely

wrinkled, often with glands. *Leaf-blade* 12.5–40 by 4.5–12(–13) cm, base cuneate to rounded or cordate; above often slightly bullate between the secondary nerves, greenish to yellowish brown, midrib deeply sunken; beneath yellowish green, mostly glabrous, secondary nerves 12–20 pairs, forming a distinct intramarginal nerve; glands mostly numerous, scattered, 0.1–0.2 mm diam. *Inflorescences* sometimes also on older nodes, shorter than the leaves; axes strongly flattened basally, ribbed, densely minutely hairy; in basal part flowers with 3 together; bracts and bracteoles relatively long-persistent. *Pedicel* 2–4 mm, minutely hairy. *Sepals*: outer sepals 2.3–3.3 by 2.1–3.3 mm, often with glands; inner sepals 2.8–4 by 2.5–4 mm. *Petals* light purple, when dry pale yellow, the longest one 8.5–11.5 mm; carina sparsely minutely appressedly hairy outside, glabrous inside; other petals slightly hairy basally, further glabrous. *Stamens*: filaments connate over (0.5–)1–3 mm, rarely some filaments free; anthers 0.5–0.9 mm long. *Ovary* (sub)sessile, ribbed, appressedly hairy; ovules 4. *Fruit* ovoid, c. 2 by 1.5 cm, apically shortly but distinctly beaked, strongly verrucately ribbed; pedicel 3–5 mm, minutely hairy.

Distr. *Malesia*: Malay Peninsula.

57. *Xanthophyllum malayanum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118; NG, Tree Fl. Mal. 1 (1972) 365; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 146; MEIJDEN, Leiden Bot. Ser. 7 (1982) 121.

Tree, up to 10 m, 10 cm dbh. Twigs very densely

brownish patently hairy with a mixture of very small and long hairs. Axillary buds nearly completely covered by indumentum, narrowly triangular, possibly up to 2.5 mm long. *Petiole* 4–10 mm, very densely patently pubescent. *Leaf-blade* 5–24 by 1.5–8.5 cm, base obtuse to slightly cordate, apex obtuse to cuspidate; above greyish green to light brownish, midrib and nerves sunken, venation obscure; beneath concolorous, rather densely patently pubescent, secondary nerves 5–8 pairs, forming a distinct intramarginal nerve; glands 2–8, up to 0.1 mm diam. *Inflorescences* unbranched or basally with a pair of side axes, shorter than to as long as the leaves; axes strongly, flattened and ribbed at base, densely rather shortly hairy, mixed with longer patent hairs; bracts and bracteoles small, relatively long-persistent. *Pedicel* 2.5–5.5 mm, ribbed, minutely densely patently hairy. *Sepals*: outer sepals 2.4–3 by 2.1–3.1 mm; inner sepals 3.4–3.8 by 2.9–3.5 mm. *Petals* purplish, when dry brownish orange, the longest one 7.5–10 mm; carina minutely hairy outside, inside minutely appressedly hairy in apical and basal part; other petals minutely patently hairy in apical part outside, upper petals inside glabrous to rather densely patently hairy. *Stamens*: filaments free or 1 mm connate, exerted from the carina in open flowers; anthers c. 0.5–0.7 mm long. *Ovary* more or less patently pubescent; ovules 4. *Fruit* (immature) shortly beaked or apically rounded, verrucately ribbed.

Distr. *Malesia*: Malay Peninsula (Pahang, Johore).

2b. Subsection *Eystathes*

Twigs and inflorescence axes sometimes with minute nodal appendages. Axillary buds (2 or 3–5(–7)), often all distant and supra-axillary. *Seed(s)* 1(–4); testa without a hard inner layer; albumen very thin; embryo without flattened areas near the base, radicle not exerted.

58. *Xanthophyllum novoguineense* MEIJDEN, Leiden Bot. Ser. 7 (1982) 122.

Tree, up to 30 m, 40 cm dbh. Axillary buds 0.8–1.6 mm long, faintly keeled. *Petiole* 6–10 mm. *Leaf-blade* 4–13.5 by 1.3–6.5 cm; above green; beneath light green, papillose, secondary nerves c. 6–8 pairs, forming an indistinct intramarginal nerve or not; glands rather numerous, scattered, c. 0.2–0.4 mm diam., basal glands c. 0.6–1.5 mm diam. *Inflorescences* up to c. 8 cm long; axes light brownish, slender, rather thinly minutely hairy; in basal part flowers with 3 together. *Pedicel* 2.5 mm, grooved, rather densely minutely more or less patently hairy. *Sepals*: outer sepals 2.4 by 2.1 mm; inner sepals 2.9 by 2.5 mm. *Petals* yellowish orange when dry, the longest one c. 7 mm; carina woolly hairy outside in apical half; other petals outside with a few hairs at

apex and at base. *Stamens*: anthers 0.35–0.4 mm long. *Ovary* appressedly hairy; ovules 4. *Fruit* unknown.

Distr. *Malesia*: New Guinea (Sorong in W, Sepik in Central), 4 collections.

Note. Part of the flowers of the type collection have abnormally developed ovules; these vary in number from 1–3 and they are placed basally in the ovary and have a distinct funiculus. The majority of the ovaries, however, contained 4 laterally inserted, sessile ovules.

59. *Xanthophyllum ngii* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; NG, Tree Fl. Mal. 1 (1972) 365, f. 5; MEIJDEN, Leiden Bot. Ser. 7 (1982) 122, f. 3B-a.

Tree, up to 35 m, 65 cm diam. at 5 m. Nodal appendages extremely small, present on very short

straight ridges adjoining the insertion of the petiole. Axillary buds 0.5–1(–1.5) mm long, blackish, rather densely hairy. *Petiole* 7.5–10 mm. *Leaf-blade* 6–17 by 1.7–6.5 cm, base rounded to narrowly cuneate, margin slightly undulate, apex acutish to shortly acuminate; above yellowish green or brownish, midrib nearly flat to slightly protruding, sometimes at very base a little sunken; beneath glaucous-papillose, secondary nerves 5–8 pairs; glands 6–12, situated halfway between midrib and margin or near midrib, 0.3–0.5 mm diam., the basal ones mostly larger. *Inflorescences* about as long as the leaves; axes flattened at base, blackish, rather densely shortly hairy; lower bracts (sub)opposite. *Pedicel* 3–4.5 mm, very densely more or less appressedly shortly hairy. *Sepals* shortly rather sparsely appressedly hairy outside, (sub)glabrous inside; outer sepals 2.2–2.9 by 2–2.8 mm; inner sepals 3.1–3.6 by 2.5–3.2 mm. *Petals* brownish orange when dry, the longest one 10–12.5 mm; carina shortly appressedly hairy outside along median veins, further glabrous outside. *Stamens*: anthers 0.3–0.4 mm long, sparsely hairy at base. *Ovary* subsessile, shortly appressedly hairy; style sparsely appressedly hairy at very base only, further glabrous; ovules 4. *Fruit* more or less apple-shaped, up to 8 cm diam., the very short pedicel enveloped by the pericarp; pericarp very hard, in mature fruit up to 3 cm thick when dry. *Seed* 1 (or '1–more' according to NG, *l.c.*), up to 2 cm diam.

Distr. *Malesia*: Southern half of Sumatra, Malay Peninsula.

60. *Xanthophyllum lanceatum* (MIQ.) J.J. SMITH, *l.c.* Bogor. 4 (1912) 109, t. 334; GORTER, *Indische Mercur* 34 (1911) 410 ('*lanceolatum*'); *Tropenfl.* 16 (1912) 50; HEGI, *Fl. Mitteleur.* 5-1 (1925) 87 ('*lanceolatum*'); HEYNE, *Nutt. Pl.* (1927) 901; BURK, *Dict.* (1935) 2268; MEUDEN, *Leiden Bot. Ser.* 7 (1982) 124, f. 10A. — *Skaphium lanceatum* MIQ. *Fl. Ind. Bat., Suppl.* (1861) 357; KURZ, *J. As. Soc. Beng.* 40, ii (1871) 46; SCHEFFER, *Nat. Tijds. Ned. Ind.* 34 (1874) 105. — *X. glaucum* WALL. [*Cat.* (1831) 4199] *ex* HASSK. *Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 193; KURZ, *J. As. Soc. Beng.* 42, ii (1873) 80; A.W. BENNETT, *Fl. Br. India* 1 (1874) 209; KURZ, *For. Fl. Br. Burma* 1 (1877) 81; KING, *Mat. Fl. Mal. Pen.* (1890) 136; GAGE, *Rec. Bot. Surv. India* 3 (1904) 24; WILLIAMS, *Bull. Herb. Boiss.* II, 5 (1905) 219; BRANDIS, *Indian Trees* (1906) 44; GAGNEP. in *Desv. J. Bot.* 21 (1908) 251; *Fl. Gén. I.-C.* 1 (1909) 245; RIDLEY, *J. Str. Br. R. As. Soc. n.* 59 (1911) 73; *ibid. n.* 73 (1916) 140; *Fl. Mal. Pen.* 1 (1922) 147; WATSON, *Mal. For. Rec.* 5 (1928) 249; CREVOST & PÉTELOT, *Bull. Econ. Indochine* (1929) 138; CRAIB, *Fl. Siam. En.* 1 (1931) 105; BURK, *Dict.* (1935) 2268; GAGNEP. *Fl. Gén. I.-C. Suppl.* 1 (1939) 219; HEND. *J. Mal. Br. R. As. Soc.* 17 (1939) 36; STADELMAN, *For. Southeast Asia*

(1966) 186; NG, *Tree Fl. Mal.* 1 (1972) 357, f. 1. — *Banisterodes glaucum* (WALL. *ex* HASSK.) O. K. *Rev. Gen. Pl.* 1 (1891) 46, *nom. illeg.* — *X. microcarpum* CHODAT, *Bull. Herb. Boiss.* 4 (1896) 263.

