FLORA MALESIANA

THYMELAEACEAE (Ding Hou, Leyden)

Shrubs, trees, or lianas, rarely undershrubs or herbs, with a very strongly developed and layered, fibrous, tough bast ("Seidenbast", silky fibres). *Leaves* opposite or decussate, spiral or alternate, very rarely some ternate, simple, entire, exstipulate, articulated at the base, glandular-punctate in *Gonystyloideae*. *Inflorescences* terminal, axillary or extra-axillary, or on internodes, sometimes on brachyblasts, simple or rarely branched, sessile or peduncled, racemose, umbelliform, spicate, capitate, or fascicled, obviously basically racemose; flowers rarely solitary, sometimes cauliflorous and condensed into glomerules, bracteate (bracts sometimes forming an involucre) or ebracteate. *Flowers* bisexual (rarely unisexual by abortion and polygamodioecious or dioecious in extra-Mal. *spp.*), homomorphic, rarely heteromorphic, regular, tubular, campanulate or infundibuliform, tube very short in *Gonystyloideae*, or with almost free sepals in extra-Mal. *spp.*, mostly caducous, some circumsciss in the lower part, or persistent (sometimes enveloping the ripe fruit in extra-Mal. *spp.*), sometimes slit lengthwise in fruit, 4–5(–6)-lobed, the lobes imbricate (rarely valvate in some extra-Mal. *spp.*), equal or rarely the interior 2 slightly smaller, erect or reflexed. *Corolla* absent or represented by free or united *petaloid appendages*, isomerous and alternating with the calyx lobes, or double in number and arranged in pairs opposite the calyx lobes, rarely more (*Gonystylus*), fleshy or membranous, filamentous or oblong, entire or lobed, rarely united into a ring, inserted at the throat of floral tube or slightly lower, sometimes behind the stamens, or absent. *Stamens* 2 only, or 4–∞, in Malaysia (except in some *Gonystyloideae*) mostly diplostemonous, in two or in one series, if in two series then at two different levels, the upper ones opposite the calyx lobes and the lower ones alternate with them, sessile or filamentous; filaments filiform or slightly flattened, entirely or partly adnate to the floral tube; anthers 2-celled, basi- or dorsifixed, obtuse or apiculate, introrse, hippocrepiform (*Gonystyloideae*), or extrorse (extra-Mal. *spp.*), dehiscing lengthwise, usually free, sometimes the lower ⅓–½ adnate to the tube (*Aquilaria cumingiana*). Disk hypogynous, membranous or subcarnose, annular, cupular, lobed, free and scale-like, or none. *Ovary* superior, 1–2-celled, 3–5(–8)-celled in *Gonystyloideae* and extra-Mal. *spp.*, sessile or shortly stalked; style filiform, caducous, sometimes very short or obscure, terminal or excentric, in *Gonystyloideae* sometimes accompanied by 'parastyles' at the base; stigma capitate, subglobose, oblong, subclavate or pyramidal, entire and smooth, or slightly emarginate, sometimes papillose. *Ovules* solitary in each cell, with axial or parietal placentation, pendulous from near the top, sometimes partly or entirely and laterally adnate to the placenta, the micropyle towards the top and outward. *Fruit* a drupe or drupaceous, a berry, or a capsule, either apically or laterally emerging from the floral tube, 1- or 2(–3)-seeded, or 3–5(–8)-seeded in *Gonystyloideae* and extra-Mal. *spp.*; pericarp membranous, pulpy, coriaceous, or fibrous. *Seeds* with a caruncle-like or tail-like appendage, usually with an aril in *Gonystyloideae*, the seed usually hanging out by one end on a thin, string-like funicle in *Aquilarioideae*; testa usually crustaceous, black, often with rather irregular ridges, glabrous or short-hairy in some *spp.* of *Aquilarioideae*; albuminous or exalbuminous. Embryo straight; cotyledons plano-convex; radicle short, superior.

Distribution. About 50 genera with about 500 species, chiefly developed in south and tropical Africa and Australia; it is almost cosmopolitan.

In addition to *subfam. Gonystyloideae* which contains 3 genera with 21 species and has been treated in this Flora (I, 4, 1953, 349–365) by AIRY SHAW, there are 9 genera with 46 species in Malaysia.

Aquilaria, *Gyrinops*, *Enkleia*, and *Linostoma* are confined to Malaysia and the southern part of tropical continental SE. Asia. *Wikstroemia* is widely distributed, from eastern Asia at about 37° N southward throughout Malaysia to northern and eastern Australia and the Pacific Islands (Bonin, Guam, Palau, Hawaii, Tahiti, Marquesas, Tonga, Samoa, Fiji, Norfolk I., and New Caledonia).

Daphne is distributed in Europe, northern Africa, through central Asia, eastward to China and Japan, and southward to Malaysia.

Phaleria is developed chiefly in Malaysia and Fiji, westward to Ceylon (*P. capitata*), southward to eastern Australia, and eastward as far as Palau, Samoa, and Tonga.

Drapetes shows the typical pattern of S. Pacific subantarctic distribution: South America (Fuegia and Falkland Is.), New Zealand, Tasmania, SE. Australia, and Malaysia (New Guinea and Borneo).

Pimelea is chiefly confined to Australia, with some outlying species in New Zealand, and two others extending northward to Malaysia (Timor, Sumba, New Guinea, and Luzon in the Philippines).

Ecology. Most Malaysian species are of small to moderate size, while a few species of *Aquilaria*, *Gyrinops*, and *Gonystyloideae* are trees up to 45 m tall. They usually occur scattered, but *Gonystylus bancanus* may occur gregarious, sometimes forming pure stands. They are chiefly constituents of primary and secondary rain-forests, while *Gonystylus bancanus* occurs predominantly in freshwater swamp and peat forest; recently J. A. R. ANDERSON found *Linostoma longiflorum* in peat swamp forest in Sarawak.

Most of the species occur at low and medium altitudes, some of them ascending into the montane zone (*e.g. Phaleria capitata* 0–1200 m and *Linostoma pauciflorum* 0–1300 m), or even confined to the montane zone (*e.g. Daphne composita* commonly recorded from 1200–2000 m, and *Aquilaria apiculata* from 1800 m). A few are restricted to the upper montane and subalpine rain-forest (*e.g. Daphne luzonica* 2000–2500 m, and *Wikstroemia brachyantha* 1400–2800 m). *Drapetes ericoides* is commonly reported from the subalpine to alpine zone from 3000–4450 m.

As to climate, most of the species are confined to everwet regions, some also extend to seasonal areas (*e.g. Phaleria capitata*, *Gyrinops versteegii*, and *Wikstroemia indica*), while *Wikstroemia androsaemifolia* and *Phaleria octandra* chiefly occur under seasonal climatic conditions.

Pollination. Insect-pollination is indicated by the brightly coloured, generally many-flowered inflorescences, the sweet scent, the occurrence of floral heteromorphism, and the usual presence of the hypogynous disk (*fide* RENDLE, Classif. Fl. Pl. 2, 1952, 371). I have no records of observations on Malaysian species.

Dispersal. Though no direct evidence has been recorded from Malaysia it can be indirectly inferred that the red or black coloured drupaceous fruits of *Wikstroemia*, *Phaleria*, and *Daphne* will be dispersed endozoically by birds or other animals. See RIDLEY, Disp. (1930) 401, 466, 472, and GUPPY, Observ. Nat. Pac. 2 (1906) 348. *Wikstroemia indica* has, probably through this agent spread from the Botanic Gardens at Bogor but its area is only slowly, though steadily, extending into a circle with Bogor in its focus; its radius of *c.* 60 km was reached only after several decades.

Another dispersal class is represented by species of *Linostoma* and *Enkleia*. In *Linostoma* the inflorescences consist of a few inconspicuous flowers subtended by a pair of thin, cream-coloured or rose-pink coloured leaf-like bracts. In anthesis they possibly act as a show apparatus attractive to pollinators. They become pale and papery when the fruit is ripe, and are detached, adhering to the fruit, so as to be blown away separately. In *Enkleia*, a lofty climber, the pair of bracts below the inflorescence is very inconspicuous during anthesis, but in fruit (one developing only) the peduncle below the small nut lengthens considerably and the bracts grow to large, stiff, coriaceous leaves (fig. 10e). When the fruit, on its peduncle, with the two bract leaves attached, separates from the plant, it rotates rapidly, drifting away in the wind, across the forest to some distance (RIDLEY, *l.c.* 92–93). Though the structure is most peculiar, its effect (for longer distances) must not be overrated as winds are scarce in the tropical rainforest, the apparatus is rather heavy, and as soon as it descends in the canopy it will come down, gradually, in a vertical line.

A third, very interesting dispersal class is represented by the capsular fruits of *Aquilaria* and *Gyrinops*, in which the seeds dangle from the apex of the fruit valves on filiform funicles, the glossy seeds having typically contrasting dark colours and possessing tails or other aril-like structures, probably of a pale colour, as is also found in *Gonystyloideae* (fig. 1 and 22). This structure is doubtless a curious adaptation to zoochorous dispersal, but unfortunately no observations have as yet revealed more exact data on its functioning.

Galls. DOCTERS VAN LEEUWEN (Zoocec. N.I. 1926, 397, f.735) recorded a leaf-gall caused by a gall-midge in *Phaleria laurifolia* (= *P. octandra*). The leaves bear spherical galls, 2–3 mm in diam.

Heteromorphous flowers. The flowers are heteromorphous in *Phaleria macrocarpa.* Two kinds of flowers are commonly found on different plants of that species, *viz* possessing exserted stamens and a short style and short stamens and an exserted style.

There is a sheet in Leyden Herbarium identified as "*Phaleria neumanni* F. v. M." collected by W. DUNN *s.n.* (in Nov. 1909) at Acacia D'K, New South Wales, which has three separate branchlets with similar vegetative parts and two forms of flowers just like the above-mentioned case. It is not clear whether they were collected from the same plant.

Wood-anatomy. DEN BERGER, Determinatietabel houtsoorten van Malesië, Veenman, Wageningen (1949) 20 (*Aquilaria*); DESCH, Mal. For. Rec. 15² (1954) 607; LÉANDRI, Ann. Sc. Nat. Bot. X, 12 (1930) 125 (hand lens); METCALFE & CHALK, Anat. Dic. 2 (1950) 1169 & 1178; MOLL & JANSSONIUS, Mikr. Holzes 5 (1934) 413.—By JANSSONIUS *l.c.* *Gonystylus* is referred to the *Thymelaeaceae*, mainly because of the characteristics shown by the pit pairs; METCALFE & CHALK *l.c.*, although recognizing common features, are treating *Gonystylaceae* as a separate family.—C.A.R.–G.

Morphology. In order to avoid confusion, it is advisable to give a concise explanation of some terms which are used in the descriptions of this revision. These terms serve for convenience of descriptive purpose.

Floral tube.—The vascular bundles going to the ovary are clearly different from those of the tube above the pedicel; the tube contains the vascular bundles of the outer whorls, it is 'appendicular' and not 'axile' in origin. Therefore, the tube is not an invaginated receptacle (*fide* LÉANDRI, Ann. Sc. Nat. Bot. X, 12, 1930, 235). Miss HEINIG (Am. J. Bot. 38, 1951, 125) confirmed the 'appendicular' origin of the tube which is composed of the fused bases of the sepals and adherent filaments. In the following I have called the tubular part of the flower the 'floral tube' and its lobes 'calyx lobes'.

Petaloid appendages.—In some genera there are petal-like structures, situated either at the throat or on the receptacle surrounding the ovary. In this treatment, they have been designated as 'petaloid appendages'. Miss HEINIG suggested (*l.c.* 127) them to represent special enations of the sepals.

Disk.—In some genera and species there is a cup-shaped or free, thin structure at the base of the ovary, which has here been designated as 'disk'. According to Miss HEINIG (*l.c.* 128) this structure is probably a part of the androecium.

Chalazal fold.—A mature seed-coat is formed by the outer integument and the inner integument; the latter is composed of a sclerenchymatous layer and a reticular layer (*cf.* GUÉRIN, Ann. Jard. Bot. Btzg 29, 1916, 29).

In all the seeds (at least in Malaysia) there is, at the basal part or chalazal end, either a caruncle-like thickening (in most of the genera) or a tail-like appendage (in some species of *Aquilarioideae*). The formation of the tail-like appendage has been interpreted in different ways. GILG (in E. & P. Pfl. Fam.III, 6a, 1894, 223) assumes it to be the downward elongation of the integument. LECOMTE (Bull. Soc. Bot. Fr. 61, 1914, 414–418) accepted it as the elongation of the lower part of the ovule. DOMKE (Bibl. Bot.111, 1934, 37, t.V, f.43a–h) believed it to be formed by a more or less deeply transverse fold of the testa and designated it as "chalazal fold". However, the ontogeny of this appendage has not been well understood and further morphological and anatomical studies are needed.

Albumen.—Endosperm is found in most of the seeds although it is often a very thin layer, predominantly found on the dorsal surface of the cotyledons; it is very abundant in the seeds of *Pimelea* (*cf.* GUÉRIN, Ann. Jard. Bot. Btzg 29, 1916, 31–32, t.4). The absence of endosperm is rather rare (some *Phalerias*).

Cytology. As far as is known a basic number of chromosomes in the family seems to be $n = 9$, which is found in *Wikstroemia*, *Gnidia*, and *Daphne*; *Edgeworthia* has $n = 18$. In *Wikstroemia indica* FAGERLIND found also an apomictic triploid $2n = 27$ (Hereditas 26, 1940, 1–50).

Taxonomy. *Subdivisions*.—According to DOMKE (Bibl. Bot. 111, 1934, 103–104) the family is subdivided into 4 subfamilies, *viz Gonystyloideae*, *Aquilarioideae*, *Gilgiodaphnoideae*, and *Thymelaeoideae*. With the exception of *Gilgiodaphnoideae*, the other three subfamilies all have some representatives in Malaysia.

The 3 genera of *trib. Aquilarioideae–Microsemmatidae*, all endemic in New Caledonia, seem to be more closely related to *subfam. Gonystyloideae* than their arrangement in two distinct subfamilies would suggest; they lack the pellucid dots and the petaloid appendages of the latter. But *Solmsia* has the typical parallel nervation, venation, and leaf texture as in *Gonystylus*, and the nervation and texture of the leaves of *Microsemma* and *Deltaria* is resembling that of *Amyxa*. Furthermore, the macroscopical structure of the bast fibers in the three genera of *Microsemmatidae* resembles that of *Gonystyloideae* and is not so fine as in typical *Aquilarioideae*. Finally, the fruit in *Aquilarioideae* is 2-celled, against 3– or more-celled in both *Microsemmatidae* and *Gonystyloideae*.

1. *Subfam.* **Gonystyloideae** has been treated in this Flora (I, 4, 1953, 349–365) by AIRY SHAW.

Leaves mostly pellucid-punctate. *Flowers* with a short or inconspicuous tube. *Petaloid appendages* 7–40, deltoid to linear-subulate, rarely joined into a low, entire annulus, inserted at the base of the floral tube. Disk 0. *Stamens* 8–80; filaments free. *Ovary* (2–)3–5(–8)-celled. *Fruit* a capsule. *Seeds* without chalazal fold, usually with aril. Endosperm 0. (*Gonystylus*, *Amyxa*, and *Aëtoxylon*.)

2. *Subfam.* **Aquilarioideae.** *Leaves* not pellucid-punctate. *Flowers* with a short to cylindric tube or sepals free. *Petaloid appendages* scale-like, free or rarely united, inserted at the throat of the tube or slightly below it or none. *Stamens* (in the Mal. *spp.*) at most 10, diplostemonous or haplostemonous; filaments (in Mal. *spp.*) partly or entirely adnate to the tube. Disk 0, or ring-shaped. *Ovary* (in Mal. *spp.*) 2-celled. *Fruit* a capsule. *Seeds* usually with a conspicuous chalazal fold, and a thin funicle, without aril. Endosperm 0, or present. (*Aquilaria* and *Gyrinops*.)

3. *Subfam.* **Thymelaeoideae.** *Leaves* not pellucid-punctate. *Floral tube* funnel-shaped or cylindric.

Petaloid appendages obscure and ridge-like or represented by scales. *Stamens* at most 10, usually diplostemonous, rarely haplostemonous or hemistemonous; filaments partly or entirely adnate to the tube. *Ovary* 1–2-celled. *Fruit* a drupe or drupaceous. *Seeds* mostly without or rarely with a small chalazal fold. Endosperm 0, or present. (*Linostoma*, *Enkleia*, *Phaleria*, *Wikstroemia*, *Daphne*, *Drapetes*, and *Pimelea*.)

Generic delimitation in Thymelaeaceae proves sometimes to be very difficult on account of the fact that though the majority of the species of one genus might be distinguished from those of another genus by two or even more good characters, there are frequently one or two species – or even different specimens of one species – which form an exception and are transitional in all but one character. Consequently such genera are then sharply separated by one character only, which is an unsatisfactory situation. For instance in *Phaleria* the petaloid appendages are rim-like, but they are distinct in *P. pentecostalis* LÉANDRI. In *Aquilaria* the opposed case occurs, *viz* that they are distinct in all species except in *A. urdanetensis* where they are rim-like. In *Aquilaria* the anthers are always free from the tube except in *A. cumingiana* where they are partly adnate to the tube in part of the specimens! Also in *Aquilaria* the petaloid appendages are free except in part of the specimens of *A. cumingiana*; the same phenomenon is observed in *Gyrinops* where they are free, but in *G. moluccana* and *G. decipiens* they are usually united.

Dr B. PETERSON, Lund, who is working on the African *Thymelaeaceae*, told us of similar difficulties encountered in defining genera in that area. He wrote (May 1959): "I have devoted much time to generic delimitation in this family. As I have examined more and more African material (*c.* 15.000 sheets) I have found that the limits are in some cases so vague that it has appeared unavoidable to merge several genera. It is often rather easy to give a specific epithet but very difficult to come to a decision of the generic name. For example the only generic characters in *Gnidia*, *Lasiosiphon*, and *Arthrosolen*, and some smaller genera, are the number of calyx lobes and the presence or absence of petaloid appendages. And these are not at all enough to keep these genera separate. Sometimes these characters do not even hold for the type species. GILG and later STANER proposed that these genera should be united but other botanists have not followed their suggestions. In my monograph of *Gnidia* I will merge seven genera."

Aquilaria and *Gyrinops* seem to be very closely allied, the first being diplostemonous, the second haplostemonous, which is the only constant character. HALLIER *f.* found this difference not sufficient for generic distinction and united these genera. Dr PETERSON found in Africa a similar case, *viz* between *Gnidia* and *Struthiola* of which the first is diplostemonous, the second haplostemonous. He "never found any trace of staminodes in *Struthiola*. In some species of *Gnidia*, however, usually, but not always, the upper whorl of stamens is abortive. All species of *Struthiola* have a whorl of hair round each petaloid appendage. This arrangement is not found in *Gnidia* except for a single species as far as I have found. This will be placed in a separate section."

In Dr PETERSON's opinion *Struthiola* and *Gnidia*, though properly only distinguished 'absolutely' by one character, should not be united; if that were done, the consequence would be that still more genera had to be merged in the complex which would lead to an unsatisfactory situation. In this revision I have not followed HALLIER *f.* in uniting *Aquilaria* and *Gyrinops*.

The difference between *Wikstroemia* and *Daphne* seems, by being merely vegetative, still more feeble, the chief distinction being the opposite phyllotaxis in *Wikstroemia*, notwithstanding the note by STAPF (Bot. Mag. 156, 1933, *sub* t. 9313, p. 2). If it is realized that the phyllotaxis varies widely within the single genus *Pimelea*, it is tempting to merge *Wikstroemia* and *Daphne*.

The merging of *Aquilaria* and *Gyrinops* and of *Daphne* and *Wikstroemia* might give a better reflection of the natural affinities, as the single character separating the components of these pairs effects, in my opinion, not a natural segregation.

Specific delimitation in Thymelaeaceae is in many cases also extremely difficult, specially because it has appeared that characters not only vary within a single species, but also within the flowers of one single specimen, as for example the shape of the disk in *Wikstroemia aurantiaca* (*cf.* STAPF, *l.c.*). I have encountered several similar cases in other species and Dr PETERSON communicated to have a similar experience with African representatives which has led him to a severe reduction of accepted species.

Specific delimitation in Malaysia proved particularly difficult in *Wikstroemia* and *Phaleria*; for *W. indica* I have accepted much wider specific limits than my predecessors.

Affinities with other families.—For a detailed review and discussion of the relationship of *Thymelaeaceae* and other families, one should consult the works of DOMKE (Bibl. Bot. 111, 1934, 1–3, 16) and HEINIG (Am. J. Bot. 38, 1951, 113 & 131).

According to Miss HEINIG's studies on the floral morphology the polypetalous and polystemonous condition of the primitive members of the *Thymelaeaceae* and the modified parietal placentation suggest a derivation from some polymerous parietalean family such as, possibly, the *Flacourtiaceae*; there seems also a possible relationship with the *Tiliaceae*.

ERDTMAN (Pollen Morph. & Pl. Tax. 1952, 43) stated that there is a more or less close relationship between *Thymelaeaceae* and *Euphorbiaceae*, especially the crotonoid members of the latter.

Uses. The heartwood of some species of *Aquilaria* and *Gonystylus* contains aromatic substances and is used as incense (*cf.* BURK. Dict. 2, 1935, 197–205). The scented portions are only found in irregular small parts of the heartwood and are obviously caused by some abnormality (infection by fungi or insects?) and they occur not in all trees. SCHUITEMAKER described the occurrence of scented thymelaeaceous wood in West Borneo and the ceremonials connected with the collecting of it (Tectona 26, 1933, 851–892, fig. 1–6). The strong barks of some species are used for weaving, walls of huts, paper-making, and tying purpose. Wood of *Gonystylus bancanus* is used for internal building construction; it is one of the most important timber exports of Sarawak and Brunei.

Note. Sterile material has a limited value and can sometimes hardly be identified even to the genus with certainty, *viz* in *Aquilaria–Gyrinops* and *Phaleria–Wikstroemia*. Flowering or fruiting material is essential for identification.

I am indebted to Dr J. LÉANDRI for putting his valuable manuscript notes at my disposal.

KEY TO THE GENERA

Based on flowering and fruiting material[1]

1. Leaves not pellucid-dotted. Stamens and petaloid appendages adnate to or inserted on the floral tube. Fruits 1–2-celled.
 2. Ligneous, perennial. Inflorescences without involucral bracts, or (in *Phaleria* and *Daphne composita*) with free ones. Stamens 4 or more.
  3. Stamens twice the number of the calyx lobes.
   4. Fruit a loculicidal capsule. Petaloid appendages usually distinct and always densely pubescent or puberulous . . . . **1. Aquilaria**
   4. Fruit a drupe or drupaceous. Petaloid appendages if present always glabrous.
    5. Ovary 2-celled (rarely one cell abortive in *Phaleria perrottetiana*). Fruits (1–)2-seeded. (Petaloid appendages none, or obscure and rim-like.) . . . . **2. Phaleria**
    5. Ovary always 1-celled. Fruits 1-seeded.
     6. Usually climbing shrubs. Inflorescences usually provided with 2 leafy bracts on each branch. Petaloid appendages well developed. Ovary densely pubescent.
      7. Stamens in two series. Style obscure or shorter than the ovary . . . . **3. Enkleia**
      7. Stamens in one series. Style several times as long as the ovary . . . . **4. Linostoma**
     6. Erect shrubs. Inflorescences without leafy bracts. Petaloid appendages none. Ovary glabrous or only hairy at the top.
      8. Leaves opposite. Disk lobed, scale-like, lobes free or united in pairs . **5. Wikstroemia**
      8. Leaves alternate. Disk ring-like or cup-shaped . . . . **6. Daphne**
  3. Stamens the same number as the calyx lobes.
   9. Shrubs or trees. Leaves ovate-oblong to lanceolate, 1½–24 by (⅓–)1–3 cm. Ovary densely hairy, 2-celled; style terminal. Fruit a loculicidal capsule, protruding either from the top or from the split side of the floral tube . . . . **7. Gyrinops**
   9. Dwarf-shrub. Leaves linear, 3–5 by ⅔ mm. Ovary hairy at the upper half or only at the top, 1-celled; style lateral. Fruit a drupe, developing inside the floral tube . . . **8. Drapetes**
 2. Annual herbs. Inflorescences with 4, partly united involucral bracts. Stamens 2 . **9. Pimelea**
1. Leaves pellucid-dotted. Stamens free. Petaloid appendages inserted on the receptacle. Fruits 3–5 (–8)-celled.
 10. Leaves decussate, sometimes some subopposite; nervation lax and open. Flowers subumbellate. Calyx lobes valvate. Petaloid appendages fused in a ring. See vol. 4, p. 365 . **11. Aëtoxylon**
 10. Leaves spiral or alternate. Inflorescences thyrsoid or racemose. Calyx lobes imbricate or subvalvate. Petaloid appendages 7–40.
  11. Leaves with few, spaced nerves. Petaloid appendages 10, more or less in pairs. Parastyles subulate-corniform. Fruits long-beaked. See vol. 4, p. 363 and this vol. p. 47 . . . **10. Amyxa**
  11. Leaves with numerous parallel nerves, veins distinctly prominent. Petaloid appendages 7–40, not in approximate pairs. Parastyles if present very small and clavate. Fruits not beaked. See vol. 4, p. 350. . . . . **12. Gonystylus**

KEY TO THE GENERA

Based on sterile material

1. Leaves not pellucid-dotted.
 2. Ligneous, perennial plants.
  3. Leaves at least 15 mm long, penninerved, not linear, at least 1 mm petioled. Lowland or montane shrubs or trees.
   4. Lateral nerves and intermediate veins more or less parallel.
    5. Leaves alternate or spiral. Erect shrubs or trees . . . . . **1. Aquilaria & 7. Gyrinops**
    5. Leaves opposite, rarely also with some subopposite ones. Liana, very rarely erect shrubs or small trees . . . . **4. Linostoma**
   4. Lateral nerves curved, intermediate veins reticulate or cross-bar like (*Enkleia*).
    6. Leaves strictly opposite or decussate . . . . **2. Phaleria & 5. Wikstroemia**
    6. Leaves alternate or spiral, or at least *not all strictly* opposite.

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(1) In some genera the floral characters can usually easily be studied in the fruiting state as the floral parts are generally persistent.

7. Liana, often provided with hooks. Cross-bar veins subparallel . . . . . **3. Enkleia**
7. Erect shrub or small tree. Venation reticulate . . . . **6. Daphne**
3. Leaves small (3–5 by ⅔ mm), with 7–9 more or less parallel, longitudinal nerves, sessile, linear. Subalpine dwarf-shrub . . . . **8. Drapetes**
2. Annual herbs . . . . **9. Pimelea**
1. Leaves pellucid-dotted.
8. Leaves opposite or subopposite. See vol. 4, p. 365 . . . . **11. Aëtoxylon**
8. Leaves alternate or spiral.
9. Leaves with few, spaced nerves, veins rather obscure. See vol. 4, p. 363 and this vol. p. 47 **10. Amyxa**
9. Leaves with numerous more or less parallel nerves, veins distinctly prominent. See vol. 4, p. 350. **12. Gonystylus**

1. AQUILARIA

LAMK, Encycl. 1 (1783) 49, *nom. gen. conserv.; ibid.* 2 (1786) 610; DOMKE, Bibl. Bot. 111 (1934) 118, map 2; QUIS. J. Arn. Arb. 27 (1946) 402.—*Agallochum* RUMPH. *ex* LAMK, Encycl. 1 (1783) 48, *nom. gen. rejic.*—*Ophispermum* LOUR. Fl. Coch. 1 (1790) 281.—*Gyrinopsis* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 41; QUIS. J. Arn. Arb. 27 (1946) 404.—*Decaisnella* O.K. Rev. Gen. Pl. 2 (1891) 584.—*Aquilariella* VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 216; Bull. Soc. Bot. Fr. 40 (1893) 77.—*Aquilaria sect. Agallochum* HALLIER *f.* Med. Rijksherb. *n.* 44 (1922) 15.—*Aquilaria sect. Gyrinopsis* HALLIER *f. l.c.* 16.—*Aquilaria sect. Amphinoman* HALLIER *f. l.c.* 18.—**Fig. 1.**

Shrubs, treelets or trees. Innovations always pubescent but usually glabrescent. *Leaves* on the lateral twigs alternate, penninerved; nerves distinct or obscure, simple or sometimes branched, usually slightly curved, ascending towards the margins and joining several intramarginal veins; veins and veinlets numerous, parallel or subparallel; margins wavy, slightly recurved and thickened. *Inflorescences* axillary or supra-axillary, sometimes on internodes, terminal, or rarely cauliflorous, sessile or short-peduncled, simple or rarely branched, umbelliform or paniculiform, usually without bracts, rarely with a few small ones. *Flowers* usually 5-merous, pedicelled, articulated at the base of the pedicel. Floral tube cupular to tubular, persistent, in fruit sometimes splitting on one side, outside puberulous or pubescent, inside puberulous with reflexed hairs arranged in lengthwise lines towards the upper part. Calyx lobes (4–)5(–6), reflexed or erect, usually shorter than or rarely as long as the tube. *Petaloid appendages* twice as many as the lobes, free, or united in a ring (*A. cumingiana*), inserted at the throat of the tube, lanceolate, ovate, semi-orbicular, or rim-like (*A. urdanetensis*), each pair opposite the calyx lobe, usually densely pubescent or puberulous. *Stamens* twice as many as calyx lobes, emerging from the tube at the same level as the appendages, rarely emerging slightly below them, sometimes behind them, sessile or filamentous, equal in length or sepalous ones longer than the others; filaments filiform, sometimes slightly swollen at the upper end; anthers linear-oblong, dorsifixed, free (but in *A. cumingiana* the lower ⅓–½ adnate to the tube); connective broad over the whole length of the anther. Disk none or rarely ring-like. Pistil included. *Ovary* sessile or stiped, ovoid, oblanceolate or ellipsoid, densely short-puberulous, 2-celled (or incompletely 2-celled in extra-Mal. *spp.*); style terminal, obscure or distinct, gradually dilated to the ovary, densely puberulous towards the base; stigma distinct, globose, capitate, pyramidal, or oblong, black. Ovule attached near the top of the septum and partly adnate to it. *Fruit* a loculicidal capsule, globose, obovoid, or oblanceolate, rugose or smooth,

Fig. 1. *Aquilaria beccariana* VAN TIEGH. *a.* Habit, × ⅔, *b.* opened flower, two anthers removed, × 3, *c.* dehiscing fruit emerging from top of floral tube with one seed dangling out, nat. size.—*A. brachyantha* (MERR.) HALL. *f. d.* Opened flower, × 3.—*A. hirta* RIDL. *e.* Opened flower, × 3, *f.* dehisced fruit, nat. size.—*A. microcarpa* BAILL. *g.* Dehisced fruit, nat. size.—*A. malaccensis* LAMK. *h.* Dehisced fruit, nat. size.—*A. cumingiana* (DECNE) RIDL. *i.* Dehisced fruit emerging from lateral slit of floral tube, one seed dangling out, nat. size (*a–b* SAN A 1726, *c* SF 29381, *d* FB 19562, *e* BÜNNEMEYER 7575, *f* CUMING 1617, *g* SAN 16965).

sometimes slightly compressed laterally, protruding either from the top or from the split side of the floral tube, distinctly stalked, densely puberulous to glabrous; pericarp coriaceous or woody. *Seeds* 2, or 1 by abortion, ovoid or ellipsoid; testa crustaceous, sometimes downy, bearing a caruncle-like or tail-shaped appendage at the base; usually the whole seed and sometimes a portion of the appendage is laterally adnate to the septum, with an obscure or a distinct funicle; in the latter case the seeds dangle out of the fruit on the end of the thin funicle in open capsules; albumen none or scant; cotyledons thick, plano-convex.

Distr. About 15 *spp.*, India (Bengal and Assam), Burma (Tenasserim), Indo-China (Cambodia, Annam, and Cochinchina), China (Hongkong and Hainan), and widely distributed in *Malaysia.*

Ecol. In forests at low and medium altitudes, some species occurring from 1000–1700 m.

KEY TO THE SPECIES

1. Flowers cupular or bell-shaped, 4–6 mm long, the lobes usually as long as the tube. Stamens distinctly filamentous, filaments of the episepalous ones at least as long and usually longer than the anthers.
2. Calyx lobes reflexed in anthesis. Ovary densely pubescent; style absent or obscure.
3. Fruits obovoid, 3–4 by 2½ cm. Seed with a tail-like, slightly twisted and pubescent appendage *c.* 10 mm long. Episepalous stamens longer than the petaloid appendages . **1. A. malaccensis**
3. Fruits slightly obcordate, ¾–1½ by 1–1½ cm. Seed with a caruncle-like, glabrous appendage *c.* 2 mm long. Episepalous stamens usually shorter or as long as the petaloid appendages. **2. A. microcarpa**
2. Calyx lobes always erect. Ovary slightly pubescent; style distinct, filiform and almost as long as the ovary . . . . **3. A. brachyantha**
1. Flowers short-tubular to cylindric, (5–6–)7–15 mm long, the lobes usually $^1/_2$–$^1/_5$ the length of the tube. Stamens sessile or subsessile, filaments rarely up to ½ as long as the anthers, in *A. urdanetensis* the episepalous ones as long as the anthers.
4. Calyx lobes *c.* ½ the length of the tube. Seed with a short caruncle-like appendage at the base.
5. Petaloid appendages obscure, rim-like. Filaments of the episepalous stamens sometimes as long as the anthers. Style distinct. (Fruits globose, contracted at the base into a distinct stalk.) **4. A. urdanetensis**
5. Petaloid appendages distinct, semiorbicular or ovate to oblong, ⅓–½ as long as the anthers. Stamens sessile or subsessile. Style absent or very short.
6. Flowers 8–10 mm long, densely pubescent outside. Ovary slightly obovate-oblong, truncate at the apex, densely covered with a layer of densely set, reflexed, short hairs mixed with some appressed, straight, long hairs. Stigma pyramidal, sessile. Leaves densely pubescent beneath. **5. A. citrinaecarpa**
6. Flowers 5–6 mm long, sparsely puberulous or glabrous outside. Ovary slightly elliptic-oblong, gradually narrowed towards the top, covered only with densely set, appressed, straight long hairs. Stigma capitate or globose, on a very short style. Leaves slightly pubescent, glabrescent, or glabrous beneath, very rarely densely pubescent.
7. Fruit with a distinct stipe as long as or longer than the floral tube. Floral tube usually not splitting in fruit. Pedicels at least as long as the flowers. . . . . **6. A. apiculata**
7. Fruit sessile or on a short stipe (*c.* 2–3 mm), not longer than the floral tube. Floral tube in fruit splitting on one side. Pedicels usually shorter than the flowers.
8. Fruits slightly obovoid or broadly ellipsoid, gradually narrowed to the base, sessile or sometimes with a very short stipe. Floral tube in fruit sometimes transversely curved and calyx lobes usually reflexed. Leaves 10–20 by 3–5½ cm, the nerves scarcely distinguishable from the intermediate veins . . . . **7. A. filaria**
8. Fruits globose, contracted at the base into a short, slender stipe. Floral tube usually flat in fruit and lobes erect. Leaves 4½–15 by 1–4½ cm, nerves 7–12 pairs, distinct from the intermediate veins . . . . **8. A. parvifolia**
4. Calyx lobes $^1/_3$–$^1/_5$ the length of the tube, *c.* $^2/_5$–$^1/_3$ in *A. beccariana.* Seeds with an elongated or tail-like appendage (except in *A. cumingiana*).
9. Fruits oblanceolate, 2–3½ by 1–1¾ cm, attenuate to the base and narrowed into a stipe which is usually longer than the floral tube. Seeds ovoid or ellipsoid-oblong, brownish hairy or puberulous, with a tail-like appendage. Petaloid appendages free and inserted at the same level as the stamens. Anthers free from the floral tube.
10. Undersurface of the leaves and the fruits densely pubescent. Leaves acute. Petaloid appendages deltoid, ⅓–½ the length of the anther, long-hairy, the hairs as long as the appendages or longer. Seeds cuneate to the base and attached to a glabrous, elongate appendage *c.* 10 mm long. **9. A. hirta**
10. Lower surface of the leaves and the fruits sparsely pubescent, glabrescent, or glabrous. Leaves acuminate.
11. Seeds narrowed to the base and elongated into a long (*c.* 15 mm), glabrous or subglabrous appendage. Petaloid appendages unknown . . . . **10. A. rostrata**
11. Seeds narrowed to the base and separated from the tail-like, hairy appendage *c.* 10 mm long by a short, thin stipe-like constriction. Petaloid appendages oblong, almost as long as the stamens, shortly puberulous . . . . **11. A. beccariana**
9. Fruits subglobose, globose, slightly obovoid or ellipsoid, 1¾ by 1⅓ cm, contracted at the base, sessile or with an obscure stipe. Seeds broadly ovoid, planoconvex, glabrous, *c.* 1 by ¾ cm, with a small caruncle-like appendage. Petaloid appendages short, usually united in a ring. Lower ⅓–½ of the anthers usually adnate to the floral tube . . . . **12. A. cumingiana**

1. Aquilaria malaccensis LAMK, Encycl. 1 (1783) 49, t. 356; DC. Prod. 2 (1825) 59; MEISN. in DC. Prod. 14 (1857) 602, *excl.* citat. of BENTH.; MIQ. Fl. Ind. Bat. 1, 1 (1858) 883; KURZ, Nat. Tijd. N.I. 27 (1864) 171; For. Fl. Burm. 2 (1877) 236; RIDL. Trans. Linn. Soc. Lond. II, 3 Bot. (1893) 341; GILG, Bot. Jahrb. 18 (1894) 506, f. 8, B; *ibid.* 28 (1900) 145; BOERL. Handl. 3 (1900) 112; RIDL. J. Str. Br. R. As. Soc. *n.* 35 (1901) 73; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 264; KOORD. Exk. Fl. Java 2 (1912) 656 (erron. record); MERR. Philip. J. Sc. 10 (1915) Bot. 44; Int. Rumph. (1917) 381; BROWN, Minor Prod. Philip. Forests 1 (1920) 403; MERR. En. Born. (1921) 417; HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 16; MERR. En. Philip. 3 (1923) 130; RIDL. Fl. Mal. Pen. 3 (1924) 147; BURK. & HENDERS. Gard. Bull. S.S. 3 (1925) 417; HEYNE, Nutt. Pl. ed. 2 (1927) 1149; HENDERS. Gard. Bull. S.S. 4 (1928) 314; METCALFE, Kew Bull. (1933) 5; CORNER, Ways. Trees (1940) 632; QUIS. J. Arn. Arb. 27 (1946) 403; MERR. J. Arn. Arb. 31 (1950) 270.—*Agallochum secundarium coinamense* & *A. malaicense* RUMPH. Herb. Amb. 2 (1741) 34–35, t. 10.—*A. ovata* CAV. Diss. (1789) 377, t. 224.—*A. secundaria* DC. Prod. 2 (1825) 59; MIQ. Fl. Ind. Bat. 1, 1 (1858) 883; BOERL. Handl. 3 (1900) 112.—*Agallochum malaccense* O.K. Rev. Gen. Pl. 2 (1891) 583.—*Aquilariella malaccensis* VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 216; Bull. Soc. Bot. Fr. 40 (1893) 77.—**Fig. 1h.**

Tree up to 40 m by 60 cm. Bark smooth, whitish; branchlets slender, pale brown, pubescent, glabrescent. *Leaves* chartaceous, subcoriaceous, glabrous, sometimes pubescent beneath, glabrescent, shining on both surfaces, elliptic-oblong to oblong-lanceolate, 7½–12 by 2½–5½ cm; base acute, attenuate, or obtuse; apex acuminate, acumen up to 2 cm; nerves 12–16 pairs, rather irregular, often branched, curving upward, elevated beneath, plane or obscure above, veins distinct beneath, invisible above; petiole 4–6 mm. *Inflorescences* terminal, axillary or supra-axillary, sometimes on internodes, usually branched with 2 or 3 umbels and each with about 10 flowers, more rarely a simple umbel; peduncle or common peduncle 5–15 mm; pedicels slender, 3–6 mm. *Flowers* green or dirty-yellow, campanulate, 5–6 mm long, scattered puberulous outside. Floral tube nearly glabrous within, distinctly 10-ribbed. Calyx lobes ovate-oblong, 2–3 mm long, densely puberulous within, almost as long as the tube, reflexed. *Petaloid appendages* oblong or slightly ovate-oblong, *c.* 1 mm long, slightly incurved, densely pilose. *Stamens* 1¼–2 mm long, the episepalous ones longer than the others; anthers linear, obtuse, as long as or shorter than the filaments. *Ovary* ovoid, 1–1½ mm long, densely pubescent; style obscure; stigma capitate. *Fruits* obovoid or obovoid-oblong, rounded at the apex, cuneate to the base, 3–4 by 2½ cm, usually compressed, pubescent outside, glabrescent; pericarp woody, the suture face *c.* 6 mm wide. *Seed* proper ovoid, including the beak 10 by 6 mm, densely covered with red hairs, the beak *c.* 4 mm long, the appendage twisted and as long as the seed, separated from it by a short, thin, stipe-like constriction.

Distr. India (Bengal and Assam), Burma (Tenasserim), and *Malaysia:* Sumatra (Simalur, Sibolangit, Palembang, and Banka), Malay Peninsula (common), N. & E. Borneo, and the Philippines (Luzon).

Ecol. Primary forests at low and medium altitudes up to 270 m.

Uses. According to HEYNE, *l.c.* and RIDLEY (1901, *l.c.*) the tree yields a celebrated incense wood which is obtained from the center of an old or dying tree. It is said to be caused by a disease which gains entry through the old decaying branches. Its greatest use has always been for fumigating and it is highly valued in the Orient for ceremonial purposes. It also furnishes a beautiful, silvery bast used for making ropes and clothes. The bast is highly prized for its strength and durability.

Vern. *Calambac, ching karas, gaharu, galoop, garu, karas, kayu gaharu, kĕkaras, kĕpang, laroo, mĕngkaras, tabak, taras gharu, tĕngkaras,* M, *sigsigi,* Borneo; Sumatra: *alim,* Batak, *halim,* Lamp., *karèh,* Minangk.; *Malayan eaglewood tree,* E.

Note. The vegetative parts of this species are similar to those of *A. microcarpa* in the herbarium, and I cannot find any good character to separate them.

2. Aquilaria microcarpa BAILL. Adansonia 11 (1875) 304; GILG, Bot. Jahrb. 28 (1900) 145; MERR. En. Born. (1921) 417; DOMKE, Bibl. Bot. 111 (1934) t. 4 f. 43f; QUIS. J. Arn. Arb. 27 (1946) 403.—*Aquilariella microcarpa* VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 216; Bull. Soc. Bot. Fr. 40 (1893) 77.—*Aquilariella borneensis* VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 217; Bull. Soc. Bot. Fr. 40 (1893) 77.—*A. borneensis* GILG in E. & P. Pfl. Fam. III, 6a (1894) 224; BOERL. Handl. 3 (1900) 112; MERR. En. Born. (1921) 417.—**Fig. 1g.**

Tree up to 40 m by 80 cm. Bark grey, superficially fissured; branchlets light brown, puberulous, glabrescent. *Leaves* subcoriaceous, shining and glabrous above, rather dull, glabrous or sometimes scattered hairy beneath, elliptic-oblong to obovate-oblong or oblanceolate, 4½–10 by 1½–4½ cm; base cuneate to attenuate; apex acute to acuminate, the acumen up to 1 cm; nerves 12–19 pairs, sometimes branched, slightly curved and ascending to the thickened margin, prominent beneath, visible above; veins and veinlets rather irregular, subparallel, distinct beneath, obscure above; petiole 3–5 mm, pubescent. *Inflorescences* axillary or supra-axillary, terminal, or on short lateral branchlets, usually branched, rarely simple, peduncle short or up to 1 cm, 6–11-flowered. *Flowers* white, light-yellow or yellow, 5 mm long; pedicels *c.* 5 mm, puberulous. Floral tube puberulous outside, sparsely puberulous inside. Calyx lobes ovate or oblong, obtuse, densely puberulous on both surfaces. *Petaloid appendages* almost as long as the stamens or sometimes slightly longer, ovate or oblong, densely hairy. *Stamens* 1–1½ mm, alternately long and short; anther *c.* ½ mm, usually shorter than the filament, rarely as long or longer. Pistil ovoid, 1½–2 mm long. *Ovary* densely pubescent; style obscure or rarely very short; stigma capitate. *Fruits* subcordate, slightly compressed, 8–12(–16) by 10–12(–15) mm, 1–(2–)seeded; persistent floral tube sometimes splitting on one side. *Seed* ovoid, 6 by 4 mm, densely brownish pubescent; caruncle-like appendage 2 mm long.

Distr. *Malaysia:* Malay Peninsula (Singapore), Sumatra (Sidjungdjung, Palembang, and Lampongs), Billiton, Banka, and throughout Borneo.

Ecol. Lowland forests up to 200 m.

Vern. Sumatra: *tĕngkaras*, M, *hepang*, Banka; Borneo: *ĕngkaras*, Dayak, *karas* or *sigi-sigi*, Bugis, *kumbil, garu, tulang*, M.

3. Aquilaria brachyantha (MERR.) HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 16; QUIS. J. Arn. Arb. 27 (1946) 403.—*Gyrinopsis brachyantha* MERR. Philip. J. Sc. 7 (1912) Bot. 313; ELM. Leafl. Philip. Bot. 5 (1913) 1629; MERR. En. Philip. 3 (1923) 130; DOMKE, Bibl. Bot. 111 (1934) t. 2, f. 8; t. 5, f. 43e. —**Fig. 1d.**

Small tree or shrub up to 2 m. Branchlets glabrous, yellowish brown to brownish when dry, the tips usually pubescent. *Leaves* chartaceous to subcoriaceous, shining on both surfaces, oblong, elliptic-oblong, or lanceolate, 8–16 by 2–4½ cm; base acute or obtuse; apex acuminate; nerves and veins numerous, homogeneous, slightly elevated beneath, obscure or invisible above; petiole *c.* 5 mm. *Flowers* greenish, small, axillary, 1 to several in a fascicle on a very short peduncle; pedicels 1–3 mm, pubescent. Floral tube campanulate, 3–4 mm long, pubescent or puberulous on both surfaces, usually glabrescent outside. Calyx lobes 5, slightly oblong or ovate-oblong, as long as the tube or sometimes slightly longer. *Petaloid appendages* linear or oblong, *c.* 1 mm long, densely pubescent. Stamens 1–1¼ mm long, filamentous, the episepalous ones slightly longer than the others. Ovary ovoid, *c.* 1½ mm long, slightly pubescent; style distinct, filiform, *c.* 1 mm; stigma capitate. *Fruits* narrowly obovoid, compressed, 1¼–1½ by ¾–1 cm. Seed including the caruncle-like appendage *c.* 1 cm long, pubescent, persistent floral tube splitting on one side.

Distr. *Malaysia:* Philippines (Luzon: Cagayan Prov.), twice collected.

Ecol. In primary forests at low altitudes.

4. Aquilaria urdanetensis (ELMER) HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 16.—*Gyrinopsis urdanetense* ELMER, Leafl. Philip. Bot. 5 (1913) 1630; MERR. En. Philip. 3 (1923) 131; QUIS. J. Arn. Arb. 27 (1946) 405.

Slender shrub, up to 7 m. Bark dull grey and smooth. Young branchlets whitish pubescent, glabrescent. *Leaves* chartaceous, shining on both surfaces, young leaves pubescent beneath especially on the nerves and veins, glabrescent, elliptic-oblong to broadly lanceolate, 4–9 by 1½–3¼ cm; base cuneate to attenuate; margins slightly thickened and shining on both surfaces; apex acuminate, the acumen up to 1 cm, pointed or obtuse at the tip; nerves and veins undistinguishable, numerous, divaricate, subparallel, some of them branched, distinct beneath, obsolete above; petiole 3–4 mm. *Inflorescences* axillary, sessile or very short peduncled, usually with a few, very small, caducous bracts, 2- or 3-flowered; pedicels *c.* 3½ mm, sparsely pubescent. *Flowers* short-tubular, 5–6 mm long, yellowish. Floral tube 3½–4 mm long, sparsely pubescent outside, pubescent towards the base and at the mouth inside. Calyx lobes 5(–6), ovate and obtuse, sparsely pubescent outside, densely puberulous inside, 1½–2 mm long. *Petaloid appendages* obscure, rim-like. *Stamens* free from the tube slightly below the petaloid appendages, ⅔–1½ mm, episepalous ones with a filament shorter than the anther or as long as it, the others sessile. Pistil *c.* 2 mm long. *Ovary* ellipsoid, densely puberulous, narrowed into a short style *c.* 1 mm; stigma nipple-like. *Fruits* globose or slightly obovate, glabrous when mature, *c.* 8 mm diam., with a slender stipe 3–6 mm; persistent floral tube splitting on one side. *Seed* ovoid, plano-convex, black, *c.* 1 cm long, with a short caruncle-like appendage.

Distr. *Malaysia:* Philippines (Mindanao: Mt Urdaneta), twice collected.

Ecol. In the mossy forest on exposed ridges, *c.* 1700 m (*cf.* MERR. *l.c.*).

Vern. *Mañgod, makolan*, Mbo.

Note. Known only from the authentic collections, ELMER 14195 (lectotype) and 13742 (paratype).

5. Aquilaria citrinaecarpa (ELMER) HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 18.—*Gyrinopsis citrinaecarpa* ELMER, Leafl. Philip. Bot. 5 (1913) 1631; MERR. En. Philip. 3 (1923) 130; QUIS. J. Arn. Arb. 27 (1946) 405.

Small tree up to 8 m. Young branches densely olivaceous tomentose, glabrescent. *Leaves* subcoriaceous, dull, olivaceous, and densely pubescent beneath, shining, reddish-brown, and glabrous above, elliptic-oblong, or slightly obovate-oblong, 6–10(–12) by 2½–4(–5½) cm; base cuneate; apex acute; margins slightly recurved; nerves 15–20 pairs, on the lower surface obscure, rarely distinct, slightly ascending towards the margin; veins and veinlets obscure or visible beneath, obscure above; petiole *c.* 3 mm. *Inflorescences* terminal and axillary, sessile or with a very short peduncle, densely hairy, usually with a few small bracts, 3–6-flowered; pedicels 2–4 mm, pubescent. *Flowers* 8–10 mm long, greenish. Floral tube cylindric, densely pubescent outside and towards the base inside. Calyx lobes oblong or ovate, 3–3½ mm long, densely puberulous on both surfaces. *Petaloid appendages* oblong or ovate, about ½ the length of the anthers, densely villose. *Stamens* sessile, 1½ mm long. Ovary slightly obovate-oblong, densely puberulous, *c.* 3 mm long, style none; stigma pyramidal, black. *Capsules* 1¾ by 1¼ cm, bright yellow or citrine, obtuse to subtruncate at the apex, attenuate to the base, sometimes slightly compressed, persistent floral tube splitting on one side. *Seeds* deltoid, 8 by 7 mm, plano-convex, acute to the apex, almost truncate at the base, with a very short caruncle-like appendage at the base.

Distr. *Malaysia:* Philippines (Mindanao), once collected.

Ecol. On moist, compact soil of forested ridges, *c.* 1300 m.

Vern. *Agododan*, Mbo.

6. Aquilaria apiculata MERR. Philip. J. Sc. 20 (1922) 411; En. Philip. 3 (1923) 130; QUIS. J. Arn. Arb. 27 (1946) 403.

Shrub or small tree up to 3 m. Branchlets reddish brown, pubescent, glabrescent. *Leaves* papery, glabrous above, sparsely or scattered pubescent beneath, elliptic-lanceolate, 8–14 by 2½–4 cm; base cuneate to attenuate; apex acuminate, the acumen up to 2 cm, tip obtuse; nerves 8–16 pairs, curved and ascending to the margin, prominent beneath, visible above; veins distinct, sometimes visible beneath, obscure above; petiole 3–5 mm. *Inflorescences* axillary, sessile or short-peduncled, usually with a few small bracts, 3–6-flowered; pedicels 6–7 mm, puberulous. *Flowers* 5–6 mm long. Floral tube short-tubular, 4–5 mm long, puberulous outside and inside, glabrescent. Calyx lobes ovate to oblong, 1½–2 mm long, densely puberulous on both surfaces. *Petaloid appendages* semi-orbicular to ovate, ⅓–½ the length of the stamens, hairy. *Stamens c.* 1 mm long, sessile or the episepalous ones on short filaments. *Ovary* slightly obovate, 3 mm long, densely pubescent, slightly attenuate towards the base, acute and narrowed towards the apex; style very short; stigma capitate. *Fruits* yellowish orange, ellipsoid, slightly compressed, developing on top of a slender ½–1 cm long stipe, protruding from the floral tube, 1⅔ by 1 cm; persistent floral tube entire or sometimes splitting at one side. *Seeds* ovoid, 8–9 by 6 mm, dark-brown, with a caruncle-like appendage *c.* 2 mm long.

Distr. *Malaysia:* Philippines (Mindanao: Bukidnon Prov.).

Ecol. In dry and mossy forests, 1100–1800 m.

7. Aquilaria filaria (OKEN) MERR. J. Arn. Arb. 31 (1950) 283, *excl. syn. Gyrinopsis brachyantha* MERR.—*Cortex filarius* RUMPH. Herb. Amb. 7 (1755) 13.—*Pittosporum ferrugineum var. β filarium* DC. Prod. 1 (1824) 347, *excl.* RUMPH. t. 7 *cit.*; DON, Gen. Hist. 1 (1831) 374.—*Pittosporum filarium* OKEN, Allg. Naturgesch. 3^2 (1841) 299.—*A. tomentosa* GILG, Bot. Jahrb. 28 (1900) 145.—*Gyrinopsis brachyantha* (*non* MERR. 1912) MERR. Int. Rumph. (1917) 380, *quoad specim.*—*Gyrinopsis acuminata* MERR. Philip. J. Sc. 17 (1920) 294; En. Philip. 3 (1923) 130.—*A. acuminata* QUIS. J. Arn. Arb. 27 (1946) 403.

Shrub or tree up to 17 m by 50 cm. Young branchlets light-brown, pubescent and glabrescent. *Leaves* subcoriaceous, glabrous or scattered hairy rarely pubescent beneath, oblong, elliptic-oblong to lanceolate, rarely oblanceolate-oblong, 10–20 by 3–5½ cm; base obtuse to cuneate; apex shortly acuminate; nerves and veins usually homogeneous, slightly elevated beneath, obscure above; petiole 3–5 mm. *Inflorescences* axillary and extra-axillary, umbelliform or condensed paniculiform, rarely cauliflorous, very short-peduncled, (1–)3–7 (–∞)-flowered; pedicels 2–5 mm, pubescent. *Flowers* yellowish-green or white, infundibular, 5–6½ mm long. Floral tube sparsely pubescent outside, glabrescent. Calyx lobes oblong to slightly ovate, *c.* 2 mm long, densely puberulous on the upper part and the margins outside, and the whole surface inside. *Petaloid appendages* oblong or deltoid, *c.* 1 mm long, densely villous. *Stamens c.* 1 mm long, the episepalous ones with short, fleshy filaments, the others sessile or subsessile. *Ovary* obovoid, *c.* 3¼ mm long, densely villous; style very short or obscure; stigma capitate. *Fruits* ellipsoid to obovoid or subglobose, slightly compressed, rugose, 1¼–1½ by 1¼ cm, sparsely hairy, glabrescent, narrowed to the base, sometimes on a very short stipe, yellow. *Seeds* deltoid, including the appendage *c.* ¾ by ¾ cm, plano-convex, black, with a very short caruncle-like appendage.

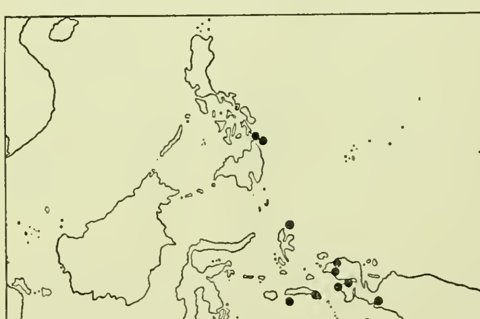

Fig. 2. Localities of *Aquilaria filaria* (OKEN) MERR.

Distr. *Malaysia:* Philippines (Dinagat I. and Bucas Grande I.), Moluccas (Morotai, Ceram, and Ambon), and New Guinea (Sorong, Babo, and Kapor). Fig. 2.

Ecol. In lowland forests, once collected in open swamp forest (Sorong: PLEYTE 393), up to 130 m.

Vern. *Agé*, Sorong, *bòkuin*, Morotai, *lason*, Ceram, *kasjik*, Tehid lang., *malowassi*, Uliassers.

Notes. In the description of *Cortex filarius* RUMPH. (Herb. Amb. 7, 1755, 13) RUMPHIUS recorded the bark with strong bast and the leaves with more or less parallel veins which agree with the characters of *Aquilaria*. He described the fruit as 2-celled; one of the cells being empty and filled with pulp, the other having two seeds. However, in *Aquilaria* the ovary is 2-celled and each has only one ovule. Based on the description, the common name 'Malowassi' and the usage, HEYNE (Nutt. Pl. 1927, p. 1151) identified it as a *Gyrinopsis sp.* (= *Aquilaria*).

MERRILL (Int. Rumph. 1917, 380) in interpreting RUMPHIUS' *Cortex filarius*, with the representing specimen (ROBINSON's Pl. Rumph. Amb. *n.* 274), referred it to *Gyrinopsis brachyantha* MERR. (= *Aquilaria brachyantha*). The leaves of these two species are very similar to each other. See also BAKKER (Fl. Mal. I, 5, 1957, 359–360).

J. SMITH initiated the error to combine the plate of *Cortex foetidus* RUMPH. (t. 7) with the description of *Cortex filarius* RUMPH. referring them both to *Pittosporum ferrugineum* (in REES, Cycl. 27 art. Pittosporum, 1814), although he remarked already that the "thready bark" ascribed to it by RUMPHIUS does not occur in *Pittosporum*. This error was continued by DE CANDOLLE, *l.c.*

In reviewing OKEN's work in 1950, MERRILL (J. Arn. Arb. 31, 1950, 283) pointed out that the description of *Pittosporum filarium* OKEN was wholly taken from RUMPHIUS' *Cortex filarius* and concluded that *Gyrinopsis brachyantha* MERR. should be added to the synonymy of *Aquilaria filaria* (OKEN) MERR.

On examining ROBINSON's specimen indicated above and another specimen collected by TEYSMANN (*s.n.*, BO) from Soja, Ambon, however, it appears that *A. filaria* is distinct from the Philippine *A. brachyantha*. *A. filaria* is characterized by calyx lobes about half the length of the tube, stamens sessile or very short-filamentous, ovary densely villous, and the style obscure, while *A. brachyantha* is characterized by calyx lobes about as long as the tube, stamens distinctly filamentous and the filaments as long as or longer than the anthers, ovary sparsely hairy, and the style distinct and as long as the ovary.

8. Aquilaria parvifolia (QUIS.) *nov. comb.*—*Gyrinopsis parvifolia* QUIS. J. Arn. Arb. 27 (1946) 405.

Shrub *c.* 1 m tall, branches light brown or reddish-brown. *Leaves* subcoriaceous, slightly pubescent beneath, glabrous above, elliptic-oblong, ovate-oblong, or lanceolate, 4½–15 by 1–4½ cm; base acute to cuneate; apex narrowly acute to acuminate; nerves 7–12 pairs, slightly curving upward, distinctly elevated beneath, slightly elevated above; veins distinct beneath, invisible above; petiole *c.* 5 mm, sparsely pubescent, glabrescent. *Infructescences* axillary, terminal, sometimes extra-axillary, umbelliform, short-peduncled, sometimes almost sessile, each with 1 to 4 fruits; pedicel *c.* 3 mm, puberulous. Persistent *flower* short-tubular, 5–6 mm long. Floral tube sparsely puberulous on both surfaces. Calyx lobes ovate or ovate-oblong, 1½–2 mm long, densely puberulous inside and on the margins and tips outside. *Petaloid appendages* orbicular or deltoid, *c.* ⅓–½ the length of the stamens, villous, the hairs slightly longer than the appendage. *Stamens* sessile, *c.* 1 mm long. *Fruits* slightly obovoid or globose, 1–1½ by 1–1¼ cm, yellowish, rugose when dry, constricted at the base into *c.* 2 mm long stipe. *Seeds* broadly ovoid, 8–9 by 6½–7 mm, dark-brown, smooth, shining, with an obscure caruncle-like appendage at the base.

Distr. *Malaysia:* Philippines (Luzon: B.S. 26876, 41562, 76441—type (A), WENZEL 1201).

Ecol. On forested slopes, 1000 m.

Note. Very closely related to *A. filaria*, but easily separated from the latter by the persistent floral tube with erect calyx lobes and the smaller leaves with distinct lateral nerves.

9. Aquilaria hirta RIDL. J. Str. Br. R. As. Soc. *n.* 35 (1901) 78; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 265; RIDL. Fl. Mal. Pen. 3 (1924) 148; DOMKE, Bibl. Bot. 111 (1934) t. 5 f. 43g.—*A. moszkowskii* GILG, Notizbl. Berl.-Dahl. 5 (1908) 84; QUIS. J. Arn. Arb. 27 (1946) 403.—**Fig. 1e–f.**

Tree up to 14 m with whitish and rather smooth bark. Young branchlets light brown, covered with silky hairs, glabrescent. *Leaves* subcoriaceous, dull and pubescent beneath especially on the midrib, nerves and veins, sometimes glabrescent, shining on the upper surface, elliptic-oblong, ovate-oblong, 6½–14 by 2½–5½ cm; base cuneate to obtuse or rounded; apex acuminate, the acumen up to 1½ cm, mucronate, pointed at the tip; nerves 16–30 pairs, irregular, sometimes branched, elevated beneath, visible to obsolete above, slightly curved upward and towards the margin; veins distinct or visible beneath, obscure or not visible above; petiole 5–7 mm, thickened, curved, pubescent. *Inflorescences* sessile or up to 10 mm peduncled, pubescent, 5–14-flowered; bracts small. *Flowers* white (*fide* Kep. 71521) or light yellow (*fide* BÜNNEMEIJER 7575), up to 2 cm pedicelled, pubescent. Floral tube cylindric 6–8 mm long, densely pubescent outside and towards the base inside, ribbed and sparsely villose within at the upper part. Calyx lobes ovate and obtuse, 2–3 mm long, densely pubescent outside and densely puberulous inside. *Petaloid appendages* inserted slightly behind the stamens, ovate or semi-orbicular, densely villous, almost as long as the stamens, sometimes even slightly longer. *Stamens* sessile, *c.* 1 mm long, oblong, connective dark-brown. Pistil clavate, 5 mm long; *ovary* densely puberulous; style absent; stigma capitate. *Fruits* protruding from the floral tube, oblanceolate, abruptly acute at the apex, attenuate to the base, including the stipe 3½–5 by 1 cm, densely golden puberulous; pericarp coriaceous. *Seeds* ovoid, 10 by 6 mm, puberulous, glabrescent, shortly beaked at the apex, cuneate at the base, black and shining, with a long glabrous appendage *c.* 10 mm long.

Distr. *Malaysia:* Malay Peninsula (Trengganu, Pahang, Johore, and Singapore; lectotype: MURTON 2, SING; paratypes: RIDLEY 3837, SING and RIDLEY 11020, K, SING), E. Sumatra (Senamaninik), Riouw, and Lingga.

Ecol. Hill slopes, from the lowland up to 300 m.

Vern. *Chandan, changang, kayu chandan, sahare,* M; Sumatra: *karas.*

Note. *A. moszkowskii* GILG was described on a sterile specimen collected by MOSZKOWSKI (12, B) at Senamaninik, eastern Sumatra. I have not seen the type, but the locality and GILG's detailed description agree very well with the present species, especially the silky hairs occurring on the underside of the leaf which is peculiar to this species.

10. Aquilaria rostrata RIDL. Fl. Mal. Pen. 3 (1924) 148.

Tree. Branchlets pubescent, glabrescent. *Leaves* subcoriaceous, glabrous, rather shining on both surfaces, lanceolate, rarely ovate-oblong, 6½–10 by 2½–4½ cm; base obtuse, cuneate to attenuate; apex acuminate, the acumen up to 1½ cm; nerves 16–many pairs, simple or rarely branched, spreading or slightly curved and ascending, elevated beneath and visible above; veins visible beneath and obscure above; petiole 3½–7 mm. Pedicels *c.* 3 mm, brownish hairy. *Floral tube* cylindric, 6 mm long, splitting on one side, glabrous outside, sparsely puberulous inside. Calyx lobes slightly oblong, *c.* 1½ mm long, puberulous on both surfaces. *Petaloid appendages* unknown. *Stamens* sessile. *Fruits* (young) obovate-oblong or oblanceolate, including the stipe 3 by ¾–1½ cm, brownish hairy outside, long-narrowed towards the base, apex beaked. *Seeds* slightly ellipsoid-oblong, 10 by 4 mm (*excl.* the appendage), brownish, puberulous, acuminate, base attenuate and elongate into a slender appendage, glabrous.

Distr. *Malaysia:* Malay Peninsula (Pahang, Wray's Camp, Gunong Tahan, RIDLEY 16264, type, K, SING).

Note. As mentioned by RIDLEY the specimens are poor. No material has been collected since the type. I have seen two sheets of the type number and one other sterile unnumbered sheet. Only young fruits are available, with the persistent floral tube. Unfortunately, the petaloid appendages and stamens of them were eaten by insects except the basal parts of two sessile stamens in one flower. From the available material, it is impossible to verify the number and shape of the petaloid appendages and the number of stamens.

This species, as pointed out by RIDLEY, is characterized by the long-beaked fruits. In addition, the floral tube is longer than the lobes, and the stamens are sessile.

11. Aquilaria beccariana VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 217; Bull. Soc. Bot. Fr. 40 (1893) 77; GILG, Bot. Jahrb. 28 (1900) 145; BOERL. Handl. 3 (1900) 112; BECC. Nelle Foreste (1902) 592; MERR. En. Born. (1921) 416.—*A. grandifolia* DOMKE, Notizbl. Berl.-Dahl. 11 (1932) 348.—*A. cumingiana var. parviflora* AIRY SHAW, Kew Bull. (1940) 261.—*Gyrinopsis grandifolia* QUIS. J. Arn. Arb. 27 (1946) 406.—**Fig. 1a–c.**

Tree up to 20 m tall and 36 cm diam. with grey and smooth bark. Young branchlets pubescent. *Leaves* papery to subcoriaceous, glabrous on both surfaces, sometimes scattered pubescent beneath, oblong, oblong-lanceolate, or elliptic-oblong, rarely elliptic, (7–)11–27 by (3–)6–8½ cm; base cuneate to attenuate; apex acute to acuminate; nerves (10–)15–25 pairs, curving and ascending towards the margin, elevated and prominent beneath, distinct above; veins loosely reticulate; petiole 5–7 mm. *Inflorescences* axillary or extra-axillary, branched and up to 1½ cm peduncled, short-paniculiform, pubescent; pedicels 3–7 mm, pubescent. *Flowers* 7–12 mm long, yellowish, greenish or yellowish-white. Floral tube cylindric, 10-costate, sparsely hairy outside. Calyx lobes slightly ovate, puberulous inside, 2–3 mm long, densely puberulous on both surfaces, sometimes glabrescent on the outside. *Petaloid appendages* oblong, *c.* 1 mm long, densely short-hairy. *Stamens* usually sessile, rarely with very short filaments, almost as long as the petaloid appendages. Disk ring-like to cupular, densely puberulous. Pistil *c.* 5 mm long, with a distinct stipe *c.* 2 mm long, the stipe accrescent and elongated. *Ovary* ellipsoid, attenuate to the base, gradually narrowed at the apex; stigma capitate. *Fruit* protruding from the top of the floral tube, ellipsoid or obovoid, 2–3½ by 1¾ cm, slightly puberulous and glabrescent, narrowed to the base into an elongate stipe up to 1½ cm, acuminate to the apex, usually slightly contracted in the middle; floral tube entire, very rarely splitting on one side (KADIR A 3601). *Seeds* black, ovoid, 10 by 5 mm, sparsely puberulous, acuminate to the apex, with an elongate tail *c.* 5 mm long, attached at the center of the appendage, the appendage slender, *c.* 1 cm long, densely reddish-brown pubescent.

Distr. *Malaysia:* Sumatra (Palembang), Malay Peninsula (Johore), and common in Borneo.

Ecol. Primary forests, rarely in swampy forest (Johore: S.F. 29008, K), from the lowland up to 825 m.

Vern. *Mĕrkaras puti*, Sum., *gaharu*, *gumbil*, *njabak*, M, *tanduk = garu*, Born.

Notes. This species is characterized by the cylindric floral tube, the oblong and puberulous petaloid appendages which are almost as long as the sessile or subsessile stamens, and the stiped pistil with a short, puberulous, ring-like disk at its base.

The type specimen of the present species was collected by BECCARI (PB 2339, FI) from Sarawak. It has rather small leaves (8½–13½ by ½–4 cm) and young flowers. The type of *A. grandifolia* (GRASHOFF 693, BO) collected in the swamp forest, Palembang, S. Sumatra, has larger leaves (17–27 by 6–8½ cm) and young flowers. Many specimens collected in the Malay Peninsula (*e.g.* S.F. 29008, 29195, 29381, 29470) and Borneo (*e.g.* bb 34916, ENDERT 3319, 4035, C.F. 34453, PURSEGLOVE P 4752, RUTTEN 68, PATRICK PING San A 1726, and WOOD San 15218) have flowers and fruits in different stages of development and their leaves show a variable size. From this additional material we can clearly infer that only one species is represented.

Aquilaria cumingiana var. parviflora was based on HAVILAND 3092 (type) and several other collections from western Borneo. All the specimens cited in the original description agree with the present species and are quite different from *A. cumingiana.*

Fig. 3. *Phaleria capitata* JACK. *a.* Habit, × ⅔, *b.* opened flower, × ⁴/₃, *c.* ovary with disk, × 7, *d.* stamens, × 7, *e.* fruit, nat. size, *f.* seed, × 2, *g.* longitudinal section of fruit, one seed removed to show meshes of endocarp, × 2.—*P. elegans* L. M. PERRY, *h.* Opened flower, × ⁴/₃, *i.* punctate bract, × ⅔.—*P. macrocarpa* (SCHEFF.) BOERL. *j–k.* Opened flowers, dimorphous, × ⁴/₃, *l.* longitudinal section of fruit, one seed removed, × ⅔.—*P. octandra* (L.) BAILL. *m.* Opened flower, × ⁴/₃, *n.* fruit, nat. size, *o.* longitudinal section of fruit, one seed removed, × 2 (*a* BAKHUIZEN VAN DEN BRINK 2294, *b–d* C.H.B. XI–B–III–8, *e–g* C.H.B. XI–B–XVII–43, *h* BRASS 24484, *i* BRASS 24483, *j* ATASRIP 139, *k–l* C.H.B. VIII–G–93, *m–o* WALSH 36).

12. Aquilaria cumingiana (DECNE) RIDL. J. Str. Br. R. As. Soc. *n.* 35 (1901) 80; HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 17.—*Gyrinopsis cumingiana* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 41, t. 1 f. B, 13–21; MEISN. in DC. Prod. 14 (1857) 603; MIQ. Fl. Ind. Bat. 1, 1 (1858) 883; F.-VILL. Nov. App. (1880) 183; VIDAL, Phan. Cuming. (1885) 140; Rev. Pl. Vasc. Filip. (1886) 230; MERR. Bull. Bur. For. Philip. 1 (1903) 41; ELM. Leafl. Philip. Bot. 5 (1913) 1629; En. Philip. 3 (1923) 131; HOLTHUIS & LAM, Blumea 5 (1942) 216; QUIS. J. Arn. Arb. 27 (1946) 405; Med. Pl. Philip. (1951) 636.—*Decaisnella cumingiana* O.K. Rev. Gen. Pl. 2 (1891) 584.—*Gyrinopsis cumingiana var. pubescens* ELM. Leafl. Philip. Bot. 5 (1913) 1629; MERR. En. Philip. 3 (1923) 131.—*Gyrinopsis decemcostata* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 17; DOMKE, Bibl. Bot. 111 (1934) t. 2 f. 9; t. 4 f. 36p.—*Gyrinopsis pubifolia* QUIS. J. Arn. Arb. 27 (1946) 406.—**Fig. 1i.**

Shrub or small tree up to 5 m. Bark ashy grey, mottled and smooth. Young branchlets densely pubescent, glabrescent. *Leaves* chartaceous to subcoriaceous, glabrous on both surfaces or sometimes pubescent on the lower surface; oblong-lanceolate, elliptic-oblong, or ovate-oblong, rarely obovate-oblong, 14–18 by 5½–8½ cm; base cuneate, rarely rounded; apex acute to acuminate, acumen up to 1½ cm; nerves 12–18 pairs, slightly curved and ascending to the margin, elevated and distinct beneath, slightly elevated above; veins and veinlets numerous, irregularly forked; petiole 4–6 mm. *Inflorescences* simple or sometimes branched, few- to many-flowered; peduncle short, *c.* 5 mm long, rarely subsessile; pedicels 3 mm, setose. *Flowers* whitish, 13–16 mm long. Floral tube cylindric, puberulous outside, glabrescent, densely or sparsely pubescent inside, the retrorse hairs appressed, sometimes distinctly 10-costate inside, usually with irregular, sulphureous, wart-like excretions. Calyx lobes ovate or oblong, obtuse, 2–3 mm long, densely puberulous on both surfaces, sometimes glabrescent. *Petaloid appendages* short, usually united in a ring, rarely free or united at the base, about half as long as the stamens, densely hairy, the hairs longer than or as long as the appendages. *Stamens* sessile, 1–2 mm long, free from the tube, slightly below the appendages or at the same level with them, the lower ⅓–½ of the anther usually adnate to the tube. Pistil *c.* 7 mm long, short-stiped, densely hairy. *Ovary* obovate, attenuate to the base; style continuous with the ovary, obscure or distinct; stigma capitate. *Fruits* globose, slightly obovoid, or ellipsoid, rugose, protruding laterally from the split floral tube, 1¾ by 1⅓ cm. *Seeds* broad-ovoid, plano-convex, 1 by ¾ cm with a short caruncle-like appendage.

Distr. *Malaysia:* S. Borneo (Sampit region), Philippines (common), and Moluccas (Morotai and Halmaheira).

Ecol. In primary forests at low and medium altitudes.

Uses. According to QUISUMBING, *l.c.*, the bark and roots are used to stop bleeding from wounds. The bark, wood, and fruit are used as a substitute for quinine.

Vern. *Alahan, maga-an, palisan,* Tag., *bago,* Mbo., *binukat,* Ak. Bis., *butlo,* Neg., *dalakit,* S.L. Bis., *magwalem,* Sub., *pamaluian,* Bag.; *giba kolano,* Halmaheira.

Note. The type specimen of *Gyrinopsis pubifolia* QUIS. is B.S. 75314 (A). According to QUISUMBING (*l.c.*) it was collected at Mt Abucay, Catanduanes, at *c.* 1600 m, September 11, 1928 (the field data on the label of this specimen are simply indicated as "Catanduanes, M. RAMOS & G. EDAÑO, July-Sept. 1928"); it has rather young flowers with the lower part of the anthers united with the floral tube. There is another specimen (B.S. 75516, SING) which is similar to the above one and bears the same field data; it has both young and mature flowers and has been distributed as *Gyrinopsis cumingiana* DECNE (= *A. cumingiana*) with which I agree. In comparing these two specimens, it appears that *Gyrinopsis pubifolia* is conspecific with *A. cumingiana.*

Excluded

Aquilaria? bancana MIQ. Sum. (1861) 355 is according to AIRY SHAW (Fl. Mal. I, 4, 1953, 361) = *Gonystylus bancanus* (MIQ.) KURZ (*Thymelaeac.*).

Aquilaria? macrophylla MIQ. Sum. (1861) 356 is according to AIRY SHAW (Fl. Mal. I, 4, 1953, 354) = *Gonystylus macrophylla* (MIQ.) AIRY SHAW (*Thymelaeac.*).

Aquilaria pentandra BLANCO, Fl. Filip. ed. 1 (1837) is according to BAKKER (Fl. Mal. I, 5, 1957, 355) = *Pittosporum pentandrum* (BLCO) MERR. (*Pittosporac.*).

2. PHALERIA

JACK, Mal. Misc. 2 (1822) 59; reimpr. HOOK. Comp. Bot. Mag. 1 (1835) 156; DOMKE, Bibl. Bot. 111 (1934) 123, t.4 f.36h, map 6; MERR. J. Arn. Arb. 33 (1952) 239.—*Drimyspermum* REINW. Syll. Pl. Ratisb. 2 (1825) 15; RCHB. Nom. Bot. Hort. 2 (1841) 65, as *Drymispermum*.—*Pseudais* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 40.—*Leucosmia* BENTH. in Hook. Lond. J. Bot. 2 (1843) 231.—*Dais* (*non* LINNÉ) *auct.*—**Fig. 3–9.**

Shrubs or trees. *Leaves* decussate or opposite. *Inflorescences* terminal or axillary, sometimes cauliflorous, capitate, fascicled or umbelliform, peduncled.

rarely sessile, peduncles usually with decussate, persistent, reddish-brown, glabrous bracteoles towards the base and gradually increasing in size and more spaced towards the upper parts, sometimes 4 or more involucral bracts at the uppermost part of the peduncle surrounding the flowers. *Flowers* monomorphous rarely heteromorphous, white, sessile, articulated at the base. Floral tube infundibuliform or cylindric, glabrous or puberulous on both surfaces. Calyx lobes 5, rarely 4 or 6, slightly unequal. *Petaloid appendages* obscure and rim-like, or none, rarely distinct (*P. pentecostalis* LÉANDRI, an extra-Mal. *sp.*). *Stamens* in two series, usually filamentous and exserted, sometimes included, rarely sessile; anthers oblong, dorsifixed. Disk cupular, submembranous. *Ovary* ovoid or ellipsoid, glabrous or hairy at the apex, 2-celled or rarely 1-celled by abortion, once found 3-celled in *P. octandra*; style terminal, filiform, sometimes exserted; stigma capitate, papillose. *Fruits* drupaceous, 2- or 1-seeded, exocarp and mesocarp fibrous and fleshy (sometimes hard in the herbarium), endocarp coriaceous and hard. *Seeds* exalbuminous; cotyledons thick and hemispherical.

Distr. About 20 *spp.*, distributed in Ceylon (*P. capitata*), SE. Asia, through Malaysia to Australia, Micronesia (*P. nisidai*), and the Pacific (as far as Samoa and Tonga).

Ecol. In rain-forests, rarely in seasonal forests, from the lowland up to 1400 m.

Note. The generic name *Drimyspermum* has in literature frequently been mis-spelled as *Drymispermum*. No attempt has been made to indicate this erroneous etymology, except where new species or combinations have been proposed.

KEY TO THE SPECIES

1. Inflorescences terminal and/or in the leaf axils of the terminal node, sometimes also occurring in the upper two nodes, rarely in several nodes in *P. octandra*, sometimes cauliflorous in *P. capitata* and *P. coccinea*. Only one peduncle in each axil, bearing (6–)8-many flowers. Flowers homomorphic. Fruits usually small, less than 3½ by 2 cm; pericarp thin, less than ½ cm thick.
2. Floral tube pubescent outside, very rarely glabrescent. Fruits ellipsoid and apiculate at both ends, often spindle-shaped.
3. Involucral bracts 8 or more, large, 2½–3½ by 1–2 cm. Floral tube wide, 12–15 mm diam. at the throat . . . . **1. P. elegans**
3. Involucral bracts usually 4 or 5, smaller, ¾–1½ by ⅓–1 cm. Floral tube narrow, 2–6 mm diam. at the throat.
4. Inflorescences 8–10(–15)-flowered, very rarely many-flowered. Flowers 1½–2(–2¼) cm long; calyx lobes ½(–⅓) the length of the tube. Ovary glabrous. Leaves elliptic-oblong, elliptic-lanceolate, or obovate, (4–)13–26 by (1½–)3–8 cm; nerves 9–11 pairs . . **2. P. octandra**
4. Inflorescences 20-many-flowered. Flowers 3–4½ cm long; calyx lobes ¼–⅙ the length of the tube. Ovary usually hairy at the top, rarely glabrescent. Leaves oblong-lanceolate, oblanceolate or rarely ovate-oblong, 11½–33 by 3½–14 cm; nerves (8–)13–22 pairs . . . **3. P. perrottetiana**
2. Floral tube glabrous outside. Fruits subglobose, ovoid, or ellipsoid, usually rounded or obtuse at both ends, sometimes apiculate at the apex (acute or acuminate towards both ends in *P. sogerensis*).
5. Stamens and style always included. Stamens sessile or short-filamentous. Style usually not longer than the tube . . . . **4. P. nisidai**
5. Stamens and style exserted. Stamens long filamentous.
6. Flowers 2½–4½ cm long. Calyx lobes ⅙–¼ the length of the tube. Ovary glabrous or hairy at the top.
7. Inflorescences usually 8-flowered, sometimes cauliflorous and many-flowered. Ovary glabrous. Fruits subglobose, 1–1½ cm in diam.; endocarp *perforated* (fibrous strands interlaced, leaving distinct meshes). **5. P. capitata**
7. Inflorescences 20-many-flowered, rarely cauliflorous. Ovary usually hairy or puberulous at the top. Fruits ellipsoid, 1½–2 by 1 cm, usually blunt at both ends, sometimes apiculate at the apex; endocarp not perforated (fibres uniformly arranged, not leaving open spaces) **6. P. coccinea**
6. Flowers 1½–2 cm long. Calyx lobes usually ½(–⅓) the length of the tube. Ovary hairy at the top. Fruits acute or acuminate towards both ends.
8. Inflorescences with usually more than 20 flowers. Leaves 12–33 by 4–14 cm. Stamens *c.* 10 mm exserted beyond the tube. Calyx lobes *c.* 3 times as long as broad . **3. P. perrottetiana**
8. Inflorescences with 6–10 flowers. Leaves 7–16 by 2½–7 cm. Stamens *c.* 5–6 mm exserted. Calyx lobes *c.* 2–2½ times as long as wide . . . . **7. P. sogerensis**

1. Inflorescences axillary and occurring in the leaf axils of several nodes along the branches or branchlets, sometimes cauliflorous; peduncles 1–3 or sometimes several or many in each axil, each peduncle bearing 2–5(–8) flowers. Flowers usually heteromorphic (sessile stamens and an exserted style, or exserted stamens and a short style, and their intermediate forms). Fruits large, 3–5½ by 3–4½ cm; pericarp thick, 1–1½ cm . . . . **8. P. macrocarpa**

1. Phaleria elegans L. M. PERRY, J. Arn. Arb. 39 (1958) 422, f. c & d.—**Fig. 3h–i.**

Shrub or small tree, 2–3 m, sparsely branched. Branchlets reddish-brown, terete, glabrous, hollow. *Leaves* chartaceous to subcoriaceous, glabrous, oblanceolate, rarely elliptic-lanceolate, 18–30 by 5½–9 cm; base attenuate; apex acute to short-acuminate; margins recurved; nerves 8–12 pairs, elevated on both surfaces, spreading, curved towards the margin; veins slightly elevated on both surfaces, rather widely reticulate; petiole stout, about as thick as the branchlet, red when fresh (*fide* BRASS), reddish-brown to black when dry. *Inflorescences* terminal and/or in the axils of the terminal node, subsessile to short-peduncled (peduncle 5–9 mm in fruit), with small, decussate bracts towards the base. Involucral bracts cream-coloured (fleshy in bud), 8 or more, arranged in whorls, those of the inner whorl longer, oblong or ovate, 2½–3½ by 1–2 cm, obtuse or acute, slightly puberulous towards the upper part inside, especially near the margins, glabrescent, sometimes pellucid-dotted, 6–20-flowered. *Flowers* infundibular, 3¾–4¼ cm long. Floral tube 1¼–1½ cm diam. at the throat, densely pubescent outside and towards the base inside. Calyx lobes sparsely pubescent outside and densely pubescent inside, ± oblong, *c.* 9 by 5 cm, obtuse. *Petaloid appendages* rim-like. *Stamens* included, filamentous, 6–10 mm, free from the tube at the throat or slightly below it; anthers oblong, about 1½ mm long. Disk cup-shaped, crenulate, *c.* 2 mm long. Pistil included. *Ovary* glabrous, ellipsoid, *c.* 3 mm long, gradually narrowed towards the apex; style filiform, *c.* 3 cm; stigma globose. *Fruit* ellipsoid to fusiform, 2¾–3⅓ by 1½–1¾ cm, slightly compressed, acuminate on both ends. *Seeds* broadly ovate or obovate, or semiglobose, plano-convex, 10 by 7–10 mm, sharply pointed at the apex.

Distr. *Malaysia:* New Guinea (Goodenough I.).

Ecol. Undergrowth of an oak forest and occasional in gullies in the forest, 1600–1750 m.

Note. This species is characterized by 8 or more, large involucral bracts which are caducous after anthesis, a wide floral tube which is densely pubescent outside, and the included stamens and style.

2. Phaleria octandra (L.) BAILL. Adans. 11 (1875) 321; MERR. Philip. J. Sc. 19 (1921) 367.—*Dais octandra* LINNÉ, Mant. Pl. 1 (1767) 69; BURM. *f.* Fl. Ind. (1768) 104, t. 32, f.2.— *Dais dubiosa* (*non* BL.) DECNE, Herb. Timor. (1834) 41; SPANOGHE, Linnaea 15 (1841) 335.—*Drimyspermum laurifolium* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 39, t. 1, f. 1–12, as *Drymispermum*; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 75; ZOLL. Syst. Verz. 2 (1854) 117; MIQ. Fl. Ind. Bat. 1, 1 (1858) 885; BLUME & DE VRIESE, Ann. Hort. Bot. (Fl. Jard.) 2 (1859) 33, with pl.—*Drimyspermum burmanni* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 40, as *Drymispermum*; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 75; MEISN. in DC. Prod. 14 (1857) 605.—*Drimyspermum blumei* (*non* DECNE) HASSK. Nat. Tijd. N.I. 10 (1856) 885. —*Drimyspermum ambiguum* MEISN. in DC. Prod. 14 (1857) 605, as *Drymispermum.*—*Drimyspermum longifolium* MIQ. Fl. Ind. Bat. 1, 1 (1858) 885, as *Drymispermum.*—*P. laurifolia* HOOK. *f.* Bot. Mag. (1869) t. 5787; VAL. Ic. Bog. 4 (1913) 211, t. 368, f. 1–3.—*P. ambigua* HOOK. *f.* Bot. Mag. (1896) t. 7471.—*P. longifolia* BOERL. Handl. 3 (1900) 111.—*P. laurifolia var. javanica* VAL. Ic. Bog. 4 (1913) 212, t. 368, f. 4–9; in K. & V. Bijdr. 13 (1914) 46; HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 23.—*P. octandra var. laurifolia* WARB. *ex* VON MALM in Fedde, Rep. 34 (1934) 282.—*P. parvifolia* BACK. Blumea 5 (1945) 494.—**Fig. 3m–o.**

Shrub up to 5 m by 5 cm. *Leaves* chartaceous to subcoriaceous, elliptic-oblong, narrowly elliptic or obovate, (4–)13–26 by (1½–)3–8 cm; base attenuate, rarely short-acute; apex acuminate; nerves 9–11 pairs, slightly ascending and curved; veins rather widely reticulate, slightly elevated below, plane and visible above; petiole 6 mm. *Inflorescences* usually terminal and/or in the axils of the terminal node, sometimes in the axils along the branchlets (BEUMÉE 2405, BO), 8–10(–15–∞)-flowered; peduncles very short to up to 1½ cm, usually with decussate, small, lanceolate scales at the base gradually increasing in size apically. Involucral bracts 4, rarely 5, ovate or obovate, 8–12 by 4–11 mm, puberulous on the upper part of both surfaces, persistent, rarely caducous after anthesis. *Flowers* (1–)1½–2¼ cm long. Floral tube cylindric, slightly swollen at the base, usually pubescent on both surfaces, sometimes glabrescent. *Petaloid appendages* sometimes rim-like. Calyx lobes 4 or 5, oblong or slightly elliptic or obovate, 4–7 by 2–3 mm, densely puberulous outside and at the upper part inside. *Stamens* and pistil long-exserted (up to 8 mm) in anthesis. Disk cup-shaped, membranous. Pistil 2–2½ cm long. *Ovary* glabrous, ellipsoid, narrowed into the filiform style; stigma capitate. *Fruits* ellipsoid, ovoid, sometimes slightly compressed, 11–16 by 9–15 mm, acute or attenuate and pointed towards both ends, usually 2-celled, 2- or 1-seeded, once found 3-seeded (VALETON 123, BO).

Distr. Australia: North Queensland (MICHAEL 1250, BO), and *Malaysia:* throughout Java, Madura, Bawean, and Lesser Sunda Islands (Bali to Timor and Tanimbar), Moluccas (Halmaheira), and South New Guinea (Daru I.). Fig. 4.

Ecol. In beach-forest, common on sandy soil of teak forest in E. Java, rarely in primary and secondary mixed forests, from the lowland up to 600 m, in Jamdena up to 800 m, in Timor up to 1000 m.

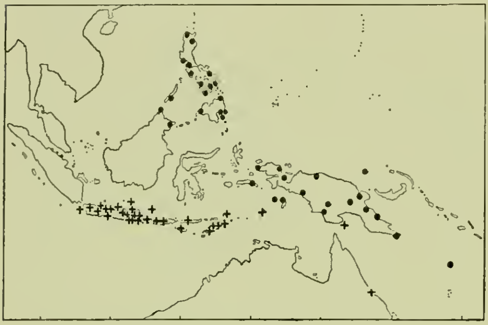

Fig. 4. Localities of *Phaleria octandra* (L.) BAILL. (+) and *P. perrottetiana* (DECNE) F.-VILL. (●).

Vern. *Kopinan, mritja sunda, pantjal pamor*, J, *kaju pateng*, Kangean, *mandalika, manpulang*, Bawean; Lesser Sunda Islands: *daun wèmpè, nu impi*, Jamdena, *koffifui*, Timor, *lolong*, Sumba; *pèpigéow*, Halmaheira, Sawai lang.

Note. *Dais octandra* was first published by LINNAEUS in 1767 (Mant. Pl. 1, p. 69). There is a specimen in the Linnean Herbarium which bears LINNAEUS's handwriting and agrees with the original description with the exception that some of the flowers are sparsely pubescent outside.

In 1768, one year later, *Dais octandra* appeared in BURMAN's Fl. Ind. p. 104, t. 32 f. 2. There are two specimens of BURMAN's in the Herb. Delessert at Geneva; one of them bears in BURMAN's handwriting "*Dais octandra*" and the other has a label "Java Kleinhoff". These two specimens are similar to each other and may belong to one collection. They are also similar to the specimen in the Linnean Herbarium mentioned above but the flowers appear more pubescent on the outside of the floral tube. I assume BURMAN has sent his drawing with one of his specimens – which might have been the one which he had used for the description – to LINNAEUS, as LINNAEUS cited "Burm. Ind. t. 33, f. 2" in the description.

In 1876 BAILLON (Adansonia 11, p. 321) rightly transferred *Dais octandra* to *Phaleria* as *P. octandra*. He mentioned only BURMAN's publication and overlooked that of LINNAEUS. According to priority we should accept LINNAEUS as the author of *Dais octandra* and the specimen in the Linnean Herbarium as the holotype.

Because of some minor discrepancies between BURMAN's (*l.c.*) description and drawing, and both of them also not exactly agreeing with the specimens preserved in BURMAN's herbarium, DECAISNE (Ann. Sc. Nat. Bot. II, 19, 1843, 40) based a new species, *Drimyspermum burmanni*, on the specimens in the BURMAN Herbarium. However, the discrepancies have no value for defining species: the floral tubes are usually pubescent outside but rarely glabrous and, as pointed out by VALETON (in K. & V. Bijdr. 13, 1914, 40), one can occasionally find glabrous flowers among the hairy ones (*cf.* KOORDERS 30200 β, 30145 β, and BUWALDA 7291).

In the Kew Herb. there are two specimens of cultivated origin identified as *Phaleria laurifolia*. One of them has flowers with a floral tube glabrous outside which has been used for the plate in CURTIS's Bot. Mag. t. 5787; the other has flowers with a floral tube pubescent outside. In other respects their characters entirely agree. It is not clear whether they were collected from the same or from different plants.

According to VALETON (Ic. Bog. 4, 1913, 47) *P. octandra* is slightly more xerophytic than the others and obviously cannot well maintain itself in rain-forest and the specimens which had been introduced in the Bogor Botanic Gardens have perished. The fibers which constitute the endo- and mesocarps form a rather thick layer, with a smooth, compact, shining inner surface, more loose than the peripheral parts but leaving no meshes among them.

In 1893 H. HALLIER (320, Bo) once collected it along the border of the Palace Garden (Hertenkamp) adjoining the Botanic Gardens at Bogor; it must have escaped or been derived from cultivation (*cf.* VALETON in K. &. V. Bijdr. 13, 1914, 47). One specimen was collected by HOOGERWERF (42, Bo) in the beach forest of Udjungkulon, W. Java, which is apparently the western limit of this species.

P. octandra is closely related to *P. perrottetiana*. Some specimens collected at Sumbawa (ELBERT 3903, 3949, 3994, 4099, 4127) have 15–∞-flowered inflorescences. One specimen collected in the Tanimber Is. (S. Moluccas) (BUWALDA 4369), has large leaves (20 by 9 cm) which are similar to those of *P. perrottetiana* both in size and shape.

3. Phaleria perrottetiana (DECNE) F.–VILL. Nov. App. (1880) 183; MERR. Sp. Blanc. (1918) 378; BROWN, Minor Prod. Philip. For. 1 (1920) 403; MERR. En. Philip. 3 (1923) 131; Philip. J. Sc. 29 (1926) 404; MERR. & PERRY, J. Arn. Arb. 22 (1941) 265.—*Drimyspermum perrottetianum* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 40, as *Drymispermum*; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 75; MEISN. in DC. Prod. 14 (1857) 605; MIQ. Fl. Ind. Bat. 1, 1 (1857) 886.—*Dais laurifolia* (*non* JACQ.) BLANCO, Fl. Filip. (1837) 375, ed. 2 (1845) 263, ed. 3, 2 (1878) 125.—*Drimyspermum urens* (*non* REINW.) SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 46.—*Drimyspermum coccineum* (*non Dais coccinia* GAUDICH.) BECC. in d'Albertis, New Guinea 2 (1880) 398, as *Drymispermum, quoad specim.*—*P. blumei* (*non* BENTH.) HEMSL. Bot. Chall. 3 (1885) 244.—*P. splendida* VAL. Ic. Bog. 4 (1913) 219, t. 370 A–B.