Low shrub or small tree, 3–12 m, 18–20 cm dbh. Twigs often sparsely appressedly hairy when young, soon glabrescent. Nodal appendages bluntly conical to triangular, up to 0.2 mm long but often smaller. Axillary buds 2–3, up to 2 mm long, sessile or the upper very shortly stipitate, acutish, often distinctly keeled, more or less densely shortly hairy. *Petiole* 3–5 mm, ± indistinctly transversely wrinkled, brownish, often sparsely thinly hairy when young, glabrescent. *Leaf-blade* 5–14 by 1.4–4(–5.5) cm, margin more or less distinctly undulate, often a little incurved, apex acutish, rarely shortly acuminate; above yellowish green to brown, midrib flat to slightly prominent in apical half, in basal half with a central groove; beneath light yellowish or brownish, papillose, midrib glaucous or sometimes sparsely appressedly hairy, secondary nerves mostly hardly distinct from finer veins, c. 8–14 pairs, not forming an intramarginal nerve; glands mostly numerous, 0.2–0.3 mm diam., but sometimes larger (up to 0.8 mm) and then of irregular form. *Inflorescences* mostly longer to much longer than the leaves, basally branched but sometimes seemingly unbranched if lower bracts resemble normal leaves; axes mostly distinctly flattened basally, rust-brown, more or less densely patently shortly hairy; in basal part flowers with 3–5 together, solitary in apical part. *Pedicel* 2–3.5 mm, ± densely patently shortly hairy. *Sepals*: outer sepals 1.7–2.2 by 1.5–2 mm; inner sepals 2.2–2.7 by 2–2.9 mm. *Petals* pinkish or white, the upper ones often with a yellow spot, when dry yellowish, the longest one 6–9 mm long; carina rather densely (woolly) hairy outside; other petals hairy at very apex. *Stamens* 8, rarely in some flowers 9; anthers 0.3–0.5 mm long. *Ovary* appressedly hairy; ovules 4. *Fruit* broadly ellipsoid to globular, 1.2–3.5 cm diam., mostly greyish brown; pericarp often wrinkled when dry, rather thick, soft. *Seed(s)* 1 or 2.

Distr. Continental SE. Asia (Bangla Desh, Burma, Thailand, Cambodia, Laos, S. Vietnam); in *Malesia*: S. Sumatra (Palembang), Malay Peninsula (incl. Langkawi Is.).

Ecol. Confined to streambanks and swamps.

Note. A common species with the largest distributional area within this subsection, and little variation in its characters except in the size of the ripe fruit.

61. *Xanthophyllum lateriflorum* MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 318; MEUDEN, *Leiden Bot. Ser.* 7 (1982) 129.

Shrub or small tree, 5–6 m. Axillary buds (2 or 3(–5), distant, the upper one 3–5(–15) mm supra-

axillary, usually shortly stipitate (stalk up to 3 mm), ± oblong, c. 1–2 mm long (excl. stalk), more or less acute. *Petiole* 3.5–4.5(–6) mm. *Leaf-blade* 4–8 by 1.5–3.5 cm, apex acuminate to cuspidate; above dark green; beneath glaucous-papillose, secondary nerves c. (5–)7 or 8 pairs, not forming an intramarginal nerve; glands c. 6–8(–10), usually near midrib, 0.1–0.3 mm diam., basal ones somewhat larger. *Flowers* unknown. *Infructescences* shorter than the leaves, unbranched; axes minutely hairy. *Fruit* (immature) globular, rather sparsely minutely appressedly hairy; pedicel 3–3.5 mm, minutely appressedly hairy. *Seed* (immature) 1; abortive ovules 3.

Distr. *Malesia*: S. Sumatra (Palembang, Lampung Distr.), 5 collections; insufficiently known species.

62. *Xanthophyllum virens* ROXB. Pl. Corom. 3 (1820) 81, t. 284, f. 1; SPRENGEL, Syst. Veg. 2 (1825) 219 ('*virescens*'); WALL. Cat. (1831) 4197; ROXB. Fl. Ind. ed. Carey 2 (1832) 221; DIETR. Syn. Pl. 2 (1840) 1277 ('*virescens*'); WIGHT, Ill. Ind. Bot. 1 (1840) 49, 50, t. 23, f. 10 (sub *X. flavescens*, *sphalm.*); DRURY, Handb. Indian Fl. 1 (1864) 56; BEDD. Fl. Sylv. Anal. Gen. 3 (1869) xix, pl. III, f. 2, 1–3; KURZ. J. As. Soc. Beng. 42, ii (1873) 79, 80; Prelim. Rep. For. Pegu (1875) 26; For. Fl. Br. Burma 1 (1877) 81; GAGNEP. in Desv. J. Bot. 21 (1908) 251; CRAIB, Fl. Siam. En. 1 (1931) 107; GAGNEP. Fl. Gén. I.-C. Suppl. 1 (1939) 219; PURKAYASTHA in Chowdhury & Ghosh, Indian Woods 1 (1958) 60; MEIJDEN, Leiden Bot. Ser. 7 (1982) 130, f. 10A. — *X. flavescens* var. *virens* (ROXB.) A. W. BENNETT, Fl. Br. India 1 (1874) 209; CRAIB, Bull. Misc. Inf. Kew (1911) 14. — *X. affine* (non MIQ.) RIDLEY, J. Fed. Mal. St. Mus. 10 (1920) 82.

Tree, up to 30 m, 1 m dbh. Nodal appendages c. 0.1 mm long. Axillary buds 3–7, 0.5–1.6 mm long, the upper one (2–)3–10(–20) mm supra-axillary. *Petiole* (5–)6–12 mm, often in apical part with

small, usually not protruding glands. *Leaf-blade* (6.5–)10–23 by 2.5–7.5 cm, margin slightly undulate, often somewhat irregular, apex acutish; above dark or greyish green, midrib prominent to flat, in basal part with a central groove; beneath usually brownish to yellowish green, smooth to papillose, secondary nerves 7–10 pairs, forming an indistinct intramarginal nerve; glands either 0–3 (or 4) and often of an irregular form, or numerous and 0.1–0.2 mm diam., basal glands larger. *Inflorescences* usually 2 per leaf axil, 5–20 mm supra-axillary, as long as or longer than the leaves, much-branched, the basal branches 1–3 together; axes flattened basally, sparsely minutely hairy at the nodes with minute appendages; flowers 1–7 together; lower bracts opposite. *Pedicel* 2.5–5.5 mm, minutely patently to appressedly hairy, sometimes subglabrous. *Sepals*: outer sepals 1.4–2.2 by 1–1.9 mm; inner sepals (1.9–)2.3–3.3 by 1.6–3.5 mm. *Petals* white or pinkish, the upper ones with a yellow spot, when dry yellowish orange, the longest one 6.5–11 mm; carina sparsely to densely appressedly hairy outside, inside sparsely hairy in apical part; other petals glabrous or sparsely hairy at apex. *Stamens*: anthers 0.3–0.5 mm long. *Ovary* appressedly hairy; style rarely only basally hairy; ovules 4. *Fruit* globular, c. 1.5 cm diam., smooth, dull, greyish, appressedly hairy apically; pericarp rather thick; pedicel 4–6 mm (see note).

Distr. Continental SE. Asia (Bangla Desh, Burma, Thailand); in *Malesia*: Malay Peninsula (Kelantan, Perak).

Ecol. Outside Malesia in (usually submontane) monsoon forest.

Notes. The Malayan collections are either sterile or only in fruit; as they have longer pedicels, they may not belong to this species.

In some collections all flowers examined had 7 stamens only; instead of 2 carinal stamens only a single one is present in those flowers.

II. Subgenus *Coriaceum*

MEIJDEN, Leiden Bot. Ser. 7 (1982) 133.

Nodal glands distinct, c. 0.3 mm diam. Axillary buds indistinct when resting. *Leaf-blade*: tertiary nerves coarsely reticulate, sometimes partly scalariform. *Inflorescences* inserted in older nodes, unbranched, few-flowered, axes up to 1.5 cm, with minute nodal glands. *Sepals* glabrous except for ciliate margin. *Petals* glabrous in apical half out- and inside, lateral petals and carina spoon-shaped, upper petals narrower. *Stamens* monadelphous. *Ovary* glabrous; style glabrous; stigma peltate; ovules 8–12. *Fruit* indehiscent, stipitate, ± globular, apically pointed, 1.2 cm diam. *Seed* 1; testa 2-layered, less than 0.1 mm thick inner layer hard; albumen forming a rather distinct, thin layer which is very thin at lateral sides of cotyledons; embryo more or less globular, green, plumule undifferentiated, radicle exerted.

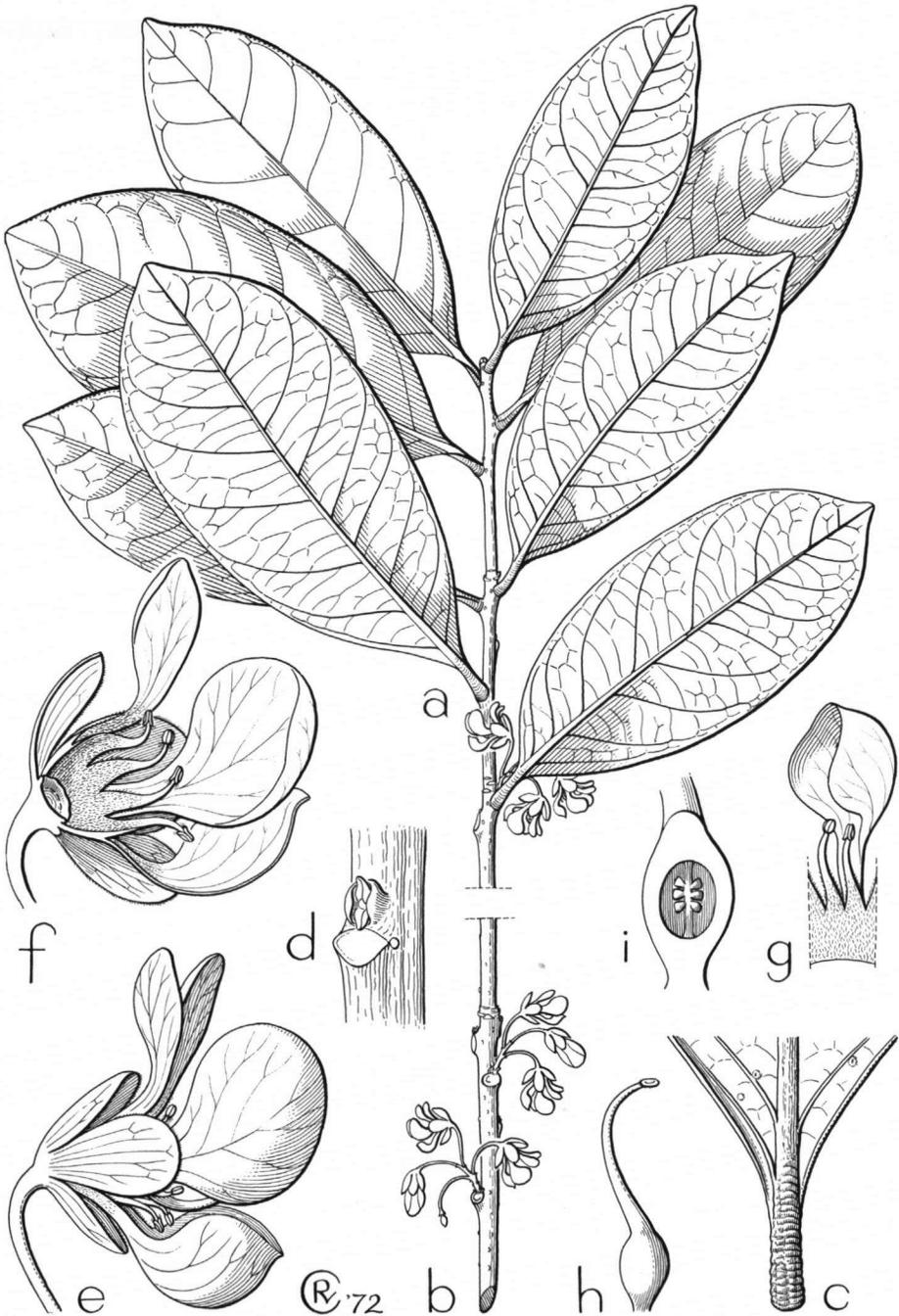


Fig. 22. *Xanthophyllum ramiflorum* MEIJDEN. *a-b*. Habit, $\times 0.7$; *c*. base of leaf with glands, $\times 2$; *d*. part of twig with axillary bud; *e*. flower; *f*. flower, longitudinal section, gynoecium removed; *g*. lower petal; *h*. gynoecium; all $\times 4$; *i*. ovary, longitudinal section, $\times 8$ (S 16051).

63. *Xanthophyllum ramiflorum* MEIJDEN, *Blumea* 18 (1970) 392; *Leiden Bot. Ser.* 7 (1982) 133, f. 16. — *X. spec.*: ANDERSON, *Gard. Bull. Sing.* 20 (1963) 152; WHITM. *Trop. Rain For. Far East* (1975) 147. — Fig. 22.

Tree, up to 30 m, 27 cm dbh. Axillary buds 2, very indistinct when resting, apparently sunken into the tissue of the twig, the upper one when bursting with 2 broadly ovate c. 1–1.5 mm long persistent scales. *Petiole* (5–)8–12 mm. *Leaf-blade* coriaceous, 7–20 by 3–8 cm, apex obtuse to subacute; above brownish, midrib slightly sunken to flat; beneath pale glaucous-papillose, secondary nerves c. 8 pairs, not forming an intramarginal nerve; glands numerous, c. 0.3 mm diam. *Inflorescences* solitary or up to 9 together in the axils of the lower leaves and those of the already fallen ones, 1–10-flowered; axes up to 1.5 cm long, thin, glabrous; nodal glands very indistinct; bracts small, scale-like. *Pedicel* 8–10 mm, glabrous.

Sepals dark reddish when dry; outer sepals c. 4–4.2 by 2.6 mm; inner sepals 4.5–4.8 by 3–3.3 mm. *Petals* white, the upper ones with a purple mark, when dry yellowish, minutely patently hairy in basal half outside and inside, further glabrous; carina like the lateral petals but a little shorter; lateral petals 7.5–8.5 by 7 mm; upper petals up to 7 by 2 mm. *Stamens* 8, exceptionally 7, up to c. 5 mm long; filaments connate over c. 1.5–2 mm, densely shortly patently hairy up to about halfway; anthers c. 0.7–0.8 mm long, minutely ciliate, very shortly hairy at base. *Ovary* light brownish, glabrous; style c. 5 mm, glabrous; stigma peltate, oblique, rather large; ovules 8–12. *Fruit* stipitate, ± globular, up to 1.2 cm diam., pustulate, dull, reddish brown, the style-scar more or less protruding and excentric.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Ecol. Confined to the lowland 'padang' peat-swamp forest on a very poor, sandy, wet soil.

III. Subgenus *Triadelphum*

MEIJDEN, *Leiden Bot. Ser.* 7 (1982) 135.

Nodal glands usually distinct, 0.3–0.7 mm diam. Axillary buds seemingly single, small, the scales usually not fully covering the bracts of young inflorescences, 0.4–1(–1.5) mm long. *Leaf-blade*: tertiary nerves coarsely reticulate. *Inflorescences* unbranched, axes slightly angular, dark, glabrous to sparsely hairy, with usually distinct nodal glands. *Sepals* glabrous outside, usually minutely hairy inside. *Petals* (sub)glabrous outside, lateral petals and the somewhat short carina spoon-shaped, upper petals narrower. *Stamens* triadelphous, connate parts c. 3–4 mm high. *Ovary* usually black, glabrous; style glabrous or hairy; stigma peltate; ovules 8–14. *Fruit* indehiscent, usually stipitate, 1–2 cm diam. *Seed* 1; testa 2-layered, c. 0.2 mm thick, inner layer c. 0.1 mm thick, hard; albumen copious, (nearly) separated into 2 halves; embryo flat, nerved, green, plumule undifferentiated, radicle exerted.