Shrub, sometimes a tree, up to 8 m. Branches and branchlets glabrous and dark-brown. *Leaves* chartaceous, oblong-lanceolate, oblanceolate, or ovate-oblong, 11½–33 by 3½–14 cm; base cuneate, rounded; apex acuminate; margins slightly recurved; nerves (8–)13–22 pairs, distinct

Fig. 5. A tree of *Phaleria sp.* in bridal attire. Kebun Raya Indonesia, Bogor.

and elevated on both surfaces, curving and ascending towards the margin, veins and veinlets slightly reticulate; petiole 1½ cm, slightly winged. *Inflorescences* terminal and/or axillary at the terminal node, sometimes in the axils of the upper two nodes of the branch, solitary, very rarely more than one in the same axil. Peduncle up to 3½ cm; bracts small, lanceolate, 3 mm long, densely decussate at the basal part, persistent. Involucral bracts 4, caducous after anthesis, rarely persistent, oblong, obovate-oblong, 15 by 8 mm, obtuse at the apex, apiculate or obtuse, densely puberulous towards the upper part on both surfaces. *Flowers* (2–)3–4½ cm long. Floral tube pubescent outside, villose at the lower half or lower ⅔ inside. Calyx lobes 5–9 mm long. *Stamens* and style *c.* 10 mm exserted beyond the tube. Disk cup-shaped, sometimes consisting of 6 or 7 free lobes (PNH 33763). *Ovary* usually hairy at the apex or on one side of the ovary, usually 2-celled, sometimes 1-celled by abortion. *Fruits* usually 1-seeded, ovate, gradually narrowed towards the apex, acute at the base, 1½–3 by 1¼–1¾ cm. *Seed* ellipsoid, plano-convex, 10 by 8 mm.

Distr. Louisiade Archipelago (Sudest I.), Admiralty Is. and *Malaysia:* New Guinea (throughout), Moluccas (Kai Is. and Ceram), Philippines (throughout), and N. Borneo (Banguey I. and Lahat Datu). Fig. 4.

Ecol. In rain-forest at low and medium altitudes, one collection (NGF 8511) at 1140 m (Western Highlands, New Guinea).

Vern. New Guinea: *kwareo*, Wanigela, *bearoa*, Gabobora; Philippines: *aligpagi*, Davao, *bágo*, Bat., *tuba*, Cag.

Note. Some specimens collected at Davao Prov., Mindanao, Philippines (B.S. 48963, 49614 and MERRILL 11616) seem to be a distinct local form of *P. perrottetiana*; this form differs from the typical one only by the rather small flowers (*c.* 2 cm long) and the floral tube which is *glabrous* outside. Because of the presence of two kinds of flowers *P. perrottetiana* has been placed in the key twice.

Some specimens (*viz* CARR 11353, 11672, and HOOGLAND 3788) bear large fruits (*c.* 3 by 1¾ cm) with rather thick pericarps (*c.* 2 mm). Their enormous size might have been caused by the attack of insects, as there are always hole(s) on the pericarps and excrements of insects inside the fruits.

4. Phaleria nisidai KANEHIRA, Fl. Micron. (1933) 248, f. 116; Bot. Mag. Tokyo 47 (1933) 675.

Shrub or small tree, up to 3 m. Branchlets smooth, glabrous, yellowish-green to reddish-brown. *Leaves* chartaceous, greenish when dry and glabrous on both surfaces, elliptic-oblong, rarely lanceolate, 10–18 by 2½–6½ cm; base obtuse, acute or cuneate; apex acuminate; nerves 6–10 pairs, curving and ascending towards the margin, elevated beneath, plane and distinct above, veins reticulate, usually rather dense, elevated beneath, distinct or obscure above.

Inflorescences terminal and/or in the axils of the terminal node, umbelliform, 10–12-flowered; peduncles *c.* 2–4 mm with a pair of opposite, green, and obovate-oblong bracts (4 by 2 mm) at the upper part; involucral bracts 4, green, glabrous, caducous after anthesis, oblong or elliptic-oblong, 8–10 by 4–6 mm. *Flowers* 2–3½ cm long. Floral tube cylindric, slightly dilated towards the top, glabrous outside, puberulous or pubescent inside. Calyx lobes 5(–4), oblong, ovate or orbicular, 2–4½ by 2–3 mm, puberulous on the margins and top outside and the whole surface inside. *Stamens* included; filaments ½–3 mm; anthers *c.* 1 mm long. Disk cup-shaped, crenate, membranous. Pistil usually shorter than the tube, rarely exserted. *Ovary* ovoid, *c.* 2½ mm long, hairy at the apex; style filiform; stigma oblong or slightly globose. *Fruits* globose or slightly obovoid, 1½–2 by 1½–2 cm, slightly compressed, constricted at the base into a 3 mm long stipe. *Seeds* broadly ellipsoid, 5½ by 7 mm.

Distr. Western Carolines (Palau: KANEHIRA 2445, K), in *Malaysia:* D'Entrecasteaux Is. (Normanby I.: BRASS 25827, K, L), New Britain (Gazelle Pen.: WATERHOUSE 908, K), Louisiade Archipelago (Misima I.: BRASS 27505; Rossel I.: BRASS 28284, L), and New Guinea (Eastern Highlands: NGF 9564).

Ecol. Rain-forests, lowland up to 600 m.

Note. All specimens cited above match very well with KANEHIRA's description and his fine drawing as well as his collection from the type locality (2445, K). This species is characterized by the leaves with rather dense venation and the flowers with included stamens and pistils.

5. Phaleria capitata JACK, Mal. Misc. (1822) 59; reimpr. in Hook. *f.* Comp. Bot. Mag. 1 (1835) 156; K. & V. Bijdr. 13 (1914) 41; S. MOORE, J. Bot. 63 (1925) Suppl. 89; HEYNE, Nutt. Pl. (1927) 1152.—*Dais dubiosa* BL. Cat. (1823) 69; Bijdr. (1826) 651; HASSK. Cat. Hort. Bog. (1844) 94; FILET, Pl. Bot. Tuin Weltevr. (1855) 50.—*Drimyspermum urens* REINW. Syll. Pl. Ratisb. 1 (1825) 15; DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 39; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 74; MEISN. in DC. Prod. 14 (1857) 604; HOLTHUIS & LAM, Blumea 5 (1942) 216.—*Drimyspermum blumei* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 39, as *Drymispermum*; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 74; ZOLL. Syst. Verz. 2 (1854) 117; MEISN. in DC. Prod. 14 (1857) 604; MIQ. Fl. Ind. Bat. 1, 1 (1857) 885.—*P. dubiosa* ZOLL. Nat. Geneesk. Arch. N.I. 1 (1844) 616.—*Drimyspermum laurifolium* (*non* DECNE) HASSK. Nat. Tijd. N.I. 10 (1856) 155.—*Drimyspermum phaleria* MEISN. in DC. Prod. 14 (1857) 604, as *Drymispermum*; MIQ. Fl. Ind. Bat. 1, 1 (1858) 884.—*Drimyspermum cauliflorum* THW. En. Ceyl. Pl. (1860) 251, as *Drymispermum*. —*P. cumingii* F.-VILL. Nov. App. (1880) 183; VIDAL, Phan Cuming. Philip. (1885) 140; Rev. Pl. Vasc. Filip. (1886) 230; BROWN, Minor Prod. Philip. For. 1 (1920) 403; MERR. Bull. Bur. For. Philip. 1 (1903) 43; En. Philip. 3 (1923) 131; KANEHIRA, Bot. Mag. Tokyo 45 (1931) 331; Fl. Micron. (1933) 248.—*P. urens* KOORD. Minah. (1898) 577; Suppl. 2 (1922) t. 98; Suppl. 3 (1922) 48.—*P. cauliflora* BEDD. For. Man. Bot. (= Fl. Sylv. vol. 3) (1873) 180, t. 25, f. 5; TRIM. Fl. Ceyl. 3 (1895) 459; HOOK. *f.* Fl. Brit. Ind. 5 (1886) 199.—**Fig. 3a–g, 6.**

Fig. 6. *Phaleria capitata* JACK. Botanic Gardens, Singapore, Febr. 1952 (Photogr. M. R. HENDERSON).

Shrub or small tree, up to 9 m by 16 cm. Branchlets reddish-brown. *Leaves* chartaceous, glabrous, in dry state reddish-brown above, pale brown beneath; elliptic-oblong, (11–)15½–21(–26) by (3½–)5½–7(–10) cm; base acute to attenuate, rarely rounded; apex narrow acute to acuminate, acumen 1¼–2½ cm; margins sometimes recurved in dry state; nerves 8–10 pairs, elevated beneath, slightly elevated above; veins loosely reticulate, distinct beneath, obscure above; petiole 5 mm. *Inflorescences* usually terminal and/or in the leaf axils of the terminal node, solitary, sometimes cauliflorous, subsessile or on very short (*c.* 3 mm) peduncles, with decussate, small bracts at the base. Involucral bracts 4, oblong, ovate or obovate, 6 by 3 mm, usually caducous after anthesis sometimes persistent, usually 8-flowered. *Flowers* 2½–4½ cm long. Floral tube cylindric, gradually enlarged towards the top, glabrous on both surfaces. Calyx lobes oblong or elliptic, 6–7 by 2–3½ mm, puberulous inside and towards the upper part and margins outside, sometimes glabrous outside. *Stamens* and style usually exserted sometimes up to 5 mm. Pistil sometimes shorter than the tube or about as long as it (BAKHUIZEN VAN DEN BRINK 5063, BAKHUIZEN VAN DEN BRINK *f.* 688, and San A 3140). Disk cup-shaped. *Ovary* ellipsoid, glabrous, apex narrowed into the filiform style; stigma capitate, 1½ by 1 mm. *Fruits* subglobose, 1–1½ cm in diam., sometimes short-acute at the apex, usually 2-celled, 2-seeded; endocarp inside with distinct meshes.

Fig. 7. Localities of *Phaleria capitata* JACK.

Distr. Ceylon, Carolines (Palau, *fide* KANEHIRA), and *Malaysia:* Malaya (cult. and natur.), Sumatra, Java, Borneo, Philippines, Celebes, Moluccas (Buru), and New Guinea (Waigeo I.). Fig. 7.

Ecol. In primary and secondary forests, from the lowland up to 1200 m.

Uses. (*Cf.* HEYNE, *l.c.*; BURK. Dict. 2, 1935, 1703). Tough fibres of the bark have been used for cordage and tying material. The fruits are sweet and edible. The seeds are used for scurfy eruptions in children.

Vern. Sumatra: *suwa lansat*, Simalur, *rimbò suloh*, Lampong; Java: *godong-laweh, kakapassan, ki-angkrieng, ki tangkieh*, S, *kojoian, lawé, lawéan, lawé-lawé, ulati*, J; Borneo: *djarum djarum*; Celebes: *suka*, Bug., *susuan, susuan*, Minah.; Moluccas: *la'awan'a*, Sangi & Talaud Is.

Notes. The mesocarp of the fruit is fleshy and rather soft. The endocarp consists of interwoven fibres which form a characteristic network; through the meshes one can see the testa of the exposed seed (*cf.* VALETON, Ic. Bog. 4, 1914, 212). Fig. 3g.

There are two specimens collected by CORNER (S.F. 28481 and 32776, SING) at Johore, Malay Peninsula, which might have escaped or been derived from cultivation.

6. Phaleria coccinea (GAUDICH.) F. v. M. Descr. Not. 2 (1885) 9, *quoad basionym*; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 459.—*Dais coccinea* GAUDICH. Voy. Uranie (1826) 443, t. 44.—*Pseudais coccinea* DECNE, Ann. Sc. Nat. Bot. II, 19 (1843) 41; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 77; MEISN. in DC. Prod. 14 (1857) 603; MIQ. Fl. Ind. Bat. 1, 1 (1858) 883.—*Drimyspermum revolutum* T. & B. Nat. Tijd. N.I. 27 (1864) 30.—*Drimyspermum cumingii* MEISN. in DC. Prod. 14 (1857) 605, as *Drymispermum*.—*P. vriesii* BAILL. Adansonia 11 (1875) 329.—*P. zippelii* BAILL. *l.c.*—*Drimyspermum coccineum* BECC. in D'Albertis, New Guinea 2 (1880) 398, *quoad basionym*, as *Drymispermum*.—*P. revoluta* BOERL. Handl. 3 (1900) 111; VAL. Ic. Bog. 4 (1913) 215, t. 369.—*P. amboinensis* MERR. Philip. J. Sc. 11 (1916) Bot. 294.—*P. platyphylla* MERR. Philip. J. Sc. 14 (1919) 429; En. Philip. 3 (1923) 131.—*P. subcaudata* MERR. & PERRY, J. Arn. Arb. 22 (1941) 265.

Small tree, up to 5 m. Branchlets red-brownish, usually hollow. *Leaves* chartaceous to coriaceous, glabrous on both surfaces; obovate, elliptic, elliptic- to lanceolate-oblong, obovate- to oblanceolate-oblong, ovate-oblong, 15½–26 by 6–11½ cm; base rounded to cuneate; margins slightly recurved; apex short-acute, acute, up to 2 cm acuminate; nerves 8–14 pairs, prominent and elevated beneath, slightly elevated or plane above, curving and ascending towards the margins; veins loosely reticulate; petiole thick, *c.* 5–7 mm long. *Inflorescences* terminal or/and axillary at the terminal node, rarely cauliflorous, (15–)20-many-flowered; peduncle up to 2½ cm. Bracts small, lanceolate, ovate to obovate, 3–10 mm long; involucral bracts 4, elliptic- or obovate-oblong, obtuse, 4–12 by 2–5 mm, caducous after anthesis, rarely persistent. *Flowers* 2½–3½ cm long. Floral tube glabrous outside, glabrous or sparsely puberulous to pubescent inside. Calyx lobes obovate-oblong or oblong, 5–7 by 2–3 mm, reflexed, usually puberulous on both surfaces. *Stamens* and style up to 8–10 mm exserted. Disk cup-shaped. *Ovary* villous or puberulous at the top, 2-celled, very rarely 1-celled. *Fruits* ellipsoid, 1½–2 by 1 cm, blunt at both ends, sometimes apiculate at the apex. Seeds ovoid, 6½ by 5 mm.

Distr. New Britain and *Malaysia:* Philippines (Panay and Mindanao), Moluccas (Sula Is., Ambon, Ceram, and Key Is.), New Guinea (Sorong, Waren, Hollandia, Central and South Division, Nabire, Sepik region).

Ecol. In rain-forests from the lowland up to 300 m.

7. Phaleria sogerensis S. MOORE, J. Bot. 61 (1923) Suppl. 43.

Shrub up to 2 m. Branchlets reddish- to dark-brown, glabrous. *Leaves* papery, rarely subcoriaceous, glabrous on both surfaces, sometimes brownish or brownish-green when dry, elliptic-oblong, oblong-lanceolate to lanceolate; 7–16 by 2½–7 cm; cuneate to attenuate towards the base; acuminate at the apex, sometimes with an acumen *c.* 2 cm long; nerves 6–10 pairs, spreading towards the margin and then curved upwards, prominent and elevated beneath, slightly elevated above; veins reticulate, distinct beneath, obscure above; petiole *c.* 5 mm. *Inflorescences* terminal, and/or in the leaf axils of the terminal one or two nodes, 6–10-flowered; peduncle none to 12 mm; involucral bracts 4, slightly obovate, *c.* 5 by 3 mm, usually caducous, sometimes persistent. *Flowers* 1½–2(–2½) cm long. Floral tube glabrous on both surfaces, rarely puberulous inside. Calyx lobes slightly oblong, 5–8 mm long, densely puberulous inside and on the margins outside. *Stamens* and

Fig. 8. *Phaleria macrocarpa* (SCHEFF.) BOERL. Kebun Raya Indonesia, Bogor (C.H.B. VIII–G–93).

Fig. 9. *Phaleria macrocarpa* (SCHEFF.) BOERL. with its beautiful, glossy, bright-red fruits. Cultivated in Kebun Raya Indonesia, Bogor.

pistil slightly exserted. Disk cup-shaped, crenate, *c.* ¾ mm long. *Ovary* usually pubescent or puberulous at the apex, rarely glabrescent or glabrous. *Fruits* ellipsoid, acute or acuminate towards both ends, 1½ by 1 cm, rarely the basal part of the endocarp inside with small meshes. *Seeds* ellipsoid, plano-convex, 8 by 5 mm with a caruncle-like appendage, *c.* 1½ mm long.

Distr. *Malaysia:* New Guinea (Sogere, Kanosia, Koitaki, Boridi, and Hollandia).

Ecol. In forests at low and medium altitudes, sometimes up to 1400 m.

8. Phaleria macrocarpa (SCHEFF.) BOERL. Handl. 3 (1900) 111; L. M. PERRY, J. Arn. Arb. 39 (1958) 420, fig. a–b.—*Drimyspermum macrocarpum* SCHEFF. Ann. Bot. Gard. Btzg 1 (1876) 46, as *Drymispermum.*—*P. octandra* (*non* (L.) BAILL.) K. SCH. & HOLLR. Fl. Kais. Wilh. Land (1889) 93; WARB. Bot. Jahrb. 13 (1891) 337.—*P. papuana* WARB. *ex* K. SCH. & LAUT. Fl. Schutzgeb. (1900) 460; GILG, Nova Guinea 8 (1910) 411.—*P. sp.* GILG, *l.c.*—*P. calantha* GILG, *l.c.*—*P. wichmannii* VAL. Ic. Bog. 4 (1913) 222, t. 371.—**Fig. 3j–l, 8–9.**

Shrub or small tree, up to 18 m by 15 cm. Young branches hollow. *Leaves* chartaceous to subcoriaceous, glabrous, ovate-oblong, elliptic-oblong, lanceolate, oblong-lanceolate, 10–25 by 3–10 cm; base cuneate or rounded; apex shortly acute to acuminate, acumen up to 2 cm; nerves 6–11 pairs, spreading towards the margins, sometimes their distal end curving upwards and united loop-like, elevated and distinct on both surfaces; veins loosely reticulate, sometimes subperpendicular to the midrib, slightly elevated on both surfaces. *Inflorescences* terminal and in the axils along the branchlets, sometimes cauliflorous, 1 to 5, rarely more peduncles in each axil; peduncles 0 or up to 2½ cm (*cf.* bb 25746), each 2–5(–8)-flowered; involucral bracts 4, small, obovate, oblong, caducous, 7 by 2 mm. *Flowers* 1½–4 cm long. Floral tube glabrous on both surfaces, sometimes puberulous and hairy on the inside towards the base. Calyx lobes oblong, 4 by 2 mm, reflexed, densely puberulous inside and on the margins outside. *Stamens* sessile or up to 6 mm exserted. *Ovary* glabrous; style shorter than or as long as the tube or *c.* 5–10 mm exserted. *Fruits* subglobose to broadly ellipsoid or rounded, sometimes slightly obovate and stipe-like narrowed towards the base, 3–5½ by 3–4½ cm, exocarp woody when dry. *Seed* subglobose or slightly ovate, *c.* 1½ by 1¼ cm.

Distr. *Malaysia:* common in western New Guinea.

Ecol. Primary and secondary forests, from the lowland up to 550 m, once at 1260 m.

Uses. It is cultivated in Sabron near Hollandia on clay soil at 120 m. The bark is used by the Papuans for making bags (BW 5468).

Vern. *Dalom*, Sentani, *kotteh*, Djair, *matoniek*, Andjai.

Note. *Phaleria macrocarpa* was first described as *Drimyspermum macrocarpum* by SCHEFFER (*l.c.*) based on fruiting specimens collected by TEYSMANN (7786, L, Bo) near Doré, western New Guinea. These young fruits are ellipsoid or slightly obovoid (15 by 12 mm) and narrowed stipe-like towards the base. This shape is not uncommon and can also be observed in for example bb 25746, BW 5468 from Hollandia, and NGF 7298 from Morobe Distr. The vegetative and morphological characters of the type agree with those of *P. calantha* and *P. wichmannii.*

The type of *P. wichmannii* was collected by ATASRIP (139, Bo, L; cult. in Hort. Bog. under *n.* VIII. G. 75) in northern Dutch New Guinea; its flowers have a long, exserted style and almost sessile stamens.

The type of *P. calantha* was collected by VERSTEEG (1939, Bo, L. K; cult. in Hort. Bog. under *n.* VIII. G. 93) at Merauke, southern Dutch New Guinea; its flowers have long filamentous stamens and a style shorter than or as long as the floral tube. The fruits of these two 'species' collected from the cultivated plants mentioned above are very similar, large and fleshy. I assume that the flowers are heteromorphous and these two 'species' represent two forms of one species. Moreover, two other forms have been found, *viz* one with both stamens and style exserted as represented for example by KLOSS *s.n.* (13/1 & 16/1, 1912 [1913], BM) and HOOGLAND 4520 (Bo, G, L), and another one with short-filamentous stamens and a short style, represented by NGF 9564 (L).

Excluded

Phaleria axillaris ELMER, Leafl. Philip. Bot. 8 (1915) 2840 is according to MERRILL (En. Philip. 3, 1923, 535) = *Tricalysia tinagaoensis* ELMER (*Rubiac.*).

3. ENKLEIA

GRIFF. Calc. J. Nat. Hist. 4 (1844) 234, in note; VAN TIEGH. Bull. Soc. Bot. Fr. 40 (1893) 69; DOMKE, Bibl. Bot. 111 (1934) 121, t.4 f.36n & map 3.—*Linostoma subg. Linostoma* KURZ, J. As. Soc. Beng. 39, ii (1870) 83; reimpr. Flora 53 (1870) 372.—*Linostoma* WALL. *ex* ENDL.: BENTH. & HOOK. *f.* Gen. Pl. 3 (1883) 197, *p.p.*—*Macgregorianthus* MERR. Philip. J. Sc. 7 (1912) Bot. 312.—**Fig. 10.**

Lianas. *Leaves* alternate, sometimes opposite towards the upper part of the branchlets, penninerved with oblique and subparallel cross-bar veins. *Inflorescences* paniculiform, terminal, lax, bearing a few flowers on the top of the ramifications, each of which always bears a few conduplicate or involute, linear, lanceolate or oblong bracts; these bracts are subopposite, opposite or alternate, usually perpendicular to the ramification and sometimes slightly curved upwards when young, the basal two accrescent and leafy in fruit, horizontally spreading or sometimes reflexed, slightly enlarged at their attachment (not enlarged in the extra-Mal. *sp.*). *Flowers* 5-merous, articulated at the base of the pedicel. Floral tube cylindric, shortly puberulous outside, glabrous inside. Calyx lobes puberulous on both surfaces. *Petaloid appendages* twice as many as calyx lobes – or the same number and then each bifid –, linear or oblong, membranous, entire or emarginate, inserted at the throat of the tube. *Stamens* included, twice as many as calyx lobes, in two series, the upper series free from the tube and inserted just below the throat, the lower series a little below the upper series, sessile, subsessile or short-filamentous; filaments if present slightly broadening towards the base of the anthers;

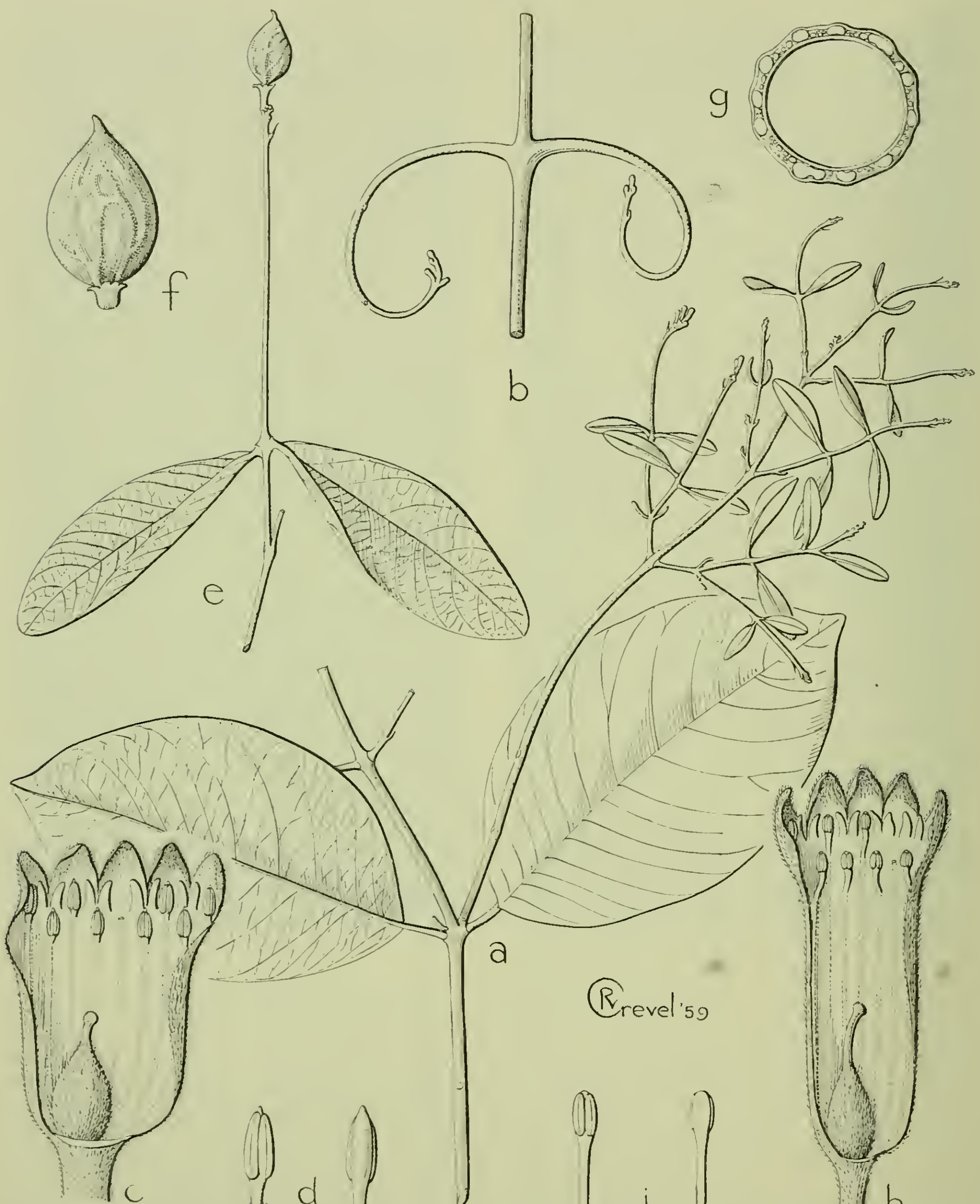

Fig. 10. *Enkleia malaccensis* GRIFF. *a*. Habit, × ⅔, *b*. part of stem with hook-like branchlets, × ⅔, *c*. opened flower, × 6, *d*. stamens, × 13, *e*. infructescence with two leafy bracts, × ⅔, *f*. fruit, × 2, *g*. cross-section showing structure of pericarp, × 4.—*E. paniculata* (MERR.) HALL. *f*.. *h*. Opened flower, × 6, *i*. stamens, × 13 (*a* KEITH 9234, *b* MAINGAY 1308/2, *c–d* HEYNE *s.n.*, *e* ELMER 20834, *f* KOSTERMANS 7034, *h–i* ZIPPELIUS 148[a]).

anthers linear or oblong, slightly apiculate or obtuse; connectives distinct on the dorsal side and almost as broad as the two locules. Disk none or obscure, sometimes represented by some minute scales. *Ovary* sessile, ellipsoid or ovoid, densely hairy; style terminal, distinct; stigma oblong. *Fruits* ovoid or ellipsoid, prominently ribbed and reticulate (in the herbarium), surrounded at the base by the torn remains of the floral tube, with thin exocarp and hard endocarp. *Seed* the same shape as the fruit, testa membranous.

Distr. Species 3, distributed in the Andaman Is., Burma, Siam, Indo-China, and *Malaysia*: Sumatra, Malay Peninsula, Borneo, Philippines, and New Guinea.

Ecol. In lowland forests.

KEY TO THE SPECIES

1. Leaves subcoriaceous to coriaceous, rather dark often red-brown when dry, usually broad-elliptic and bluntish. Floral tube not twisted after anthesis. Stamens sessile or shortly filamentous in the upper series; anther longer than the filament, acute and apiculate at the top. **1. E. malaccensis**
1. Leaves chartaceous, pale (greenish or light brown) when dry, usually ovate-oblong and rather acutish. Floral tube twisted after anthesis. Stamens distinctly filamentous in the upper series; anther shorter than or as long as the filament, obtuse to truncate at the top . . . . . **2. E. paniculata**

1. Enkleia malaccensis GRIFF. Calc. J. Nat. Hist. 4 (1844) 235, in note; GILG in E. & P. Pfl. Fam. III, 6a (1894) 231; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 262, *excl. syn.*; HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 24; RIDL. Fl. Mal. Pen. 3 (1924) 147; FISCHER, Kew Bull. (1932) 182; BURK. Dict. 1 (1935) 925; LÉANDRI, Rev. Int. Bot. Appl. & Agr. Trop. 29 (1949) 505; Proc. 8th Pac. Sc. Congr. Manila 4 (1957) 585.—*Lasiosiphon scandens* ENDL. Gen. Pl. Suppl. 4, 2 (1847) 67, *nom. illegit.*; MEISN. in DC. Prod. 14 (1857) 598; MIQ. Fl. Ind. Bat. 1, 1 (1858) 881.—*E. malayana* GRIFF. Not. As. 4 (1854) 363.—*Linostoma scandens* KURZ, J. As. Soc. Beng. 39, ii (1870) 83; reimpr. Flora 53 (1870) 371; HOOK. *f.* Fl. Brit. Ind. 5 (1886) 198, *excl. syn.*; BOERL. Handl. 3 (1900) 111; HEYNE, Nutt. Pl. (1927) 1152.—*E. riouwensis* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 25.—*E. coriacea* HALL. *f. l.c.*—**Fig. 10a–g.**

Climber up to 30 m by 10 cm. Branchlets sometimes transformed into hook-like organs, reddish brown. Branchlets, inflorescences, and young leaves always ferrugineous-pubescent. *Leaves* subcoriaceous to coriaceous, upper surface dull, olivaceous when dry, undersurface usually brownish, or reddish brown, pubescent on both surfaces, sometimes glabrescent; usually broad-elliptic and bluntish, 5½–14 by 3–7 cm, obtuse or rounded at both ends, rarely short-acute; nerves 12–20 pairs, distinct and plane beneath, visible and impressed above, veins distinct beneath, obscure above; petiole 6–12 mm, pubescent. *Inflorescences* terminal, up to 30 cm long, flowers (4–)6–8(–14) on each ramification; leafy bracts chartaceous, oblong, 4–5 by 1–2 cm. *Flowers c.* 8 mm long, yellowish or whitish, short-pedicelled. Calyx lobes *c.* 2 mm long, 3 of them larger and ovate, 2 smaller and lanceolate. *Petaloid appendages* 10, linear, *c.* ¾ mm. *Stamens c.* 8 mm, sessile or shortly filamentous. *Pistil* included, *c.* 3 mm long; ovary *c.* 2 mm; style short; stigma slightly capitate. *Fruits* ovoid, 1¼ by ½ cm.

Distr. Andaman Is., Burma (Tenasserim and Prome, *fide* KURZ), Indo-China (Laos and Cambodia), and *Malaysia:* Sumatra (Palembang), Riouw, Banka, Malay Peninsula (Singapore and Malacca), and Borneo.

Ecol. In lowland forests.

Uses. Said to give an inferior scented 'gaharu' wood (*fide* HEYNE, *l.c.*). The bast fibers can be used for tying purpose.

Vern. *Akar kareh hitam, akar panas, akar puchong kapur, garu buaja, kapang akar*, M, *tĕmentak akar*, Banka, *tĕrap akar*, Sum.; Borneo: *aka dian*, Kaya, *akar garu*, Dusun, *tuba-tuba*, Bajau.

2. Enkleia paniculata (MERR.) HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 26.—*Macgregorianthus paniculatus* MERR. Philip. J. Sc. 7 (1912) Bot. 312; GILG in E. & P. Pfl. Fam. Nachtr. 4 (1915) 212; MERR. En. Philip. 3 (1923) 132.—*E. zippeliana* HALL. *f. l.c.*—**Fig. 10h–i.**

Climbing shrub. Branchlets puberulous, glabrescent. *Leaves* chartaceous to subcoriaceous, when dry the upper surface light-brown, glabrous and shining, the lower surface somewhat paler, dull, sparsely puberulous, glabrescent; ovate-(rarely elliptic-)oblong, 5½–11 by 3–5 cm; base acute to obtuse; apex acute to ± acuminate; nerves 11–15 pairs, slightly ascending towards the cartilaginous margin and united with it, elevated beneath, slightly elevated or plane above; veins slightly elevated beneath, plane or slightly impressed above; petiole 5–8 mm, densely puberulous. *Inflorescences* in the upper axils, up to 28 cm long, densely puberulous; leafy bracts oblong, 2½–6 by ¾–2 cm. Pedicels 3–5 mm. *Flowers* pale-green, *c.* 1 cm long. Floral tube cylindric and distinctly costate inside, *c.* 8 mm long, densely puberulous outside, glabrous inside, twisted after anthesis. Calyx lobes oblong, *c.* 2 mm long, densely puberulous outside and on the margins or sometimes the whole surface inside. *Petaloid appendages* oblong, membranous, emarginate or slightly erose at the top, ⅓–1 mm long. *Stamens* of the upper series 1½–2 mm long with filaments as long as or longer than the anthers, those of the lower series *c.* 1 mm long, sessile or shortly filamentous; anthers *c.* ½ mm long, obtuse or slightly apiculate. *Ovary* ovoid or ovoid-oblong, *c.* 2½ mm long, densely pubescent; style filiform, *c.* 1½ mm; stigma obovoid, papillose. Fruit ovoid, 1½ by 1 cm.

Distr. *Malaysia:* Philippines (Luzon) and western New Guinea.

Ecol. In hill-side forests (Philip.) or lowland rain-forest, 50 m.

Note. According to HALLIER *f.* (*l.c.*) *E. zippeliana* is similar to *E. paniculata*, but would differ in leaves shortly and sparsely puberulous beneath, with conspicuous and slightly prominent network of veins on both surfaces, branchlets, petioles and panicles minutely rusty (not gray-)tomentose, and geographic distribution. However, from the two sheets of the type of *E. paniculata* (B.S. 12360, Bo, L) as compared with the type of *E. zippeliana* (ZIPPELIUS 148/a, L), it appears that these differences are only quantitative. There are only *young* flowers on the Philippine specimens and the floral characters are similar to those in the New Guinea specimen in the same stage.

4. LINOSTOMA

WALL. [Cat. (1831) *no* 4203, *nomen*] *ex* ENDL. Gen. Pl. (1837) 331; Suppl. 4, 2 (1847) 67; BENTH. & HOOK. *f.* Gen. Pl. 3 (1883) 197, *p.p.*; DOMKE, Bibl. Bot. 111 (1934) 120, map 3.—*Nectandra* (*non* BERG. 1767) ROXB. [Hort. Beng. (1814)

Fig. 11. *Linostoma longiflorum* HALL. *f.*. *a.* Habit, × ⅔.—*L. pauciflorum* GRIFF. *b.* Habit, × ⅔, *c.* upper part of opened flower, schematic, showing positions of stamens and petaloid scales, × 3, *d.* the same, in detail, × 4, *e.* pistil, × 4, *f.* disk at base of ovary, × 8, *g.* stamens, × 13 (*a* HAVILAND 1759, *b–g* H. M. BURKILL 240).

(90), *nomen*] Fl. Ind. ed. CAREY 2 (1832) 425, *non* ROLAND. *ex* ROTTB.—*Linostoma sect. Eulinostoma* MEISN. in Mart. Fl. Bras. 5, 1 (1855) 71.—*Psilaea* MIQ. Sum. (1861) 355.—*Linostoma subg. Nectandra* [(*non* BERG.) ROXB.] KURZ, J. As. Soc. Beng. 39, ii (1870) 83; reimpr. Flora 53 (1870) 372.—**Fig. 11.**

Lianas, rarely erect shrubs. *Leaves* opposite or subopposite, glabrous, with fine parallel nerves; margins somewhat reflexed. *Inflorescences* umbelliform or paniculiform, few-flowered, usually on the terminal part of the lateral branchlets, rarely axillary; bracts 2, rarely 3 or 4, discoloured, opposite or alternate. *Flowers* cylindric, lobes 5, imbricate, then spreading; pedicels articulated at the base. *Petaloid appendages* 10, long club-shaped or filiform, inserted at the throat of the tube. *Stamens* twice as many as the calyx lobes, unequal in length, free from the tube at the throat; filaments long and slender, usually exserted, broadened into the connective; anthers oblong, slightly separated by the connective except at the top. Disk obscure, sometimes just a short toothed ring at the base of the ovary. *Ovary* stipitate, oblong or slightly obovate-oblong, densely hairy; style long, filiform; stigma capitate. *Fruits* ovoid or globose, surrounded by the cleft base of the floral tube; pericarp red, crustaceous. *Seeds* of the same shape as the fruit; testa membranous.

Distr. About 6 *spp.*, distributed in Siam (Chiengmai, Singora, and Dulit), Burma (Tenasserim, Silhet, and Chittagong), southern Indo-China (Annam, Laos, Cochin-China), and *Malaysia*: Malay Peninsula, Sumatra, and Borneo.

Ecol. In primary and secondary forests, once found in swamp forest, from the lowland up to 1300 m.

Taxon. The genus has been subdivided into two sections by HALLIER *f.* (Med. Rijksherb. *n.* 44, 1922, 27) and the two species in our region both belong to the *sect.* Psilaea (MIQ.) HALL. *f. l.c.* 28.

KEY TO THE SPECIES

1. Bracts leafy, ovate, as large as the ordinary leaves, 23–40 by 14–20 mm, usually opposite or subopposite, covering at least the lower half of the flower. Flowers 2–2½ cm long **1. L. pauciflorum**
1. Bracts small, lanceolate, much smaller than the ordinary leaves, 10 by 3 mm, alternate or opposite, at most covering the base of the flower. Flowers 3–3½ cm long . . . . **2. L. longiflorum**

1. Linostoma pauciflorum GRIFF. Calc. J. Nat. Hist. 4 (1844) 234, in note; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 261; MEISN. in DC. Prod. 14 (1857) 600; MIQ. Fl. Ind. Bat. 1, 1 (1858) 882; KURZ, J. As. Soc. Beng. 39, ii (1870) 83; For. Fl. Burm. 2 (1877) 334; HOOK. *f.* Fl. Br. Ind. 5 (1886) 198; BOERL. Handl. 3 (1900) 107, 111; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 164; Fl. Mal. Pen. 3 (1924) 146.—*Psilaea dalbergioides* MIQ. Sum. (1861) 355.—*L. leucodipterum* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 28; AIRY SHAW, Kew Bull. (1940) 262.—**Fig. 11b–g.**

A climber up to 24 m, rarely a shrub or small tree up to 7 m (*cf.* H. M. BURKILL & SHAH 240). Branches long, slender, black when dry. Leaves chartaceous, glabrous, rather glaucous beneath, elliptic, 1½–4(–6) by 1–2(–3½) cm; apex obtuse and mucronate or shortly acute; base acute, cuneate, obtuse, or rounded; petiole *c.* 2 mm. *Inflorescences* terminal or rarely axillary, (1–)2–4-flowered, nodding, umbelliform, provided with 2 opposite or subopposite leafy bracts at the lower half of the peduncle, besides sometimes a small linear bract (5–7 mm long) at the top of the peduncle; leafy bracts usually smaller than but sometimes as large as the ordinary leaves, ovate or oblong-ovate, 2⅓–4 by 1½–2 cm, whitish when dry, translucent and with less lateral nerves than the leaves. Peduncles 5–10 mm; pedicels *c.* 7 mm. *Flowers* green to greenish-white. Floral tube slender, slightly narrowed towards both ends, 12–15 mm long, usually glabrous on both surfaces. Calyx lobes linear. *Petaloid appendages* club-shaped or filiform, *c.* 5 mm long. *Stamens* 7–10 mm, usually exserted. *Ovary* including the stipe 4–6 mm long; style 15–18 mm, terminal or slightly sublateral; stigma capitate. *Fruits* ellipsoid, *c.* 1¼ cm long, narrowed to both ends.

Distr. S. Siam (Singora, Dulit), Burma (Tenasserim and E of Tounghoa in the Martaban Hills), and *Malaysia:* Sumatra (Simalur), Malay Peninsula (Perlis, Kedah, Dindings, Penang, and Singapore), and Borneo (W. Borneo).

Ecol. In primary and secondary forests, from the lowland up to *c.* 1300 m.

Vern. *Bĕbora, kakat bĕtul, kakrat butu* or *butol, pĕrakat bĕtul, tuba bara*, M.

Use. The Burmese use it medicinally (*cf.* BURK. Dict. 2, 1935, 1352; field note on CURTIS 3197).

2. Linostoma longiflorum HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 29.—**Fig. 11a.**

A slender climbing shrub. *Leaves* chartaceous, glabrous, dull on both surfaces, ovate, 3–3½ by

$1\frac{1}{2}$–$2\frac{1}{2}$ cm; apex obtuse and mucronate; base rounded, sometimes shortly acute. *Flowers* solitary or sometimes 2, axillary, or terminal on the short branchlets in the inferior leaf-axils of the branch; peduncle *c.* 5 mm, provided with 2 small bracts; pedicels *c.* 7 mm. *Flowers* green. Floral tube slightly ellipsoid, 2–$2\frac{1}{2}$ cm long, glabrous outside, sparsely pubescent inside. Calyx lobes oblanceolate, *c.* 10 mm long. *Petaloid appendages* 10, club-shaped, *c.* 6 mm long. *Stamens c.* 10 mm, usually exserted. *Ovary c.* 7 mm long, surrounded at the base by a very short disk; style long filiform, $3\frac{1}{2}$ cm; stigma capitate. *Fruit* unknown.

Distr. *Malaysia:* Borneo (Sarawak).

Ecol. Primary peat-swamp forest, at low altitude (*fide* J. A. R. ANDERSON 9047).

5. WIKSTROEMIA

ENDLICHER, Prod. Fl. Norfolk. (1833) 47, as *Wickstroemia*, *nec* SCHRADER 1821 (*Theac.*), *nec* SPRENGEL 1821 (*Comp.*), *nom. gen. cons.*; Gen. Pl. (1837) 332, Suppl. 4 (1847) 68; DOMKE, Bibl. Bot. 111 (1934) 124, t.4 f.36 r & s, map 6, *excl. syn. Stellera* L. *n.* 2.—*Capura* LINNÉ, Mant. Pl. 2 (1771) 149, *nom. gen. rejic.*—*Diplomorpha* MEISN. Denkschr. K. Bayer. Bot. Ges. Regensb. 3 (1841) 289.—**Fig. 12.**

Shrubs or undershrubs, sometimes trees. *Leaves* opposite or decussate, very rarely ternate, of various texture and shapes. *Inflorescences* terminal and/or axillary, fascicled or solitary, spicate, racemose, umbelliform or capitate, often ebracteate. *Flowers* subsessile or distinctly pedicelled, 4– or 5-merous; pedicel articulated. Floral tube cylindric or tubular, sometimes slightly funnel-shaped, usually caducous after anthesis, rarely persistent for some time. *Petaloid appendages* O. Calyx lobes usually in two pairs, imbricate, the external ones cucullate and usually slightly longer than the inner ones. *Stamens* sessile or filamentous, twice as many as the lobes, included, in two distinct series, usually both free from the upper half of the tube; anthers oblong, basifixed. Disk membranous, cup-shaped and slightly crenate or dentate, deeply lobed, or free and scale-like. Pistil sessile, rarely short-stiped, included. *Ovary* usually ellipsoid, glabrous or hairy at the top, 1-celled; style terminal, short, distinct or obscure; stigma large, capitate or disciform, rarely cylindric to ovoid. *Fruits* drupaceous, sometimes surrounded by the dried remains of the floral tube; pericarp fleshy or membranous. Seeds of the same shape as the fruit; embryo with thickened or flattened cotyledons and short or slightly elongated hypocotyl.

Distr. About 70 *spp.*, in SE. Asia, through *Malaysia* to Australia, Fiji, and Polynesia.

Taxon. All Malaysian species belong to *subg.* **Wikstroemia.**—*Sect. Euwikstroemia* MEISN. in DC. Prod. 14 (1857) 543.—*Subg. Euwikstroemia* DOMKE, Bibl. Bot. 111 (1934) tab. facing p. 58 (Type species: *W. australis* ENDL.).

Nomencl. In LINNAEUS's Sp. Pl. (1753) Addenda 559, there are two species described under the genus *Stellera*, *viz* 1. *S. passerina* L. from Europe, and 2. *S. chamaejasme* L. from Siberia. As these two species belong to different genera, the generic typification of *Stellera* L. and its delimitation has caused much controversy and confusion. As far as I could trace, FASANO (Atti Ac. Sc. Fis. Mat. Napoli 1787, 1788, 235) has been the first to point out that these two species do not belong to one genus; he proposed a new genus *Ligia* (= *Thymelaea*) typified by *Stellera passerina* L. and left *S. chamaejasme* L. in *Stellera*.
In 1844, C. A. MEYER (Bull. Ac. Imp. Sc. St. Pétersb. 1, 1843, 359; reimpr. Ann. Sc. Nat. Bot. II, 19, 1843, 49) again clearly indicated *Stellera chamaejasme* L. as the type species of the genus *Stellera*. This has been followed by MEISNER (in DC. Prod. 14, 1857, 548), LECOMTE (Not. Syst. 3, 1914, 212), STAPF (in Curtis's Bot. Mag. 1924, t. 9028), and HITCHCOCK & GREEN (Proposals by British Botanists 1929, 150).

DOMKE merged *Stellera* L. with *Wikstroemia*, in transferring its type species, *S. chamaejasme* L., to *Wikstroemia*, retaining the taxon as a separate subgenus *Chamaejasme* [AMMAN] DOMKE (*cf.* Notizbl. Berl.-Dahl. 11, 1932, 362; Bibl. Bot. 111, 1934, tab. facing p. 58, and p. 124). Accordingly he made the new combination, *W. chamaejasme* (L.) DOMKE. As REHDER has correctly pointed out (J. Arn. Arb. 15, 1934, 106–107) this is against the Rules of Nomenclature, because if *Stellera* and *Wikstroemia* are united for taxonomic reasons, *Stellera* has priority over *Wikstroemia*, unless *Stellera* is proposed as a *nom. gen. rejic.*

Fig. 12. *Wikstroemia brachyantha* MERR. *a*. Habit, × ⅔, *b*. opened flower, × 4/3.—*W. androsaemifolia* DECNE. *c*. Habit, × ⅔, *d*. opened flower, × 3.—*W. tenuiramis* MIQ. *e*. Habit, × ⅔, *f*. opened flower, × 3, *g*. pistil with scale-like disk at base, × 7 (*a–b* CLEMENS 32439, *c* COERT 41, *d* RANT *s.n.*, *e–f* For. Dep. N. Borneo 4173).

REHDER (*l.c.*) and POBEDIM (Fl. U.S.S.R. 15, 1949, 502) have, however, retained *Wikstroemia* and *Stellera* as two distinct genera.

If DOMKE's system will be followed, it will be desirable to conserve *Wikstroemia* against *Stellera*.

Uses. The bark is used for tying purpose, rope-making, and is also used in the manufacture of bank-notes and other strong papers (*cf.* BROWN, Min. Prod. Philip. For. 1, 1920, 403).

Notes. FAGERLIND (Hereditas 26, 1940, 38 & 48) found an agamogenic clone of *W. indica* which is an intraspecific triploid (2n = 27).

The tropical African *Englerodaphne* GILG, reduced by DOMKE (Bibl. Bot. 111, 1934, 134) to *Gnidia*, looks astonishingly like *Wikstroemia* and seems to differ from it only by the presence of petaloid appendages.

KEY TO THE SPECIES

1. Nerves running towards the margin and merging into an intramarginal vein.
 2. Leaves membranous to papery, lanceolate to narrow-lanceolate (3–8½ by ½–2½ cm). Peduncle slender, terete. Pedicel articulated at the middle or the upper half, after falling of the flower or fruit leaving a short stalk on the rachis . . . . **1. W. lanceolata**
 2. Leaves subcoriaceous to coriaceous, rarely chartaceous, elliptic- or ovate-oblong, rarely lanceolate (5–15 by 2½–5 cm). Peduncle stout, slightly angular and gradually thickened towards the apex. Pedicel articulated at the base, after falling of the flower or fruit leaving a prominent scar on the rachis . . . . **2. W. brachyantha**
1. Nerves running towards the margin and then curving upwards, not merging into an intramarginal vein.
 3. Leaves usually ovate, elliptic to lanceolate, (1¾–15½ by ¾–5 cm), membranous to chartaceous, rarely subcoriaceous; usually olivaceous to light-brown; apex always acute to acuminate; margins not cartilaginous. All internodes of the branchlets usually distinct and more than 1 cm long.
  4. Inflorescences usually axillary and occurring in *several* subsequent leaf axils along the branchlets, sometimes also terminal in addition. (Leaves rather discoloured). . . . **3. W. tenuiramis**
  4. Inflorescences usually terminal, and/or in the axils of the terminal node.
   5. Flowers articulated at the top of the pedicel, after falling of the flower or fruit leaving a short stalk on the rachis. (Leaves ovate or ovate-oblong, 4–14 by 3½–5 cm; base usually obtuse or cuneate, rarely subcordate. Flowers 1¼–2 cm long) . . . . **4. W. ovata**
   5. Flowers articulated at the base or near the base of the pedicel, after falling of the flower or fruit leaving a prominent scar or a short protuberance on the rachis.
    6. Inflorescences racemose; rachis usually elongating, ½–4 cm long, usually many-flowered, sometimes also associated with few-flowered inflorescences.
     7. Inflorescences usually erect, or slightly curved at the upper part, very rarely nodding from the base. Flowers loosely arranged on the rachis. Ovary usually glabrous. Anthers usually apiculate . . . . **5. W. polyantha**
     7. Inflorescences nodding from the base. Flowers densely arranged on the rachis. Ovary hairy at the top. Anthers usually obtuse . . . . **6. W. venosa**
    6. Inflorescences umbelliform; rachis not elongating, very short or less than ½ cm long, few-flowered.
     8. Flowers (15–)18–22 mm long. Stamens usually sessile; anthers 1½–2 mm long. Leaf base obtuse, occasionally shallow-cordate, very rarely attenuate . . . . **7. W. meyeniana**
     8. Flowers 9–15 mm long. Stamens distinctly filamentous; anthers 1–1½ mm long. Leaf base acute, attenuate or obtuse.
      9. Flowers 9–12 mm long, puberulous outside. Leaves acute at both ends, 1¾–5½(–8) by ¾–2½ (–4) cm . . . . **8. W. androsaemifolia**
      9. Flowers *c.* 15 mm long, almost glabrous outside at maturity. Leaves acuminate at the apex, attenuate, acute or obtuse at the base, (4–)6–15½ by (2½–)3–5 cm . . **9. W. ridleyi**
 3. Leaves usually obovate- or elliptic-oblong, oblanceolate, elliptic, or rarely ovate, 1¼–4½(–7) by ½–2(–3½) cm, subcoriaceous, brown to reddish-brown; apex usually rounded or obtuse, rarely acute; margins usually cartilaginous; internodes of the branchlets usually obscure or very short, 2–5 mm long (usually transversely fissured). . . . . **10. W. indica**

1. Wikstroemia lanceolata MERR. Publ. Govt Lab. Philip. 29 (1905) 31; Philip. J. Sc. 1 (1906) Suppl. 101; 5 (1910) Bot. 366; BROWN, Min. Prod. Philip. For. 1 (1920) 404; MERR. En. Philip. 3 (1923) 133.—*W. angustissima* MERR. Philip. J. Sc. 7 (1912) Bot. 92; En. Philip. 3 (1923) 132.

An undershrub up to 4 m. Young branchlets densely appressed-pubescent and glabrescent. *Leaves* membranous to papery, glabrous, rarely sparsely pubescent on the midrib beneath, lanceolate to narrowly lanceolate, 3–8½ by ½–2½ cm; base obtuse; apex acuminate; nerves 10–16 pairs, sometimes branched and irregular, slightly elevated beneath, visible or obscure above, obliquely spreading to the margins and united into an intramarginal vein; veins obscure or distinct, spreading and loosely reticulate; petiole short, 1–2½ mm, appressed-hirtellous. *Inflorescences* umbelliform to shortly spicate, terminal, very rarely axillary; peduncles very short, sometimes up to 1½ cm, (1–)3–5(–20)-flowered; pedicels *c.* 1–1½ mm, appressed-hirtellous. *Flowers* green or yellowish-green, 6–15 mm long, puberulous, glabrescent outside. Calyx lobes ovate or oblong, obtuse, *c.* 1 mm long. *Stamens* sessile or short-filamentous, *c.* ¾–1½ mm long. Disk 2 free scales, linear or slightly oblong. *Ovary* ovoid, slightly hairy at the apex; style obscure; stigma subglobose. *Fruits* short-ovoid, *c.* 8 by 5 mm, usually glabrous sometimes sparsely hairy at the top, pericarp fleshy. *Seeds* 6 mm long.

Distr. *Malaysia:* Philippines (Palawan, Mindoro, and Luzon).

Ecol. Common on forested slopes at low and medium altitudes up to 1300 m.

Vern. Philippines: *karanpinig*, Neg., *maragawa*, *salágip*, *salagó*, Tag., *suka*, *tuka*, Ilk.

2. Wikstroemia brachyantha MERR. Philip. J. Sc. 13 (1918) Bot. 313; En. Philip. 3 (1923) 132.— *W. crassifolia* MERR. *ex* DOMKE, Bibl. Bot. 111 (1934) tab. facing p. 58.—**Fig. 12a–b.**

Shrub or small tree up to 3½ m by 2½ cm. Branchlets puberulous, light brown. Branches reddish-brown and usually transversally fissured. *Leaves* subcoriaceous to coriaceous, rarely chartaceous, in dry condition both surfaces olivaceous-brown to brownish, glabrous and shining, elliptic-oblong to ovate-oblong, rarely lanceolate, 5–15 by 2½–5 cm; base obtuse to cuneate; apex acuminate; nerves 12–15 pairs, elevated and prominent beneath, slightly elevated or plane above, obliquely spreading towards the margin and united with the intramarginal vein; veins anastomosing, almost as prominent as the nerves; petiole 2–3 mm, glabrous. *Inflorescences* terminal or/and in the leaf axils at the terminal node, distinctly peduncled; peduncles stout, brownish-pubescent, sometimes angular or flattened and gradually thickening towards the top, usually bent slightly downward, sometimes with 1 or 2 bracts below the 6 to 8 apical flowers. *Flowers* yellowish, yellowish-green or green, subsessile. Floral tube 10–12 mm long, sparsely puberulous outside, glabrous inside. Calyx lobes 4, ovate-oblong, 1½–3 mm long, obtuse. Two series of *stamens* close to each other, on very short filaments; anthers oblong, obtuse, 1½ mm long. Disk 2 free, oblong, 2-lobed scales. *Ovary* ellipsoid or slightly obovoid-oblong, 3 mm long, hairy at the top; style distinct, filiform, *c.* 1 mm; stigma globose, papillose. *Fruits* red, broadly ellipsoid, 12 by 9 mm.

Distr. *Malaysia:* Borneo (Kinabalu) and Philippines (Luzon and Catanduanes).

Ecol. In the Philippines in primary forests at low and medium altitudes, in Borneo (Mt Kinabalu) in damp and mossy forests at 1400–2800 m.

Note. This species is characterized by its usually thick leaves with prominent venation especially on the lower surface, a marginal vein on each side, and the stout peduncle.

3. Wikstroemia tenuiramis MIQ. Sum. (1861) 141 & 354; BOORSMA, Bull. Dép. Agric. I.N. *n.* 7 (1907) 19; HEYNE, Nutt. Pl. (1927) 1152; BURK. Dict. (1935) 2258.—*W. acuminata* MERR. J. Str. Br. R. As. Soc. *n.* 76 (1917) 99; En. Born. (1921) 417; Un. Cal. Publ. Bot. 12 (1929) 218.—*W. clementis* MERR. J. Str. Br. R. As. Soc. *n.* 76 (1917) 99; En. Born. (1921) 417; HEINE, Pfl. Clemens Kinabalu (1953) 69.—**Fig. 12c–g.**

Shrub or small tree, up to 10 m. Branchlets light-brown to dark-brown, sparsely pubescent, glabrescent. Branches smooth, reddish-brown, glabrous. *Leaves* membranous to papery, glabrous, in the dry state the upper surface subolivaceous or light-brown, rather shining, lower surface dirty-white or light-green, rather dull, sometimes light-brown on both surfaces, ovate-oblong, elliptic-oblong, broadly-elliptic, or lanceolate, rarely ovate, 6–12 by 1½–4½ cm; base cuneate, acute or obtuse; apex acuminate, the acumen up to *c.* 1 cm; nerves 7–12 pairs, rather irregular, slightly elevated, rarely indistinct on both surfaces, obliquely ascending close towards the margin and then curved upward; veins loosely anastomosing, reticulations usually obscure on both surfaces; petiole *c.* 4 mm. *Inflorescences* usually axillary and occurring in several leaf axils along the branches or branchlets, sometimes also terminal or on the top of a reduced or very short branchlet with bract-like reduced leaves, 1–5-flowered; peduncle very short to 1½ cm, appressed-puberulous. *Flowers* 10–13 mm long, yellowish, or cream (*fide* CLEMENS 20980), subsessile. Floral tube scattered-puberulous outside, glabrescent. Calyx lobes ovate-oblong, 2–3 mm long. *Stamens* with *c.* ½ mm space between the two whorls, those of the upper series sessile or sometimes some of them shortly filamentous, those of the lower series always shortly filamentous; anthers linear, 1–1½ mm long, acute or slightly apiculate. *Ovary* oblong or slightly obovoid-oblong, *c.* 2 mm long, glabrous or a few hairs at the top; style very short or sessile; stigma capitate, papillose. *Fruits* yellow, green or orange, ovoid, *c.* 8 by 5 mm.

Distr. *Malaysia:* Sumatra (Menggala), Banka, Borneo (N. Borneo, Brunei, Sarawak, and S. Borneo: Sampit).

Ecol. In forests, swampy land, and hills, from the lowland up to 1600 m.

Uses. According to BOORSMA (*l.c.*) it provides a scented wood which is used only occasionally. The wood is harder than that of *Aquilaria* and scentless, but when burned it gives forth a fragrance similar to that of *Aloe*-wood. In Banka the bark is used for making ropes.

Vern. *Injat*, Brunei, *kaju lingau*, Menggala, *měnaměng*, *těměntak tindat*, Banka.

Note. This species can easily be distinguished from related ones by the axillary inflorescences which occur in several leaf axils along the branchlets or branches, the more or less discoloured leaves, and the usually indistinct venation.

Mrs CLEMENS once noted this species to be a vine (*n.* 31292) but I believe this to be due to erroneous information by her native collectors.

4. Wikstroemia ovata C. A. MEY. [Bull. Ac. Imp. Sc. St. Pétersb. Cl. Ph.–M. 1 (1843) 357; reimpr. Ann. Sc. Nat. Bot. II, 20 (1843) 50, *nomen*] *ex* MEISN. in DC. Prod. 14 (1857) 544; MIQ. Fl. Ind. Bat. 1, 1 (1858) 880; F.-VILL. Nov. App. (1880) 182; VIDAL, Phan. Cuming. (1885) 140; Rev. Pl. Vasc. Filip. (1886) 230, *excl. syn. Daphne aquilaria* BLANCO; MERR. Philip. J. Sc. 1 (1906) Suppl. 101; Sp. Blanc. (1918) 279; BROWN, Min. Prod. Philip. For. 1 (1920) 404; MERR. En. Philip. 3 (1923) 133, *excl.* citation of VIDAL, Synopsis; QUIS. Med. Pl.

Philip. (1951) 637.—*Daphne indica* (*non* LINNÉ) BLANCO, Fl. Filip. (1837) 309, ed. 2 (1845) 215, ed. 3, 2 (1878) 38.—*Daphne foetida* (*non* LINNÉ) BLANCO, *l.c.* 308, as *phaetida*, *ll. cc.* 217, 37.

Shrub up to 5 m by 7–8 cm. Young branchlets appressed-hirtellous, glabrescent or glabrous. *Leaves* membranous or papery, glabrous, rarely sparsely pubescent on the midrib beneath; ovate to ovate-oblong, 4–14 by 3½–5 cm; base usually obtuse or cuneate, rarely subcordate; apex acuminate; nerves 8–12 pairs, curved and ascending, slightly elevated below, distinct above; veins reticulate, distinct beneath, visible or obscure above, petiole 3 mm, sparsely appressed-hirtellous. *Inflorescences* terminal, short-spicate or umbelliform, peduncled, sparsely puberulous, sometimes with 1 or 2 caducous bracts, 7–20-flowered. *Flowers* 1¼–2 cm long, greenish, yellowish, at the upper end of the peduncle, short-pedicelled. Floral tube cylindric, sparsely puberulous outside. Calyx lobes oblong, obtuse, 2–4 mm long. *Stamens* sessile or on short filaments; anthers 1–1½ mm, slightly apiculate. Disk 2 free, oblong, scales. *Ovary* ellipsoid, 2–3 mm long, hairy at the apex; style distinct, filiform, ¾–1¼ mm; stigma capitate. *Fruits* subglobose to slightly ellipsoid, 8–10 by 6–8 mm.

Distr. *Malaysia:* Borneo (North Borneo, Sebattik I., Sampit, and Pulu Lampei) and the Philippines (Palawan, Mindoro, Luzon, Negros, and Mindanao). Fig. 13.

Ecol. In thickets, primary and secondary forests at low and medium altitudes up to 800 m.

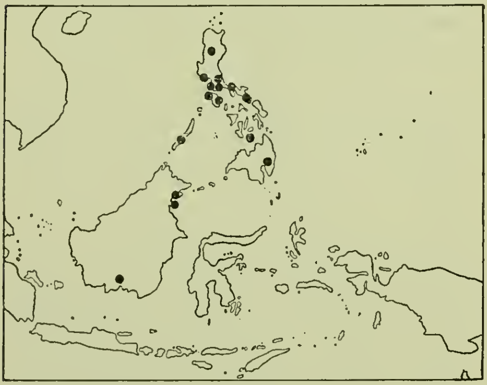

Fig. 13. Localities of *Wikstroemia ovata* C. A. MEY. *ex* MEISN.

Uses. This plant has been used by the Filipinos as a purgative. The leaves are a strong purgative when chewed and swallowed and one bowel movement is produced for every taken. The fresh bark or branches of this plant are tied round about the neck of a patient to relieve bronchial catarrh (*cf.* GARCIA, Philip. J. Sc. 51, 1933, 485–494; QUIS. *l.c.*).

Vern. Philippines: *arandón*, Ilk, *dapnit*, *suka*, Bon., *salagó*, Tag.; Borneo: *gĕlam hutan*, Brunei, *pait-pait*, Bajau.

5. Wikstroemia polyantha MERR. Philip. J. Sc. 10 (1915) Bot. 332; En. Philip. 3 (1923) 133.—*W. candolleana* (*non* MEISN.) RIDL. Trans. Linn. Soc. Bot. II, 3 (1893) 341, as *candollei*, corr. p. 456; J. Str. Br. R. As. Soc. *n.* 35 (1901) 180; Fl. Mal. Pen. 3 (1924) 145; BURK. & HEND. Gard. Bull. S.S. 3 (1925) 417; HEYNE, Nutt. Pl. (1927) 1152; BURK. Dict. (1935) 2258; SYMINGT. J. Mal. Br. R. As. Soc. 14 (1936) 358.—*W. junghuhnii* (*non* MIQ.) K. & V. Bijdr. 13 (1914) 58, *sphalm. junghuhniana.*—*W. ridleyi* (*non* GAMBLE) GIBBS, J. Linn. Soc. Bot. 42 (1914) 132; MERR. En. Born. (1921) 417.—*W. calva* BACK. Blumea 5 (1945) 494.

Shrub or small tree up to 7 m by 7½ cm. Branchlets reddish to dark-brown, sparsely puberulous, glabrescent. *Leaves* membranous, chartaceous, rarely subcoriaceous, glabrous on both surfaces, rarely scattered hairy beneath especially on the midrib, in dry condition light-brown to dark-brown above, paler beneath, ovate-oblong, elliptic-oblong, or lanceolate, 6–9(–12) by 1½–3½ (–4½) cm; base acute to cuneate, sometimes obtuse or rounded; apex acuminate, rarely acute; margins sometimes slightly recurved; nerves 8–15 pairs, irregular, often branched, elevated beneath, distinct or plane above, obliquely ascending towards the margin; veins obscure on both surfaces, sometimes as distinct as the nerves; petiole 2–4 mm, sparsely pubescent. *Inflorescences* terminal or/and in the axils at the terminal node, spicate, gradually elongating, up to 4 cm, rarely to 6 cm, erect or slightly curved, very rarely nodding (S.F. 20726), with 6 to many flowers; peduncle distinct, sparsely hairy. *Flowers c.* 10 mm long, yellow, yellowish-green, or rarely white (*fide* RIDLEY), loosely arranged on the rachis; pedicels very short, ½–1 mm, puberulous, articulated at the base. Floral tube scattered puberulous outside, glabrous inside. Calyx lobes oblong or ovate-oblong, 1½–3½ mm long. *Anthers* linear, *c.* 1 mm long, the two series close to each other; filaments *c.* ½ the length of the anther. Disk 2 free, linear or obovate-oblong, *c.* 1 mm long, irregularly lobed or dentate scales. *Ovary* ellipsoid or obovoid, 1½–2½ mm long, glabrous or sparsely hairy at the top; style distinct, as long as or slightly longer than the stigma; globose or slightly oblong, *c.* ½ mm long, papillose. *Fruits* ovoid, red, *c.* 8½ by 5½ mm.

Distr. *Malaysia:* Malay Peninsula (Pahang, Kedah, Perak, Johore, Kelantan, Selangor, and Gunong Korbu), Java (western part), North Borneo, and Philippines (Luzon).

Ecol. In forests, from the lowland up to 2200 m.

Use. The wood yields incense.

Vern. *Chandan pĕlaudok*, M.

Notes. BACKER (*l.c.*) has pointed out that the name "*Wikstroemia junghuhniana*" (*non* MIQ.) given by KOORDERS & VALETON (*l.c.*) was an error because they intended to identify their specimens (KOORDERS 26824 β and J. J. SMITH 292, Bo) as *W. junghuhnii* MIQ. (= *W. androsaemifolia* DECNE). The sheets cited by KOORDERS & VALETON under "*W. junghuhniana*" as mentioned above differ from *W. junghuhnii* MIQ. and belong to a different species; therefore, BACKER provided them with a new name "*Wikstroemia calva*" to indicate the 'completely glabrous ovary tip'. However, whether the ovary is glabrous or hairy at the apex is not a constant character as some specimens (*e.g.* VAN STEENIS 4187 & 12930) have both kinds of ovaries. Specimens collected at high altitude have thicker and reddish-brown leaves.

The species is characterized by the long-spicate inflorescences which are gradually elongating during flowering time. It is closely related to *W. nutans* CHAMP. from Kwangtung, China, differing from it by the larger leaves, distinct style, and the approximate insertion of the two whorls of stamens.

The inflorescences are erect or slightly curved with the exception of one specimen (S.F. 20726) collected in Pahang at *c.* 2100 m, which has both erect and nodding ones.

6. Wikstroemia venosa MERR. & PERRY, J. Arn. Arb. 22 (1941) 266.

Shrub, *c.* 1 m. Young branchlets densely yellowish-brown puberulous; older ones reddish- or dark-brown, puberulous, glabrescent. *Leaves* chartaceous or subcoriaceous, lower surface of the young leaves densely pubescent on the midrib and scattered pubescent on the lamina, glabrescent; in dry condition light brown or brown above and shining, glaucous beneath; ovate-oblong to lanceolate, 2–7 by 1–3 cm; base obtuse or cuneate; apex acute to acuminate; nerves 7–10 pairs, rather irregular, obliquely spreading towards the margin and then slightly curved ascending, elevated beneath, plane or slightly depressed above; petiole *c.* 2 mm long, puberulous. *Inflorescences* terminal, nodding, sessile or up to 1 cm peduncled; spicate, rachis elongated, ½–2 cm, puberulous. *Flowers* crowded, *c.* 8 mm, green; pedicel *c.* 1 mm, articulated at the base, puberulous. Floral tube scattered-puberulous outside and glabrous inside, sometimes glabrous outside. Calyx lobes oblong or ovate-oblong, 2–2½ mm long. *Stamens* shortly filamentous; anthers linear, *c.* 1 mm long, obtuse, the space between the two series *c.* ¾ mm. Disk 2 free linear scales, bilobed at the top, sometimes disk cup-shaped and erose at the top, ½–1 mm long. *Ovary* slightly obovate-oblong, *c.* 1½ mm long, sparsely strigose at the top; style short, *c.* $^1/_5$ mm; stigma capitate. *Fruits* ellipsoid, 6–8 mm long, slightly narrowed at both ends. *Seed* similar in shape to the fruit.

Distr. *Malaysia:* New Guinea (Balim Valley, Manokwari, Humboldt Bay, Hollandia, and Rona (Central Div.)).

Ecol. Deforested slopes, grassland, occasionally on grassy banks of streams, lowland up to 1900 m.

7. Wikstroemia meyeniana WARB. in Perk. Fragm. Fl. Philip. (1905) 171; MERR. Philip. J. Sc. 1 (1904) Suppl. 101; BROWN, Min. Prod. Philip. For. 1 (1920) 404, t. 23; MERR. En. Philip. 3 (1923) 133. —*Daphne cannabina* (*non* LOUR.) SCHAUER, Nov. Act. Caes. Leop.-Car. 19 (1843) Suppl. 1, 411.— *W. longifolia* LECOMTE, Not. Syst. 3 (1914) 128; Fl. Gén. I.-C. 5 (1915) 167; LÉANDRI, Proc. 8th Pac. Sc. Congr. 4 Bot. (1957) 582, *incl. var.*— *W. fenicis* MERR. Philip. J. Sc. 13 (1918) Bot. 312; En. Philip. 3 (1923) 132.

Shrub up to 3 m. Young branchlets sparsely pubescent, glabrescent, sometimes glabrous. *Leaves* papery, glabrous, olivaceous, shining, lanceolate rarely elliptic-lanceolate, (5–)9½–13 by (1½–) 3½–4½ cm; base obtuse occasionally shallow-cordate or attenuate; apex acuminate; nerves 9–14 pairs, slightly curved and ascending, elevated beneath, visible or obscure above, veins reticulate, slightly elevated beneath, obscure above; petiole 3–4 mm. *Inflorescences* terminal and axillary, umbelliform, sometimes occurring on short, reduced branchlets associated with reduced leaves (2–3 cm long) and resembling a leafy panicle, (2–)5–6 (–10)-flowered; peduncle up to 3 cm, densely appressed-hirtellous. *Flowers* greenish-yellow, (15–) 18–22 mm long, densely puberulous outside. Floral tube cylindric. Calyx lobes narrow-oblong, 2–3½ mm long. *Stamens* usually sessile rarely some of them on short filaments, 1½–2 mm long. Disk 2 free, oblong scales. *Ovary* slightly obovoid, 2–2½ mm long, hairy at the apex; style distinct, ½–1 mm long; stigma oblong, ⅓–½ mm long. *Fruit* ovoid, *c.* 8 by 6 mm.

Distr. Indo-China and *Malaysia:* Philippines (Luzon to Mindanao).

Ecol. In primary humid forests at low and medium altitudes, up to *c.* 400 m.

Vern. Philippines: *sagú*, Tag., *salagó*, Bik., Tag.

8. Wikstroemia androsaemifolia DECNE, Ann. Sc. Nat. Bot. II, 20 (1843) 50; in Jacq. Voy. Bot. (1844) 146; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 74; MEISN. in DC. Prod. 14 (1857) 546; MIQ. Fl. Ind. Bat. 1, 1 (1858) 879; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 77, p. 5.—*W. spanoghii* DECNE, Ann. Sc. Nat. Bot. II, 20 (1843) 50; in Jacq. Voy. Bot. (1844) 146; BLEEKER, Nat. Geneesk. Arch. N.I. 2 (1845) 74; MEISN. in DC. Prod. 14 (1857) 545; MIQ. Fl. Ind. Bat. 1, 1 (1858) 879.—*Eriosolena viridiflora* ZOLL. & MOR. Nat. Geneesk. Arch. N.I. 1 (1844) 615, *excl. syn.* Hassk. Cat. 117; ZOLL. Syst. Verz. 2 (1854) 116.—*W. candolleana* MEISN. in DC. Prod. 14 (1857) 544; K. & V. Bijdr. 13 (1914) 56; MIQ. Fl. Ind. Bat. 1, 1 (1858) 878; HALL. *f.* Med. Rijksherb. *n.* 12 (1912) 26; K. & V. Bijdr. 13 (1914) 56; HEYNE, Nutt. Pl. (1927) 1152; BURK. Dict. 2 (1935) 2258. —*W. junghuhnii* MIQ. Fl. Ind. Bat. 1, 1 (1858) 879; HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 30.— **Fig. 12c–d.**

Shrub up to 2½ m by 4 cm. Young branchlets slightly flattened at the nodes, densely appressed-pubescent, glabrescent. Branches terete, reddish-brown, glabrous; axillary buds densely covered with golden-coloured hairs. *Leaves* papery, glabrous, rarely sparsely hairy on the lower surface and especially on the nerves and veins of young leaves, in dry state light-greenish, light-brown or greenish-brown to brownish and shining on the upper surface; pale-greenish, light-yellowish -green or light-brown and dull on the undersurface; elliptic, elliptic- or ovate-oblong, rarely broadly elliptic, 1¾–5½(–8) by ¾–2½(–4) cm; base acute; apex acute to narrow-acute, very rarely obtuse; nerves 8–11 pairs, elevated below and slightly depressed above, obliquely spreading towards the margin and then curved upward; veins almost as distinct as the nerves, loosely reticulate beneath, obscure above; petiole *c.* 2 mm. *Inflorescences* umbelliform or spicate, 5–10-flowered, terminal and in the axils of the terminal node, so usually 3 inflorescences at the top of the branchlet, of which usually the middle one (sometimes also the lateral ones) is provided with a pair of bracts or reduced leaves; peduncle obscure to 3½ cm, erect or slightly curved; pedicels *c.* 1 mm, articulated at the base. *Flowers* light-green or yellowish-green. Floral tube slightly pubescent outside, 9–12 mm long. Calyx lobes oblong, or slightly ovate, fleshy, 2–3½ mm long, obtuse. Disk 2, rarely 3 free, linear scales. *Stamens* filamentous; anther *c.* 1 mm long, obtuse, the space between the anthers of upper and lower series 1–1½ mm. *Ovary* ellipsoid or slightly obovoid, 1½–2½ mm long, pilose at the top, sometimes glabrescent; style obscure to 1 mm long; stigma globose, *c.* ¼ mm in diam. *Fruits* red, oblong, rounded.

Distr. *Malaysia:* Central and East Java, Madura, Kangean Arch., Lesser Sunda Islands (Flores and Timor), Borneo (North Borneo, Koetai and Balikpapan), Celebes (Bonthain, Manado, and G. Pangararan), and W. New Guinea.

Ecol. In lowland forests from near the beach up to 1800 m, in Celebes at 2200–2400 m.

Note. There are two authentic sheets of *W. androsaemifolia* in the Nat. Hist. Mus., Paris; one is labelled as 'Java Leschenault' and the other as 'Daphne *n.* 341'. Apparently these specimens may belong to one collection, as they are very similar. The leaves are papery and rather discoloured, brownish above, light-brown beneath, and not larger than 6 by 2½ cm. The flowers are about 10 mm long, sessile, and fascicled or crowded on a short peduncle (*c.* 10 mm). The ovary is sparsely hairy or glabrous at the top.

The type of *W. spanoghii* was collected by SPANOGHE (*s.n.*, L) in Timor. Its leaves are rather membranous, pale-greenish beneath, light-greenish above, and the size is up to 8 by 2½ cm. It has longer, spicate inflorescences and the longest peduncle is *c.* 2½ cm. The ovary is densely hairy at the top, and the style is obscure.

When one compares the type specimens of these two species they do not seem to be conspecific. However, after examining a large range of specimens, there are too many intermediate forms in which the differential characters break down. Consequently I have interpreted them as forms of one variable species.

The type specimen of *W. junghuhnii* MIQ. collected by JUNGHUHN (*s.n.*, L) on Mt Ungaran (Central Java) and some specimens (*e.g.* KOORDERS 43148 *β*, 43875 *β*, 43876 *β*, and VAN STEENIS 17974) collected on mountains between 1100–1800 m have leaves with distinct, densely reticulated venation, and flowers with distinct peduncles and short styles.

HANDEL-MAZZETTI described a different species from Yunnan, China, as *W. androsaemifolia* in 1923. If this proves to be a good species it must be renamed.

9. **Wikstroemia ridleyi** GAMBLE, Kew Bull. (1912) 200; J. As. Soc. Beng. 75, ii (1912) 260; RIDL. Fl. Mal. Pen. 3 (1924) 146, f. 147; BURK. Dict. (1935) 2258.

Shrub up to 2 m. Branchlets reddish-brown, sparsely puberulous and glabrescent. *Leaves* membranous to chartaceous, usually olive-brown when dry, glabrous on both surfaces, rarely sparsely puberulous on the midrib beneath, elliptic-oblong, lanceolate, ovate-oblong or ovate, 4–15½ by 2½–4½ cm; base attenuate, acute or obtuse; apex acuminate; nerves 7–12 pairs, slightly curved towards the margin and then upward, slightly elevated on both surfaces; veins obscure on both surfaces; petiole 2–3 mm, sparsely puberulous when young. *Flowers c.* 15 mm long, yellow or greenish-yellow, 6–14, umbelliform on a terminal, very short, slightly puberulous peduncle; pedicels *c.* 1 mm, articulated towards the base, puberulous. Floral tube sparsely puberulous outside, glabrescent, glabrous inside. Calyx lobes ovate-oblong, obtuse, 3½–4 mm long. *Stamens* shortly filamentous, free from the tube at the upper half, the two series *c.* 1 mm apart; anthers linear, obtuse or slightly apiculate, *c.* 1½ mm long. Disk 2 free linear, *c.* 1 mm long, 2-lobed scales. *Ovary* ellipsoid or slightly obovoid, 1½–2 mm long, hairy at the apex; style very short or obscure; stigma globose and papillose. *Fruits* red, ellipsoid or ovoid, 8 by 5 mm. Seeds ovoid, the same shape as the fruit.

Distr. Lower Siam (Telok Udang) and *Malaysia:* Malay Peninsula, chiefly on the east coast (Kelantan, Trengganu, Pahang, Burau Bay).

Ecol. Sandy open coastal country.

Uses. The species contains a purgative substance and the leaves are eaten as an aperient. The bark is used as entering into a compound potion against small-pox; it is pounded and converted into a poultice for applying to boils, or merely tied round the neck to stop vomiting. It is also used as a fish-poison. The fruits are poisonous (*cf.* BURKILL).

Vern. *Dĕpu*, *dĕpu pĕlandok*, M; *dalu pĕlandok* is a misprint (*cf.* BURKILL, *l.c.*).

Note. According to RIDLEY this plant was brought from Pekan (not: Penang!) to Singapore in 1890 and "ran wild for some time in Tanglin, Singapore".

Three specimens have been cited in the original description, collected by RIDLEY at Pahang (Kwala Brawas: RIDLEY 1583, lectotype and Pekan: RIDLEY *s.n.*, Aug. 1889, paratype) and Tringganu (Pulo Katan: RIDLEY *s.n.*, Aug. 22, 1899, paratype).

10. **Wikstroemia indica** (L.) C. A. MEY. Bull. Ac. Sc. St. Pétersb. 1 (1843) 357; reimpr. Ann. Sc. Nat.

Bot. II, 20 (1843) 50; MEISN. in DC. Prod. 14 (1857) 543; MIQ. Fl. Ind. Bat. 1, 1 (1858) 880; BENTH. Fl. Austr. 6 (1873) 37; F.-VILL. Nov. App. (1880) 182; VIDAL, Rev. Pl. Vasc. Filip. (1886) 229; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1894) 398; BOERL. Handl. 3 (1900) 111; BAILEY, Queensl. Fl. pt 4 (1901) 1369; BOLD. Zakfl. (1916) 171; MERR. Sp. Blanc. (1918) 279; BROWN, Min. Prod. Philip. For. 1 (1920) 404; MERR. En. Philip. 3 (1923) 132; REHDER, J. Arn. Arb. 15 (1934) 103; MERR. Comm. Lour. (1935) 278; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 77, p. 4; HOLTH. & LAM, Blumea 5 (1942) 216.—*Daphne indica* LINNÉ, Sp. Pl. (1753) 375.—*Daphne aquilaria* BLANCO, Fl. Filip. (1837) 310; ed. 2 (1845) 216; ed. 3, 2 (1878) 39.—*W. viridiflora* MEISN. Denkschr. K. Bayer. Bot. Ges. Regensb. 3 (1841) 286; DECNE, in Jacq. Voy. Bot. 4 (1844) 145; MEISN. in DC. Prod. 14 (1857) 546; MIQ. Fl. Ind. Bat. 1, 1 (1858) 879; VIDAL, Rev. Pl. Vasc. Filip. (1886) 229; MERR. Philip. J. Sc. 3 (1908) Bot. 422; BACK. Ann. Jard. Bot. Btzg Suppl. 3 (1909) 419; K. & V. Bijdr. 13 (1914) 54; RIDL. Fl. Mal. Pen. 3 (1924) 145; GUILLAUMIN, J. Arn. Arb. 13 (1932) 88; BURK. Dict. (1935) 2259; LÉANDRI, Proc. 8th Pac. Sc. Congr. Manila 4 (1957) 582.—*W. ovata* (*non* C. A. MEY.) VIDAL, Synopsis (1883) 229.—*W. indica var. viridiflora* HOOK. *f.* Fl. Br. Ind. 5 (1886) 195.—*W. linearifolia* ELM. Leafl. Philip. Bot. 2 (1910) 680; MERR. En. Philip. 3 (1923) 133.—*W. pulgarensis* ELM. Leafl. 5 (1913) 1844; MERR. En. Philip. 3 (1923) 133.—*W. pachyphylla* MERR. Philip. J. Sc. 12 (1917) Bot. 297; En. Philip. 3 (1923) 133.—*W. subcoriacea* MERR. J. Str. Br. R. As. Soc. *n.* 76 (1917) 100; En. Born. (1921) 417; HEINE, Pfl. Clemens Kinabalu (1953) 69.—*Daphne sp.* STEEN. Bull. Jard. Bot. Btzg III, 13 (1933) 254.

Shrub up to 3 m. Branchlets black-brown, scattered puberulous, glabrescent, sometimes transversally fissured. Internodes usually very short or even obscure. *Leaves* chartaceous to subcoriaceous, in dry condition usually brown to reddish-brown, sometimes glaucescent, sparsely puberulous beneath, glabrescent, or glabrous, shining above and rather dull beneath, obovate- or elliptic-oblong, oblanceolate, elliptic, rarely ovate, 1¼–4½(–7) by ½–2(–3¼) cm; base cuneate to attenuate; apex rounded, obtuse, sometimes slightly emarginate, or acute; margins usually cartilaginous; nerves 5–12 pairs, irregular, and often branched, obliquely ascending towards the margin, rarely the basal 1 or 2 nerves on each side ascending along the margin towards near the top, usually distinct beneath obscure above, sometimes obscure on both surfaces; veins obscure or invisible on both surfaces. Petiole *c.* 2 mm. *Inflorescence* terminal, sometimes 1–2 additional ones in the axils of the terminal node, few-flowered, subsessile, sometimes on a very short peduncle; pedicels 1½–2 mm, articulated at the base. *Flowers* green, 10–12 mm long, sparsely puberulous outside, glabrous inside. Calyx lobes 2–3 mm long, broadly ovate or oblong, obtuse. *Stamens* very shortly filamentous, rarely sessile; anthers linear, *c.* 1 mm long, sometimes those of the lower series slightly shorter, obtuse rarely apiculate at the apex, the two series *c.* 1 mm apart. Disk 2 free, linear, *c.* ¾ mm long scales with narrowed or obliquely truncate top, sometimes lobed or crenate at the apex. *Ovary* slightly obovoid or elliptic, *c.* 1½ mm long, sparsely hairy or glabrous at the top; style very short or obscure; stigma globose, *c.* ⅓ mm diam. *Fruits* broadly ellipsoid, *c.* 6 by 4 mm, red.

Distr. India, SE. Asia, through Malaysia to Australia (N. Australia, Queensland, and N.S. Wales) and Melanesia (as far E as Fiji), in *Malaysia* not found in the seasonal parts: absent from the Lesser Sunda Islands, in Java only found in the vicinity of Bogor and once found at 1100 m near Sindanglaja as an escape from the Botanic Gardens, now locally thoroughly naturalized and slowly spreading along roadsides and in other anthropogenous terrain (BACKER, 1909 *l.c.*).

Ecol. In thickets and secondary growths, obviously very soil-tolerant and occurring in various biotopes, for example on sandy soil near the beach, on limestone of a ridge top, on granite peaks, along river-banks, and on open hill-sides, from the lowland up to 1300 m, a few above 2200 m even up to 2700 m (in Celebes and New Guinea).

Vern. Borneo: *lajak*, M; Philippines: *inyam*, P. Bis., *arandón*, *baleo*, Ilk., *palupó*, *titpuho*, Iv., *salagó*, Tag., Bis., Bik., *talo*, Bik.; Celebes: *pĕràpata* or *posi-posi*, Manado.

Note. *W. indica* is a widely distributed species and is very variable in its vegetative parts. As pointed out by BENTHAM in a note under *W. indica* (Fl. Austr. 6, 1873, 37), "it is, however, not always easy to determine the limits to be assigned to it". FAGERLIND (*l.c.*) has found apomixis in this species, which may give an explanation of its great vegetative variability and difficulties involving in specific demarcation. With a large number of specimens of this species available, no sharply defined infraspecific taxa or forms can be distinguished.

Excluded

W. amplifolia (SCHLTR) DOMKE (Bibl. Bot. 111, 1934, 60) of New Caledonia (isotype: SCHLECHTER 14749, L) has erroneously been recorded for New Guinea by DOMKE (*l.c.*).

6. DAPHNE

LINNÉ, Gen. Pl. ed. 5 (1754) 167; Sp. Pl. (1753) 356; MEISN. in DC. Prod. 14 (1857) 530; GILG, in E. & P. Pfl. Fam. 3, 6a (1894) 237; DOMKE, Bibl. Bot. 111 (1934) 130, t.4 f.i & map 8.—*Scopolia* LINNÉ *f.* Suppl. (1781) 409, *non* JACQ. 1764, *nec al.*—*Eriosolena* BL. Bijdr. (1826) 651; VAN TIEGH. Bull. Soc. Bot. Fr. 40 (1893) 67; DOMKE, Bibl. Bot. 111 (1934) 70–83, 130, t.4 f.36 C & map 10.—

Fig. 14. *Daphne luzonica* C. B. Rob. *a.* Habit, × ⅔, *b.* opened flower, × 4.—*D. composita* (L. *f.*) Gilg. *c.* Habit, × ⅔, *d.* opened flower, × 4, *e.* fruit, × 2, *f.* seed, × 2, *g.* longitudinal section of fruit, × 2 (*a–b* BS 40335, *c–d* Rahmat si Boeea 11238, *e–g* SF 51832).

Daphne sect. Eriosolena Meisn. Denkschr. K. Bayer. Bot. Ges. Regensb. 3 (1841) 283; in DC. Prod. 14 (1857) 540.—**Fig. 14.**

Shrubs, rarely small trees or dwarf shrubs. *Leaves* spirally arranged, sometimes subopposite or crowded towards the upper part of the branchlets. *Inflorescences* usually capitate, ebracteate or surrounded by caducous bracts, terminal and/or axillary, sessile or peduncled, sometimes racemose or a few flowers in a fascicle, rarely paniculiform, usually with some linear bracteoles in the leaf axils or at the base of the peduncle. *Flowers* 4-merous, sessile. Floral tube cylindric or slightly infundibuliform, glabrous or pubescent outside, usually caducous after anthesis, rarely persistent and surrounding the fruit (in extra-Mal. *spp.*). Calyx lobes 4, erect or spreading, alternating longer and shorter. *Petaloid appendages* none. *Stamens* 8, in two rows, sessile or on short filaments; anthers linear, dorsi- or basifixed. Disk annular and entire, or membranous and irregularly toothed or split, sometimes elongated on one side, or obscure, or absent. Pistil always included in the floral tube. *Ovary* ovoid, sessile or slightly stalked, usually hairy towards the top or in the upper half; sometimes glabrous; style sessile or short-filiform, terminal, sometimes slightly lateral (in extra-Mal. *spp.*); stigma globose or capitate. *Drupe* ovoid or ellipsoid, with fleshy or dry pericarp, endocarp sclerified. *Seed* similar in shape to the fruit; testa crustaceous.

Distr. Species *c.* 70, distributed in the Old World on the northern hemisphere, from Europe and northern Africa to eastern Asia and *Malaysia.*

Ecol. The genus is represented in Malaysia by two species of widely different affinity. *D. composita* belongs to a small section *Eriosolena* (BL.) MEISN. (*cf.* GILG in E. & P. Pfl. Fam. 3, 6a, 1894, 238) which is restricted to the undergrowth of the montane rain-forest of SE. continental Asia and West Malaysia, centering in Asia. *D. luzonica* belongs to a section *Daphnanthoides* GILG (*l.c.*) which occurs chiefly in the Himalaya, China, Japan, and Formosa, and has reached northern Luzon where it occurs at high-montane altitude.

Note. *Scopolia* (*non* JACQ. *nec al.*) LINNÉ *f.* and *Eriosolena* BL. which are congeneric and even based on the same species (though with different type specimens) have been separated from *Daphne* because the flower of this taxon possesses a tubular hypogynous disk, it being absent in *Daphne*. In 1841 MEISNER (*l.c.*) reduced *Eriosolena* BL. to a section of *Daphne* and in 1857 (*l.c.*) he reduced also *Scopolia* L. *f.* to *Daphne*. The reduction of *Eriosolena* has been adopted *e.g.* by BAILLON (Hist. Pl. 6, 1877, 131), BENTHAM & HOOKER (Gen. Pl. 3, 1880, 190), GILG (in E. & P. Pfl. Fam. 3, 6a, 1894, 238), BOERLAGE (Handl. 3, 1900, 105), BACKER (Bekn. Fl. Java, em. ed., 4A, 1945, fam. 77, p. 5), and others.

In 1893 VAN TIEGHEM (Bull. Mus. Hist. Nat. Paris VII, 17, p. 195; Bull. Soc. Bot. Fr. 40, p. 68) restored *Eriosolena* to generic rank, basing himself on anatomical characters of the branches and leaves and the presence of a tubular disk.

In 1914 H. LECOMTE (Not. Syst. 3, 99) agreed with VAN TIEGHEM, adding that *Eriosolena* was, besides, characterized by typical, caducous, involucral bracts. In passing it may be remarked that such bracts also occur in *Daphne s. str.*. *Eriosolena* has been further upheld by HALLIER *f.* (Med. Rijksherb. *n.* 44, 1922, 30), DOMKE (Bibl. Bot. 111, 1934, 130), LÉANDRI (Rev. Intern. Bot. App. Agr. Trop. 29, 1949, 503, and Proc. 8th Pac. Sc. Congr. Manila 4, 1957, 581) and some others.

In 1915, however, H. LECOMTE (Bull. Mus. Hist. Nat. Paris 21, p. 291–292) reversed his opinion on the status of *Eriosolena*. After having examined all the species of *Daphne* contained in the Paris Herbarium, he observed that they possessed, without exception, a very clear annular disk, sometimes developed into a truly cupular disk surrounding the base of the ovary, for example in *D. papyracea* WALL. *ex* STEUD. (*D. cannabina* (*non* LOUR.) WALL.)! He further advanced that the anatomical data found by VAN TIEGHEM (Ann. Sc. Nat. Bot. VII, 17, 1893, 185) concerning the origin of periderm, the presence or absence of internal phloem in the leaves, the existence or absence of crystals and their nature, although they are interesting in themselves, cannot serve for solving the question about the rank (generic or sectional) of *Eriosolena*. He did not recognize it as a separate genus to which I agree.