64. *Xanthophyllum ellipticum* KORTH. ex MIQ. *Ann. Mus. Bot. Lugd.-Bat.* 1 (1864) 276; A.W. BENNETT, *Fl. Br. India* 1 (1874) 211; KING, *Mat. Fl. Mal. Pen.* (1890) 140; CHODAT in E. & P. *Nat. Pfl. Fam.* 3, 4 (1896) 344; RIDLEY, *J. Str. Br. R. As. Soc. n.* 33 (1900) 45; GAGNEP. in *Desv. J. Bot.* 21 (1908) 253; MERR. *En. Born.* (1921) 326; CHODAT in *Merr. Pl. Elm. Born.* (1929) 133, *excl. var.*; FISCHER, *Kew Bull.* (1933) 487; KEITH, *N. Born. For. Rec.* 2 (1938) 225; MASAMUNE, *En. Phan. Born.* (1942) 379; MEIJER, *Bot. News Bull. Sandakan* 7 (1967) 88; FOX, *Sabah For. Rec.* 7 (1970) 65; NG, *Fed. Mus. J. n.s.* 13 (1971) 137; *Tree Fl. Mal.* 1 (1972) 357, f. 3; CORNER, *Gard. Bull. Sing. Suppl.* 1 (1978) 146, 211; MEIJDEN, *Leiden Bot. Ser.* 7 (1982) 135, f. 3A-p, 17. — *Banisterodes ellipticum* (KORTH. ex MIQ.) O. K. *Rev. Gen. Pl.* 1 (1891) 46, *nom. illeg.* — *X. citrifolium* CHODAT, *Bull. Herb. Boiss.* 4 (1896) 255;

in E. & P. *Nat. Pfl. Fam.* 3, 4 (1896) 345; MASAMUNE, *En. Phan. Born.* (1942) 379; ANDERSON, *Gard. Bull. Sing.* 20 (1963) 152. — *X. kingii* CHODAT, *Bull. Herb. Boiss.* 4 (1896) 255; RIDLEY, *Fl. Mal. Pen.* 1 (1922) 143; WATSON, *Mal. For. Rec.* 5 (1928) 249; CRAIB, *Fl. Siam. En.* 1 (1931) 106; BURK. *Dict.* (1935) 2268; WYATT-SMITH, *Mal. For. Rec.* 17 (1952) 80, 361; *ibid.* 23² (1963) iii, 12, 57. — Fig. 23.

Shrub or tree, up to 30 m, 40 cm dbh. Twigs glabrous to minutely hairy. *Petiole* (4–)5–7 mm, glabrous to minutely hairy. *Leaf-blade* 5–20 by 2–7 cm, margin often irregular, sometimes shallowly crenate because of glands; above usually brownish, midrib narrowly sunken; beneath more or less concolorous, secondary nerves 5–9 pairs, forming a rather distinct intramarginal nerve; glands rather numerous, c. 0.4–0.8 mm diam., scattered but at least 8 present on the leaf margin itself, other glands

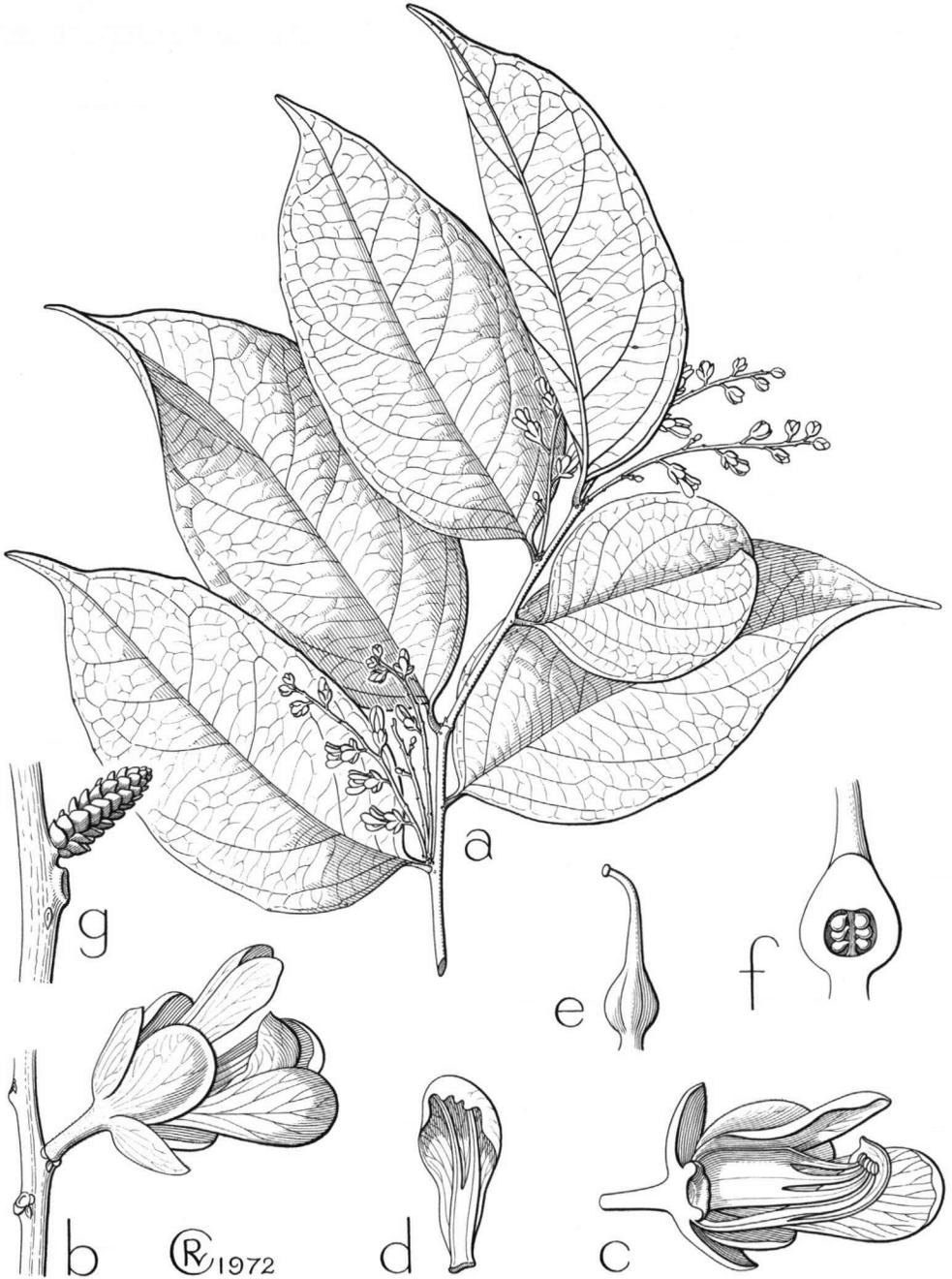


Fig. 23. *Xanthophyllum ellipticum* KORTH. ex MIQ. *a*. Habit, $\times 0.5$; *b*. flower and inflorescence axis; *c*. flower, longitudinal section, gynoecium removed; *d*. carina with two stamens enclosed; *e*. gynoecium; all $\times 3$; *f*. ovary, longitudinal section, $\times 6$; *g*. part of twig with young inflorescence, $\times 4.5$ (S 25564).

(4-)6-10. *Inflorescences* often several together on the secondarily thickened nodes, shorter than the leaves. *Pedice*l c. 3-4 mm, rather sparsely to rather densely minutely (woolly-)hairy. *Sepals* mostly nigrescent, glabrous to minutely hairy inside; outer sepals 3-3.8 by 1.8-2.2(-2.7) mm; inner sepals 3.8-4.8(-6) by 2.3-3.2(-4.5) mm. *Petals* white to light yellow, when dry light brown to dark orange, inside minutely hairy only above base; carina 6-7(-8) mm long; other petals 8-9 mm long, lateral petals 3-4 mm wide, upper petals 1.5-2 mm wide. *Stamens*: filaments glabrous; anthers 0.4-0.6 mm long, shortly hairy at base, ciliolate along slits, often cohering around the stigma. *Ovary* subsessile; style glabrous; ovules 8-14. *Fruit* sessile, globular, 1.5-2.2 cm diam., smooth, dark reddish, somewhat shiny; pericarp thin, brittle; pedicel 3-6(-8) mm long. *Seed* often (sub)apical.

Distr. S. Thailand; in *Malesia*: Malay Peninsula (incl. Singapore, Penang I.), Sumatra (incl. Simalur, Nias; Riouw: Karimun Is.), Borneo.

65. *Xanthophyllum celebicum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 137.

Tree, 25 m. Older nodes usually with a cluster of adventitious buds. *Petiole* 5-7 mm, not transversally wrinkled, more or less smooth. *Leaf-blade* 8-15 by 3-6 cm; above green, midrib sunken; beneath concolorous, secondary nerves 5 or 6 pairs, not forming an intramarginal nerve; glands present only in apical half of the leaf-blade, c. 0.2 mm diam., scattered but up to 6 present on the leaf margin itself, other glands c. 8-12. *Inflorescences* up to 4 cm long; nodal glands rather distinct. *Pedice*l 5-7 mm, rather sparsely minutely woolly hairy. *Sepals* sparsely minutely hairy inside; outer sepals 4 by 2.5 mm; inner sepals 4.9 by 2.4 mm. *Petals* brownish orange when dry, the longest one 7.5 mm long; carina inside in middle part shortly appressedly sparsely hairy; other petals inside densely appressedly shortly hairy. *Stamens* triadelphous; filaments densely rather shortly hairy; anthers 0.6 mm long, sparsely hairy at base, ciliolate along slits. *Ovary* shortly stipitate, slightly pustulate; style rather densely shortly more or less patently (\pm woolly) hairy; ovules 13. *Fruit* globular, c. 1.5 cm diam., smooth, dark reddish; pericarp thin; pedicel 7-9.5 mm.

Distr. *Malesia*: Central Celebes (Malili), one collection.