KEY TO THE SPECIES

1. Flowers in distinctly peduncled (2½–6½ cm) heads enveloped by two caducous, involucral bracts. Floral tube densely appressed-hairy outside. Disk distinct, membranous, cup-shaped. Ovary densely hairy at the top . . . . **1. D. composita**
1. Flowers in sessile or short peduncled (0–3 mm) heads without involucral bracts. Floral tube glabrous outside. Disk obscure, ring-like. Ovary glabrous . . . . **2. D. luzonica**

1. Daphne composita (L. *f.*) GILG in E. & P. Pfl. Fam. 3, 6a (1894) 238; KOORD. Exk. Fl. Jav. 2 (1912) 657; GAMBLE, J. As. Soc. Beng. 75, ii (1912) 258; K. & V. Bijdr. 13 (1914) 49; KOORD. Fl. Tjib. 2 (1923) 201; BURK. & HOLTT. Gard. Bull. S.S. 3 (1923) 70; BURK. & HEND. *ibid.* 3 (1925) 417; MOORE, J. Bot. Suppl. 63 (1925) 89; HOCHR. Candollea 2 (1925) 443, *incl. var. montana* HOCHR.

and *var. montana f. macrophylla* HOCHR.; BURK. Dict. (1935) 765; CORNER, Ways. Trees (1940) 633, f. 240; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 77, p. 5; HEYNE, Nutt. Pl. (1927) 1152.—*Scopolia composita* L.*f.* Suppl. (1781) 409.—*D. javanica* THUNB. Mus. Nat. Acad. Upsal. App. 11 (1806) 4, *nomen*; Fl. Jav. (1825) 13.—*D. pendula* SM. Pl. Ic. ined. 2 (1790) 34, t. 34, *nom. illegit.*; WIKSTR. Kongl. Vet. Acad. Handl. (1818) 296; MEISN. Denkschr. K. Bayer. Bot. Ges. Regensb. 3 (1841) 285; in DC. Prod. 14 (1857) 540, *incl. β montana* MEISN. and *γ concolor* MEISN.; MIQ. Fl. Ind. Bat. 1, 1 (1858) 877; KURZ, For. Fl. Burm. 2 (1877) 333; HOOK. *f.* Fl. Br. Ind. 5 (1886) 194; BOERL. Handl. 3 (1900) 111; RIDL. Fl. Mal. Pen. 3 (1924) 144.—*Eriosolena montana* BL. Bijdr. (1826) 651; HASSK. Cat. Hort. Bog. (1844) 92, *incl. α macrophylla* HASSK. and *β minor* HASSK.; ZOLL. Nat. Geneesk. Arch. N.I. 1 (1844) 616; Syst. Verz. 2 (1854) 116.—*D. montana* MEISN. Denkschr. K. Bayer. Bot. Ges. Regensb. 3 (1841) 284.—*Eriosolena composita* VAN TIEGH. Ann. Sc. Nat. Bot. VII, 17 (1893) 196; Bull. Soc. Bot. Fr. 40 (1893) 68; MERR. Contr. Arn. Arb. 8 (1934) 111.—*Eriosolena pendula* BL. *ex* LECOMTE, Not. Syst. 3 (1914) 101.—**Fig. 14c–g.**

Shrub or small tree up to 10 m by 16 cm. *Leaves* chartaceous to subcoriaceous, usually brownish above and glaucous beneath when dry, elliptic-oblong to lanceolate, (3½–)7–14(–20) by (1½–)2–5 cm; base attenuate; apex acuminate; nerves 9–14 pairs, distinct and elevated beneath, visible or obscure above, sometimes distinct on both surfaces; petiole 3–5 mm. *Inflorescences* axillary, solitary or very rarely 2 inflorescences in an axil (*cf.* KING's coll. 6940); involucral bracts 2, ovate-oblong to oblong, 1–1½ cm long, minutely pubescent outside; peduncle 2½–6½ cm, usually nodding, with several small linear bracts at the base, (4–)7–12-flowered. *Flowers* light-yellowish or white, fragrant, 10–15 mm long, sessile, densely covered with appressed, golden-yellowish or whitish hairs outside. Calyx lobes convolute, 2 longer and 2 shorter, lanceolate or ovate-oblong, rarely oblong, 2–4 by 1 mm. *Stamens* sessile or with short filaments; anthers linear, 1–1½ mm long. *Ovary* ellipsoid, 1½–2 mm, densely hairy; style *c.* 1½ mm; stigma globose. *Fruits* ellipsoid or ovoid, 10–15 by 5 mm, black (BACKER *s.n.*) or red (BACKER 14479).

Distr. India, Burma (Southern Shan States, Tenasserim and Tounghoo), Indo-China (Annam), China (Yunnan), and *Malaysia:* Sumatra, Malay Peninsula, Borneo, and West Java.

Ecol. In rain-forests (900–1000–)1200–2000 m.

Use. The bark is used as binding material.

Vern. *Kakapasan* (also used for *Phaleria*), *kĕmandèn*, S, *ki-salam*, J; Sum.: *kulei manis rimbo.*

Note. *Daphne javanica* THUNB. (1806, *l.c.*) is a *nomen nudum.* There is a specimen under that name bearing THUNBERG's handwriting in his herbarium at Uppsala, kindly sent on loan from there. This specimen might have come from Java as the epithet indicated (*cf.* also WIKSTR. Kongl. Vet. Acad. Handl. 1818, 297). It is distinctly *D. composita.* On the back of the sheet at the upper left corner is written in THUNBERG's handwriting "e Ceilona. Thunberg", for this reason the species has also been listed in THUNB. Fl. Ceilan. (1825) 5. However, the genus does not occur in Ceylon and the record of this specimen from Ceylon is apparently an error.

2. Daphne luzonica C.B. ROB. Bull. Torr. Bot. Cl. 35 (1908) 72, 75; MERR. Philip. J. Sc. 5 (1910) Bot. 366; En. Philip. 3 (1923) 132; STEEN. Bull. Jard. Bot. Btzg 13 (1934) 254.—**Fig. 14a–b.**

Slender shrub up to 1½ m. Branchlets light brown to reddish-brown, glabrous. *Leaves* chartaceous to subcoriaceous, glabrous on both surfaces, narrow elliptic-oblong, 8–9 by 2¼–2½ cm; base cuneate to attenuate; apex acuminate; nerves 6–8 pairs, distinct beneath, obscure above, curved ascending; petiole almost absent, up to 3 mm. *Inflorescences* sessile or up to 3 mm peduncled, few- to many-flowered; pedicels 1 or 2 mm. Buds very acute. *Flowers c.* 10 mm long, articulated at the base. Calyx lobes ovate, 2½–3 mm by 2 mm, very acute. *Stamens* subsessile, or with a very short filament; anthers 1½–2 mm long. Disk ring-like. Ovary ellipsoid-oblong, 3 by 1 mm, glabrous; style obscure; stigma globose. *Fruit* (young) ovoid, 7 by 4 mm.

Distr. *Malaysia:* Philippines (N. Luzon: Benguet Prov.).

Ecol. In the mossy forest on the higher mountains, 2000–2500 m.

Note. The leaves are similar to those of *D. odora* THUNB., from which it differs by obviously smaller flowers, absence of bracts below the umbel, and absence of the typical yellow tomentum on peduncle and pedicels. From *D. kiusiana* MIQ. it differs in the glabrous flowers, from the Formosan *D. arisanensis* HAYATA by the absence of floral bracts, the very acute calyx lobes, shorter pedicels, longer anthers, and larger calyx tube.

Though MERRILL (1908, *l.c.*) suggested that there is a closely allied form in Yunnan, I have not succeeded in identifying it with a Chinese species.

Excluded

Daphne decandra BL. Bijdr. (1825) 650 is according to SLEUMER (Fl. Mal. I, 5, 1954, 91) = *Casearia velutina* BL. (*Flacourt.*) (*cf.* also MIQ. Fl. Ind. Bat. 1, 1, 1858, 709).

Eriosolena affinis ZOLL. Syst. Verz. 2 (1854) 116. I have seen two sheets, one from Paris, with ZOLLINGER's own handwriting and the type number 3209, collected in Lombok, and one at Leyden. MIQUEL (Fl. Ind. Bat. 1, 1, 1858, 878) already had suggested it to represent a *Rubiaceae* and I have to thank Dr BAKHUIZEN VAN DEN BRINK for the final reduction to *Antirrhoea hexasperma* (ROXB.) MERR. En. Philip. 3 (1923) 540 (*Rubiaceae*).

7. GYRINOPS

GAERTN. Fruct. 2 (1791) 276, t.140 f.6; DOMKE, Bibl. Bot. 111 (1934) 119, map 2; QUIS. J. Arn. Arb. 27 (1946) 404.—*Lachnolepis* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 132.—*Brachythalamus* GILG, Bot. Jahrb. 28 (1900) 146.—*Aquilaria sect. Brachythalamus* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 19.—*Aquilaria sect. Gyrinops* HALL. *f. l.c.*—*Aquilaria sect. Lachnolepis* HALL. *f. l.c.*—**Fig. 15.**

Trees or shrubs. *Leaves* spirally arranged, usually with distinctly parallel veins joining the several intramarginal veins; margin thickened. *Inflorescences* terminal or axillary, sessile or short-peduncled, in fascicles or a few flowers at the top of a peduncle, with 2 or 3 small caducous bracts. *Flowers* 5-merous, pedicels articulated at the base. Floral tube cupular to cylindric, puberulous outside, inside puberulous with reflexed hairs arranged in lengthwise lines towards the upper part, sometimes glabrous. Calyx lobes 5, spreading, puberulous on both surfaces. *Petaloid appendages* 5, distinct, or united in a ring (*G. moluccana* and *G. decipiens*), inserted at the throat of the tube, alternating with the calyx lobes, usually densely hairy. *Stamens* 5, episepalous, free from the tube, inserted at the same level as the petaloid appendages or slightly below, sessile or subsessile, linear, basifixed. Disk shortly cup-shaped or ring-like, scale-like, or none. *Ovary* ellipsoid or obovoid, pilose, sessile or short-stiped, 2-celled; style terminal, distinct or obscure; stigma small. *Fruits* a loculicidal capsule, obovoid or ellipsoid, long-stiped and emerging from the top or from the side of the floral tube. *Seeds* slightly ovoid, plano-convex, usually with a caruncle-like appendage at the chalazal end.

Distr. Species 8, distributed in Ceylon (*G. walla* GAERTN.), and *Malaysia* (Lesser Sunda Islands, Celebes, Moluccas, and New Guinea). Fig. 16.

The distribution pattern is very similar to that of *Trichadenia* (see vol. 5, p. 39).

Ecol. In forests from the lowland up to 900 m.

KEY TO THE SPECIES

1. Floral tube tubular, 12–14 mm long. Fruits emerging from the lateral slit of the floral tube.
 2. Leaves narrow-lanceolate, 5–8 times as long as wide. Flowers in a raceme . **1. G. moluccana**
 2. Leaves elliptic-oblong to ovate-lanceolate, *c.* 2½ times as long as wide. Flowers in an umbel.
  3. Nerves prominent and spaced beneath, 16–20 pairs. Infructescences 12–14-flowered. Pedicels *c.* 2 mm. Petaloid appendages united in a ring. Fruits ovoid-oblong, *c.* 22½ mm long; valves *c.* 3 mm thick at the suture . . . . **2. G. decipiens**
  3. Nerves obsolete and close to each other, 25–35 pairs. Infructescences 2–3-flowered. Pedicels 3–5 mm. Petaloid appendages distinct and connected only at the base. Fruits pyriform, *c.* 17½ mm long. Valves $^3/_5$–$^4/_5$ mm thick at the suture . . . . **3. G. ledermannii**
1. Floral tube cupular, 2–5 mm long. Fruits emerging from the top of the intact floral tube.
 4. Leaves usually narrow-lanceolate, 1½–10 by $^1/_5$–1 cm. Petaloid appendages oblong, as long as the stamens . . . . **4. G. salicifolia**
 4. Leaves elliptic-oblong or ovate-oblong, very rarely lanceolate, 6–15 by 1½–5 cm. Petaloid appendages shorter than the stamens.
  5. Pedicels more than twice as long as the floral tube. Petaloid appendages transverse-oblong. **5. G. caudata**
  5. Pedicels usually shorter than the floral tube. Petaloid appendages deltoid or slightly oblong.
   6. Nerves and veins usually similar. Pistil usually shorter than the floral tube. Style none. Fruits obovoid-oblong or ellipsoid, acuminate . . . . **6. G. versteegii**
   6. Nerves distinct and more prominent than the veins. Pistil usually longer than the floral tube. Style distinct. Fruits pyriform, acute, bearing the persistent, curved style. **7. G. podocarpus**

1. Gyrinops moluccana (MIQ.) BAILL. Adansonia 11 (1875) 326; GILG in E. & P. Pfl. Fam. 3, 6a (1894) 225; BOERL. Handl. 3 (1900) 111; QUIS. J. Arn. Arb. 27 (1946) 404.—*Lachnolepis moluccana* MIQ. Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 132.—*Aquilaria moluccana* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 19.—**Fig. 15a–d.**

Shrub. *Leaves* chartaceous, glabrous, oblong-lanceolate, (8–)18–24 by (1⅓–)2–3 cm; base obtuse; apex acuminate; nerves 23–32 pairs, slightly

Fig. 15. *Gyrinops moluccana* (MIQ.) BAILL. *a.* Habit, × ⅔, *b.* opened flower, one anther removed, × 3, *c.* attachment of stamen, × 7, *c′.* stamen, × 7, *d.* fruit bulging out of floral tube, × 2.—*G. versteegii* (GILG) DOMKE. *e.* Opened flower, × 5.—*G. podocarpus* (GILG) DOMKE. *f.* Opened flower, × 5, *g.* frontal and lateral view of fruit protruding from floral tube, × 2.—*G. decipiens* DING HOU. *h.* Habit, × ⅔, *i.* dehisced fruit bulging out of floral tube, × 2, *j.* opened floral tube of fig. i, × 3.—*G. salicifolia* RIDL. *k.* Habit, × ⅔.—*G. caudata* (GILG) DOMKE. *l.* Habit, × ⅔, *m.* opened flower with characteristic long pedicel, × 5, *n.* young fruit protruding from floral tube, × 2 (*a–d* DE VRIESE & TEYSMANN *s.n.*, *e* VERSTEEG 1381, *f–g* PLEYTE 567, *h–j* KJELLBERG 889, *k* KANEHIRA & HATUSIMA 12443, *l–m* BECCARI PP 911).

curved and ascending, at *c.* 60° to the midrib, distinct or visible beneath, indistinct above; veins ± parallel. *Inflorescences* axillary, sometimes on the branches, simple, rarely branched, 3–5-flowered; peduncle almost none up to *c.* 10 mm, sometimes 2 or 3 in an axil; pedicels *c.* 4 mm. *Flowers* long-tubular, *c.* 15 mm. Calyx lobes oblong, *c.* 3 mm long, erect, the apex slightly incurved. *Petaloid appendages* usually united behind the stamens, with hairs almost as long as themselves. *Stamens* inserted slightly below the appendages, sometimes the lower part of the anthers adnate to the tube. Pistil *c.* 4 mm long. *Ovary* ovoid or ellipsoid, gradually narrowed into a distinct style, pilose; stigma ovoid. *Fruits* emerging through the lateral slit of the floral tube, ovoid, shortly stalked, sparsely pilose, ovoid, 1½ by 1 cm, 1- or 2-seeded. *Seeds* ovoid, with a short and thick appendage at the base.

Distr. *Malaysia:* Moluccas (Buru: Kajeli and Halmaheira), thrice collected. Also cultivated in Hort. Bog. (from seed of Buru).

Note. One specimen collected from a cultivated plant in Hort. Bog. has smaller leaves (8–14½ by 1⅓–2¼ cm).

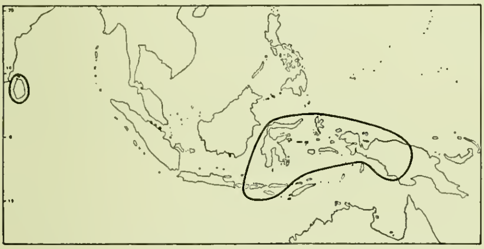

Fig. 16. Distribution of *Gyrinops* GAERTN.

2. Gyrinops decipiens, *nov. sp.*

Differt ab *G. moluccana* foliis elliptico- vel subobovato-oblonga, pedunculis brevibus validis apiceque incrassatis, floribus umbellatis, antheris liberis, pericarpio late suturato. *Typus* G. KJELLBERG 889, Bo, L.—**Fig. 15h–j.**

Small tree, *c.* 4 m. *Leaves* chartaceous, glabrous, rarely sparsely hairy beneath, shining on both surfaces when dry, elliptic- or slightly obovate-oblong, 14–17 by 5–7 cm; base narrowly cuneate; apex shortly acuminate; nerves 16–20 pairs, slightly curved or obliquely spreading towards the margin, elevated beneath, visible sometimes obscure above. *Infructescences* terminal and axillary, umbelliform, 12–14-flowered; peduncle very short to 2¼ cm, thick, accrescent, knob-like thickened at the top; pedicels *c.* 2 mm. *Flowers* long-tubular, *c.* 15 mm long. *Floral tube* almost glabrous inside. Calyx lobes oblong, 3–4 mm long. *Petaloid appendages* united behind the stamens with hairs as long as themselves. *Stamens* inserted slightly below the appendages. *Fruits* ovoid-oblong, *c.* 2¼ by 1¼ cm, acuminate to the apex, suture surface *c.* 3 mm wide. *Seeds* unknown.

Distr. *Malaysia:* Central Celebes (Wavatoli, Palarahi).

Ecol. In rain-forest, at 100 m.

Note. This species is closely related to *G. moluccana* by the long tubular flowers with petaloid appendages united into a ring and fruits emerging through the lateral slit, but differs from it by the characters shown in the key.

The leaves are similar to those of *Aquilaria beccariana.*

3. Gyrinops ledermannii DOMKE, Notizbl. Berl.-Dahl. 11 (1932) 349.

Shrub. *Leaves* subcoriaceous, glabrous except sparse hairs at the lower parts on both surfaces and the midrib beneath, oblong- or ovate-lanceolate, sometimes obovate-lanceolate, 6½–12 by 2½–5 cm; base rather acute or shortly narrowed towards the petiole; apex acute or acuminate; nerves spreading, obsolete, close to each other, among which *c.* 25–35 stronger pairs, curved and ascending towards the apex. *Infructescences* pseudo-lateral or terminal, subsessile, 2–3-flowered; pedicels thin, 3–5 mm. *Floral tube* cylindric, indistinctly ribbed, 13 mm long, 1½ mm in diam. Calyx lobes ovate, 1½–2 by *c.* ½ mm, the outer lobes acute and the inner ones obtuse, pubescent outside, tomentose inside, and also with a tuft of hairs at the top. *Petaloid appendages* ± rectangular, *c.* $^3/_5$ by ½ mm, obtuse, connected at the base, villose. *Stamens* sessile, oblong, 1–1¼ by $^1/_5$ mm. *Fruits* ± pyriform, *c.* 1¾ by ⅓ cm (including stipe 3 mm and acute and cuspidate apex 4 mm), short pilose, compressed, irregularly, transversely ± rugose. *Seeds* 2 or 1 by abortion, *c.* 9 mm long (including an appendage *c.* 3 mm long), woolly.

Distr. *Malaysia:* New Guinea (Sepik R., Station Mt Pfingst: LEDERMANN 7401).

Ecol. Slope in dense, virgin forest, at the foot of the mountain, 0–200 m altitude.

Note. The type specimen of this species is not available and no additional material has been collected in that area. The description above is extracted from the original one. From DOMKE's detailed description, this is a distinct species characterized by the long floral tubes, distinct petaloid appendages and the leaves with many obscure nerves. It is closely allied to *G. moluccana* and *G. decipiens* by the flower with a tubular floral tube and the fruit emerging from the lateral slit of it, but differs from both of them by the characters given in the key.

4. Gyrinops salicifolia RIDL. Trans. Linn. Soc. Bot. II, 9 (1916) 145.—*Gyrinopsis salicifolia* QUIS. J. Arn. Arb. 27 (1946) 407.—**Fig. 15k.**

Slender shrub, *c.* 1 m. Branchlets light brown, pubescent. *Leaves* sparsely pubescent on the midrib and sometimes on the nerves and veins beneath, lanceolate to linear-lanceolate, 1½–10 by $^1/_5$–1 cm; base cuneate; apex acuminate and pointed; nerves and veins similar and equally strong, slightly visible beneath, obscure above; petiole *c.* ½ mm. *Inflorescences* terminal, sessile, 3–5-flowered; pedicel *c.* 2 mm. *Flowers* pale yellow, *c.* 3 mm long. Floral tube *c.* 2½ mm long, cupular, pilose outside. Calyx lobes oblong, *c.* 1 mm long, puberulous. *Petaloid appendages* oblong, *c.* ½ mm long, shortly hairy. *Stamens* sessile, as long as the petaloid appendages. Disk obscure, ring-like. Pistil *c.* 2 mm long, densely short-hairy. *Ovary* obovate, 1 mm long; style filiform, *c.* 1 mm; stigma obscure. *Fruit* unknown.

Distr. *Malaysia:* western New Guinea (Utakwa and Nabire).

Ecol. In fringing rain-forest, 300 m.

5. Gyrinops caudata (GILG) DOMKE, Notizbl. Berl.-Dahl. 11 (1932) 349; QUIS. J. Arn. Arb. 27 (1946) 404.—*Brachythalamus caudatus* GILG, Bot. Jahrb. 28 (1900) 147; in E. & P. Pfl. Fam. Nachtr. 3 (1903) 238.—**Fig. 15l–n.**

Shrub or tree up to 17 m by 36 cm, *fide* BW 6738. Branchlets greyish, whitish pubescent and glabrescent. *Leaves* chartaceous, glabrous, dull beneath and shining above, elliptic-oblong, ovate-oblong, rarely lanceolate, 6–13 by 1½–4 cm; base cuneate; apex up to 1½ cm, acuminate; nerves and veins scarcely distinguishable, numerous, parallel, visible beneath, obscure above; petiole *c.* 3 mm. *Inflorescences* axillary or terminal, 3–10-flowered, sessile and peduncled, peduncle up to 8 mm. *Flowers c.* 5 mm pedicelled. Floral tube cupular, 2 mm long. Calyx lobes oblong, 1 mm long. *Petaloid appendages* transverse-oblong, *c.* ½ mm long. *Stamens* subsessile, slightly longer than the appendages. *Ovary* ovoid, densely pilose; style very short; stigma capitate.

Distr. *Malaysia:* New Guinea (Sidai and Mt Arfak).

Ecol. Primary forest, 5–20 m (*fide* BW 6738).

Vern. *Niwawur*, Amberbaken language.

Note. This species is easily recognized by the pedicel usually *c.* 2 times as long as the floral tube.

6. Gyrinops versteegii (GILG) DOMKE, Notizbl. Berl.-Dahl. 11 (1932) 349; QUIS. J. Arn. Arb. 27 (1946) 404.—*G. walla* (*non* GAERTN.) KOORD. Minah. (1898) 577; BOERL. Handl. 3 (1900) 111.—*Brachythalamus versteegii* GILG, Nova Guinea 8 (1910) 410.—*Aquilaria versteegii* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 19.—*G. sp.* HALL. *f. l.c.* 20. —**Fig. 15e.**

Shrub up to 6 m, or tree up to 21 m by 65 cm (*fide* bb 21394, Bo). *Leaves* chartaceous to subcoriaceous, pubescent, especially on the nerves and veins beneath, glabrescent or glabrous, dull and yellowish-brown beneath, shining and reddish-brown above, elliptic-oblong, ovate-oblong, or obovate-oblong, 5–14 by 1½–5 cm; base cuneate; apex up to 2 cm narrow-acuminate; nerves and veins similar, numerous, slightly oblique and parallel; petiole short, 3–5 mm. *Inflorescences* sessile, usually terminal, consisting of 6 to 8 flowers, rarely axillary, or on the branchlets; pedicels 1–3 mm. *Flowers* white, yellowish, light greenish, or yellowish-green. Floral tube cupular, *c.* 3½ mm long. Calyx lobes oblong, *c.* 1 mm long. *Petaloid appendages* deltoid, about half as long as the anther, densely hairy. *Stamens* sessile, *c.* ¾ mm. Disk scale-like. Pistil *c.* 2½ mm long, densely puberulous, except the stigma. *Ovary* ovoid, *c.* 1 mm long, narrowed towards the apex; style absent; stigma ovoid. *Fruits* yellow, slightly obovoid or ellipsoid, 2½ by 1 cm, shortly acuminate to the apex, attenuate to the base. *Seeds* ovoid, plano-convex, 9 by 6 mm, with a caruncle-like appendage at the base, *c.* 2 mm thick.

Distr. *Malaysia:* Lesser Sunda Islands (Lombok, Sumbawa, Flores, and Sumba), NE. Celebes (Minahassa), and West New Guinea (Alkmaar Bivouac and Somula).

Ecol. In forests, scattered, from the lowland up to 900 m.

Vern. *Kĕtĕmunan*, Lombok, *ruhu wama*, Sumba, *seke*, Flores.

Note. Closely related to *G. podocarpus*; more material is needed to verify whether it deserves specific distinction.

7. Gyrinops podocarpus (GILG) DOMKE, Notizbl. Berl.-Dahl. 11 (1932) 349; QUIS. J. Arn. Arb. 27 (1946) 404.—*Brachythalamus podocarpus* GILG, Bot. Jahrb. 28 (1900) 146; in E. & P. Pfl. Fam. Nachtr. 3 (1908) 238.—*Aquilaria podocarpus* HALL. *f.* Med. Rijksherb. *n.* 44 (1922) 19; DOMKE, Bibl. Bot. 111 (1934) t. 2 f. 10.—*G. ledermannii* (*non* DOMKE) MERR. & PERRY, J. Arn. Arb. 22 (1941) 264.—**Fig. 15f–g.**

Slender shrub, ½–2 m. *Leaves* chartaceous, pubescent beneath especially on the nerves and veins, glabrescent or sometimes glabrous, glabrous above, elliptic-oblong, narrow-oblong, slightly obovate-oblong, 10–15 by 3–5 cm, base cuneate, apex up to 2½ cm acuminate; nerves 25–40 pairs, distinct beneath, obscure above; veins and veinlets visible beneath, indistinct above, sometimes nerves and veins similar. *Inflorescences* terminal or axillary, sessile or with a short peduncle up to 6 mm, 2–6-flowered; pedicels 2–3 mm, pubescent. *Flowers* white, 4–5 mm long. Floral tube cupular. Calyx lobes ovate, 1–1½ mm long. *Petaloid appendages* deltoid or slightly oblong, ¼–½ mm long, densely whitish hairy. *Stamens* sessile. Disk shortly cup-shaped, crenate. Pistil shortly stipitate, densely hairy except the stigma, *c.* 4½ mm long. *Ovary* oblanceolate; style distinct, *c.* 1½ mm; stigma capitate. *Fruit* (young) green, pyriform, 15 by 6 mm, densely puberulous, acute to the apex and crowned by the persistent, curved style, stipe-like, cuneate towards the base.

Distr. *Malaysia:* West New Guinea (Ramoi, Sorong, Monep, and Idenburg R.).

Ecol. In primary forests, from the lowland up to 750 m.

Vern. *Kokkoree*, Asmat language.

8. DRAPETES

BANKS *ex* LAMK, J. Hist. Nat. Paris 1 (1792) 188, t.10 f.1a–d; PERSOON, Syn. 1 (1805) 148; GAERTN. Fruct. 3 (1807) 199, t. 215; ENDL. Gen. Pl. (1837) 33; Suppl. 4 (1847) 61; BENTH. Fl. Austr. 6 (1873) 35; BENTH. & HOOK. *f.* Gen. Pl. 3 (1880) 196; DOMKE, Bibl. Bot. 111 (1934) 138, map 17.—*Kelleria* ENDL. Gen. Pl. Suppl. 4 (1847) 61; DOMKE, Bibl. Bot. 111 (1934) 137, map 16.—*Daphnobryon* MEISN. in DC. Prod. 14 (1857) 566.—*Drapetes sect. Daphnobryon* BOERL. Handl. 3 (1900) 106.—**Fig. 17.**

Dwarf shrubs with creeping, radiant, or ± tufted and glabrous stems, sending out fibrous roots from beneath, the lower part of the stems marked with prominent scars of fallen leaves. *Leaves* subopposite or spiral, more or less appressed, sessile, narrow-linear, convex on the dorsal side, plane or slightly concave on the ventral side, with 5–9 striated longitudinal nerves; apex obtuse, with a tuft of hairs; margins ciliate especially in the young ones. *Flowers* aggregated in small, sessile, terminal heads almost entirely immersed in the leaves; pedicels short, articulated at the apex, articulation hairy. Floral tube continuous, or circumsciss above the ovary (S. American *sp.*), usually pilose outside, glabrous inside, caducous after anthesis. Calyx lobes 4, slightly spreading. *Petaloid appendages* inserted at the mouth of the tube, consisting of 1-2 episepalous scales (or 0). *Stamens* 4, free from the tube at the mouth. alternate with the lobes; filaments slender, basifixed, usually longer than the anthers; anthers oblong or sometimes subglobose. Pistil sometimes abortive. Fertile pistil usually included, rarely exserted. *Ovary* ellipsoid or slightly obovoid, 1-celled, pilose or hairy in the upper half or at the apex; style linear, lateral, usually longer than the ovary, caducous after anthesis; stigma capitate and papillose when young. *Fruit* a small drupe with a thin-fleshy pericarp. Seed similar in shape to the fruit, closely enveloped by the endocarp.

Distr. Species 4, three of them in S. America (Fuegia and Falkland Is.), New Zealand, Tasmania, and Australia, one in *Malaysia* (New Guinea and North Borneo). Fig. 18.

Ecol. On dry grassy, or rocky places in the mountains, in the tropics almost confined to subalpine and alpine heights.

Note. *Drapetes* was described in 1792 by LAMARCK (*l.c.*) with only one species, *D. muscosus*, known from Fuegia and the Falkland Islands in S. America. Its perianth tube (*i.e.* floral tube) is circumsciss above the ovary, whence the upper part falls away after anthesis; there are no scales at the throat. The style is terminal. Since then some other species have been described from the Old World.

In 1847 ENDLICHER (*l.c.*) based a new genus *Kelleria* on *D. dieffenbachii* HOOK. from New Zealand, which should differ from *Drapetes sens.str.* by the continuous perianth tube, the presence of 4 appendages alternating with the stamens at the throat of the perianth tube, and the capitate stigma.

HOOKER *f.* (in Hook. J. Bot. Kew. Misc. 5, 1853, 300) maintained that all species of *Drapetes* resemble each other very closely and form one natural genus without necessity to recognize *Kelleria* as a distinct genus.

In 1857 MEISNER (*l.c.*) proposed a new genus *Daphnobryon* for *Drapetes ericoides* HOOK. *f.* from Borneo and *D. tasmanicus* HOOK. *f.* from Tasmania. This should be characterized by 8 appendages alternating in pairs with the stamens and by the distinctly lateral style.

VAN TIEGHEM (Bull. Soc. Bot. Fr. 40, 1893, 72) stated that the anatomical characters of the twigs of *Drapetes*, *Kelleria*, and *Daphnobryon* as a group closely agree and differ profoundly from those found in all other *Thymelaeaceae*. Still, because of the different origin of the periderms, different texture of the cells in the pith, and the quantity of the lignified peridesmic fibers in the meristele in the limbs of their leaves, he found reason to maintain the three genera as distinct.

DOMKE (*l.c.*) maintained only *Drapetes* and *Kelleria*. *Drapetes* being characterized: floral tube cylindric, circumsciss. No appendages. Style terminal. Leaves ovate, semi-amplexicaulous; S. America. *Kelleria*: floral tube short-cylindric or funnel-shaped, continuous. Appendages present. Style lateral. Leaves needle-like, not semi-amplexicaulous, spiral or decussate; New Zealand to Borneo.

BENTHAM (*l.c.* 36) pointed out that whether the perianth is circumsciss above the ovary or not "is no more than what is admitted as sectional only in *Pimelea*". As for the pairs of appendages, whether they are distinct or confluent into a single entire or notched one, is not constant, as has been pointed out by BENTHAM (*l.c.* 36) and GILG (Bot. Jahrb. 18, 1894, 514, f. 9A). I have also observed this variation in a single specimen (TRAVERS *s.n.*, IV, 1909, New Zealand), and even in a single flower! Because of the great resemblance in habit and the number of stamens being the same as that of the perianth lobes, BENTHAM (*l.c.* 36) and BENTHAM & HOOKER *f.* (Gen. Pl. 3, 1880, 196) reduced *Kelleria* and *Daphnobryon* to *Drapetes*. I have followed them in this treatment and believe the first and last could be distinguished in the rank of sections.

1. Drapetes ericoides HOOK. *f.* Ic. Pl. (1852) t. 895; STAPF, Trans. Linn. Soc. II, 4 Bot. (1894) 221; BOERL. Handl. 3 (1900) 111; GIBBS, J. Linn. Soc. Bot. 42 (1914) 132; MERR. En. Born. (1921) 417. — *Daphnobryon ericoides* MEISN. in DC. Prod. 14 (1857) 566; MIQ. Fl. Ind. Bat. 1, 1 (1858) 881.— *Kelleria papuana* DOMKE, Bot. Jahrb. 62 (1929) 484; STEEN. Bull. Jard. Bot. Btzg 13 (1934) 254.— *Kelleria ericoides* DOMKE, Bot. Jahrb. 62 (1929) 485; STEEN. Bull. Jard. Bot. Btzg 13 (1934) 254.— *Kelleria patula* MERR. & PERRY, J. Arn. Arb. 22 (1941) 267.—**Fig. 17.**

Stem reddish- or dark-brown, up to 50 cm; young branchlets villous, glabrescent. *Leaves* 3–5

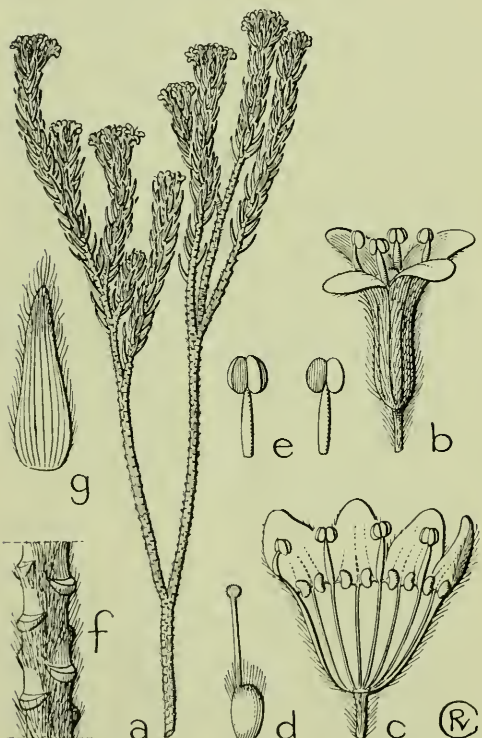

Fig. 17. *Drapetes ericoides* HOOK. *f.*. *a.* Habit, nat. size, *b.* flower, × 6, *c.* opened flower, pistil removed, × 6, *d.* pistil, × 6, *e.* stamens, × 13, *f.* stem showing leaf-scars, × 6, *g.* leaf, × 6 (ROBBINS 315).

Fig. 18. Localities of *Drapetes ericoides* HOOK. *f.*

by ⅔ mm. *Inflorescences* (1–)4–9-flowered; pedicels short, *c.* ½ mm. *Flowers* white, cylindric, slightly expanded towards the apex, 3–5 mm long, 12-costate. Calyx lobes ovate, obtuse, 1–1½ mm long. Stamens *c.* 1 mm long; anthers as long as or slightly shorter than the filaments. *Petaloid appendages* always 8, in 4 episepalous pairs. Pistil 2–3 mm long, the abortive ones only *c.* 1 mm. *Fruits* ellipsoid.

Distr. *Malaysia:* Borneo (Mt Kinabalu) and New Guinea (Mt Carstensz, Lake Habbema, Mt Wilhelmina, Mt Doorman, Hagen Range, Mt Giluwe, Mt Wilhelm, Mt Albert Edward, Mt Victoria, and Central Div.). Fig. 18.

Ecol. Alpine plant, on dry grasslands, shallow soil over rocks on sheltered grasslands, plentiful on sandy banks of streams, and in cracks of granite, usually occurring from 3000 to over 4000 m.

9. PIMELEA

BANKS & SOLAND. *ex* GAERTN. Fruct. 1 (1788) 186, *nom. gen. cons.*; MEISN. in DC. Prod. 14 (1857) 496; BENTH. Fl. Austr. 6 (1873) 1; DOMKE, Bibl. Bot. 111 (1934) 138, map 18, *non Banksia* FORST. 1776.—*Thecanthes* WIKSTR. Kongl. Vet. Acad. Handl. Stockh. (1818) 269, 271.—**Fig. 19–20.**

Fig. 19. *Pimelea cornucopiae* VAHL. *a*. Habit, × 2/3, *b*. inflorescence, × 2, *c*. longitudinal section of inflorescence, × 2, *d*. flower, × 4, *e*. opened flower, × 4, *f*. stamen, × 13, *g*. seed, × 13.—*P. concreta* F. v. M. *h*. Inflorescence, × 2, *i*. longitudinal section of inflorescence, × 2, *j*. flower, × 4, *k*. pistil, × 4 (*a* WOMERSLEY & VAN ROYEN 5853, *b–g* WOMERSLEY 8767, *h–k* VAN STEENIS 3304).

Herbs, shrubs or undershrubs (extra-Mal. *spp.*). *Leaves* opposite or decussate, sometimes subopposite, or alternate. *Inflorescences* terminal or axillary (extra-Mal. *spp.*), capitate, rarely spicate or solitary (extra-Mal. *spp.*); involucral bracts partially united, or free (extra-Mal. *spp.*), 4, or in extra-Mal. *spp.* 4–6(–8) or more, sometimes wanting. *Flowers* bisexual, sometimes unisexual by abortion or dioecious (extra-Mal. *spp.*), at least in Mal. *spp.* developing centripetally. Floral tube tubular, often silky villous outside, in Mal. *spp.* circumsciss above the ovary. Calyx lobes 4, spreading or erect. *Petaloid appendages* 0, but the throat usually thickened or rim-like folded. *Stamens* 2, inserted in the throat of the tube and opposite the 2 outer calyx lobes. Disk consisting of 4, scale-like, filiform or club-shaped lobes or wanting (extra-Mal. *spp.*). *Ovary* ovoid; style long-filiform and attached to one side of the ovary immediately below the apex. *Fruit* a small drupe. *Seed* in shape similar to that of the fruit, albuminous.

Distr. Subendemic in Australia and New Zealand, comprising *c.* 80 *spp.*, two of which extend to Malaysia.

Ecol. In Malaysia in grassland and savannahs in the seasonal areas, mostly at low altitude, ascending to 1000 m.

Note. The two Malaysian species belong to *subg. Thecanthes* (WIKSTR.) MEISN. *ex* GILG (in E. & P. Pfl. Fam. 3, 6a, 1894, 243); in the text "Untergen." was erroneously printed as "Unterfam.", *cf.* also DE DALLA TORRE & HARMS p. 340).

KEY TO THE SPECIES

1. Flowers at anthesis long-exserted from the involucral bracts, the exserted parts usually longer than the length of the involucral lobes. Calyx lobes usually spreading. Stamens exserted; filaments at least twice as long as the anthers . . . . **1. P. concreta**
1. Flowers at anthesis usually included or slightly exserted from the involucral bracts. Calyx lobes usually erect. Stamens included; filaments almost as long as the anthers. . **2. P. cornucopiae**

1. Pimelea concreta F. v. M. Fragm. 5 (1865) 73; BENTH. Fl. Austr. 6 (1873) 6.—*P. brevituba* FAWC. in Forbes, Wand. (1885) 516; GILG in E. & P. Pfl. Fam. 3, 6a (1894) 243, f. 84, D, E.—*P. sp.* DAMMERMAN, Nat. Tijd. N.I. 86 (1926) 45, f. 1.—**Fig. 19h–k, 20.**

Fig. 20. *Pimelea concreta* F. v. M. Sumba (Photogr. DE VOOGD).

Annual, simple or branched, up to 50 cm, glabrous throughout. *Leaves* membranous, narrowly oblong or oblong-lanceolate, or obovate-oblong, 1¾–3½ cm by 4–8 mm; base acute to obtuse; apex acuminate and minutely apiculate; nerves obscure, 4–6 pairs; petiole short, *c.* 1 mm. Involucral bracts 4, united at the lower third or lower half into an obconical cup, 7–15 mm long, the free parts ovate or deltoid, rarely obovate, 4–10 by 6–8 mm, acute or acuminate, imbricate, the outer pair overlapping the inner pair and usually longer than wide rarely wider than long. *Inflorescences* terminal, usually more than 50-flowered; peduncles variable in length, very short or up to 4½(–7) cm; pedicels flat, usually dilated at the base, very short to 1½ mm, articulated at the top. *Flowers* 10–15 mm long, inserted on the cup-shaped part of the involucre, centripetally developing, white to rose. Floral tube cylindric. Calyx lobes 4, imbricate, oblong or slightly obovate-oblong, 2–2½ mm long. Disk scale-like, small, *c.* ½ mm long. Stamens 2½–3½ mm. *Ovary* ovoid, 1–1½ mm long; style exserted; stigma sub-capitate. *Fruits* ovoid, 2–4 by 1 mm, short-stalked.

Distr. Australia (Northern Territory) and *Malaysia:* Lesser Sunda Islands (Sumba and Timor). Fig. 21.

Ecol. Grassland and sandy ground, from the lowland up to 1000 m.

Vern. *Tua leu*, Timor.

Note. Some specimens collected in Sumba have the involucral bracts deltoid and slightly wider than long.

2. Pimelea cornucopiae VAHL, En. Pl. 1 (1804) 305; R. BR. Prod. (1810) 359; MEISN. in DC. Prod. 14 (1857) 496; F. v. M. Fragm. 7 (1869) 3; BENTH. Fl. Austr. 6 (1873) 6; F. v. M. Descr. Not. 2 (1885) 8; BAILEY, Queensland Fl. pt 4 (1901) 1363.—*Thecanthes cornucopiae* WIKSTR. Kongl. Vet. Acad. Handl. Stockh. (1818) 271.—*P. philippinensis* C. B. ROB. Philip. J. Sc. 6 (1911) Bot. 345; MERR. En. Philip. 3 (1923) 134.—**Fig. 19a–g.**

Annual up to 50 cm tall. *Leaves* membranous, lanceolate, narrowly oblong, rarely obovate-lanceolate, (1¼–)2–3½ cm by 1½–6(–7½) mm; apex acuminate; base obtuse; nerves obscure, 3–6 pairs; petiole very short, *c.* 1 mm. *Inflorescences* terminal, 15–40-flowered; peduncles variable in length, very short, or up to 5½ cm; pedicels 1–5 mm, flat but not dilated at the base, articulated at the top. Involucral bracts 4, united at the lower third or half into an obconical cup, 7–10(–15) mm long, the free parts ovate and acuminate, imbricate, the outer pair overlapping the inner pair, longer than wide, 6–8 by 2½–4(–7) mm. *Flowers* 7–10 mm long, inserted on the cup-shaped part of the involucre, white, usually included in the involucral bracts, sometimes slightly protruding beyond them. Calyx lobes 4, imbricate, oblong, or slightly obovate, 1–2 mm long. Disk small and obscure. *Stamens* 1–1½ mm, slightly shorter than the calyx lobes. *Ovary* ovoid, 1½ mm long; style slightly protruding beyond the floral tube; stigma small, globose. *Fruits* ellipsoid, 3 by 1½ mm, slightly stiped.

Distr. Australia (Queensland), D'Entrecasteaux Is. (Fergusson I.), New Britain, Louisiade Archipelago (Misima I. and Sudest I.), and *Malaysia:* Philippines (extreme N of Luzon, Cagayan Prov. near Sanchez Mira, once collected, B.S. 7410, US) and New Guinea (Western and Central Divisions). Fig. 21.

Ecol. Common on savannah ridges and grasslands, from the lowland rarely up to 570 m.

Fig. 21. Localities of *Pimelea concreta* F. v. M. (+) and *P. cornucopiae* VAHL. (●) in Malaysia; both species also occur in Australia.

10. AMYXA

Cf. AIRY SHAW, Fl. Mal. I, 4 (1953) 363, f.5.—**Fig. 22.**

1. Amyxa pluricornis (RADLK.) DOMKE, Bibl. Bot. 111 (1934) 116; AIRY SHAW, Fl. Mal. I, 4 (1953) 363.—**Fig. 22.**

SHAW questioned whether the fruit of this small Bornean tree is dehiscent. Judging from fruiting material collected in Sept. 1958 by M. JACOBS (*n.* 5376) near Belaga, in the Third Division of Sarawak, this seems indeed to be the case, though the spontaneous dehiscence of the almost mature fruit happened during the process of drying the specimens. But the dehiscence of the valves appears so regular along distinct sutures that there seems to be hardly any doubt that dehiscence will also take place in nature. The seed colours are marked: fruit green, softish, seed dark glossy brown, funicle partly very fleshy, aril-like, white. How these colours will be at complete maturity is unknown; they may change at the last moment. Tropical fruits are often devoured by animals before maturity. When mature the attractive seed with its contrasting colours will dangle out of the dehisced capsule hanging on the thin basal part of the funicle from the apex of the valve; it is likely to be dispersed by animals.

Distr. Now also twice collected by KOSTERMANS in West Kutai, East Borneo.

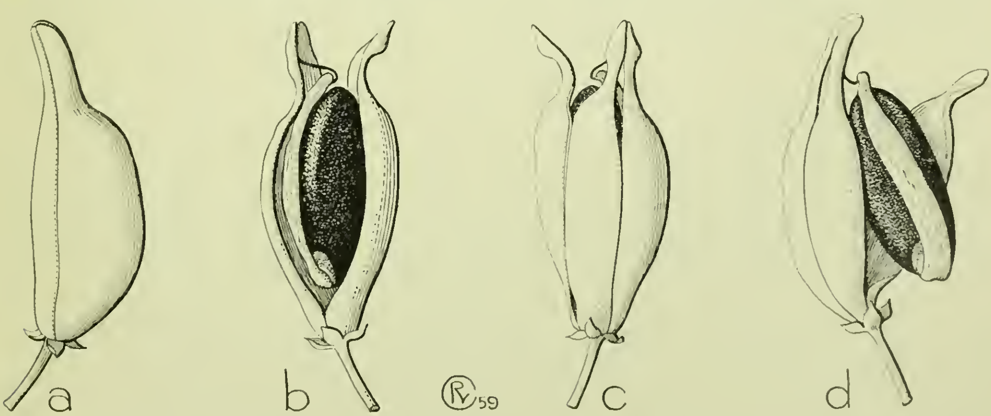

Fig. 22. Fruit of *Amyxa pluricornis* (RADLK.) DOMKE, nat. size. When collected it was still closed, but dehisced during drying with 3 valves showing the dark seed and the funicle which is thread-like at the base but thickened, pale, and fleshy in its apical part. In nature the seed is in the ripe state probably dangling from the dehisced fruit (JACOBS 5376).

Excluded and Doubtful

Gnidia oppositifolia (*non* L.) BLANCO, Fl. Filip. (1837) 299, and *Gnidia? philippinica* MEISN. in DC. Prod. 14 (1857) 592 are according to EXELL (Fl. Mal. 1, 4, 1954, 555) = *Terminalia polyantha* PR. (*Combret.*).

Hornera JUNGH. Tijd. Nat. Gesch. Phys. 7 (1840) 314.
H. glomerata JUNGH. *l.c.* 316.—Japan.
H. umbellata JUNGH. *l.c.* 316.—Japan.
No type specimen of either of these species has been as yet located. Dr VAN STEENIS and Dr HATUSIMA (*in litt.*) could not clarify them from the description. They might not be natives of Japan (*cf.* BENTH. & HOOK. *f.* Gen. Pl. 3, 1880, 188–189). Mr AIRY SHAW *(inlitt.)* assumes them to be Lauraceous.

Passerina javanica THUNB. Fl. Jav. 2 (1825) 19. The type specimen could not be found in THUNBERG's herbarium at Uppsala (*cf.* BACKER *c.s.*, Blumea 6, 1950, 358) and the description is entirely inadequate.

STAPHYLEACEAE (B. L. van der Linden, Leyden)

This smallish family, containing five genera[1], is almost confined to the northern hemisphere in both the Old and New World, overstepping the equator only in Ecuador and Peru in S. America and in Malaysia, where it is found southward to Java and New Guinea.

Among the genera *Huertea* is confined to Peru and the West Indies (Cuba, Haiti). *Tapiscia* and *Euscaphis* are East Asian. *Staphylea* is widely distributed in the subtropical and temperate zone on the northern hemisphere. *Turpinia* is subtropical and tropical, it is the only genus represented in Malaysia. It is remarkable that the distributional areas of the latter two genera seem to exclude one another save for a slight overlapping in SE. Asia.

Ecologically the members of the family may be found from the tropical lowland up into the mountains, in Malaysia up to the upper border of the montane zone at *c.* 2400 m, but in the Sinohimalayan area they may ascend to *c.* 3000 m. Latitudinally the northern frontier is found at *c.* 50° N (Central Germany, South Canada); in S. America the southern border is found in Ecuador and Peru.

The taxonomic position of the family has a chequered history. In the 18th century its place was designated in the affinity of *Rhamnaceae*. A. P. de Candolle (1825) and Meisner (1836) referred the family as a tribe to the *Celastraceae;* Endlicher (1840) had *Staphyleaceae* as an order next to the *Celastraceae* but placed *Ochranthe* as a separate family near the *Hypericineae.* Reichenbach (1828) had arranged it near *Sapindaceae* and this position was accepted by Bentham & Hooker, and up to the present day it is referred to *Sapindales* by Asa Gray, Engler, Hutchinson, *etc.*

Lindley (1835) kept it as a separate family in the *Hypericineae* together with *Cunoniaceae.* Hallier *f.* has repeatedly stressed their close affinity to the *Cunoniaceae* (Über Juliania, *etc.* 1908, 74, 116, 182; Arch. Néerl. Sc. Ex. Nat. III B, 1912, 164).

The affinity with the *Cunoniaceae* seems to be without much doubt and is shown by the fact that *Turpinias* have twice been wrongly described as members of the *Cunoniaceae*, *viz* as *Ochranthe* and *Kaernbachia.* The vegetative resemblance is large as both families have stipulate, decussate, pinnate leaves and terminal inflorescences. Besides, the differential characters are few, mainly 5 stamens in *Staphyleaceae* and diplostemonous flowers in *Cunoniaceae*, the 3-celled ovary against a mostly 2-celled one, and more vague differences in filaments and fruit. Leaves of *Staphyleaceae* are herbaceous and the articulations of petiole and rachis shrink in the herbarium; leaves of *Cunoniaceae* are generally coriaceous and the junctions do not shrink. In his key Hutchinson differentiates *Cunoniaceae* and *Staphyleaceae* by having pendulous and ascending ovules respectively, but the importance and constancy of this character seems doubtful. (Krause, p. 272). The pollen structure of *Staphyleaceae* is ± similar to that of several other families, for example *Celastraceae* (Erdtman, 1952).

The wide separation of *Staphyleaceae* (near *Sapindales*) and *Cunoniaceae* (near *Rosales*) is not only unsatisfactory from a taxonomical standpoint, but also anatomically. Dr. Metcalfe, Kew, has made an anatomical investigation as far as available material permitted and his conclusion is that there are marked anatomical differences between *Turpinia* and the *Sapindaceae* and that both *Staphyleaceae* and *Cunoniaceae* show more mutual affinity than either of them with the *Sapindaceae.* In his opinion "an anatomist could not disagree with a taxonomist who wished to 'remove' the *Staphyleaceae* from the 'vicinity' of the *Sapindaceae*" (*cf.* Nova Guinea n.s. 10, 1959, 212).

Plantgeographically *Staphyleaceae* represent a marked northern counterpart to the *Cunoniaceae* which is largely a southern hemisphere family. Such 'pairs' turn up repeatedly as our studies of plant geography advance: *Fagus* and *Nothofagus*, *Dillenia* and *Hibbertia*, *Ericaceae*

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(1) Gagnepain has described a sixth genus, *Triscaphis*, from Indo-China (Not. Syst. 13, 1948, 190; Fl. Gén. I.-C. Suppl. 1, 1950, 999, fig. 128 3–8). According to the description this is almost certainly not staphyleaceous through its exstipulate, spiral leaves and 3-merous flowers; it might be anacardiaceous. According to Lemée it would be sapindaceous (Dict. Suppl. 10, 1959, 213)

Fig. 1. Details of Malaysian species of *Turpinia*.—*T. borneensis* (MERR. & PERRY) VAN DER LINDEN. *a*. Habit, × ½, *b*. open nerves and venation, × ½, *c*. flower, × 5, *d*. *ditto*, in section, × 5, *e*. fruit with cross-section, nat. size, *f*. stamen, × 10.—*T. montana* (BL.) KURZ. *g*. Leaf showing its closed nervation, × ½, *h–i*. stamens, × 10.—*T. pomifera* (ROXB.) DC. *j–k*. Fruit and its section, nat. size.—*T. sphaerocarpa* HASSK. *l–m*. Fruit and its section, nat. size, *n*. embryo, × 4.—*T. ovalifolia* ELMER. *o*. Fruit and its section, nat. size.—*T. stipulacea* VAN DER LINDEN. *p*. Defoliated part of twig showing persistent stipules (*a*, *c–d*, *f* CLEMENS 30070, *b*, *e* CLEMENS 28840, *i* KERR 2527, *j–k* LAM 2855, *o* RIDLEY 15906, *p* SF 27516).

and *Epacridaceae*, *etc*. The meeting point of the areas of each pair and their overlapping margins are almost always found in the vicinity of the tropical zone. It would seem that the birthplace of these pairs must have been the tropics from where their ancestors have been branched off with a northward and southward directed distribution, respectively giving way to a subsequent development (diversity) in antipodial centres. Other explanations for the phenomenon of these antipodial pairs of affinity seem less likely, *viz* if the pairs had to be explained as random parallel development which is extremely unlikely if we take the close taxonomical affinity of each pair into consideration. And the mere suggestion that the phenomenon is due to 'coincidence' seems not worthy to consider.

Vegetatively *Turpinia* shows a marked, structural resemblance with *Sambucus*, both possessing decussate, simply-pinnate, frequently herbaceous, toothed leaves, with stipules and gland-like stipels (though stipules are not always well represented in the latter genus and some *Turpinias* have simple leaves). Properly the sympetaly and inferior ovary of *Sambucus* separates them mainly in the reproductive section, but these two 'characters' are gradually losing their unique value as essentials for natural affinity. Some time the relationship between *Sambucus* and the *Staphyleaceae* should be scrutinized more carefully by modern methods.—VAN STEENIS.

1. TURPINIA

VENT. Choix (1803) 31, t.31. *nom. gen. conserv. prop.*; MERRILL & PERRY, J. Arn. Arb. 22 (1941) 543; J. KRAUSE[1], in E. & P. Pfl. Fam. ed. 2, 20b (1942) 306; BAKH., V. D. LINDEN & VAN STEENIS, Taxon 9 (1960) 57–58.—*Triceros* LOUR. Fl. Coch. 1 (1790) 184, *nom. gen. rejic. prop. non* GRIFF. 1854; SPRENG. Syst. 1 (1825) 947; MORITZI, Syst. Verz. (1846) 15; BAILL. Hist. Pl. 5 (1874) 342, 343, *excl. Euscaphis*; MAZA, Dicc. Bot. Nom. Vulg. Cub. & Puerto-Riq. (1889) 15; *cf.* also O.K. Rev. Gen. Pl. 1 (1891) 148.—*Dalrympelea* ROXB. [Hort. Beng. 1814, 17, *nomen*, '*Dalrympelia*'] Pl. Corom. 3 (1820) 76, t.279.—*Ochranthe* LINDL. Bot. Reg. 8 (1836) t.1819.—*Hasskarlia* MEISN. Pl. Vasc. Gen. 2 (1843) 348; *cf.* WALP. Ann. 1 (1849) 753.—*Maurocenia* § *Triceros* O.K. Rev. Gen. 1 (1891) 149.—*Kaernbachia* SCHLTR, Bot. Jahrb. 52 (1914) 151, *nom. illeg.*, *non* O. KUNTZE, Rev. Gen. 1 (1891) 62, *nom. illeg.*; ENGLER, in E. & P. Nat. Pfl. Fam. ed. 2, 18a (1930) 241, fig. 140; *cf.* HOOGL., VAN DER LINDEN & STEEN. Nova Guinea n.s. 10 (1959) 211–212.— **Fig. 1.**

Evergreen trees or shrubs with terete, pithy twigs; pith terete. Indument, if present, consisting of simple hairs. *Stipules* interpetiolar, 2 to each node, partly inserted in the axil of the petioles, imbricate, entire, rarely 2-tipped, *early* caducous (except in *T. stipulacea*), leaving a distinct *annular* scar. *Leaves* decussate, simple or odd-pinnate; petiole sulcate. Articulations (base of petiole, nodes of rachis) shrinking in the dry state. Two small glands (sometimes called stipels) on the rachis near the insertion of the petiolules and also 2 near the base of the leaflet. *Leaflets* 3–11 in compound leaves, herbaceous to subcoriaceous, mostly 2–3 times as long as wide, penninerved, midrib prominent, apex acute to acuminate, base obtuse to rounded, sometimes cuneately decurrent, margin glandularly serrate, dentate or crenate. *Panicles* axillary, terminal or subterminal, mostly glabrous. Bracts small. Pedicels with or without 1 or 2 minute bracteoles, not articulated with the flower, apically widened into the short obconical receptacle. *Flowers* regular, bisexual, 5-merous. *Sepals* persistent, free, imbricate, the outer ones broader than the inner ones, ovate, broadly attached at the base, rounded at the apex, fleshy, more or less ciliate at the margin. *Petals* free, imbricate, spathulate or oblong-elliptic, or obovate, equal-sized, narrowly attached, membranous, more or less ciliate at the margin, longer than the sepals, caducous. *Stamens* 5, epi-

(1) KRAUSE, *l.c.*, has cited all subsequent different spellings of *Dalrympelea*, *Ochranthe*, *Turpinia*, *etc.* and cited them erroneously as synonyms. I have omitted their mention, to avoid a complicated, unnecessary formality.

sepalous, equal; filaments linear, gradually widened to the base, (in Mal. *spp.*) glabrous, inserted close to the disk, caducous; anthers rounded or ovate, with spreading cell-bases, dorsifixed, dehiscing lengthwise, introrse, sometimes distinctly apiculate. *Disk* annular, glabrous and crenate, fleshy. *Ovary* superior, (2–)3(–4)-celled, the three cells and styles closely appressed but not connate, the combined stigmas 3-lobed. *Ovules* 1–∞ in each cell, anatropous, attached on the dissepiment very close to the axis, in 2 vertical rows. *Fruit* up to 2½ cm diam., with a more or less fleshy pericarp (in dry state rather hard), indehiscent, globular, slightly 3-lobed, sometimes crowned by the horn-like conical style remains. *Seeds* 1–∞ in each cell, of various shape, mostly roundish or reniform, or compressed, yellow-brown to dark-brown when dry; hilum large; endosperm present; cotyledons flat, roundish.

Distr. Probably *c.* 30–40 *spp.*, occurring in the continental–Asiatic and throughout the Malaysian tropics (from Ceylon to S. Japan southward to Java and New Guinea) and in the Central and South American tropics (West Indies, Columbia, Ecuador, Peru), in the West Pacific northward to S. China on the continent but to Formosa, Riukius, and S. Japan (Kyushu: Yakushima, at 32° N) in the more mild oceanic climate (Kuro Sjio current). Absent in the Pacific and the Australian continent. Though *Turpinia* is not found in North America the trans-Pacific disjunction belongs obviously to a disrupted, former North Pacific distribution, similarly to that of *Staphylea.*

Some species have a wide distribution, for example *T. montana* (BL.) KURZ, from Java and Sumatra northward to Indo-China, Hongkong, and Yunnan, and *T. pomifera* (ROXB.) DC. in SE. Asia and Malaysia (rare) where it has often been confused with *T. sphaerocarpa* HASSK., a species confined to Malaysia. The other species in Malaysia are all of a more restricted distribution.

The greatest density of species is found in Borneo (among which 2 endemic species on Mt Kinabalu); New Guinea, though situated at the southeastern end of the generic distribution, possesses 2 endemic species. In the Lesser Sunda Islands *Turpinia* is very rare which is probably due to the fact that *Turpinias* avoid countries subject to seasonal climatic conditions. Fig. 2.

Ecol. Obviously all species are constituents of tropical to subtropical rain-forest areas. They are evergreen and frequently of small stature, belonging to the undergrowth or substage. But some species may attain large size, up to 26 m, once noted 35 m with a free bole of 22 m, diam. 50 cm. They shun the areas subject to periodical drought and none has been found in several of the Lesser Sunda Islands or similar areas in South New Guinea.

As to altitude *Turpinia* prefers the montane zone, the highest stations in Malaysia being at *c.* 2400 m in New Guinea and on Mt Kinabalu. In the Himalaya and Yunnan representatives may ascend to 3000 m (and in Yunnan even to 3300 m, *cf.* KRAUSE).

RIDLEY does not cite any records for dispersal of *Turpinia*, but it is most likely that the fleshy, sometimes edible fruits will be devoured by birds and other animals and that the very hard-shelled seeds will be able to stand the passing of the intestinal duct and be dispersed endozoically.

As to pollination nothing is known definitely, but FYSON (Fl. Nilg. Puln. Hill-tops 1, 1915, 91) recorded for *T. nepalensis* that the disk is producing an appreciable amount of honey attracting insect visitors. The flowers lack, it is true, singly, attractive colours and size, but the inflorescences are large and sometimes very many-flowered and the honey scent may be a powerful agent for attracting insects, in a comparable way as is known from the equally unattractive flowers of *Leea*, as I have been informed by Dr M. A. LIEFTINCK. LÖRZING repeatedly noted the flowers of *T. sphaerocarpa* to be sweet-scented.

Morph. *Stipules.* MERRILL & PERRY mention in their key (*l.c.* 545) that the stipules would be connate in some Papuan species, but this rests on erroneous observation.

Characters which are suitable for specific distinction are not particularly showy, but they prove to be very constant; some are unexpected. They are:

(1) Number of ovules per cell, for example *T. montana* has always 2, *T. pentandra* 4(–5), and *T. brachypetala* 8(–7). In *T. sphaerocarpa* the number is less constant.

(2) Size and shape of flower parts (calyx, petals, anthers).

(3) Size and shape of the fruits and the thickness of the pericarp.

(4) Stipules in *T. montana* are very small and hairy and with a bifid apex, in others they are glabrous and entire. Unfortunately in many specimens and even of some species no stipules are available for examination. *T. stipulacea* possesses by exception obviously persistent stipules.

(5) The leaves provide reliable characters in only rather few species, for example in *T. montana* and *T. nitida*, they are simple in *T. simplicifolia*.

(6) Hairiness occurs in a few species but the indument is very short and sparse, it is only typical in *T. grandis*.

The place of insertion of the inflorescences has generally been accepted as terminal and I can confirm this in a general way. However, there are specimens in which there are 2, or twin pairs of peduncles in anthesis which are only seemingly terminal, but really separated by a small terminal bud visible between the bases of these peduncles. If such a flowering branch starts growing after the anthesis the infructescences become lateral and the central terminal bud prolongs the twig and produces a new flush with some leaf pairs and the same mode of pseudo-apical reproduction is repeated.

Galls. A few zoocecidia have been described by DOCTERS VAN LEEUWEN (Zoocec. Neth. Ind. 1926, 331, fig.), *viz* a stem gall caused by a gall midge on *T. montana*; two leaf galls caused by gall midges and a witches' broom caused by a gall mite on *T. sphaerocarpa*.

Vern. The vernacular names have little use generally for the species identity; I have only taken up those which I have found on sheets which I have identified, as in literature taxa have frequently been combined under one name (with all the vernaculars) pertaining to different species.

Uses. The timber is available only in small quantity and dimension and is of inferior quality with a low durability; it is only exceptionally used. By its quick growth *Turpinia* has been tried out as a pioneer for reafforestation on devastated mountain slopes in Central Java (Pangentjongan on Mt Galunggung and Klèdung on Mt Sindoro) which were promising, according to KOORDERS's report.

Wood Anat. DEN BERGER, Meded. Proefstat. Boschw. 13 (1926) 95, Determinatietabel houtsoorten van Malesië, Veenman, Wageningen (1949) 30; DESCH, Mal. For. Rec. 15^2 (1954) 524 (hand lens); HEIMSCH, Lilloa 8 (1942) 163; METCALFE & CHALK, Anat. Dic. 1 (1950) 445; MOLL & JANSSONIUS 2 (1908) 416.—The presence of the primitive features: many-barred scalariform perforation plates, fiber tracheids, long-tailed rays, do not favour the position of the family near to the *Sapindales*. JANSSONIUS *l.c.* recognized the large differences between the two families; HEIMSCH *l.c.* p. 182, 189 (erroneously cited by METCALFE & CHALK *l.c.* p. 446) suggested affinity to *Celastrales* but critical studies are necessary; DESCH *l.c.* p. 525 stated that too many genera of the *Celastrales* do not show affinity to *Turpinia*.—C.A.R.-G.

Notes. Practical research with *Turpinia* has proved extremely difficult by the inadequacy of the herbarium material which is often scrappy, in bud, or only bearing either flowers or fruit, bearing witness that collectors do not sufficiently realize the manifest need of collecting complete material for scientific purpose. It is lamentable that this has led to description of new species, and creation of types, on an insufficient basis: the types of *T. parviflora*, *T. simplicifolia*, *T. unifoliata*, and of *T. laxiflora* were described without fruit. Admittedly I am committing myself in this revision, but the two new species proposed here have such outstanding vegetative characters that I feel excused.

The venation of *mature* leaves is rather characteristic in herbarium materials. Leaflets have mostly a rather wide open venation *beneath* with prominence in *various* degree in proportion to the order of the veins (primary, secondary, tertiary, *etc.*). The upper surface of the leaflets shows mostly no prominence of the small veinlets.

However, in a number of species the veinlets of different order are all about equally strongly prominent on *both* surfaces giving the surface under the lens a reticulation approaching that of a tessellate structure. This is characteristic for *T. borneensis*, *T. nitida*, *T. grandis*, *T. stipulacea*, and *T. ovalifolia*.

The measurements of the flowers given in this revision are based on those of mature ones, boiled from herbarium material.

It is rather remarkable that several specimens of the Euphorbiacea *Bischofia javanica* BL. have in the herbarium been identified as *Turpinias* though having spiral leaves and no annular, stipular scars.

As the vegetative parts offer only occasionally distinctive characters collectors should secure fertile material, preferably with both flowers and fruit. Observations are desirable on the size and shape of the stipules and the mode of regeneration of the flush and inflorescences.

The framing of a separate key on sterile material did not seem of much practical use and has been omitted.

KEY TO THE SPECIES

1. Leaves all and always simple, lanceolate-oblong, 10–15 by 3½–5½ cm, on both sides with prominent venation. Sepals and petals *c.* 2½–3 mm long. Filaments up to 2 mm. Ovules 2 per cell. **1. T. simplicifolia**
1. Leaves 1–∞-jugate, the upper ones under the inflorescence exceptionally 1-foliolate.
2. Stipules large, ovate-triangular, *c.* 1½ cm long, *persistent*, stout (fig. 1p). Leaflets (7–)9, rather thin, elliptic, *c.* 9 by 5 cm. Venation on both sides fine-reticulate (tending to be tessellate) and prominent (in the herb.). Petals *c.* 2½–3 mm long. Stamens *c.* 2½ mm long; anthers $^{2}/_{5}$ mm. Ovules 4 per cell. **2. T. stipulacea**
2. Stipules early caducous. Not this combination of characters.
3. Upper internodes, stipules, petioles and petiolules, and inflorescence with a very short (puberulous) but continuous indument (also in fruit). Leaflets 3–1, large, 15–23 by 10–16 cm, ovate to ovate-oblong, sharply dentate; venation on both sides dense and prominent (tending to be tessellate). Leaf-articulations hardly shrinking in the herb.. Fruits globular, without horns, *c.* 1–1½ cm diam.; pericarp *c.* ½–1 mm diam. Seeds pale to pale brown, rather large, 10–18 per fruit. (Flowers unknown) . . . . **3. T. grandis**
3. Such indument absent. Not this combination of leaf-size and venation characters.
4. Flowers small (petals *c.* 1½–2½ mm long; anthers *c.* ½ mm). (Mature fruits not crowned by 3± distinct horns).
5. Pericarp (mostly much) thinner than 1 mm (fig. 1e). Stamens 1½–2 mm.
6. Stipules 2–3 mm long, pubescent, shortly bifid at the apex. Ovules 2 per cell (exceptionally 3–4 in a few flowers of an inflorescence). Fruit *c.* 8 mm diam.; testa $^{1}/_{5}$–⅓ mm diam.. Nerves patent and ± straight, connected by regular loops of equal strength and prominence (fig. 1o). Leaflets mostly thin and herbaceous (mostly pale green) in the herb., rather narrow-elliptic oblong, *c.* 5–10(–16) by 1½–5(–7) cm. Inflorescences delicate . . . . **4. T. montana**
6. Stipules *c.* 4½–9 mm long, glabrous, entire. Ovules 4–8 per cell. Fruit *c.* 8–15 mm diam. Testa ½–1 mm diam.. Nerves curved-ascending, not connected by regular loops of equal strength (fig. 1a, b). Leaflets chartaceous to thin-coriaceous. Inflorescences less delicate.
7. Venation dense and prominent with small areoles and tending to be tessellate on both surfaces. Anthers distinctly apiculate, *c.* ½ mm long. Ovules 4 in each cell. Seeds large, *c.* 9 mm averagely; testa $^{4}/_{5}$–1 mm diam.. Leaflets mostly distinctly widest below the middle, often towards the base . . . . **5. T. borneensis**
7. Venation rather lax with wider areoles and veins of various degree in prominence, the finest not prominent, not tending to be tessellate. Stamens 1¾–2 mm. Anthers not apiculate, *c.* ⅓–½ mm long. Ovules 6–7–8 in each cell. Seeds *c.* 5 mm, testa ½ mm diam.. Leaflets widest in the middle, wide and large, brown in the herb., shallow-dentate. Inflorescences 30–45 cm long. **6. T. laxiflora**
5. Pericarp thicker than 1 mm (fig. 1l). Stamens (generally) 2–3 mm. Anthers *c.* 0.5 mm, little to distinctly apiculate. Ovules 6–8 per cell. Seeds *c.* 5 mm, testa *c.* ½–1 mm diam.. Leaflets elliptic, not very wide, rather coarse-dentate, upper surface often greyish or metallic, discolored. **7. T. sphaerocarpa**
4. Flowers large (petals 3–4 mm, anthers at least ¾ mm).
8. Venation of dried leaves distinctly prominent on both sides.
9. Pericarp thinner than 1 mm. Fruit ± globose, crowned by 3 distinct horns, *c.* 7–12 mm diam.. Leaflets 3, shining, large (10–20 by 4–8½ cm), with 8–10 very patent, regular nerves prominent on both sides, more or less straight in the lower half, upwards curving and distinctly arching, coriaceous. Anthers 1 mm, apiculate. Pericarp *c.* ⅓–¾ mm diam..Ovules 4(–5) per cell. Testa ¾–1 mm diam. . . . . **8. T. nitida**
9. Pericarp 1–2 mm diam.. Fruit small, oval, globular, crowned (at least when young) with approximate style horns, *c.* 4–10 mm diam.. Leaflets 3, 4, or 5, mostly not shining on both sides, 7–20 by 4–10 cm; nerves 5–7, prominent below, spreading, ascending from the base, not distinctly looped, chartaceous. Anthers ¾ or 1–1¼ mm, not (or slightly) apiculate. Ovules 5 or 6(–8) per cell. Testa 0.3–0.4 mm diam. . . . . **9. T. ovalifolia**
8. Venation in the herbarium not distinctly prominent at both sides.
10. Pericarp thick, at least 5 mm diam. (fig. 1j). Ovules (5–)6(–7) per cell. Full-grown fruit large. Plant glabrous . . . . **10. T. pomifera**
10. Pericarp 1–2 mm diam. Ovules 4(–5) or 8(–7) per cell. Full-grown fruit 10–15 mm diam. Plants often puberulous.
11. Ovules 4(–5) per cell. Fruit with 3 distinct horns, at least when young. Leaflets 2½–4½ (–6½) cm wide . . . . **11. T. pentandra**
11. Ovules 8(–7) per cell. Fruit without style horns. Leaflets (3½–)5½–8 cm wide. **12. T. brachypetala**

1. Turpinia simplicifolia MERR. Philip. J. Sc. 27 (1925) 34.—*T. unifoliata* MERR. & CHUN, Sunyatsenia 2 (1934) 37.

Tree up to 4 m. *Leaves* simple, lanceolate-oblong to oblong-elliptic, glabrous, acuminate, decurrent at the base, slightly dentate, 10–15 by 3½–6 cm; petiole up to 4 cm long, glabrous. Stipules small, glabrous, 2–3 mm long. *Panicles* axillary, up to 18 cm long. Sepals elliptic, rounded, scarcely ciliate, *c.* 2½ mm long. Petals oblong-elliptic, ciliate, 2½–3 mm long. Stamens *c.* 2½ mm long; filaments 2 mm. Ovary 3-celled, each cell with 2 ovules. *Fruit* globular, *c.* 8 cm diam., without style-horns; pericarp very thin, 0.1–0.2 mm thick.

Distr. Hainan; in *Malaysia:* Philippines (Luzon), thrice collected.

Ecol. In forests.

Notes. The type (LOHER 12992) bears an inflorescence and slightly immature foliage. In comparing the characters it seems not specifically different from that of *T. unifoliata* MERR. & CHUN (S. P. KO 52249, NY) from Hainan, which has more mature leaves but an inflorescence which is in bud; the sizes of the floral parts (stamens) are obviously for this reason somewhat smaller than those of *T. simplicifolia.*

Another (fruiting) specimen from Hainan (F. C. How 73403, SING) was preliminarily referred by MERRILL to the same species, but from its venation and leaf-shape I conclude this to represent *T. indochinensis* MERR. This seems to be extremely close to *T. formosana* NAKAI which has only 4 ovules per cell, *T. indochinensis* having 8. It might probably be better to reduce the latter as a variety to *T. formosana.*

MASAMUNE (Fl. Kainant. 1943, 178) reduced *T. unifoliata* to *T. formosana* NAKAI, J. Arn. Arb. 5 (1924) 80. In my opinion this is a different species by possessing 4 ovules per cell, larger flowers (petals 4 mm), lesser nerves (7–9 pairs), and hairy stamens. I have not seen the type (WILSON 10130), but TANAKA & SHIMADA 13554 and 11180, which agree with the description of *T. formosana.*

The leaves are astonishingly resembling those of certain specimens of *T. borneensis*, but this species has 5 leaflets, petals less than 2 mm long, and 4 ovules per cell.

Its closest alliance is, as MERRILL & CHUN already remarked, not with other 1-foliolate species (such as *T. arguta*), but with *T. nepalensis* from which it differs by a more regular nervation, finer inflorescence, 2 ovules per cell, and simple leaves.

2. Turpinia stipulacea V. D. LINDEN, *nov. sp.*— **Fig. 1p.**

A speciebus omnibus differt stipulis maximis persistentibus lignescentibus. Folia 4–5-jugata, foliolis 6–10 × 2½–5 cm. Inflorescentiae robustae, usque ad 25 cm longae. Sepala 2–2½ × 1½–2¼ mm. Petala 2½–3 mm longa. Stamina c. 2½ mm longa, antheris suborbicularibus subapiculatis. Ovula 4 in utroque loculo. T: SF 27516 CARR, Sing.

Tree *c.* 18 m high. *Leaves* 4–5 jugate; leaflets ovate, glabrous, acuminate, rounded at the base, margin denticulate, 6–10 by 2½–5½ cm; petiole up to 8 cm; petiolules of the lateral leaflets 3–7 mm. Stipules large, 17 by 10 mm, persistent, woody, glabrous. *Panicles* axillary up to 25 cm long; pedicels 1–2 mm long. Sepals ovate-oblong, green, suffused red down to the middle of the segments, 2–2½ by 1½–2¼ mm. Petals obovate-oblong, creamy-yellow, 2½–3 mm long. Stamens *c.* 2½ mm long; filaments *c.* 2 mm; anthers round, slightly apiculate, $^2/_5$ mm long. Ovary 3-celled, with 4 ovules per cell. *Fruit* unknown.

Distr. *Malaysia:* North Borneo (Mt Kinabalu, near Tibabah R.), once collected, 2100 m; *fl.* June.

Notes. A remarkable species deviating from all others by its obviously persistent, very large stipules. The large number of leaflets and the 4 ovules per cell remind of the Papuan *T. pentandra*, but this species has another venation and much larger anthers. It is possibly more allied to *T. borneensis* with which it shares the prominent venation and 4 ovules, but this species has narrower, more pointed leaf-shape, smaller flowers, and finer, shorter inflorescences, besides lacking the unique stipules.

3. Turpinia grandis V. D. LINDEN, *nov. sp.*

Arbor 10–18 m alta. Internodia ultima, petioli et infructescentiae indumento denso brevi muniti. Folia 1–3 foliolata, foliolis magnis grosse-serratis, 15–23 × 10–16 cm, venulis utrinque prominentibus. Infructescentiae 30 cm longae. Fructus globosus ecorniculatus, 1–1½ cm diam., pericarpio c. ½–1 mm crasso. Semina flavescenti-brunnea, 10–18 in fructo singulo. T.: ENDERT 4669, L.

Tree 10–18 m. Upper internodes, stipules, petioles, and infructescences with a very short (puberulous) but continuous indument. *Leaves* 1–3-foliolate; leaflets ovate to ovate-oblong, acuminate, rounded at the base, sharply dentate, 15–23 by 10–16 cm; venation on both sides dense and prominent; petiole up to 7 cm long; petiolules of the lateral leaflets ½–1½ cm. Stipules small, *c.* 5 mm long. *Flowers* unknown. *Infructescences* axillary, sub-terminal or terminal, up to 30 cm long. *Fruit* globular, without horns, *c.* 1–1½ cm diam.; pericarp ½–1 mm thick. Seeds pale to pale-brown, rather large, 10–18 in each fruit.

Distr. *Malaysia:* Central E. Borneo (W. Kutai: Kiau; Mt Kemul; Long Petah), thrice collected.

Ecol. On forested river-banks and in deep ravines, 450–1000 m.

Note. Superficially somewhat resembling *T. laxiflora* but with 1–3 leaflets. Besides, *T. laxiflora* has a loose, only slightly prominent venation, smaller fruits, and sepia-coloured seeds. It is probably closest allied to *T. borneensis*, but it differs from that species by its indument, leaf-size, and number of ovules.

4. Turpinia montana (BL.) KURZ, J. As. Soc. Beng. 44, ii (1875) 182, α *genuina*; KOORD. Exk. Fl. Java 2 (1912) 528; Atlas Baumarten 1 (1913) t. 92; Fl. Tjib. 2 (1923) 149; HOCHR. Candollea 2 (1925)

412, *incl. f. arborescens et f. scandens*; MERR. Contr. Arn. Arb. 8 (1934) 93; BACKER, Brittonia 3 (1938) 81; MERR. J. Arn. Arb. 19 (1938) 42; MERR. & PERRY, J. Arn. Arb. 22 (1941) 552; BACK. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 152, p. 1.—*Zanthoxylum* (*Xanthoxylum*) *montanum* BL. Bijdr. (1825) 248; MIQ. Fl. Ind. Bat. 1, 2 (1859) 670, *cf.* RADLK. Sitz. Ber. K. Bay. Ak. Wiss. 16 (1886) 305–306 (1887).—*Zanthoxylum serrulatum* BL. Bijdr. (1825) 249; MIQ. *l.c.*—*Triceros cochinchinensis* (*non* LOUR.) MORITZI, Syst. Verz. (1846) 15.—*Maurocenia zollingeri* O.K. Rev. Gen. Pl. 1 (1891) 147, 150, *cf.* BACKER, Brittonia 3 (1938) 81.—*T. parva* K. & V. Bijdr. Booms. 9 (1903) 249; BACK. Schoolfl. (1911) 272; CRAIB, Fl. Siam. En. 1 (1926) 338.—*Evodia parviflora* CRAIB, Kew Bull. (1915) 425.—*? T. gracilis* NAKAI, J. Arn. Arb. 5 (1924) 79.—*T. parviflora* CRAIB, Fl. Siam. En. 1 (1931) 339.—**Fig. 1g–i.**

Shrub or tree up to 15 m. *Leaves* 3–7-foliolate, below the inflorescence exceptionally with only 1 leaflet; leaflets elliptic to oblong, glabrous, acuminate, decurrent at the base, dentate, 3–10 (–15) by 1½–7½ cm; nerves straight, very regularly connected by a looped intramarginal vein; petiolules of the lateral leaflets ½–3 cm. Stipules *c.* 3 mm, puberulous, with a short but sharply bifid apex. *Panicles* axillary, open, up to *c.* 18 cm long. Sepals ovate, glabrous, ciliate, 1–1¼ by 1¼–2 mm. Petals obovate, glabrous, ciliate, 1–1¼ by 1¼–2 mm. Stamens *c.* 1½ mm long; filaments 1–1¼ mm; anthers ½–⅓ mm, not or only very slightly apiculate. Ovary (2–)3(–4)-celled, each cell with 2 ovules. *Fruit* globular, sometimes with 3 radial lines from the top, 8–10 mm diam.; pericarp thin, to ½ mm thick; more than one seed developed; testa 0.2–0.3 mm thick.

Distr. Deccan Peninsula (Pulney Hills), Burma, Siam, Indo-China, China (Yunnan, Kwantung, Hainan), Hong Kong, in *Malaysia:* Sumatra to Central and W. Java (most frequent in W. Java).

Ecol. In primary montane rain-forest, 750–2300 m. Fl. Oct.–Jan., *fr.* March–Aug.

Vern. *Puhun putàg, ki bantjèt leutik*, S.

Notes. By its thin, very regularly looped nerves and delicate inflorescence easily recognized. On the mainland a few specimens have been found with somewhat thicker, shorter leaves and more contracted inflorescences (in drier climate?); venation and ovules are however exactly matching those of *T. montana*. This form has been described as a distinct species *T. parviflora* CRAIB from Siam (KERR 2527, K) and is also found in Indo-China (PIERRE 907, L). The size of the flower parts is slightly smaller than that in *T. montana*, but this is due to the fact that both specimens cited above are in bud. There is no question that this species is ever scandent. The number of leaflets may occasionally be up to 11 (GARRETT 792, Thailand).

A collection from the Pulney Hills (A. SAULIÈRE 115, Bo, K, L) certainly represents *T. montana*; it has the same venation, glabrous stamens, constantly 2 ovules per cell, and 3–4 mm long bifid stipules.

There is a distinct affinity with *T. nepalensis* which, however, has never only 2 ovules per cell.

T. montana var. borneensis MERR. & PERRY I have found to represent a distinct species under that epithet.

Whether the Chinese *T. glaberrima* MERR. (Lingn. Sc. J. 7, 1931, 312; *ibid.* 14, 1935, 27; J. Arn. Arb. 22, 1941, 552) differs from *T. montana* is not certain as several numbers MERRILL & PERRY mentioned to belong to it (TSIANG 2715, HOW 71654, 73218, CHUN & TSO 43918) represent in my opinion *T. montana.*

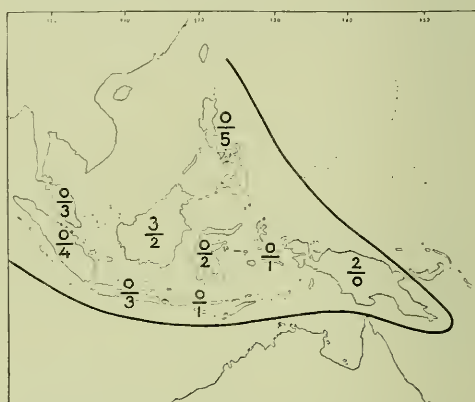


Fig. 2. Demarcation of the Indo-Malaysian part of the distributional area of *Turpinia*, showing also the number of species in each island or island group; above the hyphen the number of endemic species, below it other species.

5. Turpinia borneensis (MERR. & PERRY) V. D. LINDEN, *nov. comb.*—*T. montana var. borneensis* MERR. & PERRY, J. Arn. Arb. 22 (1941) 553. T: CLEMENS 29391 *bis.*—**Fig. 1a–f.**

Tree up to 15 m. *Leaves* 3–5(–7)-foliolate; leaflets ovate-oblong to almost lanceolate, glabrous, distinctly acuminate, rounded at the base (in the Philippine specimens sometimes cuneately decurrent), dentate, 7–17 by 2½–6 cm; primary nerves and the reticulating veins distinctly prominent on both sides; petiolules of the lateral leaflets *c.* ¼–2 cm long. Stipules *c.* 5 mm, glabrous. *Panicles* axillary, open, up to *c.* 20 cm. Sepals ovate, ciliate, 2 by 1½ mm. Petals obovate, ciliate, 1¾ by 1¼ mm. Stamens 1¾ mm long; filaments *c.* 1½ mm; anthers ½ mm long, apiculate. Ovary (2–)3-celled, each cell with 4 ovules. *Fruit* globular, sometimes with 3 radial lines from the top, 8–15 mm diam.; pericarp thin, 0.1–0.2(–0.5) mm diam. Seeds large brown; testa ¾–1 mm thick.

Distr. *Malaysia:* Borneo and the Philippines.

Ecol. In rain-forests, up to 1600 m.

Note. MERRILL & PERRY already remarked that their *T. montana var. borneensis* might deserve specific rank. Its venation, prominent on both sides, ovate-oblong leaf, its curved nerves, and 4 ovules per cell (in *T. montana* always 2) remove it distinctly from *T. montana.* The latter is an exclusively montane species distributed from SE. Asia along the Sumatran track to Java.

6. Turpinia laxiflora RIDL. J. Str. Br. R. As. Soc. *n.* 82 (1920) 179; Fl. Mal. Pen. 1 (1922) 512; MERR. & PERRY, J. Arn. Arb. 22 (1941) 553.—*T. pomifera var. sphaerocarpa* (*non* HASSK.) KING; KING, J. As. Soc. Beng. 65, ii (1896) 453, *pro parte.*

Tree, up to 24(–35) m by 50 cm. *Leaves* 3–7-foliolate; leaflets ovate-elliptic, glabrous, dentate, acuminate, rounded at the base, 8–24 by 3½–12 cm; petiolules of the lateral leaflets 4–20 mm, glabrous. Stipules 5–9 mm long, glabrous. *Panicles* axillary, lax, long, up to 45 cm, the ultimate branches minutely puberulous. Sepals ovate, sparsely ciliate, 1½–2 by 1–2 mm. Petals oblong, distinctly ciliate, 2¼–2½ by 1–1¼ mm. Stamens 1¾–2 mm long; filaments 1½–1¾ mm; anthers ⅓–½ mm long, roundish, not apiculate. Ovary 3-celled, each cell with (6–)7–8(–9) ovules. *Fruit* globular, in dry state mostly wrinkled, ½–1 cm diam.; pericarp (very) thin, 0.2(–0.9) mm diam. Seeds several in each fruit; testa *c.* ½ mm thick.

Distr. *Malaysia:* N. Sumatra (also Simalur I.) and Malay Peninsula (Perak: Larut).

Ecol. In rain-forests, at low altitudes, up to 150 m, once at 900 m. *T. laxiflora* has been noted by RIDLEY (*n.* 6214, coll. *a.* 1894) to change its foliage with new flush appearing simultaneously with young inflorescences. Young leaflets, when they first appear, are narrow elliptic-lanceolate! As no later similar data have been reported it seems premature to conclude that it is deciduous.

Vern. *Arilan-buluh, arilan pajó ĕtem, arilan sitobudlung,* (*awā*)*arilan uding, awā mātān nanas, lahulung, matan-nanas pajo,* Simalur, *kaju longgakan, k. songgak,* Sumatra, *k. rĕbung,* Pasemah (Palembang).

Note. Closely allied to *T. sphaerocarpa* but obviously distinct by a different pericarp, larger inflorescences, and generally wider leaflets which are brown in dry state.

7. Turpinia sphaerocarpa HASSK. Flora 25, ii (1842) Beibl. 1, p. 42; MIQ. Fl. Ind. Bat. 1, 2 (1859) 593; RIDL. J. Mal. Br. R. As. Soc. 1 (1923) 58; BAKER *f.* J. Bot. 62 (1924) Suppl. 24; MERR. & PERRY, J. Arn. Arb. 22 (1941) 548.—*Dalrymplea javanica* HASSK. Pl. Jav. Rar. (1848) 439.—*T. pomifera* [*non* (ROXB.) DC. 1825]: MIQ. Sum. (1861) 201, 513; K. & V. Bijdr. Booms. 9 (1903) 245; BACK. Schoolfl. Java (1911) 272; KOORD. Exk. Fl. Java 2 (1912) 528; Atlas Baumart. 1 (1913) t. 93; Fl. Tjib. 2 (1923) 149; HOCHR. Candollea 2 (1925) 412; BACK. Bekn. Fl. Java (em. ed.) 7 (1948) fam. 152, p. 1; HEINE, Pfl. Kinabalu (1953) 57.—*Maurocenia sphaerocarpa* O.K. Rev. Gen. Pl. 1 (1891) 147, 149.—*T. pomifera var. sphaerocarpa* KING, J. As. Soc. Beng. 65, ii (1896) 453, *pro nomen, partim.*—*T. latifolia* WALL. [Cat. 4939] *ex* RIDL. J. Str. Br. R. As. Soc. *n.* 82 (1920) 178; Fl. Mal. Pen. 1 (1922) 512.—*T. sambucifolia* ELMER, Leafl. 9 (1934) 3217.—*T. nepalensis* (*non* [WALL. Cat. 4277] *ex* W. & A. 1834): MERR. Contr. Arn. Arb. 8 (1934) 94.—**Fig. 11–n.**

Large shrub or tree, up to 20 m high, 55 cm diam. *Leaves* 3–5–7(–11)-foliolate, brownish-red when young; leaflets ovate, oblong or elliptic, glabrous, more or less acuminate, base obtuse or obtusely rounded or decurrent, more or less (sometimes not) dentate, 3–18 by 2–10 cm; petiolules of the lateral leaflets 3–15 mm, glabrous or puberulous. Stipules large, 8–9 mm long, glabrous. *Panicles* axillary, open, up to 30 cm long. Sepals ovate, ciliate, 1½–2 by 1½–2½ mm. Petals oblong to elliptic, thin, more or less ciliate, 2½ by 1½ mm. Stamens 2¼–3 mm long; filaments 2–2½ mm; anthers ½ by ½ mm, generally more or less apiculate. Ovary (2–)3(–4)-celled, each cell with 5–6(–8) ovules. *Fruit* globular, mostly with three grooves from the top, *c.* 1–1½ cm diam.; pericarp 1–3 mm thick. Seeds brown, mostly several per fruit; testa ½–1 mm thick.

Distr. *Malaysia:* Sumatra, Malay Peninsula, Borneo, Java, Lesser Sunda Islands (Bali, Flores), Celebes, Philippines, Moluccas (Ceram, Ambon).

Ecol. Frequent in rain-forests, on various soil types, 50–2000 m.

Vern. *Ki bangkong, ki bantjèt, ki keujeup, ki pongpasang, ki tjĕhai, tjawané soré,* S; *godong bantjèt,* J; *langkiang ĕtĕm, rĕbung, tutuh sirawi,* Simalur, *aĕ, kua,* Endeh.

Notes. This species has often been confused with *T. pomifera* but the differences in size of the flowers and thickness of the pericarp make it desirable to distinguish these taxa as two species; their areas overlap. No attempt has been made to unravel all confusions in the references.

In the Malay Peninsula and Sarawak *T. sphaerocarpa* is mostly represented by a slightly distinguishable form described as *T. latifolia* but I cannot find any fitting characters to delimit it against *T. sphaerocarpa.*

A specimen from Ceram (EYMA 2150) shows a remarkable resemblance to the Papuan species but it has small flowers (2½ mm) and constantly 6 ovules per cell. In fruit these species can hardly be distinguished.

In Sumatra some specimens have been found which are shortly but rather stiffly hairy on *both* leaves and inflorescences; they represent a minor variety, *var.* **pubescens**, *nov. var.* No great importance can be attached to this variety, although it is occupying a geographically coherent area in Central Sumatra. A specimen from Mt Kinabalu (CLEMENS 34462) and one from Celebes (Palu: bb 28283) deviate in having *only* the inflorescence puberulous, besides having stamens 1½–1¾ mm, anthers ¾ mm.

Of MERRILL's record of *T. nepalensis* in N. Sumatra I saw only one cited number (BANGHAM 981) which I refer to *T. sphaerocarpa.* This is a fruiting specimen; the leaf is typically discoloured as in *T. sphaerocarpa.* The ripe fruits are distinctly too large for *T. nepalensis* and may well fit the size and structure of *T. sphaerocarpa,* but they have a distinctly 3-horned tip which is unusual for the latter species. The horns are not widely spaced as in *T. cochinchinensis* which species has also no discoloured leaves.

8. Turpinia nitida MERR. & PERRY, J. Arn. Arb. 22 (1941) 549.

A recumbent treelet, 4½–6 m high. *Leaves* 1–5-foliolate; leaflets coriaceous, oblong to elliptic, glabrous, denticulate, acuminate, rounded at the base, upper surface shining, 11–25 by 5½–10½ cm; nerves prominent, arcuately ascending, then parallel with the margin; petiole up to 6 cm long, glabrous; petiolules of the lateral leaflets 12–20 mm. Stipules small, glabrous, *c.* 5 mm long. *Panicles* axillary, subterminal (or terminal), up to 22 cm long. Pedicels 2–2½ mm. Sepals oblong-elliptic, ciliate, 2–4 by 1½–2½ mm. Petals oblong, ciliate, 4 by 2 mm. Stamens 2½–3½ mm long; filaments *c.* 3 mm; anthers *c.* 1 by 1 mm, distinctly apiculate. Ovary (2–)3-celled, each cell with 4(–5) ovules. *Fruit* globular, with 3 distinct, sometimes closely appressed horns; pericarp ¼–¾ mm thick. Seeds large, two or more in each fruit; testa ¾–1 mm thick.

Distr. *Malaysia:* North Borneo (Mt Kinabalu).

Ecol. Fairly frequent on wet forest ridges, 900–1800 m.

Note. In size of the leaflets resembling *T. grandis* (also occurring on Mt Kinabalu), but differing in the shape of the fruit, the venation of the leaflets, and the absence of an indument.

9. Turpinia ovalifolia ELMER, Leafl. Philip. Bot. 2 (1908) 490; MERR. & PERRY, J. Arn. Arb. 22 (1941) 544.—*T. trifoliata* RIDLEY, J. Str. Br. R. As. Soc. *n.* 82 (1920) 178; Fl. Mal. Pen. 1 (1922) 511.—*T. lucida* NAKAI, J. Arn. Arb. 5 (1924) 80.—*? T. pachyphylla* MERR. Philip. J. Sc. 27 (1925) 33, *ex descr.*—**Fig. 1o.**

Tree *c.* 8 m or sometimes higher. *Leaves* 3–5 (–7)-foliolate; leaflets rounded to elliptic, glabrous, acuminate, sometimes with an abrupt acute point, rounded at the base, margin crenate with fine, whitish, callous points, (2½–)4–20 by (1–)4–10 cm; petiolules of the lateral leaflets 4–15 mm, glabrous. Stipules small, 2½–3 mm long, glabrous. *Panicles* mostly short, *c.* 10–15 cm long (in fruit to 30 cm), rather dense. Sepals ovate, ciliate, 2–4½ by 1½–3 mm. Petals obovate-oblong, thin, ciliate, 3½ by 2 mm. Stamens 2½ mm long; filaments 2–2½ mm; anthers ¾ or 1–1¼ mm long, not (or slightly) apiculate. Ovary (2–)3-celled, each cell with 5 or 6(–8) ovules. *Fruit* with 3 short horns on top, 4–12 mm diam.; pericarp thick 1–4 mm; testa 0.3–0.4 mm thick.

Distr. *Malaysia:* Malay Peninsula (Nyalas, Selangor), Philippines (Luzon, Palawan).

Notes. I cannot well separate *T. ovalifolia* and *T. trifoliata*; the type of the former is extremely poor; the flowers ELMER described are not present in any of the isotypes I have had on loan for study. Though there is a slight difference in the size of the anthers I cannot discriminate the Malayan specimens from those of the Philippines. The species can be expected to occur in Borneo.