66. *Xanthophyllum montanum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 137, f. 10B.

Tree, up to 30 m, 60 cm dbh. Nodal glands elliptic, 0.3-0.6 mm long. *Petiole* 3.5-5 mm, indistinctly transversely wrinkled. *Leaf-blade* (4-)6-9 by 1-2.5(-3.5) cm, apex gradually acuminate; above brownish green, midrib sunken; beneath concolor-

ous, secondary nerves c. 6-8 pairs, forming an intramarginal nerve; glands (2-)4-8(-15), present in middle and apical part, absent from margin itself but (in Sumatran coll.) rather close to the margin, or (in Bornean coll.) rather closely together and not near the margin, 0.3-0.6 mm diam. *Inflorescences* up to 3 cm long; nodal glands elongate, usually very distinct. *Pedice*l c. 5 mm, sparsely minutely woolly hairy. *Sepals* minutely hairy inside; outer sepals c. 3.1 by 2.3 mm; inner sepals 3.5-4.3 by 2.3-2.8 mm. *Petals* yellowish brown when dry, the longest one 6-6.5 mm long; carina inside minutely hairy above base, upper petals minutely hairy inside. *Stamens*: filaments minutely hairy in basal part; anthers 0.6 mm long, glabrous. *Ovary* 0.5-0.7 mm stipitate, glabrous; style glabrous or only at base very sparsely minutely hairy; ovules 8-12. *Fruit* globular, up to 0.9 cm diam., yellowish to greenish brown, smooth, dull; pericarp thin; pedicel 4-5.5 mm.

Distr. *Malesia*: Sumatra (near Lake Toba), Borneo (Sabah: Mt Kinabalu).

Ecol. Submontane rain-forests, 900-1600 m.

67. *Xanthophyllum contractum* MEIJDEN, Leiden Bot. Ser. 7 (1982) 138.

Tree, flowering on older twigs from adventitious axillary buds. Nodal glands indistinct, elongated. *Petiole* 9-10 mm. *Leaf-blade* 14-20 by 6.5-8 cm, apex obtuse to very shortly acuminate; above yellowish green, midrib protruding; beneath: secondary nerves 8 or 9 pairs, not forming an intramarginal nerve; glands c. 12-18, mostly at 2-5 mm from the margin, some scattered, 0.2-0.3 mm diam. *Inflorescences* up to 4 cm long; nodal glands present but very indistinct. *Flowers* unknown. *Fruit* (immature) c. 3 mm stipitate, ovoid, c. 2 by 1.2 cm, more or less fleshy, finely pustulate, light reddish, glabrous; pericarp hard; pedicel 5-6 mm, glabrous. *Seed* 1 (sub)apical, developing from one of the 12 opposite ovules which are situated only in the apical half of the young fruit.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

68. *Xanthophyllum hildebrandii* MEIJDEN, Leiden Bot. Ser. 7 (1982) 139, f. 10B.

Petiole c. 6 mm, not transversally wrinkled. *Leaf-blade* c. 15 by 5-7 cm, papery thin; above dull, midrib sunken; beneath reddish brown, secondary nerves c. 7 pairs, in apical half forming a rather indistinct intramarginal nerve; glands numerous, mostly situated very close to midrib and a few scattered, 0.5-1.1 mm diam. *Inflorescences* 1 or 2 together; nodal glands distinct; axes up to 10 cm long, sparsely shortly woolly hairy. *Flowers* unknown. *Fruit* (very young) c. 2.5 mm stipitate, ovoid, apically with gland-like pustules, black, glabrous; pedicel 7-10 mm, dark, minutely woolly hairy. *Seed* (immature)

1, (sub)apical, developing from one of c. 12 ovules situated in apical 2/3 part of the fruit.

Distr. *Malesia*: Borneo (Sabah: Mt Kinabalu, Dallas), one collection only.

Note. Dedicated to the late Mr. F.H.HILDEBRAND who cleverly recognized many inadequate specimens of the genus by means of macroscopical characters of the wood of the twigs.

IV. Subgenus *Exsertum*

MEIJDEN, Leiden Bot. Ser. 7 (1982) 139.

Presence of nodal glands uncertain. Axillary buds 2(–4), usually seemingly single, black when dry. *Leaf-blade*: tertiary nerves coarsely reticulate. *Inflorescences* unbranched, up to 6–8 cm long, axes slightly angular, black when dry, rather sparsely woolly hairy, sometimes with indistinct nodal glands. *Sepals* nigrescent. *Petals* (sub)equal, spatulate-lanceolate, apex flat, (sub)glabrous outside, densely lanately ciliate. *Stamens*: filaments free, longer than petals, rather densely woolly hairy. *Ovary* black when dry, hairy inside, outside glabrous or hairy; stigma small, bilobed; ovules 8–16. *Fruit* indehiscent, globular, 2–6 cm diam., black when dry. *Seeds* c. 4–12, more or less bean-shaped, testa with rather thick and soft, fibrous outer layer and a hard inner layer; albumen copious, (nearly) separated into 2 halves; embryo flat, elliptic, nerved, plumule undifferentiated, radicle exserted.

69. *Xanthophyllum suberosum* C.T. WHITE, J. Arn. Arb. 10 (1929) 229; MEIJDEN, Leiden Bot. Ser. 7 (1982) 141, f. 18. — Fig. 24.

Tree, up to 25 m, up to 70 cm dbh. *Petiole* 6–7 mm, black, sometimes glaucous. *Leaf-blade* 4.5–11 by 2–5.5 cm; above olive-green, midrib narrowly sunken, nervation mostly rather indistinct; beneath reddish olive-green, secondary nerves c. 7–9 pairs, forming an indistinct intramarginal nerve, glands 10–14, sometimes more, mostly \pm halfway between midrib and margin, or near the margin, 0.1–0.3 mm diam., basal ones c. 0.3–0.4 mm diam. *Pedicel* 8–11 mm, rather sparsely shortly lanate. *Sepals* sparsely minutely hairy outside, rather densely shortly lanate. *Sepals* sparsely minutely hairy outside, rather densely shortly hairy inside; outer sepals 3.5–5.5 by 3.5–4 mm; inner sepals 5–7.5 by 4–5 mm. *Petals* 14–16 mm long, white, when dry dark reddish, rather sparsely hairy outside, subglabrous inside. *Stamens*: filaments 17–22 mm, glabrous at very base, further densely woolly hairy; anthers 1–1.3 mm long, hairy from base to apex. *Disk* densely hairy, with a small number of patent hairs on upper and lower lobes. *Ovary* very densely (velvety) hairy; style rather sparsely woolly hairy; ovules 10–16. *Fruit* (immature) c. 2 cm diam., shortly stipitate, finely pustulate, dark, distinctly bluish-waxy, hairy; pericarp c. 1–4 mm thick; pedicel slender, c. 15–18 mm.

Distr. *Malesia*: New Guinea (incl. Meos Num, Biak & Japen Is.).

70. *Xanthophyllum amoenum* CHODAT, Bull. Herb. Boiss. 4 (1896) 259; in E. & P. Nat. Pfl. Fam. 3, 4

(1896) 344; GAGNEP. in Desv. J. Bot. 21 (1908) 252; MASAMUNE, En. Phan. Born. (1942) 379; WYATT-SMITH, Mal. For. Rec. 17 (1952) 80, 363; *ibid.* 23² (1963) f. 8; ANDERSON, Gard. Bull. Sing. 20 (1963) 152; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; NG, Tree Fl. Mal. 1 (1972) 356, f. 1; MEIJDEN, Leiden Bot. Ser. 7 (1982) 141, f. 3A-n. — *X. stipitatum* var. *nitidum* CHODAT in Merr. Pl. Elm. Born. (1929) 137; MASAMUNE, En. Phan. Born. (1942) 381. — *X. stipitatum* var. *pachyphyllum* CHODAT in Merr. Pl. Elm. Born. (1929) 137; MASAMUNE, En. Phan. Born. (1942) 381.