T. robusta CRAIB from Siam is habitually very similar to Malay Peninsula specimens of "*T. trifoliata*" but its flowers are smaller and there are only 4 ovules per cell; it is unfortunately only described after flowering material which in all its characters is extremely close to *T. cochinchinensis* (LOUR.) MERR., all species having 4 ovules per cell. The latter species has much larger fruits (1–2 cm diam.) with spaced horns; *T. nepalensis* has small fruits *c.* ½ cm diam., also provided with small remains of the style bases.

10. Turpinia pomifera (ROXB.) DC. Prod. 2 (1825) 3; WALL. Cat. 4267; KURZ, J. As. Soc. Beng. 44, ii (1875) 182, *excl. syn.*; HAYATA, Ic. Pl. Form. 1 (1911) 160; ?KING, J. As. Soc. Beng. 65, ii (1896) 453, *pro nomen, excl. var. sphaerocarpa*; KANJILAL & DAS, Flora of Assam 1, 2 (1937) 309; MERR. & PERRY, J. Arn. Arb. 22 (1941) 546; HOLTHUIS & LAM, Blumea 5 (1942) 205; GAGN. Fl. Gén. I.-C. Suppl. 1 (1950) 993.—*Dalrympelea pomifera* ROXB. [Hort. Beng. (1814) 17] Pl. Corom. 3 (1819) 76, t. 279 (*Dalrympelia*).—*Maurocenia pomifera* O.K. Rev. Gen. Pl. 1 (1891) 147, 149.—*Turpinia sp.* MERR. For. Bur. Bull. (Philip.) 1 (1903) 34.—**Fig. 1j–k.**

Tree, *c.* 10–20 m. *Leaves* 3–5–7(–9)-foliolate; leaflets elliptic-oblong, glabrous, distinctly acuminate, decurrent (sometimes a little rounded) at the base, dentate, 12–25 by 6–10 cm; petiolules of the lateral leaflets 3–10 mm. Stipules triangular, 4–5 mm. *Panicles* terminal, subterminal or axillary, 10–30 cm long, sometimes slightly puberulous. Sepals ovate, unequal, fleshy, scarcely ciliate, 2–3½ by 1¼–2 mm. Petals oblong, thin, scarcely ciliate, 3–3½ by 1–1½ mm. Stamens 3 mm long; filaments *c.* 2½ mm; anthers $^4/_5$–1 mm long, mostly subapiculate. Ovary 3-celled, each cell with (5–)6 ovules. *Fruit* globular, mostly with 3 grooves from the top, up to 25 cm (perhaps to 37 mm); pericarp very thick, to *c.* 5 mm diam. Seeds small and brown, glossy.

Distr. Continental Asia from the East Himalaya eastward; in *Malaysia* rare: Sumatra, Java, Central Celebes (Nuha Distr.: KJELLBERG 2303) and Minahassa, Talaud Is, and Philippines (Mindanao: AHERN 354; Luzon: Camarines Sur: BS 76375).

Ecol. In forests, 0–2100 m; *fl.* March, *fr.* Sept.–Oct.

Vern. *Ki bangkong*, *ki rĕnggang*, S, *lampasia*, Minahasa.

Notes. *T. pomifera* which is a common species on the Asiatic continent is rare in Malaysia. It is characterized by a very thick pericarp closely enveloping the seeds, and besides it differs from *T. sphaerocarpa*, with which it has frequently been confused in Malaysia, by larger flowers and much larger anthers. In sterile state it is impossible to tell them apart.

The only specimen of the Malay Peninsula which might represent true *T. pomifera* is KING's coll. 4243 (SING), but the material is too inadequate to be conclusive.

In the W. Deccan (Ghats and Nilgiris) and Ceylon the records of *T. pomifera* have been straightened out by GAMBLE (Kew Bull. 1916, 135; Fl. Madras pt 2, 1918, 241); it appears that two different species are concerned, *viz T. nepalensis* and a new species, *T. malabarica* GAMBLE, which is also the single one occurring in Ceylon, characterized *i.a.* by hairy filaments.

11. Turpinia pentandra (SCHLTR) V. D. LINDEN, Nova Guinea n.s. 10 (1959) 212.—*Kaernbachia pentandra* SCHLTR, Bot. Jahrb. 52 (1914) 151, f. 5 H–N; ENGLER, in E. & P. Pfl. Fam. ed. 2, 18a (1930) 241.—*T. papuana* MERR. & PERRY, J. Arn. Arb. 22 (1941) 554.—*? T. papuana* HARMS in E. & P. Pfl. Fam. ed. 2, 20b (1942) 312, *descr. germ., sine typ., homon. illeg.*

Tree, 15–20(–25) m. *Leaves* (1–)2–3-jugate (rarely paripinnate by absence of the terminal leaflet); leaflets oblong or ovate-oblong, glabrous, shallowly serrate, distinctly obtusely acuminate, obtuse to rounded at the base, 6–12(–15) by 2½–4½(–6½) cm; petiole 2–4½(–7) cm, very short-hairy to glabrous; petiolules of the lateral leaflets 3–5(–8) mm. Stipules triangular, glabrous or sparsely hairy outside, 5–7 by 3–4 mm. *Panicles* axillary, open, up to 25 cm long. Pedicels ½–3 mm long. Sepals broad-obovate, ciliate, 3–3½ by 1½–2 mm. Petals obovate, rounded or obtuse at the apex, thin, ciliate, 4–4½ by 1¾–2 mm. Stamens 3½–4¼ mm long; filaments 2½–3 mm; anthers ¾–1 mm long, apiculate. Ovary 3-celled, each cell with 4(–5) ovules. *Fruit* globular, mostly with 3 distinct horns (remains of the styles), *c.* 1½ cm diam.; pericarp *c.* 2 mm thick. Seeds mostly 1(–2).

Distr. *Malaysia:* New Guinea.

Ecol. In primary rain-forests, locally frequent, 1200–2500 m.

Vern. *Naun*, Waria (Mt Hagen).

Note. Very close to *T. brachypetala*, but constantly differing in the number of the ovules, the shape of the fruit (horns), and width of the leaflets.

12. Turpinia brachypetala (SCHLTR) V. D. LINDEN, Nova Guinea n.s. 10 (1959) 212.—*Kaernbachia brachypetala* SCHLTR, Bot. Jahrb. 52 (1914) 153, f. 5 A–G; ENGLER, in E. & P. Pfl. Fam. ed. 2, 18a (1930) 241, f. 140 A–G.—*T. versteeghii* MERR. & PERRY, J. Arn. Arb. 22 (1941) 554.

Tree, 4–26 m; bark brownish grey, flaky. *Leaves* (1–)2–3-jugate (rarely paripinnate by absence of the terminal leaflet); leaflets ovate-oblong, serrate, glabrous, obtuse, more or less acuminate, obtuse to rounded at the base, (6½–)8–17 by 4½–8½ cm; petiole 3½–9 cm long, very short-hairy or glabrous; petiolules of the lateral leaflets 4–9 mm long; young foliage glossy brownish green. Stipules triangular, glabrous or sparsely hairy outside, 4–7 by 3–6 mm. *Panicles* axillary, open, up to 30 cm long. Pedicels ½–3 mm long. Sepals ovate, ciliate, white, 3½–4 by 2–2¾ mm. Petals obovate-oblong, spathulate, thin, sparsely ciliate, white, 3½–4½ by 1½–1¾ mm. Stamens 3½–4½ mm long; filaments 3–4 mm; anthers ¾–0.9 mm long, distinctly apiculate. Ovary 3-celled, each cell with (7–)8 ovules. *Fruit* globular, sometimes with 3 radial lines from the top, 1–1½ cm diam.; pericarp *c.* 2 mm thick. Seeds mostly 3 or more.

Distr. *Malaysia:* New Guinea.

Ecol. In primary rain-forests, locally frequent, 300–2000 m.

Note. We have at present rather numerous collections from various places all over New Guinea from both *T. pentandra* and *T. brachypetala*. They are doubtless closely allied, but there appear to be no intermediates. If only fruiting material is available *T. brachypetala* can hardly be distinguished from *T. sphaerocarpa* HASSK.

CAPPARIDACEAE (M. Jacobs, Leyden)

Herbs or shrubs, often climbing, rarely trees. Indument, if present, consisting of simple (unicellular or multicellular) hairs (sometimes capitate-glandular), stellate hairs, or appendages (*Cleome*). *Leaves* spirally arranged, petioled, simple, palmately dissected, or compound, entire, penninerved, in *Stixis* pellucid-dotted. *Stipules* thorny, or minute, or wanting. *Inflorescences* racemose, terminal or lateral, rarely the flowers axillary, or sometimes serial. Bracts, if present, small and caducous, rarely with stipular bracteoles. *Flowers* bisexual but sometimes the gynoecium reduced (in extra-Mal. *spp.* staminodes may occur), actinomorphic with a tendency towards zygomorphism, especially in the receptacle and in the position of the petals, mostly in bud until anthesis, but in *Crateva* opening at a very early stage. *Sepals* 4, either equal or in 2 whorls of 2 and then the outer pair enveloping the bud and slightly different from the inner pair, or (in *Stixis*) in 2 equal whorls of 3, free, rarely the outer pair connate in bud. *Petals* 4 or (in *Stixis*) absent, free, often unguiculate, equal, or sometimes 2 of the petals slightly asymmetrical and adjoining at the base. Receptacle more or less conical, often with peculiar protrusions, such as (in Malaysia) a small anterior disk in *Capparis*, or a long anterior tubular gland in *Cadaba*, or a ring in *Crateva*. *Stamens* (4–)6 to ∞, in Malaysian genera all fertile, either free or their base connate with the gynophore in a very short to very long androgynophore; anthers dorsifixed, often near the base, introrse, 2-locular, dehiscent lengthwise, connective inconspicuous. *Ovary* generally on a long gynophore, to sessile, ovoid to cylindrical, with a small, simple, sessile stigma, 2–6-carpellate, in Malaysia 1–3-locular. Ovules mostly ∞, on parietal, rarely axillary placentas, campylotropous, with 2 integuments, a third, thin, innermost seed-coat of tracheal tissue being present at least in certain examined cases. *Fruit* a capsule, or a berry with tough exocarp. *Seeds* ∞, rarely 1 (*Stixis*), mostly coiled-reniform, poor in endosperm; embryo curved, horseshoe-shaped or coiled, the cotyledons mostly involute or plicate, or coiled, or one partly enveloping the other; testa in seeds of dry fruits mostly sculptured and sometimes with an elaiosome, otherwise smooth.

Distribution. About 45 genera and approximately 700 *spp.* in tropical and subtropical regions. The largest genera are *Capparis* (over 250 *spp.*), *Cleome* (over 150 *spp.*), *Maerua* (over 50 *spp.*), and *Boscia* (over 35 *spp.*). *Capparis* and *Cleome* are both best-represented in the neotropics; another large centre is Africa. Monotypic genera are extremely numerous in this family: of the 45 genera acknowledged by Pax & Hoffmann 20 (44 %) are monotypic. Even if some might be reduced in future studies the figure will remain remarkably high. SE. Asia and Australia are the poorest in monotypic genera, either area having 3; it is not certain that all these six monotypic genera can be upheld. These six monotypic genera are also endemic and only SE. Asia has one more endemic genus. On account of these facts, I presume that the family occupied these parts of the world later than Africa and the neotropics.

Of the 5 Malaysian genera, *Crateva*, *Capparis*, and *Cleome* are pantropic. *Cadaba* extends from Africa to Australia, and only *Stixis* is limited to the SE. Asian rain-forest area.

Ecology. Most of the *Capparidaceae* are *xerophilous*, and it is the world's drier regions that are richest in representatives. In Malaysia *Cadaba* and partly *Capparis* show such a xerophilous distribution. It is notable how many species of *Capparis* avoid the everwet Sunda shelf land and are distributed around it. This tendency also holds for *Cadaba*, but not for *Crateva* and *Stixis*.

Most *Capparidaceae* are *heliophilous*. Next to the above-mentioned tendency to xerophily, adaptations to other conditions occur. A few *Capparis spp.* prefer more or less light forest, as do the species of *Stixis*. *Crateva* seeks the proximity of rivers, both in the everwet and monsoon areas. *Cleome* seems in Malaysia anthropochorous. Most *Capparidaceae* are lowland plants; a few ascend as high as 1500 m or slightly higher.

Pollination. The type of flower with numerous radiating stamens, as it occurs in *Capparis*, is, flower-biologically, likely to represent the basic condition in this family. The production of nectar seems to represent a later development. RADLKOFER, who gave an extensive description of the flower of *Capparis micracantha*, found that the sweet nectar excreted by the disk can only be reached through a very small slit nearly halfway up between the upper petals (Sitz. Ber. Bay. Ak. Wiss. 14, 1884, 111–116). Fig. 17a, d. This, the great distance between the anthers and the nectar, and the difficulty for insects to land on the flower, especially at nocturnal anthesis, renders this species apt to be pollinated by Sphingids, as has been repeatedly stated to occur in *Capparis*. In *C. micracantha* and *C. pubiflora* the basal median part of the upper petals has a red, pink, or yellow honey-guide. The nocturnal flowers of *C. spinosa* and *C. lucida* are sweet-scented and produce nectar. *Cadaba capparoides*, with its long, tubular, nectar-hiding gland and dark, versatile anthers, possesses indeed the most perfect adaptations in this field. Fig. 26, 27.

Since the *Rhoeadales* apparently lack the potentiality of producing a style, a gynophore became necessary to elevate the ovary into the sexual zone. The peculiar position of the petals, which are all pointing upwards (in *Cadaba*, in *Cleome p.p.*, in *Crateva* there being a tendency to it) seems useful to form a showier beacon to the nocturnal butterflies.

Next to the above described sphingophilous type (as here found in *Cleome gynandra*, *C. speciosa*, and *C. spinosa*, all noctiflorous), another type has developed in the *Cleomoideae* where the stamens are not exceeding the petals; this type is better adapted to pollination by bees (the other Mal. *spp.*).

It is noteworthy that in extra-Malaysian species of *Cleome* and of *Cadaba* ornithophily was observed, and in the South African *Cleome natalensis* psychophily, *i.e.* pollination by diurnal butterflies.

Thanks are due to Dr L. VAN DER PIJL, who supplied most of the above information.

Dispersal. RIDLEY cites very few facts about dispersal of *Capparidaceae*. It seems certain that *Crateva* fruits are dispersed by water. The berries of *Capparis*, which can attain considerable size in some species, have sometimes a lively colour (yellow, orange, or bluish-black) and dispersal by birds and/or bats seems likely. Several species of *Cleome* have seeds provided with an elaiosome and are supposed to be dispersed by ants. Their seeds are sometimes provided with small bristles on the sculptured testa and easily adhere to cloth *etc.* and seem therefore fit for epizoic dispersal.

Morphology. M. Y. ORR (Notes Bot. Gard. Edinb. 12, 1921, 249–257) found that in several genera of *Capparidaceae*, *i.a.* in *Cleome*, *Polanisia* (notably in our *spp. Cleome viscosa* and *C. chelidonii*), *Capparis* and *Crateva*, the embryo is completely enveloped by a thin sheath of parenchymatic cells with such thickenings in the wall as there are found in the water-conducting tracheal tissue. It is assumed that this layer plays a part in the water supply of the embryo. In the cells of this third innermost seed-coat the tracheal thickenings are found in the periclinal walls in the *Cleomoideae*, and in the anticlinal walls in the *Capparidoideae*. The same phenomenon was found (*l.c.* 259) in seeds of the *Resedaceae*. It may be of value with regard to classification and judgment of relationships.

The phenomenon of partial sterility is worthy of attention and of closer study. We can observe here the beginning of an evolutionary development which may finally lead to a complete segregation of the sexes as in monoecious or dioecious plants. In nearly all Malaysian *Capparidaceae* only a small part of the flowers set fruit, except in *Cleome spp.* where the fertility is complete or almost so. Apparently some flowers, though not obviously different in structure, are more fit to produce a ripe fruit than others. In the Bogor Botanic Gardens I could observe three ligneous species, all represented by a single plant; of these *Capparis lucida* regularly produced fruits with viable seeds, whereas in *Capparis pubiflora* and in *Crateva nurvala* not one fruit ever developed. Since all three are native in Java, I am not inclined to believe that effective pollinators would be absent. Rather I think that the two non-fruiting plants are self-sterile. Experimental work is needed to reach a conclusion.

In several extra-Malaysian *Capparidaceae* reductions in the androecium occur. In several Malaysian species we see reductions in the gynoecium. In part of the flowers of *Crateva* the whole gynophore with ovary is shed in an early stage of development. *Capparis micracantha* and *C. scortechinii* produce some flowers with a very short gynophore and a deaf ovary. In *Cleome gynandra* it is mostly the apical flowers of a raceme that possess a much smaller, sessile and sterile ovary (see also p. 105).

STOUDT published a valuable study on alternation of sexes and intermittent production of fruits in *Cleome spinosa*, dealing with the intricate pattern of reductions both in gynoecium and androecium (Am. J. Bot. 10, 1923, 57–66).

Phytochemistry. Characteristic features for the *Capparidaceae* are the following: presence of myrosin cells, isothiocyanates (mustard-oils) and their parent glucosides (glucocapparin), the frequent occurrence of deposits of calcium salts (carbonate, sulfate, oxalate) and the absence of leucoanthocyanins and tannin-like compounds in leaves and stems. These features point to a distinct affinity with the *Cruciferae*. This is strengthened by the fact that in both families there is found accumulation of quaternary ammonium compounds (*e.g.* tetramin in *Capparidaceae*, sinapin in the *Cruciferae*). If sinapin and erucic acid (in seed oil) could be demonstrated in *Capparidaceae* this would suggest still closer affinity between the two families. HUTCHINSON's evaluation in ascribing the agreement to parallelism is very improbable from a phytochemical point of view.—R. HEGNAUER.

Taxonomical affinity. The hitherto generally acknowledged place of the *Capparidaceae* is in the order *Rhoeadales*, with the *Cruciferae*, *Resedaceae*, *Tovariaceae*, *Moringaceae*, *Papaveraceae*, and *Fumariaceae*; the hierarchic pattern of these relationships varies only slightly with different authors.

HUTCHINSON in his concept of two main trends of affinity in the angiosperms, the divisions *Herbaceae* and *Lignosae*, has recently proposed to break up the *Rhoeadales* (Fam. Fl. Pl. ed. 2, 1, 1959, 224). He separated the herbaceous *Cruciferae*, *Resedaceae*, *Papaveraceae*, and *Fumariaceae* from the largely ligneous *Capparidaceae*, admitting only a superficial resemblance with the *Cruciferae*, due to parallel evolution. In his circumscription the order *Capparidales* comprises the *Capparidaceae*, *Tovariaceae*, and *Moringaceae*; it is related to *Pittosporales*, *Tamaricales*, *Violales*, and *Polygalales*.

The anatomical evidence relating to the affinity of *Capparidaceae* and *Cruciferae* is meagre but significant, as METCALFE & CHALK note that the "presence of myrosin cells in certain genera suggests that the *Capparidaceae* and *Cruciferae* may have affinities with one another, and also with the *Resedaceae* where similar cells occur" (Anat. Dic. 1, 1950, 94).

As pointed out above by Dr HEGNAUER the phytochemical data run parallel with the anatomical and taxonomical evidence. This agreement can in our opinion not be interpreted by parallel development. It seems likely that the *Capparidaceae* are a tropical, probably old stratum from which the *Cruciferae* represent a specialized branch. This could also well agree with the geographical distribution pattern of the families, the *Capparidaceae* being mostly tropical, the *Cruciferae* mostly temperate.

Wood anatomy. DEN BERGER, Determinatietabel houtsoorten van Malesië, Veenman, Wageningen (1949) 48 (*Crateva*) & 51 (*Capparis*); DESCH, Mal. For. Rec. 15[1] (1941) 70 (hand lens); METCALFE & CHALK, Anat. Dic. 1 (1950) 91; MOLL & JANSSONIUS, 1 (1906) 175.—C.A.R.-G.

Uses. No plant of appreciable economic significance is found among the *Capparidaceae*. Some minor uses will be dealt with under the species.

Notes. Collectors are requested to pay attention to flower biology. In *Crateva* too little is known about the mature fruit and its properties, and of the variability in leaves on one and the same tree.

As to *Capparis*, a search in the Malay Peninsula and North Sumatra will yield much to complete our knowledge of certain species. It is highly desirable to make field observations on the structure of flowers in most species, and to mention the state of maturity whenever fruits are collected. Some *Capparis* species produce juvenile or sterile twigs different from the flowering ones; these are badly known and of much importance.

KEY TO THE GENERA

1. Leaves simple. Plants ligneous.
  2. Stamens free, *i.e.* not connate with the gynophore and consequently after anthesis leaving no scars on its base. Fruit a berry with leathery pericarp . . . . **2. Capparis**
  2. Stamens at the base connate with the gynophore, leaving scars which remain still distinctly visible in fruit.
    3. Androgynophore 10 mm or longer. Stamens 5–7. Sepals not reflexed. Petals with a long claw. Fruit cylindrical, ∞-seeded. **3. Cadaba**
    3. Androgynophore 1 to a few mm long. Stamens ∞. Sepals reflexed. Petals absent. Fruit ellipsoid, 1-seeded . . . . **4. Stixis**
1. Leaves palmately compound or dissected.
  4. Ligneous plants. Leaves compound. Flowers opening in a very early stage. Fruit globular to ellipsoid, indehiscent, fleshy . . . . **1. Crateva**
  4. Herbaceous plants. Leaves dissected. Flowers mostly in bud until anthesis. Fruit cylindrical, dehiscent, dry . . . . **5. Cleome**

1. CRATEVA

LINNÉ, Gen. Pl. ed. 5 (1754) 203; Sp. Pl. 1 (1753) 444; HAMILTON, Trans. Linn. Soc. 15 (1827) 116 (*Crataeva*); KURZ, J. Bot. 12 (1874) 193; CORNER, Gard. Bull. S. S. 10 (1939) 15.—**Fig. 1–4.**

Small to medium-sized trees, facultatively shortly deciduous and then flowering when bare; glabrous. *Branchlets* terete with distinct leaf-scars. Stipules small, caducous. *Leaves* 3-foliolate, the top of the long petiole sometimes bearing gland-like appendages on the upper surface. Leaflets sessile to shortly stalked, the lateral ones basiscopically asymmetrical, sometimes with more or less distinct pellucid dots. *Raceme* terminal, corymbiform, either with arrested growth or growing through and developing into a leafy twig with lateral flowers. Flowers sustained by bracts, rarely by leaves, pedicelled, opening at a very early stage of development, floral parts not persistent. Bracts stipulate. Receptacle wide; disk dish-shaped and incurved. *Sepals* equal, ovate-spathulate, green. *Petals* equal, unguiculate, more or less ovate to rhomboid with narrowed base, first white, later cream-coloured, the lower (anterior) pair tending to take a transversal (horizontal) position.

Fig. 1. *Crateva nurvala* HAM. *var. nurvala* (Cult. Hort. Bog. IV–F–76; JACOBS, 1955).

Stamens (8–)12–30, filaments at the very base connate with the gynophore, long, filiform, spreading. *Gynophore* approximately as long as the stamens. Ovary 1-locular, the 2 placentas sometimes intruding to about halfway the lumen but not coalescent. Stigma conspicuous, flat, soon after anthesis obsolete. In fruit pedicel, torus and gynophore woody and more or less thickened, the last with a whorl of filament-scars near the base; the gynophore mostly not stretching. *Berry* large, 1-celled, with tough, sometimes papillate skin. Seeds densely packed; embedded in pulp, horseshoe-shaped, smooth or crested, one cotyledon larger, curved round the other.

Distr. A genus of *c.* 6 *spp.*, pantropical but neither in Australia nor in New Caledonia, the area of the 3 Indo-Malaysian *spp.* extending from Ceylon, Western India, South China, South Japan, the Ryukyus, Formosa, and Hainan, through Malaysia to Tahiti.

Ecol. Mostly in periodically inundated lowland forest near rivers, below 700 m. In dry regions shortly deciduous, the flowers then appearing simultaneously with the flush. Also cultivated for ornamental purposes and presumably occasionally introduced.

Notes. In part of the flowers the gynophore is shed shortly before anthesis, leaving a scar. In some specimens only the apical flowers remain bisexual. Few flowers set fruit.

It appears to me that there are, in Indo-Malaysia, only few species, widely distributed, which show in many respects a considerable variability, for example in the size of the floral parts and, to a less degree, in the sculpture of the seed.

Several authors stated that in some cases the ovary is 2-celled, and they attributed specific value to this 'character'. The matter is, however, that the two parietal placentas intrude into the lumen to a varying degree, sometimes so deeply as to divide it seemingly into 2 locules, but as far as known, the placentas do never actually fuse.

KEY TO THE SPECIES[1]

1. Leaflets with fewer than 11 pairs of nerves. Rachis up to 10 cm long, with up to 20, rarely 40, flowers.
 2. Leaflets generally sessile or subsessile, occasionally on petiolules up to 5 mm, very rarely 13 mm. Blade thin-herbaceous, green when dry, (5½–)8½–16(–27) cm. Fruit 6–12(–15) cm long, papillate, greyish when dry . . . . **1. C. religiosa**[1]
 2. Petiolules 4–5(–6) mm. Blade herbaceous to subcoriaceous, mostly red-brownish when dry, 5½–10 (–14) cm. Fruit 3½–4 cm long, smooth, red-brownish when dry . . **2. C. odora** *f.* **axillaris**
1. Leaflets with (7–)10–15(–22) pairs of nerves. Rachis 10–16 cm, 20–90-flowered. Leaflets below paler and duller than above, firmly herbaceous to subcoriaceous. Fruit *c.* 5 cm long, papillate, finally more or less smooth, greyish when dry . . . . **3. C. nurvala** *var.* **nurvala**

1. Crateva religiosa FORST. *f.* Pl. Escul. Ins. Oc. Austral. (1786) 45, (*Crataeva*); Fl. Ins. Austral. Prod. (1786) 35; DC. Prod. 1 (1824) 243, *p.p.*; *non* HOOK. *f.* Fl. Br. Ind. 1 (1872) 172; LAUT. Bot. Jahrb. 52 (1914) 110; MERR. Philip. J. Sc. 11 (1916) 272; WALKER, Imp. Trees Riukiu (1954) 95, f. 45.—*C. membranifolia* MIQ. Sum. (1861) 387, 158; Illustr. (1870) 21; KOORD. Minah. (1898) 343; LAUT. Bot. Jahrb. 52 (1914) 111; MERR. En. Born. (1921) 280; CORNER, Ways. Trees (1940) 181.—*C. macrocarpa* KURZ, J. Bot. 12 (1874) 195, t. 148 f. 8–10; KING, J. As. Soc. Beng. 58, ii (1889) 397; RIDL. Fl. Mal. Pen. 1 (1922) 125; MERR. Philip. J. Sc. 29 (1926) 371; CORNER, Gard. Bull. S.S. 10 (1939) 16 (*Crat. B*).—*C. hansemannii* K. SCH. Bot. Jahrb. 9 (1888) 201; K. SCH. & HOLLR. Fl. Kais. Wilh. Land (1889) 50; WARB. Bot. Jahrb. 13 (1891) 318; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 335, *p.p.*; VALETON, Bull. Dép. Agric. Ind. Néerl. 10 (1907) 15; LAUT. Bot. Jahrb. 52 (1914) 110.—*C. speciosa* VOLKENS, Bot. Jahrb. 31 (1901) 463; KANEH. J. Dep. Agr. Kyushu Imp. Univ. 4 (1935) 321.—**Fig. 2a.**

Tree (1–)5–15(–30) m. Stipules ½–1 mm, subulate. *Leaflets* thin-herbaceous, when dry on both sides of the same greenish colour, much varying in size on one and the same tree, (5½–) 8½–16(–27) by (3–)4–10½ cm, central leaflet oblong, obovate, the base narrowly decurrent, the apex shortly (incidentally up to 2½ cm) acuminate, often mucronulate; nerves 7–11 pairs; petiole (3½–)6½–10 cm, on sterile twigs often longer, up to 22 cm; petiolules 0–5(–13) mm. *Flowers* with a few to over a dozen; rachis 3–5(–14) cm; lower flowers inserted above the axil of normal leaves, the others subtended by an early caducous bract. Pedicels 2–9 cm. Bracts 10 by 1–1½ mm, 3–5 mm petioled. *Sepals* ovate, obtuse to acute, 4–7 by 1½–3 mm. *Petals* once recorded orange, 5–20 mm stalked, blade broadly ovate to elliptic, acute to obtuse, upper pair 2–3(–4) by 1–2(–2.3) cm, lower pair 1½–2 by 1–1½ cm, nerves 4–6 pairs. *Stamens* (10–)13–18(–30); filaments 4½–11½ cm, pink or purple towards the top; anthers 2½–6 by 1½ mm, sometimes recurved. *Gynophore* 4–7 cm; ovary 4–6 by 1½–2½ mm, subcylindrical, sometimes ovoid, contracted below the stigma 1½ mm in diam. Pedicel in fruit (4–)5–7½(–8) cm, 3–4(–5) mm thick; torus 7–11 mm wide; gynophore 5½–8½(–14) cm long, sometimes cylindrical, *c.* 3–5 mm diam., or gradually thickened and up to 1 cm thick at the top. *Fruit* subglobular to (ob-) ovoid, 6–12(–15) by 5½–9½ cm, wall in the unripe stage up to 7 mm thick, at maturity probably not thicker than 1–1½ mm, smooth when very young but soon covered with flat, pale, dry papillae,

Fig. 2. Lateral leaflets of *Crateva*, *a. C. religiosa* FORST. *f.*, *b. C. odora* HAM. *f. axillaris* (PRESL) JACOBS, *c. C. nurvala* HAM. *var. nurvala*, all × ²/₅.

(1) See also 4. *C. hygrophila*, under imperfectly known species.

sometimes giving the impression of a thin, dull, yellowish grey crust. *Seeds* more or less asymmetrically cordate, 10–19 by 5–17 mm diam. and 4–8 mm thick, dorsally with a keel rather narrow and sparsely tuberculate to very broad and densely tuberculate (sometimes rather smooth), the sides smooth to shallowly grooved.

Distr. India (E. Himalaya), Burma, Lower Siam, Indo-China, Ryukyus, through Micronesia (Marianes & Carolines) and Melanesia (Solomons) to Polynesia (Fiji, Samoa, Society Is., Gambier Is.); in *Malaysia:* Sumatra, Riouw Arch., Malay Peninsula, W. Java (twice collected), Borneo (also Banguey I.), S. Philippines (Palawan, Sulu Arch.), Celebes (also Kabaena and Muna Is), Moluccas (Talaud, Sula, Buru, E. Ceram, Ambon, Kai, Aru, and Tanimbar), New Guinea (also Normanby I. and Salawati), New Ireland.

Ecol. The species seems to be frequent in Borneo, New Guinea, and the Solomon Is where it is often found in periodically inundated forest along rivers, rarely in secondary or primary dry-land forest; one record from the beach in Sarawak, where it seems to attain smaller size. Mostly below 100 m, but up to 700 m. *Fl. fr.* in all months. Incidentally cultivated.

Vern. *Kĕpayan* (*ayĕr*), Malaya, *ujesta*, S, *tigarun*, *tjigaron*, S. and W. Borneo, *kĕnohan sĕguntu*, Kutei, *makendem alus*, *malasut*, *sangkiauw*, Minahasa, *tjandaule*, SE. Celebes: Tokolaki, *kamfooiju*, Mangoli, *bala-lehe*, Muna, *papangi-nasu*, Talaud, *ombo-ombo*, SW. New Guinea, *ai-yumba*, *bam-baimovi*, Solomons, *pua veoveo*, Tahiti.

Uses. In the Solomon Is the leaves are heated and applied in case of ear-ache, and the fruits are used against constipation. In Yap the fruits are eaten. The raw fruit is used as fish-bait in W. Borneo.

BURKILL briefly refers (under *C. macrocarpa*) to occult power ascribed to *Crateva* species in India and Polynesia where it is planted round temples, to which also FORSTER's epithet refers (Dict. p. 676).

Notes. The species is very variable in floral parts, in the shape of the fruit, and the size of the seeds.

The leaves are mostly (in Malaya to a less degree) so thin in texture that a herbarium specimen with undamaged leaves is extremely rare and there is no difference in colour between the upper and the lower surface. Besides, the seeds, however variable, have always a more or less developed crest of warts on the dorsal side.

The fruit is once recorded to be compressed. In West Malaysia the subglobular to ellipsoid shape seems to prevail, whereas in eastward regions the fruits are more elongate. In Malaya the seeds also seem to be smaller than in the eastern specimens. From the Solomon Is the fruit is reported to be sausage-shaped 14 by 4 cm, with unpleasant odour when cut; in W. New Guinea VAN ROYEN noted that "the smell of the fruit fills the forest with a soury scent not unlike durian". From Yap VOLKENS mentioned a fruit 18 by 10 cm and added that a variety exists with fruits as small as a thumb's length. Another record about such small fruits could not be found. The few field notes give the colour of the young fruit as pale green, once dark mauve, and of the ripe fruit white. According to VAN ROYEN in New Guinea the fruits are light green with yellowish scales, hard pericarp, spongy endocarp, and possess floating capacity. In Bornean specimens seeds were measured 1 by ¾–1 cm in diam. and ½ cm thick; in one specimen from Java the seeds were 1½ by 1–1¼ cm in diam. and ½ cm thick.

About the identity of the Palawan specimens I am not certain. The material available, ELMER 12650 and CENABRE *c.s.* FB 27861, is not in a very good state and seems to be intermediate in characters between *C. religiosa* and *C. odora*. Provisionally, on account of the large seeds, the comparatively large leaflets with a base somewhat decurrent on the petiolule and a short-acuminate top, I assume them to belong to *C. religiosa*, notwithstanding the brownish colour of the leaves in the ELMER specimen and the almost smooth surface of the seeds.

Mr N. G. BISSET observed in Tanimbar that the fruit pulp had a burning taste, and that the seeds contained a very high amount of alkaloids, while starch was practically absent.

2. Crateva odora HAM. Trans. Linn. Soc. 15 (1827) 118.

f. **axillaris** (PRESL) JACOBS, *stat. nov.*—*C. tapia* (*non* L.) BL. Bijdr. 2 (1825) 54; MIQ. Fl. Ind. Bat. 1, 2 (1858) 102.—*C. axillaris* PRESL, Rel. Haenk. 2 (1835) 85; F.-VILL. Nov. App. (1880) 10.—*C. religiosa* (*non* FORST. *f.*) BLANCO, Fl. Filip. (1837) 399, ed. 2 (1845) 279, ed. 3, 2 (1878) 154, t. 176; F.-VILL. Nov. App. (1880) 10; VIDAL, Sinopsis Atlas (1883) 13, t. 6 f. C; Phan. Cuming. (1885) 94; Rev. Pl. Vasc. Filip. (1886) 48; MERR. Sp. Blanc. (1918) 158; En. Philip. 2 (1923) 210; QUIS. Med. Pl. Philip. (1951) 341.—*C. tumulorum* MIQ. Illustr. (1870) 21, t. 11; K. & V. Bijdr. 4 (1896) 269; BACK. Schoolfl. (1911) 64; Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 6.—**Fig. 2b, 3.**

Small tree, 3–10(–30?) m. Stipules falcate, small. *Leaflets* on slender stalks 4–5(–6) mm long, herbaceous to subcoriaceous, in herb. dull, red-brownish; 5½–10(–14) by 2½–5(–7) cm, elliptic to oblong, rarely lanceolate; base cuneate, top abruptly acutely *c.* 1–1½ cm acuminate; central leaflet mostly the largest, broadest at or somewhat above, rarely below the middle; lateral leaflets strongly asymmetrical; nerves generally 5, sometimes up to 7, rarely up to 10 pairs; petiole slender, (3½–)6–8(–10) cm, on top occasionally with a triangular gland. *Inflorescences* on small twigs, afterwards whether or not growing through, flower-bearing part *c.* 3(–10) cm long, with a few to about forty flowers partly above the axils of young leaves or bracteate. Pedicels 4–5(–7) cm. *Sepals* ovate, acute, *c.* 4–6 by 1½–2½ cm. *Petals* suborbicular to broadly ovate-elliptic, (1½–)2½–3 by 1–2 cm, the top blunt to rounded or

Fig. 3. *Crateva odora* HAM. *f. axillaris* (PRESL) JACOBS. Sumbawa, 1934 (DE VOOGD 1911).

sometimes notched, base rounded and (rather) abruptly narrowed into the stalk 6–10 mm. *Stamens* 21–25, 3–4 cm long, anthers *c.* 3 by 1 mm, recurved. *Gynophore* (2–)3–4(–6½) cm, ovary subglobular to oblong, *c.* 2–5 by 2 mm, constricted below the stigma *c.* 1½ mm broad. In fruit the gynophore slightly thicker than the pedicel, *c.* 2–3 mm thick all over, torus *c.* 7 mm wide. *Fruit* globular, (up to?) 3½–4 cm diam. (in Indo-Chinese specimens up to 6 cm), pericarp leathery, *c.* 1 mm thick, smooth during the whole development, at maturity probably red when fresh, brownred when dry. Seeds rather irregularly horseshoe to deeply kidney-shaped, about 6 by 2 mm, smooth.

Distr. The species occurs throughout India, Ceylon, Burma, Indo-China, S. China, Formosa, and Hainan, the *Malaysian* form in S. India (Coimbatore), Ceylon, Malay Peninsula (Malacca: cultivated), Java (W. and E. part, cultivated), Madura, Kangean Arch., Lesser Sunda Is. (Sumbawa), Philippines (N. Palawan, Mindoro, Luzon, most provinces, Guimaras, Mindanao).

There are far more collections from Luzon than from any other locality. It looks as if the species is native in the Philippines. It cannot be verified whether it is introduced or native in Kangean and Sumbawa; in Madura, Java, and Malaya there is little doubt that it has been introduced long ago; it is sometimes found planted on graves.

Ecol. Prefers dry, shrubby places. Mostly deciduous, the flowers then appear just before the young leaves break out, but the blossoming seems not to show periodicity. In the Malay Peninsula it is only rarely found in fruit.

Uses. QUISUMBING, Med. Pl. Philip. (1951) 341, mentioned quite a few minor medical applications.

Vern. *Sĕmpal wadak*, J (for the genus, reliable); *kĕmalo-kĕmalowan*, *sĕkar bulan*, Kangean, *saling-bogog*, Tag. (Philip.).

Notes. From *C. religiosa* distinguished vegetatively by its leaves being firmer in texture, often red-brownish in the herbarium, especially the specimens from Java and the Lesser Sunda Is., and giving a more graceful impression, due to the smaller size, the slender distinct petiolule, and the acute longer tip of the leaflets. In fruit it is different by its shorter gynophore and by the surface of the fruit which is smooth and not papillate; this character being more reliable than those provided by the (often immature) seeds.

In one specimen, cultivated in Hort. Bog. under IV-F-81, the largest leaflet was 17 by 9 cm. Its adult leaves were only slightly reddish tinged, the tip being more or less abortive or absent. This seems to prove once more that species may show deviations unknown from the wild state merely by cultivation in a botanic garden.

The closest affinity is with the African *C. adansonii* DC. which could even be looked upon as a subspecies. In *C. adansonii* the inflorescence rachis is ± 4–5 cm, and finally set with the thick callous scars of the shed pedicels; this top of the rachis often starts to grow again vegetatively afterwards. The petals are about 2–3 by 1–2 cm in all, the stamens 15–20, *c.* 3 cm long, the fruit greenish and not reddish in the dry state. On account of these differences it seems appropriate to keep them apart.

3. Crateva nurvala HAM. Trans. Linn. Soc. 15 (1827) 121, (*Crataeva Nürvala*); W. & A. Prod. 1 (1834) 23; KURZ, J. Bot. 12 (1874) 195; GAGN. Not. Syst. 8 (1939) 213; Fl. Gén. I.-C. Suppl. 1 (1939) 157, t. 14 f. 8.

var. **nurvala**.—*C. nurvala* HAM. *l.c.*; MIQ. Illustr. (1870) 20; K. & V. Bijdr. 4 (1896) 266; BACK. Schoolfl. (1911) 64; HALL. *f.* in Winkl. Bot. Jahrb. 49 (1913) 369; MERR. En. Born. Pl. (1921) 280; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 6.—*Nürvala* RHEEDE, Hort. Malab. 3 (1682) 49, t. 42.—*C. religiosa* (*non* FORST. *f.*) BL. Bijdr. 2 (1825) 54; RIDL. Fl. Mal. Pen. 1 (1922) 125; RENDLE, J. Bot. 63 Suppl. (1924) 5.—*C. magna* [*an* (LOUR.) DC.?] HASSK. Pl. Jav. Rar. (1848) 179; MIQ. Fl. Ind. Bat. 1, 2 (1858) 102; Sum. (1862) 158, 387.—*C. religiosa non* FORST. *f. var. nurvala* (HAM.) HOOK. *f.* & THOMS. Fl. Br. Ind. 1 (1872) 172, *p.p.*—*C. lophosperma* KURZ, J. Bot. 12 (1874) 195, t. 147 f. 4–6, *an var. propria*?; CORNER, Gard. Bull. S.S. 10 (1939) 16 (*Crat. A*); Ways. Trees (1940) 181, f. 48.—**Fig. 1, 2c, 4.**

Tree, (8–)10–15(–20) m, to 40 cm diam. *Branchlets* slightly zig-zag. Stipules minute, late caducous, acute with broad base. *Leaflets* firmly herbaceous to subcoriaceous, (0–)3–6(–10) mm stalked, mostly lanceolate, sometimes oblong, rarely linear, (4½–)9–15(–28) by (1½–)3–5(–6½) cm; base acute, top acuminate, tip acute; central leaflet broadest about or below, rarely above the middle, lateral ones more or less symmetrical; nerves (7–)10–15(–22) pairs; surface below duller and paler than above, sometimes on both sides with minute grey-brown scattered papillae. Petiole (4–)5½–9½(–14) cm, vigorous, broadly sulcate, on top bearing numerous pale to light brown gland-like appendages up to 1 mm long. *Inflorescence* ultimately *c.* 10–16 cm long, bearing 20–100 flowers. Bracts early caducous, 5–9 by ¾–1½ mm, acute, their stipules minute, longer persistent. Pedicels 4–7 cm. *Sepals* 2–3½ by 1¼–1½ mm, ovate, acute, somewhat narrowed at the base. *Petals* 5–12 mm stalked, blade (8–)15–30 by (5–)15–22 mm, suborbicular or subrhomboid to elliptic, ovate, base rounded, abruptly narrowed into the stalk, top obtuse. *Stamens* 15–25, 3½–4½(–6) cm; filaments purple; anthers *c.* 2–3 by 1 mm. Ovary ellipsoid to cylindrical, *c.* 5–6 by 2½ mm; stigma dark purple. *Gynophore* 3½–5½ cm, in fruit probably not or hardly lengthened (rarely up to 10 cm), 3–4(–5) mm thick, only slightly thicker towards the top; pedicel mostly thinner, torus 7–8 mm wide. *Fruit* unknown in fully mature state, ellipsoid, rarely ovoid, (up to?) 5–5½ by 4–4½ cm, pericarp 4–5 mm thick, covered with a thin, dull, yellow-greyish crust breaking into minute particles which seem to peel off sooner or later, leaving the surface smoothish. *Seeds* deeply horseshoe-shaped, 6–9 mm long and wide, 2–3 mm thick, dorsally with a crest of sharp irregular protrusions.

Fig. 4. *Crateva nurvala* HAM. *var. nurvala*. Flower, front view (Cult. Hort. Bog. IV-F-76; JACOBS. 1955).

Distr. India (Deccan, Sikkim, Assam), Burma, S. China (Yunnan, Kweichow?), Hainan, Indo-China, Siam; in *Malaysia:* Sumatra (P. Weh, East and West Coast Res., Palembang), Malay Peninsula, W. to E. Java, and Borneo. Cultivated throughout the area, for ornamental or magic purposes.

Another variety occurs in India (mainly in the Northeast), Burma, Siam, Indo-China, S. China (Yunnan, Kwangtung, Fukien), Hainan, and S. Japan (probably this species).

Ecol. Mostly along streams in shady places, sometimes behind the sea-shore, at low altitudes up to 600 m. Seems to be rare everywhere. Flowering and fruiting time irregular.

Vern. *Si baluak*, Sumatra, *badat, dala(h), dalur*, Mal. Pen., *barun(d)aj, ki howe*, S, *djaranan, sĕmpal wada*, J, *pingos, sasagah, sĕbĕlu, tigarun*, Borneo.

Uses. The wood seems to find local application as timber. In Malaya the root, leaf, or bark are boiled with oil and applied externally in case of 'sakit angin'. In Siam the fruit is used as fish-bait and the young leaves are pickled in salt. See BURKILL (Dict. 1, p. 676) for other minor uses. According to FILET, *cf.* HEYNE, Nutt. Pl. p. 682, the bark contains an acrid, bitter substance and is pounded in water, used as a skin-irritant against high fever, *etc.*

Notes. This species is vegetatively characterized by its nerf-pattern: the leaves have underneath a typical aspect by the thin but vigorous and prominent nerves, more numerous than in other species, while the insertions of the intermediate veins on the midrib are also far more distinct. Besides, the lower surface is more pale, dull, and greyish or glaucous than the upper, the difference being far greater than in the other *Cratevas*.

In none of the herbaria consulted any type material of *C. lophosperma* was found. KURZ named as type specimen "GUSTAV MANN, from banks of the Koolsee River, Kamroop, Assam, *Fr.* July." From the description it is clear that one of the two varieties of *C. nurvala* was meant; probably it was *var. nurvala*. CORNER's interpretation of KURZ's species as *C. nurvala s. lat.* was correct; his cited material no doubt belongs to *var. nurvala*, but perhaps KURZ himself had HAMILTON's '*C. unilocularis*' at hand, which is more frequent in Assam than *var. nurvala*.

Imperfectly known

4. Crateva hygrophila KURZ, J. As. Soc. Beng. 41, ii (1872) 292; J. Bot. 12 (1874) 196, t. 148 f. 6, 7; J. As. Soc. Beng. 48, ii (1874) 33; Fl. Burm. 1 (1877) 67.

Leaves herbaceous, dull reddish brownish, largest leaflet 12½ by 3½ cm, leaflets sessile, not much asymmetrical, narrowed towards base and top; nerves ± 6–7 pairs, as the midrib narrow, prominent above. *Inflorescence* rachis practically none. *Flowers* unknown. Pedicels in fruit 5½–6½ cm, *gynophore* 4¾–5¾ cm, both blackish, woody, ± 2–2½ mm in diam. *Fruit* (immature) cylindrical umbonate, ± 9 by 2½ cm, dull brown-purplish with numerous white lenticel-like specks, *c.* 1½ mm thick. *Seeds* irregularly horseshoe-shaped, ± 11 by 8 by 3 mm, the outer side with some coarse sculpture.

Distr. Burma (Pegu); in *Malaysia:* Penang (KING's Coll. 1412).

Note. There are only two collections; both are inadequate but match very well. They come nearest to *C. religiosa*, but I feel reluctant to refer them to this species. They may represent an abnormal, deviating form.

Excluded

Crateva marmelos L. Sp. Pl. (1753) 444 = *Aegle marmelos* (L.) CORREA in Trans. Linn. Soc. 5 (1800) 223 (*Rutaceae*).

2. CAPPARIS

TOURN. *ex* LINNÉ, Gen. Pl. ed. 5 (1754) 222; Sp. Pl. 1 (1753) 503; LAMK, Encycl. 1 (1785) 604; DC. Prod. 1 (1824) 245; MIQ. Illustr. (1870) 22–36, t. 12–19; GAGN. in Morot, J. Bot. 21 (1908) 53; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 172.—*Busbeckea* ENDL. Fl. Norfolk. (1833) 64.—**Fig. 5–25.**

Shrubs, often sprawling or climbing, rarely small trees, mostly hairy but glabrescent. *Leaves* simple, with a pair of stipular *thorns* which are occasionally wanting, sometimes these persistent on knobs on the main stems; nerves arcuating fairly regularly and interlooping near the margin. *Flowers* pedicelled, arranged in serial, supra-axillary rows (flowering basiscopically!), or in racemes with the pedicels subumbellately conferted towards the top, the subumbels sometimes paniculate, or more rarely flowers solitary, axillary. Bracts mostly present but early caducous, rarely 2 basal bracteoles. *Sepals* biseriate, mostly imbricate, the outer pair mostly strongly concave, the inner pair flattish, rarely (in *sect. Busbeckea*) the outer pair connate in bud. *Petals* 4, variously imbricate, rather delicate, not unguiculate, the two adaxial ones (upper pair) with asymmetrical base coherent and surrounding a small disk, the two abaxial ones (lower pair) quite free. Receptacle (torus) slightly thickened, ± conical, with a more or less developed adaxial disk. *Stamens* ∞, rarely (7–)8(–12) free, radiating, longer than the petals, glabrous; anthers small. *Gynophore* about as long as the stamens, sometimes longer, not or very little stretching in fruit, exceptionally abortive, irregularly coiled in bud. Ovary 1-locular, placentas 2–6, mostly 4, with ∞ ovules; stigma sessile, small. *Berry* in Mal. globular to ellipsoid, rarely elongate, with leathery or corky pericarp, 1-celled. Seeds (1–)∞, embedded in pulp, obliquely reniform, rather large, with circinnate embryo.

Distr. Presumably about 250 *spp.* in the tropics and subtropics of both hemispheres, especially in America and Africa. Another centre of development, with *c.* 40 *spp.*, is found in Burma and Indo-China. In *Malaysia* 23 *spp.* are recognized, among which only a few are confined to one island or province, the development being richest in the Philippines where also the infraspecific variability is greater than in other islands. A few species are shared by SE. Malaysia and northern Australia. There are only few species which are chiefly distributed in the large rain-forest area of western Malaysia (Malaya, Sumatra, W. Java, and Borneo) and most species avoid that area because of their preference for dry and seasonal climatic conditions. Fig. 6.

Ecol. Only few *spp.* are adapted to primary rain-forest conditions; they are most frequent in heliophilous, warm and dry habitats under seasonal climatic conditions, for example in coastal vegetation, in savannahs, hedges, light forest, secondary forest, thickets, and forest borders, in the lowlands and hills, the highest record being 1700 m.

Disp. The often large pulpy fruits may have various colours at maturity, for instance bluish-black in *C. lanceolaris* DC., deep-yellow in *C. trinervia* HOOK. *f.*, orange in *C. floribunda* WIGHT, and are likely to be eaten and (?)dispersed by animals. In the last-named species ELMER noted "fruits opened and seed eaten by birds".

Pollination. Though the flowers are often scented and the inflorescences are in several species very showy, no observations on flower visitors have come to my knowledge. The honey is very much concealed under the coherent asymmetrical bases of the adaxial petals which surround a small disk.

Two species, *viz C. lucida* (BANKS *ex* DC.) BENTH. and *C. spinosa var. mariana* (JACQ.) K. SCH., are known to be noctiflorous. *C. erycibe* HALL. *f.*, *C. micracantha* DC., and *C. pubiflora* DC. were observed to flower in the daytime; they may be open and scenting during the night as well.

Indument. The characters of the hairs covering at least the young parts of many species are often of specific value. In Asiatic species the indument consists only of hairs, but for instance in *C. breynia* JACQ. of tropical America the young parts are densely scaly like a *Durio* twig. Short-stalked, stellate hairs, with 3–4 arms arising from a 1-cellular base are found in 10. *C. sepiaria* and 20. *C. quiniflora* (also having many hairs with 2 arms, like the malpighiaceous balance-hairs); 14. *C. pubiflora* (hairs very long and silky); 15. *C. pyrifolia* (hairs slender, glassy, with unequal arms); 19. *C. zeylanica* (hairs thicker, less regularly shaped); 22. *C. spinosa var. mariana* (hairs small, white, soft, irregularly stellate, the arms somewhat twisted; hook-like hairs as depicted in E. & P. Pfl. Fam. 17b, f. 78A, were not seen in my limited material). Simple hairs, patent unless stated otherwise, occur in: 1. *C. scortechinii* (hairs soft, mostly straight, more or less erect); 2. *C. trinervia* (hairs rather long and straight, but near the base bent in an arbitrary direction); 8. *C. floribunda f. induta* (hairs soft and somewhat twisted); 7. *C. lanceolaris* (like the last, but straighter and generally shorter); 9. *C. lobbiana* (hairs stiff, straight, and very unequal); 6. *C. longestipitata* (hairs appressed, singularly short and thin); 5. *C. cantoniensis* (hairs appressed, mostly unbranched, small, soft, twisted); 23. *C. lucida* (hairs small, somewhat twisted). Species not mentioned above are glabrous or almost so.

Taxon. A complete subdivision cannot yet be given, because the Old World species need further study. If we follow DE CANDOLLE's subdivision, then *spp.* 1–22 come into the *sect. Capparis* (*Eucapparis* PLUM. *ex* DC.), with imbricate sepals.

Of these, *spp.* 4–15 fall into *subsect. Corymbosae* DC. with the flowers in subumbels, *spp.* 16–20 into *subsect. Seriales* DC. (incl. *sect. Monostichocalyx* RADLK.) with the flowers in supra-axillary rows, *sp.* 22 into *subsect. Pedicellares* DC. with axillary flowers.

Sp. 23 is the only Malaysian representative of the Australian *sect. Busbeckea* (ENDL.) B. & H. with the outer pair of sepals connate in bud.

Spp. 1, 2, 3, and 21 are as yet difficult to place in this classification.

Note. There are a few field observations that the completely mature fruit would dehisce by valves in some species. I have not seen any material confirming this.

KEY TO THE SPECIES

1. Flowers solitary in the leaf axils.
  2. Leaves oblong. Sepals 5–7 mm long . . . . **21. C. larutensis**
  2. Leaves suborbicular. Sepals longer than 10 mm . . . . **22. C. spinosa**
1. Flowers in serial rows, in axillary subumbels or panicles, or in terminal racemes or panicles (rarely depauperated to 1 flower in 23. *C. lucida*).
  3. Inflorescences exclusively terminal on *normal* twigs.
    4. Sepals longer than 7 mm. Gynophore longer than 2½ cm.
      5. Pedicels ½–1 cm. Fruit *c.* 10 cm diam. Gynophore *c.* 5 cm. . . . . **1. C. scortechinii**
      5. Pedicels 1–6 cm.
        6. Sepals in bud connate, 10–15 mm long, glabrous. Leaves shorter than 9 cm, base acute. **23. C. lucida**
        6. Sepals in bud imbricate. Leaves longer than (6–)10 cm.
          7. Plant glabrous. Leaves oblong to lanceolate, coriaceous.

8. Gynophore 3–4½ cm. Sepals 8–12 mm long. Leaves with a hardened tip. **12. C. callophylla**
8. Gynophore 2–3½ cm. Sepals 5–6(–10) mm long. Leaf-tip not particularly thickened. **13. C. zippeliana**
7. Innovations hairy, glabrescent. Leaves obovate, subcoriaceous, subtriplinerved, (6–)10–14 cm long . . . . **2. C. trinervia**
4. Sepals shorter than 7 mm. Gynophore shorter than 2½ cm.
9. Flowers in a panicle. Leaves longer than (8–)10 cm.
10. Gynophore 4–12 mm. Fruit 1½ cm diam. . . . . **4. C. erycibe**
10. Gynophore 2–3½ cm. Fruit *c.* 3½ cm in diam. . . . . **13. C. zippeliana**
9. Flowers in simple subumbels. Leaves shorter than 8 cm. Gynophore shorter than 2 cm.
11. Stamens 30–45. Gynophore (5–)6–10(–13) mm. Twigs vigorous, hairy, zig-zag, mostly with strong thorns . . . . **10. C. sepiaria**
11. Stamens 12–15. Gynophore *c.* 15 mm. Twigs slender, glabrescent, straight, with weaker thorns. **11. C. diffusa**
3. Inflorescences axillary or supra-axillary, sometimes *also* terminal.
12. Pedicels (or their scars) serial, in supra-axillary rows.
13. Sepals glabrous or ciliate. Young leaves glabrous.
14. Sepals shorter than 5 mm, glabrous. Fruit tuberculate. Thorns, if present, recurved. **16. C. buwaldae**
14. Sepals longer than 5 mm, ciliate. Fruit smooth. Thorns patent . . **18. C. micracantha**
13. Sepals puberulous outside.
15. Young leaves hairy, at least underneath. Fruit ± globular.
16. Fruit smaller than 12 mm. Thorns directed upwards, straight or slightly curved. Sepals 4–5 mm long . . . . **15. C. pyrifolia**
16. Fruit larger than 15 mm. Thorns, if present, recurved.
17. Stamens more than 30. Sepals longer than 6 mm . . . . . . **19. C. zeylanica**
17. Stamens 7–8. Sepals shorter than 5 mm . . . . **20. C. quiniflora**
15. Young leaves glabrous. Fruit elongate. . . . . **17. C. cucurbitina**
12. Flowers in sessile racemes or in subumbels or panicles.
18. Flowers in short, sessile, axillary racemes.
19. Gynophore at anthesis hairy all over. Rachis of the inflorescence inconspicuous. **14. C. pubiflora**
19. Gynophore at anthesis glabrous. Rachis of the inflorescence thick, 1–2½ cm long. **3. C. brachybotrya**
18. Flowers in subumbels or in panicles, rarely in a small leafy raceme.
20. Leaves (8–)13–20(–26) cm long, often reddish tinged when dry.
21. Gynophore 3–4½ cm. Sepals 8–12 mm long. Leaves with a hardened tip. **12. C. callophylla**
21. Gynophore 2–3½ cm. Sepals 5–6(–10) mm long. Leaf-top not particularly thickened. **13. C. zippeliana**
20. Leaves (2–)4–12(–16) cm long, green to yellowish when dry.
22. Gynophore at anthesis hairy all over. Fruit up to 2 cm long . . . **14. C. pubiflora**
22. Gynophore at anthesis glabrous, at least in the upper half.
23. Gynophore shorter than 1½ cm. Fruit ½–2 cm diam.
24. Stamens *c.* 8. Sepals 3–4 mm long. Fruit 1½–2 cm diam. . . . **8. C. floribunda**
24. Stamens ∞. Sepals 4–5 mm long. Fruit 1½ cm or smaller.
25. Twigs stout, markedly zig-zag, greyish-hairy, with vigorous thorns. Leaf-top rounded, notched. Midrib flattish above . . . . **10. C. sepiaria**
25. Twigs slack, approximately straight, glabrescent, with weaker thorns. Leaf-top acuminate. Midrib narrowly sulcate above . . . . **5. C. cantoniensis**
23. Gynophore longer than 1½ cm. Fruit (1½–)2–3½ cm diam.
26. Twigs glabrous or with appressed pubescence. Thorns, if present, recurved.
27. Leaves 6½–12(–16) cm long, the margin somewhat recurved. Sepals at least 6 mm long. Fruit 2–3½ cm diam. . . . . **7. C. lanceolaris**
27. Leaves 5–6 cm long, flat. Sepals *c.* 3 mm long. Fruit unknown . **6. C. longestipitata**
26. Twigs generally with short, patent pubescence. Leaves 4–8(–13) cm long, ovate, subcordate. Fruit *c.* 1½ cm diam. Thorns, if present, straight . . . . . . **9. C. lobbiana**

1. Capparis scortechinii KING, J. As. Soc. Beng. 58, ii (1889) 394; Ann. R. Bot. Gard. Calc. 5 (1896) 118, t. 135; RIDL. Fl. Mal. Pen. 1 (1922) 122.

Climbing shrub, 2–10 m. Twigs straight, angular and pubescent, terete and glabrescent when older; internodes 1–3 cm. *Thorns* strong, recurved, 2–4 mm. *Leaves* (sub)coriaceous, pubescent when young, soon glabrescent, ovate to obovate, 2–5 times as long as broad, 6½–12(–21) by 1½–5 (–7½) cm; base narrowed, acute; top rounded to narrowed, more or less acuminate, dark-mucronate; midrib flat above; nerves *c.* 5–6 pairs;

Fig. 5. *Capparis zeylanica* L. *a*. Flowering twig, the leaves still young, × ⅔, *b*. flower, nat. size, *c*. fruiting branch with adult leaves, the fruit opened, × ⅔.

petiole *c.* 1 cm, brown pubescent, late glabrescent. Raceme terminal, 2½–10 cm long, brown pubescent all over. Bracts 10 by 1½–2 mm, sometimes larger and resembling small leaves. Pedicels 5–10 mm, leaving a prominent scar, in fruit woody. *Sepals* densely pubescent outside, with membranous, ciliate margin 1 mm broad, outer pair coriaceous, orbicular, 8–11 mm diam., inner pair subcoriaceous, ovate, 2–6 by 4½ mm, densely pubescent outside. *Petals* pink, *c.* 8–9 by 4½–6 mm, obovate, notched, with cuneate base, sparsely pubescent inside, or glabrous. *Stamens* 35–50, *c.* 15 mm. *Gynophore c.* 5–6½ cm (occasionally abortive), in fruit transversely wrinkled, woody, thickened up to 16 mm; ovary ovoid, 1¾ by ¾ mm. *Fruit* globular, *c.* 10(–12½) cm diam., pericarp woody, 2–2½ cm thick, smooth, yellow. Seeds ∾, *c.* 2⅓ by 1¾–2½ by *c.* 1 cm.

Distr. *Malaysia:* ? Banka, Malay Peninsula (Perak, Trengganu, Pahang, Selangor, and Penang).

Ecol. In rain-forests, up to 1400 m.

Vern. *Mĕnawul*, Banka, *susoh bĕruga*, Pahang.

Note. An entirely glabrous sterile specimen collected by TEYSMANN s.n. (Bo) in Banka, probably belongs here. In KING's type collection both flowers with an abortive and a developed gynophore are represented.

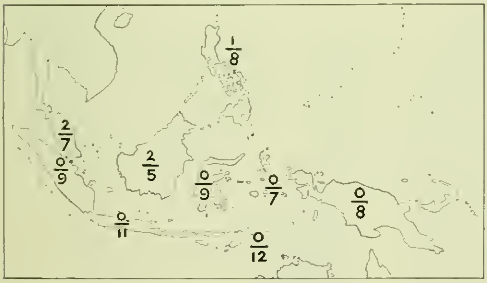


Fig. 6. Species density of the genus *Capparis* in Malaysia. The number above the hyphen refers to the number of endemic species, that below the hyphen to the number of other species in each province. *C. longipes* MERR. (incompletely known; from the P.I.) has not been incorporated.

2. Capparis trinervia HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 175; KURZ, Fl. Burm. 1 (1874) 64; GAGN. Fl. Gén. I.-C. 1 (1908) 193; Suppl. 1 (1939) 168. — *C. kunstleri* KING, J. As. Soc. Beng. 58, ii (1889) 396; RIDL. Fl. Mal. Pen. 1 (1922) 122.

Climber or shrub, up to 4 m. Young parts ferruginous-tomentose, soon glabrescent. Twigs almost straight, often angular, internodes *c.* 3–5 cm; *thorns* 1–2(–3) mm, patent or slightly recurved. *Leaves* subcoriaceous, elliptic to oblong, slightly obovate, (6–)10–14 by (2¾–)3½–5½ cm; base cuneate, often subtriplinerved, top acuminate with acute tip *c.* ¾ cm; midrib above sulcate in the basal part; nerves (6–)7–8(–10) pairs, glabrous to early glabrescent; petiole (7–)10–14(–18) mm, hairy as the twig. *Flowers* (3–)5–10(–15) in a terminal raceme. Pedicels rather vigorous, in the axils of the upper leaves or in the axils of very

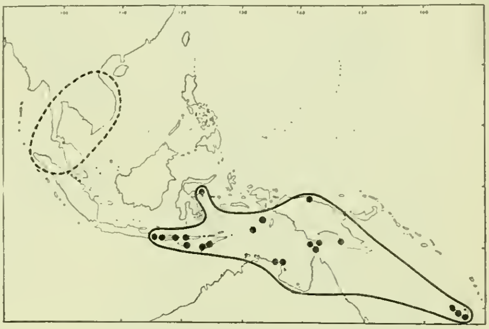


Fig. 7. Approximate area of distribution of *Capparis trinervia* HOOK. *f.* & TH. (broken line) and localities of *C. quiniflora* DC. (dots within continuous line), the latter also in Fiji.

soon caducous *c.* 4 mm long narrow bracts, *c.* 2–4 cm long, widened at the top, hairy. Buds approximately globular, pointed. *Sepals c.* 9–12 by 11 mm, outside densely orange-yellow puberulous, the outer pair coriaceous, the inner pair thinner, flattish, suborbicular, with membranous margin. *Petals* light red, obovate, *c.* 12–15 by 8–9 mm, puberulous towards the base on both sides, the margins crisp, except at the base. Torus *c.* 5(–6) mm wide, flattish. *Stamens c.* 60–70, *c.* 27 mm long, whitish. *Gynophore* 2¾–4½ cm long, light red, glabrous, ovary ellipsoid to ovoid, 2½ mm long, with umbonate stigma, green, glabrous. *Fruit* globular, deep yellow, 3½ cm in diam., pericarp soft-woody, 4 mm thick. Seeds 15–17 by 14 by 6 mm.

Distr. Indo-China (Tonkin, Laos, Annam), Burma (Tenasserim); in *Malaysia:* NE. Sumatra (Tinggiradja, N of lake Toba), Malay Peninsula (Perak: G. Booboo). Fig. 7.

Ecol. A creeper reported clinging to trees in dense jungle, and from dry, almost bare lime-cinder ledges, at low altitude.

Note. The Malaysian specimens differ slightly from those of Indo-China where the leaves have 3–5 pairs of nerves and the buds are not pointed.

3. Capparis brachybotrya HALL. *f.* in Fedde, Rep. 2 (1906) 59; LAUT. Bot. Jahrb. 52 (1914) 112.

Branchlets stout, terete, slightly zig-zag, glabrous, internodes 2½–5 cm. *Thorns* slightly recurved, minute to 2 mm long. *Leaves* coriaceous, elliptic, oblong or sublanceolate, light green when dry, glabrous, 13–21½ by 5–10½ cm; base obtusely acutish to rounded; top rounded and ?–10 mm acuminate, with a dark and stiff tip; nerves (6–)7–9(–10) pairs, depressed above. Petiole stout,

Fig. 8. *Capparis erycibe* HALL. *f. a.* Habit, × ⅔, *b.* flower, × 6, *c.* fruits, × ⅔ (after JACOBS 4838).

1–1½ cm. Racemes axillary, sometimes serially in twos; rachis stout, (1–)2½ cm, up to 20-flowered, pale-puberulous, glabrescent, at the very base surrounded by conferted bracts. Bracts subulate, small, early caducous; bracteoles stiff, subulate, minute, later caducous. Pedicel 1–2½ cm, slightly thickened towards the top, puberulous, glabrescent. *Flowers* (pinkish) white, scented. Buds subglobular, occasionally apiculate, 1 cm diam. *Sepals c.* 11–14 by 6–10 mm, more or less mucronulate, outer ones subglabrous, inner ones outside puberulous along the margin. *Petals* 12–20 by 6–10 mm, outside puberulous, especially in the upper part; upper petals the smallest, in the basal median part densely puberulous inside; lower petals glabrous inside. Disk fleshy, *c.* 1 mm diam., glabrous. *Stamens* (80–)100–160, 25–35 mm long, filaments white. *Gynophore* 2–3½ cm; ovary ovoid, 2–3 by 1 mm, stigma ½ mm, all glabrous.

f. **brachybotrya.**

Leaves elliptic, 1.7–2.1 times as long as broad, 14–22 by 7½–10½ cm, with rounded base. *Fruit* on a gynophore 1½–2¼ cm, ellipsoid with narrowed base and short, abruptly acuminate top, 4–5½ by 3¼ cm, pericarp leathery. Seeds ∞, *c.* 10 by 7 by 5 mm, light brown.

Distr. *Malaysia:* Moluccas (Kai Is), New Guinea (Vogelkop and Batanta Is).

Ecol. Primary and secondary forest, up to 250 m.

Note. The fruits belonging to the type specimen were separated from it and got lost; the only collection of ripe fruits now available was made by VAN ROYEN. He informed me that the short peduncle with several fruits on their long stalks was quite showy. The fresh fruits are somewhat larger than the dry ones, red, smooth, and they possess the abruptly pointed base and apex.

f. **angustifolia** (HALL. *f.*) JACOBS, *stat. nov.*—*C. brachybotrya var. angustifolia* HALL. *f.* in Fedde, Rep. 2 (1906) 60; LAUT. Bot. Jahrb. 52 (1914) 112. —**Fig. 9.**

Leaves oblong, 2.4–3.3 times as long as broad, 13–21½ by 5–7 cm, with obtusely acutish to rounded base. *Gynophore* 4½ cm; *fruit* (almost mature?) elongate, 4 by 1½ cm, pericarp thin. Seeds ∞, *c.* 8 by 7 by 4 mm.

Distr. *Malaysia:* Celebes (Pangkadjene, Minahasa), New Guinea (Vogelkop).

Ecol. Coastal forest.

Note. In sterile state very similar to *C. micracantha*, but easily distinguished by the axillary inflorescence with a thick rachis, *C. micracantha* having a supra-axillary row of pedicels or their scars.

4. Capparis erycibe HALL. *f.* Bull. Herb. Boiss. 6 (1898) 216; BACK. Schoolfl. (1911) 62; KOORD. Exk. Fl. Java 2 (1912) 294; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 10.—*C. paniculata* RIDL. J. Fed. Mal. St. Mus. 10 (1920) 129; RIDL. Fl. Mal. Pen. 1 (1922) 124; BAKER, J. Bot. 63 Suppl. (1924) 5.—**Fig. 8.**

Climber, about 1½(–14?) m. Twigs slack, brownish, brown-puberulous, especially when young, slightly zig-zag; internodes about 3–5 cm.

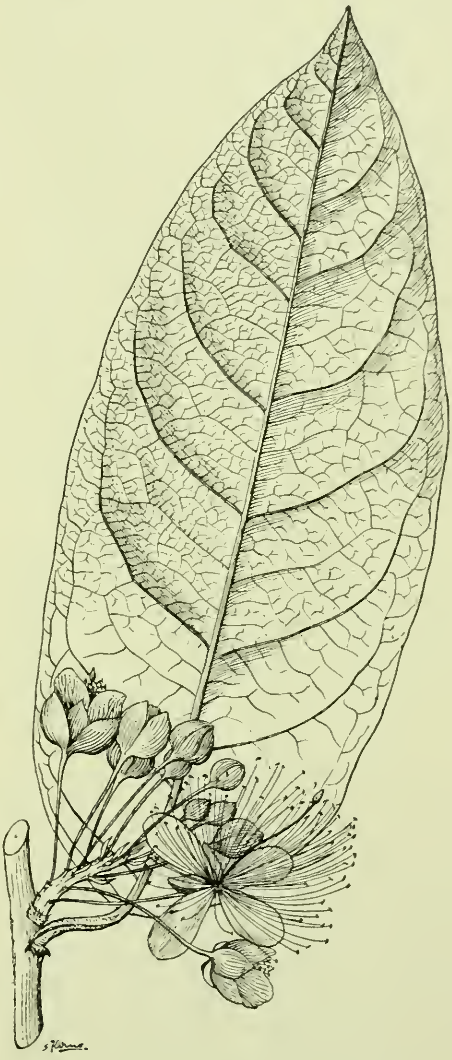


Fig. 9. *Capparis brachybotrya* HALL. *f. f. angustifolia* (HALL. *f.*) JACOBS, node with leaf and inflorescence, × ⅔ (KOSTERMANS 2819).

Thorns up to 2 mm long, recurved, mostly wanting. *Leaves* herbaceous to subcoriaceous, often reddish brown when dry, glabrous above, glabrescent beneath, broadest above, sometimes at the middle, 1.8–2.5(–2.8) times as long as broad, (9½)–12–16 (–20) by 4½–8½ cm, base mostly narrowed, sometimes rounded, acute to obtuse; top rounded to acuminate, mucronate; midrib above mostly narrowly sulcate; nerves *c.* 6–8 pairs, glabrous above, glabrescent beneath; petiole 4–10 mm, brown-pubescent, late glabrescent. Panicle mostly brown-puberulous on a *c.* 5–10 cm long, slender peduncle terminal on a twig of which the upper part has mostly lost its leaves, *c.* 10–20 by 5–15 cm. Pedicels slender, 4–18 mm. Bracts minute, sometimes wanting. *Flowers* white to greenish, sometimes tinged reddish. Buds globular, *c.* 4 mm diam. *Sepals* 4–6 by 2½–3 mm, the outer pair sometimes sparsely puberulous outside; the inner pair with broad membranous margin, glabrous. *Petals* 4 (occasionally single flowers with 5 or 6), 4½–6 by 1–4 mm, suborbicular to subspathulate, sometimes puberulous, especially at the base. *Stamens* 20–40, 5–6(–8) mm. Ovary ovoid to spindle-shaped, 2 by 1 mm, glabrous; *gynophore* 2–5 mm, glabrous, in fruit 4–12 mm long, with the pedicel and torus a little incrassate. Mature *fruit* not known, globular, *c.* 1½ cm diam., pericarp thin, leathery, smooth or finely papillate. Seeds 1–4, subglobose to angular, 9–10 by 7–9 by 4–5 mm.

Distr. Indo-China (Annam), *in Malaysia:* S. Sumatra (Lampongs), Malay Peninsula (Pahang, Kelantan), Borneo (Sarawak), Java (scattered).

Ecol. Forests, often on limestone, up to 600 m. *Fl.* Dec.-June, *fr.* July–Nov. Apparently a rare plant.

Vern. *Endog-dogan*, J, *lortĕloran*, Md.

Note. The material of *C. paniculata* RIDL. is somewhat different from the Javanese *C. erycibe* by its being less hairy, by the longer pedicels, the glabrous sepals, the more orbicular petals, and the smaller number of stamens; its fruit is unknown. The only Bornean specimen, collected by HAVILAND (SAR), and the only Sumatran specimens, FORBES 1696 and 1719A, agree quite well with the type of *C. paniculata*.

5. Capparis cantoniensis LOUR. Fl. Coch. (1790) 331; ed. WILLD. (1793) 404; DC. Prod. 1 (1824) 253; MERR. Comm. Lour. (1935) 173.—*C. salaccensis* BL. Bijdr. (1825) 54; MIQ. Fl. Ind. Bat. 1, 2 (1858) 101; Illustr. (1870) 23, t. 12A (*excl. var. celebica* MIQ., *quae est C. lanceolaris*); BACK. Schoolfl. (1911) 61; KOORD. Exk. Fl. Java 2 (1912) 294; RIDL. J. Fed. Mal. St. Mus. 84 (1917) 15; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 9.—*C. pumila* CHAMP. in Hook. J. Bot. Kew Gard. Misc. 3 (1851) 260; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 177; GAGN. Fl. Gén. I.-C. 1 (1908) 188.—*C. hasseltiana* MIQ. Illustr. (1870) 24, t. 13. —*C. celebica* MIQ. *l.c.* 26.

Slack climber, 3–20 m. Twigs almost straight, angular and puberulous when young, terete and glabrescent when older; internodes *c.* 1½–4 cm. *Thorns* patent to recurved, 2–5 mm long, especially on flowering branches minute or wanting. *Leaves* subcoriaceous, oblong to lanceolate, (2.3–)2½–4(–5) times as long as wide, sometimes ovate, rarely obovate, above glabrous, beneath sparsely puberulous but soon glabrescent, young leaves salmon-reddish, (4–)5½–10½ by (1½–) 2–3½(–4) cm; base obtuse to acutish, top narrowed, acuminate, tip often blunt, sometimes slender and acutish, mucronate; midrib above sulcate all over; nerves inconspicuous, 6–9(–11) pairs; petiole 5–6(–10) mm, hairy as the twig. *Flowers* sometimes fragrant, in axillary subumbels which are often arranged in a terminal panicle *c.* 15–20 cm long, each a few cm peduncled, sparsely hairy. Pedicels slender, ½–2 cm. Bracts subulate, 1–2 mm long, caducous; bracteoles basal, minute, sometimes wanting. Buds globular, 4–5 mm diam. Outer *sepals* 4½–6(–7) mm diam., sometimes sparsely puberulous at the base outside, inner sepals elliptic to obovate, 5–7(–8) by 4–6 mm, with membranous, ciliate margin. *Petals* white (sometimes greenish or pinkish?), (3½–)5–6½ by 2–3(–4) mm, mostly obovate, pubescent. *Stamens* 20–45, 15–25(–32) mm long, filaments white. *Gynophore* 4–12 mm, ovary approximately ellipsoid, 1½ by 1 mm, both glabrous. *Fruit* globular to ellipsoid, 1–1½ cm diam., pericarp thin, leathery, smooth. Seeds one to few, globular and 5–6 mm to elliptic and 10 by 7 by 5 mm.

Distr. India (Sikkim, Khasia, and Assam), Burma (Dawna Range), S. China, Hainan, Indo-China, and the Andamans; in *Malaysia:* Central Sumatra, Java, Lesser Sunda Islands (Bali, Lombok), Celebes, Philippines (Mindanao), Moluccas (Sula Is: Mangoli, Buru). Fig. 10.

Ecol. Forests and forest edges, frequently in the shade, seems to prefer moist places. *Fl. fr.* Jan.–Dec.

In the Himalaya, Sumatra, and Java it is found between (700–)1200 and 1750(–2000) m. In Hong Kong and vicinity it occurs near sea-level, and the same is probably the case in the Philippines and the Sula Is.

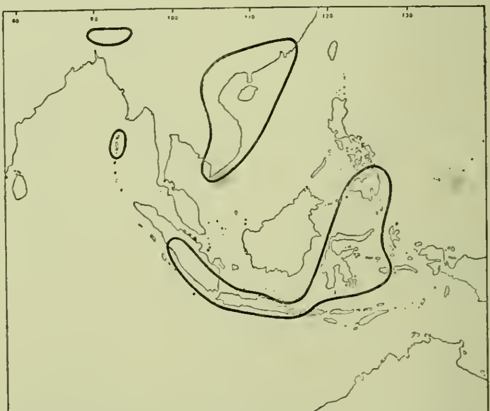


Fig. 10. Distribution of *Capparis cantoniensis* LOUR. The three areas north of Malaysia form one whole.

Vern. *Ĕndog ĕndogan, kidjĕruk, sĕgore tjalot* (?), *sigar djalak*, J, *sanik lakik*, Md.

Notes. In the two Lombok specimens, collected by ELBERT, the leaf-top is rounded to acutish.

A few specimens from Mindanao were originally identified as *C. sepiaria*, and indeed show resemblance to that species, as the leaves are comparatively small with a slightly notched top. On account of the midrib, however, which is narrowly sulcate, I reckon them to belong here. They are from altitudes below 300 m.

6. Capparis longestipitata HEINE, Mitt. Bot. Staatssamml. München. Heft 6 (1953) 210; Pfl. Samml. Clemens (1953) 41.

Young parts with a greyish, very short indument, glabrescent; twigs terete, straight, internodes *c.* 1½ cm; *thorns* hardly or not developed. Mature *leaves* firmly herbaceous, glabrous, oblong to slightly obovate, *c.* 5–6 by 2½(–3) cm, base rounded, top acuminate, tip 4–7 mm long, acute; midrib above sulcate in the basal half, otherwise flat; nerves 5–7 pairs, thinly prominent on both sides, reticulation distinct; petiole *c.* 1 cm long, hairy as the twig. Subumbels *c.* 15-flowered, in the axils of the higher leaves and some terminal, *c.* 1½–2½ cm peduncled. Pedicels *c.* 8–15 mm, on small distinct cushions; bracts subulate, few mm long, very soon caducous. Buds globular, *c.* 3 mm diam. Outer pair of *sepals c.* 3 mm diam., outside densely greyish puberulous, the inner ones smaller and flattish and hairy only in the centre. *Petals c.* 4 by 2 mm, glabrous, white. *Stamens c.* 20–30, *c.* 7 mm long. *Gynophore* 20–25 mm, glabrous; ovary spindle-shaped, subovoid, 1½ mm long, glabrous with a knob-shaped stigma. *Fruit* unknown.

Distr. Indo-China (Nhatrang in S. Annam, once coll.); in *Malaysia:* North Borneo (Mt Kinabalu, once coll.).

Ecol. In forest, at 1000 and 1500 m respectively.

Note. The Indo-China specimen, CHEVALIER 38671, differs slightly in having thorns 3–4 mm, the leaves $^{3}/_{4}$–$1^{1}/_{2}$ cm acuminate and brown-puberulous on the midrib underneath, the sepals 5–$5^{1}/_{2}$ by $3^{1}/_{2}$–4 mm, the petals 6 by 2 mm and puberulous inside, ± 18 stamens $1^{1}/_{2}$–2 cm, and the gynophore 3 cm long.

I have compared *C. longestipitata* with *C. cantoniensis* but its gynophore is longer, its midrib is only grooved in the basal half, and it has hardly any thorns. From *C. lanceolaris* it differs by the far smaller flowers.

7. Capparis lanceolaris DC. Prod. 1 (1824) 248; MIQ. Fl. Ind. Bat. 1, 2 (1858) 101; BACK. Schoolfl. (1911) 62; KOORD. Exk. Fl. Java 2 (1912) 294; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 9.—*C. subspinosa* ROXB. Fl. Ind. ed. CAREY 2 (1832) 568.—*C. roxburghii* (*non* DC.) SPAN. Linnaea 15 (1841) 166.—*C. elliptica* SPAN. *l.c.*—*C. platyacantha* TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 323.—*C. callophylla* (*non* BL.) MIQ. Pl. Jungh. (1855) 397; Fl. Ind. Bat. 1, 2 (1858) 101, *p.p.*—*C. salaccensis var. celebica* MIQ. Illustr. (1870) 23, t. 12b.—*C. oblongata* MERR. Gov. Lab. Publ. Philip. *n.* 35 (1906) 15; Philip. J. Sc. 1 (1906) Suppl. 58; En. Philip. 2 (1923) 212.—*C. copelandii* ELMER, Leafl. Philip. Bot. 2 (1910) 680; MERR. En. Philip. 2 (1923) 210.—*C. torricellensis* LAUT. Bot. Jahrb. 52 (1914) 112.—*C. viridis* ELMER, Leafl. Philip. Bot. 8 (1919) 3076.

Scandent shrub, few (up to 20?) m high, rarely self-supporting and *c.* 1½ m high. Twigs mostly overhanging, straight, fulvous to red-brownish puberulous when young, sooner or later (rarely not) glabrescent but nearly always vestiges of the pubescence persistent near the leaf axils; internodes *c.* 2–5 cm. *Thorns* mostly present, recurved, up to 7 mm long. *Leaves* subcoriaceous, above glabrous, beneath mostly glabrous, sometimes fulvous-puberulous, whether or not glabrescent, (1.5–)2.0–4.0(–4.7) times as long as broad, broadest in the middle, (3½–)6½–12(–16) cm long, (1¾–)2–4(–7) cm broad; base acutish to rounded or subcordate, top acuminate, rarely rounded to subemarginate, tip mostly acute-mucronate, margin often markedly recurved, especially towards the top; midrib above sulcate mostly all over, rarely flat; nerves 6–10 pairs, hardly visible; petiole (½–)¾–1(–1½) cm, hairy as the twigs. Subumbels mostly axillary, sometimes terminal, mostly simple, sometimes branched; peduncle 2–7 cm, occasionally leafy and up to 15 cm, more or less glabrescent. Pedicels (1¼–)2–2½(–3) cm, glabrous, sometimes each with a pair of distinct thorns at the base. Bracts small, caducous, narrow, hairy. Buds globular, 5–6(–8) mm diam. *Flowers* white, yellow-white, pink or red, whether or not

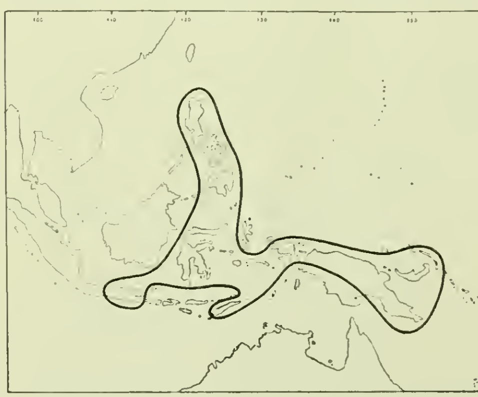


Fig. 11. Distribution of *Capparis lanceolaris* DC.

fragrant. *Sepals c.* 6–7(–10) by 5 mm, with membranous margin, glabrous; outer pair herbaceous, inner pair flatter and thinner, rarely minutely ciliate. *Petals* obovate, somewhat oblique, thin, 8–11 by 4–6 mm, puberulous towards the base, especially inside. *Stamens c.* 20 (–40), 2–3 cm. *Gynophore* (2–)3–4(–5) cm, ovary ellipsoid, 1–2 mm long, both glabrous. Fruits few; pedicel, torus, and gynophore but little incrassate. *Fruit* (sub)globular, 2¼–3½ cm, bluish black. Seeds 3 or more, *c.* 8 by 6 by 5 mm.

Distr. *Malaysia:* M.-E. Java (also Nusa Barung), Madura, Lesser Sunda Islands (Timor, Damar, Jamdena), Celebes (also Salajar and Buton), Philippines (not known from Palawan), Moluccas (Ceram, Nusa Laut), New Guinea (N. part from Manokwari to the Sepik and Papua, also Schouten I.), New Ireland. Fig. 11.

Ecol. Secondary (or primary) forests, thickets, or hedges, mostly on dry, calcareous, rocky soil, also in coastal vegetation, up to 700 m, once at 1650 m.

Vern. *Gagaan, tjantĕlan*, J, *kengkeng*, Md, *nonoh mukeh*, Timor; Philippines: *sulu-súlu*, Bag., *kamit-kabag*, Dum.

Notes. In sterile state very similar to *C. floribunda*, but this species has commonly somewhat longer petioled, mostly ovate leaves narrowing gradually towards the apex, whereas a sharply acuminate leaf tip is typical for *C. lanceolaris*, especially in the Philippines. Some sterile New Guinean specimens resemble *C. zippeliana* (see there).

In the Philippines some deviating specimens have been described as distinct species, *C. oblongata, C. viridis*, and *C. copelandii*. In the first two the innovations are glabrous to early glabrescent, the leaf base is obtuse to subcordate, the apex is narrow and sharply acuminate, the sepals are 9–10 mm long, the inner pair being sometimes minutely ciliate; sometimes also small thorns are found in the inflorescence! Besides, in some specimens identified as *C. oblongata*, the sub-umbels are conferted towards the end of the twigs and are merely subtended by minute puberulous bracts, resulting in impressive inflorescences 10–15 cm long. This latter feature, however, varies even in different duplicates of the type collection (R. MEYER FB 2632). Two other Philippine specimens have densely pubescent twigs and leaf underside; this material (in fruit) was described as *C. copelandii*.

The specimens from Java are characterized by generally well developed thorns which are also found in the inflorescence and by comparatively small leaves (3½–8 cm).

8. Capparis floribunda WIGHT, Ill. Ind. Bot. 1 (1840) 35, t. 14; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 177; F.-VILL. Nov. App. (1880) 11.—*Crataeva octandra* BLANCO, Fl. Filip. (1837) 400, ed. 2 (1845) 280. ed. 3, 2 (1878) 155, *non Capparis octandra* JACQ.—*C. luzonensis* TURCZ. Bull. Soc. Imp. Nat. Mosc. 27,2 (1854) 324; MERR. Sp. Blanc. (1918) 159; En. Philip. 2 (1923) 212, *incl. var. ampla* MERR. *l.c.*—*C. andamanica* KING, Ann. R. Bot. Gard. Calc. 5 (1896) 119, t. 137. —*C. oligostema* HAY. Ic. Pl. Form. 3 (1913) 22.

f. **floribunda.**

Young parts glabrous, rarely very soon glabrescent.—Shrub or climber (?), few m high. Twigs straight or slightly zig-zag, terete, smooth, internodes 2–5 cm; *thorns* small, recurved, mostly wanting. *Leaves* firmly herbaceous, broadest at the middle or sometimes below, mostly narrowed in the upper half, mostly 2½–3 times as long as wide, (4–)6–10(–13) by (1½–)2½–4(–6) cm; base mostly rounded and more or less acute, top variable; midrib above often narrowly sulcate; nerves 7–9 pairs; margin often slightly recurved; petiole ½–1½(–2) cm. *Flowers* numerous, white, fragrant, in small subumbels, *c.* 1–2 cm stalked, arranged in a terminal panicle up to 15 by 10 cm, with some additional smaller axillary panicles. Bracts linear, 2–6 mm, sooner or later caducous. Buds globular, 3–4 mm diam. *Sepals* 2–4 by 1½–2½ mm, ovate, patent and persistent for some time after anthesis, outer ones patent, not or narrowly membranous-margined, inner ones sometimes broader, with a broad, membranous margin. *Petals* very thin, oblong or ovate, 3–5 by 1½–2 mm. *Stamens* 7–9(–12), 6–8 mm. *Gynophore* 4–6 mm (in Ceylon up to 10 mm); ovary ovoid, acutish, 1–1½ by ½–1 mm, both glabrous. In fruit the pedicel, torus and gynophore only slightly thickened. *Fruit* globular, ± 1½–2(–2½) cm diam., soft, fleshy, pericarp coriaceous, smooth orange. Seeds 1–3, ± 13 by 10 by 6 mm.

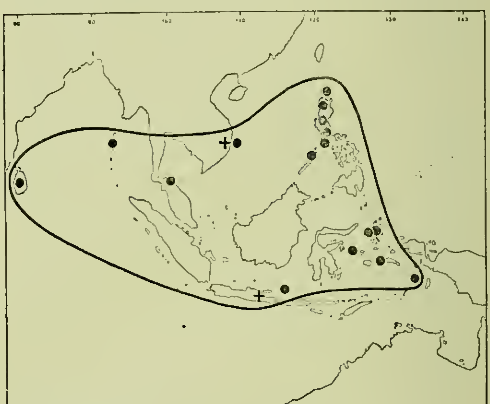


Fig. 12. Localities of *Capparis floribunda* WIGHT (●) and of its *f. induta* JACOBS (+). The locality near the Malay Peninsula (Koh Ha) is approximate. Also in the Deccan and Formosa.

Distr. Ceylon, Deccan, Indo-China (Annam), Formosa, Peninsular Siam, Andamans; in *Malaysia:* Java (only Kangean Arch.), Philippines (Debangan I. near Palawan, Babuyan I., Luzon), Moluccas (Halmaheira, Tidore, Sula Is, W. Ceram, Kai Is). Fig. 12.

Ecol. This showy plant seems to prefer dry country and rocky soil, sometimes in coastal vegetation, in the lowlands; once at 1600 m. *Fl. fr.* Jan.–Dec.

ELMER found "many fruits opened and seeds eaten by birds".

f. **induta** JACOBS, *f. nova.*

A f. floribunda differt indumento denso fulvo puberulo in partibus juvenilibus.

A dense, fulvous-puberulous indument on twigs, young leaves, and inflorescences. Outer sepals at the base somewhat hairy and petals slightly ciliate.

Distr. Indo-China (Annam); in *Malaysia:* E. Java (Surabaja Residency, Muning, fl. ix-1927, DE VOOGD 673 (L, type; Bo)).

Vern. *Wangon lanang*, J. Fig. 12.

Notes. The species is characterized by the glabrous appearance, with small or without thorns, the large number of small flowers with 8 stamens, subpersistent sepals, and a short gynophore which is more vigorous than in *C. sepiaria*; the latter species has also a lighter coloured fruit.

The only specimen known from the mainland of Java is the specimen described as *f. induta* JACOBS. In sterile state it can look like *C. lanceolaris* (see there).

The leaves are variable in width. TURCZANINOW described *C. luzonensis* on the specimen with the narrowest leaves that I have seen, the leaf index being 3.7–4.1. MERRILL's *var. ampla* actually represents the normal leaf-shape; intergrading specimens are by no means rare.

9. Capparis lobbiana TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 323; ROLFE, J. Bot. 23 (1885) 210; VIDAL, Rev. Pl. Vasc. Filip. (1886) 47.—*C. sepiaria var. acuta* VIDAL, *l.c.*—*C. littoralis* MERR. Philip. J. Sc. 7 (1912) Bot. 270; En. Philip. 2 (1923) 211.—*C. loheri* MERR. Philip. J. Sc. 7 (1912) Bot. 270; En. Philip. 2 (1923) 211.—*C. palawanensis* MERR. Philip. J. Sc. 10 (1915) Bot. 304; En. Philip. 2 (1923) 212.—*C. ilocana* MERR. Philip. J. Sc. 13 (1918) Bot. 13; En. Philip. 2 (1923) 211.—**Fig. 13.**

Climber 1½–3(–4) m high. Twigs slender, straight or slightly zig-zag, with leaves not seldom in two rows, densely clothed with up to ½ mm long, straw-coloured hairs, rarely almost glabrous or soon glabrescent; internodes 1–2(–3) cm. *Thorns* almost straight, up to 2, rarely 5 mm, thin, dark, with lighter base, pointing upwards, exceptionally downwards. *Leaves* herbaceous, broadest below, rarely at the middle, (1.5–)1.8–2.5 (–4.3) times as long as wide, glabrous or sparsely hairy above, hairy beneath, especially on the nerves, 4–8(–15) by 2–3½(–5) cm; base cuneate, sometimes rounded, rarely acute, top narrowed, acute to (rarely long-) acuminate, often with a nerf-tip; midrib above shallowly sulcate in the lower part, yellowish, sparsely hairy underneath; nerves 6–8 pairs; petiole 2–4(–12) mm, hairy as are the twigs. Subumbels axillary; peduncle ½–6 cm, thin, bearing sometimes one or more small leaves, hairy. Pedicels slender, 1½–3 cm, mostly with distant hairs, rarely glabrous. Bracts inconspicuous, narrow. Buds globular to depressed-globular, 5–6 mm diam. *Flowers* white or pale pink. *Sepals* persistent for a short time, outer pair 5–6 mm diam., herbaceous, hairy (or rarely glabrous), inner sepals 6–7 mm diam., thinner, ciliate. *Petals* very thin, ovate, 2–4 by 2½–3 mm, ciliate. *Stamens* 15 to 60, 8–12 mm long, anthers 1–1½ by ½–1 mm. Torus obscure. *Gynophore* 1½–3(–4¾) cm, glabrous; ovary ovoid, *c.* 2 by 1 mm. In fruit the pedicel, torus, and gynophore only slightly incrassate. *Fruit* globular, *c.* 1½ cm diam., pericarp leathery, thin, smooth, glossy, blackish. Seeds few, subellipsoid, *c.* ½ cm long.

Distr. *Malaysia:* Endemic in the Philippines (not known from the Sulu Arch.).

Ecol. Prefers dry, rocky conditions, also in primary forests, bamboo thickets, *etc.*, up to 600 m.