Tree, up to 35 m, up to 80 cm dbh. Axillary buds 2 or 3, the upper one up to 2 mm long. *Petiole* 4.5–10.5 mm. *Leaf-blade* 4–14 by (1–)2–7 cm; above deep brown to reddish brown, midrib narrowly sunken, nervation rather obscure to rather distinct; beneath sometimes waxy, secondary nerves 5–7, not forming an intramarginal nerve; glands 6–10(–20), scattered, 0.1–0.4(–0.5) mm diam. *Pedicel* 8–15 mm, rather densely minutely lanate. *Sepals*: outer sepals 2.5–3 by 1.8–2.2 mm, minutely rather densely hairy at both sides; inner sepals 4–4.5 by 1.8–2.4 mm, hairy outside along midrib, inside densely hairy at base, further more or less glabrous. *Petals* (8–)9–11(–12) mm long, white ('3 lower with yellow centre'; HAVILAND 2112), when dry dark reddish, glabrous outside, inside lanate especially in basal and apical part. *Stamens*: filaments 11–13(–16) mm; anthers 0.7–0.9 mm long, glabrous or with a few hairs at base. *Disk* glabrous. *Ovary* stipitate, (glabrous? or) densely lanate; style lanate; ovules 8–16. *Fruit* globular or less often ovoid, up to c. 5 cm

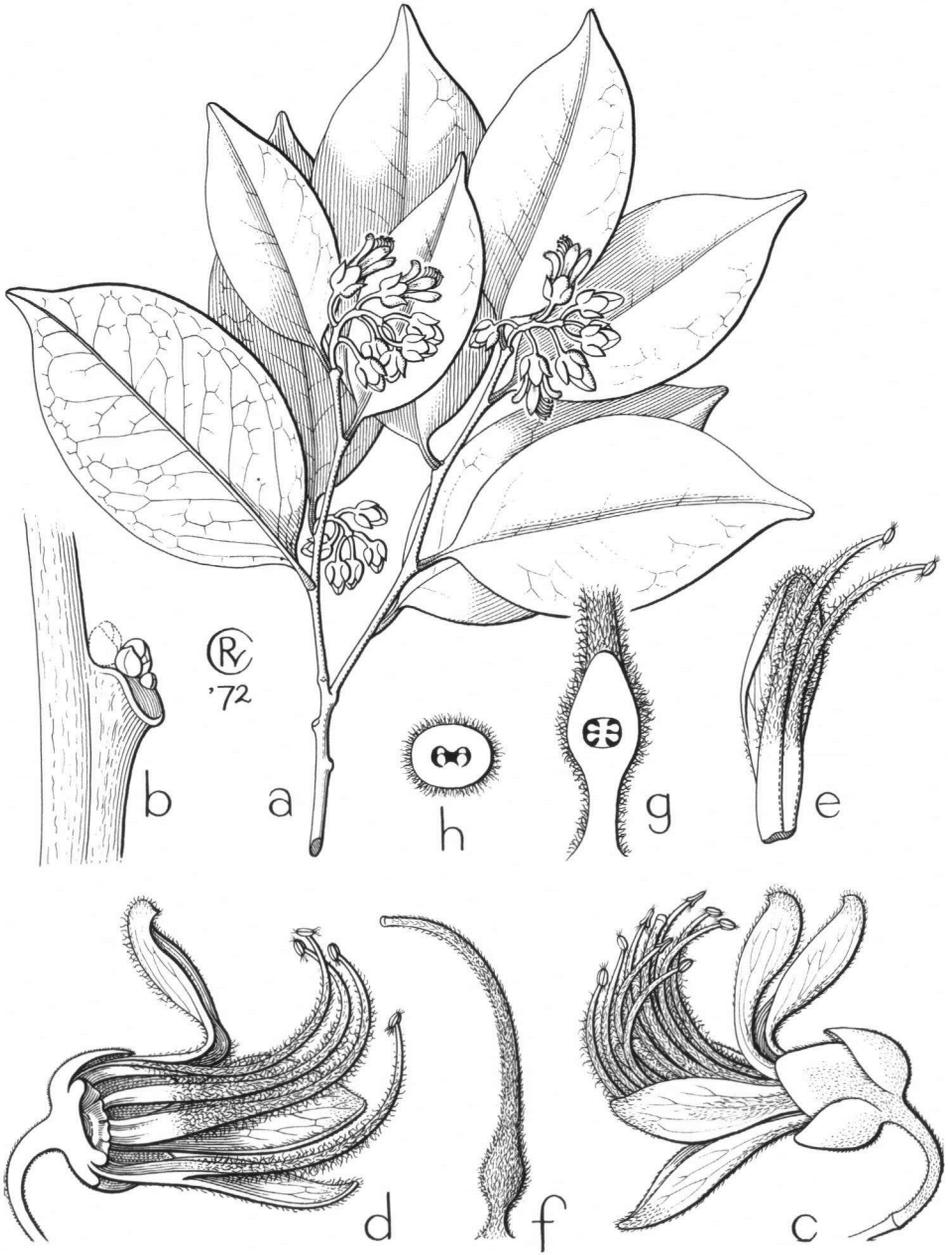


Fig. 24. *Xanthophyllum suberosum* C.T. WHITE. a. Habit, $\times 0.7$; b. part of twig with axillary buds; c. flower; d. flower, longitudinal section, gynoecium removed; e. lower petal; f. gynoecium; all $\times 2$; g-h. ovary, longitudinal and cross section, $\times 4$ (VAN ROYEN 3201).

diam., sometimes bluish waxy, hairy or apparently glabrous; pericarp 1–10 cm thick. *Seeds* 6 or more.

Distr. Malesia: Malay Peninsula, Central Sumatra, Borneo.

71. *Xanthophyllum stipitatum* A.W.BENNETT, Fl. Br. India 1 (1874) 210; KING, Mat. Fl. Mal. Pen. (1890) 140; CHODAT in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 345; RIDLEY, Fl. Mal. Pen. 1 (1922) 145; HEND. Gard. Bull. S. S. 4 (1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; CHODAT in Merr. Pl. Elm. Born. (1929) 137, *incl. var. borneense* CHODAT; BURK. Dict. (1935) 2268; WYATT-SMITH, Mal. For. Rec. 17 (1952) 81, 361; BALAN MENON, *ibid.* 19 (1956) 34; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; NG, Tree Fl. Mal. 1 (1972) 363, f. 5; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 147; MEIJDEN, Leiden Bot. Ser. 7 (1982) 142. — *Banisterodes stipitatum* (A.W.BENNETT) O. K. Rev. Gen. Pl. 1 (1891) 46. — *X. amoenum* (non CHODAT) KEITH, N. Born. For. Rec. 2 (1938) 225.

Tree, up to 50 m, 1.20 m dbh. Axillary buds 2(–4), c. 2 mm long. *Petiole* 3–8 mm. *Leaf-blade* (2.5–)4–13 by (1–)2–7 cm; above mostly greyish brown to dark brown, sometimes reddish brown, midrib slightly sunken, nerves mostly obscure; beneath concolorous, sometimes more or less waxy, secondary nerves 5 or 6 pairs, not forming an intramarginal nerve, finely prominent to rather obscure; glands few, 0–2(–4) per leaf, near the base and in the middle, 0.1–0.2 mm diam. *Pedicel* c. 8–12 mm, dark, minutely lanate. *Sepals* densely minutely hairy inside at base, further almost glabrous; outer sepals 1.8–3 by 1.8–2 mm; inner sepals 3–3.5 by 2–2.5 mm. *Petals* 7–7.5(–8) mm long, dark reddish when

dry, glabrous outside, hairy inside at base and sometimes also in apical part. *Stamens*: filaments 11–13 mm, shortly rather densely lanate, glabrous in apical part, free or (in *var. glabrum*) forming a ‘tube’ by their intertwined hairs; anthers c. 0.8 mm long, glabrous. *Disk* glabrous. *Ovary* densely lanate or rarely (sub)glabrous; style glabrous in upper half; ovules 8–12. *Fruit* c. 2–6 cm diam., often apparently sterile, shortly to long-stipitate, black, often waxy, glabrous or hairy; pericarp 0.5–1.5 cm thick; pedicel up to c. 1.5 mm. *Seeds* c. 4–12.

Distr. Malesia: Malay Peninsula, Sumatra, Borneo.

KEY TO THE VARIETIES

1. Filaments forming a ‘tube’ by their intertwined hairs. Ovary (sub)glabrous . . . **b. var. glabrum**
1. Filaments free, hairy. Ovary densely lanate
a. var. stipitatum

a. var. stipitatum — *X. stipitatum* A.W.BENNETT, *incl. var. borneense* CHODAT.

Stamens: filaments free, hairy. *Ovary* densely lanate; style densely hairy basally.

Distr. Malesia: Malay Peninsula (incl. Singapore), Central Sumatra, Borneo.

b. var. glabrum MEIJDEN, Leiden Bot. Ser. 7 (1982) 144.

Stamens: filaments forming a ‘tube’ by their intertwined hairs. *Ovary* glabrous or with a few appressed hairs; style thinly hairy basally.

Distr. Malesia: E. Borneo (Kalimantan: Long Petah).

V. Subgenus *Brunophyllum*

MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 117; Leiden Bot. Ser. 7 (1982) 144.

Nodal glands usually distinct, c. 0.3–0.5 mm diam. *Leaf-blade*: tertiary nerves coarsely reticulate. *Inflorescences* unbranched. *Sepals* glabrous to minutely hairy outside, usually woolly-ciliate, usually minutely hairy inside. *Petals* unequal with the carina boat-shaped, or equal, (sub)glabrous outside. *Stamens* 8 (–10), filaments free or up to 6 mm connate, densely woolly hairy. *Ovary* glabrous to hairy; style glabrous or hairy at base; stigma peltate; ovules 8–18(–23). *Fruit* indehiscent, pear-shaped to ovoid, large. *Seeds* 8–more, large; testa 2-layered, outer layer usually thick (thin in 76 *X. chartaceum*), soft, inner layer hard; embryo broadly triangular-ovoid and with little albumen, to flattened-ovoid and covered by much albumen; cotyledons cordate, usually seemingly peltate (except in 72. *X. brevipes*), plumule usually differentiated into a number of small scales, radicle fully enveloped by the cotyledons or just exerted at base.

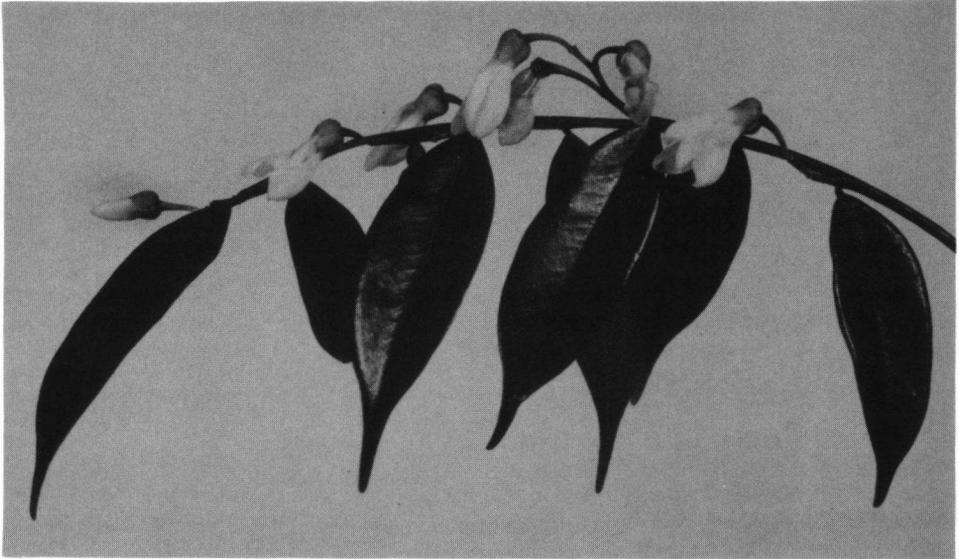


Fig. 25. Inflorescence of *Xanthophyllum brevipes* MEJDEN, collected in Arboretum, Semengoh For. Res., Sarawak (S 26838) (Photogr. P. SIE, 1971).

72. *Xanthophyllum brevipes* MEJDEN, Bot. J. Linn. Soc. 67 (1973) 117; Leiden Bot. Ser. 7 (1982) 144. — Fig. 25.

Tree, up to 35 m, 40 cm dbh. Twigs (sometimes?) all curved downwards, pendent. Nodal glands often indistinct. *Petiole* 1.5–3 mm. *Leaf-blade* 2.6–7.5 by 0.7–2.6 cm, apex acuminate to cuspidate; above brown to olive-green, midrib sunken; beneath olive-greenish brown, papillose, secondary nerves c. 10 pairs, little more distinct than finer nerves, forming an indistinct intramarginal nerve; glands more than 10, in a row between margin and midrib, c. 0.1 mm diam. *Inflorescences* 2–5-flowered; axes hardly thicker than pedicel, glabrous. *Pedicel* c. 7 mm, glabrous. *Sepals* minutely ciliate, further glabrous; outer sepals c. 3.5 by 3.5 mm; inner sepals c. 4 by 4.5 mm. *Petals* unequal, white, when dry orange-brown, faintly ciliate, the longest one 15–16 mm; carina unguiculate, boat-shaped, ciliate only at base; lateral petals narrowly boat-shaped; upper petals more or less straight, with cup-shaped apex. *Stamens*: filaments c. 0.5 mm connate, rather densely shortly hairy in basal part; anthers c. 1 mm long, glabrous. *Ovary* shortly stipitate, orange-brown, glabrous; style glabrous; ovules 18. *Fruit* pear-shaped (to broadly ovoid?), up to 4 cm diam., strongly wrinkled when dry, shiny, brown; pericarp probably very fleshy; pedicel 12–15 mm, blackish, shiny. *Seeds* more than 10, flattened-ovoid, c. 1 cm long; albumen

nearly absent from lateral sides of cotyledons, at the broad side of these forming a layer equal in thickness to each cotyledon; embryo elliptic in side view, transversally flattened, cordate at base; cotyledons thickened; plumule not differentiated; radicle slightly exerted.

Distr. *Malesia*: Borneo (Sarawak, Brunei).

Note. ASHTON mentioned in a fieldnote that the habit of the tree is very reminiscent of old specimens of *Salix babylonica* because of its pendant twigs.

73. *Xanthophyllum obscurum* A.W.BENNETT, Fl. Br. India 1 (1874) 211; KING, Mat. Fl. Mal. Pen. (1890) 141; RIDLEY, J. Str. Br. R. As. Soc. n. 33 (1900) 45; Fl. Mal. Pen. 1 (1922) 144; HEYNE, Nutt. Pl. (1927) 902; HEND. Gard. Bull. S. S. 4 (1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; WYATT-SMITH, Mal. For. Rec. 17 (1952) 81, 363; BALAN MENON, *ibid.* 19 (1956) 34; WYATT-SMITH, *ibid.* 23² (1963) f. 8; NG, Tree Fl. Mal. 1 (1972) 361, f. 3; Mal. For. 38 (1975) 89, f. 8.1 F–J, 8.3, 8.4; CORNER, Gard. Bull. Sing. Suppl. 1 (1978) 147, 211; MEJDEN, Leiden Bot. Ser. 7 (1982) 145, f. 3B-b, 10B. — *X. insigne* A.W.BENNETT, Fl. Br. India 1 (1874) 211; KING, Mat. Fl. Mal. Pen. (1890) 144. — *X. scor-techinii* KING, J. As. Soc. Beng. 59, ii (1890) 140; Ann. R. Bot. Gard. Calc. 5 (1896) 138, pl. 163; GAGNEP. in Desv. J. Bot. 21 (1908) 253; RIDLEY, Fl. Mal. Pen. 1 (1922) 143; HEND. Gard. Bull. S. S. 4

(1928) 222; WATSON, Mal. For. Rec. 5 (1928) 249; BURK. Dict. (1935) 2268; WYATT-SMITH, Mal. For. Rec. 17 (1952) 81, 361; BALAN MENON, *ibid.* 19 (1956) 34; WYATT-SMITH, *ibid.* 23² (1963) f. 5; NG, Tree Fl. Mal. 1 (1972) 363, f. 3. — *Banisterodes insignis* (A.W.BENNETT) O. K. Rev. Gen. 1 (1891) 46, *nom. illeg.* — *Banisterodes obscurum* (A.W.BENNETT) O. K. *l.c.*, *nom. illeg.*

Tree, up to 47 m, 70 cm dbh. Twigs often strongly thickened on the nodes and with adventitious buds. Nodal glands usually distinct, sometimes elongate, c. 0.5 mm diam. *Petiole* 5–11(–15) mm. *Leaf-blade* (4–)7.5–17 by (1.5–)3.5–9 cm, apex rounded to obtuse or sometimes very shortly acuminate; above dark or greyish reddish brown, rarely green, midrib flat to protruding; beneath concolorous or darker than above, midrib prominent or flat, secondary nerves c. (3–)6–9 pairs, sometimes in upper part forming an intramarginal nerve; glands 2–16, usually situated near or on the margin of the leaf, (0.2–)0.5–0.7 (–1.2) mm diam. *Inflorescences* sometimes also on the older nodes, shorter than the leaves; axes angular, black, glabrous to sparsely shortly lanate. *Pedicel* 3–11 mm, glabrous to sparsely hairy. *Sepals* black; outer sepals 2.8–5.5 by 2.8–6 mm; inner sepals 4–7.5 by 3.5–7 mm. *Petals* unequal, white or purple, the upper ones with a yellow or green spot, when dry black, inside glabrous or rather densely woolly hairy above insertion of filaments and at apex, the longest one 14–19 mm; carina boat-shaped, 9.5–16 mm long; lateral petals more or less spatulate, distinctly longer than upper petals and carina; upper petals more or less linear, flat to slightly channelled, curved upwards. *Stamens* 7.5–12 mm long; filaments connate for (0.1–)1–3 mm, glabrous in basal part, free parts of filaments lanate in basal part, hairs often intertwined, thus forming a filamental 'tube', glabrous upwards; anthers 0.7–1.7 mm long, glabrous to minutely hairy, free or attached to each other around the stigma. *Ovary* black, glabrous; style black, glabrous; ovules 8–18. *Fruit* globular, very large, the largest up to 14 cm diam., dull pinkish brown, with numerous small dark spots; pericarp 0.5–2 cm thick. *Seeds* 8–16, sticking together in drying like a ball, each c. 2–6 cm wide; testa 2-layered, outer layer thick, soft, fibrous, inner layer c. 0.1 mm thick; albumen nearly absent, usually visible only at base; embryo thick, triangular in side view, plumule and radicle situated in the very centre of the embryo, the plumule differentiated into a number of decussate scales; cotyledons seemingly peltate, peripherically with numerous vessel-like elements forming a regularly reticulate pattern.

Distr. Southernmost Thailand; in *Malesia*: Malay Peninsula (incl. Singapore & Penang I.), Sumatra, Borneo.