Vern. *Manungal-lalaki*, Mindoro.

Notes. A variable species which can always be distinguished from *C. lanceolaris* by the straight, though sometimes little developed thorns.

Capparis palawanensis MERR. represents a form with unusually large leaves, but transitions with the average leaf-size occur. *C. littoralis* MERR. represents obviously a glabrous form; in some specimens of typical *lobbiana* the leaves are also soon glabrescent. There is but poor material of *C. ilocana* MERR.; the type and another specimen agree mutually very well and seem to represent another glabrous paramorph with almost abortive thorns and subcoriaceous leaves.

10. Capparis sepiaria LINNÉ, Syst. Nat. ed. 10, 2 (1759) 1071; Sp. Pl. ed. 2, 1 (1762) 720; BURM. *f.* Fl. Ind. (1768) 118; DC. Prod. 1 (1824) 247, *incl. β glabrata*; ROXB. Fl. Ind. 2 (1832) 568; W. & A. Prod. 1 (1834) 26; DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 427; Herb. Timor. Descr. (1835) 99; SPAN. Linnaea 15 (1841) 166; JACQUEM. Voy. Ind. Bot. 4 (1844) 21, t. 24; GRAY, U.S. Expl. Exp. Bot. 1 (1854) 70; MIQ. Fl. Ind. Bat. 1, 2 (1858) 101; Sum. (1860) 159; Illustr. (1870) 27; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 177, *incl. var. vulgaris*; KURZ, Fl. Burm. 1 (1877) 66; FERN.–VILL. Nov. App. (1880) 11, *cum var.*; NAVES in Blanco, Fl. Filip. ed. 3 (1880) t. 209; VIDAL, Phan. Cuming. (1881) 94; Sinopsis Atlas (1883) 13, t. 6 f. A; HEMSL. Bot. Chall. 3 (1884) 120; VIDAL, Rev. Pl. Vasc. Filip. (1886) 47; KING, J. As. Soc. Beng. 58, ii (1889) 393; KURZ *ex* PRAIN, J. As. Soc. Beng. 59, ii (1890) 277, *incl. var. grandifolia*; *ibid.* 60, ii (1891) 302; *ibid.* 62, ii (1893) 65; BACK. Fl. Bat. (1907) 59; MERR. Philip. J. Sc. 3 (1908) Bot. 77; GAGN. Fl. Gén. I.–C. 1 (1908) 191; BACK. Schoolfl. (1911) 61; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 68; KOORD. Exk. Fl. Java 2 (1912) 294; MERR. Fl. Manila (1912) 215; RIDL. Fl. Mal. Pen. 1 (1922) 122; MERR. En. Philip. 2 (1923) 212, *excl. var. acuta* VIDAL *in synon., quae est C. lobbiana*; CRAIB, Fl. Siam. En. 1 (1925) 83; C. T. WHITE, J. Arn. Arb. 10 (1929) 217; GAGN. Fl. Gén. I.–C. Suppl. 1 (1939) 165; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 9.—*C. umbellata* R. BR. *ex* DC. Prod. 1 (1824) 247; C. T. WHITE, Proc. Roy. Soc. Queensl. 34 (1922) 31.—*C. emarginata* PRESL, Rel. Haenk. 2 (1835) 85, *non* A. RICH.; FERN.–VILL. Nov. App. (1880) 11; MERR. En. Philip. 2 (1923) 211.——*C. retusella* THW. En. Pl. Zeyl. (1864) 16 = *C. sepiaria var. retusella* THW. *l.c.* 400; FERN.–VILL. Nov. App. (1880) 11. —*C. subacuta* MIQ. Illustr. (1870) 35, *p.p., quoad specim. halmah.* —*C. trichopetala* VAL. Bull. Dép. Agr. Ind. Néerl. 10 (1907) 14 = *C. sepiaria var. trichopetala* VAL. *l.c.* 72; LAUT. Bot. Jahrb. 52 (1914) 112.—*C. affinis* MERR. Philip. J. Sc. 10 (1915) Bot. 303; En. Philip. 2 (1923) 210.

Wide, much-branched shrub, few m high, sometimes climbing. Young shoots densely fulvous or greyish puberulous, sooner or later glabrescent;

Fig. 13. *Capparis lobbiana* TURCZ. *a*. Branch with fruits and flowers, × ⅔, *b*. bud, × 3 (WILLIAMS 382 and BS 85241).

twigs stout, zig-zag, terete; internodes 1½–3½ cm. *Thorns* generally vigorous, recurved, 3–5 mm long. *Leaves* firmly herbaceous to subcoriaceous, when dry mostly greyish green (in some Philippine specimens brownish), elliptic, sometimes obovate, or ovate, exceptionally linear, hairy as the twigs, upper surface glabrescent first, often with scattered minute warts, (1½–)1.8–2.3(–4) times as long as wide, (1½–)3½–5½(–10) by (1–)1½–2½(–4) cm; top mostly rounded, nearly always notched, rarely blunt; midrib flattish above, sometimes slightly sulcate at the base; nerves 4–6(–8) pairs, not very distinct; petiole 2–4(–7) mm. Subumbels few- to 20-flowered, at the end of small lateral twigs, rarely terminal. Bracts small, hairy, early caducous. Pedicels ¾–2(–2½) cm, glabrous. Buds globular, 4(–5) mm diam. *Sepals* ovate, 4–6 by 3–5 mm, occasionally finely ciliate, outer pair herbaceous with narrow membranous margin; inner pair somewhat smaller, very thin, membranous towards the margin. *Petals* 4½–7½ by 1¼–3 mm, very thin, white, more or less pubescent, especially outside at the base of the upper pair. Torus inconspicuous. *Stamens* 30–45, 7–12 mm, filaments white, anthers 1½ by 1 mm. *Gynophore* (4–)6–10(–13) mm, glabrous; ovary ovoid, 1½–2 by 1 mm, glabrous. In fruit the torus and gynophore somewhat incrassate, the pedicel hardly so. *Fruit* rather fleshy, (sub-)globular, 1–2-seeded, 1–1½ cm diam., pericarp subcoriaceous, smooth, whitish-yellowish to almost blackish. Seeds ± 8 by 5 by 4 mm.

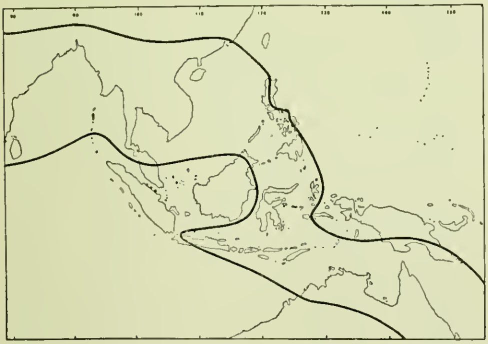


Fig. 14. Distribution of *Capparis sepiaria* L. in Malaysia.

Distr. Ceylon, India (Deccan, Sind, Punjab) to SW. Burma (Diamond I.), Andamans, SE. China (Kwangtung), Indo-China, Siam, and Hainan to Australia (Arnhem Land, Queensland, and New South Wales to *c.* 32° SL), in *Malaysia:* Malay Peninsula (Kedah, Kelantan), North Borneo, Java (in W only twice found at the N. coast), Madura, Kangean Arch., Lesser Sunda Islands (Bali, Nusa Penida, Sumbawa, Alor, Timor, Leti, Babar, Wetar), Celebes (also Salajar I. and Buton), throughout the Philippines, Moluccas (Halmaheira, Buru, Ambon, Kai Is), New Guinea (near Merauke, S. Papua). Fig. 14.

Ecol. Drier places in thickets, hedges, teak-forests, *etc.*, in the lowlands, often near the seaside, solitary or in groups, obviously bound to seasonal climatic conditions. When in fruit, often a good deal of the leaves is shed.

Vern. *Poka(n)*, Md.

Uses. The plant is said to be have some medicinal use (*cf.* QUISUMBING, Med. Pl. Philip. 340).

Notes. It seems not unlikely that this species occurs also in Africa under the names *C. corymbosa* LAMK and *C. tomentosa* LAMK, but this question deserves further research.

In the eastern part of Malaysia specimens are found which are intergrading between typical *C. sepiaria* and the Australian *C. umbellata*; they have straighter stems with less developed or often wanting thorns, larger, ovate, soon glabrescent leaves, fewer flowers in a shorter stalked and more often terminal and (sub)sessile subumbel. In a few specimens the midrib is sulcate all over.

C. sepiaria and *C. cantoniensis* are easily distinguished by the midrib, flattened in the former and narrowly sulcate in the latter.

In one sterile specimen collected by GAUDICHAUD near Manila the leaves are extremely narrow, *viz c.* 10 times as long as wide (6–7 mm). A similar phenotypic variation was found in *C. quiniflora.*

11. Capparis diffusa RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 68; Fl. Mal. Pen. 1 (1922) 122; HENDERS. J. Mal. Br. R. As. Soc. 18 (1939) 35.

Shrub or climber; twigs slender, sparsely brown-puberulous when young; internodes 2–4 cm. *Thorns* recurved, 1–3 mm long. *Leaves* elliptic, ovate to obovate, *c.* 5–8 by 2½–4 cm; base rounded to blunt, top blunt, minutely retuse, sometimes subacuminate; midrib above subprominent, sulcate at the base, brown-puberulous when young on both surfaces, or glabrous; nerves 5–6 pairs, thin; petiole 3–4 mm, sulcate above, brown-puberulous when young. Umbel terminal, sessile, 3–5-flowered. Bracts minute, caducous. Pedicels filiform, 2–5 cm, glabrous. Buds globular, 3–4 mm diam. *Sepals c.* 4 mm long, outer pair glabrous; inner pair elliptic, ciliate. *Petals* white, oblong, *c.* 4–5 mm, hairy inside. *Stamens* 12–15, *c.* 1¼ cm, anthers small, white. *Gynophore c.* 1½ cm, glabrous; ovary subglobular, acute, *c.* 1 mm long. *Fruit* unknown.

Distr. *Malaysia:* N. Sumatra (P. Weh), Malay Peninsula (Perlis), twice collected.

Ecol. On (limestone) rocks. *Fl.* Dec.

12. Capparis callophylla BL. Bijdr. 2 (1825) 53; KOORD. Minah. (1898) 342; BACK. Schoolfl. (1911) 62; Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 10.—*C. tylophylla* SPRENG. Syst. Nat. 4 (1827) 204; MIQ. Choix (1864) t. 2; Fl. Ind. Bat. 1, 2 (1858) 101; Illustr. (1870) 22; KOORD. Exk. Fl. Java 2 (1912) 294; MERR. En. Philip. 2 (1923) 213.—*C. cumingii* MERR. & ROLFE, Philip. J. Sc. 3 (1908) Bot. 101.—*C. turczaninowii* ELMER, Leafl. Philip. Bot. 5 (1913) 1755.—*C. mucronata* ELMER, *l.c.* 1757.—*C. robusta* HEINE, Mitt. Bot. Staatssamml. München. Heft 6 (1953) 211; Pfl. Samml. Clemens (1953) 41.

Climbing, glabrous shrub, few m high. Twigs stout, (reddish-)brown when dry; internodes 2–7 cm. *Thorns* often wanting, if present recurved, up to 5 mm long. *Leaves* coriaceous, often reddish brown when dry, broadest in the middle, (1½–) 2–3(–3½) times as long as wide, (8–)14½–20 (–26) by (3½–)5–9(–14) cm; margin slightly recurved; base more or less acute to rounded, sometimes subcordate, top rounded (or emarginate) and mostly with a hardened tip or shortly and bluntly acuminate; midrib above flat to sulcate; nerves *c.* 6–7 pairs, subprominent above; petiole 1–2(–2½) cm, stout, dark-coloured, rough. Inflorescence a more or less leafy, terminal panicle of subumbels. Pedicels 2–4½ cm. Bracts early caducous. Buds globular, 8–12 mm diam. *Flowers* white, pink or red-brown. Outer *sepals* coriaceous, subpersistent, 10–13 by 8 mm, rough; inner sepals subcoriaceous, 12–14 by 6–10 mm, thinner towards the margin. *Petals* oblong to obovate-subspathulate, 22–35 by 6–11 mm. Torus 4–5 mm broad. *Stamens c.* 50–80, filaments light red, 3½–4½ cm, anthers 2–3 by 1 mm. *Gynophore* 3–4½ cm, ovary ellipsoid, *c.* 4 by 2–3 mm, both glabrous. In fruit the pedicel (especially towards both ends), the torus, and the gynophore towards the top, considerably incrassate. *Fruit* globular to ellipsoid, 5–6½ cm long, pericarp 2–5 mm thick, smooth, yellowish orange. Seeds ∞, *c.* 1 by ½ cm.

Distr. Formosa (a variety), in *Malaysia:* Sumatra (Palembang), W. Java, Madura, North Borneo, Celebes, and throughout the Philippines. Fig. 15.

Except in the Philippines, the species seems to be rare.

Ecol. Mostly on dry, often calcareous soil, but also in moister habitats, in secondary forest, *etc.*, from the lowland up to 700, in N. Borneo up to 1700 m. *Fl. fr.* Jan.–Dec.

Vern. *Manunggal*, Mindoro, *sani*, Minahasa.

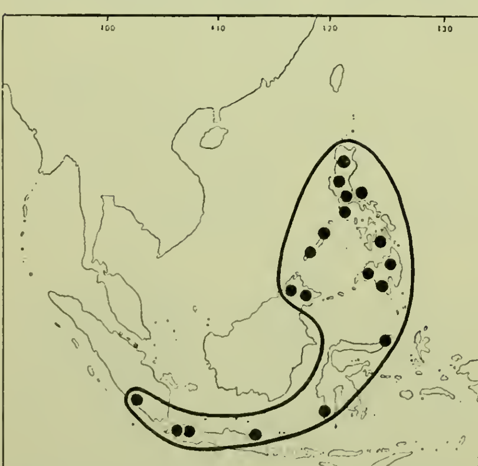


Fig. 15. Localities of *Capparis callophylla* BL.; a variety in Formosa.

13. Capparis zippeliana MIQ. Illustr. (1870) 25, t. 14; SCHEFF. Ann. Jard. Bot. Btzg 1 (1876) 5; K. SCH. & HOLLR. Fl. Kais. Wilh. Land (1889) 49; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 336; LAUT. Bot. Jahrb. 52 (1914) 114, f. 1a–d, *incl. var. novohibernica*, f. 1e, *et var. novobritannica*, f. 1f; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 178, f. 90.—*C. dahlii* GILG & K. SCH. Notizbl. Berl.-Dahl. 1 (1896) 208; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 335.—*C. carolinensis* KANEH. Bot. Mag. Tokyo 48 (1934) 919, f. 6.

Small climber. Twigs slender, fairly straight, glabrous, rarely glabrescent; internodes 2–5 cm. *Thorns* mostly wanting, if present slightly recurved, up to 3 mm. *Leaves* firmly herbaceous, often dull red-brownish when dry, broadest in the middle, (1.7–)2.2–2.8(–3.5) times as long as wide, (8–) 13–20(–26) by (4½–)5–8(–10) cm, glabrous or rarely thinly puberulous below; margins subrevolute; base rounded or acutish or subcordate, top (rarely sharply) acuminate, or rarely emarginate; midrib above mostly sulcate in the basal part, to flat; nerves 5–9 pairs; petiole (¾–) 1–1½(–1¾) cm, sulcate above, glabrous, rarely glabrescent. Subumbels up to 10-flowered, mostly sparsely puberulous, sometimes axillary but mostly arranged in a terminal panicle, slender, 2–7(–12) cm peduncled. Pedicels 1–4½(–6) cm. Bracts small, subulate, hairy, caducous. Buds globular, 5–6(–10) mm diam. *Sepals* subpersistent, outside sparsely hairy or glabrous, with membranous margin, 5–6(–12) mm diam.; outer pair subcoriaceous, one often initially enveloping the bud for ⅔; inner pair suborbicular, herbaceous. *Petals* thin, obovate, 6–8 by 2½–4 mm, white, minutely puberulous on both sides, base narrowed, top rounded (sometimes crisped?). *Stamens c.* 25–45, (1½–)2½–3 cm long, white or pale pink; anthers 1½–2½ by ½ mm. *Gynophore* 2–3½(–4) cm, often thinly puberulous at the base, soon glabrescent; ovary ellipsoid, 1½ by 1 mm. In fruit the pedicel, torus, and gynophore are rather incrassate. *Fruit* ovoid or ellipsoid, *c.* 4½ by 3½ cm, top sometimes umbonate, pericarp thin, leathery, smooth, red. Seeds ∞, *c.* 12 by 9 by 6 mm.

Distr. Micronesia (Palau), in *Malaysia:* S. Moluccas (Tanimbar and Kai), New Guinea, New Britain, New Ireland, and Solomons (Ulawa). Fig. 20.

Ecol. Primary and secondary rain-forests, sometimes on rocky soil, below *c.* 1200 m alt. *Fl. fr.* Jan.–Dec.

Vern. *Dschiriguh*, Constantinhafen, *wendos*, Manokwari, *walakenaru*, Solomons.

Note. In the sterile state much resembling *C. lanceolaris*, though the different average leaf-size is generally a good character; besides, *C. lanceolaris* is pubescent on the mature twig near the leaf-insertion which is glabrous in *C. zippeliana*.

14. Capparis pubiflora DC. Prod. 1 (1824) 246; DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 246; Herb. Timor. Descr. (1835) 98; DELESS. Ic. Pl. 3 (1837) t. 12; SPAN. Linnaea 15 (1841) 165; MIQ. Fl. Ind. Bat. 1, 2 (1858) 100; Illustr. (1870) 27, t. 15, *incl. var. sumatrana et var. moluccana* MIQ. *l.c.* 28; KING, J. As. Soc. Beng. 58, ii (1889) 394, *incl. var. perakensis* SCORT.; HALL. *f.* in Koord. Minah. (1898) 343; RIDL. J. Fed. Mal. St. Mus. 10 (1920) 129; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 13.—*C. nigricans* SPAN. Linnaea 15 (1841) 165; MIQ. Fl. Ind. Bat. 1, 2 (1858) 100.—*C. cerasifolia* A. GRAY, U.S. Expl. Exp. Bot. 1 (1854) 71; C. MUELLER in Walp. Ann. 7 (1868) 189 (*crassifolia, sphalma*); MERR. Philip. J. Sc. 3 (1908) Bot. 77; En. Philip. 2 (1923) 210.—*C. brachyscias* TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 323. —*C. lasiopoda* TURCZ. *l.c.* 322; FERN.-VILL. Nov. App. (1880) 11; VIDAL, Phan. Cuming. (1885) 94; Rev. Pl. Vasc. Filip. (1886) 48.—*C. myrioneura* HALL. *f.* in Fedde, Rep. 2 (1906) 60, *p.p.*—*C. dealbata* (*non* DC.) BACK. Schoolfl. (1911) 62.—*C. perakensis* (SCORT. *ex* KING) RIDL. Fl. Mal. Pen. 1 (1922) 124.—*C. borneensis* MERR. Pl. Elm. Born. (1929) 91.—**Fig. 16–17.**

Fig. 16. *Capparis pubiflora* DC. (Cult. Hort. Bog. XV–J–B–II–6; JACOBS, 1956).

Shrub 2–5 m high. Young shoots densely fulvous-tomentose, soon (rarely late) glabrescent; twigs often zig-zag, terete; internodes 1–3 cm. *Thorns* straight or slightly curved upwards, patent, 3–6 mm (wanting or very small in the Philippine specimens). *Leaves* herbaceous to sub-coriaceous, glabrous with yellowish nerves, (1.7–)2.7–3(–4.4) times as long as wide, often obovate, rarely ovate, (5–)8–16(–27½) by 2½–6 (–9) cm; base acute to blunt, sometimes rounded, top acuminate, tip up to 2 cm, acute to blunt; midrib sometimes sulcate above; nerves (6–)7–9 (–13) pairs, reticulations distinct; petiole 5–8 (–11) mm. *Flowers* either 1–5(–10) in short, axillary racemes, with a persistent, densely tomentose, subulate bract and 2 smaller basal bracteoles, or sometimes this inflorescence replaced by a short young twig with axillary flowers; racemes and young twigs with a number of minute subulate bract-like leaves at the base. Pedicels ½–3(–5) cm, glabrescent. Buds globular to ovoid, *c.* 5 mm long. *Sepals* herbaceous, concave, 4½–7 by 2½–4 mm, outside puberulous, outer pair acute or blunt, sometimes slightly cucullate, inner pair with blunt or rounded top. *Petals* thin, mostly obovate, 7—10 by 3–4 mm, outside soft-hairy at top and margins. Torus conical, disk *c.* 1 mm. *Stamens* 20–30(–50), filaments 15–20(–25) mm, anthers elliptic, 1 by ½ mm. *Gynophore* 15–25 mm, densely tomentose, in fruit glabrescent; ovary ellipsoid, 2½ by 1½ mm, hairy as the gynophore, the small, knob-shaped stigma glabrous. Pedicel and gynophore not much incrassate in fruit. *Fruit* subellipsoid, 12–21 by 10–19 mm, shortly umbonate, pericarp leathery, verruculose, glabrous, black, sometimes with a reddish or bluish tinge. Seeds 5–15(–25), *c.* 6 by 5 by 4 mm, smooth.

Distr. Siam, Indo-China, Hainan, in *Malaysia:* Central & S. Sumatra (Gajo Lands, once collected), Malay Peninsula (Perak, Kelantan, Pahang, Selangor), North Borneo, Java (E of Lembang, also Nusa Barung), Madura, Lesser Sunda Islands (Bali, Lombok, E. Sumbawa, Timor), Celebes, Philippines (Palawan, Luzon, Mindanao with Pujada I.), Moluccas (Ceram, Ambon, Halmaheira), New Guinea (Vogelkop). Fig. 18.

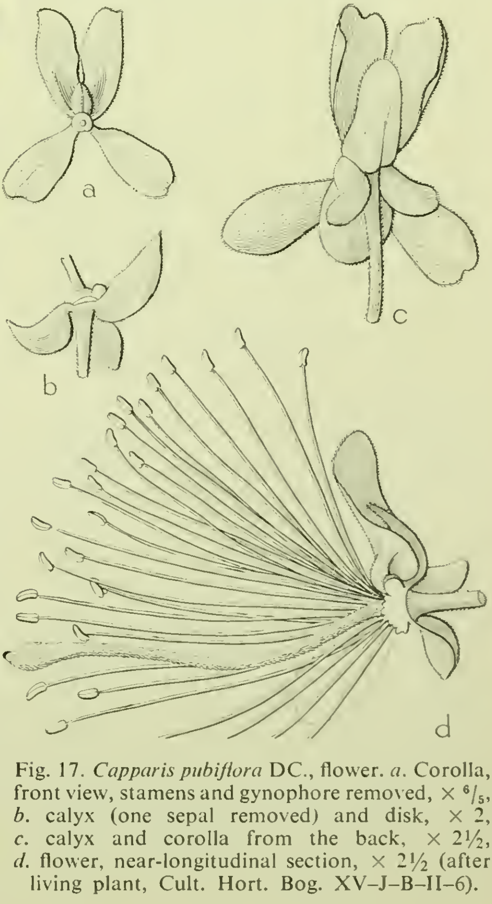


Fig. 17. *Capparis pubiflora* DC., flower. *a.* Corolla, front view, stamens and gynophore removed, × 6/5, *b.* calyx (one sepal removed) and disk, × 2, *c.* calyx and corolla from the back, × 2½, *d.* flower, near-longitudinal section, × 2½ (after living plant, Cult. Hort. Bog. XV–J–B–II–6).

Ecol. More or less dry places, such as hedges, roadsides, teak forests, brushwood, jungle, up to 400(–600) m. *Fl.* June–July, *fr.* March.

Vern. (*Daun*) *poka*, *saneg-sanegan*, Md, *djĕnggotan*, *waan-waanan*, J, *bangol bangol*, Bali; Minahasa: *maha-limu*, Ratahan, *malemo*, Tonsawang, *tutunean woring*, Tontemboan, *sahamuntei*; *wama pusu*, Halmaheira, *holiboi*, Mbo.

Notes. Some specimens from Sumatra and the Malay Peninsula, and generally those from Celebes, the Moluccas, and the Philippines, have markedly larger, obovate leaves; they cannot be distinguished taxonomically from the population in Java and the Lesser Sunda Islands.

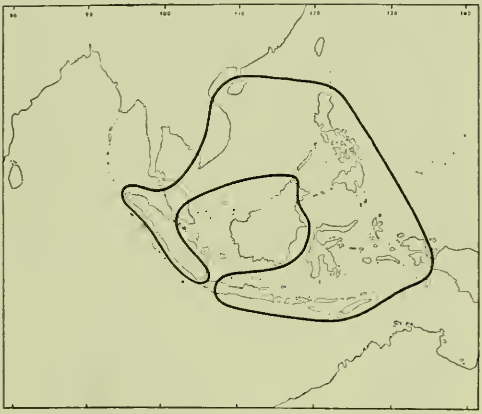


Fig. 18. Distribution of *Capparis pubiflora* DC.

C. MUELLER, *l.c.*, copied A. GRAY's name *C. cerasifolia* as *C. crassifolia*. PAX & HOFFMANN continued this mistake in a remarkable way when stating: "Die Ueberleitung zu den Philippinen bilden die 2 Arten der Sulu-Inseln: *C. cerasifolia* A. GRAY und *C. crassifolia* A. GRAY" (in E. & P. Nat. Pfl. Fam. ed. 2, 17b, 1936, 178).

15. Capparis pyrifolia LAMK, Encycl. Bot. 1 (1785) 606, *quoad* α; DC. Prod. 1 (1824) 246; DELESS. Ic. Pl. 3 (1837) t. 11; *non* W. & A. Prod. 1 (1834) 25, *quae est C. grandiflora* WALL. *ex* HOOK. *f.* & TH. — *C. acuminata* WILLD. Sp. Pl. 2 (1799) 1131; DC. Prod. 1 (1824) 247; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 178; BACK. Fl. Bat. (1907) 56; Voorl. (1908) 13; Schoolfl. (1911) 63; KOORD. Exk. Fl. Java 2 (1912) 293; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 7.—*C. zeylanica* (*non* L.) DC. Prod. 1 (1824) 247, *quoad specim. javan.*; W. & A. Prod. 1 (1834) 25.—*C. foetida* BL. Bijdr. 2 (1825) 52; MIQ. Fl. Ind. Bat. 1, 2 (1858) 99; GAGN. Fl. Gén. I.-C. 1 (1908) 184; CRAIB, Fl. Siam. En. 1 (1925) 80; GAGN. Fl. Gén. I.-C. Suppl. 1 (1939) 161.—*C. dasypetala* TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 322.—*C. oxyphylla* MIQ. Pl. Jungh. 4 (1855) 397; Fl. Ind. Bat. 1, 2 (1858) 100.—*C. horrida* (*non* L. *f.*) MIQ. Illustr. (1870) 34, *pro var.* α *pro parte et synon. C. foetida et C. oxyphylla.*

Shrub, sometimes climbing, 1½–2½(–3½) m; twigs straight, terete, with minute, stellate, ferruginous hairs, glabrescent; internodes 2–5 cm. *Thorns* patent, straight or slightly curved upwards, 1–3(–4) mm. *Leaves* on lateral branches mostly distichous, more or less firmly herbaceous, elliptic, when young with minute, stellate, fulvous-ferruginous indument giving it a farinaceous aspect, glabrescent, (1.2–)1.7–2.2(–3) times as long as wide, often ovate, sometimes obovate, 5–9½ (–15) by 2½–4½(–6½) cm; base rounded to blunt, top acuminate with a mostly blunt tip ½–1½ cm long; nerves yellow to light-brown, midrib sometimes sulcate above; nerves *c.* 5 pairs, veins reticulate; petiole *c.* ½ cm, densely greyish brown tomentellous. *Flowers* 2–4, serial. Pedicels (1–) 1½–2(–2½) cm, thin, densely hairy, glabrescent except for the somewhat broadened top. Buds globular, 4–5 mm diam. *Sepals* elliptic-ovate, 4–5 by 2½–4 mm, minutely hairy outside, 3-nerved, outer pair (especially the posterior one surrounding the disk) slightly larger and more obtuse than the inner. *Petals* elliptic to oblong, 6–8 by 2–4 mm, very thin, on both sides floccose-hairy, white tinged pale yellow, green, or violet, upper pair mostly slightly smaller than the lower pair, the base thickened with a mostly yellow-coloured, later red honey-guide. Disk bilobed, fleshy, roundish, up to 2 mm diam. *Stamens c.* 20, 15–23 mm long, filaments pale, anthers 1 mm, sordidly blue. *Gynophore* 18–20(–25) mm; ovary 1 by ¾ mm, stigma obtusely conical, ½ mm high, both glabrous. In fruit neither the pedicel, nor the gynophore much incrassate. *Fruit* about globular, 8–12 mm diam.; pericarp minutely rugose when dry, glossy, black when ripe (once reported red), glabrous. Seeds 2–6, 6 by 3–4 by 2 mm, smooth, glossy brown.

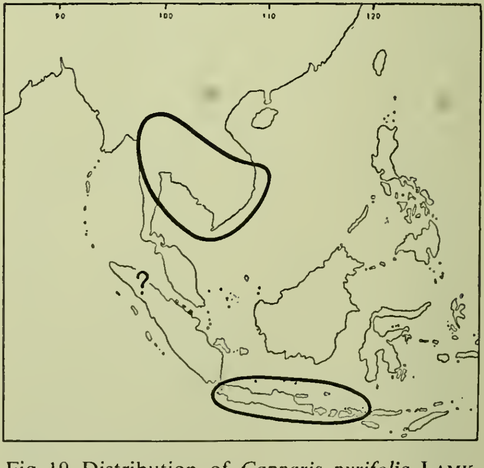


Fig. 19. Distribution of *Capparis pyrifolia* LAMK.

Distr. Siam, Indo-China (Annam, Cochinchina); in *Malaysia:* N. Sumatra (Laubalang?), Java, Kangean Arch., Madura, Lesser Sunda Islands (Bali, E. Sumbawa). Fig. 19.

Ecol. In the lowlands and hills in dry places, in teak forests, brushwood, hedges, on limestone hills, fairly common in Java, up to *c.* 850 m. *Fl.* especially Sept., no flowers collected Febr.–May; *fr.* July–Febr.

Vern. *Kaju tudjuh*, S, *gagahan*, *gĕdangan*, *kĕdĕling*, *lorowan*, *risini*, *tjantĕlan*, *waan-waanan*, *wan-uwanan*, J, *sanek*, *sanik-lakek*, Md, *kaloang-kaloangan*, *pokak-pokaän*, Kangean.

Uses. According to HEYNE (Nutt. Pl. 1927, 682) the white wood is sold in Djakarta as 'kaju tudjuh' against bile and stomach ache, and an extract of the rasped wood is taken against dizziness. Fruit once reported to be sweet and edible.

Notes. It cannot always easily be observed that the flowers are serial because the row is sometimes very short. This could lead to confusion with *C. pubiflora*, which is characterized, however, by the hairy gynophore and a fruit over 12 mm diam.

16. Capparis buwaldae JACOBS, *sp. nov.*

Glabra. Spinae stipulares breves, recurvatae. Folia ± *6 mm petiolata, oblongata, apice acute acuminata*; *costa nervique majores supra sulcati. Flores 2–4 in serie supraaxillare dispositi, minores*; *alabastra globosa acuta 3 mm diametro*; *pedicellus gynophoriumque fructiferum vix incrassatum. Fructus globosus vel ellipsoideus, umbonatus, 2–4 cm longus, irregulariter tuberculatus*; *semina majora.*

Typus: HALLIER *f.* 2573 (Bo, holotype; L, isotype).

Climbing shrub or liana, 2–15 m high, glabrous; twigs terete, slightly zig-zag; internodes 1–8 cm. *Thorns* recurved, 1–3 mm long, often wanting. *Leaves* firmly herbaceous, oblong, sometimes ovate or obovate, (2.2–)2.4–4(–5) times as long as wide, 6–13(–23½) by (1½–)2½–4½(–8) cm; base rounded to acute, top narrowed, acuminate, tip acute, often mucronulate, 3–20 mm long; midrib sulcate above; nerves (4–)6–9 pairs, conspicuously looped-arcuating; petiole 4–7(–10) mm. *Flowers* white, as a rule on slender, short, lateral twigs, serial, 2–4, supra-axillary. Pedicels slender, 1–3(–4) cm long, glabrous. Buds globular, acute, *c.* 3 mm diam. *Sepals* ovate, 3–5 by 2–3 mm, with a slightly thickened and more or less acute top, outer pair almost glabrous at the margins, inner pair slightly ciliate. *Petals* very thin, 4–6 by 2–3 mm, white, outside more pubescent than inside, often minutely ciliate. Disk bilobed, fleshy, 1 by 1½ mm. *Stamens* 20–30, *c.* 2 cm long. *Gynophore* 13–20 mm, ovary ellipsoid to globular, *c.* 1½ by ¾–1 mm, smooth, stigma ½ mm long, all glabrous. In fruit the pedicel hardly incrassate and the gynophore slightly so. *Fruit* orange or red, globular to ellipsoid, 3–5½ by 2½–3½ cm, shortly umbonate at the top and sometimes also at the base; pericarp woody to coriaceous, 2–3 mm thick, more or less tuberculate. Seeds ∾, embedded in whitish pulp, 10 by 6–8 by 5–6 mm, smooth, brown.

Distr. *Malaysia:* throughout Borneo (also P. Laut).

Ecol. Forests, jungle, along rivers, from the lowland up to *c.* 1600 m. *Fl. fr.* Jan.–Dec.

Vern. *Dunggol manok*, Sarawak.

Uses. Two collectors mention the fruit(pulp) to be edible.

Note. In vegetative characters much resembling *C. micracantha ssp. korthalsiana* but distinguished by the recurved thorns, the narrower leaves with long and slender tip, and the nerves being more prominent towards the margin.

17. Capparis cucurbitina KING, J. As. Soc. Beng. 58, ii (1889) 395; Ann. R. Bot. Gard. Calc. 5 (1896) 119, t. 136; RIDL. Fl. Mal. Pen. 1 (1922) 124.

Scandent, 6–10 m high; twigs slightly zig-zag, (nearly) glabrous; internodes *c.* 2 cm. *Thorns* recurved, 2–3 mm long, sharp. *Leaves* herbaceous, obovate, *c.* 2½ times as long as broad, glabrous, *c.* 9–18½ by 3½–7½ cm; base generally rather abruptly rounded and acute, top rounded and rather abruptly acuminate, tip narrow and acute, 1–1½ cm; midrib above sulcate in the basal part; nerves 6–8 pairs, thinly subprominent above, reticulations distinct on both sides; petiole ½–¾ cm. *Flowers* in mature state unknown, pale green, yellow inside, 2–3, serial. Pedicels 2–3 cm. Buds ovoid, acute, 4 mm long. *Sepals* ovate-lanceolate, acuminate. *Petals* broadly elliptic, obtuse. *Stamens c.* 20. In fruit neither the pedicel nor the torus incrassate, the *gynophore* 11–17 mm, slightly thickened, obviously articulated with the fruit. *Fruit* irregularly spindle-shaped, (3½–)5½–7½ by 1½–2½ cm, the base slightly acuminate-tapering, the top umbonate; pericarp 1 mm thick, leathery, yellow to glossy orange. Seeds ∾, ovoid, 9 by 7 by 7 mm.

Distr. *Malaysia:* Malay Peninsula (Perak), few collections.

Ecol. Dense mixed lowland jungle, up to 200 m.

Notes. The only flowering material which we have is KING's Coll. 8824 (CAL). Contrary to KING I found the sepals not puberulous but glabrous.

Differs vegetatively from *C. micracantha ssp. korthalsiana* in that the leaves of the latter are much coarser, and thicker, while in *C. cucurbitina* the leaf tip is longer and more slender.

18. Capparis micracantha DC. Prod. 1 (1824) 247.

KEY TO THE SUBSPECIES

1. Ripe fruit (sub)globular. Stamens *c.* 20–35(–60). Sepals mostly obtuse . . *ssp.* **micracantha**
1. Ripe fruit elongate, acute. Stamens 60–100. Sepals acute to acuminate. West Malaysia. *ssp.* **korthalsiana**

ssp. **micracantha**.—*C. micracantha* DC. Prod. 1 (1824) 247; BL. Bijdr. 2 (1825) 52; SPRENG. Syst. Veg. 4, 2 (1827) 204 (*micrantha*, *sphalma*, *non* A. RICH.); MIQ. Fl. Ind. Bat. 1, 2 (1858) 99; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 179; KURZ, J. As. Soc. Beng. 43, ii (1874) 31; RADLK. Sitz.

Ber. Bayer. Ak. Wiss. 14 (1884) 118, 128; VIDAL, Rev. Pl. Vasc. Filip. (1886) 47; KING, J. As. Soc. Beng. 58, ii (1889) 394; PAX in E. & P. Pfl. Fam. 3, 2 (1891) 231; BRANDIS, Ind. Trees (1906) 36; MERR. Philip. J. Sc. 1 (1906) Suppl. 58; BACK. Fl. Bat. (1907) 57, *incl. var. callosa* (BL.) HALL. *f.*; GAGN. Fl. Gén. I.–C. 1 (1908) 186; BACK. Schoolfl. (1911) 63; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 68; HALL.*f.* Med. Rijksherb. 12 (1912) 18; KOORD. Exk. Fl. Java 2 (1912) 293; MERR. Fl. Manila (1912) 215; Sp. Blanc. (1918) 160; RIDL. Fl. Mal. Pen. 1 (1922) 123, f. 11; W. H. BROWN, Min. Prod. Philip. For. 2 (1921) 282; MERR. En. Philip. 2 (1923) 212; PARKINS, For. Fl. Andam. (1923) 82; GEERTS–RONNER, Trop. Natuur 13 (1924) 167, f. 8; CRAIB, Fl. Siam. En. 1 (1925) 82; MERR. Philip. J. Sc. 29 (1926) 371; GAGN. Fl. Gén. I.–C. Suppl. 1 (1939) 162; CORNER, Ways. Trees (1940) 180, f. 47; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 7; QUIS. Med. Pl. Philip. (1951) 339.—*C. billardierii* DC. Prod. 1 (1824) 247; MIQ. Fl. Ind. Bat. 1, 2 (1858) 99.—*C. callosa* BL. Bijdr. 2 (1825) 53; MIQ. Fl. Ind. Bat. 1, 2 (1858) 99; Illustr. (1870) 29, t. 16; NAVES in Blanco, Fl. Filip. ed. 3 (1877–83) t. 180; RADLK. Sitz. Ber. Bayer. Ak. Wiss. 14, 1 (1884) 131; K. & V. Bijdr. 4 (1896) 262; KOORD. Gedenkb. Jungh. (1910) 167.—*C. flexuosa* BL. Bijdr. 2 (1825) 53; *non* L., *nec* VELLOZO; HASSK. Pl. Jav. Rar. (1848) 178; MIQ. Analecta 3 (1852) 1; Fl. Ind. Bat. 1, 2 (1858) 98; Illustr. (1870) 30; RADLK. Sitz. Ber. Bayer. Akad. Wiss. 14, 1 (1884) 101, 129.—*C. odorata* BLANCO, Fl. Filip. (1837) 439, ed. 2 (1845) 305, ed. 3, 2 (1878) 201; FERN.–VILL. Nov. App. (1880) 11; MERR. Philip. J. Sc. 3 (1908) Bot. 77.–*C. forsteniana* MIQ. Illustr. (1870) 32, t. 18, *excl. syn. C. ovalifolia* ZIPP., *quae est C. zeylanica* L.; HALL. *f.* in Koord. Minah. (1898) 343.—*C. roydsiaefolia* KURZ, J. As. Soc. Beng. 39, ii (1870) 62.—*C. myrioneura* HALL. *f.* in Fedde, Rep. 2 (1906) 60, *p.p.*, *excl.* KOORD. 16341, *excl. var. latifolia*.—*C. venosa* MERR. Philip. J. Sc. 10 (1915) Bot. 305, *ex descr.*; En. Philip. 2 (1923) 213.

Stout shrub or small tree, rarely climbing, 2–6(–10) m; trunk greyish, finely fissured and set with small knobs each surmounted by a thorn; branchlets terete, mostly zig-zag, when young sparsely pubescent; internodes *c.* 2½–4 cm. *Thorns* 2–4(–7) mm long, patent or directed upwards, straight or slightly curved. *Leaves* (sub-) coriaceous, glabrous, 1.7–2.9(–4.1) times as long as wide, mostly broadest about halfway, sometimes below, or rarely above the middle, 8–18(–24) by 4–8(–12½) cm; base mostly rounded, sometimes blunt to subcordate or acute, top broader or narrower rounded, sometimes slightly emarginate, or acute, rarely acuminate, dark-tipped; midrib subprominent above, nerves 5–7(–10) pairs, light green when dry; petiole 6–10(–15) mm. *Flowers* up to 6, serial. Pedicels 1(–2) cm. Buds ellipsoid, acute, 5–12 mm long. *Sepals* firmly herbaceous, 5½–13 by 2½–5½ mm, ± boat-shaped, ovate to oblong, the margins mostly hairy. *Petals* very thin, oblong to lanceolate, 10–25 by 3–7 mm, white, honey-guide yellow, turning dark red or brownish, or dark violet. Disk bilobed, *c.* 1 mm. *Stamens* *c.* 20–35(–60); filaments 18–30 mm, white; anthers 1½–2½ by ½ mm, grey or bluish. *Gynophore* 15–30(–35) mm, ovary ovoid to ellipsoid, *c.* 3 by 2 mm, both glabrous, sometimes vestigial. In fruit the gynophore 4–6 mm diam., the pedicel thinner. *Fruit* globular to ellipsoid, with 4 longitudinal sutures, 3–6½ by 3–4½ cm, yellow, orange, or red; pericarp smooth, 2 mm thick, when dry woody-coriaceous, pulp juicy. Seeds *c.* 6–8 by 4½–7 by 3–5 mm, red to shiny black, smooth.

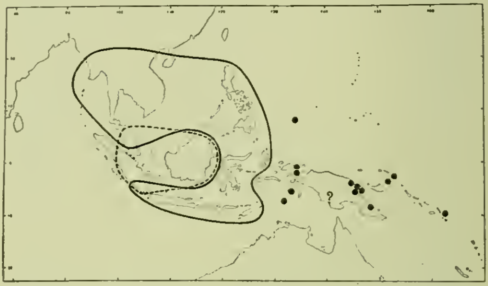


Fig. 20. Distribution of *Capparis micracantha* DC. *ssp. micracantha* (continuous line, add Formosa) and of *ssp. korthalsiana* (MIQ.) JACOBS (broken line). Localities of *C. zippeliana* MIQ. (dots).

Distr. Burma, Siam, Indo-China, S. China, Formosa (a variety), Hainan, Andamans, in *Malaysia:* S. Sumatra, Malay Peninsula (except in the S. corner), Java (in W only a few coastal localities, also Prinsen I., Nusa Kembangan), Madura, Kangean Arch., Lesser Sunda Islands (Bali, Lombok, E. and W. Sumbawa, W. Flores, Komodo, Alor, Timor, Wetar), North Borneo (also Banguey), throughout the Philippines, Celebes, Moluccas (Halmaheira). Fig. 20.

Ecol. Especially in light shade (monsoon, teak, or evergreen forest) on dry, often calcareous soil, also in thickets, savannahs, hedges, *etc.*, not seldom coastal, mostly below 500 m, highest record 1400 m. *Fl. fr.* Jan.–Dec.

Anat. RAGHAVAN investigated the vascular supply of the floral parts in a '*C. flexuosa*' from Java, cultivated at Kew (the plant was no longer living in 1959) (J. Linn. Soc. Bot. 52, 1939, 247).

MOLISCH stated that nearly all the parenchyma cells of the petiole, the leaves, and the stem contain a strongly refractive crystal of lime. Also bodies of silicon are sometimes found (Ber. Deut. Bot. Ges. 34, 1916, 154–160).

Note. *C. billardierii*, *C. flexuosa*, and *C. roydsiaefolia* have been described on specimens with a vestigial gynophore and ovary. RADLKOFER's *sect. Monostichocalyx* comprised *C. flexuosa* BL., *C. callosa* BL., and *C. micracantha* DC. which are in my opinion all synonyms.

ssp. **korthalsiana** (MIQ.) JACOBS, *stat. nov.*—*C. korthalsiana* MIQ. Illustr. (1870) 31, t. 17; MERR. En. Born. Pl. (1921) 280.—*C. finlaysoniana* WALL. [Cat. (1832) 6992 B, *nomen*] *ex* HOOK. *f.* & TH.

Fl. Br. Ind. 1 (1872) 179; KING, J. As. Soc. Beng. 58, ii (1889) 395; RIDL. Fl. Mal. Pen. 1 (1922) 124; Kew Bull. (1925) 77.

Fruit oblong, c. 6–17 by 2½–3¾ cm, tapering to the top and sometimes to the base. *Leaves* acuminate, not mucronate, mostly recurved, never cordate at the base. *Sepals* very acute and slightly cucullate at the top, the buds therefore (sub-) acuminate. *Flowers* comparatively large. *Stamens* very numerous (up to 100).

Distr. *Malaysia:* Malay Peninsula (Perak, Pahang, Johore, Singapore), Central and S. Sumatra, Borneo. Nowhere common. Fig. 20.

19. Capparis zeylanica LINNÉ, Sp. Pl. ed. 2 (1762) 720; DC. Prod. 1 (1824) 247, *quoad specim. Ceyl.*; DUNN, Kew Bull. (1916) 62; *non* HOOK. f. & TH. Fl. Br. Ind. 1 (1872) 174, *quae est C. brevispina* DC. — *C. horrida* L. *f.* Suppl. (1781) 264; DC. Prod. 1 (1824) 246; WIGHT, Ic. Pl. Ind. Or. 1 (1839) t. 173; MIQ. Illustr. (1870) 34, *quoad var. β erythrodasys*; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 178; FERN.-VILL. Nov. App. (1880) 11; VIDAL, Rev. Pl. Vasc. Filip. (1886) 48; MERR. Philip. J. Sc. 1 (1906) Suppl. 58; GAGN. Fl. Gén. I.-C. 1 (1908) 185; BACK. Schoolfl. (1911) 63; RIDL. J. Str. Br. R. As. Soc. *n.* 59 (1911) 69; KOORD. Exk. Fl. Java 2 (1912) 294; MERR. Fl. Manila (1912) 215; Sp. Blanc. (1918) 159; W. H. BROWN, Min. Prod. Philip. For. 2 (1921) 282; MERR. En Philip. 2 (1923) 211; CRAIB, Fl. Siam. En. 1 (1925) 81; GAGN. Fl. Gén. I.-C. Suppl. 1 (1939) 161; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 8; QUIS. Med. Pl. Philip. (1951) 338.—*C. dealbata* DC. Prod. 1 (1824) 246; DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 426; Herb. Timor. Descr. (1835) 98; SPAN. Linnaea 15 (1841) 165; MIQ. Fl. Ind. Bat. 1, 2 (1858) 100; Illustr. (1870) 27.—*C. zeylanica* (*non* L.) ROXB. Fl. Ind. ed. CAREY 2 (1832) 567; GAMBLE, Fl. Pres. Madras 1 (1915) 18.—*C. aurantioides* PRESL, Reliq. Haenk. 2 (1835) 86; GRAY, U.S. Expl. Exp. Bot. 1 (1854) 70; FERN.-VILL. Nov. App. (1880) 11.—*C. linearis* (*non* JACQ.) BLANCO, Fl. Filip. (1837) 438, ed. 2 (1845) 305, ed. 3, 2 (1878) 200.—*C. nemorosa* (*non* JACQ.) BLANCO, Fl. Filip. (1837) 438.—*C. micracantha* (*non* DC.) BLANCO, Fl. Filip. ed. 2 (1845) 305, ed. 3, 2 (1878) 200, t. 188.—*C. rufescens* TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 321.—*C. erythrodasys* MIQ. Pl. Jungh. (1855) 397; Fl. Ind. Bat. 1, 2 (1858) 99.—*C. ovalifolia* ZIPP. *ex* MIQ. Illustr. (1870) 33.—*C. viminea* (*non* HOOK. *f.* & TH.) FERN.-VILL. Nov. App. (1880) 11.—*C. myrioneura var. latifolia* HALL. *f.* in Fedde, Rep. 2 (1906) 61.—**Fig. 5.**

Climbing shrub 2–5(–10) m. Innovations brown-red to greyish-tomentose; branchlets mostly zigzag, glabrescent; internodes 2–7 cm. *Thorns* recurved, 3–6 mm long. *Leaves* subcoriaceous, (1.2–)1.7–2.3(–2.9) times as long as broad, ovate or elliptic, rarely obovate, above soon glabrescent then glossy, beneath later or not glabrescent, and dull, 4–10(–18) by 3–5½(–9) cm; base rounded, sometimes subcordate, rarely acute, top acute to rounded, rarely slightly acuminate, generally with a recurved, stiff, darker mucro up to 3 mm; midrib subdepressed above; nerves 3–8 pairs; petiole ½–1½(–2) cm, glabrescent. *Flowers* developing before the leaves on young twigs, conspicuous, 2–6, serial. Pedicels 4–20(–28) mm, hairy. Buds globular, c. 8 mm diam. *Sepals* subcoriaceous, outside more or less densely tomentellous, outer pair orbicular to elliptic, mostly acute, 6–11 by 5–9 mm, the posterior one (surrounding the disk) the largest; inner pair elliptic to oblong with more rounded top, 6–10 by 3–7 mm. *Petals* very thin, oblong with rounded top, 9–12(–16) by 3½–5 mm, white, turning pink, largely glabrous; upper pair with a pinkish to reddish basal-median spot, hairy at the base. Disk c. 1 mm diam. *Stamens* 30–45(–70), 20–30(–35) mm, white, turning red; anthers oblong, slightly broader at the base, c. 2 by 1 mm, bluish grey. *Gynophore* slightly exceeding the stamens, up to 4½(–5½) cm, basal part pale pubescent, otherwise glabrous; ovary ellipsoid, 1½–2½ by 1–1½ mm, stigma ½ mm long. In fruit the pedicel sometimes still hairy, gynophore glabrous, up to 5½ cm by 3–6 mm, as thick as the pedicel. *Fruit* globular to ellipsoid, up to 5 by 4 cm, pericarp c. 2 mm thick, woody-coriaceous, smooth, reddish, orange or purple. Seeds ∞, 5–7 by 5–4½ mm, brown.

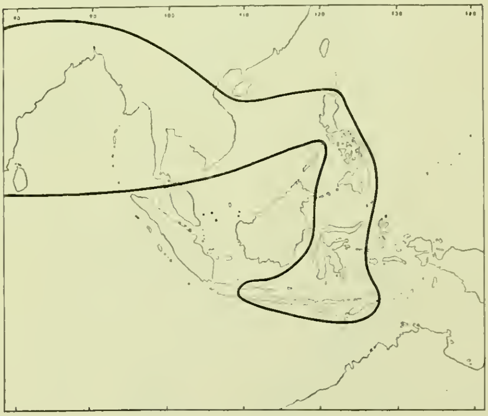


Fig. 21. Distribution of *Capparis zeylanica* L. in Malaysia. Add Hainan.

Distr. Ceylon, India (largely E of the line Bombay-Delhi-Dehra Dun, S of the Himalaya), Burma, Siam, Indo-China, Hainan, Andaman Islands, in *Malaysia:* Java (east of Djokjakarta), Lesser Sunda Islands (Lombok, Sumbawa, Semau. Timor), Celebes (also Salajar I.), Philippines (Mindoro, Luzon, Mindanao, Sulu Arch.). Uncommon in Indonesia, common in the Philippines. Fig. 21.

Ecol. Forest edges, bushes, savannahs, hedges, limestone hills, obviously bound to seasonal climatic conditions, mainly in the lowlands, up to 700 m. *Fl. fr.* Jan.-Dec.

Uses. Of less importance; see QUIS. *l.c.*

Vern. Philippines: *Manunggal laláki*, Mindoro, *baraláuik*, Ibn., *dauag*, *halubágat-báging*, Tag., *laginau*, Bis., *talakták*, *tarabtáb*, Ilk.

Fig. 22. *Capparis quiniflora* DC. *a*. Flowering branch, × 2/3, *b*. flower from the back, × 2, *c*. fruit, × 2/3, *d–e*. narrow leaves, × 2/3 (*a–b* SPECHT 697 from N. Austr., *c* JAHERI 238, *d* ELBERT 3827, *e* SOEHANDA exp. DE JONG 272).

Note. From *C. pyrifolia* and *C. micracantha* easily distinguished by the recurved thorns.

20. Capparis quiniflora DC. Prod. 1 (1824) 247; BENTH. Fl. Austr. 1 (1863) 94; F. v. M. Descr. Not. Pap. Pl. 1[1] (1875) 5; BAILEY, Queensl. Fl. 1 (1899) 57; LAUT. Bot. Jahrb. 52 (1914) 112; DOMIN, Bibl. Bot. Heft 89 (1925) 685.—*C. trapeziflora* SPAN. Linnaea 15 (1841) 165; MIQ. Fl. Ind. Bat. 1, 2 (1858) 99.—*C. subcordata* SPAN. Linnaea 15 (1841) 166; MIQ. Fl. Ind. Bat. 1, 2 (1858) 99; Illustr. (1870) 34.—*C. richii* A. GRAY, U.S. Expl. Exp. Bot. 1 (1854) 69; SEEM. Fl. Vit. (1865) 6.—**Fig. 22.**

Climbing shrub; twigs slightly zig-zag, densely minutely grey or ferruginous-tomentose, sometimes glabrescent; internodes up to 9 cm. *Thorns* recurved, *c.* 1–2(–3) mm, sharp, sometimes wanting, especially on flowering twigs. *Leaves* subcoriaceous to coriaceous, often brownish green when dry, ovate to (rarely) obovate, 1.6–4.3 times as long as wide, initially densely minutely ferruginous-tomentose, soon glabrescent and glossy above, (5½–)7–9(–12) by 1¾–4(–7½) cm; base rounded, subcordate, blunt, or acute, top mostly attenuate and acuminate, rarely blunt, acumen up to ½ cm, acutish with a minute, thickened mucro; midrib flat to shallowly sulcate above; nerves 6–8(–11) pairs under an angle of *c.* 45°; intermediate veins often wanting, reticulations distinct; margin sometimes crinkled; petiole 5–17 mm, hairy as the twigs. *Flowers* white, serial, sometimes developing before the leaves at the end of young twigs, 2–10 in a row 2–12 mm long, pedicels 6–17 mm, hairy as the twigs, finally glabrescent; floral leaves sometimes abortive. Buds *c.* 4 mm diam. *Sepals* herbaceous, acute, ferruginous-tomentellous outside, outer pair *c.* 4–5 by 2–3 cm, the inner pair narrower and flattish. *Petals* ovate to elliptic, 5–7 by 2–4 mm, slightly unequal, puberulous on both sides. Disk up to 1 mm long. *Stamens* 7–8(–12), filaments 20–27 mm. *Gynophore* 2–2½ cm but sometimes abortive and only a few mm, glabrous or glabrescent at the base; ovary ovoid, *c.* 1½ by 1 mm, stigma knob-shaped. Pedicel, torus, and gynophore slightly incrassate. *Fruit* (sub)globular, *c.* 2–2¾ by 2–2½, pericarp corky-leathery, *c.* 1½–2½ mm thick, with small scattered warts. Seeds ∞, up to 7–8 by 5–6 by 4 mm.

Distr. Pacific (Fiji and New Caledonia), North Australia to Cape York Peninsula, in *Malaysia:* SE. Celebes, Lesser Sunda Islands (Lombok, Sumbawa, Flores, Semau, Timor), Moluccas (Kai and Tanimbar Is), New Guinea (NW. part; Papua; islands in Torres Strait). Fig. 7.

Ecol. Prefers obviously coastal habitats in drier areas, rambling on shore trees, bound to a seasonal climate, in the lowland.

Notes. Although in fertile material the leaves are variable in shape, the venation (see fig. 22a, d–e) is constant and very characteristic.

The Australian specimens are much more uniform in leaf index than those of Malaysia, where it does not exceed 1.8.

In the material described by A. GRAY from Fiji as *C. richii* the leaf-shape is remarkably variable, one specimen having the average leaf-index, the second having leaves 9½–11 by 1½–1¾ cm, the third having linear leaves *c.* 4–10 cm by 1–4 mm. In West Flores a similar, also sterile linear-leaved specimen was collected (SOEHANDA, exp. DE JONG 272, Bo, K, L); its thorns are strongly recurved, 1–3 mm, the leaves measure 4–10 by 0,1–0,4 cm. As I observed in several other species of *Capparis* such sterile shoots have larger thorns than the fertile twigs. Might it be that such shoots have been developed under exceptionally dry weather conditions?

The only collection from Bali is a duplicate specimen from Bogor in Paris with a ZOLLINGER label "Leg. Teysmann, Balie, Buleling". As no other sheets were seen from Bali, the location seems to be erroneous.

21. Capparis larutensis KING, J. As. Soc. Beng. 58, ii (1889) 393; Ann. R. Bot. Gard. Calc. 5 (1896) 118, t. 134; RIDL. Fl. Mal. Pen. 1 (1922) 122.

Climber, 10–13 m. Twigs straight, brown-puberulous, more or less glabrescent; internodes 1–2 cm. *Thorns* vigorous, recurved, 3–4 mm long, glabrous, with darker, glossy, very sharp top. *Leaves* firmly herbaceous to subcoriaceous, oblong, sometimes slightly obovate, glabrous, 2–3½ by ¾–1¾ cm, base acute to subcordate, top obtuse to acuminate, tip finely retuse; midrib narrowly sulcate above; nerves 4–5 pairs, hardly visible; margin somewhat recurved when dry; petiole 3–6 mm, brown-pubescent. *Flowers* axillary. Pedicel 1½–2 cm, glabrous. *Sepals* fleshy, 7 by 5 mm, ciliate towards the top, the outer pair ovate, the inner pair suborbicular. *Petals* obovate, *c.* 8 by 5 mm, white then pink, puberulous inside. *Stamens* (10?–)30, 2½ cm, anthers 2 mm long. Torus 2 mm broad. *Gynophore* 3½–4 cm; ovary ovoid, *c.* 1½ mm long. Mature *fruit* unknown, at least 13 by 10 mm, globose, umbonate. Seeds several.

Distr. *Malaysia:* Malay Peninsula (Perak, Selangor).

Ecol. Dense jungle, clinging to trees, below 200 m. *Fl.* Sept., Nov.

22. Capparis spinosa LINNÉ, Sp. Pl. 1 (1753) 503; HEMSL. Bot. Chall. 3 (1885) 120 (*var.*).

var. **mariana** (JACQ.) K. SCH. Bot. Jahrb. 9 (1888) 201; K. SCH. & LAUT. Fl. Schutzgeb. (1901) 335; LAUT. Bot. Jahrb. 52 (1915) 111.—*C. cordifolia* LAMK, Encycl. 1 (1785) 609; MERR. Philip. J. Sc. 7 (1912) Bot. 235; Fl. Manila (1912) 216; Sp. Blanc. (1918) 159; En. Philip. 2 (1923) 210; DE VOOGD, Trop. Natuur 25a (Jub. Uitg.) (1936) 72, f. 9; MERR. Philip. J. Sc. 9 (1914) Bot. 84.—*C. mariana* JACQ. Hort. Schoenbr. 1 (1797) 57, t. 109; DC. Prod. 1 (1824) 245; DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 426; Herb. Timor. Descr. (1835) 98; SPAN. Linnaea 15 (1841); BLANCO, Fl. Filip. ed. 2 (1845) 305; MIQ. Fl. Ind. Bat. 1, 2 (1858) 100; TEYSM. Nat.

Tijd. N.I. 34 (1874) 359; NAVES in Blanco, Fl. Filip. ed. 3, 2 (1878) 201, t. 179; FERN.–VILL. Nov. App. (1880) 11; SAFFORD, Contr. U.S. Nat. Herb. 9 (1905) 212; BURK. Dict. 1 (1935) 443.—*C. sandwichiana* DC. Prod. 1 (1824) 245; A. GRAY, U.S. Expl. Exp. Bot. 1 (1854) 69; DEGENER, Fl. Hawaii. 1 (1937) fam. 142, with plate.—*C. baducca* (*non* L.) BLANCO, Fl. Filip. (1837) 438. —**Fig. 23–24.**

Tree? or shrub, mostly prostrate. Twigs terete, mostly zig-zag; internodes 1–3 cm; innovations whitish-tomentose, glabrescent. *Thorns* wanting in Mal.. *Leaves* suborbicular, rarely elliptic, often ovate, (1½–)2½–6(–7½) cm diam., subcoriaceous (fleshy when fresh); base truncate to rounded, top rounded, seldom minutely emarginate to acute; midrib above shallowly depressed in the basal part, otherwise flat; nerves *c.* 5–7 pairs, thin, subprominent on both surfaces; petiole ¾–1¼ cm. *Flowers* axillary. Pedicel 4½–7½ cm, glabrescent. Buds conical when young, later bulging at the posterior base, sometimes acuminate, finally 2–2½ cm diam. *Sepals c.* 25–28 mm long, fulvously pubescent towards the base, glabrescent, ovate, outer pair 8–18 mm wide,

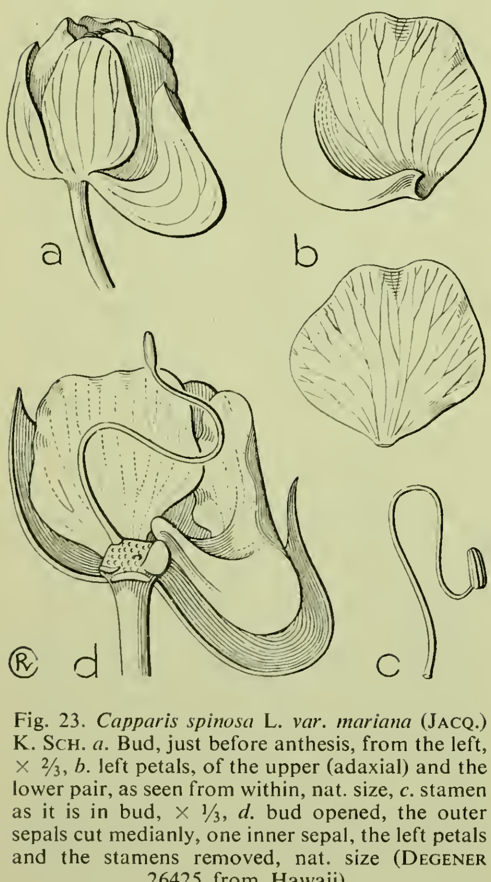


Fig. 23. *Capparis spinosa* L. *var. mariana* (JACQ.) K. SCH. *a.* Bud, just before anthesis, from the left, × ⅔, *b.* left petals, of the upper (adaxial) and the lower pair, as seen from within, nat. size, *c.* stamen as it is in bud, × ⅓, *d.* bud opened, the outer sepals cut medianly, one inner sepal, the left petals and the stamens removed, nat. size (DEGENER 26425 from Hawaii).

the posterior one the larger and strongly saccate, sometimes slightly keeled, inner pair equal, slightly larger than the outer pair, 11–20 mm wide, with broad-membranous margin. *Petals* pure white, sometimes slightly emarginate, upper pair more or less rhomboid, (3–)3½–4½ by 2–4 cm, with thick fleshy base, lower pair 3–3½ by 1½–1¾(–3¼) cm. Torus conical, 4–5 mm broad, the disk *c.* 4 by 5 mm. *Stamens* more than 100, white, 4½–5 cm, anthers 4 by ¾ mm, brownish. *Gynophore* 6–7 cm, subpubescent towards the base; ovary oblong, 5–8 by 1–2 mm, glabrous. In fruit the gynophore incrassate until it is as thick as the pedicel, and sometimes coiled as a pig's tail. *Fruit* ellipsoid to spindle-shaped, *c.* 5 by 1½ cm, narrowed towards the apex, with 5 nerves. Seeds ∞, subglobular, *c.* 4 mm through.

Distr. Scattered over the Pacific within the quadrangle formed by the Sandwich Is, Marianas (Guam), Solomon Is, and Henderson I. (ENE of Pitcairn, 24°20′S, 128°20′W), NW. Australia (once coll.); a different form of the species in Australia (see notes), in *Malaysia:* Lesser Sunda Islands (Semau, Timor, Leti, *n.v.*), Philippines (Luzon, cultivated in a few localities; Bohol, spontaneous along the sea-shore), New Ireland, and New Britain (*n.v.*).

C. spinosa, the well-known caper bush, has a wide distribution from the Mediterranean through the Near East to India (Sind and the Punjab). Several varieties have been distinguished, *cf.* BOISSIER (Fl. Orient. 1, 1867, 420).

Ecol. Prefers semi-arid or seasonal conditions, dry lavas, limestone, coastal stations, *etc.* A noctiflorous species, in the lowland up to *c.* 350 m.

In Timor and locally in the Philippines obviously quite capable of maintaining itself in suitable places and thoroughly naturalized (*vide infra*). It can be propagated by suckers or seed.

Vern. *Alcaparras*, Philippines, *acapares*, Guam, both corruptions of the Spanish *alcaparro*.

Uses. In Malaysia none. According to SAFFORD, *l.c.*, it appeared from the archives at Agaña in Guam that some of the early governors of Guam exported the pickled unripe capsules in considerable quantities, employing the natives to gather them. This is at variance with the common habit of pickling the flower buds, and probably the latter were meant. From Guam the plant would have been introduced into the Philippines.

Notes. The Malaysian and Pacific population is markedly uniform in appearance and has a coherent area, taxonomically and geographically well separated from the population in India, where it occurs eastwards to about 90° E long. It is absent between India and Timor.

Many paramorphs have been described in *C. spinosa*. The *var. mariana* is distinct by a combination of the following characters: twigs unarmed, not too densely tomentose and glabrescent, leaves comparatively large and orbicular, lacking an apical spine, flowers very large with one saccate sepal. *Capparis galeata* FRESEN. of Arabia and E. Africa has similar flowers, the odd sepal being even more irregularly shaped, but this plant has strong stipular thorns and an apical leaf-spine.

The species is taxonomically widely different from all native *Capparis* in Malaysia and Australasia and it had and has a distinctly economic significance in the Mediterranean. From this it appears probable that the species was introduced in the Indo-Pacific as a cultigen in post-Columbian time. The first records from the Pacific-E. Malaysian area are:

Marianas, *via* SONNERAT[1] between 1774 and 1781,

Sandwich Is, MENZIES, Vancouver Exp. 1792,

Timor, CUNNINGHAM, 1818,

Society Is, BEECHEY's Voyage, 1826,

Philippines, BLANCO, before 1837.

The dates of this list are significant, because it appears clearly that it had not been collected during the earliest Pacific expeditions such as 'Cook's Voyages' and the 'Boudeuse et l'Etoile', 1768–1770, on which such trained botanists collected as BANKS, SOLANDER, the FORSTERS, COMMERSON, *etc.*, who did not discriminate between cultivated, introduced, and native plants, as MERRILL rightly observed in his account of Cook's Voyages (Chron. Bot. 14, 1954, 173). They travelled widely in Central Polynesia, but did not visit Guam and the northern islands. Obviously the species was then not in Central Polynesia.

Its spreading in the Pacific, notwithstanding its use, and its early abundance in Guam, must have taken more than a century, because already onwards of 1520 there had been a connection by Spanish ships between Acapulco in West Mexico (from where, however, the species is not known) and Manila via Guam in the Marianas; the regular galleon route was initiated, for return voyages, in 1565, with 1–2(–3) ships yearly in either direction, to be abandoned in 1815 (MERRILL, *l.c.* 193). It is remarkable that the species has never been reported from Mexico.

In this respect it appears significant that the earliest record from the Pacific, 1774–1784, is from the Marianas, from where is also the very early record of its being cultivated and exported.

In the Philippines there is the indication that it has been imported there from Guam.

RUMPHIUS makes no mention of it, though he frequently referred to plants from islands outside the Moluccas proper.

In Timor there is no indication of such import, but it is not far-fetched to assume its introduction by the Portuguese. One may question why it has not further spread in arid places in East Malaysia and the Lesser Sunda Islands. It may well be that the capers, this well-known delicacy to Mediterranean people, did not appeal to the native taste and were therefore not further dispersed.

In conclusion, there remains hardly any doubt of its introduction at an early date from presumably seeds from the Mediterranean into the Marianas and dispersal by man from thence into E. Malaysia and Polynesia, as suggested by HEMSLEY, *l.c.*

It seems likely that introduction took place once only, because of the variability pattern of the species: repeated introduction would presumably have caused a greater variation of the population.

Fig. 24. *Capparis spinosa* L. *var. mariana* (JACQ.) K. SCH. Flower (VAN DER PIJL).

In addition it should be stated that the species occurs also on the west coast of Australia and in Queensland, from where it has been described as *C. nummularia* DC., a name also taken up by BENTHAM. It has, probably rightly, been reduced to *C. spinosa* by F. v. MUELLER (Syst. Cens. Austr. Pl. 1882, 5; 2nd ed. 1889, 8) and considered to represent a variety of *C. spinosa* by F. M. BAILEY (*var. nummularia* (DC.) F. M. BAILEY, Syn. Queensl. Pl. 1883, 15). It has even been found in arid places in Central Australia. The Australian plants look hardly different from those of the Mediterranean and they are distinctly thorny. But there is one specimen from NW. Australia (PRITZEL 284) which matches the Polynesian material. For this reason it seems likely that the Australian form is an introduction which took place independently from that in the Pacific. As a

(1) LAMARCK stated to have received his material from SONNERAT, but the latter never visited the Marianas (see vol. 1, p. 494). He attached himself, however, to COMMERSON and worked with him for three years in Mauritius, Bourbon, and Madagascar. JACQUIN also described the plant from the Marianas but did not mention the collector's name. Therefore it remains obscure who brought plants or seeds from the Marianas; it was obviously not brought by some early botanical explorer. But the seeds may have been derived from the Spanish export from Guam and have been cultivated in Mauritius where SONNERAT obtained his specimens.

matter of fact the case of the rather early record of this European or West Asian plant in Australia is matched by some other examples. In all these cases the Australian population is (mostly slightly) deviating and Dr VAN STEENIS has suggested this convivial or racial differentiation to be due to the effect of selection through isolation (this Flora I, 4, 1949, lii). Different imports of a cultigen will likely lead to slightly different racial development.

How the introduction in Australia has taken place is dubious; it could be surmised that occasionally ships or life-boats thrown out of their way touched these coasts or that they resulted from ship-wrecks. There may have been more than one introduction.

It seems to me that *C. spinosa* offers an interesting opportunity for introducing experimental taxonomical investigation into ethnobotany.

23. Capparis lucida (BANKS *ex* DC.) BENTH. Fl. Austr. 1 (1863) 96; BAILEY, Queensl. Fl. 1 (1899) 60; BRITTEN, Ill. Austr. Pl. 1 (1900) 6, t. 6; DOMIN, Bibl. Bot. Heft 89 (1925) 688; C. T. WHITE, J. Arn. Arb. 10 (1929) 217.—*Thylachium lucidum* BANKS *ex* DC. Prod. 1 (1824) 254.—*C. subacuta* MIQ. Fl. Ind. Bat. 1, 2 (1858) 101; Illustr. (1870) 35, t. 19, *quoad specim. javan.* (*vide sub C. sepiaria*); K. & V. Bijdr. 4 (1896) 260; BACK. Schoolfl. (1911) 63; KOORD. Exk. Fl. Java 2 (1912) 293 (*acuta, sphalma*); BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 10.—*C. nobilis* (*non* BENTH.) F. v. M. Descr. Not. Pap. Pl. 2[8] (1886) 41.

Tree or shrub, *c.* 2–12 m. Twigs terete, straight, densely fulvous pubescent, sooner or later glabrescent; internodes less than 2 cm. *Thorns* in flowering specimens nearly always wanting, if present up to 2 mm. *Leaves* coriaceous, ovate to obovate, glabrous above, mostly very soon glabrescent beneath 1.7–2.5(–3.5) times as long as wide, (3–)5½–7(–9) by (2–)2½–3 cm; base acute to cuneate, top rounded to obtuse, sometimes mucronate; midrib above subprominent, nerves 5–9 pairs, subprominent on both sides; petiole ½–1½ cm, hairy as the twigs. *Raceme* pubescent, terminal, with up to a dozen of sweet-scented flowers, the lower in the axils of small leaves. Bracts proper, if present, small, acute. Pedicels 1½–6 cm. Buds ovoid, *c.* 1½ cm long, often with umbonate top. Outer pair of *sepals* coriaceous, initially connate and completely enveloping the bud, then splitting more or less regularly, patent at anthesis, *c.* 10–15 by 10 mm, acuminate, glabrous; inner pair rather thin, flat, ovate, *c.* 11–13 by 5–6 mm, shortly acuminate. *Petals* subobovate, 18–30 by 10 mm, pubescent inside and outside towards the base, white to yellowish. Torus comparatively broad, short-conical, with a small posterior disk. *Stamens c.* 50–70, 2½–5 cm, filaments white, anthers *c.* 2½ mm long. *Gynophore* 2½–7 cm, mostly thinly woolly in the basal half, glabrescent; ovary ellipsoid, acuminate, *c.* 3–4 mm long, glabrous, stigma dark-purple. In fruit the pedicel, the torus, and the gynophore somewhat incrassate. *Fruit* globular, 2½–4½ cm diam., pericarp *c.* 3 mm thick, soft, leathery, smooth, dull purplish brown, pulp spongy. Seeds 7–30, sometimes subangular, *c.* 9 by 6 by 5 mm.

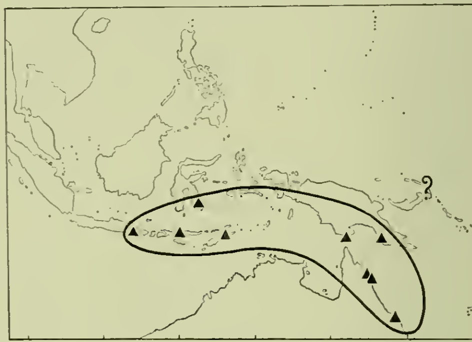


Fig. 25. Localities of *Capparis lucida* (BANKS *ex* DC.) BENTH. From the New Hebrides one unconfirmed record. In Australia several other localities to 30° S, and one unspecified locality "Gulf of Carpentaria".

Distr. Australia: NW. coast (BENTHAM), and NE. coast of Queensland to 20° S. lat.; in *Malaysia* a rare plant: E. Java (one locality), Lesser Sunda Islands (Komodo, Pada, Timor), SE. Celebes, New Guinea (Papua), Booby I. in Torres Strait, ?Bismarck Arch. Fig. 25.

Ecol. Chiefly coastal, but also in savannahs. *Fl. fr.* Jan.–Dec.

The sweet-scented, white or pale lemon-yellow flowers are typically nocturnal. KOORDERS noted that the fruit pulp has a sourish stench, like that of rotten fish. In a living plant in Kebun Raya Indonesia (II–Q–17) I found the spongy, yellow pulp tasting and smelling as insipid mango. They might be eaten by bats which could add to their dispersal.

Notes. In the Bogor Gardens another specimen is cultivated (XI–B–V–117); it is a tree, 5 m by 15 cm; it stands in deep shade and never flowers. The leaves of its long, overhanging twigs tend to have a distichous position and are subtended by straight thorns 2–2½ mm long.

Seeds sown from *n.* II–Q–17 produced seedlings of which the shoot is very similar to those of the just mentioned sterile tree. And though I have not observed the transitional stage wherein the seedling gets unarmed twigs with normal leaves I consider the unarmed sterile tree as a retarded juvenile stage through the effect of shade.

The occurrence of a sterile juvenile stage with thorns seems to be typical for the mainly Australian *sect. Busbeckea:* BENTHAM reported it in *C. canescens* BANKS *ex* DC. and I observed it in several specimens of *C. nobilis* F. v. M. and *C. mitchellii* LINDL.

DE CANDOLLE referred this species to the genus *Thylachium* on account of lacking petals; this error is perhaps due to their being very easily caducous.

Incompletely known species

Capparis longipes MERR.[1] Philip. J. Sc. 13 (1918) Bot. 12; En. Philip. 2 (1923) 211.

Scandent, glabrous shrub, branches slender, terete, brownish or olivaceous, the ultimate branchlets *c.* 1 mm diam. *Thorns* straight, usually 2–4½ mm. *Leaves* lanceolate, membranaceous to chartaceous, green or greenish-olivaceous when dry, somewhat shining, 7–11 by 2–3 cm, narrowed upwards to the very slender apex, sharply acute-acuminate, base acute; nerves *c.* 15 pairs, slender, distinct on both surfaces, anastomosing, primary reticulations lax, ultimate ones close, both distinct; petiole 2–3 mm. *Infructescences* axillary, very slender, sparingly branched, up to 20 cm long, each branch bearing a single fruit, its pedicel *c.* 3 cm. *Fruit* globose, brown when dry, glabrous, *c.* 12 mm in diam.

Distr. *Malaysia:* Philippines (Luzon: Abra), only known from the type BS 26980 RAMOS (US, K; L, photogr.).

Notes. The identity of this specimen could not be established with certainty, as the holotype in Manila has been lost, and the isotypes have no fruit. From the description by MERRILL (*vide supra*) and the completely sterile isotypes it is not possible to form an adequate idea about the structure of the inflorescence.

Though MERRILL did not mention the bract-like minute scales towards the base of the shoots which are typical for *C. pubiflora* I am inclined to compare the material with that species, with which it agrees in the greyish pubescence of the innovations, the straight thorns, and the venation pattern. It may represent a deviating form (teratological or developed in shade?) though I have as yet not seen any comparable paramorph in *C. pubiflora*.

Excluded

Capparis carandas BURM. *f.* Fl. Ind. (1768) 118, 119. MERRILL reduced this to *Carissa carandas* L., *cf.* Rumph. Herb. Amb. (1917) 425. Dr BAEHNI kindly sent me BURMAN's authentic material in the Geneva Herbarium on loan. The entry on p. 118 may refer to one sheet which is most probably a *Carissa*; the entry on p. 119 refers to four other sheets belonging to *Carissa carandas* L. Mant. 1 (1767) 12 (*Apocynaceae*). According to the labels the material was derived from cultivated plants in Java.

Capparis versicolor GRIFF. Notul. 4 (1854) 577; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 175. Recorded from Tenasserim and from Java by HOOKER, who suggested its possible identity with *C. salaccensis* BL.

I have seen the type in the Calcutta Herbarium and agree that it is vegetatively similar to *C. cantoniensis*; the buds have disappeared but are assumed to have measured *c.* 12 mm diam. on pedicels *c.* 3 cm.

3. CADABA

FORSK. Fl. Aegypt.-Arab. (1775) 67; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 185.—**Fig. 26–27.**

Shrubs, often glandular-pubescent (or with scales), occasionally with stipular thorns. *Leaves* simple (or 3-merous, or wanting). Racemes terminal (or flowers solitary, axillary). *Sepals* 4, in 2 whorls, unequal, caducous, outer pair enveloping the bud, valvate, inner pair apert. *Petals* mostly 4 and equal, unguiculate. Receptacle with an adaxial, cylindrical gland. *Stamens* 4–8, their base connate with the gynophore (androgynophore); anthers comparatively large. *Ovary* on a long gynophore, 1-celled; placentas 2–4; ovules ∞, 2-seriate; stigma sessile, indistinct. *Fruit* mostly cylindrical, dehiscent with 2 coriaceous valves (or an indehiscent berry). Seeds ∞, subglobose, with a cartilaginous, sculptured testa; cotyledons incumbent-convolute; radicle conical.

Distr. About 30 *spp.* in the drier regions of Africa, Madagascar, the Middle East, India, Ceylon, one *sp.* in South *Malaysia* and in N. Australia.

Taxon. There are 3 sections, distinguished by the leaves (simple, 3-foliolate, or wanting) and the number of petals and stamens. The Malaysian *sp.* belongs to *sect. Cadaba* (*Eu-cadaba* ENDL.). The other two sections are monotypic and occur in South Africa and the Deccan Peninsula respectively.

1. **Cadaba capparoides** DC. Prod. 1 (1824) 244; DECNE, Nouv. Ann. Mus. Hist. Nat. Paris 3 (1834) 427; Herb. Timor. Descr. (1835) 99; DELESS. Ic. Sel. Pl. 3 (1837) 5, t. 9; SPAN. Linnaea 15 (1841) 164; MIQ. Fl. Ind. Bat. 1, 2 (1858) 97; BENTH. Fl. Austr. 1 (1863) 92; MIQ. Illustr. (1870) 21; KOORD. Exk. Fl. Java 2 (1912) 295; BACK. Onkr. Suiker. (1931) 256, Atlas t. 266; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 186, f. 806, 85 F–G; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 11.—**Fig. 26–27.**

Shrub, ⅓–3 m, procumbent to erect, very dense

(1) *C. longipes* STANDL. Contr. U.S. Nat. Herb. 23 (1922) 303, *non* MERR. 1918 = *C. discolor* STANDL. *op. cit.* 20 (1919) 182, *non* DONN. SMITH, 1897 = *C. renominata* JACOBS, *nom. nov.* It is a Mexican species.

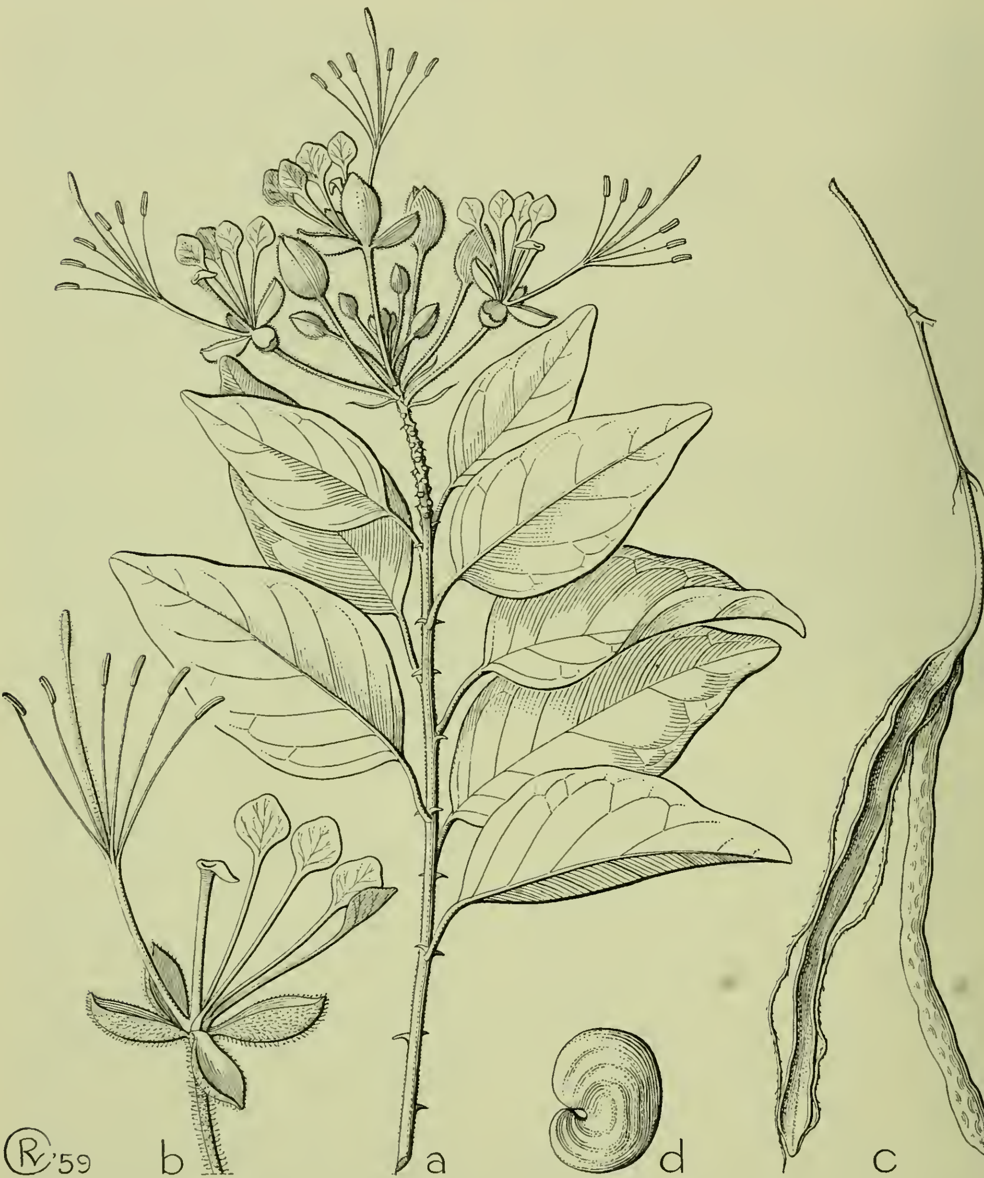


Fig. 26. *Cadaba capparoides* DC. *a.* Habit, × ⅔, *b.* flower from the left, nat. size, *c.* pedicel with androgynophore, gynophore, fruit, × ⅔, *d.* seed, × 3 (*a–b* type specimen, LESCHENAULT *s.n.*, *c–d* TEYSMANN *s.n.*).

glandular-pubescent to almost glabrous. Twigs terete, straight; internodes ¾–2½ cm. *Thorns* straight to slightly recurved, 1½–4 mm, yellowish, sometimes small or wanting. *Leaves* simple, firmly herbaceous, ovate (to rarely obovate), (1.6–)2–3(–5.2) times as long as wide, (3½–)6–10 (–13½) by (1¾–)2½–4½(–8½) cm; base rounded to acute, sometimes obtuse, top narrowed, blunt to acutish, rarely rounded, mostly mucronate; nerves *c.* 7–9 pairs; petiole (¼–)½–4 cm. *Racemes* terminal, corymbiform; rachis 2–3 cm. Pedicels (1½–)2–3(–3½) cm. Bracts caducous, 2–5½ mm stalked, blade 6–10 by ½–2½ mm, lanceolate to ovate, acute, subtended by 2 minute thorns. Buds ovoid, acute. *Sepals* glandular-puberulous outside, boat-shaped, (8–)10–15(–20) by (3–)6–9(–12) mm, ovate, acute to acuminate, inner pair somewhat smaller, flattish, sometimes up to 1 mm clawed,

Fig. 27. *Cadaba capparoides* DC. Open flower. The gland is in the centre (VAN DER PIJL).

obovate, acute. *Petals* pure white on a green claw, all pointing upwards at the adaxial side, (4½–) 8–15(–22) mm clawed, blade orbicular to broad-elliptic, 5–12 by 4½–7 mm. Gland green, 5½–15 by *c.* 1 mm; top yellow, flat, transverse, one-sided, lanceolate, 4½–6 mm long. *Stamens* (5–)6(–7), androgynophore 1–2½ cm; filaments 1–2 cm, anthers 3½–5 by ¾ mm, all glabrous. *Gynophore* 1½–2½ cm; ovary cylindrical, 4½–6 by ¾–1 mm, both sparsely glandular-puberulous; stigma knob-shaped, small; placentas 2. In fruit the pedicels hardly stretched or thickened, androgynophore (1–3–)2–3(–3½) cm, gynophore (1½–)2–3(–3½) cm, more or less densely glandular-puberulous. *Fruit* cylindrical, dull grey-brownish, (4½–)7–11 cm by 5–13 mm, ± glabrescent, dehiscing basiscopically, the filiform placentas persisting as a replum. Seeds up to *c.* 20, 3–4 by 2½–3 by 1½ mm, more or less deeply reniform, with shallow concentric ribs, dull dark brown.

Distr. Australia (N. coast and Vansittart Bay), in *Malaysia:* E. Java (along the N. coast E of Surabaja), Lesser Sunda Islands (Bali, Sumbawa, Flores, Komodo, Timor, Leti). Fig. 29.

Ecol. Not rare in dry shrubby or grassy habitats, sometimes coastal, also reported from limestone, and once from periodically inundated coastal forest, at low altitude, a typical constituent of the flora of the monsoon area with a long dry season.

Vern. *Bangol bangol*, Bali (also in use for other *Capparidaceae*), *paumahatas*, Timor.

4. STIXIS

LOUR. Fl. Coch. (1790) 295, ed. WILLD. (1793) 361; PIERRE, Bull. Soc. Linn. Paris 1 (1887) 652.—*Roydsia* ROXB. Pl. Corom. 3 (1819) 87; HOOK. *f.* Fl. Br. Ind. 1 (1874) 180, 409.—*Covilhamia* KORTH. Ned. Kruidk. Arch. 1 (1848) 307.—**Fig. 28.**

Rather small, unarmed, woody climbers, rarely shrubs. Branches lenticellate. *Leaves* simple, acuminate, rather large, often with minute, whitish pustules along the midrib, finely pellucid-dotted; petiole incrassate at the apex. *Racemes* or *panicles* ∞-flowered, axillary or terminal, with caducous bracts. Pedicels short. *Sepals* mostly 6, in two whorls of 3, valvate, at the top of the bud the outer sepals covering the margins of the inner ones, more or less strap-shaped, densely fulvous-tomentose on both sides, inserted on the margin of a widened, dish-shaped, persistent torus. *Corolla* absent. *Stamens* on a short, ± cylindrical androgynophore, 20–50(-*c.* 100), unequal, the outer ones shortest, about as long as the sepals. *Gynophore* about equalling the filaments. *Ovary* subglobular, 3-celled, with 3 axillary placentas each bearing 5–8(–10) ovules; style simple or split into three arms. *Fruits* few, on a thick woody stalk, ellipsoid, 2½–5 cm long, sometimes with small persistent style, finally more or less lenticellate. Seed 1, large, embedded in pulp, with a thin testa; cotyledons unequal, one enclosing the other.

Distr. Seven *spp.*, in India (Khasia, Sikkim, Assam, Chittagong), Burma, Indo-China, Hainan, in *West Malaysia*: 3 *spp.* Fig. 29.

Taxon. HOOKER's division into *Roydsia* (style short or none, stigmas 3, free) and *Alytostylis* HOOK. *f.* (style long, with 3 minute terminal stigmas), brought by PIERRE to sectional level, is here abandoned. The division is, in my opinion, artificial, as it separates *S. suaveolens* (ROXB.) PIERRE and *S. philippinensis*

Fig. 28. *Stixis ovata* (KORTH.) HALL. *f. ssp. ovata*. *a*. Habit, × ⅔, *b*. flower, one inner sepal removed, × 4, *c*. pedicel, torus, gynoecium, × 4, *d*. cross-section through ovary, × 3, *e*. fruit, × ⅔ (*a* type specimen, KORTHALS *s.n.*, *b–d* CLEMENS 26647, *e* CLEMENS 26000).

which seem to be mutually closer related than *S. suaveolens* and *S. obtusifolia* (HOOK. *f.* & TH.) PIERRE, which two species would belong to § *Roydsia*. An examination of the division of the stigmas shows that this character is less qualitative than quantitative. A grouping according to the length of the androgynophore seems to be more satisfactory, it being considerably longer in *S. suaveolens* and *S. philippinensis* than in the rest of the species.

Anat. In leaf sections of *S. ovata*, made by Mr P. D. BURGGRAAF, we found that the whitish pustules are groups of sclerenchymatic cells in the mesophyll tissue; when the leaves are dried and the mesophyll shrinks these places become prominent.

KEY TO THE SPECIES

1. Gynophore longer than 6 mm, hairy. Leaves and ovary glabrous. Sepals 11–12 mm long. **1. S. philippinensis**

1. Gynophore shorter than 5 mm, glabrous. Sepals *c.* 4 mm long.

 2. Adult leaves hairy underneath. Ovary hairy . . . . **2. S. ovata** *ssp.* **ovata**

 2. Adult leaves glabrous, occasionally with a few hairs underneath on the nerves only. Ovary glabrous. **3. S. scortechinii**

1. Stixis philippinensis (TURCZ.) MERR. Govt Lab. Publ. (Philip.) *n.* 35 (1906) 72; Philip. J. Sc. 1 (1906) Suppl. 58; En. Philip. 2 (1923) 213; ERDTMAN, Pollen Morph. (1952) 97.—*Roydsia philippinensis* TURCZ. Bull. Soc. Nat. Moscou 27, 2 (1854) 329; FERN.–VILL. Nov. App. (1880) 11; VIDAL, Sinopsis Atlas (1883) 13, t. 6 f. B; Phan. Cuming. Philip. (1885) 94; Rev. Pl. Vasc. Filip. (1886) 48.—*Roydsia floribunda* PLANCH. *ex* HOOK. *f.* Fl. Br. Ind. 1 (1874) 409.—*S. floribunda* (PLANCH. *ex* HOOK. *f.*) PIERRE, Bull. Soc. Linn. Paris 1 (1887) 655.

Climber (?), 6 m by 2 cm, glabrous except the inflorescence. *Leaves* subcoriaceous, elliptic to oblong, sometimes slightly obovate, 1.3–2.2 times as long as broad, (9–)13–21(–25) by (6–)8–10 (–11½) cm, smooth except for a few pustules above near the base of the midrib, top *c.* ½ cm acuminate; midrib above broadly sulcate; nerves 9–11 pairs; petiole 2–3 cm. *Panicle* ∞-flowered, terminal, *c.* 25 cm long; branches up to 15 cm, all axes angular and fulvous-puberulous. Bracts orbicular ½ mm to linear 3 mm. Pedicels ½ cm. Buds 10–11 mm long, with cylindrical base and somewhat swollen, acute top. Torus 1½–2 mm broad. *Sepals* during anthesis reflexed halfway, narrow-spathulate, blunt to acute, obscurely 3–5-nerved, the base not narrowed but slightly thickened. Androgynophore 2–3 mm, sometimes hairy at the top. *Stamens c.* 35–40(–48), glabrous, filaments 10–15(–16) mm. *Gynophore* 8–11 mm, densely puberulous; ovary subglobular, glabrous, *c.* 2 by 1½ mm; style 1½–2(–2½) mm, glabrous, with 3 small but distinct stigmatic lobes. Pedicel in fruit *c.* 1 cm, torus 4 mm broad, gynophore 3 mm thick, still hairy. *Fruit* (only some unripe and a few fragments of a ripe one are known) globular with persistent style, up to 3½ cm diam.; pericarp thin, leathery. Seed *c.* 2 by 1½ cm.

Distr. Philippines (Luzon: Bataan and Laguna Prov.; Basilan; Mindanao: Surigao, Cotabato, and Davao Prov.). Seems to be very local. Fig. 29.

Ecol. Forests at low and medium altitudes. *Fl.* Jan.–Dec., *fr.* March–April.

2. Stixis ovata (KORTH.) HALL. *f.* Beih. Bot. Centralbl. 39, ii (1921) 35.—*Covilhamia ovata* KORTH. Ned. Kruidk. Arch. 1 (1848) 307; MIQ.

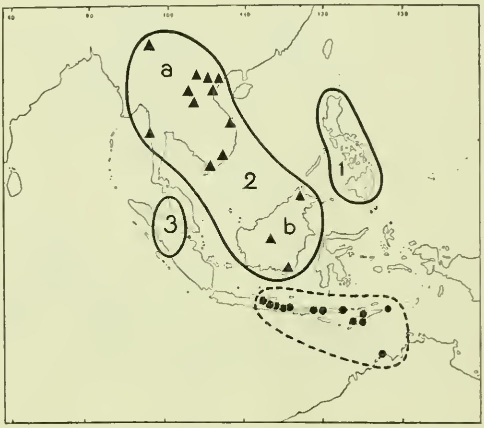


Fig. 29. Distribution of the Malaysian species of *Stixis* and of *Cadaba*.—1. *S. philippinensis* (TURCZ.) MERR., 2. *S. ovata* (KORTH.) HALL. *f.* (triangles representing localities), *a. ssp. fasciculata* (KING) JACOBS, *b. ssp. ovata*, 3. *S. scortechinii* (KING) JACOBS.—*Cadaba capparoides* DC. (dots representing localities).

Fl. Ind. Bat. 1, 2 (1858) 180; MERR. En. Born. (1921) 381.—*S. fasciculata var. borneensis* HEINE, Mitt. Bot. Staatssamml. Münch. Heft 6 (1953) 212.

ssp. **ovata**.—**Fig. 28.**

Branchlets fulvous-tomentose, finally glabrescent. *Leaves* firmly herbaceous, oblong to lanceolate, mostly somewhat obovate, rather narrow, ¾–1½ cm acuminate, fulvous-pubescent, glabrescent, (8–)12–17(–22) by 4–8(–11) cm; midrib above sulcate; nerves 7–9 pairs, mostly densely set with minute whitish pustules. Petiole 1–2(–2½) cm, hairy as the twigs. *Racemes* or *panicles* axillary (rarely a terminal panicle), 6–17 cm long, axes angular, fulvous-tomentose. Bracts linear, 2–3 (–4) mm, tomentose. Pedicels thin, *c.* ½ cm. Buds obovate, 4–5 mm long. *Flowers* greyish green. Torus 1 mm wide. *Sepals* reflexed, lanceolate, *c.* 4 by 1 mm, acutish, obscurely 3-nerved. Androgynophore *c.* ½ mm long and wide, glabrous. *Stamens* 26–34, filaments 2½–3½ mm, glabrous.

Fig. 30. *Cleome rutidosperma* DC. *a*. Flowering branch, × ⅔, *b*. flower, lower sepal and petals removed, right 3 stamens omitted, × 6, *c*. flower from the adaxial side, upper sepal, petals, two stamens removed, lower petals partly, other sepal and stamens omitted, × 6, *d*. front view of flower, × 2, *e*. flower, × 4, *f*. flower from the abaxial side, lower petal and 4 stamens removed, upper sepal, petals, and stamens omitted, × 6, *g–h*. seed with elaiosome, × 6 (living material, Bogor).

Gynophore 1–2 mm, glabrous; ovary ellipsoid, *c.* 1¼ by 1 mm, densely appressed-pubescent; style 1½–2 mm, slender, glabrous, stigma obscurely 3-lobed. *Fruit* on a woody stalk ¾ by ½ cm, ellipsoid, 3–3½ by 2¼–2½ cm; pericarp ¾–1 mm thick, leathery-corky, irregularly covered with whitish crust-like fragments, glabrous, crowned by the style base. Seed oblong, *c.* 2¾ by 1½ cm.

Distr. *Malaysia:* Borneo. Fig. 29.

Ecol. In forests, up to 1200 m.

Vern. *Sansang*, Dusun (N. Borneo).

Note. In continental Asia (Burma, Tenasserim, and Indo-China) another subspecies occurs, formerly distinguished as a separate species, which differs from the type subspecies in having the gynophore hirsute except at the base, flowers in terminal panicles 12–35 cm long or racemes over 12 cm long. Bract mostly 4 mm.

3. Stixis scortechinii (KING) JACOBS, *nov. comb.*—*Roydsia scortechinii* KING, J. As. Soc. Beng. 58, ii (1889) 397; Ann. R. Bot. Gard. Calc. 5 (1896) 120, t. 139; RIDL. Fl. Mal. Pen. 1 (1922) 121.—*Roydsia parviflora* (*non* GRIFF.) KING, J. As. Soc. Beng. 58, ii (1889) 396.

Shrub, often twining (to the left), (1–)3–4(–8) m. Branchlets downy puberulous, glabrescent. *Leaves* firmly herbaceous to subcoriaceous, elliptic to oblong, glabrous, *c.* (1.4–)2 times as long as broad, mostly obovate, (8–)10–16(–20) by 4–7(–9) cm, base more or less narrowed and acute, top rounded and abruptly acuminate with triangular, short, blunt tip; midrib above flat to finely sulcate, below mostly densely set with pustules; nerves 6–7(–8) pairs, reticulations prominent; petiole (1–)1½–2(–2½) cm. *Inflorescence* a terminal, slender, leafy, many-flowered panicle 15–20 cm long, densely downy-puberulous. Bracts linear, *c.* 3 mm. Pedicels 2–3(–5) mm. Buds obovoid, 2½–3 mm long. Flowers fragrant. Torus *c.* 1¼ mm wide. *Sepals* reflexed, strap-shaped, somewhat obovate, acute, inside pink, 3–4(–4½) by ¾–1¼(–1½) mm. Androgynophore hardly visible, glabrous. *Stamens* (20–)25–40; filaments 1½–3½ mm; anthers elliptic, *c.* ¾ mm long. *Gynophore* ¾–1¼ mm long; ovary ellipsoid to ovoid, *c.* 1–1¼ by 1mm, both glabrous; style 1–1½ mm, slender, glabrous, after anthesis somewhat recurved, stigmas obscure. *Fruit* on a woody stalk, 5–7 by 4–5 mm, ellipsoid *c.* 3–4 by 2–3 cm; pericarp leathery, thin, mostly smooth but sometimes spotted with whitish, crustlike fragments. *Seeds c.* 2½ by 1½ cm, embedded in pulp *c.* 3 mm thick.

Distr. *Malaysia:* Northern Sumatra (East and West Coast Res.), Malay Peninsula (Wellesley, Perak, Selangor, Negri Sembilan, Penang). Fig. 29.

Ecol. Dry sunny places, young secondary forest, landslides, jungles, 100–1100 m. *Fl. fr.* Jan.–Dec.

Uses. Sore eyes are treated with the juice from the roots (NE. Sumatra).

Vern. *Simar silaun*, Toba, *andor si bunbun*, Sum. E. C.

Note. KUNSTLER recorded it on his labels once as a "tree 40–50 ft" and once as a "splendid climber 80–100 ft"; this needs verification.

5. CLEOME

LINNÉ, Gen. Pl. ed. 5 (1754) 302; Sp. Pl. 2 (1753) 671; R. BR. in Oudney, Denh. & Clapp. Narr. Trav. Disc. Afr. (1826) App. 220; DC. Prod. 1 (1824) 238; SCHULTES, Syst. 7^1 (1829) 23; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 210.—*Pedicellaria* SCHRANK in Roem. & Ust. Mag. Bot. 3, pt 7 (1790) 10.—*Polanisia* (*non* RAF.) *sensu* DC. Prod. 1 (1824) 242, *excl. spec. typ. P. graveolens*, *cf.* ILTIS, Brittonia 10 (1958) 33; PAX in E. & P. Pfl. Fam. 3, 2 (1891) 224.—*Gynandropsis* DC. Prod. 1 (1824) 237; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 217.—**Fig. 30–33.**

Annual (or perennial) herbs, often hairy, sometimes glandular-hairy. Stipules none or obsolete; seldom with stiff, recurved, thorn-like, stipular (?) enations at the base of the leaf. *Leaves* petioled, herbaceous, in the Mal. *spp.* palmately dissected into 3–7 leaflets. *Flowers* pedicelled, in leafy, terminal racemes or panicles, the leaves apically gradually reduced, mostly slightly zygomorphic in the position of the petals. *Sepals* 4, free. *Petals* (normally) 4, the base often clawed. Stamens 6 to ∞, in Mal. *spp.* all fertile, sometimes at the base connate with the *gynophore* to an *androgynophore*. Disk small. Ovary 1-celled, sometimes sessile but mostly on a gynophore; stigma knob-shaped or flattish, subsessile. *Capsule* linear, terete, 2-valved, beaked, dehiscing from the base or from the apex, the 2 placentae forming a persistent replum. *Seeds* ∞, orbicular to horseshoe-shaped (with a more or less open cleft), sometimes with a funicular elaiosome, on the dorsal side sculptured to scaly.

Distr. A pantropical and subtropical genus with over 150 *spp.*, many of them in America, in the Old World *c.* 65 *spp.* mostly in Africa and the Middle East; in Malaysia 8 *spp.*, of which 2 cultivated, and the others native or introduced. Several *spp.* have in recent time been introduced into other continents as aliens and are now widely spread weeds.

Ecol. In Malaysia most species are weeds along roadsides and in fields at low altitudes.

Uses. Two *spp.* are cultivated as ornamentals, especially *C. speciosa.* Some are used as vegetables and in primitive medicine.

Hairs. In all Malaysian *Cleomes* the hairs are simple and multicellular. They are densely set, patent, and glandular in *C. gynandra, C. spinosa, C. viscosa, C. aculeata*; in the last species the hairs are very small and non-glandular hairs are mixed with the glandular ones. *C. speciosa* is almost glabrous; its scarce vestiture resembles that of *C. aculeata.* In *C. chelidonii* the plants are covered, mostly densely, with appressed, stiff, glassy hairs with a more or less bulbous base. In *C. aspera* and *C. rutidosperma* there are sparse, subpatent, epidermal appendages, too large to be regarded as hairs in the strict sense.

Taxon. DE CANDOLLE (1824) distinguished *Cleome, Gynandropsis,* and *Polanisia.* R. BROWN (1826) suggested the reduction of *Gynandropsis* as a section to *Cleome*, except for *C. gynandra* on which he based a new section *Gymnogonia.* The SCHULTESes (1829) sunk all three genera into a single genus *Cleome* in which they distinguished four sections; their classification has still its merits and is preferred here to that of PAX & HOFFMANN which seems to be somewhat unbalanced. Their sections were: *sect.* A. *Gynandropses* (DC.) SCHULT., with an androgynophore, to which would belong *C. gynandra* and *C. speciosa*; *sect.* B. *Cleomes* (DC.) SCHULT., with 6 free stamens, which is subdivided into *subsect.* 1. *Pedicellaria* (DC.) SCHULT., with a long fleshy torus and a long gynophore, to which would belong *C. spinosa*, and *subsect.* 2. *Siliquaria* (FORSK.) SCHULT. with a small torus and a short or wanting gynophore, to which would belong *C. aspera, C. rutidosperma,* and *C. aculeata*; *sect.* C. *Polanisiae* (DC.) SCHULT., with more than 8 non-clavate stamens, to which would belong *C. viscosa*; *sect.* D. *Corynandrae* (SCHRAD.) SCHULT., with numerous, clavate stamens, to which would belong *C. chelidonii.*

According to ILTIS the Malaysian species are to be grouped as follows: *sect. Gymnogonia* R.BR.: *C. gynandra*; sect. *Tarenaya* (RAF.) ILTIS: *C. spinosa, C. speciosa, C. aculeata*; *sect. Ranmanissa* (ENDL.) GRISEB.: *C. viscosa*; *sect. Corynandra* (SCHRAD.) SCHULT.: *C. chelidonii*; *sect. Rutidosperma* ILTIS: *C. aspera, C. rutidosperma.*

Dr ILTIS (Brittonia 10, 1958, 33 and 12, 1960, *in the press*) is also of opinion that there are no good reasons to maintain the genus *Gynandropsis*, because the connation of the staminal base with the gynophore to form an androgynophore is merely a character of degree, of quantitative value. In this last conclusion ILTIS was preceded by WOODSON, who suggested to refer the bisexual species of *Gynandropsis* to *Cleome*, and proposed an emendation of the S. American genus *Podandrogyne* to incorporate the monoecious species of *Gynandropsis* (Ann. Mo. Bot. Gard. 35, 1948, 139–141).

As to *Polanisia*, ILTIS pointed out that it is satisfactory to restrict *Polanisia* to the original concept of RAFINESQUE, the type species being the N. American *P. graveolens* RAF. (= *P. dodecandra* (L.) DC.). DE CANDOLLE, followed by many later authors, had extended the concept with the cleomoid Old World species possessing more than 6 stamens, but these possess no large adaxial gland as in the type species. These should be referred to *Cleome.*

Thanks are due to Dr H. H. ILTIS, who kindly put his MS at my disposal and gave additional critical remarks, enabling me to take advantage of his extensive knowledge of the American and other species.

KEY TO THE SPECIES

1. Androgynophore longer than 5 mm.
 2. Gynophore in flower 1–2 mm, in fruit 4–10 mm. Petals 7–15 mm long, open in bud, white. **1. C. gynandra**
 2. Gynophore *c.* 6 cm. Petals 25–35 mm long, imbricate, pink . . . . . . **2. C. speciosa**
1. Androgynophore none or at most 3 mm long.
 3. Gynophore *c.* 4 cm. Androgynophore 1–3 mm high. Plant with scattered prickles. **3. C. spinosa**
 3. Gynophore shorter than 1 cm, or none. Stamens free.
  4. Stamens more than 8. Ovary sessile.
   5. Stamens 30 or more, filaments club-shaped. Fruit with a narrowed base; valves parallel-nerved. Plant with stiff scaly hairs. Flowers pink . . . . **4. C. chelidonii**
   5. Stamens less than 30, filaments almost filiform. Fruit hardly narrowed at the base, valves centripetal-nerved. Flowers yellow . . . . **5. C. viscosa**
  4. Stamens 6. Ovary on a short gynophore.
   6. Plant with recurved stipular thorns, glabrous or glandular-puberulous. Flowers white to cream. **6. C. aculeata**
   6. Plant unarmed, with scattered, retrorse hair-like appendages, not glandular.
    7. Petals violet-blue, 9–12 mm long. Fruit 4 mm diam. Seeds with an open cleft. **7. C. rutidosperma**
    7. Petals white, 4–5(–7) mm long. Fruit 2 mm diam. Seeds orbicular, with a closed cleft. **8. C. aspera**

1. Cleome gynandra LINNÉ, Sp. Pl. 2 (1753) 671; C. B. ROBINS. Philip. J. Sc. 3 (1908) Bot. 182.– *Lagansa rubra* RUMPH. Herb. Amb. 5 (1747) 280, t. 96 f. 2.—*C. triphylla* LINNÉ, Sp. Pl. ed. 2 (1763) 938.—*C. pentaphylla* LINNÉ, *l.c.* 938; R. BR. in Oudney, Denh. & Clapp. Narr. Trav. Disc. Afr. (1826) 222.—*Pedicellaria pentaphylla* SCHRANK in Roem. & Ust. Mag. Bot. 3, pt 7 (1790) 11; MERR. Publ. Govt Lab. Philip. *n.* 27 (1905) 18.—*Gynandropsis pentaphylla* DC. Prod. 1 (1824) 238; MIQ. Pl. Jungh. (1854) 397; Fl. Ind. Bat. 1, 2 (1858) 96; Sum. (1860) 19; EICHL. Fl. Bras. 13, 1 (1865) 261, t. 58 f. 3; HASSK. Neu. Schlüss. Rumph. (1866) 263; MIQ. Illustr. (1870) 19; FERN.–VILL. Nov. App. (1880) 10; KING, J. As. Soc. Beng. 58, ii (1889) 392; MERR. Philip. J. Sc. 1 Suppl. (1906) 58; BACK. Fl. Bat. (1907) 53; Schoolfl. (1911) 60; MERR. Fl. Manila (1912) 216; LAUT. Bot. Jahrb. 52 (1915) 110; MERR. Int. Rumph. (1917) 241; Sp. Blanc. (1918) 158; RIDL. Fl. Mal. Pen. 1 (1922) 120; V. D. PIJL, Trop. Natuur 19 (1930) 162. —*Gynandropsis affinis* BL. Bijdr. 2 (1825) 51.— *C. affinis* SPRENG. Syst. Veg. ed. 16, 4, 2 (1827) 138, *non* DC. 1824.—*C. blumeana* SCHULT. Syst. Veg. 7^1 (1829) 23.—*C. alliacea* BLANCO, Fl. Filip. (1837) 522.—*C. blumeana* D. DIETR. Syn. Pl. 2 (1840) 1065.—*C. alliodora* BLANCO, Fl. Filip. ed. 2 (1845) 363, ed. 3, 2 (1879) 307, t. 233.—*Gynandropsis gynandra* BRIQ. Ann. Cons. Jard. Bot. Genève 17 (1914) 382; MERR. En. Philip. 2 (1923) 209; DOCTERS VAN LEEUWEN, Zoocecidia (1926) 211; HEYNE, Nutt. Pl. (1927) 681; OCHSE & BAKH. Ind. Groenten (1931) 96, f. 57; BACK. Onkr. Suiker. (1931) 253, Atlas t. 264; Trop. Natuur 22 (1933) 112; BURK. Dict. 1 (1935) 1119; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 218; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 4; MERR. Pl. Life Pac. World (1946) 135, f. 119.

Erect, mostly widely branched, annual herb, 15–80 cm. Stem glandular-pubescent to glabrous. Normal *leaves* with 5 leaflets, lowest and upper with 3, towards and in the inflorescence diminishing in size; leaflets thinly herbaceous, about twice as long as wide, obovate, *c.* 2–7½ by 1–3¾ cm, base cuneate, top rounded and ± distinctly acuminate, ciliate to denticulate; nerves 5–8 pairs; petiole 2–10 cm, petiolules 1–3 mm, webbing at the base, densely glandular puberulous. *Flowers* in long, corymbose racemes, nocturnal. Pedicels thin, 1½–2½ cm, glandular-puberulous. *Sepals* 2½–5 by ½–1½ mm, acute, puberulous, ciliate. *Petals* with open aestivation, all pointed upwards towards the adaxial side, elliptic with narrowed base and rounded top, 1½–5 mm stalked, 7–15 mm long in all, 1½–4 mm broad. Androgynophore 9–16 mm. *Stamens* 6; filaments 1½–2 cm; anthers linear, 2–3 mm long. *Gynophore* 1–2 mm; ovary cylindric, *c.* 3 by ½ mm, in some flowers (especially the apical ones) sessile and reduced. In fruit pedicels 1–3 cm, androgynophore 13–20 mm, gynophore 4–10 mm. *Fruit* cylindrical, tapering to both ends, 2–11 cm by 3–4(–6) mm; beak 1–4 mm; valves with longitudinal, centripetal veins. *Seeds* depressed-globular, *c.* 1⅓ mm diam., with a shallow and narrow cleft, black-brown, with many superficial concentric ribs and numerous irregular distinct cross-ribs. No elaiosome.

Morph. RAGHAVAN found in this species (in S. India) that about 50% of the ovaries are sessile and sterile with only vestiges of ovules being present (J. Linn. Soc. Bot. 52, 1939, 239).

MAURITZON studied the embryology (Ark. Bot. 26, *n.* 15, 1935, 1).

Distr. From Ceylon and the Punjab throughout SE. and E. Asia as far as Peiping; throughout *Malaysia.* Widely introduced in the New World.

Ecol. A weed, in dry rice-fields, along roadsides, near houses, from the lowlands up to *c.* 500 m. *Fl. fr.* Jan.–Dec.

Vern. *Maman(g)*, *mamam*, M, S, *bobowan*, *èntjèng-èntjèng*, J, *bhubhuwan*, Md; Philippines: *apoi-apoian*, *balabalanoian*, Tag.; *halaya*, *hulaya*, P. Bis., *tantandok*, *t.-a-dadakel*, Ilk.

Uses. Some minor medicinal applications are mentioned by BURKILL, *l.c.* and HEYNE, *l.c.* According to OCHSE, *l.c.*, the bitter leaves are prepared by boiling and salting as a vegetable, especially in Java.

2. Cleome speciosa RAF. Fl. Ludovic. (1817) 86; H.B.K. Nov. Gen. & Sp. Pl. 5 (1821) 84, t. 436. —*Gynandropsis speciosa* DC. Prod. 1 (1824) 238; HASSK. Nat. Tijd. N.I. 10 (1856) 118; Hort. Bog. Descr. (1858) 11; MIQ. Fl. Ind. Bat. 1, 2 (1858) 96; FERN.–VILL. Nov. App. (1880) 10; MERR. Philip. Govt. Lab. Publ. *n.* 6 (1904) 24, *n.* 27 (1905) 18; BACK. Fl. Bat. (1907) 54; GAGN. Fl. Gén. I.–C. 1 (1908) 174; BACK. Ann. Jard. Bot. Buit. Suppl. 3 (1910) 403; Schoolfl. (1911) 60; BRIQ. Ann. Cons. Bot. Genève 17 (1914) 384; SCHROO, Trop. Natuur 4 (1915) 108, f. 1–7; MERR. Sp. Blanc. (1918) 158; En. Philip. 2 (1923) 209; DOCTERS VAN LEEUWEN, Zoocecidia (1926) 211; HEYNE, Nutt. Pl. (1927) 681; BURK. Dict. 1 (1935) 1119; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 4. —*C. speciosissima* DEPPE *ex* LINDL. Bot. Reg. 14 (1831) t. 1312; BURK. Dict. (1935) 580.—*Gynandropsis pentaphylla* (*non* DC.) BLANCO, Fl. Filip. (1837) 523.—*C. gigantea* (*non* L.) BLANCO, *ibid.* ed. 2 (1845) 364, ed. 3, 2 (1879) 307, t. 234.

Little-branched herb, *c.* 1–1½ m, erect, glabrous or glabrescent. *Leaflets* 5–7, herbaceous, subsessile, slightly webbing at the insertion, narrowed towards base and top, lanceolate, *c.* 10–12(–18) by 2½–4½ cm; nerves 14–16(–25) pairs; petiole *c.* 8–12(–17) cm. Raceme up to 40 cm long. *Flowers* subtended by subsessile leaves upwards gradually simplified and diminishing in size. Pedicels thin, *c.* 2½–3½ cm. Buds cylindric, *c.* 2–2¼ cm by 3 mm; petals imbricate, androgynophore with the base of the filaments bulging out at the anterior side shortly before anthesis; flowers opening at dusk. *Sepals* patent, subulate, 5 mm, ciliate. Torus *c.* 1½ mm wide. *Petals* during anthesis pointing upwards adaxially, *c.* (25–)30(–35) by 5–8 mm, lanceolate, rounded, narrowed into a claw *c.* 5 mm, glabrous, pink or white (sometimes referred to as *f. alba*). Androgynophore 5–7(–9) mm, slightly incrassate towards base and top, glabrous. *Stamens* 6, glabrous, filaments filiform, *c.* 5–6 cm, anthers *c.* 7 mm, linear. *Gynophore c.* 6 cm, glabrous, ovary cylindrical, few mm long, glabrous. *Fruit* cylindric, *c.* 8–9 cm by 3 mm, valves indistinctly parallel-nerved. Seeds *c.* 2¾ mm diam., 2 mm thick, with a fairly shallow cleft, light brown, the surface with small, pale, scattered scales; no elaiosome.

Distr. South America from Mexico to Peru and Guyana, cultivated as an ornamental in SE. Asia, up to 1500 m, in *Malaysia* collected in Sumatra (East Coast), Java, Borneo (Sarawak, W. Borneo), Philippines (Luzon), Moluccas (Aru Is). According to HASSKARL (1856, *l.c.* 119) introduced in Malaysia some years before 1855.

Ecol. SCHROO, *l.c.*, observed that in Java the flowers open between 4 and 5 p.m.; small stingless bees (*Apis indica*) collect pollen but do not touch the nectar; pollination would be effected by nocturnal butterflies.

3. Cleome spinosa JACQ. En. Pl. Carib. (1760) 26; LINNÉ, Sp. Pl. ed. 2 (1762) 939; DC. Prod. 1 (1824) 239; EICHL. Fl. Bras. 13, 1 (1865) 252; MERR. En. Philip. 2 (1923) 208; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 2.—*C. sandwicensis* A. GRAY, U.S. Expl. Exp. Bot. 1 (1854) 65.

Herb 1—1¼ m. Stems vigorous, glandular-pubescent. Stipular *thorns* minute (some petioles without) to 4 mm long, sharp, recurved. *Leaves* much reduced towards the inflorescence; leaflets 5–7, herbaceous, lanceolate, slightly webbed at the base, sparsely glandular-hairy, central leaflet largest, 6–8(–10) by 1¾–2¼(–3) cm; base cuneate, decurrent, top attenuate, acute, mucronate; nerves 10–15 pairs; petiole *c.* 5–10 cm, sometimes with scattered prickles as the midrib beneath. Racemes up to 40 cm. *Flowers* subtended by subsessile, ovate-oblong, sparsely glandular-hairy bracts, gradually diminishing in size from 2 to ½ cm. Pedicels 2–3 cm, short glandular-hairy. Buds cylindrical, *c.* 2¾ cm by 4 mm, glabrous; petals imbricate, androgynophore with the base of the stamens bulging out at the anterior side shortly before anthesis. *Sepals* patent, narrow-triangular, (4–)6–7 mm, glandular-hairy outside. *Petals* glabrous, on a filiform claw (5–)10–12 mm, blade oblong, ± asymmetrical, 10–17 by 4–6 mm, with cuneate base and rounded top. *Stamens* 6; androgynophore 1–2 mm, glabrous; filaments filiform, 3½–4 cm; anthers linear, 7–8 mm. *Gynophore* glabrous, in flower *c.* 4 cm, in fruit to 5½ cm; ovary linear, *c.* 4 mm, glabrous. *Fruits* patent, cylindrical, blunt at both ends, 5½–6½ cm by 4 mm, valves finely and densely nerved. Seeds asymmetrical, 2 mm diam., almost smooth, concentric and cross ribs subprominent; elaiosome not present.

Distr. Native in tropical America, also occasionally cultivated in the tropical to the temperate zones, in *Malaysia:* occasionally cultivated, known from Luzon and from Java, in the latter island once found run wild.

Note. According to ILTIS (*in litt.*) the Malaysian material would not belong to *C. spinosa*, but to the related *C. houtteana* SCHLECHT. (Linnaea 8, 1851, 669) which would be recognizable by glabrous buds and ovaries, and pink flowers.

4. Cleome chelidonii LINNÉ *f.* Suppl. (1781) 300; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 170.—*Polanisia chelidonii* DC. Prod. 1 (1824) 242; MIQ. Fl. Ind. Bat. 1, 2 (1858) 97; BACK. Schoolfl. (1911) 60; HEYNE, Nutt. Pl. (1927) 682; BACK. Onkr. Suiker. (1931) 254, Atlas t. 264; Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 5.—*Polanisia angulata* DC. Prod. 1 (1824) 242; MIQ. Fl. Ind. Bat. 1, 2 (1858) 97; Illustr. (1870) 20.—**Fig. 31, 32a–b.**

Widely branched herb, 15–80 cm; tap-root stout, white. Stems angular, with sparse, appressed, pale, stiff hairs with a bulbous base. *Leaflets* firmly herbaceous, 6–7 below to apically only 3 or 1, obovate, mostly densely appressed-hairy, central leaflet largest, up to 4(–6) by 1¼(–1¾) cm; base cuneate, top rounded and subacuminate to acute; nerves 4–5 pairs; petioles upwards gradually decreasing in length from *c.* 8–10 cm to almost zero, hairy as the stem, apex and petiolules white. Raceme corymbiform, *flowers* subtended by reduced leaves, actinomorphic. Pedicels (1–)1½–3 cm, hairy as the stem. Buds ellipsoid, ± obovate, acute, 6–10 mm long. *Sepals* narrowly imbricate, appressed, elliptic (to obovate), acuminate, 2–4 mm long, sparsely scaly-hairy outside, margin membranous. *Petals* 4(–8), mostly obovate with narrowed base and rounded top, 7–12(–15, in India –21) by 3–5 mm, glabrous, light red-purple. *Stamens* 30–40(–55), somewhat shorter than the petals, glabrous; filaments with a thickened top; anthers *c.* 1 mm, yellow. Ovary linear, about as long as the stamens, glabrous. *Fruit* linear, parallel-nerved, narrowed at the very base, glabrous, *c.* 1–3 mm beaked. Seeds asymmetrical nearly 2 mm, cleft open, dull blackish, not ribbed but warty by scattered scales mainly on the dorsal side. Elaiosome wanting.

Distr. India, Burma and Siam (locally), in *Malaysia:* Central and East Java.

Anat. T. S. RAGHAVAN investigated the development of the female gametophyte, embryo, and seed, and the vascular supply of the floral parts (J. Linn. Soc. Bot. 51, 1937, 43–72; *ibid.* 52, 1939, 249).

Ecol. Fallow sawahs, sugarcane-fields on heavy clays, and marls periodically drying out during the pronounced dry season, in Java below 100 m, locally sometimes so abundant that the fields are coloured red-purple by the flowers (BACKER, 1931). *Fl. fr.* Jan.–Dec.

KOOPER defined a weed community characterized by *Polanisia chelidonii* on constantly moist, fairly to very heavy clay in sugarcane-fields (Rec. Trav. Bot. Néerl. 24, 1927, 84 *seq.*).

MIRASHI found it characteristic in the vegetation of freshwater swamps in India; he discussed also some anatomical details (Proc. Ind. Ac. Sc. 43B, 1956, 233–236).

Note. The type material of *Polanisia angulata* DC., hailing from Java, could not be located in the Paris Herbarium; his description is vague, but he records a field note by LESCHENAULT "flowers violet". This character occurs only in

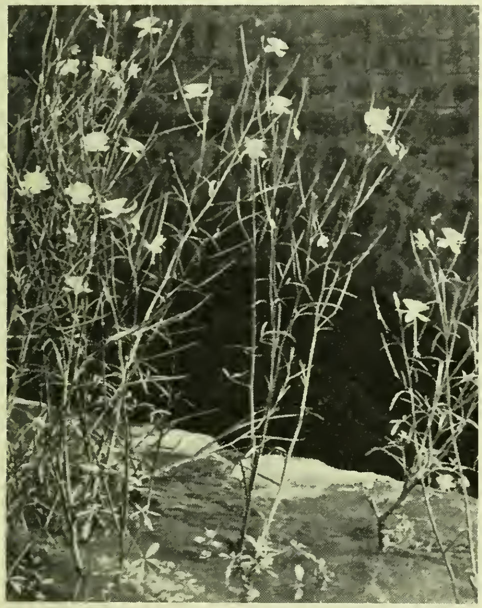


Fig. 31. *Cleome chelidonii* L. *f.* (India, Raipur, HEWETSON, 1950).

C. chelidonii; therefore, I agree with BACKER in referring it here.

5. Cleome viscosa LINNÉ, Sp. Pl. 2 (1753) 672; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 170; F. v. M. Descr. Not. Pap. Pl. 1^4 (1876) 52; RIDL. Fl. Mal. Pen. 1 (1922) 119.—*Lagansa alba* RUMPH. Herb. Amb. 5 (1747) 280, t. 96 f. 3.—*C. icosandra* LINNÉ, Sp. Pl. 2 (1753) 672; in Stickman, Herb. Amb. (1754) 21; BURK. Dict. 1 (1935) 581.—*Polanisia viscosa* DC. Prod. 1 (1824) 242; BL. Bijdr. (1825) 52; BLANCO, Fl. Filip. ed. 2 (1845) 364, ed. 3, 2 (1878) 308; MIQ. Fl. Ind. Bat. 1, 2 (1858) 97; Illustr. (1870) 20; FERN.-VILL. Nov. App. (1880) 10; VIDAL, Phan. Cuming. (1885) 94; BACK. Fl. Bat. (1907) 52, *quoad var.* α; MERR. Philip. J. Sc. 3 (1908) Bot. 407; BACK. Schoolfl. (1911) 60; MERR. Fl. Manila (1912) 216; Int. Rumph. (1917) 240; Sp. Blanc. (1918) 158; HEYNE, Nutt. Pl. (1927) 682; BACK. Onkr. Suiker. (1931) 255, Atlas t. 266, *quoad f. typica.*—*Polanisia icosandra* W. & A. Prod. (1834) 22; MERR. En. Philip. 2 (1923) 209; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 5, *quoad f. typica*; MERR. Plant Life Pac. World (1946) 135, f. 121; QUIS. Med. Pl. Philip. (1951) 344.—*C. acutifolia* ELMER, Leafl. Philip. Bot. 7 (1914) 2574.—*C. chelidonii* (*non* L. *f.*) BURK. Gard. Bull. S.S. 3 (1924) 280; Dict. 1 (1935) 580.—**Fig. 32c–d.**

Annual, mostly widely branched herb up to 1 m, glandular, yellowish hairy, viscid and stinking. *Leaflets* tinhly herbaceous, 5–3, diminishing upwards in size, subsessile, oblong, the central leaflet *c.* 1–3(–5½) by (¼–)½–1(–2) cm; base cuneate, top acute to obtuse; nerves 3–6 pairs; petiole (½–)1–3(–6) cm. *Racemes* corymbose; flowers in the axils of reduced leaves, largely actinomorphic, opening in the morning, closing in the afternoon, ephemeral. *Sepals* oblong, blunt to acute, (2½–)6–7(–8) by (½–)1–3 mm. *Petals* yellow (once reported white), thin, glabrous, oblong, (4–)7–12 by (1¼–)3–5 mm, base cuneate or ± clawed, top rounded. *Stamens* (8–)10–20 (–30), glabrous; filaments (3–)5–7 mm towards the abaxial side, gradually increasing in length by

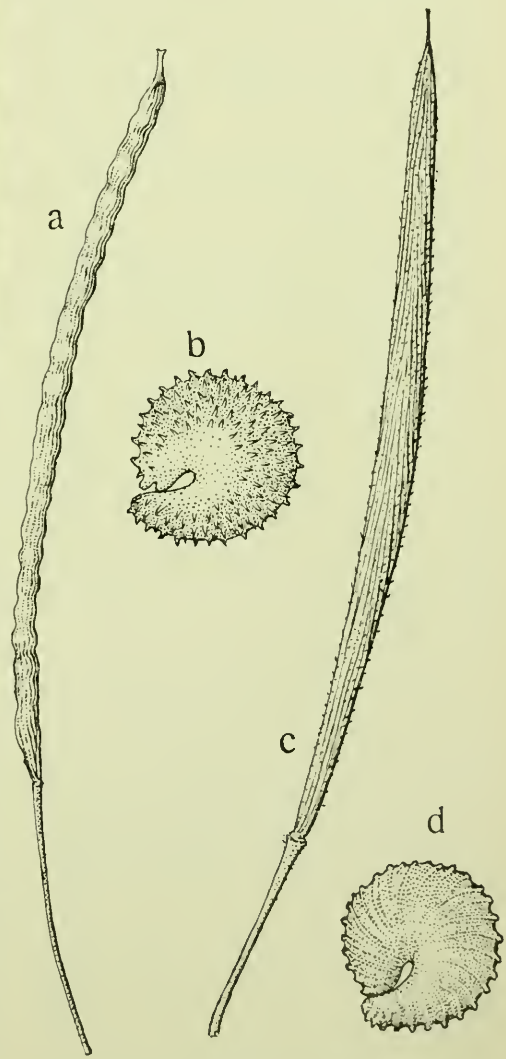


Fig. 32. Fruit and seed of *Cleome. a–b. C. chelidonii* L. *f.*, *c–d. C. viscosa* L. (*a*, *c* nat. size, *b*, *d* × 10).

1–2 mm, not or only very slightly swollen at the top; anthers linear, *c.* 1½–2 mm. Ovary sessile, *c.* 3–10 mm beaked, minutely glandular-hairy. *Fruit* erect, (⅓–)2–3(–4) cm pedicelled, (1½–)6–8 (–10) cm by (2–)3–4½ mm, beak 2½–4(–7) mm; valves with distinct centripetal nerves. Seeds *c.* 1¼ mm diam., 1 mm thick, red-brown, cleft narrow, with strong cross-ribs and faint concentric ribs. No elaiosome.

Distr. Native in the Old World, from tropical Africa and S. Arabia to tropical Australia; common throughout *Malaysia*, commonly adventive in the New World.

Ecol. A common, very tolerant, ruderal plant, on fallow land, along roadsides, on rubbish-heaps, in fields, *etc.*, often on sandy, sometimes on calcareous soil, both under seasonally dry and everwet climatic conditions, sometimes near the coast or in savannahs, up to 500 m, mostly lower. *Fl. fr.* Jan.–Dec.

According to RIDLEY in Malaya dispersed endozoically by water-buffalos (Disp. p. 368). FOSBERG observed in the Marianas that the seeds were eaten by birds.

KOOPER found on the sugarcane-fields in East Java a weed community, characterized by *Polanisia viscosa*, typical for recent, very pervious, volcanic, light soils valuable for sugar culture. He recorded wilting experiments with this species under dry conditions (Rec. Trav. Bot. Néerl. 24, 1927, 56 *seq.*, 218 *seq.*).

Mr N. G. BISSET found the seeds containing an appreciable amount of alkaloid.

Uses. There is a record from Java and one from Hainan stating that the sap of the leaves with water or milk is applied on the eyes. In Perak the herb is rubbed on the body against rheumatism. In Central Sumatra the leaves and seeds are added to tobacco to stress its narcotic properties. Besides, the plant finds a number of other minor medical applications; see HEYNE (*l.c.* p. 682) and QUISUMBING (*l.c.* p.346).

Vern. *Daun maman pantai, machmud panta, maman panta, maman patih*, Perak, *poko kutepeng*, Malacca, *maman hutan*, M, *nai velai*, Tamil (Mal. Pen.), *dek tau chan*, Penang, *daun gliengang ajam*, Palembang, *maman, mamman*, S, *antjang antjang, bobowan, èntjèng èntjèng, ètjèng, ètjèng tĕmbĕking*, J, *bhubhuan*, Kangean, *pupuan loke, tjongblĕntjongan*, Md, *ahuru*, Nenusa Is, *susawi utan*, Ambon, *poompito*, N. Celebes; Philippines: *apoi-apoian, balabalanóian, silisilíhan*, Tag., *huláya, tuláyag*, P. Bis., *kabáu*, Iv., *lampotaki*, Tagb., *tandandók*, Ilk.

Notes. BURKILL recorded *C. chelidonii* for the Malay Peninsula (Gard. Bull. S.S. 3, 1924, 280; see also Dict. p. 580). The material he cited belongs, however, to *C. viscosa*, partly to its *f. deglabrata*.

As far as could be established DE CANDOLLE was the first to combine *C. icosandra* and *C. viscosa* and, under *Polanisia*, he chose the epithet *viscosa* (1824).

f. **deglabrata** (BACK.) JACOBS, *stat. nov.*—*Polanisia viscosa var. deglabrata* BACK. Fl. Bat. (1907) 53; DOMIN, Bibl. Bot. Heft 89 (1925) 683.—*Polanisia icosandra f. deglabrata* BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 5.

Differs from *f. viscosa* in being entirely glabrous; not with a distinct smell.

Distr. *Malaysia:* Malay Peninsula, Java.

6. Cleome aculeata LINNÉ, Syst. Nat. ed. 12, 3 (1768) 232; DC. Prod. 1 (1824) 241; HASSK. Nat. Tijd. N.I. 10 (1856) 119; Hort. Bog. Descr. (1858) 12; MIQ. Fl. Ind. Bat. 1, 2 (1858) 96; EICHL. Fl. Bras. 13, 1 (1865) 259, t. 58 f. 2; BACK. Ann. Jard. Bot. Buit. Suppl. 3 (1910) 398; Schoolfl. (1911) 59; RIDL. Fl. Mal. Pen. 1 (1922) 120; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 2.—*C. hulletii* KING, J. As. Soc. Beng. 58, ii (1889) 392; Ann. Bot. Gard. Calc. 5 (1896) 117, t. 133A. —**Fig. 33a.**

Erect, widely branched, annual herb, ¼–½ m, rather densely covered with minute, glandular hairs, neither viscid nor smelling. Stem with fulvous, recurved, stipular thorns *c.* 1½ mm. *Leaves* upwards gradually reduced in size, ultimately simple and subsessile. *Leaflets* 3, subsessile, thinly herbaceous, oblong, sometimes obovate, central leaflet *c.* 2½–3(–3½) by 1¼–1¾ (–2) cm; base acute to cuneate, slightly decurrent, top acute; nerves 5–8 pairs; petiole 2–3(–4½) cm. *Racemes* few-flowered, flowers subtended by simple, subsessile leaves. Pedicels 1½–2 cm. *Sepals* linear, 1½–2¼ by ¼–½ cm, minutely glandular-hairy outside. *Petals* 1¾–4 mm (incl. claw ¼–1 mm), obovate, pale yellowish. *Stamens* 6, slightly exceeding the petals, anthers 1½–2 mm. Ovary subsessile, cylindric, 2–3 mm long, glabrous. *Fruit* on a gynophore ½–2½ mm, cylindric but abruptly tapering to both ends, 3½–4 cm by 3 mm; valves finely parallel-nerved. Seeds asymmetrical, with closed cleft, 2–2¼ mm diam.; concentric ribs faint, obtuse, cross-ribs irregular, scattered, incomplete, distinctly prominent; elaiosome distinct.

Distr. Native from Mexico to N. Argentina, introduced in *Malaysia:* W. Java (Bogor and vicinity. According to HASSKARL (1856, *l.c.*) incidentally introduced with soil from Suriname into the Hortus Bogoriensis, whence it escaped before 1889), Malay Peninsula (Singapore), New Guinea (Papua: Kanosia, one record of 1935).

7. Cleome rutidosperma DC. Prod. 1 (1824) 241; ILTIS, Brittonia 12 (1960) *in the press.*—*C. ciliata* SCHUM. & THONN. Dansk Vid. Selsk. Afh. 4 (1828) 67; JOCHEMS, Trop. Natuur 17 (1928) 80, f. 1, 2; BEUMÉE, Trop. Natuur 18 (1929) 99; PAX & HOFFM. in E. & P. Pfl. Fam. ed. 2, 17b (1936) 213; BACK. Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 3; JOHNSON & TAN, Gard. Bull. Sing. 17 (1959) 325–330, fig. 1–2.—**Fig. 30, 33b.**

Erect to spreading, widely branched, annual, odourless herb, ¼–1 m; stem, petioles, and the nerves underneath with sparse prickle-like, softish appendages up to 2 mm long. *Leaflets* 3, upwards gradually reduced and subsessile, thinly herbaceous, ovate to subrhomboid or oblong-lanceolate, ciliate, central leaflet 3–3½(–5) by 1½–2½ cm; base cuneate, decurrent, top narrowed, acute to blunt; nerves 6–9 pairs; petiole generally 3–4(–5) cm, slightly webbing between the short petiolules. *Racemes* with reduced leaves. Pedicels filiform, 2–3 cm, in fruit *c.* 3 cm, rather densely set with minute, gland-like hairs. *Sepals* 3½–4 by ¼–¾ mm, ovate, acute to acuminate, hairy like the

Fig. 33. Seeds of *Cleome*. *a*. *C. aculeata* L., *b*. *C. rutidosperma* DC., *c*. *C. aspera* KOEN. *ex* DC., all × 8.

nerves below. *Petals* violet-blue, all pointing upwards at the adaxial side, 9–12 mm (including a claw 2–3 mm) by 1½–2½ mm. *Stamens* 6, 7–10 mm; anthers linear, 2 mm, strongly curved after anthesis. *Gynophore c.* 1½ mm, ovary linear, *c.* 8–10 mm, slightly S-curved, minutely glandular, beak *c.* 1 mm. *Fruit* on a gynophore 4–8(–10) mm, cylindrical, tapering at both ends, 5–7½ cm by 4 mm, beak 1–4 mm, valves glabrous, parallel-nerved. Seeds dull black, asymmetrical, with a pale centre, with faint, obtuse concentric ribs and stronger cross-ribs, cleft open, 1¾ by 1½ mm; ribs sometimes with microscopical bristles; base of the seed with a white elaiosome.

Distr. West tropical Africa (from Guinea to Angola and the Congo), introduced in the Caribbean region and occasionally found in *Malaysia:* first records 1920: Belawan, Sumatra East Coast; 1924: Singapore; 1946: Java (Tandjung Priok); 1958: wide-spread from Sarawak to N. Borneo. In 1946 found in Siam (100 km NW. of Kanburi), in 1948 in Burma (Insein Distr.) and in Manila.

Ecol. A lowland ruderal in the course of extending its area with a tendency to become a common plant. BEUMÉE, *l.c.*, observed the plant growing in trees, where the seeds were obviously brought by ants attracted by the fatty elaiosome. About one third of the ovaries is 2–3 mm long and sterile.

Vern. *Sĕru walai*, Tamil (Malaya).

Note. The exact synonymy I owe to Dr ILTIS (unpublished) who found that the type specimen of *C. rutidosperma* must have actually come from Sierra Leone, Africa, but was erroneously labelled by DE CANDOLLE "Antilles" and described by him as from "Tabago".

8. Cleome aspera KOEN. *ex* DC. Prod. 1 (1824) 241; HOOK. *f.* & TH. Fl. Br. Ind. 1 (1872) 169; BACK. Onkr. Suiker. (1931) 252, Atlas t. 262; Bekn. Fl. Java (em. ed.) 4A (1942) fam. 45, p. 3. —**Fig. 33c.**

Erect, widely branched, annual, stinking herb, ¼–¾ m high. Stem, petioles, and nerves underneath sparsely set with small prickle-like, softish appendages. *Leaflets* 3(–5), upwards reduced and becoming subsessile, on short petiolules webbing at the insertion, thinly herbaceous, ovate-lanceolate, ciliate, central leaflet generally 2½–3 (–5½) by ¾–1(–1¼) cm; base cuneate, top blunt; nerves 4–9 pairs; petiole generally 1½–2½(–8) cm. *Racemes* with reduced leaves. Pedicels filiform, ½–1½ cm, 1½–2 cm in fruit, rather sparsely set with minute glandular hairs. *Sepals* 2–3 by ¼–½ mm, acuminate to obtuse, glandular-hairy. *Petals* white, 4–5(–7) (including claw 1–2 mm) by ¾–1½ mm, oblong-lanceolate, top rounded. *Stamens* 6(–7), 4–6 mm; anthers *c.* 1 mm, linear, curved after anthesis. *Gynophore c.* 1 mm; ovary 3–4 mm long, linear. *Fruit* on a gynophore 3–6(–10) mm, 3–6 cm by 2 mm, cylindrical, tapering to both ends, the beak 2–8 mm; valves parallel-nerved, glabrous. Seeds suborbicular, *c.* 1½ by 1¾ mm, dark-brown, with small paler centre, with very narrow-elevated, strongly prominent cross-ribs, and distinct obtuse concentric ribs, cleft closed; no elaiosome.

Distr. Native in India and Ceylon, in *Malaysia:* Central and East Java, Madura, and Bali.

The oldest Malaysian collection is by HORSFIELD from Java between 1802 and 1819; the second one is from Pekalongan, in 1912.

Ecol. Obviously bound to a distinctly seasonal climate.

Vern. *Èntjèng èntjèng-kĕbo*, J (in use for all *Cleomoideae*).

CAMPANULACEAE (B. Moeliono, Amsterdam & P. Tuyn, Leyden)

Annuals, perennials, more rarely shrubs, small trees, or vines, mostly laticiferous, sometimes with subterranean tubers. *Leaves* exstipular, simple, entire or toothed to incised (rarely pinnatifid), spirally arranged or alternate, rarely opposite. *Flowers* often blue, violet, red, or white, frequently protrandrous (rarely dioecious), axillary or terminal, solitary or in mostly bracteate, racemose inflorescences (rarely cymes), bisexual (rarely unisexual or dioecious), isomerous, mostly 5-merous, regular or symmetric. Pedicels mostly with 2 bracteoles. *Calyx* segments mostly free, often persistent, valvate. *Petals* connate to various degree, sometimes almost free (exceptionally free), valvate in bud; in strongly zygomorphous flowers the corolla bilabiate dorsally slit and the lobes often very unequal, the lower lip often with 2 convexities near the base. *Stamens* adnate to the corolla or free from it, mutually mostly partly connate (either the filaments or part of them and the anthers or only the latter); filaments often widened at the base; anthers introrse, in zygomorphic flowers often unequal, often 2 or more with apical setae, further glabrous or haired. *Disk* epigynous, mostly free. *Ovary* inferior or partly so (rarely superior), 2–5-celled. Style 1, often with hairs below the 2–5 stigmatic lobes. *Ovules* ∞, mostly on axile placentas (exceptionally parietal in incompletely celled ovaries). *Fruit* capsular or a berry, or berry-like, mostly dehiscing at the apex with valves, or circumsciss. *Seeds* ∞; embryo straight; albuminous.

Distribution. Rather large family, with a worldwide distribution, with approximately 60–70 genera and roughly between 1000 and 1500 *spp.*, the largest ones, *Lobelia* and *Campanula*, counting several hundreds of species. In Malaysia the family is sparsely represented although with one endemic genus, *Phyllocharis*, in New Guinea, and a subendemic one, *Pentaphragma*.

Two genera show a remarkable trans-Pacific distribution, *viz Laurentia sect. Isotoma* with the majority of species Australian and one species in tropical America, and the *Pratia* affinity of *Lobelia* which is a distinctly South Pacific-Subantarctic group.

Codonopsis on the other hand is typically East Asian, mainly Chinese, and *Peracarpa* is Sino-Japanese. *Wahlenbergia* is worldwide distributed. *Sphenoclea* is a monotypic Old World swamp plant.

Ecology. The family is but little represented in the tropical lowland of Malaysia; most species occur in the hills or in the montane zone. The highest localities are reached by *Wahlenbergia confusa* Merr. & Perry in New Guinea between 3500 and 4000 m, while some other *Lobelia* species are well up in the subalpine zone.

As to the climate almost all representatives belong to the undergrowth of the rain-forest. Exceptions are *Sphenoclea* which grows on damp soils and is indifferent to climate, *Lobelia alsinoides* which is bound to a seasonal lowland climate, and *Lobelia nicotianaefolia*, *Wahlenbergia marginata*, and *W. hookeri* which are obviously bound to a seasonal montane climate.

No Malaysian *Campanulacea* occupies a very special ecological niche and none occurs gregarious to an extent worthy of note.

Flower biology. Nothing is known about this subject for Malaysian representatives. It is certain that protrandry prevails in the family; the pollen is often shed in bud and the growing style, which is mostly provided with hairs, pushes the pollen up above the anthers. It has been said that apids collect it and would effect cross-pollination. In *Wahlenbergia* the stamens shrivel very soon. The stigma opens at a much later stage. Autogamy is, however, not entirely excluded in this way. Docters van Leeuwen (1933) emphasized that in *Wahlenbergia marginata* autogamy is the rule.

The long-tubed *Lobelias* are said to be adapted to be visited by birds and *L. nicotianaefolia* might fall under this category, but no data are available on this species. It is remarkable that also *L. montana* has scentless flowers; neither Docters van Leeuwen (1933) nor I myself have ever observed insects visiting the showy flowers. As fruit production is abundant, Docters van Leeuwen concluded to successful autogamy.

Seed dispersal. Part of the genera have capsular fruits, part of them possess berries; in *Peracarpa* the fruit is indehiscent. In all cases the seeds are numerous and small. As all but one are of delicate or creeping habit and live mostly in shaded habitats the chance that wind may have an appreciable effect can be neglected, save for the few subalpine *Lobelias* and *Wahlenbergia* which are exposed to mountain winds.

Also for the species with berries the way of dispersal is rather obscure. I have often found the very large showy berries of *Codonopsis javanica* and *Lobelia montana* entirely untouched and shrivelling on the plant. There is, therefore, no indication that seed dispersal is likely to cover large distances.

Only for *Lobelia angulata* RIDLEY (Disp. 1930, p. 508) recorded that its small berries are, according to the ornithologist H. C. ROBINSON, a favourite food of the tree partridge, *Arborophila campbellii*. The distribution of this mountain bird coincides indeed remarkably well with the localities of the plant: from the Himalaya to Formosa and the Sunda Islands. And Dr JUNGE tells me that there are allied *Phasianinae* in East Malaysia and Australia; in South America this group is replaced by the *subfam. Odontophorinae* which may take over dispersal. However, we have no proof that the seeds pass the intestinal duct undamaged and that the eating of the berries is indeed effective for the intensive and wide dispersal of the seeds.

Lobelia chinensis is often seen along stream banks and this would point either to dispersal of seeds by water, or to aquatic transport of rhizomes.

Laurentia longiflora which is introduced and very common on ruderal places is also often found in damp places near streams and ditches; its seeds may be locally transported by water, as they are said to be water-repellent. It is sometimes also found on old walls which would point to dispersal by ants, but as far as I know the seeds of *Campanulaceae* have no aril or elaiosome.

Anatomy. METCALFE & CHALK (Anat. Dic. 2, 1950, 821) confirmed the close relationship between the *Lobeliaceae* and *Campanulaceae* which they find reflected in many similarities between the two families. Within the *Campanulaceae* they admitted that *Sphenoclea* and *Pentaphragma*, which are both not laticiferous, show some deviating anatomical characters. They expect that laticiferous canals probably occur in all genera of the *Campanulaceae*. The question arises why the *non*-laticiferous *Goodeniaceae* are kept separate from this complex; by the development of the indusium below the style they obviously represent a specialized branch of the same stock.

Chromosomes. The number of the chromosomes of the *Campanulaceae* and *Lobeliaceae*, as found in DARLINGTON & WYLIE's 'Chromosome Atlas' (1955) provide a rather confusing picture, in contrast with for example the allied *Goodeniaceae* which show in 7 publications on 4 genera constantly n = 8.

In *Campanulaceae* the basic numbers vary considerably, sometimes even in taxonomically coherent genera, *e.g. Phyteuma* in which is found n = (6), 12, 13, 14, and in *Jasione* n = 6 and 7. In *Campanula* the situation is even n = 8, 10, 12, 13, 14, and 17. Also within the species the numbers may vary, although not as aneuploids, but as polyploids, with some irregularities. Polyploidy seems to be very common indeed.

Phytochemistry. This family has not been studied intensively by phytochemists. The facts known point on the one hand to many metabolic similarities between the two great subfamilies, *Campanuloideae* and *Lobelioideae*, and on the other hand to marked differences. *Campanulaceae sensu lato* are characterized by local accumulation of silicic acid and/or carbonate of lime in epidermal cells of the leaves, especially in the hairs and neighbouring cells. Furthermore all *Campanulaceae* accumulate inulin and/or inulin-like oligo- and polyfructosans in their vegetative organs. The tendency to accumulate fructosans is even more accentuated in this family than in *Compositae*. In *Campanulaceae* fructosans are synthesized not only by perennial species but also by the annual ones as COLLIN and CHOLLLET have demonstrated. In the seeds fatty oils are stored. Flavonols and leucoanthocyanins are usually absent from the leaves of *Campanulaceae* but ferulic and/or sinapis acid are of common occurrence. All *Campanulaceae* contain articulated, ramified latex vessels in the phloem. The constituents of latices seem to be different in the two subfamilies:

Campanuloideae: The chemistry of latices of this taxon is practically unknown. Phytosterols and a phenolic glycoside, called campanulin, have been demonstrated to occur in the latex. Alkaloids or other toxic principles are not known to be present.

A saponin, platycodin, was isolated from the roots of *Platycodon grandiflorum* DC. but saponins are by no means widely distributed in the subfamily. Caffeic acid on the other hand seems to be a phenolic constituent frequently present in the leaves.

Lobelioideae: Many species of this subfamily are known to be toxic. The toxic principles are alkaloids accumulated in the latex. Many different alkaloids were demonstrated to be present in *Lobelia* and *Isotoma* species. The medicinally used North American *Lobelia inflata* L. has been thoroughly investigated for alkaloids. This plant produces about 30 alkaloids which seem all to be related structurally to lobeline, an α, α^1-disubstituted-N-methylpiperidine base. The alkaloids of all other species of *Lobelioideae* are very imperfectly known. There is, however, no doubt that other types of alkaloids occur in the subfamily. *Lobelioideae* are also characterized by the occurrence of chelidonic acid in the majority of species. On the other hand caffeic acid seems to be absent from this subfamily. Ellagic acid was found in *Centropogon lucyanus* SCHÖNL. which also contains a little leucocanthocyanin in the leaves.

Some species of *Lobelioideae* are reported to accumulate a fair amount of rubber in their latices.

Finally it may be stated that by the accumulation of inulin-like fructosans the family is related to *Goodeniaceae*, *Stylidiaceae*, and *Compositae*, and by the articulated latex bearing vessels to the *Cichorieae* subfamily of *Compositae*. These indices of relationship are, however, rather weak. A thorough chemotaxonomical discussion of *Campanulaceae s.l.* must be postponed until the chemistry of the family has been more thoroughly explored.—R. HEGNAUER.

Taxonomy. AIRY SHAW has recently suggested to 'purify' the *Campanulaceae* by raising the genera

Pentaphragma and *Sphenoclea* to the status of family, suggesting that the latter genus would only be remotely allied to *Campanulaceae* but more to *Phytolaccaceae*. Though it should be admitted that both genera deserve a special status in the family I agree with WIMMER and HUTCHINSON (Fam. Fl. Pl. ed. 2, 1, 1959, 477), who keep them together in the *Campanulaceae*.

There seems little in favour of separating *Campanulaceae* and *Lobeliaceae* as they remain side by side. And in the latter family there are many genera and species which can hardly be termed zygomorphous; also there is degree in the connation of the stamens.

The Malaysian genera can be arranged as follows:

1. *Tribus* **Campanuleae** BTH.: *Peracarpa*, *Wahlenbergia*, *Codonopsis*.
2. *Tribus* **Sphenocleae** SCHÖNL.: *Sphenoclea*.
3. *Tribus* **Pentaphragmeae** SCHÖNL.: *Pentaphragma*.
4. *Tribus* **Lobelieae** BTH.: *Lobelia*, *Phyllocharis*, *Laurentia*.

The affinity of the Campanulaceae seems distinctly fixed with the *Stylidiaceae*, *Goodeniaceae*, and *Compositae*, on morphological, phytochemical, cytogenetical, and anatomical grounds.

The classification of the major groups within the family seems also rather well established.

Generic distinction has been liable, however, to difference of opinion and in this revision has amply been discussed under *Codonopsis*, *Wahlenbergia*, *Laurentia*, and *Lobelia*. A century ago, when few species were known, genera could often be more or less easily defined, but as more species were found these accepted generic distinctions have often broken down in a number of species ('links'), necessitating a revision of generic limits. This revision of the hierarchy within the family can logically not be performed without either merging genera or segregating others to bring the mutual relations into balance, *i.e.* bringing taxa of the same rank on a ± common footing. In either case we have to face name changes. The latter procedure (segregation) has several manifest disadvantages against the former (large genera, subdivided into sections and subsections), *viz* that the number of generic names becomes confusingly large, and what is more regrettable, generic names become not any longer bound to some clear structural plan, but to small details, which seem rather technical than structural. Segregation will also necessitate the breaking up of genera which nobody wants to break up, because if we split up *Wahlenbergia sens. lat.* into 10–20 genera, it would be absurd to leave *Campanula* intact, as this would greatly upset the standard of the generic level within the family. A further disadvantage will be the increase of monotypic genera, as for those in favour of a larger number of genera, the only means to 'remove' links is to bring them to the generic level in their own right. But most undesirable consequences hover over the splitting procedure, because this is not the end: many novelties wait for exploration and description, and it is almost certain that among them there will be still more 'links' threatening the limits of the so-called small, uniform genera. Finally I find a great disadvantage with the small genera because in a family where the characters are so 'variable', detailed technical characters are no guarantee for common ancestry and are likely to be at least in part artificial. This will namely always be the case where species are reticulately allied. In reticulate affinities, which are obviously mostly a consequence of proportionally recent speciation[1], one will always find 'links' in attempts to subdivide such an affinity. The cytogenetical data emphasize that such a situation is found in the family.

The merging of genera is often objected with the practical argument that genera become too large and so-called 'unwieldy'. We have, however, to accept that there are large genera on which all agree that they should not be segregated, for example *Carex*, *Ficus*, *Acacia*, *Rhododendron*, *Fimbristylis*, *Astragalus*, *Bulbophyllum*, *Dendrobium*, *Malaxis*, *Calamus*, *Eugenia*, *Eucalyptus*, *etc.*

The classical, proper way to deal with these genera is to subdivide them into a hierarchy of infrageneric levels as good as we can. Segregation in such genera will never be useful, the more we learn about them.

Most recent specialists on the *Campanulaceae* agree with this view (WIMMER, MCVAUGH, NANNFELDT, and others), but some are reluctant because of name changes; as said before this cannot be remedied by segregation which will result into even more name changes. I fully agree with Dr MEIKLE, who wrote me: —"I am not happy about generic distinctions in *Campanulaceae*, and wonder if a resurvey of the family could not now be considered". As far as was compatible with the scope of the present revision we have found fit to make a small contribution towards improving generic delimitation; the necessity of name changes should, in our opinion, never be an impediment towards a real improvement of a taxonomic system.

In this revision, for which my two keen collaborators have examined much more extra-Malaysian material and have studied more literature than strictly necessary, it has been shown impossible to keep *Campanumoea* separate from *Codonopsis*, further to keep *Cephalostigma* and *Lightfootia* apart from *Wahlenbergia* which itself is very close to *Campanula*. A more serious deviation from current usage is the merging of *Pratia* with *Lobelia*, as the first was, by its berried fruit, mostly arranged widely apart from the capsular genera of *Lobelioideae*. The same discrepancy is, however, found in *Codonopsis* where berried and capsular fruits are found in one distinctly natural genus. It would appear that a subdivision of *Lobelieae* based only on the structure of the fruit (capsular or berried) is artificial.

[1] The remarkable development of a large number of species of *Lobelia cq.* genera with arboreous habit on the high African volcanoes and the Hawaiian Islands point in the same direction.

Specific variability. As is usual some species have proved more variable than others and after due examination of much extra-Malaysian material some have been accepted in a wider sense than mostly employed, notably *Wahlenbergia marginata, Lobelia angulata, L. nicotianaefolia, Codonopsis javanica,* and *C. lancifolia,* all of which show a wide area of distribution. Variable species are not unknown in the family, as even STEARN, who is certainly not particularly in favour of extreme lumping, felt baffled with the astonishing variability of *Campanula rotundifolia.* Part of this variation is according to the cytogenetical data due to the occurrence of chromosome races, part of it can be ascribed to raciation whether or not effected by isolation on islands. In most cases we have refrained from giving names to these races, as a proper naming should only be achieved after much more detailed field study combined with cytological and experimental-taxonomical research.

Also random paramorphs are common; as has already been remarked by SCHÖNLAND (in E. & P. Pfl. Fam. 4, 5, 1894, 43) there is a great variability in the numbers of the floral parts; see also under *Wahlenbergia marginata.*

Uses. HEYNE *l.c.* has enumerated the few, minor uses recorded in Malaysia. Some exotic species are cultivated as ornamentals; they have been enumerated at the end of the family and under *Lobelia* a key has been given to five cultivated species of that genus. It must be emphasized, though, that most *Campanulaceae* can in the tropics only successfully be grown in the montane zone.

Notes. Mr MOELIONO is responsible for revising *Lobelia, Codonopsis,* and *Peracarpa,* Mr TUYN for *Laurentia, Phyllocharis,* and *Wahlenbergia.* The drawing of the family description, the introductory notes, and key to the genera has been my privilege.—VAN STEENIS.

KEY TO THE GENERA

1. Anthers during anthesis free. Flowers regular.
 2. Flowers in dense spikes.
  3. Leaves very large and wide, asymmetrical, alternate. Spikes one-sided (scorpioid), axillary. Petals or corolla segments valvate. Fruit an indehiscent berry. See vol. 4, p. 517. **5. Pentaphragma**
  3. Leaves symmetrical, lanceolate, spirally arranged. Spikes regular, not scorpioid, terminal. Corolla lobes imbricate. Capsule circumsciss-dehiscent, opening with a lid. See vol. 4, p. 27. **4. Sphenoclea**
 2. Flowers solitary or in cymes, racemes or panicles.
  4. Leaves at least partly (lower ones) decussate. Base of the corolla tube adnate to the ovary. Fruit (in Mal. *spp.*) a berry . . . . **3. Codonopsis**
  4. Leaves spirally arranged or distichous. Corolla not adnate to the ovary. Fruit capsular.
   5. Erect or slightly ascending herbs. Flowers blue or white, terminal. Capsule loculicid, with 2–3 apical valves . . . . **2. Wahlenbergia**
   5. Prostrate, creeping, delicate herb, rooting at the nodes. Flowers solitary, axillary, white. Capsule indehiscent . . . . **1. Peracarpa**
1. Anthers and mostly part of the filaments connate during anthesis. Corolla dorsally often slit to near the base, often zygomorphic.
 6. Corolla white, tube 7½–11 cm long, narrow-cylindric, not dorsally slit, almost actinomorphic. Stamens inserted high in the tube (in Mal. *sp.*) . . . . **8. Laurentia**
 6. Corolla much smaller, at most *c.* 3 cm long, generally distinctly zygomorphic, tube dorsally mostly deeply slit. Filaments free at the base or inserted on the base of the corolla tube.
  7. Flowers solitary, through connation with the leaf epiphyllous . . . . **7. Phyllocharis**
  7. Flowers arranged in various ways, not epiphyllous . . . . **6. Lobelia**

1. PERACARPA

HOOK. *f.* & TH. J. Linn. Soc. Bot. 2 (1858) 26; FEER, Bot. Jahrb. 12 (1890) 620, t. VII B.

Prostrate, creeping herb; stem terete, rooting at the nodes. Leaves spiral. *Flowers* 5-merous, actinomorphous, solitary, axillary, sometimes terminal. *Sepals* free, erect. *Corolla* campanulate, 5-lobed. Disk fleshy, semiglobose, 3-sulcate. Stamens 5, free from the corolla. Ovary 3-locular; ovules ∞; style simple; stigma 3(–4)fid. *Capsule* pyriform, pendulous, with a thin pellucid wall, lengthwise nerved, not dehiscent, pericarp swollen above the oblong seeds.

Distr. Monotypic, from the Himalaya to Kweichow, Japan, and Formosa, in *Malaysia:* Philippines (N. Luzon), only in the mountains.

1. **Peracarpa carnosa** (WALL. in Roxb.) HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 26; CLARKE, Fl. Br. Ind. 3 (1881) 437; FEER, Bot. Jahrb. 12 (1890) 620, t. 7B; CRAIB, Fl. Siam. En. 2 (1936) 308; YAMAMOTO, Obs. Fl. Form. 13 (1936) 149; HARA, J. Jap. Bot. 21 (1947) 20;

MAKINO, Ill. Fl. Japan (1954) 82, *incl. var. circaeoides*.—*Campanula carnosa* WALL. in Roxb. Fl. Ind. 2 (1824) 102; Cat. (1828) *n*. 1282; DC. Prod. 7 (1839) 474.—*Campanula circaeoides* FR. SCHMIDT *ex* MIQ. Ann. Mus. Lugd. Bat. 3 (1867) 195, 204; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1889) 9.—*P. circaeoides* FEER, Bot. Jahrb. 12 (1890) 621; FEDOROV, Fl. U.R.S.S. 24 (1957) 380.—*P. luzonica* ROLFE, Kew Bull. (1906) 201; MERR. & MERRITT, Philip. J. Sc. 5 (1910) Bot. 392; MERR. En. Philip. 3 (1923) 586.

A weak, branching succulent herb up to 16 cm long. *Leaves* broad ovate to ovate, 4–30 by 4–20 mm, cordate or truncate, entire or crenate, acute or obtuse, both sides puberulous, the underside sometimes glabrous; petiole as long as to a little shorter than the leaves, 4–25 mm, glabrous. *Flowers* 5–12 mm. Pedicels 6–30 mm. *Sepals* 5, free, subulate, sometimes triangular, ½—1(—1½) by ½ mm, entire, glabrous. *Corolla* 3–12 mm, campanulate, varying from blue to white; lobes 5, for up to ⅓ connate, nearly equal, elongate to elliptic 2¾–10 by 1–2 mm, entire, acute or obtuse, glabrous. *Stamens*: anthers *c.* 1 mm, glabrous; filaments linear, broadened to the base, 2–4 mm, finely haired, sometimes glabrous. *Ovary* obconical to campanulate, 1½–3 by 1–2 mm, glabrous; style simple, glabrous, rarely hairy, with narrow stigmas. *Fruit* ovoid to obovoid, 3–5 by 3–5 mm, with a very thin wall, pendent on the pedicels. *Seeds* fusiform-ellipsoid, 1–1½ mm, brown and smooth.

Distr. SE. Asia: N. India (Himalaya), Siam, S. China (Yunnan, Kweichow), Japan, and Formosa; in *Malaysia*: Philippines: Luzon (Benguet and Lepanto: Mt Osdung; Mt Pulog) and Panay.

Ecol. In moist mountain (oak) forest, at the base of trees, 1450–3000 m. *Fl. fr.* Febr.–June.

2. WAHLENBERGIA

SCHRAD. [Pl. Sem. Hort. Ac. Gott. 1814, p. 3, *nom. nud.*] *ex* ROTH, Nov. Pl. Sp. (1821) 399, *nom. gen. cons.*, *cf.* STEEN. Taxon 9 (1960) 125; ?D. DON, Prod. Fl. Nep. (1825) 156; SCHRAD. Blumenbachia, *etc.* (1827) 123; RCHB. Ic. Pl. Rar. cent. 5[8] (1827) 47, t. 480; SCHRAD. Comm. Gott. 6 (1828) 123; DC. Mon. Camp. (1830) 129; BREHMER, Bot. Jahrb. 53 (1915) 9; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 201.—*Lightfootia* l'HÉRIT. Sert. Angl. (1789) 4, t. 4, *non* SW. 1788 (*Flac.*), *nec* SCHREB. 1789 (*Rub.*); R. S. ADAMSON, J. S. Afr. Bot. 21 (1955) 155.—*Campanula sect. Campanopsis* R. BR. Prod. (1810) 560.—*Cervicina* DELILE, Fl. d'Egypte (1813) 7, Atlas t. 5, f. 2, *nom. gen. rejic.*—*Cephalostigma* DC. Mon. Camp. (1830) 117.—*Campanulopsis* ZOLL. & MOR. Nat. & Geneesk. Arch. Nêerl. Ind. 1 (1844) 484, *nomen; cf.* STEEN. Bull. Jard. Bot. Btzg III, 17 (1948) 463.—*Campanopsis* O.K. Rev. Gen. Pl. 2 (1891) 378, *nom. illeg.*

Annual or perennial, erect or ascending herbs, sometimes woody at the base. Stems simple or branched, glabrous or hairy. *Leaves* (in Mal.) mostly sessile, spirally arranged, hairy or glabrous, elliptic to linear, seldom obovate or spathulate, margins mostly thickened, shallowly dentate or almost entire. Inflorescence (or flowers) terminal or axillary, usually sparsely flowered. Bracts narrow, small. Pedicels glabrous or hairy. *Flowers* distinctly protrandrous, regular, mostly blue or white. *Calyx* inferior to (in Mal.) superior, lobes 3–6 (in Mal. 3–5), acute, blunt or slightly acuminate, triangular to linear, persistent. *Corolla* 5- or 4-partite, or a 3–6- (in Mal. 3–5-) lobed tube, sometimes inside bearing slender hairs. *Stamens* 5, alternate with corolla lobes, free; anthers narrow; filaments membranous, broad or broadened at the base, ciliate, the apical part often recurved. Style about as long as corolla tube, or longer, lengthening during anthesis, the basal part sometimes bearing long, slender hairs, the upper portion sometimes with short bristle-like hairs, sometimes bearing warts at or near the base of the stigmatic lobes; stigmas 2–3 (in extra-Mal. *ssp.* up to 5), spreading late in anthesis. *Ovary* inferior (in Mal.) to superior, 2–3-celled (in extra-Mal. *spp.* up to 5-celled). *Capsule* loculicid, opening by as many apical valves as there are cells in the ovary. *Seeds* ∞, ellipsoid or triangular, shining, up to 1 mm.

Distr. Large genus, possibly comprising more than 150 *spp.*, almost cosmopolitan, with the bulk of the species on the southern hemisphere, specially in Africa. In continental Asia and Malaysia only a few species. Roughly it forms a geographical and taxonomical complement to *Campanula*, which is mainly a northern hemisphere genus.

Ecol. Extremely variable, preferring open localities in steppe, savannahs, and at high altitudes, the four Malaysian species only on the mountains.

Flower biology. The flowers are distinctly protrandrous. The sticky pollen is shed already in bud, and covers in great masses the upper portion of the style and the stigmatic lobes, concealing their shape and structure. The anthers are withering in early anthesis and are often not found in fully opened flowers. The margins and/or lobes of the filaments are incurved. Their filiform apex is mostly recurved and closely appressed to the widened central portion of the filaments. The stretching of older filaments, which are so frequent in the herbarium, is a very delicate work. All other floral parts are growing during flowering, which makes it very difficult to extract exact measurements from herbarium material. The stigmatic lobes are spreading in a later stage. The hairs that are sometimes found on the inside of the corolla and on the style seem to fall off later.

Taxon. After ample consideration we have in this revision combined the genera *Lightfootia* and *Cephalostigma* with *Wahlenbergia* and feel compelled to give our reasons for this conclusion. A century ago, when few species were known, it was rather easy to separate and define these three genera, though all of them are only separated from *Campanula* by the apical dehiscence of the fruit. *Lightfootia* would be characterized against *Wahlenbergia* by the deeper incised corolla, the narrower corolla lobes, and the style, which would be proportionally longer if compared with the corolla. *Cephalostigma* would be closest to *Lightfootia* in having a narrow-lobed, very deeply incised corolla and a simple knob-like stigma. The latter observation of DE CANDOLLE was erroneous: there are three short lobes which form in outline a more or less globular whole.

In proportion to the tremendous increase in described species the already not particularly strong differences have gradually become vague and VON BREHMER (1915, *l.c.*) in a thorough study of the African species of *Wahlenbergia* came to the conclusion that a sharp separation of the genera *Wahlenbergia* and *Lightfootia* cannot be upheld because in both genera so many different combinations are represented (by different species), that the differential characters imperceptibly merge into one another. His scheme of style and stigma structure in the various groups of species (*l.c.* p. 12) showed that no demarcation can be drawn. He maintained both names because of his 'personal aversion' to use the nomenclaturally older name *Lightfootia* l'HÉRIT. 1789 for the *Wahlenbergias* which he assumed to be older in the phylogeny, excusing this curious conclusion by stating that in the *Campanulaceae* genera are often distinguished by "sekundäre" characters. Dr R. S. ADAMSON, *l.c.*, could not find more convincing arguments and merely referred to VON BREHMER. In a recent letter he kindly elucidated his standpoint, admitting that there is not any key character that would separate the two genera; for the South African species the corolla and style characters work fairly well, but "these features break down for some of the *Lightfootia* species in tropical Africa which I feel do not really belong to the genus". He continues: "I do not feel in favour of placing the whole lot in one comprehensive genus. This would possibly be the most logical but would be very unwieldy, would entail a lot of name changes, and would tend to obscure some geographical lines of development. My own feeling is rather to increasing the number of genera. The two in question could with advantage both be split up. The smaller units would admit of key diagnosis. I am not sufficiently familiar with the extra-S. African species to attempt even an outline".

Mr CANNON of the British Museum (Nat. Hist.), Botany Department, though making the provision that he has no specialized knowledge of the group, kindly commented to us that in his opinion "it does not seem that the grounds for keeping the genera separate are anything more than mere convenience. Presumably merging the genera would bring about a large number of new combinations, but this can scarcely be regarded as a valid reason for not adopting what appears to be the scientifically correct course of action".

Finally, Dr R. D. MEIKLE, Kew, granted us the privilege of his opinion: "Quite frankly, I think that all the supposed distinctions are untenable, and I would certainly unite the two genera. I suspect the nomenclatural consequences have alone dissuaded others from doing so. I can see no good reason for conservation of either, and even if the change calls for a lot of new combinations, that simply cannot be helped".

To a serious matter like this, where we deal in this Flora with only few species of a large, worldwide distributed aggregate, we think ample consideration should be given to the opinion of specialists.

What should be strived at, specially in generic distinction, is a balanced system of recognizable units at about one level throughout the family which are structurally more or less comparable, though these units may differ considerably in the number of species. We can expect that with increase in the number of species described through intensified exploration, generic limits which were once clear may entirely disappear. From the scientific standpoint we should not leave such cases unattended, but should try to improve our insight in the family by applying a sound generic distinction.

In this case there is unanimity about the evaluation of the facts, but there is difference of opinion about the course we should take in future. Scientifically we cannot share the aversion of VON BREHMER, neither to required name changes nor to his argument of phylogeny, as for the latter the nomenclature is entirely irrelevant.

Dr ADAMSON's perspective we feel we cannot share either, because we see no advantage in segregation in this case. Firstly it is not certain that it would really be possible, but if we discard this doubt for a moment, secondly it would lead to a large number of small genera ranking taxonomically below the generic level proper and disturb the hierarchy within the family. Naturally, subgenera are generally more "natural" than genera and sections more natural (coherent) than subgenera, and so forth descending in the ranks. But the advantage to have a large genus *Wahlenbergia* is that of generic balance in the family whilst Dr ADAMSON's desire for coherent units can well be fulfilled by distinguishing *within* the genus the natural subgeneric taxa in various ranks. A similar procedure has been followed within other natural, but very large genera, as in *Astragalus*, *Bulbophyllum*, *Carex*, *Dendrobium*, *Ficus*, *Eucalyptus*, *Acacia*, *etc.* I assume this infrageneric distinction will be similarly satisfactory in *Wahlenbergia sens. lat.* and will meet the needs for distinction of natural units felt by Dr ADAMSON.

As to the third genus, *Cephalostigma*, DE CANDOLLE erroneously stated (1830, *l.c.* 56) that it would deviate from *Lightfootia* by a "stigma en tête" (*capitatum, simplex, l.c.* 117); he assumed it to be intermediate between *Wahlenbergia* and *Lightfootia*. Really, the stigma has afterwards always been described as consisting of 3 lobes, as in the other genera. Consequently *Cephalostigma* cannot be upheld, as its stigmatic form is also found in *Wahlenbergia*.

Nomencl. Though *Lightfootia* l'HÉRIT. is the oldest name, it is a later homonym of *Lightfootia* Sw. (see for publication dates Fl. Mal. I, 4, 1954, cxcvii, ccxiv). Fortunately more species have been described under *Wahlenbergia* than under *Lightfootia*, so that the smallest possible amount of transfers will be necessary.

KEY TO THE SPECIES

1. Petals narrow, almost free. Capsules with as many lengthwise nerves as there are calyx lobes.
  2. Ovary hispid. Seeds ellipsoid, compressed. Filaments 3-lobed . . . . **1. W. erecta**
  2. Ovary glabrous. Seeds trigonous. Filaments narrow triangular . . . . . . **2. W. hookeri**
1. Corolla with a distinct tube, much longer than the calyx lobes. Capsules with twice as many nerves as calyx lobes.
  3. Filaments very narrow triangular. Fruit wider than long, 3-celled. Calyx lobes longer than the ovary. Corolla tube about twice as long as the calyx lobes (sometimes longer). Corolla (stretched) 12–18 mm. **3. W. confusa**
  3. Filaments abruptly narrowed about halfway, the basal part about pentagonal, deltoid, or pseudo-2-lobed. Fruit longer than wide, 2–3-celled. Calyx lobes shorter or longer than the ovary. Corolla tube shorter or longer than the calyx lobes (never more than twice as long). Corolla (stretched) 2½–12 mm (in *var. grandiflora* 15–25 mm) . . . . **4. W. marginata**

1. Wahlenbergia erecta (ROTH *ex* R. & S.) TUYN, *nov.comb.*—*Dentella erecta* ROTH *ex* R. & S. Syst. Veg. 5 (1819) 25, *ex descr.*; Nov. Pl. Sp. (1821) 140; CHAM. & SCHLECHTEND. Linnaea 4 (1829) 151; DC. Prod. 4 (1830) 419.—*Dentella perotifolia* WILLD. *ex* R. & S. Syst. Veg. 5 (1819) 25, *descr. in syn.*, *nom. illeg.*; DC. Prod. 4 (1830) 419.—*W. perotifolia* W. & A. Prod. (1834) 405, *nom. illeg.*; DC. Prod. 7 (1839) 434; WIGHT, Ic. Pl. Ind. 3 (1844–45) 4, t. 842.—*Cephalostigma schimperi* HOCHST. *ex* RICH. Tent. Fl. Abyss. 2 (1851) 2; CLARKE, Fl. Br. Ind. 3 (1881) 428; TRIM. Fl. Ceyl. 3 (1895) 58.—*Cephalostigma erectum* (ROTH) VATKE, Linnaea 38 (1874) 699, *quoad specim. pro parte*.—**Fig. 1h-i.**

Annual, erect herb. Stems 5–10 (–35) cm, flexuose, branched, blunt-angular, the angles pale elevated lines, patently ± hispid-hairy. *Leaves* 5–20 by 1½–6 mm, spirally arranged (sometimes almost distichous), sessile, oblong, sometimes elliptic, acute, mostly obtuse at the base, sparsely hairy (hairs especially along the midrib) or almost glabrous, margin thickened, undulate shallowly and remotely dentate. *Flowers* axillary and terminal. Pedicels 5–10 mm, filiform, hairy. *Calyx* lobes 5, 1½–3 mm, linear to narrow-triangular, acute, outside sparsely patently hairy. *Corolla* 5-parted, segments linear acute about as long as the calyx lobes. *Stamens* 5, anthers 0.5 by 0.2 mm; filaments 0.8 mm, membranous, broad at the base, 3-lobed, the side lobes small, the middle lobe bearing the anther. *Ovary* 2–2½ mm, bell-shaped to obconical, patently hispid-hairy (hairs up to ½ mm), top conical, apparently lengthening during anthesis to about 1½ mm; style 1½ mm, narrow-cylindric, thickened below the apex, with 3 short stigmatic lobes. *Fruit* 2–3 mm, obconic to bell-shaped, 5-nerved, valves 3, before opening forming a glabrous cone 1–1.7 mm high. *Seeds* ∾, compressed-ellipsoid, shining, brown, ½ mm.

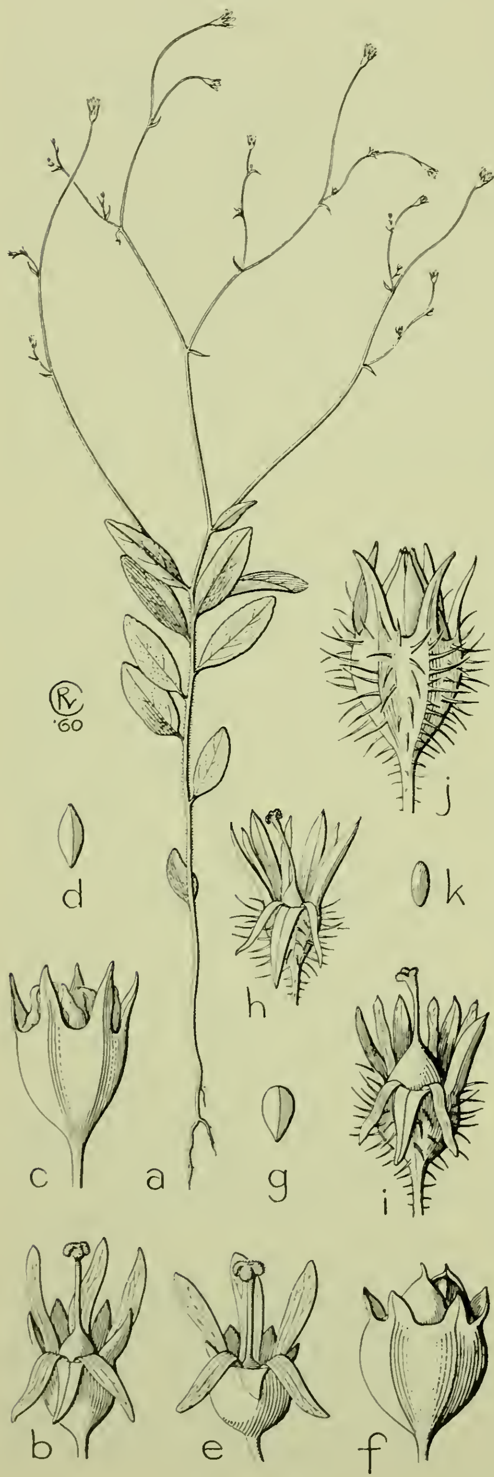
Distr. East Africa, ?Ceylon, India (the Deccan and Khasya), in *Malaysia*: North Sumatra (Karo and Toba-Batak Highlands). According to TRIMEN, *l.c.*, probably not in Ceylon.

Ecol. Open, heath-like land and waste places, 750–1400 m.

Vern. *Dukut tawar*, Karo-Batak.

Note. This species has sometimes been confused with *W. hirsuta* (EDGEW.) TUYN, *nov.comb.*[1] (*Cephalostigma hirsuta* EDGEW. Trans. Linn. Soc. 20, 1846, 81); the latter has also a hispid ovary but trigonous seeds.

[1] The name *Wahlenbergia hirsuta* STEUD. Nomencl. ed. 2, 2, p. 782, is a *nomen nudum* and has no nomenclatural status.



2. Wahlenbergia hookeri (CLARKE) TUYN, *nov.comb.* —*Cephalostigma hookeri* CLARKE, Fl. Br. Ind. 3 (1881) 429; DANGUY, Fl. Gén. I.-C. 3 (1930) 690; CRAIB, Fl. Siam. En. 2 (1936) 307.—*Cephalostigma paniculatum* (*non* DC.) HOSSEUS, Beih. Bot. Centr. Bl. 28, ii (1911) 446.—**Fig. 1a-g.**

Slender annual herb, erect. Stems 10–20 cm, hairy. *Leaves* 10–30 by 4–9 mm, (sub) petiolate, oblong, elliptic, obtuse or acute, hairy, margin thickened, crenate, shallowly dentate. *Inflorescence* slenderly branched, glabrous or nearly so, bracts 4 by 1 mm, or (mostly) smaller, pedicels 4–30 mm, filiform. *Calyx* lobes 5, 1–1.2 mm, elongate-triangular, acute, sometimes with a few hairs at the apex, further glabrous. *Corolla* 5-parted, 2 by 0.4 mm, about twice the length of the calyx lobes. Stamens 5; anthers 0.4 by 0.1 mm; filaments 1 mm, narrow triangular, sometimes almost filiform. *Ovary* 1—1½ mm, bell-shaped to obconic, glabrous; top conic, up to 1 mm high; style 1.3–1.6 mm, narrow-cylindric, 3 short narrow stigmatic lobes. Fruit (only one seen, in poor condition) 2 by 2 mm, semispherical, 2-valved. Seeds numerous, triangular, brown, shining, 0.6 mm.

Distr. India (Behar, Khasya), N. Siam (Doi Sutep), in *Malaysia*: East Java (Mt Idjen: L. VAN DER PIJL 144, BO, L, K), only once collected, June 1929.

Ecol. In reed stands (?*Themeda*), probably *c.* 1000—1200 m alt.

Note. Differs from *Wahlenbergia candollei* TUYN, *nom.nov.* [*Cephalostigma paniculatum* DC. Mon. Camp. (1830) 117, *non Wahlenbergia paniculata* (THUNB.) DC. *l.c.* p. 153] in its smaller flowers and the bell-shaped, not obconic ovary.

The shape of the seed in the Indian and the Javanese material is elliptic, in the only specimen from Siam (HOSSEUS 225) the seeds are more obovate.

3. Wahlenbergia confusa MERR. & PERRY, J. Arn. Arb. 22 (1941) 383.—**Fig. 2.**

Probably perennial, usually glabrous, sometimes stem and leaves (midrib, margin) with sparse bristle-like hairs. Stems ascending, 10–25 cm long, sulcate. *Leaves* ± uniform in shape, thickish, 2–11 by ½–3 mm. *Flowers* solitary. Pedicels 2–7 cm. *Calyx* lobes 5, ± spreading, linear-lanceolate, acute to acuminate, usually entire, always longer than the ovary, 2½–4 mm long. *Corolla* tube about twice as long as the calyx lobes, sometimes longer, 6½–8 mm; lobes 5, ovate, acute, 5–10 mm. Filaments linear-triangular, 2½–3½ mm. *Ovary* obconical, 3-celled, 1.2–3 mm; style slightly

Fig. 1. *Wahlenbergia hookeri* (CLARKE) TUYN. *a.* Habit, × ⅔, *b.* flower, stamens removed, × 7, *c.* fruit, × 7, *d.* seed, × 13, *e.* flower, stamens removed, × 7, *f.* fruit, × 7, *g.* seed, × 13.—*Wahlenbergia erecta* (ROTH *ex* R. & S.) TUYN. *h–i.* Flowers, stamens removed, × 7, *j.* fruit, × 7, *k.* seed, × 13 (*a–d* VAN DER PIJL 144 (E. Java), *e–g.* HOSSEUS 224 (Siam), *h–k* LÖRZING 7190 (N.Sumatra).

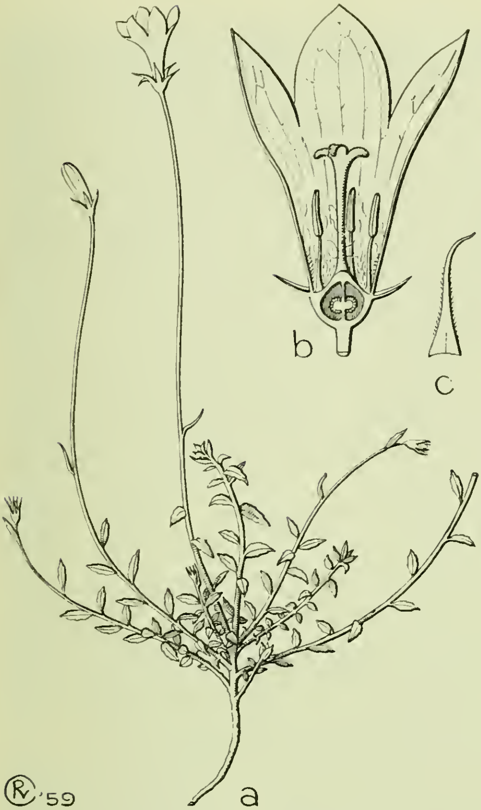


Fig. 2. *Wahlenbergia confusa* MERR. & PERRY. *a.* Habit, × ⅔, *b.* longitudinal section of flower, × 2, *c.* filament, × 6 (BRASS 9399).

shorter than the corolla tube, 5½–7 mm; stigma 3-lobed, (1–)1½–3 mm long. *Fruit* slightly wider than long, 3-valved, 2–3 mm diam., crowned by the recurved calyx lobes.

Distr. *Malaysia*: West New Guinea (vicinity of Mt Wilhelmina).

Ecol. Wet, grassy, open places along streams, once noted on sandstone, 3400–4000 m.

Note. MERRILL compared his new species with *W. eurycarpa* DOMIN (Bibl. Bot. Heft 89, 1929, 638) but already remarked that the fruit in the latter would appear too long. DOMIN himself compared his species with *W. sieberi* and gave the differences with *W. multicaulis* which species I have reduced to *W. marginata*. As DOMIN neither mentions the shape of the filaments nor the relative length of the corolla tube, and as his material is not available to me, I refrain from giving a definite opinion.

4. Wahlenbergia marginata (THUNB.) DC. Mon. Camp. (1830) 143; Prod. 7 (1839) 433; SIEB. Fl. Jap. 2 (1845) 179; KOORD. Exk. Fl. Java 3 (1912) 300; NANNFELDT, Act. Hort. Gothob. 5 (1929) 32; ALSTON, Fl. Ceyl. Suppl. 6 (1931) 176; DOCTERS VAN LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. 2, 31 (1933) 267; HOCHR. Candollea 5 (1934) 290, *cum var.*; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 179; CRAIB, Fl. Siam. En. 2 (1936) 307; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 212, *cum var.*; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 183, p. 5; HATCH, Trans. Proc. R. Soc. New Zeal. 79 (1952) 368, *cum var.*; YUNCKER, Bull. Bern. P. Bish. Mus. 220 (1959) 261.—*Campanula marginata* THUNB. Fl. Jap. (1784) 89.—*Campanula gracilis* FORST. Prod. (1786) 84; R.BR. Prod. (1810) 561, *incl. var.*—*Campanula quadrifida* R.BR. Prod. (1810) 561.—*Campanula dehiscens* ROXB. [Hort. Beng. (1814) 85] *ex* WALL. As. Res. 12 (1816) 571, *cum ic.*; Fl. Ind. 2 (1824) 96.—*Campanula agrestis* WALL. in Roxb. Fl. Ind. 2 (1824) 97; Cat. (1829) 1292.—*Campanula lavandulaefolia* REINW. *ex* BL. Bijdr. (1825) 726.—*W. gracilis* [SCHRAD. Blumenbachia (1827) 38, *in obs.*] DC. Mon. Camp. (1830) 142, *incl. var.*; Prod. 7 (1839) 433; JUNGH. Nat. Geneesk. Arch. Neêrl. Ind. 2 (1845) 48, *cum var. hirsuta* JUNGH.; HOOK. *f.* Fl. Tasm. 1 (1860) 239; BTH. Fl. Austr. 4 (1869) 137; CLARKE, Fl. Br. Ind. 3 (1882) 429; WARB. Bot. Jahrb. 18 (1893) 212; HEMSL. J. Linn. Soc. 30 (1894) 183; BAILEY, Queensl. Fl. 3 (1900) 922; CHEESEMAN, New Zeal. Fl. (1906) 402; DEN BERGER, Trop. Natuur 6 (1917) 104 f. 4; STEARN, Dict. Gard. R.H.S. 4 (1951) 2257.—*W. quadrifida* (R. BR.) DC. Mon. Camp. (1830) 144; Prod. 7 (1839) 433; N. E. BROWN, Gard. Chron. 54 (1913) 316; DOMIN, Bibl. Bot. Heft 89 (1929) 1192; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 210.—*W. dehiscens* (ROXB.) DC. Mon. Camp. (1830) 145; Prod. 7 (1839) 434; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 216.—*W. agrestis* DC. Mon. Camp. (1830) 145; Prod. 7 (1839) 434; WIGHT, Ic. Pl. Ind. Or. 4 (1850) 1175; HOOK. *f.* & TH. Proc. Linn. Soc. Lond. 2 (1858) 21; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 215.—*W. lavandulaefolia* DC. Mon. Camp. (1830) 144; Prod. 7 (1839) 433; ZOLL. Nat. Geneesk. Arch. Neêrl. Ind. 2 (1845) 567.—*W. indica* DC. Mon. Camp. (1830) 146; Prod. 7 (1839) 434; WIGHT, Ic. Pl. Ind. Or. 4 (1850) 1176; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 209.—*W. sieberi* DC. Mon. Camp. (1830) 144; Prod. 7 (1939) 433; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 219.—*W. multicaulis* BTH. in Hügel, En. Pl. Nov. Holl. (1837) 75; DC. Prod. 7 (1839) 433; N. E. BROWN, Gard. Chron. 54 (1913) 337; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 229; STEARN, Dict. Gard. R.H.S. 4 (1951) 2258.—*Campanula sieberi* DIETR. Syn. Pl. 1 (1839) 752.—*Campanula indica* DIETR. *l.c.* 753.—*Campanula littoralis* LABILL. Pl. Nov. Holl. 1 (1844) 49, t. 70.—*Campanulopsis cyanea* ZOLL. & MOR. Nat. Geneesk. Arch. Neêrl. Ind. 1 (1844) 484, *nomen*.—*W. simplicicaulis* DE VRIESE in Lehm. Pl. Preiss. 2 (1846) 241; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 209.—*Lobelia dubia* DE VRIESE in Lehm. Pl. Preiss. 2 (1846) 242.—*Lightfootia gracilis* MIQ. Fl. Ind. Bat. 2 (1856) 567, *cum var. lavan-*

Fig. 3. *Wahlenbergia marginata* (THUNB.) DC. Grassy place near lava rocks, Mt Lawu, East Java (ARENS).

dulaefolia MIQ.—*Campanopsis marginata* O.K. Rev. Gen. Pl. 2 (1891) 378, *cum var. rigida, nom. illeg.*—*Cervicina gracilis* BRITT. Ill. Bot. Cook 2 (1901) 56, t. 182.—*W. bivalvis* MERR. Philip. J. Sc. 1 (1906) Suppl. 242.—*W. gracilenta* LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 217.—**Fig. 3-5.**

Perennial. Stem 3–60 cm, glabrous or hairy, or only pilose in the lower part. *Leaves* linear to elliptic, the lower ones usually tending to be broadest, decreasing in size upwards, 1/5–5½ cm by ½–5 mm. *Inflorescence* 1- to few-flowered. Pedicels 1–15 cm. *Calyx* lobes 3–5, linear-lanceolate, acute or ± obtuse (China), usually entire, sometimes sparsely dentate, usually about as long as the corolla tube, sometimes shorter or up to twice as long, 0.8–4 mm. *Corolla* tube 1–5 mm, lobes 3–5, ovate or elliptic, acute or acuminate, 1.2–7(?) mm. Anthers narrow, ½–2½ mm long; basal part of the filaments about pentagonal or obtrapezoid, abruptly narrowed, the upper portion filiform, 0.8–2 mm. *Ovary* obconical bell-shaped, 2–3-celled; 1–5 mm; style 1.6–5 mm; stigma 2–3-lobed. *Fruit* obconical to bell-shaped, 2–3-valved, 1½–10 by 1–5 mm.