74. *Xanthophyllum papuanum* WHITM. ex MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 119; WHITM. Guide For. Br. Sol. Is. (1966) 92, 151; PAIJMANS, Land Research Ser. 29 (1971) 107; VERSTEEGH, Meded. Landb. hogesch. Wageningen 71-19 (1971) 63; EDDOWES, Commerc. Timbers P.N.G. (1977) 46 ('Boxwood'); MEIJDEN, Leiden Bot. Ser. 7 (1982) 147, f. 3B-c, 19. — *X. affine* (non MIQ.) K.SCH. & HOLLR. Fl. Kaiser Wilhelm Land (1889) 68; K.SCH. & LAUT. Fl. Schutzgeb. Südsee (1901) 388. — Fig. 26.

Tree, up to 43 m, up to 1.1 m dbh. *Petiole* 5–9 mm. *Leaf-blade* 5–14 by 2.8–9.3 cm; above greyish mid-green, rarely yellowish brown, midrib mostly sunken, sometimes flat, rarely prominent; beneath concolorous, secondary nerves 5 or 6 pairs; glands 6–10(–14), in middle part close to the midrib, in upper part often along margin and midrib, 0.4–0.5 mm diam. *Inflorescences* ± as long as to longer than the leaves; axes angular, brown, rather densely shortly lanate; in basal part flowers with 3(–7) together. *Pedicel* 3–4 mm, ribbed, densely shortly lanate. *Sepals* brownish, shortly lanate outside; outer sepals 2.5–3.5 by c. 2 mm; inner sepals 3–4.5 by c. 2.5 mm. *Petals* (sub)equal, obovate-lanceolate, 7–8.5 mm long, with slightly cupped apex, white, when dry orange-brown, outside with a few woolly hairs along midrib, woolly-ciliate especially at apex, inside woolly hairy. *Stamens* 8 or 9, the middle carinal stamen rather often developed; filaments free or 0.1 mm connate, densely lanate to apex; anthers 0.7–0.8 mm long, sparsely woolly hairy. *Ovary* 0.5–0.7 mm stipitate, inside glabrous to sparsely hairy, outside densely shortly lanate on median rib, further glabrous; style basally shortly lanate, upwards nearly glabrous; ovules 14–16. *Fruit* pear-shaped, c. 5–15 cm long, 3–12 cm diam., reddish brown to greyish greenish brown, often with darker spots; pericarp c. 0.5 cm thick, hard; pedicel up to 5 mm. *Seeds* mostly more than 8, rarely less, sticking to the pericarp in drying, broadly triangular-ovoid, up to 5 cm wide when dry; testa 2-layered, outer layer thick, soft, not fibrous, inner layer less than 0.1 mm thick, hard; albumen nearly absent, usually visible only at the base; embryo thick, triangular in side view, plumule and radicle situated below the centre of the embryo, plumule differentiated into a number of decussate scales; cotyledons seemingly peltate, peripherically without vessel-like elements; top of radicle hardly exerted at base.

Distr. Solomon Islands; in *Malesia*: New Guinea (incl. Fergusson I. in E, and Salawati, Numfoor, Japen & Mios Waar Is. in W), Moluccas (Ceram), Central Celebes (Palopo).

Note. In a number of collections all flowers examined have 9 stamens: 3 instead of 2 stamens are placed before the adaxial petal.



Fig. 26. *Xanthophyllum papuanum* WHITM. ex MEULDEN. *a.* Habit, $\times 0.7$; *b.* flower and part of inflorescence axis; *c.* flower, longitudinal section, gynoecium removed; *d.* lower petal with three stamens; *e.* gynoecium; all $\times 4$; *f.* ovary, longitudinal section, $\times 8$ (HOOGLAND 5072).

75. *Xanthophyllum ecarinatum* CHODAT, Bull. Herb. Boiss. 4 (1896) 254; in E. & P. Nat. Pfl. Fam. 3, 4 (1896) 344; MERR. En. Born. (1921) 325; MASAMUNE, En. Phan. Born. (1942) 379; MEIJER, Bot. News Bull. Sandakan 7 (1967) 87; MEIJDEN, Leiden Bot. Ser. 7 (1982) 148, f. 3B-d. — *X. kalimantanum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118.

Tree, up to 25 m, 16 cm dbh. *Petiole* (1.5–)4–6.5 mm. *Leaf-blade* (ovate-)oblong, (3–)7–17 by (1–)2.8–7 cm, apex acuminate to cuspidate; above dark reddish brown to dark olive-green, midrib slightly prominent to flat, or sunken in basal part; beneath concolorous, secondary nerves 5–7 pairs, forming a rather indistinct intramarginal nerve; glands 0–8, situated in middle and apical part, (0.1–)0.2–0.4 mm diam. *Inflorescences* (much) shorter than the leaves; axes lanate; flowers solitary or in basal part with up to 3 together. *Pedicel* (1.5–)3–4 mm, dark, sparsely lanate. *Sepals* black when dry; outer sepals (3–)4–5.5 by (1.5–)2.5–3.5 mm; inner sepals (3.5–)6–7 by (1.5–)2.5–4 mm. *Petals* subequal, 9.5–12 mm long, white, the upper ones with a yellow spot, when dry nearly black, ciliate to apex, inside hairy above insertion of filaments. *Stamens* 8(–10); filaments connate over c. 5–6 mm, glabrous at base, upwards densely (woolly) hairy; anthers 0.5–0.65 mm long, glabrous to sparsely woolly hairy at base. *Ovary* stipitate for 2.5–3 cm, dark, glabrous or with a few rather long hairs; style glabrous to rather sparsely lanate; ovules 12–18 (–23). *Fruit* ellipsoid, up to 11 by 6 cm, attenuate at base and apex, often more or less smooth, orange to dark brown; pericarp rather soft, c. 0.5 mm thick. *Seeds* 8 or more, like those of 74. *X. papuanum*, but albumen forming a thin layer along outer side of the cotyledons.

Distr. *Malesia*: Borneo (Sarawak, Sabah, Kalimantan).

76. *Xanthophyllum chartaceum* MEIJDEN, Bot. J. Linn. Soc. 67 (1973) 118; Leiden Bot. Ser. 7 (1982) 149. — *X. spec. E*, NG, Tree Fl. Mal. 1 (1972) 366.

Tree, up to 30 m, 1 m dbh. *Petiole* 3–4 mm. *Leaf-*

blade 4.5–11.5 by 2–4.2 cm, papery thin, base nearly cordate to cuneate, apex acuminate to cuspidate; above very dark green, midrib flat to slightly prominent; beneath ± glabrous, concolorous, secondary nerves c. 5–7 pairs; glands very few, up to 3, c. 0.1 mm diam., very indistinct. *Flowers* unknown. *Inflorescences* short; axes black, glabrous. *Fruit* globular to more or less pear-shaped, up to 8.5 cm long, strongly wrinkled, when dry black, probably glabrous; pericarp rather thick, hard. *Pedicel* c. 5 mm, black, glabrous. *Seeds* 8 or more, like those of: *X. papuanum*, but both layers of the testa much thinner, and albumen forming a thin layer along the outer side of the cotyledons.

Distr. *Malesia*: Malay Peninsula, Central Sumatra (Indragiri).

Note. Because of its thin nigrescent leaves with few laminar glands, its habit is atypical in *Xanthophyllum*. As its flowers may be atypical too (*i.e.* in being possibly 'regular'), flowering material may have been collected already but identified wrongly.

Excluded

Xanthophyllum glaucescens MIQ. Fl. Ind. Bat., Suppl. (1861) 394; Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 274, has been identified by HILDEBRAND and KOSTERMANS as *Litsea insignis* (BLUME) BOERL. (*Lauraceae*).

Xanthophyllum hebecarpum CHODAT, Bull. Herb. Boiss. 4 (1896) 263; RIDLEY, J. Str. Br. R. As. Soc. n. 73 (1916) 139; Fl. Mal. Pen. 1 (1922) 149, was identified by SYMINGTON, Kew Bull. (1937) 318 as *Ryparosa kunstleri* KING (*Flacourtiaceae*); SLEUMER, Fl. Males. 1, 5 (1954) 48.

Xanthophyllum subglobosum ELMER, Leaf. Philip. Bot. 5 (1913) 1676, *incl. var. longifolium* ELMER, was identified by MERRILL, En. Philip. 2 (1923) 485 as *Siphonodon celastrineus* GRIFFITH (*Celastraceae*); DING HOU, Fl. Males. 1, 6 (1964) 395.

Excluded

Semeiocardium ZOLL. Nat. Tijd. Ned. Ind. 17 (1858) 245, the type of a monospecific genus, was by ZOLLINGER assigned to *Balsaminaceae*, but later referred to *Polygalaceae* by HASSKARL (in Miq. Ann. Mus. Bot. Lugd.-Bat. 1, 1863, 142). Still later CHODAT reduced it to *Polygala triphylla* (Monogr. 1, 1891, 41). BACKER (Gard. Bull. S. S. 9, 1938, 70) showed that ZOLLINGER was correct.