Distr. Widely distributed from China and Japan through tropical SE. continental Asia and Malaysia to New Caledonia, Tonga, Australia, the Kermadecs, and New Zealand; in *Malaysia*: Java (from Mt Patuha eastwards), Lesser Sunda Is (Bali, Lombok, Sumbawa, Flores, Alor, Timor), S. Moluccas (Aru Is), SW. Celebes (Mt Bonthain), Philippines (Luzon), and New Guinea.

MIQUEL (Sum. 1860, 234) recorded it from Sumatra, but this seems erroneous.

CLARKE & HEMSLEY recorded *W. gracilis* even from S. Africa, but I have seen no records from Africa; this is probably in confusion with *W.*

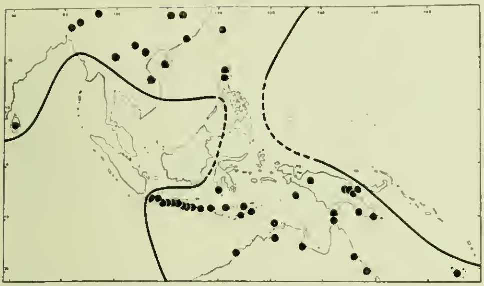


Fig. 4. Distribution of *Wahlenbergia marginata* (THUNB.) DC. with localities dotted in the area covered by the map.

gracilis E. MEY., a *nomen nudum* and a later homonym.

Ecol. In Malaysia only in the mountains (100, 800–900–) 1000–3500 m, in light *Eucalyptus* and *Casuarina* forest, along forest edges, among rocks, on lava-streams, in grassfields, and along trails as an apophyte. In India curiously recorded from sea-level upwards (CLARKE, *l.c.*), in Malaysia only found at low altitude in the Aru Is. *Fl. fr.* Jan.–Dec., specially May–July.

It seems that this plant prefers regions with a feeble to strong dry season which may explain its absence in the wet rain-forest core of West Malaysia (Sumatra, Malaya, Borneo). According to DOCTERS VAN LEEUWEN self-pollination is the rule in Java.

Vern. *Angkĕb*, *kĕrĕkan lanang*, *patikan*, *tĕlugi*, J (local), *djukut rint*, S; Papua: *ik*, Dunantina, *iki*, Asaro, Kefamo, *goiekul*, Chimbu, Masul, *kulkal*, Hagen, Togoba.

Uses. According to BACKER used against skin diseases on Mt Diëng.

Notes. In the past many authors have already pointed to the high degree of variability of this species, *e.g.* DE CANDOLLE (1830), JUNGHUHN (1845), HOOKER *f.* (1860), BENTHAM (1869), BAILEY (1900), CHEESEMAN (1906), and STEARN (1951).

This variability concerns both habit and morphological characters. The distinction between annual and perennial species, as advanced by N. E. BROWN (1913) and followed by LOTHIAN (1947) is not reliable and is impracticable. Specimens flowering in their first year are very thin and meagre with very small flowers; they have often been found together in exactly the same spot with vigorous old plants (BRASS 32353, v. STEENIS 18425, 18426). Annual dwarfs with tiny stems and small flowers are often found as kremnophytes on steep talus. Another source of such dwarfs may be that seeds have germinated in the wrong season and were forced into flower in a juvenile stage, before having attained a good, full-grown vegetative state.

Further the woody shoots of old obviously perennial plants may produce such thin shoots (*cf.* BTH. Fl. Austr. 4, p. 137; CLARKE, Fl. Br. Ind. 3, p. 430; and BAILEY, Queensl. Fl. 3, p. 922). Such shoots may appear frequently in burnt savannahs and grasslands.

Besides this ontogenous variability there is also an astonishing individual variability, for instance in the degree of the hairiness of stem, leaves, and floral parts, which has sometimes been used as the only characteristic to separate species (LOTHIAN, 1947; STEARN, 1951). The development of the indument is not reliable, as it may show large variation in flowers of a single plant. Hairiness of stems and leaves seems to be very much dependent on the habitat.

There is further much variation to be observed in both the absolute and relative dimensions of nearly all the floral parts, without an appreciable geographical correlation (raciation). This variation has been drawn for the shape of the filaments in fig. 5. It must be taken into consideration that the filaments and their margins are bent inwards already in a very early stage (*cf.* DECAISNE, Rev. Hort. 3, 1849, 41 fig.); in herbarium material it is very difficult to flatten them out because of their delicacy and entangled fringe-like marginal hairs.

The length of the calyx lobes may vary as much as 1½ mm in different flowers of a single plant during anthesis (HLB 958–307–469).

From the Philippines MERRILL has described *W. bivalvis* MERR. which would be characterized by capsules with 2 apical valves. In the syntypes of MERRILL 4361 (Bo, L, NY) which I could examine I have only found capsules with 3 valves. In a number of other specimens ranging through Celebes, the Lesser Sunda Is, and S. Moluccas to New Guinea and Thursday Island I have found indeed 2-valved capsules and all these specimens have very slenderly branched inflorescences (except ELBERT 1083 from Lombok): Celebes: BÜNNEMEIJER 11528, partly; Lombok: ELBERT 1332; Aru Is: BUWALDA 5354; SE. New Guinea: FORBES 847; Thursday Island: JAHERI *s.n.*; Warrior Island: LE GUILLOU Warrior 16.

But there are other less delicate-branched specimens which have in a single plant 2- and 3-

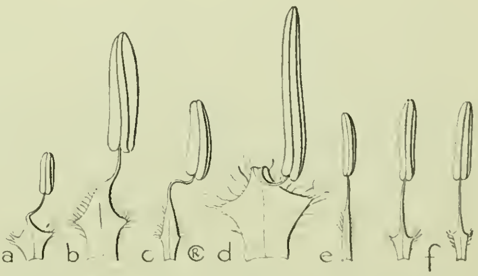


Fig. 5. *Wahlenbergia marginata* (THUNB.) DC. Geographical survey of stamen types (boiled material). *a*. From Hunan (China), *b*. Hongkong, *c*. Hongkong, *d*. Central Java (Mt Sumbing), *e*. Lombok, *f*. Timor, all × 10 (*a* FAN & LI 57, b LAMONT 405, *c* WRIGHT *s.n.*, *d* LÖRZING 3, *e* ELBERT 1332, *f* FORBES 4048).

valved capsules: Lombok: ELBERT 1557; China: Herb. Bog. *sine coll.* 133584; Celebes: *sine coll.* 136. Further there are also slenderly branched specimens with 3-valved capsules: Celebes: BÜNNEMEIJER 11528, partly, VAN STEENIS 10400.

For these reasons *W. bivalvis* MERR. cannot be maintained.

Chromosomes. According to the Chromosome Atlas by DARLINGTON & WYLIE (1955) *W. gracilenta*, *W. consimilis*, *W. quadrifida*, and *W. gracilis* would have 2 n = 18, 36, 54, and 64 chromosomes respectively, with the basic numbers 9 and (?) 8 which might point to the occurrence of chromosome races.

var. **grandiflora** TUYN, *nov.var.*—*W. consimilis* LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 223; MELVILLE, Bot. Mag. 172 (1959) t. 343.—*W. gloriosa* LOTHIAN, *l.c.* 224.

Corolla longior, c. 1½–2½ *cm longa.*

Similar to the species, but the corolla (in Mal.) 1¾–2 cm long, the tube *c.* 6–10 mm, usually *c.* 1½–2 times as long as the calyx lobes (3–5 mm). Calyx lobes always longer than the ovary (2–2½ mm). Fruit broad-obconical to bell-shaped, 4½–6 by 4–5 mm.

Distr. Australia (S. New South Wales to S. Australia and Tasmania), in *Malaysia*: New Guinea.

Notes. Also in this variety the hairiness is variable.

Var. grandiflora seemed to differ from the descriptions of *W. consimilis* and *W. trichogyna* mainly in the calyx lobes, which are somewhat shorter compared with the corolla tube (*cf.* LOTHIAN, *l.c.* and MELVILLE, *l.c.*). This character, however, proved to be very variable in the Australian material which I could examine. The relative length of calyx lobes and corolla tube differs sometimes considerably in different flowers of the same specimen (*e.g.* HOOGLAND 3074, 3075), whereas in the typical *trichogyna* forms the corolla tube is sometimes much longer than the calyx lobes.

It seems that *W. trichogyna* STEARN, Gard. Chron. III, 130 (1951) 169.—*Campanula gracilis* (*non* FORST.) SIMS, Bot. Mag. 18 (1803) t. 691.—*Campanula vincaeflora* VENT. Jard. Malm. (1803) t. 12, *nom. illeg.*—*W. gracilis var. vincaeflora* DC. Mon. Camp. (1830) 142; Prod. 7 (1839) 433.—*W. vincaeflora* (VENT.) DECNE, Rev. Hort. 3 (1849) 4, *cum ic. col.*; LOTHIAN, Proc. Linn. Soc. N.S.W. 71 (1947) 220, differs only in having a hairy ovary and is better subordinated as *subvar. trichogyna* (STEARN) TUYN, *nov. subvar.* It is native in East Australia and has not yet been found in New Guinea.

CRUTTWELL 776 and BRASS 22258 have the calyx lobes clearly dentate and the broadened part of the filaments seems longer than usual.

As there are found sometimes specimens with a few teeth at the margin of the calyx lobes (*e.g.* CLEMENS 4873, 5870) and the filaments are very variable throughout the species, there seems no reason to create a new variety.

3. CODONOPSIS

WALL. in Roxb. Fl. Ind. 2 (1824) 103; KOMAROV, Act. Hort. Petrop. 29 (1908) 98; CHIPP, J. Linn. Soc. Bot. 38 (1908) 374; ANTHONY, Not. R. Bot. Gard. Edinb. 15 (1926) 173; NANNFELDT, *ibid.* 16 (1931) 149; Bot. Tidsskr. 34 (1940) 381.—*Glosocomia* D. DON, Prod. Fl. Nepal. (1825) 158.—*Campanumoea* BL. Bijdr. (1826) 726.—*Cyclocodon* GRIFF. Not. Pl. As. 4 (1854) 279; KURZ, J. As. Soc. Beng. 46, ii (1877) 209.—**Fig. 6-7.**

Perennial, erect or climbing herbs with tuberous roots. *Leaves* opposite, at least in part. *Flowers* usually large, peduncled, solitary, axillary, or in cymes on short, leafless branches. *Calyx* adnate to the ovary (or below it), persistent, 4–6 spreading lobes. *Corolla* wide-campanulate, the base adherent to the ovary, 4–6 lobes, white, greenish, or tinged purple. *Stamens* (4–)6, free, inserted near the base of the corolla tube on the ovary; filaments dilated at the base; anthers free. *Ovary* 4–6-celled; placentas axile, thick, with many ovules; style cylindric; stigmas 4–6 short and broad lobes. *Fruit* a berry, subglobose or cylindrical, with truncate top, indehiscent or an acutish, apically dehiscent capsule. *Seeds* many, small, ellipsoid.

Distr. About 30 *spp.* from Turkestan to India, SE. & NE. Asia, Hainan, Formosa, and Japan; 2 *spp.* in *Malaysia*.

Taxon. To establish the proper name and circumscription for this genus I was faced with two aspects, *viz* the view taken by several early authors who combined *Codonopsis* and *Campanumoea* and those who kept them separate; among the latter are CHIPP, *l.c.*, and KOMAROV, *l.c.*, among the former for instance HOOKER *f.* (Ill. Him. Pl. 1855, 116). A third view was taken by GRIFFITH, followed by KURZ, who also distinguished two genera but of other circumscription.

The only distinction between *Codonopsis* and *Campanumoea* is the structure of the fruit, opening by 5 small, apical valves (slits) in the first and indehiscent in the latter. When capsular, the valves are formed in the conically protruding apical part of the fruit which is crowned by the style.

In order to find out whether this is a really 'natural' character I have gone through practically all species of both genera. If it was really a natural character the species of each genus should by necessity be more closely allied *inter se* than with any species of the other genus. This appeared not to be the case, as the distinction on the fruit characters cuts through another character, *viz* whether the plants are really twiners (as in *C. javanica*) or semi-erect or sprawling (as in *C. celebica*). It thus happens that *Campanumoea lancifolia* shows in foliage and habit more resemblance with for instance *Codonopsis purpurea* WALL. in ROXB. than with other *Campanumoeas*; reversely *Campanumoea javanica* shows a close resemblance to *Codonopsis viridis*.

A second point in favour of merging the genera is the fact that within *Codonopsis* in the restricted sense, CHIPP could illustrate not less than 4 very distinct floral types, which, each separately, could serve for the same aim as a generic one-character difference. Fig. 6. This would be useless, considering the unmistakably close relationship of all the species together and their distinction against other campanulaceous genera.

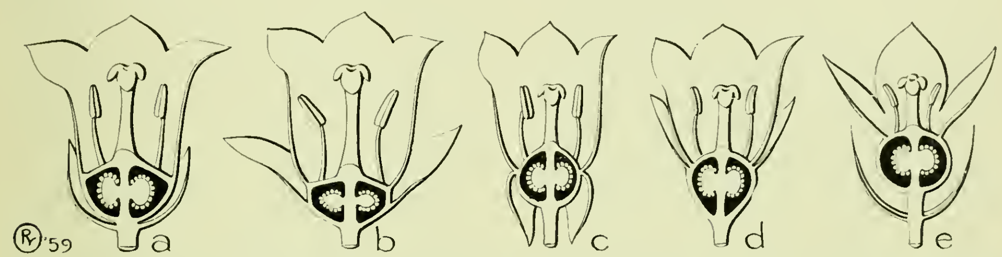


Fig. 6. The five floral types in *Codonopsis*, with different place of insertion of calyx and corolla, schematic, largely after CHIPP. *a–d*. Types used for subdivision in CHIPP's key, *l.c.* 375, *e*. structure in *C. parviflora*, after GRIFFITH, Ic. t. 481 (*Cyclocodon distans* GRIFF.).

The third point is the fact, as I have found in the relationship between *Pratia* and *Lobelia*, that apparently the character of the 'berry' *versus* the 'capsule' does not carry much important generic weight in certain groups of this family.

In merging the two genera I feel strengthened by a succinct note by DIELS, who remarked under *Campanumoea* "von folgender Gattung (= *Codonopsis*) wohl nicht zu trennen". (Bot. Jahrb. 29, 1901, 606).

A similar conclusion was reached by NANNFELDT, who made much study of *Codonopsis*. He wrote:— "In my opinion the most logical treatment should be to unite these genera (*i.e. Codonopsis* and *Campanumoea*), but in order to avoid disagreeable nomenclatural changes it is perhaps more practical to maintain *Campanumoea* as a distinct genus on account of its baccate fruits".

As far as I can see all combinations under *Codonopsis* have been made save one, so that the nomenclatural consequences are very slight indeed; the taxonomical gain is, however, considerable.

CHIPP, ANTHONY, and NANNFELDT have subdivided the genus into sections and series. I have refrained from fitting in this scheme the Malaysian *Campanumoeas*. I do not believe that they can be maintained under one subgenus or section, as they differ greatly in habit, one being sprawling and with small, white flowers ('*Cyclocodon*'), the other having the typical twining habit and large, greenish flowers of the '*pilosula*' group of NANNFELDT.

In such genera in which the species show reticulate affinity, it appears difficult to make natural subdivisions reflecting common ancestry ('Sippen').

Morph. The species of this genus gave occasion to make an observation on the remarkable nature of the inferior ovary, often called 'calyx tube' by Anglo-Saxon botanists. As CHIPP has illustrated four floral types can be distinguished in *Codonopsis*, depending on the insertion of the calyx and corolla, *viz* (1) both calyx and corolla adnate to the ovary halfway, (2) *ditto* so up to the ovarial apex, (3) corolla adnate to the apex, but calyx only half-way so, (4) corolla adnate to the ovarial apex, but calyx inferior and properly free. Fig. 6.

In no instance a free calyx 'tube' is formed.

KEY TO THE SPECIES

1. Twining. Leaves with cordate base. Flowers 1.5–3.8 mm, wide-campanulate, greenish. **1. C. javanica**
1. Sprawling or erect. Leaves decurrent at the base. Flowers ¾–1½ cm, white. **2. C. lancifolia**

1. Codonopsis javanica (BL.) HOOK. *f.* Ill. Him. Pl. (1855) 116, t. 16B; MIQ. Fl. Ind. Bat. 2 (1857) 566; MERR. Lingn. Sc. J. 6 (1930) 289.—*Campanumoea javanica* BL. Bijdr. (1826) 727; DC. Prod. 7 (1839) 423; HASSK. Cat. Hort. Bog. (1844) 106; VAN HOUTTE, Fl. Serres 12 (1857)

157, t. 1264; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 18; KURZ, J. As. Soc. Beng. 46, ii (1877) 209; CLARKE, Fl. Br. Ind. 3 (1881) 435; FORB. & HEMSL. J. Linn. Soc. Bot. 26 (1889) 8; DIELS, Bot. Jahrb. 29 (1901) 606; MAKINO, Bot. Mag. Tokyo 22 (1908) 155, *incl. var. japonica*; KOORD. Exk. Fl. Java 3 (1912) 300; Fl. Tjib. 3 (1923) 54; HEYNE, Nutt. Pl. 2 (1927) 1427; DANGUY, Fl. Gén. I.-C. 3 (1930) 694 & f. 78,10; HOCHR. Candollea 5 (1932) 290; MERR. Lingn. Sc. J. 11 (1932) 60; CRAIB, Fl. Siam. En. 2 (1936) 307; MASAMUNE, Fl. Kain. (1943) 330; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 183, p. 3; MAKINO, Ill. Fl. Japan (1954) 81, *cum var.—C. cordata* HASSK. Nat. Tijd. N.I. 10 (1856) 9; Ned. Kruidk. Arch. 4 (1856) 1; MIQ. Fl. Ind. Bat. 2 (1857) 566; WALP. Ann. 5 (1858) 393; Bot. Mag. 89 (1863) t. 5372.—*Campanumoea cordata* MIQ. Sum. (1862) 599; MAXIM. Bull. Ac. Imp. Sc. Pétersb. 12 (1868) 68; CRAIB, Kew Bull. (1911) 404. —*Campanumoea japonica* MAXIM. Bull. Ac. Imp. Sc. Pétersb. 12 (1868) 67, *non* SIEBOLD *et* MORREN, 1863.—*C. cordifolia* KOMAROV, Act. Hort. Petrop. 29 (1908) 108.—*Campanumoea maximowiczii* HONDA, Bot. Mag. Tokyo 50 (1936) 389.—**Fig. 7.**

A sinistrorse-twining plant, up to 2 m (according to KOORDERS 6–14 m long); stem 1½–4 mm diam., glabrous. *Leaves* opposite, higher up often spirally arranged, ovate to oblong-ovate, 2.6–8 by 2–5 cm, base cordate, apex obtuse, acute, sometimes acuminate, serrulate to serrate, sometimes crenate, on both sides puberulous to hairy, sometimes glabrous, underside often pruinose; petiole 1½–6½ cm. *Flowers* axillary, 1½–3.8 mm. Pedicels 1–5½ cm. *Calyx* lobes oblong to lanceolate, 11–23 by 3–4 mm, entire or denticulate to serrate, glabrous or puberulous to hairy. *Corolla* 12–35 mm, more than half-way lobed, greenish-white or yellowish-white, outside sometimes hairy, tube inside with purplish streaks or veins, lobes ovate, acuminate. *Anthers c.* 2–4 mm; filaments 3–8 mm, linear, broadened towards the base, glabrous. *Style* 5–10 mm, glabrous or hairy with 3–6 ovate-acute to elliptic lobes. *Ovary* (3–)4–5(–6)-celled, the outside partly concealed by the corolla, campanulate, visible part from the outside 3–4 by 3–4 mm, glabrous. *Fruits* subglobular, ½–1½ by 1–2½ cm, red to dark-purple to black-bluish, at the base sustained by the persistent and patent or sometimes reflexed wine-red calyx lobes and crowned by the withered corolla; walls membranous to coriaceous, sometimes fleshy; placentas fleshy. *Seeds* ovoid to ovoid-cylindrical, *c.* 1 mm, reticulate, light brown.

Fig. 7. *Codonopsis javanica* (BL.) HOOK. *f. a.* Flower, *b.* fruit sustained by the star-shaped calyx and topped by the marcescent corolla, all × ⅔.

Distr. In SE. Asia (from the Deccan through the Himalayan region, Burma, and Siam to South and Central China), Japan, Hainan; in *Malaysia:* Central to South Sumatra (Mts Kerintji and Dempo), Java (from Mt Pangrango eastwards).

Ecol. In open forest, mostly on forest edges, in secondary forest and thickets, sometimes in grassy fields, 900–2200 m. *Fl. fr.* Jan.–Dec.

Vern. *Kitjĕpot, srintil-srintil, susu munding,* S, *gutji, indil-indil, sigerpolo, urĕk-urĕk polo,* J.

Uses. The fruits are eaten and the tuberous roots are used for drugs.

2. Codonopsis lancifolia (ROXB.) MOELIONO, *nov. comb.—Campanula lancifolia* ROXB. Fl. Ind. 2 (1824) 96; DC. Prod. 7 (1839) 485.—*Campanumoea celebica* BL. Bijdr. (1826) 727; DC. Prod. 7 (1839) 423; CLARKE, Fl. Br. Ind. 3 (1881) 436; BOERL. Handl. 2 (1891) 259; STAPF, Trans. Linn. Soc. II, 4 (1894) 188; GAMBLE, J. As. Soc. Beng. 74, ii (1905) 53; ROBINSON, Philip. J. Sc. 3 (1908) Bot. 216; CRAIB, Kew Bull. (1911) 404; DIELS, Bot. Jahrb. 55 (1917) 121; MERR. En. Born. (1921) 585; RIDL. Fl. Mal. Pen. 2 (1923) 202; MERR. En. Philip. 3 (1923) 587; DANGUY, Fl. Gén. I.-C. 3 (1930) 693; CRAIB, Fl. Siam. En. 2 (1936) 307; MASAMUNE, En. Pl. Born. (1942) 123; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 183, p. 4.—*C. truncata* WALL. [Cat. (1829) *n.* 1301, *nomen*] *ex* DC. Mon. Camp. (1830) 122; Prod. 7 (1839) 423; MIQ. Fl. Ind. Bat. 2 (1857) 566.—*C. albiflora* GRIFF. Not. Pl. As. 4 (1854) 279.—*Cyclocodon adnatus* GRIFF. *l.c.* 278.—*C. celebica* MIQ. Fl. Ind. Bat. 2 (1857) 566.—*C. leucocarpa* MIQ. *l.c.* 565.—*Cyclocodon truncatum* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 18.—*Cyclocodon lancifolium* KURZ, Flora 55 (1872) 303; J. As. Soc. Beng. 46, ii (1877) 210.—*Campanumoea axillaris* OLIV. in Hook. Ic. III, 8 (1888) t. 1775; HEMSL. J. Linn. Soc. Bot. 26 (1889) 7.—*Campanumoea truncata* DIELS, Bot.

Jahrb. 29 (1901) 606; MAKINO, Bot. Mag. Tokyo 8 (1904) 21; MERR. Philip. J. Sc. 7 (1912) 104.—*Campanumoea lancifolia* MERR. En. Philip. 3 (1923) 587; Lingn. Sc. J. 5 (1927) 181; Pap. Mich. Ac. Sc. 20 (1935) 111; YAMAMOTO, Obs. Fl. Form. 13 (1936) 147; MASAMUNE, Fl. Kain. (1943) 33; HARA, En. Sperm. Jap. 2 (1952) 96.

Sprawling or erect herb, with a hollow stem, *c.* 3 m high, nearly glabrous or hairy, mostly branched. *Leaves* opposite, petioled, lower ones ovate to ovate-elliptic, higher ones elliptic, often bract-like, 3–14 by 1–4 cm; acute to acuminate, bluntly edged at the base, coarsely serrate to serrulate, upperside glabrous, underside glabrous or puberulous to hairy; petiole 3–15 mm, glabrous. *Flowers* 7–15 mm, axillary, solitary or in cymes of 3, through reduction of the higher leaves resembling a terminal panicle. Pedicels or peduncles (1–)3–6 cm, glabrous, with two bracteoles, ½–2 cm long, linear to elliptic, glabrous or hairy. Buds winged, ovate. *Calyx* lobes 4–7, lanceolate, 4–10 by 1 mm, entire to dentate-serrate to pinnatifid, carnosulate, glabrous to puberulous. *Corolla* white, pale pink, lilac, outside glabrous, corolla tube as long as the lobes, lobes ovate to triangulate, acute, entire. *Stamens* 4–6 mm. *Anthers* as long as the filaments. Filaments linear to broadened at the base in various degree (deltoid to ovate), the broad forms inside with long hairs at the base. *Style* glabrous or scabrid. *Ovary* cupular to campanulate, 2–4 mm diam., glabrous to puberulous. *Berry* ± globular with a flattened apex, the persistent calyx adnate about half-way, greenish, turning to white, *c.* ½–1 cm diam. *Seeds* many, testa fine-reticulate.

Distr. SE. Asia (India: Himalaya and Sikkim; Burma) to S. China, Formosa, and Hainan; in *Malaysia*: Malay Peninsula (Selangor: Taiping Hills; Perak: Semangkok Pass, *ex* RIDLEY, not seen), Sumatra, E. Java (Pantjur Idjen, once found), N. Borneo (Kinabalu), Celebes, Philippines (N. Luzon; Panay; Mindanao), Moluccas (Buru and Ambon), and New Guinea.

Ecol. In open terrain or along forest-borders and trails, on tali and near streamlets, rarely in forest regrowth and young secondary forest, often in wet places, 280–1500 m. *Fl. fr.* Jan.–Dec.

Vern. *Gordang-gordang*, M (Toba), *ĕmlapagar*, Palu (W. Cel.); Philippines: *lakoronbolan*, Buk.

Note. There are two subspecies which largely replace one another geographically.

ssp. **lancifolia**.—All synonyms except *C. celebica* and *C. leucocarpa*.

Leaves generally large, 8½–16½ by 3–7½ cm, towards the apex of the stems not very much reduced, never glaucous beneath, entirely glabrous. Calyx lobes coarsely dentate to subpectinate. Filaments distinctly widened downwards, either triangular or roundish, long-hairy inside.

Distr. Continental Asia, in *Malaysia*: N. Sumatra (Atjeh, Toba), Philippines, and Moluccas (Buru, Ambon).

ssp. **celebica** (BL.) MOELIONO, *comb. nov.*—*Campanumoea celebica* BL. *l.c.*—*C. celebica* (BL.) MIQ.—*C. leucocarpa* MIQ.

Leaves averagely smaller, 5½–8(–11½) by 1½–2¾(–3¾) cm, towards the apex distinctly shorter giving the apical part of the stem the appearance of a panicle, glaucous and hairy beneath or glabrous. Calyx lobes entire to toothed. Filaments linear to triangular-broadened towards the base, glabrous (once found short hairy inside, OUWEHAND 215).

Distr. Siam (KERR 1217), in *Malaysia*: Central and South Sumatra, SE. Java, Borneo, Celebes, Philippines, Moluccas, and New Guinea.

6. LOBELIA

LINNÉ, Gen. Pl. (1754) 401; Sp. Pl. 2 (1753) 929, *non sensu* ADANS. Fam. Pl. 2 (1763) 157 *et* MILLER, Gard. Dict. ed. 8 (1768), *cf. nom. gen. cons. n.* 8716; DC. Prod. 7 (1839) 357; WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 317; Pfl. R. Heft 107 (1953) 408.—*Pratia* GAUDICH. Ann. Sc. Nat. 5 (1825) 103; PRESL, Prod. Mon. Lob. (1836) 46; WIMMER, Pfl. R. Heft 106 (1943) 104.—*Dortmanna* ADANS. Fam. Pl. 2 (1763) 134; STEUD. Nomencl. (1840) 526; O. K. Rev. Gen. 2 (1891) 379 (*Dortmannia*).—*Rapuntium* MILLER, Gard. Dict. ed. 8 (1768); PRESL, Prod. Mon. Lob. (1836) 11.—*Piddingtonia* DC. Prod. 7 (1839) 341; MIQ. Fl. Ind. Bat. 2 (1857) 572.—*Isolobus* DC. Prod. 7 (1839) 352.—*Speirema* HOOK *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27.

Herbaceous, annual or perennial, sometimes woody below, rarely arborescent (Africa, Hawaii), often laticiferous. *Leaves* spirally arranged, alternate (distichous), or in rosettes. *Flowers* axillary or in racemes or panicles, with or without bracts, 5-merous, epigynous, ☿, rarely unisexual (some Australian *spp.* dioecious), protrandrous. *Calyx* lobes well-developed. *Corolla* gamopetalous, zygomorphic, with a dorsal slit mostly to or near the base; limb with 2 dorsal lobes, mostly diverging from the 3 others which form a trifid whole consisting of a ventral lobe and 2 laterals; lobes valvate in bud, connate to various degree. *Stamens* 5, alternate with the corolla lobes, free or adnate to the corolla tube; filaments linear, sometimes broadened at the base; anthers basifixed, introrse, 2-celled, cells opening lengthwise. Disk absent. *Ovary* 2-celled; style 1, at the apex below the 2 stigmas provided with 'collecting hairs', during anthesis lengthening with appressed stigmatic lobes through the anther tube. *Ovules* ∞, axile, anatropous. *Fruit* fleshy to dry in various degree, *i.e.* a berry or an apically 2-valved capsule, crowned by the persistent calyx lobes. *Seeds* ∞, provided with endosperm.

Distr. Probably more than 200 *spp.*, mostly in the tropics and subtropics, especially in America.

Ecol. The Malaysian species are mostly hill and mountain plants in everwet country, except *L. alsinoides*, which is typical for lowland seasonal climatic conditions, and *L. zeylanica*, which grows from the lowland up into the montane zone.

The flowers are resupinate, even before they are open. There are 'collecting hairs' under or at the base of the stigmas of the bifid style. By the lengthening of the style, the unopened stigmas enter into the anther tube, pushing the pollen out of the tube. This occurs before the stigmas are receptive, for receptiveness is acquired long after the pollen is shed.

Nomencl. Unfortunately former typification of some common species has been unsatisfactory which has necessitated to accept several name changes. Besides, the taxonomic changes proposed here, by merging *Pratia* with *Lobelia*, and severe reduction of the number of species of *Pratia*, have resulted in a rather complicated synonymy.

Taxon. Hitherto the genus *Pratia* has almost unanimously been distinguished from *Lobelia* by the fruit, it being baccate and non-dehiscent against being capsular and apically 2-valved in *Lobelia*.

By the subdivision of the *Lobelioideae* into berried and capsular genera, advanced first by DE CANDOLLE (1839) and followed almost unanimously up to the monograph by WIMMER (1943, 1953) *Lobelia* and *Pratia* have become distant allies. The lively coloured berries of the *Pratias* which are native in the Pacific area of the southern hemisphere represent a showy character, but it should be added that flowering specimens cannot be distinguished from certain *Lobelias* which are also prostrate and rooting, humble plants in the same area.

In my opinion it seems unquestionable that they are very closely allied. This opinion is sustained by the curious fact that in the abundant material of *Pratia angulata*, which I could study, the Asiatic and West Malaysian specimens have definitely berry-like, indehiscent fruits, but those of Celebes and New Guinea show in otherwise 'inseparable' specimens various transitions in the mature state (as shown by ripe seed inside). In East Malaysia the fleshy pericarp becomes 'drier' and thinner, almost membranous, and the lengthwise nerves become more pronounced; the apex of the fruit which is in typical *Pratia* berries flat, becomes convex and tends to become tardily 2-valved. In one case of profuse material (EYMA 1161) fleshy berries and true capsules could be found in one collection. In this area also the variability of other characters of the species (hairiness, size of the flowers, leaves, pedicels, *etc.*) is wider than in West Malaysia and continental Asia, which have, obviously, a more homogeneous 'marginal' population. The tendency to possess a conical ovary is continued towards the South Pacific.

These observations have induced me to merge *Pratia* with *Lobelia*. It would be of profound interest if additional field observations could be made to verify my conclusions.

In specific delimitation I have allowed far more variation than WIMMER, SKOTTSBERG, and some other authors.

KEY TO THE SPECIES

1. Stems developed.
 2. Stems erect or rarely ascending, not rooting at the nodes.
  3. Stems terete or ribbed, not 2–3-angled. Rather coarse plants.
   4. Leaves mainly in a dense, persistent rosette, ± sparsely long-white-pilose along the margin and on the upper surface. Stems angular, unbranched. Cauline leaves oblanceolate, upwards gradually smaller, 2–5 by ½–1 cm. Perennial plant, with a strong rhizome. . . . **2. L. sumatrana**
   4. Flowering stems without such a rosette. Leaves glabrous or hairy but not long-white-pilose, elliptic-lanceolate, mostly much larger.
    5. Flowers solitary axillary, 2–4½ cm long. Berry globose, 7–12 mm diam., on a reflexed pedicel, violet, finally black-purple . . . . **9. L. montana**
    5. Flowers in terminal panicles or terminal or leaf-opposed racemes.
     6. Racemes terminal, later leaf-opposed. Fruit a berry . . . . . . **10. L. borneensis**
     6. Racemes or panicles terminal. Fruit capsular . . . . **1. L. nicotianaefolia**

3. Stems 2–3-angled, sometimes winged along the edges. Rather delicate, annual herbs.
7. All anthers bearded at their apex. Seeds trigonous.
8. Free basal part of the 2 anterior filaments twice as broad as that of the others and densely haired. Stem sharply triangular-winged. Stem, leaves, pedicels, and calyx glabrous or sparsely hairy. Leaves ovate-oblong or even narrower, sessile, narrowed or contracted towards the base. **3. L. alsinoides**
8. Free basal part of all filaments of equal width. Stem terete, under each leaf with 2 narrow ridges. Stem, leaves, pedicels, and calyx crisped-patent-hairy. Leaves ovate to roundish with very blunt to subcordate base set off against a distinct petiole (1–)3–20 mm long **4. L. zeylanica**
7. Only the two anterior anthers bearded at their apex. Seeds ellipsoid . . **5. L. heyniana**
2. Stems creeping or ascending, rooting at the nodes.
9. Leaves spirally arranged. All anthers bearded at their apex . . . . . **4. L. zeylanica**
9. Leaves distichous. Only 2 anthers bearded at their apex.
10. Leaves sessile, densely set (almost equitant), semi-amplexicaulous, fleshy. Plant glabrous. Filaments glabrous . . . . **12. L. conferta**
10. Leaf-base not semi-amplexicaulous.
11. Leaves glabrous, sessile, with acute base, subentire, oblong to elliptic, rather narrow. Testa smooth . . . . **6. L. chinensis**
11. Leaves exceptionally glabrous, at least the lower almost always petioled, mostly ovate to rounded, with a rounded (very rarely acutish) base.
12. Corolla hardly twice as long as the calyx lobes, campanulate, with ovate-deltoid lobes. Hairs more-celled. Testa smooth . . . . **8. L. brachyantha**
12. Corolla at least *c.* 3 times as long as the calyx lobes, not campanulate, with narrow-lanceolate or ovate-lanceolate lobes. Hairs 1-celled. Testa finely reticulate . . . **11. L. angulata**
1. Stemless. Flowers solitary axillary, *c.* ½ cm long. Leaves very thin, roundish, petioled. **7. L. archboldiana**

1. Lobelia nicotianaefolia ROTH *ex* R. & S. Syst. Veg. 5 (1819/?20) 47; ROTH, Nov. Pl. Sp. (1821) 143; WALL. in Roxb. Fl. Ind. 2 (1824) 110; Pl. As. Rar. 2 (1831) 43; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 381; WIGHT, Illustr. 2 (1850) 111, t. 135 f. 1–10; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 29; HOOK. *f.* Bot. Mag. 92 (1866) t. 5587; CLARKE, Fl. Br. Ind. 3 (1881) 427, *incl. var. trichandra*; TRIM. Handb. Fl. Ceyl. 3 (1895) 57; PEARSON, J. Linn. Soc. Bot. 34 (1898) 348; MERR. & MERRITT, Philip. J. Sc. 5 (1910) Bot. 392; MERR. En. Philip. 3 (1923) 588; SKOTTSB. Medd. Göteb. Bot. Trädg. 4 (1928) 9–13, f. 1, 8–11, 12b, *incl. var. macrostemon*, *l.c.* 13, f. 13–14; ALSTON, Fl. Ceyl. Suppl. (1931) 175; ELMER, Leafl. 9 (1934) 3180, *incl. var. mollis*; KAUSIK, J. Ind. Bot. Soc. 17 (1938) 161–168; WIMMER, Pfl. R. Heft 107 (1953) 643, *incl. var. nicotianaefolia, bibarbata, & trichandra*; SANTAPAU, Rec. Bot. Surv. Ind. 16 (1953) 157.—*L. pyramidalis* WALL. As. Res. 13 (1820) 376; D. DON, Bot. Mag. 50 (1823) t. 2387; WALL. in Roxb. Fl. Ind. 2 (1824) 113; D. DON, Prod. Fl. Nepal. (1825) 57; WALL. Pl. As. Rar. 2 (1831) 42; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 381, *incl. var. β*; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 29; CLARKE, Fl. Br. Ind. 3 (1881) 426; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1889) 3; SKOTTSB. Medd. Göteb. Bot. Trädg. 4 (1928) 17, 21, f. 12e, 25–31; DANGUY, Fl. Gén. I.-C. 3 (1930) 676, f. 76 1–4; CRAIB, Fl. Siam. En. 2 (1936) 304; WIMMER, Pfl. R. Heft 107 (1953) 646.—*L. rosea* WALL. in Roxb. Fl. Ind. 2 (1824) 115; Pl. As. Rar. 2 (1831) 42, t. 152; G. DON, Gard. Dict. 3 (1858) 29; DRURY, Handb. Ind. Fl. 2 (1866) 108, *excl. syn.*; KURZ, J. As. Soc. Beng. 46, ii (1877) 212; CLARKE, Fl. Br. Ind. 3 (1881) 427; J. Linn. Soc. Bot. 25 (1890) 41; DANGUY, Fl. Gén. I.-C. 3 (1930) 675; WIMMER, Pfl. R. Heft 107 (1953) 653.—*L. excelsa* LESCH. *ex* ROXB. Fl. Ind. 2 (1824) 114, *non* BONPL. (1813); WALL. Pl. As. Rar. 2 (1832) 42; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 381; WIGHT, Ic. 4 (1850) t. 1173–4; THWAITES, En. Pl. Zeyl. (1860) 170; CLARKE, Fl. Br. Ind. 3 (1881) 427.—*L. stimulans* HAM. *ex* D. DON, Prod. Fl. Nepal. (1825) 157.—*L. purpurescens* WALL. Cat. (1828) 1307, *non* R.BR. (1810), *nomen nudum ab auctore ipso ibidem relictum* p. 157.—*L. colorata* WALL. Pl. As. Rar. 2 (1831) 42; DC. Prod. 7 (1839) 380; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 28; DRURY, Handb. Ind. Fl. 2 (1866) 108; CLARKE, Fl. Br. Ind. 3 (1881) 426; WIMMER, Pfl. R. Heft 107 (1953) 655, *incl. var.*—*Rapuntium pyramidale* PRESL, Prod. Mon. Lob. (1836) 23.—*Rapuntium nicotianaefolium* PRESL, *l.c.* 24.—*Rapuntium coloratum* PRESL, *l.c.* 24.—*Rapuntium wallichianum* PRESL, *l.c.* 24.—*Rapuntium roseum* PRESL, *l.c.* 24.—*Rapuntium leschenaultianum* PRESL, *l.c.* 24.—*L. wallichii* STEUD. Nomencl. 2 (1841) 62, *nomen superfl. ad L. purpurescens* WALL.—*L. robusta* WALL. *ex* VOIGT, Hort. Suburb. Calc. (1845) 367, *non* GRAHAM (1831).—*L. eurostos* VOIGT, *l.c.* 367.—*L. aromatica* MOON [Cat. Pl. Ceyl. (1824) 14, *nomen*] *ex* WIGHT, Ic. 4 (1850) 2, t. 1172; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 29; ALSTON, Fl. Ceyl. Suppl. (1931) 175.—*L. trichandra* WIGHT, Ic. Pl. Ind. Or. 4 (1853) t. 1171; SKOTTSB. Medd. Göteb. Bot. Trädg. 4 (1928) 16, f. 12d, 18.—*L. wallichiana* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 29; KURZ, J. As. Soc. Beng. 46, ii (1877) 211.—*L. erecta* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 28, *non* DE VRIESE (1845); CLARKE, Fl. Br. Ind. 3 (1881) 426.—*Dortmannia leschenaultiana* O. K. Rev.

Fig. 8. *Lobelia nicotianaefolia* ROTH *ex* R. & S. Bandarawele, Ceylon, *c.* 2–2½ m tall, 1956.

Gen. 1 (1891) 972.—*Dortmannia erecta* O. K. *l.c.* 972.—*Dortmannia nicotianaefolia* O. K. *l.c.* 973.—*Dortmannia rosea* O. K. *l.c.* 973.—*Dortmannia colorata* O. K. *l.c.* 973.—*Dortmannia pyramidalis* O. K. *l.c.* 380.—*L. seguinii* LÉVEILLÉ & VAN, in Fedde, Rep. 12 (1913) 186; WIMMER, Pfl. R. Heft 107 (1953) 648, *incl. var.*—*L. fossarum* WIMMER, Akad. Anz. Wien *n.* 14 (1924) 3.—*L. eryliae* FISCHER, Kew Bull. (1928) 141; WIMMER, Pfl. R. Heft 107 (1953) 652.—*L. leschenaultiana* SKOTTSB. Medd. Göteb. Bot. Trädg. 4 (1928) 4, f. 3–7; WIMMER, Pfl. R. Heft 107 (1953) 659.—*L. doniana* SKOTTSB. Medd. Göteb. Bot. Trädg. 4 (1928) 19, f. 12, 19–24, *nomen illegit.*—*L. philippinensis* SKOTTSB. *l.c.* 13, f. 12c, 15–17; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 178; STEUP, Trop. Natuur 27 (1938) 142, f. 60; TOXOPEUS, *l.c.* 109, f. 21.—*L. epilobioides* WIMMER, in Fedde, Rep. 38 (1935) 79; Ann. Naturh. Mus. Wien 56 (1948) 367, *incl. var. sarasinorum*; Pfl. R. Heft 107 (1953) 652.—*L. leucanthera* KERR, Kew Bull. (1936) 34; CRAIB, Fl. Siam. En. 2 (1936) 304; WIMMER, Pfl. R. Heft 107 (1953) 641.—*L. palustris* KERR, Kew Bull. (1936) 35; CRAIB, Fl. Siam. En. 2 (1936) 304.—*L. camptodon* WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 366; Pfl. R. Heft 107 (1953) 637.—*L. beddomeana* WIMMER, Pfl. R. Heft 107 (1953) 645.—**Fig. 8-9.**

A coarse herb, up to 2(–4½) m. Stem terete at the base, angular towards the apex, hollow, simple or apically branched. *Leaves* spirally arranged, densely set in juvenile plants, oblong to narrow-lanceolate, the lower ones sometimes obovate-oblong, gradually decurrent towards the petiole-like base, 50–10 by 8–4 cm to 9–3 by 3–¾ cm; acuminate towards the apex (tip acute or blunt),

Fig. 9. *Lobelia nicotianaefolia* ROTH *ex* R. & S. SW. Celebes, 1937.

serrate-toothed along the margin, hairy on both sides, especially on the nerves, rarely glabrous, decreasing in size towards the apex. *Racemes* up to 45 cm long, together often forming a large, leafy panicle; rachis angular, hairy. Bracts under the lower flowers exceeding the pedicels and connate with them at the base, the higher ones shorter and higher connate, finally linear-subulate. Pedicels 1–2½ cm, obliquely patent, ascending, terete, hairy; bracteoles 2, minute, 3–12 mm long (in Indian material often caducous or absent). *Flowers* 1¼–3¾ cm long, variable in colour, pale, whitish, blue, dark purple, or rose. *Sepals* linear to lanceolate, 4–12 by 1 mm, entire to distinctly toothed, acute, glabrous or hairy. *Corolla* ¾–3 cm, outside glabrous or hairy, inside hairy to densely hairy, often with two gibbosities; dorsal lobes half as high connate with the lateral ones as compared with their junction with the ventral lobe, three times as long as the other lobes or even longer, linear; ventral and lateral lobes about equal in length, the lateral ones slightly falcate, all three ovate-acute, with a slightly crenate margin. (In immature corollas the lobes are cohering.) *Filaments* free and hairy at the base, upwards puberulous or hairy, 8–10 mm; anthers glabrous or hairy on the connectives, the two anterior ones with a hair tuft on top, from dorsal to ventral 3–4 to 2–3 mm. *Ovary* roundish cupular or narrower, 7–12-nerved, glabrous to densely hairy, 4–10 by 2–4 mm; style glabrous. *Capsule* cylindric-cupular, ¾–1 cm by 4–6 mm, glabrous or hairy. *Seeds* flattened ellipsoid, ½–5/8 mm, brown and smooth.

Distr. SE. Asia (from the Deccan to S. China), Formosa, in *Malaysia*: Philippines (Luzon and Biliran), Celebes (Central part and SW. peninsula as far as Mt Bonthain). Fig. 10.

Ecol. Open places on ridges in mossy forest, often on grassy mountain slopes and hill sides, 600–2300 m. *Fl. fr.* Dec.–Aug.

Vern. Philippines: *Adlabong, katlabung, kanynong*, Ig., *balinyungyung, balyongyong, luñgogluñgog, subasob*, Bon.

Uses. The milky juice is said to be poisonous (EYMA *in sched.*).

Notes. After having studied many specimens both from Malaysia and continental Asia I have come to the conclusion that this complex represents one widely distributed and very polymorphous species, both in Asia and in Malaysia. Characters used by former authors to distinguish microspecies often do not hold in one single specimen: bracteoles may be present or absent, may be inserted at the base or in the middle of the pedicels; sepals may be toothed or not, plants may be branched or unbranched, hairy or glabrous. The differentiating characters of 'species' in this complex have gone into hair-splitting detail.

In general there are in SE. Asia two groups according to the size of the flowers, but they do not show a geographical replacement. There are many local forms but in my opinion they should not be named.

KAUSIK (J. Ind. Bot. Soc. 17, 1938, 161–167), who has studied the gametogenesis and embryology of this species, stated that the chromosome

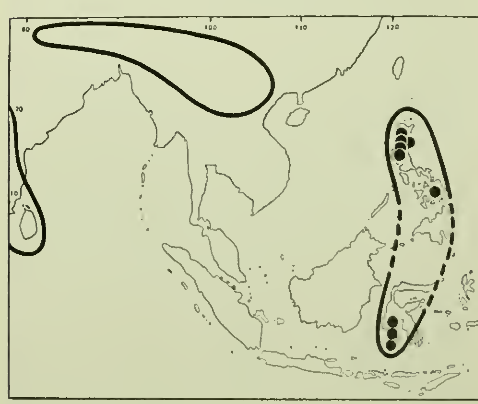


Fig. 10. Distribution of *Lobelia nicotianaefolia* ROTH *ex* R. & S., localities in Malaysia indicated by dots.

number of a plant collected at Koppa (Mysore) is n = 14.

Fig. 11. *Lobelia sumatrana* MERR. Mt Losir, Gajo Lands (N.Sumatra), 1937.

2. Lobelia sumatrana MERR. Not. Nat. Ac. Sc. Philad. 47 (1940) 9; WIMMER, Pfl. R. Heft 107 (1953) 654.—*L. sp.* STEEN. Tijd. Kon. Ned. Aardr. Gen. 55 (1938) 800. — **Fig. 11.**

Erect, perennial herb, 15–40 cm, with a firm rootstock. Stem angular, glabrous to sparsely pilose. Rosette *leaves* narrowly spathulate to obovate-lanceolate, tapering towards the base, shallowly crenate-dentate, blunt, 2–5 by ½–1 cm; cauline ones erect, narrower, more distinctly sessile and smaller, all pilose. *Raceme* unbranched, up to *c.* 10-flowered, rachis 5–10 cm, glabrous. Bracts herbaceous, ovate to elliptic-oblong, resembling the leaves but smaller, 5–15 mm long. Pedicels terete, pilose, 5–8 mm, with two small, linear, hairy bracteoles. *Flowers* 1½–2½ cm long. *Calyx* lobes oblong, *c.* 5 by 1½–2 mm, blunt to broadly triangular at the apex, shallowly crenate, glabrous or pilose. *Corolla* ¾–2 cm, slit to the base, lilac or pale purple, purple-veined, inside and on the nerves and margins outside hairy, dorsal lobes connate with the lateral ones for 4–5 mm, lateral lobes connate with the ventral one for 7–9 mm; dorsal lobes narrowly lanceolate, boat-shaped, 9–11 by 2 mm, acute, lateral and ventral lobes about equal, oblong-lanceolate, 6–8 by 1½–2 mm. *Filaments* 6–8 mm, up to 1/3 free and hairy, anthers from dorsal to ventral 4–2 mm, dorsally hairy, the ventral ones with an apical hair tuft. *Ovary* 2–4½ by 2–4 mm, trumpet-shaped to campanulate, distinctly ribbed, glabrous to densely hairy; style glabrous. *Capsule c.* 5 by 4 mm, cupular, campanulate to ovoid, hirsute to pilose. *Seeds* ½ by ½ mm, flattened ellipsoid, light brown and smooth.

Distr. *Malaysia*: N. Sumatra (Gajo Lands: Mts Losir, Kemiri, Goh Lembuh).

Ecol. Mountain heaths and meadows (blangs), common, 2400–3300 m. *Fl. fr.* Febr.–May.

Note. Obviously related to certain SE. Asiatic forms of *L. nicotianaefolia* described as *L. colorata* WALL. (specially CLARKE 42477), differing by the angular stem, large rhizome, smaller narrow spathulate leaves, and a persistent rosette of leaves.

3. Lobelia alsinoides LAMK, Dict. Bot. 3 (1791) 588; R. & S. Syst. Veg. 5 (1819) 60; DC. Prod. 7 (1839) 378; SOND. Fl. Cap. 3 (1865) 539, *excl. syn. L. trialata*; WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 360; Pfl. R. Heft 107 (1953) 571, f. 93g = *icon. specim.* LAMARCK.; SANTAPAU, Rec. Bot. Surv. Ind. 16 (1953) 158.—*L. filiformis* (*non* LAMK) CAV. Ic. 6 (1801) 7, t. 511, f. 1.—*L. filiformis var. luzoniensis* PERS. Syn. 2 (1807) 214; R. & S. Syst. Veg. 5 (1819) 61; G. DON, Gard. Dict. 3 (1834) 713; DC. Prod. 7 (1839) 368; MIQ. Fl. Ind. Bat. 2 (1856) 577; F.-VILL. Nov. App. 4 (1880) 121.—*L. trigona* ROXB. [Hort. Beng. (1814) 85, *nomen*] Fl. Ind. 2 (1824) 111; Fl. Ind. ed. Carey (1832) 506; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 359; HOOK. *f.* Ic. Pl. 4 (1841) t. 358, *excl. syn. L. trialata et L. heyneana*; WIGHT, Ic. 4 (1848) t. 1170; MIQ. Fl. Ind. Bat. 2 (1857) 574; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27, *p.p.*;

MIQ. Sum. (1861) 234; KURZ, J. As. Soc. Beng. 46, ii (1877) 211; CLARKE, Fl. Br. Ind. 3 (1881) 423; TRIM. Fl. Ceyl. 3 (1895) 56; KOORD. Exk. Fl. Java 3 (1912) 302; YAMAMOTO, Obs. Fl. Formosa 13 (1936) 148, *excl. syn. L. trialata et L. heyneana*.—*L. triangulata* ROXB. Hort. Beng. (1814) 16, *nomen nudum*.—*L. stipularis* ROTH, in R. & S. Syst. Veg. 5 (1819) 67; Nov. Pl. Sp. (1821) 144; WALL. Pl. As. Rar. 2 (1831) 43.—*Rapuntium alsinoides* PRESL, Prod. Mon. Lob. (1836) 22.— *L. sp.* GRIFF. Not. Pl. As. 4 (1854) 281.—*L. griffithii* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 28; KURZ, J. As. Soc. Beng. 46, ii (1877) 211, *incl. var. genuina et var. dopatrioides*; CLARKE, Fl. Br. Ind.3 (1881) 424; RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1911) 124; CRAIB, Kew Bull. (1911) 404; RIDL. Fl. Mal. Pen. 2 (1923) 201; DANGUY, Fl. Gén. I.-C. 3 (1930) 682, f. 75, 7-9; CRAIB, Fl. Siam. En. 2 (1936) 303; WIMMER, Pfl. R. Heft 107 (1953) 569.—*L. dopatrioides* KURZ, J. As. Soc. Beng. 39, ii (1870) 77; Flora 55 (1872) 302; CRAIB, Fl. Siam. En. 2 (1936) 303.—*L. microcarpa* CLARKE, Fl. Br. Ind. 3 (1881) 424; KOORD. Exk. Fl. Java 3 (1912) 302; DANGUY, Fl. Gén. I.-C. 3 (1930) 681; MERR. & PERRY, J. Arn. Arb. 22 (1941) 385; WIMMER, Pfl. R. Heft 107 (1953) 574.—*L. terminalis* CLARKE, Fl. Br. Ind. 3 (1881) 424; CRAIB, Kew Bull. (1904) 404; DANGUY, Fl. Gén. I.-C. 3 (1930) 680; CRAIB, Fl. Siam. En. 2 (1936) 306; WIMMER, Pfl. R. Heft 107 (1953) 573.—*Dortmannia griffithii* O.K. Rev. Gen. Pl. 2 (1891) 380.—*Dortmannia trigona* O.K. *l.c., incl. var. microcarpa et terminalis*.—*Dortmannia alsinoides* O.K. *l.c.* 972.— *L. luzoniensis* (PERS.) MERR. En. Philip. 3 (1923) 588; WIMMER, Pfl. R. Heft 107 (1953) 543.—*L. chevalieri* DANGUY, Bull. Mus. Paris (1929) 263; Fl. Gén. I.-C. 3 (1930) 683, f. 76, 9; WIMMER, Pfl. R. Heft 107 (1953) 569.—*L. thorelii* WIMMER, in Fedde, Rep. 26 (1929) 3, t. 71 f. 3.—*L. hosseusii* WIMMER, *l.c.* 2, t. 71 f. 5; DANGUY, Fl. Gén. I.-C. 3 (1930) 681; CRAIB, Fl. Siam. En. 2 (1936) 304, *incl. var.*; WIMMER, Pfl. R. Heft 107 (1953) 574.— *L. hainanensis* WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 348; Pfl. R. Heft 107 (1953) 506.—*L. chinensis* (*non* LOUR.) HANCE, J. Linn. Soc. Bot. 13 (1873) 110; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1889) 3; DANGUY, Fl. Gén. I.-C. 3 (1930) 680, f. 75, 10-12.—*L. radicans* (*non* THUNB.) HOSSEUS, Beih. Bot. Centralbl. 28, ii (1911) 446.— **Fig. 16c.**

Erect to ascending, unbranched to strongly branched herb, 3–35(-40) cm; stem 3-angled and winged. *Leaves* ½–1½ by ½–2 cm, sessile or short-petioled, contracted or narrowed to the base, acute or blunt, entire or toothed, glabrous to sparsely hairy; basal leaves ovate-oblong, cordate or elliptic, upwards sometimes sublanceolate, up to 1 by 0.3 cm. *Flowers* 8–12 mm, axillary, often in the higher axils, and then forming a lax terminal raceme. Pedicels 1–3½ cm, 3-angled, glabrous or slightly patent-hairy. Bracteoles basal, minute to 2 mm long and linear, often caducous. *Calyx* lobes triangular, subulate, 2¼–3¼ by ½–1 mm, entire, sometimes ciliate, glabrous or sparsely hairy. *Corolla* 4–12 mm, varying from bright blue to violet (sometimes, in Celebes, white), inside hairy (except for the specimens described as *L. hosseusii* which are glabrous, its *var. villosa* excluded), with 2 (white) gibbosities, dorsally split to the base, dorsal lobes connate with the lateral ones for 3–4½ mm, lateral lobes connate with the ventral one for 3½–6 mm; dorsal lobes 1–3 mm, falcate-oblong or falcate-ovate, acute or acuminate, margin entire or subentire, lateral and ventral lobes oblong or ovate, 1–2½ mm, acute or acuminate, entire or subentire. *Filaments* 3–5 mm, free to half-way up or higher, connate, the two anterior ones ± twice as broad as the anthers, the outside patent hairy; dorsal anthers 1¼, ventral ones 1 mm, each anther at the apex with a hair tuft, otherwise glabrous or hairy. *Ovary* 2–2½ by 1½–2½ mm, oblong, trumpet-shaped to cupular, glabrous or sparsely hairy; style glabrous. *Capsule* ± hemispherical, 2–3 by 1½–3 mm. *Seeds* ½ by 1/3 mm, trigonous, brown.

Distr. SE. Asia (Ceylon and the Deccan to S. China: Kwangtung), Hainan, and Formosa, in *Malaysia*: Malaya (Perlis: Chupeng; Singapore, WIMMER, *l.c.*), W. Java (Indramaju), Celebes (SW. & SE. peninsula), Philippines (Mindanao, Davao), S. New Guinea (N of Merauke, Wuroi, Oriomo R., Lake Daviumbu, Borovia). Fig. 12.

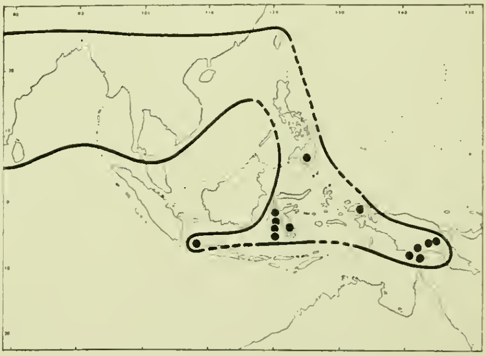


Fig. 12. Distribution of *Lobelia alsinoides* LAMK with localities in Malaysia dotted.

Ecol. In West Java and in SW. Celebes during the wet season in marshy grassland often dominated by 'siil' (*Sorghum nitidum*) and/or *Cyperaceae*; in S. Celebes also along margins of dry rice-fields. In New Guinea this species is found on swampy grounds, together with *Eriocaulon*, *Utricularia*, and several *Cyperaceae*; on wet places in savannahs with *Melaleuca*, *Acacia*, *Eucalyptus* stands and scattered *Antidesma ghaesembilla* trees. From sea-level up to 1000 m, restricted to regions subject to a dry monsoon. *Fl. fr.* Nov.–Aug.

Note. A polymorphic species with intergrading forms, so we can find a range of subsequent 'species', beginning from the typical *L. griffithii*, with its scale-like leaves to the normal broad-ovate leaves of *L. dopatrioides* and the petiolate leaves of *L. terminalis.* I cannot trace any geographical or ecological replacement of these forms. The shape and size of the bracteoles have also lead to superfluous names: the Indian specimens have relatively long bracteoles, which induced ROTH to name this form *L. stipularis.*

L. luzoniensis (PERS.) MERR. was based upon a specimen in herb. NÉE from Luzon near Santa Cruz de la Laguña. MERRILL mentioned two recent collections from Luzon (Laguña) and Mindanao (Davao), citing COPELAND 368 and WEBER 1472 respectively. WIMMER quoted the last mentioned number under *L. alsinoides*, Pfl. R. Heft 107 (1953) 573. I have seen COPELAND 368, which was distributed as a *Wahlenbergia* (NY); it has all anthers bearded and trigonous seeds and undoubtedly represents *L. alsinoides.* This confirms my opinion, made from the plate and description, that *L. luzoniensis* is conspecific with *L. alsinoides.* CAVANILLES's figure of the plant is twice enlarged; he mentions the short seta on top of the corolla lobes and hairy anthers.

4. Lobelia zeylanica LINNÉ, Sp. Pl. 2 (1753) 932; OSBECK, Dagbok Ostindisk Resa (1757) 241; BURM. *f.* Fl. Ind. (1768) 186; R. & S. Syst. Veg. 5 (1819) 64; ROXB. Fl. Ind. 2 (1824) 113; WALL. Pl. As. Rar. 2 (1831) 43; G. DON, Gard. Dict. 3 (1834) 709; KURZ, Flora 55 (1872) 302; J. As. Soc. Beng. 46, ii (1877) 211, *incl. var. affinis*; YAMAMOTO, Obs. Fl. Form. 13 (1936) 149; MERR. & PERRY, J. Arn. Arb. 22 (1941) 386; GREENWOOD, *ibid.* 30 (1949) 78.—*L. succulenta* BL. Bijdr. (1826) 728; DC. Prod. 7 (1839) 373; MIQ. Fl. Ind. Bat. 2 (1856) 577; KOORD. Exk. Fl. Java 3 (1912) 303; OCHSE, Trop. Groent. (1925) 22, fig.; OCHSE & BAKH. Ind. Groent. (1931) 92, f. 54; HOCHR. Candollea 5 (1932) 292; MERR. Pap. Mich. Ac. Sc. 20 (1935) 111; CRAIB, Fl. Siam. En. 2 (1936) 305; WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 361, *incl. var.*; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 3; WIMMER, Pfl. R. Heft 107 (1953) 576, *incl. var. lobbiana et f. glabra.*—*L. affinis* WALL. [Cat. (1828) 35 *et* 158 *no* 1131] *ex* G. DON, Gard. Dict. 3 (1834) 709; *non* MIRBACH, 1805; DC. Prod. 7 (1839) 360; MIQ. Fl. Ind. Bat. 2 (1856) 574; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27; DRURY, Handb. Ind. Fl. 2 (1866) 108; CLARKE, Fl. Br. Ind. 3 (1881) 424, *incl. var. lobbiana*; TRIM. Fl. Ceyl. 3 (1895) 57; GAMBLE, J. As. Soc. Beng. 74, ii (1905) 52; CRAIB, Kew Bull. (1911) 404; KOORD. Exk. Fl. Java 3 (1912) 121; S. MOORE, Trans. Linn. Soc. Bot. II, 9 (1916) 88; DIELS, Bot. Jahrb. 55 (1917) 121; RIDL. Fl. Mal. Pen. 2 (1923) 200, f. 89; DANGUY, Fl. Gén. I.-C. 3 (1930) 679; MERR. Lingn. Sc. J. 6 (1930) 332.—*Rapuntium affine* PRESL, Prod. Mon. Lob. (1836) 13.—*Rapuntium succulentum* PRESL, *l.c.* 13.—*Rapuntium zeylanicum* PRESL. *l.c.* 13.—*L. subcuneata* MIQ. Fl. Ind. Bat. 2 (1857) 574.—*L. lobbiana* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 28; DRURY, Handb. Ind. Fl. 2 (1866) 110.—*Dortmannia succulenta* O.K. Rev. Gen. Pl. 1 (1891) 973.—*Dortmannia zeylanica* O.K. *l.c.* 380, *pro nomen, excl. sched.*—*Dortmannia subcuneata* O.K. *l.c.* 973.—*Dortmannia trigona* O.K., *pro var. affinis* O.K. *l.c.* 380.—*L. barbata* WARB. Bot. Jahrb. 13 (1891) 444; K. SCH. & LAUT. Fl. Schutzgeb. (1900) 593.—*Pratia torricellensis* K. SCH. & LAUT. Nachtr. (1905) 402.—*Pratia ovata* ELMER, Leafl. Philip. Bot. 2 (1909) 593; MERR. Philip. J. Sc. 11 (1916) Bot. 317; En. Philip. 3 (1923) 589.—*Pratia begonifolia* (*non* LINDL.) HOSSEUS, Beih. Bot. Centralbl. 28, ii (1911) 477.

Creeping to ascending herb, 20–90 cm, stems often rooting at the lower nodes, terete, higher up sometimes angular, glabrous to sparsely hairy. *Leaves* spirally arranged, ovate to broad ovate, (¾–)1–6 by (½–)1–3½ cm; base cordate to truncate or sometimes decurrent, apex acute, sometimes blunt, margin subentire to subdentate to repand-dentate; upper surface puberulous or glabrous, underneath puberulous, especially the nerves, or glabrous; petiole terete, 1–20 mm, sometimes puberulous to appressed-hairy. *Flowers* axillary, 7–12 mm. Pedicels terete, 1–2 cm, ebracteolate. *Calyx* lobes lanceolate to oblong triangular, acute, patent-hairy, sometimes glabrous, 3–5 by ½ mm, entire to subdentate, with curved hairs to dentate-ciliate. *Corolla* 5–9 mm, purplish to pale or creamy, inside glabrous to subglabrous with two gibbosities, dorsally slit to the base; dorsal lobes connate with the lateral ones for 2–3½ mm, lateral lobes connate with the ventral one for 4–7 mm; dorsal lobes oblong or elliptic, 2½–3 by 1–1½ mm, falcate, entire to wavy, acute, outside on the nerves with long hairs, lateral and ventral lobes spathulate to ovate, 1–2 by 1–2 mm, entire, at the centre of the ventral lobe a white spot surrounding a purple stripe. *Filaments* 3–5 mm, for more than ¾ free; free parts narrowed towards the base, all of equal width, haired; anthers from dorsal to ventral 1–1½ mm to ¾–1 mm, hairy; all anthers at the apex with a hair tuft. *Ovary* cupular to obconical, 1¼–3 by 1 mm, scattered hairy to hairy (glabrous in specimens from Hainan); style glabrous. *Capsule* obconical to oblong ovate, 3–7 by 2–4 mm, with distinct nerves and a membranous pericarp. *Seeds* trigonous, 0.4 by 0.3 mm, light-brown; after withering the nerves and remains of the placenta persistent.

Distr. SE. Asia (from Ceylon and the Deccan through the Himalaya to SE. China: Kwangtung, Kwangsi, Chekiang), Hainan, and Formosa, almost throughout *Malaysia*, but not yet found in the Lesser Sunda Islands and the Moluccas; also in the Fiji Is.

Ecol. On shaded grassy grounds and moist places, under everwet climatic conditions. In coffee, tea, and rubber plantations, in open places in primary forest along streams, in shaded ravines, *etc.*, from the lowland up to 1500, rarely 1650–2000 m. *Fl. fr.* Jan.–Dec.

Vern. *Bĕlimbing tanah*, M, *rantji djadjar*, J, *djukut bulu mata kĕrbo*, *ramo kujah*, S.

Use. According to OCHSE the young leaves are eaten as 'lalab' (steamed vegetable) with rice.

Notes. There is in literature no unanimous opinion about the typification of this Linnean species and this even induced CRAIB to suggest to reject it as a *nomen confusum* (Fl. Siam. En. 2, 1936, 305–306). DE CANDOLLE accepted it as conspecific with *L. affinis* WALL. which is in turn conspecific with *L. succulenta* BL.; he excluded from it LINNAEUS's reference to SEBA which he found fit to describe as *L. sebae* DC., now accepted as a synonym of *Monopsis simplex* (L.) WIMMER. In this interpretation he was followed later by several others, for instance KURZ, and recently MERRILL & PERRY.

The other interpretation started with CLARKE, who, for his revision of the Indian *Lobelias*, examined the material of *L. zeylanica* in the Linnean Herbarium, and stated (Fl. Br. Ind. 3, 1881, 425):—"that LINNAEUS's excellent specimen of the species is named *L. zeylanica* in his own hand, but the name has been altered (erroneously) by Sir J. E. SMITH to *L. anceps*, an Australian species."

CRAIB, *l.c.*, re-examined the Linnean specimens, two sheets: —"on one sheet marked *L. zeylanica* are 2 specimens but different plants, *viz* one what we call now "*L. succulenta*" BL. and a second non-campanulaceous plant." . . ."Pinned to this "*L. zeylanica*" sheet is another, on which is written, in LINNAEUS's hand, "18", *i.e.* the number of *L. zeylanica* in Sp. Pl. The plant on this sheet belongs to *L. zeylanica* as usually understood to-day."

This latter is obviously the specimen which CLARKE designated as the lectotype. It is referred to by SAVAGE (Cat. Linn. Herb. 1945, 165) under 1015 as *no* 42. According to SAVAGE it is not indicated on any of the Linnean sheets which came from China and was collected by OSBECK.

MERRILL & PERRY rightly considered that, though LINNAEUS derived his specific name from *Campanula ceylanica, senecionis folio, flore purpureo* SEBA, Thes. I: 37, t. 22, f. 12. 1734, yet, at the same time, he added a question mark to this reference; his description was based wholly on a plant collected by OSBECK, near Canton, in China, which represents a species totally different from the form SEBA illustrated (J. Arn. Arb. 22, 1941, 386). They concluded that the OSBECK specimen(s) are unquestionably the type of *L. zeylanica*.

In the rather detailed description OSBECK gave the following characters:—"*Perianthium . . . subtus villosum . . . filamenta . . . duo basi villosa . . . Caulis teres . . . Folia cordata . . . petiolata*." This definition leaves no doubt that OSBECK's plant must agree with *L. succulenta* BL.

This is corroborated by an OSBECK collection in the Bergius Herbarium, which we could examine through the courtesy of Prof. FLORIN, Stockholm. On the back is written:—"*ceylanica. Lobelia foliis ovatis obtusis petiolatis crenatis caule diffuse: In China agris aquosii oryzae legi* 1751 OSBECK." The specimen doubtless represents *L. succulenta* BL.

Through the diligence of Dr NORLINDH, Lund, two other OSBECK specimens were located in the Riksmuseet Stockholm, both marked "*zeilanica*" and "*18 zeylanica*" respectively. The latter specimen has possibly actually been in the hands of LINNAEUS.

5. Lobelia heyniana R. & S. Syst. Veg. 5 (1819) 50; *non* SPRENG. 1825; BL. Bijdr. (1826) 728; G. DON, Gard. Dict. 3 (1834) 709 (*heyneana*); WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 344; Pfl. R. Heft 107 (1953) 474, *incl. var. div.*; SANTAPAU, Rec. Bot. Surv. Ind. 16 (1953) 158.—*L. decurrens* ROTH, Nov. Sp. (1821) 145; *non* CAV. 1801.—*L. micrantha* HOOK. Exot. Fl. 1 (1823) t. 44; *non* H.B.K. 1818.—*L. trialata* HAM. *ex* D. DON, Prod. Fl. Nep. (1825) 157; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 360; CLARKE, Fl. Br. Ind. 3 (1881) 425, *incl. var. lamiifolia*; CRAIB, Kew Bull. (1911) 404; KOORD. Exk. Fl. Java 3 (1912) 302; BOLD. Zakfl. (1916) 41; GAMBLE, Fl. Pres. Madras 4 (1921) 736; CRAIB, Fl. Siam. En. 2 (1936) 306.—*L. subincisa* WALL. [Cat. (1828) *n.* 1320, *nomen*] *ex* DC. Prod. 7 (1839) 367; MIQ. Fl. Ind. Bat. 2 (1856) 575.—*Rapuntium reinwardtianum* PRESL, Prod. Mon. Lob. (1836) 14.—*Rapuntium trialatum* PRESL, *l.c.* 13.—*Rapuntium arenarioides* PRESL, *l.c.* 17.—*L. arenarioides* DC. Prod. 7 (1839) 367.—*L. reinwardtiana* DC. *l.c.* 367; MIQ. Fl. Ind. Bat. 2 (1856) 565; KOORD. Exk. Fl. Java 3 (1912) 303.—*L. inconspicua* RICH. Tent. Fl. Abyss. 2 (1851) 8.—*L. zeylanica* (*non* L.) MOON, Cat. (1824) 14, *nomen*; CLARKE, Fl. Br. Ind. 3 (1881) 425, *incl. var. walkeri*; TRIM. Fl. Ceyl. 3 (1895) 56; KOORD. Exk. Fl. Java 3 (1912) 302; BOLD. Zakfl. (1916) 41; HAINES, Bot. Bihar & Orissa 4 (1922) 501, *incl. var. aligera*; BACK. & SLOOT. Theeonkr. (1924) 213, fig.; DANGUY, Fl. Gén. I.-C. 3 (1930) 678, *incl. var. parviflora*; HOCHR. Candollea 5 (1932) 292; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 2.—*L. subracemosa* MIQ. Fl. Ind. Bat. 2 (1857) 576, *incl. var. rigidior.*—*L. dichotoma* MIQ. *l.c.* 576; WIMMER, in Fedde, Rep. 38 (1935) 78; Ann. Naturh. Mus. Wien 56 (1948) 345, *incl. var. aligera et var. pilosella*; Pfl. R. Heft 107 (1953) 476, *incl. var.*—*L. trigona* (*non* ROXB.) HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27, *p.p.*; THWAITES, En. Pl. Zeyl. (1860) 169, *p.p.*; BENTH. Fl. Hongk. (1860) 197, *p.p.*; HOSSEUS, Beih. Bot. Centralbl. 28, ii (1911) 466, *p.p.*—*Dortmannia zeylanica* O.K. Rev. Gen. Pl. 2 (1891) 380.—*Dortmannia trialata* O.K. *l.c.* 973.—*Dortmannia inconspicua* O.K. *l.c.* 972.—*Dortmannia reinwardtiana* O.K. *l.c.* 973.—*L. aligera* HAINES, J. As. Soc. Beng. n.s. 15 (1920) 316.—*L. bialata* MERR. Philip. J. Sc. 7 (1912) Bot. 105, *ex descr.*; WIMMER, Pfl. R. Heft 107 (1953) 474.—**Fig. 16d.**

An ascending or erect herb, 5–50(–60) cm; stem 3-angled and winged. *Leaves* spirally arranged, the lower ones rhomboid to broad-ovate, upwards elliptic to linear-lanceolate, decurrent at the base, acute at the apex, ½–4 by ¼–3 cm, serrate to serrate-dentate, glabrous or sparsely hairy, especially the higher ones; petiole up to 3 mm.

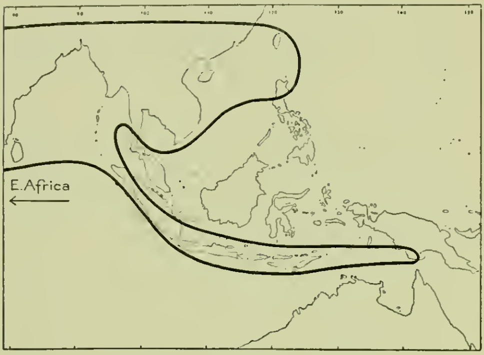


Fig. 13. Distribution of *Lobelia heyniana* R. & S.

Flowers 4½–12 mm, axillary, often forming a terminal raceme. Pedicels ½–2 cm, 3-angled, patent, glabrous or hairy with 2(–1), small, linear to minutely reduced bracteoles. *Calyx* lobes lanceolate-elliptic, 2–4 by ¼–1 mm, acute, entire to subdentate, glabrous to sparsely hairy. *Corolla* 3½–10 mm, pale-purple, lilac, sometimes white, inside with 2 gibbosities and a dark spot, nearly glabrous to hairy, slit to the base; dorsal lobes connate with the lateral ones for 1½–5 mm, lateral lobes connate with the ventral one for 2–7 mm; dorsal lobes linear to lanceolate, 1–4 by ¼–1 mm, often reflexed, sometimes longitudinally folded, small compared with the others, lateral and ventral lobes spathulate to ovate, 1–7 by ½–2½ mm, acute or blunt, entire to subcrenate. *Filaments* 3–7 mm, up to half-way free, of equal width, glabrous or hairy. Anthers from dorsal to ventral 1–1½ to ½–¾ mm, glabrous or hairy, only the 2 anterior ones with an apical hair tuft. *Ovary* trumpet- to cup-shaped, 1½–4 by 1–2½ mm, glabrous, sometimes hairy; style glabrous. *Capsule* obconical to obconical-campanulate, 3–8 by 2–2½ mm. *Seeds* semi-ellipsoid, ½ by ¼ mm, smooth, brown.

Distr. E. Africa (Erytrea, Abyssinia, Kenya to Tanganyika), SE. Asia (Ceylon and the Deccan Peninsula to S. China), *Malaysia*: North to Central Sumatra, Java (from Mt Patuha eastward), Lesser Sunda Islands (Bali: G. Agung; Lombok: G. Pusuk, G. Sembalung; Sumbawa: Batu Sulang; Timor: Noiltoko, G. Mutis), Philippines (Luzon: Bontoc, VANOVERBERGH 902, type of *L. bialata* MERR., *non vidi*), and W. New Guinea (Merauke). Fig. 13.

Ecol. In moist and swampy places, in marshes, on steep slopes and in light forest, 500–2700 m. *Fl. fr.* Jan.–Dec.

Vern. *Djukut mata kĕbo*, *kitombè*, S, *krĕmo*, *krinjingan*, *kukunnang*, J.

Note. Small specimens possess often lax racemes and leaves as in some specimens of *L. alsinoides*.

6. Lobelia chinensis LOUR. Fl. Coch. (1790) 514, ed. Willd. (1793) 628; R. & S. Syst. Veg. 5 (1819) 41; G. DON, Gard. Dict. 3 (1834) 709; DC. Prod. 7 (1839) 360; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1889) 2; DIELS, Bot. Jahrb. 21 (1901) 607; MERR. Lingn. Sc. J. 5 (1927) 181; CRAIB, Fl. Siam. En. 2 (1936) 302; YAMAMOTO, Obs. Fl. Form. 13 (1936) 148; WIMMER, Pfl. R. Heft 107 (1953) 609.—*L. erinus* (*non* L.) THUNB. Fl. Jap. (1784) 325.—*L. erinoides* (*non* L.) THUNB. *l.c.* 325.—*L. radicans* THUNB. Trans. Linn. Soc. 2 (1794) 330; R. & S. Syst. Veg. 5 (1819) 60; ROXB. Fl. Ind. 2 (1824) 110; CLARKE, Fl. Br. Ind. 3 (1881) 425; FORBES & HEMSLEY, J. Linn. Soc. Bot. 26 (1889) 3; KOORD. Exk. Fl. Java 3 (1912) 302; BOLD. Zakfl. (1916) 41; KOORD. Fl. Tjib. 3 (1918) 55; BACK. & SLOOT. Theeonkr. (1924) 212, fig.; ALSTON, Fl. Ceyl. Suppl. (1931) 175; MERR. Lingn. Sc. J. 7 (1931) 325; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 2; T. MAKINO, Ill. Fl. Japan (1954) 80.—*L. campanuloides* THUNB. Trans. Linn. Soc. 2 (1794) 331; KER, Bot. Reg. 9 (1823) t. 733; G. DON, Gard. Dict. 3 (1834) 709.—*L. caespitosa* BL. Bijdr. (1826) 729; DC. Prod. 7 (1839) 366; MIQ. Fl. Ind. Bat. 2 (1856) 575.—*Rapuntium caespitosum* PRESL, Prod. Mon. Lob. (1836) 13.—*Rapuntium campanuloides* PRESL, *l.c.* 13.—*Rapuntium chinense* PRESL, *l.c.* 13.—*Rapuntium radicans* PRESL, *l.c.* 14.—*Isolobus radicans* DC. Prod. 7 (1839) 353.—*Isolobus kerii* DC. *l.c.* 353.—*Isolobus roxburghianus* DC. *l.c.* 353; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27.—*Isolobus campanuloides* DC. Prod. 7 (1839) 353.—*Isolobus caespitosus* HASSK.

Fig. 14. *Lobelia chinensis* LOUR. Bogor (West Java), in dense sods in the Tji Liwung valley (1928).

Bonpl. 7 (1859) 180.—*Pratia radicans* G. DON, Gard. Dict. 3 (1834) 700.—*Pratia thunbergii* G. DON, *l.c.* 700.—*Dortmannia chinensis* O.K. Rev. Gen. Pl. 2 (1891) 380.—*Dortmannia campanuloides* O.K. *l.c.* 380.—*Dortmannia radicans* O.K. *l.c.*—**Fig. 14.**

A glabrous, branched, caespitose or prostrate rooting herb; stem 5–15 cm, terete, with two longitudinal ridges. *Leaves* alternate (distichous) with decurrent sessile or subsessile base, elliptic-ovate or lanceolate (especially apically), 13–33 by 2–6 mm; acute or blunt, subentire to shallowly toothed towards the apex. *Flowers* axillary, 7–15 mm, on one stem mostly 1–2, only one opened at a time. Pedicels terete, 6–37 mm, erect, ebracteolate. *Calyx* lobes narrow-triangular, 1½–3 by ½–¾ mm, dentate at the base. *Corolla* 5–12 mm, white to pale-purple (red in China), outside glabrous, inside hairy, sometimes with 2 green gibbosities, slit to the base; dorsal lobes connate with the lateral ones for 4–4½ mm, lateral lobes connate with the ventral one for 4½–6 mm; dorsal lobes 4½–8 mm, linear, sometimes, reflexed, blunt, lateral and ventral lobes 3–6 mm, equal, linear to lanceolate, acute. *Filaments* 5–6 mm, for more than half-way free, all of equal width, the 2 anterior ones patent hairy, with a seta or hair tuft at the top; anthers from dorsal to ventral 2–1 mm, glabrous or hairy. *Ovary* 2–5 by 1 mm, trumpet-shaped, glabrous; style hairy at the base. *Capsule* on a recurved pedicel, 4–6 mm, obconical, glabrous. *Seeds* 3/8–½ mm, ellipsoid, somewhat compressed, dark-brown, smooth.

Distr. SE. to E. Asia (from the Deccan to China and Japan), in *Malaysia*: Malay Peninsula (Singapore) and Java (eastwards to Mt Diëng), according to BACKER & VAN SLOOTEN since long introduced from continental Asia.

Ecol. On moist, grassy places, along water-courses and on cultivated land, on rice-fields and in tea and cinchona plantations, 500–1600 m, occasionally at lower altitudes. According to BACKER & VAN SLOOTEN no capsules with ripe seeds are found in Java. VAN STEENIS has found a plant at Bogor (*n.* 2151) with ripe capsules and seeds. I also saw a sheet in the Leyden Herb. (SCHIFFNER 2728, from Tjibodas) with ripe capsules and seeds. It remains questionable whether these seeds are viable.

Propagation is normally vegetative. According to BACKER & VAN SLOOTEN it descends along water-courses to lower altitudes, even to the lowlands, by stolons or stems dispersed by water. However, such lowland habitats are only temporary.

Vern. *Djukut mata keujeup, ki tombè*, S.

7. Lobelia archboldiana (MERR. & PERRY) MOELIONO, *nov. comb.*—*Pratia archboldiana* MERR. & PERRY, J. Arn. Arb. 30 (1949) 59; WIMMER, Pfl. R. Heft 107 (1953) 765.—**Fig. 15.**

Stemless, delicate plant, sometimes with stolons, 2–4 cm. *Leaves* in rosette, ovate to roundish, ½–1½ cm diam., subcordate or truncate at the base, wavy to denticulate along the margin,

Fig. 15. *Lobelia archboldiana* (MERR. & PERRY) MOELIONO. *a.* Habit, × 2½, *b.* young flower, × 3, *c.* open flower, × 3 (CLEMENS 12442).

obtuse at the apex, very thin, glabrous or sparsely hairy above, glabrous underneath; petiole 3–7(–23) mm, glabrous or sparsely pilose. *Flowers* 5–6½ mm, axillary or terminal. Pedicels 2–12 mm, glabrous or hairy. *Calyx* lobes linear-lanceolate, with 1–2 pairs of teeth, hairy, 2–3 mm. *Corolla* red to dark wine-red, the tube 2–3 mm long, outside glabrous to sparsely hairy, inside glabrous, dorsally split to 1 mm from the base; dorsal lobes half-way connate with the lateral ones, their free part lanceolate, 2–3 mm, reflexed, lateral and ventral lobes also half-way connate, their free part lanceolate, 3–3.2 mm, acute. *Stamens c.* 2 mm, filaments for ¾ of their length free, glabrous; anthers from dorsal to ventral 1¾–¾ mm; 2 anterior ones with a short bristle and some hairs. *Ovary* campanulate to trumpet-shaped, 1–2½ by 1–2 mm, sparsely hairy; style glabrous. *Capsule* roundish to ovoid, 3 by 3 mm, sparsely hairy, with a thin wall. *Seeds* roundish to ovoid, *c.* ½ by ½ mm, smooth, dark-brown to black.

Distr. *Malaysia*: E. New Guinea (Murray Pass, Wharton Range; Rawlinson Range, Morobe Prov.), rare, twice collected.

Ecol. Under a rock wall on grassy bank of a creek and in deep holes above deep water-courses, 2840–3600 m. *Fl. fr.* July–Aug.

8. Lobelia brachyantha MERR. & PERRY, J. Arn. Arb. 22 (1941) 385; WIMMER, Pfl. R. Heft 107 (1953) 487.—**Fig. 16a-b.**

Tiny, creeping, branched herb; stem terete, rooting, sparsely pilose. *Leaves* alternate, orbicular-reniform, 2½–5 by 2½–6 mm, base cordate to truncate, margin subundulate to dentate, upper surface sparsely pilose, beneath glabrous; petiole

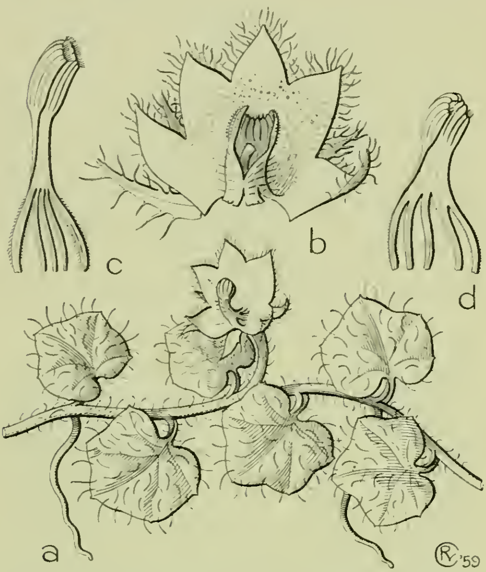


Fig. 16. *Lobelia brachyantha* MERR. & PERRY. *a.* Habit, × 2½, *b.* flower, × 5.—*L. alsinoides* LAMK. *c.* Stamens, × 5.—*L. heyniana* R. & S. *d.* Stamens, × 5 (*a–b* BRASS 11570, *c* VAN STEENIS 6705, *d* DE VOOGD 2615).

1–3 mm. *Flowers c.* 5 mm, axillary. Pedicels terete, 4–5 mm, hairy, ebracteolate. *Calyx* lobes oblong-triangular, 2–2½ by ½–¾ mm, with a distinct tooth at the base, sparsely pilose. *Corolla* subcampanulate, 4 mm long, dark purplish-red, outside pilose, inside the 3 anterior lobes papillose, dorsally not entirely split to the base; dorsal lobes connate with the lateral ones for 1 mm, lateral lobes connate with the ventral one for 2 mm; all lobes ovate-deltoid, 1½ mm, acute to blunt. *Filaments* 1½ mm, up to 1/3 free, equal, glabrous or hairy. Anthers from dorsal to ventral 1–¾ mm, glandular hairy; the 2 anteriors at the apex finely hairy (according to MERRILL & PERRY 'setigeris'). *Ovary* cupular, 1 by 1½ mm, long-hairy; style glabrous. *Capsule* cupular-ovoid, 3 by 2 mm. *Seeds* ellipsoid to roundish, 0.6–0.8 mm, smooth, light-brown.

Distr. *Malaysia*: New Guinea (Bele River, near Habbema Lake), once found.

Ecol. Creeping on bare rock on a sparsely vegetated limestone precipice, 2350 m.

Note. The pilose indument of this plant is very typical, because the hairs are more-celled. The structure of the corolla is also very unlike that of the other Malaysian species by its very short tube which gives the corolla a campanulate shape.

9. Lobelia montana REINWARDT *ex* BL. Bijdr. (1826) 728; DC. Prod. 7 (1839) 386.—*Pratia montana* HASSK. Flora 25, 2 (1842) Beibl. 1, p. 23; Cat. Hort. Bog. (1844) 106; CLARKE, Fl. Br. Ind. 3 (1881) 423; KOORD. Exk. Fl. Java 3 (1912) 304; Fl. Tjib. 3, 2 (1918) 56; DANGUY, Fl. Gén. I.-C. 3 (1930) 677, f. 75, 1–5; HOCHR. Candollea 5 (1932) 293, *incl. f. variegata*; HEND. Gard. Bull. S.S. 7 (1933) 109; DOCTERS VAN LEEUWEN, Verh. Kon. Ak. Wet. A'dam sect. 2, 31 (1933) 240; STEEN. Bull. Jard. Bot. Btzg III, 13 (1934) 179; MERR. Contr. Arn. Arb. 8 (1934) 165; WIMMER, Pfl. R. Heft 106 (1943) 116, *incl. f. variegata et var. cyanocarpa*; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 5.—*Piddingtonia montana* MIQ. Fl. Ind. Bat. 2 (1857) 573; BUIJSMAN, Flora 106 (1913) 127, *excl. syn.*—*Piddingtonia patens* MIQ. Fl. Ind. Bat. 2 (1857) 573.—*Speirema montanum* HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 27; CLARKE, J. Linn. Soc. Bot. 15 (1876) 147.—*Piddingtonia cyanocarpa* HASSK. Bonpl. 7 (1859) 179.—**Fig. 17.**

Erect, mostly branched, medium-sized to coarse, nearly glabrous herb, *c.* 1–2 m; stem terete. *Leaves* spirally arranged, ovate-oblong to lanceolate, 3½–12 by 1½–4¼ cm, decurrent at the base, dentate to subdentate, acute to acuminate; petiole *c.* ½ cm, glabrous to appressed-hairy. *Flowers* axillary, solitary, secund, scentless. Pedicel 2–4½ cm, during anthesis erect. *Calyx* lobes lanceolate, 5–11 by 1–1½ mm, obliquely patent, entire, acute. *Corolla* 1½–3 cm, purplish to lilac-blue with

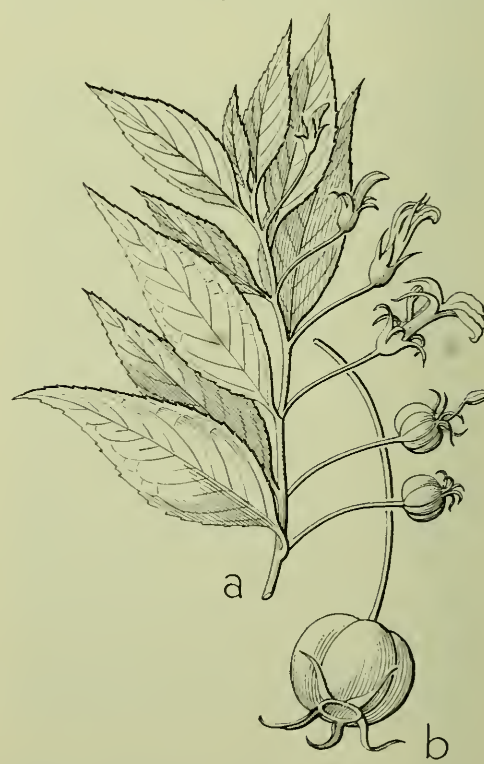


Fig. 17. *Lobelia montana* REINW. *ex* BL. *a.* Apex of flowering stem, × ⅔, *b.* ripe fruit, natural poise, × ⅔.

white-shaded margins, outside glabrous, inside hairy and with two pilose gibbosities, dorsally slit to 1–2 mm from the base; dorsal lobes connate for 1–3 mm, connate with the lateral lobes for 7–10 mm, lateral lobes connate with the ventral one for 9–12 mm; dorsal lobes linear-lanceolate, 9–10 mm, flat or crisped, margins glabrous, lateral and ventral lobes oblong-lanceolate, the ventral one broadest, 7–12 mm, crisped and ciliate, acuminate. *Filaments* 4–7 mm, for 1/3 of their length free, glabrous; anthers from dorsal to ventral 5–3 mm long, hairy; the two anteriors besides at their apex with a hair tuft. *Ovary* campanulate to hemispherical, 3–5 by 3–6½ mm, glabrous; style glabrous. *Berry* globose, ¾–1½ cm diam. (living *c.* 2–2½ cm), on long (over 6 cm), patent, afterwards recurved pedicels, violet, later dark purple. *Seeds* broad-ellipsoid to ovoid, *c.* ½ mm long, brown, smooth.

Distr. India (from the Deccan to the Himalaya) to Indo-China (Tonkin), S. China (Yunnan), and *Malaysia*: Malay Peninsula (Cameroon Highlands), Sumatra, and Java (eastwards to Mt Diëng.) Fig. 18.

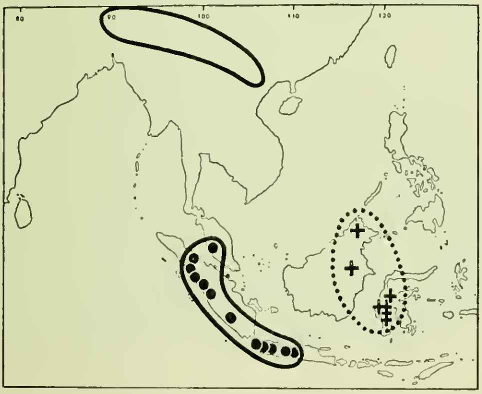


Fig. 18. Distribution of *Lobelia montana* REINW. *ex* BL. (continuous line, localities in Malaysia dotted), and *Lobelia borneensis* (HEMSL.) MOELIONO (dotted line, localities in Malaysia indicated by crosses).

Ecol. Open or half-shaded places in mountain forest, light spots in mossy forests, 1400–2600 m. According to DOCTERS VAN LEEUWEN (1933) the species is autogamous in Java.

Vern. *Ki bèwo, ki leuntja, tětěra*, S, *kěmalon, tjělengan*, J.

Note. KURZ recorded to have found this species on the summit of Mt Menumbing in Banka I. (Nat. Tijd. Ned. Ind. 27, 1864, 206); though I have not seen his collection this record must rest on an error.

10. Lobelia borneensis (HEMSL.) MOELIONO, *nov. comb.*—*Pratia borneensis* HEMSL. in Hook. Ic. Pl. 16 (1886) t. 1532; STAPF, Trans. Linn. Soc. Bot. II, 4 (1894) 188, *incl. var. grandiflora*; GIBBS, J. Linn. Soc. Bot. 42 (1914) 100; MERR. En. Born. (1921) 585; WIMMER, Pfl. R. Heft 106 (1943) 117; *ibid.* Heft 107 (1953) 765; LAM, Blumea 5 (1945) 568.

Coarse, erect half-shrub, *c.* 1–1½ m, branching, sometimes reclining; stem glabrous, slightly to strongly angular and furrowed. *Leaves* spirally arranged, elliptic-lanceolate, 9–11 by 2¾–3½ cm, slightly dentate, decurrent at the base, acute to acuminate at the top, glabrous to puberulous, darker green at the upper side, paler beneath, glossy on both surfaces; petiole 3–7 mm. *Peduncle* angular and furrowed, inflorescence a terminal raceme or pseudo-axillary by sympodial growth, erect, faintly puberulous. Bracts lanceolate, 6–7 by 1–2 mm, slightly dentate. Pedicels 5–10 mm, thin, whether or not with 1 or 2 tiny lanceolate bracteoles in the basal half. *Flowers c.* 2½ cm. *Calyx* lobes lanceolate, 6½–7 by 1½ mm, longitudinally nerved, subentire, obtuse to acute, faintly puberulous. *Corolla* 1¾–2¼ cm, blue purple or white with purple at the base of the margin of the segments or lavender tinged, inside with 2 gibbosities whether or not papillose; dorsally split to 0–2 mm from the base; dorsal lobes connate with the lateral ones for 2–4 mm, lateral ones connate with the ventral one for 7–11 mm; dorsal lobes oblong-lanceolate, 6–10 mm, longitudinally folded, recurved, the margins crisp to flat, obtuse to subacute, glabrous or slightly ciliate, lateral lobes oblong-lanceolate, 6–10 by 2 mm, recurved, ventral lobe oblong-lanceolate, 8–12 by 2–2½ mm whether or not incurved. *Filaments* up to half their length free at the base, *c.* 5 mm, glabrous; anthers from dorsal to ventral 4–2 mm, at the apex a tuft of hairs. *Ovary* 5 by 5 mm, campanulate to hemispherical, faintly puberulous; style glabrous. *Berry* 3–5 mm (mature?), globose, green. *Seeds* ¾–1 mm, globose to broad ellipsoid, slightly angular, reticulate.

Distr. *Malaysia*: Borneo (N. Borneo: Mt Kinabalu; E. Kutei), Celebes (Central part and SW. peninsula). Fig. 18.

Ecol. In secondary jungle, on forest edges, along forest paths, and in open grassfields, (500–)900–1800 m. *Fl. fr.* Jan.–Dec.

Vern. *Akar maga pawang*, N. Borneo.

Note. The nearest allies of this and the foregoing species are obviously found in remote places, China, New Zealand, and Guatemala!

11. Lobelia angulata FORST. Fl. Ins. Austr. Prod. (1786) 58, *n.* 309; R. & S. Syst. Veg. 5 (1819) 65; A. RICH. Fl. Nouv.-Zél. (1832) 227; G. DON, Gard. Dict. 3 (1834) 713; DC. Prod. 7 (1839) 366.—*L. nummularia* LAMK, Dict. Bot. 3 (1789) 589; R. & S. Syst. Veg. 5 (1819) 64; BL. Bijdr. (1826) 727; G. DON, Gard. Dict. 3 (1834) 709.—*L. begonifolia* WALL. Asiat. Res. 13 (1820) 377; in Roxb. Fl. Ind. 2 (1824) 115; D. DON, Prod. Fl. Nep. (1825) 158; WALL. Pl. As. Rar. 2 (1831) 43.—*L. javanica* THUNB. Fl. Jav. (1825) 9, *cf.* Blumea 6 (1950) 360.—*L. obliqua* HAM. *ex* D. DON, Prod. Fl. Nep. (1825) 158.—*L. pratiana* GAUDICH. Ann. Sc. Nat. Bot. 5 (1825) 103.—

Pratia repens GAUDICH. *l.c.* 103; in Freyc. Voy. Bot. (1826) 456, t. 79; G. DON, Gard. Dict. 3 (1834) 340, *incl. var.*; HOOK. *f.* Fl. Antarct. 1 (1844) 42; REICHE, Fl. Chil. 5 (1910) 63.—*L. rugulosa* GRAHAM, Edinb. N. Phil. J. (1829) 186.—*Pratia begonifolia* LINDL. Bot. Reg. (1830) t. 1373; G. DON, Gard. Dict. 3 (1834) 699 (*begoniaefolia*); PRESL, Prod. Mon. Lob. (1836) 46; CLARKE, Fl. Br. Ind. 3 (1881) 442; RIDL. J. Str. Br. R. As. Soc. *n.* 33 (1900) 102; MERR. Philip. J. Sc. 1 (1906) Suppl. 241; BURKILL & HOLTTUM, Gard. Bull. S. S. 3 (1923) 56 (*begoniifolia*); RIDL. Fl. Mal. Pen. 2 (1923) 201; DANGUY, Fl. Gén. I.-C. 3 (1930) 674; CRAIB, Fl. Siam. En. 3 (1936) 302.—*L. reniformis* CHAM. Linnaea 8 (1833) 210; DC. Prod. 7 (1839) 365.—*L. hederacea* CHAM. Linnaea 8 (1833) 212.—*Pratia hederacea* G. DON, Gard. Dict. 3 (1834) 699; HOOK. *f.* & ARN. J. Bot. 1 (1834) 277; PRESL, Prod. Mon. Lob. (1836) 46; DC. Prod. 7 (1839) 340, *incl. var. elliptica*; HOOK. *f.* Fl. Antarct. 1 (1884) 43; KANITZ, in Mart. Fl. Bras. 6, 4 (1878) 135, t. 40 f. 1; WIMMER, Rev. Sudamer. Bot. 2 (1935) 96; Pfl. R. Heft 106 (1943) 114.—*Pratia serpyllacea* PRESL, Prod. Mon. Lob. (1836) 46.—*Rapuntium angulatum* PRESL, *l.c.* 30.—*Rapuntium reniforme* PRESL, *l.c.* 15.—*Rapuntium nummularium* PRESL, *l.c.* 30.—*Piddingtonia nummularia* DC. Prod. 7 (1839) 341; MIQ. Fl. Ind. Bat. 2 (1857) 572; HOOK. *f.* & TH. J. Proc. Linn. Soc. Bot. 2 (1858) 26; HASSK. Bonpl. 7 (1859) 180; BENTH. Fl. Hong. (1861) 196.—*L. littoralis* R. CUNN. *ex* A. CUNN. Ann. Nat. Hist. I, 2 (1839) 50; REGEL, Gartenfl. 38 (1888) 662, f. 148.—*Pratia zeylanica* HASSK. Flora 25, 2 (1842) Beibl. 1, p. 23; Cat. Hort. Bog. (1844) 106.—*Pratia arenaria* HOOK. *f.* Fl. Antarct. 1 (1844) 106, t. 29 *in icon. errore Pratia arenosa*; Fl. Nov. Zel. 1 (1853) 157.—*Pratia angulata* HOOK. *f.* Fl. Antarct. 1 (1844) 43; Fl. Nov. Zel. 1 (1853) 157, *incl. var. arenaria*; Handb. Fl. New Zeal. (1867) 172; CHEESEMAN, Man. New Zeal. Fl. (1906) 397; Ill. New Zeal. Fl. (1908) t. 16; WIMMER, Pfl. R. Heft 106 (1943) 110, *incl. var.*—*Piddingtonia palliardii* LEHM. Hamb. Gartenz. 8 (1851) 337; Linnaea 25 (1852) 310; WALP. Ann. 5 (1858) 391.—*L. rotundifolia* BANKS & SOL. *ex* HOOK. *f.* Fl. Nov. Zel. 1 (1853) 158.—*L. horsfieldiana* MIQ. Fl. Ind. Bat. 2 (1857) 577.—*Pratia nummularia* A. BR. & ASCHERS. Index Sem. Hort. Berol. (1861) Append. 6; KURZ, J. As. Soc. Beng. 46, ii (1877) 210; KOORD. Exk. Fl. Java 3 (1912) 303; BOLD. Zakfl. (1916) 41; KOORD. Fl. Tjib. 3, 2 (1918) 55; HEYNE, Nutt. Pl. 2 (1927) 1428; MERR. Lingn. Sc. J. 1 (1927) 181; YAMAMOTO, Obs. Fl. Form. 13 (1936) 150; WIMMER, Pfl. R. Heft 106 (1943) 112; LAM, Blumea 5 (1945) 569; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 3; Blumea 6 (1950) 360.—*Pratia linnaeoides* HOOK. *f.* Handb. New Zeal. Fl. (1867) 172.—*Pratia reniformis* KANITZ, in Mart. Fl. Bras. 6, 4 (1878) 136, t. 40 f. 2; WIMMER, Rev. Sudamer. Bot. 2 (1935) 96; Pfl. R. Heft 106 (1943) 115.—*L. linnaeoides* PETRIE, Trans. New Zeal. Inst. 23 (1890) 405; CHEESEMAN, Man. Fl. New Zeal. (1906) 400; PETRIE, Gard. Chron. III, 47 (1910) 99, f. 50; WIMMER, Pfl. R. Heft 107 (1953) 483, *incl. var. brevipilis.*—*Pratia papuana* S. MOORE, Trans. Linn. Soc. II, 9 (1916) 88; DIELS, Bot. Jahrb. 55 (1917) 125; *ibid.* 62 (1929) 493; WIMMER, Pfl. R. Heft 106 (1943) 114.—*Pratia wollastonii* S. MOORE, Trans. Linn. Soc. II, 9 (1916) 89; WIMMER, Pfl. R. Heft 106 (1943) 111.—?*Pratia podenzanae* S. MOORE, J. Bot. 55 (1917) 306; WIMMER, Pfl. R. Heft 106 (1943) 111.—*L. arfakensis* GIBBS, Arfak (1917) 183; KANEHIRA & HATUSIMA, Bot. Mag. Tokyo 57 (1943) 128; WIMMER, Pfl. R. Heft 107 (1953) 483.—*L. paradoxa* WIMMER, in Fedde, Rep. 26 (1929) 2; Pfl. R. Heft 107 (1953) 483.—**Fig. 19-20.**

Fig. 19. *Lobelia angulata* FORST. Mt Patuha, West Java (DE VOOGD).

Polymorphous, creeping and branching herb; stem terete, up to ½ m long, rooting at the nodes, glabrous or hairy. *Leaves* alternate, round to ovate, broad-ovate or reniform, 2–25 by 2–35 mm, cordate, truncate, or even decurrent at the base, crenate, dentate or subdentate to subentire at the margin, acute or rounded at the top, glabrous to hairy; petiole 0–25 mm, glabrous or densely hairy. *Flowers* 6–18, axillary, solitary. Pedicels ½–5(–7) cm, ebracteolate, glabrous or hairy. *Calyx* lobes linear-lanceolate to triangular, 1–11 mm, entire to distinctly dentate with up to 3 teeth at either side, acute or blunt, glabrous to puberulous. *Corolla* 4½–15 mm, outside and inside glabrous or hairy, sometimes with two gibbosities inside, dorsally split to the base or nearly so; dorsal lobes connate with the lateral ones for 1½–5 mm, laterals connate with the ventral one for 2–12 mm; dorsal lobes lanceolate, 2–14 mm long, falcate and reflexed, lateral and ventral lobes spathulate, obovate, or lanceolate, 2–12 mm, the ventral one generally broadest. *Filaments* 3–11 mm, very variable. free for ¾ of their length, equal in width, sometimes narrowed to the base, or the two anteriors broader, sometimes the two anteriors adnate to the corolla, glabrous or hairy or only the two anterior ones hairy; anthers from dorsal to ventral 1–2 to 1–½ mm, glabrous or hairy, only those of the two anteriors with a hair tuft or with a seta and some hairs. *Ovary* trumpet-shaped to obconical or ovoid or campanulate, 1–4 by 1–3 mm; glabrous to densely hairy; style glabrous or sparsely pilose. *Fruit* an indehiscent or dehiscent capsule or a subcarnose to baccate purple fruit, (1–)6½–16 by (1–)5–13 mm, glabrous to hairy, ellipsoid to globose, sometimes flattened at the apex. *Seeds* flattened-ellipsoid to ellipsoid, nearly 1 mm, brown, reticulate to fine-reticulate.

Distr. Very widely distributed, through SE. Asia (Nepal, Sikkim, Khasia, Burma, Siam, Indo-China) to China (Yunnan, Kwangsi, Hainan, Formosa), throughout *Malaysia*, Borneo and the Moluccas excepted, Australia, Tasmania, New Zealand, and adjacent islands, to S. America.

Ecol. Moist open or shaded places, in mountain forest, mossy forest, along river-banks and forest trails, 600–3300 m.

Vern. *Aäntingan, ki tombè, kitomè, kuweung, ramo keujeup, djukut mata keujeup gunung, tangkal sutji*, S, *kĕtrus alus, manikan, sĕrintil, urĕk urĕk polo*, J; Philippines: *gubagubai, kanapa, pisa*, Ig., *tutugi*, Bon.; *tikiritoka*, Kopanko, New Guinea.

Notes. An extremely polymorphous species. As reported in the note to the description of the genus, it is in this species that the fruits are varying not only in shape, but even in structure in the New Guinean and some Celebes specimens, which also vary in floral characters. In the abundant material I have studied, I cannot make any distinct demarcation and I am convinced that it will be wise to consider the specimens as belonging to one species. It may be possible that more numerous, detailed field data will enable to segregate infraspecific taxa.

The polymorphism had already been indicated by DIELS, who, in his revision of the Papuan species, remarked:—"Diese drei Arten (*Pratia papuana, P. nummularia*, und *P. angulata*) sowie die *P. wollastonii* von der Nassaukette, und mehrere andere bei *Pratia* diagnostisierte Spezies, sind übrigens so geringfügig, dass nach genauem Studium der Formenkreis, wahrscheinlich umfassender Arten angenommen werden müssen." (Bot. Jahrb. 55, 1917, 125; *ibid.* 62, 1929, 493).

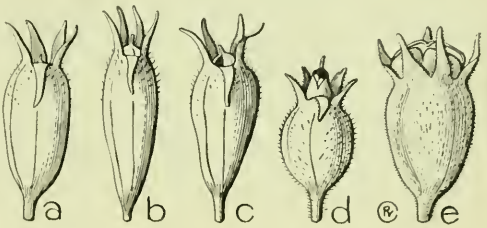


Fig. 20. Various fruits of *Lobelia angulata* FORST. *a–c*. Fleshy berry to capsule, from Celebes, *d–e*. capsular New Guinea specimens, all × 2½ (*a–c* EYMA 1161, *d* BRASS 10622, *e* NGF 4789).

Also WIMMER himself, in identifying a Philippine specimen which was astonishingly resembling *Pratia nummularia* but possessed fruits with valves on top, came obviously reluctantly to the conclusion that this character settled it as a *Lobelia*; he named it *L. paradoxa*!

BEUZENBERG & HAIR recently found the following chromosome numbers: for *L. linnaeoides* (HOOK. *f.*) PETRIE n = 7 and for *Pratia angulata* (FORST.) HOOK. *f.* n = 35 (N. Zeal. J. Sc. 2, 1959, 532, 537).

12. Lobelia conferta MERR. & PERRY, J. Arn. Arb. 59 (1949) 59.—*Pratia conferta* WIMMER, Pfl. R. Heft 107 (1953) 764.—**Fig. 21.**

Tiny, prostrate, fleshy, glabrous herb, with short stems. *Leaves* distichous, conferted, semi-amplexicaulous, sessile, oblong-lanceolate, entire, 4–5 mm by 1–2 mm, blunt to obtuse, smooth and shining. *Flowers* 5 mm long, in the upper leaf axils. Pedicels 2–5 mm, ebracteolate. *Calyx* lobes linear to lanceolate, 1½–2½ mm by 1 mm, entire, blunt to slightly acute. *Corolla* 4–4½ mm, glabrous, very light purple, inside with two gibbosities, dorsally split to the base; dorsal lobes

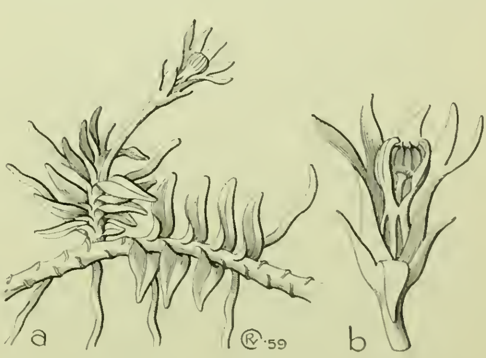


Fig. 21. *Lobelia conferta* MERR. & PERRY. *a*. Habit, × 2½, *b*. flower, × 5, anther tube opened in front (BRASS 4417).

connate with the lateral ones for 1½–2 mm; lateral lobes connate with the ventral one for 2–2½ mm; dorsal lobes lanceolate, ½–2½ mm, reflexed, sometimes of unequal length; lateral and ventral lobes equal, lanceolate to ovate, 1½–2½(–3) mm by ¾–1 mm, reflexed. *Filaments* 1½–3 mm, halfway free, linear, glabrous; anthers from dorsal to ventral 1½–1 mm, glabrous, the two anterior anthers finely haired at the apex. *Ovary* trumpet-shaped to cupular, ½–¾mm long. *Fruit* not seen.

Distr. *Malaysia*: New Guinea (Owen Stanley Range, SW. slope of Mt Albert Edward), once found.

Ecol. Wet grasslands, 3680 m.

KEY TO SOME CULTIVATED SPECIES

(in all *spp.* both anterior anthers with bearded tip)

1. Corolla tube less than 7 mm long. Pedicels glabrous. Leaves petiole-like decurrent.
  2. Corolla tube 5–7 mm long. Flowers axillary. Pedicels 1½–5 cm. Calyx tube 2–4 mm, lobes 3½–11 mm. Corolla blue or violet, rarely white. Stem triangular. Leaves 1½–5 by 1/3–1 cm, oblong lanceolate, entire to serrate. Annual, native in S. Africa. **L. erinus** L.
  2. Corolla tube 3–3½ mm, inside hairy. Pedicels less than 1½ cm. Calyx tube 2–3 by 2 mm, lobes 2–2½ by ½ mm, acute, entire. Corolla blue or blue-violet. Stem quadrangular, fistulose. Leaves broad-ovate, rather coarsely sinuate-dentate, 1½–3½ by 1–2 cm. Native of Central America, early introduced as an ornamental . . . . **L. cliffortiana** L.
1. Corolla tube longer than 10 mm. Pedicels hairy. Leaves sessile, the upper ones longer than 5 cm. Perennials.
  3. Flowers all axillary. Pedicels 2½–8 cm, shorter than the sustaining leaf. Sepals erect, 2½–3½ mm. Corolla tube bright red, 18–21 mm; lobes yellow to orange, 12–14 mm, lower lip short-3-lobed, posterior lobes linear. Leaves ovate-lanceolate, very shallowly dentate, 6–12 by 1¾–3 cm. Erect shrub 1½–2½ m. Native in Mexico. **L. laxiflora** H.B.K.
  3. Upper flowers in bracteate, terminal racemes. Pedicels shorter than 3 cm. Sepals longer than 5 mm. Lower lip over halfway 3-split. Herbs.
    4. Flowers purple, rarely white. Pedicels 6–8 mm. Racemes 5–20 cm, lower bracts foliaceous. Sepals erect, 8–10 mm, with recurved ciliate margins. Corolla tube 12–15 mm, lower lip 10–12 mm, at the base with 2 white convexities. Leaves oblong, 6–15 by 2–5 cm. Native in N. America . **L. syphilitica** L.
    4. Flowers dark-red. Pedicels 8–28 mm. Racemes 8–30 cm. Bracts narrow. Sepals recurved, glabrous, 10–15 mm. Corolla tube 15–20 mm, lobes 20–35 mm long, posterior ones much narrower than the anteriors. Leaves linear-lanceolate, glabrous, 8–20 by 1–2½ cm. Native in America, mostly cited as *L. fulgens* WILLD. **L. cordigera** CAV.

Excluded

Lobelia anceps THUNB. Prod. (1794) 40, *non* LINN. *f.* 1781; MIQ. Fl. Ind. Bat. 2 (1856) 578 = *Lobelia alata* LABILL. Nov. Holl. Pl. 1 (1804) 51, t. 72; WIMMER, Pfl. R. Heft 107 (1953) 469.

MIQUEL, *l.c.*, quoted this species as possibly occurring in the Sunda Islands. According to WIMMER it is an extra-Malaysian species with a distribution in S. Africa, Australia, and Chili.

Lobelia pumila BURM. *f.* Fl. Ind. (1768) 186, t. 60, f. 3 (type in G) = *Mazus pumilus* (BURM. *f.*) STEEN. Nova Guinea n.s. 9 (1958) 31 (*Scrophulariaceae*).

Lobelia tetragona BL. Bijdr. (1826) 729; HASSK. Cat. Hort. Bog. (1844) 105 = *Lobelia cliffortiana* LINNÉ, Sp. Pl. 2 (1753) 931; MIQ. Fl. Ind. Bat. 2 (1857) 577; WIMMER, Pfl. R. Heft 107 (1953) 526.

BLUME described this species as an endemic from Mt Gedeh, in West Java, but his specimens have doubtless been erroneously localized and were derived from specimens cultivated in the Botanic Gardens at Bogor or possibly naturalized in their vicinity. It is a native of Central America and has been introduced as an ornamental plant into several other countries at an early date and seems to have frequently naturalized.

Rapuntium longifolium PRESL, Prod. Mon. Lob. (1836) 26.—*L. longifolia* DC. Prod. 7 (1839) 382; MIQ. Fl. Ind. Bat. 2 (1856) 578; F.-VILL. Nov. App. 4 (1880) 121; MERR. En. Philip. 3 (1923) 588 = *Lobelia graminea* LAMK, Dict. Bot. 3 (1791) 583; WIMMER, Pfl. R. Heft 107 (1953) 413.

PRESL based this species on a specimen from the Malaspina Expedition collected by HAENKE. According to MERRILL it was erroneously localized in Luzon and came really from Central America. WIMMER has examined the type specimen (in Mus. Prague) and has referred it to *L. graminea* LAMK, which is a native of Panama and Mexico.

Rapuntium haenkeanum PRESL, Prod. Mon. Lob. (1836) 26.—*L. haenkeana* DC. Prod. 7 (1839) 382; MIQ. Fl. Ind. Bat. 2 (1856) 578; F.-VILL. Nov. App. 4 (1880) 121; MERR. En. Philip. 3 (1923) 588; WIMMER, Pfl. R. Heft 107 (1953) 685.—*Dortmannia haenkeana* O.K. Rev. Gen. Pl. 2 (1891) 972 = *Lobelia nelsonii* FERNALD, Proc. Am. Ac. Arts Sc. 36 (1901) 503 = *Lobelia laxiflora var. nelsonii* MCVAUGH, North Am. Fl. 32A (1943) 97.

According to PRESL this species was based upon a specimen from Luzon. MERRILL, *l.c.*, already suspected that this record was based on a Malaspina Expedition plant from tropical America erroneously localized as Philippine. WIMMER, *l.c.*, saw HAENKE's type specimen (Mus. Prague) and stated that it is conspecific with "*Lobelia laxiflora var. nelsonii* MCVAUGH" from Guatemala, corroborating MERRILL's statement about its native country.

7. PHYLLOCHARIS

DIELS, Bot. Jahrb. 55 (1917) 122; WIMMER, Pfl. R. Heft 107 (1953) 724.—**Fig. 22.**

Delicate, erect or ascending annual herbs; stems producing roots in the basal part. *Leaves* spirally arranged, petioled, often unequal at the base. *Flowers* solitary, inserted on the midrib of the leaves. *Calyx* obliquely cup-shaped, 5-lobed. *Corolla* 5-lobed, dorsally split to the base, bilabiate, the 2 posterior lobes much prolonged, narrow, almost free. Stamens 5, connate; anthers curved, unequal; filaments free at the base. *Ovary* inferior, 2-celled; style filiform; stigma 2-lobed. *Capsule* obliquely obovoid, opening with valves at the top, thin-walled with prominent nerves. *Seeds* ∞, ellipsoid, verruculose or smooth.

Distr. In *Malaysia*: 4 *spp.*, all endemic in New Guinea.

Ecol. Damp, shady, humous or rocky places in the undergrowth of rain-forests, 300–1650 m, apparently rare.

Notes. The genus is only distinct from *Lobelia* in the epiphyllous flowers, with 2 much prolonged upper lobes. A third differential character mentioned by DIELS, *viz* esetose anther tips, does not hold for *P. subcordata*. DIELS assumed that the fruit is finally also loculicidally dehiscent at the base, but I have seen no trace of such dehiscence.

I have seen only material of *P. subcordata* and *P. saxicola*. Of all species only one or very few numbers have been collected and though the differential characters appear satisfactory it remains to be seen whether they will prove to be constant.

Sincere thanks are due to Dr VAN ROYEN for putting his MS revision of the genus at my disposal, granting permission to publish the new species which he had fully described.

KEY TO THE SPECIES

1. Leaf-base cuneate.
 2. Leaves oblong-elliptic, entire, with callose-fimbriate protruding veins. Flowers inserted at about the middle of the midrib. Calyx glabrous, warty. Posterior corolla lobes at least twice as long as the anterior ones. Seeds verruculose . . . . **1. P. oblongifolia**
 2. Leaves ovate to ovate-elliptic, dentate. Flowers inserted in the basal quarter of the midrib. Calyx hairy. Posterior corolla lobes less than twice the anterior ones. Seeds smooth . **2. P. schlechteri**
1. Leaf-base rounded, truncate or subcordate. Seeds verruculose.
 3. Leaves narrow-ovate to ovate, almost entirely glabrous, the base tending to be cordate; margin crenate-serrate. Calyx glabrous . . . . **3. P. subcordata**
 3. Leaves ovate to elliptic, on both surfaces crispy-hairy, the base rounded to truncate; margin with very small protruding callose vein-tips, almost entire to faintly dentate or shallowly crenate. Calyx hairy . . . . **4. P. saxicola**

1. Phyllocharis oblongifolia DIELS, Bot. Jahrb. 55 (1917) 124, fig. 1 L–N; WIMMER, Pfl. R. Heft 107 (1953) 724, fig. 108 c.—**Fig. 22g.**

Almost glabrous herb, stems 15–30 cm. *Leaves* 6–11 by 2¼–3 cm, oblong-elliptic, ± acuminate, base cuneate, entire but the veins protruding as small callose-fimbriate teeth; nerves *c.* 8 pairs, arching; petioles 1–3½ cm. *Flowers* inserted at about the middle of the midrib. Pedicels *c.* 5 mm. *Calyx* tube 1½–2 by 2 mm, lobes lanceolate, acute, 2–3 mm, both warty. *Corolla* tube ½–1 mm; posterior lobes 9 by ½ mm, at least twice as long as the anterior ones, narrow-spathulate, broadened at the base, acute; anterior lobes 3½–4 by 2–2½ mm, ovate, acute, connate up to the middle, at the inside near the posterior lobes somewhat pilose, further glabrous. Androecium 2½–3½ mm long; anthers 1–1½ mm, posterior ones dorsally ± hairy. *Seeds* verruculose.

Distr. *Malaysia*: NE. New Guinea (Udu: SCHLECHTER 17445).

Ecol. Rain-forest, 300 m. *Fl. fr.* March.

2. Phyllocharis schlechteri DIELS, Bot. Jahrb. 55 (1917) 124, fig. 1 A–K; WIMMER, Pfl. R. Heft 107 (1953) 725.—**Fig. 22h.**

Stems 10–20 cm, glabrous below, the upper part slightly puberulous. *Leaves* 2–5 by 1½–2½ cm, ovate to ovate-elliptic, acute, base cuneate, very sparsely hairy above, puberulous on the nerves beneath, margin dentate, ends of the veins callously protruding at the margin; nerves *c.* 6–7 pairs; petioles glabrous, ½–1½ cm. *Flowers* inserted in the basal quarter of the midrib. Pedicels 5–6 mm, glabrous. *Calyx* tube *c.* 1½ mm long, hairy, 10-ribbed; lobes 4 by ½ mm, linear, acute, with scattered hairs along the margin. *Corolla* tube 1 mm; posterior lobes 7–8 by ½ mm, ⅓ to ¼ longer than the anterior ones, linear, acute, glabrous; anterior lobes 5–6 by 1½–2½ mm, oblong-ovate, acute, connate for about ⅔ of their length, inside papillose. Androecium 3 mm long; anthers 1 mm, posterior ones dorsally hairy. *Capsule* 6–7 by 3 mm. Seeds smooth.

Distr. *Malaysia*: NE. New Guinea (Bismarck Mts: SCHLECHTER 18620).

Ecol. In humous rain-forest, 1200 m. *Fl. fr.* Nov.

Fig. 23. *Laurentia longiflora* (L.) PETERMANN. Java (ROEPKE).

3. Phyllocharis subcordata MERR. & PERRY, J. Arn. Arb. 22 (1941) 387; WIMMER, Pfl. R. Heft 107 (1953) 725, fig. 108b.—*P. lamiifolia* WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 372; Pfl. R. Heft 106 (1943) 11, fig. 8e.—**Fig. 22a-c.**

Plant almost glabrous, 5–20 cm. *Leaves* 1–3½ by 1–2 cm, ovate to ovate-oblong, acute, truncate to cordate at the base, glabrous or with some scattered hairs along the nerves beneath, margin dentate; nerves *c.* 4 pairs; petioles *c.* 1–1½ cm. *Flowers* inserted near the base of the midrib, yellow (*ex coll.*). Pedicels 4–6 mm, glabrous. *Calyx* tube 1–2 mm, glabrous, lobes 2–4 mm, linear, somewhat obtuse. *Corolla* tube 0.5–1 mm, posterior lobes 6–8 mm, linear, 1–1½ mm wide at the base, twice as long as the anterior ones, acute, glabrous, anterior lobes 3 by 1½ mm, ovate, acute, connate at least up to the middle, inside papillose. Androecium 2–3 mm; anthers 1–1½ mm, posterior ones dorsally pilose, anterior ones with a few setae on top. *Capsule* 4–4½ by 2–3 mm. Seeds about ½ mm, verruculose, showing on the surface of the ripe fruit.

Distr. *Malaysia*: NE. New Guinea (Morobe district: Yoangen: CLEMENS 3426, type; Mt Ako, Malolo Mission: CLEMENS 4404A).

Ecol. Along a wet stream bank in mountain forest, 750–1200 m. *Fl. fr.* June, Nov.–Dec.

4. Phyllocharis saxicola VAN ROYEN, *nov. sp.*—**Fig. 22d-f.**

Caules, folia et calyx pilis crispis albis pubescentes. Folia ovata ad elliptica, obtusiuscula, integra vel propter venulas ultra marginem in callositate breviter producta denticulata, basi rotundata ad truncata. Flores in costae parte quarta inferiore inserti. Semina verruculosa. Typus: CARR 14083, L.

Stems 5–12 cm, short crisped-hairy. *Leaves* sparsely hairy on both sides, 1–2½ by ½–2 cm, ovate to elliptic, rounded, truncate to subcordate at the base, margin subentire to very shallowly sinuate-dentate with ± remote vein-teeth; nerves 3–6 pairs; petioles $^1/_5$–1 cm, hairy. *Flowers* known to me in bud only, inserted near the base of the midrib. Pedicels 5–7 mm, whitish hairy. *Calyx* tube 1 mm long, whitish hairy, lobes 2–2½ mm, linear, ± acute, sparsely whitish hairy. Posterior *corolla* lobes green with a crimson median line, anterior lobes crimson, whitish pilose near the apex. Androecium *c.* 2 mm long; posterior anthers with a few white hairs. *Capsule* 4–6 by 2–3 mm, very obliquely oblong-obovoid, 10-nerved, pilose. Seeds verruculose, ½ mm.

Distr. *Malaysia*: Papua (Lala River).

Ecol. On rocks in forest, 1650 m. *Fl. fr.* Dec.

Fig. 22. *Phyllocharis subcordata* MERR. & PERRY. *a.* Habit, × ⅔, *b.* flower, × 4, *c.* fruit, × 4.—*Phyllocharis saxicola* VAN ROYEN. *d.* Habit, × ⅔, *e.* fruit, × 4, *f.* seed × 13.—*Phyllocharis oblongifolia* DIELS. *g.* Flower, × 4.—*Phyllocharis schlechteri* DIELS. *h.* Flower, × 4 (*a–c* CLEMENS 4404, *d–f* CARR 14083, *g–h* after DIELS).

8. LAURENTIA

MICH. *ex* ADANS. Fam. 2 (1763) 134, 568; ENDL. Gen. Pl. 1 (1838) 511; DC. Prod. 7 (1839) 409; MCVAUGH, Bull. Torr. Bot. Cl. 67 (1940) 778; WIMMER, Pfl. R. Heft 107 (1953) 386.—*Isotoma* LINDL. Bot. Reg. 10 (1824) t. 964; PRESL, Prod. Mon. Lob. (1836) 42; DC. Prod. 7 (1839) 412; BENTH. Fl. Austr. 4 (1869) 134.—*Hip-*

pobroma G. DON, Gard. Dict. 3 (1834) 717; MCVAUGH, Bull. Torr. Bot. Cl. 67 (1940) 782; N. Amer. Fl. 32 A, pt 1 (1943) 99.—*Enchysia* PRESL, Prod. Mon. Lob. (1836) 40.—**Fig. 23.**

Annual or perennial, laticiferous herbs. *Leaves* spirally arranged, rarely rosulate and radical. *Flowers* in terminal racemes or solitary, axillary. *Calyx* lobes 5, sometimes unequal. *Corolla* tube entire, limb 5-parted, almost regular to slightly zygomorphic with unequal lobes. *Stamens* 5; anthers connate, sometimes bearing apical bristles; filaments free at the base, and sometimes below the anthers, free from the corolla, or 2 adnate, or all inserted above the middle of the corolla tube. *Ovary* inferior, 2-celled; stigma 2-lobed. *Capsule* opening by 2 loculicidal valves at the top between the persistent calyx lobes. *Seeds* ∞, ellipsoid, brown, up to 1 mm.

Distr. About 25 *spp.*, in the Mediterranean (3), South Africa (18), Australia (10), and the Americas (4).

Notes. It is not unexpected that also in the affinity *Lobelia*, *Laurentia*, *Isotoma*, *Palmerella*, and *Solenopsis* there is no unanimity of opinion about generic distinction, due to different evaluation of characters. *Lobelia* is properly only distinguished from the *Laurentia* assemblage by a distinctly zygomorphous corolla entirely or partially split on one side. MCVAUGH (Bull. Torr. Bot. Cl. 67, 1940, 780) even suggested that this would not hold on the argument that it would not be present in *L. sinaloae*; but this seems to be an error, *cf.* WIMMER, *l.c.* fig. 91 f. Whereas MCVAUGH is in favour of merging these genera into *Lobelia*, it is curious that he maintained the single American species of *Isotoma* as representing a monotypic genus, although it is manifestly allied to its Australian congeners. GLEASON on the other hand (Bull. Torr. Bot. Cl. 52, 1925, 93) believed that more attention should be paid to the characters of corolla and anther appendages; this would lead to more than one genus in the assemblage, but would also have the consequence that *Lobelia*, where a similar diversity is found, would have to be split up in smaller segregates. At the present these characters have been used in *Lobelia* and other genera for the distinction of infra-generic taxa. It seems satisfactory to follow this principle within the *Laurentia* complex, as has been done by ENDLICHER, WIMMER, and others.

It should be admitted that another solution could be the subordination of *Laurentia sens. lat.* as a subgenus under *Lobelia*, as there is, also in *Laurentia*, a tendency towards zygomorphism, but this is characteristic for the entire tribe *Lobeliae*.

ADANSON based his genus on the pre-Linnean *Laurentia* MICH. Gen. 18, t. 14 = *Lobelia laurentia* L. 1753 = *Laurentia gasparrinii* (TINEO) STROBL.. As he reduced *Lobelia* L. to *Laurentia* a formal conservation of *Laurentia* would seem necessary.

1. Section Isotoma

(R. BR.) ENDL. Gen. Pl. 1 (1838) 512; WIMMER, Ann. Naturh. Mus. Wien 56 (1948) 335; Pfl. R. Heft 107 (1953) 398.—*Lobelia sect. Isotoma* R. BR. Prod. (1810) 564; MCVAUGH, Bull. Torr. Bot. Cl. 67 (1940) 794.—*Isotoma* LINDL. Bot. Reg. 10 (1824) t. 964.—*Hippobroma* G. DON, Gard. Dict. 3 (1834) 717.—*Laurentia subg. Isotoma* PETERMANN, Pflanzenreich (1845) 444, t. 118 fig. 665.

Leaves spirally arranged, coarsely sinuate-dentate or pinnatifid. Flowers solitary, axillary, almost regular. Corolla tube long, slender, lobes spreading, almost equal. Stamens inserted on the corolla tube above the middle.

Distr. Ten *spp.* endemic in Australia, one native in the West Indies, widely spread by cultivation and naturalized in the tropics.

1. Laurentia longiflora (L.) PETERMANN, Pflanzenreich (1845) 444, t. 118 fig. 665; ed. 2 (1847) *id.*; WIMMER, in McBride Fl. Peru 6[2] (1937) 474; Ann. Naturh. Mus. Wien 56 (1948) 337, *cum var. runcinata* (HASSK.) WIMMER; Pfl. R. Heft 107 (1953) 405.—*Lobelia longiflora* LINNÉ, Sp. Pl. (1753) 930; LINDL. Bot. Reg. 14 (1828) t. 1200. —*Rapuntium longiflorum* MILL. Dict. ed. 8 (1768) n. 7.—*Hippobroma longiflora* G. DON, Gard. Dict. 3 (1834) 717; MCVAUGH, Bull. Torr. Bot. Cl. 67 (1940) 783; N. Am. Fl. 32A, pt 1 (1943) 99.—*Isotoma longiflora* PRESL, Prod. Mon. Lob. (1836) 42; DC. Prod. 7 (1839) 413; HEYNE, Nutt. Pl. (1927) 1428; BACK. Trop. Natuur 9 (1920) 129, fig. 1–3; FAWC. & RENDLE, Fl. Jam. 7[5] (1936) 138; BACK. Bekn. Fl. Java (em. ed.) 8 (1949) fam. 184, p. 5; STEEN. Fl. Sch. Indon. (1949) 376; QUIS. Med. Pl. Philip. (1951) 955.—*Isotoma runcinata* HASSK. Bonplandia 7 (1859) 189, *ex descr.*—**Fig. 23.**

Perennial (always?), erect or ascending, 10–30 cm; stems up to 5 mm diam., hairy to nearly glabrous, woody at the base, with ribs or wings running from the leaves downwards. *Leaves* sessile, elongate-obovate, attenuated at the base, acute or obtuse, mostly sparsely hairy, coarsely sinuate-dentate, 3–16 by 1–3 cm. *Flowers* solitary, axillary, almost regular. Pedicels densely short-hirsute, 3–15 mm. Bracteoles 2, at the base of the pedicels, narrow, acute, up to 5 mm. *Calyx* lobes inequal, narrow-lanceolate or linear, irregularly dentate, acute, hairy, 8–20 mm. *Corolla* white, hairy, persistent, tube funnel-shaped, 5–9 cm, lobes spreading, almost equal, lanceolate, acute or obtuse, 10–25 mm. *Filaments* inserted above the middle of the corolla tube, more or less united, as long as or somewhat exceeding the corolla tube, anthers curved forward, with a bearded top, 4–6 mm, the 2 in front 2–3 mm. *Ovary* obconic to bell-shaped, (mostly 10-)ribbed, densely hairy, especially along the ribs, 3–7 mm; style equalling the anther tops or somewhat longer; stigma broad, flat, $\pm$ 2-lobed, bearing long slender hairs beneath. *Capsule* nodding, ellipsoid. Seeds ∞, ellipsoid, foveolate-reticulate.

Distr. Native in the West Indies (the type from Jamaica), in the lowlands from Florida and Sonora to Brazil and Peru; introduced into Pennsylvania (U.S.A.), Hawaii, the Marianas, and the Old World tropics, almost throughout *Malaysia*.

Ecol. In damp places, along ditches and streams, against walls, from sea-level up to 300 (–1200) m. *Fl.* Jan.-Dec.

This is the sole species which does not possess a trigger-hair on the two lower anthers, as described in *Isotoma* by HILDEBRAND (Bot. Zeit. 27, 1869, 476, f. 8–12) and MELVILLE (Kew Bull. 14, 1960, 277–279, f. 1). In several American *Laurentias* the two lower anthers have each 2 setae.

Vern. *Daun tolod*, S, *daun kĕndali*, J, *tambakis*, N. Born., Philip.: *estrélla*, Sp., Tag., *lagrimao de San Diego*, *revienta caballos*, Sp.

Note. The milky juice is said to be very poisonous, in particular for horses. According to BOORSMA (HEYNE, QUIS., *ll. cc.*) its alcaloids have a paralysing effect. The frequent occurrence along streams seems to point to seed dispersal by water; that against walls to seed dispersal by ants, but there is no elaiosome.

Cultivated species

Besides the already mentioned species of *Lobelia*, BACKER mentioned in his Flora of Java (em. ed.) 8 (1949) fam. 183 the following species to be cultivated in the mountains of Java: *Campanula medium* L., *C. rapunculoides* L., *Legousia speculum-veneris* (L.) FISCH., and *Platycodon grandiflorum* (JACQ.) DC.

JUGLANDACEAE (M. Jacobs, Leyden)

Juglandaceae represent a characteristic northern hemisphere family, in the New World going south to Central America (Mexico, Costa Rica, Guatemala, Panama, Cuba, Hispaniola and found S of the equator as fas as *c.* 30° S, absent from Africa, and overstepping the equator also in the Malaysian region where *Engelhardia* extends to Java and New Guinea. This distribution shows a remarkable resemblance with that of the *Fagaceae-Castaneae* which though absent S of the equator in the Americas, occur in Africa in the Mediterranean part only, and though rather well represented as far as New Guinea are also absent in Australia and the Pacific islands. A noteworthy detail of this parallel is that although both are well represented in the Himalayan region and the Indo-Chinese Peninsula no representative of either group is found in Ceylon and the Deccan Peninsula!

Northwards the family extended much farther in Tertiary time and fossils are known from Sakhalin, E. Siberia to 61° N (where at present *Juglans* occurs to 51° N), also Alaska (pollen grains), Greenland, and Spitsbergen. Several genera which are now confined to East Asia or North America occurred in Europe from the Upper Cretaceous until the Pliocene but became gradually extinct there during the Pleistocene Ice Age. See also under *Engelhardia*.

Taxonomy. The family comprises 6 genera with *c.* 58 *spp.*. *Platycarya* and *Pterocarya* are Asiatic, *Alfaroa* is American, while *Engelhardia*, *Carya*, and *Juglans* occur in both the Old and the New World. As for the disputed monotypic genus *Annamocarya* Chev. (synonyms: *Caryojuglans* Kirchh., *Juglandicarya* Reid & Chandler, *Rhamphocarya* Kuang), described in 1941 from S. China and Tonkin, we refer to Leroy, Mém. Mus. Hist. Nat. n.s. Bot. 6 (1955) 66.

The family is a coherent one. *Engelhardia* and *Alfaroa* form a natural and rather primitive group.

Thusfar three systems of subdivision for the *Juglandaceae* have been proposed. The first is by Oersted, Vid. Medd. Nat. For. Kjøbenhavn (1870) 159–174. The second is by Koidzumi, who gives a complete subdivision with a taxonomic survey of the genera in Acta Phytotax. & Geobot. 6 (1937) 1–16. The third is by Leroy, *l.c.* 1–246. The three systems have in common, that they always keep *Engelhardia* together with *Pterocarya*, and *Carya* together with *Juglans*.

The affinity of the *Juglandaceae* within the *Amentiferae* seems to be closest with the *Myricaceae*.

Palynology. According to Erdtman (Pollen Morph. & Pl. Tax. 1952, 216) the pollen grains have several characters in common with those in *Betulaceae*, *Casuarinaceae*, *Myricaceae*, and *Rhoipteleaceae*; those of *Fagaceae etc.* are less similar.

Phytochemistry. This family is known to accumulate different types of polyphenolic compounds. The most characteristic constituent of *Juglandaceae* is naphtoquinon juglon. It has been proved to occur in species of *Juglans*, *Carya*, and *Pterocarya*. In the tissues juglon is present as a monoglucoside of the reduced form of the quinon (dihydrojuglon). Enzymatically dihydrojuglonglucoside is split very rapidly and dihydrojuglon set free is concurrently oxydized to juglon. Juglon is very toxic to fungi and seedlings of higher plants. It is also toxic to animals and may well be the ichthyotoxic principle of *Juglandaceae*; fresh barks and leaves of *Juglans rupestris* Engelm., *Carya illinoensis* (Wang) K. Koch, *Engelhardia spicata* Bl., and *Engelhardia polystachya* Radlk. are reported in literature to be used as fish poison.

Besides juglon, flavonoid compounds and tannins are known to accumulate in considerable amounts in *Juglandaceae*. The bark of *Engelhardia formosana* Hayata contains up to 7.5 % of flavonoid glycosides (engelitin, isoengelitin, afzelin, astilbin, quercitrin). Similar compounds were isolated from leaves of *Juglans spp.* The tannins of *Juglandaceae* have been investigated in recent years. They seem to belong to the hydrolyzable class and hydrolysis gives rise to gallic acid, ellagic acid, and glucose. One tannin, juglanin, was proved to be isomeric with corilagin. Ellagic acid and gallic acid occur also in the free state in the wood of *Juglans sieboldiana* and *Platycarya strobilacea*.

Fig. 1. *Engelhardia rigida* BL. *a*. Fruiting twig, × ½, *d–f*. variation in the ♂ flowers, all × 6, *g*. ♂ flower after removal of the stamens, with 2 perianth lobes and 3 bract lobes, *h*. ♂ flower from above, with the bract lobes (b) and 4 perianth lobes.—*E. serrata* BL. (?) *b*. Seedling, × ½.—*E. spicata* LECHEN. *ex* BL. *c*. ♀ Flower, × 6 (*a* BRASS 11061, *b* BURKILL 9984, *c* KOORDERS 29792, *d* ENDERT 3447, *e* ENDERT 4407, *f–h* CLEMENS 494).

The high ascorbic acid contents (= vitamin-C) of different organs of *Juglans regia* reported in literature are greatly exaggerated because juglon interferes strongly in the usual determination of ascorbic acid.

The available data permit the characterization of the *Juglandaceae* phytochemically as a family which accumulates many types of tannin-like polyphenolyc compounds. In this respect it resembles many other woody families, *e.g. Hamamelidaceae*, *Fagaceae*, *etc.*—R. HEGNAUER.

1. ENGELHARDIA

LECHEN. *ex* BLUME, Bijdr. 10 (1825) 528; Fl. Jav. Jugl. (1829) 5, '*Engelhardtia*'; C.DC. Ann. Sc. Nat. IV, 18 (1862) 35; Prod. 16, 2 (1864) 140; NAGEL, Bot. Jahrb. 50 (1914) 475.—*Pterilema* REINW. Syll. 2 (1826) 13.—*Oreomunnea* OERST. Vid. Medd. Nat. For. Kjøbenh. (1856) 52.—**Fig. 1-9.**

Trees, mostly lepidote with golden yellow, glandular scales 0.1–0.2 mm diam. Pith solid. Leaf buds naked, with a resemblance to hands. Young twigs densely brownish tomentellous, young leaves mostly reddish. Stipules none. *Leaves* spirally arranged (in Asiatic members), paripinnate; leaflets slightly asymmetrical, the acroscopic side being mostly wider with higher inserted base than the basiscopic side; midrib above flattish with a narrow, raised keel, nerves camptodromous. Monoecious or dioecious. *Flowers* small, in catkins (each flower solitary) which are often arranged to lateral or terminal panicles, the flower fused with a 3-lobed bract; perianth 4-lobed.—♂ *Flowers:* perianth often reduced and irregular; stamens 4–13 (in Asiatic members), (sub)sessile.—♀ *Flowers:* perianth lobes in 2 whorls partly connate with the ovary, the median pair exterior; ovary 2-carpellate, the carpel sutures median, 1-locular with an incomplete, simple (in Asiatic members), transverse septum, sometimes also with an abortive median septum; ovule 1, erect, at the top of the main septum, conical with broad base, atropous, with 1 integument. Style in *sect. Engelhardia* well-developed with 2(–4) transversal elongate, papillose, persistent stigmas, in *sect. Psilocarpeae* the 4 stigmas small and sessile. In *fruit* the strongly accrescent bract forms a 3-lobed, obovate, scarious wing with midribs and reticulate venation and partly adnate to the nut; the central (abaxial) lobe is about twice as large as the lateral ones, sometimes a smaller adaxial simple or irregularly dissected lobe is present. Nut indehiscent, pea-sized; pericarp cartilaginous, mostly hispid with itching hairs. *Seed* filling the space between the septa; testa forming an even covering of the seed; cotyledons strongly plicate and divided into 4 lobes, later epigeal, radicle superior, endosperm none.

Distr. Five *spp.* in the Old World, from the W. Himalaya to China S of ± 30° N, all over the Indo-Chinese Peninsula, Malaysia, and Formosa; in America 2–3 *spp.* in Mexico, Costa Rica, and Guatemala. Fig. 2.

Ecol. Trees, mostly small or medium but sometimes growing very large, in evergreen, primary dryland forest, apparently not on limestone. In Malaysia they prefer the mountains between *c.* 1000 and 2000 m, although sometimes found in the lowlands.

Though *Engelhardia* is a regular constituent of the fagolauraceous montane rain-forest in Java, none of the species occurs gregarious or dominant, but in open grassy places they may occur in groups in anthropogenous pseudosavannahs. VAN STEENIS observed on Mt Patuha (W. Java) abundant regeneration of seedlings *c.* 10–200 cm high in a dense thicket of *Eupatorium inulifolium* on abandoned cinchona plantations near Tjipadaruum, at *c.* 1800 m; the seeds were derived from three old fruiting trees which happened to be in the adjacent forest border. See further under *E. spicata*.

Often (always?) shortly deciduous and then flowering. Pollination and seed dispersal are clearly adapted to wind. However, the matter may be not so simple as that. Dr P. VAN ROYEN told me that in New Guinea, where *E. rigida* is very common, he repeatedly found all the fruiting catkins, shed as a whole, on the ground under the trees.

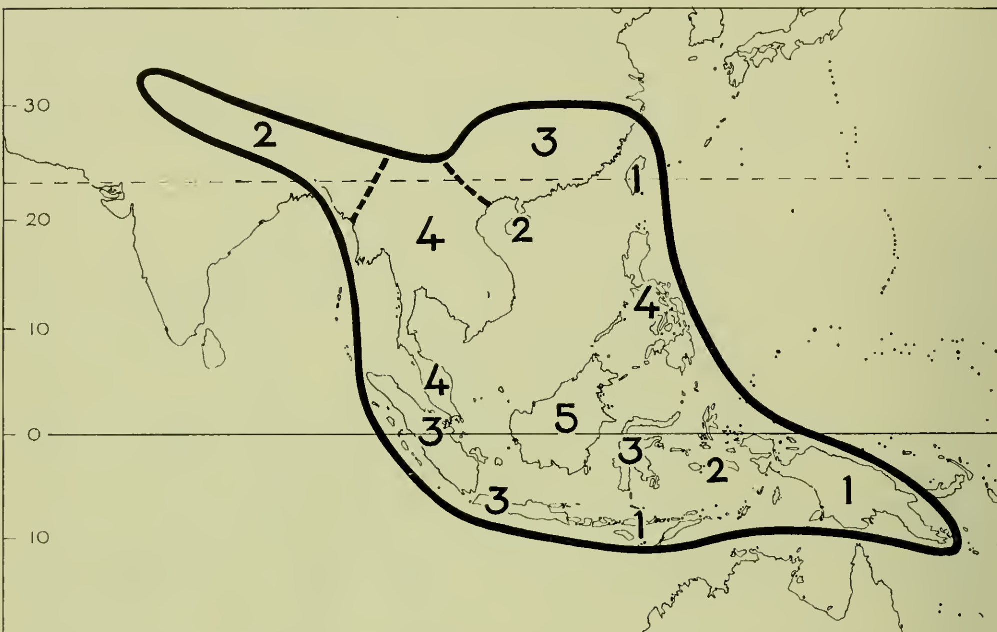


Fig. 2. Distribution of *Engelhardia* LECHEN. *ex* BL. in the Old World, with number of species indicated for each subarea.

Wood-anat. BEEKMAN, Meded. Proefstat. Boschw. 5 (1920) 96; DEN BERGER, Meded. Proefstat. Boschw. 13 (1926) 13, Determinatietabel van Malesië, Veenman, Wageningen (1949) 62 (hand lens.) HEIMSCH, Lilloa 8 (1942) 164; KRIBS, Trop. Woods 12 (1927) 16; METCALFE & CHALK, Anat. Dic. 2 (1950) 1287; MOLL & JANSSONIUS, Mikr. Holzes 6 (1936) 308; TIPPO, Bot. Gaz. 100 (1938) 42. For various opinions about the affinities of the family see METCALFE & CHALK, *l.c.*—C.A.R.-G.

Morph. Not all authorities agree on the nature of the floral parts, called by MANNING the floral envelope, in his opinion consisting, when complete, of a 3-lobed bract, 2 bracteoles, and a 4-lobed perianth. Other authors hold the view that the flower is surrounded by a 1-lobed bract with 2 bracteoles, and a 4-lobed perianth, the lobes of which are some times called sepals. The nature of the bracteoles is subject to interpretation. The smaller and facultative adaxial lobe of the fruit is, in my opinion, too variable to represent anything but an outgrowth of the two adaxial margins of the bract lobes.

HJELMQVIST, basing his opinion on a comparison with the *Myricaceae*, supposed that the flower was originally unisexual and of a pseudanthic nature, *i.e.* it has arisen through union of a number of simply built flowers. NAGEL and MANNING suppose that the flower was initially bisexual and has become unisexual by reduction. This is supported by the fact that, very rarely, seemingly ♂ catkins are found where part of the flowers have a prolonged bract. Such flowers often show both a reduced androecium and a reduced gynoecium, *i.e.* a sterile stigmatiferous ovary surrounded by a subnormal number of stamens.

The nut is also regarded as a sort of drupe with thin flesh which, however, is derived from the involucre or perianth and not from carpel tissue.

The ovule seems only to be basal on a columella. Virtually it is not truly basal, but modified axile, at the apex of one of the primary septa.

According to HJELMQVIST the integument is protracted upwards to a narrow tube in *E. spicata* and *E. parvifolia* (the latter here reduced to *E. serrata*).

Several important studies have been published, all covering the whole family. We mention NAGEL, Bot. Jahrb. 50 (1914) 459–530; MANNING, Amer. J. Bot. 25 (1938) 407–419 on the inflorescence, *ibid.* 27 (1940) 839–852 on the ♀ flowers, *ibid.* 35 (1948) 606–621 on the ♂ flowers, Bull. Torrey Bot. Club 86 (1959) 190–198 on *Engelhardia* and *Alfaroa* in America; HJELMQVIST, Bot. Notis. Suppl. 2^1 (1948) 5–171; LEROY, Mém. Mus. Hist. Nat. n.s. Bot. 6 (1955) 1–246.

Fossils. Many records prove the wide occurrence of *Engelhardia* in the warmer parts of Europe and also of N. America in the Tertiary. Dr W. H. ZAGWIJN kindly informed me, that *Engelhardia* pollen forms an important part (up to 20 %) of the anemophilous elements of a flora which existed in the SE. part of the Netherlands and the adjacent region in Germany. This flora, of the Miocene and Pliocene clay and browncoal formations, is remarkable for its strong E. Asiatic and American affinities, and for the many tropical and subtropical elements it contains, especially in the Mid-Miocene, where these make up about 50 % of the flora. See also ZAGWIJN, Aspects of the Pliocene and early Pleistocene Vegetation in the Netherlands, thesis Leiden 1960. An endocarp of †*E. nucifera* (LUDWIG) MÄDLER is depicted in Fortschr. Geol. Rheinl. u. Westf. 4 (1959) t. 1, by the same author.

Fig. 3. Fruiting *Engelhardia spicata* LECHEN. *ex* BL. above Sembalun, Mt Rindjani, Lombok, *c.* 2000 m (DE VOOGD).

Variability. There is a significant difference between juvenile and adult leaves. The juvenile leaves, on young trees and suckers, bear more pairs of leaflets, are thinner, longer acuminate, more serrate, and denser hairy than those of mature trees. This holds for both the American species and at least for part of the Malaysian ones.

The numerous field data on bark characters vary so much that it was found impossible to make reliable descriptions.

In reproductive parts there is an astounding variation. The panicles of catkins are variously reduced, often the single ♀ catkin or the few ♂ catkins remaining. In *sect. Engelhardia* the perianth is often liable to much reduction. In the ♂ flowers some stamens in a row may be lacking, or the individual stamens are reduced in size. In the nuts part of the perianth lobes may be wanting, or, on the other hand, may have grown out excessively, up to nearly the length of the lateral wing lobes. The variation displayed by the adaxial lobes is practically beyond description.

In the descriptions the ♀ flowers are not mentioned because they are considered rather irrelevant for diagnostic purpose. Their size varies much in the course of development and it is difficult to define in dry material the exact moment when the stigmas are receptive; material with ♀ flowers is, moreover, very rare in herbaria. The collecting of ♀ flowers and the making of observations on their anthesis is strongly recommended to the attention of field workers.

Taxon. Several authors have, in the course of time, contributed to the present subdivision into 3 sections.

Sect. 1. **Engelhardia.**—*Sect. Pterilema* (REINW.) C. DC.—*Sect. Trichotocarpeae* NAGEL. Leaves spirally arranged. Inflorescences lateral. Male flowers: subsessile; bract with 3 distinct narrow lobes; receptacle elongate; perianth flat, irregular, reduced, often obscure; stamens in transversal rows of 2–3, hirsute. Female flowers: stigmas commissural, hence transversal, linear, style far exceeding the perianth lobes. Nut hispid, (sub)sessile, about halfway adnate to the wing, 2(–4)-celled at the base. Here belong *E. spicata* LECHEN. *ex* BL. (the type *sp.* of the genus), *E. rigida* BL., *E. serrata* BL., and *E. apoensis* ELMER *ex* NAGEL.

Sect. 2. **Psilocarpeae** NAGEL *emend.* LEROY. Leaves spirally arranged. Inflorescences terminal, sometimes also lateral. Male flowers: stalked; bract very obscurely 3-lobed; receptacle orbicular; perianth regular, 4-lobed, lobes cucullate, stamens (2–)3 at the base of each lobe, glabrous. Female flowers: stigmas split-carinal, cushion-like, concealed by the perianth-lobes; no style. Nut scaly, not hairy, stalked, hardly adnate to the wing, 2(–4)-celled at the base. Here belongs *E. roxburghiana* WALL.

Sect. 3. **Oreomunnea** (OERST.) C. DC. (only American and not incorporated in the above generic description). Leaves opposite or whorled. Inflorescence lateral. Male flowers: subsessile; bract obscurely 3-lobed; receptacle elongate, periant 2–4-lobed, flattish; stamens ± 16–19(–23), irregularly arranged, glabrous. Female flowers: septa nearly complete, ramified, one true septum transversal, a false septum median; stigmas carinal, hence median, cushion-like on short styles just or almost exceeding the perianth lobes. Nut (sub)sessile, not hairy but obscurely scaly, 8-celled at the base, 4-celled in the middle, 1-celled at the apex; the testa attached to all irregularities in the pericarp; wing for ± ⅓ adnate to the nut, often very large, with a large simple adaxial lobe completely concealing the nut. This section, which comprises the 2–3 American *spp.*, is considered to represent the most primitive group in the genus.

Oreomunnea OERSTED, often spelled *Oreamunoa*, which is more correct from an etymological but not from a nomenclatural point of view, is by several authors kept apart. MANNING gave reasons for its reduction to *Engelhardia* in Bull. Torrey Bot. Club 76 (1949) 196–209; in the same paper he commented on characters in *Alfaroa* and *Engelhardia*.

Uses. The wood is locally applied for timber but considered of inferior quality. The bark is occasionally used for fish-poison.

Notes. An attempt has been made to evaluate all names given to Asiatic *Engelhardias*. I was not able to place *E. mollis* HU, Bull. Fan Mem. Inst. Biol. Peiping, Bot. 10 (1940) 161, from SW. Yunnan.

The author is greatly indebted to Professor Dr WAYNE E. MANNING, Lewisburg, Penns., U.S.A., who spent much time to go through the MS and put the fruits of his lifelong work in the *Juglandaceae* at our disposal in a most generous and liberal way.

KEY TO THE SPECIES

1. Nut hispid, (sub)sessile, with distinct style and stigmas. Bract of the ♂ flowers with 3 distinct narrow lobes. Stamens hairy. Inflorescences lateral.
   2. Leaflets underneath more or less densely set with yellow scales (hand lens!). Fruiting catkins on a slender subterete stalk.
      3. Nut subglobose, 3–5 mm long, wing up to 4, rarely to 6 cm long. Leaflets widest about the middle or above, the base acutish to obtuse. Stamens 3–7. Dioecious.
         4. Leaflets entire . . . . **1. E. rigida**
         4. Leaflets (more or less distinctly) serrate or crenate . . . . **2. E. serrata**
      3. Nut elongate, ovoid, 6–8 mm long, wing 5½—7½ cm long. Leaflets ovate, the base subcordate to rounded. (Flowers unknown) . . . . **3. E. apoensis**
   2. Leaflets underneath sometimes with minute greyish (not yellow) scales, but mostly with hairs only or glabrous. Stamens 8–13. Fruiting catkins on a vigorous, angular stalk. Monoecious. **4. E. spicata**
1. Nut scaly, not hairy, stalked, stigmas concealed. Bract of the ♂ flowers obscurely lobed, but 4 perianth lobes distinct. Stamens glabrous. Inflorescence terminal, sometimes also lateral. **5. E. roxburghiana**

1. **Engelhardia rigida** BL. Bijdr. 10 (1825) 528; Fl. Jav. Jugl. (1829) 13, t. 3; MIQ. Fl. Ind. Bat. 1, 1 (1856) 842; C. DC. Prod. 16, 2 (1864) 142; K. & V. Bijdr. 5 (1900) 175; KOORD. Exk. Fl. Java 2 (1912) 53; BACK. Bull. Jard. Bot. Btzg II, *n.* 12 (1913) 16; NAGEL, Bot. Jahrb. 50 (1914) 476; KOORD. Atlas 4 (1916) t. 698; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7A (1948) fam. 155 p. 2.—*E. subsimplicifolia* MERR. Govt Lab. Publ. Philip. *n.* 34 (1906) 6; Philip. J. Sc. 1 (1906) Suppl. 41; NAGEL, Bot. Jahrb. 50 (1914) 477; MERR. En. Philip. 2 (1923) 24.—*E. lepidota* SCHLTR, Bot. Jahrb. 50 (1913) 66, f. 1; NAGEL, Bot. Jahrb. 50 (1914) 477; RENDLE, J. Bot. 61 (1923) Suppl. 53.—*E. zambalensis* ELMER, Leafl. Philip. Bot. 9 (1934) 3195.—**Fig. 1a, d-h, 4c-f.**

Tree 15–30(–47) m, sometimes with buttresses up to 3 m high and 2 m out; the bark once reported decorticating in small flakes. *Leaf* rachis vigorous, blackish, (1½–)3–6(–21) cm, mostly glabrous or scaly, rarely puberulous, (1–)2–3 (–5)-jugate; leaflets rather thick-coriaceous, sessile to 5 mm stalked, blade 2¼–3½(–4) times as long as wide, widest at the middle or rarely above, 5½–10½(–16½) by 2½–4(–7½) cm; base acutish, top subacuminate, tip acute; margin entire (in New Guinea exceptionally crenate towards the top), surfaces more or less densely set with golden yellow glandular-scales, especially underneath, otherwise glabrous or rarely hairy on the nerves. Dioecious. Catkins lateral on leafy and on slightly older twigs, rarely serial in twos. *Male catkins* solitary or 2–3 on a ½–1 cm long stalk, 1½–5 cm long, rachis scaly and/or hairy. Bract 2–4 mm, scaly, lobes irregular, narrow. Perianth 4-lobed, the lobes resembling those of the bract, to completely reduced. Stamens (3–)4–6(–7), the anthers equal or unequal, (½–)1 mm, more or less hispid, connective not or shortly protruding; if there is a single proximal stamen, this has sometimes a filament up to 1 mm, the others being sessile. *Fruiting catkins* (6–)10–15(–22) cm including a peduncle 2–3(–7) cm; peduncle subterete, in the basal half with 2 scars; rachis rather slender, more or less densely scaly and/or puberulous. Nut (sub)sessile, ± 3 mm diam., hispid, wing (2–)2½–3(–6) cm long with the nut, 3–8 mm wide; perianth lobes sometimes very unequal, one or both of the median lobes sometimes attaining half the length of the wing; style about as long as the stigmas, the whole 2–4 mm long.

Distr. *Malaysia*: W. Java (rare), Borneo, Philippines (W. Luzon, N. Mindanao), Central and SW. Celebes (also Banggai Arch.), Moluccas (Halmaheira, Morotai), New Guinea (also Japen and Numfoor). In New Guinea rather common, elsewhere rare.

Ecol. Primary forest, only once reported from secondary forest, *c.* 1000–1800(–2300) m.

Vern. *Ki hudjan*, S, *sibiri*, Papua.

Uses. The wood is used for canoes, native buildings, *etc.*

Notes. Only in Borneo, the Philippines, and Celebes occur specimens with 1-jugate leaves.

Closely related to *E. serrata*, and arguments could be advanced to regard the two as subspecies. Separation based on reproductive characters is practically impossible. However, apart from the different distribution, either species has its own particular pattern of variability, as has been pointed out in the descriptions. For separation two characters have been found, notably the leaf margin, which is entire or serrate, and the decreasing in size of the leaflets towards the leaf base; this feature is generally far more pronounced in *E. serrata*, where the basal leaflets are about half as long as the largest ones. These characters mostly concur. In the cases where they do not, I am inclined to take the leaf margin character as decisive, since in a few *E. rigida* specimens from New Guinea and elsewhere such small basal

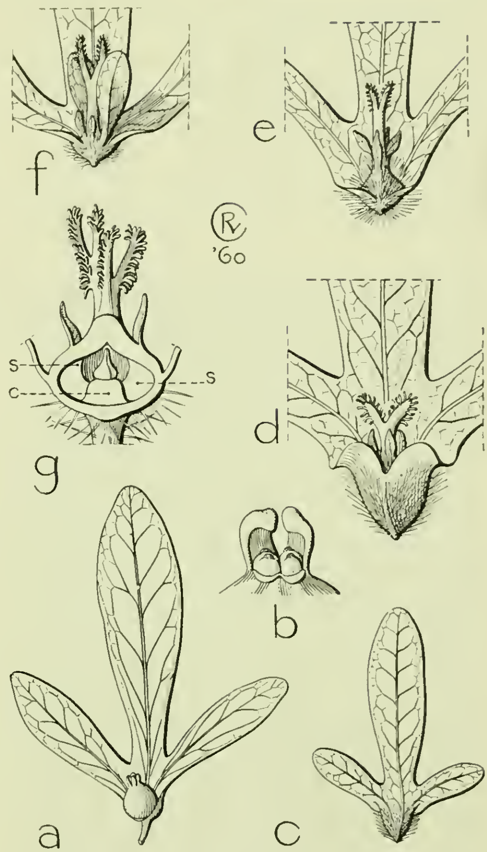


Fig. 4. Fruits of *Engelhardia*. *a*. *E. roxburghiana* WALL., ventrally, nat. size, *b*. the stigmas, shown by removal of 2 perianth lobes, × 4.—*E. rigida* BL. *c*. Fruit dorsally, × 2, *d–f*, fruits ventrally, showing variation in perianth and adaxial lobe, × 2.—*E. serrata* BL. *g*. Longitudinal section of fruit, showing ovulum on columella (c) and partial septa (s), × 4 (*a–b* CLEMENS 27250, *c–d* WINCKEL 1540β, *e* BRASS 11051, *f* KALKMAN 4363, *g* JACOBS 4677).

leaflets were also found. *Engelhardia zambalensis*, described on a specimen with entire leaflets but much reduced towards the leaf base, is therefore placed by me under *E. rigida*, but if one accepts the narrowing leaf base as the key character, it would come under *E. serrata*.

Two sterile specimens from Japen and Numfoor are believed to belong here, notwithstanding they lack scales on the underside of the leaves.

In ENDERT 3833 and KOSTERMANS 7648, both from E. Borneo, the fruit bears no long hairs, only a soft pubescence and scales. From *E. roxburghiana* these specimens are distinguished by well-developed style and stigmas. In ROBBINS 569 from New Guinea even the anthers bear scales.

2. Engelhardia serrata BL. Fl. Jav. Jugl. (1829) 14, t. 4, 5c; MIQ. Fl. Ind. Bat. 1, 1 (1856) 843; C. DC. Prod. 16, 2 (1864) 141; HOOK. *f.* Fl. Br. Ind. 5 (1888) 596; K. & V. Bijdr. 5 (1900) 172, 174; KOORD. Exk. Fl. Java 2 (1912) 53, f. 7; NAGEL, Bot. Jahrb. 50 (1914) 477; KOORD. Atlas 4 (1916) t. 699; DODE, Fl. Gén. I.-C. 5 (1930) 928; QUIS. Philip. J. Sc. 76 (1944) 37; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7A (1948) fam. 155 p. 3.—*E. palembanica* MIQ. Sum. (1861) 346, 139.—*E. parvifolia* C. DC. Ann. Sc. Nat. IV, 18 (1862) 34; Prod. 16, 2 (1864) 141; NAGEL, Bot. Jahrb. 50 (1914) 477; MERR. En. Philip. 2 (1923) 23.—*E. nudiflora* HOOK. *f.* Ic. Pl. 18 (March 1888) t. 1747; Fl. Br. Ind. 5 (Dec. 1888) 597; NAGEL, Bot. Jahrb. 50 (1914) 477; GAMBLE, J. As. Soc. Beng. 75, ii (1915) 401, *incl. var. crenata* HOOK. *f. ex* GAMBLE; RIDL. Fl. Mal. Pen. 3 (1924) 369, f. 158; CORNER, Ways. Trees (1940) 333, f. 117.—*E. permicrophylla* ELMER, Leafl. Philip. Bot. 9 (1934) 3194.—**Fig. 1b, 4g, 5.**

Tree (2–)20–25(–42) m, sometimes with buttresses up to 3–4 m high and 1½ m out. *Leaf* rachis (3–)5–18(–21) cm, more or less hairy, 3–7(–9)-jugate; leaflets varying from small, coriaceous, and glabrous to large, herbaceous, and hirsute (mainly on the nerves), (sub)sessile, markedly decreasing in size towards the leaf-base, the basal leaflets attaining about half the length of the largest ones, 1½–3 times as long as wide, widest at the middle or above, (1–)2–13½ by (½–)1–4 cm; base narrowed, acutish to obtuse, top acutish to subacuminate; margin crenate or serrate sometimes from the base but at any rate towards the top; surface dull, underneath more or less densely set with golden yellow glandular scales. Dioecious. Catkins lateral on leafy and on slightly older twigs, the peduncles solitary in the leaf axil or serial by twos or threes. *Male catkins* in bundles of 2–3, sessile to 3 cm stalked, 3–10 cm long; perianth completely reduced or almost so; stamens (3–)5–7, sessile to ⅓ mm stalked, anthers sometimes unequal, ½–1 mm, sparsely hirsute, connective not or hardly protruding. *Fruiting catkins* 9–14 cm long in all, 2–5 cm stalked, rachis as thick as that of the leaves, shallowly grooved. Nut (sub)sessile, $\pm$ 3 mm diam., hispid, wing 1½–3¼(–3¾) cm long with the nut, 5–10 mm wide; perianth lobes rather equal, often not adnate to the style, style about as long as the stigmas, the whole 2–4 mm long.

Distr. Upper Burma, N. Siam, Indo-China (Laos, Cambodia), in *Malaysia*: Malay Peninsula, Sumatra (S of Lake Toba, also Bengkalis, Banka, Billiton), W. Java, Borneo, Philippines (Luzon to N. Mindanao), Celebes, Moluccas (W. Ceram).

Ecol. Primary dryland forest (rarely secondary forest) on sandy or clayey soil, from sea-level to 2200 m. In Malaya the leaves are shed at the end of a dry spell without fading into autumn tints (CORNER).

Vern. *Ki hudjan*, (*lang*)*kĕdi*, (*bĕ*)*bĕri*, M, *ki keper*, S.

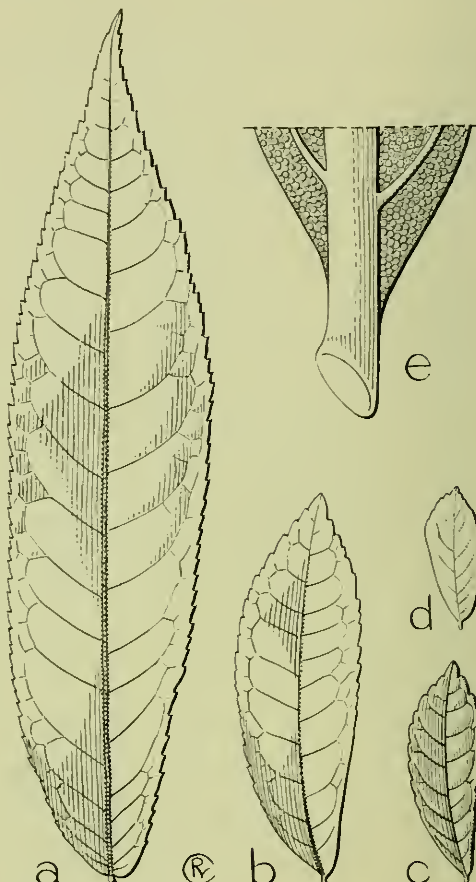


Fig. 5. Variation in leaflets of *E. serrata* BL., the acroscopic side on the left, *a–d.* $\times$ ⅔, *e.* leaf base densely set with glandular scales (*a* Houtsoorten Gedeh 126, *b* SULIT 21595, *c*, *e* HOLTTUM 14857, *d* CLEMENS 16888).

Notes. In the Philippines several collections possess very small leaflets, glabrous, *viz* 2–3 cm, the fruit wing being $\pm$ 15–21 mm long. In Celebes specimens occur in which the leaflets are slightly larger and 2–3-jugate, the fruit wing being slightly smaller. In Malaya, Sumatra, Banka, and Billiton the leaflets are generally 5–7 cm and glabrous. In Java the leaflets are thin in texture, up to 9-jugate, 8–13½ cm long, serrate from the base, and hirsute, especially on the nerves. Intergrading specimens occur throughout the area.

PIERRE 3301, from Cambodia, is a very bad specimen with entire, acuminate leaves glandular-scaly on both sides. Most probably it belongs here.

JACOBS 4677, from Mt Sago in W. Sumatra, in fruit, is the only specimen with entire leaflets. The leaf rachis is sparsely hairy, the leaflets are 4 times as long as wide, the perianth lobes are not connate with the style. It tallies with a specimen from the same locality that has serrate leaves.

Most of the extra-Malaysian specimens, especially those from N. Siam, are very densely brown-pubescent on the twigs, the rachises of leaves and catkins, on the leaflets underneath and the nerves above. The largest leaflet seen was 17½ by 5½ cm. The leaflets are sometimes nearly entire, with their indument resembling *E. spicata var. colebrookeana*, but have always yellow scales below.

3. Engelhardia apoensis ELMER *ex* NAGEL, Bot. Jahrb. 50 (1914) 477; ELMER, Leafl. Philip. Bot. 7 (1915) 2693.—*Engelhardtia sp.* CORNER, Ways. Trees (1940) 333, f. 117.—**Fig. 6.**

Leaf rachis 13–23 cm, more or less densely set with scales and small hairs. Leaflets alternate, 7–10, thinly coriaceous, 2–4 mm stalked; blade ± 2½–3 times as long as wide, ovate, (7–)9–13 by 2¼–3(–5) cm; base rounded to subcordate, top narrowed; margin comparatively finely serrate, especially in the basal part; surface above glossy, below glabrous or (in the type specimen) with

Fig. 6. *Engelhardia apoensis* ELM. *ex* NAGEL, leaflet and fruit, × ⅔ (CF 24424 SYMINGTON).

some minute tomentum on the nerves. Flowers not known; inflorescences presumably lateral. *Fruiting catkins* 12–30 cm long in all, stalk 4–6 cm. Nut ± 6–8 by 5–6 mm, the body ovoid, elongate, wing (5½–)6–7½ cm long with the nut, 11–18 mm wide, adaxial lobe well developed, 4–6(–15) mm long, style 2–3 mm, stigmas 10 mm long.

Distr. *Malaysia*: Malay Peninsula, Borneo (N. Sarawak), Philippines (Mindanao: Mt Apo).

Notes. This taxon is remarkable for its ovate leaflets and elongate nut.

The 7 examined specimens from Malaya match the type specimen from Mindanao, ELMER 11744, very well, the Malayan plants having somewhat longer catkins and larger fruits. In RICHARDS 1521 from N. Sarawak the leaves are entire.

4. Engelhardia spicata LECHEN. *ex* BL. Bijdr. 10 (1825) 528; Fl. Jav. Jugl. (1829) 8, t. 1, 5A; MIQ. Fl. Ind. Bat. 1, 1 (1856) 842; C. DC. Prod. 16, 2 (1864) 140; KURZ, For. Fl. Burma 2 (1877) 491; VIDAL, Sin. Atlas (1883) t. 90A; HOOK. *f.* Fl. Br. Ind. 5 (1888) 595; K. & V. Bijdr. 5 (1900) 165, 170, *incl. var. α genuina et var. β aceriflora, var. γ colebrookiana quoad specim. tantum*; KOORD. Exk. Fl. Java 2 (1912) 51, f. 6; NAGEL, Bot. Jahrb. 50 (1914) 476, *incl. var. aceriflora*; LEEFM. Trop. Natuur 3 (1914) 46 with fig., 77;

Fig. 7. *Engelhardia spicata* LECHEN. *ex* BL. Large tree, over 40 m tall, in primary forest near Tjikahuripan, Mt Gedeh, W. Java; stem base 8.84 m in girth, dbh 2.8 m (F. KRAMER, who is standing in front).

GAMBLE, J. As. Soc. Beng. 75, ii (1915) 400; KOORD. Atlas 4 (1916) t. 700; MERR. Sp. Blanc. (1918) 120; En. Philip. 2 (1923) 24; KOORD. Fl. Tjibodas 7 (1923) 10, *var. aceriflora* (REINW.) K. & V.; RIDL. Fl. Mal. Pen. 3 (1924) 368; DOCTERS VAN LEEUWEN, Zoocecidia (1926) 103; DODE, Fl. Gén. I.-C. 5 (1930) 930, f. 107, 3-7; CHUN, Sunyatsenia 4 (1940) 245; CORNER, Ways. Trees (1940) 333, f. 117; KANJ. *c.s.* Fl. Assam 4 (1940) 229; DE VOOGD, Trop. Natuur 30 (1941) 103, f. 5-6, 125; BAKH. *f.* in Back. Bekn. Fl. Java (em. ed.) 7A (1948) fam. 155 p. 2.—*Pterilema aceriflorum* REINW. Sylloge 2 (1826) 13.—*E. aceriflora* BL. Fl. Jav. Jugl. (1829) 11, t. 2, 5B; MIQ. Fl. Ind. Bat. 1, 1 (1856) 842; C. DC. Prod. 16, 2 (1864) 141; HOOK. *f.* Fl. Br. Ind. 5 (1888) 596, '*acerifolia*'; FORBES & HEMSL. J. Linn. Soc. Bot. 26 (1899) 495; VON MALM, Fedde Rep. 34 (1934) 271.—*E. roxburghiana* LINDL. *ex* WALL. Pl. As. Rar. 2 (1831) 85, t. 199 f. 7, *quoad fruct.*—*Juglans pterococca* ROXB. Fl. Ind. (ed. Carey) 3 (1832) 631, *quoad fruct.*, '*plerococca*'.—*Girocarpus pendulos* BLANCO, Fl. Filip. ed. 2 (1845) 55, ed. 3 (1877) 104, t. 387.—*E. philippinensis* C. DC. Ann. Sc. Nat. IV, 18 (1862) 34, t. 2 f. 15; Prod. 16, 2 (1864) 141.—**Fig. 1c, 3, 7-9.**

Fig. 8. *Engelhardia spicata* LECHEN. *ex* BL. in clearing of coffee estate Kalisat, Mt Idjen, E. Java (J. H. COERT).

Tree (5–)12–30(–36) m, sometimes with small buttresses. *Leaf* rachis vigorous, blackish, (5½–) 10–30(–40) cm, glabrous and/or scaly to hirsute and/or tomentose, (2–)4–5(–7)-jugate; leaflets firmly herbaceous to coriaceous, sessile to 5(—15) mm stalked, blade (1.7–)2.4–3.0(–3.4) times as long as wide, widest about the middle or rarely above, (6–)8½–16(–30) by (3–)5½–6(–8) cm; base very unequal, acute to subcordate, top shortly acuminate, the tip obtuse to acute, rarely the top rounded to acutish; margin entire, rarely serrate; surfaces glabrous to hirsute, especially underneath and on the nerves, sometimes underneath with domatia and/or thin flat greyish (never yellow) scales. In juvenile specimens and suckers leaves large, the leaflets serrate, hirsute. Inflorescences mostly bisexual, paniculate, lateral on leafy and on slightly older twigs, with 1(–0) central ♀ catkin and 2–5 basal ♂ catkins subtended by a caducous subulate bract 3–5 mm, rarely the basal catkins also ♀. *Male catkins* (5–)10–18 cm long in all, 0–1 cm stalked; bracts 2–4 mm, the apical lobe sometimes mucro-like, the lateral lobes very irregular, narrow, sometimes much reduced, perianth whether or not reduced, very irregular, the lobes up to 2 mm long, a small proximal lobe mostly present. Stamens 8–12(–13), anthers (sub)-sessile, equal or unequal, ± 1 mm long, hirsute, connective ¼–½ mm pointed. *Fruiting catkins* (12–)21–40(–60) cm long in all, peduncle 2–10½ cm, vigorous, angular, glabrous and/or greyish-scaly. Nut (sub)sessile, 3–4 mm diam., hispid, wing (2–)2¾–3¾(–6½) cm long with the nut, (3–)7–9 mm wide, adaxial lobe undivided to 5-lobed, often very irregular; perianth lobes fairly equal, mostly small and connate with the style; style about as long as the stigmas, the whole ± 3½–9 mm long.

Distr. India (in the montane Himalayas between about 75° and 90° E; Assam: Khasia, Cachar, and Naga Hills, Manipur; E. Bengal: Tripura, Chittagong), Tibet (MANNING, *in litt.*), China (Yunnan, Kwangsi, *n.v.*), Burma (S of about 25° N), Siam, Indo-China (Laos, Cambodia, Cochin-China), Hainan, in *Malaysia*: Sumatra (Medan to Bencoolen), Malay Peninsula (Perak), Java (W to E, very common), Lesser Sunda Islands (Bali, Lombok, Sumbawa, Sumba, Flores), Borneo (scattered), Philippines (Luzon, Mindoro, Negros, Panay, Cebu, Mindanao; rather common).

Ecol. Primary evergreen forest. Seems to prefer the mountains up to 2000(–2500) m, especially frequent in the *Casuarina* forests on the volcanoes in Central and East Java. On the W. side of Mt Jang in E. Java it is known to form locally pure stands. Similar local dominance has been observed by DE VOOGD, *l.c.*, on Mt Rindjani in Lombok; he also observed it pioneering in mountain savannahs. The dominance is due to succession and seral; with *Pittosporum*, *Homalanthus giganteus*, *Vernonia arborea*, *Dodonaea*, *Wendlandia*, *etc.* belonging to the pioneers of the rain-forest

Fig. 9. *Engelhardia spicata* LECHEN. *ex* BL. in pyrogenous mountain savannah near Sembalun, Mt Rindjani, Lombok, *c.* 2000 m (DE VOOGD).

which try to invade the pyrogenous *Casuarina junghuhniana* stands.

Often deciduous for a short time and then flowering, not in definite periods.

Vern. *Ki hudjan*, S, *sowo, donglu*, J, with various prefixes and variations.

Note. Easily distinguished from other species by lacking the golden-yellow glandular scales on the lower surface of the leaves. If scales are present, these are flat, greyish and never golden-yellow.

var. **colebrookeana** (LINDL. *ex* WALL.) O. KUNTZE, Rev. Gen. Pl. 1 (1891) 637, *non* K. & V. Bijdr. 5 (1900) 169, 172.—*E. colebrookeana* LINDL. *ex* WALL. Pl. As. Rar. 3 (1832) 4, t. 208; BRANDIS, For. Fl. NW. & C. India (1874) 499; HOOK. *f.* Fl. Br. Ind. 5 (1888) 596; DODE, Fl. Gén. I.-C. 5 (1930) 929; MERR. En. Philip. 2 (1923) 23.—*E. villosa* KURZ, For. Fl. Burma 2 (1877) 491, *incl. var. integra* (according to MANNING *in litt.*).—*E. esquirolii* LÉV. in Fedde Rep. 12 (1913) 507, *cf.* REHDER, J. Arn. Arb. 10 (1929) 118.—**Fig. 4a-b.**

Differs from *E. spicata var. spicata* in the following characters: tree mostly comparatively small; twigs, leaf rachis, and leaflets underneath densely hirsute, leaflets with rounded top, often grey-greenish when dry. Fruiting catkins 16–26 cm long in all, 2½–8 cm stalked, the rachis densely hirsute.

Distr. India (largely the same area as *var. spicata*, but not known from E. Bengal), S. China (Kwangsi), Hainan, Burma (KURZ), N. and E. Siam, Indo-China (Annam, Laos); in *Malaysia*: Philippines (Luzon, see below).

Notes. The material on which the Malaysian record is based, PARAISO 25483 and RAMOS & EDAÑO 37939, was identified by Dr MANNING; I have not seen it.

E. spicata is a very variable species and the variation of its characters seems to occur more or less at random and not bound to a geographical pattern. The reason that the combination of characters described above has received taxonomic recognition is solely because the specimens representing this combination are conspicuous. All these characters, however, were also found to occur separately, and in other combinations as well. Therefore I adhere no more taxonomic value to this variety than as a random assemblage of marked paramorphs.

In East Java, apart from the common form, a form dominates with densely hairy leaves, which has incorrectly been referred to *var. colebrookeana* by KOORDERS & VALETON. In my opinion this form represents a local tendency in the population that originated independently from the paramorphs on the Asiatic continent. Moreover, a complete series of intergrades exists between the glabrous and the hairy form in Java.

5. Engelhardia roxburghiana WALL. Pl. As. Rar. 2 (1831) 85, t. 199, *excl. fruct.*; BRANDIS, For. Fl. NW. & C. India (1874) 500.—*Juglans pterococca* ROXB. Hort. Beng. (1814) 68, *nomen*; Fl. Ind. (ed. Carey) 3 (1832) 631, '*plerococca*', *descr.*, *excl. fruct.*—*E. chrysolepis* HANCE, Ann. Sc. Nat. IV, 15 (1861) 227; NAGEL, Bot. Jahrb. 50 (1914) 475; CORNER, Ways. Trees (1940) 333, f. 117; METCALFE, Fl. Fukien 1 (1942) 45; P'EI, Bot. Bull. Acad. Sin. 1 (1947) 208.—*E. wallichiana* [LINDL. *ex* WALL. Cat. (1831/2) *no* 4942] C. DC. Prod. 16, 2 (1864) 141, *incl. β chrysolepis*; HOOK. *f.* Fl. Br. Ind. 5 (1888) 596; FORBES & HEMSL. J. Linn. Soc. Bot. 26 (1899) 195; NAGEL, Bot. Jahrb. 50 (1914) 475; GAMBLE, J. As. Soc. Bengal 75, ii (1915) 402; RIDL. Fl. Mal. Pen. 3 (1924) 370; DODE, Fl. Gén. I.-C. 5 (1930) 931.—*E. polystachya* RADLK. Sitz. Ber. Bayer. Ak. Wiss. Math.-Phys. Kl. 8 (1878) 385, *ex descr.*; BRANDIS, Ind. Trees (1906) 620; KANJ. *c.s.* Fl. Assam 4 (1940) 301.—*E. pterococca* O.K. Rev. Gen. Pl. 2 (1891) 637, *quoad nomen et var. α roxburghiana* O.K.—*E. spicata var. formosana* HAY. Fl. Mont. Form. (1908) 199.—*E. formosana* HAY. Ic. Pl. Form. 6 (1916) 61; KANEH. Form. Trees (1936) 80, f. 35.—*E. fenzelii* MERR. Lingn. Sc. J. 7 (1931) 300, *ex descr.*; METCALFE, Fl. Fukien 1 (1942) 45.

Tree ± 5–20 m, sometimes with low, rounded buttresses. Innovations bronze-coloured with golden yellow glandular scales which become brown when older. *Leaf* rachis 5½–14 cm, as the twig glabrous to sometimes densely brown puberulous, 2–4-jugate; leaflets coriaceous, on a stalk 6–12 mm forming mostly a distinct joint with the rachis; blade (2.4–)2.8–3.6(–4.0) times as long as wide, widest mostly below the middle, sometimes halfway, (8–)10–16(–23) by (2–)3½–5 (–7½) cm; base very unequal, acute, often basiscopically somewhat decurrent, top narrowed, gradually bluntly acuminate; midrib narrowly raised above; margin entire, surfaces in dry state never even-coloured, but with dull shades of greenish, greyish, brownish, or blackish, glabrous but underneath yellow to brown glandular-scaly. Probably sometimes dioecious, but mostly the inflorescences bisexual, paniculate, terminal on normal or slightly weaker lateral twigs, 2–4 cm peduncled, with central ♀ catkin (which may be wanting) and 2–6 basal ♂ catkins subtended by early caducuous bracts; rarely the ♀ catkin solitary. Flowers scaly. *Male catkins* 8–12 cm long in all, ½–2 cm stalked; rachis slender, scaly, not hairy; bract ± 2 by 1 mm, obscurely 3-lobed at the top, perianth lobes 4, not reduced, strongly cucullate, 1–1¼ cm diam., with membranous margin; stamens (8–)12, inserted with (2–)3 at the base of each perianth lobe, filament and anther both ½ mm long, in some stamens reduced to ⅓ mm, glabrous. *Fruiting catkins* 12–22 cm long in all, peduncle 2–5½ cm, slender, rachis tomentose, sometimes also scaly. Nut 4–8 mm stalked, transversely ellipsoid, 4–5 mm diam., scaly, not hairy; wing (3–)5–5½ cm long with the nut, 0.7–1.4(–1.8) cm wide, hardly connate with the nut, adaxial lobe almost none; perianth lobes very equal and regular, 1–2 mm long, on top of the nut together enclosing the 4 sessile stigmas.

Distr. India (Assam), S. China (all provinces S of about 30° N lat.), Hainan, Formosa, Indo-China (Tonkin, Laos, Annam), in *Malaysia*: Sumatra (in the N. part especially, S to Bencoolen), Malay Peninsula (Kedah, Perak, Pahang, Penang), Borneo (Brunei and Kinabalu region). Everywhere more or less rare.

Ecol. Primary forests in hilly country between about 700 and 1500 m alt. Flowers and fruits not at definite times.

Uses. In Sumatra said to be a fish-poison.

Note. WALLICH's treatment of this species comprises three elements: a two-line diagnosis from LINDLEY's MS, an extensive analysis after ROXBURGH's MS (the latter was to be published again, under the name *Juglans plerococca*, in 1832), and a plate which is a copy of ROXBURGH's drawing. The diagnosis that WALLICH took from LINDLEY refers, as HOOKER has already pointed out, to *E. spicata* and the same is true for that part of ROXBURGH's plate and description where the fruit is given as hairy. The remaining part of ROXBURGH's plate and description clearly refer to *E. roxburghiana* in the present sense. Since only a minor part of WALLICH's *mixtum* belongs to *E. spicata*, it is thought correct to accept WALLICH's *E. roxburghiana pro majore parte*.

Excluded

Engelhardia selanica BL. Fl. Jav. Jugl. (1829) 8 = *Shorea selanica* BL. Mus. Bot. 2 (1852) 33 (*Dipterocarpaceae*).

FLORA MALESIANA

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THE BOTANIC GARDENS OF INDONESIA, BOGOR,
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SCIENTIFIC COMMUNICATIONS

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